RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LIMITED
2X660 MW SUPER-CRITICAL THERMAL POWER STATIONS, STAGE V UNIT 7 & 8
SURATGARH, RAJASTHAN
TECHNICAL ENQUIRY SPECIFICATION
FOR
HORIZONTAL CENTRIFUGAL WATER PUMPS & VALVES FOR ASH HANDLING SYSTEM

BHARAT HEAVY ELECTRICALS LIMITED
INDUSTRIAL SYSTEMS GROUP
BANGALORE

	Prepared By	Checked by	Approved by
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Contents:

1.00 PROJECT INFORMATION:

The specification has been prepared for supply of Horizontal Centrifugal Water Pumps & Valves for 2X660 MW RRVUNL Suratgarh Stage-V Unit 7 & 8, Suratgarh, Rajasthan. Tata Consulting Engineers, Bengaluru is the consultant for the customer RRVUNL. BHEL is the principal contractor who is responsible for the establishment of the power project for unit 7 & 8. Industrial Systems Group (ISG) unit of BHEL located at Bengaluru will be executing the Ash Handling System of the 2X660 MW RRVUNL Suratgarh Stage-V Unit 7 & 8. Project information for the 2X660 MW RRVUNL Suratgarh project is as per enclosed Annexure –I (Sheet 1).

2.00 SCOPE OF SUPPLY:

The scope of supply and works includes design, manufacture, supply, assembly & testing at shop, inspection at manufacturer's work, packing & painting, delivery at site & supervision of erection & commissioning & PG test at project site. Bidder shall include the minimum **2 (two) mandays over 1 (one) visit** at site for supervision of erection & commissioning and PG test. **The Horizontal Centrifugal Water Pumps shall be supplied with required coupling guards, pump, motor, coupling between pump & motor, MS Increaser & Reducer for suction and discharge side to suit the system, Companion flanges with nuts and bolts for increaser/reducer at pump suction and discharge, pump suction and discharge gaskets, common/split base frame for Pumps and Motor along with alignment nuts and bolts, foundation bolts with nuts and washers, equipment mounting bolts for pumps and motor, and shaft keys for the pumps. The Water Line Valves shall be supplied with companion flanges, gaskets nuts and bolts required for smooth functioning of the valves as per the specification.** The pump manufacturer shall make their own arrangement for testing of Horizontal Centrifugal Water Pumps at shop floor and inspection & testing at manufacturer's work with test/job motors.

Items and accessories which are not mentioned specifically but are essential for the best performance of the equipment shall be supplied by bidder without any cost implication to BHEL.

3.00 SPECIFICATION FOR HORIZONTAL CENTRIFUGAL WATER PUMPS:

S. No.	Description	:	Technical Particulars	
3.01	Type	:	Horizontal Centrifugal Water Pumps	
3.02	Applicable	:	ISO 1940 Balancing	
		:	ASTM A 532 Grade	
		:	IS5120/IS9137/HIS	
		:	Any other relevant International / DIN standard.	
3.03	Performance Parameters	:	LP Seal Water Pump	Ash Conditioner Water Pump
	Capacity (cub.m/hr)		75	90
	Head (mWC)		70	50
	Quantity (nos.)		02	03
3.04	Duty	:	Continuous	
3.05	Design Condition	:	Horizontal Centrifugal Water Pumps shall be designed for Raw Water	
3.06	Design Temp.	:	50 deg. C	
3.07	Site Data	:	Refer Annexure-I	

4.00 MATERIAL OF CONSTRUCTION OF HORIZONTAL CENTRIFUGAL WATER PUMPS:

S. No.	Item Description	:	Technical Particulars
4.01	Casing	:	Cast Iron as per IS 210
4.02	Impellers	:	ASTM-A351-CF8M
4.03	Impeller shaft	:	EN-8
4.04	Shaft Sleeve	:	SS 410
4.05	Bolts / Nuts		MS as per IS 1363
4.06	Bearing make	:	SKF/FAG/TATA/TIMKEN
4.07	Impeller Type	:	Closed
4.08	Pump Impeller rpm	:	Maximum 3000 rpm
4.09	Noise Level	:	85 dBA at 1.5 mtr from Equipment

4.010	Pump testing standard	:	IS 5120 / IS 9137 / ISO 9906

5.00 MANDATORY SPARES OF HORIZONTAL CENTRIFUGAL WATER PUMPS:

The following mandatory spares shall be repeated for each type of pump:

S. No.	Item Description	Quantity
5.01	**Mechanical**	
i)	Rings (as applicable)	2 Sets of each type
ii)	Shaft sleeve	2 Sets of each type
iii)	Bearings for pump with seal	2 Sets of each type
iv)	Gland packing	2 Sets of each type
v)	Impeller	2 Nos. of each type
5.02	**Electrical (Motor)**	
i)	Motor	1 no. of each type & rating
ii)	Bearing	1 set of each type
iii)	Space heaters	1 no. of each type
iv)	Cooling fan	3 nos. of each type

6.00 SPECIFICATIONS FOR VALVES:

S. No.	Location		Type	Operation	Size(NB)	Working Pressure	Qty.
	Water Pump	Suction/Discharge					
1.	LP SEAL	Suction	Gate	Manual	150	-	02 Nos.
2.	ASH CONDITIONER	Suction	Gate	Manual	150	-	03Nos.
3.	LP SEAL	Discharge	Gate	Manual	150	70 mWC	02 Nos.
4.	ASH CONDITIONER	Discharge	Gate	Manual	150	50 mWC	03 Nos.
5.	LP SEAL	Discharge	NRV	-	150	70 mWC	02 Nos.
6.	ASH CONDITIONER	Discharge	NRV	-	150	50 mWC	03 Nos.

7.00 STANDARDS/MATERIAL OF CONSTRUCTION OF VALVES:

S. No.	Item Description	:	Technical Particulars
7.01	**Gate Valves**	:	
i)	Design Standard	:	IS 14846-2000 OR PN10/PN 16 pressure rating as per BS 5150
ii)	Body	:	CI as per IS 210 FG 260
iii)	Bonnet	:	CI as per IS 210 FG 260
iv)	Wedge	:	CI as per IS 210 FG 260
v)	Gland	:	CI as per IS 210 FG 260
vi)	Stem	:	SS 410
vii)	Gland Packing	:	PTFE/Teflon
viii)	Body Seat ring and Wedge seat ring	:	Gun metal as per IS 318 Gr LTB 2 OR ASTM A 217 Gr CA 15
7.02	**Non-Return Valves**	:	
i)	Type	:	Swing check
ii)	Design Standard		IS 5312 part 1-2004 OR PN10/16 pressure rating as per BS 5153 OR API 594 for wafer type
iii)	Body & Cover	:	CI as per IS 210 FG 260

iv)	Disc/Door/Flap	:	CI as per IS 210 FG 260 OR ASTM A 351 CF8
v)	Body Seat Ring	:	Rubber OR Gun metal as per IS 318 Gr LTB 2 OR ASTM A 217 CA 15
vi)	Disc/Door/Flap Seat Ring	:	Rubber OR Gun metal as per IS 318 Gr LTB 2 OR ASTM A 217 CA 15
vii)	Hinge pin	:	SS410/ ASTM A 351 CF8
viii)	Approved Makes for Valves	:	Kirloskar Brothers Ltd, Pune/ Crescent Valves Ltd, Jalandhar/ Audco/ Seltec/ Leader Valves Ltd, Jalandhar/ Weir BDK/ H Sarkar/ L & T Valves/ Fouress Engineering Ltd, Bangalore

8.00 MANDATORY SPARES FOR WATER VALVES:

S. No.	Item Description	:	Quantity	Unit
4.01.	Complete valve assembly for each size and type of valve	:	01	No
4.02.	Valve flaps/slides of each type	:	10	%

9.00 DESIGN & CONSTRUCTION FEATURES:

i)	Dynamic balancing test, static balancing test & visual inspection shall be conducted at works in the presence of purchaser
ii)	Life of oil lubricated anti-friction type bearings shall be at least 40,000 running hours. Pump Bearings shall be of SKF/FAG/TATA/TIMKEN make.
iii)	The rotational speed of the impeller at design point shall not exceed 3000 rpm.
iv)	Bearing temperature shall be within 90 deg. C including maximum ambient temperature under normal operating condition.
v)	Material Test Certificate shall be provided for Impeller& impeller ring, Casing & casing ring, shaft and shaft sleeve.
vi)	Ultrasonic Test shall be conducted for Shaft.
vii)	Dye Penetration test shall be conducted for shaft and shaft sleeve
viii)	The stage inspections for above tests and final inspection shall be done by BHEL, Customer/ Consultant as per approved QAP of successful bidder.
ix)	The Water pump shall be such that the noise level requirement as stated below can be complied with:- “Maximum noise level shall not exceed 85 dB (A) when measured at 1.5m away from noise emission source. Any Statutory changes in stipulations regarding noise limitation that may occur in future according to Central Pollution Control Board or Environment & Forest regulation during tenure of the Contract, the Supplier shall comply with the requirement”
x)	Vibration level of each Horizontal Centrifugal Water Pump shall be limited to as per the stipulations prescribed in relevant standards.
xi)	Pump shall have a drooping characteristics curve, with the head continuously increasing with decreasing flow to maximum head and the pumps shall preferably be non-overloading type beyond rated duty point.
xii)	The characteristics curves of each set of pumps shall match each other for equal load sharing in case of parallel operation and such pumps shall be identical and all parts shall be fully interchangeable. Standard type pumps with a proven record of reliability shall only be provided.
xiii)	Complete technical data from pump supplier regarding head drop v/s mixture concentration and clearance diagram for impeller and casing and complete information shall be furnished
xiv)	Painting shall be as per manufacturer’s standard, however the total DFT should not be less than 100 micron.

10.00 ACCESSORIES:

Bidder shall include following items/accessories as part of water pump in their scope:	
1.	MS increaser/reducer with nuts & bolts at pump suction and discharge side as per IS3589.

2.	Companion flanges along with nuts & bolts for MS increaser/reducer at pump suction and discharge of the pumps shall be supplied.
3.	Coupling between pump & motor
4.	Coupling guards for coupling
5.	Pump with motor & motor shaft keys
6.	Suction and discharge gaskets, commissioning spares (as required), and all other accessories, which are not mentioned specifically but are essential for sound performance of the equipment.
7.	HT bolts for pumps and motors as required
8.	Base frame with foundations bolts, Coupling guard, anti-vibration pads, eye bolts etc. as required for the ash water pump.
9.	All necessary instruments to ensure smooth and satisfactory operation of the ash water pump and also for the safe and reliable operation of the Compressor.
10.	Tool kit for operation and maintenance of the Horizontal Centrifugal Water Pumps Valves.
11.	Lubrication fittings as necessary for proper and easy lubrication of the equipment.
12.	All the above pump accessories shall be dispatched along with pumps from Bidder's manufacturing works.

11.00 INSPECTIONS & TESTING:

1. All Quality plans shall be submitted in soft and hard copy (5nos.) for BHEL/Customer/customer's Consultant approval.
2. Bidder shall give 15 days' advance written notice of equipment being ready for testing. Such tests shall be to bidder's account including for the expenses of the inspector's for RRVUL/TCE/Third Party Inspector. The customer / Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within 15 days of the date on which the equipment is notified as being ready.
3. **Cost towards the inspection of indigenous/offshore equipments by RRVUNL/TCE Engineer/Inspector will be to Bidder's account, which includes to & fro Airfare/Railway/Road fare charges, Boarding and Lodging, local transportation and other related expenses. The cost shall be included in the price.**
4. Type & routine test report/certificates shall include details of standard to which the tests are performed, test parameters, acceptance criteria, test set up etc. used during the testing along with the test piece details/ rating and the detailed test record and final test result.
5. All inspection, measuring and test equipment used by the contractor shall be calibrated periodically. Bidder shall maintain all relevant records of periodic calibration, instrument identification, and shall provide for inspection by bidder wherever asked specifically; bidder shall calibrate measuring / testing equipment in the presence of employer.
6. The details of the checks to be carried out for various components (MQP) are to be submitted within one month from the date of Purchase order by bidder for customer approval.
7. Vendor shall maintain strict quality norms and standards for Bought out/ self-manufactured items through its wide network of quality departments throughout the country who carryout stage and final inspection of the product as per quality standards agreed by engineering/quality specialists.
8. After completion of inspection the material will be treated as cleared for dispatch by BHEL/Customer/customer's Consultant inspector, if inspection is OK as observed by Inspection Engineers.
9. Category of inspection for the items is as given below:
    1. **All Water Pumps- CAT-I (Inspection shall be done by RRVUNL along with BHEL)**
    2. **Water Valves-CAT-III (Valves shall be inspected & tested by pump supplier and IR/TC to be submitted for to BHEL for review & getting MDCC)**

12.00 TESTING PARAMETER:

1. Material Test Certificate shall be provided for Impeller& impeller ring, Casing & casing ring, shaft and shaft sleeve.
2. Ultrasonic Test shall be conducted for Shaft.
3. Dye Penetration test shall be conducted for shaft and shaft sleeve.
4. The stage inspections for above tests and final inspection shall be done.
5. Hydro test of Hydro test of Casing shall be done at 2 times the rated head or 1.5 times the shut off pressure of the pump whichever is higher.

6. During inspection, the performance test (for head, capacity and power) of pumps shall be carried out at reduced length and at reduced speed with calibrated test bed motor and readings for performance curve shall be taken on different points from shut off head to 120% of the rated flow (including rated flow).
7. Bearing temperature shall be within 90°C including maximum ambient temperature under normal operating condition.
8. Quantum of check for performance test during inspection of Horizontal Centrifugal Water Pumps shall be one per type and model.

13.00 TECHNICAL INPUTS TO BE FURNISHED/CONFIRMED ALONG WITH THE OFFER:

Following documents are to be necessarily enclosed for Horizontal Centrifugal Water Pumps & Valves by the Bidder as a part of the offer:

a) Manufacturer's QAP to be submitted for approval.
b) Sectional Assembly Drawings complete With Bill of Material.
c) Performance Curve.
d) Duly filled in Bidder's Data Sheet.
e) Catalogues for the offered model of Horizontal Centrifugal Water Pumps & Valves.
f) Torque speed Curve for verifying the selection of motor.
g) GD2 value of all rotating parts for verifying the selection of motor.
h) Bidder shall submit signed copy of all the pages of enquiry specification.
i) List of Commissioning Spares.

14.00 LIST OF DRG/DOC TO BE FURNISHED AFTER PLACEMENTOF LOI:

11.1	Sectional assembly drawing of Horizontal Centrifugal Water Pumps & Valves complete with bill of material and its part numbers for approval.
11.2	GA drawing Horizontal Centrifugal Water Pumps & Valves and motor for approval.
11.3	Technical Data sheet of pump, motor & water valve for approval
11.4	Performance Curves and Torque Speed Curves.
11.5	Operational And Maintenance Manual for information
11.6	Storage & Installation Manual
11.7	Lubrication schedule.
11.8	Manufacturer's QAP for BHEL/Customer/customer's Consultant approval.
11.9	Painting Schedule for approval.
11.10	Load Data for designing Civil foundation.
11.11	GA drawings of base frames, MS suction increaser and reducer with flange, flexible coupling between pump and motor.
11.12	Any other relevant document which may be felt necessary during execution of Contract.
11.13	Successful bidder shall submit all the above with proper title block within a week of receipt of LOI. Bidder's LD on account of delay on submission and revised submission of these documents/drawings shall not be entertained.
11.14	The approval time for Drawings/Documents from BHEL/Customer shall be considered by bidder as three weeks for their planning of supply of equipment within time frame.

15.00 OPERATION & MAINTENANCE MANUAL:

O & M manual shall contain the following:

1. Principle of operation of the equipment.
2. Details of preventive/repair maintenance for equipment and accessories used.
3. Details about the general specifications, design capacities of equipment and their function.
4. Equipment Bidder's address, telephone nos., contacts person details to be furnished.
5. Required Dismantling devices, tools etc.,
6. List of DO's and DO NOT's.
7. Test certificates.
8. All drawings.

9. Calculations
10. Storage and erection instructions.
11. Proper procedures & sequence of operation.
12. Details of consumable.

Important Notes:

i) All manual shall be supplied in proper bound books or in folders, preferably in A4 size.
ii) The volume and section number shall be intimated by the Bidder.
iii) Prospective Bidder shall submit the regular progress reports for self-manufacturing & their bought out items/equipment ordering /manufacturing status, drgs status once in fifteen days.
iv) Bidder shall directly send O&M Manuals to BHEL-ISG HQ as per distribution schedule given below in Clause – 12.0 14.0 with covering letter copy to Project Manager, BHEL-ISG, Bangalore. BHEL Project Manager shall co-ordinate and ensure submission to Customer/customer's Consultant for the equipments as per BHEL standard practice.

16.00 COMMISSIONING SPARES:

The optional price of commissioning spares with complete list shall be furnished by bidder along with offer. These spares, if ordered at later date, shall be supplied immediately after Boiler Light Up (BLU) of any unit which shall be intimated to the bidder by BHEL.

17.00 DISTRIBUTION OF DRAWINGS/DOCUMENTS DURING DETAIL ENGINEERING:

1. Distribution of drawings/ documents:
   For Approval and Information category drgs :
   Initial submission –Soft copy (AutoCAD version and Pdf version)
   Commented copies back to the sender- Soft copy (Pdf version)
   Resubmission of revised drg – Soft copy (AutoCAD version and Pdf version).
   Final approved drawings/documents – 5 nos. hard copies.
2. BHEL/Customer/customer's Consultant shall review and furnish their comments/approval within 15 days from the date of receipt of drawings/documents. M/s BHEL/Customer/customer's Consultant will furnish Comments /approval to the Vendor after review of each drawing/document.
3. Considering the criticality of the project requirement, all efforts shall be made to re-submit the drawings/documents as early as possible. However, the commented drawings shall be re-submitted by successful Bidder within 7 days from the date of receipt of commented drawings/ documents from BHEL/Customer/customer's Consultant.
4. Drawings approved under Cat-B shall hold good for construction/execution subject to taking care of comments of M/s BHEL/Customer/customer's Consultant.
5. In case, successful Bidder does not agree with any specific comments, successful Bidder shall furnish the explanation for the same to M/s BHEL/Customer/customer's Consultant within the framework of contractually agreed specification for consideration, acceptance and formal approval under Category A, as per specifications.
6. For Category C, BHEL/Customer/customer's Consultant will send soft copies of marked up drawings for further action by successful Bidder.
7. Final distribution of copies of all Category A approved drawings/documents shall be submitted by successful Bidder to BHEL/Customer/customer's Consultant as per distribution schedule given above.

18.00 ESSENTIAL SPARES:

The Bidder shall furnish Essential Spares list required for initial three years for successful operation of Horizontal Centrifugal Water Pumps.

19.00 ELECTRICAL SCOPE:

Attached As per Annexure II.

RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LIMITED
2X660 MW SUPER-CRITICAL THERMAL POWER STATIONS, STAGE V UNIT 7 & 8
SURATGARH, RAJASTHAN
TECHNICAL ENQUIRY SPECIFICATION
FOR HP SEAL WATER PUMPS FOR ASH HANDLING SYSTEM

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Contents:

1.00 PROJECT INFORMATION:

The specification has been prepared for supply of HP Seal Water Pumps for 2X660 MW RVUNL Suratgarh, Unit 7&8 for RVUNL, Suratgarh for which Tata Consulting Engineers, Bangalore is customer's consultant. BHEL is the principal contractor who is responsible for the establishment of the power project for unit 7 & 8. Industrial Systems Group (ISG) of BHEL located at Bangalore will be executing the Ash Handling System for 2X660 MW RVUNL Suratgarh, Unit 7& 8.

Project information for the 2X660 MW RVUNL Suratgarh project is as per enclosed Annexure –I (Sheet 1-2)

2.00 SCOPE OF SUPPLY:

The scope of supply and works includes design, manufacture, supply, assembly & testing of HP Seal Water Pumps at shop floor with job motor, delivery and supervision of erection & commissioning and PG test at site. Bidder shall include the minimum **1 (one) manday** over **1(one)** visits at site for supervision of erection & commissioning and PG test. Bidder's guaranteed power for pumps shall be measured during inspection of pumps with job motor at manufacturer's shop at duty point and the same shall be referred during PG test at site. **The HP Seal Water pumps shall be supplied with required motor, coupling between pump & motor coupling guards, pump suction and discharge gaskets, base plate or stool piece for Pumps and/between Motor along with alignment nuts and bolts, foundation bolts with nuts and washers, equipment mounting bolts for pumps and motor, and shaft keys for the pumps and other accessories as required for the trouble free operation of the pump.** The pump manufacturer shall make their own arrangement for testing of water pumps at shop floor with job motor.

Items and accessories which are not mentioned specifically but are essential for the best performance of the equipment shall be supplied by bidder without any cost implication to BHEL.

3.00 SPECIFICATION FOR HP SEAL WATER PUMP			
3.01	Type	:	Vertical In-line
3.02	Applicable Codes/Standards	:	ISO 1940 Balancing
			ASTM A 532 Grade
			IS5120/IS9137/HIS
			Any other relevant International / DIN standard.
3.03	Performance Parameters	:	Water Pump
i)	Capacity	:	12 cub.meter/hr
ii)	Head		Suction @ 70 mWc
			Discharge @ 130 mWc
iii)	Quantity		Two (02) nos.
3.04	Duty	:	Continuous
3.05	Design Condition	:	Suitable for raw water
3.06	Design Temperature	:	50 deg C
3.07	Site Data	:	Refer Annexure-I

4.00 MATERIAL OF CONSTRUCTION/DESIGN FEATURES:			
i)	Casing	:	AISI 304
ii)	Impellers	:	AISI 304
iii)	Shaft	:	AISI 304

iv)	Bolts/Nuts	:	MS as per IS 1363
v)	Bearing make	:	SKF/FAG/TATA/TIMKEN
vi)	Noise level	:	85 dBA at 1.5mtr from equipment.
vii)	Pump Impeller rpm	:	Maximum 3000 rpm

5.00 MANDATORY SPARES:		
5.01	**ITEM DESCRIPTION (Mechanical)**	
i)	Rings (as applicable)	2 Sets of each type
ii)	Shaft sleeve	2 Sets of each type
iii)	Bearings for pump with seal	2 Sets of each type
iv)	Gland packing	2 Sets of each type
v)	Impeller	2 Nos. of each type
5.02	**ITEM DESCRIPTION (electric motor)**	
i)	Motor	1 no. of each type & rating
ii)	Bearing	1 set of each type
iii)	Space heaters	1 no. of each type
iv)	Cooling fan	3 nos. of each type

6.00 DESIGN & CONSTRUCTION FEATURES:	
i)	Life of oil lubricated anti-friction type bearings shall be at least 40,000 running hours. Pump Bearings shall be of SKF/FAG/TATA/TIMKEN make.
ii)	The rotational speed of the impeller at design point shall not exceed 3000 rpm.
iii)	Material Test Certificate shall be provided for Impeller& impeller ring, Casing & casing ring, shaft and shaft sleeve.
iv)	The Water pump shall be such that the noise level requirement as stated below can be complied with:- “Maximum noise level shall not exceed 85 dB (A) when measured at 1.5m away from noise emission source. Any Statutory changes in stipulations regarding noise limitation that may occur in future according to Central Pollution Control Board or Environment & Forest regulation during tenure of the Contract, the Supplier shall comply with the requirement”
v)	Vibration level of each ash Water pump shall be limited to as per the stipulations prescribed in relevant standards.
vi)	Pump shall have a drooping characteristics curve, with the head continuously increasing with decreasing flow to maximum head and the pumps shall preferably be non-overloading type beyond rated duty point.
vii)	Standard type pumps with a proven record of reliability shall only be provided.
viii)	Complete technical data from pump supplier regarding head drop v/s mixture concentration and clearance diagram for impeller and casing and complete information shall be furnished
ix)	Painting shall be as per manufacturer’s standard, however the total DFT shall not be less than 100 micron.

7.00 ACCESSORIES:
Bidder shall include following items/accessories as part of water pump in their scope:

1.	Companion flanges along with nuts & bolts at pump suction and discharge of the pumps shall be supplied.
2.	Coupling between pump & motor
3.	Coupling guards for coupling
4.	Pump shaft keys
5.	Suction and discharge gaskets, commissioning spares (as required), and all other accessories, which are not mentioned specifically but are essential for sound performance of the equipment.
6.	HT bolts for pumps and motors as required
7.	Base plate for Pump and Motor, along with alignment nuts and bolts with foundations bolts, Coupling guard, anti-vibration pads, eye bolts etc. as required.
8.	All necessary instruments to ensure smooth and satisfactory operation of the ash water pump and also for the safe and reliable operation of the Compressor.
9.	Tool kit for operation and maintenance of the HP Seal Water Pump.
10.	Lubrication fittings as necessary for proper and easy lubrication of the equipment.

8.00 INSPECTIONS & TESTING:

1. All Quality plans shall be submitted in soft and hard copy (5nos.) for BHEL/Customer/customer's Consultant approval.
2. Type & routine test reports/certificates shall include details of test standard , test parameters, acceptance criteria, test set up etc. used during the testing along with the test piece details/rating etc. All the documents shall be sent to client for review.
3. All inspection, measuring and test equipment used by the contractor shall be calibrated periodically. Bidder shall maintain all relevant records of periodic calibration, instrument identification etc.
4. Vendor shall maintain strict quality norms and standards for Bought out/self-manufactured items through its wide network of quality departments throughout the country who carryout stage and final inspection of the product as per quality standards agreed by engineering/quality specialists.
5. The pump shall be inspected by BHEL shall be cleared for dispatch by customer after review of the IR/TC of the Pumps found to be ok.

9.00 TECHNICAL INPUTS TO BE FURNISHED/CONFIRMED ALONG WITH THE OFFER:

Following documents are to be necessarily enclosed for each type of HP Seal Water Pump by the Bidder as a part of the Offer:

1. Manufacturer's QAP.
2. GA drawing & Sectional assembly drawings complete with bill of material.
3. Duly filled in Bidder's Data Sheet.
4. Catalogues for the offered models.
5. Bidder shall submit signed copy of all the pages of enquiry specification.
6. List of Commissioning Spares.
7. The list of tools in the Tool Kit for operation and maintenance of the HP Seal Water Pump.
8. Bidder to specify the design standard followed for design of HP Seal Water Pumps and also specify the equivalent Indian Standard/MOC for foreign standards
9. Painting Schedule for HP Seal Water Pump and motor.

10.00 LIST OF DRG/DOC TO BE FURNISHED AFTER PLACEMENTOF LOI:

1.	Sectional assembly drawings complete with bill of material and its part numbers for approval.

2.	GA drawing of pump & motor for approval
3.	Technical Data sheet of pump & motor for approval
4.	Manufacturer's QAP of pump & motor for approval
5.	Operational and maintenance manual for information
6.	Lubrication schedule for information
7.	Painting Schedule of pump & motor for approval
8.	Any other relevant document which may be felt necessary during execution of Contract.
9.	Successful bidder shall submit all the above with proper title block within a week of receipt of LOI. Bidder's LD on account of delay on submission and revised submission of these documents/drawings shall not be entertained.
10.	The approval time for Drawings/Documents from BHEL/Customer shall be considered by bidder as three weeks for their planning of supply of equipment within time frame.

11.00 OPERATION & MAINTENANCE MANUAL:

O & M manual shall contain the following:

1. Principle of operation of the equipment.
2. Details of preventive/repair maintenance for equipment and accessories used.
3. Details about the general specifications, design capacities of equipment and their function.
4. Equipment Bidder's address, telephone nos., contacts person details to be furnished.
5. Required Dismantling devices, tools etc.,
6. List of DO's and DO NOT's.
7. Test certificates.
8. All drawings.
9. O& M Manual for Solenoid valves.
10. O& M Manual for air/Pneumatic Cylinders.
11. O& M Manual for Limit Switches.
12. Storage and erection instructions.
13. Proper procedures & sequence of operation.
14. Details of consumable.

Note:

i) All manual shall be supplied in proper bound books or in folders, preferably in A4 size.

ii) The volume and section number shall be intimated by the Bidder.

iii) Prospective Bidder will submit the regular progress reports for self-manufacturing & their bought out items/equipment ordering /manufacturing status, drgs status once in fifteen days.

iv) Bidder shall directly send O&M Manuals to BHEL-ISG HQ as per distribution schedule given below in Clause – 12.0 14.0 with covering letter copy to Project Manager, BHEL-ISG, Bangalore. BHEL Project Manager shall co-ordinate and ensure submission to Customer/customer's Consultant for the equipments as per BHEL standard practice.

12.00 COMMISSIONING SPARES:

The optional price of commissioning spares with complete list shall be furnished by bidder along with offer. These spares, if ordered at later date, shall be supplied immediately after Boiler Light Up (BLU) of any unit which shall be intimated to the bidder by BHEL.

13.00 DISTRIBUTION OF DRAWINGS/DOCUMENTS DURING DETAIL ENGINEERING:

a) Distribution of drawings/ documents:

For Approval and Information category drgs :

Initial submission –Soft copy (AutoCAD version and Pdf version)

Commented copies back to the sender- Soft copy (Pdf version)

Resubmission of revised drg – Soft copy (AutoCAD version and Pdf version).

Final approved drawings/documents – 5 nos. hard copies.

b) BHEL / Customer / customer's Consultant shall review and furnish their comments/approval within 15 days from the date of receipt of drawings/documents. M/s BHEL/Customer/customer's Consultant will furnish Comments /approval to the Vendor after review of each drawing/document.

c) Considering the criticality of the project requirement, all efforts shall be made to re-submit the drawings/documents as early as possible. However, the commented drawings shall be re-submitted by successful Bidder within 7 days from the date of receipt of commented drawings/ documents from BHEL/Customer/customer's Consultant.

d) Drawings approved under Cat-B shall hold good for construction/execution subject to taking care of comments of M/s BHEL/Customer/customer's Consultant.

e) In case, successful Bidder does not agree with any specific comments, successful Bidder shall furnish the explanation for the same to M/s BHEL/Customer/customer's Consultant within the framework of contractually agreed specification for consideration, acceptance and formal approval under Category A, as per specifications.

f) For Category C, BHEL/Customer/customer's Consultant will send soft copies of marked up drawings for further action by successful Bidder.

g) Final distribution of copies of all Category A approved drawings/documents shall be submitted by successful Bidder to BHEL/Customer/customer's Consultant as per distribution schedule given above.

14.00 ESSENTIAL SPARES:

The Bidder shall furnish Essential Spares list required for initial three years for successful operation of the HP Seal Water Pumps.

15.00 ELECTRICAL SCOPE:

Attached As per Annexure II.

ANNEXURE-1
GENERAL PROJECT INFORMATION

1.1	**GENERAL SITE CONDITIONS**		
1.	Owner / Purchaser	:	Rajasthan Rajya Vidyut Utpadan Nigam Ltd. (RRVUNL)
2.	Engineer/consultant	:	Tata Consulting Engineers Ltd (TCE) 73/1, St. Marks Road, Bangalore – 560 001
3.	Project Title	:	2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan
4.	Project location	:	Prabat Nagar, Suratgarh, Sriganganagar district, Rajasthan.
5.	Elevation (above Sea level)	:	186 m (approximate)
6.	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)
7.	Temperatures : Annual basis	:	Mean of daily max. 32.3 deg.C Mean of daily min. 19.6 deg.C
8.	Highest temperature recorded	:	50 deg.C
9.	Lowest temperature recorded	:	(-) 2.8 deg.C
10.	Design temperature	:	50 deg. C
11.	Relative humidity	:	Varies between 21% and 81%
12.	Annual average rain fall	:	312 mm
13.	Annual mean wind speed : Calculations for wind effect shall be in accordance with IS:875-1987(Part-3) taking into account the following	:	4 km/hr a) Basic wind speed = 47 m/sec b) Factor K1 = 1.07 c) Category of terrain = Category 2 d) K3 – as per IS 875
14.	Seismic data (As per IS: 1893 latest issue)	:	Zone II; Designs & design coefficients will be based on IS 1893:2002
15.	Nearest railway station	:	Suratgarh JN
16.	Nearest airport	:	Jaipur
1.2	**POWER SUPPLY SYSTEMS**		
1.2.1	**MV System**		
	System Voltage	:	6.6 kV ± 10%, 3 Phase, 3 wire
	System Frequency	:	50 Hz ± 5%
	Combined Variation	:	10% (absolute)
	System Fault level	:	40 kA for 3s
	System Earthing	:	Non effectively earthed
	Drives	:	161kW-1500kW
1.2.2	**LV System**		
	System A.C voltage	:	415 V ± 10%
	System Frequency	:	50 Hz ± 5%
	Combined Variation	:	10% (absolute)
	Phase	:	3 ph, 3- wire
	System fault level	:	50 kA for 1s
	System Earthing	:	Solidly grounded
	Panel space heater, lighting, AC Control & Protection Supply	:	240V, Single phase
	Drives	:	up to 160kW
1.2.3	**DC System**		
	System Voltage	:	220V, +10%, -15%, 2-wire
	Fault level	:	20 kA
	System Earthing	:	Unearthed

ANNEXURE-1
GENERAL PROJECT INFORMATION

1.1	**GENERAL SITE CONDITIONS**		
1.	Owner / Purchaser	:	Rajasthan Rajya Vidyut Utpadan Nigam Ltd. (RRVUNL)
2.	Engineer/consultant	:	Tata Consulting Engineers Ltd (TCE) 73/1, St. Marks Road, Bangalore – 560 001
3.	Project Title	:	2 x 660 MW, Super-Critical TPS, Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan
4.	Project location	:	Prabat Nagar, Suratgarh, Sriganganagar district, Rajasthan.
5.	Elevation (above Sea level)	:	186 m (approximate)
6.	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)
7.	Temperatures : Annual basis	:	Mean of daily max. 32.3 deg.C Mean of daily min. 19.6 deg.C
8.	Highest temperature recorded	:	50 deg.C
9.	Lowest temperature recorded	:	(-) 2.8 deg.C
10.	Design temperature	:	50 deg. C
11.	Relative humidity	:	Varies between 21% and 81%
12.	Annual average rain fall	:	312 mm
13.	Annual mean wind speed : Calculations for wind effect shall be in accordance with IS:875-1987(Part-3) taking into account the following	:	4 km/hr a) Basic wind speed = 47 m/sec b) Factor K1 = 1.07 c) Category of terrain = Category 2 d) K3 – as per IS 875
14.	Seismic data (As per IS: 1893 latest issue)	:	Zone II; Designs & design coefficients will be based on IS 1893:2002
15.	Nearest railway station	:	Suratgarh JN
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1.2	**POWER SUPPLY SYSTEMS**		
1.2.1	**MV System**		
	System Voltage	:	6.6 kV ± 10%, 3 Phase, 3 wire
	System Frequency	:	50 Hz ± 5%
	Combined Variation	:	10% (absolute)
	System Fault level	:	40 kA for 3s
	System Earthing	:	Non effectively earthed
	Drives	:	161kW-1500kW
1.2.2	**LV System**		
	System A.C voltage	:	415 V ± 10%
	System Frequency	:	50 Hz ± 5%
	Combined Variation	:	10% (absolute)
	Phase	:	3 ph, 3- wire
	System fault level	:	50 kA for 1s
	System Earthing	:	Solidly grounded
	Panel space heater, lighting, AC Control & Protection Supply	:	240V, Single phase
	Drives	:	up to 160kW
1.2.3	**DC System**		
	System Voltage	:	220V, +10%, -15%, 2-wire
	Fault level	:	20 kA
	System Earthing	:	Unearthed

ANNEXURE-II

A. LT MOTOR:

1. All LT motors shall be Efficiency class IE3 as per latest revision of IS 12615 along with amendments (2nd rev: 2011).
2. Motor shall be suitable for power supply of 415 V, 3 ph, 50 Hz, AC.
3. Motor shall be suitable for operation under voltage variation of + 10%, frequency variation of + 5% and combined voltage & frequency variation of 10% absolute.
4. Motor shall be squirrel cage induction type and shall generally conform to IS-325.
5. 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.
6. 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.
7. Motors shall be suitable for DOL starting.
8. 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.
9. 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 nonmagnetic material. All motors located in hazardous area shall have flame proof enclosure. All motors for outdoor duty shall have detachable metal canopy.
10. Motor shall have minimum class 'F' insulation with temperature rise restricted to class 'B' under the design ambient temperature

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.

12. 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.

13. 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.

14. 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.
15. Each motor shall have two earthing terminals.
16. The maximum double amplitude vibrations for motors shall be as per IS 12075.
17. Maximum noise level measured at a distance of 1.5 meter from the outer surface of the motor shall not exceed 85 db (A).
18. LT motors 15 kW and above shall be provided with external greasing arrangement.
19. All motors below 15 kW shall be provided with sealed ZZ bearings.
20. Motor bearing shall be insulated wherever required.
21. LT motors 30 kW and above shall be provided with space heaters using 240 V AC supply.

For additional technical details, list of makes and data sheet format, refer Annexure-IIA.

B.INSPECTION AND TESTING

Motor shall be tested at manufacturers work in presence of BHEL/RRVUNL representative as per approved QAP. QAP hall be submitted by Bidder for approval by BHEL/RRVUNL.
Inspection notice shall be issued fifteen (15 days) in advance along with internal (manufacturer) TCs.
All materials, components covered under this specification shall be procured, manufactured, inspected and tested as per approved Quality plan only.

ANNEXURE-II

A. LT MOTOR:

1. All LT motors shall be Efficiency class IE3 as per latest revision of IS 12615 along with amendments (2nd rev: 2011).
2. Motor shall be suitable for power supply of 415 V, 3 ph, 50 Hz, AC.
3. Motor shall be suitable for operation under voltage variation of + 10%, frequency variation of + 5% and combined voltage & frequency variation of 10% absolute.
4. Motor shall be squirrel cage induction type and shall generally conform to IS-325.
5. 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.
6. 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.
7. Motors shall be suitable for DOL starting.
8. 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.
9. 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 nonmagnetic material. All motors located in hazardous area shall have flame proof enclosure. All motors for outdoor duty shall have detachable metal canopy.
10. Motor shall have minimum class 'F' insulation with temperature rise restricted to class 'B' under the design ambient temperature

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.

12. 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.

13. 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.

14. 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.
15. Each motor shall have two earthing terminals.
16. The maximum double amplitude vibrations for motors shall be as per IS 12075.
17. Maximum noise level measured at a distance of 1.5 meter from the outer surface of the motor shall not exceed 85 db (A).
18. LT motors 15 kW and above shall be provided with external greasing arrangement.
19. All motors below 15 kW shall be provided with sealed ZZ bearings.
20. Motor bearing shall be insulated wherever required.
21. LT motors 30 kW and above shall be provided with space heaters using 240 V AC supply.

For additional technical details, list of makes and data sheet format, refer Annexure-IIA.

B.INSPECTION AND TESTING

Motor shall be tested at manufacturers work in presence of BHEL/RRVUNL representative as per approved QAP. QAP hall be submitted by Bidder for approval by BHEL/RRVUNL.
Inspection notice shall be issued fifteen (15 days) in advance along with internal (manufacturer) TCs.
All materials, components covered under this specification shall be procured, manufactured, inspected and tested as per approved Quality plan only.

Annexure-IIA

Sr. No.	DESCRIPTION	UNITS	DATA
1.0	Application		
2.0	Manufacturer		BHEL/Crompton Greaves Ltd/KEC/ABB Ltd/Siemens/Areva (Marathon)/Bharat Bijlee Ltd, Mumbai
3.0	Country of Origin		India
4.0	Applicable Standards		
5.0	Efficiency Category (For Energy Efficient Motors Only)		IE3(Premium Efficiency) Class
6.0	Rated a) Output / Quantity b) Speed c) Frame Size	 KW / Nos. RPM	
7.0	Type of Duty (IS 325 or equivqlent)		S1 Continuous
8.0	Supply Conditions a) Allowable Variation in i) Voltage AC/DC ii) Frequency iii) Combined b) Permissible unbalance in supply voltage		 +/-10% +/-5% 10% (absolute) NA for LV Motors
9.0	Guaranteed Efficiency of Motor a) At Full Load b) At Duty Point c) At No Load		
10.0	Guaranteed Power Factor of Motor a) At Full Load b) At Duty Point c) At No Load		
11.0	Current At a) Starting b) Full Load c) Duty Point d) Full Load & 70% of rated supply voltage		 770%FLC subject to tol. As per Standards
12.0	Rated Voltage a) HT Motors b) LT Motors c) UPS Supplied d) Single Phase e) DC Motors	 Volts	 NA 415 NA NA NA
13.0	Number of Phase		3
14.0	Rated Frequency for AC Motor	Hz	50
15.0	Normal Winding Connection	Star/Delta	
16.0	Method of Starting a) AC Motors b) DC Motors		 DOL NA

17.0	Temp. rise above ambient of 50 deg. By Resistance method		
18.0	Type of Duty		S1 Duty
19.0	Duty Designation		Continuous
20.0	Synchronous Speed a) Constant Speed b) Variable Speed (For VFD)		 NA
21.0	Starting time at specified minimum starting voltage	Sec.	
22.0	Starting Torque (as % FLT)		
23.0	Pull Out Torque (as % of FLT)		
24.0	Location considered-Hazardous area division		
25.0	Atmosphere considered-Chemical/Dust/Salt Laden)		
26.0	Whether motor is suitable for VFD drive		
27.0	Details of Bearing		
28.0	VOID		NA
29.0	Whether CT for differential protection required		NA
30.0	Whether vibration detectors required		NA
31.0	Details of winding / space heaters		
32.0	Details of accessories a) Fans b) Temperature Gauge c) Bearing d) Cooling Mot e) Cooling Water Parameters f) Heaters g) Lube oil system details		 NA NA NA NA NA NA NA
33.0	Maximum size & number of cables that can be accommodated in motor terminal box		
34.0	Thermal Capability curve to be attached		
35.0	Relay co-ordination guide to be attached		NA for LV Motors
36.0	Min. voltage required under starting conditions to accelerate driven equipment to rated speed	Volts	80% Rated Voltage
37.0	Locked rotor current withstand time (safe stall time) at 110% rated voltage a) At rated temp. (hot) b) When cold	 Sec. Sec.	
38.0	Stator thermal time constant	Sec.	
39.0	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		 _

40.0	Method of Starting and maximum starting current inclusive of tolerances		
	AC HT Motors		
	a) DOL	450% above 1500KW & 600% all other	NA for LV Motors
	b) Soft Starters	200%	NA for LV Motors
	AC LT Motors		
	a) DOL	600%	770%FLC subject to tolerance
	b) Star Delta	200%	
	c) Star Delta with series resistance	200%	
	d) Star Delta with rotor resistance	200%	
	e) Soft Starters	200%	
	DC Motors		
	a) Soft Starters	200%	NA
	b) Any Other	200%	NA
41.0	Expected Bearing Life	Hours	
42.0	Dynamic & Static load	Kgs	
43.0	Maximum induced shaft Voltage	Volts	
44.0	Noise & Vibration Level		
45.0	Paint Shade		Paint shade shall be 631(Light Gray)
46.0	Moment of Inertia (GD2)	kgm2	

Annexure-IIA

Sr. No.	DESCRIPTION	UNITS	DATA
1.0	Application		
2.0	Manufacturer		BHEL/Crompton Greaves Ltd/KEC/ABB Ltd/Siemens/Areva (Marathon)/Bharat Bijlee Ltd, Mumbai
3.0	Country of Origin		India
4.0	Applicable Standards		
5.0	Efficiency Category (For Energy Efficient Motors Only)		IE3(Premium Efficiency) Class
6.0	Rated a) Output / Quantity b) Speed c) Frame Size	 KW / Nos. RPM	
7.0	Type of Duty (IS 325 or equivqlent)		S1 Continuous
8.0	Supply Conditions a) Allowable Variation in i) Voltage AC/DC ii) Frequency iii) Combined b) Permissible unbalance in supply voltage		 +/-10% +/-5% 10% (absolute) NA for LV Motors
9.0	Guaranteed Efficiency of Motor a) At Full Load b) At Duty Point c) At No Load		
10.0	Guaranteed Power Factor of Motor a) At Full Load b) At Duty Point c) At No Load		
11.0	Current At a) Starting b) Full Load c) Duty Point d) Full Load & 70% of rated supply voltage		 770%FLC subject to tol. As per Standards
12.0	Rated Voltage a) HT Motors b) LT Motors c) UPS Supplied d) Single Phase e) DC Motors	 Volts	 NA 415 NA NA NA
13.0	Number of Phase		3
14.0	Rated Frequency for AC Motor	Hz	50
15.0	Normal Winding Connection	Star/Delta	
16.0	Method of Starting a) AC Motors b) DC Motors		 DOL NA

17.0	Temp. rise above ambient of 50 deg. By Resistance method		
18.0	Type of Duty		S1 Duty
19.0	Duty Designation		Continuous
20.0	Synchronous Speed a) Constant Speed b) Variable Speed (For VFD)		 NA
21.0	Starting time at specified minimum starting voltage	Sec.	
22.0	Starting Torque (as % FLT)		
23.0	Pull Out Torque (as % of FLT)		
24.0	Location considered-Hazardous area division		
25.0	Atmosphere considered-Chemical/Dust/Salt Laden)		
26.0	Whether motor is suitable for VFD drive		
27.0	Details of Bearing		
28.0	VOID		NA
29.0	Whether CT for differential protection required		NA
30.0	Whether vibration detectors required		NA
31.0	Details of winding / space heaters		
32.0	Details of accessories a) Fans b) Temperature Gauge c) Bearing d) Cooling Mot e) Cooling Water Parameters f) Heaters g) Lube oil system details		 NA NA NA NA NA NA NA
33.0	Maximum size & number of cables that can be accommodated in motor terminal box		
34.0	Thermal Capability curve to be attached		
35.0	Relay co-ordination guide to be attached		NA for LV Motors
36.0	Min. voltage required under starting conditions to accelerate driven equipment to rated speed	Volts	80% Rated Voltage
37.0	Locked rotor current withstand time (safe stall time) at 110% rated voltage a) At rated temp. (hot) b) When cold	 Sec. Sec.	
38.0	Stator thermal time constant	Sec.	
39.0	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		 _

40.0	Method of Starting and maximum starting current inclusive of tolerances		
	AC HT Motors		
	a) DOL	450% above 1500KW & 600% all other	NA for LV Motors
	b) Soft Starters	200%	NA for LV Motors
	AC LT Motors		
	a) DOL	600%	770%FLC subject to tolerance
	b) Star Delta	200%	
	c) Star Delta with series resistance	200%	
	d) Star Delta with rotor resistance	200%	
	e) Soft Starters	200%	
	DC Motors		
	a) Soft Starters	200%	NA
	b) Any Other	200%	NA
41.0	Expected Bearing Life	Hours	
42.0	Dynamic & Static load	Kgs	
43.0	Maximum induced shaft Voltage	Volts	
44.0	Noise & Vibration Level		
45.0	Paint Shade		Paint shade shall be 631(Light Gray)
46.0	Moment of Inertia (GD2)	kgm2	