



SECTION – 2.29

NITROGEN INJECTION FIRE PROTECTION SYSTEMS

1.0.0 INTENT OF SPECIFICATION

This specification covers the requirements of NIFPS for transformers.

2.0.0 SCOPE OF WORK

2.1.0 The scope of work shall include, supply, design, Engineering, manufacturing, assembly, procurement, transportation, loading, unloading, internal handling erection, installation, testing and commissioning etc. of following equipment for NIFPS.

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the relevant IS/International standards including amendments, if any, except where modified and / or supplemented by this specification. Some of the applicable standards and guidelines are listed below

TAC Manual	Manual of Tariff Advisory Committee of Insurance Cos. Of (India)
NFPA Codes	National Fire Protection Association Codes
IS 2189:2008	Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System Code of Practice.
CEA regulation	Measures relating to Safety and Electricity Supply Regulations, 2010, 2015, 2019 and 2018, Draft 2021
IS 694:1990	Installation & maintenance of power cable
IS 2175:1988	Specification for heat sensitive detector
IS 11360:1985	Specification for photo smoke detector
IS 9779:1981	Specification of sound level

4.0.0 DESIGN CRITERIA

4.1.0 Each transformer shall be provided with a dedicated Nitrogen Injection system. It shall act as a fast and effective fire fighter without employing water or carbon dioxide. Fire shall be extinguished within 3 minutes of system activation and within 30 seconds of commencement of nitrogen injection.

4.2.0 Fire Extinguishing Cubicle placed on a plinth at a distance of about 5 m away from transformer. The cubicle shall be enclosed in civil structure (three sided with roof) of appropriate size considering ease of approach for manual operation in case of fire. The system shall be connected to the top of transformer oil tank for depressurization of tank and from its bottom through oil pipes to the steel oil tank (capacity 10% of total volume of oil in transformer). The cubicle should house a pressurized nitrogen cylinder, connected to the oil tank of transformer. The Transformer Conservator Isolation Valve (TCIV) shall be fitted between the conservator tank and Buchholz relay. The Cubicle shall be made of CRCA sheet of 2 mm (minimum) thick complete with the base frame, painted inside and outside with post



office red colour (shade 538 of IS -5. 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.
- Oil drain pipe extension of suitable sizes for connecting pipes to oil pit.
- Panel lighting and Space heater.

4.3.0 Specifications for cover of Soak oil / Burnt oil tank shall be as per below:

Size: 600 X 600 mm

Material: Cast Iron

Type: Heavy duty Airtight

4.4.0 A pit / sump of appropriate size in a corner of the tank for inverter duty transformer (IDT) shall be provided by EPC contractor with adequate slope to facilitate suction of the pump for complete emptying of the tank.

4.5.0 The existing oil pit of adequate capacity for the power transformer shall be utilized, subject to clearance from the statutory authority.

4.6.0 A Control box shall be placed in the control room for monitoring system operation, automatic control and remote operation. Separate control box for each transformer is to be provided. Enclosure of control box shall be of Rittal Make only. Two or more transformer control box in one enclosure shall not be acceptable. Potential Free contacts shall be available for alarm troubles for input to Substation automation system. A separate hooter & emergency trip provision shall be provided in control room. Control box shall also to be connected to relay panel in control room for receiving system activation signals. Control supply voltage shall be of 220 V DC. The following alarms, indications, switches, push buttons, audio signal etc. shall be provided. Only DIN mounted auxiliary contactors (of approved vendor) with or without add-on block are to be provided for signaling / contact multiplication etc. Use of miniature relays shall not be acceptable.

- System ON.
- 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
- PRD / RPRR trip
- Transformer 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 PRD
- 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

- 4.7.0 Transformer conservator isolation valve (TCIV) shall be fitted in the conservator pipeline, 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 be flow sensitive and shut off when the flow in the pipe is more than the flow expected in the permissible normal operating conditions. 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 consequences. The closing of TCIV means stoppage of breathing of transformer. Locking plates shall be provided for pad locking. A suitable platform and ladder shall be provided to approach buchholz relay and the TCIV valve for manual reset. The ladder shall be pad lockable cover right from FGL to avoid unauthorized climbing in transformer charged condition and with top handrail.
- 4.8.0 The system shall be complete with adequate number of detectors (quartz bulb) fitted on the top cover of the transformer oil tank. Detectors shall be connected in parallel to the signal box by Fire survival cables. Fire survival cables (capable to withstand 750 deg C.) 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.
- 4.9.0 Signal box shall be mounted away from transformer 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.
- 4.10.0 Fire Retardant Low Smoke (FRLS) cable shall be used for all interconnections associated with the NIFPS system, including 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. Separate cables for AC supply & DC supply shall be used.
- 4.11.0 The cables shall be of high-reliability, fire-retardant, low-smoke, low-toxicity (FRLSLT) type suitable for EHV substation environments.



4.12.0 Cable Type & Construction

- Cables shall comply with IEC 60331 (Circuit integrity during fire)
- Flame retardant performance as per IEC 60332-1 & IEC 60332-3
- Low smoke emission as per IEC 61034
- Halogen-free requirements as per IEC 60754
- Indian equivalents:
- IS 7098 (Part 2) for XLPE insulated power/control cables
- IS 1554 for PVC insulated FRLS control cables

4.13.0 The cable jacket shall maintain integrity under fire exposure and not emit corrosive or toxic gases.

4.14.0 Cable Temperature & Fire Performance

- FRLS cables shall be capable of withstanding high-temperature fire exposure typical of transformer tank top fires.
- Minimum fire survival performance:
- Circuit integrity for 90 minutes under flame (IEC 60331)
- Flame retardant category: Category C as per IEC 60332-3
- Low smoke generation, optical density within IEC 61034 limits

4.15.0 Installation Requirements

- AC and DC circuits shall be wired using separate cables, routed in independent conduits/trays to avoid mutual faults.
- Cables shall be routed away from hot surfaces and the transformer tank wherever possible.
- All FRLS cables shall be armoured when routed outdoors or exposed to mechanical impact.
- Terminations shall use nickel-plated brass double compression glands and tinned copper lugs.

4.16.0 Pipes complete with connections, flanges, bends and tees etc. shall be supplied along with the system.

- Oil drain and nitrogen injection openings with gate valves on transformer tank at suitable locations.
- Flanges between Buchholz relay and conservator tank for fixing TCIV.
- Pipe connections between transformer and FEC and between FEC and oil pit required for collecting top oil.
- Butterfly valves / Gate valves on oil drainpipe and nitrogen injection pipe which should be able to withstand full vacuum.



- 4.17.0 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.
- 4.18.0 Besides automatic control, remote electrical push button control at Control box and local manual control in the cubicle shall also be provided. Tripping of all circuit breakers (on HV & LV side) associated transformers is the pre-requisite for activation of system.
- 4.19.0 The following electrical signals shall be used for activating the system under prevention mode/fire extinguishing mode.
- 4.20.0 **For prevention:**
- Differential relay operation.
 - Buchholz relay paralleled with pressure relief Rise Relay
- 4.21.0 **For extinguishing:**
- Fire Detector
 - Buchholz relay paralleled with pressure relief Relay.
- 4.22.0 The system shall be designed to be operated manually in case of failure of power supply to the system. It shall be ensured that once the system gets activated manually or in auto mode, all the connected breakers shall not close until the system is put in OFF mode. Also, PRD shall get closed only if all the connected breakers are open.
- 4.23.0 The supplier shall demonstrate the entire functional test associated with the following Factory Acceptance Tests:
- FEC, Control Box
 - Fire Detector
 - Transformer Conservator Isolation Valve
- 4.24.0 The performance test of the complete system shall be carried out after erection of the system with transformer at site.