



**PRODUCT STANDARD**  
**STEAM TURBINE ENGINEERING**

ST 39013

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REF. DOC.

ST22002

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21.8.84

INVENTORY No.

P-5538

**TECHNICAL SPECIFICATION OF TURBINE OIL PURIFICATION SYSTEM (TYPE-A)**

**1.0 SCOPE OF SPECIFICATION**

- 1.1 This specification is intended to cover design, manufacture, assembly, testing and delivery of equipment and accessories for turbine oil purification system.
- 1.2 The scope of the work shall include in addition to clause 1.1 the final checking of the installation at site, the supervision of commissioning and putting the system into satisfactory operation and performance test at site.
- 1.3 This specn. includes specific requirements of instruments etc.

**2.0 EQUIPMENT TO BE FURNISHED**

- 2.1 One unit oil purification system, comprising of
  - (a) One oil, water and solid particles separator alongwith its drive, indirect oil heater and all other accessories. (2x50% separators in parallel shall also be considered but not preferred in case 1x100% offer is available)
  - (b) One dirty oil feed pump complete with its drive.
  - (c) One clean oil feed pump complete with its drive.
  - (d) polishing filter, if required. Refer clause 5.2

NOTE: A common drive system for separator, dirty oil feed pump and clean oil feed pump will also be considered. Clean oil pump integral with centrifuge, shall also be considered.

- 2.2 One sight overflow fitting.
- 2.3 All relevant valves, Y-type strainer, fittings and inter-connecting pipings. All flanged end valves and flanged terminal points of piping should be provided with counter flanges, nuts, bolts and gaskets. for minimum scope of supply refer annexure -V. The offer with any exclusion in scope than annexure V shall not be considered.
- 2.4 All relevant controls, interlocks and instrumentation. For detailing, see clause 4.12 of this specification.
- 2.5 Foundation plates, anchor bolts, sleeves, inserts etc. required for installation of unit on foundation.
- 2.6 Necessary lugs and eye bolts on each and every equipment for lifting the unit during erection and maintenance.

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REVISION	a	DISTRIBUTION	QTY.	APPROVED	ST
DATE	28-11-92			ENG. DEV. MANAGER	8.20
				PREPARED	ISSUED
				STE	STE (TL)
					HARDWAR
					DATE
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2.7 Special Tools and Tackles

Along with every purification unit a set of special tools and tackles, required for erection and maintenance of the unit.

2.8 Spare Parts

Spare parts for 3 years satisfactory operation of unit and for satisfactory commissioning of unit.

2.9 Drawing, data sheets, test reports, certificates, storage, erection, commissioning, operation and maintenance manuals. Details of same is specified in clause 10 of this specification.

3.0 GENERAL INFORMATION

3.1 The oil purification unit shall operate on a bypass system and the capacity of the unit shall be as per the Annexure-1 to this specification.

3.2 The unit will be located inside the machine hall in oil room near oil tank.

3.3 Temperature of the suction oil may vary between 50 to 55°C during normal operation of turcoaset.

4.0 GENERAL TECHNICAL REQUIREMENTS

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

4.2 The unit should be suitably designed to operate in tropical climatic conditions. All instruments/devices shall have IP 55 degree of protection. Equipment shall be designed for ambient temp. of 55°C and relative humidity of 95%.

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

4.4 The unit should be completely vapour tight to prevent foams and vapours from entering the turbine room.

4.5 The equipment should be suitable for continuous operation round the clock.

4.6 On load automatic cleaning of bowl assembly is preferable.

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

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- 4.8 Each purifying unit shall be furnished with a positive displacement feed pump and a similar type discharge pump, if needed. Each pump shall be of the helical, herring bone, spur gear or screw type with a normal capacity of at least 10% greater than that of the purifying unit when operating under the maximum suction lift against the pressure required to feed the purifier. Each pump shall be fitted with adequate relief by pass valve to prevent damage from excess pressure.
- 4.9 Although oil temp. inlet to heater during normal operation of T3 set shall be  $\approx 50^{\circ}\text{C}$  but unit should be designed to operate with oil at  $20^{\circ}\text{C}$  during cold starting of T3 set which may last for max. 10 hrs. During such operation even if guaranteed purification cannot be achieved the unit shall be accepted.
- 4.10 MATERIAL
- 4.10.1 The material for rotating parts, bowl and disc of separator assembly shall be of high grade stainless steel  $\Delta$  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 IS, BS or equivalent standard.
- leg. austenitic*
- 4.10.2 All valves, fittings and piping should be suitably selected as per applicable IS, BS or equivalent standard.
- 4.10.3 Strainers, wherever provided, should be designed to enable them to be cleaned during operation.
- 4.10.4 All instruments i.e. pressure gauges, thermometers etc. should be reliable and 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.  $\pm 1\%$ . Pressure gauge and ~~thermometer~~ shall be H. Kuru/Bestowell make.
- 4.11 Electrical motors and instruments should be suitable to operate with following supply:

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4.11.1 Auxiliary electric supply available at site comprises of 415V, 30, 50Hz and 220V D.C. If supplier requires any other supply for his devices, instruments and drives etc. he shall arrange for the necessary transformer to convert 415V, 30 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 bidders scope.

4.11.2 Variation in supply voltage and frequency may be taken as follows:

DC Voltage + 10 pct.  
- 15 pct.

AC Voltage ± 10 pct

Frequency ± 5 pct.  
Combined 10 pct. (sum of absol. values)

4.11.3 Motor shall be explosion proof as per IS: 2148 and make shall be of NGEF/Siemens or approved equivalent.

#### 4.12 Control and Instrumentation

4.12.1 Offer should include all necessary interlocks and instruments along with remote indication facility in the control panel of protection type ~~IP-48~~ <sup>LIP52</sup>. Purchaser will review same and necessary addition/subtraction in interlocks and 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 an interlock to prevent the operation of the unit unless the feed pump and the discharge pump are operating.
- b) A system of annunciating the flooding of the separator due to loss of water seal, clogging of heavy phase discharge pipe etc. shall be provided.

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c) The temperature of the oil leaving the heater shall be automatically controlled by fully adjustable thermo-static switch in steps. The thermostatic switch shall operate suitable controls which shall function to open the heater circuits when the desired temperature is exceeded and to close the heater circuits before the temp. drops below that necessary for proper purification of the oil. The heater circuits shall be inter-locked with the pump motor circuits to shut off the heaters when the pumps are not being operated.

d) Local and remote indicating facility at all relevant places e.g. inlet and outlet of centrifuge, pumps indirect heater etc. shall be provided.

e) In case of polishing filter, it shall be equipped with a differential pressure switch with adjustable contacts to indicate high pressure drop across the filter.

L filter along with alarm and annunciation system.

f) Local instruments for pressure, temp. & flow indication shall be provided in accordance with clause 9.0 of Annexure-II.

g) The unit should be provided with suitable alarm & annunciation system for easy operation and 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 control room.

h) An ammeter on control panel for oil centrifuge motor shall be provided.

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

4.12.3 Remote operating facility for all electrically operated components should be provided on control panel.

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

4.12.5 Control switches shall be of English Electric/ KAYCEE/ EASUN Reyrolle or owner approved equivalent.

4.12.6 Indicating lamps shall be of L&T/Siemens /Technique or owner approved equivalent.

4.13 The separator shall be substantial in construction and free from any unbalanced condition and shall operate without objectionable noise or vibration.

4.14 The entire oil purifying equipment shall be mounted upon substantial metal base having a raised lip around the outside with a drain connection.

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- 4.15 Name plate in Hindi and English and mimic diagram shall be provided on the unit.
- 5.0 GENERAL PERFORMANCE REQUIREMENTS
- 5.1 The separator should be capable to handle a flow rate as specified in Annexure-1.
- 5.2 The separator should be designed to separate moisture completely and foreign particles from the turbine oil whose properties are given in Annexure-1 down to cleanliness level of 18/15 as per ISO 4406 in single pass without removing any additives/inhibitors present in the oil and maintaining the lubricating value of the oil. Polishing filter shall be capable of handling the quantity of clean oil, coming out of the centrifuge & filtering it down to 2 microns ( $\beta_2 = 75$ ) including colloidal carbon but shall not remove any rust inhibitor or oxidation inhibitor. It shall have suitable by pass arrangement.
- 5.3 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, should be provided. But to take care of situation while temp. is much below than 50°C, an arrangement of utilizing the heater to elevate the temp. of oil in the main oil tank to 50°C should be provided. Heater shall be provided with suitable by pass arrangement.
- 6.0 Quality assurance, inspection and testing (general requirements are enclosed separately).
- 6.1 The manufacturer shall conduct all tests required to ensure all the component parts of the oil purification unit offered conform to the requirements of the specification and in compliance with requirements of applicable codes and standards.
- 6.2 The bidder shall submit alongwith his offer quality plan in the prescribed BHEL's format.
- 6.3 The particulars of the proposed shop tests and procedures for the tests shall be submitted to the BHEL/Owner for approval along with quality plan.
- 6.4 The equipment shall be despatched only after inspection and clearance of material by BHEL/Owner and approval of test certificates by BHEL/Owner.



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6.5 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 subject to the approval of BHEL and Owner. BHEL/Owner reserves the right to ask for any more checks at the time of quality plan finalisation.

6.5.1 Testing of Materials

The material of each component that is bowl, bowl cover, disc, heater tubes, pump casings, shafts, gear/screws, valve body etc. shall be tested as per relevant specification for its chemical composition and mechanical properties, viz, YS, U<sub>t</sub>, impact, % age elongation, % RA etc. Suitable NDT on components to ensure freedom from surface and subsurface defects shall be carried out.

6.5.2 Following tests shall be carried out during various stages of manufacture at manufacturer's works.

a) Check for dimensions of all the component parts including surface finish, axial and radial run out of shaft etc.

b) NDT

Bowls shall be subjected to DP after final machining to ensure freedom from surface defects. Shafts shall be subjected to UT and DP to ensure freedom from internal and surface defects.

c) Static and dynamic balancing test on all rotating elements of the centrifuge.

d) All butt welds on oil piping shall be subjected to 10% RT & fillet welds to 100% MP/DP.

e) 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 and seat leakage test of valves at 1.0 times of working pressure.

f) Capacity test of complete centrifuge. During capacity test, the complete purifier shall be tested at manufacturer's works for mechanical running, vibration and noise level, sequential operation and interlocks, test for  $\angle$

$\angle$  vapour tightness, maximum particle size and moisture content in discharge.

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①  
L thermostat, level switch and solenoid valve

- g) Performance test on lube oil pump, purifier motor heaters, control system and other accessories.
- h) Type test reports detailing the results for motors of similar ratings shall be furnished for owner's approval. The type test shall also include degree of protection test for the specific grade and test for explosion proof requirement. In the absence of these test reports, at the discretion of owner, supplier may be required to carryout all the type tests as per IS:325 & IS:4029.

- 1) Control panel shall be subjected to the following final testing in addition to the stage inspection carried out by the vendor.
  - \*L as applicable, as routine test (unless otherwise stated) ①
  - a) Dimensional checks as per approved drawing including proper cut outs, mounting of all instruments/accessories etc. as per approved general arrangement drawing.
  - b) Functional/operational check of all wiring schematics, operational/sequential interlocks etc. are applicable as per approved drawing.
  - c) Degree of protection test as per IS:2147 (Type test).
  - d) High voltage test & IR measurement before and after test.
  - e) Pick up and drop down test and performance with  $\pm 10\%$  voltage variation. ①

7.0 STORAGE

Bidder shall inform to purchaser alongwith the offer regarding storage facility which they require 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.

8.0 CLEANING, PROTECTION AND PAINTING

- 8.1 All surface shall be thoroughly cleaned of all mill scales, oxide and other coatings and prepared in the shops. The protective coatings should be such as to prevent the deterioration of coating itself by action of oil. The supplier shall give exact and precise details about the measures envisaged 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.

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- 8.2 The pretreatment/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: 5. The total thickness of paint shall be a minimum of 75 microns and maximum of 150 microns.
- 8.3 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.
- 9.0 GUARANTEE
- 9.1 The unit should be guaranteed for trouble free operation for a minimum period of 18 months after commissioning or 36 months after despatch whichever is earlier.
- 9.2 The purification level as indicated in clause 5.2 shall be guaranteed by the supplier.
- 9.3 The supplier shall guarantee the power consumption of the motor at normal duty point.
- 9.4 If during erection, commissioning and operation at site any deficiency in a part is detected within 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.
- 10.0 DRAWING, CURVES AND INFORMATION REQUIRED WITH THE OFFER.
- 10.1 Outline drawing of the equipment offered, arrangement and layout drawing showing various equipment with all fittings, accessories and connections as well as clearances necessary for other equipment or structural members for operation and maintenance, loading data and foundation details of unit and control panel.
- 10.2 Complete piping and instrumentation diagram indicating all instruments and devices.
- 10.3 Detailed technical literature on various instruments supplied and GA diag. of control panel.
- 10.4 Characteristic curve of all pumps.

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- 10.5 Manufacturer's descriptive and illustrative literature showing details of equipment and method of operation of the complete system.
- 10.6 Electrical single line drawing, control wiring diagram, interlock schematic, protection scheme, motor details and details of starter etc.
- 10.7 Cross-sectional drawing of each and every equipment including horizontal and vertical section of separator indicating the recommended/offered spare parts.
- 10.8 Details of standards used for designing the various equipment and selecting the material of various components.
- 10.9 A list of customers and sites where same/similar type of units are in operation.
- 10.10 Name of the manufacturer and illustrative literature of all components which have been arranged from outside source for purchaser/owner approval.
- 10.11 All other relevant data and drawings which supplier consider necessary for better understanding of the system.
- 10.12 Filled in data in annexure-II.
- 11.0 ENGINEERING INFORMATION

Successful bidder shall supply all engineering information data and drawing in term of reproducibles within 2 weeks time after getting order, so that same may be multiplied in required No. of prints by purchaser. The motor details are to be filled in data sheet to be supplied by BHEL after the order is placed.

12.0 STORAGE, ERECTION, COMMISSIONING, OPERATION & MAINTENANCE MANUAL

Successful bidder shall supply per unit 15 nos. of storage erection, commissioning, operation and maintenance instructions. Before bidder finalise these manual, same will be reviewed by purchaser and after getting approval of purchaser final manual in required quantity be dispatched. Manual shall clearly indicate the inspection & test to be carried out at site covering the following stages and if any check list/log sheets etc. are required to carryout specified inspection & test that shall be made part of manual.

- a) Receipt of material at site.
- b) Storage and conservation.
- c) Pre-erection.
- d) Erection
- e) Pre-commissioning.
- f) Commissioning
- g) Post commissioning.

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I) The properties of the turbine medium oil are given below:

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°C	28 c. s.	IS: 1448 - P25
2	Viscosity Index	Min 97	IS: 1448 - P56
3a	Inorganic acidity	N11	IS: 1448 - P2
b	Organic Acidity	Max 0.14 mg of KOH per gm of the oil	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	IS: 1448 - P69
7.	Copper strip corrosion test at 100°C for 3 hrs.	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

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ANNEXURE-I

S.No.	Properties	Value	Test Method
12	Foaming characteristics Max.		
	a) at 24°C	Nil	Volume in Ml of foam after 10 minutes.
	b) at 93.5°C	Nil	
	c) at 24°C after testing at 93.5°C	Nil	
13	Degeneration capacity at 50°C	6 Mts. Max.	DIN 51381
14	Ash (% by weight)	Max.0.01	IS: 1448 -P:4
15	Water content by weight	% gm below the limit of quantitative detectability.	DIN 51582
16	Mechanical solid impurities.	Below the limit of quantitative detectability.	DIN 51592
17	Water separation capacity after steam treatment.	Max. 300 seconds	DIN 51589

II OIL RECOMMENDED

Description	Supplier
a) Servoprime-46	M/s Indian Oil Corporation
b) Turbinol-47	M/s Hindustan Petroleum

III Capacity of oil system	Variant-1 for 200/210 MW T <sub>1</sub> set	Variant-2 for 500 MW T <sub>1</sub> set	Var.-3
	30M <sup>3</sup>	37.5 M <sup>3</sup>	30 M <sup>3</sup>
IV Base area limitation for purification unit length x width mm mm	<del>2500 x 2500</del> 2200 x 2200	4000 x 4000	2200 x 2200

V Rate of oil to be handled by purification Unit l/Hr.	6000 20% of Capacity	7500 20% of Capacity	4500 15% Capacity
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ANNEXURE-II

DATA SHEET  
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 thermostats Yes/No  
 (b) - (indirect)
- 2.6 Flow meter Yes/No
- 2.7 Pressure gauges Yes/No
- 2.8 Temp. indicators Yes/No
- 2.9 Antiflood 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 Solenoid valve at inlet of feed pump to close on loss of centrifuge water seal. Yes/No

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ANNEXURE-II**2.16 Heater (With Valves) Connections**

- |   |        |
|---|--------|
| a) Oil inlet  | Yes/No |
| b) Oil outlet   | Yes/No |
| c) Oil drain  | Yes/No |
| d) Water drain  | Yes/No |
| e) Make-up water  | Yes/No |
| f) Open vent connection for drum                        | Yes/No |
| g) Globe valved by pass connection to heater (Oil side) | Yes/No |

2.17 Centrifuge feed pump relief valve Yes/No

2.18 Centrifuge discharge pump relief valve Yes/No

2.19 Isolating & bypass valves for flometer. Yes/No

**3.0 DESIGN FEATURES OF CENTRIFUGE**

3.1 Location Indoor

3.2 Type of operation

3.3 Max. hydraulic capacity Lit/Hr.  
(for Turbine Oil)

3.4 Recommended through put for best performance Lit/hr.  
(for turbine oil)

3.5 Speed RPM

3.6 Particle size distribution in terms of ISO rating in purified oil at centrifuge outlet after single pass.

3.7 Particle size in purified oil at outlet of polishing filter (if offered). Microns

3.8 Water content in purified oil at outlet of centrifuge. % (by volume)

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P. 5538

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A.K. Jain 6.8.84

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K.C. Sachan 6.8.84



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ANNEXURE-II

- 3.9 Water content in purified oil at outlet of polishing filter  $\frac{1}{2}$  (by) volume
- 3.10 OIL TEMPERATURES
- 3.10.1 Inlet to electric heater °C (Max.)  
°C (Min.)
- 3.10.2 Outlet from electric heater °C (Not to exceed 70°C)
- 3.11 Water temperature in the heater tank °C (Not to exceed 90°C)
- 3.12 Bearings : 1 Nos.  
2. Type  
3. Manufacturer
- 3.13 Dirt holding capacity of the bowl Lt.
- 4.0 CONSTRUCTION FEATURES OF CENTRIFUGE
- 4.1 Automatic tripping of all electric motors on actuation of antiflood 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

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**STEAM TURBINE ENGINEERING**

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ANNEXURE-II

- 5.6 Gear
- 5.7 Worm
- 5.8 Oil injection nozzle
- 5.9 Other inlet and outlet parts
- 5.10 Other wetted bowl parts
- 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 Voltage Volts (AC)
- 6.1.4 Frequency C/s
- 6.1.5 Phase
- 6.2 i) Number of thermostats 3 (2 Nos. for oil temp. and one for water temp.)
- ii) Range
- iii) Model
- iv) Manufacturer
- 6.3 Heater control thermostat setting Cut in at °C  
Cutout at °C
- 6.4 i) Rating of thermostat contacts 5 amps 240V A.C.  
0.25 amps 220V D.C.
- ii) No. of contacts 2 NO + 2 NC
- 6.5 Heater tubes
- 6.5.1 Material
- 6.5.2 Number

D2

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ANNEXURE-II

6.5.3	Length	mm	
6.5.4	Outside diameter	mm	
6.5.5	Tube wall thickness	mm	
6.6	Surface area of heater tubes.	mm <sup>2</sup>	
6.7	<u>Tube Sheets</u>		
6.7.1	Material		
6.7.2	Number		
6.7.3	Thickness	mm	
6.8	Tube bundel type		Removable/ non-removable
6.9	Capacity of heater tank	M <sup>3</sup>	
7.0	<u>CENTRIFUGE FEED PUMP</u>		
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/cm <sup>2</sup>	
7.6	Relief valve setting	Kg/cm <sup>2</sup>	
7.7	Max. allowable pump working pressure.	Kg/cm <sup>2</sup>	
7.8	<u>Connections</u>		
	a) Inlet	mm	
	b) Outlet	mm	

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ANNEXURE-II7.9 Material

- a) Casing
- b) Shaft
- c) Shaft sleeves
- d) Gear/screw

7.10 Drive (AC Motor) As per enclosed annexure-3.

7.11 Motor rating KW

7.12 Bearings: i) No  
ii) Type  
iii) Manufacturer

7.13 BHP at rated capacity

8.0 CENTRIFUGAL DISCHARGE PUMP

8.1 Quantity Nos.

8.2 Type Positive displacement (Rotary i.e. Helical, Herring bone, spur gear or screw type)

8.3 Discharge pressure Kg/cm<sup>2</sup>

8.4 Capacity Lit/hr.

8.5 Speed RPM

8.6 Relief valve setting Kg/cm<sup>2</sup>

8.7 Max. allowable pump working pressure. Kg/cm<sup>2</sup>

8.8 Connections

a) Inlet mm

b) Outlet mm

8.9 Material

- a) Casing
- b) Shaft

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ANNEXURE-II

- c) Shaft sleeves
- d) Gear/Screws
- 8.10 Motor rating KW
- 8.11 Bearing: i) No.  
ii) Type  
iii) Manufacturer
- 8.12 BHP at rated capacity
- 9.0 INSTRUMENTS
- 9.1 Pressure Gauges: (For detailed specification refer Annexure-IV.
- a) Type
- b) Number 4
- c) Location
- i) Inlet to pump  
(Compound gauge)
- ii) Outlet from feed pump
- iii) Inlet to centrifuge
- iv) Outlet from discharge pump. (In case polishing filter, outlet from polishing filter)
- d) Range Kg/cm<sup>2</sup>
- e) Accuracy ±10% or better
- f) Manufacturer G
- 9.2 Temperature Indicators: (For detailed specification refer Annexure-IV)
- a) Type
- b) Number 3
- c) Location
- i) Inlet to electric heater
- ii) Outlet from electric heater
- iii) Water temperature of indirect heater.

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ANNEXURE-II

- a) Range °C  
e) Manufacturer  
f) Model No.  
g) Accuracy

9.3 Flow meter

- a) Type  
b) Accuracy  
c) Location downstream of centrifuge feed pump.  
d) Connections, type & size.  
e) Model No.  
f) Range  
g) Manufacturer

10.0 LEVEL SWITCH

(For detail specification, refer annexure -IV)

- a) Number 2  
b) Type  
c) Location 1) Indirect oil heater  
11) antiflood device  
d) Range  
e) Manufacturer  
f) Model No.  
g) No. of contacts & contact rating. 2 Nos. SPDT contacts } (02)  
5 A for 240 VAC  
0.25 A for 220 VDC

11.0 LEVEL GAUGE

- a) Number One  
b) Location Indirect oil heater  
c) Type

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- d) Model No.
- e) Length
- f) Manufacturer
- 12.0 Indicating type differential pressure switch (across polishing filter if offered).
  - a) Type
  - b) Number One
  - c) Location Polishing filter (if provided)
  - d) Model No.
  - e) Manufacturer
  - f) No. of contacts & contact rating.
- 13.0 List of spares furnished for three(3) years normal operation and maintenance enclosed with bid. Yes/No
- 14.0 List of special tools furnished enclosed with bid. Yes/No
- 15.0 Any deviation against specification. Yes/No
- 16.0 If yes, details of all deviations (enclose separate sheet, if required).

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## PRODUCT STANDARD

ST 39013

## STEAM TURBINE ENGINEERING

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ANNEXURE-IIISPECIFICATION OF MOTOR

- 1.0 A suitable motor conforming to the purification unit requirement shall be supplied. The motor shall also meet the following requirements broadly. The motor shall conform to IS: 4722, IS: 325, IS: 2253, IS: 2254, IS: 4029, IS: 3202 & IS: 2148 or equivalent BS: specification.
- 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 50°C 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 upto 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 60% of I-rated.
- 1.9 Starting Torque : 1.3 (Min) of rated torque
- 1.10 Break down torque : 2.05 times (min) of rated value.
- 1.11 Efficiency at full load : 90% (Min)
- 1.12 Power factor at full load: 0.85 (Min)

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PRODUCT STANDARD  
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ANNEXURE-III3.0 SPECIAL REQUIREMENTS

3.1 The motor shall be rewoundable

3.2 The motor shall have on line greasing facility.

3.3 The motor construction shall be suitable for easy disassembly and reassembly.

3.4 The terminal box shall be suitable for top and bottom entry of cables and shall be suitable for PVC insulated PVC sheathed armoured aluminium cables and shall be capable of being rotated by 180° in steps of 90°. (01)

4.0 Documents to be supplied with delivery with each unit. These shall be supplied in 15 copies each or two copies and a set of reproducible per set.

4.1 Characteristics (at 80%, 100% and 110% of rated voltage) (01)

4.1.1 Starting current v/s time

4.1.2 Torque v/s slip

4.1.3 Thermal with stand

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 100% rated voltage under hot condition.

4.5 Motor GD<sup>2</sup>

4.6 Total wt. of motor.

4.7 Expected life of bearing (but not &lt; 30000 hrs.)

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

4.9 Type &amp; routine test certificate as per IS: 4722.

4.9.1 In addition to cl 4.9, the following tests shall also be carried out (01)

i) Degree of protection test as type test

ii) 20% over speed test for 2 minutes as routine test.

iii) Measurement of vibration as routine test as per IS 12075 (06)

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ANNEXURE-IVPRESSURE GAUGE.

The pressure gauge should confirm to the following technical specifications:-

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

TEMPERATURE INDICATOR

Type Mercury in steel dial thermometer Rigid steam type with thermowell.

Case Die cast aluminium alloy moisture proof case, heavily enamelled black & sloved.

Dial Size 150mm

Range As per design

Accuracy 1% of total range

Bulb Material  $\frac{1}{2}"$  bulb diameter made of SS.316

Thermowell SS-AISI316 (with thread size  $G \frac{1}{2}"$ ) - (b)

Ambient Temp. 60°C max.

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18/8/84  
P. 55 38

ANNEXURE-IV

MAGNETIC LEVEL SWITCH

Process Connection : - Nb25 <sup>(b)</sup>

Material All parts coming in contact with the liquid made of stainless steel SS 316. <sup>(b)</sup>

Electrical Characteristics

Switch: Single pole double throw change over switch with silver contact for handling the following currents.

AC 250V - <sup>5.0</sup>~~1.0~~ A <sup>(02)</sup>

DC ~~upto 24V-2.5 A~~  
220V - 0.25 A

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.

WORKED BY A.K. JAIN

*A.K. Jain*

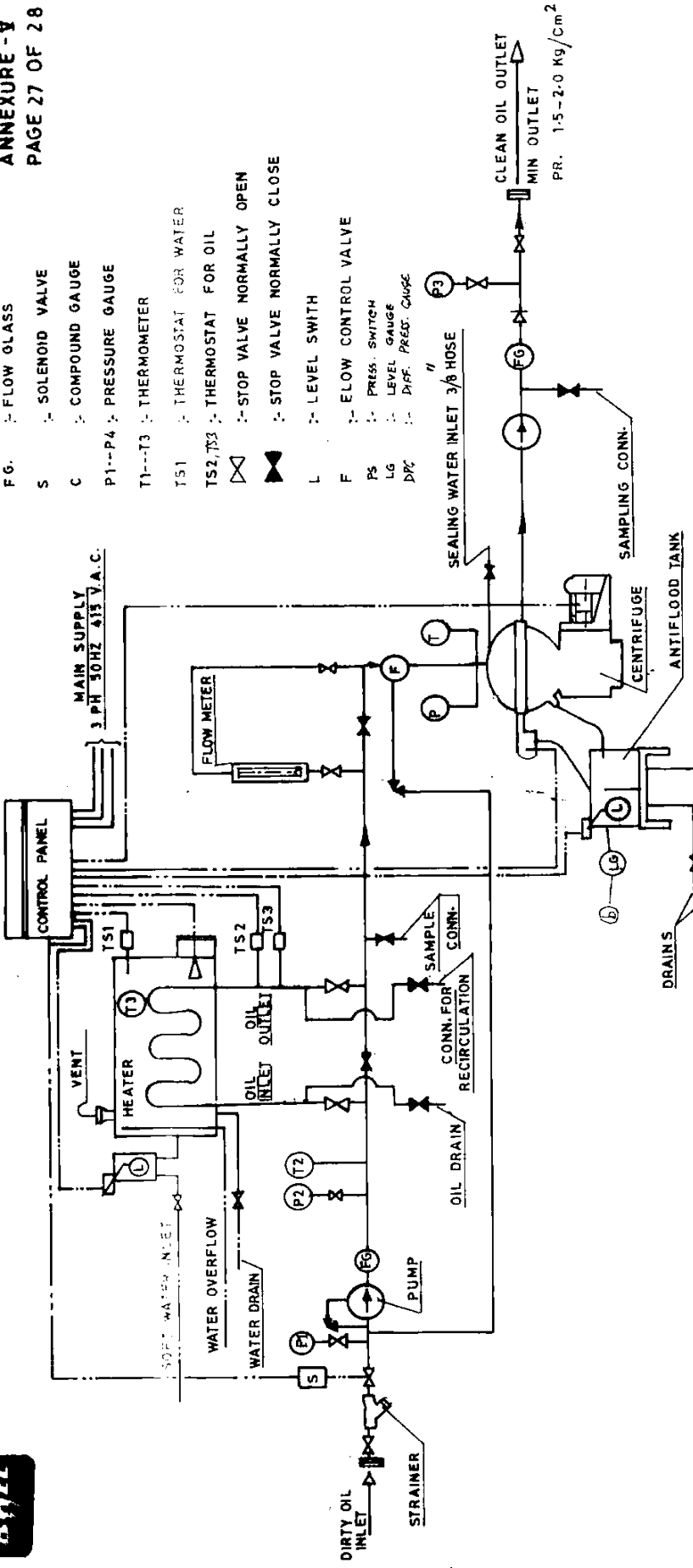
6.8.84

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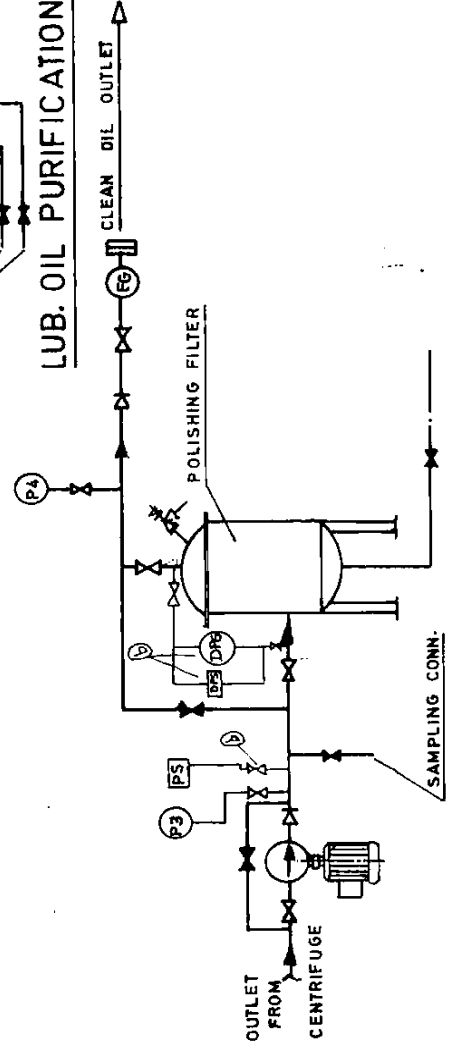
*K.C. Sachan*

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- DPS : DIFF. PRESS. SWITCH
- FG : FLOW GAUGE
- S : SOLENOID VALVE
- C : COMPOUND GAUGE
- P1--P4 : PRESSURE GAUGE
- T1--T3 : THERMOMETER
- TS1 : THERMOSTAT FOR WATER
- TS2, TS3 : THERMOSTAT FOR OIL
- ⊘ : STOP VALVE NORMALLY OPEN
- ⊚ : STOP VALVE NORMALLY CLOSE
- L : LEVEL SWITCH
- F : FLOW CONTROL VALVE
- PS : PRESS. SWITCH
- LG : LEVEL GAUGE
- DPC : DIFF. PRES. GAUGE



LUB. OIL PURIFICATION SCHEME WITHOUT POLISHING FILTER



L.O.P. SCHEME WITH POLISHING FILTER

WORKED BY	S. CAGRAWAL	28.10.86
CHECKED BY	A.K. JAIN	29.10.86

P. 5738 30.10.86



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RECORD OF CHANGES

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REV CODE	NO. OF CHGS	DOCU NO	SHEET NO.	SIGN	DATE	REV CODE	NO. OF CHGS	DOCU NO	SHEET NO.	SIGN	DATE
01	01	STE-84-549	SH. NO-7,8,22 23 & 24	<i>AKJ</i>	28.12.84						
02	06	STE-85-279	Page-4, 5, 16 20 and 26.	<i>AKJ</i>	16.4.85						
03	06	STE-86-359	page No 1 to 28 Page No 27 added	<i>AKJ</i>	28.10.86						
04	08	STE-87-373	Page No 12, 1	<i>AKJ</i>	6.10.87						
a	03	STE-92-650	Sht. 1 and 14 Sht. no 6, Super- seded by new Sheet under the same Sht. No.	<i>Jms</i>	28.11.92						
b	12	STE-95-570	Sh. no. 2, 4, 5, 13, 19, 24, 25, 26 & 27.	<i>AKJ</i>	23.1.96						
c	2	STE-2001- 370	Sh. no. 22 & 23	<i>AKJ</i>	10.10.01						

DISTRIBUTION OF PRINTS

DEPTT.	TGE	STE	AME	DME	HGE	HTE	ACE	HXE	MTE	CFX	IN-SUL SYS.	HLE	TSX	THC	PPX	MCX	CSX
		✓											✓				
DEPTT.	AIX	MSX	CCX	FAX	TFX	TLX	TTX	TTX-ST	TTX-HT	TTX-EM	WT	QAX	QCX	PCM	WC 202	WC 205	WC 227
												✓					
DEPTT.	FBM BL II	HTM	STM	WC 632	ACM	CIM	FBM BLV	SUM	WWM	FBM BL VIII	PMG						
											✓						

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INVENTORY NO

23.8.84

P-5538

REVISION	DRAWN	WORKED	CHECKED
		A. K. Jain	K.C. Sachan
		6.8.84	6.8.84

**ADDENDUM TO SPECIFICATION NO.: ST39013 REV.-C**

**APPLICATION : STEAM TURBINE**

**ITEM : OIL PURIFICATION UNIT**

**ADDITIONAL SPECIFICATION :**

1. The quality of purified oil at 65 °C shall be as follows.
  - 1.1. Purification level at the outlet of Oil Purification System shall be equal to or better than class 15/12 as per ISO 4406.
  - 1.2. Moisture contents in purified oil should not be more than 500 ppm.
2. One number polishing filter at the outlet of centrifuge shall be provided with  $\beta_3 = 200$  or better.
3. 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. **For the measurement, preferably transmitter shall be used.**
4. The test certificate for particle size & water content at the outlet of oil purification system shall be submitted. The particle size at the outlet of oil purification system shall be class 15/12 as per ISO 4406 from class 21/18 at the inlet of the oil purification system in single pass. The moisture content shall be maximum 300 to 500 ppm from inlet of maximum 15000 ppm in single pass.
5. Noise level shall not exceed 85 decibel measured at a distance of 1 meter from the equipment.
6. Drain and vent connections for level switch specified in Annexure-IV to ST39013 shall be NB15( $\phi$ 21.3X2.6).
7. The inlet, outlet & overflow connections to overflow sight fitting (as per clause 2.2 of BHEL spec. ST39013) shall be NB80( $\phi$ 88.9X3.96)/NB40( $\phi$ 48.3X3.96)/NB15( $\phi$ 21.3X2.6) 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.
8. Indirect Heater rating should be 72 KW (Steps: 36KW, 18KW, 18KW) to meet the requirements of clause 5.3 of ST39013.
9. Painting scheme for oil purification unit shall be as below.

<b><u>Paint (Coat)</u></b>	<b><u>Paint Type</u></b>	<b><u>No. of coat</u></b>	<b><u>DFT*</u></b>
Primer Paint:	Epoxy base Zinc rich primer paint	2 Coat	70
Intermediate Paint:	Epoxy TiO <sub>2</sub> Pigmented Polyamide Cured Paint	1 Coat	70

**ADDENDUM TO SPECIFICATION NO.: ST39013 REV.-C**

Finish (Final) Paint:	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	2 Coat	60
-----------------------	---	--------	----

Total Minimum DFT= 180

\*DFT– Dry Film Thickness (Final) in micron.

Paint Shade shall be as below or as informed later.

- For Oil purifier- Light Blue(RAL 5012)
- For Control Panel- External-Light Grey (shade 631 of IS-5)  
Internal- Brilliant White

10. Five set of each of filled data sheet, drawings, control panel schematic & write-up etc. shall be furnished **by vendor** for approval by BHEL/CUSTOMER after placement of order. Finally, thirteen set(paper based) and 2 set(in CDRom) of O&M manual shall be furnished after approval.

11. For relay based control panel, following additional requirements shall be met.

a. Panel construction:

Type: Fabricated from cold rolled sheet steel

Frame thickness: 2.0 mm

Enclosure thickness: 1.6 mm

Gland plate thickness: 3.0 mm

- b. Cables for Motors and heaters shall be adequately sized keeping sufficient margin. Sizes shall be subject to BHEL approval.
- c. Adequately sized copper ground bus shall be provided for each panel.
- d. **240/110 V AC**, single phase, thermostatically controlled, space heater shall be provided. For other projects it is subject to change.
- e. Panel shall be provided with a door switch operated fluorescent lamp and a 240 V AC plug point for panel lighting.
- f. Cable glands suitable for incoming 415 V feeder cables shall be provided. Sizes will be intimated later.
- g. Panel shall have 20% spare terminals.
- h. The material of all the sensing instruments shall be SS316.**
- i. All the sensing instruments shall be from single make and same shall be indicated in the BOM (Bill of Material).**
- j. Data sheets of all instruments, thermostats and motor shall be furnished for BHEL approval.

**ADDENDUM TO SPECIFICATION NO.: ST39013 REV.-C**

k. Purifier fault signals are to be available in DCS.

l. Fault level shall be 50 KA RMS for 1 second.

12. If a requirement is mentioned in special instructions of indent, then the requirement mentioned in indent will supersede the requirement mentioned in this addendum and BHEL specification ST39013.

13. Along with the offer and after placement of Purchase Order vendor shall provide drawings approved by BHEL for a technically same and earlier project (if applicable)

14. Vendor to specify type of drive for Oil Purification Unit. Wherever the drive is of gear type the lubricating oil for the lubrication of drive shall be in the scope of supply of vendor.

15. Above requirements supersede the corresponding requirements of ST39013.

(QAX)

(CIE)

(PED)

Record of Revision:-

S.No.	Revision History	Date	Revised by
1 Rev-01	Points revised :- 1.1,1.2;2;3 ; 10.4 ,10.8 ,10.9 ,10.11	14/09/2011	Pooja Joshi, Saurabh Tripathi

**ADDENDUM TO SPECIFICATION NO.: ST39013 REV.-C**

**APPLICATION : STEAM TURBINE**

**ITEM : OIL PURIFICATION UNIT**

**ADDITIONAL SPECIFICATION :**

1. The quality of purified oil at 65 °C shall be as follows.
  - 1.1. Purification level at the outlet of Oil Purification System shall be equal to or better than class 15/12 as per ISO 4406.
  - 1.2. Moisture contents in purified oil should not be more than 500 ppm.
2. One number polishing filter at the outlet of centrifuge shall be provided with  $\beta_3 = 200$  or better.
3. 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. **For the measurement, preferably transmitter shall be used.**
4. The test certificate for particle size & water content at the outlet of oil purification system shall be submitted. The particle size at the outlet of oil purification system shall be class 15/12 as per ISO 4406 from class 21/18 at the inlet of the oil purification system in single pass. The moisture content shall be maximum 300 to 500 ppm from inlet of maximum 15000 ppm in single pass.
5. Noise level shall not exceed 85 decibel measured at a distance of 1 meter from the equipment.
6. Drain and vent connections for level switch specified in Annexure-IV to ST39013 shall be NB15 ( $\phi 21.3 \times 2.6$ ).
7. The inlet, outlet & overflow connections to overflow sight fitting (as per clause 2.2 of BHEL spec. ST39013) shall be NB80( $\phi 88.9 \times 3.96$ )/NB40( $\phi 48.3 \times 3.96$ )/NB15( $\phi 21.3 \times 2.6$ ) 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.
8. Indirect Heater rating should be 72 KW (Steps: 36KW, 18KW, 18KW) to meet the requirements of clause 5.3 of ST39013.
9. Painting scheme for oil purification unit shall be as below.

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

**ADDENDUM TO SPECIFICATION NO.: ST39013 REV.-C**

Polyurethane Finish paint

Total Minimum DFT= 180

\*DFT– Dry Film Thickness (Final) in micron.

Paint Shade shall be as below or as informed later.

- For Oil purifier- Light Blue(RAL 5012)

10. Since unit oil purifier and central oil purifier are same, the drawings/documents to be furnished to BHEL for approval shall be common for both.
11. Five set of each of filled data sheet, drawings, control panel schematic & write-up etc. shall be furnished **by vendor** for approval by BHEL/CUSTOMER after placement of order. Finally, thirteen set (paper based) and 2 set (in CDRom) of O&M manual shall be furnished after approval
12. The purification system shall be operated from control room as well as local panel having the logic built in BHEL control system (DCS) instead of relay based control system. Following additional requirements shall be met.
  - 10.1. 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
  - 10.2. ON/OFF control, indication, and alarm functions shall be provided on the LCP as well as on MMI system (DCS).
  - 10.3. Mimic diagram as per Cl. 4.15 of ST39013 is not required.
  - 10.4. Control voltage shall be 110 V AC.
  - 10.5. Cables for Motors and heaters shall be adequately sized keeping sufficient margin. Sizes shall be subject to BHEL/NTPC approval.
  - 10.6. 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.
  - 10.7. Cable glands suitable for incoming 415 V feeder cables shall be provided. Sizes will be intimated later.
  - 10.8. LCP shall have 20% spare terminals.

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- 10.9. Data sheets of all instruments including RTDs , motor, solenoid valves, instruments and 3 way pneumatic valve shall be furnished for BHEL/Customer approval.
- 10.10. 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.
- 10.11. 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.
- 10.12. Reports of type tests shall be those conducted within last five years.
- 10.13. 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.
- 10.14. 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.
- 10.15. Interconnection diagram shall be provided along with offer.

**13. Control Philosophy**

- 11.1. 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.
- 11.2. 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.
- 11.3. 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.
- 11.4. 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.
- 11.5. Alarms shall be generated in DCS and output shall be given for driving the alarm windows in LCP.

**ADDENDUM TO SPECIFICATION NO.: ST39013 REV.-C**

- 11.6. A 3 way pneumatic valve shall be provided for recirculation of oil. A pressure switch at outlet of centrifuge and a level switch in anti flood tank shall be provided for detection of liquid seal breakage.
  - 11.7. Control of individual heaters stages shall be from DCS for maintaining required oil temp using 2 nos. duplex RTDs in place of thermostats.
  - 11.8. Limit switch shall be provided for separator cover for remote monitoring.
  - 11.9. Flow switch shall be provided at centrifuge inlet.
  - 11.10. List of drives to be operated from DCS, list of instruments and list of alarms shall be furnished along with the offer.
  - 11.11. Air requirement for 3-way valve shall be furnished with the offer.
  - 11.12. Functional testing of system shall be done with local control panel and by simulating DCS outputs.
14. If paint requirement is mentioned in special instructions of indent, then the requirement mentioned in indent will supersede the requirement mentioned in this addendum and BHEL specification ST39013.
15. Alongwith the offer and after placement of Purchase Order vendor shall provide drgs. approved by BHEL for a technically same and earlier project (if applicable)
16. Vendor to specify type of drive for Oil Purification Unit. Wherever the drive is of gear type the lubricating oil for the lubrication of drive shall be in the scope of supply of vendor.
17. Vendor to specify type of drive for Oil Purification Unit. Wherever the drive is of gear type the lubricating oil for the lubrication of drive shall be in the scope of supply of vendor.
18. Above requirements supersede the corresponding requirements of ST39013.

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(QAX)

S.No.	Revision History	Date	Revised by
1 Rev-01	Points revised :- 1.1,1.2;2;3 ; 10.4 ,10.8 ,10.9 ,10.11,	28/06/2012	Pooja Joshi, Saurabh Tripathi

**ADDENDUM TO SPECIFICATION NO.: ST39013 REV.-C**

	Point 15,16 inserted		
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**APPLICABLE MANDATORY SPARE LIST FOR LUB OIL PURIFICATION UNIT**

DRAWING NO-41810D61001 REV 00

PROJECT-**3X660 MW NORTH KARANPURA**

<b><u>LT switchgear &amp; LT BUSDUCTS</u></b>		
<b><u>SL NO</u></b>	<b><u>ITEM</u></b>	<b><u>REQUIRED QTY</u></b>
1	Aux contact set	<b>6 Sets</b>
2	Door Limit switches	<b>10 nos</b>
3	Fixed contact & moving contact main contact kit set	<b>6 sets</b>
4	Relays	<b>1 nos. of each type</b>
5	Power Contactor	<b>2 nos. of each type &amp; rating</b>
6	Control and Selector switches	<b>5 nos of each type and rating</b>
7	Indication lamp holders complete	<b>10 nos.</b>

NOTE-DRAWING SHOULD BE READ ALONGIWITH THE SPECIAL INSTRUCTIONS MENTIONED IN THE INDENT.

(B.S. RANA)

(DEVESH TIWARI)

(KAVITA MAURYA)

SDGM

ENGR

ASTT. ENGR

## **ADDENDUM TO SPECIFICATION NO ST39013.**

### **ADDENDUM NO-41810D51000 rev00**

supplier to consider and confirm below given technical requirements for instruments while designing the Lub Oil Purification System.

#### **Resistance Temperature Detector ( RTD )**

**Sr.**

**No.**

##### **Features Essential/Minimum Requirements**

- 1 Type of RTD. : Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
- 2 No. of element : Duplex
- 3 Housing/Head : IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection.
- 4 Sheathing of RTD : Metal sheathed, ceramic packed
- 5 Calibration and accuracy : As per DIN-43760 Class-A for RTD
- 6 Characteristic : Linear with respect to temp, within  $\pm 1/2$  percent of top range value.
- 7 Accessories : Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.
- 8 Standard : DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.

#### **NOTES :**

- 1) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.
- 2) The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice

#### **ROTAMETERS**

**Sr.**

**No.**

##### **Features Essential / minimum requirements**

1. Type Variable Area Metal Tube
2. Fluid media Water/oil
3. Tube body SS316
4. Material of float 316 SS
5. Indicator Linear scale
6. Accessories Flange, orifice in case of bypass Rota meter (for line size above 100 mm)
7. Housing protection class  
IP-55
8. Accuracy + 2% of measured value

**ADDENDUM TO SPECIFICATION NO ST39013.**

**ADDENDUM NO-41810D51000 rev00**

**ADDENDUM TO SPECIFICATION NO ST39013.**

**ADDENDUM NO-41810D51000 rev00**

**PROCESS ACTUATED SWITCHES**

**FEATURES**

**ESSENTIAL / MINIMUM REQUIREMENTS**

	Pressure/ Switches/ Switches	Draft DP	Temperature switches	Level switches
Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum		Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (10 m minimum)	Capacitance types, conductivity type, Ultrasonic type, float type, RF type,
Material	316 SS		Bulb 316 SS/ capillary 304 SS	316 SS
End connection	½ inch NPT (F)		½ inch NPT (F)	Manufacturer standard
Over range proof pressure	150% of max. design pr.	-		150% of max. design pressure
Repeatability	±0.5% of full range			
No. of contacts	2 No.+2NC. SPDT snap action dry contact			
Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)			
Elect. Connection	Plug in socket.			
Set point	Provided over full range.			
Dead band adjustment	Adjustment upto 10% at set points.			
Enclosure	Weather and dust proof as per IP-55			
Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process		Thermo well of 316 SS and packing glands	All mounting accessories
Mounting	Suitable enclosure/ mounting or direct mounting	for rack or	Suitable for rack mounting or direct mounting	-
Power Supply (wherever required)	24 V DC, to be arranged by Contractor except for Ash Level Switches, where the same shall be as per Contractor's Standard practice.			

## **ADDENDUM TO SPECIFICATION NO ST39013.**

### **ADDENDUM NO-41810D51000 rev00**

Notes :-

- 1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.
- 2) Pressure / Diff Pressure switches for very low pressure / DP measurements can have sensor material other than SS316 e.g. silicon etc., if the offered material is suitable for that application and the offered product is standard product of the manufacturer for very low pressure applications.
- 3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.
- 4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

#### **SOLENOID VALVES:-**

Solenoid valves shall fulfil the following requirements :

- a. Type 2/3/4 way SS 316/Forged Brass (depending on the application subject to Employer's approval during detailed Engg.)
- b. Power supply 24 V DC + 10%.
- c. Plug and socket electrical connection.
- d. Insulation : Class 'H'

MOTOR:-

MOTOR should be premium efficient class-IE3 for all LT motors.

note:-

This addendum to be read along with ST39013 and special instruction mentioned in indent.

**ADDENDUM TO SPECIFICATION NO.: ST39013**

**APPLICATION : STEAM TURBINE**

**ITEM : OIL PURIFICATION UNIT**

**ADDITIONAL SPECIFICATION :**

1-LT motors for continuous duty equipment shall be energy efficient (eff2) as per IS 12615-2004.

2- While considering of design of OPU system vendor to take care below given technical requirements

**Specifications for RTD**

S.N	Features	Minimum Requirements
1	Type	3 / 4 wire , Pt-100 (100 ohm at 0 deg C) (as per DIN 43760)
2	No. of Element	Duplex
3	Housing/Head	IP-65/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection
4	Sheathing of RTD	Metal sheathed , mineral insulated, ceramic packed
5	Calibration and accuracy	As per DIN-43670 Class-A for RTD
6	Stability	Zero & span drift within 0.1% of span for a 6 month period.
7	Characteristic	Linear with respect to temp, within $\pm 1/2$ percent of top range value
8	Standard	As per DIN-43670 for RTD & ASME PTC- 19.3 for Thermowell
9	Accessories	a) Adjustable Nipple-Union-Nipple with thermo well connection / plug in connectors
		b) Compression fittings / unions
		c) Flanges etc.
		d) Thermowell as per requirement

1. RTDs shall be of duplex, platinum three / four wire type with a nominal resistance of 100 ohms at 0°C and conform to DIN 43760 / BS 1904.

Stability of RTD over full range shall be better than 0.05 ohms and the repeatability figure shall be better than 0.02 ohms. Accuracy shall be of the order of 0.15% or better and response time shall be less than 20 seconds with thermo well.

2. The protective-sheath material shall be SS 316, seamless tubes using compacted magnesium oxide packing for insulation. The insulation resistance at 540°C shall not be less than 5 mega-ohms.
3. The time constant of the RTD shall suit the process requirements and shall be subject to approval of Owner / Consultant.

**ADDENDUM TO SPECIFICATION NO.: ST39013**

**Specification for Float/Displacer Type Level Switch**

S.N	Feature	Minimum Requirement
1	Type	Float/Displacer type
2	Float/Stem/Displacer Material	SS 316
3	Repeatability	± 0.5 % of full range or better
4	Accuracy	± 0.5 % of full scale or better
5	Working temperature	As per process requirement
7	Process connection	As per requirement
8	Over-range proof	150% of max. design pressure
9	No. of contact	2 NO. + 2 NC, SPDT, snap action type dry contact
10	Rating of contacts	5A, 240 V AC / 2A, 24 V DC / 0.25 A, 220V DC
11	Enclosure	IP 65
12	Hydro Test	Chamber - 100% at 1.5 times rated pressure or as per ANSI flange rating Float - 1.1 times of operating pressure
13	Electrical Connection	Plug-in socket
14	Accessories	All mounting accessories

**Specification for Flow Switch**

S.N	Feature	Minimum Requirement
1	Type	Vane actuated/Differential bellow type
2	Vane/bellow Material	SS 316
3	Repeatability	± 0.5 % of full range or better
4	Accuracy	± 0.5 % of full scale or better

**ADDENDUM TO SPECIFICATION NO.: ST39013**

S.N	Feature	Minimum Requirement
5	Working temperature	As per process requirement
7	Process connection	As per requirement
8	Over-range proof	150% of max. design pressure
9	No. of contact	2 NO. + 2 NC, SPDT, snap action type dry contact, shock & vibration proof
10	Rating of contacts	5A, 240 V AC / 2A, 24 V DC / 0.25 A, 220V DC
11	Enclosure	Cast Aluminium/IP 65
12	Cable connection	Compression type cable gland/ ½" NPT Conduit connection
13	Electrical Connection	Plug-in socket
14	Accessories	All mounting accessories

**Specification for Rotameter**

S.N	Feature	Minimum Requirement
1	Type	Variable area Linear scale
2	Fluid media	Water/Oil
3	Float Material	SS 316
4	Accuracy	± 2 % of full scale or better
5	Working temperature	0 to 70°C
6	Process connection	As per requirement
7	Over-range proof	150% of max. design pressure
8	Enclosure	Transparent toughened glass/IP 65
9	Accessories	Flange, orifice in case of bypass Rotameter

**ADDENDUM TO SPECIFICATION NO.: ST39013**

**Specification for Flow Glass**

S.N	Feature	Minimum Requirement
1	Application	Online observation of fluid flow in Pipeline
2	Type	Double window for pressurized pipe with rotary wheel for installation in horizontal or vertical pipeline. Full view for non-pressurized pipeline.
3	Size	Double window up to 12" and 600 lbs

S.N	Feature	Minimum Requirement
		rating. Full view up to 6" and 150 lbs rating.
3	Body Material	SS 316
4	Glass	Pyrex tempered glass
	Others	Rotor & wetted parts shall be bronze All accessories shall be SS316
5	Protection class	IP-65
6	Connection	Screwed up to 50 NB size Flanged ANSI 150 RF – above 50 NB size
7	Accessories	Name plates, mating flanges with gasket, bolts & nuts etc.

**Specification for Pressure Gauge/ DP Gauge/ Draft Gauge**

S.N	Feature	Minimum Requirement
1	Type	Bourdon / Bellows / Diaphragm
2	Sensing Element Material	AISI 316 SS
3	Movement Material	AISI 304 SS

**ADDENDUM TO SPECIFICATION NO.: ST39013**

S.N	Feature	Minimum Requirement
4	Case Material / Protection Class	SS / IP 65
5	Dial Size	150 mm For Special application 250 mm shall be used
6	Scale	Black lettering on white background in 270 °C arc
7	Range Selection	Normally operate at 75% of its maximum pressure range. Instruments measuring varying pressures shall operate in a band of 60% of its maximum pressure range.
8	Over range Protection	150% of maximum range by internal stop. External stop below zero.
9	Adjustment	External Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment.
10	Stop at Max. Reading	Shall be provided
11	Element Connection	Argon welding
12	Process Connection	½" NPT(M) bottom connection for local mounting, back connection for panel mounting
13	Accuracy	+/- 1.0 % of full scale or better
14	Operating Ambient Temperature	50 °C (Max. continuous)
15	Safety Feature	Neoprene Safety Diaphragm (Blowout disc) at the back
16	Window	Shatter-proof glass
17	Chemical Seal Unit	SS 316 Flange and Diaphragm, PTFE coated / block, Silicon Oil filling fluid
18	Accessories	Snubbers for pulsating fluid applications / 3-way gauge cock / 2-valve manifold / Pigtail / Siphon for steam service / Gauge Saver, if maximum or Design Pressure is very high than the Operating Pressure / Counter Flanges / Bolts, Nuts, Gaskets / SS Tag Plate

1. Directly connected pressure measuring instruments shall be diaphragm, bourdon or bellow type elements depending upon the services conditions. In general, diaphragm elements shall be used in the range of 0 to 1000 mm water column pressure, bellow type element for ranges of 0 to 1 Kg/cm<sup>2</sup> and bourdon type element for ranges greater than 1 Kg/cm<sup>2</sup>.
2. Primary element material shall be corrosion resistant to process fluid or diaphragm seals shall be provided for protection.
3. For draft measurement Teflon coated beryllium copper diaphragm shall be used.

**ADDENDUM TO SPECIFICATION NO.: ST39013**

4. Snubbers shall be floating pin type, externally mounted and externally adjustable. It shall be used for all pulsating services.
5. Diaphragm seals, filled type or mechanical type shall be furnished where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be the clean out type with flushing connection.
6. Over-range protection shall be provided to at least 150 % of range. For vacuum service, the element shall have under-range protection to full vacuum
7. Ranges of the gauges shall be so selected that the gauge normally operates in the middle third of the scale and conform to IS 3624 standard dials, wherever necessary.
8. The sensing elements for all gauges shall be properly aged and factory tested to remove all residual stresses and shall be SS 316 with forged socket and tip of the same material. Elements above 70 Kg/sq. cm range shall be bored instead of drawn.
9. For low pressure application where long elements are used, well supported protecting tube shall be installed to prevent mechanical damage and erosion of the elements.

**Specification for Temperature Gauge**

S.N	Feature	Minimum Requirement
1	Type	Mercury filled
2	Sensing Element material	Bourdon AISI 316 SS
3	Movement Materials	AISI 304 SS
4	Case Material/Protection class	SS / IP65
5	Capillary Armouring	SS Flexible
6	Capillary	SS 316 ( 5 mtr. Length for Local & 15 metre for panel Mounting)
7	Bulb/Stem Diameter	12 mm
8	Dial Size	150 mm
9	Window	Shatterproof glass
10	Scale	Black lettering on white background in 270 °C arc
11	Adjustment	Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment.
12	Pointer	Externally Adjustable
13	Range Selection	Normal Process Temperature –

**ADDENDUM TO SPECIFICATION NO.: ST39013**

S.N	Feature	Minimum Requirement
		approximately two third of Temperature range.
14	Stop at Max. Reading	Shall be provided
15	Over range Protection	150% of FSD
16	Instrument Connection	Bottom connection for local mounting, back connection for panel mounting.
17	Process Connection	½" NPT with Thermowell
18	Performance :-	
a	Accuracy	+/-1.0% of full scale or better
b	Repeatability	Less than 0.5% of full range
c	Response Time	30 seconds (max.) with Thermowell and 15 seconds Bare.
19	Operating Ambient Temperature	50 °C (Max. continuous)
20	Accessories	Mounting brackets, Bolts, Nuts, Gaskets / SS Tag plate, SS Thermowell etc.

1. Temperature gauges shall be dial thermometers (liquid spring / steam pressure spring / metal expansion thermometer), either rigid stem or capillary tube depending upon application; if this is not possible for design reasons, industry type liquid – in – glass thermometers shall be used.
2. Case shall have back or bottom connection with adjustable gland to permit adjustment of thermometer into the thermo well.
3. Thermometer stem adjustable gland with union connection and bushing shall be suitable for ½ inch NPT connection.
4. Bi-metallic type dial thermometer, if used, shall be hermetically sealed, back or bottom connection type, with 150 mm dial.
5. The gauges shall be provided with automatic ambient temperature compensation.
6. Scale ranges shall be selected so that normal process temperature in middle two – third of full scale range

**ADDENDUM TO SPECIFICATION NO.: ST39013 REV.-C**

**APPLICATION : STEAM TURBINE**

**ITEM : OIL PURIFICATION UNIT**

**ADDITIONAL SPECIFICATION :**

1. The quality of purified oil at 65 °C shall be as follows.
  - 1.1. Purification level at the outlet of Oil Purification System shall be equal to or better than class 15/12 as per ISO 4406.
  - 1.2. Moisture contents in purified oil should not be more than 500 ppm.
2. One number polishing filter (with  $\beta_3 = 1000$  or better) at the outlet of centrifuge shall be provided.
3. 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. **For the measurement preferably transmitter shall be used.**
4. The test certificate (not older than 5 years) for particle size & water content at the outlet of oil purification system shall be submitted. The particle size at the outlet of oil purification system shall be class 15/12 as per ISO 4406 from class 21/18 at the inlet of the oil purification system in single pass. The moisture content shall be maximum 300 to 500 ppm from inlet of maximum 15000 ppm.
5. Noise level shall not exceed 85 decibel measured at a distance of 1 meter from the equipment.
6. Drain and vent connections for level switch specified in Annexure-IV to ST39013 shall be NB15( $\phi$ 21.3X2.6).
7. The inlet, outlet & overflow connections to overflow sight fitting (as per clause 2.2 of BHEL spec. ST39013) shall be NB80( $\phi$ 88.9X3.96)/NB40( $\phi$ 48.3X3.96)/NB15( $\phi$ 21.3X2.6) 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.
8. Indirect Heater rating should be 90 KW (Steps: 48KW, 24KW, 12KW, 6KW) to meet the requirements of clause 5.3 of ST39013.
9. Painting scheme for oil purification unit shall be as below.

<b><u>Paint (Coat)</u></b>	<b><u>Paint Type</u></b>	<b><u>No. of coat</u></b>	<b><u>DFT*</u></b>
Primer Paint:	Epoxy base Zinc rich primer paint	2 Coat	70
Intermediate Paint:	Epoxy TiO <sub>2</sub> Pigmented Polyamide	1 Coat	70

**ADDENDUM TO SPECIFICATION NO.: ST39013 REV.-C**

Finish (Final) Paint:	Cured Paint		
	Aliphatic Acrylic 2 Pack	2 Coat	60
	Polyurethane Finish paint		

Total Minimum DFT= 180

\*DFT– Dry Film Thickness (Final) in micron.

Paint Shade shall be as below or as informed later.

- For Oil purifier- Light Blue(RAL 5012)

10. Since unit oil purifier and central oil purifier are same, the drawings/documents to be furnished to BHEL for approval shall be common for both.
11. Five set of each of filled data sheet, drawings, control panel schematic & write-up etc. shall be furnished for approval by BHEL/CUSTOMER after placement of order. Finally, thirteen set (paper based) and 2 set (in CDROM) of O&M manual shall be furnished after approval.
12. The purification system shall be operated from control room as well as local panel having the logic built in BHEL control system (DCS) instead of relay based control system. Following additional requirements shall be met.
  - 11.1. 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
  - 11.2. ON/OFF control, indication, and alarm functions shall be provided on the LCP as well as on MMI system (DCS).
  - 11.3. Mimic diagram as per Cl. 4.15 of ST39013 is not required.
  - 11.4. Control voltage shall be 110 V AC.
  - 11.5. Cables for Motors and heaters shall be adequately sized keeping sufficient margin. Sizes shall be subject to BHEL/NTPC approval.
  - 11.6. 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.
  - 11.7. Cable glands suitable for incoming 415 V feeder cables shall be provided. Sizes will be intimated later.
  - 11.8. LCP shall have 20% spare terminals.

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- 11.9. Data sheets of all instruments including RTDs , motor, solenoid valves, instruments and 3 way pneumatic valve shall be furnished for BHEL/Customer approval.
- 11.10. 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.
- 11.11. 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.
- 11.12. Reports of type tests shall be those conducted within last five years.
- 11.13. 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.
- 11.14. 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.
- 11.15. Interconnection diagram shall be provided along with offer.

**13. Control Philosophy**

- 12.1. 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.
- 12.2. 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.
- 12.3. 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.
- 12.4. 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.
- 12.5. Alarms shall be generated in DCS and output shall be given for driving the alarm windows in LCP.

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- 12.6. A 3 way pneumatic valve shall be provided for recirculation of oil. A pressure switch at outlet of centrifuge and a level switch in anti flood tank shall be provided for detection of liquid seal breakage.
- 12.7. Control of individual heaters stages shall be from DCS for maintaining required oil temp using 2 nos. duplex RTDs in place of thermostats.
- 12.8. Limit switch shall be provided for separator cover for remote monitoring.
- 12.9. Flow switch shall be provided at centrifuge inlet.
- 12.10. List of drives to be operated from DCS, list of instruments and list of alarms shall be furnished along with the offer.
- 12.11. Air requirement for 3-way valve shall be furnished with the offer.
- 12.12. Functional testing of system shall be done with local control panel and by simulating DCS outputs.
- 14. Alongwith the offer and after placement of Purchase Order vendor shall provide drgs. approved by BHEL for a technically same and earlier project (if applicable)
- 15. Scope of supply of vendor shall be such, that Oil Purification System can be used as purifier as well as clarifier.
- 16. Above requirements supersede the corresponding requirements of ST39013.
- 17. If paint requirement is mentioned in special instructions of indent, then the requirement mentioned in indent will supersede the requirement mentioned in this addendum and BHEL specification ST39013.

(QAX)  
Revision Record

(CIE)

(PED)

S.No.	Revision History	Date	Revised by
1 Rev-01	Points revised :- 1.1,1.2;2;3 ; 10.4 ,10.8 ,10.9 ,10.11, Point 14 inserted	28/06/2012	Pooja Joshi, Saurabh Tripathi
2- Rev-02	Point revised: 4, 15	22.11.14	Saurabh Tripathi

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.	AS PER PO											
		SPEC.	AS PER PO											
	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			REMARKS	
1	2	3	4	5	6	7	8	9	D	M	B	N	10	11


MANUFACTURER/SUBCONTRACTOR		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	
		ALL 'W' INDICATED IN COLUMN 'N' SHALL BE 'CHP' OF CUSTOMER		APPROVED BY