REF. DOC. ST22002

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. (2×50% separators in parallel shall also be considered but not preferred in case 1×100% offer is available) 64

(b) One dirty oil feed pump complete with its drive.

(c) One clean oil feed pump complete with its drive. a

(d) polishing filter, ~~if required. Refer clause 5.2~~ 3

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. 63

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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			DRAWN		
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SIGN & DATE 21.8.84

INVENTORY No. P. 5538

REVISION a

DATE 28-11-92

DISTRIBUTION | QTY.

APPROVED 25/8/84

ENGG. DEV. MANAGER

ST 8.20

PREPARED	ISSUED	DATE
STE	STE (TL) HARDWAR	25.8.84

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 turboset.

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%.* (8)

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 TG set shall be $\simeq 50^{\circ}C$ but unit should be designed to operate with oil at $20^{\circ}C$ during cold starting of TG 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 (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 IS, BS: or equivalent standard.

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, hysterisis, repeatability etc. shall be within the specified limits i.e. ±1%. Pressure gauge and thermometers shall be H. Guru/ 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 ,3Ø,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, 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 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 alongwith remote indication facility in the control panel of protection type/~~IP 42~~ IP52 (02) 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 switches in steps. The thermostatic switches 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 interlocked with the pump motor circuits to shut off the heaters when the pumps are not being operated. → not less than 3 (6)

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 pr. switch with adjustable contacts to indicate high pressure drop across the 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 hookedup with central annunciation system in the control room.

(02) h) An ammeter on control panel for oil centrefuge 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 alongwith 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 suostantial 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 cleanlines 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.

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, Uts, impact, % 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 buttwelds 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 vessle 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

/ vapour tightness, maximum particle size and moisture content in discharge.

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g) Performance test on luoe 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.

(01) L thermostat, level switch and solenoid valve

i) 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) (01)

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 ±10% Voltage variation. (01)

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 throughly 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 pretmatment/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 throughly cleaned, dried and conserved before packing. Conservation shall be suitable for storing in saline atmesphere & 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 of 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 drg. 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 detials 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 ½ 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. Manaul shall clearly indicated 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-erectbon.
d) Erection
e) Pre-commissioning.
f) Commissioning
g) Post commissioning.

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ANNEXURE-I

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	Nil	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	Deaeration 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

		Variant-1 for 200/210 MW T/ set	Variant-2 for 500 MW T/ Set	Var.-3
III	Capacity of oil system	30M³	37.5 M³	30 M³
IV	Base area limitation for purification unit length x Width mm mm	~~2900 x 2900~~ 2500 x 2500	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 (indirect)	Yes/No
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 centrigue 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 (for Turbine Oil)	Lit/Hr.
3.4	Recommended through put for best performance (for turbine oil)	Lit/hr.
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

(a)