APPLICABLE MANDATORY SPARE LIST AND ADDITIONAL DETAILS FOR LUB OIL PURIFICATION UNIT

DRAWING NO-41810370004 REV 00

PROJECT- 3 X 250 MW BONGAIGAON TPP

WO: 10254M10805

SNO	ITEM DESC	MATERIAL CODE	QTY	UOM	Make	Model	Remarks
1	PRESSURE INDICATOR (RANGE-0-6 BAR)	W90318103176	1	NO	GIC	BSPG-V-15-S4-S-4-15NTM-(0 to 6)-A-G	
2	FLOW INDICATOR (RANGE-1000-10000 LPH)	W90318103206	1	NO	Eureka Instruments	SVF-MTS-12	
3	VACUUM INDICATOR (RANGE-(-1)-5 BAR)	W90318103354	1	NO	GIC	BSPG-V-15-S4-S-4-15NTM-(-1 to 5)-A-G	
4	TEMERATURE INDICATOR (0-120 C)	W90318103184	1	NO	GIC	MIS-R-V-15	
5	PRESSURE SWITCH (RANGE-0.4-4 BAR)	W90318103150	1	NO	SWITZER	GM203-02-A6K-WW-3	
6	LEVEL SWITCH (2 SPDT MICRO SWITCH)	W90318103192	1	NO	Pune Techtrol Pvt. Ltd.	FPS-OSO2RWW	
7	FLOW SWITCH	W90318103290	1	NO	SWITZER	HR-40-M-I-2, 50-150 LPM, 1.1/2" BSPF	
8	RTD FOR OPU	W90318103168	2	NO	GIC	RTD-HEAD-ACF-2pt100 - 6mm	

NOTE-1: THIS DOCUMENT SHOULD BE READ ALONGIWTH SPECIFCATIONS AND SPECIAL INSTRUCTIONS MENTIONED IN THE INDENT.

APPLICABLE MANDATORY SPARE LIST AND ADDITIONAL DETAILS FOR LUB OIL PURIFICATION UNIT

ADDITIONAL TECHINCAL DETAILS (Minimum):

1. **PRESSURE INDICATOR (RANGE-0-6 BAR)- Material code: W90318103176**
   - i) Type : Bourdon Tube
   - ii) Dial Size : 150mm
   - iii) Over range : 130%
   - iv) Protection : IP67
   - v) Process Connection: ½ " NPT(M)
   - vi) Range : 0-6 Kg/cm2
   - vii) Accuracy : ±1%
2. **FLOW INDICATOR (RANGE-1000-10000 LPH) - Material code: W90318103206**
   - i) Type: Variable area Metal tube Rotameter
   - ii) Accuracy : ±2% of full Scale
   - iii) Connection, Type, Size: 40 NB Flanged
   - iv) Range: upto 10000 LPH for Turbine oil (operating 7500 LPH)
3. **VACUUM INDICATOR (RANGE-(-1)-5 BAR) – Material code: W90318103354**
   - i) Type : Bourdon Tube
   - ii) Dial Size : 150mm
   - iii) Over range : 130%
   - iv) Protection : IP67
   - v) Process Connection: ½ " NPT(M)
   - vi) Range : (-1)-5 Kg/cm2
   - vii) Accuracy : ±1%
4. **TEMERATURE INDICATOR (0-120 C) – Material code: W90318103184**
   - i) Type: Mercury in steel dial thermometer Rigid stem with SS Thermowell
   - ii) Dial Size : 150mm
   - iii) Over range : 130%
   - iv) Protection : IP67
   - v) Process Connection: ½ " NPT(M)
   - vi) Range : 0-120°C
   - vii) Accuracy : ±1%
5. **PRESSURE SWITCH (RANGE-0.4-4 BAR) – Material code: W90318103150**
   - i) Sensing Element: Bellow
   - ii) Material of sensing Movement: SS316L
   - iii) End Connection: ¼ " NPT(F)
   - iv) Over Range Test : 150% of Max Design Pressure
   - v) Repeatability : ±0.5% of FSR
   - vi) No. of contacts : 2SPCO (2SPDT), Snap action Dry Contacts
   - vii) Rating of contacts : 15A at 250V AC, 6A at 24V DC

APPLICABLE MANDATORY SPARE LIST AND ADDITIONAL DETAILS FOR LUB OIL PURIFICATION UNIT

viii) Electrical connection : Plug in socket
ix) Set point / Dead Band Adjustment : Provided Over Full Range
x) Housing : Weather and Dust proof, IP66
xi) Identification : Name plate
xii) Mounting : Suitable for rack mounting / direct mounting

6. LEVEL SWITCH (2 SPDT MICRO SWITCH) – Material Code: W90318103192

i) Type: Magnetic Float Operated Pivoted
ii) Process Connection: 92mm X 92PCD
iii) Pressure Rating : 10 kg/cm2
iv) MOC: SS316
v) Differential : 15±5 mm
vi) No. of Contacts & Contact rating: 2 Nos. SPDT contacts; 5A at 250V AC, 0.2A at 24V DC
vii) Electrical Connections: Plug in Socket
viii) Degree of protection: IP66
ix) Accuracy: ±2 mm
x) Repeatability : ±1 mm

7. FLOW SWITCH – Material code: W90318103290

i) Model no. : HR-40-M-I-2
ii) Make : Switzer
iii) Range: 50-150 LPM
iv) Process connection: 1.1/2" BSPF

8. RTD FOR OPU – Material code: W90318103168

i) Type of RTD : RTD 100 OHM (as per DIN-43760/IEC-751) , 4 wire
ii) No. of Elements : Duplex
iii) Connection: ½ " NPT(M)
iv) Housing Head : IP-55 / Die cast Aluminum with Hinged Cover
v) Sheathing of RTD : Metal Sheathed, Magnesium Oxide Packed
vi) Type of Measuring Insert : spring Loaded for Positive contact with well
vii) Calibration and Accuracy : As per IEC751 – Class A
viii) External Dia of sheath : 6mm OD
ix) Insulation Resistance : Greater than 10 Mega ohm at Room Temp with 500 V DC Megger
x) Electrical connections : Plug in socket

09/10/25
(Sunil Kumar Gautam)
Dy. Manager

09/10/25
(Deepak Goyal)
Sr. Manager

09/10/25
(Suresh Chandra)
Sr. DGM

PRE-QUALIFICATION REQUIREMENTS FOR CI SPARES ITEMS FOR OPU

1. Vendor to submit experience-list[$] (manufacturing/supplying/ testing/ support after sales) for supply of any one Instruments of the enquiry for continuous operation as per details outlined below:-

   $ where experience list means fulfillment of below parameters: -

   a) Supply of at least 1 no. of any one instrument of the enquiry in last 5 (Five) years from the date of Enquiry.

   b) Further details of experience-list to be furnished in the following tabular format: -

Sl No.	Project/Customer Name & Location	Purchase Order Reference No.	Date of referred Purchase Order	Details of items supplied	Contact Details of End-Customer (Name, Full Address, Phone, Email etc.)

2. Vendor to submit unpriced copy of Purchase Orders in support of clause 1 (a) above.

3. BHEL reserve the right to verify the information submitted by bidder. In case the information found to be false /incorrect, the offer shall be rejected. Bidder to confirm.

Sunil 08/07/25
Sunil Kumar Gautam
Dy. Manager/CIE

DeepakGoyal 08/07/25
Sh. Deepak Goyal
Sr. Manager/CIE

Suresh 08/07/25
Sh. Suresh Chandra
SDGM/CIE

MANUFACTURER'S NAME AND ADDRESS		QUALITY PLAN		TO BE FILLED BY BHEL	TO BE FILLED BY BHEL
BHEL	VENDOR'S NAME	ITEM	QP NO.		
			REV		
		DRG. NO.	AS PER PO		
		SPEC.	AS PER PO		
		REV	Page 1 of 1		

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS		AGENCY			REMARKS
										M	B	N	
1	2	3	4	5	6	7	8	9	D	10			11

Note: All page of inspection documents shall be numbered in chronology with the QAP clause , dully mentioning the corresponding QAP clause nos. at the top of each page. One index page containing the documents descriptions, their page no & QAP clause shall be attached upfront the inspection documents.

		LEGEND: ! RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. M: MANUFACTURER / SUBCONTRACTOR B: BHEL / NOM. INSPECTION AGENCY N: CUSTOMER INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION	FOR CUSTOMER USE	
MANUFACTURER/SUBCONTRACTOR		ALL 'W' INDICATED IN COLUMN 'N' SHALL BE 'CHP' OF CUSTOMER		APPROVED BY

दिनांक एवं हस्ताक्षर SIGN & DATE	भी एच ई एल BHEL	उत्पाद क्रय विनिर्देश (हीप : हरिद्वार) **PRODUCT PURCHASE SPECIFICATION** **(HEEP: HARIDWAR)**	ST39013 पृष्ठ 40 का 1 Page | 1 of 40

सामग्री सूची संख्या को अधिक्रमित करता है SUPERSEDES INVENTORY NO: BASED ON ST22002

दिनांक एवं हस्ताक्षर SIGN & DATE: 2/4/16

Bid Specification
For
Turbine Oil Purification System

(Centrifuge type)

				नाम NAME	दिनांक एवं हस्ताक्षर SIGNATURE & DATE
CIE	B. S. Rana		अनुवादक TRANSLATED BY	-------	
QAX	S. K. Chauhan		निर्माणकर्ता WORKED BY	Anil Kumar	Anil Kumar 18.03.16
TSX	DEEPAK	Deepak 23/3/16	जाचकर्ता CHECKED BY	A. S. Rajput	18.03.16
सहमत विभाग AGREED DEPTT.	नाम NAME	दिनांक एवं हस्ताक्षर DATE & SIGNATURE	पर्यवेक्षणकर्ता SUPERVISED BY	R. Panja	18-03-16
Worked By	Anil Kumar	Anil Kumar 17/3/2022	स्वीकृति APPROVED : S. K. Baveja	DBavej 18.3.16	Gr. NO. 8.20
Checked By	S.K.Sankar	Sankar 17/03/2022			
REV.NO.	08		निर्माण PREPARED : PED	जारी ISSUED : TSX	दिनांक DATE : 25.8.84
Dt.	29.03.16				
CHANGE ADVICE NO.	STC-22-18	Reaffirmed Year 2022			

सामग्री सूची संख्या INVENTORY NO: P-55308

LIST OF CONTENTS:

1 INTENT OF SPECIFICATION

This specification is intended to cover design, manufacturing, testing, delivery supervision of system & commissioning of turbine oil purification system and putting the system into satisfactory operation.

RESPONSIBILITY OF BIDDER: The bidder shall be responsible for providing all material, equipment and services, specified or otherwise which are required to complete the project and fulfill the intent of ensuring operability, maintainability and the reliability of the complete work covered under this specification. It is not the intent to specify completely here in, all aspects of design and construction of equipment. Nevertheless, the equipment shall conform in all respects to high standards of engineering, design & workmanship & shall be capable of performing in continuous commercial operation, in a manner acceptable to Purchaser/Owner. Bidder is requested to carefully examine and understand the specification & seek clarification, if required, to ensure that they have understood the specifications prior to submit the bid.

2 SCOPE OF SUPPLY

2.1 One oil purification system (OPS) shall comprise of:

a. One centrifuge along with its drive & accessories.

b. Indirect type oil heater and accessories

c. One dirty oil feed pump complete with its drive & accessories.

d. One clean oil discharge pump complete with its drive & accessories (if applicable).

e. Polishing filter with suitable bypass arrangement.

f. Adequately sized booster pump (if required).

g. One overflow sight fitting (loose supply).

h. The OPS shall be such that it can be used both as purifier as well as clarifier.

i. An arrangement to detect and raise alarm in case of liquid seal breakage.

j. All relevant valves, Y-type strainer, fittings and inter-connecting piping.

k. All flanged end valves and flanged terminal points of piping along with counter flanges, nuts, bolts and gaskets.

l. All relevant controls, interlocks and instrumentation.

m. Foundation plates, anchor bolts, sleeves, inserts etc. required for installation of the complete system on foundation.

n. Necessary lugs and eye bolts of all equipments for lifting the complete system during erection and maintenance.

o. A set of required special tools and tackles for erection & commissioning and operation & maintenance of the system.

2.2 **Spare Parts: -** Spares for satisfactory commissioning of the OPS are to be supplied (apart from mandatory spares). Also, a list of recommended spare parts with price break-up for 3 year satisfactory operation of the system shall also be supplied by vendor. Purchase order on the same shall be placed later by BHEL as per customer's requirement. Validity shall be kept suitable to meet our customer's requirement.

3 GENERAL TECHNICAL REQUIREMENTS

3.1 The OPS shall operate on a bypass system and the capacity of the unit shall as per the Table-A of this specification. The oil in system conforms to Servoprime-46 / ISO VG 46 / Turbinol-47 / BHEL standard practice (refer Annexure -I). The system will be located inside the turbine hall in oil room near oil tank.

3.2 The OPS should be as compact as possible so that it may be installed in the minimum required space and easy to handle.

3.3 The OPS should be suitably designed to operate in tropical climatic conditions. Equipment shall be designed for ambient temperature of 55°C and relative humidity of 95%.

3.4 Base area/ foundation of purifier shall be designed to be as compact as possible without any vibration problem as per IS: 10816-2.Norms as per approved datasheet.

3.5 All valves and instruments should be readily accessible to facilitate maintenance and operation.

3.6 The OPS should be completely vapour tight to prevent fumes and vapours from entering.

3.7 The equipment shall be suitable for continuous operation round the clock.

3.8 On load automatic cleaning of bowl assembly is preferable.

3.9 The OPS shall be equipped with sight glasses both for the purified oil and the separated water from the collecting pan.

3.10 Each purifier system shall be furnished with a positive displacement feed pump & a similar type discharge pump, if needed. Each pump shall be of the helical, herringbone, Spur gear or screw type with a normal capacity of at least 10% greater than that of the purifier system when operating under the maximum suction lift against the pressure required to feed the centrifuge. Each pump shall be fitted with adequate relief bypass valve to prevent damage from excess pressure.

3.11 Although oil temperature at the inlet to heater during normal operation of Turbine Generator set shall be 65°C but system should be designed to operate with oil at 20°C during cold starting of TG-set. During such operation, even if guaranteed purification cannot be achieved, the system shall be accepted.

3.12 Arrangement of oil recirculation piping/piping connection should be provided with recirculation line connecting to clean oil line at oil purifier outlet (with applicable NRVs) such that there are only two interfaces of oil inlet & outlet connection to oil purifier.

3.13 For two or more centrifuges running in parallel, a common skid housing for both or multiple centrifuges shall be supplied with inlet & outlet manifold. Connection interface with BHEL shall be inlet & outlet only, not multiple connections.

3.14 Pressure at the outlet of oil purification system shall be 1.5 to 2.0 bar (gauge).

3.15 The inlet, outlet & overflow connections to overflow sight fitting shall be NB80 (ø88.9X3.96)/NB40 (ø48.3X3.96)/NB15 (ø21.3X2.6) respectively. Also, it is to be noted that overflow sight fitting is to be supplied loose and the same shall be fitted in BHEL's Main Oil Tank at site.

3.16 A common drive system for separator, dirty oil feed pump and clean oil discharge pump (if required) shall also be considered. Details of such drive should be clearly submitted by the vendor in his offer.

3.17 Different variants for combination of Flow capacity of Oil Purification System, Control Panel Type and Heater Rating are given below in **Table- A.**

TABLE- A

Var. No.	Flow capacity of purification system (Litre Per Hour)	Control Panel Type	Heater Rating (kW)
1.	7500	DCS	90 kW
2.	6000	DCS	72 kW
3.	2 x 4500	DCS	120 kW
4.	7500	Relay	90 kW
5.	6000	Relay	72 kW
6.	2 x 4500	Relay	120 kW
7.	7500	DCS	55 kW
8.	6000	DCS	45 kW
9.	2 x 4500	DCS	80 kW
10.	7500	Relay	55 kW
11.	6000	Relay	45 kW
12.	2 x 4500	Relay	80 kW

4 CONTROL AND INSTRUMENTATION

4.1 Offer should include all necessary interlocks & instruments along with remote indication facility in the control panel (protection type). Purchaser will review same & necessary addition / subtraction in interlocks & instruments, considered essential for smooth operation of the unit, will be asked to include. Some of the important interlocks/controls, required, are given below.

(a) Separator shall be provided with interlocks to prevent the operation of the unit unless the feed pump & the discharge pump are operating.

(b) A system of annunciating the flooding of the separator due to loss of water seal shall be provided.

(c) All instruments i.e. pressure gauges, RTDs etc. should be reliable & of proven design. Purchaser has full right to ask them changed from one supply source to another according to operational experience. All instruments should be calibrated at minimum 5 points throughout the range and accuracy, hysteresis, repeatability etc. shall be within the specified limits i.e. ± 1%.

(d) Auxiliary electric supply available at site comprises of 415V, 3ø, 3 wires, 50 Hz (± 10% V,± 5% frequency,± 10% combined). If supplier requires any other supply for his devices, instruments and drives etc. he shall arrange \ to convert 415V, 3ø supply to the required value for further distribution. Isolating switches, over current protection, fuses, junction boxes with terminal strips etc. as required for sub-distribution shall be deemed to be in bidder's scope.

(e) Motor shall be flame proof as per IS: 2148 and make shall be of BHEL approved vendor make. Motor shall be preferably of class 2 or better in efficiency rating. If motor of any other efficiency is required, the same will be intimated to vendor during enquiry. Technical requirement for motor is given in Annexure-III.

(f) The temperature of the oil leaving the heater shall be automatically controlled by RTD in not less than 3 steps. RTD shall function to open the heater circuits when the desired temperature is exceeded & to close the heater circuits before the temperature drops below that necessary for proper purification of the oil. The heater circuits shall be interlocked with the pump motor circuits to shut off the heaters when the pumps are not being operated. Heater rating should be as given in Table-A. Heaters shall be designed to operate in minimum of three steps & shall be of indirect type.

(g) In case of polishing filter, it shall be equipped with a differential pressure switch with adjustable contracts to indicate high pressure drop across the filter along with alarm & annunciation system.

(h) Local instruments for pressure temp. & flow indication shall be provided in accordance with clause 8.0 of Annexure-I.

(i) The unit should be provided with suitable alarm & annunciation system for easy operation & identification of fault conditions. It should have spare outputs in the form of potential free contact to be hooked-up with central annunciation system in the room.

(j) All control switches, indicating lamps & sound alarm devices shall be mounted on the front face plate of a cubicle (panel) to be supplied with purification unit.

(k) Remote operating facility for all electrically operated components should be provided on control panel.

(l) All motors, heaters included in the offer, should be supplied along with its starter which will be mounted in the same panel.

(m) An arrangement to detect and raise alarm in case of liquid seal breakage shall be provided. It may be adequately sized anti-flood tank with necessary drain valves along with level gauge or any other equivalent arrangement as per standard practice of the vendor. Drain and vent connections for level switch specified in Annexure-III to ST39013 shall be NB15 (ø21.3X2.6).

(n) Control switches & Indicating lamps shall be as per vendor's standard practice or owner approved vendor/ make (project dependent).

(o) If a common control panel is provided by vendor for two or more oil purifiers running in parallel, then control panel should be designed in such a way that it allows control of both the separators on the same panel. Control panel & controls shall also be able to work a purifier satisfactorily while one purifier is in shutdown/ breakdown.

(p) Local Panel (LCP)construction:
Type: Fabricated from cold rolled sheet steel
Frame thickness: 2.0 mm
Enclosure thickness: 1.6 mm
Gland plate thickness: 3.0 mm

(q) ON/OFF control, indication, and alarm functions shall be provided on the LCP as well as on HMI system (DCS).

(r) Adequately sized copper ground bus shall be provided for each panel.

(s) Control voltage shall be 110 V AC/220 VAC.This will be informed at the time of detail Engineering.

(t) Cables for Motors and heaters shall be adequately sized keeping sufficient margin. Sizes shall be subject to BHEL/Customer approval.

(u) Cable glands suitable for incoming 415 V feeder cables shall be provided. Cable Sizes will be intimated later.

(v) LCP shall have 20% spare terminals.

(w) Polishing filter (if applicable), chock alarm shall be provided through DPS.

(x) All instruments/ Devices shall have IP55 degree of protection.

(y) For level switches and other instruments, plug and socket type connectors shall be provided. For level switch over range proof pressure shall be 150% of max design pressure.

(z) For Pressure gauge, Temperature gauge and level gauge over range test pressure shall be 1.5 times the maximum design pressure at 38 C. Range selection should cover 125% of max of scale. For Rotameter, the housing shall be IP55 protection class.

(aa) Reports of type tests shall be those conducted within last five years.

(bb) The local control panel shall have main switch fuse unit, power contactors, control transformer, space heater, alarm lamps, terminals, switchgear, OLR for separator motors and heaters and other contactors.

(cc) Interconnection diagram shall be provided along with offer.

(dd) Anti vibration pads shall be provided. Control panel should also be designed in such a way that it is able to withstand the site vibtations.

(ee) Instruments/ equipments used in parallel system of 2x4500LPH system shall be of same make & type for both the purifiers in a single project.

4.2 For DCS control panel, additional requirements

The purification system shall be operated from control room as well as local panel having the logic built in BHEL control system instead of relay based control system.

It shall also have Local/remote switch, separator start/stop selector Switch, heater on/off sel. Switch Test/Accept/Reset push buttons and 24 V DC interfacing relays with DCS.

Control Philosophy

(a) The purification system shall be operated from control room, as well as local control panel "DCS/Local" selector switch shall be provided on the LCP.

(b) All field instruments shall be wired to a JB, which shall be in vendor scope. From JB these shall be wired to DCS by BHEL.

(c) Operating sequence and interlocks for various drives shall be programmed in BHEL's DCS. Vendor shall furnish Logic diagram and write-up for operation of the system. All interlocks shall be clearly brought out in the logic diagram and write-up.

(d) 24V Interfacing relay are to be supplied by vendor mounted in the LCP for operation of drives. 24V commands shall be given from DCS to these relays for operation of various drives.

(e) Alarms shall be generated in DCS and output shall be given for driving the alarm windows in LCP.

(f) Control of individual heaters stages shall be from DCS for maintaining required oil temp using 2 nos. duplex RTDs.

(g) Limit switch or any other alternate arrangement with BHEL approval shall be provided for separator cover for remote monitoring when operating in DCS.

(h) Flow switch shall be provided at centrifuge inlet.

(i) List of drives to be operated from DCS, list of instruments and list of alarms shall be furnished along with the offer.

(j) Air requirement for 3-way valve shall be furnished with the offer.

(k) Functional testing of system shall be done with local control panel and by simulating DCS outputs.

5 PERFORMANCE REQUIREMENTS

a. The quality of purified oil at outlet of OPS at 65°C shall be as follows.

(i) Particle size of impurities at the outlet of OPS shall be equal to or better than class 15/12 as per ISO 4406 from class 21/18 at the inlet of the oil purification system in single pass without removing any additives/ inhibitors present in the oil and maintaining the lubricating value of the oil.

(ii) Moisture contents at the outlet of OPS shall be maximum 300 to 500 ppm from inlet of maximum 15000 ppm.

b. Polishing filter shall be capable of handling the quantity of clean oil, coming out of the centrifuge & filtering it down to β3=1000 or better including colloidal carbon but shall not remove any rust inhibitor or oxidation inhibitor.

c. Noise level shall not exceed 85 decibel measured at a distance of 1 meter from the equipment and at height of 1.5 meter from the ground level.

d. Facility of indirect heater for heating oil from 50°C to the temperature which is required to make separation of water and oil most effective shall be provided. But to take care of situation while temperature is much below than 50°C, an arrangement of utilizing the heater to elevate the temperature of oil in the main oil tank to 50°C shall be provided. Heater shall be provided with suitable bypass arrangement.

6 GUARANTEES

6.1 The unit should be guaranteed for trouble free operation for a minimum period of 18 months after commissioning or 36 months after dispatch whichever is earlier.

6.2 The purification level as indicated in clause 5.2 shall be guaranteed by the supplier.

6.3 The supplier shall guarantee the power consumption of the motor at normal duty point.

6.4 If during erection, commissioning and operation at site any deficiency in a part is detected with in guarantee period, BHEL site representative shall prepare the assessment report and a copy of the same shall be forwarded to the supplier. The supplier shall replace/ rectify the concerned items free of charge. The supplier if, he so desires may depute his representative at site at his own cost, otherwise the finding of BHEL/ Owner representative shall be final and binding on the supplier.

6.5 Care should be taken during packing of electrical/electronic items to insure that there is no damage to these items during handling/transportation.

7 QUALITY ASSURANCE, INSPECTION AND TESTING

7.1 The manufacture shall conduct all tests required to ensure all the component parts of the oil purification unit offered conform to the requirements of the specification & in compliance with requirements of applicable codes & standards.

7.2 The bidder shall submit along with his offer quality plan in the prescribed BHEL's format as per Annexure-VI.

7.3 The particulars of the proposed shop tests & procedures for the tests shall be submitted to the BHEL / owner for approval along with quality plan.

7.4 The equipments shall be dispatched only after inspection & clearance of material by BHEL/ Owner & approval of tests certificates by BHEL /Owner.

7.5 The minimum tests / checks to be carried out on the unit as envisaged by purchaser are given below. This is however , not intended to form a comprehensive testing programme as it is supplier's responsibility to prepare the detailed quality plan, which should also include tests checks carried out by supplier as a part of their normal practice. This quality plan is subjected to the approval of BHEL & owner. BHEL/ Owner reserves the right to ask any more checks at the time of quality plan finalization.

(1) TESTING OF MATERIALS: The material of each component that is bowl, bowl cover, disc, heater tubes, pump casing Shafts, gear/screw, valve body etc. shall be tested as per relevant specification for its composition & mechanical properties, viz. YS, UTS, impact strength, % elongation, % RA etc. suitable NDT on the above components to ensure freedom from surface & subsurface defects shall be carried out.

(2) Following tests shall be carried out during various stages of manufacture at manufacture's works.

(a) Check for dimensions of all the component parts including surface finish, radial run out of shaft

(b) NDT:- Bowls shall be subjected to DP after final machining to ensure freedom from surface defects. Shaft shall be subjected to UT & DP to ensure freedom from internal & surface defects. All butt welds on oil piping shall be subjected to 10% RT & fillet welds to 100% MP/DP. Norms for acceptance to be informed in the offer for BHEL approval.

(c) Static & dynamic balancing test on all rotating elements of the centrifuge. Acceptance Norms for vibration is 5.6 mm/s.

(d) Hydraulic testing of all pressure parts including polishing filter if offered and vessel body etc. for 1.5 times of working pressure for 30 minutes & seat leakage test of valves at 1.0 times of working pressure for 30 minutes. No leakage to be ensured.

(e) Performance test on feed & discharge oil pump, purifier motor, heaters, control system & other accessories. Reference & Acceptance norms for vibration to be informed in the offer for BHEL approval.

(f) Type-test reports detailing the results for motors of similar ratings shall be furnished as called annexure III.

(g) Routine test reports of motors to be furnished as per annexure III.

(h) Control panel RTD, level switch & solenoid valve shall be subjected to the following final testing as applicable as routine test (unless otherwise stated) in addition to the stage inspection carried out by the vendor.

(i) Dimensional checks as per approved drawing including proper cut outs, mounting of all instruments/ accessories etc. as per approved general arrangement drawing.

(j) Functional/ operational checks of all wiring schematics, operational/ sequential interlocks etc. are applicable as per approved drawing.
i) Degree of protection test as per IS: 2147 (Type test) at 2.0 KV.

(k) High voltage test & IR measurement not less than 30 mega ohm (MΩ) before and after test.
ii) Pick up and drop down test & performance with ±10% voltage variation.

(l) Capacity test of complete oil purification system. During capacity test, the complete purifier shall be tested at manufacture's works for mechanical running, vibration & noise level, sequential operation & interlocks, test for vapour tightness (if applicable), maximum particle size & moisture

content at the outlet of oil purification system. Acceptance norms for vibration to be informed in the offer for BHEL approval

(m) Verification/ BHEL approved type-test report for max. particle size & moisture content.

7.6 Party to furnish certificate of compliance for the instruments which are being installed in the system after P.O. placement.

7.7 STORAGE:- Bidder shall inform to purchaser along with the offer regarding storage facility which they require at the site for their equipment if the unit is to be stored at site for their equipment. If the unit is to be stored at site for next 12 to 18 months after dispatch from manufacturer's works.

8 DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY SUPPLIER

8.1 DRAWINGS/ DOCUMENTS REQUIRED WITH THE OFFER

a. GA drawing of the equipment offered, arrangement and layout drawing showing various equipments with all fittings, accessories and connection as well as clearance necessary for other equipment or structural members for operation and maintenance, loading data and foundation details of oil purification system.

b. Data sheets of all instruments including RTDs, motor, solenoid valves, instruments and 3-way pneumatic/solenoid valve for oil purification system shall be furnished as per Annexure-II of this specification for BHEL's review.

c. P&ID including bill of material indicating piping, valves, all instruments and devices of the system as per BHEL format annexure-VII.

d. Drawings / Documents of all equipments such as heater, y-strainer, dirty & clean oil pump etc. shall also be included in the offer.

e. Detailed technical literature on various equipments/ instruments and GA drawing of control panel.

f. Characteristic curves of all pumps.

g. Manufacturer's descriptive and illustrative literature showing details of equipments and method of operation of the complete system.

h. Electrical single line diagram, control wiring diagram, interlocks schematic, protection scheme, details of motor and starter etc.

i. Cross-sectional drawings of all equipments including horizontal and vertical section of separator indicating the recommended and mandatory spare parts. Also, list of recommended and mandatory spares with their part no. / model no. and quantity required.

j. Details of standards /codes used for designing of the various equipments and selecting the material of various components.

k. Name of the manufacturer and illustrative literature all components which have been out-sourced for purchaser's review.

l. All other relevant data and drawings which supplier considers necessary for better understanding of the system.

m. Type test Reports for capacity, moisture content, particle size of impurities and motor efficiency conducted within last 5 years.

n. Interconnecting diagram of DCS control panel (if required).

o. Acceptance norms for (i) in process NDT of bowl, shaft, butt welds of piping. (ii) Static & dynamic balancing of shaft. (iii) Performance test on pumps & motors. (iv)Vibration norms for pumps, motor and unit.

p. Also, Bidder to shall furnish the filled up check list of BHEL format as per annexure –VII.

8.2 **DRAWINGS / DOCUMENTS REQUIRED WITHIN 30 DAYS AFTER PLACEMENT OF ORDER**

a. Five sets (paper based) of each of GA drawing, P&ID, filled in data sheet, control panel schematic & write-up etc. shall be furnished for review/ approval by BHEL/CUSTOMER after placement of order.

b. Motor datasheet, curves/ graphs, type- test reports, efficiency rating etc. for review/ approval by BHEL/CUSTOMER after placement of order.

c. O & M manual (soft/ paper based) shall be furnished for BHEL review/ approval.

8.3 **DRAWINGS/ DOCUMENTS REQUIRED ALONGWITH SUPPLY**

a. All relevant test certificates & full details of the tests carried out as per the requirement of this specification before dispatch.

b. Twenty sets (paper based) and 2 set (in CDROM) of O&M manual shall be furnished containing all drawings and datasheets, catalogues of all instruments and instructions for storage, erection &

commissioning, operation and maintenance after approval. Vendor shall keep 2 copies of O&M manual in the dispatch box & shall also mention the same in its shipping list.

c. Before bidder finalises these manuals, the same will be reviewed by purchaser. After getting approval of purchaser, final manual in required quality shall be dispatched. Manual shall clearly indicate all inspections & tests to be carried out at site and if any check list/ log sheets etc. are required to carry-out specified inspection & test that shall be made part of manual.

d. Data sheets of all instruments, thermostats and motor .The same shall be included in O&M manual of oil purification system along with the catalogues of all instruments.

9 MATERIALS OF CONSTRUCTION

9.1 The material of all rotating parts / components i.e. "bowl, bowl cover, disc, Shaft/spindle, gear/screw shall be of high grade stainless steel (e.g. austenitic) considering the purpose and the extent of contact with oil. Other parts coming in direct contact with water shall be of stainless steel or other corrosion resistant material conforming to applicable standard (IS / BS) or equivalent standard. All those parts that are coming in contact with oil & are not of Stainless steel / other corrosion resistant shall be mentioned in their offer. This should be submitted as a separate document indicating material/ make of all parts.

9.2 All piping, fittings & valves should be suitably selected as per applicable IS, BS or equivalent standard.

9.3 Strainers, wherever provided, should be designed to enable them to be cleaned during operation.

9.4 All other parts/ components shall be of compatible material to suit the applications.

10 CODES AND STANDARDS

In addition to the codes and standards specifically mentioned in the relevant technical specification for the equipment/ plant/ system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes (National/International).

11 CLEANING, PROTECTION AND PAINTING

Painting scheme shall be according to BHEL approved/ previously approved scheme. Painting scheme for oil purification system shall be as below.

Paint (Coat)	Paint Type	No. of coat	DFT*
Primer Paint:	Epoxy base Zinc rich primer paint	2	70
Intermediate Paint:	Epoxy TiO2 Pigmented Polyamide Cured Paint	1	70
Finish (Final) Paint:	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	2	60

Total Minimum DFT= 180
*DFT– Dry Film Thickness (Final) in micron.

Paint Shade shall be as below:-

- For Oil purifier- Light Blue (RAL 5012)
- For Control Panel generally it is - External-Light Grey (shade 631 of IS-5), Internal- Brilliant White or paint shade will be informed during later stage of engineering.

11.1 All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coating and prepared in the shops. The protective coating should be such as to prevent the deterioration of coating itself by him for internal and external surface protection which shall be checked and approved by BHEL / Owner. All surfaces which will not be easily accessible after the shop assembly, shall before hand be treated and protected for life of the equipment.

11.2 The pre-treatment/ painting of the control panel shall be done by 7 tank process/ shot blasting/ sand blasting, by 2 coats of primer and 2 coats of paint of shade no. 692 as per IS: 6005. The total thickness of paint shall be a minimum of 180 micron and maximum of 250 micron.

11.3 After testing of unit, its internals shall be thoroughly cleaned, dried and conserved before packing. Conservation shall be suitable for storing in saline atmosphere & for a period of 2 years before use. Unit shall be suitably packed for transportation. Supplier shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

11.4 Painting treatment for LCP shall be as per IS: 6005. Two coats of lead oxide primer followed by powder painting. External shade for front and Rear shall be RAL9002 and for panel sides shall be RAL5012. Internal color shall be same as external color indicated above.

12 DESIGN CO-ORDINATION MEETING

Supplier shall attend the meeting on his own cost, whenever felt necessary, called by purchaser / owner to clarify the subject matter to them during engineering, erection, commissioning, and any stage prior to handing over.

13 LIST OF CROSS-REFERRED STANDARDS

13.1 IS: 10816-2
13.2 IS: 325,
13.3 IS: 4029,
13.4 IS: 2147,
13.5 IS: 2148,
13.6 IS: 6005,

13.7 IS: 5,
13.8 IS: 4722,
13.9 IS: 2253,
13.10 IS: 2254,
13.11 IS: 3202,
13.12 IS: 4722-1992,
13.13 ISO: 4406,
13.14 IS: 12075,
13.15 IS: 12615:2011,
13.16 IS: 10816-2.

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(HEEP: HARIDWAR)

14 ANNEXURE-I (PROPERTIES OF TURBINE OIL)

S. No.	Properties	Value	Test Method
1. a.	Kinematic viscosity at 37.8°C	47.5 c.s. to 49.5 c.s.	IS : 1448-P25
b.	Kinematic viscosity at 50.0°C	28 c.s.	IS : 1448-P25
2.	Viscosity index	Min 97	IS : 1448-P56
3. a.	Inorganic acidity	Nil	IS : 1448-P2
b.	Organic acidity	Max. 0.14 mg of KOH	IS : 1448-P2
c.	Neutralisation No.	Max. 0.2 mg of KOH per gm of oil	IS : 1012
4.	Colour	Max. 2	IS : 1448-P12
5.	Specific gravity at 50 °C	0.852	IS : 1448-P32
6.	Flash point Cleveland Open cup	Min. 200°C	
7.	Copper strip corrosion test At 100°C for 3 hours	Not worse than No.1	IS : 1448-P15
8.	Pour point	-6 °C max.	IS : 1448-P10
9.	Rust preventing characteristics	negative test passed	ASTM : D665
10.	Emulsion characteristics	40-40-0(20 minutes)	ASTMD : 1401-67
11	Total acidity after 1000 hrs. oxidation	Max. 2.0 mg of KOH per gm of the oil.	ASTMD : 943-54/ IP 157/64
12.	Foaming characteristics Max.		
	(a) At 24ºC	Nil	Volume in ml of foam after 10 minutes.
	(b) At 93.5ºC	Nil	

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S. No.	Properties	Value	Test Method
	(c) At 24ºC after testing at 93.5ºC	Nil	
13.	De-aeration capacity at 50ºC	6 Minute Max.	DIN 51381
14.	Ash (by weight)	Max. 0.01	IS : 1448- P4
15.	Water content by weight	% gm below the limit of quantitative detectability.	DIN 51592
16.	Mechanical solid impurities.	Below the limit of quantitative detectability.	DIN 51592
17.	Water separation capacity After steam treatment.	Max. 300 seconds	DIN 51589

15 ANNEXURE-II (DATA SHEET OF TURBINE OIL PURIFICATION SYSTEM)

1.0 NUMBER OF UNITS OFFERED:

2.0 SCOPE OF SUPPLY:

2.1	Centrifuge	Yes/No
2.2	Centrifuge feed pump	Yes/No
2.3	Centrifuge discharge pump	Yes/No
2.4	Speed indicator	Yes/No
2.5	Thermostatically controlled electric heater with control and trip thermostat (indirect)	Yes/No
2.6	Flow meter	Yes/No
2.7	Pressure gauges	Yes/No
2.8	Temp. indicators	Yes/No
2.9	Anti-flood device	Yes/No
2.10	Y-Strainer at suction of feed pump	Yes/No
2.11	Electric control panel	Yes/No
2.12	Common base plate for complete equipment	Yes/No
2.13	Necessary spares for three (3) years of normal operation & maintenance.	Yes/No
2.14	Special tools	Yes/No
2.15	Heater (With Valves) connections	
2.15.1	Oil inlet	Yes/No
2.15.2	Oil outlet	Yes/No
2.15.3	Oil drain	Yes/No
2.15.4	Water drain	Yes/No
2.15.5	Make-up water	Yes/No
2.15.6	Open vent connection from drum	Yes/No
2.15.7	Globe valve by pass connection to heater (Oil side)	Yes/No
2.16	Centrifuge feed pump relief valve	Yes/No
2.17	Centrifuge discharge pump relief valve	Yes/No
2.18	Isolating & bypass valves for flow meter.	Yes/No

3.0 DESIGN FEATURES OF CENTRIFUGE

3.1	**Location**	Indoor
3.2	Type of operation	
3.3	Max. hydraulic capacity with turbine oil (110% of design capacity)	Lit/Hr.
3.4	Recommended through put for best performance (for turbine oil)	Lit/Hr.

3.5	Speed	RPM
3.6	Particle size distribution of impurities in purified oil at outlet of centrifuge in single pass as per ISO 4406	
3.7	Particle size distribution of impurities in purified oil at outlet of oil purification system (i.e. polishing filter) in single pass as per ISO 4406	
3.8	Moisture/Water content in purified oil at outlet of oil purification system / polishing filter	ppm
3.9	OIL TEMPERATURES	
3.9.1	Inlet to electric heater	^{0}C (Max), ^{0}C (Min)
3.9.2	Outlet from electric heater	^{0}C (Not to exceed 90^{0}C)
3.10	Water temperature in the heater tank	
3.11	Bearings :	
3.11.1	Nos.	
3.11.2	Type	
3.11.3	Manufacturer	
3.12	Dirt holding capacity of the bowl	

4.0 CONSTRUCTION FEATURES OF CENTRIFUGE

4.1	Automatic tripping of all electric motors on actuation of anti-flood device	Not provided /provided
4.2	Cleaning of centrifuge bowl	Self-cleaning/manual
4.3	Type of centrifuge drive	Worm & Gear /Belt
4.4	If centrifuge is belt driven automatic tripping of all electric motors on belt failure.	Not Provided/Provided
4.5	Hand brake	Not Provided/Provided

5.0 MATERIALS OF CONSTRUCTION OF CENTRIFUGE (INDICATE STANDARDS)

5.1	Bowl body	
5.2	bowl cover	
5.3	Separating discs	
5.4	Drive shaft	
5.5	Bowl nut	
5.6	Worm & Gear /Belt	

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5.7	Oil injection nozzle	
5.8	Other inlet and outlet parts	
5.9	Other wetted bowl parts	
5.10	Valve Body	

6.0 DESIGN/CONSTRUCTION FEATURES OF ELECTRIC HEATER

6.1	**Heater details**	
6.1.1	Quantity	Nos.
6.1.2	Kilowatts	kW
6.1.3	Rating of steps (kW)	
6.1.4	Voltage	Volts (AC)
6.1.5	Frequency	C/s
6.1.6	Phase	
6.1.7	Number of thermostat	3 (2Nos. for oil temp. and one for water temp.)
6.1.8	Range	
6.1.9	Model	
6.1.10	Manufacturer	
6.2	**Heater control thermostat setting**	Cut in at ^{0}C/ Cut out at ^{0}C
6.2.1	Rating of thermostat contacts	5 amps 240V A. C 0.25 amps 240V D.C
6.2.2	No. of contacts	2 No + 2 N C
6.3	**Heater tubes**	
6.3.1	Material	
6.3.2	Number	
6.3.3	Length	mm
6.3.4	Outside diameter	mm
6.3.5	Tube wall thickness	mm
6.3.6	Surface area of heater tubes.	mm^2
6.4	**Tube Sheets**	
6.4.1	Material	
6.4.2	Number	
6.4.3	Thickness	mm
6.5	Tube bundle type	Removable/non-removable
6.6	Capacity of heater tank	M3

7.0 CENTRIFUGE FEED PUMP & DISCHARGE PUMP

	FEED PUMP	DISCHARGE PUMP

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7.1	Quantity	Nos.		
7.2	Type	Positive displacement (Rotary i.e. Helical, Herring bone , spur gear or screw type)		
7.3	Capacity	Lit/hr.		
7.4	Speed	RPM		
7.5	Discharge pressure	Kg/cm2 (g)		
7.6	Relief valve setting	Kg/cm2 (g)		
7.7	Max. allowable pump working pressure	Kg/cm2 (g)		
7.8	Connections			
7.8.1	Inlet	mm		
7.8.2	outlet	mm		
7.9	Material			
7.9.1	Casing			
7.9.2	Shaft			
7.9.3	Shaft sleeves			
7.9.4	Gear/screw			
7.10	Drive (AC Motor)	As per enclosed annexure-3.		
7.11	Motor rating	KW		
7.12	Bearings :			
7.12.1	Nos.			
7.12.2	Type			
7.12.3	Manufacturer			
7.13	BHP at rated capacity			

8.0 Y-STRAINER

8.1	Make & Model	
8.2	Number	
8.3	Location	
8.4	Connection sizes	
8.5	Mesh size	
8.6	Material of element	

9.0 POLISHING FILTER

9.1	Capacity	
9.2	Make & Model	
9.3	Type	
9.4	Number	
9.5	Location	
9.6	Material of filter element	
9.7	Connection sizes	
9.8	Design Pressure (body)	Kg/cm^2
9.9	Pressure differential at choking	Kg/cm^2

10.0 INTERCONNECTING PIPINGS OF THE SYSTEM

10.1	Sizes of pipes	
10.2	Material of piping	

11.0 ANTI-FLOOD TANK

11.1	Capacity	
11.2	Number	
11.3	Location	
11.4	Connection sizes	

12.0 PNEUMATIC/SOLENOID OPERATED THREE-WAY VALVE

12.1	Make & Model	
12.2	Type	
12.3	Number	
12.4	Location	
12.5	Connection sizes	

13.0 INSTRUMENTS

13.1	**PRESSURE GAUGES: (For detailed specification refer Annexure-IV)**	
13.1.1	Type	
13.1.2	Number	
13.1.3	Location	1) Inlet to pump (Compound gauge) 2) Outlet from feed pump 3) Water temperature of indirect heater Outlet from discharge Pump.(In case

		polishing Filter, outlet from polishing Filter)
13.1.4	Range	Kg/cm^2
13.1.5	Accuracy	± 1% or better
13.1.6	Manufacturer	
13.2	**TEMPERATURE INDICATORS: (For detailed specification refer Annexure-IV)**	
13.2.1	Type	
13.2.2	Number	
13.2.3	Location	1) Inlet to electric heater 2) Outlet from electric heater 3) Inlet to centrifuge 4) Oil temperature at outlet of purifier
13.2.4	Range	^{0}C
13.2.5	Accuracy	± 1% of span
13.2.6	Manufacturer	
13.3	**FLOW METER**	
13.3.1	Type	
13.3.2	Number	
13.3.3	Location	Downstream of centrifuge feed pump.
13.3.4	Range	
13.3.5	Accuracy	
13.3.6	Connections, type & size.	
13.3.7	Model No.	
13.3.8	Manufacturer	
13.4	**PRESSURE SWITCH**	
13.4.1	Type	
13.4.2	Number	
13.4.3	location	Outlet of centrifuge
13.4.4	Range	
13.4.5	Accuracy	
13.4.6	Model No.	
13.4.7	No. of contacts & contact rating	
13.4.8	Manufacturer	
13.4.9	End connection	½'' NPT(F)
13.4.10	Electrical connection	Plug in socket
13.4.11	Repeatability	
13.5	**RESISTANT TEMPERATURE DETECTOR (RTD)**	
13.5.1	Type of RTD	
13.5.2	No. of element	Duplex
13.5.3	Housing/ Head	IP-55/Die cast Al. plug-in connectors are

		to be provided for external cable connection
13.5.4	Sheeting of RTD	Metal sheathed, ceramic packed
13.5.5	Calibration & accuracy	
13.5.6	Thermo well	
13.5.7	Model no.	
13.5.8	Manufacturer	
13.6	**LEVEL SWITCH (For detail specification, refer annexure-IV)**	
13.6.1	Number	
13.6.2	Type	
13.6.3	Location	Indirect oil heater Anti-flood device
13.6.4	Range	
13.6.5	Manufacturer	
13.6.6	Model no.	
13.6.7	No. of contacts & contact rating	2 NOs. SPDT contacts 5A for 240 VAC 0.25A for 220 VOC
13.7	**LEVEL GAUGE**	
13.7.1	Number	
13.7.2	Type	
13.7.3	location	
13.7.4	Model No.	
13.7.5	Length	
13.7.6	Manufacturer	
13.8	**INDICATING TYPE DIFFERENTIAL PRESSURE SWITCH (across polishing filter)**	
13.8.1	Number	
13.8.2	Type	
13.8.3	Model No.	
13.8.4	No. of contacts & contact rating	
13.8.5	Manufacturer	
13.8.6	List of spares furnished for three (3) Years normal operation and maintenance Enclosed with bid.	Yes/No
13.8.7	List of special tools furnished enclosed with bid.	

14.0 LT MOTORS(for details refer Annex III)

14.1	GENERAL	
14.1.1.	Manufacturer & Country of origin.	
14.1.2.	Equipment driven by motor	
14.1.3.	Motor type	

14.1.4.	Quantity	
14.2	**DESIGN AND PERFORMANCE DATA**	
14.2.1.	Frame size	
14.2.2.	Type of duty	
14.2.3.	Type of enclosure /Method of cooling/ Degree of protection	
14.2.4.	Applicable standard to which motor generally conforms	
14.2.5.	Efficiency class as per IS 12615	
14.2.6.	(a)Whether motor is flame proof	Yes/No
	(b)If yes, the gas group to which it conforms as per IS:2148	
14.2.7.	Type of mounting	
14.2.8.	Direction of rotation as viewed from DE END	
14.2.9.	Standard continuous rating at 40 deg C. ambient temp. as per Indian Standard (KW)	
14.2.10.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)	
14.2.11.	Maximum continuous load demand of driven equipment in KW	
14.2.12.	Rated Voltage (volts)	
14.2.13	Permissible variation of :	
	a. Voltage (Volts)	
	b. Frequency (Hz)	
	c. Combined voltage and frequency	
14.2.14.	Rated speed at rated voltage and frequency(RPM)	
14.2.15.	At Voltage and frequency:	
	a. Full load current	
	b. No load current	
14.2.16.	Power Factor at	
	a. 100% load	
	b. NO load	
	c. Starting.	
14.2.17.	Efficiency at rated voltage and frequency,	
	a.100% load	
	b. 75% load	
	c. 50% load	
14.2.18.	Starting current (amps) at	
	a. 100 % voltage	
	b. 85% voltage	
	c. 80% voltage	
14.2.19.	Minimum permissible starting Voltage (Volts)	

14.2.20.	Starting time with minimum permissible voltage	
	a. Without driven equipment coupled	
	b. With driven equipment coupled	
14.2.21.	Safe stall time with 100% and 110% of rated voltage	
	a. From hot condition	
	b. From cold condition	
14.2.22.	Torques :	
	a. Starting torque at min. permissible voltage(kg-m)	
	b. Pull up torque at rated voltage.	
	c. Pull out torque	
	d. Min accelerating torque (kg.m) available at lowest permissible	
	e. Rated torque (kg.m)	
14.2.23.	Stator winding resistance per phase (ohms at 20 DegC.)	
14.2.24.	GD2 value of motors	
14.2.25.	No of permissible successive starts when motor is in hot	
14.2.26.	Locked Rotor KVA Input	
14.2.27.	Locked Rotor KVA/KW	
14.2.28.	Vibration limit :Velocity (mm/s)	
14.2.29.	Noise level limit (dBA)	
14.3	**CONSTRUCTIONAL FEATURES**	
14.3.1.	Stator winding insulation	
	a. Class & Type	
	b. Winding Insulation Process	
	c. Tropicalized (Yes/No)	
	d. Temperature rise over specified maximum ambient temperature of 50 deg C	
	e. Method of temperature measurement	
	f. Stator winding connection	
14.3.2.	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	
	e. Fault level (MVA),Fault level duration(sec)	

	f. Cable glands & lugs details (shall be suitable for power cable)	
14.3.3.	Type of DE/NDE Bearing	
14.3.4.	Motor Paint shade	
14.3.5.	Weight of	
	a. Motor stator (KG)	
	b. Motor Rotor (KG)	
	c. Total weight (KG)	
14.4	**List of accessories.**	
14.4. 1.	Space Heaters (Nos./Power in watts/supply voltage)	
14.4.2.	Terminal Box for Space Heater (Yes/No)	
14.4.3.	Speed switch (Yes/No)	
	No of contacts and contact ratings of speed switch	
14.4.4.	Insulation of bearing (Yes/No)	
14.4.5.	Noise reducer(Yes/No)	
14.4.6.	Grounding pads	
	i) No and size on motor body	
	ii) Nos on terminal Box	
14.4.7.	Any other fitments	
14.5	**List of curves.**	
14.5.1	Torque speed characteristic of the motor	
14.5.2	Thermal withstand characteristic	
14.5.3	Starting. current Vs. Time	
14.5.4	Starting. current Vs speed	
14.5.5	P.F. and Effie. Vs Load	

Note:- Mark N.A. in motor data sheet whichever is not applicable.

16 ANNEXURE-III (SPECIFICATION OF MOTOR)

1.0 A suitable motor conforming to the purification unit requirement shall be supplied. The motor shall also meet the following requirement broadly. The motor shall confirm to IS : 4722, IS : 325, IS : 2253, IS : 2254, IS : 4029, IS : 3202,IS12615:2011 & IS : 2148 or equipment BS : Specification. The motor shall meet all Indian statutory requirements.

1.1	Application	To drive feed pump (suction & discharge) and centrifuge
1.2	Type of Motor	Squirrel cage, induction motor
1.3	KW Rating at 500 ambient temp	It shall have at least 10-15% reserve capacity than required for drive the unit when it is discharging max. quantity at max. viscosity
1.4	KW actually required by driven equipment under specified operation/ start-up conditions.	Unit capacity
1.5	Min. Voltage required under starting conditions to bring driven equipment up to rated speed.	80% rated
1.6	Full load speed	It shall be commensurate with pump & centrifuge speed as per design
1.7	Full load current	As per design
1.8	**Starting current**	Not to exceed 600% of the rated exclusive of IS tolerance
1.9	Starting Torque	1.3 (Min) of rated torque
1.10	Break down torque	2.05 times (min) of rated valve.
1.11	Efficiency at full load	IE2 AS PER IS 12615:2011
1.12	Power factor at full load	0.85 (Min)

1.13 Motor shall be designed to with stand the voltage and torque stresses developed due to difference between the motor residual voltage and incoming supply voltage equal to 150% of the rated motor voltage during fast changeover of buses.

2.0 STARTING DATA

2.1	Starting	Suitable for DOL
2.2	Acceleration time with full load connected.	To be furnished by supplier.
2.3	Permissible starting duty cycle, No. of Starts.	3-Starts equally spread over an hour. 2-consecutive starts from hot condition without any injurious heating to the winding.

2.4	Overload (% of full load) that can be Carried by motor without impairing Overall performance and period for Which this overload is applicable.	Motor shall be capable for running at full load with 80% of rated voltage for 5 minutes and 70% of rated voltage for1 Sec. Locked rotor with stand time under hot condition at rated voltage shall be at Least 2.5 sec more than starting time
2.5	Location	Turbine oil room indoor
2.6	Class of Insulation	Class-F, fungus resistant as per IS:3202 with temp rise limited to that of class B.
2.7	Shaft disposition mountings	As per Unit's supplier requirement.
2.8	Method of connections driven equipment	As per Unit's supplier requirement.
2.9	Direction of rotation and corresponding terminal designation	To suit pumps & centrifuge
2.10	Enclosure and ventilation	Totally enclosed fan cooled and flame proof IP55.
2.11	Bearing	As per supplier's design, min life 30,000 hrs
2.12	Grounding Device	Suitable arrangement shall be provided for earthing the motor at two separate and distinct connection points. Design of earthing conductor shall be as per IS: 4722-1992.
2.13	Terminal box	Flame proof terminal box to be provided with double compression Cable gland for Al cable Fault level : 45 KA for 0.01 Sec

3.0 SPECIAL REQUIREMENTS:

3.1 The motor shall be rewound able
3.2 The motor shall have on line greasing facility.
3.3 Motor shall be suitable for working in an environment of oil fumes without any hazard.
3.4 Separate terminal box for space heater (if applicable) to be provided.
3.5 Motor bearings (DE & NDE) shall be sealed type to avoid frequent Re-greasing.
3.6 The motor construction shall be suitable for easy disassembly and reassembly.
3.7 The terminal box shall be suitable for top and bottom entry of cable and shall be suitable for PVC insulated PVC sheathed armoured aluminium cables and shall be capable of being rotated by 180^0 in steps of 90^0.
3.8 Motor vibrations shall be acceptable as per IS: 12075; motor efficiency as per IS 12615:2011& noise level as per IS: 12065. Also mechanical vibrations shall be under limits as per IS: 10816-2.

4.0 DOCUMENTS TO BE SUPPLIED WITH DELIVERY WITH EACH UNIT. THESE SHALL BE SUPPLIED IN TWO COPIES & WORKABLE SOFT COPY.

4.1 **Characteristics:** (at 80%, 100% and 110% of rated voltage)
- 4.1.1 Starting current v/s time
- 4.1.2 Torque v/s slip
- 4.1.3 Thermal with stand for HOT and Cold condition.

4.2 Type and frame size

4.3 Starting time
- 4.3.1 With 100% voltage at terminal
- 4.3.2 With 85% voltage at terminal
- 4.3.3 With 80% voltage at terminal

4.4 Safe install time at 110% rated voltage under hot condition.

4.5 Power rating requirement w.r.t. pump requirement.

4.6 Motor GD^2

4.7 Total wt. of motor.

4.8 Expected life of bearing (but not <30000 hrs.)

4.9 Type & size of cable for which gland is provided, in the terminal box.

4.10 Type & routine test certificate as per IS: 4722.

4.10.1 In addition to cl 4.10, the following tests shall also be carried out
- i) Degree of protection test as type test
- ii) 20% over speed test for 2 minutes as routine test.
- iii) Measurement of variation as routine test as per IS: 12075.

5.0 TESTS AT MANUFACTURE'S WORKS OF MOTOR:

5.1 Motor after complete assembly shall be subjected to both type and routine tests as per IS: 4722

5.2 Additional type test:-

5.2.1 Degree of protection test to conform to the specified degree of protection.

5.2.2 Measurement of noise level as per IS 12065, motor noise level shall be limited so as to achieve combined pump motor noise level as per clause no. 5(c).

5.3 Additional routine test:

5.3.1 20% over speed test for 2 minutes.

5.3.2 Measurement of vibrations per IS 12075.

6.0 CROSS REFERRED STANDARDS:

IS:325 , IS:4722, IS:2253, IS:2254, IS:3202, IS:4029, IS:12065, IS:12075, IS:12615:2011

17 ANEXURE-IV (SPECIFICATION OF INSTRUMENTS)

1) PRESSURE GAUGE

The Pressure gauge should confirm to the following technical specification:-

a) The sensing element shall be SS-316bourden tube.
b) The dial size shall be approx. 150 mm diameter.
c) The casing shall be epoxy coated die-cast aluminium with threaded bezel ring.
d) The movement shall be stainless steel rotary gear with nylon bearings.
e) The process connection shall be G1/2"
f) The over range protection should be 150% of max. range
g) The pointer shall be `micrometer adjustable with zero facility on front.
h) The accuracy shall be 1% of full scale.
i) The gauge is to be provided with pulsation dampeners.

2) TEMPERATURE INDICATOR

Type .	Bimetallic rigid system type. No use of mercury or any other hazardous/toxic material
Case	Die cast aluminium alloy moisture proof case, heavily enamelled black
Dial Size	100 mm
Range	As per design
Accuracy	1% of total range
Bulb Material	½" bulb diameter made of SS. 316
Thermo-well	SS-AISI316 (with thread size G1/2")
Ambient Temp	60^0 C max.

3) MAGNETIC LEVEL SWITCH

Process Connection: - Nb25
Material: All parts coming in contact with the liquid made of stainless steel SS316
Electrical characteristics
Switch: Single pole double throw change over switch silver contact for handling the following currents

AC 250V – 5.0A
DC 250V – 0.25A

Operating characteristics
Differential – 6 MM I. e. 3 MM on either side of centre line working pr & Temp. : As per design
Ambient Temp. : 60°C max.

ANNEXURE–V (P&ID)
SHEET 1 OF 1

सामग्री सूची संख्या INVENTORY NO 25538	Rev. no. 08	निर्माणकर्ता WORKED BY:	Anil / Kavita	18.03.16
दिनांक एवं हस्ताक्षर SIGN & DATE 23/3/16		जाँचकर्ता CHECKED BY:	A. S. Rajput / Devesh	18.03.16

उत्पाद क्रय विनिर्देश (हीप : हरिद्वार)
PRODUCT PURCHASE SPECIFICATION
(HEEP: HARIDWAR)

19 ANNEXURE–VI (QUALITY PLAN)

MANUFACTURER'S NAME AND ADDRESS | STANDARD QUALITY PLAN | TO BE FILLED BY BHEL | TO BE FILLED BY BHEL

BHEL: VENDOR'S NAME | ITEM | QP NO. | DATED | DRG. NO. | SPEC. | REV | Page 1 of 3

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY M	AGENCY B	AGENCY N	REMARKS
1	2	3	4	5	6	7	8	9	10			11

LEGEND:
I RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.
M: MANUFACTURER / SUBCONTRACTOR B: BHEL / NOM. INSPECTION AGENCY
N: CUSTOMER
INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION
ALL 'W' INDICATED IN COLUMN 'N' SHALL BE 'CHP' OF CUSTOMER

FOR CUSTOMER USE

APPROVED BY

MANUFACTURER/SUBCONTRACTOR

निर्माणकर्ता WORKED BY:	Anil / Kavita	Anil Kumar Kavita	18.03.16
जाँचकर्ता CHECKED BY:	A. S. Rajput / Devesh	A.S. Rajput Devesh	18.03.16

Rev. no. 08

सामग्री सूची संख्या INVENTORY NO. P-55328

18.03.16

20 ANNEXURE– VII (CHECK LIST)

A. CHECK LIST FOR MECHANICAL ITEMS

Sl. No.	Technical Requirements	Vendor's confirmation (Yes/No)	Remarks (if any)
1.	Is capacity of oil purifier as per BHEL specifications **(i.e. 7500 LPH)?**		
2.	a) Is particle size of impurities in the clean oil as per BHEL specifications in single pass (i.e. **class 15/12 or better** as per ISO4406)? b) Is moisture content in the clean oil as per BHEL specifications in single pass (i.e. **≤ 500 ppm**)?		
3.	Is the test certificate for particle size of impurities & moisture content provided as per BHEL specification?		
4.	Is mode of operation (i.e. purifier/clarifier) as per BHEL specifications & enquiry?		
5.	Is noise level as per BHEL specifications?		
6.	Is overflow sight fitting provided as per BHEL specifications?		
7.	Is capacity of oil feed & discharge Pump (i.e. at least 10% higher than capacity of the purifier) as per BHEL specifications?		
8.	a) Is copies of O&M manual (CD based & hard paper based) provided as per BHEL specifications? b) Are 2 copies (hard paper based) of O & M manuals kept inside the dispatch box as per BHEL specifications & enquiry?		
9.	Is polishing filter (β3= 1000 or better) provided as per BHEL specifications?		
10.	Is supervision during erection & commissioning at site by vendor offered as per BHEL specifications & enquiry?		
11.	Is lube oil recirculation piping/ piping connection provided as per BHEL specifications & enquiry?		
12.	Are sufficient spares for satisfactory commissioning and for 3 years satisfactory operation of the purifier provided as per BHEL specifications?		
13.	Are detailed lists of recommended spares and commissioning spares along with price break up provided as per BHEL specifications & enquiry?		
14.	Is separate offer for conducting test for particle size of impurities and		

	moisture content on one oil purification system provided as per BHEL specifications/enquiry?		
15.	Is the painting scheme as per BHEL specifications/enquiry?		
16.	Are all piping of oil purification system shall be stainless steel?		
17.	**Deviations taken (Please specify clearly, if any):** a) b) c) d)		

Notes: Vendors shall fill relevant columns with Yes/ No/ Value offered.

Date:
Place:

Signature &
Seal of manufacturer

उत्पाद क्रय विनिर्देश (हीप : हरिद्वार)
PRODUCT PURCHASE SPECIFICATION
(HEEP: HARIDWAR)

B. CHECK LIST FOR C&I ITEMS

Check list for OPU (DCS Based)

1. OPU is DCS Based with provision of operating from local controls panel as well control room; yes/ no
2. Plug and socket type connection for all pressure switch and level switch : yes/no
3. DCS/Local selector switch is provided on the Local control panel: yes/no
4. Relays shall be of 24 v dc and of vendor scope of supply: yes/no
5. List of drives to be operated through DCS is furnished along with list of instruments and alarms.: yes/no
6. All field instruments shall be wired to a JB which shall be in vendor scope.: yes/no
7. A pressure switch at outlet of centrifuge and a level switch in anti-flood tank shall be provided for detection of liquid seal breakage.
8. Arrangement for Liquid seal breakage alarm is provided : yes/no
9. Air requirement of pneumatic valves is mentioned: yes/no
10. Motor efficiency meeting as per special instruction/project requirement : yes ./no
11. Control panel is designed for 3 phase (415 v Ac) 3 wire power supply system: yes/no
12. Control panel is provided with anti-vibration pads to withstand vibrations: yes/no.
13. Motor data sheet shall be subject to customer/ BHEL approval: yes/no
14. Cable glands for 415 V AC incomer is provided : yes/no
15. On/Off control, indication and alarms is provided in local panel as well as HMI: yes/no
16. Painting treatment as per addendum or special instruction mentioned in indent: yes/no.
17. Construction of panel as per specification/addendum: yes/no.
18. Price break of spare item/spare of LS switchgear given along with offer: yes/no
19. 20% spare terminals have been provided at panel: yes/no.

20. All instrument as well as motor data sheet, wiring diagram write up is subject to BHEL/customer approval: yes/no
21. panel to be designed for 110 V AC control voltage : yes/no
22. For panel color exterior -Opaline green semi glossy finish, interior-glossy white and motor-smoke grey yes/no
23. All HT & LT motors shall be energy efficient type with efficiency class 1: yes/no

Date:
Place:

Signature
Seal of manufacturer

Check list for OPU (Relay Based)

1. Oil Purification Unit is relay based: yes/no
2. On/Off control, indication and alarms is provided in local panel: yes/no
3. Control panel is designed for 3 phase (415 v Ac) 3 wire incomer power supply system: yes/no
4. Motor efficiency meeting as per special instruction/project requirement : yes /no
5. Air requirement of pneumatic valves is mentioned: yes/no.
6. A pressure switch at outlet of centrifuge and a level switch in anti-flood tank is provided for detection of liquid seal breakage: yes/no
7. Cable glands for 415 V AC incomer is provided : yes/no
8. Adequately sized copper ground bus is provided for each panel: yes/no
9. Painting treatment as per addendum or special instruction mentioned in indent: yes/no
10. Paint shade of control panel as per addendum/special requirement: yes/no
11. Construction of panel as per specification/addendum: yes/no
12. Control panel is provided with anti-vibration pads to withstand vibrations: yes/no.
13. Plug and socket type connection for all instruments : yes/no
14. Arrangement for Liquid seal breakage alarm is provided: yes/no
15. Price break of spare item/spare of LS switchgear given along with offer: yes/no
16. Motor data sheet shall be subject to customer/ BHEL approval: yes/no
17. 20% spare terminals have been provided at panel: yes/no
18. All instruments shall be of reputed make.

Date:
&Place:

Signature
Seal of manufacturer