2X660 MW SURATGARH STPS

RRVUNL RAJASTHAN

VOLUME - II B & III

TECHNICAL SPECIFICATION
FOR
WORKSHOP EQUIPMENT

SPECIFICATION NO. PE – TS – 392 - 568 – A001

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

CONTENTS

SECTION - A

SCOPE OF ENQUIRY

1.0 SCOPE OF ENQUIRY/ INTENT OF SPECIFICATION

1.1 The specification is intended to cover design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, painting, proper packing and supply and dispatch to power station site, Performance and guarantee testing and handing over of **WORKSHOP EQUIPMENTS** as per details in different sections / volumes of this specification for **2 X 660 MW Suratgarh STPS Stage V unit 7&8.**

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 vendor from the responsibility of providing such facilities to complete the supply of **WORKSHOP EQUIPMENTS**.

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

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

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

1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification. 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 schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.

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

1.10 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 RRVUNL including their consultant as interpreted by BHEL in the relevant context.

SECTION - B

PROJECT INFORMATION

1.0	Owner	Rajasthan Rajya Vidyut Utpadan Nigam Ltd., Jaipur
2.0	Consulting Engineer	TATA Consulting Engineers Ltd. 73/1, St. Marks Road, Bangalore – 560 001 Tel : 080 – 6622 6000 Fax : 080 – 22274874
3.0 4.0	Location of the plant Latitude and longitude	Prabat Nagar, Suratgarh Sriganganagar district, Rajasthan. Latitude : 29 deg. 10 min. N Longitude : 74 deg.01 min. E
5.0	Elevation above mean sea level	186 m (approximate)
6.0	**Climatic conditions**	
6.1	Temperatures : Monthly basis	
	Mean of daily max.	32.8 deg.C (in the month of May)
	Mean of daily min.	17.6 deg.C (in the month of Jan)
6.2	Temperatures : Annual basis	
	Mean of daily max.	32.3 deg.C
	Mean of daily min.	19.6 deg.C
	Highest temperature recorded	50 deg.C
	Lowest temperature recorded	(-) 2.8 deg.C
	Design Ambient Temperature for Electrical Equipment design	50 deg C
6.3	Relative humidity	Varies between 21% and 81%
6.4	Annual average rain fall	312 mm
6.5	Annual mean wind speed :	4 km / hr.
7.0	Wind load	

	Calculations for wind effect shall be in accordance with IS:875-1987(Part-3) taking into account the following:	
	a) Basic wind speed = 47 m/sec	
	b) Factor K1 = 1.07	
	c) Category of terrain = Category 2	
	d) K3 – as per IS 875	
8.0	Seismic data (As per IS: 1893 latest issue)	
	a) Zone	Zone II
	Designs & design coefficients shall be based on IS 1893:2002	
	Design condenser cooling water inlet temperature	33 Deg C
9.0	Auxiliary power supply:	
	Auxiliary electrical equipment to be supplied against this specification shall be suitable for operation on the following system:	
a)	For motors rated 160 kW and below.	415V AC, 3-phase, 3-wire effectively earthed.
b)	For motors rated above 160 kW and up to 1500 kW	6600V AC, 3-phase, 3-wire, 50 Hz, non-effectively earthed
c)	For motors rated above 1500kW	11000V AC, 3-phase, 3-wire, 50 Hz, non-effectively earthed
d)	For motor control centres	415V AC, 3-phase, 3/4-wire effectively earthed.
e)	DC motor starters, DC solenoids, DC alarm control and protection	220 V DC, 2-wire unearthed
f)	AC control & protective devices	110 V 1 phase, 50Hz, 2 wire AC supply. The single phase 110V AC supply shall be derived by VENDOR by providing 415V / 110 V Control transformers of adequate rating with MCCB / MCB on both the primary and secondary sides.
g)	Uninterrupted power supply	230 V, 1-phase, 50 Hz, 2-wire, AC

		supply (For all instrumentation and control system equipment and solenoid valves)

g) Lighting fixtures and space heaters — 240 V, 1 phase, 2 wire, 50Hz,solidly earthed system

h) Construction supply — 415 V, 3 phase, 4 wire, 50Hz AC supply with neutral lead solidly earthed.

i) The above voltages may vary as follows :

All devices shall be suitable for continuous operation over the entire range of voltage and frequency indicated below without any change in their performance.

AC supply	Voltage variation ± 10% Frequency variation ± 5% Combined voltage & frequency variation 10%
DC supply	Voltage variation +10% ,-15%
j) For instrument and control system of steam generator and steam turbine generator.	230 V ± 5% AC UPS, 1-phase, 50 Hz, 2-wire. The 24 V DC required for control system shall be generated from this UPS.

10.0 All the electrical equipment shall be designed for 50^{o} C reference ambient temperature.

11. 0 LOCATION OF PLANT

The proposed power project shall be located in the state of Rajasthan, in Shriganganagar Distt. The proposed power project is located within 393 km from Jaipur 169 km from Bikaner and 367 Km from Delhi.

Major road distances of the project site are as follows:-

Between		**Distance in KMs.**
Project-Suratgarh	:	31 km (Neraest Railhead)
Projecdt-Jaipur (State Capital)	:	393 km
Project- Delhi	:	367 Km
Project - Jaipur	:	393 km (Nearest Airport in Rajasthan)
- Amritsar	:	378 km (Nearest Airport)
Project - Bikaner	:	169 km

SECTION - C

SPECIFIC TECHNICAL REQUIREMENTS

1.0 SYSTEM DESCRIPTION AND SCOPE OF WORK

Various types of equipment / machines which are included in bidder's scope of work and required for the maintenance and repair workshop of the power station equipment are given under :-

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
1.1	**Lathe Machines**			
1.	General purpose Lathe	Height of centres: 300 mm, swing over bed – 600 mm, DBC (distance between centers) – 3000 mm, Swing over cross slide-350 mm, speed range 16 from 32 to 1200 rpm, Straight bed, Swing in gap- Manufacturer standard	Dog plate, Thread dial indicator, Dead centre, Live centre, Four-way change tool post with tool holders or quick change tool post, Steady rest, Follow rest, Coolant pump with fittings, 3- jaw self-centering chuck, 4-jaw independent chuck, rapid traverse of saddle, Machine lamp, Swarf tray, Splash guard, Set of standard operating / cutting and maintenance tools, Set of change gears for metric with worth and fractional threads, Taper turning attachment, Operation and maintenance manual.	1
2.	General purpose Lathe	Height of centres: 400 mm, swing over bed – 800 mm, DBC (distance between centers) – 3000 mm, Swing over cross slide-350 mm, speed range 16 from 32 to 1200 rpm, Straight bed, Swing in gap- Manufacturer standard	Dog plate, Thread dial indicator, Dead centre, Live centre, Four-way change tool post with tool holders or quick change tool post, Steady rest, Follow rest, Coolant pump with fittings, 3- jaw self-centering chuck, 4-jaw independent chuck, rapid traverse of saddle, Machine lamp, Swarf tray, Splash guard, Set of standard operating / cutting and maintenance tools, Set of change gears for metric with worth and fractional threads, Taper turning attachment, Operation and maintenance manual.	1

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
3.	Heavy Duty Centre Lathe	Height of centres :550 mm, swing over bed – 1100 mm, DBC (distance between centers) – 5000 mm, Swing over cross slide-700 mm, speed range 16 from 4.5 to 450 rpm, cross slide travel-575 mm, Swing in gap-Manufacturer standard	Starter, Start / Stop push buttons, Indicating Lamps, Motor, Control Systems, Dog plate, Thread dial indicator, Dead centre, Live centre, Quick change tool post, Steady rest, Follow stop, Coolant pump with fittings, 3- jaw self-centering chuck, Taper turning attachment, rapid traverse of saddle (Motor operated), Machine lamp, Swarf tray, Splash guard, Set of operating and cutting tools, Change gear for different threads, 4-Jaw independent chuck, Foundation bolts and Nuts, Set of maintenance tools, Operation and maintenance manual.	1
4.	High speed precision Lathe	Height of centres :250 mm, swing over bed – 500 mm, DBC (distance between centers) – 3000 mm, Swing over cross slide-300 mm, speed range 16 from 50 to 2000 rpm, Straight natural gap bed, Swing in gap-Manufacturer standard	3 jaw self-centering chuck, 3-jaw Precision Self centering chuck, 4-Jaw independent chuck, Universal face plate, Collect chuck and collets, Rear tool post, Steady rest, Follow stop, Longitudinal stop, Roll stop, Taper turning attachment, Set of change gears of nonstandard type, Diametral and circular pitches, Parallel and Taper threads on bolt and pipes, Coolant equipment, Splash guard, Machine lamp, Quick change tool post with 5 nos tool holders, Set of operating / cutting and maintenance tools, Centre reduction sleeve, Driving plate with peg, Operation and maintenance manual	1
1.2	**Drilling Machines**			

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
1.	Radial drill	Drilling in steel / CI – 50 / 60 mm diameter, Drilling radius (max):1500mm, Max. distance between base plate and spindle- 1000 mm, Max. drilling head traverse – 1000 mm, spindle travel drilling depth – 250 mm, speed range 12 from 40 to 1800 rpm	Starter, Start / Stop push buttons, Indicating Lamps, Motor, Control Systems, Universal table (725mm X 500mm X600mm), Coolant Equipment with fittings, Machine Lamp, Standard box table (600mm X 500mm X 500mm), Electro-Hydraulic Locking Mechanism, Magnetic Clamp, Foundation bolts and nuts	1
2.	Bench drilling Machine	Drilling capacity in steel -20-40 mm, Column to centre spindle -250mm, Spindle nose to work table-750 mm, Spindle travel-125 mm, Spindle nose to Base plate maximum-1000 mm, Work table size (with trough) -350 X 350 mm, Round work table (with trough)- 430 dia	Starter, Start / Stop push buttons, Indicating Lamps, Motor, Control Systems, 3 Jaw drill chuck, Machine Vice, Coolant equipment with fittings, Round table elevating arrangement, Machine Lamp, Set of maintenance tools, Operation and maintenance manual	2
3.	Portable drill guns	Drilling capacity – 6 mm to 25 mm and portable drill guns shall be geared motors to obtain different spindle speeds.	Complete set of drill bits and drill chucks, Removable type of spade handle and side handle for heavy duty drilling, 10 meters length of power cable with reeling drum, Portable work table with vice	2
4.	Column Drilling Machine	Drilling capacity-40 mm in steel & 50 mm in CI, No of range of spindle feeds -10.	Starter, Start / Stop push buttons, Indicating Lamps, Motor, Control Systems, Universal table, Coolant equipment with fittings, Machine Lamp without bulb, Standard Box table, Electro Hydraulic locking mechanism, Magnetic clamp, Foundation bolts and nuts.	1
1.3	**Grinding Machines**			
1.	Cylindrical Grinding Machine	Cylindrical Grinding Machine specified as SOB (swing over bed) – 350 mm, DBC (distance between centers) – 1500 mm.	3-Jaw self-centering chuck, work light without bulb, Wheel balancing stand, Additional Standard wheel flanges with balancing blocks	1

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
2.	Double-ended grinder	350 mm grinding wheel diameter. Double wheel pedestal grinder, Base to centre line height distance-500 mm, Distance between sheels-600 mm	Medium graded wheel on one end and fine grade on the other end for finish grinding, Starter, Start / Stop push buttons, Motor, Control Systems, Adjustable work rest, Eye shields, Container for coolant, Set of maintenance tools, foundation bolts and nuts, Wheel nut spanner, Operation and Maintenance Manual	1
3.	Double-ended grinder (Rough Grinding)	350 mm grinding wheel diameter. Double wheel pedestal grinder, Base to centre line height distance-500 mm, Distance between wheels-625 mm.	Coarse wheels on both sides for rough grinding and shall be heavy duty, Starter, Start / Stop push buttons, Motor, Control Systems, Adjustable work rest, Eye shields, Container for coolant, Set of maintenance tools, foundation bolts and nuts, Wheel nut spanner, Operation and Maintenance Manual.	1
4.	Tool & Cutter Grinder	Tool & cutter grinder specified as SOB (swing over bed) – 260 mm, DBC (distance between centers) – 750 mm, wheel dia 250 mm.	Indexing Head, Complete cooling system including motor, tank, piping and fittings, Universal machine vice, Machine lamp without bulb	1
5.	Flexible shaft grinder wheel	Grinding wheel dia : 150 mm, Electric geared motor, Rotating, Straight swiveling and tilting mounting, Speed range three.	Grinding wheels and guards, One set of maintenance tools, Three (3) meters of flexible shaft, Geared motor for different speeds, Tools holder and collets, Operation and maintenance manual.	2
1.4	Shaping Machine	Stroke of Ram (max): 600 mm, table size top length 600mm, top width 550mm, side height 550 mm, Horizontal travel of the table on slides 750 mm, Vertical travel of the table 350 mm, Admit on top table 400 mm	Swiveling table, Universal table, Quandrant tool box, Set of operating and maintenance tools, Cooling pump with fittings, Operation and maintenance manual.	2
1.5	**Bending and Shearing Machine**			

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
1	Hydraulic pipe Bender	Bending capacity : 10 – 80 mm pipe of 10 mm thickness.	Universal head plates, Head formers for all pipe sizes, Outer formers for all pipe sizes, Extension for piston rod, Set of maintenance tools, Hydraulic pump motor, Standard die blocks, Stand, Three wheel type pipe outer, Operation and maintenance manual	1
2	Plate Shearing Machine (Hydraulic Type)	Capacity : width x thickness - 2500 mm x 12 mm.	Nil	1
3	Hand-operated plate shears	Hand operated, geared, Up to 12 SWG.	Nil	1
1.6	**Press**			
1	Mechanical Press	Vertical hydraulic press, Cap 100 MT.	Nil	1
2	Fly Press	Capacity: 2 Ton.	Nil	1
1.7	Vertical Turning & Boring machine	Max turning dia 1700mm, Table dia-1500, working height 1000 mm, Max vertical travel ram head-550 mm, vertical travel of side ram head-700mm, swivel angle of ram head +30 degree, AC Variable Frequency drive, Horizontal travel of side ram head-Manufacturer standard	Nil	1
1.8	Slotting machine	Storke-500 mm, rotary table-510 mm, Longitudinal movement-400mm, cross movement-400mm, cutting speed strokes/min 60 to 90.	Nil	1
1.9	**Other Machinery**			
1.	Hydraulic hacksaw	To cut squire material up to 300 mm and round material up to 300 mm.	Coolant equipment and tank, Machine light without bulb, Vice, Bar Support stand, Set of maintenance tools, Operation and maintenance manual	1

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
2.	Pipe Threading Machine	Capacity – 62.5mm to 150 mm for pipes, threading length 150mm.	Nil	1
3.	One (1) No. Dynamic Balancing machine	Job dia (Max) -1 meter, Job Weight – 2 Tons.	Nil	1
4.	Universal Milling machine	Universal milling machine : Table dimensions – 1500 mm x 300 mm, Power operating long traverse 950 mm, Power operating cross traverse 320 mm, Power operating vertical traverse 400 mm, Spindle speed range 35 to 2400	Machine vice with swivel base, Self-centering vice, Universal dividing head, Height adjustable tail stock, Hand operated vertical indexing head, Hand operated horizontal indexing head, Slotting attachment, Hand operated circular table, milling arbors and stub arbors, Collect chuck with collets, Machine lamp, Climb milling attachment, Coolant equipment, Over arm brace, Two arbor support bearing, Set of operating and maintenance tools, Thread milling attachment, Vertical and universal milling attachment, Operation and maintenance manual, Back lash eliminator, Magnetic chuck, Rack milling attachment, One Set of cutters including gear cutter	1
2.0	**General Equipment for Machine Shop**			
1.	Work benches with vice	Carpenter type work bench with metal frame, size – 1800(L) mm X 1200(W) mm X 900(H) mm, 150 mm vice on four corners	Nil	6
2	Portable drilling & Grinding machines	Drilling capacity 6 mm (Qty. 5 Nos.) and grinding machine wheel dia 100 mm (Qty. 5 nos.).	Nil	5 no. each
3.	Two(2) Set of measuring tools	Scales, Protractors, Dial Gauge, Depth Gauge, Screw Driver Sets, Dividers, V Blocks, Planer Graphs, Tri Squares	Nil	2 Set

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
4.	Surface Plate	1.0 M X 1.5 M Granite	Nil	2
5.	Two (2) set of snap on tools	Allen keys (in mm):4, 5, 6. Pipe wrenches:0-3/4",0-1",0-2" Double end spanners: 6x7, 8x9, 10x11, Ring spanners: 6x7,8x9,12x13 Torque wrenches: 0-1", 0-1 ½" , 0-2" Rachets: 255mm Hammers:500 gms,800gms Box spanners:6x7,8x9,10x11	Nil	2 Set
6.	Six (6) Set of general tools	Screw Drivers, Spanners, Cutting Pliers, Dial Gauge with magnetic stand graduation-0.01mm, Measuring span 10 mm	Nil	6 Set
7.	Vernier and Precision Micrometer	Vernier (0-150, 0-300, 0-600 mm), Inside Micrometer (0-50 mm, 0-150 mm, 0-300 mm), Outside micrometer (0-50, 0-100, 0-150, 0-300 mm)	Nil	2 Sets
8.	Crimping Tools	For crimping of aluminium / tinned copper, terminals, lugs, connectors, Range (0.5 to 16 mm^2, 10 to 95 mm^2, 10 to 185 mm2, 50 to 400 mm^2)	Nil	1 Set
9.	Lockers	Size 1200 mm X500 mm X 1800 mm (H), 10 compartments with individual locking provision	Nil	1

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
10.	Almirahs	Size 1200 mm X500 mm X 1800 mm (H), thickness 0.7 mm steel sheet fitted with 7 lever lock with 5 nos. of adjusted shelves	Nil	1
11.	One pneumatically operated spanner set with all accessories.	Pneumatic impact wrenches 1/2",3/8", air drill 2200 rpm power 0.44kw	Nil	1 no. each
11.	Three(3) sets of hand lamps	Without bulb	Nil	3
13.	Static balancing Machine	Static balancing machine-capable of handling job dia 1.0m and job weight 2 T	Nil	1
14.	Hot Air Blower	Hot air blower of capacity 30m3/Hr	Nil	1
15.	Incubation Heater	Incubation Heater-200 Watt		1
16.	Hydraulic Puller	Hydraulic Puller-100 T, max outside dia 1000 mm, Vertical height from floor to ram min. 250 mm and max. 1250 mm	100 T capacity hydraulic power pack, Control Panel and Other equipments.	1
17.	Sets Of Spanners	Double Ended open type all sizes upto 2 inches, Box type all sizes upto 2 inches	Nil	2 Set
18.	Valve Grinding and Lapping Tools	For Valve upto 150 NB	Nil	1

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
19.	General Tools Kit	Set of fitter's hammers, Set of Soft hammers, Two each of files (Flat, Head, Square, Round, Half Round, Three Square, Warding, Pillar, Mile, Horse rasp File), Two each of chisels (Flat, Cross, Half Round, Diamond Pointed chisel), One each of drift (Simple, Key, Toothed, Pin drift), Arbor press, Flat Scraper, half round Scraper, hacksaw, Set of screw drivers, Set of taps and dies, Centre punch, Diagonal wire cutter, Set of wrenches, Plier	Nil	3 Sets
20.	Measuring Tools Kit	Set of adjustable angle plates (Cast iron), Set of vee blocks, Set of parallel bars, Tool maker clamp, Spirit Level, Dividers (Spring and firm joint type), Set of calipers (Spring and firm joint type comprising inside, outside, transfer and hermaphrodite types), Set of trammels, Set of filler gauges, Set of engineers's scales, Set of straight edges, Combination set, Universal surface gauge, Set of engineers squares, Bevel protractor, Tri Square, Depth gauges, Marking gauges and planer gauges	Nil	2 Sets
2.1	**Paint Shop**			

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
1.	Portable compressor and compressed air spraying equipment complete with spray gun and accessories suitable for painting application	Capacity: 127 liters / min, Pressure - 7.0 kg / cm2 (g), Reciprocating, Air cooled, Non lubricated, Air Receiver mounted, receiver capacity – 10 gallon with suitable spray gun and accessories.	Nil	1
2.	Portable sanding machine	Diameter - 180 mm, 5.1kg (without pad)	Nil	1
3.	Set of sign writing equipment and stencils	Stencils cutting machine 1'' Heavy Duty, with the following accessories:- 1. 7"X22"double side poly-laminated oil Stencil Boards-200 Nos. 2. Stencil Brushes-6 Nos. 3. 1 kg tin oil Stencil Ink (Black)-1 No. 4. Dust cover-1 No. 5. Stainless Steel cleaning hook-1 No.	Nil	1
4.	Buffing and polishing machine	Capacity 0.75 KW.	Nil	1
2.2	**Welding**			
1.	A.C welding Transformer	Portable Air /oil cooled, Max. continuous hand welding current (60% duty cycle) 300 Amps, Welding current range 50 to 400 Amps, Drip proof enclose, Maximum intermittent hand weld current 400 Amps.	Electrode cable length 5meter, Electrode holder, Protective mask / shield with coloured glass, Earthing clamp and cable 5 meter, Chipping hammer 6 Nos., Wire scratch brush, Chrome leather gloves, Chrome leather apron, welder goggles.	2

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
2.	Welding generator	Max. continuous hand welding current (60% duty cycle) 300 Amps, Welding current range 50 to 400 Amps, Drip proof enclose, Maximum intermittent hand weld current 400 Amps.	Electrode cable length 5meter, Electrode holder, Protective mask / shield with coloured glass 2 Nos., Earthing clamp and cable 5 meter, Chipping hammer 2 Nos., Wire scratch brush 2 Nos., Leather gloves 2 pairs, Chrome leather apron, welder goggles, Detachable regulator for remote control of welding current.	2
3.	TIG arc welding set	Portable forced air cooled, Capacity 200 Amps. 50 nos spare electrodes along with cable, hand gloves, protection shield.	Electrode cable length 5meter, Electrode holder, Earthing clamp and cable 5 meter, Chipping hammer, Wire scratch brush, Pair of hand gloves, Face shield with coloured glasses and two numbers of clear glasses	2
4.	Welding Rectifier	Max. continuous hand welding current (60% duty cycle) 300 Amps, Welding current range 50 to 400 Amps, Maximum intermittent hand weld current 400 Amps.	Electrode cable length 5meter, Electrode holder, Earthing clamp and cable 5 meter, Chipping hammer, Wire scratch brush, Pair of hand gloves, Face shield with coloured glasses and two numbers of clear glasses, Chrome leather Apron, Welders goggles protected by clear glass	2
5.	Gas Cutting Welding and Brazing Set	Capacity: Welding (Mild Steel)-25 mm (Max.), Cutting (Mild Steel)-150 mm (Max.)	Shank, Mixer, Cutting attachment, One set of torch for cutting, welding and brazing, One set of cutting nozzle, One set of welding nozzle, Oxygen and acetylene single stage regulators, 10 meter oxygen and acetylene fitted hoses, Rayflex goggles, Acetylene and oxygen flash back arrester, Flint spark lighter, Operations spanners, Cylinder Trolley	4

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
6.	Oxy-acetylene gas welding/ cutting sets	Oxy-acetylene gas welding set with dual regulator and gas cylinder without any gas.	Spark lighter, gas welding / Gas cutting nozzles, Gas pressure regulators (oxygen / acetylene), Red and black hose pipes (10 meters length each), Hose clips, Cylinder key spanners, Two cylinder trolleys with tool box, Gas welding gloves, Pressure Gauges, Chrome leather apron, Chrome leather gloves, Hose protectors, Regulators spanners, Spindle keys and outfit spanners, Hose connectors, Hose connections, check valves and nuts, Standard wire brush, Narrow wire brush, Blow pipe for welding & cutting (Standard and adaptable), Welding torch with separable tips and mixing head.	4
7.	Electric drying oven	Temperature : 0 to 300 ^{0}C, working space (approx.)– 500 mm x 500 mm	Nil	1
8.	Welding tables	Size – 750 mm (length) X 750 mm (width) X 900 mm (Ht)	Nil	4
9.	Soldering irons	25 watts, 250 Volts	Nil	6
10.	Portable electrode drier	Temperature : 50 to 250 0C, working space (approx.)– 80 mm dia. & 445 mm depth	Nil	3
11.	Welder accessories	Hand Gloves, Goggles, Shield, Leather apron	Nil	6 Sets
2.3	**Misc. Equipment**			

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
1.	Portable centrifuge (Trolley Mounted)	This is used for removal of sludge and moisture from lube oil, Trolley mounted Centrifuge Unit comprises feed pump, oil centrifuge, discharge pump, drive motor, integral piping, electrical starter etc., Capacity:2000 L/hr., Motor explosion proof (EExD), Properties of oil- fluid handled- turbine oil type ISO, VG 46 or Servo prime 46 of IOC, Viscosity of oil- 18 mm^2/s (CST) at 65 degree C and 46 mm^2/s (CST) at 40 degree C, Specific gravity 0.88, Viscosity index 96, Guaranteed size of solids in the oil at the outlet of the centrifuge at rated capacity shall be 5 microns, Maximum water content allowed is 300 to 500 PPM free water, Suction lift of feed pump 4 MWC, Discharge pressure of discharge pump 15 MWC, Centrifuge shall be supplied as purifier assembly, centrifuge unit should be free from copper and copper alloys, centrifuge shall be assembled as a single unit and shall be ready to use, Material of centrifuge is SS-316	2 Numbers of 15 meter length of flexible SS branded hoses with inlet and outlet rotating flanged connections 1 ½'' ANSI, 20 Meter length of Armored power cable in 1.5 mm2, 3 core with flame proof plug socket for connection to explosion proof starter, Standard tools and commissioning spares	3
2.	Portable pumping unit	Screw pump having capacity :6600 L / hr, Head 10 M, Liquid to be pump Oily Sludge / oil, contains solid size 3 to 4 mm and percentage 6 to 8%, viscosity of oil 200-500 Centipoise (cP)	Nil	2

S. N.	EQUIPMENT NAME	TECHNICAL SPECIFICATION	ACCESSORIES	QTY.
3.	Trolley mounted pumping unit	Screw pump having capacity :10000 L / hr, Liquid to be pump Oily Sludge / oil, contains solid size 3 to 4 mm and percentage 6 to 8%, viscosity of oil 200-400 Centipoise (cP)	Nil	1
4.	Diesel tank	Diesel tank of capacity 20 KL (Min). MOC of tank shall be FRP.	Nil	1

Painting of workshop equipment: Following painting specification shall be followed for above workshop equipment except item no. 1.2 (3), 2.0 (2 to 12 and 17 to 20), 2.1 (3, 4), 2.2 (1 to 10), 2.3 (1 to 4). For these machines, manufacture's standard epoxy painting
specification shall be followed.

At Works

Pre-treatment:- Degreasing and surface preparation to SA 2 1/2.

Prime coat: - One (1) coat of Epoxy based polyamide cured (2) pack HB zinc phosphate primer. Dry-film thickness 75 microns per coat.

Intermediate coat: - One (1) coat of Epoxy based MIO pigmented polyamide cured paint. Dry-film thickness 50 microns per coat.

Finish coat: - Two (2) coat of Aliphatic Acrylic (2) pack glossy polyurethane paint. Dry-film thickness 30 microns per coat.

Total system: - Dry film thickness 185 microns.

Final shade of paint shall be as per manufacturer's standard only.

NOTES:-

1) Maintenance tools and tackles as required for the various machines, commissioning spares for various machines as applicable, first fill lubricant /coolant for each equipment is included in Bidder's scope of work.

2) Machines shall be supplied with the manufacturer's standard accessories & other accessories as indicated above. Bidder shall submit list of all other special accessories in their bid & furnish item wise price in the price bid.

.

2.0 **The followings shall also be included in bidder's scope of work:-**

2.1 Required numbers of machines in new / unused condition along with standard accessories and special accessories as listed above in the specification.

2.2 First fill of lubricants, oil, coolants etc. for all machines.

2.3 Painting of equipment shall be done by the bidder before despatch as per the attached painting schedule. Bidder shall also supply adequate quantity of loose touch up paint along with the equipment so that damage in transition, if any, can be taken care.

2.4 Base plates, Support plates, anchor bolts, foundation bolts and nuts, lifting lugs, eye bolts etc. if any. All commissioning spares shall be included in the scope of work of each equipment / item.

2.5 Terminal points for electrical shall be the power supply terminals in respective machines and power cable glands and lugs shall be in bidder's scope.

2.6 The electrical equipment supplied as a part of machine shall include isolating switch for power supply isolation incorporating mechanical safety as required.

2.7 VOID.

2.8 Commissioning spares shall be included in the scope of work of the bidder.

2.9 A complete unused new set of special purpose service / maintenance tools & tackles shall be supplied with each machine. The tools shall be supplied in steel tool box & shall be of the best quality & specially protected against rusting in tropical climate.

2.10 VOID.

2.11 Five (5) metres of power cable (spare) shall be supplied alongwith each machine / item.

2.12 Any other works not covered above but required for the safe operation of the machines.

3.0 CODES & STANDARD

The machines covered under the scope of work shall be new, of streamlined construction, rugged and vibration free in line with the Indian / international standard and practices.

4.0 SERVICES BY CUSTOMER

4.1 Draining arrangement of liquid coolant from source to the nearest drain.

4.2 Construction of Workshop building.

4.3 Pipe trench & cable trenches, doors / windows, rolling shutter, ramp and glass partition wall, if any.

4.4 Cable termination.

4.5 One no. D/G EOT crane of 25/5 tonnes capacity.

4.6 Erection and commissioning of workshop machines.

5.0 DOCUMENTS AND DATA REQUIRED TO BE SUBMITTED FOR EACH MACHINE WITH THE BID

a) Brief technical parameters of the machine, list of standard accessories, list of special accessories as per the specification, weight of heaviest part of the component, total

weight of machine in tonnes, length, width & height of machine, no. of motors in a machine & their KW rating.

b) Catalogue of each item / machine.

c) Sketch showing dimensions and maintenance space required for the machine.

d) Filled up motor data sheet. Please fill up all the data sheet for each machine indicating no. of motors, their name plate rating, guaranteed power consumption, type of feeder required etc. as per BHEL's format.

e) Commissioning spares in terms of numbers indicating sizes / ratings.

f) No deviation certificate

NOTE:- All the above data are required to be submitted along with the technical offer failing which the offer is likely to be rejected.

6.0 **DOCUMENTS AND DATA REQUIRED TO BE SUBMITTED AFTER PLACEMENT OF LOI**

Following drawings and documents shall be submitted to BHEL for approval after the placement of LOI:-

a) General arrangement drawing indicating overall dimensions, total weights, foundation details and bill of material for all types of machines including requirement of withdrawal space.

b) Final details of motors (machine wise) indicating guaranteed power consumption as per BHEL's format.

c) Manual calculation for selection of machines including authentic supporting literature (e.g. handbook / standards).

d) Manual calculation for requirement of air / water quantity and pressure including authentic supporting literature (e.g. handbook / standards).

e) Final filled up Data sheet "B" / Data sheet "C"

f) Quality assurance plan being followed for all items of each type of machine starting from raw material to final product including routine and type test being conducted at works.

g) Write - up on working principle and special safety features envisaged for each type of machines.

h) Final requirement of air and water indicating quantity, pressure and terminal points, if any.

i) Painting schedule.

j) O & M manual.

k) List of spares (commissioning).

l) List of Tools and Tackles.

m) Schedule of lubricants indicating quantity, make and trade name of at-least three manufacturers.

n) Data sheet of machines.

NOTE:-

1) The list of drawings and documents to be submitted after placement of order shall be forwarded to the successful bidder after award of contract.

2) Only manual calculation with authentic supporting literature shall be furnished (e.g. Hand book / standards / codes).

3) 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.

6.1 **General requirement**

01. All the drawings shall be prepared in Auto Cad - 2007 version and required number of hardcopies and soft copies of all the drawings, documents, O & M and spare parts manuals shall be furnished to BHEL during detailed engineering stage as per Annexure – II enclosed with the NIT specification.

02. Inspection checklist / quality plan and recommended field quality plan for each machine and submitted to BHEL for approval after placement of order and any changes required by BHEL / CUSTOMER for the same shall be incorporated and adhered by the bidder without any commercial implications.

03. BHEL will require 21 days time to offer their comments on the drawings and documents being submitted by the bidder from the date of receipt.

04. All drawings including general arrangement, civil foundation drawing shall be furnished to BHEL during detailed engineering stage and shall include BOQ / BOM in tabular form indicating all major components including bought out items, standard as well as optional accessories which are covered under the bidder's scope of supply and their quantity, material of construction indicating its applicable code / standard, weight, make.

05. All drawings of each machine including general arrangement and foundation drawings shall be furnished to BHEL during detailed engineering stage and shall include / indicate the following details for clarity w.r.t. inspection, construction, erection and maintenance etc. :-

a) All drawings and documents shall bear BHEL's title block and drawing / document number. However, BHEL's drawing / document numbering scheme shall be furnished to the successful bidder after the placement of L.O.I.

b) All drawings shall indicate the list of all reference drawings including general arrangement and foundation drawings.

c) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view and all major self manufactured, bought out items, standard as well as

optional accessories which are covered under the bidder's scope of supply shall be labelled and included in BOQ / BOM in tabular form.

d) Specification / schedule of coolant / oil for oil cooler / lubricant / paint indicating atleast 3 trade name shall be made as a part of general arrangement drawing of each machine.

e) Extreme location of various items / assembly due to movement shall be shown in dotted lines indicating the dimensions of the same from the extreme point of idle location.

f) Location of motor (s), control panel along with dimensions shall be shown in the drawing.

g) Space required for the door opening of panel shall be shown in dotted lines with dimensions in all the general arrangement drawing.

h) Details of job feeding and withdrawal direction with arrow and its required space shall be shown in dotted lines with dimensions from some reference point like edge / centre of the machine.

i) Location of operator and required space for his movement shall be shown in the general arrangement drawing in dotted lines with dimensions from some reference point like edge / centre of the machine.

j) Requirement of withdrawal space for maintenance, if any, shall be shown in the general arrangement drawing in dotted lines with dimensions from the reference point like edge /centre of the machine.

k) Recommended clearance / maintenance space around the machine shall be shown in the general arrangement drawing in dotted lines with dimensions from the reference point like edge / centre of the machine.

l) Mounting details of each machine indicating size and required number of holes and the distances between them shall be indicated in the general arrangement drawing.

m) Distance between the mounting holes and distances of the same from some reference point like centre line of machine / edge of the machine to ensure correct construction of foundation and to know maximum space required for civil foundation and mechanical equipment.

n) Technical parameters of the machine shall be furnished (gearbox details, job rpm, vibration limit, noise level at a distance of 1.0 metre at a level of 1.5 metres above ground, V - belt details, details of pulley, details of all motors and hydraulics, whether the machine will be dispatched / delivered in the assembled condition or dismantled condition indicating the weight as the case may be, recommended capacity of E.O.T Crane, weight of heaviest (single) part / component of the machine, weight of machine along with accessories, job and total weight shall be furnished separately etc.) in all the general arrangement drawing and those shall be indicated in the drawing with dimensions to the extent possible.

o) Details of cable entry for each machine shall be shown in all the 3 views (plan, elevation and side view).

p) Hardness and type / method of hardening of various parts of each machine shall be indicated in the general arrangement drawing.

06. Manual Calculation for motor (s) sizing shall be furnished to BHEL during detailed engineering stage for approval along with the copy of authentic supporting literature e.g. Hand book, National / international Standards etc in line with the technical specification.

07. O & M manual shall be furnished to BHEL for approval during detailed engineering stage along with the general arrangement drawing.

08. Drawing / data sheet of all accessories shall be furnished to BHEL for approval during detailed engineering stage indicating brief specification.

09. Operational write-up along with safety features and interlock / control details of each machine shall be furnished to BHEL separately for approval during detailed engineering stage.

10. Separate drawing for lifting arrangement of machine during erection shall be furnished to BHEL for approval indicating dimensions and details of lifting lugs, rope etc.

11. Civil foundation drawing of each machine shall be furnished to BHEL for approval during detailed engineering stage showing / including the followings:-

a) Scope of work by BHEL and vendor which shall be indicated with different legend or in the form of note.

b) Weight of moving parts, its frequency and its height from floor shall be furnished.

c) Recommended location of cable trench for feeding cable to machine shall be furnished along with the details of cable entry.

d) Civil loads per bolt (static and dynamic) shall be furnished in tabular form considering weight of maximum size of job and worst cutting force.

12. Separate general arrangement drawing of drive arrangement shall be furnished to BHEL for approval during detailed engineering stage.

13. Characteristic curve of motor shall be furnished to BHEL for approval during detailed engineering stage showing torque, speed, current & voltage.

14. Design of machines shall be such that no cooling water / air from external source shall be required for cooling of any part of machine. Necessary cooling arrangement, as required, shall be provided by the bidder in their machines.

15. First fill of all oil, lubricants, coolants etc. shall be included in scope of work of the bidder for each machine and shall be supplied along with the machine and **price for the same shall be taken care in the price bid, if any**.

16. Filled up sketch indicating various dimensions for the space requirements of each equipment, centre line of job feeding and its dimension from some reference point like the centre line of machine or edge of the machine, location of operator, direction of job feeding & withdrawal and details of cable entry.

17. Bidder has to depute competent designer (s) of each machine at BHEL's office during detailed engineering stage to discuss drawings and other technical documents as and when required by BHEL. However, minimum 7 days notice shall be served for the same.

18. **Unit price for each special accessories of each machine shall be furnished in the price bid.**

19. Make of various bought items shall be as indicated in the NIT specification. Bidder will seek approval from BHEL during detailed engineering stage for those items which are not appearing in the list but required for the machine. However, Bidder shall not approach BHEL for approval of additional make of any item which is already appearing in the list.

20. Painting specification and schedule shall be provided by the bidder for each machine as indicated in the NIT specification. However, painting specification of those items / equipments which are not covered in the specification, bidder to prepare the painting specification (suitable for sea atmosphere) for each item / machine / equipment and will be submitted to BHEL / CUSTOMER for approval after placement of order and any changes required by BHEL / CUSTOMER for the same shall be incorporated and adhered by the bidder without any commercial implications. Bidder to include adequate quantity of loose touch up paint for each item / equipment / machine which is required to be supplied along with the item / equipment / machine to take care damage during transit and price for the same, if any, shall be taken care in the price bid.

21. Noise level for each machine at a horizontal distance of 1.0 metre from the edge of the machine and at a height of 1.5 metres from the ground shall be limited to 85 dba and the same shall be shown during the “PG” test.

22. Inspection checklist / PG TEST procedure etc. shall be prepared by the bidder and will be submitted to BHEL / CUSTOMER for approval after placement of order and any changes required by BHEL / CUSTOMER for the same shall be incorporated and adhered by the bidder without any commercial implications. Necessary instruments / job material (steel plate / bar etc.) as required for the testing / inspection of machines shall be arranged by the bidder and shall also be included in bidder’s scope of work.

23. All foundation nuts, bolts, lock nuts, washers etc. as required for fixing the machine with foundation shall be included in bidder’s scope of work for each machine and the same shall be supplied along with the machine and **price for the same shall be taken care in the price bid, if any**.

24. All necessary guards, devices, tools & other means that will effectively protect all personnel from any accidental or injury that may occur while machine is in running condition shall be in bidder’s scope of work and shall be provided and shown in the drawings to be submitted during detail engineering stage.

25. Offered machines shall be suitable for the electrical conditions like voltages, frequencies, variations etc. as indicated in project information of NIT specification.

26. BHEL, will provide one (1) no. feeder per machine. Bidder to note & confirm that they will distribute the power requirement of various motors at their end only for this feeder.

27. Blank.

28. List of maintenance tools / hand tools & tackles in terms of numbers only indicating sizes / ratings etc. in annexure form for each machine shall be submitted during detail engineering

stage and the same shall be included in bidder's scope of work. Maintenance tools and tackles shall be supplied along with the tool box(es) and **price for the same shall be taken care in the final price bid, if any.**

29. Blank.

30. List of commissioning spares in terms of numbers only indicating sizes / ratings etc. in annexure form for each machine shall be indicated in the offer and shall be supplied along with the machine. **Price for the same shall be taken care in the final price bid, if any**.

31. One (1) no. EOT Crane of capacity 25 Tonnes shall be provided by BHEL in the workshop building for maintenance of the machines. Bidder to check and confirm that the heaviest part of individual machine shall not exceed 25 Tonnes.

32. Necessary earthing studs / facilities for the machine and cables within the machine shall be provided by the bidder.

33. All machines shall be provided with DOL starter.

34. Bidder to furnish the Signed & stamped copy of quality plan for motors attached with the NIT specification during detail engineering stage.

35. Cable Glands shall be double compression tinned brass type and the cable glands shall be supplied as a part of the each machine and **price for the same shall be taken care in the price bid, if any**.

36. All cable lugs shall be heavy-duty tin-plated crimping type the cable lugs shall be supplied as a part of each machine and **price for the same shall be taken care in the price bid, if any**.

37. All technical parameters of LV motors shall comply data sheet –A for LV motors.

38. Filled up motor data sheet of motor (for each motor) and filled up electrical load data format (enclosed with the NIT specification) for each machine shall be submitted during detail engineering stage**.**

39. All the hand wheels shall be polished / Nickel - Chrome plated.

40. List of standard accessories (which will be supplied free of cost along with the machine) in terms of numbers only for each machine shall be indicated in the offer and included in bidder's scope of work. **Price for the same shall be taken care in the price bid, if any**.

41. Bidder to indicate the material of construction of major parts of the machines indicating relevant IS / BS no.

7.0 SPECIFIC REQUIREMENTS REGARDING ERECTION / TESTING & COMMISSIONING

Field quality plan for all machines shall be prepared by the bidder during detailed engineering stage as per agreed schedule and the same shall be approved by BHEL to facilitate handling of equipment, erection & commissioning.

8.0 BID EVALUATION CRITERIA

The bid shall be evaluated based on the price quoted for main machine, commissioning spares, tools and tackles, manufacturer's standard accessories and special accessories as per specification and any technical loading due to non adherence to the technical specification. However, the price for recommended spares and other special / optional accessories which are not included in bidder's scope of work shall not be considered for evaluation purpose.

9.0 CONDITION OF REJECTION

Bid may be rejected if the data which have asked in clause No. 5.0 above is not properly filled-up and submitted along with the bid with company seal.

10.0 INSPECTION, TESTING AND CODES

10.1 The machine offered shall conform to the latest relevant Indian / international Codes / Standards, their electrical drives shall conform to the latest Indian Electricity Rules and shall comply for the currently applicable statutory regulations and safety codes for the locality where the equipment shall be installed.

10.2 Each machine before despatch shall be shop assembled & tested for its performance in the presence of purchaser's representative. Vendor to ensure the proper quality checks during manufacturing & assembly of machine, including identification, co-relation & verification of material test certificates for critical components like gears, shafts, spindles, sleeves etc. and radiographic tests for welds and ultrasonic tests on forging/castings to ensure defects free components and furnish test procedure, reports & test certificates on shop tests.

11.0 Drawing / document distribution schedule is attached in the NIT specification. Bidder shall follow the same during detail engineering stage.

ANNEXURE - I

MAKES OF SUB VENDORS ITEMS OF WORKSHOP EQUIPMENT

S.N.	ITEM	MAKES
1.0	Bearing	SKF / FAG / TATA / NBC
2.0	V - Belt	Fenner / Dunlop
3.0	Hydraulic Power Pack	Vickers - Perry / Rexroth
4.0	CABLES	
a)	LT XLPE Power Cables	APAR INDUSTRIES LTD., CORDS CABLE INDUSTRIES LTD., CRYSTAL CABLE INDUSTRIES LTD., Diamond Power Infrastructure Ltd, GEMSCAB INDUSTRIES LTD., Govind Cable Industries, GUPTA POWER INFRASTRUCTURE LIMITED, Havells India Limited, KEI INDUSTRIES LTD., KRISHNA ELECTRICAL INDUSTRIES LTD., KEC INTERNATIONAL LIMITED, MANSFIELD CABLES COMPANY LTD., PARAMOUNT COMMUNICATIONS LTD., POLYCAB WIRES PVT. LTD., RAVIN CABLES LIMITED, SUYOG ELECTRICALS LTD., SPECIAL CABLES PVT. LTD., SRIRAM CABLES PVT. LTD., Scot Innovation Wires and Cables Pvt. Ltd., TORRENT CABLES LTD., THERMO CABLES LTD., TIRUPATI PLASTOMATICS PVT. LTD.
b)	LT PVC Power Cables	APAR INDUSTRIES LTD., CORDS CABLE INDUSTRIES LTD., Diamond Power Infrastructure Ltd, GOYOLENE FIBRES (INDIA) PVT.LTD., Govind Cable Industries, GUPTA POWER INFRASTRUCTURE LIMITED, Havells India Limited, KEI INDUSTRIES LTD., KRISHNA ELECTRICAL INDUSTRIES LTD., KEC INTERNATIONAL LIMITED, MANSFIELD CABLES COMPANY LTD., NICCO CORPORATION LTD., PARAMOUNT COMMUNICATIONS LTD., POLYCAB WIRES PVT. LTD., RADIANT CORPORATION PRIVATE LIMITED, RAVIN CABLES LIMITED, SUYOG ELECTRICALS LTD., SRIRAM CABLES PVT. LTD., Scot Innovation Wires and Cables Pvt. Ltd., Sam Cables & Conductors (P) Ltd., THERMO CABLES LTD.
c)	LT XLPE Control cables	APAR INDUSTRIES LTD., CABLE CORPORATION OF INDIA LTD., CRYSTAL CABLE INDUSTRIES LTD., Diamond Power Infrastructure Ltd, GEMSCAB INDUSTRIES LTD., Govind Cable Industries, Havells India Limited, KEI INDUSTRIES LTD., KRISHNA ELECTRICAL INDUSTRIES LTD., KEC

		INTERNATIONAL LIMITED, PARAMOUNT COMMUNICATIONS LTD., POLYCAB WIRES PVT. LTD., RADIANT CORPORATION PRIVATE LIMITED, RAVIN CABLES LIMITED, SUYOG ELECTRICALS LTD., SRIRAM CABLES PVT. LTD., TORRENT CABLES LTD., UNIVERSAL CABLES LTD.
d)	LT PVC Control cables	Advance Cable Technologies (P) Ltd., APAR INDUSTRIES LTD., CMI LTD., CORDS CABLE INDUSTRIES LTD., CRYSTAL CABLE INDUSTRIES LTD., DELTON CABLES LTD., Diamond Power Infrastructure Ltd, ELKAY TELELINKS LTD., GEMSCAB INDUSTRIES LTD., Govind Cable Industries, GUPTA POWER INFRASTRUCTURE LIMITED, Havells India Limited, Incom Cables (P) Ltd., KEI INDUSTRIES LTD., KRISHNA ELECTRICAL INDUSTRIES LTD., KEC INTERNATIONAL LIMITED, MANSFIELD CABLES COMPANY LTD., NICCO CORPORATION LTD., PARAMOUNT COMMUNICATIONS LTD., POLYCAB WIRES PVT. LTD., RAVIN CABLES LIMITED, SUYOG ELECTRICALS LTD., SPECIAL CABLES PVT. LTD., Scot Innovation Wires and Cables Pvt. Ltd., Sam Cables & Conductors (P) Ltd., SPM POWER & TELECOM PVT. LTD, TORRENT CABLES LTD., THERMO CABLES LTD., TIRUPATI PLASTOMATICS PVT. LTD., UNIVERSAL CABLES LTD.
5.0	Pump for coolant	Phulsons, Rajpura / Rajamane Industries Pvt. Ltd., Bangalore
6.0	LT Motors	SIEMENS / NGEF/ CROMPTON / KIRLOSKAR / BHARAT BIJLI / ALSTOM / ABB (NGEF UPTO 15kW only)
7.0	Paint	Asian Paints (I) Ltd., Berger Paints India Ltd, Goodlass Nerolac, Jenson & Nicholson (I) Ltd , CDC carboline (I) Ltd., Shalimar Paints Ltd., Addison Paints Ltd, Grand Polycoat, Bombay Paints, Hemple Paints (Singapore), Jotun Paints

Note:

1. **Make is indicative, subject to customer's / consultant approval during detail engineering. Acceptance/non acceptance of same shall not have any impact on manufacturing, delivery schedule and on cost of the equipment.**

ANNEXURE - II

Drawings / documents distribution schedule

S.N.	DESCIPTION	CUSTOMER / CONSULTANT	BHEL / Customer SITE	PEM (ENGINEERING)
1)	Drawings / documents during approval stage	10	Nil	6 – hard copy and 1 – soft copy (CD)
2)	Finally approved drawings / documents	10	9	6 – hard copy and 6 - softcopy (CD)
3)	As built drawings / documents	10	9	6 – hard copy and 6 - softcopy (CD)
4)	Approved erection / installation manual	10	9	6 – hard copy and 6 - softcopy (CD)
5)	Approved O & M manuals	10	9	6 – hard copy and 6 - softcopy (CD)

Note: The above requirement is minimum. However, exact quantities of drawings / documents requirement shall be informed to the successful bidder during detailed engineering stage for which no commercial implication shall be entertained by BHEL.

All drawings & documents shall be prepared in Autocad and submitted for review / approval in soft copies also. Catalogues shall be scanned for soft copy.

Note:- Manually prepared drawings are not acceptable.

Soft copy in CD Rom and Reproducible Tracings of all drawings / documents shall be submitted along with Final / As-Built submission.

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

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's Internal proxy setting should not block DMS application's link (http://124.124.36.198/wrenchwebaccess/login.aspx)"

D19

MISCELLANEOUS EQUIPMENT

WORKSHOP EQUIPMENT

(a) The equipment covered in this section shall be installed in the workshop building common for two units.

(b) The following workshop equipment shall be supplied complete with all accessories. The Contractor shall furnish the machinery required for operation, maintenance and overhaul of the power plant equipment and for production of some spares of power plant equipment. The Contractor shall note that the machinery and equipment parameters specified hereunder are minimum requirements. However the Bidder can increase these capacities/ ranges depending on the equipment being offered for this specific project. All the work shop equipments listed below shall be supplied with necessary tools like drill bits, lathe tools, HSS tools, key, necessary accessories and attachment for the successful functioning of machine. Bidder shall furnish details of tools, accessories etc.

(c) Bidder shall note that all the motors required for misc equipments should be as per electrical specification.

1.0 TRACKS REQUIRED FOR MOVEMENT OF TRANSFORMERS

Transformer wheel tracks shall be provided in such a way that the transformers can be moved to the station building.

2.0 WORKSHOP EQUIPMENT

Following workshop equipment shall be supplied complete with all accessories to carry out the maintenance and / or for production of spare parts of power plant requirement.

2.1 Lathe Machines

2.1.1	Three (3) general purpose lathes	Two(1) no : (Height of centres : 300 mm; swing over bed : 600 mm (dia) Distance between centres : 3000 mm) One (1) no: (Height of centres : 400 mm; swing over bed : 800 mm (dia) Distance between centres : 3000 mm) One (1) no Heavy Duty: (Height of centres : 550 mm; swing over bed : 1100 mm (dia) Distance between centres : 5000 mm)
2.1.2	One (1) high speed precision lathe	One (1) no: (Height of centres : 250 mm; swing over bed : 500 mm (dia) Distance between

		centres : 3000 mm)
2.2	Drilling Machines	
2.2.1	One (1) radial drilling machine	(Drilling capacity : 50 mm (steel), Drilling radius (max) : 1500 mm)
2.2.2	Two (2) bench drilling machine	(Drilling comm. Steel)
2.2.3	Two (2) portable drill gun	
2.2.4	One (1) No. Column Drilling Machine with all accessories.	
2.3	Grinding Machines	
2.3.1	One (1) cylindrical grinding machine	(Grinding wheel dia. 350 mm, Distance between centre : 1500 mm)
2.3.2	Two (2) double ended pedestal grinder	(Wheel size 350 mm)
2.3.3	One (1) tool and cutter grinder	(Grinding wheel dia : 250 mm)
2.3.4	Two (2) flexible shaft grinder wheel	
2.4	Shaping Machines	
	Two(2) nos.,	Medium stroke and suitable table size
2.5	Bending and Shearing Machine	
2.5.1	One (1) hydraulic pipe bender	(Bending capacity 10 – 80 mm pipe size, 10 mm thick)
2.5.2	One (1) plate shearing machine	(Capacity : width x thickness : 2500mm x 12 mm)
2.5.3	One (1) hand operated shear	
2.6	Press	
2.6.1	One (1) mechanical press	

2.6.2	One (1) fly press	
2.7	Vertical turning machine and bore machine	Max. Turning diameter-1700mm, Table diameter - 1500mm, Max. working height - 1000mm, Max. vertical travel ram head - 550mm Horizontal travel of side ram head - 300mm Vertical travel of side ram head - 700mm , Swivel angle of ram head +30 o ,
2.8	Slotting machine	No of table speed - AC variable frequency drive Stroke-500mm, rotary table - 510mm, Longitudinal movement - 400mm, Cross movement - 400mm, Cutting speed ram stroke per minutes) - 60-90
2.9	Other Machinery	
2.9.1	One (1) Hydraulic hacksaw	(Capacity : to cut square / round material upto 300 mm sq. / 300 mm dia.
2.9.2	One (1) pipe threading machine	
2.9.3	One (1) set of balancing equipment	
2.9.4	One (1) No. Universal milling machine with all accessories.	
2.10	General Equipment for Machine Shop	
2.10.1	Six (6) work benches with vices.	(Size 1800 x 1200 x 900 mm)
2.10.2	Five (5) nos portable drilling & grinding machines	
2.10.3	Two (2) set of snap on tools	
2.10.4	Two (2) lot of measuring tools like Scales, protractors, dial gauges, depth gauges, screw driver sets, dividers, V blocks, planer graphs, Tri squares.	

2.10.5 Six (6) sets of general tools (such as screw drivers, spanners and cutting pliers) - Two surface plates, Two sets of precision micrometers (upto 500mm), 1 set crimping tools, 2 sets soldering irons, 1 set of Lockers, Almirahs etc. with all accessories.
Mitutoyo make Vernier 0-150, 0-300, 0-600mm - 2set each
Inside micrometer 0-50mm,0-150,0-300mm - 2set each.
Outside micrometer 0-50, 0-100, 0-150, 0-300 - 2 sets each
Dial guage with magnetic stand graduation - 0.01mm,
measuring span 10mm- 5 no.s

2.10.6 One (1) set of pneumatically operated spanners

2.10.7 Three (3) sets of hand lamps

2.10.8 General Machines - One (1) static balancing m/c, One (1) hot air blower, One (1) incubation heater, One (1) hydraulic puller.

2.11 Paint Shop

2.11.1 One (1) portable compressor complete with 10 gallon capacity compressed air spraying equipment complete with spray gun, stirrer and accessories.

2.11.2 One (1) portable sanding machine

2.11.3 One (1) set of sign writing equipment and stencils

2.11.4 One (1) buffing and polishing machine

2.12 Welding

2.12.1 Two (2) A.C. welding transformer

2.12.2 Two (2) welding generator

2.12.3 Two (2) tig welding set

2.12.4 Four (4) oxy-acetylene gas welding/cutting sets

2.12.5 One (1) electrode drying oven (size 500 mm x 500 mm)

2.12.6 Four (4) welding tables

2.12.7 Four (4) soldering irons

2.12.8 Three (3) portable electrode driers

2.12.9 Six (6) welder accessories sets

Note:
Location of workshop equipment: All the workshop equipment (except few) specified above shall be located in a separate workshop building, the construction of which is included in the scope of the CONTRACTOR.

1.0	**DESIGN DATA**	
1.1	Equipment designation	Column Drilling Machine
1.2	Quantity	One (1)
1.3	Drilling Capacity in Steel / CI	40 / 50
1.4	No. of Range of Spindle feeds	*
2.0	ACCESSORIES	
2.1	Starter, Start / Stop Push Buttons, Indicating Lamps, Motor, Control Systems	
2.2	Universal Table	
2.3	Coolant Equipment with Fittings	
2.2	Machine Lamp	
2.3	Standard Box Table	
2.4	Electro-Hydraulic Locking Mechanism	
2.5	Magnetic clamp	
2.6	Foundation Bolts and Nuts	

Notes :

* As per Manufacturer Standards

1.0	**DESIGN DATA**	
1.1	Equipment designation	Crimping Tools
1.2	Quantity	One (1) Set
1.3	Application	**For crimping of aluminium/tinned copper** terminals, lugs, connectors etc.
1.4	Range	**0.5 to 16 mm2** 10 to 95 mm2 10 to 185 mm2 50 to 400 mm2

SL. NO.	ITEM	UNIT
	The following general equipment, tools, instruments shall be supplied. The applicable codes and standards shall include, but not be limited to the latest editions of the standards indicated against each item.	
1.0	Two (2) sets of spanners of DE open type, all sizes upto 2 inches.	
2.0	Two (2) sets of spanners of box type, all sizes upto 2 inches	
3.0	One (1) set of valve grinding and lapping tools for valve sizes upto 150 NB size	
4.0	**GENERAL TOOLS KIT** Three (3) sets of general tools kit (All sizes) shall be supplied each of which shall consist the following:	
4.1	Set of fitter's hammers	IS: 1841 HAND HAMMERS
4.2	Set of soft hammers	

SL. NO.	ITEM	UNIT
4.3	Two (2) each of the following files	IS: 1931 ENGINEERING FILES
	a) Flat file	- do -
	b) Head file	- do -
	c) Square file	- do -
	d) Round file	- do -
	e) Half round file	- do -
	f) Three square file	- do -
	g) Warding file	- do -
	h) Pillar file	- do -
	i) Mile file	- do -
	j) Horse rasp file	- do -
4.4	Two (2) each of the following chisels:	IS: 402 ENGINEERING COLD CHISELS
	a) Flat chisel	- do -
	b) Cross chisel	- do -
	c) Half round chisel	- do -
	d) Diamond pointed chisel	- do -

SL. NO.	ITEM	UNIT
4.5	One (1) each of the following drifts	IS: 6935 DRIFTS
	a) Simple drift	- do -
	b) Key drift	- do -
	c) Toothed drift	- do -
	d) Pin drift	- do -
4.6	One (1) Arbor press	- ---
4.7	One (1) Flat scraper	---
4.8	One (1) Half round scraper	----
4.9	One (1) Hacksaw	IS: 5169 HACKSAW FRAME
4.10	Set of screw drivers	IS: 844 SCREW DRIVERS
4.11	Set of taps and dies	IS : 6175 Hand taps & short machine taps for isometric screw threads IS : 6172 Hand taps for pipe threads parallel IS : 7796 Hand taps pipe threads taper IS : 3239 Die holder for circular thread cutting IS : 5616 Thread cutting circular dies for conduit threads
4.12	One (1) centre punch	IS : 7177 CENTRE PUNCHES

SL. NO.	ITEM	UNIT
4.13	One (1) diagonal wire cutter	---
4.14	Set of wrenches	IS : 6131 Technical requirements for hand operated wrenches and sockets
4.15	One (1) pliers	IS : 2615 General requirements for pliers, pincers and nippers
5.0	**MEASURMENT TOOLS KIT** Two (2) Nos. measuring tools kit (All sizes) shall be supplied which shall consist of the following:	
5.1	Set of adjustable angle plates (cast iron slotted)	IS : 6973 Precision angle plates. IS : 6985 Precision box angle plates.
5.2	Set of Vee blocks	IS : 2949 Plain V block
5.3	Set of parallel bars	IS : 4241 Engineers parallels
5.4	One (1) No. tool maker's clamp	---
5.5	One (1) No. spirit level	IS : 5706 Spirit levels for use in precision engineering
5.6	One (1) dividers (spring and firm joint type)	IS : 4019 Firm joint dividers IS : 4083 Spring dividers
5.7	Set of callipers (spring and firm joint type comprising inside, outside, transfer and hermaphrodite types)	IS : 4189 Firm joint inside, outside callipers IS : 4052 Spring callipers
5.8	Set of trammels	---

SL. NO.	ITEM	UNIT
5.9	Set of feeler gauges	IS : 3179 Feeler gauges
5.10	Set of engineer's scales	IS : 1480 Metric scales foe general purposes IS : 1481 Metric scales for engineers
5.11	Set of straight edges	IS : 2220 Steel straight edges
5.12	Combination set	---
5.13	One (1) No. universal surface gauge	---
5.14	Set of engineer's squares	IS : 2103 Engineer's squares
5.15	One (1) No. bevel protractor	IS : 4239 Mechanical bevel protractors
5.16	One (1) No. tri square	---
5.17	One set each of depth gauges, marking gauges and planer gauges	---

1.0	**DESIGN DATA**	
1.1	Equipment designation	Flexible shaft grinder
1.2	Number required	Two (2)
1.3	Type	Electric
1.4	Type of Drive	Geared Motor
1.5	Mounting of Motor	Rotating, Straight swivelling and tilting mounting.
1.6	Speed range	Three speed
2.0	ACCESSORIES	
2.1	Grinding wheels and guards	
2.2	One set of maintenance tools	
2.3	Three (3) metres of flexible shaft	
2.4	Geared motor for different speeds	
2.5	Tools holders and collets	
2.6	Operation and maintenance manual	

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment designation		Pedestal grinder
1.2	Type		Double ended
1.3	Quantity		Two (2)
1.4	Wheel size	mm	350 dia
1.5	Speed of wheels	rpm	Single speed (As per manufacture standard)
1.6	Base to Centre Line Height Distance	mm	500 (min)
1.7	Distance between wheels	mm	MFU STD
2.0	**ACCESSORIES**		
2.1	Grinding Wheels		a) Coarse wheel b) Fine wheel
2.2	Starter, Start / Stop Push Buttons, Motor, Control Systems		
2.3	Adjustable work rest		
2.4	Wheel Guards with side covers		
2.5	Eye Shields		
2.6	Container for Coolant		
2.7	Set of Maintenance Tools		
2.8	Foundation Bolts & Nuts		
2.9	Wheels nut spanner		
2.10	Operation and Maintenance Manual		
	Notes :		

SL. NO.	ITEM	UNIT	
	• One pedestal grinder shall have medium graded wheels on one end and fine grade on the other for finish grinding. • The second pedestal grinder shall be coarse wheels on both sides for rough grinding and shall be heavy duty.		

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment Designation		Hydraulic Hacksaw
1.2	Number required		One (1)
1.3	To cut square material up to	mm	300
1.4	To cut round material up to	mm	300 mm or Nearest standard size
2.0	**ACCESSORIES**		
2.1	Coolant equipment and tank		
2.2	Machine light		
2.3	Vice		
2.4	Bar support stand		
2.5	Set of maintenance tools		
2.6	Operation and maintenance manual		

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment designation		Hydraulic Puller
1.2	Quantity		One (1)
1.3	Application		For removing all pulleys, bearings, gears and couplings from shafts
1.4	Capacity	T	100
	Maximum outside diameter	mm	1000
	Vertical height from floor to ram	mm	Min 250 Max 1250
2.0	**ACCESSORIES**		
2.1	100 T capacity hydraulic power pack		
2.2	Control panel and other instruments		
2.3	Cutting attachment		
2.2	1 Set of torch for cutting, welding and brazing		
2.3	1 Set of cutting nozzle		
2.4	1 Set of welding nozzle		
2.5	Oxygen and acetylene single stage regulators		
2.6	10 meter oxygen and acetylene fitted hoses		
2.7	Rayflex goggles		
2.8	Acetylene and oxygen flash back arrester		

SL. NO.	ITEM	UNIT	
2.9	Flint spark lighter		
2.10	Operating spanners, etc		
2.11	Cylinder trolley		

1.0	**DESIGN DATA**	
1.1	Equipment Designation	Centre Lathe General purpose
1.2	Quantity required	Two (2)
1.3	Height of Centre	300 - 400 MM
1.4	**Swing over Bed**	600 - 800 MM
1.5	**Swing over cross slide**	350 MM
1.6	Distance between Centres	3000 MM
1.7	Type of Bed	Straight bed
1.8	Swing in gap	500
1.9	Speed range	32 to 1200 rpm
2.0	ACCESSORIES	
2.1	Dog plate	
2.2	Thread Dial Indicator	
2.3	Dead Centre	
2.4	Live Centre	
2.5	Four-way change tool post with tool holders or quick change tool post	
2.6	Steady Rest	
2.7	Follow Rest	
2.8	Coolant Pump with Fittings	
2.9	3-Jaw Self Centering Chuck	
2.10	4-Jaw Independent Chuck	
2.11	Rapid Traverse of Saddle	
2.12	Machine Lamp	
2.13	Swarf Tray	
2.14	Splash Guard	
2.15	Set of Standard operating / cutting and maintenance Tools	
2.16	Set of Change Gears for Metric, whitworth and Fractional Threads	
2.17	Taper Turning Attachment	
2.18	Operation and maintenance manual	

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	**Equipment Designation**		Heavy duty centre Lathe
1.2	***Quantity***		One (1)
1.3	Height of centres	mm	550
1.4	Swing over Bed	mm	1100
1.5	Swing over cross slide	mm	700 or Nearest standard size
1.6	Distance between centres	mm	5000
1.7	Gap bed required		Open gap
1.8	Type of Bed		*
1.9	Swing in gap	mm	1150
1.10	Speed range	rpm	*
1.11	Cross slide travel	mm	575
2.0	ACCESSORIES		
2.1	Starter, Start/Stop push buttons, Indicating Lamps, Motor, Control systems		
2.2	Dog plate		
2.3	Thread dial indicator		
2.4	Dead centre, Live centre		
2.5	Quick change tool post		

SL. NO.	ITEM	UNIT	
2.6	Steady Rest		
2.7	Follow stop		
2.8	Coolant pump with fittings		
2.9	3 – Jaw self centering chuck		
2.10	Taper turning attachment		
2.11	Rapid traverse of saddle (Motor Operated)		
2.12	Machine lamp		
2.13	Swarf tray		
2.14	Splash guard		
2.15	Set of Operating and Cutting tools		
2.16	Change gear for different threads		
2.17	4-Jaw independent chuck		
2.18	Foundation bolts and Nuts		
2.19	Set of Maintenance tools		
2.20	Operation and Maintenance manual		

Note : * to be indicated by Bidder

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment designation		Steel Lockers
1.1.1	Quantity		One (1)
1.1.2	Overall size		1200X500X1800 (H)
1.1.3	Compartments		10 Nos.
1.1.4	Each compartment shall have individual locking provision.		
1.2	Equipment designation		Steel Almirahs
1.2.1	Size		1200X500X1800 (H)
1.2.2	Shall be manufactured from 0.7 mm thick steel sheet fitted with 7 lever lock with 5 Nos. of adjusted shelves.		

1.0	**DESIGN DATA**	
1.1	Equipment designation	Hydraulic Pipe Bending Machine
1.2	Number required	One (1)
1.3	Type	Hydraulic
1.4	Bending Capacity	10 to 80 mm pipe size, upto 8 mm pipe thickness
2.0	ACCESSORIES	
2.1	Universal head plates	
2.2	Head formers for all pipe sizes	
2.3	Outer formers for all pipe sizes	
2.4	Extension for piston rod	
2.5	Set of maintenance tools	
2.6	Hydraulic pump motor	
2.7	Standard die blocks	
2.8	Stand	
2.9	Three wheel type pipe outer	
2.10	Operation and maintenance manual	

1.0	**DESIGN DATA**	
1.1	Equipment designation	Pipe Threading machine
1.2	Quantity	One (1)
1.3	Maximum Pipe dia to thread	150 mm

1.0	**DESIGN DATA**	
1.1	Equipment designation	Portable Drill
1.2	Number required	Two (2)
1.3	Drilling capacity	6 mm to 25 mm
1.4	Type of Drive	Geared Motor to obtain different spindle speeds
2.0	ACCESSORIES	
2.1	Complete set of drill bits and drill chucks	
2.2	Removable type of spade handle and side handle for heavy duty drilling.	
2.3	10 metres length of power cable with reeling drum.	
2.4	Portable work table with vice.	

SL. NO.	ITEM	UNIT	
1.0	DESIGN DATA		
1.1	Equipment Designation		High Speed Precision Lathe
1.2	Quantity		One (1)
1.3	Height of centres	mm	250
1.4	Swing over Bed	mm	500
1.5	Swing over cross slide	mm	300
1.6	Distance between centres	mm	3000
1.7	Type of Bed		Straight natural gap
1.8	Swing in gap	mm	550
1.9	Speed range	rpm	50 to 2000
2.0	ACCESSORIES		
2.1	3 –Jaw Self centering chuck		
2.2	3 – Jaw Precision Self-centering Chuck		
	4 – Jaw independent Chuck		
2.2	Universal face plate		
2.3	Collect Chuck and Collets		
2.4	Rear tool post		
2.5	Steady Rest		

SL. NO.	ITEM	UNIT	
2.6	Follow stop		
2.7	Longitudinal stop		
2.8	Roll stop		
2.9	Taper turning attachment		
2.10	Set of change gears of non standard type		
2.10	Diametral and Circular pitches, Parrallel and Taper threads on bolt and pipes		
2.11	Coolant equipment		
2.12	Splash guard		
2.13	Machine lamp		
2.14	Quick change Tool post with 5 nos Tool Holders		
2.15	Set of operating / Cutting and maintenance tools		
2.16	Centre reduction sleeve		
2.17	Driving plate with Peg		
2.18	Operation and maintenance manual		

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment designation		Radial Drilling machine
1.2	Quantity		One (1)
1.3	Drilling Capacity in Steel / CI		50 / 60
1.4	Maximum Drilling Radius		1500
1.5	Maximum Distance between Base Plate and spindle		1000
1.6	Maximum Drilling Head Traverse		1000
1.7	Spindle Travel Drilling Depth		250
1.8	No. of Range of Spindle feeds		*
1.9	Swing of Arm		*
2.0	ACCESSORIES		
2.1	Starter, Start / Stop Push Buttons, Indicating Lamps, Motor, Control Systems		
2.2	Universal Table		
2.3	Coolant Equipment with Fittings		
2.2	Machine Lamp		
2.3	Standard Box Table		
2.4	Electro-Hydraulic Locking Mechanism		
2.5	Magnetic clamp		

SL. NO.	ITEM	UNIT	
2.6	Foundation Bolts and Nuts		

Notes :

* As per Manufacturer Standards

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment designation		Shaping machine
1.2	Number		Two (2)
1.3	Maximum length of Stroke	mm	600
	Table Size		
1.4	Top Length	mm	600
1.5	Top Width	mm	550
1.6	Side height	mm	550
1.7	Horizontal Travel of the Table on slides	mm	750
1.8	Vertical Travel of the table	mm	350
1.9	Admit on Top table	mm	400
2.0	**ACCESSORIES**		
2.1	Swivelling Table		
2.2	Universal Table		
2.3	Quandrant Tool Box		
2.4	Set of operating and maintenance tools		
2.5	Cooling Pump with Fittings		
2.6	Operation and maintenance manual		

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment designation		Universal Milling machine
1.2	Number		One
1.3	Length	mm	1500
1.4	Width	mm	300
1.5	Power Operating Long Traverse	mm	950
1.6	Power Operating Cross Traverse	mm	320
1.7	Power Operating Vertical Traverse	mm	400
1.7	Spindle Speed Range	rpm	35 to 2400
2.0	ACCESSORIES		
2.1	Machine Vice with Swivel Base		
2.2	Self Centering Vice		
2.3	Universal Dividing Head		
2.4	Height Adjustable Tail Stock		
2.5	Hand Operated Vertical Indexing Head		
2.6	Hand Operated Horizontal Indexing Head		
2.7	Slotting Attachment		
2.8	Hand Operated Circular Table		
2.9	Milling Arbors and Stub Arbors		

SL. NO.	ITEM	UNIT	
2.10	Collect Chuck with Collets		
2.11	Machine Lamp		
2.12	Climb Milling Attachment		
2.13	Coolant Equipment		
2.14	Over arm Brace		
2.15	Two Arbor Support Bearings		
2.16	Set of operating and maintenance tools		
2.17	Thread Milling Attachment		
2.18	Vertical and Universal Milling Attachment		
2.19	Operation and maintenance manual		
2.20	Back lash eliminator		
2.21	Magnetic chuck		
2.22	Rack milling attachment		
2.23	Set of cutters including gear cutter - One set		

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment designation		Work bench with knee
1.2	Type		Wooden with metal frames
1.3	Quantity		Six (6)
1.4	Size		1800 (L) x 1200 (W) x 900 (H)
1.5	Material of wood		To be decided by bidder
1.6	Thickness of wood		To be decided by bidder
1.7	No. of vice on each work Bench		Four (4) Fitted on four corner
1.8	Vice Jaw width		150

Notes:-

The work benches should be essentially of wooden construction with M.S frame work and sheet metal top over wooden top and should be robust in design. Each work bench should have two sets of two drawers fitted with locks positioned at diagonally opposite sides. One drawer suitable for holding tools and the second for keeping miscellaneous things. The work benches should be capable of withstanding approximately 1 tonne load and should be sound enough for working like chipping, filling, hammering, assembly etc. Each bench should be fitted with bench vices on opposite sides. The bench vice should be generally as per IS 2686.

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment Designation		Gas Cutting, Welding & Brazing Set
1.2	Quantity		Four (4)
1.3	Capacity: a) Welding(Mild steel) b) Cutting (Mild steel)	 mm mm	 25 (Max) 150 (Max)
2.0	**ACCESSORIES TO BE SUPPLED**		
2.1	Shank		
2.2	Mixer		
2.3	Cutting attachment		
2.4	1 Set of torch for cutting, welding and brazing		
2.5	1 Set of cutting nozzle		
2.6	1 Set of welding nozzle		
2.7	Oxygen and acetylene single stage regulators		
2.8	10 meter oxygen and acetylene fitted hoses		
2.9	Rayflex goggles		
2.10	Acetylene and oxygen flash back arrester		

SL. NO.	ITEM	UNIT	
2.11	Flint spark lighter		
2.12	Operating spanners, etc		
2.13	Cylinder trolley		

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment Designation		OXY – ACETYLENE SET
1.2	Quantity		FOUR (4)
2.0	ACCESSORIES		
2.1	Spark Lighter		YES
2.2	Gas Welding / Gas Cutting Nozzles		YES
2.3	Gas Pressure Regulators (Oxygen / Acetylene)		YES
2.4	Red and Black Hose Pipes (10 metres each)		YES
2.5	Hose Clips		YES
2.6	Cylinder Key Spanners		YES
2.7	***Two Cylinder Trolleys with Tool Box***		YES
2.8	Gas Welding Gloves		YES
2.9	Pressure Gauges		YES
2.10	Chrome Leather Apron		YES
2.11	Chrome Leather Gloves		YES
2.12	Hose Protectors		YES
2.13	Regulator Spanners, Spindle Keys and Outfit Spanners		YES

SL. NO.	ITEM	UNIT	
2.14	Hose Connectors		YES
2.15	Hose Connections, Check valves and Nuts		YES
2.16	Standard Wire Brush		YES
2.17	Narrow Wire Brush		YES
2.18	Blow Pipe for Welding (Standard and Adaptable)		YES
2.19	Blow Pipe for Cutting (Standard and Adaptable)		YES
2.20	Welding Torch with Separable Tips and Mixing Head.		YES
2.21	Gas Cylinder	1 Nos	YES

Notes:

The above units should be of standard make. Each of the cutting / welding units should be complete with the various spare nozzles to facilitate cutting / welding of different thickness of metals.

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment Designation		MOTOR GEN. WELD SET (DC)
1.2	Type		PORTABLE
1.3	Quantity		TWO (2)
1.4	Maximum Continuous Hand Welding Current (60% Duty cycle)	A	300
1.5	Range of Welding Current	A	50 – 400
1.6	Input Supply	V, Ph. Hz.	415V, 3PH, 50 Hz
1.7	Type of Enclosure :		DRIP PROOF
1.8	Insulation Class		By BIDDER
1.9	Tolerances for Rated Current and Normal Speed.		By BIDDER
1.10	Induction Motor for Running Generator Required (Motor to Conform to IS: 325)		YES
1.11	Max, Intermittent Hand Welding Current		400
1.12	Type of Current Settings.		STEPPED / STEPLESS
2.0	ACCESSORIES TO BE SUPPLED		
2.1	Electrode Cable (5 m Length)		

SL. NO.	ITEM	UNIT	
2.2	Electrode Holder (Insulated)		
2.3	Protective Mask / Shield with Coloured Glass (2 nos.)		
2.4	Earthing Clamp and Cable (5 m Length)		
2.5	Chipping Hammers (2 nos)		
2.6	Wire Scratch Brush (2 nos Standard & Narrow)		
2.7	Leather Gloves (2 Pairs)		
2.8	Detachable Regulator for Remote Control of Welding Current		
2.9	Chrome Leather Apron		
2.10	Welders Goggles Protected by Clear Glass		

SL. NO.	ITEM	UNIT	
1.0	**DESIGN DATA**		
1.1	Equipment Designation		WELDING RECTIFIER
1.2	Quantity		TWO (2)
1.3	Input Supply	V, Ph, Hz.	415V, 3 Ph, 50Hz
1.4	Open Circuit Voltage		BY BIDDER
1.5	Welding Current Range	A	50 - 400
1.6	Maximum Continuous Hand Welding Current (60% Duty Cycle)	A	300
1.7	Maximum Intermittent Hand Welding Current	A	400
1.8	Type of Current Settings		STEPPED / STEPLESS
1.9	Insulation Class		BY BIDDER
1.10	Type of Cooling		BY BIDDER
1.11	Type of Enclosure		BY BIDDER
2.0	ACCESSORIES TO BE SUPPLED		

SL. NO.	ITEM	UNIT	
2.1	Electrode Cables		
2.2	Electrode Holder		
2.3	Earthing Clamp		
2.4	Pair of Hand Gloves		
2.5	Face Shield with Coloured Glasses and two numbers of clear glasses		
2.6	Chipping Hammer		
2.7	Wire Scratch Brush		
2.8	**Chrome Leather Apron**		
2.9	Welders Goggles Protected by Clear Glass		
3.0	TESTS AND TEST CERTIFICATES		
3.1	The following routine tests shall be conducted and test certificates for the same shall be furnished		
3.1.1	Short circuit test		
3.1.2	High voltage test		
3.1.3	Insulation resistance test		
3.1.4	Open circuit voltage test		
3.1.5	Type of Certificate for the following tests shall be furnished.		
3.2	Testing for maximum welding current		

SL. NO.	ITEM	UNIT	
3.2.1	Temperature rise test		

1.0	**DESIGN DATA**		
1.1	Equipment Designation		TRANSFORMER WELD SET
1.2	Type		Air / Oil cooled
1.3	Quantity		Two (2)
1.4	Maximum Continuous Hand Welding Current (60% Duty cycle)	A	300
1.5	Range of Welding Current	A	50 – 400
	Input Supply	V, Ph. Hz.	415V, 3ph, 50 Hz
2.0	Open Circuit		By Bidder
2.1	Insulation Class Voltage not to Exceed 8O V, RMS		By Bidder
2.2	Type of Enclosure		DRIP PROOF
2.3	Maximum Intermittent Hand Weld Current	A	400
2.4	Type of Current Settings		STEPPED / STEPLESS
2.5			
2.6	**ACCESSORIES**		
2.7	Electrode Cables		YES, 5 M Length
2.8	Electrode Holder		YES
2.9	Protective Mask / Shield with Coloured Glass		YES
2.10	Earthing Clamp and Cable		YES, 5 M Length per set

2.11	Chipping Hammer		YES, 6 Nos
2.12	Wire Scratch Brush		YES
2.13	Pair of Leather Gloves		YES, Chrome Leather
2.14	Chrome Leather Apron		YES
2.15	Welders Goggles Protected by Clear Glass		YES
2.16	TESTS AND TEST CERTIFICATES		
2.17	<u>The following routine Tests shall be conducted and test certificates for the same shall be furnished</u>		
	Short circuit test		
2.18	High voltage test		
2.19	***Insulation resistance test***		
2.20	Open Circuit Voltage Test		
3.0	***Test certificate for the following tests shall be furnished***		
3.1	Testing for maximum welding current		
3..2	Temp rise test		
	Notes		
	The transformer shall be capable of operating continuously at maximum continuous hand welding current at the specified duty cycle without overheating.		

ISSUE
R1

VOL - II B

ELECTRICAL

RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD.
2 x 660 MW SURATGARH SUPER CRITICAL TPS
UNIT # 7 & 8

WORKSHOP EQUIPMENT

TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENTNOIDA, UTTAR PRADESH, INDIA

CONTENTS

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 SCOPE OF ENQUIRY

General technical requirement of LT motors are indicated in specification no. PE-SS-999-506-E101_Rev00. Project specific technical requirement for motors are listed in customer specification for motor & actuators. Stipulations of Customer Specifications (inclusive of Datasheet-A for motors & actuators) shall prevail, in case of conflicts between Customer specification and General technical requirements for LT Motors.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".
b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any technical, commercial, delivery implications to BHEL/Customer.
c) Supply of mandatory spares as specified in the specifications of mechanical equipment's.
d) Erection and commissioning spares.
e) Erection & Maintenance tools & tackles.
f) Electrical load requirement for WORKSHOP EQUIPMENT.
g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL.
i) Various drawings, data sheet as per required format, quality plans, calculations, Type test & Routine test reports & certificates, operation and maintenance manuals, Complete technical literature with catalogues etc shall be furnished as specified at contract stage. All documents shall be subject to customer /BHEL approval without any commercial implications to BHEL.
j) The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implications.

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

Refer "Electrical Scope between BHEL and Vendor".

4.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

4.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:

a) A copy of this sheet "Electrical Equipment Specification for WORKSHOP EQUIPMENT and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
b) List of Erection and Commissioning spares.
c) List of Erection & Maintenance tools & tackles.
d) Electrical load requirement.

4.2 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.

5.0 LIST OF ENCLOSURES

5.1 Electrical scope between BHEL & Vendor
5.2 General Technical requirements for LV motors (PE-SS-999-506-E101_Rev00)
5.3 Customer Technical specification for motor & actuator along with data sheet A of motor & actuator.
5.4 Electrical Load data format
5.5 Datasheet-C of Motors & Actuators (to be filled by Vendor)
5.6 QP for motors

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE : WORKSHOP EQUIPMENT

PROJECT : 2X660 MW SURATGARH STPP

S.NO	DETAILS	SCOPE SUPPLY		REMARKS
1	415V MCC	BHEL		1. 415 V AC / 240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all the equipment's supplied by vendor as part of the contract including power supply equipment's (battery charger etc.) required for the PLC/ Control panel (as applicable) for the system supplied by the vendor. 2. Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based systems, shall be provided by BHEL in MCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.
2	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL		1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
3	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor		
4	Cable trays, accessories & cable trays supporting system	BHEL		Local cabling from nearby tray to equipment terminal shall be through conduits
5	Cable glands and lugs for equipments supplied by Vendor	Vendor		1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
6	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor		Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ BHEL approval at contract stage.
7	Lighting	BHEL		
8	Equipment grounding & lightning protection	BHEL		
9	Below grade grounding	BHEL		

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE : WORKSHOP EQUIPMENT

S.NO	DETAILS	SCOPE SUPPLY		REMARKS
10	LT Motors with base plate and foundation hardware	Vendor		Makes shall be subject to customer/ BHEL approval at contract stage.
11	Mandatory spares	Vendor		Vendor to quote as per specification.
12	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor		As per specification
13	Any other equipment/material/service required for completeness of system based on the system offered by vendor (to ensure trouble free and efficient operation of the system).	Vendor		
14	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor		Cable listing (including soft copy) in BHEL Cable Schedule in excel format (excel format shall be provided to vendor during contract stage) for C&I system for the package shall be submitted by vendor during detailed engineering stage.
15	Equipment layout drawings	Vendor		1) For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL/Customer approval. 2) Layout drawing preparation wherever in vendor's scope: the cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts etc) shall be decided during contract stage, and the arrangement philosophy/ approval of the same shall be subject to BHEL/Customer approval without any commercial implications to BHEL.
16	Electrical Equipment GA drawing	Vendor		For necessary interface review.

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE : WORKSHOP EQUIPMENT

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.

2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

3. For skid mounted system, 2 nos. (1W+1S) supply feeders of 415 V, 3 phase, 3 wire AC shall be provided by BHEL. Complete skid including changeover between feeders/starters/LCP/ inter-locks/protection devices /any other supply etc. shall be in bidder's scope only. Bidder to also provide 24 V AC supply and suitable arrangement for switching it on automatically for heating of motor stator winding during motor's idle time.

4. Local switch fuse/ socket for isolating the power supply shall be provided by the vendor.

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

Page 88 of 149

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)

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.		ORIGINATING AGENCY		PEM (ELECTRICAL)
		PROJECT TITLE	2X660 MW SURATGARH 7&8	NAME		DATA FILLED UP ON
		SYSTEM / S	WORKSHOP EQUIPMENT	SIGN.		DATA ENTERED ON
		DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

MOTORS

*** 1.2. LT motors for continuous duty (S1) operation & S3 (intermittent periodic duty) with a cyclic duration factor of 80% or higher, shall be energy efficient class IE-3 in line with IS -12615-2011. The starting current shall be in line with IS: 12615-2011, subject to IS tolerance (refer clause 14.1 of IS 12615).**

1.0 AC & DC MOTORS

1.1. HT motors of rating above 1500kW shall be suitable for 11kV, 3 phase, 50Hz power supply. Motors above 160kW and up to 1500kW shall be suitable for 6.6kV, 3 phase, 50Hz. Motors rated 160kW and below shall be suitable for 415V, 3 phase, 50 Hz power supply.

* 1.2. All LT motors shall be energy efficient class – I in line with IS: 12615. However, the starting current shall be limited to 600% (inclusive of 20% tolerance) of full load current.

1.3. The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher, considering highest system frequency. Motors shall be capable of starting and accelerating the load with the applicable method of starting without exceeding acceptable winding temperatures when supply voltage is 80% of the rated voltage for HT motors and 85% for LV motors. HT motors shall also be capable of satisfactory operation at full load at a supply voltage of 80% of the rated voltage for 5 min. commencing from hot condition. DC motors shall be suitable for the DC system voltage of 220V. Motor shall be capable of starting and accelerating the load with the applicable method of starting, without exceeding acceptable winding temperatures, when the supply voltage is in the range of 85% to 110% of rated motor voltage.

1.4. Motors shall be capable of running for one second if the supply voltage drops to 70% of the rated voltage. If such operation is envisaged for a period of one second, the pull out torque of the motor shall be at least 205% of full load torque.

1.5. Motors shall withstand for 1 second the voltage and torque stresses developed due to the vector difference between the motor residual voltage and the incoming supply voltage equal to 150% of the rated voltage during fast changeover of buses.

1.6. Locked rotor current of the HT motors rated 1500 kW and below shall be limited to 600% (inclusive of 20% tolerance) of the full load current of the motors and motor rated above 1500 kW shall be limited to 450% (inclusive of 20% tolerance) of full load current of the motor.

1.7. The locked rotor withstand time under hot condition at 110% rated voltage shall be more than the starting time at minimum permissible voltage specified above by at least three seconds or 15% of the accelerating time whichever is greater. Provision of speed switch shall be avoided to the extent possible.

These motors shall be designed to withstand at least 5% harmonics in the supply voltage.

1.8. The degree of protection for the motor enclosure (including terminal box) shall be IP-55 for outdoor. For single core cable termination, gland plates shall be of non-magnetic material. All motors located in hazardous area shall have flame proof enclosure.

1.9. All HT motors shall be provided with vibration pads for mounting vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in X &Y direction with remote DCS monitoring, alarms and tripping

1.10. Motors rated 1000kW and above shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. The CTs shall be of relay accuracy and the CT characteristics shall be compatible with the differential relay. The additional 3 nos. CTs of identical characteristics shall be provided in the 11kV/6.6 kV switchgear panel.

1.11. The terminal box of motor shall be of suitable size, suitable to terminate and maintain the cables easily. Terminal box shall be suitable to rotate at 90 degrees.

1.12. The ring oiling system shall be adequate for starting and continuous operation of the motor for at least one half hour without pressure oiling system in operation.

1.13. For 11kV & 6.6 kV motors, 6-nos. duplex RTD s for winding shall be provided for remote monitoring, alarm and tripping at DCS. Each bearing shall be provided with one duplex RTD for temperature remote monitoring, alarm and tripping at DCS. 6 nos. spare RTDs shall be provided for winding in HT motors.

1.14. The maximum double amplitude vibrations for motors shall be as per IS 12075.

1.15. Maximum noise level measured at a distance of 1.5 meter from the outer surface of the motor shall not exceed 85 db (A).

1.16. Cable boxes of all 11kV & 6.6 kV motors shall be Phase segregated & shall be provided with quick disconnecting type terminal connectors to facilitate easy disconnection and removal of the motors without requiring unsealing or otherwise disturbing the external cable connections and leaving the phase segregated terminal box intact. The terminal boxes shall have fault withstand capacity equal to at least rated short circuit level of system voltage for 0.25 sec. The terminal boxes shall be reversible to suit cable entry from top or bottom and suitable for termination of FRLS, XLPE armoured cables.

1.17. The star connection side terminal box should have sufficient capacity to accommodate CT's for differential protection for motor above 1000kW.

1.18. The insulation system for 11000 V AC & 6600 V AC motors shall withstand the negative or positive 0.3 / 3.0 microsecond wave (2.7 pu rated peak line to earth operating voltage) switching surges originating from non-effectively earthed power system. All 11000V AC & 6600 V AC motors shall have BIL and power frequency withstand voltage as per relevant standards.

1.19. Motor bearing shall be insulated wherever required.

1.20. All HT motors shall be with VPI insulation or better

1.21. All HT motors / LT motors 15 kW and above shall be provided with external greasing arrangement

1.22. CACW motor shall be provided with water leakage detector with remote alarms and tripping.

1.23. All HT motors / LT motors 30 kW and above shall be provided with space heaters using 240 V AC supply. However, for all the actuators, irrespective of its rating, space heaters shall be provided using 240V AC supply.

1.24. All motors below 15 kW shall be provided with sealed ZZ bearings

1.25. Each motor shall have two earthing terminals.

1.26. All motors for outdoor duty shall have detachable metal canopy.

1.27. HT motors shall be designed for operation as follows:

a) Upto 1000kW – Vacuum circuit breakers/SF6.

b) Above 1000kW-Vacuum circuit breakers/SF6.

c) All motors shall be suitable for DOL starting.

1.28. Separate terminal boxes to be provided for space heater, RTDs for windings/bearings, vibration monitors etc. All terminal boxes shall be provided with two earth studs for termination of protective earth conductor. Double compression type brass cable glands and crimping type copper lugs shall be provided for termination.

1.29. Provision shall be made at DCS to monitor, integrate running hours, nos. of starts and stop recording for all motors.

1.30. The terminals of all motors shall be suitable for terminating Aluminium conductor, XLPE insulated, armoured cables, the sizes of which will be intimated by the Purchaser.

2.0 ACTUATOR

2.1. GENERAL TECHNICAL REQUIREMENT

2.1.1. Actuator shall be weatherproof type with enclosure conforming to IP-64 degree of protection. It should be suitable for out-door use without the need for canopy. If the IP-68 degree of protection is required due to occasional submergence, the purchaser shall specify the depth and duration of such submergence.

2.1.2. The actuator shall be suitable for installation in any position without lubrication leakage or other operational difficulty.

2.1.3. All actuators shall be supplied with non integral starters for open & close. The main gearbox of the actuator shall be special grease filled.

2.1.4. Each actuator should have a hand wheel for emergency manual operation. Clockwise operation of hand wheel shall cause clockwise movement of the

output drive. The hand wheel shall be clearly marked with an arrow and the word CLOSE.

2.1.5. The hand wheel shall automatically disengage when the power to the motor is restored i.e. power drive shall have a preference over manual drive.

2.1.6. The manual effort should not exceed 400 N (push / pull). A top bevel gear set (side mounted hand wheel) shall be employed to reduce the manual effort.

2.1.7. Each actuator shall have a local mechanical position indicator. It should be suitable to indicate 0 - 100% position of the valve (continuous type).

2.1.8. In order to minimise the amount of spare parts required, parts and sub-assemblies limit / torque switches, limit switch counter gear assembly, torque switch drive assembly, mechanical position indicator assembly etc. individually interchangeable / replaceable throughout the models selected.

2.1.9. The actuator shall be painted with corrosion resistant epoxy resin paint. Paint shade shall be Grey (Shade 631) as per IS-5.

2.1.10. In order to prevent condensation, a space heater shall be provided in the switch compartment, suitable for continuous operation. Actuator mounting dimensions shall be according to ISO-5210. For rising stem applications, the design must allow the removal of actuator from the output drive without disturbing the function of valve.

2.2. LIMIT AND TORQUE SWITCHES

2.2.1. Independent torque and limit switches shall be provided in the actuator. A minimum of two position limit switches and two torque switches, one each for each direction of travel, having 4 NO + 4 NC potential free contacts, shall be supplied. If called for in the data sheet, two additional limit switches shall be provided for intermediate positions.

2.2.2. Torque switch dial shall be graduated directly in “kg-m” for easy setting to desired value within the range specified. Separate dials shall be provided for CLOSE and OPEN torque switches.

2.2.3. Two additional limit switches with 2NO + 2NC contacts, each adjustable at any intermediate position, shall be provided in the actuator.

2.2.4. The rating of both torque and limit switches shall be 240 V AC, 5 Amps. The switches shall individually be enclosed to a minimum of IP-64 protection class.

2.2.5. Torque and limit switches shall have only stainless steel flaps for better protection against environmental condition.

2.2.6. Limit switches shall be operated by gear driven cams, which are mechanically linked to the driving devices. The counter gear used for counting and tripping the limit switches shall be of metallic construction like brass etc. No plastic gearing shall be allowed.

2.2.7. To guarantee proper function under high ambient temperatures, torque and limit switch sensing shall be of mechanical type.

2.3. ELECTRIC DRIVE FOR ACTUATOR (MOTOR)

2.3.1. All motors shall be specifically designed for valve actuator operation, which is characterised by high starting torque, low stall torque & low inertia. All motors shall be high starting torque type to facilitate 'unseating' of valve.

2.3.2. Motor shall be suitable for power supply of 415 V, 3 ph, 50 Hz, AC.

2.3.3. Motor shall be squirrel cage induction type and shall generally conform to IS-325.

2.3.4. Motor shall have minimum class 'F' insulation with temperature rise restricted to class 'B' under the design ambient temperature.

2.3.5. Motor shall be of totally enclosed surface cooled (TESC) type with IP-67 protection class after mounting on actuator.

2.3.6. Motor shall have three thermostats connected in series, one in each phase of stator winding, for protection against overheating.

2.3.7. Motor shall be suitable for operation under voltage variation of + 10%, frequency variation of + 5% and combined voltage & frequency variation of 10% absolute.

2.3.8. Motor shall be suitable for direct on-line (DOL) starting and starter shall be non integral to the motor.

2.3.9. It should be possible to separate the motor from the lubricant filled gearing of the actuator allowing easy replacement of motor without loosing any lubricant regardless of mounting position.

2.3.10. Finsh shall be provided on the motor body to ensure better heat dissipation.

2.3.11. It shall be possible to change the output rpm of the actuator, if required, at the site at a later date, without hampering the mounting arrangement and loss of any lubricant.

2.4. CODES & STANDARDS

All the equipment specified herein shall comply with the requirements of the latest issue of the relevant National & International standards.

The design and materials used for the components shall also comply with the relevant National & International standards.

As a minimum requirement, the following standards shall be complied with :

Electric motor operated actuators:IS 9334

Degrees of protection provided by enclosures at low:IS 2147
voltage switch gear and control gear

Flame Proof enclosure at electrical apparatus:IS 2148
Specification for three phase induction motors:IS 325

AC contactor for voltages not exceeding 1000 V:IS 2959

Degree of protection provided by enclosures for :IS 4691
Rotating electrical machinery

Specification for rotating electrical machines:IS 4722
For other code refer Section D28.

2.5. OTHER REQUIREMENTS OF ACTUATOR.

2.5.1. Common potential free contact shall be available to annunciate the fault condition to the remote control station or DCS.

2.5.2. The following individual relay / potential free contacts shall be provided for the remote indication:-

- Actuator OPEN.
- Actuator CLOSE
- Actuator fault feed-back

- Thermal overload relay shall be provided to trip the actuator in case of overload

2.6. The DC and AC actuator shall be provided with accessories viz., Torque limit switch, end of travel switch, adjustable limit switch, hand wheel motor, thermostat, etc. Complete actuator shall be tested at factory as per IS 9334. All actuators should have minimum 2 limit switches for each position, and should have position transmitters wherever required.

3.0 TESTS

3.1. All routine & acceptance tests as per relevant IS shall be conducted on motors. For all AC and DC motors of rating below 100kW, type test certificates shall be furnished. If the test reports are not found in order by Purchaser then these tests shall be conducted by the Vendor without any cost implication.

3.2. Type test shall be carried out on one no. of each type and rating of motor of rating 100kW and above, which shall be witnessed by Purchaser.

3.3. Efficiency and loss measurements shall be done for all LT motors as per relevant standard (Being energy efficient motors.) as routine test.

3.4. For 11000V AC & 6600V AC motors, in addition to all the tests specified above, polarisation index test shall be carried out as a routine test on each motor (the minimum value of polarisation index for all motors shall be 2 when determined according to IS: 7816).

3.5. Noise level measurement test shall be conducted on one motor of each type.

3.6. Vibration measurement shall be taken for each motor of 45kW & above.

3.7. Dielectric tests to establish the insulation withstand level of motors as indicated above shall be performed on a sample coil (identical to those to be used in the motor quoted for) for each type of motor. These tested sample coils shall not be used in the motors to be supplied.

4.0 For technical particulars refer datasheet-A.

Sr. No.	Descriptions	Unit	Client specification
1.	Applications		*
2.	Manufacturer		*
3.	Frame Size		*
4.	Quantity		*
5.	Model No. of motor		*
6.	Supply Conditions		*
	(a) Allowable variation in		*
	(i) Voltage AC/DC	%	± 10/ +10% to -15 %
	(ii) Frequency	%	± 5
	(iii) Combined	%	10
	(b) Permissible unbalance in supply voltage		*
7.	Speed	rpm	*
8.	Rated voltage a)HT motors b)LT motors c)UPS supplied d)Single phase e)DC motors		a)11000V & 6600V AC b)415V AC c)230V AC d)240V AC e)220V DC
9.	Number of phase		3-Phase
10.	Rated frequency for AC motor	Hz	50
11.	Normal winding connection	Star / Delta	*
12.	Method of starting a)AC motors b) DC motors		 a)DOL (preferably) b) Resistance start
13.	Temperature rise above ambient of 50 deg. by Resistance method	Deg. C	HT motors – Shall be limited to Class B LT motor – Class B

Sr. No.	Descriptions	Unit	Client specification
14.	Type of rotor (Slip ring/ squirrel cage)		Squirrel cage
15.	Type of duty		*
16.	Duty designation		*
17.	Synchronous speed a) Constant speed b) Variable speed (for VFD)		*
18.	Starting time at specified minimum starting voltage	Sec	*
19.	Starting torque	% of FLT	*
20.	Pull out torque	% of FLT	*
21.	Class of insulation		HT motors- Class F LT motors including actuator motors-Class F.
22.	Ref. Ambient temperature	deg. C	50
23.	Location considered – Hazardous area division		*
24.	Installation		
24.1.	Location		Indoor/Outdoor
24.2.	Hazardous area division (IS:5572 or equivalent)		*
24.3.	Atmosphere considered- Chemical/Dusty/Salt laden		*
25.	Type of cooling (IS: 6362) LT motors HT motors		 TEFC TEFC / TETV / CACW

Sr. No.	Descriptions	Unit	Client specification
26.	Degree of protection		IP 55 – Outdoor IP 54 - Indoor
27.	Rotation as seen from Non-drive end		Clockwise/Anti-Clockwise
28.	Main terminal box		
28.1.	Terminal box Short time rating a) HT for 0.25 sec b) LT for 0.25 sec Dynamic rating a) HT b) LT	 KA KA KA peak KA peak	 40 (minimum) 50 (minimum) 102 (minimum) 127.5 (minimum)
28.2.	Location as seen from non-drive end:		TOP/RIGHT/LEFT
28.3.	Phase Segregated	YES/NO	*
28.4.	Terminal box degree of rotation	Degree	90
29.	Weather motor is suitable for VFD drive		*
30.	Details of bearing		*
31.	Color shade of paint		Shade 631 of IS-5
32.	Whether CT for differential protection required		*
32.1.	C.T. PARTICULARS :		
32.2.	3 CTs, one in the neutral lead of each phase		
32.3.	Ratio		
32.4.	Class	PS	

Sr. No.	Descriptions	Unit	Client specification
32.5.	Knee point voltage	KPV	*
32.6.	MAX. R.C.T. secondary winding resistance	OHMS	*
32.7.	MAX. exciting current AT 1/2 KPV		*
32.8.	Class of Insulation		*
33.	Whether vibration detectors required		*
34.	Details of winding / space heaters		*
35.	Guaranteed Efficiency of motor a) At full load b) At duty point c) At no load		*
36.	Guaranteed Power factor of motor a) At full load b) At duty point c) At no load		*
37.	Current at a) Starting b) Full load c) Duty point d) Full load & 70 % of rated supply voltage.		*
38.	Quantity & type of temperature detectors for all HT motors a) Winding hot spot b) Bearing		Minimum 6 Duplex RTD Minimum two thermocouple per bearing.
39.	Details of accessories a) Fans		*

Sr. No.	Descriptions	Unit	Client specification
	b) Temperature gauge c) Bearing d) Cooling motors e) Cooling water parameters f) Heaters g) Lube oil system details		
40.	Maximum size & number of cables that can be accommodated in motor terminal box.		*
41.	Thermal capability curve to be attached		*
42.	Relay co-ordination guide to be attached.		*
43.	Min. voltage required under starting conditions to accelerate driven equipment to rated speed.	Volts	*
44.	Locked rotor current withstand time (safe stall time) at 110 % rated voltage a) At rated temp. (hot) b) When cold	 sec sec	*
45.	Stator thermal time constant	sec	*
46.	Permissible no. of equally spread starts per hour a) Normal service conditions b) In quick succession with cold M/C at room temp. c) Hot restarts		*
47.	Method of Starting and maximum starting current inclusive of tolerances AC HT Motors a) DOL		 450 % above 1500 kW & 600 % all other.

Sr. No.	Descriptions	Unit	Client specification
	b) Soft starters		*
	AC LT Motors		
	c) DOL		600 %
	d) Star Delta		200 %
	e) Star Delta with series resistance		200%
	f) Soft Starters		*
	DC Motors		
	a) Resistance starting		200%
	b) Soft starters		200%
	c) Any other		*

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.

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

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**

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.

LT MOTORS

A. GENERAL

1.	Manufacturer & Country of origin. (Shall be as per approved QA make)	
2.	Equipment driven by motor	
3.	Motor type	
4.	Quantity	

B. DESIGN AND PERFORMANCE DATA

1.	Frame size		
2.	Type of duty		
3.	Type of enclosure /Method of cooling/Degree of protection		
4.	Applicable standard to which motor generally conforms		
5.	Efficiency class as per IS 12615		
6.	(a)	Whether motor is flame proof	Yes/No
	(b)	If yes, the gas group to which it conforms as per IS:2148	
7.	Type of mounting		
8.	Direction of rotation as viewed from DE END__		
9.	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)		
10.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)		
11.	Maximum continuous load demand of driven equipment in KW		
12.	Rated Voltage (volts)		
13.	Permissible variation of :		

a. Voltage (Volts)

b. Frequency (Hz)

c. Combined voltage and frequency

14. Rated speed at rated voltage and frequency(RPM)

15. At rated Voltage and frequency:

a. Full load current

b. No load current

16. Power Factor at

a. 100% load

b. NO load

c. Starting.

17. Efficiency at rated voltage and frequrecy,

a. 100% load

b. 75% load

c. 50% load

18. Starting current (amps) at

a. 100 % voltage

b. 85% voltage

c. 80% voltage

19. Minimum permissible starting Voltage (Volts)

20. Starting time with minimum permissible voltage

a. Without driven equipment coupled

b. With driven equipment coupled

21. Safe stall time with 100% and 110% of rated voltage

    a. From hot condition

    b. From cold condition

22. Torques :

    a. Starting torque at min. permissible voltage(kg-mtr.)

    b. Pull up torque at rated voltage.

    c. Pull out torque

    d. Min accelerating torque (kg.m) available

    e. Rated torque (kg.m)

23. Stator winding resistance per phase (ohms at 20 Deg.C.)

24. GD^2 value of motors

25. No of permissible successive starts when motor is in hot condition

26. Locked Rotor KVA Input

27. Locked Rotor KVA/KW

28. Vibration limit :Velocity (mm/s)

29. Noise level limit (dBA)

C. CONSTRUCTIONAL FEATURES

1. Stator winding insulation

    a. Class & Type

    b. Winding Insulation Process

    c. Tropicalised (Yes/No)

d. Temperature rise over specified maximum ambient temperature of 50 deg C

e. Method of temperature measurement

f. Stator winding connection

2. Main Terminal Box

a. Type

b. Location (viewed from NDE side)

c. Entry of cables(bottom/side)

d. Recommended cable size (To be matched with cable size envisaged by owner)

e. Fault level (MVA), Fault level duration (sec)

f. Cable glands & lugs details (shall be suitable for power cable)

3. Type of DE/NDE Bearing

4. Motor Paint shade

5. Weight of

a. Motor stator (KG)

b. Motor Rotor (KG)

c. Total weight (KG)

D. List of accessories.

1. Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)

2. Terminal Box for Space Heater (Yes/No)

3. Speed switch (Yes/No)
No of contacts and contact ratings of speed switch

4. Insulation of bearing (Yes/No)

5. Noise reducer(Yes/No)

6. Grounding pads

   i) No and size on motor body

   ii) Nos on terminal Box

7. Vibration pads

   i) Nos and size

   ii) Location

8. Any other fitments

E. List of curves.

1. Torque speed characteristic of the motor

2. Thermal withstand characteristic

3. Starting. current Vs. Time

4. Starting. current Vs speed

5. P.F. and Effi. Vs Load

F. Additional Data to be filled for each rating of DC Motor

1. Rated armature voltage (Volt)

2. Rated field excitation (Amp)

3. Permissible % variation in voltage

4. Minimum Permissible Starting voltage (volt)

5. At rated voltage

   i) Full load Armature current.(Amp)

   ii) Full load Field current (Amp)

iii) No load Armature current (Amp)

6. Full load Field current (Amp)

7. No load Aramature current (Amp)

8. Minimum permissible field current(Amp) to avoid overspeeding at

   i) Maximum permissible voltage

   ii) Rated voltage

   iii) Minimum Permissible Voltage

9. Resistance (indicative Values) in ohm

   i) Armature winding (Arm + IP + Series) at 25 deg.C

   ii) Field Winding at 25 deg. C

10. Inductance (indicative values)

    i) Armature winding

    ii) Field winding

11. Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at

    i) 220 V DC

    ii) 250 V DC

    iii) 187 V DC

12. Value of the external resistance (ohm) required to be connected in series with armature during starting only

13. Technical data sheet for external resistance box

14. GA drawing of motor

15. Starting time calculation

16. Starter resistance design calculation

17. Electrical connection diagram of motor

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
	SHEET 1 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3

BHEL	PARTICULARS	BIDDER/VENDOR
	NAME	
	SIGNATURE	

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01	SPECIFICATION : TITLE :
	SHEET 2 OF 2	SYSTEM	ITEM AC ELECT. MOTORS BELOW 55KW (LV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1. ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON
2. WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.
3. FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

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

	QUALITY PLAN	CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER			
		BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE			
	SHEET 1 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	

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

	QUALITY PLAN	CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER			
		BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE			
	SHEET 2 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III

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

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

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

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

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

	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION NUMBER			
	SHEET 4 OF 9	BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE			
		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	

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

	QUALITY PLAN	CUSTOMER			PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE			
	SHEET 5 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	

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

	QUALITY PLAN	CUSTOMER			PROJECT TITLE			SPECIFICATION NUMBER			
		BIDDER/ VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE			
	SHEET 6 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

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

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

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

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

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

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

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

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

NOTES:

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

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

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

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

GENERAL TECHNICAL REQUIREMENTS
OF
CONDUITS AND PIPES
SPECIFICATION NO. PES-507-27
REV 0

1.0 GENERAL

1.1 This specification covers the manufacture, inspection & testing at vendor's works and delivery to site of conduits, pipes and their fittings for electrical installation.

2.0 CODES AND STANDARDS

2.1 The material, constructional features and various processes involved in manufacture shall comply with currently applicable Indian Standards.

2.2 The following Indian Standards shall be applicable, in general. However if Data Sheet A specifies conformance to other international standards, the equivalent IEC/BS/other standards shall be considered.

a) IS:9537 (All Parts) Conduits for electrical installation.

b) IS:3480 Flexible steel conduits for electrical wiring.

c) IS:6946 Flexible non-metallic conduits for electrical installation.

d) IS:1239 Mild steel tubes, tubulars and other wrought steel fittings. (for size above 63mm dia of rigid conduits)

e) IS:2667 Fittings for rigid steel conduits for electrical wiring.

f) IS:3837 Accessories for rigid steel conduits for electrical wiring.

g) IS:3419 Fittings for rigid non-metallic conduits.

h) IS:6005 Code of practice for phostating iron & steel.

i) IS:2629 Recommended practice for hot dip galvanizing on iron and steel.

j) IS:4759 Specification for hot dip zinc coatings on structural steel and allied products.

k) IS:6745 Methods for determination of mass of zinc coating on zinc coated iron and steel articles.

3.0 DESIGN REQUIREMENTS AND CONSTRUCTIONAL FEATURES

The conduit and conduit accessories shall include conduit plugs & caps, gaskets and box cover etc in addition to any specific requirement given in Data Sheet A. The diameter of conduits and accessories shall be uniform throughout the length.

3.1 Rigid Conduits and Fittings

3.1.1 Rigid conduits shall generally conform to the requirements of IS:9537 (Part I & Part II). However conduits above 63mm diameter shall conform to the requirements of IS:1239. Unless specified otherwise in Data Sheet A, all conduits and pipes shall be of medium duty.

3.1.2 The rigid conduits shall be hot dip galvanized inside and outside. Weight of zinc shall be as per IS:4759. Conduits shall be thoroughly cleaned and pretreated, conforming to IS:6005.

3.1.3 Conduits shall be supplied in approximate length as specified below

a) Rigid Conduits 5 metres

b) Flexible Conduits 10 - 30 metres

3.1.4 Each end of conduit length shall be threaded. The ends of conduits shall be sealed with protective caps to prevent damage to threaded portions and entrance of moisture and foreign material.

3.1.5 The inside surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.

3.1.6 Conduit fittings shall be made out of tube or cast to the shape as to match with corresponding conduit sizes and meet their purpose without any special adjustment.

3.1.7 All fittings shall be screwed type and hot dip galvanized inside and outside.

3.2 Flexible Metallic Conduits and Fittings

3.2.1 Flexible metallic conduits shall generally conform to the requirements of IS:3480.

3.2.2 Flexible conduits shall be made of strip steel which shall be of cold rolled mild steel. The strip shall be of uniform width and thickness throughout.

3.2.3 The strip shall be electro galvanized to a minimum thickness of 25 microns as specified in IS:3480. The surface of the strip shall be thoroughly cleaned before application of protective coating. Pretreatment, before galvanization, shall conform to IS:6005.

3.2.4 The strip for making flexible conduit shall be wound tightly and so overlapped in subsequent helicals that no openings are seen in normal position.

3.2.5 Flexible conduits shall be lead coated for application in high temperature zones, if specifically mentioned in Data Sheet A.

3.2.6 The conduit shall have uniform diameter throughout its length. The internal surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.

3.3 PVC Conduits

3.3.1 PVC conduits shall generally conform to the requirements of IS:9537(Part I & Part III).

4.0 INSPECTION

4.1 The following stages of manufacture shall be stage inspected by Purchaser or his duly authorized representative.

4.1.1 Inspection of manufacturing processes such as shearing, punching, bending, welding, galvanizing etc.

4.1.2 Inspection of packing material and procedure.

4.1.3 Inspection of finished product.

4.2 The inspection will be carried out as per agreed quality plan.

5.0 TESTING

5.1 Rigid Conduits

a) Acceptance Tests - as per IS:9537 Part 1 & 2 upto 63mm OD
- as per IS:1239 above 63mm OD

i) Dimension checks

ii) Bending test (below 32mm OD)

iii) Compression test

b) Special Tests (as acceptance test) as applicable to galvanizing.

5.2 Flexible Steel Conduits

a) Acceptance Tests - as per IS:3480

i) Dimension checks

ii) Linear breaking test

iii) Test for flexibility

iv) Bend fracture test

v) crushing test

b) Special Tests (as acceptance test) as applicable to galvanizing.

5.3 PVC Conduits

a) Type Tests - as per IS : 9537 (Part 1 & 3)

i) Dimension checks

ii) Bending test

iii) Compression test

iv) Impact test

v) Collapse test

vi) Resistance test

vii) Resistance to burning

viii) Electrical Characteristics

b) Acceptance tests - as per IS:9537 (Part 1 & 3)

i) Dimension checks

ii) Bending test

iii) Compression test

iv) Collapse test

v) Resistance to burning

vi) Electrical characteristics

5.4 Sampling for the tests shall be done as per applicable standards mentioned above.

5.5 The testing shall be carried out as per agreed quality plan.

6.0 PACKING

6.1 The material shall be packed as per manufacturer's standard. Packing procedure shall be to the purchaser's approval.

7.0 DRAWING, DATA AND DOCUMENTS REQUIRED

7.1 The following information shall be furnished within two weeks of award of contract, for purchaser's approval.

a) Manufacturing drawings/details.

b) Recommended Field quality plan covering site handling, storing, laying etc.

c) Final quality plan.

7.3 The following information shall be furnished after testing and inspection

Type Test, routine test and special test certificates in bound volume in requisite number.

DATASHEET A

SPECIFIC TECHNICAL REQUIREMENTS

1.0	APPLICABLE STANDARDS:	IS:9537,IS: 1239, IS:3480
2.0	RIGID STEEL CONDUITS & STEEL PIPES	
a)	Material:	Cold rolled mild steel to IS:226
b)	Applicable standard	
	i) Upto 63mm OD:	IS:9537 Part I & II
	ii) Above 63mm OD:	IS:1239
c)	Surface treatment:	Hot dip galvanizing inside & outside as per IS:2629
d)	Wt. of zinc:	as per IS 4759
e)	Duty:	Medium
f)	Fittings:	Screw type as per IS:2667
3.0	FLEXIBLE CONDUITS:	
a)	Material:	Strip steel cold rolled and annealed
b)	Standard applicable:	IS: 3480
c)	Surface treatment:	Electro galvanized as per IS: 3480
d)	Whether lead coated:	YES
e)	Minimum thickness: of zinc coating	25 microns
4.0	PVC CONDUITS	
a)	Material:	PVC
b)	Applicable standard:	IS: 9537 (Part I & III)

SECTION D16

CABLES AND CABLE CARRIER SYSTEM

1.0 CABLES

1.1 H T POWER CABLES

System cables shall be 11kV (UE) and 6.6 kV (UE) grade suitable for use in medium resistance earthed system, stranded & compacted aluminium conductor, extruded semi conducting screen over conductor, XLPE insulated, semi-conducting followed by copper tape screened, extruded PVC Type ST – 2 inner sheathed, aluminium/GS wire armoured, overall FRLS PVC outer sheathed, conforming to IS 7098 (Part II), IEC-502 for constructional details and tests.

1.2 L T POWER CABLES

LV Power Cables shall be 1100 V grade, single / multi core, stranded aluminium conductor, XLPE insulated, with PVC inner sheath, armoured and outer sheath made of FRLS PVC compound, generally conforming to IS 7098 (for XLPE). The cables used for DC system shall be of single core type. Minimum conductor cross section of power cables shall be 6-sq. mm for aluminium cables.

1.3 CONTROL CABLES

Control cables shall be 1100 V grade, multi core, minimum 1.5 sq. mm cross section, stranded copper conductor having minimum 7 strands, PVC insulated, PVC inner sheathed / galvanised steel wire armoured, overall FRLS PVC outer sheathed generally conforming to IS 1554 Part-I. In situations where accuracy of measurement or voltage drop in control circuit warrants, higher cross sections as required shall be used.

1.4 INSTRUMENTATION CABLES

The instrumentation cables shall be Annealed, tinned stranded copper conductor, 0.5 sq mm , twisted into pairs, overall screened (I1 type) for digital signals, individual and overall screened (for I2 type) for low level analog signals, individual triplet and overall screened (type I3), PVC insulated , inner PVC sheathed, GS wire armoured and overall sheathed with FRLS PVC. The insulation shall be strippable manually as well as by mechanical stripping devices without damage to the conductor.

1.5 TRAILING POWER AND CONTROL CABLES FOR MOBILE EQUIPMENT.

11 kV(UE) and 6.6 kV (UE) and 1100V-(E) grade power & control flexible trailing, annealed tinned copper conductor, EPR insulated, EPR inner sheathed, CSP outer sheathed and shall have conductor screen of rubber. Cables shall conform to IS requirements and any other applicable standards.

1.6 FIRE SURVIVAL CABLES

1.6.1 Power and control, single/multi, stranded copper conductor fire survival cables complying with IEC-60331 shall be provided for following systems as per CEA guidelines.

(a) DC emergency lube oil pumps

(b) DC seal oil pumps

(c) DC emergency lighting cables for main building

(d) Batteries to chargers and DC distribution boards

(e) Turbine lube oil pumps

(f) Jacking oil pumps

(g) Emergency turbine trip by pushbutton in control room

(h) Boiler Turbine: Generator inter trip which includes the interconnecting cables between:

- Boiler master fuel trip and turbine trip relays
- Generator trip relays and turbine trip relays
- Generator trip relays and 400kV breakers
- Generator trip relays and generator field breakers
- Generator trip relays and ST and UT breakers

1.6.2 FS cables shall have following properties:

(a) Excellent fire resistance characteristics

(b) Cables shall have features of nontoxic and low smoke generation

(c) Flame non-propogation property

(d) Ability to withstand burning & continue to function during and after fire

(e) Low smoke emission & low halogen property to maintain circuit integrity to essential services under severe fire condition.

1.6.3 Construction of FS cables

(a) Conductor- Copper stranded

(b) Fire proof layer- heat barrier based

(c) Insulation- elastomer rubber

(d) Fire proof layer- same as 2 above but optional – natural or synthetic, fibre or elastomer

(e) Filler- suitable filler optional

(f) Binder tape – two layers of glass fibre tape

(g) Inner sheath- HOFR FRLS elastomer (heat & oil flame retardant)

(h) Armouring/screening – suitable wire

(i) Over all sheath – HOFR FRLS

1.7 Cables for the fire detection and alarm system and communication system shall be as described else where.

2.0 CABLE PROPERTIES

2.1 All single core power cables shall have wire / strip armouring of aluminium, whereas multi core power cable shall have galvanised steel wire / strip armouring.

2.2 The sheath shall be resistant to water, UV radiation, fungus, termite and rodent attack.

2.3 The outer sheath of FRLS PVC compound shall meet the following performance requirements:

(a) The critical oxygen index value shall be minimum 29 when tested at 27± 2^0C as per ASTM-D-2863-77 and the temperature index shall be minimum 250^0C at oxygen index value of 21 when tested as per ASTM-D-2863.

(b) The maximum acid gas generation as determined by titration method shall be less than 20% by weight when tested as per IEC-60754-1 (1994). Halogen acid content in outer sheath in FS cables shall not be more than 2%.

(c) Flammability

(i) Cables shall pass tests under fire condition as per IS-10810-Part-53.

(ii) Cables shall also pass tests as per IS-10810 Part-61 & Part-62. Category group shall be considered as Category 'A'.

(iii) Fire survival cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.

(d) The smoke generation under fire shall have maximum smoke density rating of 60% when tested as per ASTM-D-2843-77 (1977). Smoke density in FS cables shall not exceed 20%.

(e) The cables shall pass the ultraviolet tests as per DIN 53387.

(f) The cables shall pass the tests for Water absorption tests as per IS 10810.

2.4 The finished cable shall pass the flammability test as per IEC-322-1 (1993) and IEEE-383. In addition, it shall also pass flammability test as per Class F3 of Swedish Standard SS-424-1475 (1977).

2.5 In addition, cables for devices mounted on or near hot surfaces of Steam Generators, Turbine Generators, Main steam etc shall have heat resistance type outer sheath.

2.6 All LT cable shall have embossing at interval of 1 meter for owner name, size/ core type and length.

2.7 All cables shall be embossed with the name of RVUNL in addition to what is specified in the standards.

3.0 DESIGN CRITERIA FOR CABLE SIZING

3.1 POWER CABLES

Power cable sizes shall be selected on the following basis:

3.1.1 Power cables shall carry the full load current of the circuit continuously under site conditions considering the condition listed below:-

(a) Ambient design temperature 50 deg. C.

(b) Maximum allowable temperature under normal full load condition and under short circuit condition based on material selected (XLPE).

(c) Maximum short circuit fault current.

(d) Ambient temperature for underground cables, 50 deg. C.

(e) De-rating factors as per IS/IEC and manufacturer's standard catalogues.

3.1.2 Power cables shall withstand the fault current of the circuit for the duration not less than the maximum time taken by the primary protective system to isolate the fault. Fault clearing times for ties between two 6.6 kV switchgears shall be considered as 1 sec. Fault clearing times for ties between two 415V switchgears shall be considered as 0.5 sec.

3.1.3 For the cables to 415 V motors and feeders protected by fuses, the cross section shall be chosen according to the cut-off current of the fuse and its fusing time.

3.1.4 Voltage drop from transformer secondary to motor terminals during starting of motors will be limited to the following values:

(a) For HV motors (except MDBFP motor) – 15% of the rated voltage

(b) For MDBFP motors – 20% of the rated voltage

(c) For LV motors – 15% of the rated voltage.

3.1.5 Voltage drop in feeder cables shall be limited to 3% during full load running condition. Voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 5 % of rated voltage.

3.1.6 For power supply to valve actuator motors, actuators of various isolating and regulating dampers and exhaust fans, 3 core 2.5 sq. mm stranded copper conductor cable may be used in view of ease of termination. These cables shall be in other respects similar to cables described in Clause 1.2 above.

3.1.7 Design Calculation for arriving at cable size shall be submitted for purchaser's approval.

3.1.8 DC System Cables:-

3.1.8.1 1100 V grade, single core cables as specified in LT power cables shall be used from batteries/ battery chargers to main DCDB, between main Distribution Board, from main Distribution Board to sub distribution board, main DC supply to various system cabinets/panels, Switchgears etc and for critical auxiliaries. Flexible cables with PVC insulation shall be used where termination of XLPE/PVC insulated cables is difficult.

3.1.8.2 Voltage drop in cables between battery to DCDB and battery charger to DCDB shall be limited to 2%. Voltage drop in cables between DCDB and loads shall be limited to 3%.

3.1.8.3 Design Calculation for arriving at cable size shall be submitted for purchaser's approval.

3.2 CONTROL CABLES

3.2.1 Current transformer leads shall be checked for the lead burden vis-a-vis the current transformer VA capacity. In case 2.5 sq. mm conductor impose unacceptably high burden on CTs, 4.0-sq. mm conductor shall be used. The conductor material shall be copper.

3.2.2 Voltage transformer leads shall be checked for voltage drop which shall be limited to within 1% for all cases other than tariff metering. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5 sq. mm conductors exceed this value, higher conductor sizes shall be used.

3.3 INSTRUMENTATION CABLE

3.3.1	Element identification	:	As per IEC-60189-2
3.3.2	Core wrapping	:	By non-hygroscopic material by taping or by extrusion
3.3.3	Element screening	:	By copper tape of minimum 0.04mm thickness or by copper laminated plastic tape
3.3.4	Rip cord	:	Non-metallic rip cord under the core wrapping
3.3.5	Drain wire	:	A tinned copper drain wire of minimum 0.05 mm^2 cross section in contact with each screen of cabling element.

Cabling elements shall be any one of the following:

A 'Pair' of two insulated conductors twisted together designated by alphabet 'p' printed on a binding tape at 200 mm intervals.

A 'Triple' of three insulated conductors twisted together designated by alphabet 't', printed on a binding tape at 200 mm intervals.

Maximum length of lay in the finished cable shall be 120 mm.

3.3.6 Units

Cables shall be bunched together in units of twenty cabling elements or sub units of five or ten elements, stranded in concentric layers. The units or sub

units shall be designated by p1, p2, p3,. t1, t2, t3..,q1, q2, q3, .., or Q1, Q2, Q3 ..., etc. depending on the combination.

3.3.7 Overall screening and armouring

Cables shall have an overall screen made up of copper/aluminium tape of 0.04 mm thickness or copper/aluminium of 0.008 mm thickness laminated with plastic tape with a minimum overlap of 15%.A drain wire of tinned copper with minimum 0.5 mm^2 cross section shall be provided in continuous contact with the screen.

3.3.8 Inner and Outer Sheath

The inner and outer sheaths shall consist of black PVC compound.

3.3.9 Insulation Resistance

Minimum insulation resistance per km shall be 500 mega Ohm.

3.3.10 Mutual Capacitance

Mutual capacitance of any pair of conductors shall not exceed 120 nF/km.

3.3.11 Capacitance Unbalance

The capacitance unbalance between any two pairs shall not exceed 400 pF for 500 metre length of cable.The construction, performance and testing of cables except as mentioned above shall generally comply with the following standards :

IEC-60189 - Part-1 : Low frequency cables and wires with PVC insulation and sheath. General test and measuring methods

IEC-60189 - Part-2: (-do- Cables in pairs and triples).

4.0 CABLE TERMINATIONS

4.1 Cables shall be laid in trays /trenches/ conduits by the Bidder. Also joint markers shall be provided at each joint.

4.2 All 1100V termination for XLPE/PVC power cables and control cables shall be by Double compression weather proof type cable glands. Heavy duty, tinned, long barrel copper lugs shall be used for termination.

5.0 CABLE JOINTS

Cable joints shall be avoided to the extent possible. If joints are unavoidable due to circuit length, in excess of permissible maximum drum length, they shall be heat shrinkable types having a short circuit with stand capacity value as specified in clause 3.1.2 above. Lugs shall be heavy duty, tinned copper, long barrel type. All cable glands shall be double compression, weather proof.

6.0 POWER RECEPTACLES

3 phase, 5 pin, 63A power receptacles with switch shall be provided . The receptacle shall be industrial heavy duty type and shall have suitable interlock facility for safety. The receptacle shall conform to IS 1293 and the switch to IS 4064.

7.0 CABLE CARRIER SYSTEM

7.1 The cable carrier system shall be designed considering the following :

(a) Facility for easy laying of cables.

(b) Access to maintenance.

(c) Neat and aesthetic appearance.

(d) Safety of equipment & personnel.

(e) Ground water seepage.

(f) Drainage system for oil and water.

7.2 Cables shall be laid in prefabricated ladder (for power and control) / perforated (instrumentation) type trays and in conduits. Also joint markers shall be provided at each joint. The cable trays shall be laid vertical in boiler and ESP area, coal handling and ash handling area.

7.3 Cable trays and supporting structures in chemically corrosive area like battery room and water treatment plant shall be mild steel painted trays finished with chlorinated rubber based paint/epoxy paint.

7.4 Cable trenches will be avoided to the extent possible inside Fuel oil pump house, water treatment plan where possibility of oil and water collection exists and Boiler & ESP areas.

7.5 No direct underground burial cables shall be laid except lighting tower, street lighting. For some exceptional case like isolated individual equipments it shall be allowed after approval by the owner /consultant.

8.0 CABLE INSTALLATION AND ACCESSORIES

8.1 All material and accessories required for cable installation like cable trays, tray covers, support steel, etc., shall be hot dip galvanized. Conduits/pipes shall also be hot dip galvanized steel. The racks/trays, conduits/pipes, trenches required to route the cables to individual equipment shall be supplied and installed by the BIDDER.

8.2 Separate trays shall be provided for LV Power (AC&DC)/Control & Instrumentation cables.

8.3 After laying all the cables, BIDDER shall dress all cables by clamping at every metre, so that the cables are securely held and aesthetically good.

8.4 Cable trays shall be avoided very close to the pipes carrying high temperature steam. When they are inevitable, it shall be laid after OWNER approval and

suitable insulation material shall be provided between the cable trays and pipes.

8.5 1100 V cables up to 120-sq. mm. can be laid in two layers. Control and Instrumentation cables can be laid in three layers.

8.6 One spare conduit shall be provided for cable of center / outer drive in clarifier.

8.7 Power and control cables for critical / emergency drives / equipment like DC EOP / JOP shall be kept away and routed in separate cable trays

8.8 All cable entries to the buildings to be sealed by fire proof & water proof cement after cable installation.

8.9 One drum (500m) spare LT power/control of each size of cable shall be included.

9.0 CABLE TRAYS AND COVERS

9.1 All outdoor cable trays are to be provided with covers. All vertical cable tray race ways are to be provided with covers all round. Cable trays shall be of ladder / perforated type complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories. Cable trays of ladder and perforated types and the associated accessories such as coupler plates, tees, elbows, etc., shall be fabricated from 12 gauge (2.5 mm thick) mild steel sheets. Cable tray covers shall be provided for all cable trays and raceways. The cable tray accessories like trays, elbows, bends, etc., shall be fabricated and galvanized before bringing to site. Cable tray covers shall be fabricated from 16 gauge (1.7 mm thick) MS sheets. All the sheet steel shall be hot dip galvanized.

9.2 1100 V rated cables of sizes 120-sq. mm and above shall be laid in single layer. Single core cables used for 3-phase AC power circuits shall be laid in Trefoil form with suitable PVC aluminum clamps to hold the cables.

9.3 The sizing of cable trays from TG building to other areas shall consider para 9.2 above an additionally to avoid crowding and criss crossing of cables, especially in boiler area where vertical risers are to be provided for various power, control and instrumentation cables to higher elevations of boiler.

9.4 Slotted angles shall not be used for cabling. In all locations smaller size cable trays of 50 mm / 100 mm wide shall be used for one or two cables.

10.0 FIRE-PROOF SEALING OF CABLE PENETRATION

Cables / cable tray openings in walls and floors or through pipe sleeves from one area to another or one elevation to another, between the units and within the same unit, shall be sealed by a fire-proof sealing system. The fireproof sealing system (FPSS) shall effectively prevent the spread of fire from the flaming to the non-flaming side, in the event of a fire. The FPSS shall conform to the following requirements:

(a) FPSS shall have a fire rating of two hours.

(b) The FPSS shall be subjected to fire endurance test, hose stream test, temperature measurement of non-flaming side as per ASTM-E119. 'Standard method of fire tests of building construction and materials'.

(c) The FPSS will also conform to the in-combustibility test carried out in accordance with IS: 3144-1992.

(d) Under fire condition, the FPSS material shall not emit excessive smoke or any corrosive or toxic fumes.

(e) FPSS shall have minimum life of 25 years.

11.0 FIRE BREAK

11.1 Fire break shall be provided by applying a suitable fire-resistant coating on cables for the required length to meet the fire rating of 30 minutes.

11.2 Fire break shall be provided at an interval of 15 metres in the straight portion of each of the cable tray above ground, at intervals of 30 metres in cable trenches and at 5M for all vertical trays. All cable inter section and tee offs shall be provided with firebreaks.

11.3 When pipe sleeves are provided for cables from outdoor areas to indoor areas, the pipe opening at the outdoor side shall be sealed by fire proof sealing material, which is also continuously waterproof. The indoor side of the pipe opening shall also be sealed by continuous fire proof sealing materials. The duct banks in outdoor areas also need to be sealed by water poof seals. It is necessary to explore possibility of applying waterproof coating on fireproof sealing.

12.0 TESTS

All routine tests and FRLS tests as per relevant standard shall be performed on each size of cable. If same size is supplied in different lots, inspection shall be done for each lot. If same cable is supplied by different agencies, test shall be carried out on cables supplied by each agency. These tests shall be carried out as per relevant standards as applicable.

Routine and acceptance test shall be carried out on FPSS.

Type test certificates for type tests conducted on identical design and size of the Cables shall be submitted for review. If type tests have not been done or the certificates are found to be not in order by purchaser then these type tests shall be conducted on Cables to be supplied for this project at no extra cost to Purchaser.

13.0 For technical particulars refer datasheet-A.

Sr. No.	Description	unit	Client specification
1.0	Name of manufacturer		*
2.0	Make of cable		
3.0	Conductor No. core x Size Form- circular/segmented Effective cross sectional area sq. mm		*
4.0	Whether cores identification numbers for cables with 5 cores and above to be provided		Yes
5.0	Whether incremental running lengths are marked on cable		Yes
6.0	Finished cable a) Diameter under armour in mm b) Diameter over armour in mm c) Overall diameter in mm		*
7.0	Cable drums a) Whether cable drums confirm to IS : 10417 b) Length of cables in drum & tolerance c) Weight of cable drum without cables d) Weight of cable drum with cables e) Type of end sealing		*
8.0	FRLS cables a) Critical oxygen index value at 250 deg C when tested for temperature index test as per ASTM-		Ref. Clause 2.3

Sr. No.	Description	unit	Client specification
	D-2863 b) Total acid gas generation by weight when tested as per IEC – 754-1 in % c) Percentage of light transmission under fire for assessment of smoke generation when tested as per ASTM – D – 2843-77 d) Will the cables offered against this specification pass the flammability tests as per 1) Class – F3 – Swedish standard S5-424- 1475 2) IEC 60332 – 1C 3) IEC 60331 – 1		
9.0	Maximum dielectric loss of cable per KM at normal voltage and frequency	Watt/ km	*
10.0	Short circuit capability for 1 Sec (HT & LT Power Cable)	kA rms	Minimum 40kA and 50 kA for HT and LT respectively and shall be in line with requirements of the switchgear and protection.
11.0	Maximum dielectric stress at core screen	KV/c m	*
12.0	Max. overall diameter of cables	mm	*

'*' indicated above shall be filled by BIDDER.

VOL - III

DOCUMENTS TO BE FURNISHED WITH OFFER FOR TECHNICAL EVALUATION

1) SCHEDULE OF TECHNICAL DEVIATION (IF ANY)
   OR

   'NO DEVIATION CERTIFICATE' – Clearly mentioning that bidder has considered 'No - Deviation' from the technical specification provided by BHEL.

2) SIGNED AND STAMPED COPY OF COMPLIANCE CUM CONFIRMATION CERTIFICATE.
3) Catalogue of each item / machine furnished
4) Filled up electrical load data format indicating no. of motors, their name plate rating, guaranteed power consumption, type of feeder required etc. as per BHEL's format furnished.
5) Commissioning spares in terms of numbers indicating sizes / ratings furnished and included in bidder's scope.
6) Unpriced format, duly mentioned 'Quoted'.

NOTE:

i) NO OTHER DOCUMENTS OTHER THAN THOSE LISTED ABOVE ARE REQUIRED TO BE S UBMITTED FOR TECHNICAL EVALUATION. IN CASE ANY OTHER DOCUMENT IS FURNISHED, THE SAME WILL NOT BE TAKEN INTO CONSIDERATION FOR TECHNICAL EVALAUATION.

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions other than those mentioned under "exclusion" in section C and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified/ intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre - bid discussions, otherwise BHEL/ Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

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

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.

h) Guarantee for plant /equipment shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price and within purview of the tender specification even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities.

j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel 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.

DEVIATION SHEET (COST OF WITHDRAWL)

PROJECT:- 2X660 MW SURATGARH STPS

PACKAGE:- WORKSHOP EQUIPMENT

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

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

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawl of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.
14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.