388885/2021/PS-PEM-MAX

THE WEST BENGAL POWER DEVELOPMENT CORPORATION LTD (WBPDCL)

SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III

TECHNICAL SPECIFICATION FOR DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY

SPECIFICATION NO.: PE-TS-445-501-A002 Rev 0

BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, INDIA

388885/2021/PS-PEM-MAX

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY	SPECIFICATION No: PE-TS-445-501-A002 SECTION REV. 00 JUL 2021 SHEET : 1 OF 1

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SECTION I
SPECIFIC TECHNICAL REQUIREMENTS

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SUB-SECTION IB : Specific Technical Requirements (Electrical)
SUB-SECTION IC : Data Sheet-A

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION No: PE-TS-445-501-A002	
		SECTION I	
		REV. 00	JUL 2021

1. SCOPE OF ENQUIRY/ INTENT OF SPECIFICATION

1.1 This specification includes, but not limited to SUPPLY PART, SERVICE PART & MANDATORY SPARES comprising of design (i.e. preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles, fill of lubricants & consumables along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, trial run at site and carrying out Performance Guarantee/Functional/Demonstration tests at site (as applicable), for project and package specified above complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. **Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection &commissioning and load testing of the cranes and its accessories**.

1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

1.5 The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Section-III of the specification**.** In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed deviation schedule along with cost of withdrawal; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.

1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, more stringent requirement as per the interpretation of the owner shall apply.

1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.11 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or customer including their consultant as interpreted by BHEL in the relevant context. For details refer the relevant clause in GCC.

1.12 Manufacturing Quality Plan for reference is included in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the quality plan's minimum requirement during manufacturing and testing. Further all checks and tests indicated in Quality Assurance Requirement as detailed in Customer's specification etc have to be followed.

Note:

Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 Mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's internal proxy setting should not block DMS application's link (https://www.bhelpem.com/wrenchweb).

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SECTION IA
SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)

1.0.0. SCOPE OF WORK

1.1.0. SCOPE OF SUPPLY

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

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

1.1.3. One (1) number 35T Double Girder Crane for TG hall-BC Bay and One (1) number 50T/5T Double Girder Crane for CWPH shall include but not be limited to the following: -

a. Bridge girders with platform
b. End carriages with wheels
c. Crab (trolley)
d. Cross Travel & Long Travel drive arrangement.
e. All electrical equipment including cables, junction box, VVVF drive, pendent, RRC, panels etc.
f. PVC insulated shrouded bus bar Copper conductor type DSL.
g. Rail complete including all accessories and end stopper.
h. Main Isolating switch/Changeover in enclosure at operating floor for disconnecting supply to DSL. Termination of incoming cable (from BHEL) into isolating switch shall be in bidder's scope.
i. Earthing arrangement.
j. Fill of lubricant till commissioning of crane.
k. Painting of cranes and accessories.
l. Maintenance tools & Tackles.
m. Erection & Commissioning spares.
n. Mandatory Spares.

1.1.4 Makes of Sub - Vendor items

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

1.1.5 **Maintenance Tools and Tackles**

As per Annexure III, Section-IA of this specification.

1.1.6 **Mandatory Spares**

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

1.1.7 **PAINTING & COLOUR SCHEME**

Refer Annexure IV, section-IA of this specification.

1.1.8 **Erection and Commissioning spares**

The Bidder shall also supply erection & commissioning spares along with the main equipment as per their experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. Oil and grease required for first filling along with ten (10%) percent excess quantity. The bidder shall deliver to the Owner all equipment complete with initial fill of fluids, grease or lubricants, in drums / containers. Bidder shall supply minimum following spares

i)	Oil seal for each gear box	1 Set
ii)	Indicating Lamps 1 no. of each type	1 Set
iii)	Push Button 1 no. of each type	1 Set
iv)	Aux. contactor 1 no. of each size	1 Set
v)	Limit switches- 1 no. of each type	1 Set
vi)	Any other spare/s, as per experience of bidder	

Note:

a. Any spare, not quoted by bidder, but required during erection & commissioning shall be supplied by bidder without any additional cost to purchaser.

b. One set means 100% requirement of one crane.

1.1.9 Any supplies to be done under warranty clause & any other clause of NIT, GCC, SCC as relevant to the package.

1.1.10 Packing as per Annexure VI, forwarding and transportation to delivery address as per SCC.

1.2.0 **Services to be provided by the bidder**

1.2.1. Packing, forwarding and transportation to site.

1.2.2. Development of storage space including ward & watch of the equipment and handling at site.

1.2.3. Unloading, storage and handling at site.

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

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

1.2.4 Arranging test load at site

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

1.2.5 Erection and Commissioning of EOT cranes and all accessories.

1.2.6 Demonstration / Load test at bidder's Works and at Site.

1.2.7 Obtaining clearance and acceptance certificate from the concerned competent Authority after site test and as and when required as per Government Norms /Statutory body till the time of final handling over to Customer. Necessary fees/expenditure as required shall be borne by the supplier.

1.2.8 Training to Customer's Operation & Maintenance staff.

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

1.3.0. Works Excluded

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

Steel Gantry girder.

Dead load for load/ overload testing at site.

Space for storage.

Exclusion, if any, mentioned in GCC, SCC.

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

Drawing and documents submission schedule along with number of prints / copies required for various drawing and documents are listed in Annexure –V, Section-C, Volume II-B of this specification.

3.0.0. Deviations

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

4.0.0. Performance Test requirement

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

The bidder shall have the full responsibility for the safe and efficient operation of the crane with associated accessories as a single unit. If the site performance tests indicate the failure of any of the components to achieve the desired performance, the deficiency shall be made good at bidder's cost. Performance test shall be carried out each time after the rectification /modification is carried out. Performance test of the crane shall include load tests and speeds in various motions at site.

4.1.0 Testing at Works

Refer section IA: QUALITY ASSURANCE AND INSPECTION REQUIREMENT.

4.2.0 Testing at Site

4.2.1 Completely assembled crane at site shall be check for misalignment of gears, shafts and other items. Following minimum tests shall be conducted on the crane at the site under supervision of bidder's representative.

i. Deflection test of bridge girder at rated load.

ii. Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated. Electrical tests for brakes, panel, electrical equipment etc as per IS 3177.

iii. Speed test at rated load for hoisting, CT and LT mechanism.

iv. Brake test.

v. Any other test as per IS-3177

Note: The test shall be carried out with actual panels, RRC, pendent push button station, master controller etc.

5.0 Consumables

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

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SECTION IA

QUALITY ASSURANCE AND INSPECTION REQUIREMENT

1.1.0. Inspection and Testing

Bidder shall submit Manufacturing Quality Plan (MQP) based on the guidelines given in the specification & MQP enclosed herein. Format shall be as agreed with Customer in line with **Customer's specification** "FORMAT OF QUALITY ASSURANCE PROGRAMME" Volume: II-A Section : VIII.

1.1.1. Inspection and testing at Manufacturer's works

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

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

STAGE INSPECTION

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

i. All test certificates shall be in original and legible. Photocopies certified by Mill/ manufacturer of raw material used, are acceptable.

ii. For tensile testing of hooks/ forgings, samples shall be drawn from the full cross section of the shank diameter of hooks/ forgings Samples forged to reduced cross section for testing purposes is not acceptable. Hooks shall be manufactured from Blooms, billets, rounds by forging with forging ratio of at least 3:1. Hooks manufactured from plates are not acceptable.

iii Radiographs shall be inspected to a sensitivity of 2%.

iv Ultrasonic test on forgings and casting of critical components like cross head (hook suspension block), Hooks, Shafts, Axles, Gears, Wheels, Pulleys etc. Ultrasonic test on forgings shall be carried out as per norms given below. UT shall be carried out in Proof machined condition (single diameter/ Flat surface without steps, keyways, teeth cutting or other profile machining which can create difficulty in ultrasonic testing). Components shall be identified with Heat number and serial number by punching). Hardening operation shall be carried out prior to Ultrasonic testing.

Unacceptable defects in forgings are as given below:

1. Cracks, flakes, seams and laps
2. Defects giving indication larger than '4 (four) mm diameter equivalent flaw' except for wheels for which Defects giving indication larger than '6 (six) mm diameter equivalent flaw.
3. Group of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 50% except for wheels for which Group of defects with maximum indication less than that from a 6 mm dia. equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced by 40%.

4. Defects giving indication of 2 to 4 mm dia. equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws except for wheels for which Defects giving indication of 3 to 6 mm dia. Equivalent flaw, separated by a distance less than 4 (four) times the size of the larger of the adjacent flaws Ultrasonic test on Castings shall be carried out as per ASTME 609.

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

v. Gear boxes shall be checked at No load for backlash, tooth contact, noise, temperature rise and vibration as per attached Procedure No. PEM (Q)/001.

vi. Test certificates shall be furnished for verification of Type tests including environmental tests - for electrical and electro-mechanical items. If Type tests for items with similar / identical construction are not available, arrangement shall be made to conduct the same in the presence of BHEL/ Customer's representative (as required).

vii. Acceptance and routine tests (HV and insulation) for all electrical and electro-mechanical components and system as per governing specification

FINAL INSPECTION OF CRANES- (TESTING OF CRANES AT SUPPLIER'S WORKS)

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

a) Deflection test of bridge girder at rated load. Crane shall rest on centerline of LT wheels.

b) Load test and Overload test (running of CT and Hoisting mechanism at 125% of the rated load). Capability of crane to lift the overload from mid-air shall be demonstrated.

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

d) All Other tests as per IS-3177.

Procedure No. PEM (Q)/001

SHOP TEST PROCEDURE FOR GEAR BOX

1.0.0	**Scope: Acceptance Norms for Crane Gear Boxes**
1.1.0	This procedure lays down the Acceptance norms for the Gear boxes for EOT crane. This standard also covers vertical gear boxes. Reduction Gears shall be tested for reduction ratio, backlash & contact pattern. Gear Box shall also be subjected to No load run test to check for oil leakage, temp. rise, noise and vibration.
2.0.0	The following dimensions shall be checked:
2.1.0	i. Diameter and keyway dimensions of input and output shafts. ii. Projection of input and output shafts beyond foundation holes and Centre lines of gear box. iii. Centre distance between input and output shafts. iv. Centre Height. v. Distance between foundation holes with respect to center line of the output shaft and distance of foundation holes from center line of the gearbox. vi. Overall dimensions
3.0.0	**Backlash**
3.1.0	The back lash shall be checked by dial gauge preferably (refer Figure –1). Lead wire may be also be used but final decision in case of dispute shall be taken by using dial gauge. The backlash shall be within the limits specified in the drawing. If the value of the backlash allowed is not specified in the drawing, the allowed backlash shall be a given in Table-1
4.0.0	**Area of Contact:**
4.1.0	Area of contact shall be taken by applying Prussian blue. The contact area shall be within the limits mentioned below (refer Figure –2) For final stage of Hoist gearing: h / H shall be more than 30% (a – c) / b shall be more than 40% For all other gears: h / H shall be more than 40% (a – c) / b shall be more than 50%
5.0.0	Running Test
5.1.0	1.1.1 The gear boxes shall be run under no-load condition at the rated speed for

	minimum four hours in each direction and the following are to be checked: i. All bolts at the joints remain tight ii. All gear mesh lines are getting enough lubrication iii. All bearings are getting enough lubrication iv. Bearing temperatures after running for four hours shall not exceed 50 deg. Centigrade or 15 deg. centigrade above ambient whichever is higher. Temperature shall be checked after every hour. v. Vibration: Maximum limit 125 microns (peak to peak) vi. Sound: The gearbox shall not emit unusual sound as obtained under conditions of hard meshing, high spots etc. Maximum sound level shall be 85 dBA at a distance of 1000mm and 91 dBA at a distance of 300 mm. vii. There shall be no Oil leakage at parting lines, bearing housings or inspection covers.
6.0.0	1.1.2 General
6.1.0	1.1.3 In addition to the above specific points, the following general points shall be ensured: i. Inspection pockets are provided as required. ii. Gear box casings are provided with at least two fit bolts/dowels at the parting line. iii. Dip sticks with minimum / maximum level markings are provided. iv. Drain plugs are provided at convenient locations preferably at vertical wall of the housing. v. Breathers are provided. vi. Lifting lugs or eye bolts ar provided as required. vii. Wherever bearings have splash lubrication, oil retainers are provided. viii. Gear boxes are painted as per specification outside and inside. Inside surfaces shall be painted with Oil proof paint. ix. In case of vertical gear boxes having more than two stage reduction, forced lubrication is also provided. 1.1.4 Name plate should provide information eg. Ratio, KW rating, Bearing details and manufacturers name.

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CRANE SPECIFIC TECHNICLA REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-445-501-A002	
		SECTION IA	
		REV. 00	JUL 2021

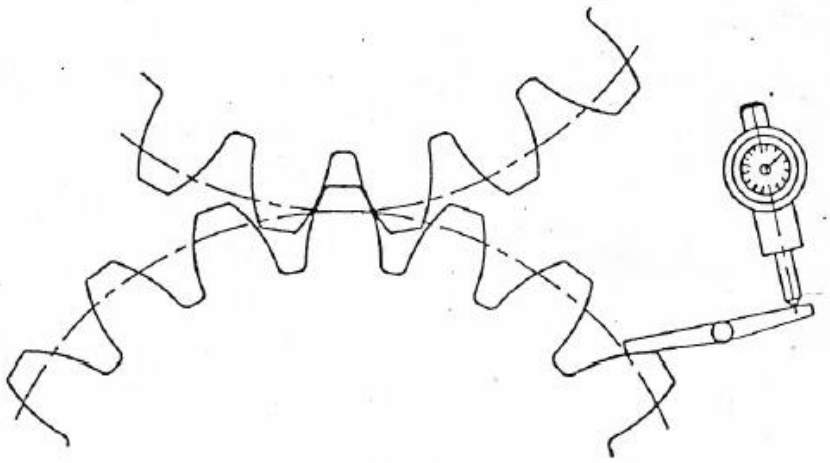

FIG.1 MEASUREMENT OF BACKLASH

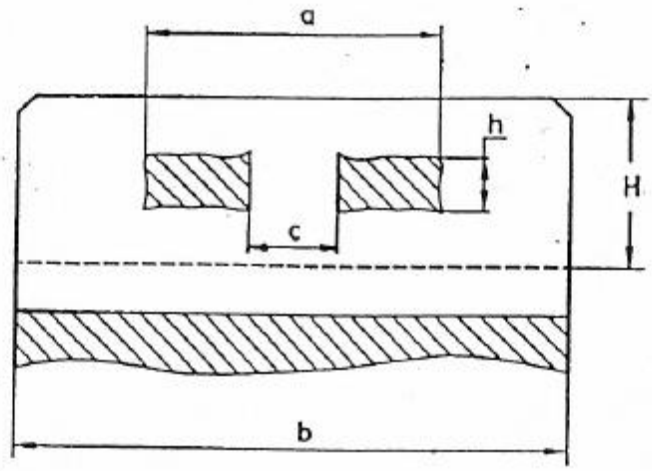

FIG.2 AREA OF CONTACT OF GEAR TEETH

TABLE 1

BACKLASH AND GEARING SPECIFIED BY MODULE

(Clause 3.1.0)

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

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-445-501-A002	DATE: JUL 2021
	CUSTOMER : THE WEST BENGAL POWER DEVELOPMENT CORPORATION LTD (WBPDCL)		QP NO.:---	DATE:--
	PROJECT: SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III.		PO NO.:	DATE:
	ITEM: DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY	SYSTEM: EOT CRANE	SECTION:	SHEET OF

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
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 witnessed 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:			

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-445-501-A002	DATE: JUL 2021
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SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		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	

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

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-445-501-A002	DATE: JUL 2021
	CUSTOMER : THE WEST BENGAL POWER DEVELOPMENT CORPORATION LTD (WBPDCL)		QP NO.:---	DATE:--
	PROJECT: SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III.		PO NO.:	DATE:
	ITEM: DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY	SYSTEM: EOT CRANE	SECTION:	SHEET OF

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		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	
		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	Macro Etching,Flattening for Seamless Pipe	100%		ASTM A 106-2007,GR-B	ASTM A 106-2007,GR-B	I.R.	√	P	V	V	

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	CUSTOMER : THE WEST BENGAL POWER DEVELOPMENT CORPORATION LTD (WBPDCL)		QP NO.:---	DATE:--
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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
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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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-445-501-A002	DATE: JUL 2021
	CUSTOMER : THE WEST BENGAL POWER DEVELOPMENT CORPORATION LTD (WBPDCL)		QP NO.:---	DATE:--
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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		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	# W - FOR MAIN HOOK
		NDT after Proof Load (UT only shank portion)	Major	U.T & MPI 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)

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					M	C/N				D	M	C	N	
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	
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	

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
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 / Relevant Std.	Drg./ Data Sheet / Relevant 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	**Refer Note 6** for Motor Up to 50 KW. For Motor above 50 KW separate QP Shall be applicable.
		Routine Test / Clearance of QP for Motor above 50 KW	Major	Measurement	100%		IS: 325 / App. Data sheet/CUSTOMER ADS	IS: 325 / App. Data sheet/CUSTOMER ADS	COC / Mfg T.C. (As per Note-3)	√	P	V	V	
d.	Brakes	Make,Type, Rating	Major	Measurement	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg. TC		P	V	V	

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		IR,HV,Functional Test	Major	Measurement	100%		MFG. STD.	MFG. STD.	Mfg. TC		P	V	V	
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 / Trialing / Flexible)	Make, Type, Size	Major	Visual	100%		CUSTOMER approved BOI list / SLD / DRG / BOM / ADS		Mfg TC		P	V	V	Being small quantity of cables used for each size and type less than 500 mtr. Separate QAP for cable not required.
		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	

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
h.	Anti - Collision Device , Cable Gland & lugs , Rectifier ,Lamps, load Cell, Illumination and Earthing material	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	
	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**													

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
a.	Welding	WPS & PQR	Major	Review of Document	100%		ASME SEC IX 2007	ASME SEC IX 2007	ASME PRO	√	P	V*	V	* Welder/procedure qualification will be witness by Customer/ BHEL as per appd. WPS. In case the BHEL/NTPC/Lloyds /any other renowned approving agency already available, and doing the job, requalification is not required.
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	V	DP test of fillet weld for rope drum to be conducted after final machining.
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 before Stress relieving.

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														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./ Relevant Std. / CUSTOMER Spec.	Drg./ Relevant Std. / CUSTOMER Spec.	SR Chart	√	P	V	V	
f.	Cabin(if applicable), 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

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					M	C/N				D	M	C	N	
		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	
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	

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

BIDDER/ SUPPLIER	
Sign & Date	
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Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-445-501-A002	DATE: JUL 2021
	CUSTOMER : THE WEST BENGAL POWER DEVELOPMENT CORPORATION LTD (WBPDCL)		QP NO.:---	DATE:--
	PROJECT: SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III.		PO NO.:	DATE:
	ITEM: DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY	SYSTEM: EOT CRANE	SECTION:	SHEET OF

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
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 # Witness for Noise & vibration measurement during the final inspection
f.	DSL Guard	Dimensional	Major	Dimension	100%		Mfg. Drg.	Mfg. Drg.	I.R.		P	V	V	

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
7.	**FINAL INSPECTION**													
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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Reviewed by:			Reviewed by:		

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
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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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		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

BHEL						BIDDER/ SUPPLIER	
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	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:			Checked by:				
Reviewed by:			Reviewed by:				

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
8.	Lifting beam (for tandem operation) at works (if applicable)	Measurement	Major	Dimension, Visual and load /overload test	100%	100 %	Approved G.A. Drg. / IS 3177 / Load test procedure / DS	Approved G.A. Drg. / IS 3177 / 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	

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.

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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.

5) FOR MOTORS, FOLLOWING MODALITIES SHALL BE ADOPTED.
For Motors of 50kW rating and above Routine Test will be witnessed by BHEL and Type test Certificate for identical frame size will be reviewed for validity and conformance. For below 50kW rating routine tests to be witnessed by supplier of crane and type test Certificate for identical frame size will be reviewed for validity and conformance. Photocopies of Type Test Certificates are acceptable but shall be authenticated by Manufacturer.

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.

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Reviewed by:			Reviewed by:		

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Approved by:			

SECTION IA
CUSTOMER'S SPECIFICATION

VOLUME : II-A

LEAD SPECIFICATION

CONTENTS

VOLUME : II-A **LEAD SPECIFICATION**

SECTION-I	:	INTENT OF SPECIFICATION
SECTION-II	:	NOT USED
SECTION-III	:	PROJECT SYNOPSIS AND GENERAL INFORMATION
SECTION-IV	:	SCOPE OF SUPPLY & SERVICES
SECTION-V	:	GENERAL TECHNICAL REQUIREMENTS
SECTION-VI	:	PROJECT MANAGEMENT & SITE SERVICES
SECTION-VII	:	ENGINEERING SERVICES
SECTION-VIII	:	QUALITY ASSURANCE REQUIREMENTS
SECTION-IX	:	PERFORMANCE GUARANTEES AND TESTS
SECTION-X	:	REQUIREMENT OF SPARES, TOOLS & TACKLE
SECTION-XI	:	PROTECTIVE COATING AND PAINTING
SECTION-XII	:	SALIENT DESIGN DATA

SECTION-I

INTENT OF SPECIFICATION

SECTION-I

INTENT OF SPECIFICATION

1.00.00 This specification is intended to cover design, engineering, manufacture, inspection and testing at manufacturer's works, packing and shipment and delivery at site, unloading, storage and handling at site of all equipment and materials, all necessary civil/structural/ architectural works, erection of all mechanical / electrical / control& instrumentation equipment and materials, site testing, commissioning, trial run, performance and guarantee tests and other services including supply co-ordination, engineering and project management related to the equipment/systems comprising 1 x 660 MW Unit, as specified hereinafter and in accordance with the requirements, conditions, annexures, drawings etc. stated in Volume-I and Volumes II-B to II-L which shall be considered as a part of this volume as completely as if bound herewith.

The specification consists of Volumes-I, II, III detailed index of which has been furnished elsewhere. This specification shall be read and construed in conjunction with the drawings and annexures to determine the scope of work. The quantities shown on drawings and annexures are indicative. Any variation arising during detailed engineering stage will be taken into account by the Contractor without any extra cost and time to the owner.

The Bidder shall be responsible for providing all material, equipment and services, specified or otherwise which are required to meet the intent of this specification, ensuring high degree of reliability and ease of operation and maintenance. The equipment and system/sub-systems shall conform to all aspects of high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the Owner and shall also be in line with the current practice for reliable and efficient functioning of the plant.

Owner shall interpret the meaning of the specification, drawings, requirement of operation, maintenance, redundancy etc., and shall have a right to reject or accept any work or material which in his assessments is not technically complete to meet the requirements of this specification and/or applicable National and International standards mentioned elsewhere in this specification.

Bidder is required to carefully examine and understand the specifications and seek clarifications, if required, to ensure that he has understood the specifications as intended by the Owner. In the absence of any specific clarifications made by the Owner during bidding stage, the interpretation of Owner shall be final. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. All such points are required to be clarified during bidding stage.

In the event of conflict between requirements of any two clauses of this specification/documents or requirements of different codes/standards, specified, the more stringent requirement as per the interpretation of the Owner shall apply.

In case all the above requirements are not complied with, the offer may be considered as incomplete and liable to be treated as non-responsive.

2.00.00 Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific items mentioned shall be understood as establishing type, function and quality desired.

SECTION-II

NOT USED

SECTION-III

PROJECT SYNOPSIS AND GENERAL INFORMATION

CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	INTRODUCTION	1
2.00.00	APPROACH TO SITE	1
3.00.00	LAND	1
4.00.00	SOURCE OF COAL	2
5.00.00	SOURCE OF WATER	2
6.00.00	ASH DISPOSAL AREA	2
7.00.00	DETAILS OF EXISTING FACILITIES OF PHASE-II	3
8.00.00	SALIENT DESIGN DATA	16

SECTION-III

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The West Bengal Power Development Corporation Limited (WBPDCL) proposes to extend their on-going Phase-II extension project of 2x500 MW at Sagardighi by adding one super critical unit of 660 MW as Phase-III extension unit. Sagardighi TPS is located in the village Manigram in Murshidabad district of West Bengal, India. The West Bengal Power Development Corporation Limited, a Company fully owned by the Government of West Bengal formed in the year 1985, have commissioned 2x300 MW Thermal Power Plant together with all other infrastructure at Sagardighi Thermal Power Project. Presently WBPDCL is also working on their under-construction Phase- II extension project of 2x500 MW at Sagardighi.

The Bidder shall acquaint himself, by visiting the site, with the conditions prevailing at site. The information given here in under is for general guidance only.

2.00.00 APPROACH TO SITE

Sagardighi Super Thermal Power Station site is located at Manigram village, 13 KM north of Sagardighi town by the side of the SMGR (Sagardighi-Manigram-Gankar-Raghunathganj) Road at a distance 20 KM from National Highway 34 in Murshidabad District, West Bengal and around 240 KM from Kolkata, India. The nearest rail station is Manigram adjacent to the site on Bandel - Barhawara branch line and 6.5 KM from Sagardighi Railway Station on Sainthia - Azimgunj line of Eastern Railway. From Sagardighi railway station a railway line will branch off to the site for material unloading and coal marshalling. The equipment will be normally transported by rail only and under exceptional cases by road. The material consignments shall be as per the restrictions of rail and road transportation prevailing in the country.

Nearest Airport – Kolkata.

Nearest Seaport –Haldia.

3.00.00 LAND

The total land available for the Power Station and Plant auxiliaries will be generally as per the Site Location Plan (12A05-DWG-M-002) enclosed and flexibility will remain to make the final equipment layout based on equipment sizes.

All construction material, heavy equipment, over dimensioned consignments (ODC) for the station during construction may be transported through road/rail access. During operation stage, coal would be transported through rail access.

The total land, approximately 706 hectares, has already been acquired for the present and proposed extension. The locations of various facilities and plant auxiliaries for Unit 1 & 2 under Phase-I and Units 3 & 4 in Phase-II and the space provision for extension unit no. 5 (660 MW) will be as per the General Layout enclosed. About 456 acre of land has been kept for disposal of ash. The Bidder shall accommodate equipment offered under this specification generally within the spaces allocated for such equipment in the General Layout. Specific approval from Owner/Consultant shall be taken by the contractor prior to any revision or relocation.

Except where stated otherwise, the plinth levels of all buildings shall be 300 mm above the corresponding developed grade level and the road level shall be 150 mm above the developed grade.

4.00.00 SOURCE OF COAL

The Power plant shall receive coal from ECL mines. Coal is planned to be transported in rake loads through the existing Pakur- Tildanga-Dhulian-Monigram broad gauge line or through Pakur- Nalhati (proposed)–Takipara-Gosaingram-Poradanga-Monigram broad gauge line. The coal would be carried in rake loads of BOBR/BOX-N wagons.

It is considered that coal would be received from the same source as the plant under Phase-I and Phase-II station with similar characteristics and a new mine at Pachwara (north) in Jharkhand being developed by WBPDCL. These sources being connected by B.G. rail track, coal would be transported by rail only. For coal unloading, crushing and storage facility it is proposed that a new Wagon tippler along with crusher houses, conveyors will be installed in addition to existing coal handling plant of Phase-II station with suitable extension from the end of Transfer Point (TP-19).

5.00.00 SOURCE OF WATER

The source of water for this project is the River Bhagirathi (5 km) through the proposed intake pump house under implementation for Phase-II station. The water from the River Bhagirathi will be transferred and stored in the five (5) nos. Plant Raw Water Reservoirs by augmentation of the Intake water transportation system for phase - II for meeting the requirement of Phase-III Sagardighi TPS.

The Power station will operate on semi open recirculating condenser cooling system using cooling towers. In addition all water conservation and recycling measures will be adopted to minimize requirement of make up water. The proposed project will adopt zero effluent discharge philosophy.

6.00.00 ASH DISPOSAL AREA

Bottom Ash (BA) shall be extraction in wet form and conveyed to the disposal area in lean slurry form. Whereas Fly Ash (FA) shall be extracted in dry form and stored in dry form for onward usage. However, arrangement shall be also

CIVIL, STRUCTURAL AND ARCHITECTURAL WORK (BUILDINGS CONSTRUCTED WITH SPACE FOR PHASE III)

Necessary Walkway connection between operating floors of Power House of Phase – II (Existing) and Phase – III shall be considered by Bidder.

Few civil foundations have already been constructed for future equipment. Such existing foundation details including bolts, inserts etc. to be studied in detail before procurement of specific equipment for respective purposes so that the same can safely be placed over the existing foundations complying all technical compatibility. In case this is not at all possible, new foundations need to be constructed after complete demolition of existing foundations.

For further details regarding the existing facilities of Phase – II, please refer Volume – II G1, G2 and G2: Technical Specifications for Civil, Structural and Architectural..

8.00.00 SALIENT DESIGN DATA

8.01.00 For implementation of the project, the Bidder shall consider the following Site and Meteorological data:-

a)	Location	:	Manigram village, Sagardighi, Raghunathganj sub-division, Murshidabad District, West Bengal.
b)	Latitude and Longitude	:	24^0 22’ 13.7” N, 88^0 6’ 15.8” E (Topo sheet No.78/D/3)
c)	Nearest Towns	:	Ajimganj, Jangipur, Raghunathganj.
d)	District Head Quarters	:	Berhampore - 40 km.
e)	Approach Road	:	20 km from National Highway (NH-34)
f)	Nearest Railhead	:	Manigram railway station on Bandel-Barhawara branch line 1 km from site.
g)	Source of Water	:	Bhagirathi River - 5 km
h)	Source of Coal	:	Pachwara (North) mine block in Jharkhand.
i)	Fuel Transportation	:	By rail in rake loads of BOBR/BOX-N wagons.
j)	Surrounding Habitations	:	Villages - Manigram, Chhamugram, Karaia, Thakurpara on the south; Bhumhar, Khasittor, Ekrakhi on the west;

Dhalo, Bagpara, Santoshpur on the north and Harirampur, Chandparam, Dogachhi on the east.

k) Level : Within 34.5 m contour. Land is above HFL (highest flood level) of the area.

l) Soil : Less fertile alluvial soil.

m) Land Use : Within existing plant boundary of WBPDCL.

Meteorological data of site is given below:

a) Design ambient dry bulb temperature : 50 ºC maximum
5 ºC minimum

b) Highest wet bulb temp : 26.9 ºC

c) Maximum relative humidity : 84%

d) Average relative humidity : 73%

e) Average annual Rainfall : 1389 mm

f) Wind load : In accordance with IS-875 for a basic wind speed of 47 m/sec, up to a height of 10 metres above mean ground level.

g) Seismic Zone : Zone III as per IS: 1893 latest edition.

h) Altitude : 34M above MSL

SECTION-IV

SCOPE OF SUPPLY AND SERVICES

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CLAUSE NO.	DESCRIPTION	PAGE NO.
A.	SUPPLY OF EQUIPMENT AND SYSTEMS	1
B.	SERVICES TO BE RENDERED BY THE BIDDER	11
C.	EXCLUSIONS	12
D.	TERMINAL POINTS	12

ATTACHMENT

ANNEXURE-I	TERMINAL POINTS	13

the present specification.
For further details refer Volume: IIG/1, G/2 & G/3 of this specification.

One set of spares for all plants and equipment for all systems, as recommended by the respective manufacturer/bidder for regular reliable operation of minimum three (3) years. Bidder is to develop recommended list of spare parts with prices by items and this shall be furnished separately in the prescribed format. Sufficient description and drawings are to be provided to permit analysis and evaluation of spares recommended.

One set of tools and tackle, fixtures etc. in new condition, as required for regular operation and maintenance of the plant and equipment offered. Adequate means shall be provided for lifting and handling of each item of plant and equipment including slings etc. Except turbine room crane handling arrangement for all equipment like BFP, Mill, Fans etc. are to be provided; and above 3 tonnes load, handling equipment shall be motor operated type. Price for such tools & tackle, fixtures etc. shall be furnished separately in the prescribed format.

B. SERVICES TO BE RENDERED BY THE BIDDER

The services to be rendered by the Bidder shall include but not be limited to the following:

1.00.00 Services for complete engineering, co-ordination and project management as detailed in Section-VI of this specification volume.

2.00.00 Services for shop tests and quality assurance, etc. as detailed elsewhere in this specification.

3.00.00 Services for construction, fabrication, equipment erection, testing as well as trial run & commissioning of various equipment and accessories under the contract. The details of such services are indicated in Section-VI of this specification volume. Bidder shall arrange tower crane for erection and construction work, wherever necessary. Moreover, all erection tools and tackles necessary for generator stator handling and erection shall be arranged by the bidder.

4.00.00 Supply of all mandatory, erection/commissioning and recommended spares, special tools & tackle including required after-sales services during and after the warranty period.

5.00.00 Supply of all consumables required for the works as per provision of respective clauses specified in conditions of contract.

6.00.00 Furnishing of all document, drawings, design basis reports, optimization, study reports, instruction manuals, etc. including "As built" drawings, as called for in the specification both in requisite no. of hard copies and in soft form (CD).

7.00.00 Operation and Maintenance training.

8.00.00 Obtaining approval from statutory bodies in India.However, Purchaser shall

provide assistance to do so.

9.00.00 Equipment shop painting.

For details of painting, please refer section-XI of volume-IIA. For painting of large diameter piping, please refer section-V of Vol. II-J1.

10.00.00 Any other service, although not specifically called for but required for a turn-key contract of the size and nature indicated in this specification.

11.00.00 For details of services under clause B, subsequent sections of this Lead specification may be referred.

~~**C.**~~ ~~**EXCLUSIONS**~~

~~Intake Water System.~~

~~Raw Water System including raw water reservoir.~~

~~Clarified Water Pumping System including reservoir~~

~~DM Plant including DM water Storage Tanks~~

~~Potable water System beyond terminal point as specified in Annexure-I.~~

~~Fuel Oil Unloading System.~~

~~CHP upstream of Transfer Point -19~~

~~Cooling Tower~~

~~Chimney (However, supply, erection & commissioning of all the `On line Stack Monitoring' equipment are under Bidder's scope. Bidder shall furnish the cut out details of the same to the owner well in advance to facilitate the design & construction work).~~

~~Material Handling section of FGD Plant~~

~~Ash Dyke Area~~

~~Workshop~~
~~Power evacuation and transmission system beyond the sub-station/switchyard. Necessary coordination with Transmission package supplier shall be the responsibility of the Bidder under this contract~~

~~**D.**~~ ~~**TERMINAL POINTS**~~

~~The terminal points shall be as specified in **Annexure-I** of this section. For all terminal points scope of this contract shall include making the joint including supply of mating flanges, gaskets, bolts, nuts etc. and including any isolation~~ valve.

SECTION-V

GENERAL TECHNICAL REQUIREMENTS

WBPDCL

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SECTION-V

GENERAL TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

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

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

1.03.00 Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Electricity Rules, Indian Explosives Act, Factories Act etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Successful Bidder.

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

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Successful Bidder proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Successful Bidder to advise Owner of the resulting effect.

2.00.00 RESPONSIBILITY FOR DESIGN

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

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

2.03.00 The Bidder shall carry out optimization studies for selection of pipe size and equipment wherever required. The result of such studies shall be included as part of bid proposal.

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

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

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

3.00.00 **NAME PLATES (RATING PLATES)**

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

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

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

3.04.00 The size and location of nameplates shall be subject to Approval of the Owner/Owner's Engineer.

4.00.00 **SAFETY AND SECURITY**

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

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

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

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

5.00.00 **GUARDS**

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

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

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

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

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

6.00.00 **LOCATION AND LAYOUT REQUIREMENTS**

The majority of plant and equipment shall all be of indoor installation. A broad list of buildings housing such equipment is given In Vol-II-G2 Section I. Layout shall facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings enclosed in Vol-II-L show the location of major installations and auxiliary buildings. The Bidder

shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's acceptance alter the same to suit the space requirement of the equipment offered.

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

a) The minimum width of clear access corridors around equipment shall be 1.2 meters.

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

c) The plinth level with respect to the existing grade level shall be as indicated elsewhere in Vol-II-A Section-V/Annexure-II.

d) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of 2.2 meters shall be maintained between the floor and any overhead piping/cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.

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

f) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces shall be as specified in Vol-II-A Section-V/Annexure-II.

g) All rail/road crossings for pipe/cable racks shall be constructed with minimum 8 meters headroom from top of rail/road to bottom of rack. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II of this section.

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

i) Pipe rack, cable rack and Pipe cum Cable rack shall have hand railings (not less than 1200 mm high) in walkways (min. 800 mm wide) on both sides at appropriate heights.

7.00.00 **OPERATION AND MAINTENANCE CONSIDERATIONS**

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

7.02.00 Lifting devices i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling of any equipment and/or part having weight in excess of 100 Kg during erection and maintenance activities. Suitable beams, hooks etc. for this purpose shall be provided in the buildings and clear space provided below to a platform or floor which will allow normal risk free transport means to be used.

Lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall also be provided by the Bidder for lifting the various equipments and accessories covered under this specification.

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

8.00.00 **MATERIALS**

8.01.00 In selecting materials of construction of equipment, the Bidder shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled.

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

8.02.00 Materials used for various components shall be those which have already proven operating experience in similar type of applications.

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

8.04.00 **Prohibited Materials**

The use of the following materials is prohibited:

a) High alumina cement in structural elements

b) Wood wool slabs in permanent framework to concrete

c) Calcium chloride in mixtures for use in concrete works

d) Naturally occurring aggregate for use in reinforced concrete that does not comply with the applicable codes and standards.

e) Cast iron for any oil service

f) Carcinogenic material and suspected carcinogenic materials by World Health Organization.

g) Asbestos or any other fibrous form of hydrated magnesium silicate

h) Any other material generally known to be deleterious if used or incorporated in such project like the facility.

9.00.00 **LUBRICATION**

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

9.02.00 Non ferrous capillary tubing shall be used throughout.

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

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

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

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

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10.00.00 **LUBRICANTS, SERVO FLUIDS AND CHEMICALS**

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

10.02.00 The Bidder shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Successful Bidder shall endeavor to reduce the verities and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognized standards and shall be easily

obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.

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

11.00.00 PLANT LIFE AND MODE OF OPERATION

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

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

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

12.00.00 PACKAGING & MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Bidder shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

Bidder shall conduct his own route survey and transportation logistics for transportation of the equipments to project site by road/rail/sea and indicate the same in his proposal.

Each package shall have 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 Bidder shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Bidder, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

13.00.00 PROTECTION

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

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

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs shall be sealed and taped. Male threaded openings shall be closed with rough usage covers or plugs shall be sealed and taped. Female threaded openings shall be closed with forged steel plugs.

Returnable containers and special shipping devices shall be returned by the Bidder.

14.00.00 PAINTING

14.01.00 General

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

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

Procedure for painting of any item, if not indicated in the relevant specification, shall be developed by the Bidder. This procedure and quality of paint shall be subject to Owner’s acceptance

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

All primers shall be properly applied on to the surface and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the spray painting equipment.

If the drying interval between successive coats of paint or primer exceeds the manufacturer’s recommendations, the paint already applied shall be completely and uniformly abraded with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not be done indoors, without the prior notification and specific acceptance of the Owner. Spray guns shall not be used outdoors in windy weather nor near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment or unprotected humans.

The Bidder shall provide suitable protection for adjacent plants from air borne materials during cleaning and spraying to the satisfaction of Owner

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

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel. For detail please refer relevant electrical sub-section Volume II F1 & F2.

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

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

The colour scheme shall be submitted during execution of contract for acceptance by the Owner.

14.02.00 **Surface Preparation**

The grade of surface preparation shall be classified as indicated in Annexure-I of this section.

Sl. No.	Type of Preparation	Reference Standards		
		SSPC	SIS	BS 4232
1.	Solvent cleaning	SP1	-	-
2.	Hand Tool Cleaning	SP2	St-2	-
3.	Power Tool Cleaning	SP3	St-3	-
4.	Flame cleaning of new steel	SP4	-	-
5.	White metal blast cleaning	SP5	Sa-3	First Quality
6.	Commercial blast cleaning	SP6	Sa-2	Third Quality
7.	Brush-off blast cleaning	SP7	Sa-1	-
8.	Pickling	SP8	-	-

9.	Weathering followed by blast cleaning	SP9	-	-
10.	Near white blast cleaning	SP10	Sa-2.5	Second Quality

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

The abrasive to be used shall be metal grit.

The surface preparation of all steel surfaces to be coated shall be free from all mill scales, rust corrosion products, oxides, paints, oil or other foreign matter.

All welded areas and appurtenances shall be given special attention for removal of welding flux in crevices. Welding splatter, slivers, laminations and underlying mill scale exposed during shot blasting shall be removed or repaired.

No acid/solvents/other cleaning solutions shall be used on surfaces after they have been blasted.

14.03.00 **Application of Primer and Paint**

Primer shall be applied immediately after surface preparation has been completed.

Brushing, spraying, roller coating or other suitable method shall be adopted for application of primer and paint and the work shall be carried out strictly as per the recommendation given by the paint manufacturer.

Primarized surfaces shall be faultless and shall not have mudcracking, dripping over thickness and dry sprays.

Before application of paint/primer, the following shall be particularly checked for conformance to this specification and recommendation of the paint manufacturer:

a) Surface preparation profile.

b) Catalysis ratio for two component paints.

c) Pot life.

d) Minimum and maximum top coating times.

e) Type and quantity of thinners (if required)

f) Viscosity

g) Soundness of previous coating.

h) Ambient conditions (temperature, humidity, etc)

Depending on the degree of contamination by foreign matters, the surfaces primed at shop shall be washed as follows to the satisfaction of the Owner:

a) With clean water under a pressure of a least 7 Kg/cm2 (g) using suitable nozzles. During washing broom of corn brushes shall be used.

b) With suitable solvents, (such as Carbon Tetrachloride, Trichloroethylene etc.) if necessary, to remove traces of grease, oil etc.

Coated parts shall be carefully handled using hemp ropes, cloth belts, pendulum conveyors or suitable means as instructed by the Owner.

Surfaces which cannot be painted after fabrication shall be primed and provided with suitable rust preventive oil before boxing up.

Paints shall be stored in well-ventilated rooms, far away from heat sources, open flames, sparks and protected from sun. Outdoor storage is not permitted. Storage life shall be clearly indicated on the container. Paints, which have thickened or gelled or contained in non-original containers or in unsealed containers shall not be used. Owner's decision in this regard shall be final and binding.

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as per Table I & II of this section.

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

14.04.00 **Damaged Paintwork**

Any damaged paintwork shall be made good as follows:

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

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

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

14.05.00 Surface preparation and painting work shall not be carried out under the following weather conditions:

a) When the surface is wet or expected to become wet before the paint/primer has dried up due to impending rain, fog or mist.

b) High winds.

c) Ambient temperature below 5deg.C or surface temperature less than 3 deg.C above dew point.

d) Relative Humidity is more than 85%.

14.06.00 **Inspection and Testing of Painting**

The following inspection and testing shall be performed during and on completion of paint systems.

- Shot blasting profile shall be checked using a suitable profile-meter. Acceptable profile shall be 25-30 microns.

- Check of time of top coating and drying, in accordance with the recommendation of paint manufacturer.

- Check of Dry Film thickness by suitable Non Destructive Equipment. The painting shall be rejected if any of the spot measurement shows thickness to be less than 80% of the specified thickness.

- Check of adhesion of Paint Material by "Chequering" or another suitable method.

- Check of porosity of coating for internals, by the use of a suitable instrument.

- Visual inspection of appearance and uniformity of the surfaces painted.

If during above inspection, painting defects are observed, the Bidder shall carry out rectification to bring the faulty surface to the acceptable degree.

The areas where defective or damaged coatings have been repaired or replaced shall be re-inspected to the original requirements.

Surface temperature and humidity readings shall be taken prior to application of each coat. The work shall not proceed if the ambient temperature parameters are outside the requirements of this specification. If more stringent, the coating manufacturer’s requirement shall dictate.

The dry film thickness shall be tested with a micro test film gauge or an accepted equivalent. The testing method shall be in accordance with SSPC – PA 2.

15.00.00 **COLOUR CO-ORDINATION & FINISH**

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

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

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

15.04.00 Final colours and finishes shall be to the acceptance of the Owner.

16.00.00 **ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT**

16.01.00 **Environment Protection**

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

The Plant shall be designed meeting the latest environmental requirement issued by MoEF, GOI. In the event of Ministry of Environment & Forest stipulate any other conditions not specified hereunder, the Bidder shall comply with those requirements.

16.01.01 **Liquid Effluent Discharge**

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

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

16.01.02 **Air Quality Emissions**

a) Suspended Particulate Matter at chimney outlet - Maximum 30 mg/Nm^3

b) Oxides of Nitrogen (NO_x) - 100 mg/Nm^3 .

c) Sulphur di-Oxide(SO_2) - 100 mg/Nm^3

d) Mercury (Hg) - 0.03 mg/Nm^3

e) The Efflux velocity from boiler stack(s) shall not be less than 25 m/sec.

g) Outlet dust emission level of bag filter installed in AHP and CHP shall be restricted to 30 mg/NM^3.

h) For The Coal Handling Plant, areas covered under Dry Fog Dust Suppression (DFDS) shall be designed to control the dust emission level in the working area measured at distance of 2m from the dust generation sources, over and above the atmosphere background dust level to shall be within 5 mg/NM3

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

16.02.00 **Noise Level Requirement**

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

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

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

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

17.00.00 **INSPECTION AND TESTING**

17.01.00 Inspection and Tests during Manufacture

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

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

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

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

The Successful Bidder shall forthwith forward to the Owner's Engineer duly certified copies of the Test Certificates in Three (3) copies for approval.

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

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

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

17.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material.

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

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

17.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed. Statutory payments in respect of IBR approvals including inspection shall be made by the Successful Bidder. Successful Bidder's scope and responsibility shall also include preparation of all necessary documents in the specific formats stipulated by the statutory bodies, coordination and follow up for above approvals.

17.02.00 **Performance Tests at Site**

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

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

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

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

18.00.00 TRAINING OF OWNER'S PERSONNEL

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

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

18.01.00 Training at Successful Bidder's Premises

The Successful Bidder shall conduct training of Sixty Five (65) engineers of the Purchaser on engineering, operation and maintenance of the Plant at the Successful Bidder's or Associates or Sub Vendor's premises where adequate training facilities are available during the design and manufacturing stage of the successful Bidder.

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

Discipline	No. of Engineers	No. of Man-month
Operation	25 heads	25
Maintenance Boiler, Turbine,	25 heads	25
Electrical Maintenance	5 heads	5
Control & Instrumentation	10 heads	5
	65 heads	60

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

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

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

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

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

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

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

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

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

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

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

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

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

18.02.00 **Operation and Maintenance Training at Site**

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

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

a) One (1) for Steam Generator and Auxiliaries

b) One (1) for Turbine Generator and Auxiliaries

c) One (1) for Electrical Works

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

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

18.03.00 **On-the-Job Training**

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

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

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

a) International Standards Organisation (ISO).

b) International Electro-technical Commission (IEC).

c) American Society of Mechanical Engineers (ASME).

d) American National Standards Institute (ANSI).

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

f) American Institute of Steel Construction (AISC).

g) American Welding Society (AWS).

h) Architecture Institute of Japan (AIJ).

i) National Fire Protection Association (NFPA).

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

k) Japanese Electro-technical Committee (JEC).

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

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

n) Instrument Society of America (ISA).

o) National Electric Code (NEC).

p) Heat Exchanger Institute (HEI).

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

r) Hydraulic Institute (HIS).

s) International Electro-Technical Commission Publications.

t) Performance Test Code (PTC).

u) Applicable German Standards (DIN).

v) Applicable British Standards (BS).

w) Applicable Japanese Standards (JIS).

x) Electric Power Research Institute (EPRI).

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

z) Bureau of Indian Standards Institution (BIS).

aa) Indian Electricity Rules.

bb) Indian Boiler Regulations (IBR).

cc) Indian Explosives Act.

dd) Indian Factories Act.

ee) Tariff Advisory Committee (TAC) rules.

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

gg) Pollution Control regulations of Ministry of Environment & Forests, Govt. of India.

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

ii) National Building Code (NBC).

jj) Indian Road Congress (IRC).

kk) Latest guidelines of Railway Authority.

ANNEXURE-II

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

The guidelines shall be applied in general, unless otherwise stated in other technical Volumes. In addition to these guidelines, Bidder shall refer the attached Plot Plan, drawing no. **12A05-DWG-M-003A,** for tentative arrangement of the various facilities under this package.

	ITEM	SPECIFICATION REQUIREMENT
A.	**Site conditions to be considered**	
1.	Prevalent wind direction during summer (for deciding Cooling Tower orientation)	Refer wind-rose in plot plan.
2.	Prevalent wind direction(s) during dry seasons (for deciding the location of coal stock pile and ash dump/ unloading areas, minimising the pollution effect due to dust)	Refer wind-rose in plot plan .
3.	**Location of:**	
a)	Water intake point.	Towards South.
b)	Water discharge point.	-.
c)	Plant drainage outfall point(s).	Towards East.
d)	Railway entries & exits.	Towards South.
e)	Road entries & exits.	Towards North & North-East.
f)	Electrical power transmission grid system.	Towards East.
g)	selected ash dump area.	Towards North.
h)	Nearest residential area.	Towards South.

	ITEM	SPECIFICATION REQUIREMENT
B.	**Layout Requirements**	
1.	**Maximum permissible slope in**	
a)	Rail track	1 in 400
b)	Road	1 in 30
c)	Sides of unpaved embankment	1 in 2
2.	**Required road width**	
a)	Main roads	8.0 Metres with 2.5m wide shoulders on either side.
b)	Auxiliary interconnections	4.0 Metres with 1.0m wide shoulders on either side.
c)	Road to the power house unloading bay :	
	• Only for entry to the unloading bay • To pass through the unloading bay	Yes. No.
3.	**Required minimum horizontal distance between the nearest points of**	
a)	Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b)	Electrical transformer and any other building/facility	As per the Tariff Advisory Committee Rules.
c)	Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee Rules.
d)	Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code.
4.	**Required minimum vertical clearance**	
a)	Under pipes/cable racks at road crossings	8.0 Metres.
b)	Soil coverage over underground pipes	1.0 Metre (minimum).
c)	Pipe/Cable trench	No Trench. Pipe/Cable Racks shall be used exclusively.

	ITEM	SPECIFICATION REQUIREMENT
5.	Railway Wagon clearance	As per the rules of the Indian Railways.
6.	Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres.
7.	**Required level, above the local developed grade level, of**	
a)	top of all roads	150 mm.
b)	all outdoor paved areas	150 mm.
c)	Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes.

BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS

	ITEM	SPECIFICATION REQUIREMENT
A.	**Minimum clear space required at all working and walking areas for operating & maintenance personnel**	
1.	**Horizontal, in all directions**	
a)	Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C.	1200 mm.
b)	Adjacent to any other plant facilities (including walls/structures)	1000 mm.
2.	**Vertical (head-room clearance)**	
a)	Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items.	2.2 Meters.
b)	Under any other plant facilities (including structures, pipes etc.)	2.2 Meters.
3.	**For all areas** where any equipment (including trucks, trolleys and other material handling equipment) will move or maneuver.	Minimum 500 mm clear in all direction from the outer edges of the equipment.
4.	**Minimum clear hand space required for**	
a)	The application of thermal insulation	100 mm
b)	Welding work	150 mm
c)	Bolt tightening	150 mm

B.	**Floors, platforms, staircase, ladders, walls, doors & windows**	
1.	**Statutory Requirement**	As per the regulations of OSHA, Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.
2.	**Operation & Maintenance Requirement**	
a)	Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.	Yes
b)	Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.	Yes
3.	**Plinth level** of all buildings, above the Finished Ground Level (FGL)	300 mm. However, 500 mm for power house building.
4.	**Minimum access** opening required (with rolling shutter)	3.5 m wide x 4 m high or, more wherever entry of loaded truck is envisaged, depending upon the equipment size to be handled.
C.	**Other Maintenance Requirement**	
C.	Other Maintenance Requirement	
1.	Generator stator handling In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking /lowering assembly, dismantling of building end walls/structures etc. shall be kept.	Yes

2.	Maintenance of the internals/impellers of all important equipment, like boiler feed pumps, feed water heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, cooling water pumps, coal mills, air compressors, blowers, heat exchangers, fuel oil pumps, filters etc.	Shall be possible without disconnecting or dismant-ling any piping/ducting.
3.	Overhauling and handling of the casings for the above items	Shall be possible without disturbing/dismantling any piping/ducting not directly connected to them.
4.	Crane Approach	
	Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible.	Yes
D.	Central Control Room	
	All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.	Yes
	The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration.	
	However, as a guide line, following features are given :	
a)	False ceiling and false flooring shall be provided.	
b)	Uniform height, colouring schemes for cabinets etc. shall be available.	
c)	The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.	
d)	No opening shall be provided from Boiler side.	
e)	Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.	

f) Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.

g) The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.

h) Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.

i) Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.

D. **Toilet and drinking water facility** — Required in all buildings and on all floors wherever operating personnel are to be deployed.

SECTION-VI

PROJECT MANAGEMENT AND SITE SERVICES

CONTENT

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SECTION-VI

PROJECT MANAGEMENT AND SITE SERVICES

1.00.00 PROJECT MANAGEMENT SERVICES

1.01.00 Responsibility

The Bidder shall identify a separate and independent project management team headed by a Project Manager for the execution of this project. Responsibilities of this project Management team shall cover the areas listed below :

a) Planning and Monitoring

b) Owner's Engineering Management

c) Contracts Management

d) Quality Assurance, Inspection & Expediting

e) Construction Management

f) Spares Management

g) Commissioning Management

Detailed responsibilities in the above areas are discussed below :

1.02.00 **Organisation**

1.02.01 **Headquarters**

The project management team shall be stationed at the organizational headquarter and headed by a senior level executive designated as the Project Manager who shall be responsible to Owner for the execution of the project. . He should have adequate financial power and authority to give decision.

Separately, designated leaders shall be identified for each of the areas mentioned under 1.01.00, who, in turn, will report to the Project Manager for all matters related to this contract.

1.02.02 **Central Co-ordination Cell**

The central coordination/ cell shall be based in Kolkata and shall have sufficient technical personnel to coordinate technical matters and to quickly resolve day to day queries or references made by Owner and his Consultants without having the need to refer to his headquarters each time.

1.02.03 **Site Organisation**

The site should have a competent construction manager for all site operations with adequate financial power and sufficient level of authority to take site decisions. The organisation chart for site should indicate the various levels of experts to be posted for supervision in the various fields in civil construction, erection, commissioning etc.

1.02.04 **Organisation Chart**

The Bidder shall furnish a detailed organisation chart for the project management team, clearly identifying the key personnel in each of the areas mentioned at 1.01.00 above. The expected number of executives at different levels shall also be indicated, separately for headquarters, central coordination cell and site organisation.

1.03.00 **Implementation Schedule**

The following milestones shall be followed by the Contractor against each activity as detailed below:

1.	Letter of Award (LOA)	Zero Date
2.	Supply Completion	36 months from LOA
3.	Synchronization	38 months from LOA
4.	Completion of Trial Operation	42 months from LOA
5.	System & Completion of all facilities as per contract and handing over	45 months from LOA After rectifying all jobs as identified in the Punch List to the satisfaction of the Owner.
6.	P. G. Test	To be completed within three (3) months after Completion of all facilities and handling over.
7.	Guarantee/Warranty Period	For a period of 18 months from the date of completion of the facilities or twelve (12) months from the date of operation acceptance (or any part thereof), whichever occurs first and any suitable extension of time for completion of rectified job granted by Employer
8.	Final Acceptance	After the expiry of defect liability period

1.03.01 **Owner's Engineering Schedules**

These schedules shall cover various design submissions indicating different Owner's Engineering activities to be performed. Such schedules shall be furnished by the Bidder for each and every plant/systems/ equipment/ item covered in the scope of this specification.

1.03.02 **Manufacturing Schedule**

The Contractor shall submit to the Owner's Engineer his manufacturing and delivery schedules for all equipment within thirty (30) days from the date of issue of the Letter of Award (LOA). Such schedules shall be in line with the detailed network for all phases of the work of the Contractor. Such schedules shall be reviewed, updated and submitted to the Owner's Engineer, once in every two months thereafter, by the Contractor. Schedules shall also include the materials and equipment purchased from outside suppliers.

1.03.03 **Erection Schedules**

In order to achieve the overall completion schedule, the Contractor shall provide the Owner all the information covering erection sequence, testing and commissioning activities. These schedules may be based on the recommended erection procedures and will be subject to discussions/agreements with the Owner subsequent to the award of contract.

1.03.04 The successful Bidder shall have to provide all the above schedules (i.e. 1.03.01, 1.03.02 & 1.03.03) in a tabular form in addition to that in the form of L2 & L3 networks and these shall necessarily include information not limited to the earliest and latest dates for various activities/submissions and also any related constraints. However, the Bidder shall include in his proposal a Level-1 (L-1) network showing the major activities and various milestones to achieve the above mentioned completion schedule.

1.03.05 The Contractor shall provide the Owner the original disc/software for all such schedules along with requisite no. of copies (as required by the Owner) within an agreed time schedule. This time schedule will be agreed between Owner/Bidder at the time of award of Contract. The Contractor's project management software shall be compatible with that of the Owner and the input data shall be furnished to the Owner in a manner compatible with Owner's project management software, Primavera.

1.04.00 **Detailed Responsibilities**

1.04.01 **Planning & Monitoring**

a) **Planning**

The Bidder shall prepare a Master Network Schedule in the form of PERT network consisting of at least 500 activities.

The network shall be prepared on a Work Breakdown Structure for the project which sub-divides the project into a set of manageable systems/sub-systems. The master network will identify milestones of key events for each system/package in the areas of Owner's Engineering, procurement, manufacture and despatch and erection and commissioning. The master network shall represent the Level-I plan and will form the basis for development of detailed second and third tier execution plans. The master network shall conform to the overall schedule prescribed by Owner.

The master network should be submitted along with the bid, which would be mutually discussed and finalised before the Award of Contract. This master network would clearly indicate the responsibility of the Bidder and project management team. This master network would form a part of the contract. The master network shall also identify a complete list of inputs to be furnished by the Owner which may be required for proper interfacing and tie-up. Scheduled dates for providing such inputs shall also be indicated, which will be mutually discussed and finalised.

b) **Monitoring & Progress Reporting**

The progress reports would be emanated every month, one from the head office of the Contractor and another from the site office. The progress report emanating from the head office should necessarily include the following sections:

i) Report on key milestones.

ii) Management summary indicating critical areas with details of actions initiated and effect of any on the project.

iii) Action needing attention of the Owner/Consultant.

iv) Detailed package wise status of Owner's Engineering submissions, quality plan submissions and approval, procurement manufacture and despatch.

The monthly report generated from the site office should necessarily include:

i) Report on key milestones.

ii) Management summary indicating critical areas with details of actions initiated and effect if any on the project.

iii) Action needing attention of the Owner/Consultant.

iv) This report would also cover the areas pertaining to the receipt of the equipment at the port, port clearance, transport, receipt at site, erection and commissioning.

In addition to the above, as the project execution progresses, the Contractor shall also be responsible for generating more frequent reports in the form of fax/e-mail information on progress in critical areas so that actions can be expedited. The exact format of the progress report shall be finalised after award of Contract.

1.04.02 **Owner's Engineering Management**

Based on the master network for the project (L-1) the Contractor will prepare an exhaustive list of Owner's Engineering activities for the equipment/systems covered in his scope and a detailed programme of accomplishing the same within the time frame specified in the master network. This schedule will form the Level-2 (L-2) network for Owner's Engineering activities.

Based on (L-2) network, the Bidder shall further develop the Level-3 (L-3) network for Owner's Engineering activities which will indicate schedule for data availability, drawing release date and document submission dates.

Detailed (L-2) and (L-3) networks would be submitted sequentially by the Contractor within two months from the date of issue of Letter of Award and finalised within one (1) month thereafter.

All such networks shall be provided in MS PROJECT software.

The Owner's Engineering management team should also co-ordinate all interface Owner's Engineering activity between the Contractor and the equipment sub-vendors so as to ensure the correctness and completeness of related Owner's Engineering documentation before the same is submitted to the Owner.

1.04.03 **Contracts Management**

Based on the master network, the Contractor shall submit L-2 programmes of manufacture and despatch. In addition, the master network shall also include periods considered for site activities viz. erection, commissioning etc. These L-2 programmes would be submitted in 2 months time from the date of award of contract and finalised within one (1) month thereafter. The Contractor will also submit site mobilisation plan. This programme would be submitted at the time of finalisation of award of contract and agreed immediately thereafter so that immediate development of the various activities at site could take place.

The Contractor should also submit L-3 programmes for the manufacturing, despatch of the various items. These networks shall also show the customer hold points (CHP) which have to be cleared by Owner or their authorised representative(s) before further manufacturing can take place. These L-3 programmes for the manufacture and despatch would clearly identify responsibilities of the Contractor, sub-Contractor and Owner. These networks

shall be submitted within one (1) month of the date of finalisation of the various sub-contracts by the Contractor.

In case all the manufacture is being done by the Contractor then the L-2 programmes would be themselves amplified to cover details of the manufacture, inspection, clearance by Owner and despatch.

The Contractor shall also submit the programme for procurement of bought out items, detailed shipping schedule and cash flow statement for Owner's approval.

1.04.04 **Quality Assurance, Inspection and Expediting**

The Contractor shall submit the list of manufacturers/sub-vendors from whom the equipment are expected to be procured and the quality assurance plans thereof for the manufacture shall be approved by the QA group of Owner before the manufacturing is commenced. The list of major suppliers would be submitted along with the bid and this shall be mutually discussed and approval will be given by the Owner during contract negotiation meeting prior to placement of Letter of Award. This approved list will be binding to the bidder. In the said list, Owner reserves the right to include reputed/reliable vendors of his own choice. Regarding the various other sub-vendors, the list would be submitted within six (6) months of the award of the contract that shall be scrutinized by the Owner to accord approval. In such list Owner reserves the right to include vendors of his own choice. No further vendor approval will be given after six (6) months. On the quality plans, the customer hold points will also be identified based on which Owner would give clearance for the manufacture to proceed further.

Quality assurance/Inspection group of Owner or its representative would issue a material despatch clearance certificate (MDCC) after the inspection clearance which will enable the Contractor to despatch the equipment and claim the payment. In the despatch programme, the Contractor shall indicate a schedule of estimated programme, tonnages specifically identifying various oversize dimensioned consignments (ODC). Further the Contractor will also be required to ensure at all stages of shipment that packing of all shipments despatched are suitable for ocean freight to India, handling at the port of entry, inland transportation and preservation at site up to erection. All despatch details & item lists shall be made available to both Owner & site immediately after shipping.

The Contractor shall also expedite all despatches from their own works/works of their sub-vendors, so as to match with the various activities mentioned at 1.04.03 above.

1.04.05 **Construction Management**

Based on the L-1 Master Network Programme, within two (2) months of the issue of Letter of Award, the Contractor shall submit a programme of construction/erection/commissioning, either in continuation with the manufacture and despatch or separately for the implementation. These

programmes would be amplified showing when the civil drawings shall be released by him and construction of civil works shall be completed by him to facilitate start of erection and subsequent activities and shall form the basis for site execution and detailed monitoring. The three monthly rolling programme with the first month's programme being tentative based on the site conditions would be prepared based on these L-3 programmes. The Contractor shall also be involved along with the Owner to tie up detailed resource mobilisation plan over the period of time of the contract matching with the performance targets.

The L-3 programme would be jointly finalised by the site in-charge of the Contractor with the Owner's project coordinator as well as the site planning representative. The erection programme will also identify the sequential erectable tonnages that are required for various equipment which should be taken care of in the despatch programmes.

Erection and commissioning of the equipment shall also be done under the supervision of experts from the respective equipment/ system supplier.

1.04.06 **Spares Management**

Along with the proposal for the plant and equipment, the Contractor shall also submit proposals/schedule for the following:

a) Mandatory spares

b) Recommended spares

While the award for mandatory spares will be finalised at the time of the award of contract, recommended spares will be finalised within twelve (12) months thereafter.

1.05.00 **Project Progress Review Meetings**

Keeping in mind the overall responsibility of the Contractor it is intended that periodic progress reviews on the entire activities of execution in respect of Sagardighi Thermal Power Plant unit #5 will be held initially at least once in two (2) months at Kolkata/site. During peak period it may be held once in a month. These meetings will be attended by reasonably higher officials of the Contractor and their leading sub- contractors and will be used as a forum for discussing all areas where progress needs to be speeded up. Actions will be placed on the concerned agencies and decisions will be taken to expedite/speed up the progress. Minutes of such meetings will be issued reflecting the major discussions and decisions taken and circulated to all concerned for reference and action. The Contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings.

In addition to the above, and to streamline the construction and erection at site, a suitable frequency and forum of periodic meetings between the Contractor and the Owner will be decided upon as part of erection coordination procedure. Site co-ordination meeting may be held on weekly basis.

1.06.00 **Owner's Consultant**

The Owner would appoint a consultant to assist him in some of the areas mentioned at 1.01.00 above. The details of interaction and procedures for coordination between Owner/Owner's Consultant and Contractor/Contractor's project management team shall be finalised during contract negotiations.

1.07.00 **Commissioning Management**

1.07.01 For commissioning of the various equipment/system covered under the scope of contract, Owner will form an organisation structure which may consist of the following committees. The Contractor shall nominate his representative on one or more of the committee as decided by the Owner:

a) Commissioning Teams.

b) Testing Teams.

1.07.02 Commissioning documents shall be prepared by the Contractor in the following manner and submitted for Owner's approval :

a) Paper of Principle

This document shall be prepared for the various equipment/ systems under commissioning and shall have the following objectives to fulfill and shall be submitted for Owner's approval at least six (6) months before their actual commissioning :

i) Establish design data against which Plant Performance will be compared.

ii) Set-out the testing objectives and proposals.

iii) Define the documentation required.

b) **Testing/Commissioning Schedule**

These shall be prepared for the various equipment/systems under consideration and shall contain sections like detailed testing method, programme, safety, individual responsibility and results.

c) **Standard Check Lists**

Standard checklists are intended for use at the completion of erection to ensure correct erection, testing and to a limited extent operation for repetitive items.

1.07.03 **Test Reports**

After the completion of commissioning activity of equipment/ systems, the Contractor shall prepare the test reports which shall include all the relevant information related to various commissioning checks, tests carried out, any deviations/commissions noticed with respect to the intended design requirements, sequence of various commissioning activities as actually adopted vis-à-vis as recommended in the procedures, programme schedules achieved and any other such information as required. These test reports shall be submitted in requisite number of copies to the Owner and this should be duly signed jointly by the Owner/Consultant and the Contractor/Equipment supplier, who are involved during the commissioning activities.

2.00.00 **SITE SERVICES**

These services shall be rendered by the Bidder as part of the overall project management service. The services shall broadly include but not be limited to the following :

2.01.00 Arranging material despatch from the shop by rail/road and/or sea as applicable.

2.02.00 Monitoring movement of materials & follow-up as necessary with Railways, road transport, port clearance etc. from the time of despatch F.O.R. works/F.O.B. port of shipment by Contractor till receipt of the same at site.

2.03.00 Unloading of materials at Railway Station/Railway Siding inside project area, transportation to site store, assessment of lost/damaged items in transit and arranging insurance claims and replacement of lost/damaged items. The Contractor shall submit to the Owner's Engineer a report detailing all the receipts during the week.

2.04.00 Issuing materials from site store/open yard from time to time for erection as per the construction programme. The Contractor shall be the custodian of all the materials issued till the plant is officially taken over by the Owner after complete erection and successful trial run & commissioning.

2.05.00 Transportation of materials to their respective places of erection and erection of the complete plant & equipment as supplied under this specification.

2.06.00 Trial run and commissioning of individual equipment/sub-systems and the plant as a whole to the satisfaction of the Owner, including supply of temporary equipment & services for chemical cleaning, steam blowing as well as performance guarantee tests.

For Coal Handling Plant, satisfactory operation of the system, amongst others, shall consist of operation without spillage or choking anywhere even during monsoon.

Provision for preservation of individual equipment after trial run and commissioning e.g. Nitrogen blanketing etc. as necessary shall also be in the scope of the Bidder.

2.07.00 Supply and application of the final paints lubricating oils and all consumable till completion of facilities and hand over..

2.08.00 For the purpose of erection and commissioning the Contractor's scope of work shall include but not be limited to the following :

2.08.01 Deployment of all skilled and unskilled manpower required for erection, supervision of erection, watch & ward, commissioning and other services to be rendered under this specification.

2.08.02 Deployment of all erection tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the erection work to be handled under the scope of this specification.

Supply of commissioning spares.

2.08.03 Supply of all chemicals and consumables, e.g. Regeneration chemicals, alum, lime, polyelectrolyte, resin, welding electrodes, cleaning agents, diesel oil, grease, lubricant etc. as well as materials required for temporary supports, scaffolding etc. as necessary for such erection commissioning work till completion of facilities and hand over, except those listed under exclusion elsewhere in this specification.

2.08.04 Construction of all civil/structural/architectural works, including construction of foundation for all equipment supplied as required, grouting of equipment on foundation after alignment, and all other incidental civil activities as detailed elsewhere.

2.08.05 All structural steel fabrication and erection work as detailed elsewhere in the specification.

2.08.06 Providing support services for the Contractor's erection staff e.g. construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, insurance cover, watch & ward for security and safety of the materials under the Contractor's custody etc. as required.

2.08.07 Maintaining proper documentation of all the site activities undertaken by the Contractor as per the proforma mutually agreed with the Owner; submitting monthly progress reports as also any such document as and when desired by the Owner; taking approval of all statutory authorities e.g. Boiler Inspector, Factory Inspector, Inspector of Explosives etc. for respective portions of work under the jurisdiction of such statutes or laws.

2.08.08 The Contractor shall provide `Industrial Relations' unit and `Medical' unit to take care of his erection staff and the Owner shall have no obligation in this regard.

2.09.00 **Site Organisation**

The Contractor shall maintain a site organisation of adequate strength in respect of manpower, construction machinery and other implements at all times for smooth execution of the contract. This organisation shall be reinforced from time to time, as required, to make up for slippages from the schedule without any commercial implication to the Owner. The site organisation shall be headed by a competent construction manager having sufficient authority to take decisions at site.

On award of contract, the Contractor shall submit to the Owner a site organisation chart indicating the various levels of experts to be deployed on the job. The Owner reserves the right to reject or approve the list of personnel proposed by the Contractor. The persons, whose bio-data have been approved by the Owner, will have to be posted at site and deviations in this regard will not generally be permitted.

The Contractor shall also submit to the Owner for approval a list of construction equipment, erection tools, tackle etc. prior to commencement of site activities. These tools & tackle shall not be removed from site without written permission of the Owner.

2.10.00 **General Guidelines for Field Activities**

2.10.01 The Contractor shall execute the works in a professional manner so as to achieve the target schedule without any sacrifice on quality and maintaining highest standards of safety and cleanliness.

2.10.02 The Contractor shall co-operate with the Owner and other Contractors working in site and arrange to perform his work in a manner so as to minimise interference with other Contractors' works. The Owner's Owner’s Engineer shall be notified promptly of any defect in other Contractor's works that could affect the Contractor's work. If rescheduling of Contractor's work is requested by the Owner's Owner’s Engineer in the interest of overall site activities, the same shall be complied with by the Contractor. In all cases of controversy, the decision of the Owner shall be final and binding on the Contractor without any commercial implication to owner.

2.10.03 The Owner’s Engineer shall hold weekly meetings of all the Contractors working at Site at a time and a place to be designated by the Owner’s Engineer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Owner’s Engineer and shall strictly adhere to those decisions in performing his Work. In addition to the above weekly meeting, Owner’s Engineer may call for other meetings either with individual contractors or with selected number of contractors and in such a case the Contractor, if called will also attend such meetings.

2.10.04 Time is the essence of the Contract and the Contractor shall be responsible for performance of his Work in accordance with the specified construction schedule. If at any time the Contractor is falling behind the schedule, he shall

take necessary action to make good of such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such action in writing to the Owner's Engineer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

2.10.05 The Owner's Engineer shall however not be responsible for provision of additional labour and or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.

2.10.06 The works under execution shall be open to inspection & supervision by the Owner's Owner's Engineer at all times. The Contractor shall give reasonable notice to the Owner before covering up or otherwise placing beyond the reach of inspection any work in order that same may be verified, if so desired by the Owner.

2.10.07 Every effort shall be made to maintain the highest quality of workmanship by stringent supervision and inspection at every stage of execution. Manufacturer's instruction manual and guidelines on sequence of erection and precautions shall be strictly followed. Should any error or ambiguity be discovered in such documents, the same shall be brought to the notice of the Owner's Owner's Engineer. Manufacturer's interpretation in such cases shall be binding on the Contractor.

2.10.08 The Contractor shall comply with all the rules and regulations of the local authorities, all statutory laws including Minimum Wages, Workmen Compensation etc. The contractor shall engage maximum number of local unskilled and semi skilled labours for construction works. All registration and statutory inspection fees, if any, in respect of the work executed by the Contractor shall be to his account.

2.10.09 All the works such as cleaning, checking, leveling, blue matching, aligning, assembling, temporary erection for alignment, opening, dismantling of certain equipments for checking and cleaning, surface preparation, edge preparation, fabrication of tubes and pipes as per general Owner's Engineering practice at site, cutting grinding, straightening, chamfering, filling, chipping, drilling, reaming, scrapping, shaping, fitting-up bolting/welding, etc., as may be applicable in such erection and are necessary to complete the work satisfactorily, are to be treated as incidental and the same shall be carried out by the Contractor as part of the work.

2.10.10 In case of any class of work for which there is no such specification as laid down in the contract such as, blue matching, welding of stainless steel parts, etc., the work shall be carried out in accordance with the instructions and requirements of the Owner's Engineer.

2.10.11 It may sometimes be necessary to remove some of the erected structural members to facilitate erection of bigger/pre-assembled equipment. In such cases, the removal and re-erection of such members, which are essential, and if so agreed by the Owner's Engineer, will have to be done by the Contractor.

2.10.12 Attachment welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., both for regular measurement and performance testing to be provided on equipment, its auxiliaries or pipelines covered within the scope of this tender, will also be the responsibility of the Contractor and the same will be done as per the instructions of Owner's Engineer. The erection and welding of all above items will be the Contractor's responsibility, even if :

a) Product groups under which these items are re-leased are not covered in the scope of this tender.

b) Items are supplied by an agency other than the Contractor.

2.10.13 Preservation of all materials/equipment under custody of the Contractor during storage, pre-assembly & erection, commissioning etc., shall be the responsibility of the Contractor. All necessary preservatives and consumables like paints, etc., shall be arranged by the Contractor. Necessary touch up painting, periodic application of preservatives/paints on pressure parts/other equipment even after erection until completion of work shall be carried out by the Contractor. The Contractor shall fabricate piping, install lub oil systems and carry out the acid cleaning of fabricated piping. The Contractor shall also service the lub oil system, carryout the hydraulic test of oil coolers, etc.

2.10.14 It is responsibility of the Contractor to do the alignment etc. if necessary, repeatedly to satisfy Owner's Engineer, with all the necessary tools & tackles, manpower, etc. The alignment will be complete only when jointly certified so, by the Contractor's Owner's Engineer & Owner. Also the Contractor should ensure that the alignment is not disturbed afterwards.

2.10.15 Additional platforms for approaching different equipment as per site requirement, which may not be indicated in drawings, shall be fabricated and erected by the Contractor. The materials required for these works shall be supplied by the Contractor and he will have to fabricate them to suit the requirement.

2.10.16 Equipment and material, which are wrongly installed, shall be removed and reinstalled to comply with the design requirement at the Contractor's expense, to the satisfaction of the Owner/ Consultant.

2.10.17 Before erection of any equipment on a foundation, the Contractor shall check and undertake if necessary rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin, etc.

2.10.18 Assistance for calibrating/testing the power cylinders, valves, gauges, instruments, etc., and setting of actuators coming under various groups shall be provided by Contractor.

2.10.19 It shall be the responsibility of the Contractor to provide ladders on columns for initial works till such time stairways are completed. For this, the ladder should not be welded on the column and should be prefabricated clamping type. No

temporary welding on any structural member is permitted except under special circumstances with the approval of Owner.

2.10.20 Structural materials required for the supporting/operating platforms required for the valves at various levels for the safe operation of valves will be arranged by the Contractor.

2.10.21 For civil, structural and architectural works, volume IIG/1 & IIG/2 may be referred. For Instrumentation and Electrical works Vol. IIE and Vol. IIF1 & F2 may be referred.

2.11.00 Safety

2.11.01 Safety and overall cleanliness of work site shall be given top priority. The Contractor shall ensure the safety of all workmen, materials and equipment either belonging to him or to others working at site. He shall observe safety rules & codes applied by the Owner at site without exception.

2.11.02 The Contractor shall notify the Owner of his intention to bring to site any equipment or material which may create hazard. The Owner shall have the right to prescribe the conditions under which such equipment or material may be handled and the Contractor shall adhere to such instructions. The Owner may prohibit the use of any construction machinery, which according to him is unsafe. No claim for compensation due to such prohibition will be entertained by the Owner.

2.11.03 Storage of petroleum products & explosives for construction work shall be as per rules and regulation laid down in Petroleum Act, Explosive Act and Petroleum and Carbide of Calcium Manual. Approvals as necessary from Chief Inspector of Explosives or other statutory authorities shall be the responsibility of the Contractor.

2.11.04 The Contractor shall be responsible for safe storage of his and his sub-contractor's radioactive sources.

2.11.05 All requisite tests & inspection of handling equipment, lifting tools & tackle shall be periodically done by the Contractor. Defective equipment shall be removed from service. Any equipment shall not be loaded in excess of its recommended safe working load.

2.11.06 All combustible waste and rubbish shall be collected and removed from the worksite at least once each day. Use of undercoated canvas paper, corrugated paper, fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed.

2.11.07 The Contractor shall provide adequate number of fire protection equipment of the required types for his stores, office, temporary structures, labour colony etc. Personnel trained for fire-fighting shall be made available by the Contractor at site during the entire period of the Contract.

2.11.08 All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The Contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installation.

2.11.09 All workmen of the Contractor working in construction site shall wear safety helmets, safety boots and safety belts. The Contractor shall take appropriate insurance cover against accidents for his workmen as well as third party.

2.11.10 All the worksites shall be provided with adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. by the Contractor for proper working environment during night times.

2.11.11 Adequate number of temporary toilets/urinals (men & women separate) shall be provided at work places with soak pits. Adequate drinking water facilities and rest rooms shall be provided for workers to take food and rest.

2.11.12 All safety precautions shall be taken for welding and cutting operations as per IS-818.

2.11.13 All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

2.12.00 Taking Delivery & Storage

2.12.01 The Contractor shall arrange issue of all equipment and materials to be erected under the contract from the stores/open yard at site by signing on standard indent forms. After completion of work, detailed auditing of the materials so issued shall be submitted to the Owner.

2.12.02 The Contractor shall arrange for proper and safe storage of materials till the same are taken over by the Owner as per terms of the contract. Manufacturer's instructions for preservation shall be strictly followed.

2.12.03 All empty containers, packing materials, gunny bags, transport frames and also surplus and unused materials reconciliation prior to completion of contract shall be the property of the Owner and returned to the Owner by the Contractor.

2.13.00 Site Welding & Heat Treatment

2.13.01 Welding shall be done in accordance with IS-813, IS-816, IS-9595 & other relevant IS/International standards and as per instructions of Contractor. Only those welders, who are qualified as per IS-817 for ordinary welds and as per IBR/ASME Section-IX for high pressure welds, shall be employed in the job.

2.13.02 All welders shall be tested and approved by Owner’s Engineer before they are actually engaged on the work even though they may possess the requisite certificates. The Owner reserves the right to reject any welder without assigning any reason. The welder identification code as approved by the Owner’s Engineer shall be stamped by the welder on each joint done by them. The

Contractor will be responsible for the periodic renewal, re-testing of the welders as demanded by Owner.

2.13.03 The Owner's Engineer is entitled to stop Contractor's any welder from his work if his work is unsatisfactory for any technical reason or there is a high percentage of the rejection of joints welded by him, which in the opinion of Owner's Engineer will adversely affect the quality of welding even though the welder has earlier passed the tests. The welders having passed the tests do not relieve the Contractor from his contractual obligations, to check the performance of the welders.

2.13.04 All charges for testing of welders including destructive and non- destructive tests if conducted by Owner or by the inspection authority at site shall have to be borne by the Contractor. The necessary test materials and consumables will have to be arranged by the Contractor and all testing facility made available, as required.

2.13.05 All welded joints shall be subject to acceptance by Owner's Engineer. Inspection of welds shall be in accordance with IS-822 or equivalent code.

2.13.06 Preheating/post-heating and stress relieving after welding are part of fabrication and erection work and shall be performed by the Contractor in accordance with the instruction of Owner's Engineer. Contractor shall arrange to supply heating equipment with automatic recording devices. Also the Contractor shall have to arrange for the labour, heating elements, thermocouples, compensating cables, insulation materials like mineral wools, asbestos cloth, ceramic beads, asbestos rope, etc. required for the heat-treatment and stress relieving works. During pre- heat/stress relieving operations, the temperature shall be measured at one or more points as required by attaching thermocouples and recorded on a continuous printing type recorder. All the record graphs for the heat treatment works carried out shall be got signed by the Owner's Engineer prior to the commencement of each cycle and handed over to Owner's Engineer on completion. The graphs will be the property of Owner. The Contractor has to provide thermo-chalks temperature recorders, thermocouple attachments, units, graph sheets, etc. required for the job and maintain them in good condition.

2.13.07 All electrodes shall be baked and dried in the electric/electrode drying oven to the required temperature and for the period specified by the Owner's Engineer before they are used in erection work. The electrodes used shall be as per IS-814, IS-815, IS-1442, IS-7280 and other codes as applicable, and shall be of approved reputed manufacture. The electrodes shall meet the requirement of the pipe material. No electrode manufactured more than 12 months ago and the type covered under certificate issued after conducting tests more than 6 months ago shall be used. All electrodes shall be preserved at works and at site as per manufacturer's recommendations.

2.13.08 Oxy-acetylene flame or Exothermic chemical heating for stress relieving is not permitted. Heating shall be by means, of electric induction coil or electric resistance coil.

2.13.09 It may become necessary to adopt inter layer radiography/MPT/UT depending upon the site/technical requirement necessitating interruptions in continuation of the work and making necessary arrangement for carrying out the above work.

2.13.10 Gas tungsten arc welding process (TIG) shall be adopted for all root pass welds except for structural works until 4.75 mm thickness is deposited. Subsequent welding after root pass can be carried out by manual metal arc welding with coated electrodes. For pipes of thickness less than 6 mm the entire welding has to be carried out by TIG welding.

Fillet weld shall be made by shielded metal arc process as per applicable codes.

However, the Owner's Engineer will have the option of changing the method of welding as per site requirement. The method adopted for manual arc welding shall be weaving technique and the width of weaving shall not exceed 1.5 times of the dia. of the electrode.

In case of deviation from welding process and electrodes, the Contractor shall take approval of the Owner prior to adoption of same.

2.13.11 The root pass for butt joints shall be such as to achieve full penetration with complete fusion of root edges.

2.13.12 Each pass shall be cleared and freed of slag before the next pass is deposited.

2.13.13 On completion of each run, craters, weld irregularities, slag etc. shall be removed by grinding or chipping.

2.13.14 Each layer of welding shall have an even and smooth appearance.

2.13.15 Welding sequence shall be adjusted in such a way that distortion due to welding shrinkage is minimised. Further any movement, shock or vibration during welding shall be avoided to prevent weld cracks.

2.13.16 Proper protection of welders and the work shall be taken during periods of rain. No welding shall be carried out when surfaced to be welded are wet from any cause.

2.13.17 Following will be stages of inspection during welding:

a) Two pieces to be joined shall be individually checked for the weld edge preparation and profile dimensionally and to the template. Dye penetrant check shall be carried out on edge prepared surfaces at random. The percentage will depend upon on criticality as specified by Owner's Engineer.

b) Joint fit up will be a stage of inspection. Misalignment after fit up may vary from 0.3 mm to 1.6 mm depending on outside diameter and thickness.

c) All joints shall be offered for visual inspection after root run. Subsequent welding should be made only after the approval of root run.

2.13.18 All welded joints shall be painted with anti-corrosive paint immediately on completion of radiography and stress-relieving.

2.14.00 For further details on procedures of work at site on civil, architectural, electrical and instrumentation & control services, refer Volume: II-E, II-F1 & F2 and II-G/1 G/2 & G/3 of this specification.

3.00.00 **PROTECTION AND CARE**

3.01.00 All construction and erection activities for this project are to be carried out in the plant premises.

3.02.00 Generator Stator Lifting may be considered by either of the two options as mentioned below:

a) ~~With the help of two (2) nos. turbine room cranes~~.

b) With the help of separate lifting arrangement to be provided by the Bidder from outside the TG building A-row column before the construction of A-row building wall.

388885/2021/PS-PEM-MAX

The West Bengal Power Development Corporation Limited
(A Government of West Bengal Enterprise)
Corporate Identity No.: U40104WB1985SGC039154
Registered & Corporate Office: Bidyut Unnyan Bhavan,
Plot – 3/C,LA – Block, Salt Lake City, Sector – III, Kolkata – 700 098
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website: www.wbpdcl.co.in. E-mail: wbpdcl@wbpdcl.co.in

Ref. No. WBPDCL/Corp./SGMP03/AV/8/047 Date: 16.06.2020

To,
Shri A.K. Singhal, GM
PS- MKTG. BHEL House,
Siri Fort, New Delhi 110 049

Sub : Vendor List of Sagardighi Thermal Power Extension Project Unit No.5 (1X660MW)

Ref : E-mail from BHEL PS-MKTG dtd. 29th August, 2019

Dear Sir,

Please find the reviewed Vendor List for the captioned Project.

BHEL may note that some Vendors have been identified under 'DR' category for which BHEL is requested to provide detail credentials of the Vendor in line with the tender requirements for Approval consideration from WBPDCL.

The entire Vendor List is divided under the following sub heads-

a)	Mechanical Aux.Packages	:	Annexure-A
b)	Mechanical Equipment List	:	Annexure-B
c)	FGD Plant Equipment List	:	Annexure-C
d)	CHP Equipment List	:	Annexure-D
e)	AHP Equipment List	:	Annexure-E
f)	Electrical Equipment List	:	Annexure-F
g)	C&I Equipment List	:	Annexure-G
h)	FPA Equipment List	:	Annexure-H
i)	HVAC System	:	Annexure-I
j)	PSER Erection Vendors	:	Annexure-J

This is for your information and further necessary action from your end.

Thanking you,

Yours faithfully

16.6.2020

Kalyanbrata Chakrabarty
GM (Projects)

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

SL. NO.	Item Description	Vendor Name	Remarks
1	OXYGEN DOSING SYSTEM	ENPRO INDUSTRIES PVT.LTD. MARKAL KHED,PUNE	Approved
		POWER PIPING COMPANY ,Mandaiyur	DR
		PSI ENGINEERING SYSTEMS (P) LTD., Chennai	Approved
		Positive Metering Pumps (I) Pvt. Ltd.,Nasik	DR
		V.K PUMP INDUSTRIES PVT LTD, Nasik	Approved
2	CHEMICAL DOSING SYSTEM	ENPRO INDUSTRIES PVT.LTD., MARKAL KHED,PUNE	Approved
		PSI ENGINEERING SYSTEMS (P) LTD., Chennai	Approved
		SWELORE ENGG. PVT. LTD, AHMEDABAD	Approved
		TECHNO CONSULTANTS , GHATKOPAR (W) MUMBAI	Approved
		MILTON ROY INDIA (P) LTD.	Approved
		V.K PUMP INDUSTRIES PVT LTD, Nasik	Approved
3	CONDENSATE POLISHING UNIT	BGR ENERGY SYSTEMS LIMITED.,	Approved
		DRIPLEX WATER ENGINEERING INTERNATIONAL PRIVATE LIMITED, Hardwar	Approved
		ION EXCHANGE (INDIA) LTD	Approved
		THERMAX LTD. PUNE	Approved
		VA TECH WABAG LTD	Approved
4	MILL REJECT SYSTEM (PNEUMATIC TYPE)	MECAWBER BEEKAY PVT LTD., GREATER NOIDA	Approved
		UNITED CONVEYOR CORPORATION (INDIA) PVT.LTD.,KOLKATA	Approved
5	COLTCS	GEA BGR ENERGY SYSTEM INDIA LTD., Nellore	Approved
		TAPROGGE GmBH, Noida	Approved
		TECHNOS, FRANCE	Approved
		EIMCO WATER TECHNOLOGIES ,LLC, USA	Approved
		KLUMP & KOLLER GmbH	Approved
		FILTRATION ENGINEERS LTD.	Approved
		MULTITEX FILTRATION ENGINEERS LIMITED,	Approved
6	CW TREATMENT PLANT (Items to be procured from the approved Vendor List)	CLEAR WATER LTD.	Approved
		THERMAX LTD.	Approved
		DRIPLEX WATER ENGG. LTD.	Approved
		CHEMBOND ASHLAND WATER TECHNOLOGIES LTD.,MUMBAI	Approved
		VA TEC WABAG LTD	Approved
7	CHLORINATION PLANT (Items to be procured from the approved Vendor	PERFECT CHLORO SYSTEMS	Approved
		METITO POLLUTION CONTROL INDIA LTD	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
1	VIBRATION ISOLATION	GERB	Approved
2.	STEEL GATE / GLOBE / NR VALVES 'BHEL' Make Valves are approved for only for 1500 CLASS or below.	WEIR B.D.K VALVES INDIA PVT. LTD.	Approved
		KIRLOSKAR BROTHERS LTD.	Approved
		LEADER VALVES LTD.	Approved
		KSB VALVES	Approved
		FOURESS ENGG.INDIA LTD.	Approved
		VAG VALVES	DR
		AUDCO INDIA	Approved
		DEWARANCE	DR
		Hawa Valves (India) Pvt. Ltd.	Approved
		HAWA ENGINEERS LTD.	Approved
		INTERVALVE POONAWALLA LTD.	Approved
		MICON VALVES (INDIA) PVT. LTD.	DR
3.	BALL VALVES	FLOW CHEM INDUSTRIES	Approved
		FISHER SANMAR LIMITED	Approved
		KIRLOSKAR BROS. LTD.	Approved
		LEADER VALVES LTD.	Approved
		KSB VALVES	Approved
		WEIR B.D.K VALVES INDIA PVT. LTD.	Approved
		VAG VALVES	Approved
		A.V. VALVES LTD	Approved
		Hawa Valves (India) Pvt. Ltd.	Approved
		INTERVALVE POONAWALLA LTD.	Approved
4.	CAST IRON GATE /GLOBE/ NRV/ SAFETY RELIEF VALVES	H.SARKER & COMPANY	Approved
		G.M.DALUI & SONS PVT.LTD.	Approved
		KIRLOSKAR BROS. LTD.	Approved
		LEADER VALVES LTD.	Approved
		VENUS PUMP & ENGG. WORKS	Approved
5.	SAFETY RELIEF VALVE (TUBE SIDE AND SHELL SIDE)	BHEL-HPBP TRICHY	Approved for Class 1500 or below
6.	Safety Valve, Safety relief Valve & ERV **'BHEL' Make Valves are approved for only for 1500 CLASS or below.**	SEMPELL GmbH./Germany	Approved
		DRESSER CONSOLIDATED,/USA	Approved
		DRESSER CONSOLIDATED,/United Kingdom	Approved
		TYCO VALVES & CONTROLS,/USA	Approved
		MEIWA CORPORATION,/Japan	Approved
		BOPP&REUTHER,SICHERHEITS-UND/Germany	Approved
		REINEKE MESS-UND REGELTECHNIL GMBH/Germany	Approved
		VALVTECHNOLOGIES,/USA	Approved
		BOPP&REUTHER,SICHERHEITS-UND/Germany	Approved
		VALVTECHNOLOGIES,/USA	Approved
7	GUN METAL VALVES	A.V.VALVES LTD,	Approved
		LEADER VALVES LTD.,	Approved
		VALTECH INDUSTRIES	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
8	BUTTER FLY VALVES (STEAM SERVICE)	FOURESS ENGG.INDIA LTD.	Approved
		INSTRUMENTATION LTD.	Approved
		BDK PROCESS CONTL. HUBLI	Approved
9.	BUTTER FLY VALVES (WATER SERVICE)	WEIR B.D.K VALVES INDIA PVT. LTD.	Approved
		FOURESS ENGG.INDIA LTD.	Approved
		INSTRUMENTATION LTD.	Approved
		LARSEN & TOUBRO LTD.	Approved
		KIRLOSKAR BROS. LTD.	Approved
		TYCO VALVES & CONTROLS INDIA PVT.LTD.	Approved
10.	SPRING LOADED BYPASS VALVES/ PLUG VALVES/ ANGLE DRAIN VALVES	WEIR VALVES & CONTROLS M.E.	Approved
		WEIR B.D.K VALVES INDIA PVT. LTD.	Approved
		FISHER SANMAR LIMITED	Approved
		LARSEN & TOUBRO LTD	Approved
		LEADER VALVES LTD.	Approved
		REINEKE MEB-UND REGELTECHNIK GMBH	Approved
		SEMPELL AG, GERMANY	Approved
		VELAN INC.,CANADA	Approved
11.	AIR RELEASE VALVES	H.SARKER & COMPANY	Approved
		LEADER VALVES LTD.	Approved
		VENUS PUMP & ENGG. WORKS	Approved
		G.M.DALUI & SONS PVT.LTD.	Approved
		A.V. VALVES LTD	Approved
12.	DUAL PLATE CHECK VALVES	VENUS PUMP & ENGG. WORKS	Approved
		FLUIDLINEVALVES COMPANY PRIVATE LTD.	Approved
13.	FLOAT VALVES	H.SARKER & COMPANY	Approved
		G.M.DALUI & SONS PVT.LTD.	Approved
		LEADER VALVES LTD.	Approved
14	CONDENSATE PUMP-LP	SAM TURBO INDUSTRY PVT LIMITED	Approved
		SULZER PUMPS INDIA PVT LTD	Approved
		KIRLOSKAR BROTHERS LTD	Approved
		CLYDE PUMPS INDIA PVT LTD,	Approved
15.	FUEL OIL PUMPS (POSITIVE DISPLACEMENT PUMPS)	TUSHACO PUMPS PVT. LTD.,	Approved
		ALEKTON ENGG.INDUSTRIES PVT.LTD.	Approved
		U.T.PUMPS & SYSTEMS (P) LTD.	DF
		ALLWEILER INDIA PVT.LTD.,	Approved
16.	PGB SPECIAL OIL-ISO VG 320	INDIAN OIL CORPN.LTD.,	Approved
		HINDUSTAN PETROLEUM CORPN. LTD.	Approved
		CASTROL INDIA LIMITED	Approved
		EXXONMOBIL LUBRICANTS PVT LTD	Approved
		SHELL INDIA MARKETS PRIVATE LIMITED	Approved
17.	JACKING OIL PUMPS WITH MOTOR (SCREW TYPE) FOR MAIN TURBINE	TUSHACO PUMPS LIMITED	Approved
		ALLWEILER AG ,GERMANY	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
19.	AUX. OIL PUMP (AOP) & EMERGENCY OIL PUMP WITH MOTOR (EOP) FOR MAIN TURBINE	KSB PUMPS LIMITED	Approved
		MATHER & PLATT PUMPS	Approved
		KBL	Approved
20.	VACUUM PUMPS	EDWARDS LIMITED, UK	Approved
		NI-TECH INC. USA	DR
		NASH ELOM INDUSTRIES, GERMANY	Approved
21	LUB OIL TRANSFER PUMPS	MATZ PUMPS PVT.LTD.	DR
		TUSHACO PUMPS PVT.LT	Approved
		IDEX INDIA PVT LTD	DR
		DELTA P D PUMPS PVT LTD	Approved
		ALLWEILER INDIA PRIVATE LIMITED	Approved
22	CONCRETE VOLUTE PUMP	KIRLOSKAR BROS. LTD.	Approved
		CLYDE UNION PUMPS	Approved
		FLOWSERVE CORPORATION	Approved
		BHEL HYD BASED ON MHI COLLABORATION	DR
23.	MISC.PUMPS (VERTICAL)	KIRLOSKAR BROS. LTD.	Approved
		KSB PUMPS LTD.	Approved
		SULZER PUMPS INDIA LTD.	Approved
		WEIR,UK	Approved
		WPIL LIMITED	Approved
		FLOWMORE	Approved
		BHARAT PUMPS & COMPRESSORS LTD	Approved
		WILO MATHER & PLATT PUMPS PVT. LTD.	Approved
24.	BOILER WATER RECIRCULATION PUMP	TORISHIMA PUMP MFG CO.LTD, Japan	Approved
		KSB AKTIENGESELLSCHAFT, Germany	DR
25.	PUMPS (HORIZONTAL) Type-I (FLOW<300 CMH)	KIRLOSKAR BROS. LTD.	Approved
		MATHER & PLATT PUMPS LTD.	Approved
		KSB PUMPS LTD.	Approved
		SULZER PUMPS INDIA LTD.	Approved
		WEIR,UK	Approved
		WPIL LIMITED	Approved
26.	PUMPS (HORIZONTAL) Type- II (FLOW>300 CMH)	FLOWMORE LTD.	Approved
		WPIL LIMITED	Approved
27.	SUMP PUMPS / SUBMERSIBLE PUMPS/ SLUDGE PUMP	KISHOR PUMPS PVT.LTD	Approved
		KIRLOSKAR BROS. LTD.	Approved
		KSB PUMPS LTD.	Approved
		FLOWMORE LTD.	Approved
		JASCO PUMP PVT. LTD.	Approved
		SAM TURBO	Approved
28.	OIL MODULE AND ACCESSORIES	HYDAC (INDIA) PVT. LTD.	Approved
		ALLWEILER INDIA PRIVATE	Approved
		AEL APPARATEBAU GMBH LEISNIG	Approved
		VDL DELMAS GMBH	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
		FLENCO FLUID SYSTEM S.R.L (FOR	Approved
		KELAG AG	Approved
29.	LUBE OIL PUMPS (CENTRIFUGAL)FOR TDBFP	KSB PUMPS LTD.	Approved
		KIRLOSKAR EBARA, KIRLOSKARWADI	Approved
		SULZER, MUMBAI.	Approved
		FLOWSERVE SANMAR LTD.,	Approved
30.	LUBE OIL PUMPS (SCREW TYPE) FOR TDBFP	ALLWEILER, GERMANY	Approved
		IMO PUMP, USA	Approved
		TUSHACO, DAMAN	Approved
		LEISTRITZ (EMPIRE), GERMANY	Approved
31.	JACKING OIL PUMP TDBFP	HAGULLAND DENSION	Approved
		TUSHACO PUMPS PVT. LTD.,	Approved
		DELTA P D PUMPS PVT LTD	Approved
32	EHA FOR TURBINE VALVES	BOSCH REXROTH AG	Approved
		HORST THIELE MASCHINENBAU HYDRAULISCHE GERATE GMBH, GERMANY	Approved
33.	HPSU FOR TURBINE VALVES	HYDAC (INDIA) PVT LTD	Approved
		REINEKE MESS-UND REGELTECHNIK GMBH	Approved
		BOSCH REXROTH (INDIA) PRIVATE LIMITED;	Approved
		HYDAC SYSTEM GMBH	Approved
		KEICHER ENGINEERING AG	Approved
34.	OIL ACCUMALATOR	BOLENZ & SCHAFER MASCHINENFABRIK, Germany	Approved
		HYDAC INDIA PVT LTD, Navi Mumbai	Approved
		PARKER HANNIFIN CORPORATION, USA	Approved
35.	VACUUM BREAKER VALVE ASSY	MULLER CO-AX AG	Approved
		INSTRUMENTATION LIMITED	Approved
		CRANE PROCESS FLOW	DR
36.	SCANNER AIR FAN	C.DOCTOR & CO.PVT.LTD.	Approved
		PATELS AIRFLOW LTD.	Approved
		AIR CONTROL & CHEMICAL ENGG. CO.LTD.	Approved
37.	OIL PURIFICATION UNIT (OIL CENTRIFUGE)/PORTABLE OIL PURIFIERS	ALFA LAVAL LIMITED, INDIA	Approved
		SERVIZE INDUSTRIAL, ITALY	DR
		ALFA-LAVALSEPARATION AB - SWEDEN	Approved
38.	ELECTRICAL HOIST	REVA INDUSTRIES LTD	Approved
		CONSOLIDTED HOIST PVT LTD	Approved
		TUOBRO FURGUSON(INDIA)PVT.LTD	Approved
		HERCULES HOISTS LTD.	Approved
		UNIVERSAL HOIST – O- FABRIK	Approved
		BRADY & MORRIS ENGINEERING CO. LTD.	Approved
		TRACTEL TIRFOR INDIA PVT. LTD.	Approved
		UNIVERSAL HOIS –O-FABRIK	Approved
		HERCULES HOISTS LTD.	Approved
		TUOBRO FURGUSON(INDIA)PVT.LTD	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
39	CHAIN PULLEY BLOCK	BRADY & MORRIS ENGINEERING CO. LTD.	Approved
		TRACTEL TIRFOR INDIA PVT. LTD.	Approved
		UNIVERSAL HOIS –O-FABRIK	Approved
		HERCULES HOISTS LTD.	Approved
		TUOBRO FURGUSON(INDIA)PVT.LTD	Approved
40	DOUBLE GIRDER EOT CRANES UPTO 50T	UNIQUE INDUSTRIAL HANDLERS PVT.LTD	Approved
		MUKAND LIMITED,	Approved
		REVA INDUSTRIES LTD.	Approved
		HEAVY ENGG. CORPORATION LTD.	Approved
		UNIVERSAL HOIST-O-FABRIK,	Approved
		CONSOLIDATED HOISTS PVT LIMITED	Approved
41	D/G EOT CRANES UP TO 100T	FURNACE & FONDRY EQUIPMENT CO.	Approved
		FURNACE & FONDRY EQUIPMENT CO.	Approved
		Grip Engineers Pvt. Ltd.,	Approved
		HEAVY ENGG. CORPORATION LTD.	Approved
		MUKAND LIMITED	Approved
		REVA INDUSTRIES LTD.	Approved
		TUOBRO FURGUSON (INDIA) PVT LTD	Approved
		UNIQUE INDUSTRIAL HANDLERS PVT LTD.	Approved
42	D/G EOT CRANES ABOVE 100T	FURNACE & FONDRY EQUIPMENT CO.	Approved
		HEAVY ENGG. CORPORATION LTD.	Approved
		MUKAND LIMITED	Approved
		REVA INDUSTRIES LTD.	Approved
		UNIQUE INDUSTRIAL HANDLERS PVT LTD.	Approved
43	Single Girder EOT / HOT Misc. Cranes	BRADY & MORRIS ENGINEERING CO. LTD.	Approved
		CONSOLIDATED HOISTS PVT LTD	Approved
		REVA INDUSTRIES LTD.	Approved
		TRACTEL TIRFOR INDIA PVT. LTD.	Approved
		Universal Hoist-O-Fabrik	Approved
44	MILL HANDLING EQUIPMENT	GRIP ENGINEERS PVT LTD, HYDERABAD	Approved
		LIFTING EQUIPMENT & ACCESSORIES ,NEWDELHI	Approved
		REVA INDUSTRIES LIMITED,FARIDABAD	Approved
		CONSOLIDATED HOIST,PUNE	Approved
		EDDYCRANES ENGINEERS PVT,MUMBAI	Approved
		CENTURY CRANE ENGINEERS (P) LTD.	Approved
		UNIVERSAL HOIST-O- FABRIK,MUMBAI	Approved
45	FURNACE MAINTENANCE PLATFORM	N.V.SKY CLIMBER EUROPE S.A	Approved
		N.V.SKY MAN INTERNATIONAL S.A.	Approved
		ALTREX B.V, Netherlands	DR
46	QUICK ERECT SCAFFOLD	INSTANT UPRIGHT LIMITED,DUBLIN	Approved
47	ELEVATOR-PASSENGER CUM GOODS	KONE ELEVATOR INDIA LTD.	Approved
		OTIS ELEVATOR	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
48.	CASTABLE REFRACTORY	BASKAR REFRACTORIES AND S.W PIPES(P)LTD	Approved
		THE ACE REFRACTORIES LTD.	Approved
		DALMIA REFRACTORIES	Approved
		SOUVENIOR CERAMICS	Approved
		MAHAKOSHAL REFRACTORIES PVT. LTD,	DR
		CASTWEL INDUSTRIES	DR
49.	POURABLE INSULATION	BASKAR REFRACTORIES & STONEWARE PIPES(P)LTD	Approved
		THE ACE REFRACTORIES LTD.	Approved
		DALMIA REFRACTORIES	Approved
		INDUSTRIAL ASSOCIATES,	Approved
		CASTWEL INDUSTRIES	DR
50.	FIRE BRICKS	BASKAR REFRACTORIES AND STONEWARE PIPES (P) LTD	Approved
		DALMIA REFRACTORIES	Approved
51.	WOOL MATTRESS	ROCKWOOL INDUSTRIES LTD	Approved
		MINWOOL ROCK FIBRES LTD	Approved
		LAPINUS ROCKWOOL PVT. LTD	Approved
		ROCKWOOL INDIA LTD.	Approved
		LLOYD INSULATION (I) LTD.	Approved
		LLOYD ROCKFIBRES LTD.	Approved
		DHANBAD ROCKWOOL INSULATION PVT LTD	Approved
		GOENKA ROCKWOOL (INDIA) PVT LTD.,	Approved
		JAMSHEDPUR MINERAL WOOL MFG.CO.	Approved
52	MINERAL WOOL MATTRESS	JAMSHEDPUR MINERAL WOOL MFG.CO.	Approved
		ROCKWOOL (INDIA) PVT LTD.	Approved
		ROCKWOOL INDUSTRIES	Approved
		DHANBAD ROCKWOOL INSULATION PVT LTD	Approved
		GOENKA ROCKWOOL (INDIA) PVT LTD.,	Approved
53.	THERMAL INSULATION OF STEAM TURBINE/THERMAL INSULATION OF TURBINE INTEGRAL PIPING/THERMAL INSULATION-ROCKWOOL MATTRESSES/ PIPE SECTIONS	LLOYD INSULATIONS	Approved
		ROCKWOOL	Approved
		HEINRICH TAPP GMBH	Approved
		EUGEN ARNOLD GMBH	Approved
		Dhanbad Rockwool Insulation (P) Ltd.	Approved
		GOENKA ROCKWOOL (INDIA) PVT.LTD.	Approved
54.	THERMAL INSULATION - ANCILLARY MATERIAL	LLOYD INSULATIONS (INDIA) LIMITED	Approved
		ALLIED INSULATIONS (INDIA), GHAZIABAD	Approved
		ENERGY SAVING & ALLIED PRODUCTS	Approved
55.	INSULATION:BED MATERIALS	BHASKAR REFRACTORIES&SW PIPES P LTD, Faridabad	Approved
		SOUVENIOR CERAMICS, Faridabad	Approved
		ALWAR REFRACTORIES PVT LTD, Jaipur	Approved
		CHAMPION CERAMICS PVT LTD, Champa	DR

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
56.	INSULATION:CALCIUM SILICA	HYDERABAD INDUSTRIES LTD., Faridabad	DR
		NEWKEM PRODUCTS CORPORATION, Mumbai	DR
57.	INSULATION:CERAMIC WOOL	LLOYD INSULATIONS (INDIA) LIMITED, Chennai	Approved
58.	INSULATION:WOVEN WIRE CLO	BANARASWALA METAL CRAFTS PVT.,COIMBATORE	Approved
		BOKARIA WIRENETTING INDUSTRIES,CHENNAI	Approved
		JEETMULL JAICHANDLALL (MADRAS),CHENNAI	Approved
		KIRAN WIRE NETTING CO.,CHENNAI	Approved
		QUALITY WIRE PRODUCTS,NAVI MUMBAI	Approved
59	STEAM TRAPS	SPIRAX MARSHALL PVT.LTD.	Approved
		PENNANT ENGINEERING PVT.LTD.	Approved
		ESCO STEAMCON PVT. LTD.	Approved
		FORBES MARSHALL PVT. LTD.	Approved
60	AIR TRAPS	PENNANT ENGINEERING PVT.LTD.	Approved
		SPIRAX MARSHALL PVT.LTD.	Approved
		ESCO STEAMCON PVT. LTD.	Approved
		FORBES MARSHALL PVT. LTD.	Approved
61	GRAVIMETRIC FEEDER	STOCK INDIA	Approved
62	COMPRESSED AIR SYSTEM	ATLAS COPCO (INDIA) LTD.	Approved
63	SELF CLEANING STRAINERS	FILTERATION ENGINEERS (I) PVT. LTD.	Approved
		GEA BGR ENERGY SYSTEM INDIA LTD.	Approved
		MULTITEX FILTRATION ENGINEERS LIMITED	Approved
64	DEBRIS FILTER	GEA BGR ENERGY SYSTEM INDIA LTD.	Approved
		MULTITEX FILTRATION ENGINEERS LIMITED	Approved
		TAPROGGE GmBH	Approved
65	ALUMINIUM SHEETS/ COILS/CLADDING	BHARAT ALUMINIUM CO.LTD.	Approved
		INDIAN ALUMINIUM CO.LTD.	Approved
		HINDALCO INDUSTRIES LTD.	Approved
		NATIONAL ALUMINIUM COMPANY LTD.	Approved
		JINDAL ALUMINIUM LIMITED	Approved
66	CORRUGATED AL SHEET	HINDALCO INDUSTRIES LTD.,Chennai	Approved
		JINDAL ALUMINIUM LIMITED, Bangalore	Approved
		MPIL STEEL STRUCTURES LTD.,Thane	Approved
67	HOC TYPE GAS DRIER	DELAIR INDIA PVT. LTD.	Approved
		ATLAS COPCO (INDIA) LTD.	Approved
68	REFRIGERATION TYPE GAS DRIER	DELAIR INDIA PVT. LTD.	Approved
		SUMMIT	Approved
		SAVRO	Approved
		JINDAL ELECTRONICS PVT. LTD.	Approved
		SPAN MANUFACTURING CO. PVT.	DR
		MELLCON ENGINEERS PVT. LTD.	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
69	MISC. TANKS (SHOP)	GENERAL MECHANICAL WORKS	Approved
		UNITECH MACHINES LTD.	Approved
		TECHNO ELECTRIC & ENGG. CO. LTD.	Approved
		THERMOPADS PVT LIMITED	Approved
		VIJAY TANKS & VESSELS LTD	Approved
		THERMOSYSTEMS PVT. LTD.	Approved
70	MISC. TANKS(SITE FABRICATED)	TECHNO ELECTRIC and ENGG. CO. LTD.	Approved
		THERMOSYSTEMS PVT. LTD. HYDERABAD	Approved
		UNITECH MACHINES LTD.	Approved
71.	FLAME ARRESTOR (MISCELLANEOUS TANKS)	PROCESS INSTRUMENTS	Approved
		ASIAN INDUSTRIAL VALVES	Approved
		ACCOUSTICS INDIA PVT. LTD.	Approved
		MULTITEX FILTERS PVT. LTD.	Approved
72	M.E. BELLOWS	FLUIDINE ENGRS.INDIA PVT.LTD	Approved
		EXPANSION JOINT SYSTEMS INC. USA	Approved
		MUNRO & MILLER FITTINGS LTD., U.K	Approved
		SENIOR FLEXONICS, U.K.	Approved
		SUR INDUSTRIES PVT.LTD.,KOLKATA	Approved
		CORBIS	Approved
		FLEXATHERM EXPANLLOW PVT LTD	Approved
		MB METALLIC BELLOWS PVT. LTD,	Approved
		FLEXICAN BELLOWS & HOSES (P) LTD	Approved
		LONE STAR INDUSTRIES	Approved
73	EXPANSION BELLOWS-NON METALLIC	EAGLE BURGMANN K.E. PVT.LTD, Chennai	Approved
		AIROCHEM ENGINEERING COMPANY, Kolhapur	Approved
		PATELS AIRFLOW LIMITED,Ahnedabad	Approved
		MECHWELL INDUSTRIES LTD, Mumbai	Approved
74	HEAT EXCHANGERS (PLATE TYPE)	ALFA LAVAL (INDIA) LTD.	Approved
		GEA ECOFLEX INDIA PVT LTD	Approved
		TRANTER INDIA PRIVATE LIMITED	Approved
		L&T	Approved
		IDMC LIMITED	Approved
75	JOURNAL BEARING BFP & BP/THRUST CUM JOURNAL BEARING FOR CEP/THRUST BEARING (BFP & BP)	COLHERENE, UK	Approved
		WAUKESHA BEARINGS (GLACIER), UK	Approved
		KINGSBURY, USA	Approved
		MITCHELL, UK	Approved
76	THRUST BEARING FOR CWP	MICHELL BEARINGS,	Approved
		OSBORNE ENGINEERING LIMITED	DR
		OSAKA ASAHI METAL MFG. CO. LTD.	DR
		MICHELL BEARINGS (INDIA) LLP	Approved
77.	HYDRAULIC COUPLING	VOITH TURBO PVT LTD	Approved
		VOITH TURBO PVT. LTD. - HYDERABAD, INDIA	Approved
		VOITH TURBO GMBH & CO. KG. - GERMANY	Approved
78.	DISCONNECTING COUPLING FOR TDBFP	ZURN INC, USA	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
79.	SUCTION STRAINERS (BFP, BP & CEP)	OTOKLIN	Approved
		MULTITEX	Approved
		GUJARATH OTOFILT	Approved
		FILTERATION ENGINEERS INDIA PVT LTD	Approved
		JAY-EESH ENGINEERING COMPANY	Approved
80.	MECHANICAL SEAL (BFP/BP & CEP)	BURGMANN, GERMANY.	Approved
		EAGLE POONAWALA LTD.PUNE	Approved
		FLOWSERVE SANMAR, CHENNAI	Approved
81.	CONNECTING COUPLING FOR CEP , DRIP PUMP , CWP, BFP & BP	FLEXIBOX LTD., UK	Approved
		TURBOFLEX, UK	Approved
		BIBBY TURBOFLEX (FORMERLY EUROFLEX), UK	Approved
		EUROFLEX TRANSMISSION LTD., HYDERABAD.	Approved
		CUBIC TRANSMISSION PVT. LTD.	DR
		JOHN CRANE SEALING SYSTEMS, UK	Approved
82	CONNECTING COUPLING (MEMBRANE TYPE/GEAR TYPE) FOR TDBFP	EUROFLEX TRANSMISSION, HYDERABAD.	Approved
		RENK AG,GERMANY	Approved
		JOHN CRANE, UK	Approved
		KOPFLEX, USA	Approved
		BIBBY TURBOFLEX (FORMERLY EUROFLEX), UK	Approved
		AMERIDRIVES (ZURN), USA	Approved
		LUFKIN, USA/FRANCE	Approved
		BHS, GERMANY	Approved
		FLENDER GRAFFENSTADEN, FRANCE	Approved
		RENK AKTIENGESELLSCHAFT -	Approved
83	GEAR BOX FOR TDBFP	WALCHAND NAGAR, PUNE	Approved
		RENK AG,GERMANY	Approved
		LUFKIN, USA/FRANCE	Approved
		FLENDER GRAFFENSTADEN, FRANCE	Approved
		BHS, GERMANY	Approved
		VOITH TURBO BHS - GETRIEBE GMBH,	Approved
		RENK AKTIENGESELLSCHAFT -	Approved
		TRIVENI ENGG & IND LTD	Approved
84.	BARE RUBBER BELLOWS	CORI ENGINEERS PVT. LTD CHENNAI.	Approved
		SRM ESOFLEX PVT. LTD. KOLKATTA	Approved
		CORBIS	Approved
85.	SPRING SUPPORTS / HANGERS	SARATHI ENGG. ENTERPRISES PVT. LTD.	Approved
		HYDERABAD PIPING & ENERGY PRODUCTS (P) LTD. NEW DELHI	Approved
		SHAPE BAHADARABAD	Approved
		DARSHANI-INDIA	Approved
		PAL ENGINEERING YAMUNANAGAR	Approved
86	SELF LUBRICATING BEARING	TEN MAT LTD UK	Approved
		(FEROFORM T 814 TUBES)	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
[illegible]	TUBES FOR BF VALVES	THORDON	Approved
		THORPLAS TUBES, CANADA	Approved
87	KNIFE GATE VALVES	VAAS	Approved
		TYCO, USA	Approved
		VELAN, UK/USA	Approved
		INDURE PVT. LTD.	Approved
		ORBINOX INDIA (P) LTD.	Approved
		JASH ENGINEERING LIMITED	Approved
		GALAXY CONTROLS PVT LTD.,	Approved
88	MS AND GI PIPES	SAIL	Approved
		JINDAL	Approved
		INDUS TUBES	Approved
		SURYA ROSHNI	Approved
		TATA	Approved
89	STAINLESS STEEL PIPES	RATNAMANI METAL & TUBES	Approved
90	VACUUM PUMP / MECHANICAL EXHAUSTER (LIQUID RING TYPE)	VACUNAIR	Approved
		GARDNER DENVER,KOREA	Approved
		EDWARDS LIMITED, UK	Approved
91	STRAINER	STRAINWELL INDIA	Approved
		ACME FLUID SYSTEMS	Approved
		SRK STRAINERS & VALVES INDIA	Approved
		FILTERATION ENGINEERS INDIA PVT LTD	Approved
		GUJARAT OTOFILT,	Approved
92	CONICAL STRAINERS	FILTERATION ENGINEERS (I) PVT. LTD.	Approved
		GUJARAT OTOFILT	Approved
		JAY-EESH ENGINEERING COMPANY	Approved
		MULTITEX FILTRATION ENGINEERS LIMITED	Approved
		OTOKLIN GLOBAL BUSINESS LIMITED	Approved
93	CONDENSER TUBES	RATNAMANI METALS & TUBES LTD	Approved
		REMI EDELSTAHL TUBULARS LTD	Approved
		RATNADEEP METAL & TUBES LTD.	Approved
94	GRINDING ROLLS	AIA Engineering Ltd., Ahmedabad	Approved
		Magotteaux Industries Pvt. Ltd.,Rajkot	Approved
95	BULL RING SEGMENTS	AIA Engineering Ltd., Ahmedabad	Approved
		Magotteaux Industries Pvt. Ltd.,Rajkot	Approved
96	PGB SPECIAL OIL-ISO VG 320	INDIAN OIL CORPN.LTD.,	Approved
		HINDUSTAN PETROLEUM CORPN. LTD.	Approved
		CASTROL INDIA LIMITED	Approved
		EXXONMOBIL LUBRICANTS PVT LTD	Approved
		SHELL INDIA MARKETS PRIVATE LIMITED	Approved

Sagardighi Extn. U#5 (PROJ3)
Mech.Equipments

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
97	CANISTER DRAINAGE PUMP SUBMERSIBLE/ BOOSTER PUMPS OF CVP	KIRLOSKAR BROTHERS LTD	Approved
		KSB PUMPS LIMITED,	Approved
		SULZER PUMPS INDIA LIMITED	Approved
		CLYDE PUMPS LTD.	Approved
98	SPIRAL WOUND GASKETS	CHAMPION SEALS (INDIA) PVT LTD.,	Approved
		STARFLEX SEALING (I) PVT .LTD	DR
		DYNAMIC GASKETS PVT LTD	DR
		SPIRASEAL GASKETS PVT LTD	DR
		GOODRICH GASKET PRIVATE LIMITED,	DR
99	PTFE SHEETS	As per BHEL Approved Sources	
100	AVERAGING PITOT TUBE	TECHNOMATIC	Approved
		EMERSON PROCESS MANAGEMENT (I) PVT	Approved
		MINCO (INDIA) PVT. LTD.	DR
		SWITZER PROCESS INSTRUMENTS	Approved
101	SEALING COMPOUND	As per BHEL Approved Sources	
102	H2, N2 & CO2 CYLINDERS (EMPTY)	BHARAT PUMPS AND COMPRESSORS	Approved
		SARJU IMPEX LTD	Approved
		EVEREST KANTO CYLINDER LIMITED	Approved
		RAMA CYLINDERS PVT LTD.	DR
103	STROBOSCOPE	ZENTRONIC SYSTEMS	Approved
		BEM-MESSTECHNIK GMBH	Approved
		IAG AUTOMATION PVT LTD	Approved
104	AIR CYLINDER	EASTERN PNEUMATICS PRIVATE LTD., Kolkata	Approved
		INSTRUMENTATION LTD.,Kerala	Approved
		KELTRON CONTROLS,Aroor	Approved
		NUCON PNEUMATICS PVT.LTD. Medak	Approved
		VELJAN HYDRAIR LIMITED, Hyderabad	Approved
		DUNCAN ENGINEERING LIMITED, Pune	Approved
		NEWTON PNEUMATICS, Chennai	Approved
105	SLIDING BEARING	Avi Oilless die Components India Pvt. Ltd, Pune	DR
		NEXGEN FLUOROPOLYMERS PVT.LTD, Alwar	DR
106	BLOWERS	ACME AIR EQUIPMENTS CO PVT LTD,Ahmedabad	Approved
		AERZEN MACHINES INDIA PVT.LTD., Vadodara	Approved
		RKR,GEBLASE UND VERDICHTER GMBH, Germany	Approved
		SWAM PNEUMATICS PVT LTD.	Approved
107	DIRECT WATER LEVEL GUAGE	CLARK RELIANCE CORPN, USA	Approved
		IGEMA GmbH, Munster Germany	Approved
		NISAN SCIENTIFIC PROCESS,Mumbai	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description	Vendor Name	Remarks
		PENTAIR VALVES & CONTROLS INDIA, Baroda	Approved
108	HEA IGNITOR ASSY	UNISON INDUSTRIES, USA	Approved
		IGNITION SYSTEM Inc., USA	Approved
		DURAG, Germany	Approved
		FIVES COMBUSTION SYSTEMS PVT. LTD	Approved
		TESI SPA, Italy	Approved
		TURBINE TECHNICS, INC., Florida USA	Approved
109	HP FILL & PURGE FILT	PALL INDIA PVT LTD, Mumbai	Approved
		VENS HYDROLUFT (P) LTD, Chennai	Approved
110	VARIABLE ORIFICE	BMW STEELS LTD., UTTAR PRADESH	DF
		ELECTRO PORCELAIN DIVN., BANGALORE	DF
		PROMECON GmbH., GERMANY	Approved
111	Lub oil system for FANS (ID, FD & PA)	PSI ENGINEERING Systems pvt ltd	Approved
		SOUTHERN LUBRICATION PVT LTD	Approved
		YUKEN INDIA LTD	Approved
112	STEAM COIL AIR PRE HEATR	C DOCTOR INDIA PVT LTD	Approved
		PATEL AIR TEMP(INDIA) LTD	Approved
		BARODA EQUIPMENT &VESSEL PVT LTD	Approved
		NU WAY HEATRANSFER PVT LTD	Approved
		CHINTAMANI THERMAL TECHNOLOGIES PVT LTD	Approved
		PAR ENERGY INFRA PVT.LTD	Approved
113	AIR RECEIVER	VEE SONS ENERGY SYSTEM PVT LTD	Approved
		PATEL AIR TEMP(INDIA) LTD	Approved
		C DOCTOR INDIA PVT LTD	Approved
		AIRCON HANDLING SYSTEMS PVT LTD	Approved
		BARODA EQUIPMENT &VESSELS PVT LTD	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

SL. NO.	Item Description	Vendor Name	Remarks
1	Slurry Recirculation pumps	BHEL, Hyderabad	DR
		Duchting Pumpen, Germany	Approved
		KSB, Germany	Approved
		KSB India	DR
		Weir Minerals, Australia	Approved
		Weir Minerals, India	DR
		~~Andritz China~~	
		Andritz India	DR
		~~Xiangyang WuerWu China~~	
2	Oxidation Blowers	BHEL, Hyderabad	DR
		ITO, Japan	Approved
		GEMSL, UK	Approved
		Aerzen, Germany	Approved
		Aerzen, India	Approved
		Howden, India	Approved
		Boldrocchi, India	Approved
		Siemens, Italy/Germany	Approved
		Boldrocchi, Italy	Approved
3	Slurry pumps	Duchting Pumpen, Germany	Approved
		Weir Minerals, Australia	Approved
		Weir Minerals, India	DR
		~~Andritz China~~	
		Andritz India	DR
		Metso Minerals USA	Approved
		Metso Minerals India	DR
		KSB Germany	Approved
		KSB India	DR
		Krebs USA	Approved
		Krebs India	DR
		~~Xiangyang WuerWu China~~	
4	Agitators	Ekato, Germany	Approved
		Ekato, India	DR
		STC, Germany	Approved
		REMI-STC, India	DR
		Nippon Gears, Japan	Approved
		SPX, USA	Approved
		SPX, India	DR
		~~Chemineer, China~~	

SL. NO.	Item Description	Vendor Name	Remarks
		~~Zhejiang Great wall mixers china~~	
		Mixing Solutions, USA	Approved
		Mixing Solutions, India	DR
		Milton Roy Mixing, France	Approved
		Milton Roy Mixing, India	Approved
		Tschamber, Germany	Approved
5	Mist Eliminator	REA Plastik Tech GmBH, Berlin Germany	Approved
6	Wet Ball Mills	Christian Pfeiffer, Germany	Approved
7	Vacuum Belt Filter and Hydrocyclone	Xuhe, Japan	Approved
8	Rubber lining	Steuler-KCH GmBH	Approved
		Rubber Source Inc.	Approved
		Blair Rubber Company	Approved
9	Rubber lining Applicator	Labrex, Puducherry	Approved
10	Alloy C276/Alloy 59 liner	ATI, Relentless Innovation	Approved

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SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

SL. NO.	Item Description	Vendor Name	Remarks
1	PIPES & CONDUITS/ACCESSORIES	As per BHEL approved source.	
2	EM BRAKES	SIEGERLAND-BREWSEN, GERMANY	Approved
		STROM KRAFT CONTROLS, MUMBAI	Approved
		BCH Electric Limited	Approved
		SIEMENS India Ltd.	Approved
	Caliper Brakes,EHT Gear Boxes,Industrial Valves,	KATEEL Engineering Industry Pltd	DR
3	SOLENOID VALVES	ASCO, Chennai	Approved
4	AIR CONDITIONING SYSTEMS	shall be as per approved sources listed in Package items in Main Plant Package area.	
5	VENTILATION SYSTEM	shall be as per approved sources listed in Package items in Main Plant Package area.	
6	VALVES	shall be as per approved sources listed in Mechanical Equipment in Main Plant Package area.	
7	DUST EXTRACTION SYSTEM	C.Doctor & Company Privae Ltd.,	Approved
		DUSTVEN Pvt .Ltd., Bangalore	Approved
		THERMEX	Approved
		Batliboi Environmental Engg Ltd.,	Approved
		TPS,DELHI	Approved
		F. Harley	Approved
		SPRAYING SYSTEMS INDIA PVT. LTD	Approved
8	DUST SUPPRESSION SYSTEM	SPRAYING SYSTEMS INDIA PVT. LTD	Approved
		KAVERI ULTRA POLYMER LTD.	Approved
		F. HARLEY & COMPANY. PVT. LTD.	Approved
		TPS INFRASTRUCTURE LTD.	Approved
9	E O T CRANE / MANUAL HOIST	shall be as per approved sources listed in Mechanical Equipment in Main Plant Package area.	
10	PUMPS & ACCESSORIES	shall be as per approved sources listed in Mechanical Equipment in Main Plant Package area.	
		PHOENIX CONVEYOR BELT INDIA PVT LTD	Approved
		SEMPERTRANS INDIA PRIVATE LIMITED	Approved
		HILTON-FORECH	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

11	CONVEYOR BELT	MRF	Approved
		YOKOHAMA	Approved
		FORECH INDIA LTD, KOLKATA	Approved
		HINDUSTAN RUBBERS, SILVASA	Approved
		NORTHLAND RUBBER MILLS, NEW	Approved
		ORIENTAL RUBBER INDUSTRIES PVT LTD.	DR
		JONSON RUBBER INDUSTRIES	Approved
		EUREKA COVEYOR BELTINGS PVT LTD.	Approved
		FLEXER RUBBER PVT LTD	Approved
12	BELT VULCANIZER	SHAW ALMEX	Approved
		S. V. DATTAR	Approved
		NILOS	Approved
13	STRUCTURAL STEEL	Follow Civil Structural Vendor Approval List.	
14	COAL SAMPLING UNIT	ADVANCED SYSTEMS SAMPLING PVT LTD	Approved
		THERMO RAMSAY, AUSTRALIA	Approved
		ERIEZ MAGNETICS EUROPE LTD., CAERPHILLY	Approved
		EASTMAN CRUSHER Co. (P) Ltd.	Approved
15	BELT WEIGHER SCALES	THERMO RAMSAY, AUSTRALIA	Approved
		AVERY INDIA LTD., NEW DELHI	Approved
		TRANSWEIGH	Approved
		SCHENCK PROCESS INDIA LIMITED	Approved
16	FLAP GATES	PRECISION PROCESSING EQUIPMENT CO.	Approved
		DA ENGG.	Approved
		MERIT CHENNI	Approved
		MMHE	Approved
		MSE	Approved
		HINDUSTAN M/C TOOLS CORPORATION, KOLKATA	Approved
		CONTINENTAL PROFILES LTD., FARIDABAD	Approved
17	Flow elements, Condensate pots, Manifolds etc for process instrumentation	shall be as per approved sources listed in C&I in Main Plant Package area.	
18	GRATINGS	PATNY SYSTEMS, HYDERABAD	Approved
		PINAX STEEL INDUSTRIES PVT LTD	Approved
		INDIANA GRATINGS PVT. LTD.	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

		CAUVERY ENGINEERING WORKS	Approved
19	GEAR BOXES	R&D MULTIPLES (METAL CAST) PVT. LTD.	Approved
		ESSENTIAL POWER TRANSMISSION PVT.LTD	Approved
		FLENDER	Approved
		NEW ALLENBURRY	Approved
		KATEEL Engineering Industry Pltd	DR
		PREMIUM TRANSMISSION LIMITED	Approved
		SHANTHI GEARS LIMITED	Approved
20	ERW PIPES	STEEL AUTHORITY OF INDIA LTD.	Approved
		WELSPUN GUJARAT STAHL ROHERN LTD	Approved
		TUBES INDIA	Approved
		JCO GAS PIPE LIMITED	Approved
		RATNAMANI METALS & TUBES LTD	Approved
		MAHARASHTRA SEAMLESS LIMITED	Approved
		JINDAL PIPES LIMITED	Approved
21	COMPRESSORS	ATLAS COPCO (INDIA) LIMITED	Approved
		ELGI EQUIPMENTS LTD	Approved
		INGERSOLL- RAND (INDIA) LIMITED	Approved
22	Bull Dozer	BHARAT EARTH MOVERS LIMITED	Approved
23	Twin Wagon Trippler	THYSSENKRUPP INDUSTRIES INDIA PVT	Approved
24	Feeders (Apron ; Grizzly; Vibrating; Paddle)	FL Smidth	
		Metso Minerals(I) Pvt.Ltd.	Approved
		LARSEN & TOUBRO LTD, ECC DIVN	Approved
		ELECON ENGINEERING COMPANY LTD	Approved
		TRF LTD., JAMSHEDPUR	Approved
		THYSSENKRUPP INDUSTRIES INDIA PVT	Approved
25	Crusher	LARSEN & TOUBRO LTD	Approved
		TRF LIMITED	Approved
		ELECON ENGINEERING COMPANY LTD	Approved
		THYSSENKRUPP INDUSTRIES INDIA PVT	Approved
		SANDVIK ASIA PRIVATE LIMITED	DR
		MCNALLY SAYAJI ENGINEERING LIMITED	Approved
		Amps Engineering & Equipments Pvt Ltd	DR
		Devas Engineering Systems	DR
		GOLDEN ENGINEERING INDUSTRIES	DR
		INDIANA CONVEYORS PVT LTD	DR
		VISHWA INDUSTRIAL COMPANY LTD.,	DR
		NEW ERA CONVEYORS PVT LTD.,	DR

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

26	Idlers	TURBO ENGINEERS (CBE),	DR
		ROLLWELL CONVEYOR COMPONENTS PVT LTD	DR
		ELECON ENGINEERING CO. LTD.	Approved
		ARUDRA	Approved
		TRF LIMITED	Approved
		MCNALLY BHARAT, ENGG. CO. LTD.	Approved
		TEGA	Approved
		BENGAL TOOLS.	Approved
		ARYAN CLEAN COAL TECHNOLOGIES PVT LTD.,	DR
		Bevcon Wayors Pvt Ltd	DR
		I & B ENGINEERS PVT LTD	DR
		TECHNO IMPEX	DR
27	Pulleys	INDIANA CONVEYORS PVT LTD	DR
		AMPS ENGINEERING & EQUIPMENTS PVT LTD	DR
		Devas Engineering Systems	DR
		VISHWA INDUSTRIAL COMPANY LTD.,	DR
		NEW ERA CONVEYORS PVT LTD.,	DR
		TURBO ENGINEERS (CBE),	DR
		BENGAL TOOLS	Approved
		MCNALLY BHARAT ENGG. CO. LTD.	Approved
		ELECON	Approved
		ARUDRA	Approved
		ROLLWELL CONVEYOR COMPONENTS PVT LTD	DR
		ARYAN CLEAN COAL TECHNOLOGIES PVT LTD.,	DR
		BEVCON WAYORS PVT.LTD.	DR
		I & B ENGINEERS PVT LTD	DR
		TECHNO IMPEX	DR
28	Internal / External Scrapers & Skirt Board Sealing System	As per BHEL approved source.	
29	Roller SCREENS	POSCO PLANT ENGINEERING CO., LTD.,	DR
		ELECON	Approved
		msel	Approved
		Thyssen	Approved
		Electro Zavod (India) Pvt Ltd.	DR
30	RPG GATES	BENGAL TOOL	Approved
		MSEL	Approved
		DA ENGG.	Approved
		HMTC ENGINEERING CO (KOLKATA) PVT LTD	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

31	HVAC System	shall be as per approved sources listed in Package items in Main Plant Package area.	
32	REDUCTION GEAR BOX	PREMIUM ENERGY TRANSMISSION	Approved
		FLENDER LIMITED	Approved
		ELECON ENGINEERING CO. LTD.	Approved
33	FLUID COUPLING	VOITH	Approved
		PREMIUM ENERGY TRANSMISSION	Approved
		FLUIDOMAT	Approved
34	FLEXIBLE GEAR COUPLING	GMB MFG. (P) LTD., KOLKATA	Approved
		HI-CLIFF	Approved
		FENNER	Approved
		LOVEJOY	Approved
		WELLMAN	Approved
		CONCORD	Approved
		ELECON ENGINEERING COMPANY LIMITED	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

SL. NO.	Item Description	Vendor Name	Remarks
1	Ash Slurry Pumps	SAM TURBO INDUSTRY PRIVATE LTD	Approvec
		WIER MINERALS (India) Pvt. Ltd	Approvec
		INDURE PVT. LTD.	Approvec
		METSO MINERALS (INDIA) PVT LTD.,	Approvec
2	Water Pumps & Accessories	KIRLOSKAR BROTHERS LIMITED	Approvec
		Flowmore Limited, Gurgaon	Approvec
		BEACON WEIR LTD, CHENNAI	Approvec
		Kishor Pumps Pvt. Ltd., Chennai	Approvec
		Maxflow pumps india Pvt ltd.	Approvec
		Wilo Mather and Platt Pumps Pvt Ltd	Approvec
3	ERW Pipes	STEEL AUTHORITY OF INDIA LTD.	Approvec
		WELSPUN GUJARAT STAHL ROHERN LTD	Approvec
		TATA	Approvec
		JCO GAS PIPE LIMITED	Approvec
		TUBES INDIA	Approvec
		RATNAMANI METALS & TUBES LTD	Approvec
		MAHARASHTRA SEAMLESS LIMITED	Approvec
		JINDAL PIPES LIMITED	Approvec
4	Compressors	ATLAS COPCO (INDIA) LIMITED	Approvec
		ELGI EQUIPMENTS LTD	Approvec
		INGERSOLL- RAND (INDIA) LIMITED	Approvec
5	FLUIDIZING AIR HEATER	ESCORTS	Approvec
		SPHEREHOT	Approvec
		RAYCOLD	Approvec
		INDURE PVT. LTD.	Approvec
6	Cast Basalt Lined bends/ fittings/ pipes	TURBO ENGINEERS (CBE)	Approvec
		INDURE PVT. LTD.	Approvec
		DEMECH	Approvec
		ENVIRO ABRASION	Approvec
		Densen Technologies, Thane	Approvec
		Deccan Mechanical and Chemical Industries Pvt. Ltd.,	Approvec
7	ALLOY C.I. FITTINGS & LINERS	MENON METALLIKS	Approvec
		CRAWLEY & RAY	Approvec
		SAM CASTINGS	Approvec
		CRESENT	Approvec

8	E O T CRANE / MANUAL / Electric HOIST	shall be as per approved sources listed in Mechanical Equipment in Main Plant Package area.	
9	Gear Box	R&D MULTIPLES (METAL CAST) PVT. LTD.	Approved
		ESSENTIAL POWER TRANSMISSION PVT.LTD	DR
		KATEEL Engineering Industry Pltd	DR
		PREMIUM TRANSMISSION LIMITED	Approved
		New Allenburry	Approved
10	Couplings	ESCO COUPLINGS & TRANSMISSIONS PVT LTD	Approved
		PREMIUM TRANSMISSION LIMITED	Approved
		ELECON ENGINEERING COMPANY LIMITED	Approved
11	Air conditioning	shall be as per approved sources listed in Package items in Main Plant Package area.	
12	Ventilation System	shall be as per approved sources listed in Package items in Main Plant Package area.	
13	Valves/Gate	shall be as per approved sources listed in Mechanical Equipment in Main Plant Package area.	
14	TWIN LOBE TYPE ROTARY FLUDIZING AIR BLOWER	SWAM PNEUMATICS	Approved
		KAY INTERNATIONAL	Approved
		EVEREST	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT PHASE-III, UNIT#5 (1 x660 MW)			
SL. NO.	Item Description	Vendor Name	Remarks
1	Electrical Valve Actuators	AUMA (I) LTD., BANGALORE	Approved
		AUMA, GERMANY	Approved
		LIMITORQUE (I) LTD, FARIDABAD	Approved
		LIMITORQUE, US	Approved
		ROTORK CONTROLS (I) LTD, CHENNAI & BANGALORE	Approved
		ROTORK, UK	Approved
		NIPPON GEAR CO., JAPAN	DR
2	OIL FILLED TRANSFORMER (More than 10 MVA)	BHEL	Approved
		GE	Approved
		AREVA T & D INDIA LIMITED	Approved
		FUJI	Approved
		ABB	Approved
		ALSTOM	Approved
3	OIL FILLED SERVICE TRANSFORMER (Applicable only for less than 10 MVA)	KIRLOSKAR ELECTRIC CO.LTD. Mysore	Approved
		BHEL	Approved
		SCHNEIDER ELECTRIC INFRASTRUCTURE LIMITED	DR
		TOSHIBA TRANSMISSION & DISTRIBUTION SYSTEMS(i) PVT.LTD.,MEDAKH	DR
		CROMPTON GREAVES LTD.	Approved
		AREVA T & D INDIA LIMITED ,	Approved
		MARSONS LIMITED	Approved
		VOLTAMP TRANSFORMERS LTD.	Approved
4	SEGREGATED PHASE BUSDUCTS	BHEL	Approved
		L&T	Approved
		SIEMENS	Approved
		ALSTOM LTD.	Approved
		BEST & CROMPTON	Approved
5	ISOLATED PHASE BUSDUCT	BHEL	Approved
		SIMELECTRO, FRANCE	Approved
6	HT MOTORS (above 500 kW)	ABB	Approved
		BHEL	Approved
		SIEMENS	Approved
7	HT MOTORS (upto 500 kW)	ABB	Approved
		BHEL	Approved
		SIEMENS	Approved
		CROMPTON GREAVES	Approved

8	ELECTRIC LT MOTOR (ABOVE 90 KW)	CG POWER AND INDUSTRIAL SOLUTIONS LIMITED	Approved
		MARATHON ELECTRIC MOTORS INDIA LIMITED	Approved
		ABB	Approved
		SIEMENS	Approved
9	ELECTRIC LT MOTOR (UPTO 90 KW)	CG POWER AND INDUSTRIAL SOLUTIONS LIMITED	Approved
		MARATHON ELECTRIC MOTORS INDIA LIMITED	Approved
		ABB	Approved
		SIEMENS	Approved
		KIRLOSKAR	Approved
		BHARAT BIJLEE	Approved
10	HT SWITCHGEAR (11KV, 3.3 KV)	AREVA LTD.	Approved
		BHEL.	Approved
		Schneider	Approved
		SIEMENS LTD	Approved
11	LT Switch Gear Panel [PMCC, PCC & MCC]	Siemens India ltd	Approved
		GE India Industrial pvt ltd	Approved
		Schneider Electric India pvt ltd	Approved
		ABB	Approved
		AREVA LTD.	Approved
		LARSEN & TOUBRO LTD.	Approved
12	TRANSFORMER (DRY TYPE)	VOLTAMP	Approved
		AREVA	Approved
		CGL	Approved
		BHEL	Approved
13	NON SEGREGATED PHASE BUS DUCTS	KGS Engineering Limited	Approved
		L&T	Approved
		SIEMENS	Approved
		ALSTOM LTD.	Approved
		BEST & CROMPTON	Approved
14	ACDB, DCDB, , MLDB, ELDB, PDB, WELDING DB, VENTILATION DB	Siemens India ltd	Approved
		GE India Industrial pvt ltd	Approved
		Unilec Engineers ltd	Approved
		Schneider Electric India pvt ltd	Approved
		ABB	Approved
		AREVA LTD.	Approved
		LARSEN & TOUBRO LTD.	Approved
15	LOCAL STARTER PANEL, LOCAL CONTROL PANEL, LIGHTING PANEL	L & T	Approved
		Schneider	Approved
		L & T	Approved
		Siemens	Approved
		UNILEC ENGINEERS LTD.	Approved
		AREVA LTD.	Approved
		PYROTECH	Approved
16	VacuumInterrupter,3.6kV40kA	BharatElectronicsLtd.	Approved
17	VacuumInterrupter,12kV50kA	EatonIncorporation	Approved

18	Air Circuit Breaker (ACB)	ABB	Approved
		Schneider	Approved
		L & T	Approved
		Siemens (3WL model only)	Approved
		AREVA LTD.	Approved
		GE-POWER	Approved
19	Molded case circuit breakers (MCCB)/Motor Protection Circuit Breaker (MPCB)/ Power Contactor/Aux. Contactor/ Thermal Overload Relay (OLR)/SFU	ABB	Approved
		Schneider	Approved
		L & T	Approved
		Siemens	Approved
		GE-POWER	Approved
20	Miniature Circuit Breaker (MCB)	ABB	Approved
		Schneider	Approved
		L & T	Approved
		Siemens	Approved
		GE-POWER	Approved
		LEGRAND	Approved
21	Electronic Motor Protection Relay (EMPR)	ABB	Approved
		Schneider	Approved
		Siemens	Approved
		GE-POWER	Approved
22	Current transformer / Voltage Transformers (VT/PT)/ Control Transformers(CST) upto 1.1KV	Automatic Electric	Approved
		Prayog Electricals	Approved
		Precise Electricals	Approved
		Kappa Electricals	Approved
		Pragati Electricals	Approved
		Indcoil	Approved
23	Interposing Relays	Jyoti	Approved
		OEN	Approved
		PLA	Approved
		Schneider	Approved
		GUARDIAN	Approved
		OMRON	Approved
24	Numerical Relay	Asea Brown Boveri Ltd., Vadodara	Approved
		Asea Brown Boveri Limited, Bangalore	Approved
		GE (Alstom)	Approved for MICOM Series
		Siemens Ltd.	Approved for SIPROTEC Series
		Schnieder Electric Infrastructure limited	Approved for MICOM Series

25	Static / Electromechanical / Auxiliary / Tripping Relays	Asea Brown Boveri Ltd., Vadodara	Approved
		Asea Brown Boveri Limited, Bangalore	Approved
		Schnieder Electric Infrastructure limited	Approved
		GE T & D India Limited	Approved
		Siemens Ltd.	Approved
		Alstom, Chennai	Approved
26	Energy Meters	SCHNEIDER CONZERVE	Approved
		Secure Meters (SEMS)	Approved
27	Multifunction Meter	Secure Meters (SEMS)	Approved
		SIEMENS Ltd.	Approved
		Schneider	Approved
28	Alarm Annunciators	MINILEC India Pvt Ltd.	Approved
		Accord Electro-Technics Pvt. Ltd.	Approved
		Alan Instrumentation Pvt. Ltd.	Approved
		JVS Electronics Pvt. Ltd.	Approved
		PROCON Instrumentation (P) Ltd.	Approved
		VESTAL Electronics	Approved
29	Timer/ TIME DELAY RELAY	ABB	Approved
		Schneider	Approved
		L & T	Approved
		Siemens	Approved
		GE-POWER	Approved
30	Digital Indicating meters	Automatic Electric Limited (AEL)	Approved
		RISHABH Instruments Pvt Ltd.	Approved
		L&T	Approved
		MECO Instrument Pvt. Ltd.	Approved
		MASIBUS AUTOMATION & INSTRUMENTATIO, GANDHI NAGAR	Approved
		Secure	Approved
		Schneider/conzerv	Approved
31	Analog Indicating meters	Automatic Electric Limited (AEL)	Approved
		MECO Instrument Pvt. Ltd.	Approved
		RISHABH Instruments Pvt Ltd.	Approved
		ABB	Approved
		GOSSEN	Approved
		YOKOGAWA	Approved
		PYROTECH Electronics Pvt. Ltd.	Approved
		SELEC Controls Pvt. Ltd.	Approved
32	Transducers	Camille Bauer, Germany	Approved
		Automatic Electric Limited (AEL)	Approved
		ELSTER Metering Pvt Ltd, Mumbai	Approved
		Siemens	Approved
		MASIBUS Automation and Instruments (P) Ltd.	Approved
		Southern Transducers Pvt. Ltd.	Approved
33	Control / Selector Switches	KAYCEE Industries Ltd., Mumbai	Approved
		L & T (Salzer)	Approved
		Reliable Electronic Components Pvt. Ltd (RECOM)	Approved
		SETON Electrical Products	Approved
		SWITRON Devices	Approved

34	Discrepancy switch	Asea Brown Boveri Limited(ABB)	Approved
		Control Dynamics	Approved

35	FUSE Base with holder	ABB	Approved
		Schneider	Approved
		L & T	Approved
		Siemens	Approved
		GE-POWER	Approved
36	FUSES (Power/Control)	GE-Power	Approved
		Siemens	Approved
		L & T	Approved
		Schneider	Approved
		COPPER BUSSMANN	Approved
		ABB	Approved
37	Indicating Lamp	Siemens	Approved
		Vaishno	Approved
		L & T (ESBEE)	Approved
		Schneider	Approved
		ABB	Approved
		SECO	Approved
		TEKNIK	Approved
38	Push Button	Siemens	Approved
		Vaishno	Approved
		L & T (ESBEE)	Approved
		TEKNIK	Approved
		Schneider	Approved
		ABB	Approved
39	Disturbance Recorders / Event Logger	Asea Brown Boveri Limited (ABB)	Approved
		Alstom T&D India Ltd. Chennai	Approved
		Ametek Power Instruments, USA	Approved
		QUALITROL HATHWAY, UK	Approved
40	Time Synchronizer	SERTEL, Chennai	Approved
		ARBITER, USA	Approved
		SEL, USA	Approved
		MASIBUS Automation and Instruments (P) Ltd.	Approved
41	(Indoor) CT / PT up to 11 kV, CBCT,Aux. CT / PT (ICT)	Prayog Electricals (P) Ltd.	Approved
		Pragati Electricals Pvt. Ltd.	Approved
		Silkaans Elect. Mfg. Co. Pvt. Ltd.	Approved
42	Surge Suppressor/Arrestor (Less than 15KV)	Raychem	Approved
		CGL	Approved
		Elpro	Approved
		Oblum Electrical Industries (P) Ltd.	Approved
43	Bus Transfer Scheme Panel(Numerical)	Aartech Solonics Ltd.	Approved
		Asea Brown Boveri Ltd.	Approved
44	Data Concentrator	ABB	Approved
		Schneider	Approved
		SIEMENS	Approved
		GE(ALSTOM)	Approved

45	Ethernet Switches	RUGGEDCOM	Approved
		NETGEAR	Approved
		HIRSCHMANN	Approved
		MOXA	Approved
		CISCO	Approved
46	Terminals Block	Phoenix	Approved
		Connect well	Approved
		Elemex	Approved
		Wago	Approved
47	Cable Glands	HEX	Approved
		Commet	Approved
		DOWELLS	Approved
		Jainson	Approved
		3D	Approved
		Sunil & Co.	Approved
48	Cable Lugs	HEX	Approved
		Commet	Approved
		DOWELLS	Approved
		Jainson	Approved
		3D	Approved
		Sunil & Co.	Approved
49	Local Motor Starter	L & T	Approved
		Schneider	Approved
		ABB	Approved
		BCH	Approved
50	LPBS (NON-FLAME PROOF)	L&T	Approved
		SCHNEIDER	Approved
		Tecknic Controls	Approved
		SIEMENS	Approved
51	LPBS(FLAME PROOF)	BALLIGA	Approved
		EX-PROTECTA	Approved
52	Industrial Switch & Socket / Receptacles	Schneider	Approved
		Anchor	Approved
		Bajaj	Approved
		Philips	Approved
		crompton Greaves	Approved
		BEST & CROMPTON ENGG. LIMITED	Approved
		AJMERA INDUSTRIES & ENGG. WORKS	Approved
		BCH Electric	Approved
53	ISOLATING SWITCH	SALZER, L&T	Approved
		SIEMENS	Approved
		ALSTOM LTD.	Approved
		GE – POWER	Approved
		SCHNEIDER	Approved
		ABB	Approved
		KAYCEE	Approved

54	SYNCHROSCOPE	AUTOMATIC ELECTRIC	Approved
		GEC - ALSTHOM	Approved
55	EARTH LEAKAGE CB	SCHNEIDER	Approved
		L&T	Approved
		SIEMENS	Approved
		ABB	Approved
56	EARTH LEAKAGE RELAY [ELR] ALONGWITH CBCT	AREVA	Approved
		PRO'KDEVICES	Approved
57	EARTH LEAKAGE RELAY [ELR] ALONGWITH CBCT	AREVA	Approved
		PRO'KDEVICES	Approved
58	PANEL SPACE HEATER	C&S ELECTRIC	Approved
		SPACEAGE	Approved
59	Neutral Grounding Transformer	Pragati Electricals Pvt. Ltd., Thane	Approved
		Prayog Electricals Pvt. Ltd., Pune	Approved
60	Lightning Arrester for Busduct	Elpro International Ltd., Pune	Approved
		Oblum Electronics, Hyderabad	Approved
61	Surge Capacitor	ABB Ltd., Bangalore	Approved
		Madhav Capacitor Pvt. Ltd., Pune	Approved
62	NEUTRAL GROUNDING RESISTOR	LACHHMAN ELECTRONICS, NEW DELHI	Approved
		RSI SWITCHGEAR PVT. LTD., Bhiwadi Extn, INDIA	Approved
		RESITECH ELECTRICALS PVT.LTD. KOLKATA	Approved
		S.R.NARKHEDE ENGG.PVT.LTD. PUNE	Approved
63	TREFOIL CLAMPS	AJMERA INDUSTRIAL & ENGINEERING WORKS, MUMBAI	Approved
		ELECTROMAC INDUSTRIES, MUMBAI	Approved
		MOULDED FIBREGLASS PRODUCTS, KOLKATA	Approved
		SUMIP COMPOSITES PVT.LTD. Ahmedabad	Approved
64	CABLE TRAYS & ACC	INDUSTRIAL PERFORATION (I) PVT.LTD.	Approved
		PREMIER POWER PRODUCTS (CAL) PVT. LTD., Howrah	Approved
		PATNY SYSTEMS (P) LTD	Approved
		PARMAR METALS PVT.LTD.	Approved
		UNITECH FABRICATORS and ENGINEERS PVT LTD	Approved
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD., Howrah	Approved
		RABI ENGINEERING WORKS PVT. LTD., Kolkata	Approved

65	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	INDUSTRIAL PERFORATION (I) PVT.LTD., Kolkata	Approved
		PREMIER POWER PRODUCTS (CAL) PVT. LTD., Howrah	Approved
		UNITECH FABRICATORS and ENGINEERS PVT LTD	Approved
		PATNY SYSTEMS (P) LTD	Approved
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD., Howrah	Approved
		RABI ENGINEERING KOLKATA	Approved
		HOWRAH	Approved
66	ABOVE GROUND EARTHING MATERIALS	INDUSTRIAL PERFORATION (I) PVT.LTD., Kolkata	Approved
		PREMIER POWER PRODUCTS (CAL) PVT. LTD., Howrah	Approved
		PATNY SYSTEMS (P) LTD, HYDERABAD	Approved
		UNITECH FABRICATORS and ENGINEERS PVT LTD	Approved
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD., Howrah	Approved
		RABI ENGINEERING WORKS PVT. LTD.	Approved
67	CABLE TERM.& JOINT KITS	3M Electro and Communication India P.Ltd	Approved
		RAYCHEM RPG PRIVATE LIMITED	Approved
68	FIRE SEALING SYSTEM	3M INDIA LIMITED, Bangalore	Approved
		HILTI India Pvt. Ltd.,New Delhi	Approved
		LLOYD INSULATIONS (INDIA) LIMITED, Chennai	Approved
		MULTI KILFIRE PVT LTD, VADODARA	Approved
		VIJAY SYSTEMS ENGINEERS PVT.LTD.,MUMBAI	Approved
69	ELECTRICAL - HEAT TRACING	THERMOPADS PVT.LTD.,	Approved
		XICON INTERNATIONAL LTD.	Approved
		THERMON INDIA PVT. LTD.	Approved
		RAYCHEM RPG LIMITED	Approved
70	HT XLPE CABLES	CABLE CORPORATION OF INDIA LTD.	Approved
		UNIVERSAL CABLES LTD.	Approved
		KEC INTERNATIONAL LIMITED	Approved
		RAVIN CABLES LIMITED	Approved
		KEI INDUSTRIES LTD., ALWAR	Approved
		POLYCAB WIRES PVT. LTD. Daman	Approved
		UNIVERSAL CABLES LTD., SATNA	Approved
71	LT XLPE POWER CABLE	GEMSCAB INDUSTRIES LTD.	Approved
		SUYOG ELECTRICALS LTD.	Approved
		RAVIN CABLES LIMITED	Approved
		CORDS CABLE INDUSTRIES LTD., BHIWADI DIST.	Approved
		CMI LTD.	Approved
		CRYSTAL CABLE INDUSTRIES LTD., HOWRAH	Approved
		KEI INDUSTRIES LTD., ALWAR	Approved
		KEC INTERNATIONAL LIMITED, Silvassa	Approved

Sagardighi Extn. U #5 (PROJ3)
Electrical E quipments
Ref: SGMPO3/AV/8/047

		POLYCAB WIRES PVT. LTD., Daman	Approved

72	LT PVC CONTROL CABLE	Advance Cable Technologies (P) Ltd., Bengaluru	Approved
		CORDS CABLE INDUSTRIES LTD., BHIWADI DIST.	Approved
		CMI LTD.	Approved
		CRYSTAL CABLE INDUSTRIES LTD., HOWRAH	Approved
		KEI INDUSTRIES LTD., ALWAR	Approved
		KEC INTERNATIONAL LIMITED, Silvassa	Approved
		POLYCAB WIRES PVT. LTD., Daman	Approved
		RAVIN CABLES LIMITED	Approved
		UNIVERSAL CABLES LTD., SATNA	Approved
73	SCREENED CONTROL CABLES	CORDS CABLE INDUSTRIES LTD., BHIWADI DIST.	Approved
		DELTON CABLES LTD. FARIDABAD	Approved
		KEI INDUSTRIES LTD. , ALWAR	Approved
		POLYCAB WIRES PVT. LTD., Daman	Approved
		THERMO CABLES LTD. HYDERABAD	Approved
74	LT XLPE FIRE SURVIVAL CABLES	KEI INDUSTRIES LTD., ALWAR	Approved
		POLYCAB WIRES PVT. LTD., Daman	Approved
75	DC LEAD ACID BATTERIES	EXIDE INDUSTRIES LTD, KOLKATA	Approved
		HOPPECKE BATTERIEN GMBH & CO.KG,	Approved
76	DC Ni-Cd BATTERIES	HBL Power Systems Ltd Hyderabad	Approved
77	DC BATTERY CHARGER	CHHABI ELECTRICALS PVT.LTD.()	Approved for Capacity < 100 AH
		AMAR RAJA POWER SYSTEMS, TIRUPATHI	Approved for Capacity < 100 AH
		Chloride Power Systems & Solutions Ltd., Kolkata	Approved
		HBL POWER SYSTEMS LTD ,	Approved
		STATCON ENERGIAA PRIVATE LIMITED,Hapur	Approved
78	MS ROD FOR BELOW GROUND EARTHING	RASHTRIYA ISPAT NIGAM LIMITED	Approved
		STEEL AUTHORITY OF INDIA LTD.	Approved
79	STATION LIGHTING SYSTEM	BAJAJ ELECTRICALS LTD., PUNE	Approved
		CROMPTON GREAVES LTD.	Approved
		PHILIPS INDIA LTD.	Approved
80	LIGHTING TRANSFORMERS	SUDHIR TRANSFORMERS LIMITED	Approved
		INDCOIL TRANSFORMERS PVT LTD	Approved
81	LIGHTING MAST	BAJAJ ELECTRICALS LIMITED	Approved
		CROMPTON GREAVES CONSUMER ELECTRICALS LIMITED	Approved

82	LIGHTING POLE	BOMBAY TUBE & POLES CO..	Approved
		BAJAJ ELECTRICALS LTD.	Approved
83	LIGHTING WIRE	CORDS CABLE INDUSTRIES LTD	Approved
		DELTON CABLES LTD.	Approved
		KEC	Approved
		KEI INDUSTRIES LTD.	Approved
		NICCO CORPORATION LTD.	Approved
		POLYCAB WIRES PVT.LTD	Approved
		TORRENT CABLES LTD.	Approved
		UNIVERSAL CABLES D.	Approved
		Finolex	Approved
		CMI Energy India Pvt. Ltd.	Approved
		Elkay Telelinks Ltd.	Approved
		Havells India Ltd	Approved
		Paramount Communications Ltd.	Approved
		Ravin Cables Ltd	Approved
		Special Cables Pvt. Ltd.	Approved
		Anchor	Approved
		CABLE CORPORATION OF INDIA	Approved
		RR Kabel Limited	Approved
		Thermo Cables Limited	Approved
84	HVR Transformer and EC Panel	ADOR POWERTRON LTD.,	DR
		BHARAT HEAVY ELECTRICALS LIMITED	Approved
		KRAFT POWERCON INDIA PRIVATE LTD	DR
85	Rubber Bellow for Bus Duct	Cori Engineers Pvt. Ltd., Chennai	Approved
		Resistoflex Pvt. Ltd., Noida	Approved
		United Rubber Industries, Mumbai	Approved
86	Epoxy Insulator for Bus Duct Package	A-Bond Strands Pvt. Ltd., Chennai	Approved
		Baroda Bushing & insulator, Vadodara	Approved
		Baroda Mould & Dies, Vadodara	Approved
		Ganpati Fibertech India (P) Ltd.	Approved
87	Epoxy Seal Off Bushing for Bus Duct Package	A-Bond Strands Pvt. Ltd., Chennai	Approved
		Baroda Bushing & insulator, Vadodara	Approved
		Baroda Mould & Dies, Vadodara	Approved
88	Current Transformer for Bus Duct Package	Instrans Engg & Mfg, Bangalore	Approved
		Pragati Electricals Pvt. Ltd., Thane	Approved
		Prayog Electricals Pvt. Ltd., Pune	Approved
		Silkaans Electrical Mfg. Co. Pvt. Ltd., Bangalore	Approved
89	Voltage/ Potential Transformer for Bus Duct Package	Instrans Engg & Mfg, Bangalore	Approved
		Pragati Electricals Pvt. Ltd., Thane	Approved
		Prayog Electricals Pvt. Ltd., Pune	Approved
		Silkaans Electrical Mfg. Co. Pvt. Ltd., Bangalore	Approved

90	Hot Air Blowing Equipment for Bus Duct	Elmech Pneumatic Industreis	Approved
		Melcon Engg, New Delhi	Approved
		Powergear Ltd	Approved
91	Air Pressurization Equipment for Bus Duct Package	Elmech Pneumatic Industries, New Delhi	Approved
		Mellcon Engineers Pvt. Ltd., New Delhi	Approved
		Powergear Ltd	Approved
92	LAVT & NG Cubicle Assembly for Bus Duct Package	BHEL-RUDRAPUR	Approved
		Pyrotech Electronics Pvt. Ltd., Udaipur	Approved
		RSI Switchgear Pvt. Ltd., Gurgaon	Approved
		Busbar Systems India Ltd.	Approved
		Powergear Ltd.	Approved

93	Copper Strip Flexible/Copper Braided Flexible for Bus Duct Package	B.B. Electro Technique, Mumbai/Thane	Approved
		Shree Cable & Conductors Pvt. Ltd., Bhopal	Approved
94	DG SET ENGINE	CUMMINS	Approved
		MITSHUBISHI	DR
		CATERPILLAR	Approved
95	ALTERNATOR	NIDEC-LEROY SOMER	Approved
		CATERPILLAR	Approved
		KIRLOSKAR ELECTRIC	Approved
		CUMMINS GEN TECH.(STAMFORD)	Approved
96	DG SET ASSEMBLERS	JAKSON LTD.	Approved
		POWERICA LTD.	Approved
97	DG SET BATTERY BANK	EXIDE	Approved
		HBL	Approved
		CUMMINS	Approved
98	DG SET CONTROL PANELS / AUX.DIST. BOARD	JAKSON LTD	Approved
		PYROTECH	Approved
99	ALUMINUM TUBE	Hindalco Industries Limited	Approved
		Jindal Aluminium Ltd Bangalore Karnataka	Approved
		Balco	Approved
		Alom Extrusions Ltd.	Approved
100	CLAMPS & CONNECTORS	Electromech & Transtech Private Limited Kolkata West Bengal	Approved
		Klemmen Engineering Corporation Chennai Tamil Nadu	Approved
		Peevee Engineering Enterprises Bangalore Karnataka	Approved
		Utsav Electro-Mech Pvt Ltd Vadodara Gujarat	Approved

101	SWITCHYARD CONTROL PANELS	ABB India Limited	Approved
		GE T&D India Limited Noida Uttar Pradesh	Approved
		Schneider Electric Infrastructure Limited Noida Uttar Pradesh	Approved
		Siemens Ltd	Approved
102	SPACER COUPLING (REGIFLEX TYPE)	SIEMENS LTD	Approved
		ESCO COUPLING NV	Approved
		KTR Couplings (India) pvt.ltd	Approved
		UNIQUE TRANSMISSION INDIA P LTD.	Approved
		ESCO COUPLING & TRANSMISSION PVT LTD.	Approved
		Cubic Transmission pvt ltd unit-II	Approved
		RATHI TURBOFLEX PVT LTD	Approved
		Dipl.ing.Herwarth Reich GMBH	Approved
		Reich India ltd	Approved
		KTR KUPPLUNGSTECHNIK Gmbh	Approved
103	BAY CONTROL UNIT	ALSTOM	Approved
		SIEMENS	Approved
		ABB	Approved
104	FRP JUNCTION BOXES/ JUNCTION BOXES(POWER/CONTROL), LIGHTING JB	Jakson Engineers Limited	Approved
		Jasper Engineers Private Limited	Approved
		Mika Engineers	Approved
		Popular Switchgears Pvt Ltd	Approved
		Pyrotech Electronics Pvt Ltd	Approved
		RSI Switchgear Private Limited	Approved
		Sarvana Switchgears	Approved
		Unilec Engineers Ltd	Approved
105	MARSHALLING KIOSK	Mika Engineers Thane Maharashtra [MSE: MICRO]	Approved
		Popular Switchgears Pvt Ltd Nashik Maharashtra	Approved
		Pyrotech Electronics Pvt Ltd Udaipur Rajasthan	Approved
		RSI Switchgear Private Limited Bhiwadi Rajasthan	Approved
		RST Electricals Pvt. Ltd. Sahibabad Uttar Pradesh	Approved
		Sarvana Switchgears Bangalore Karnataka	Approved
		Unilec Engineers Ltd Gurgaon Haryana	Approved
106	PIPE STRUCTURE	Advance Steel Tubes Ltd. Ghaziabad Uttar Pradesh	Approved
		Associated Power Structures Pvt. Ltd. Vadodara Gujarat upto 400 kV System	Approved
		Goodluck India Limited Sikandrabad Uttar Pradesh	Approved
		Vijay Transmission Pvt. Ltd Raipur Chhattisgarh	Approved
		New Modern Technomech Pvt Ltd	Approved
		Rs Infraprojects Pvt. Ltd. Noida Uttar Pradesh	Approved
		UTKARSH TUBES & PIPES LIMITED Kolkata	Approved
		DEEPAK FASTNERS LTD	Approved

107	STRUCTURE HARDWARE	NAVEEN METAL INDUSTRIES, KOLKATA	Approved
		NEW INDIA ENGINEERING CORPORATION	Approved
		TECHMAN (INDIA)	Approved
108	SHIELD WIRE	Bharat Wire Ropes Ltd	Approved
109	STRING INSULATOR HARDWARE	Asbesco (India) Pvt. Ltd.	Approved
		Electromech & Transtech Private Limited	Approved
		EMC	Approved
		ITPPL	Approved
		TYCO	Approved
		Tag Corporation, Chennai	Approved
		IAC	Approved

110	400 kV SF6 BREAKERS	ABB	Approved
		CGL	Approved
		SIEMENS	Approved
		GE T&D India Limited	Approved
111	400 kV SWITCHYARD CURRENT TRANSFORMER	ABB	Approved
		CGL	Approved
		GE T&D India Limited	Approved
		BHEL	Approved
		SIEMENS	Approved
112	400 kV SWITCHYARD PT/POTENTIAL TRANSFORMER/VOLTAGE TRANSFORMER	ABB	Approved
		CGL	Approved
		SIEMENS	Approved
		ALSTOM	Approved
		BHEL	Approved
113	400 kV ISOLATOR	SIEMENS	Approved
		ABB	Approved
		GE T&D India Limited	DR
114	400 kV EARTH SWITCH	SIEMENS	Approved
		ABB	Approved
115	400 KV LATTICE STRUCTURE	GOOD LUCK STEEL TUBES LTD., BULANDSHAHAR (UP)	Approved
		UTKARSH TUBES AND PIPES LIMITED, KOLKATA, WEST BENGAL	Approved
		Richardson & Cruddas (1972) Ltd, NAGPUR	Approved
116	ACSR CONDUCTOR	HINDUSTAN VIDYUT PRODUCTS LTD., HARYANA	Approved
		GUPTA POWER INFRASTRUCTURE LTD., BHUBANESWAR	Approved
		HIREN ALUMINIUM Ltd., SILVASSA DADRA & NAGAR HAVELI	Approved
117	RAIL POLE	SAIL	Approved
		RINL	Approved
		TATA	Approved
118	CABLE for ROLLED -E-CHAIN BAY CONTROL UNIT	IGUS	Approved
		ALSTOM	DR
		SIEMENS	DR
		ABB	DR

119	Control and Relay Panel / SAS	ABB India Limited	Approved
		GE T&D India Limited	Approved
		Siemens Ltd	Approved
120	400KV LIGHTNING ARRESTOR	Crompton Greaves Ltd	Approved
		Elpro International Ltd	Approved
		Oblum Electrical Industries Pvt Ltd	Approved
121	400 kV DISC INSULATOR/ LONG ROD INSULATOR (120KN)/ BUS POST INSULATOR(For Switchyard)	BHEL	Approved
		NGK BIRLA, JAYASHREE	Approved
		W.S. INDUSTRIES LTD,CHENNAI	Approved
		INDIAN POTTERIES	Approved
		Saravana Global Energy Limited	Approved
		Aditya Birla Insulators (A unit of Aditya Birla Nuvo Ltd.)	Approved
		Modern Insulators Ltd.	Approved
		ESP/HVR (Jhansi Works)	
122	CRGO Steel-ESP/HVR TRANSFORMERS UPTO 95 KVP, 1400 mAmps	Bralco Resources,Canada (Mill-A K Steel, USA)	Approved
		Nippon Steel Corporation , Japan	Approved
		Kawasaki Steel , Japan	Approved
		TKES , Germany	Approved
		POSCO, Korea	Approved
		Viz Stal, Russsia	Approved
123	PICC (PAPER INSULATED COPPER CONDUCTOR)Conductor-ESP/HVR TRF	Shree Cables & Conductor, Bhopal	Approved
		BCPL , Raisen / Mandideep	Approved
		Shakti Insulated Wires, Ankleshwar / Mumbai	Approved
		Delta Trans Conductors Pvt. Ltd. Mumbai	Approved
		KSH Internationa,l Mumbai	Approved
		Signet Conductors, Rewa	Approved
		NKM Sales, Mandideep	Approved
		Electromech, Rewa	Approved
		Chandra Metals, Allahabad	Approved
		Malwa Strips, Dewas	Approved
		Precision Wires India Ltd,	Approved
		Mimani Indore.	Approved
		RIMA TRANSFORMER	Approved
124	Press Board	Senapathy Whitley, Bangalore	Approved
		Raman Boards, Mysore	Approved
		H Weidman / Weidman Systems, Switzerland	Approved

125	Transformer Oil (Mineral Oil)-ESP/HVR TRF	Apar Indistries, Mumbai	Approved
		Savita Oil Tech. ltd. Mumbai	Approved
		Raj Petro Specialties Mumbai	Approved
		COLOMBIA PETRO CHEM, INDIA	Approved
		Savita Chemicals India Pvt. Silvasa	Approved
126	Transformer Oil (Silicon Oil)	GE Momentive Silicon, USA	Approved
		DOW Corning, USA	Approved
		Shin-ETSU, Singapore	Approved
127	Synthetic Rubber Bonded Cork Sheet	James Walker, UK	Approved
		NU Cork Product, Gurgaon	Approved
		Gujrat Cork And Rubber, Valsad	Approved
		Indian Cork Industries	Approved
128	OTI	Perfect Control, Chennai	Approved
		Precimeasure, Bangalore	Approved
129	Buchholz Relay	ATVUS Industries, Kolkata	Approved
		Press-N-Forge, Mumbai	Approved
		A.J Service, Mumbai	Approved
130	MOG	Sukrut Udyog, Pune	Approved
		ATVUS Industries, Kolkata	Approved
		Yogya Enterprises, Jhansi	Approved
		Press-N-Forge, Mumbai	Approved
	Power Transformers Oil Filled(JHANSI WORKS)		
131	CRGO STEEL (Supplier)	AK STEEL, Netherlands/ USA	Approved
		NIPPON STEEL, JAPAN	Approved
		VIZSTAL, RUSSIA (Only M4 grade)	Approved
		POSCO, KOREA	Approved
132	PAPER INSULATED COPPER CONDUCTOR (PICC)	SHREE CABLES & CONDUCTORS BHOPAL	Approved
		KSH INTERNATIONAL CHAKAN,PUNE	Approved
		RIMA TRANSFORMER & CONDUCTORS BANGALORE	Approved
		BCPL, MANDIDEEP	Approved
		PRECISION WIRES INDIA LTD, SILVASSA.	Approved
		SHAKTI INSULATED WIRES PVT LTD, ANKLESHWAR	Approved
		CHANDRA METALS LTD. TELIARGANJ	Approved
		DELTA TRANS CONDUCTORS(P)LTD. MUMBAI	Approved

133	CONTINUOUSLY TRANSPOSED CONDUCTOR	ASTA INDIA PVT LTD	Approved
		KSH INTERNATIONAL PVT LTD	Approved
		PRECISION WEIR INDIA LTD	Approved
		SAMDONG	Approved
134	PRECOMPRESSED PRESSED BOARDS	ABB INDIA LIMITED, MYSORE	Approved
		ABB AB, SWEDEN.	Approved
		SENAPATHY WHITELEY PVT.LTD. BANGALORE	Approved
135	INSULATING OIL	Apar Indistries, Mumbai	Approved
		Savita Oil Tech. ltd. Mumbai	Approved
		Raj Petro Specialties Mumbai	Approved
		BPCL	Approved
136	BUCCHOLZ RELAY	P&B WEIR ELECTRICAL-UNIT 10, U.K	Approved
		PRESS-N-FORGE, MUMBAI	Approved
		A.J .SERVICES (PRAYOG), MUMBAI	Approved
		SUKRUT ELECTRIC CO.PVT.LTD. PUNE	Approved
		VIAT INSTRUMENTS PVT. LTD. KOLKAT/AHMEDABAD	Approved
137	PRESSURE RELIEF VALVE	MESSKO GMBH GERMANY	Approved
		QUALITROL COMPANY LLC USA	Approved
		RAJSHI ENGINEERS JHANSI	Approved
		Atvus, Kolkata	Approved
		SUKRUT UDYOG PUNE	Approved
138	AIR CELL	PRONAL ASIA MANUFACTURING MALAYSIA	Approved
		UNIRUB TECHNO INDIA PVT. LTD. PUNE	Approved
139	MOLG	QUALITROL COMPANY LLC, USA	Approved
		MESSKO GMBH GERMANY	Approved
		Atvus, Kolkata	Approved
		PRESS-N-FORGE, MUMBAI	Approved
		YOGYA ENTERPRISES, JHANSI	Approved
		SUKRUT UDYOG PUNE	Approved
140	OTI / WTI/ RTD	PRECIMEASURE CONTROLS (PVT.) LTD., BANGALORE	Approved
		PERFECT CONTROL, CHENNAI	Approved
141	OFI/WFI	SUKRUT UDYOG	Approved
		VIAT INSTRUMENTS PVT LTD	Approved

142	CONDENSER BUSHING-OIP	BHEL	Approved
		CGL	Approved
		GE T&D	Approved
143	ON LOAD TAP CHANGER	M/S BHEL BHOPAL	Approved
144	RADIATORS	TTP TECHNOLOGIES PVT LTD	Approved
		CTR MANUFACTURING INDUSTRIES LTD	Approved
		GURURAJ RADIATORS PVT LTD	Approved
		HI-TECH RADIATORS PVT LTD	Approved
		P.E. ENGINEERS PVT LTD	Approved
		TRANSPARES LIMITED	Approved
		BHEL, BHOPAL	Approved
145	~~N2 FIRE PROTECTION SYSTEM~~	As per Approved Vendors of Fire Detection system Package for the Main Plant.	
146	BUSHING-RIP	NANJING, CHINA	DR
		HSP, GERMANY	DR
		TRENCH, CHINA	DR
		ABB, SWITZERLAND	DR
		MOSER GLAZER, SWITZERLAND	DR
		YASH HIGH VOLTAGE INSULATORS (up to 145 kV), VADODARA	DR
		Dry Type Transformers(JHANSI WORKS)	
147	CRGO STEEL (Supplier)	Mill-A K Steel, USA/ Netherlands	Approved
		Metal One Corp.(Mill-Nippon Steel, Japan)	Approved
		TKES , Germany	Approved
		Novex Trading, Switzerland (Mills - Viz Stahl	Approved
		POSCO IPPC, Pune (Mill-Posco, Korea)	Approved
148	COPPER CONDUCTOR	Mimani Wires, Indore	Approved
		Malwa Strips, Dewas	Approved
		Copral Insulated, Hosur	Approved
		BCPL, Raisen/ Mandideep	Approved
		M P Cupro metals, Bhopal	Approved
		SCR Wires, Tunkur	Approved
		Chandra Metals, Allahabad	Approved
		Pearl, Bangalore	Approved
		COSMOS Conductors, Tunkur	Approved
		Vimlesh Industuries, Sonipat	Approved
		Permali Wallace Ltd. Bhopal	Approved
		Mica Ply, Bhopal	Approved

149	Fiber Glass Sheet	Glass Fiber Ltd. Mumbai	Approved
		Surendra Engg. Bhopal	Approved
		Texplas, Haridwar	Approved

150	Epoxy Insulators	Baroda Mould and Die, Vadodara	Approved
		Baroda Bushing, Baroda	Approved
		India Insulator, Miraj	Approved
		Epothane Civelec, Ghaziabad	Approved
		Quality Engg. & In sulation products, Bhopal	Approved
		A-Bond Strands PVl. Ltd, Chennai	Approved
151	Epoxy Casting Materials	Huntsmann Chennai	Approved
		Atul Ltd, Val sad	Approved
152	Sheet Metal Enclosure	Electro Auto Bhopal	Approved
		Shrao Engg. Bhopal	Approved
		Bansal Fabwel, Jhansi	Approved
		Anupam Industries, Jhansi	Approved
		R Industries, Bhopal	Approved
		Bharat Fabricators, Bhopal	Approved
		Mahadev Ind. Bhopal	Approved
153	Temperature Scanner	Pecon, Ahemdabad	Approved
		Precimeasure, Bangalore	Approved
		Power Transformer (Bhopal Works)	
154	PRECOMPRESSED PRESSED BOARDS	ABB INDIA LIMITED, MYSORE	Approved
		ABB AB, SWEDEN.	Approved
		KOKUSAI PULP AND PAPER CO. LTD. JAPAN	Approved
		KREMPEL GMBH GERMANY	Approved
		OJI F-TEX CO. LTD. JAPAN	Approved
		SENAPATHY WHITELEY PVT.LTD. BANGALORE	Approved
		WEIDMANN ELEC.TECHNOLOGY A.G. SWITZERLAND	Approved
		ENPAY ENDUSTRIYEL PAZARLAMA VE YATIRIM A.S. TURKIYE	Approved

155	TRANSFORMER TANK	BHARAT HEAVY ELECTRICALS LTD BHOPAL	Approved
		BHOPAL ENGINEERING GOVINDPURA BHOPAL	Approved
		DUNHIL PRODUCTS GOVINDPURA BHOPAL	Approved
		ELECTRO AUTO INDUSTRIES GOVINDPURA BHOPAL	Approved
		E.M. ELECTRO MECHANICALS PVT.LTD GOVINDPURA BHOPAL	Approved
		GTV ENGINEERING LTD. GOVINDPURA BHOPAL	Approved
		MECH & FAB INDUSTRIES GOVINDPURA BHOPAL	Approved
		SIGMA HEAVY ENGG. INDUSTRIES GOVINDPURA BHOPAL	Approved
		SATYAM (FAB) INDUSTRIES PVT. LTD., BHOPAL	Approved
		SHRAO ENGG.WORKS GOVINDPURA BHOPAL	Approved
156	STEEL PLATE	STEEL AUTHORITY OF INDIA LTD	Approved
		IISCO	Approved
		RINL	Approved
		TISCO	Approved
157	CRGO STEEL (Supplier)	AK STEEL INTERNATIONAL B.V., USA (Regd. office at Netherlands)	Approved
		JFE SHOJI TRADE CORPORATION, JAPAN (Auth. Agent POSCO PUNE)	Approved
		NIPPON STEEL, JAPAN (Auth. Trader METAL ONE JAPAN)	Approved
		VIZSTAL, RUSSIA (Auth. Trader NOVEX TRADING	Approved
		POSCO KOREA (Auth. Agent POSCO-PUNE)	Approved
158	INSULATING OIL	APAR INDUSTRIES LTD., CHEMBUR, MUMBAI	Approved
		RAJ PETRO SPECIALITIES PVT LTD MUMBAI	Approved
		SAVITA OIL TECHNOLOGIES LTD. MUMBAI	Approved
159	PAPER INSULATED COPPER CONDUCTOR (PICC)	SHREE CABLES & CONDUCTORS BHOPAL	Approved
		KSH INTERNATIONAL CHAKAN,PUNE	Approved
		RIMA TRANSFORMER & CONDUCTORS BANGALORE	Approved
		BCPL, MANDIDEEP	Approved
		BHANDARY POWER LINE, MANIPAL	Approved
		PRECISION WIRES INDIA LTD, SILVASSA.	Approved
		SHAKTI INSULATED WIRES PVT LTD, ANKLESHWAR	Approved
		CHANDRA METALS LTD. TELIARGANJ	Approved
		M.P.CUPRO METALS PVT.LTD.BHOPAL.	Approved
		DELTA TRANS CONDUCTORS(P)LTD. MUMBAI	Approved

160	CONTINUOUSLY TRANSPOSED COPPER CONDUCTOR (CTC)	KSH INTERNATIONAL CHAKAN,PUNE	Approved
		PRECISION WIRES INDIA LTD, SILVASSA.	Approved
		SAMDONG KOREA	Approved
		ASTA, INDIA VADODARA	Approved
161	UNIMPREGNATED DENSIFIED WOOD	PERMALI WALLACE PVT. LTD. GOVINDPURA, BHOPAL	Approved
		SURENDRA COMPOSITES PVT LTD RAISEN	Approved
162	ON LOAD TAP CHANGER/ OFF CIRCUIT TAP CHANGER	BHEL BHOPAL	Approved
		ABB AB COMPONENTS SWEDEN	Approved
		MASCHINENFABRIK REINHAUSEN GERMANY	Approved
163	OIL CONDENSOR BUSHING	BHEL BHOPAL	Approved
		GE T&D INDIA LIMITED, HOSUR	Approved
		GRID SOLUTIONS, A GE AND ALSTOM JOINT VENTURE, ITALY	Approved
		ABB AB COMPONENTS, SWEDEN	Approved
		CG POWER & INDUSTRIAL SOLUTIONS LTD, NASHIK	Approved
164	BUCHLOZ RELAY	P&B WEIR ELECTRICAL-UNIT 10, U.K	Approved
		SUKRUT ELECTRIC CO.PVT.LTD. PUNE	Approved
		VIAT INSTRUMENTS PVT. LTD. KOLKATA	Approved
		VIAT INSTRUMENTS PRIVATE LIMITED UNIT- II SANAND	Approved
165	OTI / WTI/ RTD	PRECIMEASURE CONTROLS (PVT.) LTD., BANGALORE	Approved
		PERFECT CONTROL, CHENNAI	Approved
166	PRESSURE RELIEF VALVE	MESSKO GMBH GERMANY	Approved
		QUALITROL COMPANY LLC USA	Approved
		RAJSHI ENGINEERS JHANSI	Approved
		SUKRUT UDYOG PUNE	Approved
167	AIR CELL	PRONAL ASIA MANUFACTURING MALAYSIA	Approved
		UNIRUB TECHNO INDIA PVT. LTD. PUNE	Approved
168	MOLG	QUALITROL COMPANY LLC, USA	Approved
		MESSKO GMBH GERMANY	Approved
		SUKRUT UDYOG PUNE	Approved
169	OIL FLOW INDICATOR	SUKRUT UDYOG, PUNE	Approved
		VIAT INSTRUMENTS PRIVATE LIMITED UNIT- II AHMEDABAD	Approved

170	OIL PUMP	FLOW OIL PUMPS PVT. LTD. BANGALORE	DR
		NXL FLOW INSTRUMENTS BANGALORE	DR
		SPP PUMPS LIMITED ENGLAND	DR
171	COOLING FAN & MOTOR ASSLY	EPC ELECTRICAL PVT.LTD. KOLKATA	Approved
		MARATHON ELECTRIC MOTORS(INDIA)LTD KOLKATA	Approved
172	RADIATOR	BHEL BHOPAL	Approved
		CTR MANUFACTURING INDUSTRIES LTD. PUNE	Approved
		TTP TECHNOLOGIES PVT. LTD. BANGALORE	Approved
173	MARSHALLING BOX / CONTROL CABINET/RTCC	ASHOKA ELECTRONICS, BHOPAL	Approved
		ENTERPRISING ENGINEERS,BHOPAL	Approved
		PURNIMA ELECTRICAL INDUSTRIES , BHOPAL	Approved
		PYROTECH ELECTRONICS PVT. LTD. (UNIT-IV), UDAIPUR	Approved
		R.S.I.SWITCH GEAR PVT LTD. BHIWADI	Approved
174	TERMINAL CONNECTOR	KLEMMEN ENGINEERING CORPN., CHENNAI	Approved
		PEE VEE ENGG.ENTERPRISES, BANGALORE	Approved
175	GAS COLLECTING DEVICE	SUKRUT UDYOG, PUNE	Approved
		YOGYA ENTERPRISES, JHANSI	Approved
176	N2 BASED FIRE PROTECTION SYSTEM	CTR MANUFACTURING INDUSTRIES LTD. NAGPUR	DR
		EASUN-MR TAP CHANGERS (P) LTD, CHENNAI	DR
		SERGI TRANSFORMER EXPLOSION PREVENTION, GURGAON (HARYANA)	DR
		VENDERE SALES SERVICES (I) PVT. LTD. AURANGABAD	DR
		GK POWER TRANSMISSION COMPANY PVT. LTD., NAGPUR	DR
177	FIBRE OPTIC HOT SPOT TEMP MONITORING SYSTEM	LUXTRON CORPORATION DBA LUMASENSE TECHNOLOGIES, USA	DR
		MACHTECH ENGINEERING SOULUTIONS LLP, VASAI	DR
		PRECIMEASURE CONTROLS (PVT.) LTD, BANGALORE	DR
		QUALITROL COMPANY LLC, USA	DR

178	ONLINE DGA	A.EBERLE GMBH AND CO. KG GERMANY	DR
		MTE METER TEST EQUIPMENT AG SWITZERLAND (Installation & Commissioning of DGA by MTE-INDIA, New Delhi)	DR
		MORGAN SCHAFFER INC CANADA (M/S Doble)	DR
		GE KELMAN (Auth. Agent PCI PRECISION CASTING LIMITED DELHI)	DR
		QUALITROL COMPANY LLC USA	DR
		CHROMATOGRAPHY & INSTRUMENTS COMPANY, VADODARA	DR
179	INSULATOR	M/S BHEL ELECTRO-PORCELAIN DIVN. BANGALORE	Approved
		M/S CJI PORCELAIN PVT. LTD. KHURJA	DR
		M/S KHYATI CERAMICS. KALOL	DR
	HT MOTOR COMPONENTS (Bhopal Works)		
180	CACA COOLER	FITWELL CORPORATION	Approved
		KARNATAKA ENGINEERING ENTERPRISES	Approved
		LAXMI ENGG. IND.	Approved
		MEHTA INDUSTRIES	Approved
181	CACW COOLER	FITWELL CORPORATION	Approved
		KARNATAKA ENGINEERING ENTERPRISES	Approved
		LAXMI ENGG. IND.	Approved
		MEHTA INDUSTRIES	Approved
182	ANTIFRICTION BEARING	SKF	Approved
		FAG	Approved
183	COPPER SECTION/ ROUND/FLAT ROTOR BAR	BHANWARDEEP COPPER STRIPS(P)LTD	Approved
		COPPER STRIPS PVT LTD	Approved
		CHANDRA METALS LTD.	Approved
		MALWA STRIPS PVT.LTD.	Approved
		OMEGA ROLLING MILLS PVT LTD.	Approved
184	FORGED SHAFT	BHARAT FORGE LIMITED	Approved
		BAY-FORGE LTD.	Approved
		BHARAT HEAVY ELECTRICALS LTD	Approved
		GHAZIABAD ISPAT UDYOG LTD	Approved
		KISCO CASTINGS (INDIA) LTD.	Approved
		KISAAN STEELS PVT.LTD	Approved
		PUNJAB HAMMERS PVT.LTD.	Approved
		PAHLADRAI STEEL FORGING WORKS,	Approved
		STEEL AUTHORITY OF INDIA LIMITED	Approved
185	ENAMELLED MICA TAPED COPPER CONDUCTOR.	M.P.CUPRO METALS PVT.LTD.	Approved
		NKM CABLES & STRIPS(PVT)LTD.	Approved
		SHREE CABLES & CONDUCTORS (P) LTD	Approved
		VIMLESH INDUSTRIES(P)LTD.	Approved

Sagardighi Extn. U#5 (PROJ3)
Electrical Equipments
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186	MICA TAPED CONDUCTORS	BHANWARDEEP COPPER STRIPS(P)LTD	Approved
		BCPL CONDUCTORS PVT.LIMITED	Approved
		COSMOS CONDUCTORS PVT.LTD.	Approved
		COPRAL INSULATED CONDUCTORS PVT.,LTD.	Approved
		CHANDRA METALS LTD.	Approved
		MIMANI WIRES PVT LTD	Approved
		MALWA STRIPS PVT.LTD.	Approved
		M.P.CUPRO METALS PVT.LTD.	Approved
		NKM CABLES & STRIPS(PVT)LTD.	Approved
		SHREE CABLES & CONDUCTORS (P) LTD	Approved
		VIMLESH INDUSTRIES(P)LTD.	Approved
187	RTD/BTD	JINDAL ELECTRONICS PRIVATE LIMITED	Approved
		TECHNO INSTRUMENTS	Approved
Note:-			
1	SUB ITEMS (not covered specifically in the Vendor List) for Power Transformer, DTT and HVR Transformer from BHEL Units.		BHEL Approved sources
2	SUB ITEMS (not covered specifically in the Vendor List) for HT Motors to be supplied from IS Motors.		BHEL Approved sources
3	SUB ITEMS (not covered specifically in the Vendor List) FOR Busduct package, supplies from BHEL-Rudrapur Unit		BHEL Approved sources

SAGARDIGHI THERMAL Power EXTENSION PROJECT PHASE-III, UNIT#5 (1 x660 MW)			
Sl No	Item	Vendor Name	Status
1	Severe Service Control Valve for BFP Re-Circulation / SH & RH Attemperation Control Valve	DRESSER VALVE INDIA PVT. LTD, Coimbatore	Approved
		CONTROL COMPONENTS INC.	Approved
		KSB MIL CONTROLS LIMITED	Approved but only for 9000 Series Valves
2	Oil Trip Valves (FUEL OIL SYSTEM)	INSTRUMENTATION LTD., KERALA	Approved
		KSB MIL CONTROLS LIMITED, THIRISSUR DIST	Approved
		Kuehme Armaturen GmbH,Germany	DR
		SAMSON CONTROLS PRIVATE LIMITED	Approved
		MASCOT VALVES PVT. LTD, AHMEDABAD	Approved
3	NORMAL SERVICE CONTROL VALVE	DRESSER VALVE INDIA PVT. LTD, Coimbatore	Approved
		EMERSON PROCESS MANAGEMENT CHENNAI LIMITED, Chennai	Approved
		INSTRUMENTATION LTD., PALAKKAD	Approved
		Koso India Private Limited, Nashik	Approved
		PARCOL S.P.A.	Approved
		SEMPELL GmbH.	Approved
		DAUME REGELARMATUREN GMBH	DR
		KSB MIL CONTROLS LTD. Thrissur	Approved
		Valvitalia S.P.A. , Italy	Approved
		WALDEMAR PRUSS ARMATURENFABRIK GMBH, Germany	Approved
4	Severe Service Control Valve for AUX PRDS	Control Component India Pvt. Ltd. Chitoor	Approved
		Daume Regelarmaturen GmbH, Isernhagen, Germany	Approved
		HOLTER REGELARMATUREN GmbH & CO., HOLTESTUKENBR OCK	Approved
		Koso India Private Limited, Nashik	Approved
		PARCOL S.p.A Canegrate MI, ITALY	Approved
5	VALVE:SOOT BLOWER PR	DRESSER VALVE INDIA PVT. LTD, Coimbatore	Approved
		CONTROL COMPONENTS INC.	Approved
		KSB MIL CONTROLS LIMITED	Approved
6	LP STARTUP CONTROL VALVES	CONTROL COMPONENT INDIA PVT LTD	Approved
		INSTRUMENTATION LTD.,	Approved
		EMERSON PROCESS MANAGEMENT CHENNAI	DR
		WELLAND & TUXHORN AG	Approved
		KOSO INDIA PRIVATE LIMITED.	Approved
		KSB MIL CONTROLS LIMITED	Approved

Sl No	Item	Vendor Name	Status
7	HIGH PR. STARTUP SCV	CONTROL COMPONENT INDIA PVT LTD, Bangalore	Approved
		SEMPELL GmbH., Germany	Approved
		KOSO INDIA PRIVATE LIMITED., Nashik	Approved
		PARCOL S.P.A., Milan Italy	Approved
8	HPBP Control Valve	SULZER-CCI AG, SWITERZERLAND	Approved
		CONTROL COMPONENT INDIA PVT LTD, Bangalore	Approved
9	LP BYPASS SYSTEM	SULZER-CCI AG, SWITERZERLAND	Approved
		CONTROL COMPONENET INDIA PVT	Approved
		WELLAND & TUXHORN AG	Approved
		HOLTER REGELARMATUREN GMBH & CO.	DR
10	SEAL STEAM VALVE/ LEAK STEAM VALVE WITH PNEUMATIC ACTUATOR	SAMSON CONTROLS PVT. LTD.	Approved
		INSTRUMENTATION LIMITED	Approved
		KSB MIL CONTROLS LIMITED	Approved
		GE OIL & GAS INDIA PRIVATE LIM	Approved
		WELLAND & TUXHORN AG	Approved
		HOLTER REGELARMATUREN GMBH & CO.	Approved
11	Air Filter Regulator [Either from OEM/Authorised Source]	Parker Hannifin, Lebonon	Approved
		SHAVO NORGREN(INDIA)PVT LTD, BANGALORE	Approved
		JRU INSTRUMENTS (Formerly PLACKA)	Approved
12	HPT STEAM EVACUATION VALVE	GE OIL & GAS INDIA PRIVATE LTD	Approved
		HOLTER REGELARMATUREN GMBH & CO., GERMANY	Approved
		KSB MIL CONTROLS LIMITED, INDIA	Approved
		INSTRUMENTATION LIMITED	Approved
13	SOLENOID VALVE	ASCO (I) LTD.	Approved
		ROTEX AUTOMATION LTD.	Approved
		NUCON INDUSTRIES PVT LTD	Approved
		IMI NORGREN HERION PVT. LTD.	Approved
14	Bypass Rotameter	EUREKA INDLEQUIPMENT PVT., LTD., PUNE	Approved
		FLUIDYNE INSTRUMENTS PVT. LTD., CHEMBUR, MUMBAI	Approved
		PLACKA INSTRUMENTS INDIA PVT LTD, CHENNAI	Approved

Sl No	Item	Vendor Name	Status
		INSTRUMENTATION ENGINEERS PVT LTD,JEEDIMATLA,HYDERABAD	Approved
		TRANSDUCER & CONTROL PVT LTD, HYDERABAD	Approved
15	C&I Laboratory Furniture/ Computer Furniture	ADARSHA CONTROL SYSTEMS PVT. LTD., BANGALORE	Approved
		COSMOS MEDIA PRODUCTS PVT. LTD,GREATER NOIDA,UP	Approved
		FEATHERLITE OFFICE SYSTEMS PVT. LTD,BANGALORE	Approved
		GODREJ AND BOYCE MANUFACTURING CO.,ROORKEY, UTTARAKAND.	Approved
		HARMONY SYSTEMS, GREATER NOIDA, UP	Approved
		OTS OFFICETECH SYSTEMS (P) LTD,BANGALORE	Approved
		PYROTECH WORKSPACE SOLUTIONS PVT. LTD, UDAIPUR	Approved
16	CBLM Sys (3D Type)	APM, Israel	Approved
		EIP TECHNOLOGIES PVT. LTD.NOIDA/ Process Management Mumbai	Approved
17	CBLM Sys (Ultrasonic Or RADAR Type) Panel	ENDRESS + HAUSER INDIA PVT. LTD. MUMBAI	Approved
		KISTLER MORSE AUTOMATION LTD.,HYDERABAD	Approved
		KROHNE MARSHALL PVT LTD.,PUNE	Approved
		VEGA INDIA LEVEL & PRESSURE MEASURMENT PVT LTD.,MUMBAI.	Approved
		EMERSON PROCESS MANAGEMENT ,MUMBAI.	Approved
		SIEMENS LIMITED, BANGALORE	Approved
18	CBLM Sys(StrainGauge Type) Sensor & Panel	KISTLER - MORSE AUTOMATION LTD., HYDERABAD	Approved
		VENTURE MEASUREMENT,US	Approved
		THERMO RAMSEY INC ,CHICAGO,US	Approved
19	CO Analyser	CHEMTROLS INDUSTRIES LIMITED, POWAI, MUMBAI	Approved
		FORBES MARSHALL CODEL PVT. LTD., PUNE	Approved
		SICK INDIA PVT LTD,MUMBAI.	Approved
		MARVEL ENGG COMPANY, CHENNAI	Approved

Sl No	Item	Vendor Name	Status
20	Compression Fittings	PARKER HANNIFIN INDIA PVT. LTD.,CHENGAL PATTU,TAMILANADU	Approved
		PRECISION ENGG INDUSTRIES, MUMBAI	Approved
		SWAGELOCK,USA	Approved
		TROUVAY & CAUVIN FRANCE	Approved
		HOKE	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	DR
21	Condensate Pots	BALDOTA VALVE AND FITTING COMPANY PVT LTD,MUMBAI	Approved
		FLOWTECH, KOLKATA	Approved
		PRECISION ENGG INDUSTRIES, MUMBAI	Approved
		EXCEL HYDRO-PNEUMATICS PVT LTD,MUMBAI	DR
		PMT ENGINEERS,N.H.NO.-8, NARODA, AHMEDABAD	DR
		HP VALVES & FITTINGS (INDIA) PVT. L,MOGAPPAIR WEST, CHENNAI	DR
		ARCELLOR CONTROLS (INDIA), Ahmedabad	DR
22	Dust Density (Opacity) Monitor(Analyzer)	CODEL INTERNATIONAL LTD ,UK	Approved
		DURAG GMBH AND CO KG, HUMBURG,GERMANY	Approved
		LAND INSTRUMENTS INTERNATIONAL, ENGLAND (UK)	Approved
		SICK MAIHAK GMBH,GERMANY	Approved
23	Dust Density (Opacity) Monitor(panel)	CHEMTROLS INDUSTRIES LIMITED, POWAI,	Approved
		DURAG INDIA INSTRUMENTATION PVT LTD,BANGALORE	Approved
		SICK INDIA PVT LTD,MUMBAI.	Approved
		MARVEL ENGG COMPANY, CHENNAI	Approved
24	E/P Convertor(if required)	FAIRCHILD INDIA PRIVATE LIMITED, NOIDA	Approved
		WATSON SMITH LTD ,UK	Approved
25	Smart Positioner	EMERSON PROCESS MANAGEMENT	Approved
		SIMENS	Approved
		ABB	Approved
		ASTEC VALVE & FITTINGS PVT. LTD,MUMBAI	Approved
		AURA INC, NEW DELHI	Approved
		BALDOTA VALVE AND FITTINGS PVT LTD,MUMBAI	Approved
		EXCEL HYDRO-PNEUMATICS PVT LTD, MUMBAI	Approved
		FLOWTECH, KOLKATA	Approved

Sagardighi Extn. U#5 (PROJ3)
Control and Inst. List
Ref: SGMPO3/AV/8/047

Sl No	Item	Vendor Name	Status
26	Erection Material	FLUID CONTROLS PVT. LTD,PUNE	Approved
		HP VALVES & FITTINGS (INDIA) PVT LTD, CHENNAI	Approved
		MET LOK HYDRO PENUMATICS PVT LTD,MUMBAI	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	Approved
		PANAM ENGINEERS LTD,MUMBAI	Approved
		PMT ENGINEERS,AHMEDABAD	Approved
		PRECISION ENGG INDUSTRIES, MUMBAI	Approved
		V.K.INDUSTRIES, BANGALORE	Approved
		VIKAS INDUSTRIAL PRODUCTS, NOIDA	Approved
		PAUL INDUSTRIES,HOWRAH	Approved
		NAV DURGA FORGING AND FITTINGS,THANE,MAHARASTRA	Approved
		SANDEEP INDUSTRIES,JALANDHAR,PUNJAB	Approved
27	FGA Insitu (SOX/NOX/CO/CO2)(Analyzer)	CODEL INTERNATIONAL LTD ,UK	Approved
		SICK MAIHAK GMBH,GERMANY	Approved
		CODEL INTERNATIONAL LTD ,UK	Approved
		SICK MAIHAK GMBH,GERMANY	Approved
28	FGA Insitu (SOX/NOX/CO/CO2)(panel)	CHEMTROLS INDUSTRIES LIMITED, POWAI, MUMBAI	Approved
		FORBES MARSHALL CODEL PVT. LTD., PUNE	Approved
		SICK INDIA PVT LTD,MUMBAI.	Approved
		ICE (ASIA) PRIVATE LIMITED, MUMBAI	Approved
29	FGA Sys(SOX/NOX/CO)Samplg Type(Analyzer)	ABB INSTRUMENTATION LTD,GLOUCESTERSHIRE,UK	Approved
		EMERSON PROCESS MANAGEMENT INDIA PVT LTD, MUMBAI	Approved
		FUJI ELECTRIC SYSTEMS CO. , LTD,SHINAGAWA-KU, TOKYO	Approved
		SICK MAIHAK GMBH,GERMANY	Approved
		SIEMENS LIMITED, BANGALORE	Approved
		YOKOGAWA ELECTRIC CORPORATION,TOKYO,JAPAN	Approved
30	FGA Sys(SOX/NOX/CO)Sampling Type(panel)	ABB LTD, Bangalore	Approved
		ADAGE AUTOMATION PRIVATE LIMITED, KHAIRANE MIDC, NAVI MUMBAI	DR
		CHEMTROLS INDUSTRIES LIMITED, POWAI, MUMBAI	Approved
		EMERSON PROCESS MANAGEMENT INDIA PVT LTD, MUMBAI	Approved

Sl No	Item	Vendor Name	Status
		YOKOGAWA INDIA LIMITED, BANGALORE	Approvec
31	H_2 GAS ANALYSER CABINET	SIEMENS LTD.	Approved
		YOKOGAWA INDIA LIMITED	Approved
		ABB INDIA LTD	Approved
32	GI Pipes	BALDOTA VALVE AND FITTINGS PVT LTD,MUMBAI	Approved
		BHUWALKA PIPES LIMITED,BANGALORE.	Approved
		FLOWTECH, KOLKATA	Approved
		JINDAL INDUSTRIES LIMITED,NEW DELHI	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	Approved
		NATHMAL DAGA & CO, BANGALORE	Approved
		PIPE CORPORATION PVT LTD, BANGALORE	Approved
		PRECISION ENGG INDUSTRIES,MUMBAI	Approved
		SURYA ROSHNI LTD,BAHADURGARH,HARYANA.	Approved
		V.K.INDUSTRIES, BANGALORE	Approved
		VIKAS INDUSTRIAL PRODUCTS, NOIDA	Approved
		SANDEEP INDUSTRIES,JALANDHAR,PUNJAB	Approved
		MKK METAL SECTIONS PVT LTD,VELLORE,TAMILANADU	Approved
		RIDDHI STEEL AND TUBE LIMITED,AHMEDABAD	Approved
		INDUS TUBES LTD,GHAZIABAD,UP	Approved
33	Impulse Pipes(Alloy steel)	BHARAT HEAVY ELECTRICALS LTD, TIRUCHIRAPALLI,TAMILANADU	Approved
		EVERGREEN SEAMLESS PIPES & TUBES PVT LTD,BANGALORE	DR
		GANPAT METALS PVT. LTD.,MUMBAI	DR
		JINDAL SAW LTD,CHENNAI	Approved
		RIDHI SIDDHI STEEL CORPORATION,MUMBAI	DR
		TROUVAY CAUVIN,GULF	Approved
		SUMITOMO CORPORATION,JAPAN.	Approved
		TPS TECHNITUBE ROHREN WERKE	Approved
		BHARAT HEAVY ELECTRICALS LTD, TIRUCHIRAPALLI,TAMILANADU.	Approved
		EVERGREEN SEAMLESS PIPES & TUBES PVT LTD,BANGALORE	DR
		GANPAT METALS PVT. LTD.,MUMBAI	DR
		HEAVY METAL AND TUBES LTD,AHMEDABAD/MUMBAI	DR

Sl No	Item	Vendor Name	Status
34	Impulse Pipes(Carbon Steel)	INDIAN SEAMLESS METAL TUBES LTD,PUNE.	Approvec
		JINDAL SAW LTD,CHENNAI	Approvec
		RIDHI SIDDHI STEEL CORPORATION,MUMBAI	DR
		TROUVAY CAUVIN,GULF	Approved
		SUMITOMO CORPORATION,JAPAN.	Approved
		SUMITOMO CORPORATION ASIA & OCEANIA PTE. LTD.,SINGAPORE	Approved
		TPS TECHNITUBE ROHREN WERKE GMBH,DAUN,GERMANY	Approved
35	Impulse Pipes(Stainless Steel)	RATNAMANI METALS & TUBES LTD, AHMEDABAD	Approved
		SUMITOMO CORPORATION,JAPAN.	Approved
		TPS TECHNITUBE ROHREN WERKE	Approved
		EVERGREEN SEAMLESS PIPES & TUBES PVT	DR
		GANPAT METALS PVT. LTD.,MUMBAI	DR
		RIDHI SIDDHI STEEL CORPORATION,MUMBAI	DR
		SUMITOMO CORPORATION,JAPAN.	Approved
		TROUVAY CAUVIN,GULF	Approved
36	Instrument Valve	BALDOTA VALVE AND FITTINGS PVT LTD,MUMBAI	Approved
		BHARAT HEAVY ELECTRICALS LTD, TIRUCHIRAPALLI,TAMILANADU.	Approved
		EXCEL HYDRO-PNEUMATICS PVT LTD, MUMBAI	Approved
		INSTRUMENTATION LIMITED, PALGHAT	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	Approved
		PRECISION ENGG INDUSTRIES, MUMBAI	Approved
37	Lab Items Mechanical	FLUKE TECHNOLOGIES PVT. LTD., ANDHERI(EAST), MUMBAI	Approved
		GE OIL AND GAS INDIA PVT. LTD,PUNE.	Approved
		ISOTHERMAL TECHNOLOGY PVT. LTD., DELHI	Approved
		NAGMAN INSTMTS. & ELECTRONICS (P) L, CHENBARAMBAKKAM,CHENNAI.	Approved
		WIKA INSTRUMENTS INDIA PVT. LTD., VILLAGE - KESNAND, PUNE	Approved
		CHEMTROLS ENGG. (P) LTD.	Approved
		LEVCON INSTRUMENTS (P) LTD.	Approved
		S. B. ELECTRO-MECHANICALS PVT. LTD.	Approved
		V. AUTOMAT & INSTRUMENTS PVT. LTD.	Approved

Sagardighi Extn. U#3 (PROJ3)
Control and Inst. List
Ref: SGMPO3/AV/8/047

Sl No	Item	Vendor Name	Status
38	LEVEL GAUGE	DK INSTRUMENTS	Approved
		SIGMA INSTRUMENTS COMPANY	Approved
		IGEMA GMBH	Approved
		ASIAN INDUSTRIAL VALVES AND	Approved
		CESARE BONETTI S.P.A	Approved
39	Level Switch Capacitance Type	LEVCON INSTRUMENTS PVT. LTD.	Approved
		ENDRESS & HAUSER	Approved
40	Level Switch Conductivity Type	EMERSON PROCESS MANAGEMENT(I)PVT. L, M.I.D.C.PAWANE,NAVI MUMBAI	Approved
		IGEMA GMBH,MUNSTER,GERMANY.	Approved
		LEVELSTATE SYSTEMS LTD,U.K	Approved
		SOLARTRON TRANSDUCER, U.K	Approved
41	Level Switch Float Type	CHEMTROLS INDUSTRIES LIMITED, POWAI, MUMBAI	Approved
		IGEMA GMBH,MUNSTER,GERMANY.	Approved
42	Level Switch Top mounted	CHEMTROLS INDUSTRIES LIMITED, POWAI, MUMBAI	Approved
		D.K.INSTRUMENTS PVT. LTD., DHAKURIA, KOLKATA	Approved
		LEVCON INSTRUMENTS Pvt LTD, KOLKATA	Approved
		PUNE TECHTROL PVT LTD,PUNE	Approved
		IGEMA GMBH,MUNSTER,GERMANY.	Approved
		SBEM PRIVATE LIMITED, PUNE	Approved
		SIGMA INSTRUMENTS COMPANY,BHANDUP(WEST),MAHARASTRA.	Approved
		V.AUTOMAT & INSTRUMENTS PVT. LTD., NEW DELHI	Approved
43	LIE/LIR	CHEMIN CONTROLS AND INSTRUMENTATION, PONDICHERRY	Approved
		PYROTECH ELECTRONICS (P) LTD.,UDAIPUR	Approved
44	LOCAL GAUGE BOARD (LGBs)	PANAM CONTROLS - HYDERABAD, INDIA	Approved
		NAGARJUNA FABRICATORS - HYDERABAD, INDIA	DR
		INSTRUMENTATION LTD. - KOTA, INDIA	Approved
		PYROTECH ELECTRONICS PVT.LTD. - UDAIPUR, INDIA	Approved
		PROCON INSTRUMENTATION PVT.LTD - CHENNAI, INDIA	Approved

Sl No	Item	Vendor Name	Status
45	Oxygen Analyser (LT)	EMERSON PROCESS MANAGEMENT INDIA PVT LTD, MUMBAI	Approvec
		EMERSON PROCESS MANAGEMENT INDIA PVT LTD, MUMBAI	Approved
46	Oxygen Analyser (LT) Panel & Accessories	EMERSON PROCESS MANAGEMENT INDIA PVT	Approved
47	Pneumatic Actuator	EMERSON PROCESS MANAGEMENT CHENNAI, CHENNAI	Approved
		INSTRUMENTATION LIMITED, PALGHAT	Approved
		MIL CONTROLS LIMITED, ALWAYE , KERALA	Approved
48	SNUBBERS	LISEGA SE	Approved
		MAURER SOHNE GMBH & CO.KG	Approved
		JIANGSU ROAD DAMPING TECHNOLOGY CO.	Approved
		PIPE SUPPORT SYSTEMS GMBH INTL.	Approved
		QUIRI HYDROMECANIQUE,	Approved
		SANWA TEKKI CORPORATION	Approved
49	Pressure & Differential Pressure Gauges	A.N.INSTRUMENTS PVT LTD, CHENNAI	Approved
		PRECISION MASS PRODUCTS PVT. LTD,GANDHI NAGAR,GUJARAT.	Approved
		BAUMER TECHNOLOGIES INDIA LTD,VAPI	Approved
		FORBES MARSHALL(HYD) LTD., HYDERABAD	Approved
		GAUGES BOURDON (INDIA) PVT. LTD, MUMBAI.	Approved
		GOA THERMOSTATIC INSTRUMENTS, GOA	Approved
		MANOMETER (INDIA) PVT. LTD.,, MUMBAI	Approved
50	Pressure &Differential Pressure Switch (Critical/Tripping applications of Boiler& Turbine)	DELTA CONTROLS LTD	Approved
		SOR INC.	Approved
		ASCROFT, USA	Approved
		DRESSER INDUSTRIES INC.	Approved
51	Pressure &Differential Pressure Switch (Non Critical applicaion)	PRECISION MASS PRODUCTS PVT. LTD,GANDHI NAGAR,GUJARAT.	Approved
		SWITZER PROCESS INSTRUMENTS PVT. LT, T Nagar, CHENNAI	Approved
		ASHCROFT INDIA	Approved
		TRAFAG CONTROLS INDIA PVT. LTD., IMT MANESAR, GURGAON	Approved
		CHEMTROLS SAMIL (INDIA) PVT. LTD., POWAI , MUMBAI	Approved
		INSTRUMENTATION ENGINEERS PVT LTD	Approved

Sl No	Item	Vendor Name	Status
52	Sight Flow Indicator	SIGMA INSTRUMENTS CO.	Approved
		D.K.INSTRUMENTS PVT. LTD.	Approved
		LEVCON INSTRUMENTS Pvt LTD, KOLKATA	Approved
		V.AUTOMAT & INSTRUMENTS PVT LTD.	Approved
		FORBES MARSHALL LTD.	Approved
53	FLOW SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Approved
		KROHNE MARSHALL	Approved
		SWITZER INSTRUMENT CO.	Approved
54	FLOW ELEMENTS (ORIFICE/NOZZLE)	MICRO PRECISION PRODUCTS	Approved
		M/S ESPL KOLKATA	Approved
		IL PALGHAT	Approved
55	IMPACT HEAD TYPE ELEMENT	DETRIECH / EMERSON PROCESS	Approved
		MIDWEST	Approved
		STARMECH	Approved
		SWITZER INSTRUMENT CO.	Approved
		VERIS INC.	Approved
		EMERSON PROCESS MANAGEMENT (INDIA) PVT. LTD.	Approved
56	RRI FOR CVP	BRAUN GMBH INDUSTRIE - ELEKTRONIK	Approved
		SHINKAWA ELECTRIC CO LTD.,	Approved
		BENTLY NEVADA, LLC	Approved
57	Socket Weld Fittings	BALDOTA VALVE AND FITTINGS PVT LTD,MUMBAI	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	Approved
		V.K.INDUSTRIES, BANGALORE	Approved
		MULTIMETAL INDUSTRIES,	DR
		COMFIT & VALVES PVT LTD.	DR
		DYNAFLUID VALVES AND FLOW	DR
		PRESHZINGER ENGINEERING CO PVT LTD.	DR
		FLUID CONTROLS PRIVATE LTD.,	DR
		VALTEX INDIA,	DR
		H.P.VALVES & FITTINGS INDIA PVT LTD	DR
		VIKAS INDUSTRIAL PRODUCTS, NOIDA	Approved
58	Steam and Water analysis Sys(Analyzer)	ABB INDUSTRIES ,SWITZERLAND.	Approved
		ABB INDUSTRIES ,SWITZERLAND.	Approved
		HACH LANGE S.A.R.L,VESENAZ,SWIZTERLAND.	Approved
		METTLER-TOLEDO INDIA PVT. LTD., POWAI, MUMBAI	Approved
		EMERSON PROCESS MANAGEMENT,USA	Approved

Sl No	Item	Vendor Name	Status
		SWAN ANALYTISCHE INSTRUMENTE AG, SWIZTERLAND.	Approved
		THERMO ORION INC., CHELMSFORD	Approved
59	Steam and Water analysis System(Panel)	ABB LIMITED, PEENYA INDL. AREA, BANGALORE.	Approved
		EMERSON PROCESS MANAGEMENT INDIA PVT LTD,MUMBAI.	Approved
		FORBES MARSHALL PVT LTD, PUNE	Approved
60	THERMOWELL	INDUSTRIAL INSTRUMENTATION	Approved
		GENERAL INSTRUMENTS CONSORTIUM	Approved
		MICRO PRECISION PRODUCTS (P) LTD.	Approved
		DETRIV INSTRUMENTATION &	Approved
		TEMPSENS INSTRUMENTS (I) PVT.LTD.,	Approved
		GOA INSTRUMENT INDUSTRIES PVT LTD.	Approved
		BAUMER TECHNOLOGIES INDIA PVT.LTD,	Approved
61	Temperature Elements	DETRIV INSTRUMENTATION AND ELECTRONICS	Approved
		OKAZAKI MANUFACTURING COMPANY,JAPAN.	Approved
		PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD,GOA.	Approved
		TECHNO INSTRUMENTS,GANDHINAGAR,GUJARAT.	Approved
		TEMPSENS INSTRUMENTS (I) PVT LTD,UDAIPUR,RAJASTHAN	Approved
		BAUMER TECHNOLOGIES INDIA LTD,MUMBAI/VAPI	Approved
		WIKA INSTRUMENTS INDIA PVT. LTD,PUNE	Approved
62	Temperature Gauges	A.N.INSTRUMENTS PVT LTD, CHENNAI	Approved
		PRECISION MASS PRODUCTS PVT. LTD,GANDHI NAGAR(Earlier Aschcroft)	Approved
		BAUMER TECHNOLOGIES INDIA LTD,MUMBAI/VAPI	Approved
		FORBES MARSHALL(HYD) LTD., HYDERABAD	Approved
		GOA THERMOSTATIC INSTRUMENTS, GOA	Approved
		WIKA INSTRUMENTS INDIA PVT. LTD,PUNE	Approved
		BALDOTA VALVE AND FITTINGS PVT LTD,MUMBAI	Approved
		EXCEL HYDRO-PNEUMATICS PVT LTD, MUMBAI	Approved
		FLOWTECH, KOLKATA	Approved

Sl No	Item	Vendor Name	Status
63	Valve Manifolds	Parker HANNIFIN INDIA PVT. LTD,LEBANON (M/s Super techical dealer for Parker)	Approved
		METPRESS ENGINEERING WORKS, KOLKATA	Approved
		MICRO PRECISION PRODUCTS PVT LTD, FARIDABAD	Approved
64	Vibration Monitoring System (Sensors, Monitors & Panel)	BENTLY NEVADA INC, MINDEN, U.S.A.	Approved
		MEGGITT SA,SWITZERLAND.	Approved
		SHINKAWA ELECTRTIC CO., LTD, TOKYO, JAPAN	Approved
65	Mercury Analyzer	DURAG ,BANGALORE(MAKE OF DURAG GERMANY)	Approved
		THERMO FISHER INDIA ,MUMBAI(MAKE OF THERMO FISHER SCIENTIFIC CONTROL,USA)	Approved
		ANALYSER INSTRUMENTATION CO PVT LTD,KOTA,RAJASTHAN(MAKE OF PS ANALYTICAL ,UK)	Approved
		SICK INDIA PVT LTD,MUMBAI.(MAKE OF SICK GMBH,GERMANY)	Approved
66	24 V DC SMPS based Battery Charger	CHHABI ELECTRICALS PVT. LTD.,JALGAON	Approved
		VERTIV ENERGY PVT LTD (FORMERLY EMERSON NETWORK POWER INDIA), Ambernath	Approved
67	24 V DC thyristor based Battery Charger	CHHABI ELECTRICALS PVT. LTD.,BANGALORE	Approved
		CHLORIDE POWER SYSTEMS & SOLUTIONS LTD, Kolkata	Approved
		STATCON POWER CONTROLS LTD.,KULICHNAGAR, DHAULANA, HAPUR	Approved
68	Cable trays	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
69	Electronic Transmitter - Pr. / Diff. Pr.	EMERSON PROCESS MANAGEMENT, Navi Mumbai	Approved
		FUJI ELECTRIC CO., LTD,OSAKI 1-CHOME, SHINAGAWA-KU, TOKYO	Approved
		HONEYWELL AUTOMATION INDIA LTD.,PUNE	Approved
		YOKOGAWA ELECTRIC CORPORATION,TOKYO 180	Approved

Sl No	Item	Vendor Name	Status
		YOKOGAWA INDIA LIMITED,BANGALORE	Approved
70	Nickel-Cadmium Battery (Fiber type/Pocket type) for UPS and Charger	HBL POWER SYSTEMS LTD,Hyderabad	Approved
71	Flexible conduit (Lead Coated)	BANSAL LABORATORIES AND,GOVINDPURA INDL. AREA, BHOPAL	Approved
		PLICA INDIA PVT LTD,GHAZIABAD, U.P.	Approved
72	Flexible conduit (Zinc Coated)	BANSAL LABORATORIES AND,GOVINDPURA	Approved
		PLICA INDIA PVT LTD,GHAZIABAD, U.P.	Approved
73	HART Communicator	ABB LIMITED,PEENYA INDL. AREA, BANGALORE.	Approved
		EMERSON PROCESS MANAGEMENT, Navi Mumbai	Approved
		HONEYWELL AUTOMATION INDIA LTD.,PUNE	Approved
		YOKOGAWA INDIA LIMITED,BANGALORE	Approved
74	Instrumentation & Control cables (PVC, FRLS Type)	ADVANCE CABLE TECHNOLOGIES (P) LTD.,GEDDALAHALLI,ASWATHNAGAR,BANGALORE	Approved
		DELTON CABLES LIMITED, FARIDABAD	Approved
		KEI INDUSTRIES LIMITED,BHIWADI	Approved
		LAPP INDIA PVT. LTD.,PHASE II, ANEKAL TALUK, BANGALORE	Approved
		POLYCAB WIRES PVT. LTD, DAMAN	Approved
		THERMO CABLES LIMITED, HYDERABAD	Approved
75	Junction Box (Explosion Flame Proof)	CHEMIN CONTROLS AND INSTRUMENTATION,PONDICHERRY	Approved
		ELECTRO MECHANICAL (INDIA),KOLKATA	Approved
		FLAMEPACK, Mumbai	Approved
		K.S.INSTRUMENTS PVT LTD,Yeshwantpur, Bangalore	Approved
		KHODAY CONTROL SYSTEMS PVT. LTD.,PEENYA INDUSTRIAL ESTATE, BANGALORE	Approved
		MANISHA COMPOSITEK PVT. LTD.,PUNE	Approved
		PRAMMEN INDUSTRIES,PUDUKKOTTAI	Approved
		PYROTECH ELECTRONICS (P) LTD.,UDAIPUR	Approved
76	Junction Box (FRP)	K.S.INSTRUMENTS PVT LTD,Bangalore	Approved
		CHEMIN CONTROLS AND INSTRUMENTATION,PONDICHERRY	Approved

Sl No	Item	Vendor Name	Status
		MANISHA COMPOSITEK PVT. LTD.,PUNE	Approvec
77	Junction Box (Metal)	CHEMIN CONTROLS AND INSTRUMENTATION,PONDICHERRY	Approvec
		ELECTRO MECHANICAL (INDIA),KOLKATA	Approvec
		K.S.INSTRUMENTS PVT LTD,BANGALORE	Approvec
		KHODAY CONTROL SYSTEMS PVT. LTD, BANGALORE	Approvec
		MANISHA COMPOSITEK PVT. LTD.,PUNE	Approvec
		PRAMMEN INDUSTRIES,PUDUKKOTTAI	Approved
		PYROTECH ELECTRONICS (P) LTD.,UDAIPUR	Approvec
78	Junction Boxes (Die cast aluminium)	PYROTECH ELECTRONICS (P) LTD.,UDAIPUR	Approved
		K.S.INSTRUMENTS PVT LTD,Yeshwantpur, Bangalore	Approved
		MANISHA COMPOSITEK PVT. LTD.,PUNE	Approved
79	Lead Acid - Plante Battery for UPS and Charger	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
80	Lead Acid - Tubular Battery for UPS and Charger	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
81	ULTRASONIC FLOW METERS	FLEXIM Flexible Industriemesstechnik GmbH	Approved
		NIVUS GMBH	Approved
82	Level Transmitter (RADAR type)	EMERSON PROCESS MANAGEMENT, Navi Mumbai	Approved
		ENDRESS + HAUSER (I) PVT. LTD.,L.B.S. Marg, Vikhroli (West), Mumbai	Approved
		MAGNETROL INTERNATIONAL NV,BELGIUM	Approved
		VEGA GRIESHABER K.G,SCHILTACH	Approved
83	Level Transmitter (Ultrasonic type)	SIEMENS,BANGALORE	Approved
		EMERSON PROCESS MANAGEMENT, Navi Mumbai	Approved
		ENDRESS + HAUSER (I) PVT. LTD.,L.B.S. Marg, Vikhroli (West), Mumbai	Approved
		ENDRESS+HAUSER GMBH+CO.KG,WEIL AM RHEIN	Approved

Sl No	Item	Vendor Name	Status
84	LT Power Cables (PVC / XLPE Insulation)	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
85	Maintenance & Calibration Equipments (Electrical Package)	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
86	Rigid Conduit	shall be as per approved sources listed in Electrical Equipment list in Main Plant Package area.	
87	RTD - TT Junction Box (FRP)	K.S.INSTRUMENTS PVT LTD,Yeshwantpur, Bangalore	Approved
		MANISHA COMPOSITEK PVT. LTD.,PUNE	Approved
88	RTD - TT Junction Box (Metal)	CHEMIN CONTROLS AND INSTRUMENTATION,PONDICHERRY	Approved
		ELECTRO MECHANICAL (INDIA),KOLKATA	Approved
		K.S.INSTRUMENTS PVT LTD,Yeshwantpur, Bangalore	Approved
		KHODAY CONTROL SYSTEMS PVT. LTD.,PEENYA INDUSTRIAL ESTATE, BANGALORE	Approved
		MANISHA COMPOSITEK PVT. LTD.,PUNE	Approved
		PRAMMEN INDUSTRIES,PUDUKKOTTAI	Approved
		PYROTECH ELECTRONICS (P) LTD.,UDAIPUR	Approved
89	Thermocouple extension cables (PVC, FRLS Type)	ADVANCE CABLE TECHNOLOGIES (P) LTD.,GEDDALAHALLI,ASWATHNAGAR,BANGALORE	Approved
		DELTON CABLES LIMITED,FARIDABAD	Approved
		KEI INDUSTRIES LIMITED,BHIWADI	Approved
		POLYCAB WIRES PVT. LTD, DAMAN	Approved
		THERMO CABLES LIMITED HYDERABAD	Approved
89	UPS System with ACDB	VERTIV ENERGY PRIVATE LIMITED	Approved
		HITACHI HI-REL POWER ELECTRONICS,Gandhinagar	Approved
90	UPS System with ACDB ((3Ph I/p, 1Ph O/p) IGBT based Rectifier	VERTIV ENERGY PRIVATE LIMITED	Approved
		HITACHI HI-REL POWER ELECTRONICS,Gandhinagar	Approved

Sl No	Item	Vendor Name	Status
91	CCTV SYSTEM (IP BASED-OEM) WITH ACCESSORIES .	PELCO, USA	Approvec
		BOSCH	Approvec
		HONEYWELL, USA	Approvec
92	CCTV SYSTEM (IP BASED) SYSTEM INTEGRATORS	HARITASA CHECKMATE ELECTRONICS, BANGALORE	Approvec
		SCHNEIDER ELECTRIC,BANGALORE	Approvec
		TYCO FIRE AND SECURITY,BANGALORE	Approved
		HONEYWELL AUTOMATION,BANGALORE	Approved
		Siemens,BANGALORE	Approved
		SCORE INFORMATION TECHNOLOGIES LTD,KOLKATA	Approved
		WIPRO INFOTECH,BANGALORE	Approved
		ECIL,HYDERABAD	Approved
93	Public Addressing System (IP BASED-OEM)	COMMEND, AUSTRIA	Approved
		INDUSTRONICS, GERMANY	Approved
		ARMTEL, RUSSIA	Approved
		ZENITEL, SWEDEN	Approved
94	Public Addressing System (IP BASED) SYSTEM INTEGRATORS	AISHAN TECHNOLOGIES INDIA PVT LTD, BANGALORE	Approved
		INDUSTRONIC & INDCOM ENGINEERS	Approved
95	Large Video Screen	BARCO ELECTRONICS ,NOIDA	Approved
		PLANER-USA /PYROTECH-UDAIPUR	Approved
		CHRISTIE-USA	Approved
96	MODULAR DESK/CRT Desk	PYROTECH WORKSPACE SOLUTIONS PVT LTD , UDAIPUR	Approved
		CHEMIN CONTROLS AND INSTRUMENTATION , PONDICHERRY	Approved
		COSMOS MEDIA PRODUCTS PVT LTD ,NOIDA	Approved
		HARMONY SYSTEMS ,NEWDELHI	Approved
97	CONTROL PANEL/RACK	PYROTECH	Approved
		RITTAL	Approved
		BHEL	Approved
98	Dot matrix Printer	WIPRO	Approved
		EPSON	Approved
		TVS	Approved
		LEXMARK	Approved
99	WORKSTATIONS , SERVER, PC'S	DELL	Approved
		HP	Approved

Sl No	Item	Vendor Name	Status
100	PRINTERS (Laser/Inkjet)	HP	Approved
101	TFT MONITOR	DELL	Approved
		HP	Approved
102	MINI UPS FOR HMI	HITACHI HI-REL POWER ELECTRINICS,BANGALORE	Approved
		POWERTRONIX SYSTEMS LTD.,BANGALORE.	Approved
		SCHNEIDER ELECTRIC,BANGALORE	Approved
		EMERSON NETWORK INDIA,BANGALORE	Approved
		EMERSON NETWORK ,PUNE	Approved
103	GIU	DIGITAL INSTRUMENTS & CONTROL SYSTEMS	Approved
		SSM INFOTECH SOLUTIONS PVTLTD.	Approved
		SCHNEIDER ELECTRIC INDIA PVT LTD ,BANGALORE	Approved
		ROCKWELL AUTOMATION INDIA PVT LTD.	Approved
		ADVANCE TECH CONTROLS PVT. LTD.	Approved
104	STATION LAN EQUIPMENT	BHEL Approved Makes	
105	OFC	AKASH SOLAR	Approved
		SYSTIMAX	Approved
		BIRLA ERICSSON,REWA	Approved
		MOLEX	Approved
		TYCO	Approved
106	Turbine Supervisory System	MEGGITT SA,SWITZERLAND.	Approved
		BENTLY NEVADA INC. (GE OIL & GAS), U.S.A.	Approved
		SHINKAWA ELECTRIC CO. LTD., JAPAN	Approved
107	FEP insulated cables	DELTON CABLES, NEW DELHI	Approved
		HABIA CABLES,SWEDEN/CHINA	Approved
		LAPP CABLES, GERMANY	Approved
		LEONI KERPEN, GERMANY	Approved
		THERMOELECTRIC, USA	Approved
108	PTFE insulated Cables	ADVANCE CABLES TECHNOLOGIES, BANGALORE	Approved
		DELTON CABLES, NEW DELHI	Approved
		THERMOCABLES LIMITED	Approved
		CORDS CABLE INDUSTRIES LIMITED.,	Approved
		TEMPSENS INSTRUMENTS (I) PVT LTD, UDAIPUR	Approved
		UNIVERSAL CABLES LIMITED, SATNA	Approved

Sl No	Item	Vendor Name	Status
109	CONVERTERS/ INVERTORS AC, DC DRIVES	ROCKWELL AUTOMATION INDIA PVT., LTD.,	Approved
		SIEMENS INDIA LTD.	Approved
		KIRLOSKAR ELECTRIC COMPANY LIMITED.,	Approved
		LARSEN & TOUBRO LIMITED	Approved
		HIREL ELECTRONICS, GANDHINAGAR	Approved
		ABB LIMITED	Approved
110	PULSE JET CONTROLLER	SWITCHING CIRCUIT	Approved
		ADVANCE CONCEPT	Approved
		VOLTCRAFT	Approved
		SQUARE M	Approved
		MICRO SYSTEM	Approved
111	PLC / SCADA	ROCKWELL AUTOMATION INDIA PVT., LTD.,	Approved
		GE INTELLIGENT PLATFORMS PVT LTD	Approved
		SIEMENS INDIA LTD.	Approved
		LARSEN & TOUBRO LIMITED	Approved
		ABB LIMITED	Approved
		SCHNEIDER ELECTRIC INDIA PVT.LTD.	Approved
112	LIMIT SWITCHES	KA SCHMERSAL, GERMANY	Approved
		JOHAN VOLLENBROICH, GERMANY	Approved
		IFM ELECTRONIC, GERMANY	Approved
		JAYASHREE ELECTRON PVT. LTD,	Approved
		SIEMENS INDIA LTD.	Approved
		BCH ELECTRIC LIMITED	Approved
		PEPPERL+FUCHS(INDIA) PVT LTD	Approved
		JAI BALAJI & CO., CHENNAI	Approved
		ELECTRO MECHANICAL INDIA, KOLKATA	Approved
		AG SYSTEMS, (AG ELECTRONICS)MUMBAI	Approved
		BETA SYSTEMS ENGINEERING	Approved
113	PULLCHORD SWITCHES/BELT SWAY SWITCHES (BELT MONITORING / CONVEYOR SAFETY SWITCHES , AC/DC TACHOGENERATORS , SERVOMOTORS, DIGITAL DRIVES AND SELSYN MOTORS)	JAYASHREE ELECTRODEVICES PVT. LTD.,	Approved
		BETA SYSTEMS ENGINEERING	Approved
		PROTOCONTROL INSTRUMENTS (I) PVT LTD	Approved
		KANTA RUBBER PVT. LTD	Approved
		MAHAVEER ENGINEERING	Approved
		SUMAN CONTROLS, BANGALORE	Approved
		JYOTHI RUBBER UDYOG, GHAZIABAD	Approved
		SLN ENTERPRISES,BANGALORE	Approved

Sl No	Item	Vendor Name	Status
114	SAFETY ITEMS (RUBBER MATS,DANGER BOARDS ETC.)	PROGRESSIVE RUBBER WORKS	Approved
		VARDHAMAN HOSES PRIVATE LIMITED	Approved
		PREMIER POLYFILM LTD	Approved
		RMG POLY VINLY INDIA LTD	Approved
		KAN POWER RUBBER INDUSTRIES, BANGALORE	Approved
		ARADHANA AGENCY	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

SL. NO.	Item Description	Vendor Name	Remarks
1	FIRE PROTECTION, FIRE DETECTION AND ALARM SYSTEM PACKAGE	TECHNICO (INDIA) PVT. LTD.	Approved
		AGNICE FIRE PROTECTION PVT. LTD.	Approved
		HITEK ENGINEERING SERVICES	Approved
		STERLING AND WILSON PVT LTD	Approved
		MX SYSTEMS INTERNATIONAL PVT. LTD.	Approved
		UTC FIRE & SECURITY INDIA LIMITED.	Approved
		NITIN FIRE PROTECTION INDUSTRIES LI	Approved
		TYCO FIRE & SECURITY INDIA	Approved
		FIREPRO SYSTEMS PVT. LTD.	Approved
		CONSILIUM MIDDLE EAST (FZC)	Approved
		DE S TECHNICO PRIVATE LIMITED	Approved
		THERMOSYSTEMS PRIVATE LIMITED.	Approved
2	HYDRANT VALVES	SHAH BHOGILAL	Approved
		SUKAN	Approved
		NEWAGE	Approved
		VENUS	DR
		WINCO	DR
		ASCO STRUMECH PVT. LTD.	Approved
3	FIRE HOSES	NEWAGE	Approved
		CHATTARIA RUBBER	Approved
		Sukan Equipments Pvt Ltd	Approved
		SHAH BHOGILAL JETHALAL & BROTHERS	Approved
4	WATER MONITOR & WATER-CUM FOAM MONITORS	SHAH BHOGILAL	Approved
		HD FIRE	Approved
		NEW AGE	Approved
5	BRANCH PIPE, NOZZLES, COUPLINGS & FIRE BRIGDAE CONNECTIONS	SUKAN	Approved
		VENUS	Approved
		NEW AGE	Approved
		WINCO	DR
		ASCO STRUMECH PVT. LTD.	Approved
		SHAH BHOGILAL JETHALAL & BROTHERS	Approved
6	DELUGE VALVES	HD FIRE	Approved
		TYCO (GRINELL)	Approved
		KIDDE (I) LTD.	Approved
7	HVW/ MVW SPRAY NOZZLE	KIDDE (I) LTD.	Approved
		TYCO	Approved
		HD FIRE	Approved
		ASCO STRUMECH PVT. LTD.	Approved
		NEWAGE FIRE FIGHTING CO. LTD.	Approved
		SHAH BHOGILAL JETHALAL & BROTHERS	Approved

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SL. NO.	Item Description	Vendor Name	Remarks
8	QUARTZOID BULB SPRINKLERS/DETECTORS	TYCO(GRINELL)	Approved
		HD FIRE	Approved
		NEWAGE INDUSTRIES	Approved
9	HYDRO PNEUMATIC TANK	ARC WELD ENGINEERS	Approved
10	MICROPROCESSOR BASED FIRE ALARM PANEL	SIMPLEX	DR
		SCHRACK	Approved
		DETECTOMAT	Approved
		GENT	DR
11	LHS CABLE (FO Type)	AP SENSING,Germany	Approved
		SENSA,UK	Approved
	LHS CABLE (Intelligent Addressable Thermal Sensor Based)	Listec (Schrack)	Approved
12	FOAM PUMP	DEL PD PUMPS & GEARS	Approved
13	FOAM TANKS	ARC WELD ENGINEERS	Approved
		HD FIRE PROTECT PVT. LTD.	DR
14	ADDRESSABLE MULTISENSOR TYPE DETECTORS	SIMPLEX	DR
		SCHRACK	Approved
		DETECTOMAT	Approved
		GENT	DR
15	ADDRESSABLE PHOTO ELECTRIC TYPE DETECTORS	SIMPLEX	DR
		SCHRACK	Approved
		DETECTOMAT	Approved
		GENT	DR
16	ADDRESSABLE HEAT DETECTORS	SIMPLEX	DR
		SCHRACK	Approved
		DETECTOMAT	Approved
		GENT	DR
17	INFRA RED DETECTORS	PATOL	Approved
		SYSTEM SENSOR	Approved
18	COATING & WRAPPING MATERIAL/ TAPE (COAL TAR BASED)	IWL LTD.	Approved
		RUSTECH	Approved
19	INERT GAS SYSTEM	GINGEKERR	Approved
		ANSUL	Approved
		SRI	Approved
		SIEMENS	Approved
		UTC FIRE & SECURITY INDIA LIMITED. / (KIDDE)	Approved
20	BATTERY	EXIDE	Approved
		AMCO	Approved
		HOPPECKE BATTERIEN GMBH & CO KG	DR
		AMARA RAJA POWER SYSTEMS LTD	Approved

SL. NO.	Item Description	Vendor Name	Remarks
21	FIRE SURVIVAL CABLES	POLYCAB	Approved
		RRKABEL	Approved
		KEI	Approved
		DELTON	Approved
22	HOSE REEL	SIEMENS	DR
		WINCO	Approved
		NEWAGE FIRE FIGHTING CO. LTD.	Approved
		Sukan Equipments Pvt Ltd	Approved
23	FIRE EXTINGUISHER (BIS APPROVED SOURCES WITH VALID LICENSE)	NITIN FIRE PROTECTION INDUSTRIES LI	DR
		KANADIA FYR FYTER PVT. LTD.	Approved
		SAFEX FIRE SERVICES LTD.	Approved
		KIDDE	Approved
24	PROBE TYPE HEAT DETECTOR	TYCO	Approved
	Additional Items		
25	LT MOTORS	As per Approved Electrical Vendor List	
26	H.T. MOTORS (SAFE/HAZARDOUS AREA)	SIEMENS LTD	Approved
		ABB INDIA LIMITED, HYD	Approved
		KIRLOSKAR ELECTRIC CO. LTD.	Approved
		CG POWER & INDUSTRIAL SOLUTIONS	Approved
		BHEL BHOPAL	Approved
27	CABLE TRAYS	As per Approved Electrical Vendor List	
28	LEVEL GUAGES (MAGNETIC TYPE)	As per Approved C&I Vendor List	
29	PRESSURE GAUGES	As per Approved C&I Vendor List	
30	SAFETY RELIEF VALVES	INSTRUMENTATION LTD	Approved
		FORBES MARSHALL LTD.,	Approved
		UNI KLINGER LTD.	DR
		ANDERSON GREENWOOD CROSBY	Approved
31	GASKETS	BHEL Approved Sources	
32	FLANGES	BHEL Approved Sources	
33	STRAINERS (Y-TYPE / T-TYPE /	As per Approved Mechanical Vendor List	
34	VALVES-GATE/GLOBE/REG.GLOBE/NON-RETURN; MAT: CS/AS/SS; PR.CL.#150,#300,#800	LEADER VALVES LIMITED	Approved
		INTERVALVE POONAWALLA LIMITED	Approved
		MICON VALVES (I) PVT. LTD.	Approved
		WEIR BDK VALVES	Approved
		FLOTEK INDUSTRIES	Approved
		L & T VALVES LIMITED	Approved
		FOURESS ENGINEERING (I)PVT.LTD	Approved
		Any other Vendors as per Approved Mechanical Vendor List	

SL. NO.	Item Description	Vendor Name	Remarks
35	BUTT WELDED PIPE FITTINGS	BHEL Approved Sources	
36	BOLTING MATERIAL	BHEL Approved Sources	
37	WELDED PIPES UP TO 14" (M.S & G.I)	BHEL Approved Sources	
38	FOAM POURER AND GENERATION EQUIPMENTS FOR FIRE PROTECTION SYSTEMS	SHAH BHOGILAL JETHALAL & BROTHERS	Approvec
		NEWAGE FIRE FIGHTING CO. LTD.	Approvec
		HD FIRE PROTECT PVT. LTD.	Approvec
39	BALANCE PROPORTIONER FOR FIRE PROTECTION SYSTEMS	HD FIRE PROTECT PVT. LTD.	Approved
		SHAH BHOGILAL JETHALAL & BROTHERS	Approved
40	FIRE WATER PUMPS	WPIL LIMITED	Approved
		WILO MATHER AND PLATT PUMPS	Approved
		KIRLOSKAR BROTHERS LTD	Approved
41	HOSE CABINETS FOR FIRE PROTECTION SYSTEMS	SHAH BHOGILAL JETHALAL & BROTHERS	Approved
		NEWAGE FIRE FIGHTING CO. LTD.	Approved
		Sukan Equipments Pvt Ltd	Approved
		ASCO STRUMECH PVT. LTD.	Approved
42	AIR RELEASE VALVES FOR FIRE PROTECTION SYSTEMS	SHAH BHOGILAL JETHALAL & BROTHERS	Approved
		NEWAGE FIRE FIGHTING CO. LTD.	Approved
43	CAST IRON VALVES (GATE/SLUICE AND CHECK)	As per Approved Mechanical Vendor List	
44	SOCKET WELDED / SCREWED WELDED PIPE FITTINGS	BHEL Approved Sources	
45	SOLENOID VALVES	As per Approved C&I Vendor List	
46	PRESSURE AND DIFFERENTIAL	As per Approved C&I Vendor List	
47	N2 BASED FIRE PROTECTION SYSTEM	CTR MANUFACTURING INDUSTRIES LTD. NAGPUR	Approved
		EASUN-MR TAP CHANGERS (P) LTD, CHENNAI	DR
		SERGI TRANSFORMER EXPLOSION PREVENTION, GURGAON (HARYANA)	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description		Remarks
1	AIRCONDITIONING SYSTEM	Blue Star Ltd.	Accepted
		ADVANCE VENTILATION PVT.LTD.	DR
		ROOTS COOLING SYSTEMS PVT. LTD.	DR
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		VOLTAS LTD.	Accepted
2	VENTILATION SYSTEM	ADVANCE VENTILATION PVT.LTD.,Sonepat	DR
		C.DOCTOR and CO. PVT.LTD , Kolkata	Accepted
		HYDERABAD POLLUTION CONTROLS LIMITED, HYDERABAD	Accepted
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		ROOTS COOLING SYSTEMS PVT. LTD., Noida	DR
		VOLTAS LTD. , THANE WEST	Accepted
3	AIR WASHER & UAF	HYDERABAD POLUTION CONTROL	Approved
		ADVANCE VENTILATION	Approved
		DRAFT AIR	Approved
		BLUE STAR	Approved
		VOLTAS	Approved
		STERLING WILSON	Approved
		ROOTS COOLING SYSTEM	Approved
		C DOCTOR	Approved
4	CENTRIFUGAL FAN	FLAKT	Approved
		KRUGER	Approved
		DRAFT AIR	Approved
		HYDERABAD POLUTION CONTROL	Approved
		ADVANCE VENTILATION	Approved
		PATEL AIR	Approved
		MARATHON	Approved
		C DOCTOR	Approved
		SARLA	Approved
5	FRESH AIR/ SUPPLY/ EXHAUST/ RE UNIT FANS / PROPELLAR	HYDERABAD POLUTION CONTROL	Approved
		ADVANCE VENTILATION	Approved
		KRUGER	Approved
		NICOTRA	Approved
		MARATHON	Approved
		FLAKT	Approved
		C DOCTOR	Approved
		KHAITAN	Approved
6	PUMPS	BEST & CROMPTON	Approved
		JYOTI	Approved
		SAM TURBO	Approved
		KBL	Approved
		KSB	Approved
		M&P	Approved
		VOLTAS	DR
		WORTHINGTON	Approved
		SULZER PUMPS INDIA LTD.	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description		Remarks
1	AIRCONDITIONING SYSTEM	Blue Star Ltd.	Accepted
		ADVANCE VENTILATION PVT.LTD.	DR
		ROOTS COOLING SYSTEMS PVT. LTD.	DR
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		VOLTAS LTD.	Accepted
2	VENTILATION SYSTEM	ADVANCE VENTILATION PVT.LTD.,Sonepat	DR
		C.DOCTOR and CO. PVT.LTD , Kolkata	Accepted
		HYDERABAD POLLUTION CONTROLS LIMITED, HYDERABAD	Accepted
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		ROOTS COOLING SYSTEMS PVT. LTD., Noida	DR
		VOLTAS LTD. , THANE WEST	Accepted
		FLOWSERVE INDIA CONTROL PVT LTD	Approved
7	LV MOTORS (NON FLAME PROOF)	SIEMENS	Approved
		ABB	Approved
		CGL	Approved
		MARATHON	Approved
		KEC	DR
		BHARAT BIJLEE	Approved
		NGEF	Approved
8	AIR FILTER	PUROLATOR	Approved
		FMI	Approved
		ANFILCO	Approved
		JOHN FOWLER	Approved
		SPECTRUM	Approved
		AIR TECH	Approved
		PUROMATIC	Approved
9	INSULTATION MATERIAL	BEARDSHEL	Approved
		ARMAFLEX	Approved
		LLOYDS	Approved
		UP TWIGA	Approved
		AEROCELL	Approved
10	FIRE DAMPER	CARRYAIRE	Approved
		RAVISTAR (SYSTEM AIR)	Approved
11	GRILL/ DIFFUSER/ VOLUME CONTROL DAMPER	CARRYAIRE	Approved
		RAVISTAR (SYSTEM AIR)	Approved
12	HUMIDISTAT	JHONSON CONTROL	Approved
		HONEYWELL AUTOMATION	Approved
		PENN	Approved
		CARRIER	Approved
		BLUE STAR	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description		Remarks
1	AIRCONDITIONING SYSTEM	Blue Star Ltd.	Accepted
		ADVANCE VENTILATION PVT.LTD.	DR
		ROOTS COOLING SYSTEMS PVT. LTD.	DR
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		VOLTAS LTD.	Accepted
2	VENTILATION SYSTEM	ADVANCE VENTILATION PVT.LTD.,Sonepat	DR
		C.DOCTOR and CO. PVT.LTD , Kolkata	Accepted
		HYDERABAD POLLUTION CONTROLS LIMITED, HYDERABAD	Accepted
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		ROOTS COOLING SYSTEMS PVT. LTD., Noida	DR
		VOLTAS LTD. , THANE WEST	Accepted
13	SCREW CHILLER	VOLTAS	Approved
		MCQUAY (DAIKIN)	Approved
		CLIMAVENETA	Approved
14	PRECISION AC	UNIFLAIR	Approved
		BLUEBOX	Approved
		EMERSON PROCESS MANAGEMENT	Approved
		CLIMAVENETA	Approved
15	SPLIT AC	VOLTAS	Approved
		BLUE STAR	Approved
		CARRIER	Approved
		HITACHI	Approved
		DAIKIN	Approved
16	AIR HANDLING UNITS	ZECO	Approved
		CARRYAIRE (flakt)	Approved
		EDGETECH	Approved
		SYSTEM AIR	Approved
17	AHU FAN (CENTRIFUGAL FAN)	C DOCTOR	Approved
		FLAKT	Approved
		KRUGER	Approved
		NICOTRA	Approved
		COMEFRI	Approved
		MARATHON	Approved
		ADVANCE	Approved
		DRAFT AIR	Approved
		HYDERABAD POLLUTION	Approved
18	PUMPS	JYOTI	Approved
		SAM TURBO	Approved
		KBL	Approved
		KSB	Approved
		M&P	Approved
		VOLTAS	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description		Remarks
1	AIRCONDITIONING SYSTEM	Blue Star Ltd.	Accepted
		ADVANCE VENTILATION PVT.LTD.	DR
		ROOTS COOLING SYSTEMS PVT. LTD.	DR
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		VOLTAS LTD.	Accepted
2	VENTILATION SYSTEM	ADVANCE VENTILATION PVT.LTD.,Sonepat	DR
		C.DOCTOR and CO. PVT.LTD , Kolkata	Accepted
		HYDERABAD POLLUTION CONTROLS LIMITED, HYDERABAD	Accepted
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		ROOTS COOLING SYSTEMS PVT. LTD., Noida	DR
		VOLTAS LTD. , THANE WEST	Accepted
		BEACON-WEIR	Approved
		WORTHINGTON	Approved
		SULZER PUMPS INDIA LTD.	Approved
		FLOWSERVE INDIA CONTROL PVT LTD	Approved
19	COOLING TOWER	PAHARPUR COOLING TOWER	Approved
20	LV MOTORS (NON FLAME PROOF)	SIEMENS	Approved
		ABB	Approved
		CGL	Approved
		MARATHON	Approved
		BHARAT BIJLEE	Approved
		NGEF	Approved
		JYOTI	Approved
21	AIR FILTER	PUROLATOR	Approved
		FMI	Approved
		ANFILCO	Approved
		TENACITY	Approved
		JOHN FOWLER	Approved
		SPECTRUM	Approved
		AIR TECH	Approved
		PUROMATIC	Approved
22	BALANCING VALVE	ADVANCE	Approved
23	4 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY	Approved
		JOHNSON	Approved
		HONEYWELL AUTOMATION	Approved
24	Y / POT STRAINER	MULTITEX	Approved
		GREAVES COTTON	Approved
		JAYPEE	Approved
		OTOKLIN	Approved
		GUJARAT OTOFILT	Approved
		SAROJINI ENTERPRISE	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Item Description		Remarks
1	AIRCONDITIONING SYSTEM	Blue Star Ltd.	Accepted
		ADVANCE VENTILATION PVT.LTD.	DR
		ROOTS COOLING SYSTEMS PVT. LTD.	DR
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		VOLTAS LTD.	Accepted
2	VENTILATION SYSTEM	ADVANCE VENTILATION PVT.LTD.,Sonepat	DR
		C.DOCTOR and CO. PVT.LTD , Kolkata	Accepted
		HYDERABAD POLLUTION CONTROLS LIMITED, HYDERABAD	Accepted
		STERLING AND WILSON PRIVATE LIMITED	Accepted
		ROOTS COOLING SYSTEMS PVT. LTD., Noida	DR
		VOLTAS LTD. , THANE WEST	Accepted
		FILTERATION ENGINEERS INDIA PVT LTD	Approved
25	STRIP HEATER	ESCORTS	Approved
		RACOLDS	Approved
		ALCO	Approved
		HEATCO	Approved
26	PAN HUMIDIFIER	RAPID COOL	Approved
		HOTSET	Approved
		ALCO	Approved
27	RELIEF / PURGE VALVE	BRASSOMATIC	Approved
28	THERMOSTATS	HONEYWELL AUTOMATION	Approved
		RANCO	Approved
		PENN	Approved
		DANFOSS	Approved
		RANUTROL	Approved
		INDFOSS JHONSON CONTROL	Approved
29	ANTI FREEZE THERMOSTAT	RANCO	Approved
		HONEYWELL AUTOMATION	Approved
		PENN	Approved
		DANFOSS	Approved
		INDFOSS	Approved
30	RH SENSOR/TEMP SENSOR	HONEYWELL AUTOMATION	Approved
		JOHNSON	Approved
		SIEMENS	Approved
		GENERAL INSTRUMENT CONSORTIUM	Approved
31	WATER SOFTENING PLANT	THERMAX	Approved
		ION EXCHANGE	Approved

SAGARDIGHI THERMAL Power EXTENSION PROJECT
PHASE-III, UNIT#5 (1 x660 MW)

Sl. No.	Package Description	Vendor Name	Remarks
1	Civil Sub-structure pkg. (Piling & pile cap)	M/s SIMPLEX INFRASTRUCTURES LIMITED	Approved
		BRIDGE & ROOF CO. (INDIA) LTD.	Approved
		PARESH CONSTRUCTION AND FOUNDATIONS PVT. LTD.	Approved
		L&T GEOSTRUCTURE LLP.	Approved
		AKASHGANGA INFRAVENTURES INDIA LTD.	Approved
		M/s NAVAYUGA ENGINEERING COMPANY LIMITED	DR
2	Civil Super-structure pkg.	M/s JMC PROJECTS (INDIA) LIMITED.	DR
		M/s SIMPLEX INFRASTRUCTURES LIMITED	Approved
		M/s BRIDGE & ROOF CO. (INDIA) LIMITED	Approved
3	Boiler Aux.	M/s POWER MECH PROJECTS LIMITED	Approved
		M/s BRIDGE & ROOF CO. (INDIA) LIMITED	Approved
		M/s INDWELL CONSTRUCTIONS PVT. LIMITED	Approved
		M/s BHAVANI ERECTORS PVT. LIMITED	Approved
4	STG & Aux.	M/s POWER MECH PROJECTS LIMITED	Approved
		M/s INDWELL CONSTRUCTIONS PVT. LIMITED	Approved
5	C&I	M/s POWERTRONIX ENGINEERING PVT. LIMITED	Approved
		M/s EDAC ENGINEERING LIMITED	Approved
6	Electrical	M/s POWERTRONIX ENGINEERING PVT. LIMITED	Approved
		M/s PRV CONSTRUCTIONS PVT LIMITED	Approved
		M/s SIGMA CONSTRUCTION	Approved
		M/s TECHNO ELECTRIC & ENGINEERING CO LIMITED	Approved
		M/s EDAC ENGINEERING LIMITED	Approved
		M/s PACE PROCESS CONTROLS PVT. LIMITED	DR

Sagardighi Extn.U#5(PROJ3)
PSER ERECTION
Ref: SGMPO3/AV/8/047

SECTION-VII

ENGINEERING SERVICES

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SECTION-VII

OWNER'S ENGINEERING SERVICES

1.00.00 GENERAL

1.01.00 As part of the overall project management activity, the Successful Bidder shall be responsible for proper Owner's Engineering and co-ordination of activities during various phases of execution of the contract. The Successful Bidder shall identify a person, designated as Project Manager, with whom the Owner, the Consulting Owner's Engineer or the Review Consultant shall interact on matters related to Owner's Engineering as well as execution of the contract. The Project Manager shall be the single-point contact person on behalf of the Successful Bidder and shall be responsible for all Owner's Engineering co-ordination. The Owner /Consultant /Review Consultant shall interact with the Project Manager only on all matters of co-ordination between the Owner and the Successful Bidder or on matters involving the Successful Bidder, his manufacturing units and sub-vendors. For the purpose of expediting the Owner or his representative may sometimes interact with the manufacturing units or sub-vendors of the Successful Bidders. However such interaction will not, under any circumstance, dilute the responsibility of the Successful Bidder to provide a fully Owner's Engineered and coordinated package under this contract.

1.02.00 On finalization of the contract, a procedure for exchange of Owner's Engineering information will be mutually agreed and finalized between the Owner and the Successful Bidder.

2.00.00 DESIGN COORDINATION MEETING

The Successful Bidder and his sub-vendors will be called upon to attend design co-ordination meetings with the Owner's Engineer, other Successful Bidders and the Consultants of the Owner during the period of execution of contract. The Successful Bidder including his sub-vendors shall attend such meetings at their own cost at Owner's or Consultant's office in Kolkata/ or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

3.00.00 CO-OPERATION WITH OTHER CONTRACTORS AND CONSULTING OWNER'S ENGINEERS

The Successful Bidder shall agree to cooperate with the Owner's other Contractors and Consulting Owner's Engineers and freely exchange with them such technical information as is necessary to obtain the most efficient and economical design and to avoid unnecessary duplication of efforts. The Owner's Engineer shall be provided with copies of all correspondences addressed by the Successful Bidder to other Sub- Vendors and Consulting Owner's Engineers in respect of such exchange of technical information.

4.00.00 **GUIDELINES FOR OWNER'S ENGINEERING SERVICES**

4.01.00 Prior to commencement of the Owner's Engineering work as part of design submissions, all aspects of design viz., criteria for selection and sizing of all equipment and systems, design margins etc. including that for structural steel and civil work shall be outlined and these shall form the basis for the detailed Owner's Engineering work.

4.02.00 Owner's Engineering work shall be performed on modern and proven concepts and internationally accepted good Owner's Engineering practices but fully compatible with the Indian environments. Owner shall have the right to review and approve the Owner's Engineering work by themselves and/or through consultant and ask for any clarifications and changes/modifications to the work performed by Successful Bidder.

4.03.00 At any stage during the performance of assignment, the Successful Bidder may be required to make certain changes/modification/improvements in design/ drawing/other documents, which in the opinion of the Owner could result in better improved design, layout, operability, plant availability, maintainability, reliability or economy of the plant and its systems/sub-systems in view of revised and more accurate information/data available at a later date(s) or feedback(s) received during execution/operation of similar units. Such changes/ modifications/improvements required could be identified by Owner and/or consultant and mutually discussed. Owner requires the Bidder to incorporate such action in the subject assignment appropriately without any additional cost liability and time implication to the Owner and same shall be within the responsibilities and Scope of the Successful Bidder.

4.04.00 During the course of review of detailed Owner's Engineering stages, it may be essential in the opinion of Owner to obtain certain classified data for review purposes only. In case Owner so desires, the Bidder shall submit such data to Owner.

4.05.00 During the course of review of detailed Owner's Engineering, it may be essential in Owner's opinion to obtain data and information on similar equipment and plants Owner's Engineered by the Bidder. In case Owner so desires the Bidder shall submit such data and information to the Owner.

4.06.00 It is not the intent to give details of every single task covered in the total Owner's Engineering work to be carried out by Successful Bidder, however, all Owner's Engineering work required for the satisfactory completion of the plant/systems as specified shall be carried out by the Successful Bidder. Broadly, the following are the minimum requirements in respect of scope of major items of work:

4.06.01 Preparation, updating and finalisation of scheme drawings, control and interlock diagrams, detailed and fully dimensioned layout drawings (plant layout and equipment layout detailed plan, elevation and cross-sectional drawings at different elevations/ floor levels) covering all mechanical, electrical, C&I, civil and structural items, equipment, systems and facilities. Drawings and Schedules prepared by the Successful Bidder from time to time, as detailed

designs are developed, shall be submitted for Owner's/ Consultant's approval before the work is taken up. Revisions, corrections, additions to drawings and schedules shall not be considered to change the scope of work.

4.06.02 Preparation of detailed technical specifications including data sheets, tender drawings and bill of material for all bought out items, as also finalisation of corresponding sub-Vendors.

4.06.03 Review of sub-Vendor's data, drawings, design calculations, schedules, bill of materials, instruction manuals etc. for all equipment, before forwarding them to Owner/Consultant for approval.

4.06.04 Preparation of civil construction drawings for all equipment showing foundation details and full details regarding equipment loads, floor openings, details of embedments, etc. required for preparation of civil construction drawings and also as referred at relevant sections of Scope & Exclusions. These documents shall be preceded by appropriate design calculations, static and dynamic analysis as necessary.

4.06.05 Preparation and finalisation of process piping and instrumentation diagrams and schematics, complete in all respects for all systems/packages of the power plant.

4.06.06 Preparation of consolidated schedules and bills of materials, including line numbers, tag numbers, source of supply, service conditions, specifications, materials, types and connections details, quantities for items of the plant including dampers, steam traps, strainers, instrumentations, ducting.

4.06.07 Sizing of all piping and equipment as per the stipulated design criteria; carrying out of flexibility analysis/dynamic analysis as necessary; hangers & support Owner’s Engineering.

4.06.08 Final revision of all documents including preparation and compilation of Instruction Manuals for installation, commissioning, operation and maintenance for all equipment and systems. Refer clause 5.00.00 for the specific requirement in this regard.

4.06.09 Certification and submission of final as-built drawings for all areas.

4.06.10 Preparation and compilation of all drawings, schedules and instructions which may be required at site, whether separately mentioned or not.

4.06.11 All erection and assembly drawings which may be required at site.

5.00.00 **INSTRUCTION MANUALS**

5.01.00 The Bidder shall provide all necessary instruction manuals for the Owner’s review, comment, and final acceptance as required in the contract. The instruction manual shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies.

5.02.00 **Erection Manuals**

5.05.01 The erection manuals shall be submitted at least three (3) months prior to commencement of erection activities of particular equipment/system. The manuals shall contain the following as a minimum:

a) Erection strategy.

b) Sequence of erection.

c) List of tools, tackles, heavy equipments like cranes, dozers etc required for erection.

d) Bill of Materials.

e) Safety precautions to be followed during erection.

f) Erection instructions.

g) Critical checks and permissible deviation/tolerances.

h) Check-list for pre-commissioning activities

i) Check-list for commissioning of the system.

j) Procedure for initial checking, testing and acceptance norms.

5.03.00 **Operation & Maintenance Manuals**

5.03.01 The operating and maintenance instructions together with drawings of the equipment, as completed, shall be in sufficient detail to enable the Owner to operate, maintain, dismantle, reassemble, and adjust all parts of the equipment. They shall outline a step-by-step procedure for all operations likely to be carries out during the life of the plant/ equipment. Each manual shall include a complete set of drawings together with performance/ rating curves of the equipment and test certificates wherever applicable.

5.03.02 If after commissioning and initial operation of the plant, the manuals require any modification/ additions in the view of the Owner or Bidder, the same shall be incorporated and the updated final manuals shall be submitted to the Owner.

5.03.03 The manuals shall include the following:

a) List of spare parts along with their drawing and catalogue and Pro-forma for ordering spares.

b) Location and identification guide for bearings of various equipments and lubrication schedule including charts showing lubrication checking, testing and replacement procedure.

c) Wherever applicable, fault location charts shall be included to facilitate fault detection.

d) Detailed specification for all consumables (including lubricating oils, greases, chemicals etc.) required for each equipment.

6.00.00 **PLANT HANDBOOK**

The Bidder shall provide the plant handbook to the Owner as per provision of the contract.

The Plant Handbook shall contain the following as a minimum:

a) Design and performance data

b) Process & instrumentation diagrams

c) Single line diagrams

d) Sequence & Protection interlock schemes

e) Alarm and trip values

f) Performance curves

g) General layout plan and layout of Balance of Plant building and auxiliary buildings

h) Important Do's and Don'ts.

7.00.00 **TENDER STAGE DOCUMENT SUBMISSION**

7.01.00 The Bidder shall submit along with his bid all documents/drawings as specified in RFP and respective sections of the Technical Specifications in Vol-II and Vol-III. The documents shall include but not be limited to the following:

a) All Bid proposal sheets duly filled up.

b) Detailed experience list and financial resources of the Prime Bidder his collaborators/associates in this bid as well as the sub-vendors proposed.

c) Scheme drawings indicating scope of supply and service as offered by the Bidder indicating clearly exclusions, if any.

d) List of terminal points of the package offered together with quality and quantity of various input (i.e. water, air, electricity etc.) as required from the Owner at such interfaces.

e) Equipment GA, Layout, Design Calculations, interlock and other write-up, catalogues/literature etc. as required for clear understanding of the bid submitted.

f) High level project schedule network indicating target dates for intermediate milestones and final commissioning of plant systems; This network shall be supplemented by a detailed write-up on proposed sequence and method of execution for project implementation, deployment schedule for Key personnel with their bio-data, schedule of construction machinery etc.

8.00.00 CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE

8.01.00 Owner's Engineering schedule shall be submitted by the Bidder as indicated in the RFP. Owner's Engineering schedule shall be developed in format as desired by the Owner/consultant.

The documents shall be divided into two categories: a) for approval and b) for information/further Owner's Engineering and co-ordination by the Consultant.

In preparing this schedule, the Bidder shall allow one (1) week from date of receipt for review and comments by the Consultant for each submission of a document.

This document submission schedule shall require acceptance by the Owner/Consultant.

Bidder shall also develop and submit a Master drawing list to the Owner/consultant.

8.02.00 All contract documents shall be marked with the name of the Owner, the Project, the specification title and number and the unit designation.

All dimensions shall be in metric units.

All notes, markings etc. shall be in English.

8.03.00 Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval/information of the Owner/Consultant.

8.04.00 Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Consultant:

a) System scheme and Process & instrumentation Diagrams (P & IDs).

b) Design basis documents / memoranda / calculations justifying sizing and selection of equipment, vessels, tanks, piping, valves & specialities as well as the process parameters.

c) Equipment data sheets and general arrangement drawings.

d) Materials of construction.

e) General Arrangement and Layout drawings.

f) Typical control schemes, circuit diagrams, drive/ feeder-wise control scheme showing all external interfaces.

g) Control System Configuration

g) Shop Inspection and Testing Procedures, Test Set-up & Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.

h) Performance Test Procedures, Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.

i) Schedules covering equipment delivery schedules, erection, testing and commissioning schedules at L1 and L2 levels.

8.05.00 Unless specified otherwise, the following categories of documents / drawings would be treated for information/further Owner's Engineering by the Owner/Consultant. The Bidder shall, however, incorporate all additional information and clarifications in these documents/ drawings as and when desired by the Owner/ Consultant.

a) Equipment foundation drawings.

b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.

c) Predicted performance curves of equipment.

d) Various bills of quantity, schedules etc.

e) Piping fabrication drawings, isometrics etc.

f) Panel wiring diagrams.

g) Instruction/Operation manuals.

h) Service manuals and trouble shooting guide for C & I system including field instruments.

i) Operation logic diagrams.

j) Cable schedule and interconnection chart.

In essence, the Bidder is solely responsible for corrections and adequacy of design & Owner's Engineering for documents under this category.

8.06.00 Upon review, the Consultant shall put his remarks and one of the following action stamps on the drawing / document:

a) Approved.

b) Approved except as noted, forward final drawing

c) Approved except as noted, resubmission required.

d) Disapproved.

e) For information/reference only.

For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner/Consultant. For action stamp in category (b), further review by Owner/Consultant would not be necessary provided the Bidder agrees & incorporates the minor comments made on the document.

Except for action stamp under category (c) & (d), the Bidder can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/ Consultant.

The Consultant may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Bidder shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds.

The Bidder's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Consultant.

8.07.00 Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.

8.08.00 For review by the Consultant, the Bidder shall furnish three (3) prints of each drawing (only for first submission). There upon all transaction of drawings including reviewed comments and stamping shall be done in soft. All transaction of drawings shall be accompanied by a reference letter mentioning the date, revision no. and document status. Only on receiving the Approval Stamping, bidder shall distribute 6 sets of drawings (2 at WBPDCL corporate office and 4 sets at WBPDCL site office).. The Bidder shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.

8.09.00 In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.

SECTION-VIII

QUALITY ASSURANCE REQUIREMENTS

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SECTION-VIII

QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Successful Bidder's works or at his Sub-Vendor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Successful Bidder shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Successful Bidder and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Successful Bidder shall generally cover the following :

a) His organisation structure for the management and implementation of the proposed quality assurance programme.

b) Documentation control system.

c) Qualification data for Bidder's key personnel.

d) The procedure for purchase of materials, parts, components and selection of Sub-Vendor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

f) Control of non-conforming items and system for corrective actions.

g) Inspection and test procedure both for manufacture and all site related works.

h) Control of calibration and testing of measuring and testing equipments.

i) System for quality audit.

j) System for indication and appraisal of inspection status.

k) System for authorising release of manufactured product to the Owner.

l) System for handling storage and delivery.

m) System for maintenance of records.

n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-A to this section.

2.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured and tested at all the stages, as well as Services provided for erection, commissioning and testing shall be as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme and reviewed by by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Owner's representative for review. Schedule of finalisation of such quality plans will be finalised before award.

2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.

2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.

2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Consultant's approval without which manufacture shall not proceed. In these approved quality plans, Owner/Authorised representative/Consultant shall identify Customer Hold Points (CHP), test/checks which shall be carried out in presence of the Owner/Consultant/Owners Owner's Engineer or his Authorised Representative and beyond which the work will not proceed without consent of Owner/Authorised representative/Consultant in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised Representative/Consultant for acceptance and dispositioning.

2.05.00 The Bidder shall provide adequate notice to the Owner for inspection before the material is dispatched as per the provisions of the Contract. No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of

all previous tests/inspections by Owner's Owner's Engineer/Authorised representative, and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC).

2.06.00 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.

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

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

2.08.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.

2.09.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Bidder's/Sub-Vendor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.

For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.

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

All pressure parts shall be subjected to hydraulic testing as per the requirements of IBR. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than thirty (30) minutes.

2.10.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT shall be properly recorded and submitted for acceptance.

All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid

penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed. Statutory payments in respect of IBR approvals including inspection shall be made by Bidder. Bidder's scope and responsibility shall also include preparation and submission of all necessary documents in the specific formats and manner stipulated by the statutory bodies, coordination and follow up for above approvals.

2.11.00 All the Sub-Vendors proposed by the Bidder for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Bidder and finalised with the Owner shall be subject to Owner's review. Quality Plans of the successful Sub-Vendors shall be discussed, finalised and accepted by the Owner/Authorised representative and form part of the Purchase Order between the Bidder and the Sub-Vendor.

2.12.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Bidder and finalised with the Owner shall be furnished to the Owner for comments and subsequent acceptance before orders are placed.

Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their Sub-Vendor's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.

Quality audit/acceptance of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Bidder in earning satisfactory performance of equipment as per specification.

2.13.00 Quality requirements for main equipment shall equally apply for spares and replacement items.

2.14.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the acceptance of the Owner.

2.15.00 For quality assurance of all civil works refer to the specifications for civil works.

3.00.00 QUALITY ASSURANCE DOCUMENTS

3.01.00 The Bidder shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after despatch of the equipment:

a) Material mill test reports on components as specified by the specification.

b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.

c) Non-destructive examination results /reports including radiography interpretation reports.

d) Factory tests results for testing required as per applicable codes and standards referred in the specification.

e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.

f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

g) Stress relief time temperature charts.

h) Inspection reports duly signed by QA personnel of the Owner and Bidder for the agreed inspection hold points. During the course of inspection, the following will also be recorded :

i) When some important repair work is involved to make the job acceptable.

ii) The repair work remains part of the accepted product quality.

i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

4.01.00 The Successful Bidder shall give the Owner’s Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Successful Bidder's account except for the expenses of the Inspector. The Owner’s Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Successful Bidder may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.

4.02.00 The Owner’s Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Successful Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Successful Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Owner’s Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

4.03.00 When the factory tests have been completed at the Bidder's or sub-Vendor's works, the Owner/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Owner/ Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Owner/Inspector. Failure of the Owner/Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

4.04.00 The Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

WBPDCL

FORMAT OF QUALITY ASSURANCE PROGRAMME

Name of Company / Successful Bidder	NAME OF CONTRACT PACKAGE			QUALITY PLAN FOR						
	Package No. : _____ Contractorr : _____			QP No. : _____ Date _____ Rev.No.: _____ Date _____						
Sl. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks

FIELD WELDING SCHEDULE

PROJECT : FWS NO :

CONTRACTOR : REV NO. :

PACKAGE : FIELD WELDING CODE :

SYSTEM : PAGE NO. :

Sl No.	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method Quantum	NDT Specifi-cation Number	Accep-tance Norm Ref.	Remarks

The Field Welding Schedule should be submitted for :

- Pressure Parts
- Tanks/Vessels
- Piping
- Heavy/Important Structural Steel
- Heat Exchangers
- Bus Ducts

SECTION-IX

PERFORMANCE GUARANTEES AND TESTS

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SECTION-IX

PERFORMANCE GUARANTEES AND TESTS

1.00.00 PERFORMANCE GUARANTEES, PERFORMANCE/ACCEPTANCE TESTS & LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE

1.01.00 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in this specification. The guarantees are categorised as:

a) Those, which attract liquidated damages, as listed below (Category-"A"). The Bidder shall furnish signed declarations in the manner prescribed in the bid proposal schedules for these guarantees.

b) Those, which do not attract liquidated damages, as listed below (Category-"B"). This guarantee list indicated in this section is not exhaustive and the Owner reserves the right to call upon the Bidder to demonstrate any parameter, operation, etc. of any equipment as specified and as required to meet the duty conditions.

1.02.00 The Bidder shall demonstrate all the guarantees as specified in this section. In case during tests it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications to make the equipment/systems comply with guaranteed requirements. However, if the Contractor is not able to demonstrate the guarantees, even after the modifications within ninety (90) days of notification by the Owner, the Owner will at his discretion:

i) reject the equipment and recover the payment already made or engage other agencies for making good all the deficiencies, the cost to be borne & recovered from the contractor or accept the equipment only after levying liquidated damages upto a ceiling 10% of contract price as identified in this section for those guarantees which are covered under category "A".

ii) reject the equipment and recover the payment already made or engage other agencies for making good all the deficiencies, the cost to be borne & recovered from the contractor or accept the equipment only after assessing and deducting from the contract price an amount equivalent to the deficiency of the equipment/system as assessed by the Owner, for those guarantees which are covered under Category-B.

For equipment/systems not covered under this section Bidder shall demonstrate the functionality and the rated performance for such equipment/systems before handover to the owner.

1.03.00 All guaranteed parameters shall necessarily be quoted by the Bidder based on the established proven results obtained from similar units in successful operation. Evidence for this shall necessarily include the test codes used, acceptance test results, and accuracies of various instruments used for the

performance test, details of tolerances, if allowed, etc. While quoting the guaranteed parameters, the Bidder shall keep in view the requirements specified in the specification especially regarding the reliability, operability and maintainability of the equipment proposed. The Owner reserves the right to evaluate the parameters quoted by the Bidder based on his experience and published material available.

1.04.00 The liquidated damages shall be calculated prorata for the fractional parts of the unit unless stated otherwise.

1.05.00 The turbine generator, boiler, auxiliaries, and all other plant equipment and system shall perform continuously without the noise level (individual or collectively) exceeding the values specified in respective equipment specification over the entire range of output and operating frequencies.

1.06.00 **Performance/Acceptance Tests**

1.06.01 The performance/acceptance tests for various equipment and systems shall be carried out as specified under the respective equipment specifications and those specified below shall be specifically applicable. All the guarantees shall be tested together as far as practicable.

1.06.02 In case of systems with stand-by equipment the liquidated damages for non-performance will be levied for normal operating number of equipment only. However, for this purpose all the equipment including standby equipment shall be tested and average values arrived at.

1.06.03 For instrument in-accuracies during PG Test, refer subsequent clauses of this section.

1.06.04 For Total Auxiliary Power Consumption of BTG island, Off site BOP facilities and the transformers listed under the respective clauses, shall be taken together for purposes of guarantee and not individually.

2.00.00 START-UP, INITIAL OPERATION, TRIAL OPERATION AND PERFORMANCE TESTS

2.01.00 The Contractor shall provide commissioning & start-up supervisory engineering staff specially identified for the period commencing with start-up and extending through initial & trial operation and all performance tests. During this period, the Contractor shall furnish the calibration devices, special test instruments, etc. required to prepare for and conduct the performance tests. The Owner will associate his operating personnel and necessary supporting staff and shall make available fuel, and the system electrical load. Contractor's commissioning, & start-up supervisory engineering personnel shall conduct training for the Owner's personnel prior to and during this period and shall train them so that they will be able to operate and maintain the new equipment satisfactorily after acceptance by the Owner.

2.02.00 The Owner proposes to carry out in association with the Contractor, the following field inspections and tests in the sequence detailed below, and the

successful performance and completion of all the tests taken together shall constitute the Owner acceptance tests. The Contractor shall provide supervisory services during field inspection and tests.

2.02.01 **Inspection and Checking of the Unit**

After completion of erection and/or installation, and before being put into operation, the unit and all its appurtenances shall be thoroughly cleaned and then inspected, for correctness and completeness of installation and acceptability for placing in operation. All piping system shall be flushed, chemically cleaned; steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be subject to Owner's approval.

The checkouts during the pre-commissioning period should be programmed to follow the construction completion schedule. Each system, as it is completed by construction and turned over to the commissioning (start-up) engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule. Also refer specification clause on commissioning management specified elsewhere.

On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the complete equipment shall be placed on Initial Operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.

When the equipment is operating properly, its characteristics shall be recorded on the start-up report sheets. Copies of typical start-up report shall be given to the Owner. Start-up reports for all equipment shall be completed before the start of the trial operation period.

2.02.02 **Initial Operation, Reliability Run/Trial Run**

The plant shall be on Trial Operation during which period all necessary adjustments shall be made while operating over the full load range enabling the plant to be made ready for performance and guarantee tests.

The duration of Trial Operation of the complete equipment, systems, sub-systems and their control system shall be in Automatic mode for fourteen (14) days out of which at least seventy two (72) hours shall be in continuous operation on full load or any other duration as may be agreed to between the Engineer, and the Contractor. The Trial Operation shall be considered successful, provided such item of the equipment can be operated, continuously at the specified operating characteristics for the period of Trial Operation.

For the period of Trial Operation, the time of operation with any load shall be counted; minor interruptions not exceeding four (4) hours at a time caused during the continuous operation shall not affect the total duration of trial operation. However, if in the opinion of the Owner, the interruption is long, the Trial Operation shall be prolonged for the period equivalent to the duration of interruption.

A trial Operation report comprising observations and recordings of various parameters to be measured, in respect of the above Trial Operation shall be prepared by the Contractor. This report besides recording the details of the various observations during trial run shall also include the dates of start and finish of the Trial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording and print out of all the details of interruption occurred, adjustments made, any minor repairs done during the Trial Operation. Based on the observations, necessary modifications/ repairs to the plant shall be carried out to the full satisfaction of the Engineer to enable the later to accord permission to carry out Performance and Guarantee Tests on the plant. However, it is the prerogative of the Owner to grant permission for aforesaid test with minor defects, which do not endanger the safe operation of the equipments. .

Should any major failure or interruption occur in any portion of the plant due to or arising from faulty design, materials, workmanship or omissions or incorrect erection, sufficient to prevent safe and full commercial use of the plant, the reliability run shall be considered void and the reliability test period of 14 days shall recommence after the Contractor has remedied the cause of defect to the satisfaction of the owner

2.02.03 **Performance and Guarantee Test**

a) The final tests as to the performance and guarantees shall be conducted at site, by the Contractor with full involvement of the Owner. The necessary operating inputs shall be provided by the Owner. The Contractor's engineering staff for commissioning and start-up shall ensure that the equipment are ready for such tests. The Owner shall associate his necessary supporting staff with the Contractor to carry out the various activities related to P-G tests.

The necessary labour/supporting staff etc. shall be provided by the Contractor. Such tests will be conducted within a period of three (3) months after the successful completion of Trial Operation. Any extension of time beyond the above three (3) months shall be mutually agreed upon.

b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the performance guarantees.

The Contractor shall submit the test procedure for Owner's approval within thirty six (36) months from the date of letter of award of the contract. The test shall be carried out by the test grade instruments as stipulated in the applicable test code. These instruments shall be calibrated by the Contractor in a laboratory duly approved by Owner. Batch calibration will not be acceptable. The available instrumentation and control equipment in the plant if found suitable could also be used with the prior approval of the Owner after calibrations in the plant/outside laboratory. The tests will be conducted at the specified load points, and as near the specified cycle conditions as practicable. Proper corrections in calculations to take into account the conditions

which do not correspond to the specified conditions will be applied in the test report as brought out under the respective sections of the specification.

c) All special test grade instruments, equipment, tools and tackles, required for the successful completion of the Performance and Guarantee Tests shall be brought for the purpose of test, free of cost by the Contractor.

d) The guaranteed performance figures of the equipment shall be proved by the Contractor during these Performance and Guarantee Tests. The Contractor shall submit a detailed test report in the manner, already agreed to within one (1) month time of completion of the test, for Owner's approval. Should the Owner's assessment of these tests show any deterioration from the guaranteed values the Contractor/Owner shall modify the equipment as required to enable it to meet the guarantees to the satisfaction of the Owner. In such case, the Performance and Guarantee Tests shall be repeated within one (1) month, from the date the equipment is ready for retest and all costs for modifications including labour, materials and the cost of additional testing to prove that the equipment meets the guarantees, shall be borne by the Contractor.

e) The specific tests to be conducted on equipment have been brought out in the technical specifications. The procedure to be submitted by the Contractor should include the detailed methodology to conduct these tests/verify the guarantees offered by the Contractor notwithstanding whether these attract liquidated damages or not.

f) Instrument accuracies shall be in accordance with the relevant test codes. All instrument in-accuracies if applicable shall be computed as per the code and values will be corrected to the advantage of the Owner. No negative tolerance will be allowed. For example, if the inaccuracy of instrumentation has been worked out to be 1%, the measured values will be assessed to be 1% inferior for purpose of LD.

g) The Bidder shall establish the following modes of operation to the satisfaction of the Owner before acceptance test :

   i) Operation of each system by remote manual control.

   ii) Operation of the entire system in integrated manner on auto control.

   iii) Operation of the entire plant with auto-control loops fully implemented including different modes of load control with the help of control system.

h) Ten (10) copies of the test reports are to be furnished by the Contractor to the Owner backed up with jointly signed data sheets.

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The test for TG test capacity shall be carried out along with the heat rate test. Instrumentation and other details shall comply as above.

6.04.06 **Condenser**

Performance test for the condenser shall be conducted in accordance with the latest edition of ASME PTC-12.2. The condenser pressure shall be measured at 300 mm above the top row of tubes under VWO condition, estimated make-up and design CW flow and CW inlet temperature of 33 Deg. C. The cleanliness factor shall be determined in accordance with the latest edition of ASME PTC-12.2.

6.04.07 **Feed Water Heaters and Drain Cooler**

Performance test for feed water heaters shall be conducted in accordance with the latest edition of ASME PTC-12.1.

6.04.08 **Deaerator**

Performance test for deaerator shall be conducted in accordance with the latest edition of ASME PTC-12.3.

The dissolved oxygen content in feed water at outlet of deaerator shall be determined by ASME-D 888. Reference Method A and any recognised modification thereof.

Free carbon dioxide content of deaerator effluent shall be measured by APHA method.

6.05.00 **Remaining Plant and Equipment**

For other equipment, plants and systems, the performance test shall be carried out as per the respective equipment specification and the applicable codes.

SECTION-X

REQUIREMENTS OF SPARES, TOOLS & TACKLES

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ATTACHMENT

ANNEXURE-I	MANDATORY SPARES LIST
ANNEXURE-II	LIST OF TOOLS & TACKLES

SECTION-X

REQUIREMENTS OF SPARES, TOOLS & TACKLE

1.00.00 **TOOLS & TACKLE**

The Bidder shall supply with the equipment one complete set of special tools and tackles required for the erection, assembly, dis-assembly & proper maintenance of the plant and equipments and systems (including software). These special tools shall also include special material handing equipment, jigs & fixtures for maintenance and calibration/ re-adjustment, checking & measurement aids etc. A list of such tools & tackles shall be submitted by the Bidder along with the offer. Detailed description of each tool/tackles, its function along with the equipment/part for which it is meant for, shall also be indicated in the offer. These tools & tackles shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection, commissioning and initial operation. For this period, the Bidder shall bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to Owner.

2.00.00 **SPARES**

2.01.00 **General**

The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Bidder shall also state for each item of spares both mandatory and recommended, the normal expected service life.

2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with dessicator packs as necessary.

2.01.02 Each spare part shall be clearly marked or labelled on the outside of the packing with the description. When more than one spare part is packed in a single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.

2.01.03 All cases, containers or other packages are liable to be opened for examination as may be considered necessary by the Owner.

2.01.04 The Bidder shall also guarantee supply of spare parts, which shall be made, based on manufacturer's drawings on special order from the Owner for 30 years after commissioning of the plant.

2.01.05 Warranty period for all kinds of spares shall be six thousand (6000) hours of operation.

2.01.06 Design & Engineering details of all spares (make, model, rating, drawing, data sheet etc.) shall be submitted to the Owner prior to dispatch from manufacturers' works.

2.02.00 **Recommended Spares**

2.02.01 The Bidder shall provide a list of recommended spares for 3 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.

2.03.00 **Start-up Commissioning Spares**

2.03.01 Start-up commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. The list of commissioning spares to be brought by the Bidder to ensure smooth commissioning of the plant shall be subject to the Owner's approval. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Bidder, if needed, during erection & commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover.

2.04.00 **Mandatory Spare Parts**

2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above.

Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of these guidelines, an item-wise list of all components recommended as mandatory spares with the quantity. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage. During finalization of detailed engineering if some component, equipment, system, sub-system found to undergo change, then the Owner/Consultant shall revise the list for compliance by the Bidder without any implication to the Owner.

2.04.02 For Mandatory Spares refer Annexure-I of this section.

6.00.00	Balance of Plant Area Packages	
6.01.00	EOT Cranes	
6.01.01	Long Travel Unit	
(i)	Set of Bearings of Wheels	1Set for each type & capacity of EOT
(ii)	Set of Gearbox Bearings with Sleeves	1Set for each type & capacity of EOT
(iii)	Long Travel end Shaft Bearings	1Set for each type & capacity of EOT
(iv)	Seals for Travel Gear Box	1Set for each type & capacity of EOT
(v)	Long Travel Brake Shoes Liners	2Sets for each type & capacity of EOT
(vi)	Complete Set of Hydraulic Thruster for Brakes (if applicable)	1 No. for each type & capacity of EOT
(vii)	Brake Spring	1Set for each type & capacity of EOT
(viii)	Brake Coil	2Sets for each type & capacity of EOT
(ix)	Motor	1 No. for each type & capacity of EOT
6.01.02	Cross Travel Unit	

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
(i)	Axle Bearings	1Set for each type & capacity of EOT
(ii)	Set of Gearbox Bearings with Sleeves	1Set for each type & capacity of EOT
(iii)	Set of seals for Gearbox	1Set for each type & capacity of EOT
(iv)	Cross Travel end Shaft Bearing	1Set for each type & capacity of EOT
(v)	Cross travel Brake Shoes Liners	2Sets for each type & capacity of EOT
(vi)	Complete Set of Hydraulic Thruster for Brakes (if applicable)	1 No. for each type & capacity of EOT
(vii)	Brake Spring	1Set for each type & capacity of EOT
(viii)	Brake Coil	2Sets for each type & capacity of EOT
(ix)	Motor	1 No. for each type & capacity of EOT
6.01.03	Hoist	
(i)	Main Hoist Pulley Bearings [All Bearings of Each Type and size used in all Gear Assemblies, Lifting Hook, Trolley wheels etc.]	1 Set for each type & capacity of EOT
(ii)	Set of Bearings for Gear box	1 Set for each type & capacity of EOT
(iii)	Set of seals for Gearbox	1 Set for each type & capacity of EOT
(iv)	Aux. Hoist Gearbox Bearings	1 Set for each type & capacity of EOT
(v)	Aux. Hoist Gearbox Seals	1 Set for each type & capacity of EOT
(vi)	Complete Set of Hydraulic Thruster for Brakes (if applicable)	1 No. for each type & capacity of EOT
(vii)	Main & Aux. Hoist Brake Shoes [Brake shoes with lining for each size of brake (Pair of each size)]	2 Sets for each type & capacity of EOT
(viii)	Main & Aux. Hoist Brake Springs	2 Sets for each type & capacity of EOT
(ix)	Main & Aux. Hoist Brake shoe liners	2 Sets for each type & capacity of EOT
(x)	Motor for Main Hoist & Auxiliary Hoist	1 No. for each type & capacity of EOT
(xi)	Brake Coil	2 Sets for each type & capacity of EOT
(xii)	Wire Rope for Aux. Hook	100% of one crane for each type & capacity of EOT
6.01.04	Electrical	
(i)	Other Electrical Spares as applicable as per the Electrical List	Applicable Item & Quantity same as indicated in Electrical list 'B' Sl. No.7.08.00, 7.21.00.
(ii)	Limit Switches for:	
(a)	Main Hoist	1 Set for each type & capacity of EOT
(b)	Aux. Hoist	1 Set for each type & capacity of EOT
(c)	Cross Travel	1 Set for each type & capacity of EOT
(d)	Long Travel	1 Set for each type & capacity of EOT
(iii)	Master Controller for :	
(a)	Aux. Hoist	1 No. for each type & capacity of EOT
(b)	Cross Travel	1 No. for each type & capacity of EOT
(c)	Long Travel	1 No. for each type & capacity of EOT
(iv)	VVVF Drive Complete Set for:	
(a)	Main Hoist	1 No. for each type & capacity of EOT
(b)	Aux. Hoist	1 No. for each type & capacity of EOT
(c)	Cross Travel	1 No. for each type & capacity of EOT
(d)	Long Travel	1 No. for each type & capacity of EOT
~~6.02.00~~	~~Electrical Hoist~~	
~~6.02.01~~	~~Bearings for Long Travel Wheels [Bearing~~	~~1 Set for each type & capacity of Hoist~~

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
7.08.00	415V System	
7.08.01	11/0.415KV Transformer (for Each make, type and rating of Transformer)	
(i)	Door Limit Switch complete set	1 set (1 set means total requirement for one

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
		Transformer)
(ii)	Neutral CT	1 no of each type and rating
(iii)	Temperature scanner	1 no.
(iv)	bhy	3 No
(v)	LV Bushing with metal parts, connectors and gaskets	3 No
(vi)	LV neutral Bushing with metal parts, connectors and gaskets	1 No
(vii)	Post Insulator	1 set (1 set means total requirement for one Transformer)
(viii)	Limb of complete LT & HT of temperature sensing devices	1 Set (1 set means total requirement for one Transformer)
7.08.02	415V Air Circuit Breaker (for Each make, type and rating of ACB)	
(i)	Trip Coil	20% of total nos. or minimum 5 nos whichever is higher for each type and rating used in each switchgear (PCC/PMCC/MCC/ACDB)
(ii)	Closing Coil	20% of total nos. or minimum 5 nos whichever is higher for each type and rating used in each switchgear (PCC/PMCC/MCC/ACDB)
(iii)	Spring Charging Motor	2 nos.
(iv)	Spring Charging Motor with complete Mechanism	2 nos.
(v)	Spring Charged Limit Switch	5 nos.
(vi)	Thermal Overload for Spring Charging Motor	2 nos.
(vii)	Main Contact (Fixed and moving) assembly	5 sets (1 set consists of 3 nos.) for each type and rating
(viii)	Arcing Contact (Fixed and moving) assembly	5 sets (1 set consists of 3 nos.) for each type and rating
(ix)	Breaker Jaw Contact (Bus-end & Breaker- end) assembly	5 sets (1 set consists of 3 nos.) for each type and rating
(x)	Sliding Contact (Fixed & Moving)	3 sets.
(xi)	Breaker Auxiliary Contact Block	5 nos.
(xii)	Arcing Chute	2 sets (1 set consists of 3 nos.) for each type and rating
(xiii)	Plug Socket with Prefab cable	3 nos
(xiv)	Position Limit Switch	5 sets
7.08.03	415V PCC, PMCC, MCC, ACDB, DCDB, Elect. Control Panel (For each PCC, PMCC, MCC, ACDB, DCDB and Elect. Control Panel) (applicable items of PCC, PMCC, MCC, ACDB, DCDB and Elect. Control Panel shall be considered)	
(i)	Indicating Lamps complete assembly	
(a)	Red	3 nos of each make and type.
(b)	Blue	3 nos of each make and type.
(c)	Green	3 nos of each make and type.
(d)	White	3 nos of each make and type.
(e)	Amber	3 nos of each make and type.
(ii)	CT	2 nos. for each make, type and Rating

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
(iii)	Transducer	2 no for each make, type and Rating
(iv)	Trip / Neutral / close Control Switch	2 nos. for each make, type and Rating
(v)	Switch gear or MCC / Trial / Normal selector switch	2 nos. for each make, type and Rating
(vi)	Local/Remote selector switch	2 nos. for each make, type and Rating
(vii)	AC Supply On / Off Switch	1 no. for each make, type and Rating
(viii)	DC Supply On / Off Switch	1 no. for each make, type and Rating
(ix)	Motor Heater On /Off Switch	1 no. for each make, type and Rating
(x)	DC Supply Source Selector Switch (3-position)	1 no. for each make, type and Rating
(xi)	Ammeter Selector Switch	1 no. for each make, type and Rating
(xii)	Voltmeter Selector Switch	1 no. for each make, type and Rating
(xiii)	Voltmeter	2 no. for each make, type and Rating
(xiv)	Ammeter	2 no. for each make, type and Rating
(xv)	Auxiliary Control Contactor	
(a)	Auxiliary Control Contactor complete assembly	10% of total nos for each make, type and Rating.
(b)	Auxiliary Control Contactor spare kits	10% of total nos. for each make, type and Rating.
(c)	Auxiliary Control Contactor Coils	10% of total nos for each make, type and Rating.
(xvi)	Power Contactor	
(a)	Power Contactor Complete Assembly	10% of total nos for each make, type and rating
(b)	Power Contactor spare kits	10% of total nos for each make, type and Rating.
(c)	Power Contactor Coils	10% of total nos for each make, type and Rating.
(xvii)	MCCB	5% of total nos. for each make, type and rating.
(xviii)	MCB	5% of total nos. for each make, type and rating.
(xix)	Switch Fuse Unit (DC)	10% of total nos. for each make, type and rating.
(xx)	Power Fuse	5% of total nos. for each make, type and rating.
(xxi)	Control Fuse	5% of total nos. for each make, type and rating.
(xxii)	Thermal Overload Relay	5% of total nos. for each make, type and rating.
(xxii)	Sliding contact (Fixed and moving) Complete assembly	2 sets of each make, type and rating
(xxiii)	Busbar to module Lira Contact assembly	2 sets of each make, type and rating (1 set means all 3 ph+ neutral)
(xxiv)	Control and Aux. Transformer	1 no of each make, type and rating
(xxv)	Delay Timer	2 no of each make, type and rating
(xxvi)	Power Terminal Block	2 sets for each make, type and rating
(xxvii)	Control Terminal Block	2 sets for each make, type and rating
(xxviii)	End plate for Power and Control terminal block	2 sets for each make, type and rating
(xxix)	Energy meter	1 no for each make, type and rating
(xxx)	Relays (Other than numerical relay):	
(a)	Conventional (Electromagnetic/Static type) Relay	2 no for each make, type and rating
(b)	Aux. relays & Lock out relays & TIMERS	2 nos for each make, type and rating
(xxxi)	MCCB Status (On/off) Monitoring Switch/Contact	2 nos for each make, type and rating
(xxxii)	Push Button (On/Off) Complete Assembly	2 nos for each make, type and rating
(xxxiii)	Annunciation Facia with lamps complete	1 set for each make, type and rating

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
7.21.00	Motor	
7.21.01	11 KV & 3.3 KV Motor	
(i)	Motor of each type and rating (Note :	10% of the installed quantity or minimum 1

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package
	motors covered in mechanical spare items need not to be included here again)	number whichever be higher
(ii)	Neutral End Terminal Bushing with Fasteners	1 no. for each type and rating of Motor
(iii)	Bearing Temperature Gauge Driving & Non-Driving End	1 set for each type and rating of Motor
(iv)	Phase segregated terminal boxes	2 Nos. for each type and rating of Motor
(v)	Heaters	2 sets for each type and rating of Motor
(vi)	Complete Set of Coupling	1 set for each type and rating of Motor
(vii)	Bearings (DE) for each type and rating of motors	2 sets for each type and rating of Motor
(viii)	Bearings (NDE) for each type and rating of motors	2 sets for each type and rating of Motor
(ix)	Cooling Fan Internal & External	1 set for each type and rating of Motor
(x)	Neutral CT for differential protection (For motor rating >1000 KW)	2 no of each type and rating.
(xi)	End Termination kits	2 Nos. of each type and rating
(xii)	Indicating Instruments/gauges other then Bearing temperature gauge (as applicable)	1 set for each type and rating of Motor
(xiii)	Phase side Bushing and Insulator	1Set for each type and rating of Motor
(xiv)	Oil Seal Ring (as applicable)	1Set for each type and rating of Motor
7.21.02	415 Volt Motor	
(i)	Motor of each type and rating (Note : motors covered in mechanical spare items need not to be included here again) 10% of the installed quantity or minimum 1 number whichever be higher	10% of the installed quantity or minimum 1 number whichever be higher
(ii)	End Shield Cover Driving & Non-Driving End	1 set for each type and rating of Motor
(iii)	Heaters	2 sets for each type and rating of motor
(iv)	Bearings (DE and NDE) for each type and rating of motor	2 sets
(v)	Cooling Fan for all type and rating of LT motors	One (1) set
(vi)	Dust seals and gaskets for each type of motors	1 Set
(vii)	Motor Terminal Block	1 no. for each type and rating of Motor
(viii)	Complete Set of Coupling	1 set for each type and rating
7.21.04	DC Motor	
(i)	Motor of each type and rating (Note : motors covered in mechanical spare items need not to be included here again)	10% of the installed quantity or minimum 1 number whichever be higher
(ii)	Carbon brushes	2 sets for each type and rating of Motor
(iii)	Brush assemblies	2 sets for each type and rating of Motor
(iv)	Terminal blocks	1 set for each type and rating of Motor
(v)	Heaters	1 set for each type and rating of Motor
(vi)	Complete Set of Coupling	1 set for each type and rating of Motor
(vii)	Bearings (DE and NDE) for each type and rating of motor	1 set for each type and rating of Motor
(viii)	Cooling Fan	1 set for each type and rating of Motor
~~7.22.00~~	~~Local Control Station~~	

SECTION-XI

PROTECTIVE COATING AND PAINTING

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SECTION-XI

PROTECTIVE COATING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.

1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

a)	SSPC SP 10 / NACE 2 / Sa2½	:	Near White Blast Cleaning
b)	SSPC PA 2	:	Measurement of dry film coating thickness with magnetic gauges.
c)	ASTM D 45	:	Method for pull off strength using portable Adhesion Tester.
d)	NACE RP 0274 – 2004	:	High-Voltage Electrical Inspection of Pipeline Coatings.
e)	NACE SP 0188 – 2006	:	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
f)	NACE RP 0169 – 2002	:	Control of External Corrosion of Underground or Submerged Metallic Piping Systems.
g)	AWWA C 210 – 2007	:	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
h)	IS 3589:2001 Annexure-B	:	Steel Pipes for Water and Sewage Specification.
i)	AWWA C222-2000	:	Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.

j)	IS 13213 : 2000	:	Polyurethane Full Gloss Enamel (Two pack)
k)	ISC HD 20 (11902)	:	Polyurethane coating for Interior and Exterior of steel pipe and fittings.
l)	ISC HD 20 (11055)	:	Solvent less Liquid epoxy system by application of Interior and Exterior surface of steel pipeline.

3.00.00 **GENERAL REQUIREMENTS**

3.01.00 The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.

3.02.00 The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.

3.03.00 The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.

3.04.00 The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.

3.05.00 Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.

3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.

3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.

3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.

3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.

3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.

3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti-corrosive painting.

3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.

3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.

3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).

3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.

3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.

3.19.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER

4.01.00 After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

All factory finished paints shall be touched up at site as required.

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be

applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

4.02.00 **Surface Preparation**

4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting up to SSPC SP10/NACE2/Sa2½ level to get "near white metal" surface before applying the primer.

4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.

4.03.00 **Painting**

4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves shall be as follows :

a) Surface preparation shall be done by means of sand blasting, which shall conform to SSPC SP10/NACE 2/Sa2½ Standard.

b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.

c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.

d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.

e) Total DFT of paint system shall not be less than 300 microns.

4.03.02 Specification for application of paints for external surfaces protection of steel pipes and fittings which are buried underground / laid inside a Hume Pipe & or submerged Under Water and laid under Pipe Trenches (in road/rail/pipe or trench crossings) shall be as follows :

a) Surface preparation by means of sand blasting and shall conforms to SSPC SP10/NACE2/ Sa2½.

b) External surface of the pipe, fittings, specialties etc. handling raw water/ clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 1500 micron including primer coat.

4.03.03 Specification for application of paints for internal surface protection of large diameter pipes, if any, shall be as follows :

a) Surface preparation by means of sand blasting which shall conforms to SSPC SP10/NACE2/Sa2½ standard.

b) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.

c) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.

d) The minimum dry film thickness (DFT) of internal lining shall be 500 micron.

4.03.04 Specification for application of paints for protection of internal surfaces of DM Water Storage Tank(s) shall be as follows :

a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.

b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.

c) Total thickness of primer and paint should not be less than 500 microns.

4.03.05 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.

4.03.06 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.

4.03.07 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

4.03.08 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 /

NACE 2 / Sa2½ of ISO 8501 (near white metal)

a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.

b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 **Application of Epoxy Coating**

a) Coating shall be applied when

i) When the pipe surface temperature shall be at least 3°C above dew point temperature.

ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater that
50°C.

b) Material preparation shall be in accordance with manufacturer's recommendations.

c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 **Application of PU Coating**

a) PU coating shall be applied when the pipe surface temperature at least 3°C above dew point temperature (when R.H is more than 85%).

b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 **TEST REQUIREMENTS**

6.01.00 **Measurement of dry film thickness**

Measurement of dry film thickness of coating: Coating thickness shall be in the range of ±20% and as per SSPC PA 2.

6.01.01 **Apparatus / Instrument**

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

6.01.02 **Procedures**

a) **Number of measurements**

For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).

b) If the structure is less than 300 square feet, each 100 square feet should be measured.

c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.

d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet

e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness.

Area measurement must be within specified range.

6.02.00 **Electrical Inspection (Holiday) Test**

6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.

6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.

6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.

The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)

Testing Voltage V = 7900 √T ± 10 percent where T is the average coating thickness in mm.

6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.

6.03.00 **Adhesion Pull off Test**

After holiday the coated surface is subjected to adhesion pull off test as per ASTMD 4541.

6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:

A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling “Jaw” at the bottom and also dollies.

6.03.02 **Prepare the test surface**

Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.

6.03.03 **Prepare Dolly (Test Pull Stub)**

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

6.03.04 **Select an adhesive**

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 **Attach the dolly to the surface**

a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.

b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.

c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.

d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 **Adhesion Test Procedure**

a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.

b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.

c) Slide the dragging indicator pin on the black column to zero by pushing it downward.

d) Firmly hold the base of the instrument in one hand and rotate the hand wheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

e) Read the scale and record the adhesion value.

6.04.00 **Coating Repair**

Defective Coating shall be repaired in accordance with the following subsections.

6.04.01 **Surface Preparation**

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.04.03 **Coating Application**

The coating system shall be applied to the prepared areas in accordance with procedure.

6.04.04 Repair Inspection:

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 **Welded Field Joints**

6.05.01 **Preparation**

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

6.05.02 **Electrical Inspection**

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

7.00.00 **INFORMATION/DATA REQUIRED**

The Bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. and also unit rates for application of each type of paint along with supply shall be furnished.

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SECTION-II

MISCELLANEOUS CRANES

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SECTION-II

MISCELLANEOUS CRANES

1.00.00 GENERAL INFORMATION

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

2.00.00 CODES AND STANDARDS

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

2.01.00 IS : 807 - Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists.

2.02.00 IS : 3177 - Code of Practice for Design of Overhead Traveling Cranes and Gantry Cranes other than Steel Works Cranes.

2.03.00 IS : 1835 - Round Steel Wires for Ropes.

2.04.00 IS : 2266 - Steel Wire Ropes for General Engineering Purposes.

2.05.00 IS : 3443 - Crane Rail Sections.

2.06.00 IS : 15560 - Point Hook with Shank up to 160 tones - Specification.

2.07.00 IS : 5749 - Forged Ramshorn Hooks.

2.08.00 IS : 816 - Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel.

2.09.00 IS : 1323 - Code of Practice for Oxy-Acetylene Welding for Structural Work in Mild Steel.

2.10.00 IS : 9595 - Recommendations for metal arc welding of carbon & carbon - manganese steel.

2.11.00 All electrical installation work shall comply with the provisions of Indian Electricity Act and Indian Electricity Rules as amended up to date.

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

2.13.00 IS 3815: Point hook with shanks for general Engineering purpose.

2.14.00 IS 823: Code of practice for use of metal arc welding of mild steel.

2.15.00 IS 1181: Qualifying tests for metal arc welders (Engaged in welding structure other than pipe).

2.16.00 CMNA - Crane manufactures association of America.

In case of any contradiction between the above-mentioned codes and standards (item 2.01.00 thru' 2.16.00 above) and this technical specification, the later will prevail. However, nothing in this specification shall be construed to relieve the Bidder of his responsibility to comply with what is mentioned against item 2.11.00 above.

3.00.00 SCOPE OF WORK

3.01.00 Scope of work includes supply of the following:

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

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

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

3.01.04 All protective devices, anti-collision limit switches etc. as required for the crane.

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

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

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

4.00.00 SPECIFIC PERFORMANCE REQUIREMENTS

4.01.00 **Capacity**

4.01.01 The safe working load (X) for each EOT crane shall be computed as

$X = 1.25 \times a$

where a = Single heaviest equipment expected to be handled by the crane. (excluding Generator Stator and subject to a minimum capacity of 125 Tonnes for Turbine Hall EOT cranes).

Note: As per standard practice, the stator of generator which is the heaviest single- piece component in Power house to be handled shall be erected with strand jack. As such the EOT crane capacity in power house shall be determined considering other components of turbine, generator and accessories to be handled in single piece.

4.02.00 **Highest Position**

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

4.03.00 **Lowest Position**

4.03.01 The lifting hooks should reach up to the floor of its operating area or sump pits as necessary.

4.04.00 **Horizontal clearance**

4.04.01 The lifting hooks in vertical position should reach at least up to 2.5m from the end stopper.

4.04.02 Either the main or the auxiliary hook in vertical position should reach at least upto 1.0 m from the runway rails.

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

5.00.00 DESIGN & CONSTRUCTION

5.01.00 **General**

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

5.01.02 The crane shall be rigid in construction and all movements shall be smooth and non-jerky.

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

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

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

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

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

5.01.08 All fabrication by welding shall be carried out by qualified and certified welders.

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

5.01.10 Temperature Effects

Where any portion of the structure is not free to expand or contract under variation of temperature, allowance shall be kept for stress resulting from these conditions; the co-efficient of expansion for each degree centigrade variation of temperature above and below normal being taken as 0.000012 for mild steel. The maximum range of variation of temperature shall be as given in the Lead Specification. Clause 3.4 of Section 3 of IS: 800-2007 Code of practice for use of structural steel in General Building construction - shall also apply.

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

5.01.12 Not used.

5.01.13 Material of Construction

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

5.01.14 Load Indication

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

5.02.00 Structural Design Consideration

5.02.01 Minimum thickness of metal

For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8 mm thick.

For tubes having both ends sealed the minimum thickness shall be 4.9 mm (6 SWG). For unsealed tubes the minimum thickness shall be 8 mm. The chequered plates for platforms shall be minimum 6 mm thick over plain.

5.02.02 Accessibility for maintenance

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

5.02.03 Ruling dimensions and ratio

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

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

Plate girders : Span/depth = 18
Lattice girders : Span/depth = 12

5.02.04 Connections

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

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

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

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

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

f) Transverse fillet welds on load carrying members shall be avoided. If side fillets are used in end connections, the length of each side fillet

should not be less than the edge distance between the fillets.

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

h) Splices shall be designed to resist one and half times the forces and moments to which it is subjected, but in no case it shall be less than 2/3rd of the effective strength of the material spliced except that splices in the webs of the plate girders shall be designed for full strength of the web in shear as well as bending.

For splicing tension members, the net section of the splice plate shall be ten percent more than that of the material spliced. Splices shall be proportioned and arranged, so that the gravity axis of the splices is in line with the gravity axis of the member to avoid eccentricity.

5.02.05 Deflections and Camber

a) The total maximum vertical deflection of the girders produced by the dead load, weight of trolley and the rated load shall not exceed limit of Span/900.

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

5.03.00 Bridge Girder and End Carriage

5.03.01 The crane shall have single girder upto 20 Tonnes SWL, and above that it shall have double girder..

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

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

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

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

a slot in the end of the axle and if rotating type, wheels shall be keyed to them.

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

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

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

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

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

5.04.00 Trolley Frame

5.04.01 The trolley frame shall be built up from heavy steel plates, angles and channels adequately braced to resist vertical, lateral and torsional strains, welded to form a rigid one piece frame. Alternatively, it may be of cast steel construction.

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

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

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

5.05.00 Platforms and Ladders

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

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

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

5.05.04 Not used.

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

5.06.00 Operation

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

5.06.01 Operator's Cabin

a) The operator's cabin shall be open type, suitable for indoor service and complete with light, fan and seat. The cabin shall be located on one end of the crane bridge, on the opposite side of Down Shop Lead (DSL) and under one of the bridge girders, so that it is offset to one side. The cabin shall be provided with guarding handrails and the floor shall be covered with electric insulating carpet. Clear headroom of 2400 mm shall be ensured within the cabin.

b) A foot operated type-warning gong shall be provided within the cabin. The cabin shall be of ample size to contain controllers, protective panel, main isolating switch and other accessories required for operating the crane. A 4.5 kg capacity portable CO_2 fire extinguisher shall be provided in the cabin. Flash lights with hooter shall be provided to indicate the crane is travelling

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

5.06.02 Pendant Station

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

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

5.07.00 Repair Cage

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

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

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

5.08.00 Lifting Hook Block Assembly

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

The sheaves of the hook block shall be encased in an oil tight casing permitting generous lubrication of wire ropes and sheaves and also preventing accidental tapping of hands.

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

5.09.00 Gearing

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

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

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

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

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

5.10.00 Bearing

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

5.10.02 Provision shall be made for service lubrication of all bearings. Bearing enclosures shall be designed as far as practicable to exclude dirt and prevent leakage of oil or grease.

Arrangement for centralised lubrication of bearings shall be tried to the maximum extent possible and a detailed scheme for the same shall be furnished along with the Bid.

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

5.10.04 All bearings of the gearing shall be antifriction type. Angular contact ball or taper roller bearings shall be used wherever necessary. The bearings shall correctly locate the shafts while allowing for thermal expansion of the shafts.

Bearings shall be enclosed in suitable housing with proper holes and plugs to prevent any ingress of dirt and to permit easy lubrication of the bearings.

5.11.00 Guarding

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

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

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

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

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

5.11.06 All openings in foot walk flooring, for access to bottom chord platform, if any,

and to other inspection platforms, shall be provided with covers having suitable locking means to avoid any accidental opening.

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

5.12.00 Runway Rails

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

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

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

5.13.00 Trolley Rail

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

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

5.14.00 Rail Joints and Fixing

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

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

5.15.00 Tolerances

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

5.16.00 Rail End Stops

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

5.17.00 Drive Mechanism

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

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

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

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

5.17.05 All machineries for the drive unit shall be properly aligned. Self-aligning type gear couplings shall be used between connection shafts to take care of transverse as well as axial movement wherever necessary.

Wherever components of considerable amount of inertia is directly mounted on the high-speed shaft (e.g. brake drum, couplings, etc.) they shall be balanced statically to minimise vibration.

5.17.06 Motor ratings shall be calculated keeping margin of at least 25% over the maximum power requirement. Further, the hoist motors shall be rated to lift 120% of the design load on the hook at the rated speed. For other details the Clause no. 5.19.00 below shall be referred to.

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

5.18.00 Crane Electricals

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

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

5.18.03 If power supply other than that specified is required, the Bidder shall have to make his own arrangement by furnishing all necessary conversion, rectification and transformation equipment and accessories.

5.18.04 Unless otherwise specified, the crane electricals shall be designed for ambient air temperature of 50ºC relative humidity of 100% and site elevation less than 1000 metres above mean sea level.

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

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

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

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

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

5.19.00 Drive Motors

5.19.01 All crane motors shall be totally enclosed, fan cooled type, having class-F insulation with temperature rise limited to class-B operation in all cases.

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

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

5.19.04 Motors shall suit the duty class S4, cyclic duration factor (CDF) 40% and number of cycles per hour 150. Motor pull out torque shall not be less than 2.75 times rated torque.

5.19.05 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. Motor shall not stall during operation at voltage dip of 70% for 2 sec.

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

5.19.07 Starting current shall not exceed 6 times full load current.

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

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

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

5.19.11 Motors shall be suitable for both forward and reverse rotation.

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

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

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

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

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

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

5.19.18 Each motor rated 30 KW and above shall be provided with space heater, sized to maintain motor internal temperature above dew point when the motor is idle.

5.20.00 Brakes

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

5.20.01 Service Brake

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

b) Service brakes for main hoist motion shall be electro-hydraulic thrustor type, for all double girder cranes either cabin or pendant operated and electromagnetic disc. type for single girder crane; adequately sized to

arrest motion and hold at rest any load up to and including test load at any position of the lift.

5.21.00 Main Disconnect Switch

5.21.01 Main disconnect switch shall be metal-clad, 3-pole, load-break type in IP-54 enclosure, complete with compression brass glands and lugs.

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

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

5.22.00 Runway Conductors (Down Shop Leads)

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

5.22.02 The runway conductors shall be of M.S. angle sections, liberally sized so as not to exceed current density of 0.42 Amps/sq.mm. Alternatively, shrouded bus bar with copper type DSL may be used.

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

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

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

5.23.00 Cross-Conductors on Bridge

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

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

5.24.00 Power Distribution Equipment

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

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

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

a) One triple pole incoming supply disconnect switch.

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

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

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

5.25.00 Voltage Drop

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

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

5.26.00 Safety Interlocks

5.26.01 Disconnect Switch

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

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

5.26.02 Main Contactors

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

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

5.27.00 Emergency Switch

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

5.28.00 Crane Controls

The VVVF Drive control shall be used for control of each motion. The VVVF drive shall be provided with step less speed control from 0 to 100%. The VVVF Drive shall be equipped at least with 1024 Pulse in card, droop control for synchronization and crane software. The rating of VVVF shall be decided considering 250% of full load current of respective drive motor.

The VVVF drive shall be suitable for continuous operation. For long travel, motor shall be grouped in two groups and one VVVF drive for each group shall be considered.

5.29.00 Controllers

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

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

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

5.30.00 Radio remote Control of EOT Crane:

5.30.01 The system shall have facility to control EOT crane by radio frequency based wireless remote unit and shall be based upon the microprocessor based digital technology with almost nil hard wiring.

5.30.02 The remote unit shall communicate up to the distance of approximately 100 meters and it shall have two different sections viz. Transmitting Section & Receiving Section. The Transmitting section can be mounted on shoulder by suitable belt. Main controls can be of single joystick movement or double joystick movement type stepped control with spring return. The Micro control should be toggle switch type or push control type.

5.30.03 The Transmitting section shall consist of microprocessor, keypad for remote operation for the movement of the crane, LCD Display, Transmitter, power supply with battery unit etc.

5.30.04 The receiving section shall consist of microprocessor, LCD Display, receiver and relay group to control crane action. The system shall integrate with the control system of crane, which operates at 110V AC, Single Phase.

5.30.05 The transmitting section & Receiving section shall have their own frequency and address code & own security code with each system so that one particular set becomes unique and there is no interference from any other remote unit device. Frequency allotment for radio remote unit from Govt. of India, Department of Telecommunication or any other agency shall be the responsibility of supplier.

5.30.06 The remote unit shall have safety key to prevent any unauthorized operation. All the crane operations shall stop at once the communication breakdown occurs.

5.30.07 On local unit (receiver side), the system shall be provided with one selector switch so that EOT crane can be operated either from Operator Cabin or Radio Remote Unit. The Receiving section shall be able to bear the vibrations and shocks encountered in normal usage of EOT crane. The system shall have very fast response time.

5.30.08 The systems shall be programmed through software on a PC so that the Transmitting & Receiving sections may be configured as per Crane's electrical drawings.

5.31.00 Limit Switches

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

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

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

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

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

5.32.00 Panels

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

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

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

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

5.32.05 Incoming switch-fuse shall be provided at each panel for incoming AC/DC

power supplies.

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

5.33.00 Switch

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

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

5.34.00 Fuse

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

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

5.35.00 Contactors

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

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

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

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

5.36.00 Push Button and Lamp

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

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

5.37.00 Illumination

5.37.01 Crane lighting and space heating systems shall be designed for 240V 1ph 50

Hz supply and receptacle system 24V 1ph 50 Hz supply. Suitable dry type transformers shall be furnished for the purpose, complete with isolation facility and primary/secondary fuses.

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

5.37.03 40W Fluorescent fixtures shall be used for lighting operator's cabin and bridge platform. Four (4) 250W high-bay sodium vapour fixtures shall be provided below bridge for illumination of the working zones.

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

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

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

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

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

5.37.09 Conduit wiring system shall be used for lighting circuits.

5.38.00 Wiring

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

5.38.02 All wiring shall be done with 1100V grade PVC insulated wire in conduits or by 1100V grade PVC cables with extruded inner sheath.

5.38.03 Conductors shall be stranded aluminium for power and stranded copper for control. Minimum conductor size shall be not less than 2.5 sq.mm copper or equivalent. For selecting the cable rating, motor duty, ambient temperature, grouping, position of cables, voltage drop etc. shall be considered.

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

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

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

5.39.00 Grounding

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

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

5.39.03 The crane grounding system shall be connected to station ground mat.

6.00.00 INSPECTION AND TESTING

6.01.00 The Bidder shall submit his Shop and Field Quality Plan as per stipulations of Volume IIA of this specification. The Quality Plan shall indicate all the tests to be carried out in line with the relevant codes. All forgings and castings shall be subjected to ultrasonic examination. DPT/MPI shall be carried out where-ever necessary.

6.02.00 Tests at shop

6.02.01 The cranes shall be subject to full load and overload tests as per IS-3177. Otherwise the crane shall be subject to 'no-load' test after complete assembly and wiring.

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

6.02.03 If the hoisting drum offered is of welded construction, the seams shall be fully radiographed.

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

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

6.02.06 Reports of all shop tests shall be submitted to the Owner/Consulting Consultant for review.

6.03.00 Tests at site

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

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

b) Deflection tests as per IS-3177

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

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

7.00.00 DRAWINGS, DATA AND INFORMATION

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

7.01.01 Crane clearance diagram filling in the various dimensions.

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

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

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

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

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

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

7.01.08 Other relevant data and particulars.

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

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

a) E.O.T. Crane Unit

b) Bridge Assembly and Components

c) Bridge End Trucks and Wheel Assembly

d) Trolley

e) Trolley Wheel Assembly

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

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

h) Main Hook Block

i) Auxiliary Hook Block

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

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

7.02.04 Design calculation of the following :

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

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

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

7.02.07 Reports on various tests at shop and at site.

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

7.02.09 As built drawing/electrical control schematic.

7.03.00 Instruction Manual

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

i) Instruction for erection

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

iii) A detail write up on the crane control system and also on the interlocks provided.

iv) Recommended inspection points and periods of inspection.

v) Schedule of preventive maintenance.

vi) Replaceable part's list with ordering information.

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

ANNEXURE-I

LIST OF EOT CRANES

Sl. No.	Location
1.	Turbine Hall - 2 Nos. (However, if BFP cannot be handled by the TG hall EOT Crane, as per final layout requirement, then separate EOT crane shall be provided for BFP area.)
2.	CW & ACW Pump House (Inside) – 2 Nos. EOT cranes
3.	CW & ACW Pump House (Outside) – 1 No. Semi-gantry crane
4.	Coal mill area to cover all mills - 2 Nos. EOT cranes
5.	AHP Vacuum pump cum compressor House – 1 No. EOT crane
6.	Wagon Tippler Complex - 1 No. EOT crane
7.	DG Building - 1 No. EOT crane
8.	Any other area as envisaged by the EPC Bidder.

Note :

1. Exact requirement of E.O.T Cranes shall be decided during detail Engineering.
2. All EOT cranes performance test shall be certified by govt. approved agency.

ANNEXURE-II

DATA SPECIFICATION SHEET
FOR
ELECTRIC OVERHEAD TRAVELLING CRANE

1.0 GENERAL INFORMATION

Number of Cranes	:	As per Annexure-I
Location	:	As per Annexure-I
Working condition	:	Indoor
Mode of operation	:	Individual
Crane Operation	:	Cabin operated/pendent operated/Radio remote

2.0 UTILITIES AVAILABLE

Electric Power	:	Voltage: 415V ± 10%; Phase: Three Frequency: 50 Hz ± 5%
Combined voltage and frequency variation	:	10% (absolute sum)
Neutral earthing	:	Solidly earthed
3-Phase Symmetrical fault level current	:	50 KA
Compressed air available for erection work at site	:	None

3.0 GUARANTEED PERFORMANCE REQUIRED (TG Hall EOT)

Capacity (TG Hall EOT) [Safe Working Load (SWL)]	:	Main Hoist – 125% of heaviest equipment to be handled or 125 tonnes, whichever is higher Aux. Hoist - 25 tonnes
Capacity (CW Pump House [Safe Working Load (SWL)]	:	Main Hoist – 125% of heaviest equipment to be handled Aux. Hoist - 5 tonnes
Rated Speed (for any load from zero to SWL)	:	Main hoist - 1m / min. Aux. hoist - 5 m / min. Trolley travel - 10 m / min. Bridge travel - 15 m / min.

Creep Speed	:	10% of rated speed for both main and auxiliary hoist. As well as bridge and trolley travel through VFD control.

4.0 SCOPE OF SUPPLY

Crane structures complete	:	Yes
All longitudinal and trolley travel drive equipment complete with motors, driving gears, brakes, shaft bearings, limit switches etc.	:	Yes
Running rails including all clamps, anchors, bolts, nuts, sheams, inserts, end stops and other fixtures	:	Yes
Operator's Cabin/Pendent/Radio Remote with all accessories	:	Yes
All platforms and ladders required	:	Yes
Portable fire extinguisher / CO_2 bottle in operator's cabin	:	Yes
Runway conductors (DSL) and power collectors complete with all supports, insulators, brackets, fixtures etc.	:	Yes
Complete electrical work including main disconnect switch, all controls and interlocks, with necessary wiring, grounding, protective panels etc.	:	Yes
Lower limit switches for hoists	:	Yes
Illumination of crane, operator's cabin etc.	:	Yes
Fan in operator's cabin	:	Yes
Lifting lugs, eye bolts etc. for handling of crane parts	:	Yes
Shop tests	:	Yes
Site tests	:	Yes
Erection and Commissioning service	:	Complete

All equipment, accessories and consumables required for erection, testing and commissioning	:	Yes
Painting at shop and site	:	Yes
First charge of oil, lubricants, grease etc.	:	Yes
Mandatory spares	:	Yes
Recommended Spare parts (for 2 years' operation)	:	Yes
Erection & Commissioning spares	:	Yes
Set of Special tools and tackle	:	Yes
Supervision of Erection & Commissioning	:	Yes
Operation and Maintenance manual	:	Yes

5.0 DESIGN AND CONSTRUCTION

Duty Class	:	M5 as per IS-3177 and IS-807
Electrical Service Class	:	S4 as per IS-3177
Design Temperature for Motors	:	50 Deg. C
No. of Starts Per Hour	:	150
Operation	:	Cabin
No. of Trolleys	:	One
Span between runway rail centres	:	DDE
Net runway length	:	DDE
Top of runway rails	:	DDE
Top of Gantry girder	:	DDE
Elevation of bottom of building roof structures	:	DDE

Maximum lift --

a)	Main Hoist (Metres)	:	DDE
b)	Aux. Hoist (Metres)	:	DDE
	Max. Hook approach (mm)	:	DDE

Runway conductors -

a)	Material	:	Shrouded copper conductor / MS angle
b)	Maximum allowable current density	:	0.35 amps / sq. mm

End Truck -

a)	I Section acceptable	:	No
b)	Single flanged wheels acceptable	:	No

Permissible tolerance -

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

Schedule of Brakes

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

Sl. No.	Service	Type & No.
1.	Main Hoist	Two (2) nos. Electro hydraulic thruster type brake.
2.	Auxiliary Hoist	Two (2) nos. Electro Hydraulic Thruster Type Brake.
3.	Cross Traverse	Two (2) nos. Electro Hydraulic Thruster Type Brake.
4.	Long Traverse	Two (2) nos. Electro Hydraulic Thruster Type Brake.

		Two (2) nos. Hydraulic Thruster (foot operated)
5.	Emergency Brake	One(1)No. Electromagnetic Type

6.0 MATERIAL OF CONSTRUCTION

Bridge girder	:	Grade B to IS-2062 (latest)
End carriage	:	Grade B to IS-2062 (latest)
Lifting hooks	:	IS-3815 (latest) or IS-8160 (latest) and shall be made of steel (EN-3A)
Sheaves	:	Forged steel
Drum	:	Seamless pipe to ASTM A106 or fabricated rolled section to IS 2062 Grade B(latest)
Gear	:	Cast / Wrought steel or Forged from low / Medium carbon steel and suitably heat treated. The surface hardness should be 217 to 255 BHN.
Pinion	:	Cast / Wrought steel or Forged from low / medium carbon steel and suitably heat treated. The surface hardness 266 to 300 BHN. (Difference in hardness of pinion & Gear must not be less than 20 BHN)
Wire rope	:	Plough steel with fibre core to IS-2266.
Shaft	:	EN – 24 to BS-970
Wheels	:	Double flanged as per IS-3177.Cast or forged steel /rolled steel or shall have steel tyre shrunk on and registered.
Runway Rails	:	As per IS-3443.

7.0 INSPECTION AND TESTING

Deflection test at manufacturer's Works	:	Yes
Radiography of structural welds in tension	:	Yes
% of radiography	:	As specified in section M0.
Material testing & identification by	:	Manufacturer / Purchaser

Acceptance Standard	:	IS-3177
Gear box assembly, hook test, wire rope test, Routine test of electrical	:	Yes

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SECTION IA

ANNEXURES

388885/2021/PS-PEM-MAX

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-445-501-A001	
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ANNEXURE-I

MAKES OF SUB-VENDOR ITEMS

1. The sub vendor list at **Customer's Specification** "Annexure I, Volume: II-A, Section: VI , Project Management and Site Services" shall be applicable.

2.The items / makes indicated below but not covered at "Annexure I, Volume: II-A, Section: VI , Project Management and Site Services" of Customer's Specification for makes as proposed by bidder shall be put up for Customer's approval during detailed engineering stage without any commercial & delivery implication to BHEL.

3.Bidder to propose sub vendor within 4 weeks of placement of LOI, thereafter no request for additional sub-vendor shall be entertained.

4.The inspection category will be finalized after award of contract during detailed engineering. Same will be adhered by the bidder without any commercial and delivery implication to BHEL

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	STEEL	SAIL		
		TISCO		
		JINDAL		
		ESSAR		
2.	HOOKS	STEEL FORGING & ENGG. CO.,	KOLKATA	
		SIMRITI FORGING		
		KARACHIWALA		UP TO 25T CAPACITY
3.	GEAR COUPLINGS	ALLIANCE		
		FLEX-TRANS (formerly known as HICLIFF)		
		SAHARA		
		NUTECH		
		OEM		
4.	WIRE ROPE	USHA MARTIN		
		FORT WILLIAMS		
		BHARAT WIRE ROPES		
5.	BEARINGS	SKF		
		FAG		
		TATA		
		NBC		
6.	MOTORS	SIEMENS		
		NGEF (up to 15KW)		
		CROMPTON GEAVES		
		KIRLOSKAR ELECTRIC CO LTD.		
		BHARAT BIJLI		
		MARATHON		
		ABB		
		GE-POWER	CHENNAI	(FOR LT MOTORS ONLY)

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		SECTION IA	
		REV. 00	JUL 2021

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		LAXMI HYDRAULICS PVT. LTD	SOLAPUR-MAHARASHTRA	(FOR LT MOTORS ONLY)
		RAJINDRA ELECT INDUSTRIES		(FOR LT MOTORS ONLY)
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		

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-445-501-A001	
		SECTION IA	
		REV. 00	JUL 2021

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		PRECISE ELECTRICALS		
		SILKAAN ELECTRIC MFG. CO. LTD.		
		SOUTHERN ELECTRIC		
		NEC		
15.	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS		
		BAJAJ		
		CROMPTON		
16.	CABLE LUGS (HEAVY DUTY)	DOWELLS		
		UML ENGINEERS	KOLKATA	
		JAINSON		
17.	HOOTERS	BEACON		
		OSC		
		TARGET		
		KHERAJ		
18.	LIGHTING SWITCHES	ANCHOR		
		ELLORA		
		BAJAJ		
		PHILIPS		
19.	PVC POWER CABLES	APAR INDUSTRIES LTD.	MUMBAI	
		CORDS CABLE INDUSTRIES LTD.	NEW DELHI	
		DIAMOND POWER INFRASTRUCTURE LTD	VADODARA	
		GOYOLENE FIBRES (INDIA) PVT.LTD	MUMBAI	
		GOVIND CABLE INDUSTRIES	KOLKATA	
		GUPTA POWER INFRASTRUCTURE LIMITED	BHUBNESWAR	
		HAVELLS INDIA LIMITED	NOIDA	
		KEI INDUSTRIES LTD.	NEW DELHI	
		KRISHNA ELECTRICAL INDUSTRIES LTD	GWALIOR	
		KEC INTERNATIONAL LIMITED	MUMBAI	
		MANSFIELD CABLES COMPANY LTD.	NOIDA	
		NICCO CORPORATION LTD.	KOLKATA	
		PARAMOUNT COMMUNICATIONS LTD.	NEW DELHI	
		POLYCAB WIRES PVT. LTD.	MUMBAI	
		RADIANT CORPORATION PRIVATE LIMITED	HYDERABAD	
		RAVIN CABLES LIMITED	MUMBAI	
		SUYOG ELECTRICALS LTD.	VADODARA	
		SRIRAM CABLES PVT. LTD.	NEW DELHI	
		SCOT INNOVATION WIRES AND CABLES PVT. LTD.	SOLAN	
		SAM CABLES & CONDUCTORS (P) LTD	UDHAM SINGH NAGAR	
		THERMO CABLES LTD	HYDERABAD	
20.	PVC CONTROL CABLES	ADVANCE CABLE TECHNOLOGIES (P) LTD	BANGALORE	

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		REV. 00	JUL 2021

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

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-445-501-A001	
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		REV. 00	JUL 2021

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

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		JAINSON		
		DOWELL		
		ALLIED TRADERS & EXPORTERS	NOIDA	
		BALIGA LIGHTING EQPT.PVT.LTD.	CHENNAI	
		ELECTROMAC INDUSTRIES	MUMBAI	
		INCAB	KOLKATA	
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		

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-445-501-A001 SECTION IA REV. 00 JUL 2021

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		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.	LIGHTING FIXTURES, LAMPS	BAJAJ ELECTRICALS LTD.		
		PHILIPS		
		CROMPTON		
		GE		

ANNEXURE-II

MANDATORY SPARES

Mandatory spares list shall be as per “Customer’s specification” chapter “REQUIREMENTS OF SPARES, TOOLS & TACKLE” page no 70, 71, 72, 78, 79 of 103, Volume: II-A, Section : X.

Note :-

1. If percentage comes as fraction next higher integer should be considered for the purpose of quantity required.

2. The List is tentative & the bidder shall include in the offer any additional items that shall be required for the system in offer as well any item description that may undergo specific technical changes.

3. “Set for each type & capacity of EOT” shall mean 100% requirement for each type & capacity of double girder EOT cranes.

4. Any item which is quoted as “not applicable” in the above list and is found to be “applicable” at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

ANNEXURE III

TOOLS & TACKLES

One (1) lot of following unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual for the crane shall be supplied. Each tool and wrench shall be stamped so as to be identified, easy for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality and minimum the following shall be provided.

a) One (1) set of wrench, spanner having sockets.
b) One (1) set of sliding bar for socket wrench.
c) One (1) torque wrench
d) One (1) each pen hammer 1 lb. & 2 lb.
e) One (1) set of Allen key set.
f) One (1) feeler gauge set.
g) One (1) oil can size 1 pint cap along with a funnel for oil filling.
h) Fuse Puller
i) Panel indicating lamp puller
j) Hydraulically operated jack/s of capacity suitable for replacement of Long travel / cross travel wheel bearings etc.
k) One (1) tool box with lock and double keys.

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

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ANNEXURE IV

PAINTING SPECIFICATION

1.0 **PAINTING** shall be as per **"Customer's specification"** Volume: II-A, Section: XI , "Protective Coating and Painting"

2.0 **Color Shade:**

Sl no	Components	Color	IS 5 shade no	Color band
a.	Crane structure & trolley	Golden yellow	356	
b.	Bottom block assembly	Golden yellow	356	With black strips
c.	Hook	Golden yellow	356	With 100 mm wide black zebra strip
d.	Platforms, galleries, ladders and handrails.	Dark Admirality Grey	632	
e.	Panels	Light grey/ As per manufacturer's standard	631	
f.	Motor	Light grey/As per manufacturer's standard	631	

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ANNEXURE-V

DRAWINGS/ DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

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

The (#) marked drawings are basic engineering drawings. After CAT 1, Cat 1*, Cat 2, Cat 3 & Cat 5 approval /BHEL clearance on these drawings, manufacturing/procurement activities shall be initiated.

Sl no	BHEL drawing No.	Title	Category	Scheduled submission (No of weeks from LOI/LOA)
1	PE-V0-445-501-A001#	Manufacturing Quality Plan with sub vendor list FOR D/G EOT CRANES UPTO 100T CAPACITY	A	21
2	PE-V0-445-501-A002#	Mechanism Sizing Calculation Including storm brake calculation FOR D/G EOT CRANES UPTO 100T CAPACITY	A	21
3	PE-V0-445-501-A003*	General arrangement FOR D/G EOT CRANES UPTO 100T CAPACITY with CT DSL details	A	21
4	PE-V0-445-501-A005	Data sheet with painting details FOR D/G EOT CRANES UPTO 100T CAPACITY	A	42
5	PE-V0-445-501-A010#	Structural calculations FOR D/G EOT CRANES UPTO 100T CAPACITY	A	21
6	PE-V0-445-501-A012	Cable & DSL Sizing and Schedule FOR D/G EOT CRANES UPTO 100T CAPACITY	A	28
7	PE-V0-445-501-A013	General Arrangement of a) Protective panel b) Main hoist panel c) Aux. hoist panel d) Cross Traverse panel e) Long Traverse panel f) Pendent g) Remote Radio Control FOR D/G EOT CRANES UPTO 100T CAPACITY	I	28
8	PE-V0-445-501-A015#	Data sheet of motors FOR D/G EOT CRANES UPTO 100T CAPACITY	A	42
9	PE-V0-445-501-A020	Mandatory spare parts list FOR D/G EOT CRANES UPTO 100T CAPACITY	A	56
10	PE-V0-445-501-A021	O & M Manual FOR D/G EOT CRANES UPTO 100T CAPACITY	I	56
11	PE-V0-445-501-A011#	SCHEMATIC CIRCUIT DIAGRAM OF a) PROTECTIVE PANEL, MAIN AND LIGHTING CIRCUIT & BOM b) MAIN HOIST PANEL & BOM c) AUX. HOIST PANEL & BOM d) CROSS TRAVERSE & BOM E) LONG TRAVERSE & BOM INCLUDING EARTHLING DIAGRAM & WRITE UP FOR UPTO 100T CAPACITY	I	28
12	PE-V0-445-501-A004#	CRAB SUB ASSEMBLY FOR D/G EOT CRANES UPTO 100T CAPACITY with CT wheel assembly	I	21

13				
14	PE-V0-445-501-A009#	Main and Auxiliary hook block assembly with details of hook, nut and check plate for D/G EOT CRANES UPTO 100T CAPACITY	I	28
15	PE-V0-445-501-A050	Crane lubrication drawing for D/G EOT CRANES UPTO 100T CAPACITY	I	42
16	PE-V0-445-501-A021	Type test certificate (for motors) for D/G EOT CRANES UPTO 100T CAPACITY	A	56
17	PE-V0-445-501-A032	Gantry Rail installation FOR D/G EOT CRANES UPTO 100T CAPACITY	I	21
18	PE-V0-445-501-A033	Manufacturing Quality plan of motors (above 50KW) for D/G EOT CRANES UPTO 100T CAPACITY)	A	35
19	PE-V0-445-501-A008	General arrangement for PVC shrouded DSL for D/G EOT CRANES UPTO 100T CAPACITY	I	28
20	PE-V0-445-501-A010#	Long travel Machinery Assembly with LT wheel assembly for D/G EOT CRANES UPTO 100T CAPACITY	I	28
21	PE-V0-445-501-A020	Crane Operational write up for D/G EOT CRANES UPTO 100T CAPACITY	I	35

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared to the scale in Auto-CAD latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. Bidder to note that all values/dimensions/elevations etc. without supporting back up data adopted/assumed by the successful bidder (during contract stage) in the design calculation/drawings shall be taken by the customer/owner to be correct unless they are stipulated in the specification. Any problem arising later in this regard shall be made good by the successful bidder at his cost and no extension of time shall be granted for the same.
5. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

    a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

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

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

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

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

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

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

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

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

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

i. 1st submission of drawings as per the submission schedule.

ii. Every revised submission incorporating comments – within 10 days.

k) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

l) Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories :

CATEGORY- 1 : Approved
CATEGORY- 1* : Approved with comments.
Resubmit revised drawing incorporating the comments.
CATEGORY –2 : Approved except as noted, forward final drawing.

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CATEGORY - 3 : Approved except as noted, resubmission required.
CATEGORY – 4 : Disapproved.
CATEGORY – 5* : For information and record with comments.
CATEGORY – 5 : For information and record.

Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.

ANNEXURE VI – PACKING PROCEDURE

COMMON GUIDELINES FOR PACKING

1. GENERAL:

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.

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

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

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

2. TYPES OF PACKING:

The following 5 types of packing have been standardized for packing of General Components/ Assemblies.

1) '**OP**' - Open Type.

2) **'PP'** - Partially Packed.

3) '**CP**' – Crate/Box Packing - Components/Equipment requiring physical protection.

4) '**CQ**' - Case Packing – Machined components-Small & Medium Components/ Assemblies/ Equipment which require corrosion & physical protection.

5) **'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

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
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

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.
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.
Empty space in the cartons shall be filled with rubberized coir to get proper cushioning effect. The cartons shall be manufactured from corrugated Fiber Board.

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.

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 JOINTING OF PLANKS

Single length planks shall be used for cubicles whose overall length is less than 2400mm. For cubicles of length more than 2400mm, jointing is permitted. The jointing shall be done with one single or maximum of 2 planks of wood same as other planks of width 250 mm (minimum) with two rows of nails on either side of the joint in zigzag manner. From the joint along height side, it shall be of lap joint with overlap of at least the width of plank.

4.3 TONGUE AND GROOVE JOINTS

Two consecutive planks shall be joined by tongue and groove joint. Depth of tongue shall be 12+1 mm, thickness of tongue shall be 8 +1 mm. The groove dimensions shall be such that the tongue fits tightly into the groove to make a good joint. This type of joint can be done based on the product requirement wherever required.

4.4 PERMISSIBLE DEFECTS

Wood shall be free from knots, bows, visible sign of infection and any kind of decay caused by insects, fungus, etc.

End splits: Longest end splits at each end shall be measured and lengths added together. The added length shall not exceed 60mm per meter run of shook's. Wood pins shall be used to prevent further development of split.

Surface cracks: Surface cracks with a maximum depth of 3mm are permissible. A continuous crack of any

depth all along the length is not allowed.

4.5 OTHER MATERIALS

4.5.1 NAILS

The dia. of the nails shall be 3.15mm. The length of the nails shall be 65mm wherever two planks of 25mm thickness are joined and 75mm wherever a 25mm planks is joined to a 50mm plank.

4.5.2 BLUE NAILS

These are used for nailing bituminized Kraft paper/hessian cloth to the planks. The length of the nails shall be 16mm.

4.5.3 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.

4.5.4 CLIPS

These shall be used for strapping the hoop iron strips on the boxes.

4.5.5 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.

4.5.6 FASTENERS

Bolts, double nuts, spring washers will have to be used for packing of some special items like transformers, reactors, breakers, etc., to hold the job to the bottom plank of the box. The bolts, nuts, washers will be provided by the vendor. Drilling of holes will have to be done using contractor's tools.

4.5.7 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.

4.5.8 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.

4.5.9 FOAM RUBBER / 'U' FOAM:

This is used for covering the delicate items. This material is provided by the vendor.

4.5.10 MARKING PLATE:

This shall be of anodized aluminium sheet. Size of the marking plate shall be maintained minimum of size as per the details specified in the Figure 4.

4.5.11 PACKING SLIP HOLDER:

This shall be of galvanized iron tinned sheet /Aluminium sheet

4.5.12 SILICA GEL:

Silical gel shall be used for such products only where moisture needs to be avoided.

4.5.13 COTTON BAGS:

These are used for holding silica gel. The bags shall have the following matter indicated on them:

BHEL-UNIT NAME PLACE -PINCODE
SILICA GEL -INDICATING TYPE
BLUE : -ACTIVE

ROSE : -REDUCED ACTIVITY
WHITE : -NO ACTIVITY. TO BE REPLACED WITH FRESH SILICA GEL

4.5.14 COTTON/ PLASTIC TAPE:

This is used for tying small items. And also to prevent vibrations of moving parts within the cubicles.

4.5.15 MARKING INK:

The ink used normally is black in color. In some special cases other color also will have to be used. The ink shall be non-fading/indelible and non-washable by water.

4.5.16 POLYETHYLENE BAGS:

These are to be used for keeping the Packing slips. The bag shall be of size 70mm X 100mm (minimum).

4.5.17 Hessian cloth, twine thread, paint will have to be used in packing certain items.

4.5.18 Mechanical Latching clamps:

For CLW Railway panels and similar Panels self-locking clamps can also be used on need basis in conjunction with or apart from regular bolt and nut fixing arrangement. For reusable boxes, these clamps provide easy locking and unlocking arrangement. These clamps will be made available from BHEL in some cases.

4.5.19 STICKERS

The following stickers to be put by the vendor on cubicles/Boxes after packing.

1) Case No sticker: 2 nos. Size 25.Cm x 0.45Cm
2) BHEL Monogram sticker: 1 no. Size 1.75Cm x 2.3Cm
3) Address sticker: 2 nos. Size 3.8Cm x 3.0Cm
4) Direction sticker “Front” & “Back” - 4 nos. Size 2.0Cm x 0.75Cm
5) Chain Mark Sticker: 4 Nos. Size – 3.0Cm x 0.75Cm
6) "Fragile” sticker: 2 Nos. Size. 2.1Cm x 1.5Cm
7) "DO NOT STACK” sticker - 2 Nos. Size 3.0Cm x 2.2Cm

In place of stickers, writing all the details legibly with paint shall be allowed & respective units may take decision accordingly.

5. PACKING OF CUBICLES:

5.1 The packing is to be done as per clause 4 in all respects.

5.2 The cubicles are already fixed on wooden pallets. Hence the contractor need not arrange the bottom pallets normally.

5.3 The cubicles will be of different sizes both width wise and lengthwise. The cubicles may be made up of single suite, 2 Suite, 3 Suite, 4 Suite, etc., The width of the cubicles generally varies from 400 mm to 1650mm.The length of the cubicle, generally varies from 1500 mm to 4800 mm. The height is normally 2430 mm. In some cases, the height may be less/more.

5.4 MULTI LAYER CROSS LAMINATED POLY FILM

The inner surface of 4 sides of shook's shall be nailed with Multi-layer cross laminated poly film (as per 4.5.7) using blue nails (as per 4.5.2) wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.

The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film (as per 4.5.7). 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.

The cubicles shall be covered with Multi-layer cross laminated poly film (as per 4.5.7).

5.5 SILICA GEL:

Silica gel (as per 4.5.12) packed in cotton bags shall be kept at different places inside the cubicle as per BHEL-Unit directions. Each suit of cubicle shall be provided with 1 kg of Silica gel (for a 4 suit cubicle 4 kgs of Silica Gel to be used. The bag containing silica gel to be as per 4.5.13).

5.6 LOOSE PARTS:

Any loose parts in the cubicles shall be tied using cotton/ plastic tape. Wooden battens shall be provided wherever necessary.

5.7 WOODEN BATTENS:

In case of cubicle which are not rectangular in shape like control desks, sufficient number of wooden rafters/battens of proper size shall be provided to give strength to the package.

5.8 RUBBERISED COIR:

Gap between the cubicle and the case shall be filled with rubberized coir (as per 5.5.8) with distance between consecutive layers less than 500mm.

5.9 CLAMPING:

Packing shall be bound at edges by nailing M.S. Clamps / Brackets (as per 5.5.5). Each vertical edge shall have minimum 3 clamps. Top horizontal edges will have one clamp for every meter length of package. However, minimum 4 clamps shall be nailed at the top for any cubicle.

5.10 PACKING SLIP:

Packing slip kept in the polyethylene bag (As per 5.5.16) shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder (as per 5.5.11) shall be nailed to front / rear of case.

5.11 MARKING PLATE:

One no. (As per 5.5.10) shall be nailed to the front side of the case.

5.12 CASE MOUNTING:

After complete packing, stencil marking of various details and marking of symbols shall be done as per BHEL instructions using indelible / non washable marking ink.

5.13 Different types (Typical) of Cubicles with sizes for Packing

1. Single suite cubicle - 900 x 950 x2500
2. Two suite cubicle - 1650 x 950 x 2500
3. Three suite cubicle - 2400 x 950 x2500
4. Four suite cubicle - 3150 x 950 x 2500
5. Regulation cub - 1300 x 1350 x 2500
6. Thy cub - 2870 x 1350 x 2500
7. VFD Cub - 3800 x 1550 x 2500

6 PACKING OF LOOSE ITEMS/SPARES

1) Shape of cases shall be square, rectangular with single gabled roof or with double gabled roof depending on the nature of the job to be packed. Construction shall be as per drawings enclosed. Only gable will be additional as required.

2) Wood with Tongue and Groove joint as per clause 4.3.

3) Width of planks shall be at least 100 mm. Width of binding planks (battens) shall be at least 75mm.

4) External surface of planks on front and rear shall be plane 100% (except bottom plank).

5) Inner surfaces of all 6 sides shall be lined with Multi Layered Cross Laminated Polythelene Film (as per clause 4.5.7) using blue nails.

6) Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.

7) 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.

8) Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.

9) Silica gel as per clause 4.5.12 held in cotton bags as per clause 4.5.13 shall be kept at proper places in the box.

10) Packing slip kept in polyethylene bag (clause 4.5.16) shall be placed in the box.

11) Marking plate as per clause 4.5.10 shall be nailed to side of the box.

12) Two numbers of hoop iron strips as per clause 4.5.3 shall be strapped tightly on the case using clips.

13) Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.

14) Loose items to be kept inside the cubicle

- The components which are removed from cubicle for shipping purpose only, such as meters shall be kept inside the cubicle individually, kept in wooden box and tied firmly in bottom of Cubicle.
- Other items which are given loose in addition to cubicle shall be packed in separate boxes.

7 BOX SIZES

7.1 BOX SIZES

Table 1 – SPARES WOODEN BOX DETAILS

SNO	BOX TYPE	BOX SIZE (in mm)	BOX Wt (in KG)	Carrying Capacity
1	A	800 X 200 X 200	15	
2	B	1500 X 200 X 200	22	
3	C	2000 X 200 X 200	27	
4	D	1100 X 200 X 200	15	
5	E	200 X 200 X 200	5	
6	F	320 X 250 X 260	13	
7	G	320 X 250 X 430	16	
8	H	430 X 370 X 430	23	
9	I	1100 X 400 X 400	45	
10	J	1500 X 500 X 400	65	
11	K	2000 X 500 X 400	93	
12	L	2500 X 500 X 400	88	
13	M	900 X 600 X 600	100	
14	N	3000 X 400 X 400	60	
15	P	600 X 500 X 400	35	
16	Q	710 X 630 X 600	90	
17	R	850 X 630 X 670	102	
18	S	1000 X 770 X 670	140	

19	T	2500 X 850 X 800	180	
20	U	1500 X 700 X 700	120	
21	W	1200X900X600	120	
22	Y	450 X 200 X 200	10	

Table 2 – WOODEN BOX DETAILS

BOX TYPE	BOX SIZE (in MM)	BOX Wt (in KG)	Carrying Capacity
1	320X250X260	10	
2	320X250X430	15	
3	430X370X430	25	
4	670X670X470	65	
5	720X630X600	75	
6	1000X770X660	100	
7	1100X430X670	80	
8	1200X1200X900	80	
9	1300X770X1050	155	
10	2500X850X800	225	
11	2000X1500X1200	305	
12	1850X1050X1250	260	
13	2000X800X800	180	
14	2600X1500X1600	470	
15	250X250X600	20	
16	250X250X880	30	
17	300X300X700	25	
18	380X380X880	45	
19	510X510X1400	60	
20	570X570X1400	80	
21	575X575X1875	105	
22	3600X1100X1100	390	
23	900X500X800	110	
24	2000X950X740	225	
25	1600X1120X700	220	
26	2500X2000X1200	490	
27	2900X1900X1400	525	
28	3000X1000X900	370	
29	3200X2200X950	450	
30	2150X1100X750	325	
31	2000X2000X700	130	
32	700X1200X1325	130	

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TABLE 3 STEEL BOXES

S.NO.	TYPE	DIMENSION IN MM			WEIGHT	CARRYING CAPACITY (KGS)
		LENGTH	BREADTH	HEIGHT		
1	I	2480	1680	1500	339	4500
2	II	1200	900	600	61	2000
3	IIB	1800	850	950	115	2500
4	III	900	600	600	29	1000
5	IV	600	450	500	19	750
6	V	400	350	300	11	500

TYPICAL PATTERN OF WOODEN BOX

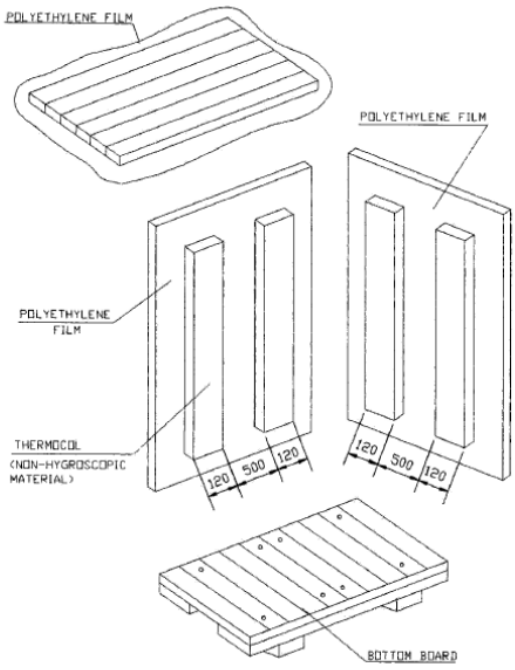
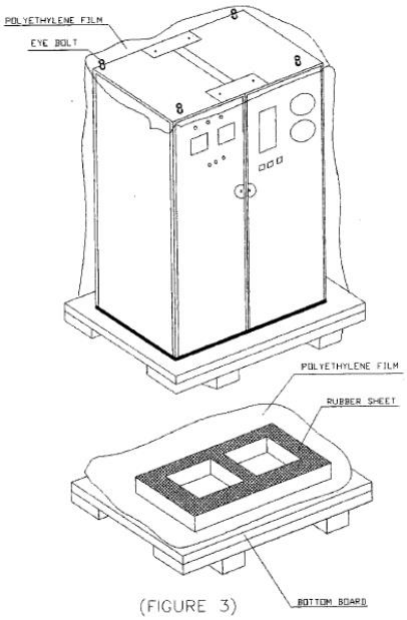


Figure 1



(FIGURE 3)

Figure 2

7.3 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 corners and edges are to be protected by rubber mats to prevent the polyethylene sheet from damage. Top surface of the case shall be free from dents to prevent rain water pockets.

8 MARKINGS/STENCILINGS

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-445-501-A001	
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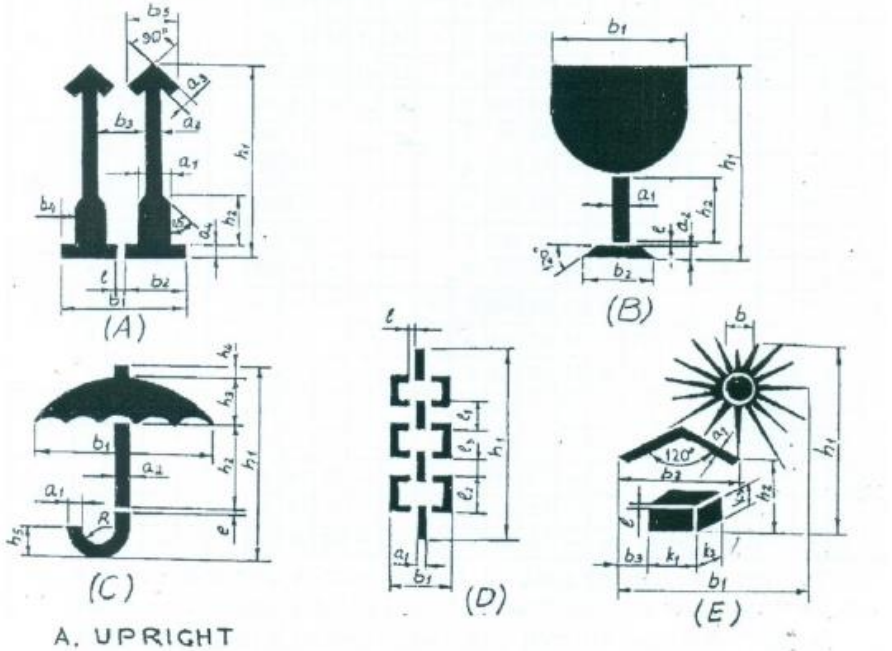
MARKINGS ON PACKING CASES

1. THIS PLANT STANDARD PRESCRIBES THE VARIOUS CAUTION SIGNS AND OTHER MARKINGS ON PACKING CASES.
2. DIMENSIONS IN THE TABLE 1 SHALL BE USED FOR MAKING STENCILS ONLY.



A. UPRIGHT
B. FRAGILE
C. PROTECTION FROM FALLING OR CONDENSING MOISTURE.
D. SLINGING POSITION
E. PROTECTION FROM DIRECT RADIATIONS.

Figure 3

DESIGN-ATION		DIMENSION IN MM																						
		a1	a2	a3	a4	b1	b2	b3	b4	b5	b	l	h1	h2	h3	h4	h5	k1	k2	k3	l1	l2	l3	R
A	1	12	5	5	4	52	25	19	8	21		2	84	23										
	2	17	7	7	6	75	36	29	11	30		3	119	33										
	3	24	10	10	8	104	50	38	16	42		4	168	46										
	4	34	14	14	11	147	71	59	23	60		5	239	65										
B	1	5	5			50	33					2	84	25										
	2	7	7			71	47					3	119	36										
	3	10	10			100	66					4	168	50										
	4	14	14			142	94					5	239	71										
C	1	4	3			66						2	80	39	19	5	11							6
	2	6	4			85						3	114	55	27	7	16							9
	3	8	6			120						4	160	78	38	10	22							12
	4	11	9			170						5	227	110	54	14	31							17
D	1	6				30						4	148								30	30	10	
	2	9				42						5	209								42	42	14	
E	1	3				69	47	10			16	2	91	26				17	8	11				
	2	4				98	67	15			23	3	128	33				24	11	16				
	3	6				138	94	20			32	4	182	62				34	16	22				

Table 4

Black and Red Marking Ink to IS:1234 "Ink, Stencil, Oil Base, For Marking Porous Surfaces" or duplicating ink stencilling, oil base for marking porous surfaces.

All cases containing fragile items are to be stencilled with red marking and stencilling paint/ink **"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".**

Besides the caution signs the product information's shall be stencilled of letters with 13mm to 50mm height. 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.

Caution signs & other markings shall be stencilled on both the end shooks & the side shooks.

Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.

Note: Incase the size of package is small for using the stencils, then hand written letters/figures shall be allowed.

	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)

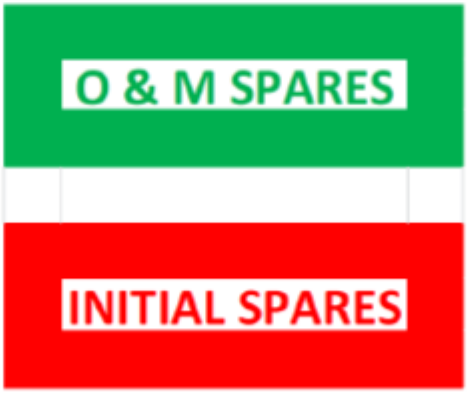


Figure 5

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

9 STANDARD METHOD OF PACKING

Table 5 - Standard Method of Packing

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
PRESSUE VESSELS								
TOWERS					O			
TANKS					O			
VESSELS					O			

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY SPECIFIC TECHNICAL REQUIREMENT (MECHANICAL)	SPECIFICATION No: PE-TS-445-501-A001	
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GASKETS	O							
FASTENERS	O							
COVERS		O						
EXCHANGERS								
HEAT EXCHANGERS					O			
TUBE BUNDLE	O							
SHELL					O			
AIR FIN COOLERS					O			
COLOUMNS, MOTOR SUSPENSIONS, PLENUM CHAMBERS, SCREEN GUARDS, ETC					O			
BEARING BLOCKS	O							
FANS	O	O						
MOTORS	O							
GASKETS	O							
FASTENERS	O							
TEST FLANGES			O					
TEST RINGS			O					
COVERS			O					
CRYOGENIC VESSELS								
COLD CONVERTERS					O			
HORIZONTAL STORAGE TANKS					O			
TRANSPORTATION TANK					O			
COLD BOX					O			
DRYING UNIT					O			
DRYING BOTTLES					O			
MOISTURE SEPARATORS					O			
SILENCERS					O			
ONGC SKIDS					O			
VAPORISER		O						
SPECIAL PRODUCTS								
SI/VI PIPING		O						
CRO BIO CONTAINERS	O							
DESCRIPTION	**CASE**	**CRATE**	**SKID**	**BUNDLE**	**BARE**	**DRUM**	**METAL DRUM**	**FIBRE DRUM**
AIR BOTTLES	O							
TITANIUM BOTTLE	O							
WAR HEAD CONTAINER	O							
MISSILE CONTAINER	O							
FUEL CONTAINER	O							
AIR LOCK ASSEMBLY	O							
BOILER DRUMS					O			
BOILER ITEMS								
COILS			O					

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PANELS					O			
HEADERS			O		O			
FEEDERS								
MACHINED ITEMS								
SHELL SEGMENTS					O			
SHELL SEGMENTS IN STACKS					O			
SPHERE PETALS								
COLOUMNS, BASE PLATES, TIERCOS, PIPES, NOZZLE E1, F1, INTERNAL PIPES, PADS ETC.					O			
ROLLERS	O							
VALVE TRAYS								
VALVE TRAY COMPONENTS	O							
LATTICE GIRDERS		O						
FASTENERS	O							
GASKETS	O							
SUB CONTRACTS								
FAB STRUCTURALS					O			
SUPPORTING STRUCTURALS					O			
STRUCTURE SUB ASSEMBLY					O			
FAB PIPES					O			
GRATINGS					O			
STAIR CASES					O			
HANDRAILS/ PLATFORMS					O			
BOUGHT OUT COMPONENTS								
IRON & STEEL (LIKE PLATES, BEAMS, ANGLES, CHANNELS ETC.)					O			
PIPE FITTINGS								
CS PIPES, TUBES					O			
SS PIPES, TUBES					O			
FIN TUBES	O							
ELBOWS		O			O			
DESCRIPTION	**CASE**	**CRATE**	**SKID**	**BUNDLE**	**BARE**	**DRUM**	**METAL DRUM**	**FIBRE DRUM**
FLANGES	O	O						
VALVES	O							
GAUGES	O							
DEMISTERS		O						
ABSCRBANTS (LIKE MOLECULAR SIEVES, ACTIVATED ALUMINA, MOBILE SORBID)						O		
PAINT TINS		O						
PAINT DRUMS						O		
IGNITORS	O							
SPRAY NOZZLES	O							
ELECTRICAL INSTRUMENTATION								

MOTORS, PUMPS, COMPRESSORS, TURBINES	O							
SWITCH BOARDS, DISTRIBUTION BOARDS, STARTERS, JUNCTION BOXES		O						
INDICATORS, VIBRATOR SWITCHES	O							
CABLE BUNDLES, CABLE DRUMS					O			
CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL		O						
OPERATIONAL SPARES	O							

10 PROCEDURE FOR HANDLING OF COMPONENTS

The purpose of this procedure is to protect the quality of the components/equipment while handling in various stages of manufacturing packing & despatching.

10.1 Adequate care shall be taken in handling the material, and components to avoid damage during receipts, storage issue manufacture & despatch operations.

10.2 Appropriate material handling equipment like fork lifters, cranes etc. shall be used where needed.

10.3 Lifting by crane and transportation by trolley of critical items and large components like rotors castings etc. shall be done carefully.

10.4 For critical items, where specified, special handling fixtures shall be used for lifting.

10.5 Slings and shackles used for lifting the components/equipment shall be checked for fitness and suitability before use.

10.6 Slings used on machined surfaces shall be suitably padded. No slings shall be used on journal surfaces.

10.7 Precision machined components like blades, catches, rollers etc. shall be lifted using suitable wooden pallets.

10.8 HANDLING OF COMPONENTS ON RECEIPT/DESPATCH

Before loading/unloading a packing case from the carrier look for the following shipping instructions painted on the packing case.

a) The markings showing the upright position.

b) The markings showing the sling position

c) Markings showing the fragile contents.

d) Other required markings as per clause no.10

10.8.1 Appropriate cranes and slings should be used for different components/ cases. Slings should normally make an angle as minimum as possible (width wise) but in no case more than 15º.

10.8.2 Handling and lifting should be done without jerks or impacts.

10.8.3 Immediately after receipt of the goods, the packing should be examined all-round for any sign of damage. If necessary, lift the cover or a number of boards of the case so as to make the contents visible. In the

event of sealed packing being used the plastic sheeting should not be damaged. It is imperative that the packing material is restored in original condition after the inspection.

10.8.4 On receipt of the equipment it should be checked with the shipping list and missing or damage if any should be reported immediately. It is important to arrange for immediate examination to determine the extent of the damage, the cause of the damage and where applicable the person or persons responsible for the damage. According to general practice when transporting by railway or by road vehicle the carrier concerned should be immediately called upon (within specified periods) for jointly establishing a statement of the damage. This is essential as a basis for a subsequent claim and possible damage report to the insurance company.

10.8.5 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.

10.8.6 Silica gel and such other chemicals kept in the box as desiccants and indicators should also be left in the box itself.

11 GENERAL GUIDELINES FOR ODC TRANSPORTATION/DESPATCH

Based on the Dimensions/Weight indicated in the Transportation Sketch, the type of Trailer is decided and indicated in the Tender Enquiry.

11.1 TRANSPORTATION:

1. LOW BED TRAILERS (LB 8):

   Well Bed Length : 10000mm
   Over Gooseneck : 13000mm
   Width : 3000mm
   Carrying Capacity : 40MT

2. LOW BED TRAILERS (LB 16):

   Well Bed Length : 12000mm
   Over Gooseneck : 16000mm
   Width : 3000mm
   Carrying Capacity : 75MT

3. TOW TYPE TRAILERS (WITH FRONT DOLLEY 16 TYRES): 12000MM length
   (for Exceptional equipment length: 30000mm and above)

Bigger Dia equipment are loaded in the Well with overhanging.

Smaller Dia equipment with excess length are loaded over Gooseneck with rear hanging.
The Vehicle Dimensions are defined above are only guidelines for selection based on actual Dimensions/ Weight of the Consignment

11.2 PACKING:

For all ODCs, Wooden Saddles are cut to the diameter of equipment as per the Transportation Sketch.

Wooden Saddles	For Diameter up to 4000mm	For Diameter above 4000mm
Length:	1836/2743mm (6'0"/9'0")	3353mm (11'0")
Width:	300mm (1'0")	300mm (1'0")
Height:	Saddle + one/two wedges a top	Saddle + three/four wedges a top

Number of Saddles:	
Minimum	3 in case of Loading inside Well +1 when loaded on Gooseneck
Maximum:	4 in case of Loading inside Well +2 when loaded on Gooseneck

For Securing the equipment firmly on the Trailer, 19mm (3/4"), wire rope with 25mm (1") Heavy Duty Turn Buckles / BD Clamps are used as Lashing for the equipment.

12 GUIDELINES FOR HANDLING/LOADING/LASHING

- Jobs to be checked for complete painting before loading.
- Components to be lifted with Nylon belts. This protects painting, edges and attachments.
- All the components to be transported by putting inside the properly fabricated Crating
- Small components may fall down while transporting without closed crating and there are chances of missing of small parts. Hence, it is always better to transport small components in closed containers/crating. Loose to be being shipped in a closed crating.
- No component loaded over the crating.
- **LASHING:** Use Nylon belts only for lashing of all components. It prevents removal off painting and cut in the materials.

ANNEXURE VII

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)

बीएचईएल BHEL Maharatna Company

Golden Jubilee 1964 - 2014 50 Years

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1 SCOPE OF THE DOCUMENT

2 PURPOSE OF STORAGE & PRESERVATION

3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

b) GENERAL PRESERVATION REQUIREMENTS

c) GENERAL INSPECTION REQUIREMENTS

4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT

5. CONCLUSION

6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

    - Ingress of moisture and corrosion damages.
    - Damage to protective coating.
    - Open ends in pipes, vessels and equipment -
        - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

    - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
    - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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

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

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

iii Open storage (O)

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

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

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

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

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

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

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

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

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

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

5. CONCLUSION

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

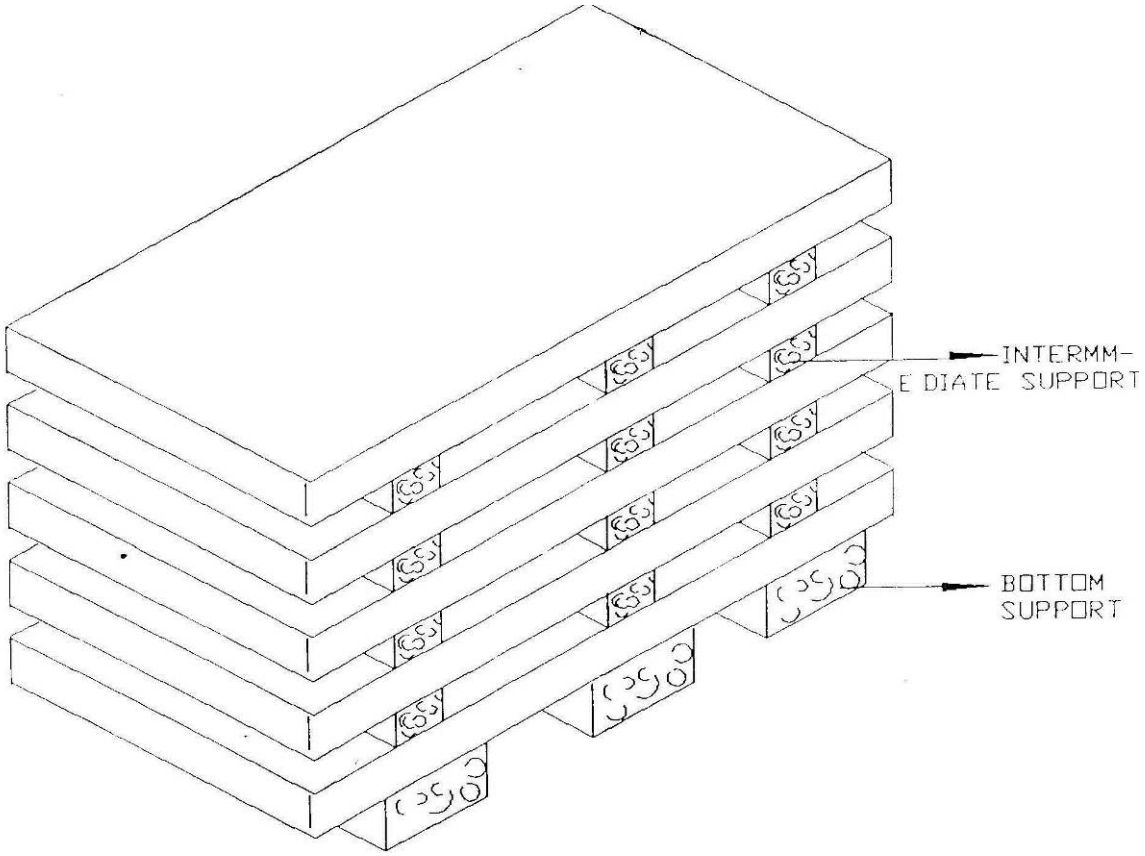

Figure – 1 – PLATE STACKING ARRANGEMENT

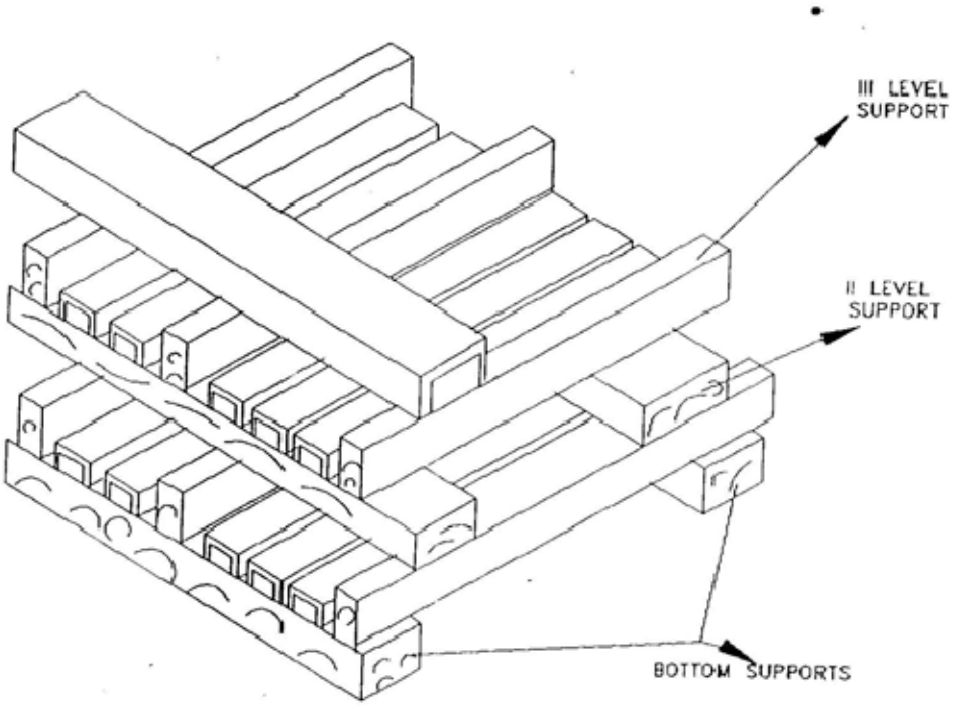

Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

388885/2021/PS-PEM-MAX

	SAGARDIGHI THERMAL POWER PROJECT, **1 X 660 MW UNIT NO 5, STAGE III.** **DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY** **SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)**	SPECIFICATION No: PE-TS-445-501-A002 SECTION IA REV. 00 JUL 2021

CRANE CLEARANCE DIAGRAM

DRAWING NO. PE-DG-445-501-A002

FIRST ANGLE PROJECTION | ALL DIMENSIONS ARE IN MM

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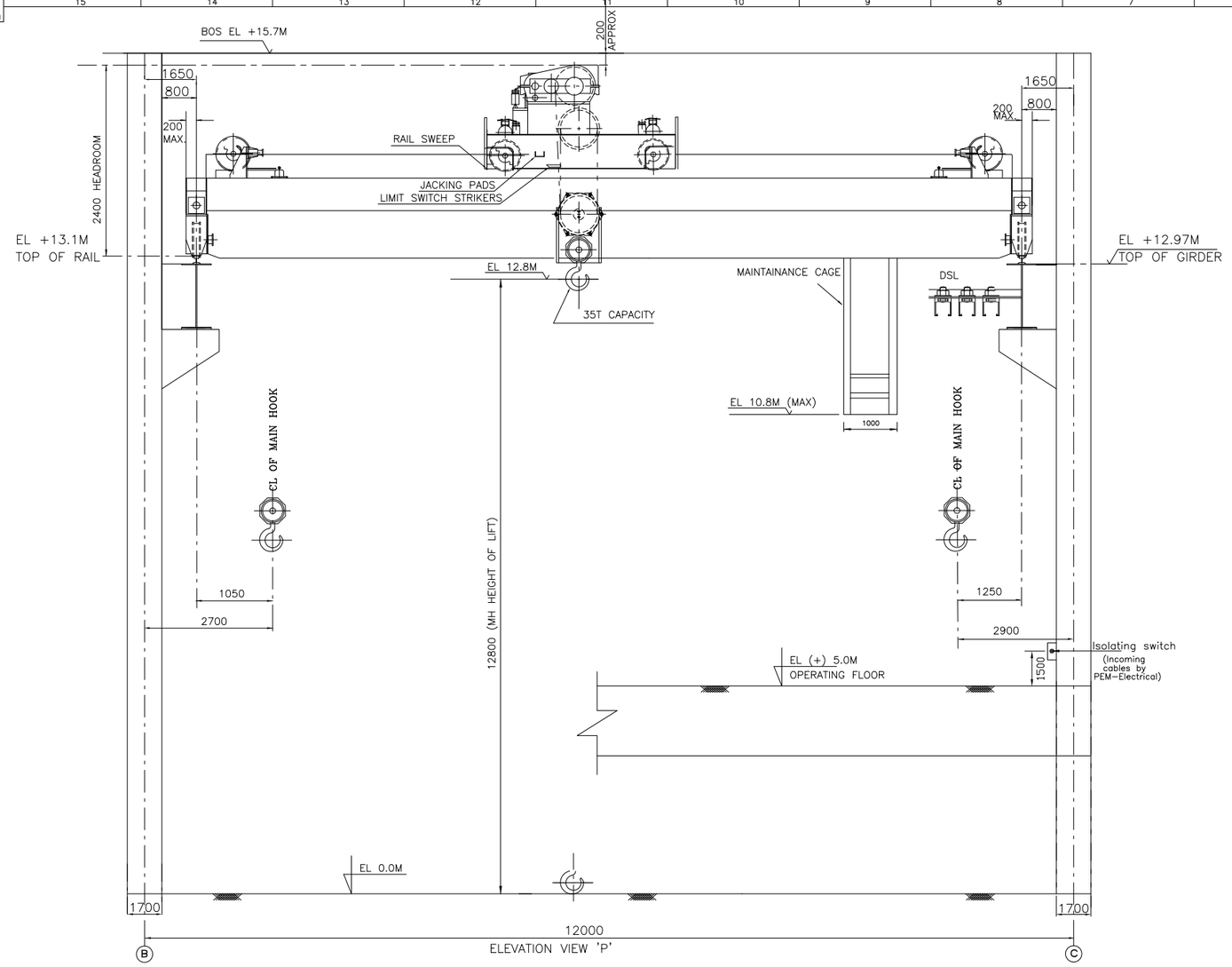
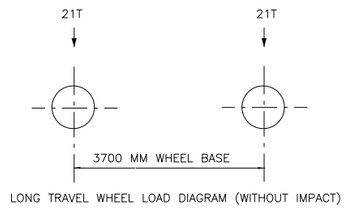
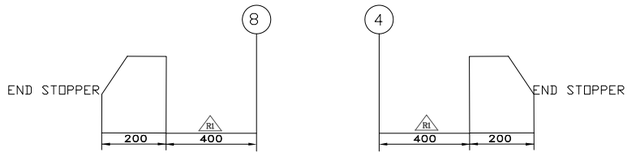
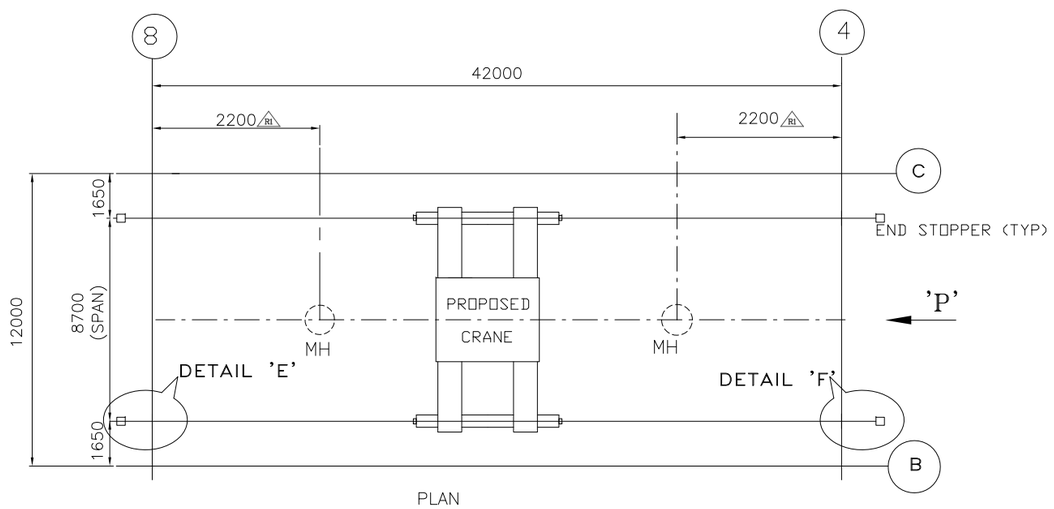


ELEVATION VIEW 'P'



LONG TRAVEL WHEEL LOAD DIAGRAM (WITHOUT IMPACT)





PLAN

NOTE:

1) DRAWING IS NOT TO THE SCALE.
2) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.
3) THE WEIGHTS AND DIMENSIONS INDICATED ARE PRELIMINARY AND SUBJECT TO CHANGE DURING DETAIL ENGINEERING AFTER AWARD OF CONTRACT TO BHEL'S SUB CONTRACTOR.
4) TOP OF RAIL IS SUBJECT TO CHANGE DURING DETAIL ENGINEERING.

REFERENCE DRAWINGS:

1) CROSS SECTION OF MAIN PLANT(TG BUILDING) –PE–DG–445–100–M007
2) T.G. EQUIPMENT LAYOUT PLAN AT EL. 0.0M– PE–DG–445–100–M003
3) STRUCTURAL FRAMING ALONG C ROW AND DETAILS OF COLUMNS & BASE PLATE.– PE–DG–445–612–C003

PRELIMINARY

REV.	DATE	ALTD	CHD	APPD
02				

REV.	DATE	ALTD	CHD	APPD
01	16-03-21	16-03-21	16-03-21	

01 –CIVIL REFERENCE DRG ADDED.
–AS PER LAYOUT DRG.

CUSTOMER: THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.(WBPDCL)
1X660MW,SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)

CONSULTANT: DEVELOPMENT CONSULTANTS PRIVATE LIMITED
KOLKATA

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

JOB NO. 445
STATUS CONTRACT
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CODE IRN	VKH		27.01.2021
DESN	VKH		27.01.2021
M CHD	RR		05.02.2021
APPD	GB		05.02.2021

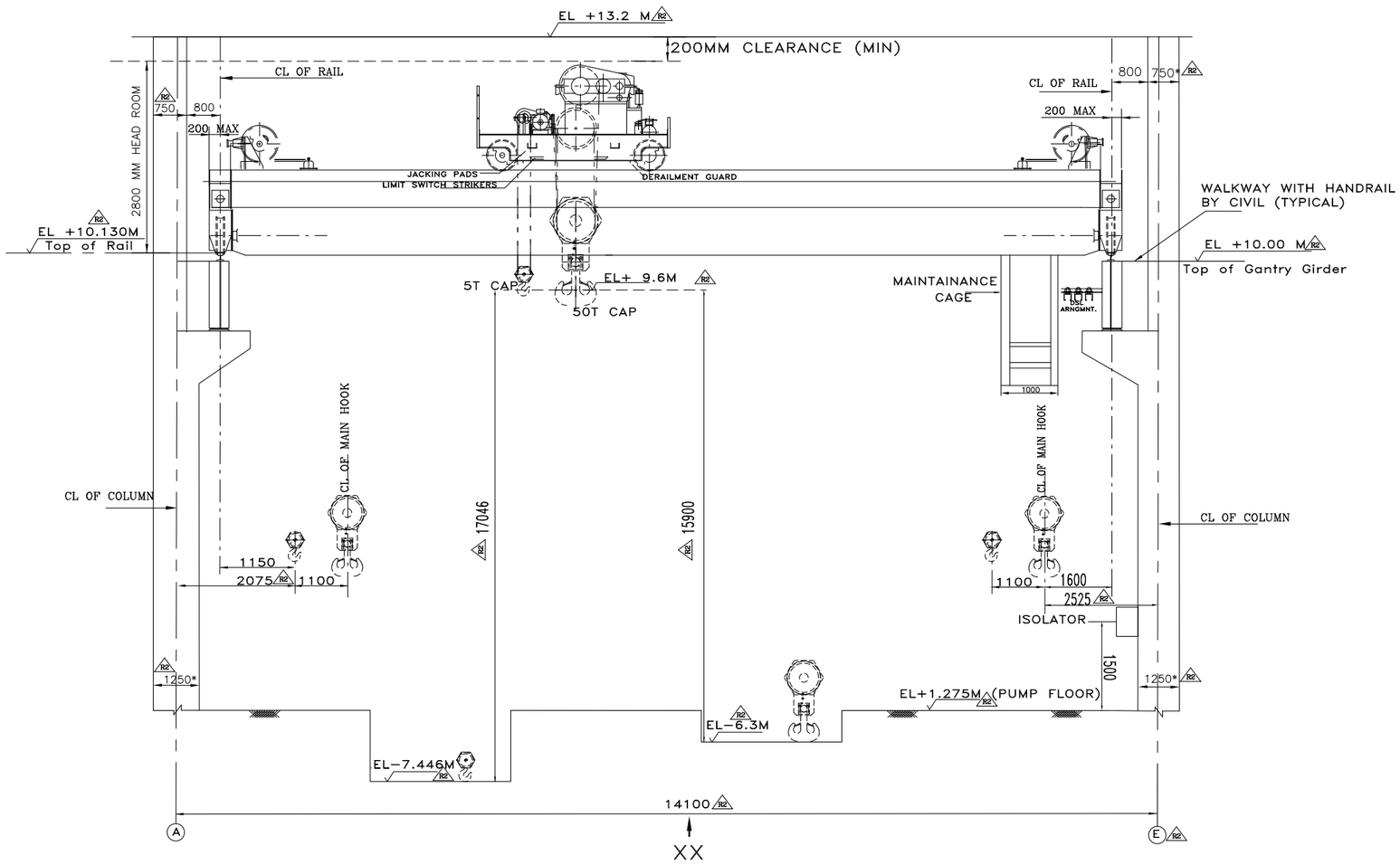
TITLE CRANE CLEARANCE DIAGRAM OF TG HALL– BC BAY EOT CRANE

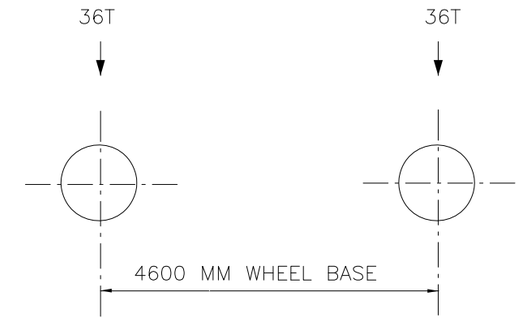
DEPT. | SCALE 1:200 | DRAWING NO. PE-DG-445-501-A002
SIGN
DATE | SHEET 2 OF 3 | REV. R01

SIZE-A0

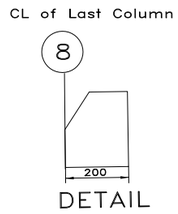
ELECTRONIC FILE NAME: 445-501-A002.

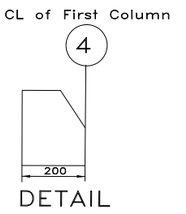
DRAWING NO. PE-DG-445-501-A003

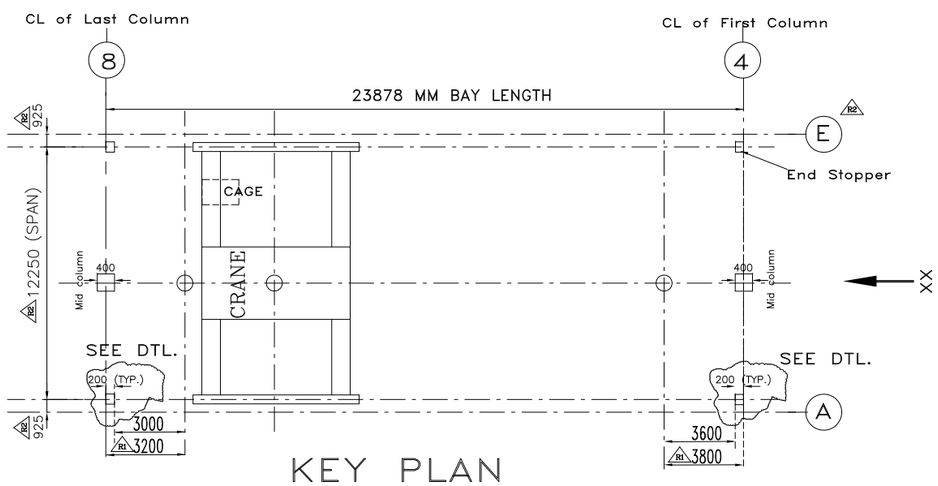




LONG TRAVEL WHEEL LOAD DIAGRAM (WITHOUT IMPACT)







KEY PLAN

NOTE:

1) DRAWING IS NOT TO THE SCALE.
2) ALL DIMENSIONS ARE IN MM & ELEVATIONS IN METRES.
3) THE WEIGHTS AND DIMENSIONS INDICATED ARE PRELIMINARY AND SUBJECT TO CHANGE DURING DETAIL ENGINEERING AFTER AWARD OF CONTRACT TO BHEL'S SUB CONTRACTOR.
4) TOP OF RAIL IS SUBJECT TO CHANGE DURING DETAIL ENGINEERING.
5) (*) MARKED DIMENSIONS ARE TO BE CONFIRMED BY CIVIL.

REFERENCE DRAWINGS:

1) MECHANICAL GA OF CW & ACW PUMP HOUSE –PE–DG–445–165–N004

PRELIMINARY

REV.	DATE	ALTD	CHD	APPD
02				
01	11-03-21	WH	RR	GB

REVISED AS PER COMMENTS.

CUSTOMER: THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.(WBPDCL)
1X660MW,SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)

CONSULTANT: DEVELOPMENT CONSULTANTS PRIVATE LIMITED
KOLKATA

BHARAT HEAVY ELECTRICALS LTD
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	DE/CN	WH		05.02.2021
	CHD	RR		08.02.2021
	APPD	GB		09.02.2021

TITLE CRANE CLEARANCE DIAGRAM OF CW PUMP HOUSE EOT CRANE

DEPT. | SCALE 1:200 | DRAWING NO. PE-DG-445-501-A003
SIGN
DATE | SHEET 3 OF 3 | REV. R02

SIZE-A0

ELECTRONIC FILE NAME:

SECTION IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

THE WEST BENGAL POWER DEVELOPMENT CORPORATION LIMITED

SAGARDIGHI THERMAL POWER PROJECT
1 x 660 MW UNIT NO. 5, PHASE – III

DOUBLE GIRDER CRANE
(ELECTRICAL PORTION)

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

388885/2021/PS-PEM-MAX

BHEL	TITLE: **TECHNICAL SPECIFICATION** **FOR** **DOUBLE GIRDER CRANE** **SAGARDIGHI THERMAL POWER PROJECT** **1 x 660 MW UNIT NO. 5, PHASE – III**	SPECIFICATION NO. VOLUME NO. : **II-B** SECTION: **C** REV NO. : **00** DATE: 08.04.21 SHEET: 1 OF 1

CONTENTS

SECTION	TITLE	NO OF SHEETS
I	SPECIFIC TECHNICAL REQUIREMENTS	1
I	ELECTRICAL SCOPE BETWEEN BHEL & VENDOR (ANNEXURE-I)	2
I	ELECTRICAL LOAD DATA FORMAT (ANNEXURE-II)	1
I	CABLE SCHEDULE FORMAT (ANNEXURE-III)	1
I	EXPLANATORY NOTES FOR CABLE ROUTING	2
I	TECHNICAL SPECIFICATION FOR MOTORS	10
I	MOTOR DATASHEET-A	1
I	SUB-VENDOR LIST	1
II	MOTOR DATASHEET-C	7
II	GENERAL TECHNICAL REQUIREMENT FOR LV MOTORS	4
II	SQP_LV MOTORS UPTO 55KW	2
II	SQP_LV MOTORS 55KW & ABOVE	9
II	CABLING, GROUNDING AND LIGHNING PROTECTION SPEC	34
II	ILLUMINATION SPEC	44

The requirements mentioned in Section-I shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-II.

BHEL	**TECHNICAL SPECIFICATION FOR DOUBLE GIRDER CRANE (ELECTRICAL PORTION)** **SAGARDIGHI THERMAL POWER PROJECT 1 x 660 MW UNIT NO. 5, PHASE – III**	SPECIFICATION NO. VOLUME NO. : **II-B** SECTION : **C** REV NO. : **01** DATE : 08/04/21 SHEET : 1 OF 1

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".
b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
d) Electrical load requirement for **Double Girder Crane.**
e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL
g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
h) Motor shall meet minimum requirement of motor specification.
i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
j) Cable BOQ worked out based on routing of cable listing provided by the vendor for "both end equipment in vendor's scope" shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

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

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

4.0 LIST OF ENCLOSURES

a) Electrical scope between BHEL & vendor (Annexure –I)
b) Electrical Load data format (Annexure –I)
c) Cable schedule(Annexure –I)
d) BHEL cable listing format (Annexure –I)
e) Technical specification for motors(Annexure –II)
f) Datasheets & quality plan for motors. (Annexure –II)
g) Technical specification for cabling, grounding and lightning protection(Annexure –II)

REV: 00 DATE: 11.03.2015

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

PACKAGE: DOUBLE GRIDER EOT CRANES

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

PROJECT: 1 **X 660 MW SAGARDIGHI TPP**

ANNEXURE-A

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

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

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

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

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

LOAD DATA (ELECTRICAL)	JOB NO.	475	ORIGINATING AGENCY		PEM (ELECTRICAL)
	PROJECT TITLE	SAGARDIGHI THERMAL POWER PROJECT, 1x 660 MW UNIT NO. 5, PHASE – III	NAME		DATA FILLED UP ON
	SYSTEM	DOUBLE GIRDER CRANE	SIGN.		DATA ENTERED ON
	DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

CABLE SCHEDULE FORMAT

ANNEXURE III

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

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

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
    a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
    b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
    f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
    g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

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

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V

(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

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

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

SECTION-I

SECTION - II

A.C. & D.C. MOTORS

1.00.00 SCOPE

1.01.00 This specification covers the general requirements of the electric motors for plant auxiliary equipment except for special application like crane, lift, submersible pump etc., motors for which are covered in individual equipment specifications.

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

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

2.00.00 STANDARDS

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

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

3.00.00 SERVICE CONDITIONS

3.01.00 The motors will be installed in hot, humid and tropical atmosphere, highly polluted area.

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

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

4.00.00 TYPE AND RATING

4.01.00 **A.C. Motors**

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

4.01.02 All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA) or closed air water cooled (CACW) type. Temperature rise shall be limited to 70 deg C by resistance method.

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

4.01.04 All LT motor shall conform to minimum efficiency performance standards (MEPS) of IE2 mentioned in IS: 12615. All HT motors shall have efficiency and power factor higher than 90% and 0.83 respectively.

4.01.05 The motor name-plate rating at 50°C shall have at least 15% margin for LT system and 10% margin for HT system, over the input power requirement of the driven equipment at rated duty point and also covering the maximum load demand of the driven equipment under entire operating range, including voltage and frequency variations, unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.06 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service. The direction of rotation of motor and its cooling fan should be properly matched with the driven equipment.

4.02.00 AC motor for VFD application (If applicable)

4.02.01 Inverter duty motors are designed according to the requirements of IEC/TS-60034 part17 & part 25 or NEMA MG-1, Part-30, Part 31 and have performance characteristics match with the driven equipment and variable speed requirement.

4.02.02 Induction motors to be operated in adjustable-speed drive applications should be de-rated as per NEMA/IEC standard due to the reduction in cooling resulting from any reduction in operating speed and the effect of additional losses introduced by harmonics generated by the control.

4.02.03 Inverter duty motors shall have VPI/improved insulation systems that do not degrade readily due to transient voltage spikes and have an adequate thermal margin.

4.02.04 Inverter duty motors shall be self ventilated without any auxiliary blower. Force ventilation shall be subject to purchaser approval.

4.02.05 Inverter motor shall be suitable for scalar (open loop) control, without any speed feedback signal, where fast response is not required. Vector (closed loop) control will be used with encoder if specified.

4.02.06 The breakdown torque at any frequency within the defined frequency range shall be not less than 150% of the rated torque at that frequency when rated voltage for that frequency is applied.

4.02.07 The motor should be capable of producing a breakaway torque of at least 140% of rated torque requiring not more than 150% rated current when the voltage boost is adjusted to develop rated flux in the motor and when the inverter is able to produce the required minimum fundamental frequencies

4.02.08 The motor shall be provided with insulated bearing on one side.

4.02.09 Normally the maximum safe speed shall be as per IEC/NEMA, however it should be coordinated with VSD requirement.

4.02.10 In case of a conflict, the requirement mentioned under clause no. 4.02.00 for motors for VFD application shall supersede the corresponding requirement for standard motors.

4.03.00 **D. C. Motors**

4.03.01 D.C. motor provided for emergency service shall be shunt wound type. It can also be of compound-wound type with the series field shorted.

4.03.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability. Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 PERFORMANCE

5.01.00 **Running Requirements**

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

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

5.02.00 **Starting Requirements**

5.02.01 Motor shall be designed for direct on line starting at full voltage. Starting current at rated voltage for LT motors shall be 6 times of full load current plus IS tolerance. For 3.3KV and 11KV motor except BFP, starting current shall be maximum 6 times of full load current inclusive IS tolerance. For Boiler feed pump motor, starting current shall be limited to 4.5times of full load current plus IS tolerance.

For D.C. Motors the starting current shall be limited to 2 times full load current.

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

5.02.03 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals without exceeding acceptable winding temperature.

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

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

5.03.00 Stress During Bus Transfer

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

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

5.04.00 Locked Rotor Withstand Time

5.04.01 For motors with starting time upto 20 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 2.5 secs.

For motors with starting time more than 20 secs. and upto 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 5 secs.

For motors with starting time more than 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 10% of the starting time

5.04.02 To prevent unwanted tripping of a high inertia load at start-up, there may be need to shunt out the motor's overload trip device. Speed switches mounted on the motor shaft may be provided in such case. Heating experienced during start-up must still be considered when sizing the motor.

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

5.05.00 Torque Requirements

5.05.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

5.05.02 Pull out torque at rated voltage shall not be less than 205% of full load torque.

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 Enclosure

6.01.01 Enclosures for the motor and the cable box shall conform to the degree of protection IP-55 unless otherwise specified.

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

6.01.03 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv. as detailed below:

a) Fuel Oil area : Group IIB
b) Hydrogen generation plant area : Group IIC (or Group-I, Div-II as per NEC or Class-1, Gr-B, Div-II as per NEMA/IEC60034)

Separate Canopy shall be provided for LT motors located in outdoor or semi-outdoor area.

6.02.00 **Cooling**

6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air cooled (CACA).

6.02.02 For large capacity motors, totally enclosed tube ventilated (TETV) may be considered for acceptance. In case of motors rated 3000kW and above, closed air circuit water cooled (CACW) motors may be offered for consideration before proceeding with design and manufacturing.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 HT motors shall have Class F insulation with winding temperature limited to 120ºC. Windings shall be impregnated to make them non-hygroscopic and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.

6.03.03 LT motors shall have Class F or higher insulation with temperature limited to 120ºC.

6.04.00 **Tropical Protection**

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

6.04.02 All fittings and hardware shall be corrosion resistant.

6.05.00 **Bearings**

6.05.01 Motor rated above 1000kW shall have insulated bearings to prevent flow of shaft currents.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings.

6.06.00 **Noise & Vibration**

6.06.01 Noise level shall not exceed 85 db (A) except for BFP motor for which the maximum limit shall be 90 db (A).

6.06.02 Peak amplitude of vibration shall be limited within the values prescribed in IS:12075 / IEC 60034-14.

6.07.00 **Motor Terminal Box**

6.07.01 Motor terminal box shall be detachable type, made of cast iron or pressed steel and located in accordance with Indian Standards clearing the motor base- plate/ foundation.

6.07.02 Terminal box shall be capable of being turned 360^{o} in steps of 90^{o}, unless otherwise approved.

6.07.03 Terminal box for all LT motors shall be diagonally split type and shall have the same degree of protection as motor.

6.07.04 The terminal box shall have sufficient space inside for termination /connection of suitable sized HT cables. Where the specified main cable size demands, adopter/extension box of suitable size shall be provided as a part integral to the motor, for easy termination of the cable.

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

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

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

6.07.08 For HT motor, the terminal box shall be phase segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match Owner's cable. All threads shall be ISO metric thread only.

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

6.08.00 **Grounding**

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

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

Motor above 90 kW	50 x 6 mm GI Flat
Motor above 30 kW upto 90 kW	35 x 6 mm GI Flat
Motor above 5 kW upto 30 kW	25 x 3 mm GI Flat
Motor upto 5 kW	8 SWG GI Wire

The above sizes shall be superseded by different sizes if so indicated in the relevant clause of the General Electrical Specification.

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

6.09.00 **Rating Plate**

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

a. Temperature rise in ^{o}C under rated condition and method of measurement.
b. Degree of protection.
c. Bearing identification no. and recommended lubricant.
d. Location of insulated bearings.

7.00.00 ACCESSORIES

7.01.00 General

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

7.02.00 Space Heater

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

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

7.03.00 Temperature Detectors

7.03.01 All HT motors shall be provided with minimum four (4) numbers simplex or two (2) numbers duplex platinum resistance type winding temperature detectors per phase.

7.03.02 Each bearing of HT shall be provided with minimum one (1) duplex or two (2) simplex type temperature detectors.

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

7.04.00 Indicator/Switch

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

a) HT motor bearing temperature.

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

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

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

7.05.00 Current Transformer for Differential Protection

7.05.01 Motor above 1000 kW shall be provided with three differential current transformers (PS class) mounted over the neutral leads within the enclosure. Matching three (3) numbers PS class CTs shall be mounted on the switchgear end.

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

7.06.00 **Accessory Terminal Box**

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

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

7.07.00 **Drain Plug**

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

7.08.00 **Lifting Provisions**

Motor weighing 25 kg. or more shall be provided with eye bolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

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

7.10.00 **Painting**

Motor including fan shall be painted with corrosion proof paints. The paint shade shall be as specified in the Annexure.

8.00.00 TESTS

8.01.00 Upon completion, each HT & LT motor shall be subject to routine tests as per Schedule-C of Section -I. In addition, any special test called for in the driven equipment specification shall be performed.

8.02.00 Unless and otherwise stated, Six (6) copies of routine test certificates shall be submitted for approval prior to the despatch of the motors from works.

8.03.00 The following type test reports shall be submitted for each type and rating of HT motor:

a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

b) Fault level withstand test for each type of terminal box.

c) Lightning impulse withstand test on the sample coil as per IEC 60034, part-15.

d) Surge withstand test on inter-turn insulation as per clause no. 5.1.2 of IEC 60034, part-15.

8.03.04 The following type tests shall be performed on a representative sample of 11000V and 3300V motor of each type & rating, even if type test certificates of these tests are submitted by the Bidder for Purchaser's approval:

a. Measurement of stator resistance (and rotor resistance on slip ring motors).

b. No load test at rated voltage to determine voltage, current, power input and speeds.

c. Locked rotor reading of voltage, current, power input and values of torque of motor.

d. Full load test to determine efficiency, power factor and slip.

e. Temperature rise test. During heat run test, bearing temperature, Winding temperature, core temperature, coolant flow and its temperature shall be recorded. In case temperature rise test is carried at any load other than rated load, specific approval for test procedure and method has to be obtained.

f. Momentary overload test.

g. Test for noise level of motor.

9.00.00 SPARE

Recommended spares for three (3) years operation shall be quoted along with the bid clearly identifying the part numbers with recommended quantities.

10.00.00 DRAWINGS, DATA & MANUALS

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

10.01.00 Along with the bid

a) List of the motors
b) Individual motor data sheet as per Annexures
c) Scheme & write up on forced lubrication system, if any.
d) Type test report

10.02.00 After Award of Contract for Information (I)/ Approval (A)

a) Dimensional General Arrangement drawing (I)
b) Foundation Plan & Loading (I)
c) Cable end box details.(I)
d) Space requirement for rotor removal (I)
e) Thermal withstands curves hot & cold (I)
f) Starting and speed torque characteristics at 80%, 100% & 110% voltage (A)
g) Complete motor data sheet (A)
h) Erection & Maintenance Manual (I)

ANNEXURE-A

SECTION-I

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11 kV, 3 Ø/, 3W, 50 Hz Non-effectively earthed Fault level 40 KA symm. for 3 second.	Motors above 1500 kW
H.T. Supply	3.3 kV, 3 Ø/, 3W, 50 Hz Non-effectively earthed Fault level 40 KA symm. for 3 second.	Motors above 160kW upto 1500 kW.
L.T. Supply	415V, 3 Ø/, 3W, 50 Hz Effectively earthed Fault level 50 KA symm. for 1 seconds.	Motors above 200W upto 160 kW
	240V, 1 Ø/, 2W, 50 Hz Effectively earthed	Motors below 200W Lighting, space heating, A.C. control protective devices
D.C. Supply	220V, 2W, unearthed Fault level 25* KA for 1 second (Min.)	D.C. alarm, control protective devices

* However actual value shall be substantiated by the bidder through calculation.

2.0 RANGE OF VARIATION

A.C. Supply

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

D.C. Supply

Voltage	:	190 to 240 Volt

3.0 Paint Shade : RAL 7032

TITLE		SPECIFICATION NO.	SECTION-I
	LV MOTORS	VOLUME	II B
	DATA SHEET-A	SECTION	D
	SAGARDIGHI THERMAL POWER PROJECT	REV NO. 00	DATE 08.04.21
	1 x 660 MW UNIT NO. 5, PHASE – III	SHEET 1 OF 1	

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	Upto & Including 160KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +5% TO –5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	* Above 90 kW upto & including 160kW(Breaker Controlled)	:	50 KA for 0.25 sec.
	* Rated upto & including 90 kW (Contactor Controlled)	:	50 KA protected by MCCB
	f) LV System grounding	:	Solidly
5.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
6.0	Minimum voltage for starting	:	80% of rated voltage
7.0	Power cables data	:	Shall be given during Detailed engg.
8.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
9.0	Space heater supply **(30KW & ABOVE)**	:	240 V, 1Φ , 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
11.0	Locked rotor current a) Limit as percentage of FLC	:	As per IS 12615
12.0	Makes	:	BHEL/ Customer approval (Package owner to take care)
13.0	Paint shade	:	RAL 7032
15.0	Additional tests	:	As per QP
14.0	Degree Of protection for motor/ terminal box	:	IP 55

* LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

- **Also detailed Customer spec. for Motors is to be referred as enclosed with technical spec.**

SECTION-I

ANNEXURE-I

SUB-VENDOR LIST

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

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

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

SCHEDULE-IIID/1

A.C. AND D.C. MOTORS

A.	A.C. MOTOR		
1.0	**GENERAL**		
1.1	Application		:
1.2	Quantity		:
1.3	Make		:
1.4	Frame Size		:
1.5	Applicable Standard		:
2.0	**TYPE AND RATING**		
2.1	Type of Motor		:
2.2	Service		:
2.3	Duty Cycle/Designation		:
2.4	Rated Continuous Output		
	At 40 Deg.C ambient	KW	:
	At 50 Deg.C ambient	KW	:
2.5	Rated Speed	r.p.m.	:
2.6	Rated Voltage & % variation		:
2.7	Rated Frequency & % variation		:
2.8	Combined voltage and frequency variation % (absolute sum)		:
2.9	Full load current	Amps	:
2.10	No load current	Amps	:
2.11	Rated Power Factor		:

2.12	Efficiency at rated voltage and frequency:					
	a) Full load	%	:			
	b) 3/4 load	%	:			
	c) 1/2 load	%	:			
3.0	**PERFORMANCE**					
3.1	Method of Starting		:			
3.2	Starting current at 110% voltage % f.l.c		:			
3.3	Starting Current at rated voltage	% f.l.c.	:			
3.4	Starting Torque at rated voltage	kg.m	:			
	a) Pull out torque	kg.m	:			
	b) Full load torque	kg.m	:			
3.5	Starting time at			80% Voltage	100% Voltage	110% Voltage
	a) With load	sec.	:			
	b) Without load (driven equipment Coupled)	sec	:			
3.6	Safe stall time at			80% Voltage	100% Voltage	110% Voltage
	a) Hot condition	sec.	:			
	b) Cold condition	sec.	:			
3.7	a) Heating time constant	min	:			
	b) Cooling time constant	min	:			
4.0	**CONSTRUCTION**					
4.1	Degree of Protection of Enclosure		:			
4.2	Method of Cooling		:			
4.3	Insulation Class		:			
4.4	Temperature Rise Over 50 Deg.C ambient (by resistance)		:			

4.5	Tropicalised	Yes/No:		
4.6	Winding Connection	:		
4.7	Bearings		D.E.	N.D.E.
	a) Make	:		
	b) Type	:		
	c) Recommended lubricant	:		
4.8	Motor Terminal Box			
	a) Type	:		
	b) Fault withstand Current KA	:		
	c) Fault Current Withstand Time Sec.	:		
	d) Cable lugs & glands furnished Yes/No	:		
	e) Position	:		
5.0	**ACCESSORIES**			
5.1	Space Heaters			
	a) No. x Watt	:		
	b) Volt, phase, frequency	:		
5.2	Winding temperature detector			
	a) Type	:		
	b) Nos. furnished	:		
5.3	Bearing temperature detector			
	a) Type	:		
	b) Nos. furnished	:		
5.4	Temperature Indicators			
	a) Type	:		
	b) Nos. provided	:		
	c) Locations	:		

5.5	Temperature Alarm Contact		
	a)	Nos. provided	:
	b)	Locations	:
	c)	Contact rating	:
5.6	Flow Switch		
	a)	Type	:
	b)	Nos. provided	:
	c)	Locations	:
	d)	Contact Rating	:
5.7	Current Transformer for differential protection		
	a)	Nos. provided	:
	b)	Current Ratio	:
	c)	Class	:
	d)	Knee point voltage	:
	e)	Excitation current at VK/2	:
5.8	Accessory Terminal Box		
	a)	No. provided	:
	b)	Cable glands furnished	Yes/No:
5.9	Speed Switch		
	a)	Type	:
	b)	Nos. provided	:
	c)	Locations	:
	d)	Contact Rating	:

6.0	GROUNDING		
6.1	No. of grounding pads provided		
	a) On motor body		:
	b) On terminal box		:
7.0	MISCELLANEOUS		
7.1	Type of mounting		:
7.2	Overall dimension (LxBxH) mm x mm x mm		:
7.3	Approximate Weight Kg		:
7.4	Moment of Inertia (Sq.GD)		
	a) Stator	Kg.Sq.m	:
	b) Rotor	Kg.Sq.m	:
	c) Total	Kg.Sq.m	:
7.5	Weight		
	a) Stator	Kg	:
	b) Rotor	Kg	:
	c) Total	Kg	:
B.	D.C MOTOR		
1.0	GENERAL		
1.1	Application		:
1.2	Make		:
1.3	Frame Size		:
1.4	Reference Standard		:
2.0	TYPE & RATING		
2.1	Type		:

2.2	Service		:
2.3	Duty cycle		:
2.4	Rated Continuous Output		
	a) at 40 Deg.C ambient KW		:
	b) at 50 Deg.C ambient KW		:
2.5	Rated voltage	Volt	:
2.6	Voltage range over which satisfactory Operation is guaranteed		:
2.7	Rated Current		
	a) Starting	Amp.	:
	b) Running	Amp.	:
2.8	Rated Speed	r.p.m.	:
3.0	CONSTRUCTION		
3.1	Enclosure		
	a) Type		:
	b) Degree of Protection		:
3.2	Method of Cooling		:
3.3	Insulation Class		:
3.4	Tropicalized?		:
3.5	Commutator Material		:
4.0	ACCESSORIES		
4.1	Motor Starter		
	a) Type		:
	b) Make		:
	c) Resistance	ohm	:

4.2	Space Heater		
	a) No. x KW		:
	b) Volts/Phase/Frequency		:
4.3	Motor Terminal Box		
	a) Type		:
	b) Cable lug/gland furnished		:
5.0	MISCELLANEOUS		
5.1	Overall Dimension (LxBxH) mm		:
5.2	Approx. Weight	Kg	:

BHEL	TITLE: GENERAL TECHNICAL REQUIREMENTs FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

BHEL	TITLE: **GENERAL TECHNICAL REQUIREMENTs FOR LV MOTORS**	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : **II-B** SECTION : **D** REV NO. : **00** DATE : 29/08/2005 SHEET : 1 OF 4

1.0 INTENT OF SPECIFIATION

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

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

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

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

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

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

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

3.5 **Stress During bus Transfer**

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

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

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

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

4.0 **CONSTRUCTIONAL FEATURES**

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

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

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

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

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

BHEL	TITLE: GENERAL TECHNICAL REQUIREMENTs FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : **II-B** SECTION : **D** REV NO. : **00** DATE : 29/08/2005 SHEET : 4 OF 4

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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	ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 of 2

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

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

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	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	TEST REPORT		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-	MANUFACTURER'S DRG./SPEC	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

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	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	-	ASTM-A388	MANUFACTURER'S STD.	INSPECTION REPORT	✔	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	INSPECTION REPORT		P/V	-	-	
		2. PHYSICAL COND.	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	INSPECTION REPORT		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	INSPECTION REPORT		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	TEST REPORT		P/V	-	-	

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	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180º	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-	

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Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	LOG BOOK		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	LOG BOOK		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	SAMPLE	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	LOG BOOK		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	

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Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	-	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	LOG BOOK	✔	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.SHADE	MA	VISUAL	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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Sign & Date	
Seal	

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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
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Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		4.RESISTANCE	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		5.INTERTURN INSULATION	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	THREE DIPS TO BE GIVEN

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Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		4.DURATION	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
		3.HV	MA	ELECT. TEST	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	100%	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	TEST/INSPC. REPORT	✔	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	
		4.DIMENSIONS	MA	MEAS.	100%	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	

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Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
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					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325//IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	W*	-	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	ELECT.TEST	100%	-	IS-325//IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	ELECT.TEST	100%	-	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT	✔	P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	-	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	ELECT. & MECH. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	TC	✔	P	V$	-	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	ELECT. & MECH. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TC	✔	P	V$	-	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	-	IS-325//IS-12615& DATA SHEET	IS-325//IS-12615 & DATA SHEET	TEST/INSPC. REPORT	✔	P	V$	-	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	-	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC	✔	P	W$	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

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					M	C/N				D	M	C	N	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / (#)	AS PER MANUFACT. STANDARD / (#)	INSPC. REPORT	✔	P	W	-	(#): REFER NOTE-8

NOTES:

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

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

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THE SAME IS VALID FOR 5 YEARS.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.

8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.

9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.

10 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,

P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

D: DOCUMENT

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BIDDER/ SUPPLIER	
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SECTION - VII

SECTION-II

ERECTION - CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM

1.00.00 SCOPE OF WORK

1.01.00 The scope of work covers complete and efficient design, supply, erection, testing and commissioning of cabling, electrical grounding and lightning protection system for the entire plant.

1.01.01 Area-wise, the scope shall broadly cover, but not be limited to :

A. Main Power House Building
B. Boiler area, ESP stack
C. Transformer yard, CHP, AHP, FGD area.
D. All auxiliary areas/ buildings (including electrical rooms of respective buildings) and structures of balance of plant (BOP) systems as details in the Lead Specification.
E. Overhead interplant cable trestle and pipe cum cable trestle.

1.01.02 Equipment-wise, the scope of work related to cabling, electrical grounding and lightning protection shall cover all electrical equipment as described in different Sections of the Specification.

1.02.00 Scope of work shall also include all civil and structural works (except cable trenches/tunnels and major equipment foundations) necessary for installation of cabling, electrical grounding and lightning protection system.

2.00.00 SCOPE OF SUPPLY & SERVICES

2.01.00 Scope of Supply

Scope of supply shall include but not be limited to the followings

2.01.01 Transportation to site in properly packed condition of all materials and miscellaneous items required to complete the erection work under this specification.

2.01.02 These materials and miscellaneous items shall include but not be limited to the following:

a) Galvanized steel rigid/flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanized sheet steel junction boxes, cable fixing clamps, nuts & bolts, etc. as required.

b) Cable trays, Fittings and Accessories

c) Cable termination and jointing kits as necessary.

d) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.

e) Mild steel rods for main ground mat, grounding electrode, column & structure grounding, risers etc.

Mild steel rod for vertical air terminals,

Materials for electronic grounding,

Galvanized steel flats for horizontal air terminals, for down conductors and for large equipment grounding

Galvanized wire (8 SWG) for small equipment grounding.

f) Fire-proof cable penetration sealing system,

g) Fire retardant cable coating system.

h) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work of Cabling, Grounding and Lightning Protection Systems shall be deemed to be included in the scope of this specification and shall be furnished by the Contractor without any extra charge to the Purchaser.

2.02.00 Scope of Services

The scope of Cabling, Grounding and Lightning Protection Systems includes but is not limited to the following:

2.02.01 Furnishing of all erection tools and tackles, testing equipment, implements, supplies, hardware and transport for timely and efficient execution of the erection work.

2.02.02 Erection work shall be performed with respect to all the equipment/materials mentioned under ‘Scope of Supply’.

2.02.03 Erection work shall also be performed with respect to the following items:

a) Cable trays and accessories

a) Power cables

b) Cables laid directly buried in ground

c) Control, instrument and special cables

3.00.00 GENERAL REQUIREMENTS

3.01.00 Codes and Standards

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

3.02.00 Erection Schedule

3.02.01 The Bidder shall agree to adhere to the Owner's Erection Schedule if such a schedule is attached with the Specification. Alternatively, in case the target completion dates alone are indicated, the Bidder shall furnish detailed erection schedules (starting from zero date) with separate 'S' curves for Cabling, Grounding and Lightning Protection works.

3.02.02 The erection schedule, as approved by the OE shall be strictly followed by the contractor. If the work is held-up for any reason, attributable to him or not, the same shall be brought immediately to the notice of the OE.

4.00.00 DESIGN CRITERIA

4.01.00 Grounding System

4.01.01 Grounding work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of bid. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
d)	Method of testing uniformity of coating on zinc coated articles	IS 2633
e)	COP for earthing	IS 3043
f)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
g)	IEEE guide for safety in AC substation grounding	IEEE 80
h)	IEEE recommended practice for grounding of industrial and commercial power systems	IEEE 142
i)	IEEE recommended practice for determining the electric power station ground potential rise and induced voltage from a power fault	IEEE 367
j)	IEEE guide for instrumentation and control equipment grounding in generating stations	IEEE 1050

4.01.02 Basic design criteria are delineated below:

a) The station grounding system shall be an interconnected network of MS conductor and MS ground rods. The system shall (a) provide safety to personnel from contact of dangerous potential caused by ground fault, (b) ensure sufficient grounding current for effective relaying and (c) stabilize circuit potential with respect to ground.

b) The station grounding system shall be designed in compliance with the IEEE- 80/ IEEE- 665 considering fault current of 50kA for 1 sec. and shall be subject to approval of the Owner.

c) Actual soil resistivity measurement shall be carried out at proposed site during dry season.

d) The surface resistivity shall be considered as 3000 Ohm-meter for gravel and 1000 Ohm-meter for concrete.

e) Major items of equipment, such as generator, switchgear, transformer, motor, relay panels and control panels etc shall have integral ground buses or connection points which shall be connected to the underground grid.

f) Electronic panels and equipment, where required, shall be grounded utilizing an insulated ground wire connected in accordance with the manufacturer's recommendations. Where practical, electronics ground loops shall be avoided. Where this is not practical, isolation transformers shall be furnished. All indoor and outdoor electrical equipment and associated non-current carrying system, metal works, support structures, buildings columns, fence, neutrals, masts, arrestors, etc shall be connected to the plant ground system.

g) Instrumentation cable screens shall be single point bonded to the instrument earth network to minimize the effects of electrical interference.

h) For Signal/case/intrinsically safe signal, grounding of control room instruments, separate earth pit not connected to main ground grid shall be used. Control cabinets shall be connected to this separate earth pit.

i) A grounding conductor (steel wire armour in case of cables with outer sheath) shall be routed parallel to all power conductors operating above 240 volts.

j) All ground wires installed in conduits shall be uninsulated.

k) Embedded grounding grid made of GI flat at basement/grade slab as well as upper floor/suspended slabs shall be provided.

l) In addition mild steel ground pads at different locations i.e. on wall/floor/ceiling inside the buildings/tunnels/trenches shall be provided. These pads will be in turn connected to below ground level earth mat through galvanized steel flat or riser. Each ground pad shall have provision for connection of at least two GI flats.

m) Treated earth pit shall be provided for system earthing at locations where generator and transformer neutrals are grounded. Two pits shall be provided for each neutral.

n) Dedicated treated earth pit shall be provided for lightning protection system.

o) Clean earthing for instrumentation shall be provided with dedicated earthing system and separate treated earth pits below the main control room, feed water pump house in turbine house etc.

p) Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

In order to meet the above design criteria, ground grid mesh will be provided for the main plant complex, viz., switchyard, transformer yard adjacent to power house building, power house building and boiler area up to stack, auxiliary buildings, etc. All electrical equipment, non-current carrying metal parts, structures, building steel, lightning protection system, generator/transformer neutrals will be connected to this station ground grid.

4.01.03 Other major design aspects that are to be considered for grounding system are given below:

1. Ground Grid Conductor

i) Ground grid conductor of mild steel rod shall be used.

ii) The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm per year over the design life of 30 years. However, the minimum size shall be 1x40 mm dia mild steel conductor.

2. Underground Grid

i) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80 & IEEE665.

ii) The ground grid conductors will be buried in earth at a minimum depth of 1000 mm. The length of ground conductors below earth will be sufficient to ensure a ground resistance less than 0.5 ohm.

iii) The ground grid conductor will be so laid as to provide short and direct connection to building steel and major electrical equipment.

iv) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.

v) All ground grid conductor connections will be welded type.

vi) Main Plant ground grid shall be connected with the other auxiliary building /area ground grid at least at two (2) points.

vii) For test pits, the electrode will be 100 mm dia. Heavy duty C.I. pipe with perforations. Electrodes installed in test pits will have disconnecting facilities

3. Above-ground Connections

i) Galvanized steel flats shall be used for all connections above earth.

ii) Inside building, ground conductors will be run for each floor supported on building steel and/or cable trays. These ground conductors in turn will be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.

iii) Two separate and distinct ground connections will be provided for each electrical equipment in compliance with I.E. Rules.

iv) All connections above ground will be welded type except connection to equipment/structures which shall be bolted type.

4. Equipment Ground Lead

Equipment ground connections will be sized to carry the available ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes.

5. Electronic Equipment Grounding

i) Internal ground connection of electronic panels shall be insulated from the enclosure, frame, and chassis are to be terminated to an insulated ground bus.

ii) Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.

iii) All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

iv) Electronic equipment and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system.

4.01.04 The minimum conductor sizes for connection of various equipment and structures shall be as given in the attached Notes and Details for Grounding & Lightning Protection Systems.

4.01.05 Entire erection of grounding work shall be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage / deformation.

4.02.00 Lightning Protection System

4.02.01 Lightning protection work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of bid. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	COP for the protection of building and allied structures against lightning	IS 2309
d)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
e)	Method of testing uniformity of coating on zinc coated articles	IS 2633
g)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
k)	IEEE guide for instrumentation and control equipment grounding in generating stations	IEEE 1050

4.02.02 Basic design criteria are delineated below:

a) The main purposes of the lightning protection system shall be (a) to provide protection to structures from lightning strokes and (b) to provide a low resistance-conducting path to lightning discharge.

b) Lightning protection shall be provided for Power House building, auxiliary building of CHP, AHP, FGD etc. and other structures.

c) Lightning protection will also be provided for building/ structures where the overall rise factor exceeds 10^{-6} as per IS: 2309.

d) For metal structures which are electrically continuous down to the ground level, no lightning protection is required except adequate grounding connections.

4.02.03 Other major design aspects that are to be considered for grounding system are given below:

a) Air termination network with down conductors and earthing electrodes will be provided on the basis of IS Code of Practice.

b) Vertical air terminals shall be of 20mm dia galvanized steel rod on the structure/building (except for chimney).

c) Horizontal air termination of 75x10 mm GS flat conductor on the roof of the installation shall be so laid out that no part of the roof will be more than 9 meters from the nearest conductor.

d) Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.

e) Down conductors of 75x10 mm GS Flat for all installations except for conveyor gallery will run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground. It shall be 25x3 mm GS flat for conveyor gallery.

f) An earth electrode of size 40 mm. diameter 3 metre long MS will be provided at the connection point of the down conductor with the station ground.

g) All connections will be of welded type.

h) Risers (for Lightning protection) shall be of 1x40 (minimum) mm dia. MS rod from underground mat to minimum 300 mm above grade level/concrete floor level.

i) Shielding mast shall be provided at the top of steel columns cap plates of power house building.

j) All other ancillary items in connection with the work described above shall be furnished to complete the work irrespective of whether such items may have been specifically mentioned or not.

4.02.04 All materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

4.02.05 Necessary drawings, data sheets and Technical leaflets for each piece of shop produced/fabricated items.

4.03.00 Cabling System

4.03.01 Cabling work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of bid. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	Steel tubes, tubulars and other steel fittings	IS 1239
d)	COP for installation & maintenance of power cables upto and including 33kV rating	IS 1255
e)	Degree of protection provided by enclosures for low voltage switchgear & control gear	IS 2147
f)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
g)	Method of testing uniformity of coating on zinc coated articles	IS 2633
h)	Flexible steel conduits for electrical wiring	IS 3480
i)	Cable Glands	BS 6121 / EN 50262
i)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
j)	Compression type tubular in-line connectors for aluminium conductors of insulated cables	IS 8309
k)	Conduits for electrical installation	IS 9537
l)	Joints & terminations for polymeric cables for working voltages from 3.3kV upto & including 33kV : performance requirements & type tests	IS 13573
m)	Conduit systems for electrical and communication installation	IS 14930

4.03.02 Erection of cabling work shall be carried out in such a way as to provide a reliable and assured electric power supply system to all station auxiliaries.

4.03.03 Cable routing will be done on unit basis as far as possible.

4.03.04 Cables will generally be laid on cable trays, cable trench, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle. Cables shall be run in concrete trenches in transformer yard and in those electrical rooms at ground level, which are without any spreader room below. However cable trench shall be avoided as far as possible in outdoor areas. Cables shall not be buried directly in ground unless explicitly permitted in some areas.

All cable trestle shall be provided with walkway by the side of cable tray for maintenance. Walkway shall have hand railing with 1200 mm minimum height.

4.03.05 Cables will generally be laid on cable trays, cable trench, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle. Cables shall be run in concrete trenches in transformer yard and in those electrical rooms at ground level, which are without any spreader room below.

4.03.06 Cable trench shall be avoided in boiler area and in outdoor areas as far as practicable. Cable shall be laid on cable trays along overhead pipe bridges. Where such overhead pipe bridges are not available, overhead pipe trestles are to be erected for taking the cable racks/trays. Cables buried directly in ground are not acceptable.

4.03.06 In indoor mechanical equipment areas like pump houses, overhead cable trays shall generally be used.

4.03.07 For underground crossing of railways, road, etc. additional protection shall be provided in form of Hume pipe or concrete encased rigid steel conduits (duct bank).

4.03.08 A.C. and D.C. circuit will not be run in same cable. Further, separately fused circuit will run in separate cables.

For Instrumentation cabling system, Bidder shall refer VOL-IIE, Section I of General Technical Requirement Under "C&I Cabling".

4.03.09 Cables for redundant equipment system shall be run in separate trays, as far as possible.

4.03.11 Erection of cabling work shall be executed keeping in view all necessities and requirements of fire fighting codes for Generating Stations having an adverse industrial environment.

4.03.12 Suitable embedded steel inserts shall be provided on wall/floor/ ceiling surfaces for welding of cable tray bracket in order to make the cable tray system withstand, in addition to normal tray cable loadings, horizontal/vertical accelerations due to seismic forces for indoor trays and also wind load for outdoor trays such as on Boiler platforms.

4.03.13 Erection work to be carried out under this specification shall conform to the ‘Notes and Details for Cabling System’ given in Annexure-A and the drawings attached to this specification.

5.00.00 SPECIFIC REQUIREMENTS - SUPPLY

5.01.00 Equipment and Material

5.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.

5.01.02 All accessories, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

5.01.03 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

5.02.00 Conduits and Accessories

5.02.01 The contractor shall provide and install all conduits, mild steel pipes, flexible conduits, rigid PVC pipes, etc. complete with accessories like tees, bends, adopters, locknuts, pull boxes, conduit plugs, caps, etc as required for the cabling work. Conduits shall be furnished in standard length of 5 metres, threaded at both ends.

5.02.02 Conduits diameter upto and including 25mm size shall be of 16 SWG and conduits above 25 mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 20 mm.

5.02.03 Conduits shall be made of hot-dip galvanized steel with an organic corrosion resistant ID coating. In chemical handling areas, battery room, etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion. Conduits, fittings & accessories shall have ISI mark.

5.02.04 For sizes above 63 mm, hot dip galvanized - both on inside and outside - steel pipes with necessary fittings & accessories shall be provided and installed by the contractor. The pipes and fittings shall be of heavy duty class with relevant ISI mark.

5.02.05 Flexible conduits complying to relevant IS and made with bright, cold-rolled, annealed and electro-galvanized mild steel strips shall be used between embedded conduits/pipes and the motor terminals. It shall also be used between fixed conduit and any equipment with vibration or equipment requiring regular removal.

5.02.06 Non-metallic conduits made of HDPE outer jacket with friction-reducing permanent internal lining shall generally be used for control & instrumentation cables in some areas where cable trays do not exist and where the runs are

straight ones Necessary fittings & accessories as may be required for the installation shall also be provided.

5.03.00 Junction Box

5.03.01 Technical requirement for both non-metallic type and galvanized steel Junction Boxes are given below. Unless the choice is specifically mentioned in the General / Lead Electrical Specification or elsewhere in the tender document, galvanized steel Junction Boxes shall be offered.

Non-metallic Junction Boxes:

a) Material of the Junction Boxes shall be halogen-free and silicon-free, glass fibre-reinforced polycarbonate for outdoor use and/or for cable sizes more than 50 sq.mm. Material shall be ABS/ polycarbonate for indoor use and/or for cable sizes upto 50 sq. mm. Junction boxes for use with fire-survival cables shall be of Duro-plast / powder-coated metal.

b) Material of all non-metallic junction boxes shall be fire retardant and self-extinguishing in accordance with UL 94 V0. It should be tested at Glow Wire test for 960º C.

c) Boxes shall be suitable for continuous operation at an ambient temperature range of -10º C to +80º C.

d) The impact strength of polycarbonate enclosures/boards i.e. the degree of protection against mechanical shock load shall be in accordance with EN 50298-98 for IK 08 (5 Joule).

e) Degree of protection shall be IP 66 to EN 60529. Junction boxes shall have integrally embedded gaskets made of Polyurethane.

f) Allowing a minimum of 20% spare terminals after complete termination, the terminal board for control and instrumentation JBs shall have 6 /12 / 24 / 36 / 48 ways.

g) Doors shall have stainless steel quick fastening screws.

h) The boxes shall be complete with all brackets/fasteners as required for installation on walls, columns and structure.

5.03.03 Steel Junction Boxes

a. Junction boxes with IP 55 (for Indoor) / IP 65 (for Outdoor) degree of protection, shall comprise of a rectangular parallelepiped case hinged door with Handle constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the box shall be arranged to slope towards the rear of the box. Gland plate shall be 3mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of

adequate strength and rigidity, hot dip galvanized as per relevant IS with epoxy powder coating paint RAL 7032 with min painting thickness 80 micron and suitable for mounting on wall, column, structures etc. The boxes shall be complete with M8 earthing stud and all brackets/fasteners as required for installation.

b) No. of Ways: 6 / 12 / 24 / 36 / 48 with 20% spare terminals after termination.

c) All outdoor JBs shall be similar but with a canopy at the top.

d) Doors shall be hinged and lockable and shall be made of the same material as the case. The doors shall have industrial heavy-duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

e) The junction boxes shall have the following indelible markings:

i) Circuit nos. on top by white-stenciled paint at site.

ii) Circuit nos. with ferrules (inside) as per approved drawing.

iii) Danger sign in case of 415V circuit.

5.04.00 Terminals

5.04.01 Multiway terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.

5.04.02 Each control cable terminal shall be suitable for connection of 2 nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.

5.05.00 Cable Termination & Straight through Joints

5.05.01 Bidder shall supply cable termination and jointing kits in requisite quantity for H.T. Power Cables, L.T. Power, Control Cables, Instrumentation Cables, etc. along with all accessories & consumables required for making termination and joints complete. Those shall be of proven design and make which have already been extensively used and type tested.

5.05.02 Components shall be pre-moulded type, taped type or heat-shrinkable type. 11kV and 3.3kV grade joints and terminations shall be type tested as per IS: 13573.

5.05.03 Kits shall be complete with the alumunium solderless crimping type cable lugs and ferrule as per DIN standard.

5.06.00 Cable Glands

Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS 6121 or to EN 50262. Ingress Protection rating for cable glands with seal, when offered conforming to EN 50262, shall be minimum IP 66 in line with BS. Cable glands shall be made of tinned brass gland, double compression type complete with necessary armour clamp and tapered washer, etc. Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall match with the sizes of different cables supplied/erected.

5.07.00 Cable Lugs

Cable lugs shall be suitable for termination of different cross-sections of H.T./L.T./Control/Instrumentation cables and shall be of following types:

i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.

ii) Copper tubular terminal end for solderless crimping to copper conductors.

Solderless crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

iii) Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ring type / U type to suit the terminals provided in the panels.

5.09.00 Cable Clamps and Straps

5.09.01 Trefoil clamps for single core cables shall be pressure die-cast aluminium or fibre glass or nylon with necessary G I fasteners. Trefoil clamps shall have adequate mechanical strength to forces generated by peak value of maximum system short circuit current.

5.09.02 Cable clamps required for multicore cables on vertical run shall be made up of 25x3mm size aluminium strip. For clamping the multicore cables, self-locking, de-interlocking type fire-resistant nylon clamps/straps of sufficient strength shall be used.

5.10.00 Consumables and Hardware

5.10.01 The Contractor shall furnish all erection materials, hardware and consumables required to complete the installation.

5.10.02 The materials shall include but not be limited to the following:

Consumables : Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials, etc.

Hardware : Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims, etc.

5.10.03 Supply of cement, sand, stone, etc. required for the execution of the contract shall be the responsibility of the Contractor.

5.11.00 Testing Equipment

5.11.01 The major testing equipment that are required to be provided by the Contractor are listed below:

a) Insulation Tests

i) Power operated Meggar - 1 KV and 10 KV grade

ii) Hand operated Meggar - 1 KV grade

b) Hand driven earth Resistance Meggar, range 0-1/3/30 ohms.

c) High potential testing set - roller mounted type

d) Tong testers of suitable ranges.

e) Contact resistance measuring set for micro-ohms.

f) Torque wrench of various sizes.

g) Multimeters, test lamp, field telephone with buzzer set, different gauges, etc.

5.11.02 The list of equipment is indicative only. Any other test equipment required will be arranged by the Contractor.

6.00.00 METHODS AND WORKMANSHIP

6.01.00 All work shall be installed in a first class, neat workmanlike manner by mechanics/ electricians skilled in the trade involved.

6.02.00 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

6.03.00 All details on installation shall be electrically and mechanically correct.

6.04.00 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

7.00.00 INSTALLATION

7.01.00 General

7.01.01 Installation work shall be carried out in accordance with good engineering practices and also as per manufacturer's instructions/ recommendations where the same are available.

7.01.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

7.01.03 Cable installation work shall mean erection of cable trays/racks, supports, hangers, junction boxes, conduits, laying of cables either in ground or on trays inside trenches tunnels/overhead trays in conduits, etc. dressing and clamping, jointing and termination inclusive of supply of necessary jointing/ termination kits, lugs, glands, ferrules, tapes, etc. and other accessories, grounding of cable armour. In case of direct laying in ground, all excavation work, necessary back-filling, supply of bricks and protective concrete slabs, removal of excess earth shall be part of the installation work.

7.01.04 Grounding installation work shall mean erection, jointing/ brazing/ welding, connection and painting, testing of ground conductors including supply of necessary steel/copper.

7.01.05 Lightning protection system installation work shall mean erection, jointing, welding, connection and painting, testing of air termination network, down conductors, shielding masts, connection to ground grid, electrodes, risers, horizontal conductors, etc. of lightning protection system.

7.02.00 Cable Trays

7.02.01 Pre-fabricated cable trays and accessories shall be assembled & erected at site. Adequate spaces will be provided to facilitate installation of cable system and to allow routine inspection and modification after installation.

7.02.02 Cable trays either inside concrete trenches or inside buildings and racks inside cable shafts shall be aligned and leveled properly. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings.

7.02.03 As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.

7.02.04 The cable trays shall be supported in general at a span of exceeding 1.25 metres horizontally and 1.0 metre vertically.

7.02.05 Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access, for installing & maintaining the cables.

7.02.06 Complete cable tray support structure after installation shall be inspected/ tested for welding strength, straightness, accuracy, use of proper sizes and compliance to drawings.

7.02.07 Complete cable tray and accessory installation work shall be inspected/tested for proper alignment, leveling, use of proper accessories, high quality workmanship, etc.

7.02.08 The Contractor shall remove the RCC/steel trench covers whenever required and shall again place the same in their positions after the erection work in the particular area is completed or when further work is not likely to be taken up for some time.

7.02.09 Whenever any pipe/conduit/cable tray emerges out or enters into a building care should be taken to ensure that no water enters into the building.

7.02.10 Cable trays in areas subject to excessive coal dust, oil spillage, mechanical damage or accessible to personal contact shall be provided with raised sheet metal tray covers, installed on upper tray in horizontal run and front in vertical run.

7.02.11 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way.

7.02.12 Cable tray/conduit system will be so designed as to accommodate maximum pulling tension and minimum bending radius of cable.

7.02.13 Cable tray/conduit system will be constructed to prevent drainage of water into equipment or building.

7.02.14 Cable tray/conduit system shall be electrically continuous and grounded.

7.02.15 Different voltage grade cables will be laid in separate trays when trays are run in tier formation. Power cables will normally be on top trays and control/instrumentation cable on bottom trays.

7.03.00 Cable and Conduits

7.03.01 The Contractor shall install, terminate and connect up all cable and conduits as per drawings and cable schedules.

7.03.02 The drawings shall be strictly followed except where obvious interference occurs. In such cases, the routing shall be changed as directed and/or approved by the Engineer.

7.03.03 Approximate lengths of cable and conduit runs will be shown by the contractor in the cable schedule for guidance only. Before commencement of work the Contractor shall take actual measurements and prepare his own cable-cutting schedule to reduce wastage to a minimum.

7.03.04 The Contractor shall also maintain and submit when requested, a record of cable insulation value when drawn from store, after laying, before and after termination/jointing.

7.03.05 Where direct heat radiation exists, heat isolating barriers, shall be adopted for cabling system.

7.03.06 Cabling/wiring in offices, laboratories, control rooms etc. shall be taken through concealed G.I. or rigid PVC pipes as directed by the owner's Engineer.

7.03.07 At certain places where hazardous fumes/gasses may cause fire to the cables, cable trenches after installation of cables shall be sand filled.

7.04.00 Conduit and Accessories

7.04.01 Conduit/pipes shall be used only in short lengths in certain areas where required and/or as directed by the Engineer.

7.04.02 The Contractor shall furnish all conduits complete with accessories as required.

7.04.03 Conduits shall be flexible type in general. However, rigid type steel conduit if required shall also be supplied by the Contractor.

7.04.04 Except for inside an enclosure wherever the cable enters or leaves the conduit, the conduit end shall be sealed by suitable sealing compound, having fire withstand capability.

7.04.05 The entire metallic conduit system, when embedded or exposed shall be electrically continuous and grounded.

7.04.06 Where it is possible for water or other liquids to enter conduits, sloping of conduit runs and drainage of flow points shall be considered.

7.04.07 Pull boxes will be installed between termination points where required to facilitate cable pulling, but at a maximum interval of 30 meters.

7.04.08 Conduits shall be firmly fastened within 900 mm of each junction box/pull box/cabinet/fitting, etc. Conduits shall be supported at least every 2000 mm.

7.05.00 Cables: Storage and Handling

7.05.01 Cable drums shall be stored on hard and well-drained surface so that they may not sink. In no case shall the drum be stored on the flat, i.e., with flange horizontal.

7.05.02 Rolling of drums shall be avoided as far as practicable, for short distance, the drums may be rolled provided they are rolled slowly and in proper direction as

marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cable.

7.05.03 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending. The drum shall be rolled on the spindle slowly so that the cable should come out over the drum and not below the drum.

7.05.04 While laying cable, cable rollers shall be used at an interval of 2000 mm. The cables shall be pushed over the roller by a gang of people positioned in between rollers over a suitable distance. Care shall be taken so that kinks and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be used. Cables shall not be dragged on ground or along structure while laying out from cable drums. Cable shall not be pulled from the end without having intermediate pushing arrangement. Bending radius of the cable during installation shall not be less than what is specified by the manufacturer.

7.05.05 Empty cable drums shall be returned to the Owner.

7.06.00 Cable Laying

7.06.01 Cable shall generally be installed in ladder type prefabricated trays except for some short run in rigid/flexible conduit for protection or crossings.

7.06.02 Cables laid on trays and risers shall be neatly dressed and clamped with self-locking type fire resistant nylon ties at an interval of 750 mm. for horizontal and vertical runs, in case of both power, control and instrumentation cables.

7.06.03 Single core power cables for 3 Ph. AC circuits shall be laid in trefoil formation and suitably clamped with self-locking type fire resistant nylon ties at an interval of 750 mm.

7.06.04 L.T. multicore power cables with cross-sectional area of 95 sq.mm and above and all H.T. multicore power cables and shall be clamped individually by self-locking type fire resistant nylon ties.

7.06.05 L.T. power cables of cross sectional area less than 95 sq.mm and all control and Instrumentation cables shall be clamped in bunches with self-locking type fire resistant nylon ties. The number of cable in one bunch shall not exceed eight (8).

7.06.06 Prior to laying of cables inside the indoor and outdoor trenches, the contractor shall properly clean the trenches.

7.06.07 In outdoor areas, buried cables shall be laid and covered with sand/riddled earth and protected from damage by bricks at sides and precast slab at top.

7.06.08 When buried cables cross road/railway track, adequate protection shall be provided in the form of hume/galvanised iron pipes laid at a minimum depth of 1 meter below ground.

7.07.00 Cable Tags & Markers

7.07.01 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedules. Cables and conduits shall be tagged at their entrance, bends, every 30.0M and exit from any equipment, junction box. When a cable/conduit passes through a wall, tags shall be fitted on both sides of the wall.

7.07.02 The tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of 16 SWG G.I. wire. For single core cable the wire shall be of non-magnetic material.

7.07.03 Location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscription 'cable-joint'.

7.07.04 Contractor shall furnish and install all tags and markers stated above.

7.07.05 For buried cable, the marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change of direction.

7.08.00 Cable Termination and Connection

7.08.01 Termination and connection of cables shall be done strictly in accordance with manufacturer's instruction, drawings and/or as directed by the Engineer.

7.08.02 Work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. All equipment required for all such operations shall be of Contractor's procurement. Furnishing of all consumable materials such as soldering material, electrical tape, sealing material as well as cable jointing kits shall be included in the offer.

7.08.04 Cable joint kits for all cables shall be supplied by Contractor under this specification. Responsibility for proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by Contractor.

7.08.05 The equipment will be generally provided with blank bottom plates for cable/conduit entry and cable end box for power cables.

7.08.06 The Contractor shall perform all drilling, cutting on the blank plate and any minor modification work required to complete the job.

7.08.07 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires major modification, the same shall be carried out by the contractor.

7.08.08 Control/instrumentation cable cores entering control panel/ switchgear/ MCC, etc. shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.

7.08.09 The Contractor shall put ferrules on all control cable cores in all junction boxes and at all terminations. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic & interlocked type.

7.08.10 Spare cores shall be similarly ferruled, crimped with lug and taped on the ends. Spare cores shall be ferruled with individual cable number.

7.08.11 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.

7.08.12 All cable entry points shall be properly sealed and made vermin and dust proof. Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least three hours.

7.08.13 Strips and special tools like manually or pneumatically driven gun/pistol for termi-point/equivalent connection shall be supplied by the Contractor.

7.09.00 Cable Joints

7.09.01 Cable shall be installed without joints as far as practicable.

7.09.02 If however jointing becomes necessary, it shall be made only by qualified cable jointer and strictly in accordance with manufacturer's recommendation.

7.10.00 Grounding

7.10.01 If supply and laying of the underground mat is included in the scope of the Contractor, the Contractor will plan and organize works to lay the grounding mat in the same sequence in which the building and equipment foundation is being done.

7.10.02 Underground mat will be made of mild steel rods laid underground in length and breadth of the area at a depth of minimum 1 metre below grade level. All crossings and straight run shall be arc welded for good electrical continuity. Ground conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 300 mm below the bottom elevation of such trenches/pipes as shown in the relevant drawing.

7.10.03 Contractor shall carryout the interconnection among various peripheral earthing grids/mats, steel structures, lightning protection system as well as grounding of all electrical equipment, etc. The grounding work shall be carried out as per provisions of I.E. rules, Indian standards and Annexure-E: Notes & Details for Grounding & Lightning Protection System.

7.10.04 Grounding shall be done by conductors of adequate sizes (size shall be selected by the bidder with supporting calculation, if not specified) and the same shall be connected to the risers of main ground mat.

7.10.05 For fabricated cable trays, a separate ground conductor (50x6 mm G.S. flat) shall run along the entire length of each route of cable tray being suitably clamped on the cable tray. Individual cable trays of each section shall be connected to above ground conductor through 50x6 mm G.S. flat to maintain continuity of ground path.

7.10.06 All ground conductor connections shall be made by electric arc welding/ brazing unless otherwise specified. Ground connections shall be made from nearest available station ground grid risers. The rods/connection shall be coated with cold galvanizing /weather resistance anti corrosive paints.

7.10.07 All ground conductors shall be painted black for easy identification.

7.10.08 Equipment ground connections, after being checked and tested by the Engineer, shall be coated with anti-corrosive paint.

7.10.09 Whether specifically shown or not in Project drawings, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. shall be effectively grounded.

7.10.10 If there is no provision to ground the L.T. transformer neutral at transformer end, to make an effectively earthed 415V system the neutral bus of all 415V distribution boards shall be connected to ground grid at two different and distinct points.

7.10.11 Ground Electrode

Ground electrodes are to be fabricated and driven into the ground by the side of mat conductor. All connections to the conductors shall be done by are wilding process.

7.10.12 Risers

Risers are required for connecting the equipment and structures with the ground mat. These will be 1x40 mm dia (minimum) M.S. rod. laid from ground mat to above ground level properly clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat shall be done by arc welding and the other end is to be kept free at least 300 mm above grade level/concrete floor level unless otherwise shown.

7.10.13 Column Grounding

All columns are required to be grounded by 1x40 mm dia (minimum) M.S. rod from ground mat. Laying, supporting along with foundation, connecting at ground mat are within the scope of this specification. At least 300 mm length

of the above rods shall be left free above the grade level/concrete floor level for connection with columns.

7.10.14 Electronic Equipment Grounding

Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chasis and to be terminated to an insulated ground bus.

Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.

All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

Electronic equipment and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system. Separate Earth pit shall be made by 3M X 3M MS Rod.

7.11.00 Painting

Contractor shall paint steel fabrications at site with two (2) coats of red oxide primer and two (2) coats of battleship grey (shade no. 632 of IS:5) synthetic enamel paint. In case a different kind of primer or a finish shade is mentioned in the Lead/General Specification due to especially corrosive atmosphere, the same shall be followed.

7.12.00 Galvanizing

Galvanizing shall be uniform, clean, smooth, continuous and free from acid spots. Should the galvanizing of the samples be found defective, the entire batch of steel has to be re-galvanized, at Contractor's cost. The amount of zinc deposit shall not be less than 610 grams per square metre of surface area. Additionally, the thickness of the zinc deposit at any spot shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by appropriate instrument and reject any component which shows thickness of zinc at any location less than 75 microns.

7.13.00 Excavation and Back Filling

7.13.01 Contractor shall perform all excavation and backfilling to the original level with good consolidation as required for buried cable and ground connections. Sheeting and shoring shall be done as necessary for protection of the work.

7.13.02 Contractor shall make his own arrangements for pumping out any water that may be accumulated in the excavation.

7.14.00 Steel Fabrication

7.14.01 All racks, trays, supports, hangers & brackets wherever necessary shall be fabricated by the Contractor.

7.14.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge and burns so as not to cause any damage to personnel or cables.

7.15.00 Cleaning up of Work Site

7.15.01 The Contractor shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.

7.15.02 Upon completion of work, the Contractor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

8.00.00 TESTS

8.01.00 Shop Tests

8.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.

8.01.02 Tests on panels/junction boxes shall include:

a) Wiring continuity tests.
b) High voltage and insulation tests.
c) Operational tests.

8.02.00 Site Tests

8.02.01 Contractor shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.

8.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

8.02.03 All power cables after installation and prior to connections shall be subjected to High Potential tests. Also the insulation resistance values shall be measured both before and after Hipot test for comparison. The leakage current shall also be measured during the Hipot test at site.

Cable cores shall be tested for :
a) Physical damage
b) Continuity
c) Correctness of connections as per relevant wiring diagram
d) Insulation resistance to earth
e) Insulation resistance between conductors

f) Proper earth connections of cable glands, cable boxes, cable armour, screens etc.

8.02.04 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

8.03.00 Test Certificates

8.03.01 Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

9.00.00 DRAWINGS, DATA & MANUALS

9.01.00 To be submitted with the Bid

9.01.01 Make, type and catalogue number of different electrical items and accessories along with technical leaflets, data sheets etc.

9.01.02 Typical General arrangement drawings showing constructional features, fixing arrangement of pre-fabricated cable trays.

9.01.03 Bill of Materials for cable trays and accessories, conduits & accessories.

9.01.04 Layout of Grounding system & lightning protection system showing connection and other details along with backup design calculations and detailed write up.

9.01.05 Bill of materials for grounding and lightning protection system.

9.01.06 Drawing showing details of equipment grounding.

9.02.00 To be submitted after Award of Contract

9.02.01 Make, type & catalogue number of cable termination kits, joints & accessories.

9.02.02 Detail dimensional drawings showing constructional features, grounding, fixing arrangement etc.

9.02.03 Bill of Materials for Pre-fabricated cable tray and accessories, Conduits & accessories.

9.02.04 Dimensional G.A. drawings and data sheets for different equipment and items supplied under this specification.

9.02.05 Layout drawing of Grounding system and Lightning protection system showing connection details along with backup design calculation and detailed write up.

9.02.06 Bill of material for grounding system and lightning protection system.

9.02.07 Drawing showing details of equipment grounding system.

Annexure-A

DETAILS FOR FIRE-PROOF CABLE PENETRATION SEALING SYSTEM

1.00.00 General

1.01.00 The Fire proof sealing, fire stop system and fire protection coating system are required to prevent spreading of fire from one place to other place (or one zone to other zone) through the openings in wall / floor, cables laid in trays / racks and openings below Electrical Switchgear, MCC, DB,/ Cabinets, Panels etc.

1.02.00 The fire-proof cable penetration (FPCP) sealing system shall conform to the requirement of BS: 476 Part 20 (latest edition with all amendments).

2.00.00 Scope of Work

The scope of work includes but is not limited to the following items of supply and installation:

i) Fire Stops in wall and floors

ii) Fire stops below switchgear, MCC, Switchboards, DBs, junction boxes / panels / cabinets, etc. which are floor mounted type

iii) Fire retardant coating to be applied for installed cables

iv) Fire proof barrier walls

v) Fire proof doors

vi) Minor civil and structural works for installation of the entire work

vii) Necessary erection materials, consumables and sundry items to complete the work for satisfactory and trouble free operation

viii) Any special tools & tackles

ix) Conducting the type test of fire proof sealing system in presence of Owner's Engineers

x) All relevant Drawings, Data sheets and instruction manuals

3.00.00 Design Criteria

3.01.00 Fire Proof Cable Penetration Sealing System

The material / components used for fire-proof sealing (FPCP) system shall be provided to meet the following requirements:

i) The product shall be age tested for not less than 30 years.

ii) Shall be free from shrinkage or cracking; should achieve smoke and gas tightness during fire and should be modifiable.

iii) Not to generate toxic or corrosive gas and cause harm to the personnel handling the system.

iv) Prohibition of production of acid or alkali during gas generation.

v) Shall be repellant to pest / rodent / termite.

vi) Expansion co-efficient - very low which is to be comparable with masonry concrete.

vii) Not soluble / reactive to acid, water, alkali.

viii) Thermal conductivity - low.

ix) The material in contact with the cables in the FPCP sealing system shall be compatible with the material used for outer sheath of cables.

x) It should not have any adverse effect on the cables and should not alter the current carrying capacity of the cables.

xi) Retrofit in design to accommodate not less than 15% more addition of cables depending upon the size of cables, physically and chemically stable.

xii) Capable of withstanding vibrations, drop-loads, foot traffics, mechanical loads, etc.

xiii) The sealing system shall maintain its integrity and perform satisfactorily even after

a. Remaining in water for a long time.

b. Accelerated thermal aging.

c. Sustaining vibrations.

xiv) The design and construction of FPCP sealing system shall specifically take into account the fact that under seismic disturbances, normal load, short circuit and fire conditions, the cable / cable trays will be subject to movement, expansion and oscillation and this shall not result in any damage or cause dislocation of the FPCP sealing system or the material constituting the FPCP sealing System.

xv) Non-hygroscopic, non-inflammable and shall not get affected over a period of time due to humidity, moisture and ozone etc. and should not

contain volatile solvents which may cause a fire hazard during application.

xvi) The fire sealing system to be installed at floor openings below C&I panels, control panels/boards etc. in Central Electrical Room, Central Control Room, Central Electronic Room shall have a fire rating of not less than two (2) hours. The fire sealing system to be installed at all other places like the rest of the wall and floor crossings of cables/cable trays, openings below Switchgears/Boards etc. shall have a fire rating of one (1) hour. The system shall be stable after application of water jet in the exposed side in order to extinguish fire.

3.02.00 Fire Protection coating to be applied on installed cables:

A. The cables shall be coated with fire protection material of 2 mm dry thickness at the strategic locations as follows so as to limit the spread of fire:

i) At fire stops in walls and floors on either side upto 500 mm length.

ii) At fire stop below Electrical Switchgears/ MCCs/ Panels/ Cabins, etc. on one side coating of 500 mm length, i.e., on the cable vault side / cable trench side.

iii) Length of 500 mm on all sides of the junction/crossing of cabling work in open cable routes/ cable trench.

iv) In fire risk areas and where specified at suitable intervals as decided upon side conditions in open cable routes.

v) Where necessary and specified at site intervals along cable routes in cable trenches.

vi) The coating shall be applied evenly on the cables only.

B. The fire protection coating shall have the following properties/composition:

i) Asbestos-free, non-volatile, not eatable by vermin, harmless and non-irritant to human skin.

ii) Not affecting the current carrying capacity of the cables and the properties of the installed cables.

iii) It shall delay fire damage to cables and prevent flame spreading meeting the requirement of IEC - 332.

iv) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum 12 times the diameter of the maximum size cable at 180°C.

v) The limiting oxygen index of the material shall not be less than 60% as per ASTMD - 2863.

vi) Life expectancy equivalent to the cable installations.

3.03.00 The various openings in the cable vault, vertical, horizontal raceways of cables penetrating walls, floors and the bottom of Electrical switchgears, MCCs, distribution boards, Cabinets, Panels shall be provided with fire stop systems. Cables passing through the openings at various locations are laid on various tiers of the cable trays/ racks in the bunch formation. Bidder shall visit the site to assess and get acquainted with the type of cable installation where fire stops and fire protection coating are to be provided. In case steel frames are required to be fabricated and fixed in the openings, the fabrication of frame & fixing of the same shall have to be done by the Contractor without any extra cost. The necessary steel section for fabrication of frames shall be supplied by the Contractor without any extra cost. Any civil works required to be done in the openings shall be carried out by the Bidder. Bidder shall also include one set of tools & accessories required for addition or removal of cables after the seal is made.

3.04.00 The bidder shall quote the unit rates for provision of supply, installation, testing & commissioning of the fire proof seals as given in the specification. Bidder is requested to quote the unit rates per square metre (i.e., area) basis of the area of the fire sealing material.

4.00.00 Type Test on Penetration Seals

4.01.00 The type tests for fire proof/ penetration seal for floor and wall opening/ fire stop system for bottom of electrical switchgear/ MCC/ panel base are as under:

i) Fire rating test

ii) Hose Stream test

iii) Accelerated aging test

iv) Fire rating test on the penetration seal system built out of accelerated aged components followed by hose stream test

v) Temp. rise test for cable in the fire stop

vi) Water absorption test followed by fire rating test

vii) Flame Resistance test for fire retardant coating material

viii) Anti-rodent test

4.02.00 Fire Rating Test

This test shall be carried out to prove the guaranteed power rating duration of the system in respect of stability, integrity and insulation characteristics of the complete system. The penetration seal system as a whole conforming to ASTM 814 and as per BS:476 Part-8 shall be built with the necessary component. The fire test shall be built with the necessary component.

The test specimen of the penetration seal built with 9-10 nos. armoured cables of various sizes passing through the seal shall be fitted to the gas fired furnace and shall form the upper most face of the furnace. The gas fired furnace shall have provision to achieve standard time temperature characteristics for fire tests as mentioned in BS-476 Part-8, according to which the temperature required to be maintained are as under:

Heating time (minute)	30	90	120	150	180	210	240
Furnace temp (°C)	821	886	1029	1062	1090	1113	1133

The pressure inside the furnace at the time of test shall be more than 2 mm water gauge. The penetration shall be subjected to fire test with surface exposed to controlled fire in the furnace conforming to time / temperature characteristics as mentioned above. During the test, temperatures of both the faces of the penetration seal i.e. one which is exposed to fire and the other unexposed, shall be measured by calibrated thermocouples after regular interval of 5 minutes. At least 3 thermocouples shall be provided for temperature measurement of each face.

4.03.00 The results at the end of the tests shall be interpreted or failure criteria as under:

i) The system is deemed to have failed to maintain stability if there is a total collapse of the penetration seal.

ii) In case cracks are seen on the face of the penetration seal or cracks through the seal system through which the flame / or gas can pass, the system is deemed to have failed to maintain integrity. The development of crack is characterized by ignition cotton wool held near the seal on the unexposed surface at a distance of about 30 mm from the aperture.

iii) In case the mean temperature rise of unexposed surface of seal exceeds 140°C above the initial temperature or temperature of unexposed surface exceeds 180°C, the system shall deemed to have failed in respect of insulation characteristics.

iv) Temperature measurement on the unexposed side of the penetration seal specimen shall be measured by the thermocouple on the surface of penetrating items and on fire stop material in accordance with ATME-814/UL 1479 at a distance of 25 mm from fire stop material and penetration items respectively.

4.04.00 Hose Stream Test:

The intention of the hose stream test is to ascertain whether the penetration seal assembly maintains its stability on application of water jet after withstanding the fire for 3 hours i.e. the guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for carrying out the fire rating test. The penetration seal system shall be subjected to the action of hose stream at the nozzle pressure of 30 psi supplied for a duration of 1.5 sec./ sq.ft.. of exposed area. The hose stream shall be applied with 1.1/ 8" dia. nozzle at a perpendicular distance of approximately 17 ft. from the centre of the assembly on a line approximately 270 deg. from the line normal to the centre for the test assembly. The water stream shall be applied within 4 minutes and 30 seconds after completion of fire rating test.

However, this period shall not exceed more than 10 minutes in case of practical difficulties experienced by testing stations. The application of water stream shall be maintained throughout the test duration and shall traverse the complete fire stop system.

The fire stop assembly is deemed to have passed the hose stream test successfully if no through projection of water is noticed on the unexposed surface of the seal. Further on completion of hose stream test, the appearance of the penetration seal system shall not alter substantially indicating thereby that the stability of the system has been maintained.

4.05.00 Accelerated aging test

The intention of accelerated aging test is to ascertain whether the artificial aging of the systems and components thereof results into change in the mechanical properties or in the form. In order to simulate aging, artificial aging shall be resorted to.

For the purpose of subjecting the penetrations seal system components to accelerated aging, the system / components shall be stored for 336 hours in air furnace where the temperature of the inside air, shall be maintained at 100° C. However, for system components in pliable form, system component shall be stored for 448 hours in air furnace where temp. of air inside the furnace shall be maintained at 75° C. It is assumed that the changes occurring during test period would roughly correspond to the effect on aging over a period of about 40 years.

After completion of 336 hours / 448 hours, the mechanical properties such as tensile strength element, elongation and hardness of the material (as may be applicable) shall be tested. These results shall be compared with corresponding values before subjecting to accelerated aging test.

The change in the form of system / components shall also be compared with the form before the tests to ascertain whether the system / components thereof have undergone any permanent change.

In case the mechanical properties before and after the accelerated aging do not indicate substantial change, the system shall be deemed to have passed the accelerated aging test. Similarly the variation in the form of the system components at the end of the test shall not indicate permanent deformation which is likely to affect the ceiling properties of the system.

4.06.00 Fire Rating test After Accelerated Aging:

Intention to this test is to ascertain whether the penetration seal built out of components already subjected to accelerated aging still passes the fire rating test for guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for fire rating test mentioned above. The assembly or the penetration seal shall be carried out with the components which were subjected to accelerated aging test based on the test procedure mentioned above. In case there is a problem of co-ordination with the test station, the prototype assembly may be subjected to aging in manufacturer's works under the conditions mentioned above and live fire test should be carried out at manufacturer's works in presence of Owner's representative.

In live fire test, the temperature of fire shall be of the order of 1000° C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

The interpretation of test results for failure shall be similar to those mentioned under fire rating test/live fire test above.

4.07.00 Temperature rise test for cable in the fire stop:

This test shall be carried out to ascertain whether due to inadequate dissipation of heat at the location of fire stop, the temperature of cable conductor or outer sheath in contact with the fire stop, rises beyond the acceptable limits due to which whether any derating is required for cables.

Fire stop systems shall be erected with, at least 8-10 armoured cables, specially power cables. While laying the cable through penetration seal, thermocouple shall be placed on the outer surface of cable in contact with the fire stop system. The location shall be selected where there exists possibility of inadequate dissipation of heat from cables to the atmosphere due to fire stop components. Two thermocouples shall also be located on the two surfaces of the fire penetration seal system. Similarly thermocouples shall also be placed on the other surface of cables where there exists contact of free air without any obstruction so as to enable adequate nature cooling.

In case the temperature of outer surface of the cable in contact or inside the fire stop system does not exceed 75° C, it is inferred that no derating of cable is required for cable when used in conjunction with the particular fire stop system.

Test shall be repeated with reduced current till the temperature of cable outer surface in contact with fire stop system is limited to 75°C. The rate of the current so guaranteed by the cable manufacturer as free air rating shall be the derating factor.

4.08.00 Water Absorption Test:

The test specimen shall be immersed in fresh clean water at a temp. of 20°C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hours soak period, the specimen shall be removed from the water and moped up with a damp cloth.

Fire rating test after water absorption is to ascertain whether the penetration seal subjected to water absorption still passes the fire rating test for guaranteed fire rating duration.

Test apparatus for this test shall be similar to the one used for fire rating test. In case there is problem of coordination with test stations, the prototype assembly may be subject to water absorption test at manufacturer's works followed by live fire test which should be carried out at manufacturer's works in presence of Owner's representative. In line fire test, the temperature of furnace shall be of the order of 1000°C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

4.09.00 Flame Resistance Test for fire Retardant Coating Material:

Sample strips shall be of ½ " wide, 12" long and approximately 70 mills in thick (without any reinforcement). Each strip shall be held vertically (clamped at the top) in a natural gas burner flame, (blue cone of flame touching bottom edge of sample) for 10 minutes. The flame shall then be removed and observation shall be recorded. In case, any flaming of the samples should cease after the removal of gas burner. White charred length of the sample should not exceed 1 & ½".

4.10.00 Anti-Rodent Test:

Physical tests:

a) This test shall be carried out to ascertain the anti-rodent properties of the components of the Fire proof sealing system.

b) This test shall be carried out at approved test station performing sealing system tests on pharmaceutical products. The complete Fire Proof sealing system shall be subjected to attack of inspect / vermin such as rate for about 20 days.

c) At the end of the test condition of the surface of Fire Proof sealing system the test material shall be compared with the surface condition before commencement of the test. The fire stop shall be deemed to have passed this test in case no marks of growth are seen on the surface.

5.00.00 Test Certificates

5.01.00 Certified copies of all tests carried out at works and at site shall be furnished in requisite number of copies.

5.02.00 Test reports shall be complete with all details and shall also contain limit valves specified in the relevant standards, wherever applicable, to facilitate review of Test Report/ Certificates.

5.03.00 The fire proof sealing system shall be installed only after receipt of approval of the test reports.

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SECTION-VI

TECHNICAL SPECIFICATION

ILLUMINATION SYSTEM

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SECTION - VI

ILLUMINATION SYSTEM

1.00.00 SCOPE OF SUPPLY

1.01.00 The work involves timely procurement and transportation to site in properly packed condition of all equipment, materials and miscellaneous items required to complete the project.

1.02.00 The equipment and materials within the scope of supply shall include but not limited to:

a) Lamp and LED type lighting fixtures and related LED accessories.

b) Lighting panels/ boards : main lighting distribution boards, emergency lighting distribution boards, emergency DC lighting panels, street lighting panels. All panel shall be provided with energy saving system.

c) Street light poles, flood lighting towers/poles/high masts.

d) Ceiling fans, receptacles, switches, switchboards, portable emergency lights, portable 24V supply module including handset as maintenance equipment etc.

e) Cables, wires, splicing/termination/connection accessories including 4 way/3 way/2 way cable junction boxes with disconnecting devices on each way.

f) Conduit and accessories, junction and pull boxes, terminal blocks.

g) Grounding materials and connections.

h) All fittings, supports, brackets, anchors, clamps and connections.

i) Steel for field fabrication of supports and brackets.

1.03.00 Carrying out of detail engineering, including detail design calculations, preparation of lighting layouts showing location of fixtures, cable, wires conduit routing, indicating number and size of wires in each conduit and preparation of cable schedule and other related drawings as detailed in subsequent clauses consider the energy saving and energy efficient illumination system.

1.04.00 Preparation of “As built” drawings at the option of owner.

1.05.00 Special tools and tackle.

1.06.00 Spare parts

1.07.00 All relevant drawings, data and instruction manuals.

2.00.00 CODES AND STANDARDS

2.01.00 Major standards, which shall be followed, are listed below. Other applicable Indian standards even if not covered in the listed standard shall be followed.

a) IS-1913

b) IS-2148

c) IS-2147

d) IS-1944

e) IS-3646

f) IS-5572

g) IS-6665

h) National Electrical Code

i) Indian Electricity Rules

j) Indian Electricity Act.

3.00.00 DESIGN CRITERIA

3.01.00 Design Basis

3.01.01 The system provides lighting and electric power supply to Main Plant Boiler Turbine, Generator area along with balance of plant areas (viz. CHP, AHP, FGD etc.). In addition, it also provides lighting to selected areas during plant emergency conditions.

3.01.02 The system will be installed in an adverse industrial environment. Equipment in some areas will be subject to vibration, coal-dust, fly-ash, oil/water vapours as prevalent in a thermal generating plant.

3.01.03 The design shall be such as to provide minimum lighting levels as specified for different areas.

3.01.04 The Bidder shall carefully consider these lighting levels and layouts in making the offer and shall clearly indicate if any change is required to achieve the design lighting levels with the equipment offered.

3.01.05 The systems shall be suitable for operation on available power supply having characteristics as given in the annexure.

3.01.06 All fittings of control room / office shall be automated control with energy efficient type lighting fixture and lamps.

3.01.07 The main plant & auxiliary building and other BOP area shall generally be provided with

- ❖ Main lighting system for full illumination under normal power supply conditions and shall operate from 415V/240V AC power supply tapped from respective MLDB/lighting panels.
- ❖ Emergency lighting system for reduced illumination operated by DG supply feeders during failure of main power supply. It shall cover 20% of fixtures in the building and associated area.
- ❖ Minimum emergency lighting system for reduced illumination during failure of main power supply with the help of 220V DC batteries/supply feeders. This is applicable for Coal Handling Plant also. Regarding lux level of emergency lighting in CHP area, please refer to Annexure-B.

3.01.08 Various lighting panel shall be fed directly from nearest Main Lighting Distribution board. All MLDBs shall have duplicate incomers and a bus-section. These MLDBs shall be fed from respective 415V switchgear/PMCC through 2x100%, 100-150KVA, Dyn11, 1:1 Dry type, isolating transformers to reduce fault level below 9kA. Each MLDB shall have outgoing feeders TPN MCCB with earth leakage current protection. The transformers may, preferably, be located inside the MLDB itself.

3.02.00 System Concept

The lighting system shall comprise following sub-systems:

3.02.01 Normal A.C. Lighting

a) This will be provided by A.C. lighting fixtures distributed throughout the plant area. These lights will be ON as long as the station / normal A.C. supply is available.

b) A.C. lighting fixtures will be fed from respective area lighting panels (LP), which in turn will be connected to nearest main lighting distribution board (MLDB). The lighting panels shall be provided with at least 20% spare outlets.

c) Arrangement shall be made for automatic daylight controlling in switchyard, boiler gallery, ESP area, turbine floor (high bay), transformer yard area as required.

3.02.02 Emergency A.C. Lighting

a) On failure of normal A.C. Supply, emergency A.C. lighting will be provided in selected areas for safe movements and operation of important auxiliaries.

b) Emergency A.C. lighting fixtures will be fed from respective area emergency lighting panels (ELP) either through cable junction box or direct, which in turn will be connected to emergency AC Main Lighting Distribution Board (ACEMLDB). It should be fed from Emergency MCC

and same like MLDB. The emergency lighting panels shall be provided with at least 20% spare outlets.

These lights will be kept "ON" from normal power supply source. But failure of normal power supply these will be fed from DG through 415V Emergency MCC. This change over of power supply will be done by automatic switching.

c) A.C. emergency lighting fixture [such as Power house(all area), ESP and ESP building, boiler(all areas and floors), switchyard, CW pump house control and switchgear room, transformer yard, auxiliary building etc.] will account for 20% of the total lighting fixtures except in main control room and DG room wherein 30% A.C. Emergency lighting shall be provided.

3.02.03 Emergency D.C. Lighting

a) This will be provided by D.C. lighting fixtures located strategically in critical operating areas and emergency exits. Emergency D.C. lighting fixtures will be fed from respective area DC lighting panels (DCLP) either through cable junction box or direct, which in turn will be connected to DC Emergency Lighting Distribution Board (DCELDB).

These lights will be ON all the time - normally from station A.C. Supply, but on its failure from station D.C. supply through automatic switching. DC emergency lighting fixtures shall account for 10% of the total fixtures provided in critical operating areas.

Emergency D.C. Lighting (for CHP, AHP, FGD areas)

a) This will be provided by emergency A.C / D.C. lighting fixtures located strategically in critical operating areas and emergency exits. Emergency DC lighting will be catered by DC Emergency Lighting Distribution (DCELDB) boards. These DCELDBs will feed the DC emergency lighting fixtures directly and through a numbers of DC emergency lighting panels (DCLP) located suitably in respective areas.

b) The DC Emergency Lighting Distribution Boards will be fed from two power sources, namely -

i) Main Lighting Distribution Board (MLDB).

ii) 220V DC distribution boards (DCDB).

These lights will be ON all the time - normally from station A.C. supply, but on its failure from respective DCDB through automatic switching.

3.02.04 Street/Area Lighting

Time switch will be used for controlling area/outdoor/coal yard/marshalling yard lights with provision for manual override and also have the provision of proven Energy Saving Systems.

Street light powered by solar energy for remote areas shall be preferred.

.

Illumination shall be provided from cable/pipe bridge running parallel and closed to the road instead of providing conventional lighting poles wherever possible.

3.02.05 Remote Emergency Lighting

This will be provided in isolated building/area/mobile equipment viz. stacker–reclaimer [where D.C. supply is not available] by self-contained battery/ automatic charger/inverter/flood light units. These portable emergency light units will be energized automatically on loss of normal A.C. supply.

3.02.06 Portable 24V supply module

24V power supply module complete shall be provided for 24V as maintenance lighting. (Not applicable for CHP)

3.02.07 Control Philosophy in Control Room / Offices with false ceiling only

Automatic lighting control solutions shall be provided to reduce energy usage by eliminating over-illumination. These solutions provide centralized control of lighting, allowing easy implementation of scheduling, occupancy control, daylight harvesting etc.

Occupancy sensors to allow operation for whenever someone is within the area being scanned can control lighting. When motion can no longer be detected, the lights shut off. Passive infrared sensors react to changes in heat, such as the pattern created by a moving person. The control must have an unobstructed view of the building area being scanned. Ultrasonic sensors transmit sound above the range of human hearing and monitor the time it takes for the sound waves to return. A break in the pattern caused by any motion in the area triggers the control. Ultrasonic sensors can see around obstructions and are best for areas with cabinets and shelving, restrooms, and open areas requiring 360-degree coverage. Occupancy sensors utilizing both passive infrared and ultrasonic technology shall be used to control fixtures and lamps.

In addition Suitable LED fixture shall be provided near transformer, switchyard equipment which shall be made ON during maintenance work.

3.03.00 Ratings & Requirements

3.03.01 All equipment and accessories shall be designed for continuous operation under site conditions without exceeding permissible temperature rise as stipulated in relevant standards.

3.03.02 Switch, fuses, MCCB, miniature circuit breakers (MCB), busbar shall be fully rated for short circuit level at the point of application. MCB shall have back-up HRC fuse if its rating is less than the available short circuit current.

3.03.03 All equipment and accessories shall have proper enclosure to suit the site conditions. In hazardous areas all equipment and accessories shall have flame-proof enclosure.

3.03.04 Wiring from lighting panels to fixtures and from lighting panels to 5/15A receptacles shall be carried out by PVC insulated wires through G.I. Conduits.

3.03.05 Heavy duty XLPE FRLSH power cables as per IS 7098 will be used for connections as follows:

a) From Main Lighting Distribution Board (MLDB) to Area Lighting Panel.

b) From Emergency Main Lighting Distribution Board (ACEMLDB) to Emergency Lighting Panels (ELP).

c) From DC Emergency Lighting Distribution Board (DCELDB) to DC Lighting Panels (DCLP).

d) From Street/Area lighting panel to street light poles / Flood Light Tower.

e) From welding DB to receptacles of 63A and above.

In main power house, Boiler, transformer yard, CWPH, ESP area and other areas like AHP, CHP, FGD etc. the 63A power receptacle shall be fed from separate Welding DBs. Each Welding DB shall be fed through 1:1, 100kVA isolating transformer. The transformer shall preferably be located inside the Welding DB panel itself. Maximum 12 nos. outgoing feeders shall be provided from each Welding DB.

Minimum Number of welding DBs to be provided:

a) Main Power House : 2 nos.
b) AHP area : 1 no.
c) CHP area : 1 no.
d) Boiler area : 2 no.
e) ESP area : 1 no.
f) CW PH area : 1 no.
g) FGD area : 1 no.

3.03.06 Inside Switchboards wiring shall be carried out with 1100V PVC stranded copper wire.

3.03.07 Distinctive earth terminal shall be provided either inside or outside of each equipment included under the scope of the bidder.

3.04.00 Method of Calculation

3.04.01 Standard Lumen method shall be adopted for interior & exterior lighting in order to calculate the number of lighting fixtures for obtaining the desired average level of illumination.

3.04.02 The coefficient of utilization shall be considered to take care of Lumen loss due to:

a) Effect of room dimensions.

b) Absorption of light in luminaires.

c) Absorption of light at various room surfaces i.e ceiling wall etc.

d) Floor cavity, ceiling cavity.

e) Mounting height.

3.04.03 Moreover a maintenance factor shall also be considered to account for the fall of illumination due to aging, pollution like dust deposit etc. Maintenance factors to be considered for various areas shall be as follows:

Area	**Maintenance factor**
Control Room	0.75
Switchgear/MCC Room	0.65
General indoor area	0.60
Dusty Area	0.55

Light loss Factor

It is recommended that in interiors with fairly clean atmosphere, for example, offices, air conditioned factory interiors etc, a light loss factor of 0.8, in interiors which are prone to accumulate dust faster, for example, most in industrial interior an LLF of 0.7 and in high dirt prone interiors an LLF of 0.6 may be adopted for calculating the no. of luminaires to be installed for a particular service illuminance.

3.04.04 To achieve the recommended luminance relationship, it is necessary to select the reflectance of all finishes of the room surfaces. The recommended reflectance values for industrial interiors and equipment are given bellow for bidder's guide lines:

Reflectance values

(For station / other BOP area except CHP)

Surface	Reflectance Percentage
Ceiling	80-90
Wall	40-60
Desk and Bench tops, machines And equipment	25-45
Floor	not less than 20

CHP Requirement:-

For Dusty area such as conveyor galleries, TPs, crusher house etc.:

Surface	Reflectance Percentage

Ceiling	50
Wall	30
Floor	10

3.04.05 Lux level to be considered for various areas are given in Annexure-B.

3.04.06 Voltage drop at the fixture from the MLDB bus shall not exceed 3%.

3.04.07 Circuit loading of each lighting Panel shall be done as per relevant codes/Indian Standards in such a way that almost balanced loading in all the phases i.e. R, Y & B is achieved.

3.04.08 At least two (2) sub circuits shall be used for illumination of a particular area.

3.04.09 Sub circuit loading of each lighting panel shall be restricted to 2000 Watts.

3.04.10 The working plane shall be considered at 0.85 m from the floor level.

3.04.11 Calculation can be done through proven software program by maintening uniformity ratio as per relevant IS.

4.00.00 SPECIFIC REQUIREMENTS - SUPPLY

4.01.00 Equipment and Material

4.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.

4.01.02 Equipment and materials furnished shall be complete and operative in all details.

4.01.03 All accessories, control devices, internal wiring, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

4.01.04 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

4.02.00 Lighting Fixtures

4.02.01 Lighting fixtures shall be designed for minimum glare. The surface finish shall be smooth, unobtrusive, scratch resistant and no bright spots are produced either by direct light source or by reflection. Fixture shall conform to latest IS / IEC and its latest amendment

4.02.02 All lighting fixtures shall be complete with LED (energy efficient type) for lighting. LED lamp fixtures shall be complete with all necessary wiring such as control gear & it's accessories ignitor, power factor improvement capacitors (if required) etc. These shall be mounted in the fitting assembly only. The Contractor shall indicate starting time of these lamps to attain full light output. Curves for starting characteristics with varying supply voltage

etc. are to be furnished by the Contractor.

4.02.03 Flood lighting shall have suitable base plate/frame for mounting on structural steel member.

4.02.04 Fixture shall be suitable for 20 mm conduit entry and 16 SWG G.I. earth wire connection.

4.02.05 High bay fixtures shall have provision for vibration damper to ensure rated lamp life. Cost of each damper shall be separately indicated.

4.02.06 Fixtures shall be fully wired up to respective terminal blocks, suitable for loop in and loop out connection of PVC stranded wires of following sizes:

a) Lighting fixture : 2.5 mm^2 Copper - Two (2) Numbers

b) Flood Light fixture : 2x2.5 mm^2 Copper - Two (2) Numbers

4.02.07 Reflector shall be of sheet steel or aluminium, minimum 20 SWG thick, securely fixed by fastening device of captive type.

4.02.08 Lamp holders

Lamp holders shall be for LED lamp.. Holders shall be designed and manufactured in accordance with relevant standard to give long and satisfactory service.

4.02.09 Capacitors

Capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits. Capacitors shall be suitable for operation at the supply voltage as specified and shall have a value of capacitance so as to correct the power factors of its corresponding lamp circuit. Capacitors shall be hermetically sealed in a metal enclosure.

4.02.10 Ballasts (if required)

Ballasts shall be designed, manufactured and supplied in accordance with latest edition of IS and function satisfactorily under site condition specified. The ballasts shall be designed to have a long service life. The power loss in ballasts (if required) for LED lamps shall not be more than the specified watts as per relevant standard.

Ballasts shall be mounted using self-locking, anti-vibration fixing and shall be easy to remove without dismantling the fixtures. They shall be totally enclosed units.

The ballasts shall be of the inductive, heavy duty type, filled with thermosetting, insulating, moisture repellent polyester compound filled under pressure or vacuum. The ballast wiring shall be of copper wire. Ballasts shall be designed for maximum winding temperature rise of 55^0C under rated conditions. They shall be free from hum. Ballasts for LED lamps shall be provided with suitable tapping to set the voltage within the range specified. End connections and taps shall be brought out in a suitable terminal block, rigidly fixed to the ballast enclosure. Separate ballasts for each lamp shall be

provided in case of multi-lamp fixtures.

4.03.00 Lamps

The LED lamps to be supplied shall conform to IS 9974 or latest edition. LED lamps shall be suitable for use in any position. Restrictions, if any, shall be clearly stated. The lamps shall be capable of withstanding small vibrations without breakage of connections at lead-in wires and filament electrodes.

The Bidder shall furnish typical wiring diagrams for all fittings including all accessories. The diagrams shall include technical details of accessories i.e. ignitors, ballasts, capacitors etc.

4.05.00 Lighting Panel

4.05.01 Lighting panels shall be metal-enclosed, cabinet type, fabricated from CRCA sheet steel minimum 2 mm thick, suitable for either wall/column mounting on brackets or floor mounting on channel sills.

4.05.02 Indoor Lighting Panels shall be dust and vermin-proof, IP-52; outdoor panels shall be weather-proof with canopy, IPW-55 or better.

4.05.03 Lighting Panels shall be so constructed as to permit free access to the terminal connections and easy replacement of parts. Front access doors shall have padlocking arrangements.

4.05.04 Lighting panels shall have provision of cable entry from top and bottom, as required, with removable gland plates. Necessary double compression type brass cable glands, tinned copper/Aluminium cable lugs are to be furnished.

4.05.05 Two ground pads with M10 G.I. bolts and nuts shall be provided on each Lighting Panel for connection to ground conductor.

4.05.06 Each Lighting Panel shall be complete with designation and caution notice plates fixed on front cover and a circuit directory plate fixed on inside of the front cover. Circuit directory plate shall contain details of the points to be controlled by each circuit including the location of the point controlled, rating of the protective units and loading of each circuit.

The plates shall be of anodized aluminium with inscriptions indelibly etched on it.

4.05.07 Bus bar shall be electrolytic grade hard drawn aluminium, colour coded for easy identification and designed for a maximum temperature of 85ºC. Minimum size shall be 25 x 6 mm.

4.05.08 Incoming and outgoing circuits shall be terminated in suitable terminal blocks.

4.06.00 Panel Equipment

4.06.01 Each panel shall have an incoming triple pole MCCB with neutral link and a number of outgoing miniature circuit breakers (MCB).

4.06.02 Panel access door shall be interlocked with incoming MCCB such that the door can be opened only when the MCCB is in OFF position. Means shall be provided to defeat this interlock.

4.06.03 All MCCB shall be single throw, air break, heavy duty type having quick-make quick-break contacts. Contactors shall be air break electromagnetic type. Push buttons shall be push to actuate type.

4.06.04 MCB shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.

4.06.05 Time switch in street lighting panels shall be clock switch type with ON-OFF time setting facility, which shall ensure respective ON-OFF operation in every 24 Hours cycle. Voltmeter/Ammeter shall be of accuracy class 2.0 or better as per IS: 1248. Voltmeter/Ammeter selector switch shall be of reputed make.

4.07.00 Receptacle

4.07.01 Receptacles shall be heavy duty, complete with individual plug and switch as detailed in the annexure. For Residential building, Electrical room, Pump room, Control Room 16/6 Amp receptacles shall be considered.

4.07.02 The conduit box of the receptacle shall be provided with earthing screws with washer and nuts welded on the surface for grounding with 16 SWG G.I. wire. Arrangement shall be provided inside the conduit box for grounding of third pin.

4.07.03 Shrouded type plug shall be provided with corresponding matching arrangement at sockets to prevent accidental contact with finger during plug insertion.

4.07.04 63 Ampere three phase four pin receptacle shall be provided at each major plant maintenance area.

4.08.00 Fans & Regulators

4.08.01 The fans shall have three well balanced metallic blades, and shall be reasonably free from noise. Pedestal fans shall also be provided as per requirement.

4.08.02 Fan motor shall be totally enclosed type with copper winding and class E insulation.

4.08.03 Regulator shall have minimum five steps in modular size. Electronic regulator with smooth control is to be provided.

4.09.00 Switch & Switch Board

4.09.01 All switch boards/boxes shall be of bent steel construction, fabricated of 14 SWG M.S. sheet with 6 mm thick colour matching FRP/ Non- Hygroscopic Synthetic cover with brass fixing screws.

4.09.02 Switch boards/boxes located in control room and office areas shall be flush mounted type on brick wall with only the switch knob projecting outside.

4.09.03 Switch boards/boxes shall have conduit knock outs on the sides. Adequate provision shall be made for ventilation of these boxes.

4.09.04 Flush type receptacles where provided shall be so located that only the plug projects outside.

4.09.05 Switches shall have quick-make and quick-break mechanism operated by a suitable external handle complete with position indicator.

4.10.00 Lighting Poles & Flood Light Tower

4.10.01 Street Light Poles

a) Street light poles shall be swaged and welded steel pole, complete with fixing brackets, weather-proof junction box and all other accessories.

b) The pole shall be coated with bituminous preservative paint on inside as well as embedded outside surface. Exposed surface shall be coated with two coats of metal primer (comprising of red oxide and zinc chromate in synthetic medium).

4.10.02 Flood Light Tower

a) Flood light tower shall be a lattice structure with maintenance platform and approach ladder. All structural members and hardware shall be hot-dip galvanized.

b) Structures shall be designed for an additional load of 1500kg for maintenance crew. Deflection under maximum wind pressure shall not exceed 1 in 360. Structural design shall be as per IS-800 and subject to Owner's approval.

4.10.03 Lighting High Masts

Applicable standards:

The following shall be Reference Standards for loading of the High Mast:

a)	IS-875 (Part-III) 1987	-	Code and practice for design loads for Structures.
b)	BSEN 10025/DIN 17100	-	Grade of M.S. Plates.
c)	BSEN-1011	-	Welding
d)	BS.ISO 1461	-	Galvanizing

Structure:

Lighting High Mast shall be of continuously tapered polygonal cross section, at least 20 sided, hot dip galvanized and presenting a good and pleasuring appearance and shall be based on proven In-Tension design confirming to the standards referred to above, to give an assured performance, and reliable

service. The structure shall be suitable for wind loading as per IS-875 Part-III, 1987. The masts dimensions shall be as per standards.

The Mast shall be of 30M/20M height with lantern carriage to enable raising / lowering for ease of maintenance, including the Head Frame, Double Drum Winch, continuous stainless steel wire rope, in built power tool, luminaries, suitable lightning protection for high mast and lantern carriage of fixtures along with necessary power cables within the mast. The mast shall be delivered in three / two sections & shall be joined together by slip stressed fit method at site. No site welding or bolted joints shall be done on the mast.

High mast shall be complete with feeder pillar panel for power distribution to lighting fixtures and winch motor. Feeder pillar panel shall be outdoor type stand mounting with dust and vermin proof, IP 55 and constructed of 14 swg sheet steel.

4.11.00 Maintenance Equipment

4.11.01 The Bidder shall supply one (1) no. of wheel mounted adjustable aluminium ladder for the maintenance of street lights.

4.11.02 For the maintenance of lighting fixtures within the power house, the Bidder shall also supply four (4) nos. free standing adjustable aluminium ladder, adjustable from 5m. to 10m.

4.11.03 For the maintenance of lighting fixtures within the FGD, AHP, CHP area, the Bidder shall supply at each area, two (2) nos. free standing adjustable aluminium ladder, adjustable from 5m. to 10m.

4.12.00 Special Requirement

4.12.01 All outdoor illumination fixtures, unless it is fed from photo cell/time switch controlled lighting panel, has to be provided with outdoor type local switches.

4.12.02 In all the air filtration units and air handling units, one marine type lamp (of 100 Watt approx.) shall be provided and the wiring & fixing of the same has to be done by the Bidder.

4.13.00 Lighting Cables & Wires

4.13.01 Lighting Cable shall be heavy duty, 1100 Volt grade, multicore stranded copper conductor, XLPE insulated, extruded PVC inner sheath, single round G.I. wire armoured and overall PVC sheathed with FRLSH conforming to IS 1554.

4.13.02 Lighting wires shall be 1100 Volt grade, PVC insulated, stranded conductor, single core cable conforming to IS 694, colour coded as below :

RED	for	R-Phase	BLACK	for	Neutral
YELLOW	for	Y-Phase	WHITE	for	+'Ve D.C.
BLUE	for	B-Phase	GREY	for	-'Ve D.C.

4.13.03 Minimum size of lighting wires shall be as follows:

From Lighting panel to Junction box	:	1/C x 6 sq. mm (Cu)
From Junction box to lighting fixture	:	1/C x2.5 Sq.mm. (Cu)
From Junction Boxes to Flood Light Fixtures	:	1C, 2x2.5 Sq. mm. (Cu)
From Lighting Panel to 230V AC, 5/15A 1-phase receptacle	:	1C, 6 Sq. mm.(Cu) (Stranded)

4.14.00 Conduits and Accessories

4.14.01 Conduits shall be rigid steel, hot-dip galvanised, furnished in standard length of 3 metres, threaded at both ends.

4.14.02 Thickness of conduits up to and including 25 mm dia shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 20 mm.

4.14.03 Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushings at both ends.

4.14.04 Flexible conduits shall be made with bright, cold rolled annealed and electro-galvanised mild steel strips and coated with PVC.

4.15.00 Junction Box

4.15.01 Junction boxes shall be of 16 SWG sheet steel hot-dip galvanised, dust and damp proof, generally conforming to IP-55.

4.15.02 Junction boxes shall be complete with gasketed inspection cover, conduit knock out/threaded hub and terminal blocks.

4.15.03 Junction box for outdoor use shall be weatherproof IPW-55. For hazardous location junction box shall be flame-proof type suitable for a particular zone / gas group in compliance with IS: 2148 / IS: 13346 and shall have certification from CIMFR, Dhanbad.

4.15.04 Junction boxes shall have following indelible markings:

Circuit nos. on top

Circuit nos. with ferrules (inside) as per drawing

DANGER sign in case of 415V circuit

4.16.00 Terminals

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

4.16.02 Each terminal shall be suitable for connection up to 2 nos. 10 Sq.mm stranded aluminium conductors without any damage to the conductor or looseness of connectors.

4.17.00 Portable Emergency Lighting Unit

The portable emergency lighting unit shall be complete with 6 volt storage battery (rechargeable), inverter, automatic charger, twin 6 watts fluorescents tube lamp and test switch. Bidder shall furnish make, type and catalogue.

4.18.00 24 V Supply Module

Each 24V A.C. supply module shall have one (1) no air cooled two winding, 500VA, 1-phase, 50HZ, 240/24V transformer with 6A (240V side) and 16A (24V side) HRC fuse and necessary 240V and 24V terminals for incoming and outgoing connections. The 240V terminals of 24V AC supply module shall be fed from respective lighting panels. A group of 6A, 24V AC receptacles located near Boiler access doors and condenser area shall be wired up from 24V side of each 24V A.C. supply module.

The 24V A.C. supply modules shall be sheet steel enclosed with louvers and shall be suitable for outdoor use. The 24V A.C. supply modules shall be suitable for wall/steel structure/column mounting. Switches shall be mounted at the front on sheet steel enclosure.

4.18.01 Portable 24 V AC supply modules having sheet steel enclosure with louvers as per above shall be supplied. 24V halogen automobiles lamps with reflector along with 1100 V, twin core PVC sheathed, 2.5 mm^2 stranded copper wire of 20 m lengths as handset.

4.19.00 Indication Lamp

Lamps shall be clustered of LED type. LED lamp shall be made in accordance with InP Technology (Aluminium Indium Gallium Phosphide Technology). The body shall be made of Poly Carbonate Unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd. All Push Button lamps shall be as per LED indicating lamp.

4.20.00 Contactors

4.20.01 Contactors shall be three pole, air break type, with non-bouncing silver/silver alloy contacts. Contactor duty shall be class III - category AC3 for unidirectional drives and AC4 for bi-directional and inching drives/class I - category DC2.

4.20.02 Each contactor shall be provided with minimum two (2) N/O and two (2) N/C auxiliary contacts rated 10 A at operating voltage. The exact requirement of contacts shall be decided by the Vendors taking into account the scheme requirements and spares.

4.20.03 Contactor starters shall comply with the requirements of IS-8544 (Part - 1) in respect of co-ordination of the characteristics of contactor, overload relay, and fuse. The type of co-ordination shall be Type - C as per IS-8544.

4.21.00 Moulded Case Circuit Breaker (MCCB)

4.21.01 MCCB shall be heavy duty, triple pole, load break-fault-make type conform to the duty as required. MCCB shall be provided with a common trip bar, so as to ensure opening of all phases even when fault occurs in only one phase.

4.21.02 MCCB shall have positive indication in ON and OFF position with indication on each Module.

4.21.03 The MCCB should be housed in a heat resistant moulded insulated housing Overload and Magnetic release of MCCB shall be suitable for setting at site. The Short Circuit release shall be of minimum of 12x In.

4.21.04 For Fuel Oil / hazardous area, one(1) no. 63Amp MCB shall be provided within a Flame-proof enclosure .The enclosure shall be Flame-proof as per the stipulations of relevant standard. It shall have a degree of protection of IPW-55. The enclosure front access door shall be interlocked with the MCB. It shall have grounding facility on opposite sides complete with designation and caution notice plates fixed on the front cover. It shall meet the requirement of IS 5571 & IS – 5572.The MCB enclosure shall suitable for entry of 4/Cx16 sq.mm XLPE Copper cable. The total unit shall have a valid certification for using in the specified zone from statuory authority preferably of CMRI and/or CE Ex II 2 G EEx-D IIB T4/T5/T6; CE Ex II2 2(1) G EEx-d (ia) IIB T5/T6; CE Ex II2 (1) GD EEx-d (ia)IIB T5/T6 or similar.

4.22.00 Nameplate

Nameplates shall be furnished for identification of devices and circuits. All switches, controls and indications shall be permanently and legibly marked in English as to clearly indicate their functions.

All lighting fixtures, receptacles, fans, junction boxes etc. shall be properly marked up indelibly with corresponding circuit numbers.

4.23.00 Samples

Owner reserves the right to call for samples if considered necessary and the same shall be submitted by the Bidder free and without any obligation.

5.00.00 SPECIFIC REQUIREMENTS - SERVICES

5.01.00 Responsibility of Erection

5.01.01 The Bidder shall be fully and finally responsible for proper erection, safe and satisfactory operation of plant and equipment under his scope of work to the entire satisfaction of the Engineer.

5.01.02 The work shall be executed in accordance with the directions, instructions, drawings and specifications which shall be supplied to the Bidder by the Engineer time to time.

5.01.03 If in the opinion of the Bidder any work is insufficiently specified or require modification, the Bidder shall refer the same in writing to the Engineer and obtain his instruction/ approval before proceeding with the work.

5.01.04 If the Bidder fails to refer such instances any excuse for the faulty erection, poor workmanship or delay in completion shall not be entertained.

5.01.05 Equipment and material which are wrongly installed shall be removed and reinstalled to comply with the design requirement at the Bidder's expense, to the satisfaction of the Engineer.

5.02.00 Supervision

5.02.01 The Engineer shall have the overall responsibility for co-ordination of Bidder's work and his direction shall be final.

5.02.02 Such direction and supervision however shall not relieve the Bidder of his responsibility of correctness and quality of workmanship and of other obligation under the contract.

5.03.00 Drawings

5.03.01 Drawings and schedules enclosed with this specification are for general guidance of the Bidder to asses the type and volume of the work involved.

5.03.02 These drawings and schedules will be revised to suit the actual requirement in related system. Additional drawings and schedules will also be furnished to Bidder if/when necessary. Final drawings and schedules will be furnished to the Bidder time to time as detailed designs are developed.

5.03.03 Such supervision, correction and addition to drawings and schedule shall not be considered to change the scope of work.

5.03.04 The Bidder shall mark in red on one (1) set of drawings all deviations/ alterations, not shown on drawing but carried out at field. After completion of work the Bidder shall furnish a set of marked up prints of "As built" drawings to the Owner.

5.04.00 Methods and Workmanship

5.04.01 All work shall be installed in a first class, neat workmanlike manner by machines/ electricians skilled in the trade involved.

5.04.02 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

5.04.03 All details on installation shall be electrically and mechanically correct.

5.04.04 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

5.05.00 Protection of work

5.05.01 The Bidder shall effectively protect his work, equipment and materials under his custody from theft damage or tampering.

5.05.02 Finished work where required shall be suitably covered to keep it clean and free from defacement of injury.

5.05.03 For protection of his work Bidder shall provide fencing and lighting arrangement, connect up space heaters and provide heating arrangement as necessary and directed by Engineer.

5.05.04 Bidder shall be held responsible for any loss or damage to equipment and material issued to him until the same is taken over by the Owner according to contract.

5.06.00 Safety Measure

5.06.01 All safety codes and rules as applicable to work shall be followed without exception.

5.06.02 all safety appliance and protective devices including belt, hand gloves, aprons, helmets, shields, goggles etc. shall be provided by the Bidder for his personnel.

5.06.03 The Bidder shall provide guards and prominently display caution notices if access to any equipment/area is considered unsafe and hazardous.

5.07.00 Co-operation

5.07.01 The Bidder shall at all time work in close coordination with the Owner's supervising personnel and afford them every facility to become familiar with erection and maintenance of the equipment.

5.07.02 The Bidder shall arrange his schedule of work and method of operation to minimize inconvenience to other Bidders working on the project.

5.07.03 In case of any difference between Bidders, the decision of the Engineer shall be final and binding of all parties concerned.

5.08.00 Erection program and Progress

5.08.01 The Bidder shall submit at such times and in such forms as maybe requested by the Engineer, schedule showing the program and the order in which the Bidder process to carry out the work with dates and estimated completion time for various parts of the work.

5.08.02 Such schedules shall be approved by the Engineer prior to starting the erection. The Bidder shall adhere to this approved program for all practical purpose. If for any reason the work is held up, the Bidder shall bring it to the attention of the Engineer in writing without any delay.

5.08.03 During the progress of work the Bidder shall submit monthly progress report and such other reports on erection work and organization as the Engineer may direct.

5.08.04 If in the of the Engineer the progress of erection work by the Bidder at any stage needs expediting so as to ensure completion of work within stipulated time, the Engineer shall have the right to instruct the Bidder to increase Bidder's manpower in appropriate categories and/or the working hours per day and/or erection tools and tackles and the Bidder shall comply with such instruction forthwith.

5.09.00 Consumables and Hardware

5.09.01 The Bidder shall furnish all erection materials, hardware and consumables required for the complete installation.

5.09.02 The materials shall include but shall not be limited to the following:

a) Consumables : Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc.

b) Hardware : Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.

c) Materials : Junction boxes, terminal blocks, connectors, ferrules, lugs, brass glands, rigid/flexible conduits, cables, ground wires etc.

5.09.03 Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Bidder.

5.10.00 Erection Tools & Tackle

5.10.01 The Bidder shall provide all tools, tackles, implements, scaffoldings, ladders etc which are required for handling and erection of the equipment and materials.

5.11.00 Testing Equipment

5.11.01 The Bidder will provide such checking and testing equipment as test lamp, buzzer, 500-volt meggar, earth meggar, lux-meter etc. with other testing equipment as required.

5.12.00 Taking Delivery

5.12.01 The Bidder shall take delivery of materials & brought to the erection site, stored or erected as necessary.

5.12.03 The Bidder shall submit a detailed account of materials after completion of each work.

5.13.00 Opening of Case

5.13.01 All packing cases and packages shall be opened in presence of Engineer or his authorized representatives.

5.13.02 Packing cases shall be opened carefully to avoid damage to timber. Nails and strips shall be collected separately in boxes and not to be thrown away in random.

5.13.03 All packing materials, timbers, nails and strips shall become property of Owner and shall be delivered to the Owner or disposed of as directed by the Engineer.

5.14.00 Checking and Cleaning of Part

5.14.01 All lighting fixtures, lamps, accessories and materials shall be carefully inspected and checked with packing list and identified with the erection drawings.

5.14.02 Any discrepancy shall be reported forthwith in writing to the Engineer and repair carried out as described herein-before.

5.14.03 all parts shall be thoroughly cleaned, all rust removed and surface polished as required.

5.14.04 Cleaned and polished parts shall be coated with anticorrosive paints where necessary and stored with care, ready for erection.

5.15.00 Installation - General

5.15.01 Installation work shall be carried out in accordance with good engineering practices and also manufacturer's instructions/ recommendations where the same are available.

5.15.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

5.16.00 Lighting Fixtures

5.16.01 In case of closed ceiling industrial premises generally a continuous mounting of fittings is to be preferred, for tubular fluorescent lamps fittings, to an arrangement of reflectors at intervals to provide a more restful view.

5.16.02 In turbine hall, fixtures shall be mounted to maintain sufficient clearance from the overhead travelling crane trolley.

5.16.03 In boiler galleries, mounting height of fixtures shall be about 2500 mm from platforms except shown otherwise.

Bracket for fixture mounting shall be fabricated at site from 40 mm conduits with a reducing socket to suit the fixtures and clamped on to the handrails. The fixing shall be strong enough to withstand vibration and high wind velocity.

If a roof over platform is available, the fixture can be pendant mounted.

5.16.04 Floodlights shall be mounted on steel base facing the tentative direction shown on drawings. Fixing holes shall be provided with slot to turn the fixture about 5 Deg on both sides. Bolts shall be finally tightened with spring washer.

The Bidder shall supply and install the steel base for fixing the flood light on the flood light towers.

Terminal connection to the floodlight shall be made through PVC coated flexible metallic conduits.

5.16.05 Fixtures shall be mounted on sub-station structures with suitable clamps. No cutting or drilling of sub-station structures is permitted. It is preferable to provide separate structures in Switchyard and Substation.

5.16.06 The fixtures after erection shall be marked up indelibly with corresponding circuit number for easy identification of lamp circuit.

5.17.00 Receptacles

Receptacles shall be installed at locations not more than 50 meter or as per approved drawings.

5.18.00 Lighting Panel

5.18.01 Lighting panels shall be erected at the convenient locations with cable junction boxes as per approved drawing.

5.19.00 Street Lighting Poles

Erection of street light poles, flood lighting towers/poles/high masts shall be at the convenient locations with cable lying as per approved drawing.

5.20.00 Conduit System

5.20.01 In case of unarmoured cable, all conduits shall originate from the respective lighting panel and terminate in lighting fixtures, receptacles etc.

5.20.02 Exposed conduits shall be run in straight lines parallel to building columns, beams and walls as far as practicable. Unnecessary bends and crossings shall be avoided to present a neat appearance.

5.20.03 Conduit supports shall be provided at an interval of 750 mm for horizontal runs and 1000 mm for vertical runs.

5.20.04 Conduits shall be clamped on to approved type spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn, shall be fixed to the building steel by welding and to concrete or brick work by grouting as shown on drawings.

Wooden plug inserted in the masonry or concrete for conduit support is not acceptable.

5.20.05 Embedded conduits shall be securely fixed in position to preclude any movement. In fixing embedded conduit, if welding or brazing is used, extreme care should be taken to avoid any injury to the inner surface of the conduit.

5.20.06 Spacing of embedded conduits shall be such as to permit flow of concrete between them and in no case shall be less than 40 mm.

5.20.07 Where conduits are run on cable trays they shall be clamped to supporting steel at an interval of 600 mm.

5.20.08 For directly embedding in soil, the conduits shall be coated with an asphalt - base compound. Concrete pier or anchor shall be provided where necessary to support the conduit rigidly and to hold it in place.

5.20.09 Conduits shall be installed in such a way as to ensure against trouble from trapped condensation.

5.20.10 Running threads shall be avoided as far as practicable. Where it is unavoidable, check nuts shall be used.

5.20.11 Conduits shall be kept, wherever possible, at least 300 mm away from hot pipes, heating device etc. when it is evident that such proximity may impair the service life of cables.

5.20.12 Slip joints shall be provided when conduits cross structural expansion joints or where long run of exposed conduits are installed, so that temperature change will cause no distortion due to expansion or contraction of conduit run.

5.20.13 For long run, junction/pull boxes shall be provided at suitable intervals to facilitate wiring.

5.20.14 Conduits shall be securely fastened to junction box or cabinets, each with a locknut and insulated bushing inside the box and locknut outside.

5.20.15 Conduit lengths shall be joined by screwed couplers. Couplers shall be clearly cut.

5.20.16 Conduit joints and connections shall be made thoroughly water-tight and rust-proof by application of a thread compound which will not insulate the joints.

White lead is suitable for application on embedded conduit and red lead for exposed conduit.

5.20.17 The Battery Room installation shall be made with acid fume proof conduits.

5.20.18 Field bends shall have a minimum radius of four (4) times the conduit diameter. All bends shall be free of kinks, indentations or flattened surfaces. Heat shall not be applied in making any conduit bend.

5.20.19 The entire metallic conduit system, whether embedded or exposed, shall be electrically continuous and thoroughly grounded.

5.20.20 Lighting fixture shall not be suspended directly from junction box in the main conduit run.

5.20.21 Conduits and fittings shall be properly protected during construction period against mechanical injury. Conduits ends shall be plugged or capped to prevent entry of foreign material.

5.20.22 After installation the conduits shall be thoroughly cleaned by compressed air before pulling in the wire.

5.20.23 In control rooms and office areas provided with false ceiling conduit run shall be concealed type, embedded in the walls.

5.21.00 Wiring/Cabling

5.21.01 Wiring shall be generally carried out by PVC wires in conduits. All wires in a conduit shall be drawn simultaneously. No subsequent drawing is permissible.

5.21.02 Wire shall not be pulled through more than two equivalent 90º bends in a single conduit run.

5.21.03 Wiring shall be spliced only at junction boxes with approved type connections or terminal strips. Maximum two wires can be connected to each way of the terminal block. Splicing of only one phase shall be done in a junction box.

5.21.04 For lighting fixtures, connection shall be teed off through suitable round conduit or junction box, so that the connection can be attended without taking down the fixture.

5.21.05 For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/ junction box.

5.21.06 A.C. and D.C. circuits shall not be run in the same conduit and junction boxes. Circuits fed from different transformers shall be run through different conduits and Junction boxes.

5.21.07 Receptacle circuits shall be kept separate and distinct from lighting and fan circuits.

5.21.08 Separate neutral wire shall be provided for each circuit. Wiring throughout the installation shall be such that there is no break in the neutral wire in form of switch or fuse.

5.22.00 Cabling

5.22.01 In outdoor areas, main runs from lighting panels shall be by means of XLPE cables, directly buried in ground or laid in trenches for the underground portion and through conduit for the over ground portion.

5.22.02 Buried cables shall be laid and covered with sand/ riddled earth, and protected from damage by bricks at sides and pre cast concrete slab at top. Buried cables shall have cable markers at 50M interval and projecting 150 mm above ground. At cable bends and joints markers shall be provided.

5.22.03 When buried cables cross road/railway track, additional protection to be provided in form of hume / G.I. pipe.

5.23.00 Grounding

5.23.01 All lighting panels, junction boxes, receptacles, fixtures, conduit etc. shall be grounded in compliance with the provision of I.E. Rules.

5.23.02 Ground connections shall be made from nearest available station ground grid. All connections to ground grid shall be done by arc welding.

5.23.03 Lighting Panels shall be directly connected to ground grid by two nos. 35 x 6 mm G.S flats.

5.23.04 Street lighting Pole shall be grounded at two points by two nos. 50x6 mm G.I flat risers from two (2) nos. earthing spike 40 mm dia & 3m long directly driven into ground at a depth of 1m from ground level. The junction box at each lighting pole is grounded at two (2) points from two (2) nos. earthing terminals by 16 SWG GI wire.

5.23.05 One 16 SWG G.I wire shall be taken up to the junction box from lighting fixtures and connected to grounding point.

5.23.06 A continuous ground conductor of 16SWG GI Wire shall run along each exposed metallic conduit run and bonded to it every 600 mm by not less than two turns of the same size of wire. This conductor shall be connected to each panel ground bus.

All junction boxes, receptacles, fixtures etc. shall be connected to this 16 SWG ground conductor.

5.24.00 Foundation & Civil Works

5.24.01 Equipment foundations, panel foundations and all other civil work will be provided by the Bidder at the option of owner.

5.25.00 Excavation and Back Filling

5.25.01 The Bidder shall perform all excavation and backfilling as required for buried cable and ground connections.

5.25.02 Excavation shall be performed up to the required depth. Such sheeting and shorting shall be done as may be necessary for protection of the work.

5.25.03 The Bidder shall make use of his own arrangements for pumping out any water that may be accumulated in the excavation.

5.25.04 All excavation shall be backfilled to the original level with good consolidation.

5.26.00 Steel Fabrication

5.26.01 All supports, hangers & brackets shall be fabricated by the Bidder. Necessary steel shall be supplied by the Bidder (optional).

5.26.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge.

5.26.03 Every effort shall be made to minimize the wastage of steel as far as practicable during fabrication. The wastage in no case shall exceed 3% of the total quantity of steel fabricated.

5.27.00 Painting

5.27.01 Street light poles shall be given two coats of aluminium paints after installation.

5.27.02 All steel fabrication shall be given two coats of red oxide primer followed by two coats of battleship Siemens gray RAL-7032.

5.27.03 All equipment shall be given touch-up paint as required after installation.

5.28.00 Cleaning up of Work Site

5.28.01 The Bidder shall, from time to time, remove all rubbish resulting from execution of his work. No material shall be stored or placed on passage or drive ways.

5.28.02 Upon completion of work, the Bidder shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

5.29.00 Inspection & Testing

5.29.01 On completion of erection works, the Bidder shall request the Engineer for inspection and tests with minimum fourteen (14) days advance notice.

5.29.02 The Engineer shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Bidder.

5.29.03 The installation shall be then tested and commissioned in presence of the Engineer and put on trial run for stipulated contract period.

5.29.04 All rectification, repair or adjustment work found necessary during inspection, testing, commissioning and trial run shall be carried out by the Bidder without any extra cost.

5.30.00 Taking Over of Installation

5.30.01 On successful testing, commissioning and trial run, the Bidder shall request Engineer in writing for taking over the installation.

5.30.02 The Engineer, on receipt of the request, shall arrange to take over the installation either wholly or in part as the case may be after a final inspection.

5.30.03 Till such taking over, the responsibility of the whole installation against theft or damage of any kind shall remain with the Bidder.

5.31.00 Guarantee

In the installation if any trouble arises due to the use of defective or faulty material and/or bad workmanship within a period of 12 months from the date of taking over, the Bidder shall guarantee to replace or repair the defective part(s) at site to the entire satisfaction of the Engineer free of charge.

6.00.00 TESTS

6.01.00 Shop Tests

6.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.

6.01.02 Tests on lighting Distribution Boards/Panels shall include:

a) Wiring continuity tests.
b) High voltage and insulation tests.

c) Operational tests.

6.02.00 Site Tests

6.02.01 Bidder shall thoroughly test and meggar all cables, wires and equipment to prove that the same are free from ground and short circuit.

6.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

6.02.03 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

6.02.04 Illumination in different areas are as per designed lux level should be established.

6.03.00 Test Witness

6.03.01 all test shall be performed in presence of Owner’s representatives, if so desired by the Owner.

6.03.02 The Bidder shall give at least thirty (30) days advance notice of shop test seven (7) days advance notice of site tests.

6.04.00 Test Certificates

a) Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner.

b) The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.

c) Type test reports LM79 and LM80 (not more than 5 years from the date of opening of Techno-commercial BID) including Type test certificate on any equipment (if so desired by the Owner) shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

7.00.00 SPECIAL TOOLS AND TACKLE

7.01.00 A set of special tools and tackles which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

7.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

8.00.00 SPARES

The Bidder shall submit a list of recommended spare parts for three (3) years satisfactory and trouble free operation, indicating the itemized price of each item of the spares.

9.00.00 DRAWINGS, DATA & MANUALS

9.01.00 Drawings, data and manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in the General Condition of Contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.

9.02.00 To be submitted with the Bid

9.02.01 Make, type and catalogue number of lighting fixtures, lamps and accessories along with technical leaflets, data sheets, polar curves etc.

9.02.02 Typical outline drawings, showing constructional features, cable/ conduit entry, fixing arrangements etc of:

a) Lighting Panel/receptacles/junction boxes.

b) Street light pole.

c) Flood light towers.

9.02.03 Technical leaflets and data sheet on each piece of equipment / device such as MCB, switch fuse, MCCB, receptacle etc.

9.02.04 Type test certificates on lighting fixtures and lighting panels, ballast, power cables.

9.03.00 To be submitted after Award of Contract

9.03.01 Detail dimensional drawing showing constructional features, cable/ conduit entry, grounding, fixing arrangement etc. of:

a) Lighting panels.

b) Receptacles & Junction boxes.

c) Street light poles.

d) Flood light tower along with design calculations

e) Lighting fixture complete with lamps and accessories.

f) Non-integral/separate type control gearbox for lighting fixtures, as applicable.

9.03.02 Data sheets for lighting panels

9.03.03 Data sheets for lighting fixture, lamps, accessories with light distribution curves, co-efficient of utilization charts etc.

9.03.04 Control schematic and wiring diagram of 415V AC/220V DC lighting panel with automatic changeover from AC to DC and back to AC normal supply on restoration, 415V normal AC Street/area lighting panel with automatic ON/OFF feature.

9.03.05 Technical leaflets and data sheet on each piece of equipment/ device such as MCB, switch, fuse, receptacle etc. Type and routine test certificates of cables.

9.03.06 Lighting layouts showing the disposition of fixtures, lighting panels/boards, circuit distributions, conduit & wire routing.

9.03.07 Key Single Line Diagram for lighting distribution, board wise single line diagram with feeder loading, cable schedule and interconnection chart, design calculation for lighting.

9.03.08 AS-BUILT lighting layout and erection drawings, properly incorporating the changes/alterations/field modifications, if any, as carried out at field along with circuit distribution schemes of all lighting panels, conduit and cable routing and as acceptable to the Owner.

9.03.09 Any other relevant drawings, data and manuals necessary for satisfactory installation, operation and maintenance or as required by purchaser.

9.03.10 The Bidder may note that the drawings, data and manuals listed are minimum requirement only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted with his bid.

Annexure-A

AVAILABLE POWER SUPPLY

1.0 System Voltage

Lighting equipment and accessories shall be designed for satisfactory operation from the following power supply sources:

1.1	A.C. Supply	:	415 Volt, 3 phase, 50 Hz, 4 wire effectively grounded system.	
			Fault Level 50KA r.m.s. symmetrical.	
1.2	D.C. Supply	:	220 V, 2 wire, ungrounded system.	
			Fault Level 25* KA	
2.0	Permissible Variation			
	Equipment and accessories shall be suitable for operation over the entire range of voltage/frequency variations as listed below:			
2.1	A.C. Supply	:	Voltage	± 10%
			Frequency	±5%
	Combined Voltage		10% (absolute sum) + Frequency	
	D.C. Supply	:	Voltage 198 to 242 Volt.	

* Minimum only; actual value will be decided by the Bidder after substantiating the same by calculation.

Annexure-B

AVERAGE LUX LEVEL FOR DIFFERENT AREAS

Sl. No.	Location	Lux Level
1.	Central Control Room and control equipment room	400
2.	Other control Rooms (With false ceiling)	400
3.	Other control Rooms (Without false ceiling)	300
4.	Turbine Hall	200
5.	General Indoor for Power House & other BOP areas	100
6.	Transformer Yard for power house & other BOP areas	50
7.	Area near large rotating Equipment /plant	250
8.	Compressor Plant	200
9.	Air Conditioning Plant Room	200
10.	Switchgear/MCC/Electrical Equipment Rooms	250
11.	Battery Rooms	150
12.	UPS Room/DAS Room	250
13.	Battery Charger & DCDB Room	250
14.	Excitation Cubicle Room	250
15.	Air Washer Room	200
16.	AHU Room	200
17.	Elevator m/c Room	200
18.	Shift Charge Engineers Room (With false ceiling)	250

Sl. No.	Location	Lux Level
19.	Central Analyser Room (With false ceiling)	250
20.	Chemical laboratory	300
21.	Cable spreader Area	70
22.	Oil Room and indoor hazardous areas	150
23.	Coal Mill area	150
24.	Power House Coal conveyor floor	150
25.	Power House Feeder floor	150
26.	Conveyors, junction/transfer Towers	150
27.	Boiler Area	100
28.	Boiler Platforms	100
29.	ESP hopper area, platforms and ESP top	100
30.	Surge tank platforms	100
31.	Switch yard	50
32.	PLC Room (with false ceiling)	250
33.	Passage, Indoor Stair, Catwalk Tunnel, Toilet etc.	70
34.	Outdoor/Semi outdoor stairs	70
35.	C.W. Pump House	250
37.	F.O. Pressuring System Pump House	250
38.	Street & periphery lighting	20
39.	Office Rooms (without false Ceiling)	250
40.	Office Room	

(With false ceiling)	250

- Medium bay fixtures shall be used where the room height is 8 M. Otherwise high bay fixtures are to be used.
- Lux level for A.C. Emergency lighting in control room shall be 50 and for other areas 20 lux.
- Lux level for main road lighting shall be 20 and for secondary road shall be 10 lux.
- One no. (1) DC emergency fixture shall be provided at entry, exit and each landing of stair cases of Electrical Substation Buildings, Control Rooms, TPs etc.
- If Lux level of any specific area is not covered in above table, Vendor shall take specific confirmation from purchaser before finalization of Bid.

Annexure-C

TYPE OF FITTINGS/FIXTURES AND OTHER AUXILIARIES

1.0 LIGHTING FIXTURES & LAMPS

Each lighting fixture shall be furnished complete with associated lamp, holder and all accessories as required.

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
1.1	ILD-1	BN108C LED 20S PSU CDL WH	Commercial/decorative type, Surface/ pendant mounted green perform LED Batten [system flux ≥ 2000 lumens, 6500K color temperature, CRI ≥ 75, System efficacy> 100lm/W] having minimum lifetime of 40,000 burning hours (at L70) with PC glossy diffuser. The luminaire shall be made up of CRCA sheet steel (IP20) with THD < 10% and PF > 0.9, similar to Philips make ENDURALED BATTEN "BN 108C LED 20S PSU CDL WH.	Swgr room / MCC room / Workshop / Maint. Shop / Office / Toilet / Corridor / Pantry / Stores
1.2	ILD-2	SM270C LED 30S 6500 PSU WH	Decorative type, Surface/ pendant mounted green perform LED Batten [system flux ≥ 3000 lumens, 6500K color temperature, CRI ≥ 80, System efficacy ≥ 80 lm/W] having minimum lifetime of 50,000 burning hours (at L70) . The luminaire shall be made up of CRCA sheet steel (IP20) with THD < 10% and PF > 0.9, similar to Philips make SMARTBRITE SM270C LED 30S 6500 PSU WH.	Office rooms / Corridor / Conference Room / Engineer's Room
1.3	ILD-3	RC869B LED 30S 6500 W30L120 D8 GR	Decorative type, recess mounted green perform LED Batten [system flux ≥ 3000 lumens, 6500K color temperature, CRI ≥ 70, System efficacy ≥ 100 lm/W] having minimum lifetime of 40,000 burning hours (at L70) with high purity anodized aluminium mirrors. The luminaire shall be made up of CRCA sheet steel (IP20) with THD < 10% and PF > 0.9, similar to Philips make SERENO "RC869B LED 30S 6500 W30L120 D8 GR".	False Ceiling areas (Control Room / Electronic Eqpt. Room / Office / Conference room / Engineer's Room / Corridor)
1.4	ILD-4	WT550C LED40S CW PSU S1 PC	Indoor, industrial, corrosion resistant type, ceiling or suspension mounting, green perform LED Batten [system flux ≥ 4000 lumens, 6500K color temperature, CRI ≥ 80, System efficacy ≥ 80 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with diffuser. The luminaire shall be made up of Polycarbonate with silicone	Battery Room / Chemical Plant / Area with corrosive atmosphere

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
			gasket material (IP65) with THD < 10% and PF > 0.9, similar to Philips make ENDURALED WATERPROOF "WT550 LED40S CW PSU S1 PC".	
1.5	ILD-5	BY415P LED145S CW NB FG PSU GR or BY415P LED145S CW WB FG PSU GR	Pressure Die cast aluminium frame (IP 65) with heat resistance toughened clear glass, Medium and High bay, dust free type, green perform LED Batten [system flux ≥ 14000 lumens, 6500K color temperature, CRI ≥ 80, System efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection with THD < 10% and PF > 0.9, similar to Philips make BY415P LED145S CW NB FG PSU GR or BY415P LED145S CW WB FG PSU GR. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	General Indoor equipment area / Pump House / Workshop/TG Hall
1.6	ILD-6	BY325P LED 100S CW PSE GR FG WB, OR BY325P LED 100S CW PSE GR FG NB	Pressure Die cast aluminium frame (IP 65) with heat resistance toughened clear glass, Medium and High bay, dust free type, green perform LED Batten [system flux ≥ 10000 lumens, 6500K color temperature, CRI ≥ 70, System efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection (> 2KV) with THD < 10% and PF > 0.9, similar to Philips make BY325P LED 100S CW PSE GR FG WB, OR BY325P LED 100S CW PSE GR FG NB LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	General Indoor equipment area / Pump House / Workshop
1.7	ILD-7	BY416P LED 220S-CW SK60 PSU GR FG NI	Pressure Die cast aluminium frame (IP 65) with heat resistance toughened clear glass, Medium and High bay, dust free type, green perform LED Batten [system flux ≥ 22000 lumens, 6500K color temperature, CRI ≥ 80, System efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection with THD < 10% and PF > 0.9, similar to Philips make BY416P LED 220S-CW SK60 PSU GR FG NI. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	General Indoor equipment area / TG Hall / Pump House
1.8	ILD-8	BY200P LED 27S CW PSU S2 PC	Integral, higher ingress protection, green perform LED Batten [system flux ≥ 2700 lumens, 6500K color temperature, CRI ≥ 80, System efficacy> 90lm/W] having minimum lifetime of 40,000	Boiler Platform / ESP Platform / Dust &Vapour laden

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
			burning hours (at L70) .The luminaire shall be made up of High pressure die cast Aluminium with polycarbonate front diffuser with THD < 10% and PF > 0.9, similar to Philips make ENDURALED WELLGLASS "BY200P LED 27S CW PSU S2PC".	areas/Conveyor Gallery/Crusher house/TPs/Wagon tippler/Bottom ash hopper/FAE Tower etc.
1.9	JA	Bajaj BJFW-125MV / eqv.	Flame proof, weatherproof, non-integral well glass luminaire for indoor / outdoor applications suitable for 1 x 125W MV lamp	Fuel Oil Pump House / Area with explosive atmosphere
1.10	JB	Bajaj BJFW-125MVI / eqv.	Flame proof, weatherproof, integral well glass luminaire for indoor / outdoor applications suitable for 1 x 125W MV lamp	Fuel Oil Pump House / Area with explosive atmosphere
1.11	IA	Philips NXC101 1xA60-60W-CL B22 GR/ eqv.	Weatherproof bulkhead luminaire suitable for 1 x 60W GLS lamp.	DC emergency lighting / staircase / exit point
1.12	OLD-1	BRP022 LED 21 CW MR S1 PSU GR	Pressure Die cast aluminium frame (IP 65) , dust free type, green perform LED Batten [system flux ≥ 2100 lumens, 5500K color temperature, CRI ≥ 70, System efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70).The luminaire shall have inbuilt surge protection (> 2KV) with THD < 20% and PF > 0.95, similar to Philips make BRP022 LED 21 CW MR S1 PSU GR LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	Building exterior lighting / Outdoor area lighting / Outdoor eqpt. Area
1.13	OLD-2	BRP410 LED CW 072 MR FG S1 PSU GR	Pressure Die cast aluminium frame (IP 65) with heat resistance toughened clear glass, dust free type, green perform LED Batten [system flux ≥ 7200 lumens, 5500K color temperature, CRI ≥ 70, System efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection with THD < 20% and PF > 0.95, similar to Philips make BRP410 LED CW 072 MR FG S1 PSU GR. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	Street lighting / boundary lighting
1.14	OLD-3	BRP322 LED 128	Pressure Die cast aluminium frame (IP 65) with	Street lighting /

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
		CW HE MR FG S3 XT	heat resistance toughened clear glass, dust free type, green perform LED Batten [system flux ≥ 12800 lumens, 5500K color temperature, CRI ≥ 70, System efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection with THD < 20% and PF > 0.95, similar to Philips make BRP322 LED 128 CW HE MR FG S3 XT. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	boundary lighting
1.15	ILD-9	SM200C LED11S 6500 PSU OD WH	Decorative type, Surface mounted green perform LED Batten [system flux ≥ 1100 lumens, 6500K color temperature, CRI ≥ 70, System efficacy ≥ 80 lm/W] having minimum lifetime of 40,000 burning hours (at L70) downlighter. The luminaire shall be made up of ABS material with THD < 10% and PF > 0.9, similar to Philips make CIRRUS MINI "SM200C LED11S 6500 PSU OD WH".	Toilet / Wash basin / staircase
1.16	ILD-10	GreenLEDi DN191B LED6S	Recess, decorative vertical mounting downlighter, green perform LED Batten [system flux ≥ 600 lumens, 6500K color temperature, CRI ≥ 70, System efficacy ≥ 80 lm/W] having minimum lifetime of 40,000 burning hours (at L70). The luminaire shall be made up of pressure die cast aluminium with a high efficiency diffuser with THD < 10% and PF > 0.9, similar to Philips make GREENLEDi "DN191B LED6S".	Control Room / Electronic Eqpt. Room / Conference room / Office / Engineer's Room as UPS emergency light
1.17	ILD-11	GreenLEDi DN193B LED12S	Decorative type, Surface mounted green perform LED Batten [system flux ≥ 1300 lumens, 6500K color temperature, CRI ≥ 70, System efficacy ≥ 100 lm/W] having minimum lifetime of 40,000 burning hours (at L70) downlighter. The luminaire shall be made up of pressure die cast aluminium with a high efficiency diffuser with THD < 10% and PF > 0.9, similar to Philips make GREENLEDi "DN193B LED12S".	Control Room / Electronic Eqpt. Room / Conference room / Office / Engineer's Room as UPS emergency light

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
1.18	OLD-4	BVP 120 LED 70 CW NB FG S3 XT	Pressure Die cast aluminium frame (IP 65), Compact, sturdy, dust free type, green perform LED Batten [system flux ≥ 7000 lumens, 5500K color temperature, CRI ≥ 70, System efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70). The luminaire shall have inbuilt surge protection (> 2KV) with THD < 20% and PF > 0.95, similar to Philips make BVP 120 LED 70 CW NB FG S3 XT. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	Area lighting / Yard lighting / Floodlighting purpose
1.19	OLD-5	BVP122 LED 146 CW NB FG XTFC	Pressure Die cast aluminium frame (IP 66), Compact, sturdy, dust free type, green perform LED Batten [system flux ≥ 14600 lumens, 5500K color temperature, CRI ≥ 70, System efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70). The luminaire shall have inbuilt surge protection (> 2KV) with THD < 20% and PF > 0.95, similar to Philips make BVP122 LED 146 CW NB FG XTFC. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	Area lighting / Yard lighting / Floodlighting purpose
1.20	OLD-6	BVP 120 LED 70 CW NB FG S3 XT	Pressure Die cast Aluminium frame (IP 65), Compact, sturdy, dust free type, green perform LED Batten [system flux ≥ 7000 lumens, 5500K color temperature, CRI ≥ 70, System efficacy ≥ 90 lm/W] having minimum lifetime of 50,000 burning hours (at L70). The luminaire shall have inbuilt surge protection (> 2KV) with THD < 20% and PF > 0.95, similar to Philips make BVP 120 LED 70 CW NB FG S3 XT. LM 79 and LM80 reports need to be submitted from a NABL/UL Approved Laboratory.	Area lighting / Yard lighting / Floodlighting purpose
1.21	EX	Philips (Exit Lamp) / eqv.	Escape lighting luminaire with “EXIT” sign fitted with 1x20 FLT. Each luminaire shall be self contained 6 volt battery, battery charger unit. Normally the luminaire shall be ON continuously through 240V AC supply. When AC supply goes OFF the in built battery & inverter system automatically takes on to ignite luminaire for duration of two & half (2½) hours. The battery shall be maintenance free and shall be trickle charged when 240 V AC mains supply is available.	Control Room / Electronic Eqpt. Room / Conference room / Office / Engineer's Room as UPS

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
1.22	FA	GE Evolve^{TM}LED Outdoor Family IBERIA / eqv.	Die-cast aluminium housing, decorative luminaire using LED technology with symmetric and asymmetric light distribution, IP 65 rated for optical assembly with high brightness LED- pole mounted.	Street lighting / boundary lighting
1.23	Ceiling/Column/wall mounted	Bajaj BJDB 100 with 1X100W. GLS/eqv	Bulkhead luminaire with wire guard, die cast Al alloy body, heat resistant prismatic glass cover with specially designed weather proof gasket.	Emergency light- ing in CHP area with AC/DC change- over

Note 1: The supply also includes associated junction boxes, brackets, supports, hangers, and wires wherever applicable.

2.0 LIGHTING PANEL

2.1	LP-1	415 V A.C. Indoor type Lighting Panel with 415 V, 100A, 3 ph, 4 wire bus, one (1) no. 100A TP & N switch/MCCB as incomer, 24 nos. 20A, 240 V, 1 pole MCBs as outgoing feeders.
2.2	LP-2	415 V A.C. Indoor type Lighting Panel with 415 V, 100A, 3 ph, 4 wire bus, one (1) no. 100A TP & N switch/MCCB as incomer, 18 nos. 20A, 240 V, 1 pole MCBs as outgoing feeders.
2.3	LP-3	415 V A.C. Indoor Lighting panel with 415 V, 3ph, 4W bus & one 63A TP & N Switch/MCCB as incomer and 12 nos 20A , 240V 1 pole MCBs as outgoing feeder.
2.4	LP-4	415V A.C. Indoor type Lighting Panel with 415V, 63A, 3 ph, 4 wire bus, one (1) no. 32 A TP & N switch/MCCB as incomer, 6 nos. 20A, 240V, 1 pole MCBs as outgoing feeders.
2.5	SLP	415 V A.C. Outdoor type Panel with 415 V, 100A, 3 ph, 4 wire bus, one 100A TP & N switch/MCCB as incomer, 18 nos. 20A, 240V, 1 pole MCBs as outgoing feeders. The lighting panel shall be provided with 63A contactor, frequency compensated timer switch, photo-cell switch push- buttons for automatic control of street/area lighting with provision for manual override.
2.6	DCLP	Indoor type emergency lighting panel with 240V bus, one no Fuse switch as incomer and 6 nos 16A two pole MCB as outgoing feeders.
2.7	FLP	Outdoor, lockable type Isolating switch of 415V, 63A, 3 ph, 4 wire TP & N. with 2 mm sheet steel/cast iron cubicle.

3.0 RECEPTACLE

3.1	RA	6A, 240 V, 2 pole, 3 pin with third pin earthed, suitable for flush mounting in office areas and control room. The switch

		shall be also flush mounted piano type. Degree of protection shall be IP 52 (for Indoor) / IP 65 (for outdoor).
3.2	RB	16A, 240V, 2 pole, 3 pin with third pin earthed, wall/ column mounted, metal clad gasketed construction, 20mm conduit entry, screwed metal cover tied to it by a metal chain, weatherproof suitable for indoor/outdoor installation. Degree of protection shall be IP 52 (for Indoor) / IP 65 (for outdoor).
3.3	RC	63A, 415 V, 3 phase, 4 pin interlocked plug and switch with earthing contact, wall/column mounted, metal clad gasketed construction, weatherproof, suitable for loop-in/loop-out connection of 4/C-35 Sq.mm XLPE cable. These shall be fed from AC Distribution Board/Station MCC. Degree of protection shall be IP 52 (for Indoor) / IP 65 (for outdoor).
3.4	RD	125 A, 415 V, 3 phase 5 pin interlocked plug & switch with fifth pin earthed, wall/column mounted metal clad gasketed construction, weatherproof, suitable for loop in and loop out connection of 3-1/2C -95 Sq.mm XLPE cable. These shall be fed from A.C-Distribution Board/Station MCC. Application at all Transformer Yard for Oil Filtration machines and other areas. Degree of protection shall be IP 65.
4.0	CEILING FANS	
4.1	FA	1200 mm sweep ceiling fan with regulator, down rod and canopy.
4.2	FB	1400 mm sweep ceiling fan with regulator, down rod and canopy.
5.0	LIGHTING POLES	
5.1	TA/TB	Single arm/double arm swaged and welded steel pole with junction box and all accessories.
6.0	SWITCHBOARD	
6.1	S-1	Switch board with 1-6A switch.
6.2	S-2	Switch board with 3-6A switch and 1-6A receptacle.
6.3	S-3	Switch board with 6-6A switch and 1-6A receptacle.
7.0	MISCELLANEOUS ITEMS	
7.1	M1	10 m high car wheel mounted aluminium ladder.
7.2	M2	Adjustable free-standing aluminium ladder height adjustable from 5 m to 10 m.+
7.3	M3	Portable Emergency light set complete with one 20W tube light, battery, battery charger and all other accessories.
7.4	M4	24 Volt Supply Module with all accessories.

Annexure-D

1100V LV POWER CABLE (XLPE)

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

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

Annexure-E

CONTROL CABLES

1.0 1100 V grade 70ºC continuous rating under normal condition and 160°C under short circuit condition rating PVC Control cable (YWY) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.

1.1	Conductor	:	Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
1.2	Insulation	:	Extruded PVC compound conforming to type A of IS: 5831.
1.3	Core Identification	:	By color coding and numbering at interval of 100mm or less
1.4	Inner sheath	:	Extruded PVC compound conforming to type ST1 of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST1.
1.5	Armour	:	Galvanised single round steel wire for twin and multicore cables.
1.6	Overall sheath	:	Extruded PVC compound conforming to type ST1 of IS 5831 with FRLSH properties.
1.7	Drum	:	Conforming to IS: 10418 (Wooden drum)

ANNEXURE – F

RATINGS AND REQUIREMENTS OF LIGHTING TRANSFORMER

Type	:	Dry type, no encapsulated VPI with nomex insulation
KVA rating	:	100-150 KVA
Voltage rating	:	415 V/415 V
Cooling	:	AN
P.V. Impedance	:	0.04 ± 10%
Voltage control	:	Off load tap switch/link with change of ± 5% in step of 2.5% tapping full capacity.
Vector Group	:	Dyn11
Class of Insulation	:	F (155^0C)
Maximum Temperature rise over 50 Deg C. ambient in winding by resistance	:	90^0C
Neutral	:	Solidly grounded.

The secondary neutral of the transformer shall be brought out for getting a grounded 4 wire supply. Each transformer shall be routine tested and one transformer shall be type tested in accordance with relevant standard.

The transformer shall be liable for rejection if the tolerance on the quoted values of losses, impedance, temperature rise, etc. exceeds the specified values of relevant standard.

The transformer shall be mounted inside sheet steel enclosure, which shall be an integral part of Lighting Distribution Board.

388885/2021/PS-PEM-MAX

SUB-SECTION IC

DATASHEET - A

388885/2021/PS-PEM-MAX

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY DATASHEET A	SPECIFICATION No: PE-TS-445-501-A002	
		SECTION IC	
		REV. 00	JUL 2021

DATA SHEET FOR DOUBLE GIRDER EOT CRANE WITH VVVF DRIVES

Details are to be furnished by bidder during detail engineering stage only

S.N.	Description	Technical Particulars	
1.0	Design, fabrication and testing of the crane confirm to standard / code number	IS: 3177 & IS 807 (latest edition)	
2.0	Number of crane/s	One (1) no. for TG hall – BC Bay	One (1) no. for CWPH
3.0	Crane classification	M5 duty for Mechanical and Electrical as per IS: 3177– (latest edition) & Structural design as per IS 807 – 2006.	
4.0	Suitable for outdoor or indoor duty	Indoor duty	
5.0	Capacity (T)	TG HALL –BC BAY CRANE	CWPH CRANE
5.1	Main hoist		
	Rated SWL – tonnes	35	50
5.2	Aux. Hoists		
	Rated SWL – tonnes	N.A.	5
6.0	Span	As per attached crane clearance diagram	As per attached crane clearance diagram
7.0	Operation from	Radio Remote Control (RRC) + Pendent push button	
8.0	CRANE PERFORMANCE		
8.1	Crane speed with full load	TG HALL –BC BAY CRANE	CWPH CRANE
a	Main Hoist (M/Min.)	1.0	1.0
b	Aux. Hoist (M/Min.)	N.A.	5.0
c	Crab travelling speed (CT motion) (M/Min.)	10.0	10.0
d	Crane travelling speed (LT motion) (M/Min.)	15.0	15.0
e	Creep speed M/Min	10% of respective speed for all the motions through VVVF drive.	
8.2	Lift in Meters		
a	Main Hoist	As per attached crane clearance diagram	As per crane clearance diagram
b	Aux Hoist	NA	As per crane clearance diagram
8.3	Hook Approaches	As per attached crane clearance diagram	As per crane clearance diagram
8.4	Hand rail pipes	32 mm NB heavy duty GI pipes as per IS 1239 having top and bottom rail At height of 1000 mm and 600 mm and vertical post spacing not Exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick)	
9.0	COMPONENT DETAILS		
9.1	Trolley/ Bridge girder		
a	Type	Fabricated	
b	Method of fabrication	Welded	

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c	Material conforming	IS: 2062 Gr. B	
9.3	Rope details		
a	Standard	IS:2266	
b	Construction	Extra flexible plough steel / 6 x 36 or 6x37 construction	
c	Factor of safety	5.25 as per IS 3177	
d	Type of core	Fibre	
9.6	Gear box details		
a	Material(gear/pinions)	Cast or wrought steel or forged steel of low or medium carbon steel or alloy steel.	
b	Gear box housing material	Cast or Fabricated	
9.8	Lifting hooks	For capacity above 40T	For capacity upto 40T
a	Type	Rams horn, shank with Safety Latch swiveling type as per IS: 5749	Point hook with shank with safety latch Swiveling type as per IS: 15560.
b	Material	Class 3A as per IS 1875	
9.9	Brakes		
A.0	Hoist Motions	Main Hoist	Auxiliary Hoist
a	Type of brake	Electro-Hydraulic Thruster type	Electro-Hydraulic Thruster type
b	Number provided	Two (2) nos for each motor	Two (2) nos for each motor
c	Braking capacity of each brake	150% of rated torque	
B.0	Travel motion	CT	LT
a	Type of brake	Electro-Hydraulic Thruster operated	Electro-Hydraulic Thruster type + Hydraulic Thruster (foot operated) Additionally, 01 no. EHT brake+ 01 no. Hydraulic Thruster (foot operated) brake per Motor shall be provided as loose supply.
b	Number provided	Two (2) nos for each motor	One (1) + One (1) nos. per motor
c	Braking capacity	125% of rated torque	125% of rated torque
10.0	Motors		
a	Type	Squirrel cage	
b	Enclosure	TEFC	
c	Voltage, phase and frequency	3 Ph, 4 wire, 415V ±10%, 50 Hz ±5% Combined voltage & frequency variation = 10% absolute	
d	Rated capacity (KW)	The hoist motors shall be rated for 125% of the heaviest equipment to be lifted. Further motor rating shall be selected keeping margin of 25% over the maximum power requirement.	
e	Service class	S4	
f	Number of starts/ hour	150 starts / hr	
g	Pull out torque	The pull out torque of the motor will not be less than 275 % of the full load torque.	
h	Space heater requirement	For motors above 30 kW rating	
11.0	Power conductors (DSL)		
a	Type	LT: PVC shrouded Cu conductor bus bar. CT: Flexible trailing cable mounting on retracting support (Festoon type) with EPR insulated, Copper conductor as per IS 9968 or	

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		alternately Energy chain (drag chain) arrangement.	
12.0	Control panel		
a	Material	Rolled sheet steel 2mm size	
b	Numbers and location	One each for Protective , MH, AH, CT and LT located on bridge platform.	
c	Degree of Protection	IP 54	
d	Features	Each panel shall have internal illumination with fluorescent lamp and thermostat controlled space heater, suitable for operation on 240V 1-ph 50 Hz supply. Lamps and heater circuits shall have individual ON-OFF Switches.	
13.0	Cable (Fixed)	Power	Control
a	Material	Stranded Copper/ Stranded Aluminum	Stranded Copper
b	Size	Minimum 2.5 mm^2 for Cu/ Minimum 6mm^2 for Aluminum	Minimum 2.5 mm^2
c	Voltage grade	1100V grade PVC cables With extruded inner sheath	1100 Volt grade flexible, heat resistant, insulated switchboard wires
14.0	Fire Extinguisher		
a	Type and size	4.5 kg , CO_2 type	
b	Numbers per crane & Location	Three on bridge	
15.0	Power Supply	One (1) no 415 V, 3 phase, 4 wire supply at operating floor at center / end of bay through an isolation switch placed at 1.5 m from operating floor.	
16.0	Transformer	Qty. / Rating	
a	Control	2 X 100 % - 415/110V	
b	Lighting	2 X 100 % - 415/240V	
17.0	Illumination		
a	In Cabin	Not applicable	
b	Over Bridge	Four (4) nos. 40W LED type	
c	Under bridge	Two (2) nos. 160 W LED type for TG hall – BC bay & CWPH EOT cranes each.	
d	For inspection of crane components	One (1) portable 40W LED type hand lamp with min. half span length flexible cable for inspection of crane components.	
18.0	Type of platform required on the full length of bridge.	Chequered plate platform 6 mm thick as per IS :3502.	
a	Type of access from gantry girder level to crane bridge	Rung ladder at ends of crane bridge from gantry girder level walkway to crane bridges walkway.	
b	Type of access to maintenance cage from crane bridges walkway	Rung ladder.	
19.0	Type of control for Various motions	Through VVVF drive.	
20.0	Maintenance isolator	One no at gantry girder level	

Other requirements

1) Centralized grease lubrication with hand operated grease pump shall be provided.

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY DATASHEET A	SPECIFICATION No: PE-TS-445-501-A002	
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2) DSL phase indicating lamps to be provided at both end of bay.

3) Girders shall be cambered to an amount approximately equal to the dead load deflection plus one-half the live load (rated load + trolley weight) deflection.

4) All motors shall be designed as 3-phase squirrel-cage motors suitable for crane duty and VVVF drive operation. Motors shall in general conform to IEC-60034. Crane motors shall suit the duty class S4 and shall not be energy efficient, cyclic duration factor (CDF) 40% and number of cycles per hour 150. Motor pull out torque shall not be less than 2.75 times rated torque. Number of poles / motor speed (rpm) shall be as per manufacturer's design.
The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. Motor shall not stall during operation at voltage dip of 70% for 2 sec.

WBPDCL

VOLUME : IIIG

SCHEDULE-IIIG/8

MISCELLANEOUS CRANES

VOLUME : IIIG

SCHEDULE-IIIG/8

MISCELLANEOUS CRANES

Bidder to fill up the particulars in the format as specified below for each and every E.O.T. Crane offered, mentioning location.

1.00.00	GUARANTEED DATA		
1.01.00	Crane Capacity (Safe working load)		
	a)	Main hoist, tonnes	:
	b)	Auxiliary hoist, tonnes	:
1.02.00	Rated Speed (for any load from zero to S.W.L)		
	a)	Main hoist, m/min	:
	b)	Auxiliary hoist, m/min	:
	c)	Trolley travel, m/min	:
	d)	Bridge travel, m/min	:
1.03.00	Tolerance of speed, %		:
1.04.00	Creep speed (main hoist), m/min		:
1.05.00	Range of speed control for each motion (load from zero to S.W.L.)		:
2.00.00	TECHNICAL PARTICULARS		
2.01.00	Name Of Manufacturers		
2.01.01	E.O.T. Crane Unit		:
2.01.02	Crane Motors		:
2.01.03	Control Equipment		:
2.01.04	Runway Rail		:
2.01.05	Runway Conductors		:
2.02.00	Crane Clearance Diagram enclosed with all data filled up ?		Yes/No :

2.03.00	Weight of Equipment		:	Bare Weight (Kg)
2.03.01	Bridge Assembly :			
	a)	Bridge Girder each	:	
	b)	End Truck each	:	
2.03.02	Trolley Assembly :			
	a)	Bare Trolley	:	
2.03.03	Total for E.O.T. Crane Unit		:	
2.03.04	Runway Rail With Accessories		:	
2.03.05	Runway Conductor with Accessories		:	
2.03.06	Total for equipment		:	
2.04.00	Design, fabrication and testing of crane conform to standard/code no. (mention the name and serial no. of the code/ standards).		:	
2.05.00	Crane service classification number (indicate also the name of the code or standard adopting the classification).		:	
2.06.00	Wheel Loading Data (Bridge)			
2.06.01	Maximum wheel load with loaded trolley at extreme position of crane bridge		:	
2.06.02	Wheel loading diagram submitted ?		:	Yes/No
2.07.00	Crane Bridge			
2.07.01	Type of girder construction		:	
2.07.02	Girder particulars (indicate vertical deflection etc. etc.)			
	a)	Size (mm x mm x mm)	:	
	b)	Number	:	
	c)	Material of Construction	:	
2.07.03	Platform			
	a)	Type of Construction	:	
	b)	Material of Construction	:	
	c)	Width	:	

	d)	Length	:	
	e)	Location	:	
2.07.04	Handrail			
	a)	Type of Construction	:	
	b)	Material of Construction	:	
	c)	Height	:	
	d)	Length	:	
	e)	Location	:	
2.07.05	Trolley Rail			
	a)	Type	:	
	b)	Length	:	
	c)	Material of Construction	:	
	d)	Gap between successive rails	:	
	e)	Rail ends provided with stoppers to prevent longitudinal shifting ?	:	Yes/No
2.07.06	Trolley Stops			
	a)	Type of Construction	:	
	b)	Material of Construction	:	
	c)	Number	:	
2.08.00	End Trucks			
2.08.01	Type of Construction		:	
2.08.02	Material of Construction		:	
2.08.03	Number		:	
2.08.04	Wheel Axles			
	a)	Type	:	
	b)	Number	:	
2.08.05	Bearings for Wheel Axles			
	a)	Type	:	

	b)	Make	:
	c)	IS/BS Specification	:
	d)	Lubrication Particulars	:
2.08.06	Bridge Wheels		
	a)	Type	:
	b)	Size	:
	c)	Number per end truck	:
2.08.07	Bridge Travel Buffers		
	a)	Number	:
	b)	Location	:
2.08.08	Runway Rail Sweep		
	a)	Type of Construction	:
	b)	Location	:
	c)	Material of Construction	:
2.09.00	Operator's Cab		
2.09.01	Type of Construction		:
2.09.02	Size		:
2.09.03	Type of operator's seat		:
2.09.04	Illumination		:
2.09.05	Warning Gong		
	a)	Type	:
	b)	Location	:
2.09.06	Ladder from cab. to bridge		:
2.09.07	Fire Extinguisher		:
2.10.00	Trolley Frame		
2.10.01	Type of Construction		:
2.10.02	Material		:

2.10.03 Trolley Wheels

a) Type :

b) Size :

c) Arrangement :

d) Material of Construction :

2.10.04 Trolley Wheel Bearing

a) Type :

b) Make :

c) IS/BS Specification :

d) Lubrication Particulars :

2.10.05 Platform

a) Type of Construction :

b) Material :

2.10.06 Handrail

a) Type of Construction :

b) Material of Construction :

c) Height :

d) Length :

e) Location :

2.11.00 Full Load Speed, Metres/Min. and Full Load Acceleration, Metres/Sq. Sec

2.11.01 Bridge Travel

a) Rated Speed :

b) Acceleration :

c) Speed Steps :

2.11.02 Trolley Travel

a) Speed

Speed Steps :

		Rated Speed	:
	b)	Acceleration	:
2.11.03	Main Hoist		
	a)	Speed	
		Inching Steps	:
		Rated Speed	:
	b)	Acceleration	:
2.11.04	Auxiliary Hoist		
	a)	Speed	
		Inching Steps	:
		Rated Speed	:
	b)	Acceleration	:
2.12.00	Bridge Drive Machinery and Trolley Drive Machinery		
2.12.01	Material of Construction		
	a)	Gears	:
	b)	Shaft	:
	c)	Chain Drives	:
	d)	Other components	:
2.12.02	Lubrication particulars		
2.12.03	Centralised lubrication arranged as specified ?		Yes/No
2.12.04	Guards and enclosure provided as necessary ?		Yes/No
2.12.05	Bearings		
	a)	Type	:
	b)	IS/BS Specification ?	:
	c)	Make	:

		Main Hoist	**Auxiliary Hoist**
2.13.00	Hoisting Mechanism		
2.13.01	Winding drum type and size	:	

2.13.02	Ratio of winding drum diameter and diameter of wire rope	:		
2.13.03	Bearing			
	a) Type	:		
	b) Material	:		
	c) Make	:		
2.14.00	Wire Rope		**Main Hoist**	**Auxiliary Hoist**
2.14.01	Material	:		
2.14.02	Type	:		
2.14.03	Size	:		
2.14.04	Number	:		
2.14.05	Make	:		
2.15.00	Particulars of Hook Block		**Main Hoist**	**Auxiliary Hoist**
2.15.01	Type of Hook	:		
2.15.02	Material of Hook	:		
2.15.03	Type of Bearing of Hook Support and bearing Specification to IS/BS	:		
2.15.04	Can the hook rotate freely under full load?	:	Yes/No	Yes/No
2.15.05	Hook Block enclosure as per Specification ?	:	Yes/No	Yes/No
2.15.06	Locking arrangement with latches	:	Yes/No	Yes/No
2.16.00	Runway Rail			
2.16.01	Type	:		
2.16.02	Size	:		
2.16.03	Material	:		
2.16.04	Manufacturer	:		
2.16.05	Length on each crane girder	:		
2.16.06	Gap between successive rails	:		
2.16.07	Rail ends provided with stoppers to prevent longitudinal shifting ?	:		Yes/No

2.17.00	Runway Rail End Stop					
2.17.01	Type	:				
2.17.02	Number	:				
2.17.03	Material	:				
2.17.04	Construction	:				
2.18.00	Load Indication sign on crane bridge provided ?	:	Yes/No			
2.19.00	Extent and type of painting on equipment, before railway shipment	:				
2.20.00	Type and quantity of final paint quoted (including primer)	:				
2.21.00	Motor		**Main Hoist**	**Aux. Hoist**	**Bridge Travel**	**Trolley Travel**
2.21.01	General					
	a) Make	:				
	b) Type	:				
	c) Rating :					
	i) Rating : KW	:				
	: Time	:				
	ii) Permissible Starts/Hr	:				
	iii) Voltage, phase, frequency	:				
			Main Hoist	**Aux. Hoist**	**Bridge Travel**	**Trolley Travel**
	iv) Rated Current	:				
	v) Rated Torque	:				
	vi) All derating factors considered	:	Yes/No			
2.21.02	Permissible Variation					
	a) Voltage	:				
	b) Frequency	:				
	c) Combined Voltage + Frequency	:				
2.21.03	Performance					
	a) Method of Speed Control	:				

b) Starting Current :

c) Starting Torque :

d) Pullout Torque :

e) Motor speed torque characteristic at all speed notch furnished ? :

2.21.04 Construction

a) Frame Size :

b) Enclosure/Cooling Type :

c) Degree of Protection :

d) Insulation Class : Stator/Rotor :

e) Temperature Rise Over 50ºC : Stator/Rotor :

2.21.05 Space Heater

a) No. x KW :

b) Voltage, Phase, Frequency :

	Main Hoist	Aux. Hoist	Bridge Travel	Trolley Travel

2.21.06 Bearing

a) Type :

b) Make :

c) Recommended lubricant :

2.21.07 Motor GD^2 :

2.22.00 Brake

2.22.01 Service Brake

a) Number :

b) Type :

c) Braking capacity in % full-load torque :

d) Brake drum diameter :

e) Brake shoe width :

f) Brake drum material :

2.22.02 Control Brake

a) Number :

b) Type :

c) Braking Capacity in % full-load torque :

d) Brake drum diameter :

2.23.00 Power Supply System

2.23.01 Main Disconnect Switch

a) Make :

b) Type :

c) Rating :

		Main Hoist	Aux. Hoist	Bridge Travel	Trolley Travel
2.23.02	Runway Conductor				
	a) Conductor Type/Material :				
	b) Conductor size :				
	c) Current Density :				
	d) Collector Type & Size :				
2.23.03	Bridge Cross Conductor				
	a) Conductor Type/Material :				
	b) Conductor Size :				
	c) Current Density :				
	d) Collector Type & Size :				

2.23.04 Safety Disconnect Switch

a) Make :

b) Type :

c) Rating :

2.24.00 Protective Panel

2.24.01 Supply Disconnect Switch

a) Make :

b) Type :

c) Rating :

2.24.02 Main Contactors

a) Make :

b) Type :

c) Duty Class/Category :

		Main Hoist	Aux. Hoist	Bridge Travel	Trolley Travel
2.24.03	HRC Fuses				
	a) Make :				
	b) Type :				
	c) Short Circuit Rating :				
2.24.04	Overload Relays				
	a) Make :				
	b) Type :				
	c) Range of Settings :				

		Hoist Motion	Travel Motion
2.25.00	Crane Control		
2.25.01	Basic Speed Control		
	a) Type :		
	b) No. of Speed Notches :		
2.25.02	Inching Speed Control		
	a) Type :		
	b) Inching speed in % full load speed :		
	c) Detailed Write - up furnished on inching speed control ? :		
2.25.03	Individual Control Panel furnished for all crane motions ? :		

2.25.04	Master controller including facility of tandem operation furnished ?	:	
2.25.05	Detail write-up on speed control furnished	:	Yes/No
	a) Detailed write-up on crane control system including facility of tandem operation furnished	:	Yes/No
2.26.00	Other Details		
2.26.01	Protective/Control Panels		
	a) Enclosure		
	i) Degree of protection	:	
	ii) Sheet steel gauge used	:	
	b) Wiring		
	i) Insulation Type	:	
	ii) Voltage Grade	:	
	iii) Minimum Size	:	
	c) Services		
	i) Space heater furnished ?	:	
	ii) Internal illumination furnished ?	:	
2.26.02	Emergency Push Button		
	a) Type	:	
	b) Make	:	
	c) Rating	:	
2.26.03	Controller		
	a) Type	:	
	b) Make	:	
2.26.04	Resistor		
	a) Type	:	
	b) Make	:	
	c) Time Rating	:	

d) Temperature rise over 50ºC ambient :

e) Enclosure :

f) Degree of protection :

2.26.05 Limit Switch

a) No. x Type furnished for :

i) Main hoist :

ii) Auxiliary hoist :

iii) Bridge Travel :

iv) Trolley Travel :

b) Contacts per limit switch :

c) Contact rating :

2.26.06 Motor Contactor

a) Make :

b) Duty Class/Category :

2.26.07 Auxiliary Transformer

a) No x KVA furnished :

b) Control Supply :

c) Space heater :

d) Illumination :

e) Receptacle :

2.27.00 Illumination

2.27.01 Main Lighting Board

a) Make :

b) Type/Enclosure :

c) Degree of Protection :

d) Branch Circuit Protection :

2.27.02	Lighting Fixture			
	a)	Watt x Type furnished for	:	
		i) Operator's Cabin	:	
		ii) Bridge platform	:	
		iii) Under bridge	:	
	b)	Anti vibration mounting furnished ?	:	
2.27.03	Portable Lamp			
	a)	Voltage	:	
	b)	Length of Flexible cable	:	
2.27.04	Wiring			
	a)	Method of wiring i.e. in conduit or armoured cables	:	
	b)	Insulation grade	:	
	c)	Minimum conductor size	:	
		i) Power	:	
		ii) Control	:	
	d)	Furnished calculation for power conductor sizing to meet 3% voltage drop criteria ?	:	Yes/No
2.28.00	Lifting Beam with Slings			
2.28.01	Lifting beam with slings for lifting stator provided ?		:	
2.28.02	Length of lifting beam		:	
2.28.03	Size of lifting beam		:	
2.28.04	No. of hooks and spacing of hooks provided on balancing beam		:	
2.28.05	Size, number and total length of slings provided		:	

2.28.06	Material of construction for :			
	a)	Lifting beam	:	
	b)	Slings	:	
2.28.07	Code followed for design of hooks		:	
2.28.08	Test load for :			
	a)	Slings	:	
	b)	Hooks	:	
	c)	Lifting beam	:	
2.29.00	Quality Control, Surveillance and shop tests conform to the requirements of Specification ?		:	Yes/No
2.30.00	Enclosed with proposal a comprehensive description or brochure on details of manufacturing facilities and testing facilities in the shop of the manufacturer ?		:	Yes/No
2.31.00	Various drawings, data, etc. enclosed with proposal as per requirements of the specification ?		:	Yes/No
2.32.00	Enclosed with proposal the experience list as required by the specification ?		:	Yes/No
3.00.00	SCOPE OF SUPPLY OF ACCESSORIES AND SERVICES			
3.01.00	All structures as specified		:	Yes/No
3.02.00	All drive motors and driving gears as specified		:	Yes/No
3.03.00	Operator's Cabin		:	Yes/No
3.04.00	Pendant Station		:	Yes/No
3.05.00	Portable fire extinguisher/CO_2 bottle in operator's cabin		:	Yes/No
3.06.00	Runway rails and trolley travel rails including all clamps, anchors, bolts, nuts, sheams, inserts, end stops and other fixtures as specified		:	Yes/No
3.07.00	Spring/rubber buffers for end trucks		:	Yes/No

3.08.00	Rail sweep as specified	:	Yes/No
3.09.00	Protection guards as specified	:	Yes/No
3.10.00	Electric fan in operator's cabin	:	Yes/No
3.11.00	Foot operated siren	:	Yes/No
3.12.00	Repair cages as specified	:	Yes/No
3.13.00	All platforms and ladders as specified and as required	:	Yes/No
3.14.00	Lifting lugs, eye bolts etc. required for handling crane parts	:	Yes/No
3.15.00	Shop tests as specified	:	Yes/No
3.16.00	Site tests as specified	:	Yes/No
3.17.00	Erection and Commissioning service as specified	:	Yes/No
3.18.00	Supervision of erection and commissioning	:	Yes/No
3.19.00	All equipment, accessories and consumables required for erection, testing and commissioning	:	Yes/No
3.20.00	Final painting	:	Yes/No
3.21.00	Balancing beam for tandem operation furnished	:	Yes/No

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SECTION – II
STANDARD TECHNICAL SPECIFICATION

DOUBLE GIRDER EOT CRANE

1.0.0 SCOPE

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

2.0.0 CODES AND STANDARDS

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

i)	IS 807	Codes of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of cranes and hoists
ii)	IS: 3177	Code of Practice for Design of Overhead Travelling Cranes and Gantry Cranes other than steel work cranes.
iii)	IS: 2266	Specification for steel wire ropes for general Engineering purposes.
iv)	IS: 4029	Guide for testing induction motor (for temperature rise).
v)	IS: 15560	Steel hooks for standard shank design.
vi)	IS: 3443	Specification for crane rail section.
vii)	IS: 325	Three phase induction motors.
viii)	IS: 900	Code of practice for installation and maintenance of induction motors.
ix)	IS: 4237	General requirement of switchgear and Control gear for voltage not exceeding 1000V.
x)	IS: 434 (Part I)	Copper conductors rubber insulated cables for voltage up to 1000V.
xi)	IS 1596	Polyethylene insulated PVC sheathed cables
xii)	IS 3043	Code of practice Earthing
xiii)	IS: 3938	Electric Wire Rope Hoists.
xiv)	IS: 2147	Degree of protection provided by enclosures for Low voltage switchgear and control gear.
xv)	IS: 1554 Part I	PVC insulated (Heavy-duty) electric cables for working voltages up to and including 1100 volts.
xvi)	IS: 691	Flexible trailing cables rubber insulated.
xvii)	IS: 1653	Steel conduits for general engineering purposes.
xviii)	IS: 2509	Rigid non-metallic conduit for electric-Installations

xix)	IS: 2062	Steel for General Engineering purposes.
xx)	IS: 1030	Carbon Steel castings for general engineering purposes.
xxi)	IS: 1570	Schedules for Wrought steels.
xxii)	IS: 1875	Carbon steel billets, blooms, slabs and bars for forgings.
xxiii)	IS: 808	Dimensions for hot rolled steel beam, column, channel and angle sections.
xxiv)	IS: 1852	Rolling and cutting tolerances for Hot rolled steel products.
xxv)	IS: 2291	Tangential Keys and Keyways.
xxvi)	IS: 2292	Taper Keys and Keyways.
xxvii)	IS: 3961	Recommended current rating for cables.
xxviii)	IS: 694	PVC insulated cables for working voltages up to and including 1100V)
xxix)	IS: 1554 (part-I)	PVC insulated (heavy duty) electric cables: Part 1: for working voltages up to and including 1100 volts.
xxx)	IS: 4289	Flexible cables for lifts and other flexible connections: Part 1: Elastomer insulated cables.
xxxi)	BS: 970	Wrought steels in the form of blooms, billets, bars and forgings.
xxxii)	IS: 5749/ BS 3017	Specification for Forged Rams horn Hooks

Indian electricity rules - 1956.

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

3.0.0 **DOUBLE GIRDER EOT CRANE**

3.1.0 **DESIGN REQUIREMENTS**

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

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

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

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

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

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

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

c. Qualification of welding procedure and welder: These shall be carried out as per ASME Boiler and Pressure vessel code Sec. IX - Welding and brazing qualifications.

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

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

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

3.1.5 VOID

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

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

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

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

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

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

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

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

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

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

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

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

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

3.2.0 **STRUCTURAL DETAILS**

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

3.2.1.1 Black bolts shall not be used in the main structure of the crane. The calculated strength of other bolted joints in structural members shall not be less than net strength of member plus 25%.

3.2.1.2 The calculated strength of riveted joint or joints made by friction grip bolts in structure members shall be not less than the calculated net strength of the member.

3.2.1.3 Bolts used in shear shall be fitted in to reamed hole.

3.2.1.4 Nuts and Bolts will be as per IS:1363, IS: 1364 and IS: 1367
High-tension friction grip bolts as per IS: 3757 and High- tension friction grip nuts as per IS: 6623

3.2.1.5 Transverse filled welding on load carrying member shall be avoided.

3.2.1.6 All butt welds on structural members subjected to tensile stress shall be of radiographic quality as ASME Sec VIII Div.1 acceptance norms.

3.2.1.7 Fillet welding on load carrying members shall be avoided.

3.2.1.8 For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8mm thick. For tubes having both ends sealed the minimum thickness shall be 4.9 mm (6 SWG). For unsealed tubes the minimum thickness shall be 8mm.

3.2.1.9 The cranes working out door or in corrosive environment, an allowance of 1.5 mm shall be added to the calculated thickness.

3.2.1.10 Minimum thickness of chequered plates for platform shall be over 6 mm over plain. Chequered plates shall not be considered for strength calculations of load carrying members.

3.2.1.11 Splice shall be designed to resist all the forces and moments to which it is subjected to plus 50% thereof.

3.2.1.12 However, in no case the strength developed by the splice shall be less than 50% of the effective strength of the material spliced. Splices shall be proportioned and arranged, so that the gravity axis of the splice in line with the gravity axis of the member joined so as to avoid the eccentricity of the loading.

3.2.1.13 The material of construction of the major components shall be as specified in the specification/data sheet. Manufacturer are however free to use alternate material which are superior for the intended service. But in all the cases, prior concurrence of the purchaser is must.

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

proportioned and arranged, so that the gravity axes of the splices are in line with the gravity axis of the member to avoid eccentricity.

3.2.2 **Bridge Girder**

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

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

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

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

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

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

3.2.2.7 There should not be accumulation of water/oil inside the box girders. If required breathing holes can be provided for expansion / contraction, due to change in temperature. Tapped (threaded) holes shall be provided with ½" NPT plug in the bottom of the girders, at both ends, to drain off any accumulation of water / Oil inside the girder. Instruction shall be painted on the girders to remove the plug and check for water/oil before lifting. Plug shall be replaced after installation.

3.2.2.8 All connection splices shall be designed for full strength of member of loads indicated unless otherwise approved. Beams and connections shall be designed for 60% of shear capacity of beam section plus additional axial load if any. Not more than one splice shall be provided to make up full length of number.

3.2.2.9 Maximum Span/ Depth ratio for Plate Girder shall be 25 or as per IS 807 latest edition.

3.2.3 **End carriage**

3.2.3.1 End carriages shall be fabricated from rolled steel section or plates. End carriage shall be of ample strength to resist all stresses likely to be imposed on them under service conditions

including collision with other cranes or stops. The length of the end carriages shall be such that no other part of the crane is damaged in collision. End carriage shall be so designed as to distribute the load evenly between the wheels from each bridge girders.

3.2.3.2 End carriage shall be fitted with safety stop to prevent the end carriage falling more than 25 mm in the event of breakage of a track wheel, bogies or axle.

3.2.3.3 Suitable jacking pads at a suitable height from rail level shall be provided on each crane for crane jacking. Jacking pad dimensions shall be suitable for full seating of the jacking pad seat without any instability. When changing the track wheel, jacking pads shall not interfere with replacement of track wheel.

3.2.4 **Crab (Trolley)**

3.2.4.1 The crab frame shall be built from heavy steel section, welded properly to form single piece frame & to resist vertical, lateral and torsional strain and to support all loads without undue deflection. It should be properly machined to receive hoisting mechanism, cross traverse arrangement/mechanism, wheels etc. etc.

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

3.2.4.3 Platforms and Ladders

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

b) Every platform shall be provided with steel chequered plate top and be securely fenced with 1000 mm high double tier hand rails and toe boards. Platforms shall be of sufficient width to enable normal maintenance work to be undertaken safely

c) Safety hand railing of tubular construction 32 mm NB Medium class of IS: 1239 having top and bottom rail at height of 1000 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate (100 mm high and 6mm thick) shall be provided on bridge walkways and on end carriages, staircases, trolley and at any other place where access is provided. Bends shall be neat and made by machine. The top rail should be so laid that there is no intermediate obstruction and hand need not be lifted from rail while walking

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

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

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

3.3.0 **MECHANICAL**

3.3.1 **Rope drums**

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

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

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

3.3.2 **Hoist ropes**

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

3.3.3 **Rope sheaves**

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

3.3.4 **Wheels**

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

3.3.5 **Buffer**

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

3.3.6 **LT drive**

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

3.3.7 **CT drive**

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

3.3.8. **Gearing**

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

3.3.9 **Gear Box**

3.3.9.1 All gears shall be completely covered and enclosed in oil tight casing & sealed with gasket. In case of totally enclosed gearboxes, splash or automatic lubrication system shall be used. Covers shall be split horizontally at each shaft centre line, so that top half can be removed for inspection and repair with out disturbing the bottom half. Gear shafts shall be supported on ball/roller bearings mounted in gearbox unless specially agreed otherwise. The gear boxes shall be provided with breather, air vent, oil level indicator, dip stick, drain plug and lugs for lifting.

Radial clearance between the gear boxes inner surface and outside diameter of the gears shall be at least 1.25 times the depth of larger gear tooth inside the gear box or 20mm

which ever in higher. Facial clearance between inner surface of gearbox and face of gear or pinion shall be at least 20 mm. Gearbox shall be inspected in line with QP and as per PEM (Q)/001 enclosed.

3.3.9.2 The gearboxes shall be of mild steel or cast steel. All fabricated gearboxes shall be stress relieved at a temperature between 590 to 680 deg. C. The temperature shall be maintained within ± 20 deg. C and at no time during the soaking cycle the temperature shall fall below 590 deg. C or exceed 680 deg. C. Soaking shall be done for a period proportionate to 1 (one) hour/ 2.5 cm. of wall thickness**.**

3.3.10 **Bearing**

3.3.10.1 Ball and roller antifriction bearing of attached sub-vendor list, make shall be used throughout, except where specified otherwise. Drive side bearing on Hoisting equipment shall be ball / roller bearing type. Rated life of ball and roller bearing shall be not less than total working life as per data sheet-A. Life of bearing shall be calculated in accordance with manufacturer's recommendations.

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

3.3.11. **Shafts, Couplings and axles**

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

Motor shafts shall be connected to gearbox input extension shafts through flexible gear coupling. Solid coupling shall be used for connecting intermediate lengths of long travel shafts. For driving hoist drum full-geared couplings shall be used between hoists drum & hoist gearbox output shaft. Couplings shall be of cast steel/wrought steel conforming to IS: 1030 grade 280-520 and shall be designed to suit service conditions.

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

3.3.12 **Repair Cage**

A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. The repair cage shall be adequately sized to accommodate two persons.

And guarded for safety and correctly located for the intended service. Suitable access to the cage shall be provided. Repair cage shall be provided at the corner of the crane.

3.3.13 **Lifting hook**

Standard hooks shall be used unless otherwise specified. These hooks shall conform to the latest edition. All hooks used shall be in normalized condition only.

3.3.14 **LIFTING HOOK BLOCK ASSY**

3.3.14.1 Lifting hook block assembly shall be Ram shorn type or approved for capacity greater than 40 Tonnes and point hook with Shank for capacity upto 40 Tonnes and shall be of forged steel construction. Hooks shall be manufactured from Blooms, billets, rounds by forging with forging ratio of at least 3:1. Hooks manufactured from plates are not acceptable. All hooks used shall be in normalized condition only. Each hook shall be supported on ball or roller thrust bearing and shall rotate freely.

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

3.3.15 **Brakes**

3.3.15.1 Selection and design of brakes shall be such as to meet the requirement. Brakes shall be designed to suit 150% of torque transmitted to the brake drum with full load for hoist motions and 125% of motor rated torque before de-rating for LT/CT motion. Brakes shall be provided as specified in Data Sheet 'A'. Brake drum shall be separately mounted and coupling halves shall not be used as brake drum.

i) **SERVICE BRAKE**

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

ii) **HOIST CONTROL**

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

3.4.0 **ELECTRICAL**

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

3.4.1.1 Main Disconnecting/Isolating Switch fuse unit shall be provided at 1.5M above the operating floor level at one end / at both the ends of bay length or in the middle as specified in the data sheet A. Termination of incoming power supply cable to isolating switch fuse unit and

further cable from switch to down shop leads shall be included in the bidder's scope of work. The switch shall be provided with Power ON Red indication lamp.

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

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

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

3.4.2 **DRIVE MOTORS**

3.4.2.1 Crane Motors shall be totally enclosed, fan cooled and as per data sheet 'A'. The starting torque of motor shall not be less than 2.25 times the rated torque and pull out torque shall not be less than 275% of the rated full load torque of motor. In case of VVVF drive system, the creep speed will be achieved through VVVF drives and the motors for Main hoists, Auxiliary hoist, CT and LT will be Squirrel cage. Hoisting drive motors shall be provided with antifriction roller / ball bearings on the drive side.

3.4.2.2 Ambient correction factors as well as voltage /frequency correction factors depending up on the ambient temperature and voltage /frequency variation shall be applied to de-rate the motors. The minimum margin of 10% shall be considered over the calculated rating of the motor. The protection class of the motors shall be as IP-55. Motors shall be tested at manufacturer's works in accordance with IS-325/as per agreed Quality plan & Reports shall be submitted for approval. Motors shall comply with the requirement of IS-325 or as per the motor spec.

3.4.2.3 All the motors shall be provided with lifting lugs two earth terminals of adequate size to accept the earthing conductors shall be provided at diametrically opposite points unless specifically designed For higher speeds, motors shall be capable of with-standing 2.5 times the rated speed.

3.4.2.4 Motors shall be painted in line with painting instructions specified in Painting Scheme Annexure IV attached along with the technical specification.

3.4.3 **Limit switches**

The hoist mechanism of the crane shall be provided with rotary type limit switch to open the control circuit & in order to prevent the crane hook from over hoisting and over lowering, one

gravity type back up limit switch of hand reset type shall also be provided. This switch will operate in the event of failure of main limit switch. Lever operated limit switches shall be provided at both ends of longitudinal travel and cross traverse. These limit switches shall be self-reset type. The limit switches shall be as per "Data Sheet A"

3.4.4 **Switch**

All switches shall be hand operated; air break, heavy duty, quick make and quick break type. Incoming supply disconnect switch shall be interlocked with panel door so that the same cannot be opened unless the switch is in OFF position. Safety Interlocks-Disconnect Switch-The operating handle of the main/ safety disconnect switch shall be mechanically interlocked with enclosure cover such that the same cannot be opened unless the switch is in OFF position. Main/ safety disconnect switch shall have provision of pad locking in OFF position

3.4.5. **Contactors.**

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

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

3.4.6 **Push button and lamp**

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

3.4.7 **Protective Panel**

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

The following minimum equipment shall be provided.

a) One triple pole air break type main contactor with thermal overload relay.

b) One triple pole main line connecting/disconnecting switch.

c) Emergency push button at convenient height for the operation for interruption of the entire power.

d) Thermal overload relay for each drive. It shall be ambient temperature compensated and adjustable type.

e) Contactors, timer and auxiliary contactors.

f) Portable Lighting Transformer rated for 415/24V.

g) Lighting Voltage Transformer with fuse 415/24V.

h) Control transformer with fuses.

i) Indicating lamps to indicate the live condition of all three phases.

j) Main supply ON/OFF lamps on the door of the protective panel.

k) Electrical interlock shall be provided to prevent the main contactor being closed unless all controllers are in OFF position.

l) Other equipment as per supplier's standard practice. Air break contactors shall conform to category AC-4 duty. The main contacts shall have the rating for 5 Amps or as specified in the data sheet A. The contactor drop off voltage shall be between 45-50% of rated voltage.

m) All internal wiring shall be identified with numbering rules at both ends as per the relevant wiring diagram.

n) Each panel shall have internal illumination with fluorescent lamp. The inside of the panel shall be painted white.

o) Separate terminal blocks shall be provided for terminating circuits of various voltage classes. At least 20% spare terminals for the wire terminations shall be provided in the cabinet.

3.4.8 Starter Panel

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

a) Contactors : AC4 duty for reversing applications
AC3 duty for non-reversing applications

b) Switches : AC23 for motor application.
AC22 for other application

c) Fuses : HRC

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

3.4.9 **MOTOR CONTROL PANEL**

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

a) Switch fuse unit with contacts of adequate rating for each motion.

b) Thermal overload relay for each drive. These shall be ambient temperature compensated adjustable type.

c) Contactors, timers and auxiliary contactors.

d) The panel shall be provided with space heater. The space heater with thermostat shall be located at the bottom of the panel and shall have individual ON/OFF switch.

e) Terminal blocks shall be stud or snap on type. A protective cover shall be fixed on top of terminal blocks to prevent accidental contact. A minimum of 20% spare terminals shall be provided.

f) Air break contactors shall be provided for main supply as well as for motors. They shall confirm to category AC-4 as per IS-1322. These shall have three main contacts and 2 No. & 2 NC auxiliary contacts.

g) The main contacts shall have the ratings as per duty requirement but auxiliary contact shall be rated for 5 amp 240V AC. The contactor drop off voltage shall be between 45-50% of rated voltage. The contactor coil shall be suitable for 240V AC supply.

h) The auxiliary contactors shall have 4 No. + 4 NC contacts for control and interlocking purposes. The contacts shall be convertible. The contacts rating shall be suitable for 5 amps at 240 Volts AC.

i) Adequate protection for overload and short circuit shall be provided for all the three phases of each motor.

j) Double pole switch fuse unit for control circuit of the contractor 'START (push button and a pilot lamp with the red lens for indicating the contactor "CLOSED" shall be furnished.

3.4.11 **Illumination**

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

a) Branch Circuits for lighting and receptacles shall be individually protected by switch fuse units.

b) CFL fixtures shall be used for lighting operator's cabin and bridge platform.

b) 40W LED lamp shall be used for lighting bridge platform.

c) Four (4) nos - 160 W LED lamps shall be provided under the bridge as specified in the data sheet "A"

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

e) 24V - 5A - 3 pin industrial socket outlets shall be provided. Minimum four (4) on the bridge along the walk way on both sides of full length platforms.

f) One (1) portable 40 W LED hand lamp with min. half span length flexible cable for inspection of crane components.

3.4.13 **Grounding**

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

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

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

3.4.15 **Wiring Systems**

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

b) All wiring shall be done with 1100V grade fire resistance PVC insulated wire in conduits or by 1100V grade PVCA PVC cables with extruded inner sheath.

c) For selecting the cable rating, cable for power wiring, consideration shall be given to the motor duty, ambient temperature grouping and disposition of the cables voltage drop etc.

d) Armoured cables or un-armoured running through the flexible conduits may be used for power wiring / control and auxiliary circuit wiring shall run through flexible conduits.

e) Each motor shall be wired independently. Power and control wiring shall be effectively separated.

f) Each wire shall be identified at both ends with wire designation in accordance with circuit wiring diagram.

g) All wire termination to the panels shall be provided with clamp type connections screw. Screw Type terminals with screw directly impinging on conductors are not acceptable.

h) Multi way terminal blocks complete with screw nut, washer and marking strips shall be furnished for terminating the panel wiring.

i) Not more than two wires shall be connected to any terminal on either side of terminal block. If necessary number of terminals shall be jumped together to provide the wiring points

j) Each terminal block shall be marked with designation in accordance with conductors wiring diagram.

SECTION III

1. DOCUMENTS TO BE SUBMITTED ALONG WITH BID
2. PRE-BID CLARIFICATION SCHEDULE
3. COMPLIANCE CUM CONFIRMATION CERTIFICATE

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY LIST OF DOCS TO BE SUBMITTED ALONG WITH BID	SPECIFICATION No: PE-TS-445-501-A002	
		SECTION III	
		REV. 00	JUL 2021

DRAWINGS / DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder shall submit the following drawings / documents along with their bid for technical offer:

a) Deviation schedule with reference to specific clauses of the specification along with reason for such deviation in the 'Deviation Schedule' (Cost of withdrawal) format as attached in GCC.

b) Un-priced copy of price format indicating "quoted/ not quoted" against each row/column.

c) Copy of technical pre-bid clarifications/ amendment/ corrigendum issued by BHEL, if any, duly signed & stamped.

d) Signed/ Stamped copy of Compliance cum Confirmation Certificate.

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

388885/2021/PS-PEM-MAX

PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

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

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPECIFICATION No: PE-TS-445-501-A002	
		SECTION III	
		REV. 00	JUL 2021

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

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

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

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

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

	SAGARDIGHI THERMAL POWER PROJECT, 1 X 660 MW UNIT NO 5, STAGE III. DOUBLE GIRDER EOT CRANES UPTO 100T CAPACITY COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPECIFICATION No: PE-TS-445-501-A002	
		SECTION III	
		REV. 00	JUL 2021

m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.