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SPECIFICATION OF NITROGEN INJECTION TYPE FIRE PROTECTION SYSTEM

TECHNICAL SPECIFICATIONS FOR THE WORK OF DESIGN, SUPPLY, ERECTION AND COMMISSIONING INCLUDING CIVIL WORK OF NITROGEN INJECTION SYSTEM FOR PROTECTION AGAINST THE FIRE & EXPLOSION FOR TRANSFORMER.

TECHNICAL SPECIFICATION NO.  
GETCO/E/TS-FF/2902 DTD.JUNE 2008.

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## TECHNICAL SPECIFICATIONS

**Name of work:** Turnkey contract for the work of design, supply, erection and commissioning of Nitrogen Injection system for protection against the transformer explosion for Transformers and Shunt Reactors as indicated in Schedule - A including all required civil works of oil sump, foundations, any other required for satisfactory working of system.


NIPPS supplier shall be Original Manufacturer (OEM) of system. The offered system have to be designed, manufactured and tested as per relevant IS/IEC/ANSI standard with latest amendments and manufacturer shall have patent of his product in their name.

Each oil filled transformer / reactor shall be provided with a dedicated Nitrogen Injection system for prevention against the transformer explosion which shall use nitrogen as quenching medium. The system shall prevent transformer / Reactor oil tank explosion and possible fire in case of internal / external cause. In the event of fire by external causes such as bushing fire, OLTC fires, fire from surrounding equipment etc., it shall act as a fast and effective fire fighter. It shall accomplish its role as fire preventer and extinguisher without employing water or carbon dioxide. Fire shall be extinguished within reasonable with time (not more than 3 minutes so as not to harm the transformer) of system activation and within 30 seconds (maximum) of commencement of nitrogen injection. The system shall have been in successful operation / commissioned in Indian / Abroad installations for at least last five years for protection of transformers of 220 KV and higher voltage class. The list of past supplies in India / Abroad along with performance certificate from users of the system shall be submitted for approval of purchaser.

### Activation of the system

Mal-functioning of the Nitrogen injection system could lead to interruption in power supply. The supplier shall ensure that the probabilities of chances of malfunctioning of the Nitrogen injection system are practically zero. To achieve this objective, the supplier shall plan out scheme of activating signals which should not be too complicated to make the system inoperative in case of actual need. The system shall be provided with automatic controls to prevent the explosion of transformers. Besides automatic control, remote electrical push button control at Control box and local manual control in the cubicle shall also be provided. The following electrical-signals shall be used for activating the system under prevention mode/fire extinguishing mode.

### Auto Mode

  
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**For prevention:**

- Differential relay operation.
- Buchholz relay paralleled with pressure relief valve or RPRR (Rapid Pressure Rise Relay)
- Tripping of all circuit breakers (on HV & LV/IV side) associated transformer / reactor is the pre-requisite for activation of system.

**For extinguishing**

- Fire Detector
- Buchholz relay paralleled with pressure relief valve or RPRR (Rapid Pressure Rise Relay).

Tripping of all circuit breakers (on HV & LV/IV side) associated with transformer / reactor is the pre-requisite for activation of system.

**Manual Mode (Local / Remote)**

Tripping of all circuit breakers (on HV & LV / IV side) associated with transformer / reactor is the pre-requisite for activation of system.

**Manual Mode (Mechanical)**

- Tripping of all circuit breakers (on HV & LV / IV side) associated with transformer / reactor is the pre-requisite for activation of system.

The system shall be designed to be operated manually in case of failure of power supply to the system.

**General description**

Nitrogen Injection system should be a dedicated system for each oil filled transformer / reactor. It should have a Fire Extinguishing Cubicle (FEC) placed on a plinth at a distance of 5-10 m away from transformer / reactor or placed next to the firewall (if fire fighting wall exists). The FEC shall be connected to the top of transformer / reactor oil tank for depressurization of tank and to the oil pit (**steel tank**) (capacity is approximately equal to 10% of total volume of oil in transformer / reactor tank / or existing oil pit) from its bottom through oil pipes. The FEC should house a pressurized nitrogen cylinder (s) which is connected to the oil tank of transformer / reactor oil tank at bottom. The Transformer Conservator Isolation Valve (TCIV) is fitted between the conservator tank and Buchholz relay. Cable connections are to be provided from signal box to the control box in the control room, from control box to FEC and from TCIV to signal

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box. Detectors placed on the top of transformer / reactor tank are to be connected in parallel to the signal box by Fire survival cables. Control box is also to be connected to relay panel in control room for receiving system activation signals.

### Operation

On receipt of all activating signals, the system shall drain - pre-determined volume of hot oil from the top of tank (i.e. top oil layer), through outlet valve, to reduce tank pressure by removing top oil and simultaneously injecting nitrogen gas at high pressure for stirring the oil at pre-fixed rate and thus bringing the temperature of top oil layer down. Transformer conservator isolation valve blocks the flow of oil from conservator tank in case of tank rupture / explosion or bushing bursting. Nitrogen occupies the space created by oil drained out and acts as an insulating layer over oil in the tank and thus preventing aggravation of fire.

### System components

Nitrogen Injection system shall broadly consist of the following components. However, all other components which are necessary for fast reliable and effective working of the system shall deemed to be included in the scope of supply.

### CUBICLE (FEC)

The Cubicle Frame shall be made of CRCA sheet of 3 mm (minimum) thick complete with the base frame, painted inside and outside with post office red colour (shade 538 of IS -5). It shall have hinged / hinged split doors fitted with high quality tamper proof lock. The doors, removable covers and panels shall be gasketed all round with neoprene gaskets. The degree of protection shall be IP55. The following items shall be provided in the Cubicle.

- Nitrogen gas cylinder with regulator and falling pressure electrical contact manometer.
- Oil drain pipe with mechanical quick drain valve.
- Electro mechanical control equipment for draining of oil of pre-determined volume and injecting regulated volume of nitrogen gas.
- Pressure monitoring switch for back-up protection for nitrogen release.
- Limit switches for monitoring of the system.
- Butterfly valve with flanges on the top of panel for connecting oil drain pipe and nitrogen injection pipes for transformer / reactors.
- Panel lighting (CFL Type)

- Oil drain pipe extension of suitable sizes for connecting pipes to oil pit.
- Space heater.

### Control box

Control box is to be placed in the control room for monitoring system operation, automatic control and remote operation. The following alarms, indications, switches, push buttons, audio signal etc. shall be provided.

- System Oil.
- TCIV open.
- Oil drain valve closed.
- Gas inlet valve closed
- TCIV closed
- Detector trip
- Buchholz relay trip
- Oil drain valve open
- Extinction in progress
- Cylinder pressure low
- Differential relay trip
- PRV / RPRR trip
- Transformer / reactor trip
- System out of service
- Fault in cable connecting fault detector
- Fault in cable connecting differential relay
- Fault in cable connecting Buchholz relay
- Fault in cable connecting PRV / RPRR
- Fault in cable connecting transformer reactor trip
- Fault in cable connecting TCIV
- Auto / Manual / Off
- Extinction release on / off
- Lamp test
- Visual / Audio alarm for AC supply fail
- Visual / Audio alarm for DC supply fail

As far as possible the control box should be such devised that all the transformers and reactors or group thereof should be controlled from single spot. Potential Free contacts shall be available for alarm troubles for input to SCADA system. Also, separate hooter & emergency trip provision shall be provided in control room over & above provided in control box (as control box is to be provided in respective yard kiosk)

### Transformer Conservator Isolation Valve.



Transformer conservator isolation valve (TCIV) to be fitted in the conservator pipe line, between conservator and buchholz relay which shall operate for isolating the conservator during abnormal flow of oil due to rupture / explosion of tank or bursting of bushing. The valve shall not isolate conservator during normal flow of oil during filtration or filling or refilling, locking plates to be provided with handle for pad locking. It shall have proximity switch for remote alarm, indication with visual position indicator.

The TCIV should be of the best quality as malfunctioning of TCIV could lead to serious consequence. The closing of TCIV means stoppage of breathing of transformer / reactor.

Locking plates shall be provided for pad locking.

### **Detectors**

The system shall be complete with adequate number of detectors (quartz bulb) fitted on the top cover of the transformer / reactor oil tank.

### **Signal box**

It shall be mounted away from transformer / reactor main tank, preferably near the transformer marshalling box, for terminating cable connections from TCIV & detectors and for further connection to be control box. The degree of protection shall be IP55.

### **Cables**

Fire survival cables (capable to withstand 750° C.) of 4 core x 1.5 sq. mm size for connection of detectors in parallel shall be used. The fire survival cable shall conform to BS 7629-1, BS 8434-1, BS 7629-1 and BS 5839-1, BS EN 50267-2-1 or relevant Indian standards.

Fire Retardant Low Smoke (FRLS) cable of adequate size shall be used for connection of signal box / marshalling box near transformer / reactor and FEC mounted near transformer/ reactor with control box mounted in control room.

Fire Retardant Low Smoke (FRLS) cable of 4 core x 1.5 sq. mm size shall be used for connection between control box to DC & AC supply source, FEC to AC supply source, signal box / marshalling box to transformer conservator isolation valve connection on transformer / reactor. Separate cables for AC supply & DC supply shall be used.

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The bidder apart from the below mentioned spares shall submit a list of recommendation spares for three years trouble free operation of the equipments and also furnish unit rates. The owners will scrutinize the said list and decide on the items on spares to be ordered and the quantities. These spares shall be supplied by the contractor before end of guarantee period. The owner reserves right to order the spares with twelve (12) months from the date of order for main equipments and the rate shall be kept valid till this date. The prices of these spares shall not be considered for evaluation of the bid.

**Mandatory Spares**

Cylinder filled with Nitrogen of required Capacity per substation.	1 No.
Detectors per transformer	3 No.
Regulator assembly per sub-station	1 No.

**Modification on the transformer**

No modification on the transformer shall be allowed which affects its performance (i.e. efficiency, losses, heat dissipation ability etc.) safety, life etc. or it's any other useful parameter. This requirement shall be paramount importance and shall form the essence of the contract.

However, in any case, performance of transformer should not be affected in any manner by having Nitrogen Injection Fire Prevention Cum Extinguishing System (NIFPES) and the Contractor / Sub-Contractor shall give an undertaking to this effect. All pipes should be washed / rinsed with transformer oil. If any damage is done to the transformer and / or any connected equipment during installation & commissioning full recovery therefore shall be effected from the Contractor / Sub-Contractor, of NIFPES system.

It shall be solely the responsibility of Contractor / Sub-Contractor to install, carry out pre-commissioning tests & commission NIFPES at the mentioned Sub-Station in this specification, to the entire satisfaction of the GETCO.

**Interlocks**

It shall be ensured that once the NIFPES gets activated manually or in auto mode, all the connected breakers shall not close until the system is actually put in OFF mode. Also PRV shall get closed only if all the connected breakers are open.

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## Tests

Contractor has to submit valid type test reports as per relevant IS/IEC, including IP 55 on FEC, control box etc. from NABL approved Laboratory or any other reputed authority nationally or internationally not older than 5 years & must be valid till expiry of validity of offer.

Reports of all routine test conducted as per relevant IS/IEC standards in respect of various bought out items including test reports for degree of protection for FEC / control box / signal box shall be submitted by the supplier.

The supplier shall demonstrate the entire functional test associated with the following as Factory Acceptance Tests:

- FEC, Control Box
- Fire Detector
- Transformer Conservator Isolation Valve

The performance test of the complete system shall be carried out after erection of the system with transformer at site.

Detailed layout drawings, equipment drawing along with 4 sets of Operation and Maintenance manual along with soft copies (In CDs) shall be submitted by the supplier along with the consignment.

The guaranteed and other technical particulars for the offered system are indicated in **Section - "Guaranteed and Other Technical Particulars"**. Any other particulars considered necessary in addition to those listed in that Section may be furnished by the Bidder.

**GUARANTEED TECHNICAL PARTICULARS  
NITROGEN INJECTION SYSTEM FOR PREVENTION OF FIRE/  
EXPLOSION FOR TRANSFORMERS/REACTORS.**

Sr. No.	Description	Guaranteed Particulars
1	Name of Manufacture and country of origin	
2	Reference standards	
3	Details of system equipments	
4	<b>FEC (Fire Extinguishing Cubicle)</b>	
4.1	Dimensions (LXBXH) mm	
4.2	Weight	
4.3	Capacity of Nitrogen cylinder	
4.4	Number of cylinders	
4.5	Pressure of Nitrogen filing	
4.6	Minimum distance of FE cubicle from the transformer	
4.7	Method of mounting	
4.8	Whether the following items are provided in FE cubicle. If so furnish make, type & other details	
4.9	Contact Manometer	
4.10	Pressure Regulator	
4.11	Oil Release Unit	
4.12	Gas release unit	
4.13	Oil drain assembly	
4.14	Pressure / limit switches	
4.15	No. of contacts & spare contacts (NO & NC)	
4.16	Oil drain Valve (ABOVE FEC)	
4.17	Make	
4.18	Type	
4.19	Size	
4.20	Type of metal	
4.21	Nitrogen Injection Valve (Above FEC)	
4.22	Make	
4.23	Type	
4.24	Size	
4.25	Oil drain pipe	
4.26	Size	
4.27	Length	
4.28	Number of openings in the transformer tank	
4.29	Material	
5	<b>Control Box</b>	
5.1	Dimensions (LXBXH) mm	

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5.2	mm	
5.3	Type & Thickness of sheet steel	
5.4	Details of components provided in the control box	
5.5	Control voltage	
5.6	Method of mounting	
5.7	Whether audio and visual alarm provided?	
6.	<b>Transformer Conservator Isolation Valve</b>	
6.1	Make	
6.2	Type	
6.3	Location	
6.4	Whether suitable for pipe of size 80 mm dia	
6.5	No. of contacts & spare contacts (NO & NC)	
6.6	Padlocking provision	
7.	<b>Detectors</b>	
7.1	Make	
7.2	Type	
7.3	Quantity required	
7.4	Method of fixing	
7.5	Effective heat sensing area	
7.6	Temperature recommended for effective heat sensing	
7.7	Number of contacts NO / NC	
7.8	Necessity and condition of Refilling	
8	Whether approved by Tariff Advisory Committee of India	
9	<b>TECHNICAL PARTICULARS FOR NITROGEN INJECTION SYSTEM FOR PREVENTION OF TRANSFORMER EXPLOSION</b>	
10	<b>Power Supply</b>	
10.1	Control box	
10.2	FEC (lighting)	
10.3	Extinction period	
10.4	On system activation	
10.5	On commencement of Nitrogen injection	
11	FEC Suitable for capacity	
11.1	Dimensions (LXBXH) mm	
11.2	Weight	
11.3	Nitrogen cylinder capacity	
12	<b>Control Box</b>	
12.1	Dimensions (LXBXH) mm	
12.2	Weight	
13	<b>Detectors</b>	
13.1	Heat sensing temperature	



13.2 Time of Operation

	Transformer Tank Explosion Prevention	Fire Extinction
a. For system activation		
b. For reduction of pressure in Tank by Nitrogen release.		

13.3 Any other technical details not covered above.

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