

Annexure-4

TECHNICAL SPECIFICATIONS FOR NITROGEN INJECTION FIRE PREVENTION AND EXTINGUISHING SYSTEM FOR OIL FILLED TRANSFORMER

1.0 GENERAL DESCRIPTION:

Nitrogen injection fire protection system designed for oil filled transformers shall prevent tank explosion and the fire during internal faults resulting in an arc, where tank explosion will normally take few seconds after arc generation and also extinguish the external oil fires on transformer top cover due to tank explosion and /or external failures like bushing fires, OLTC fires and fire from surrounding equipment.

The system shall work on the principle of DRAIN AND STIR and on activation, it shall drain a pre-determined quantity of oil from the tank top through outlet valve to reduce the tank pressure and inject nitrogen gas at high pressure from the lower side of the tank through inlet valves to create stirring action and reduce the temperature of top oil surface below flash point to extinguish the fire.

Conservator tank oil shall be isolated during bushing bursting, tank explosion and oil fire to prevent aggravation of fire.

Transformer isolation shall be an essential pre-condition for activating the system. The system shall be designed to operate automatically. However it shall be designed for manual operation, in case of failure of power supply.

The system shall consist of following equipments.

1. Fire extinguishing cubicle placed on a plinth at about 5-10 meter away from the transformer.
2. Control box placed in the control room.
3. Pre-stressed non return valve in the conservator pipe.
4. Required number of fire detectors on the tank top cover.
5. Signal box fitted on the tank top or tank side wall.

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2.0 SCOPE:

The scope of this specification covers design, engineering, supply, testing at works before dispatch; erection, testing and commissioning and performance demonstration of " fire protection and extinguishing system by nitrogen injection method". The necessary civil work which will be required for construction of oil soak – pit for the storage of oil coming out from the transformer and plinth for extinguishing cubicle is outside the scope of this specification. However, laying of oil pipe, nitrogen pipe,

electrical cables, control boxes, extinguishing cubicle, nitrogen cylinder, PRV, fire detectors and other equipments & accessories required for erection, testing, commissioning and performance demonstration of the complete fire protection system is in the scope of the tenderer. It will be the responsibility of the tenderer, i.e. transformer manufacturer to coordinate with the supplier of the Fire Protection System for all the arrangements for the complete erection, testing, commissioning and performance tests. Notwithstanding the technical specifications and requirements mentioned herewith any modification can be incorporated for correct operation of nitrogen injection fire protection system without extra cost. The full details of the same are required to be submitted to RDSO for approval.

3.0 OPERATIONAL CONTROLS:

The system shall be provided with automatic control for fire prevention and fire extinction. Besides automatic control remote electrical push button control on control box and local manual control in the fire extinguishing cubicle shall be provided. Spare interlocks are to be provided for ensuring that it should not be possible to close HV or LV circuit breakers to energize the transformer after the activation of the fire prevention and fire extinction system.

4.0 SYSTEM ACTIVATING SIGNALS:

Transformer isolation shall be an essential pre-condition for activating the system. Transformer isolation through Master trip relay or circuit breaker (HV and LV side in series) has to be incorporated. Besides, two electrical signals to be provided in series, for activating the system as under:

For Prevention :

- : Differential relay.
- : Buchholz relay paralleled with pressure relief valve.

For Extinction:

- : Fire detector.
- : Buchholz relay paralleled with pressure relief valve.

5.0 SYSTEM EQUIPMENT:

- A. Fire Extinguishing Cubicle (FEC), placed on plinth at about minimum 5 meter away from the transformer, shall consist of:
1. Nitrogen gas cylinder with regulator and falling pressure electrical contact manometer.
 2. Oil drain pipe with mechanical quick drain valve.
 3. Electro mechanical control equipments for oil drain and pre-determined regulated nitrogen release.
 4. Pressure monitoring switch for backup protection for nitrogen release.

- 5. Limit switches for monitoring of the system.
 - 6. Flanges on top panel for connecting oil drain and nitrogen injection pipes for transformer.
 - 7. Panel lighting
 - 8. Oil drain pipe extension of suitable sizes for connecting pipes to oil pit
- B. Control box with activating, monitoring devices and line faults indicators. (to be placed in control room). It should have audio visual alarm indication and push button switches.
- C. Pre- stressed non return valve (PNRV) to be fitted in the conservator pipe line, between conservator and buchholz relay operating mechanically on transformer oil flow rate with electrical signal for monitoring.
- D. Fire detectors to be fixed on transformer tank top cover and Off Circuit Tap Changer for sensing fire.
- E. Signal box to be fixed on transformer side wall for terminating cable connections from fire detectors and PNRV.
- F. All other consumables necessary for complete system.

6.0 OTHER REQUIREMENTS FOR SYSTEM INSTALLATION:

- A. Oil drain and nitrogen injection openings with gate valves on transformer ~~_____ tank at suitable locations~~
- B. Flanges with dummy piece in conservator pipe between Buchholz relay and conservator tank for fixing PNRV.
- C. Fire detector brackets on transformer top cover.
- D. Spare potential free contacts for system activating signals i.e. differential relay, buchholz relay, pressure relief valve, transformer isolation (master trip relay).
- E. Pipe connections between transformer to fire extinguishing cubicle and fire extinguishing cubicle to oil pit.
- F. Cabling on transformer top cover all fire detector to be connected in parallel and inter cabling between signal box to control box and control box to fire extinguishing cubicle.
- G. Plinth for fire extinguishing cubicle. Oil pit with capacity as 10 % of total oil quantity of transformer.

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7.0 TECHNICAL DETAILS:

Fire Extinction period

On commencement of Nitrogen injection :	Maximum	30 seconds.
On system activation up-to post cooling :	Maximum	3 minutes

Fire detectors heat sensing temperature : 141 ° C

Heat sensing area : 800 mm radius

Pre- stressed non returnvalve setting for operation: min. 60 ltr. per minute

Power Source:

Control Box.	:	110 V DC
Fire extinguishing cubicle for lighting	:	240 V AC

8.0 CABLING:

Fire survival cables, able to withstand 750 °C, 4 core x 1.5 mm sq for connection of fire detectors in parallel shall be used. The test certificates for the cables shall be submitted.

Fire retardant low smoke (FRLS) cable 12 core x 1.5 mm sq. for connection between transformer signal box/ marshalling box to control box and control box to fire extinguishing cubicle shall be used.

Fire retardant low smoke (FRLS) cable 4 core x 1.5 mm sq. for connection between control box to DC supply source and fire extinguishing cubicle to AC supply source, signal box/ marshalling box to pre- stressed non return valve connection on transformer shall be used.

9.0 PREVIOUS EXPERIENCE FOR QUALIFYING SUPPLIER:

The supplier shall have a minimum experience of two years in the design, manufacturing, erection, testing and commissioning of nitrogen injection fire protection system on power transformers of similar or higher rating. At least 2 sets of the system shall be in successful operation for a minimum period of the 2 years. The supplier shall furnish the details of nitrogen injection fire protection systems supplied by them so far, giving order reference, name and address of the customer, indicating the dates of commissioning as well as performance certificate of successful and satisfactory operation for minimum two years from the customers.

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10.0 TESTS

10.1 TYPE TESTS

Type test reports including that for detectors alongwith declared response time as per TAC's letter shall be submitted alongwith the tender.

The system shall be tested by UL, FM, LPC or a national testing body (BIS recognized laboratory). TAC's approval, if any, shall be submitted with the tender.

10.02 FACTORY TEST

Tests will be carried out on individual equipment of the system and the total system in the supplier's workshop in presence of purchaser's representative.

10.03 PERFORMANCE TEST

Performance test of the complete system shall be carried out after complete erection at site by the supplier's representative. These tests shall include simulation and verification of the response the complete system without actual draining of the oil and injection of the nitrogen gas.

In addition to above, additional tests as required necessary shall be conducted.

11.0 DRAWINGS AND MANUALS

Detailed layout drawing along with the equipment drawing to be given in the tender along with complete bill of materials. After awarding of contract, detailed dimensional drawing of the system complete bill of materials including location and size of plinth for cubicle and recommended capacity of oil soak-pit shall be submitted for purchaser's approval. After approval 10 (ten) sets of all above drawings and 5 (five) sets of operation and maintenance instruction manual (bound) shall be submitted for purchaser's use.

11.0 SPARES:

One full set of spare nitrogen gas filled cylinder, 50% of the installed no. of fire detectors (heat sensing element) shall be provided in addition to additional other recommended spares. The list of recommended spares is to be submitted along with the tender.

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