

PRODUCT PURCHASING SPECIFICATION
TRANSFORMER ENGINEERING DEPARTMENT
BHEL, JHANSI

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

1.0 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, plinth for extinguishing cubicle, MS Tank, laying of oil pipe, nitrogen pipe, electrical cables, control boxes, extinguishing cubicle, nitrogen cylinder, necessary valves, fire detectors and other equipment's & accessories required for erection, testing, commissioning and performance demonstration of the complete fire protection system is in the scope of the tenderer. 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 BHEL for approval, when first unit is implemented on a transformer of specific make & rating.

2.0 General Description

This standard lays down the specification for Nitrogen Injection Explosion prevention and Fire Extinguishing System for oil cooled transformer. Dedicated Nitrogen injection system is used to:

- Prevent transformer tank explosion and possible fire, in the event of internal fault and as such it acts as fire preventer.
- Also act as firefighting system

System comprises of Cubicle (installed near the transformer), Control Box(installed in control room), Conservator isolation valve(installed in conservator pipeline), Piping & valves for draining oil from transformer, equipment & piping for nitrogen injection, Fire detectors (on transformer top cover), Copper Cables.

3.0 Reference standards

- a) Central Electricity Authority, the Gazette of India, Extraordinary 2010
- b) Technical standards for constructions of substations and switchyards
- c) Technical standards for construction of Thermal Generating Stations
- d) Safety provisions for electrical installations and apparatus of voltage exceeding 650 volts
- e) CBIP Manual on Transformers-Publication No.317

4.0 Principle of Operation

Depressurization process commences through oil drain and simultaneously nitrogen is injected at a predetermined flow rate to create stirring action and to bring down temperature of top oil below ignition point, evacuates gases formed thereby preventing explosion of tank and in case of fire, it extinguishes fire within maximum 30 seconds. During fault condition, system operates and conservator isolation valve blocks oil flow to isolate conservator tank oil. Also in case of fire, it prevents escalation of fire.

The system comes in to operation automatically/ remotely/ manually under following conditions:-

Auto Mode

- a) For Prevention of Fire, signals in series:
 - Differential Relay Operation,
 - Buchholz Relay paralleled with Pressure Relief Valve or Rapid Pressure Release Relay
 - Tripping of all connected breakers (HV & LV side) is a pre-requisite for initiation of system activation.
- b) For Extinguishing Fire, signals in series:
 - Fire Detector,

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- Buchholz Relay paralleled with Pressure Relief Valve or Rapid Pressure Release Relay
- Tripping of all connected breakers (HV & LV side) is a pre-requisite for initiation of system activation.

Manual Mode (Remote)

- Tripping of all connected breakers (HV & LV side) is a pre-requisite for initiation of system activation.

Manual Mode (Mechanical)

- Tripping of all connected breakers (HV & LV side) is a pre-requisite for initiation of system activation.

5.0 System features

- System shall have interlock to ensure operation of system only after transformer electrical isolation to avoid nitrogen injection in energized transformer.
- Pressure monitoring switch for back-up protection for nitrogen release as redundancy to first signal of oil draining commencement for Nitrogen release shall be provided.
- Nitrogen release scheme shall be designed in such a way that the nitrogen gas shall not enter the energized transformer tank even in case of passing/leakage of valve.
- System shall have provision of testing during commissioning, during annual maintenance and on live transformers to ensure healthiness at all times.

6.0 Data Sheet

SI No	Description	Specifications/Requirement	Tick Appropriate Answer.
1.	Type and Model a) Type 1 b) Type 2 c) Type 3	Nitrogen Injection Explosion Prevention and Extinguishing System for transformer rating a) Upto 80 MVA b) 81 MVA to 160 MVA c) 161 MVA and above	Offered/Not Offered Offered/Not Offered Offered/Not Offered
2.	Details of system equipment enclosed with technical bid.	a) OGA of Fire Extinguishing Cubicle with BOM b) Logic Diagram of Control box c) Dimensioned Drawing of Conservator Isolation Valve d) Logic Diagram of Signal Box e) Technical specification of Fire Detectors/ LHD	Yes/No Yes/No Yes/No Yes/No Yes/No
3	Fire Extinguishing Cubicle	Split door	Yes/No
3.1	Dimensions (LXBXH)	Vendors to specify in mm A) Type 1 B) Type 2 C) Type 3	
3.2	Weight	Vendors to specify in kg a) Type 1 b) Type 2 c) Type 3	

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3.3.1	Capacity and quantity of Nitrogen cylinder	a) For Type 1 Minimum 1 No cylinder with 10 cu m gas at pressure of 150-200 kg/sq. cm b) For Type 2 Minimum 1 No cylinder with 10 cu m gas at pressure of 150-200 kg/sq. cm c) For Type 3 Minimum 2 No cylinders with 10 cu m gas each at pressure of 150-200 kg/sq. cm	Accepted/Not Accepted
3.3.2	Nitrogen gas purity	d) Nitrogen purity shall 99.99%. for all 3 Types of NIFPES Models	Accepted/Not Accepted
3.4	Pressure of Nitrogen filling	Maximum 200 kg/sq. cm	Accepted/Not Accepted
3.5	Minimum distance of Fire Extinguishing cubicle from the transformer	5 Meters or beside fire safety wall	Accepted/Not Accepted
3.6	Method of mounting	Plinth mounted	Accepted/Not Accepted
3.7	Items to be provided in the Fire Extinguishing cubicle		
3.7.1	Contact manometer	Will a) Show nitrogen cylinder pressure b) Show Falling pressure c) Have Electrical contact & dual indicator for actual pressure as well as level for low pressure signal	Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted
3.7.2	Pressure Regulator with safety relief valve to increased temperature variation compensation	a) Inlet pressure: 150 -200 kg/sq. cm (+/- 10%) b) Outlet pressure range: 8 to 12 kg/sq. cm	Accepted/Not Accepted Accepted/Not Accepted
3.7.3	Pressure gauge	For showing nitrogen injection pressure.	Accepted/Not Accepted
3.7.4	Oil Release Unit and suitable to operate without power	A) Electro mechanical type, operating on substation DC supply as well with provision for operation using manual lever in case of DC supply loss. B) It shall have mechanical locking arrangement to ease in maintenance and avoid unnecessary operation during maintenance test.	Accepted/Not Accepted Accepted/Not Accepted
3.7.5	Gas release unit and suitable to operate without power	a) Electro mechanical type, operating on substation DC supply as well with	

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		provision for operation using manual lever in case of DC supply loss. b) It shall have mechanical locking arrangement to ease in maintenance and avoid unnecessary operation during maintenance test.	Accepted/Not Accepted Accepted/Not Accepted
3.7.6	Oil drain assembly	Electro mechanical type, operating on substation DC supply as well with provision for operation using manual lever in case of DC supply loss.	Accepted/Not Accepted
3.7.7	Pressure monitoring switch as backup in addition to signal from limit switch to initiate nitrogen release simultaneously with oil drain commencement	Provision of Limit switch with Pressure Switch (Back up)	Accepted/Not Accepted
3.7.8	Limit switches with No of contacts & spare contacts (NO & NC)	1. Oil drain valve closed. 2NO 2.Oil drain valve open.2NO 3. Gas valve closed. 1NO+1NC 4. Gas injection started. 1NO+1NC 5.Oil drain unit locked mechanically.2NO/ 1NC+1NO 6.Nitrogen release unit locked mechanically 2NO/ 1NC+1NO	Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted
3.8	Oil drain valve (above cubicle) for system isolation from transformer		
3.8.1	Material and Type	Mild Steel, Butterfly valve	Accepted/Not Accepted
3.8.2	Size	a) Upto 80 MVA: 80 mm b) 81 MVA to 160 MVA :150 mm c) 161 MVA and above:150 mm	Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted
3.9	Nitrogen Injection valve (above cubicle) for system isolation from transformer		
3.9.1	Material and Type	Gun metal, Lockable, Stem rising	Accepted/Not Accepted
3.9.2	Size	25 NB	Accepted/Not Accepted

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3.10	Oil drain pipe size	a) Upto 80 MVA: 80 mm b) 81 MVA to 160 MVA :150 mm c) 161 MVA and above:150 mm	Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted
3.10.1	Length and Number of openings in the transformer tank	a) To be provided by Vendor as per site location, from Transformer to Fire Extinguishing cubicle & from Fire Extinguishing cubicle to oil pit/MS Tank b) 1 No. opening in tank will be given for oil draining	Accepted/Not Accepted Accepted/Not Accepted
3.10.2	Material	a) MS ERW, Heavy duty for Trfr to fire extinguishing cubicle b) GI, Medium for fire extinguishing cubicle to oil pit	Accepted/Not Accepted Accepted/Not Accepted
3.11	Degree of protection of Fire extinguishing Cubicle	IP 55	Accepted/Not Accepted
4	Control Box		
4.1	Dimensions (LXBXH)	Vendors to specify in mm a) Type 1 b) Type 2 c) Type 3	
4.2	Weight	Vendors to specify in kg a) Type 1 b) Type 2 c) Type 3	
4.3	Type & thickness of sheet steel	CRCA, 16/14 SWG	Accepted/Not Accepted
4.4	Make of components provided in the control box	Vendor to specify make of a) MCB b) Relays c) Hooters d) Contactors e) indicating lamps	

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		f) Operating switches	
4.5	Control voltage	a) 110/220 V DC/ substation voltage.	Accepted/Not Accepted
		b) AC-DC/ DC-DC converter, timer shall not be used for reliable operation	Accepted/Not Accepted
4.6	Method of mounting	Wall / Frame	Accepted/Not Accepted
4.7	Audio and visual alarms	To be provided with different volume (dB) levels	Accepted/Not Accepted
4.8	Degree of protection	IP 42	Accepted/Not Accepted
5	Conservator Isolation Valve/ Shutter		
5.1	Type	Operating mechanically on Transformer oil flow rate with visual position indicator	Accepted/Not Accepted
5.2	Location	Horizontally in the conservator pipe line between Conservator and Buchholz relay	Accepted/Not Accepted
5.3	conservator pipe	Suitable for conservator pipe size 80 mm	Accepted/Not Accepted
5.4	No of contacts & spare contacts (NO & NC)	Normally Open contact shall be provided	Yes/No
5.5	Padlocking provision for service, filtration/ refilling / filling	To be provided	Accepted/Not Accepted
5.6	Visual position indicator similar to Buchholz relay for inspection	For physical close indication to be provided	Accepted/Not Accepted
5.7	Transformer Conservator Isolation valve setting for normal operation (Valve should not close) to ensure no obstacle for transformer breathing	40 ltr / minute for 80 mm conservator pipe	Accepted/Not Accepted
5.8	Transformer conservator Isolation valve setting for operation during abnormal flow of oil due to rupture/ explosion of tank or bushing/ oil drain during system operation	60 ltr/ minute (minimum) for 80 mm conservator pipe	Accepted/Not Accepted
6	Fire Detectors or Linear Heat Detectors (LHD)		
6.1	Type	Quartz bulb, Heat sensing / Linear Heat Detector type required - Vendor to specify type offered	Quartz Bulb, Heat Sensing / Linear Heat Detector

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6.2	Quantity Required	Depending upon Transformer top cover area – to ensure full coverage	Accepted/Not Accepted
6.3	Method of Fixing	a) Bolting on Fire Detector bracket on Transformer top cover. b) using fire survival , copper cables (capable to withstand 750 deg C)	Accepted/Not Accepted Accepted/Not Accepted
6.4	Temperature for heat sensing (Minimum)	140 +/- 2 deg C	Accepted/Not Accepted
6.5	Heat sensing area	800 mm radius	Accepted/Not Accepted
6.6	Number of contacts	2 NO	Accepted/Not Accepted
6.7	Necessity and condition of refilling/replacing	After operation	Yes/No
7	Power Supply		
7.1	For Control Box	a) For operation: 110/220 V DC / Substation DC voltage b) For DC fail alarm: 230 V AC	Accepted/Not Accepted Accepted/Not Accepted
7.2	For Cubicle	For illumination and heating : 230 V AC	Accepted/Not Accepted
8	Extinction period		
8.1	On commencement of Nitrogen injection	Maximum 30 seconds	Accepted/Not Accepted
8.2	On system activation	Maximum 3 minutes	Accepted/Not Accepted
9	Provision to be given for	A. On line supervision of operating signals B. DC supply monitoring, C. Test facility (excluding CIV, FD) on live transformer, D. Anti-condensation heater for Cubicle, E. Manual operation in DC supply fail, F. Separate oil drain and Nitrogen release mechanisms.	Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted
10	Details of Tank Openings/Fittings to be provided by Vendor for items in BHEL scope after placement of Purchase Order. (Transformer OGA Drg will be given by BHEL to Vendor)	a) For Oil drain opening location on tank wall b) For Oil drain opening – size of Cast Iron Gate valve c) For nitrogen injection – location of all openings on tank wall d) For nitrogen injection – size of gun metal valves e) Flange sizes with dummy piece (length) in conservator pipe between Buchholz relay and conservator tank for fixing of	Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted

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		TCIV f) Brackets on transformer top cover for sensing equipment – location g) Brackets on transformer top cover for sensing equipment – dimensional drawing. h) Spare potential free contacts for system activating signals i.e. differential relay, buchholz relay, pressure relief valve, transformer isolation (master trip relay)-type and nos	Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted
11	CABLING	a) Fire survival cables, able to withstand 750 °C, for connection of fire detectors (if applicable) in parallel shall be used. b) Fire retardant low smoke (FRLS) copper cable 10/12 core X 2.5 mm ² along with accessories c) Fire retardant low smoke (FRLS) copper cable 4 core X 2.5 mm ² along with accessories d) Test certificates for all the above cables shall be submitted.	Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted
12	Oil pit/ MS tank	Oil pit (civil construction)/ MS tank as required by BHEL with capacity as 10 % of total oil quantity of transformer will be provided.	Accepted/Not Accepted
13	FACTORY TEST	Tests will be carried out on following in the supplier's workshop in presence of purchaser's representative. a) Cubicle, showing oil drain and nitrogen injection b) Operation of Conservator isolation valve c) Operation of Control box d) Fire Extinguishing Performance test on total system.	Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted Accepted/Not Accepted
14	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	Accepted/Not Accepted
15	TYPE TESTS	Following Type test reports from international or national (NABL accredited) lab to be submitted along with techno commercial bid :	

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		a) Performance/Operational test on Nitrogen Fire Prevention & Extinguishing system offered.	Enclosed/Not Enclosed
		b) Heat Detectors showing response time.	Enclosed/Not Enclosed
		c) TAC approval (if available)	Enclosed/Not Enclosed
16	DRAWINGS AND MANUALS	Following is to be submitted to BHEL: a) Detailed layout drawing along with the equipment drawing to be given along with techno commercial bid indicating complete bill of materials. b) 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. c) 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.	Enclosed/Not Enclosed Accepted/Not Accepted Accepted/Not Accepted
17	Spares	Spare Nitrogen Cylinder, Heat Sensor for Fire detectors or LHD, set of Hose pipes and Nitrogen Gas Regulator Assembly in required quantity to be provided.	Accepted/Not Accepted
18	Guarantee terms	A. The system shall be guaranteed for satisfactory operation and against defects in design, materials and workmanship for a period of at least 24 months from the date of received and 18 months from commissioning whichever is earlier. B. Bidder shall also quote separate charges towards incremental guarantee for every six month.	Accepted/Not Accepted Accepted/Not Accepted

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EVALUATION CRITERIA:

Evaluation will be done for each type of NIFPES as follows:

- a) NIFPES upto 80 MVA - Scope as per Annexure 4A
- b) NIFPES 81 MVA to 160 MVA – Scope as per Annexure 4B
- c) NIFPES above 160 MVA - Scope as per Annexure 4C

A. INSTRUCTIONS TO BIDDERS (ITB)-

1. Any other accessories, which is not listed in all above clauses but may be required for satisfactory operation of the system shall be deemed to be included in scope and also such item shall be clearly bring out in the bid.
2. Bidders should note that they are required to submit the techno-commercial offer for all the Types and fill the blank price bid. In case, any Bidder is not quoting for any Type, reason towards non- quoting of such Type shall be clearly brought out in its bid.
3. Bidders are required to submit questionnaire attached with this specification. It is expected that answer to all the points of questionnaire shall be “YES/ACCEPTED”. In the case if any answer is “NO”, the same should be substantiated with suitable justification/reason etc. for BHEL review. Also details may be filled where vendor to specify.
4. Bidder shall submit the undertaking that they have clearly understood the specification and any there is no deviation from their side. NO deviation, alteration of any kind in scope or equipment or specification shall be entertained at later stage once after finalization of technical bid/contract.
5. The Bidders are required to quote for following tentative quantity of each Type.

JS9006281400, Type 1	20 sets for NIFPES upto 80 MVA
JS9006281410, Type 2	80 sets for NIFPES above 81 MVA to 160 MVA
JS9006281420, Type 3	20 sets for NIFPES 161 MVA and above

The above quantity is tentative only and there is a possible variation of $\pm 30\%$ sets
6. If during the tenure of the rate agreement, OEM makes any changes in the equipment or the equipment is superseded by some other advanced equipment, Bidder is deemed to supply the updated equipment/advanced equipment without any price implication to BHEL. This shall be clearly certified by the Bidder in its bid.
7. The above specification is issued without any prejudice to BHEL's standard terms & Conditions. The specification doesn't absolve the Bidder from his basic responsibility of supplying a quality material to BHEL.

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