NITIN FIRE PROTECTION INDUSTRIES LIMITED

Introduction

- For over more than three decades, Nitin Fire Protection Industries Limited has been the insignia of trust, transparency, Cutting edge technology and differentiated services in the field of fire and safety. Rooted in Values, our growth and respectability both have been built on adherence to our vision, mission and eight pillars we stand on and deliver.

- We have continually pioneered newer technologies, bold design and precision engineering to create landmark in building the nation safer. Nitin Group has ushered in an era marked by higher standards of Design, Technology in Fire Industry. We are today one of the leading group in Fire Protection Industry in its flagship business of Fire Protection Systems with pan – India as well as international presence. When it comes to safeguarding your valued assets amongst the various security and safety measures that you adopt, you ought to provide the best innovative equipment and system as a deterrent against fire hazards.

Introduction

- We are immensely thankful to our clients who continue giving us the impetus and encouragement in expanding and improving our products and thus bringing in more and more advanced technological products. We are proud to inform that we have successfully executed number of projects in India and Globally for FIRE PROTECTION and SAFETY SYSTEMS with the backing of our team of more than 800 + highly qualified and experienced personnel.

- Our company has National as well as Global presence with full fledged offices catering to various types of clientele from cross sectors segments of industries like Petrochemical Industries; Defense Sector, Power Plants; Chemical Industries ,Automobile Industry,Pharmaceuticals,IT & Telecom sector, Hospitality Industry; Healthcare Facilities; Retails Setups and other various infrastructure developments.

Vision

- Nitin Group aspires to become a major provider of engineering solutions and become a market leader, dedicated to excellence through quality, creating value for customers, & employees through innovative technology and operational expertise.

- We are a technology driven company at the core with an overriding commitment to quality and the primary measure of success is our customers' satisfaction and shareholders' value.

- It is our strategic vision to conduct business with highest standard of ethics as we always believe "Honesty and Integrity are cornerstones of Nitin Culture".

Mission

- Continual improvements of "process, products, services and human resources" will be the norm in our business.

- Provide employees a Safe healthy work environment and an opportunity for growth that is conducive to consistent performance. Implement several safety and environmentally sensitive technologies to combat fire pollution and restore ecological balance around us. Strive to provide the best and advanced national & international certified product range in fire protection, safety and allied engineering services.

- To be Preferred Vendor in the field of Fire & Safety Services. Continuously realign ourselves to meet the expectations of our customer through best management practices and use of latest technology and innovation for sustainable growth, while being socially and environmentally responsible.

Direct Global Presence

Major Global Approvals

UNDERWRITERS LABORATORIES

LOSS PREVENTION CERTIFICATION BOARD

FACTORY MUTUAL

EUROPEAN CONFORMITY

BSI KITEMARK

VDS SCHADENVERHUETUNG

BUREAU OF INDIAN STANDARDS

NATIONAL FIRE PRTOECTION ASSOCIATION

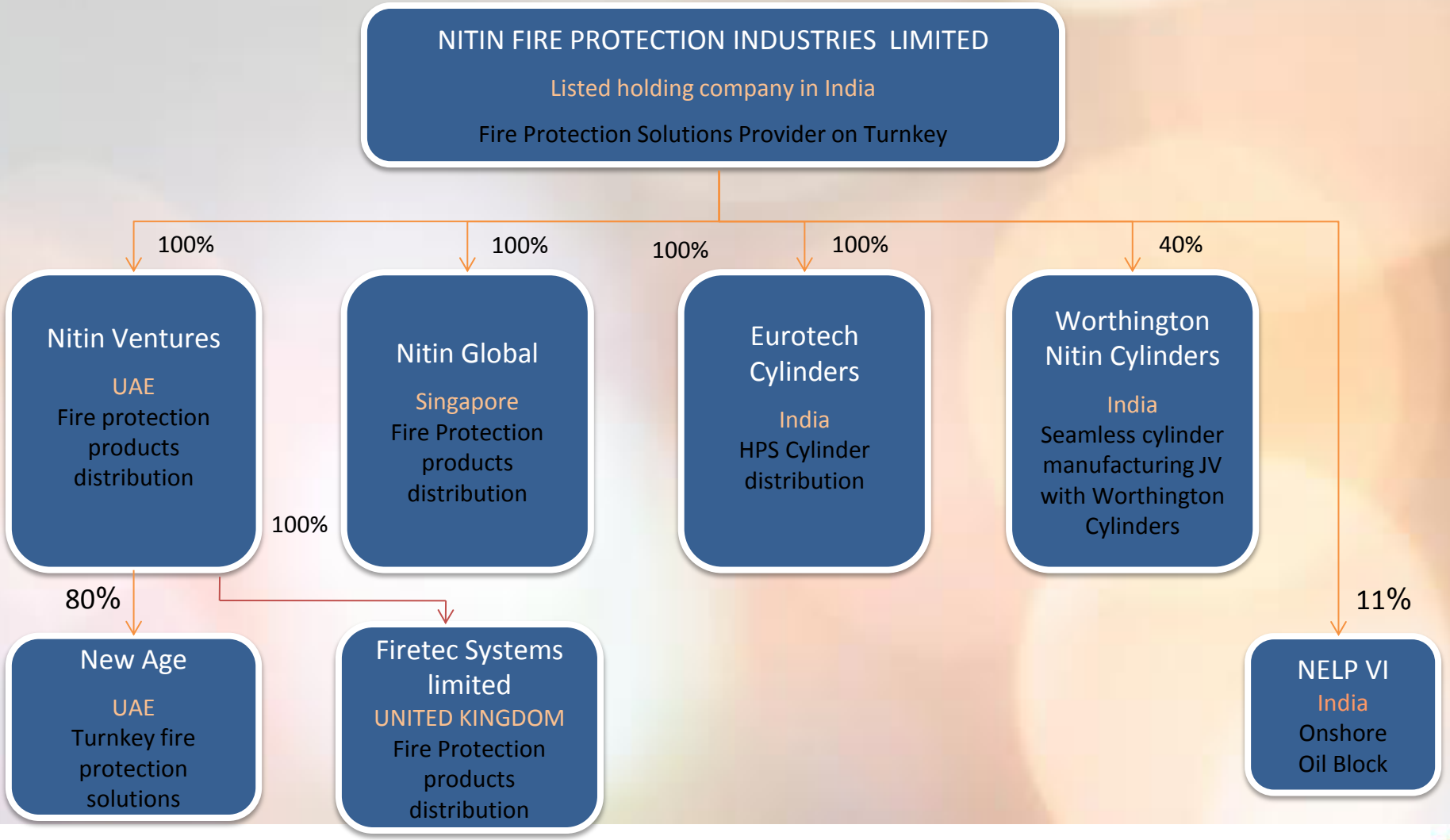
GCC & MALAYSIA

Civil Defence – Federal
UAE

PDO Oman

Bomba Malaysia

GROUP STRUCTURE



Industries Served

Nitin Fire Protection Industries Ltd. has proven technology & expertise to protect a variety of industries

Marine

Mining

Oil and Gas

Commercial Kitchens

Communication

Data Processing

Power Generation

Iron and Steel

Range of our products

- Advanced Linear Heat Detection System
- Water Mist Fire Suppression system
- Gas based fire extinguishing systems as per NFPA Norms
  a. Inert Gas based fire suppression system
  b. Chemical Gas based fire suppression system

  → Clean Agent Fire Suppression System
- Fire detection and alarm systems (Addressable and conventional)
- CO_2 fire extinguishing system
- Fire fighting pumps
- Aspiration Smoke Detection systems
- Fire fighting equipments and accessories

Advanced Linear Heat Detection System

Delta – Advanced Linear Heat Detector

FM APPROVED
FM-APPROVED

Mil-STD 810
Military Std 810

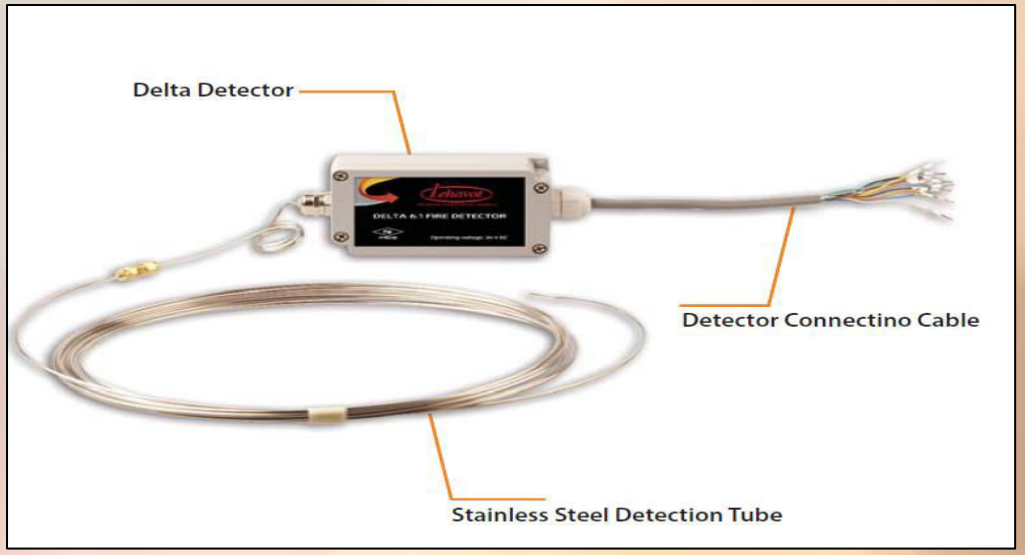
Mil-STD 1275
Military Std 1275, 461, SAE J1113

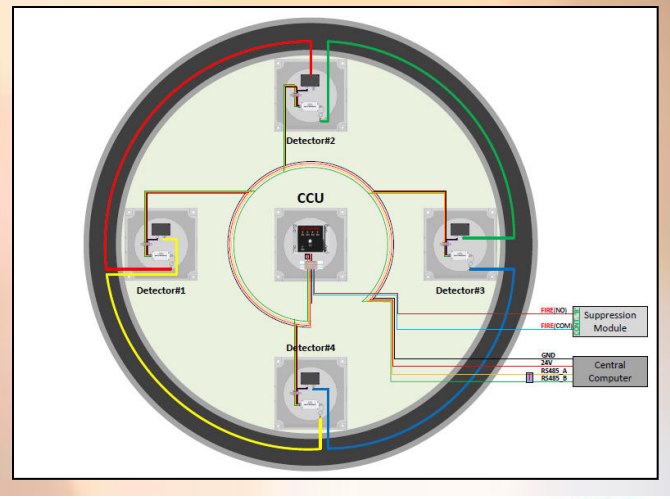
EN 54
EN 54 Certified

DEFENCE R&D ORGANISATION
MINISTRY OF DEFENCE
JSS-55555

Advanced Linear Heat Detection System

1. Advanced Rate of Rise (ROR) detector
2. Hollow 2mm Stainless Steel tube.
3. Digital Signal Processing (DSP)
4. IP67 enclosure.
5. Advanced Built In Test (BIT) mechanism.
6. FM 3210, EN, MIL STD, JSS-55555 certified.
7. No movable parts and reusable type.
8. Rodent free and easy to install.
9. Can be configured to the desired application.
10. Operating Temperature -40°C to 120°C
11. Multiple detectors can be integrated and monitored through Command Control Unit (Networking)



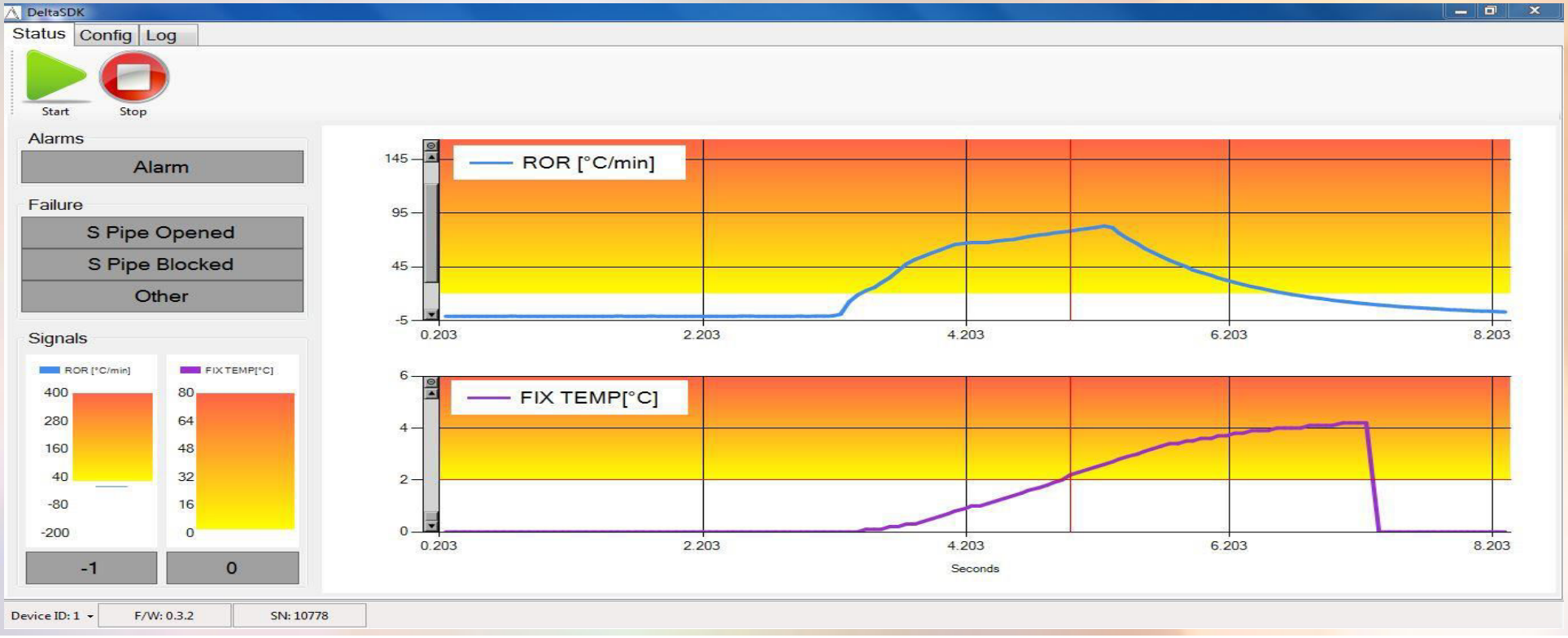


Advanced Linear Heat Detection System

12. It fits to extreme environmental conditions.

13. Signals and event logs ("Black Box") for investigation of fire events.

14. Fire\Fault or RS-485 interfaces with Fire Alarm Panels/ extinguishing systems.



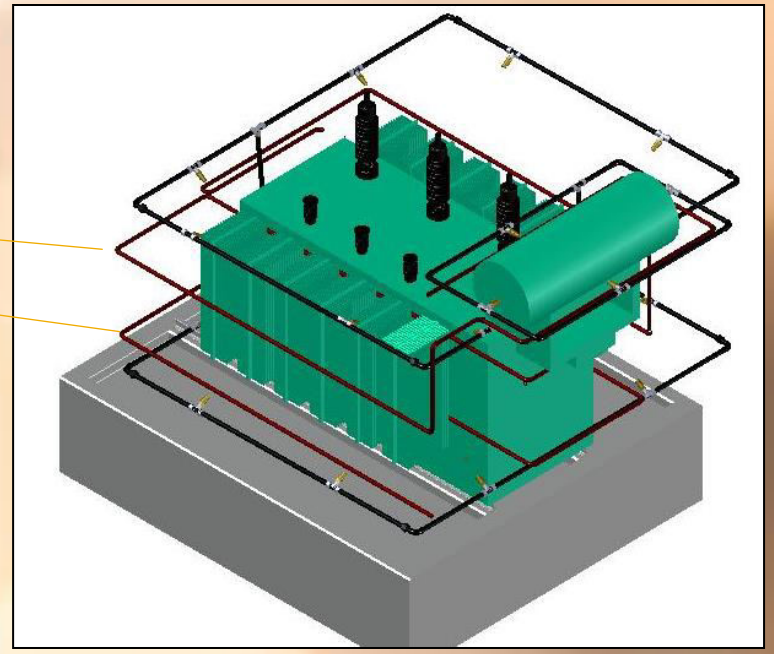
LHD system for Transformers

1. The current transformer fire detection system involves the use of Quartzoid Bulb Detector (QBD) which is to be installed at 300 mm away from the transformer body.
2. Also the bulb will get activated only when the temperature at the bulb reaches above 79°C.
3. Since these transformers are Oil Filled, it is most likely that the fire starts from the bottom of the transformer and till the time the fire is detected by the QBD, the temperature would be at least in the range of 500-600°C.

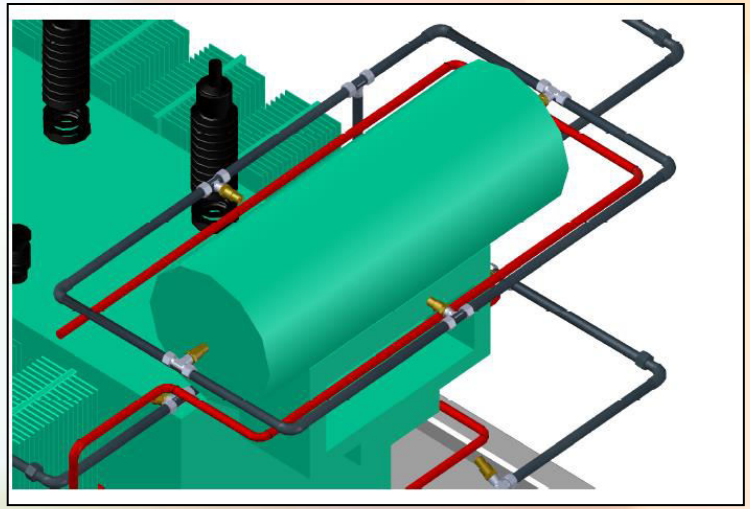
LHD system for Transformers

1. The suppression system will get activated only when the pressure in the detection system is reduced & then only it activates the deluge valve.
2. Given how the QB detector is placed, which is not near the bottom of the transformer, it takes time to detect the fire and hence the extinguishing process is delayed, increasing the damages caused by fire.
3. The bulb of the QB detectors has to be replaced after every activation & fire occurrence.

Sensor tube routed in tight spaces within the transformer.

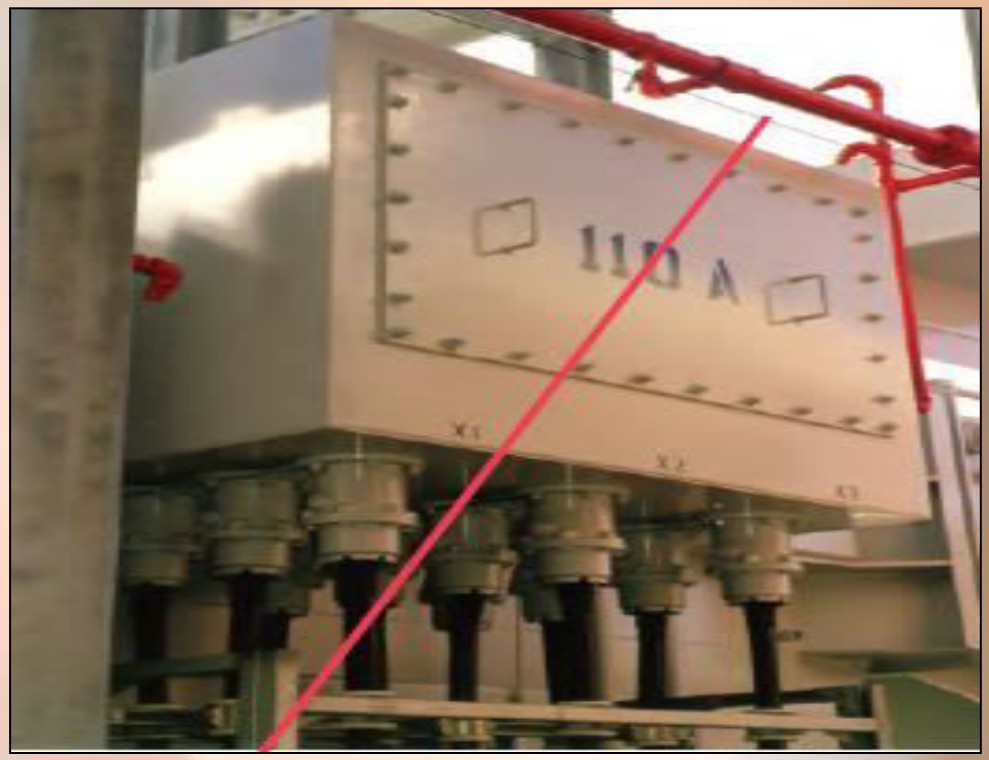


Sensor tube of 2mm coiled around the Oil Conservator.



LHD system for Transformers

4. A resemblance of how the sensor tube can be coiled along with the spray piping.
5. The piping can be used for supporting the detection tubing (easy Installation



LHD system for Cable Trenches/Galleries

1. Cable Trenches/Galleries are occupied with lots of electric cables and are therefore more susceptible to fire.

2. Since the setup of the cable trenches is so complex, it is difficult to time and again visit there and that is why a low or no maintenance is more preferable.

3. Also, it is not safe for human intervention due to the risks involved and that is where the LHD system can play a crucial role. It can be easily routed and it requires minimal maintenance to efficiently monitor and protect the cable trenches/galleries from fire.

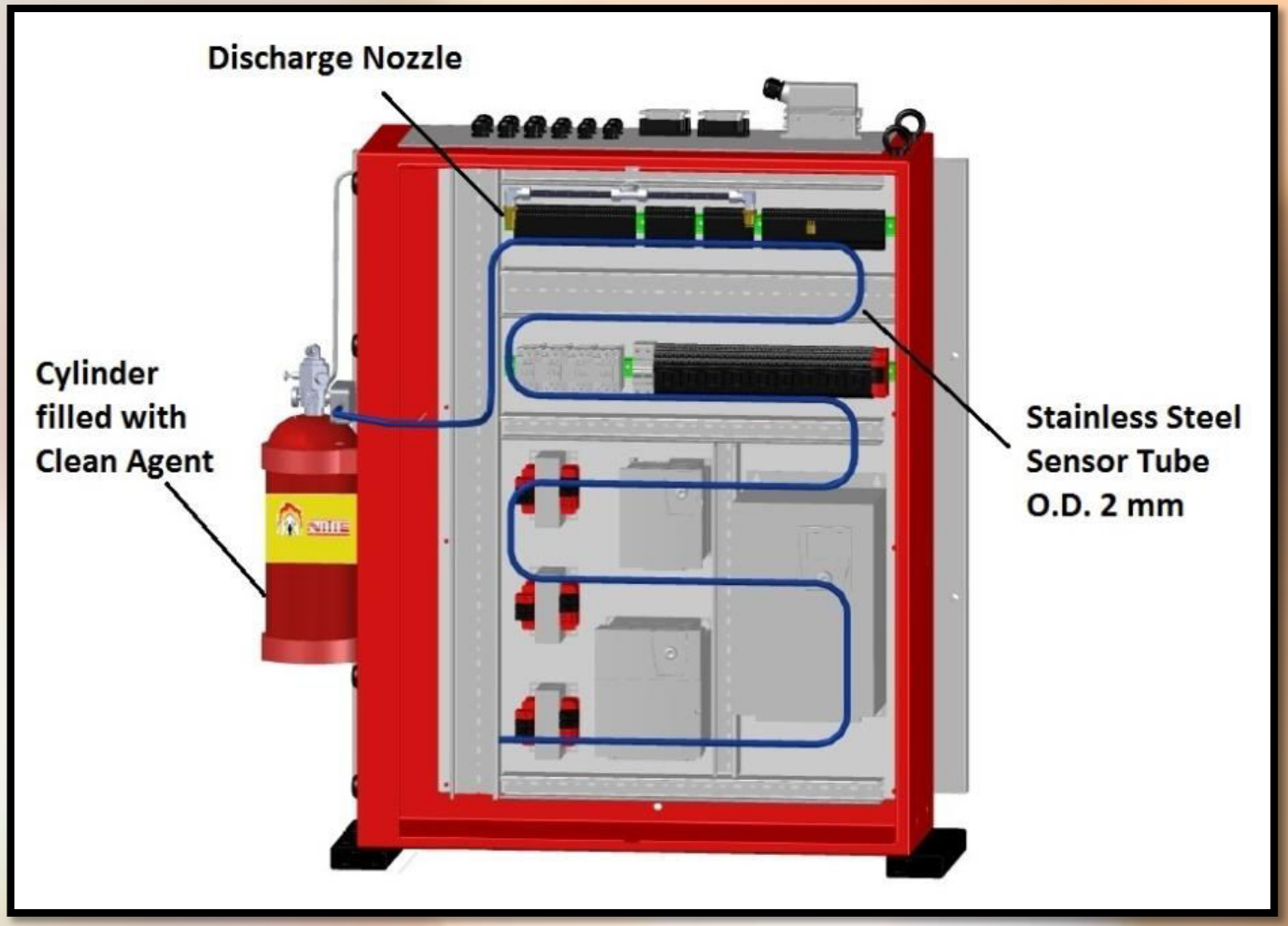
The LHD system sensor tube installed in one of the cable trenches in GAIL

LHD system for Electric Panels

- It is not easy to route or install any normal type of detection in electric panels due to the congested spacing and the sensitivity of the instrument

- The linear hollow detection tube of 2mm external diameter used in the LHD system can be easily routed due to its small and compact size without any hustle.

- As the tube is made of stainless steel, it will not burn in case of a fire event and can be reused for multiple events which would save a lot of time, installation struggles, money and most importantly no more downtime.



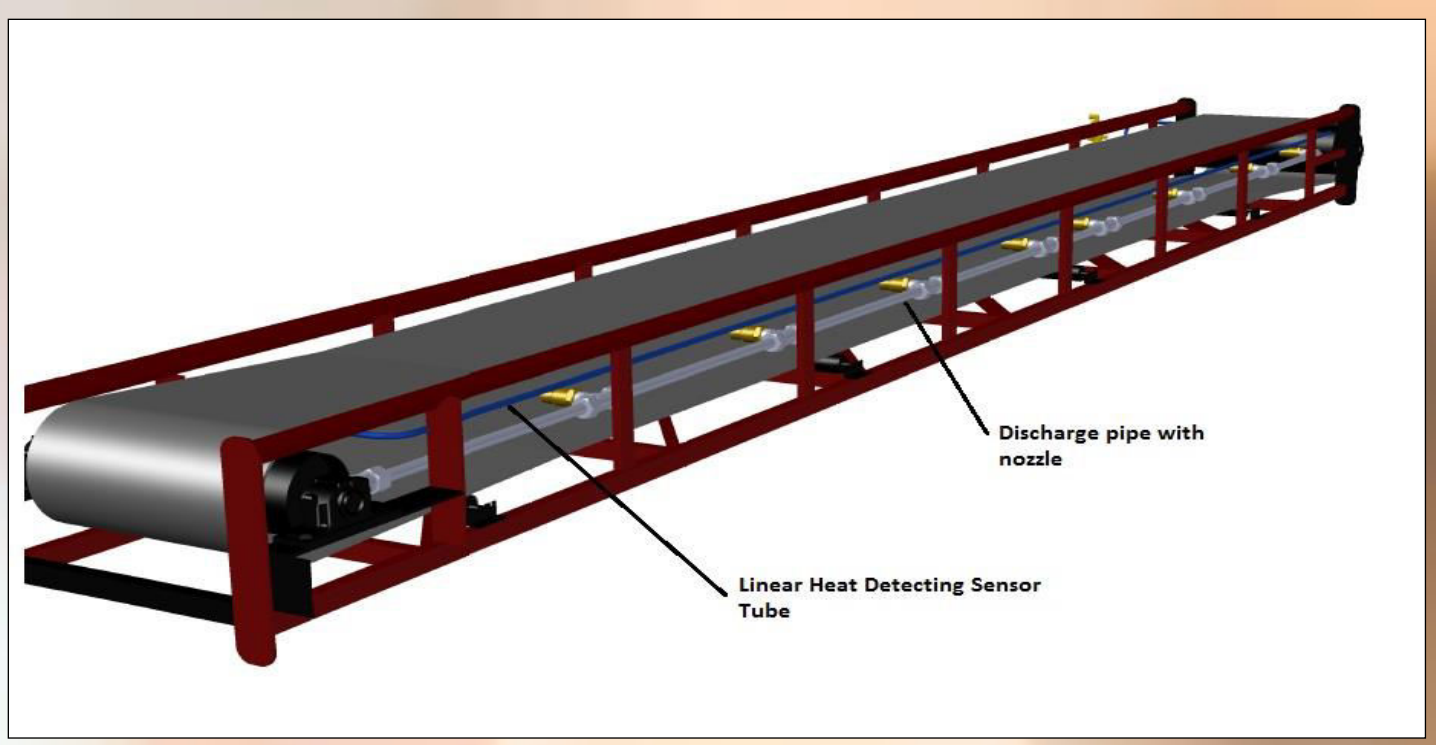
LHD system for Conveyor Belts

- The hollow 2mm O.D. heat detection tube can be routed easily around the conveyor due to its small size without obstructing the functioning of the belts.

- Also, given that the detector has an Aluminum enclosure with IP67 protection, it can sustain the extreme conditions present near the conveyors.

- The detection tube works on the rate of rise in temperature principle which helps in early detection of the fire before it spreads, preventing huge loss of lives and property.

- The tube is made of stainless steel, meaning it can be reused time and again for the same purpose without any hassle of replacement.



LHD system for Conveyor Belts

- The LHD system was installed at Lonmin Platinum Mine, Marikana K3 Concentrator Plant located in the North West province of South Africa.

- Lonmin is the world's third largest Platinum producer.

- The system was installed on 3 main feed conveyors.

- The tests conducted by the Lonmin Platinum group proved the detectors to be stable and accurate with the different tests conducted by them. The tests proved the system's effectiveness and also it's proactive nature.

LONMIN

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Marikana
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www.lonmin.com

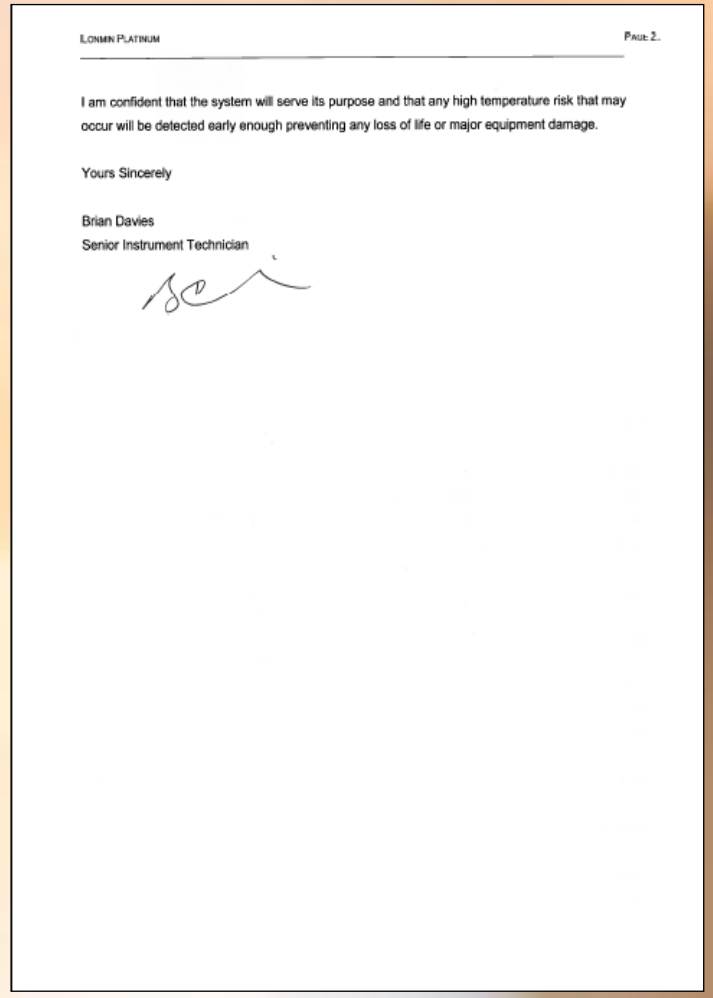
To Whom It May Concern,

Here at Lonmin Platinum Mine, Marikana K3 Concentrator Plant, we have installed the Lehavot Delta Detector on 3 of our main feed conveyors, with the intention of installing on the whole conveyor network should the detection system prove to be sustainable and sufficient. We chose these 3 conveyors for the initial installation due to the rugged environment and highest risk factors.

The Lehavot Delta Detector, which makes use of a stainless steel capillary tube for detection, had to be set up for our environment with regards to large ambient temperature changes and also tunnel verses open air conditions to eliminate false alarms. The delta detectors have proved to be stable and accurate with the tests conducted by myself and the installation team. The important aspect of this system is that the Lehavot Delta Detector is proactive rather than reactive. By detecting increase in temperature and reacting before trying to supress an actual fire. The discharging agent is foam based which cools and supresses heat build-up before an actual fire exists.

We further incorporated individual temperature detection on each and every plumber block of all the pulleys, snub, tail, head and drive. This temperature indication is displayed in the field and is totally integrated into the Lehavot Delta Detector system.

Furthermore, the system has an audible and visual alarm indication which is integrated into our current SCADA and PLC system.



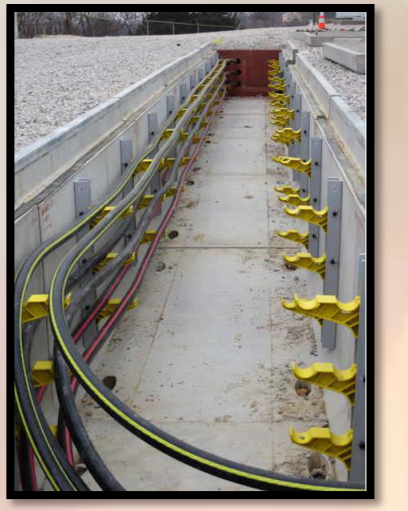
I am confident that the system will serve its purpose and that any high temperature risk that may occur will be detected early enough preventing any loss of life or major equipment damage.

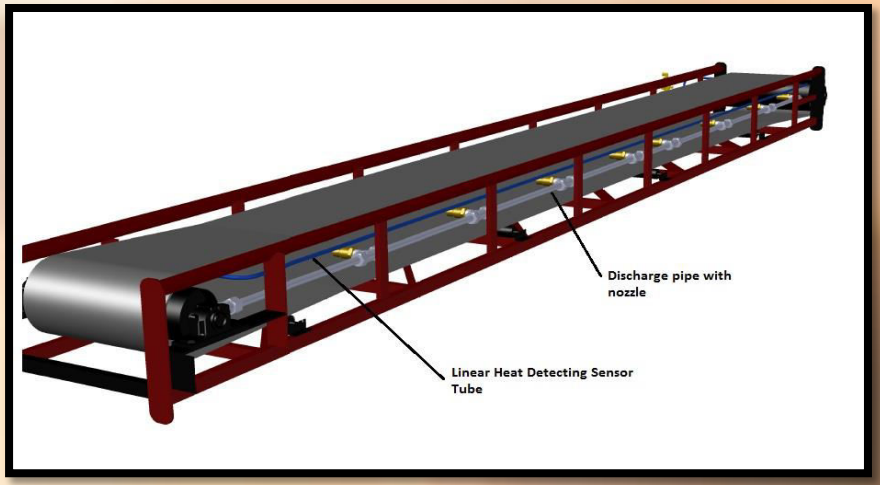
Yours Sincerely

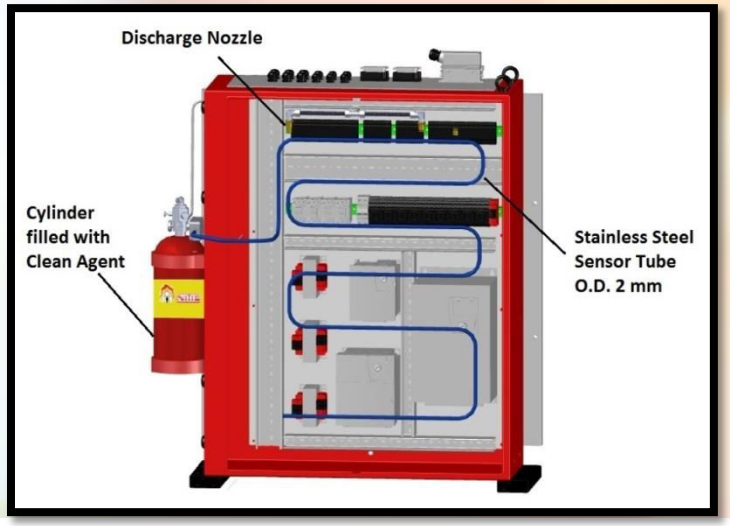
Brian Davies
Senior Instrument Technician

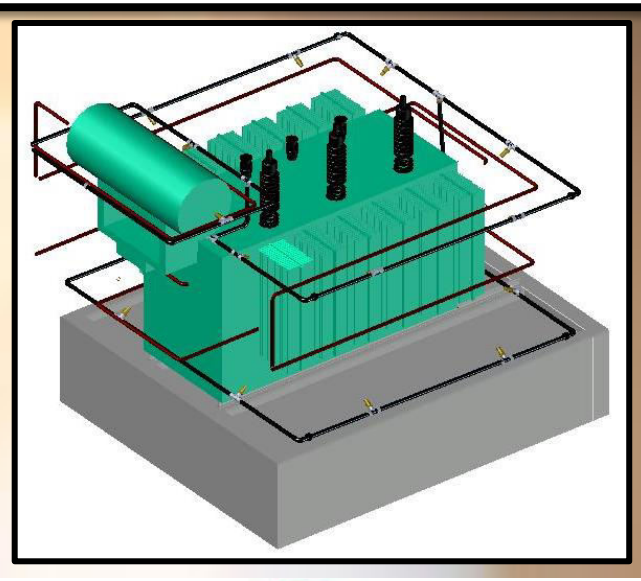
Areas of Application

- Cable Trenches/Galleries
- Transformers/Generators
- Electric Panels
- Conveyor Belts
- Oil and Gas Industry
- Heavy Earth Moving Equipment



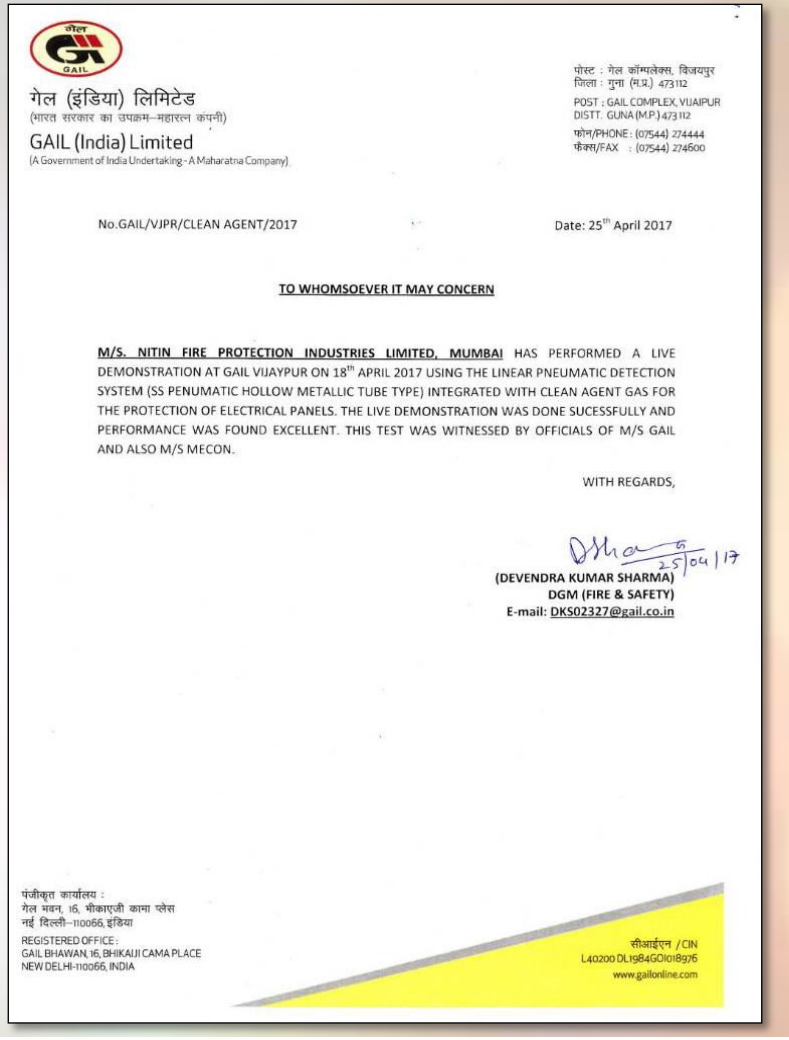






FM APPROVED

Successful demonstration of the LHD system at GAIL



गेल (इंडिया) लिमिटेड
(भारत सरकार का उपक्रम--महारत्न कंपनी)
GAIL (India) Limited
(A Government of India Undertaking - A Maharatna Company)

पोस्ट : गेल कॉम्पलेक्स, विजयपुर
जिला : गुना (म.प्र.) 473112
POST : GAIL COMPLEX, VIJAIPUR
DISTT. GUNA (M.P.) 473 112
फोन/PHONE : (07544) 274444
फैक्स/FAX : (07544) 274600

No.GAIL/VJPR/CLEAN AGENT/2017

Date: 25th April 2017

TO WHOMSOEVER IT MAY CONCERN

M/S. NITIN FIRE PROTECTION INDUSTRIES LIMITED, MUMBAI HAS PERFORMED A LIVE DEMONSTRATION AT GAIL VIJAYPUR ON 18th APRIL 2017 USING THE LINEAR PNEUMATIC DETECTION SYSTEM (SS PENUMATIC HOLLOW METALLIC TUBE TYPE) INTEGRATED WITH CLEAN AGENT GAS FOR THE PROTECTION OF ELECTRICAL PANELS. THE LIVE DEMONSTRATION WAS DONE SUCESSFULLY AND PERFORMANCE WAS FOUND EXCELLENT. THIS TEST WAS WITNESSED BY OFFICIALS OF M/S GAIL AND ALSO M/S MECON.

WITH REGARDS,

25/04/17

(DEVENDRA KUMAR SHARMA)
DGM (FIRE & SAFETY)
E-mail: DKS02327@gail.co.in

पंजीकृत कार्यालय :
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नई दिल्ली--110066, इंडिया
REGISTERED OFFICE :
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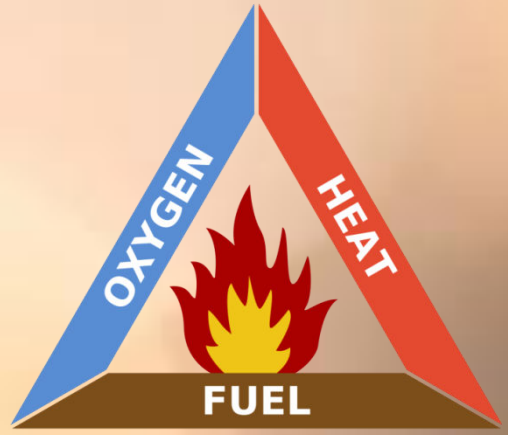
NEW DELHI-110066, INDIA

सीआईएन / CIN
L40200 DL1984GOI018976
www.gailonline.com

High Pressure Water Mist Fire Suppression System

What does Water Mist do?

A high-pressure water mist system attacks two elements of the fire triangle: oxygen and heat. The uniqueness of water mist is that it combines the suppression effect of gas and traditional sprinkler systems. As well as removing the oxygen like a gas system, it simultaneously cools the fire like a traditional sprinkler. The cooling effect additionally lowers the risk of re-ignition.



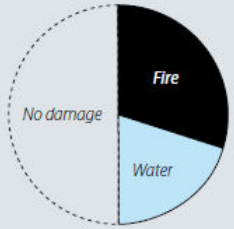
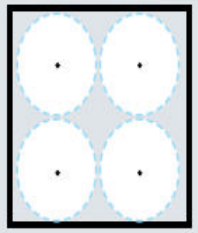
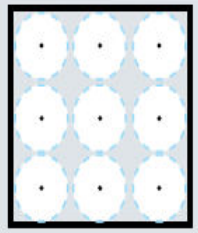
The VdS approved water mist system is a unique fire fighting system. When water is forced through nozzles, at high-pressure, a super-fine mist is formed that has a two-fold extinguishing effect. As well as cooling the fire like a traditional sprinkler, it simultaneously starves the fire of oxygen like gas systems. When the mist comes into contact with flames, it evaporates and expands minimum 1,700 times. The dense vapour created displaces the flames and quickly extinguishes the fire.

VdS

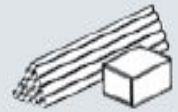
Benefits of Water Mist

- Limited water damage
- Minimal damage in the unlikely event of accidental activation
- Less need for a pre-action system
- An advantage where there is an obligation to catch water
- A reservoir is rarely needed
- Less downtime due to low fire and water damage
- Reduced risk of losing market shares, as production is quickly up and running again
- Efficient - also for fighting oil fires
- Lower water supply bills or taxes
- Easy to handle
- Maintenance free
- Attractive design for easier incorporation
- High quality and durability
- Cost-effective at piece-work
- Easy to find room for pipes
- Easy to retrofit and bend
- Short installation time
- Efficient cooling

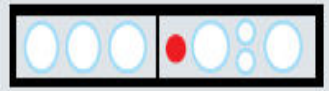
Water Mist against Traditional Sprinklers

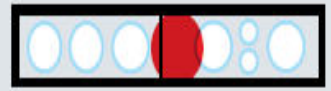
Water mist	Traditional sprinkler
LESS WATER	
	
CAUSE OF DAMAGE	
	
FEWER NOZZLES AND PIPES	
	

SMALL STAINLESS STEEL PIPES AND FEWER FITTINGS



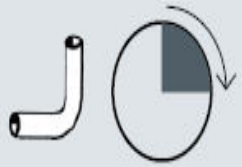
EASY TO INTEGRATE INTO BOTH NEW AND RETROFIT INSTALLATIONS

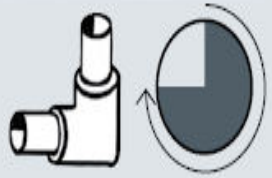




EASY TO HANDLE

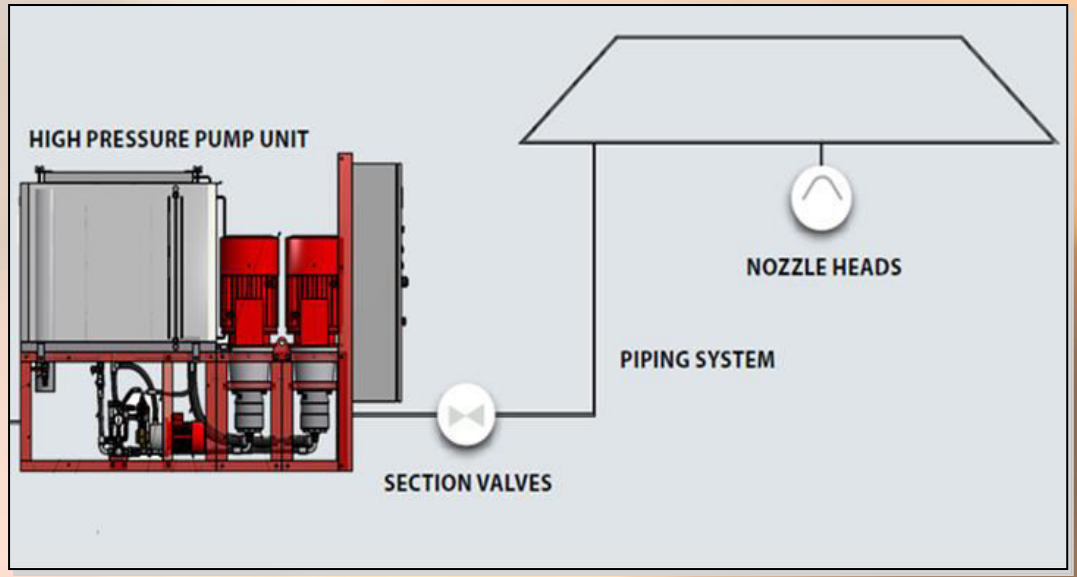
QUICK INSTALLATION





Areas of application

- Transformer
- Atriums
- Hotels
- Garages
- Tunnels
- Wind Turbine
- Schools
- Special Construction
- Libraries And Archives
- Galleries And Museums
- Paint Spray Booth
- Cable Channels
- Computer Rooms
- Generators



VdS

Clean Agent Based Fire Suppression System

Gas Based Fire Suppression System

INERTECH SMART FLOW IG-541/IG-100/IG-55/IG-01 300 BAR (4350 PSI) CLEAN AGENT FIRE SUPPRESSION SYSTEM

Proven clean agent

- Naturally-occurring gases
- Nontoxic Approved for occupied spaces
- No vision-obscuring fog upon discharge
- No ozone depletion potential
- No global warming potential

Innovative delivery system technology

- Regulates discharge pressure
- Reduces agent storage footprint
- Flexibility in design and installation
- Multiple hazard protection
- Remote storage location
- Reduces venting requirements
- "LPCB approved"

Gas Based Fire Suppression System

Inertech541(IG-541) Fire Suppression Systems

IG-541 is a colourless, electrically non-conductive gas with a density approx. same as that of air. It is an inert gas mixture consisting of Nitrogen, Argon & Carbon Dioxide. IG-541 extinguishes fires mainly by a reduction of oxygen concentration in the atmosphere of the hazard enclosure.

Inertech55(IG-55) Fire Suppression Systems

IG-55 is an inert gas blend consisting of a 50:50 mixture of two gases Argon & Nitrogen. IG-55 discharge results in a gas mixture with a density similar to that of air.

Inertech01(IG-01) Fire Suppression Systems

IG-01(Argon) extinguishing systems are based on the principle of reducing the oxygen concentration inside the protected hazard. Argon quickly and uniformly distribute within the enclosure, achieving design concentration in 60 seconds.

Inertech100(IG-100) Fire Suppression Systems

IG-100 (Nitrogen) is a gas which has the capacity to be able to treat a fire hazard in open spaces. IG-100 is stored in high pressure cylinders in the form of compressed gas. Thus, space required for such cylinder storage depends on pressure and capacity.

LOSS PREVENTION CERTIFICATION BOARD
LPCB

Chemical Based Fire Suppression System

Nitin 227 Systems – 25 Bar & 42 Bar

Using industry recognized HFC 227ea suppression agent

Designed as per NFPA 2001.

- highly effective
- Environmentally friendly
- High Quality
- Reliable Performance
- Cost efficient

Nitin 1230 Systems – 25 Bar & 42 Bar

Using Novec 1230

Novec1230 Fire Protection Fluid is a next generation halon alternative designed to balance industry concerns for performance, human safety and the environment.
Designed as per NFPA 2001.

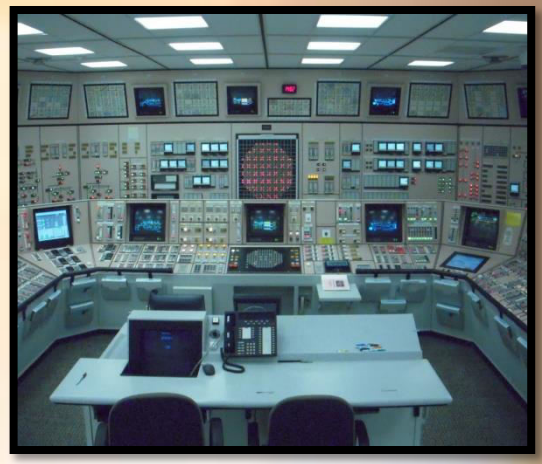
A long - term sustainable, green Technology

With zero Ozone depletion potential, extremely low global warming potential and short atmospheric life time Novec 1230 fluid is the first Halon/HFC replacement to offer a viable long - term sustainable technology for special hazards fire protection.

Gas Based Fire Suppression System

AREAS OF APPLICATIONS :

- Computer rooms
- Telecommunication Centers
- Records and data archives
- Testing / imaging equipment
- Chemical laboratories
- Clean rooms
- Control rooms/Instrument Rooms/Rack Rooms



Gas Based Fire Suppression System

AREAS OF APPLICATIONS :

- Flammable liquid storage Control Rooms
- Offshore drilling rigs
- Steel Plants
- Textile manufacturing
- Electric utility facilities
- Media storage
- Military vehicles
- Art / artifacts / historical collections

NITIN FIRE PROTECTION INDUSTRIES LIMITED

THANK YOU

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WORTHINGTON NITIN CYLINDERS PVT. LTD.
cylinders@worthingtonnitincylinders.com INDIA.

NITIN GLOBAL PTE
SINGAPORE

Corporate Headquarter
501, Delta, Technology Street, Hiranandani Gardens, Powai, Mumbai – 400 076. Maharashtra, India.
Ph: +91 22 4045 7000 Fax: +91 22 6692 0910
Email: nitinfire@vsnl.com Website: http://www.nitinfire.com

Easun - MR Tap Changers (P) Ltd.

" Easun MR " make NIFPS System

Easun – MR (EMR) is

Largest OLTC Manufacturer in Asia

The largest NIFPS manufacturing Capacity in India

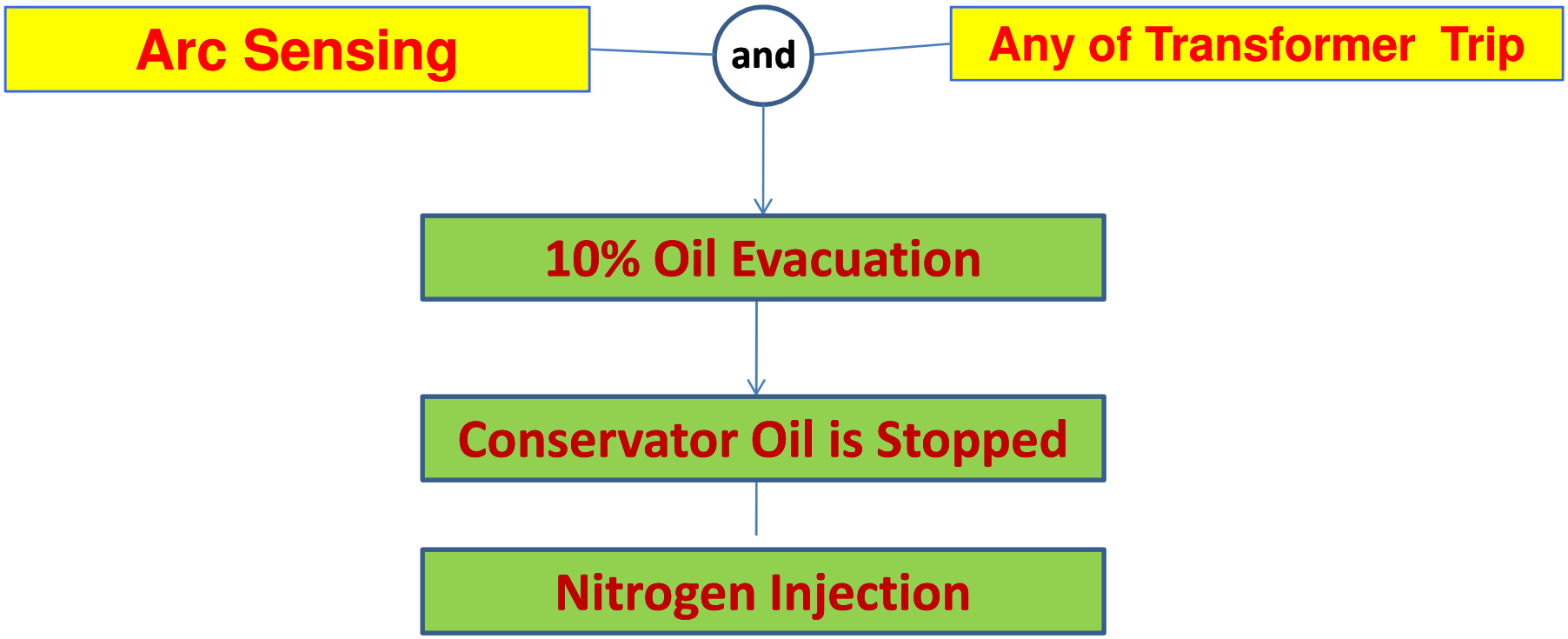
Factory – I, Chennai

Factory – II, Pondicherry

Factory – III, Pondicherry

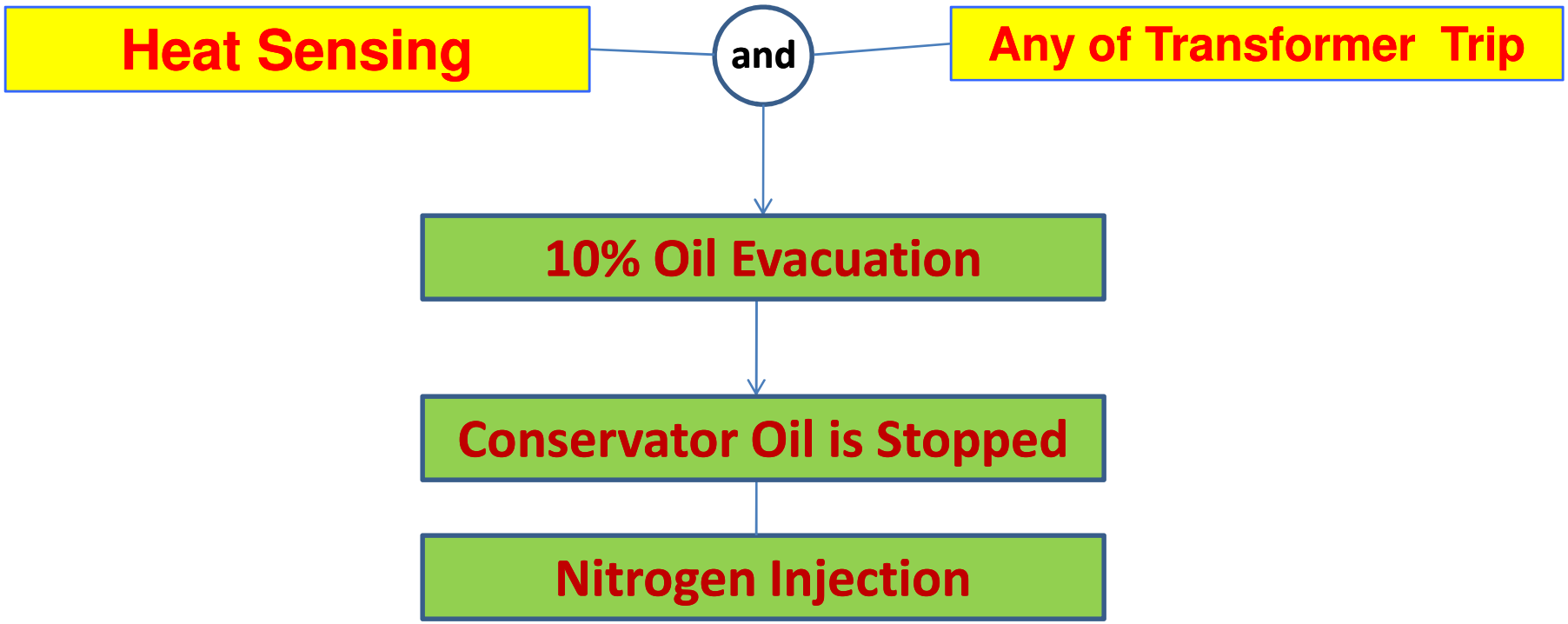

TRANSFORMER FIRE PROTECTION SYSTEM
EMR

Impeccable Operating Logic



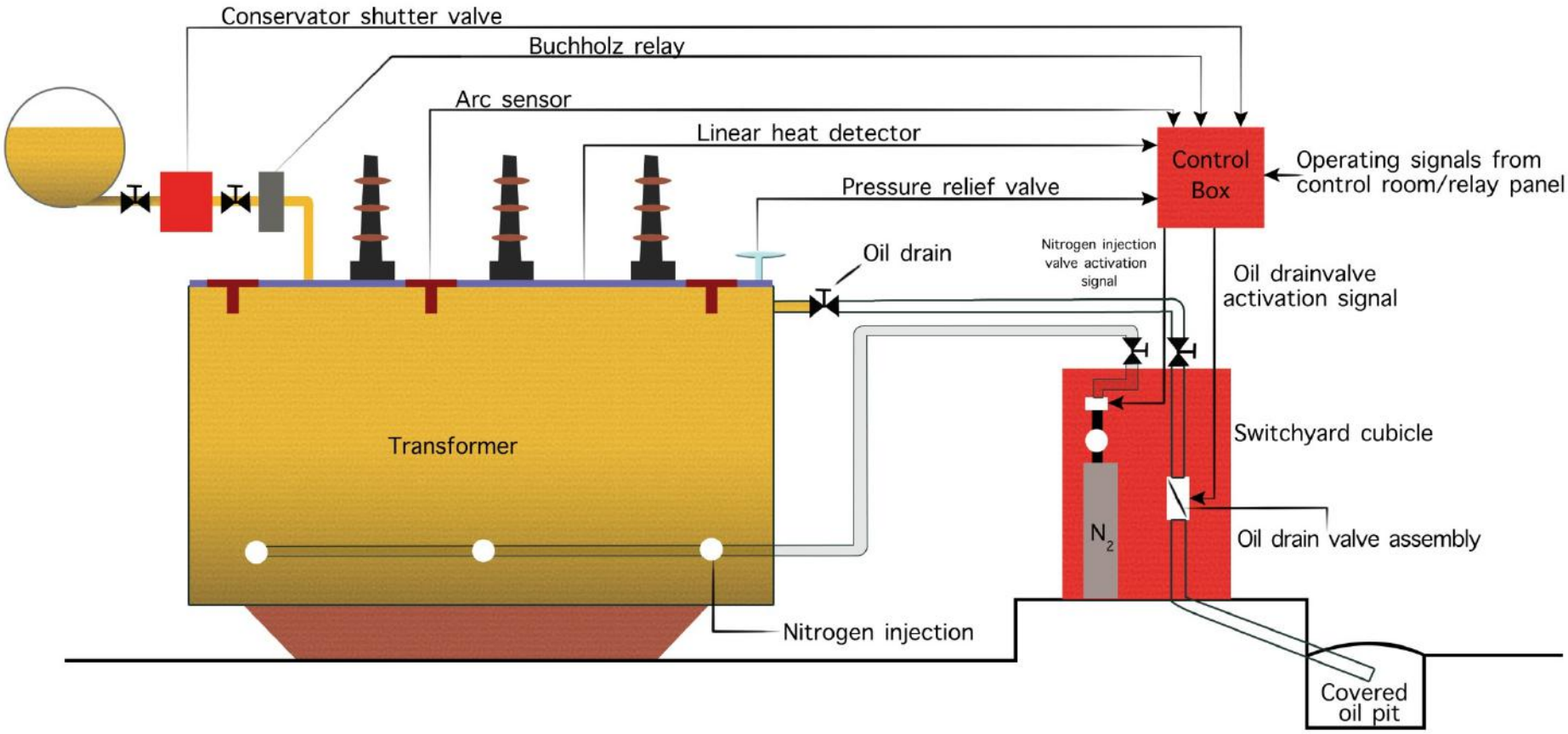
Prevention Mode

Impeccable Operating Logic

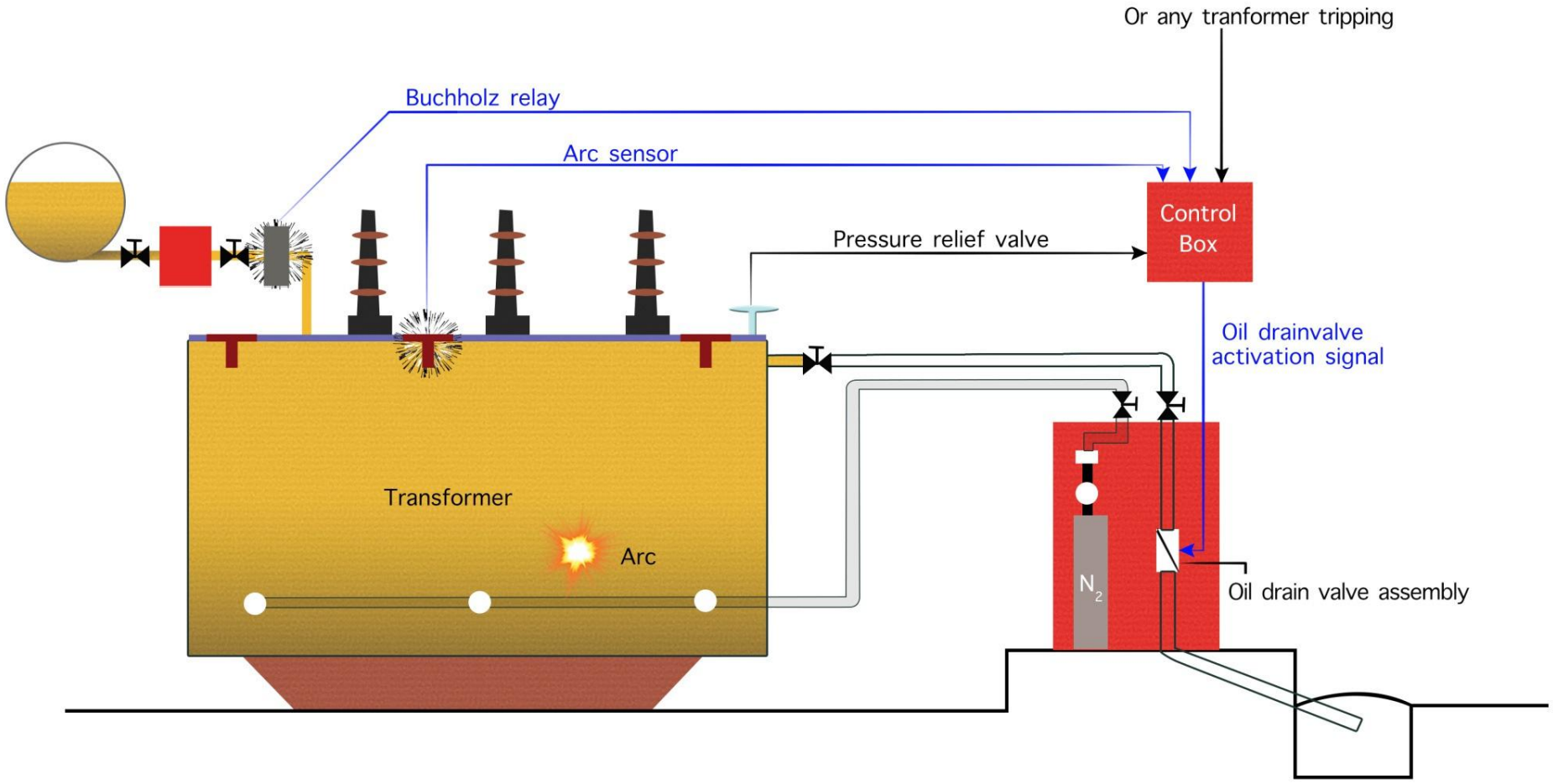


Extinguishing Mode

NITROGEN INJECTION FIRE PREVENTION AND EXTINGUISHING SYSTEM



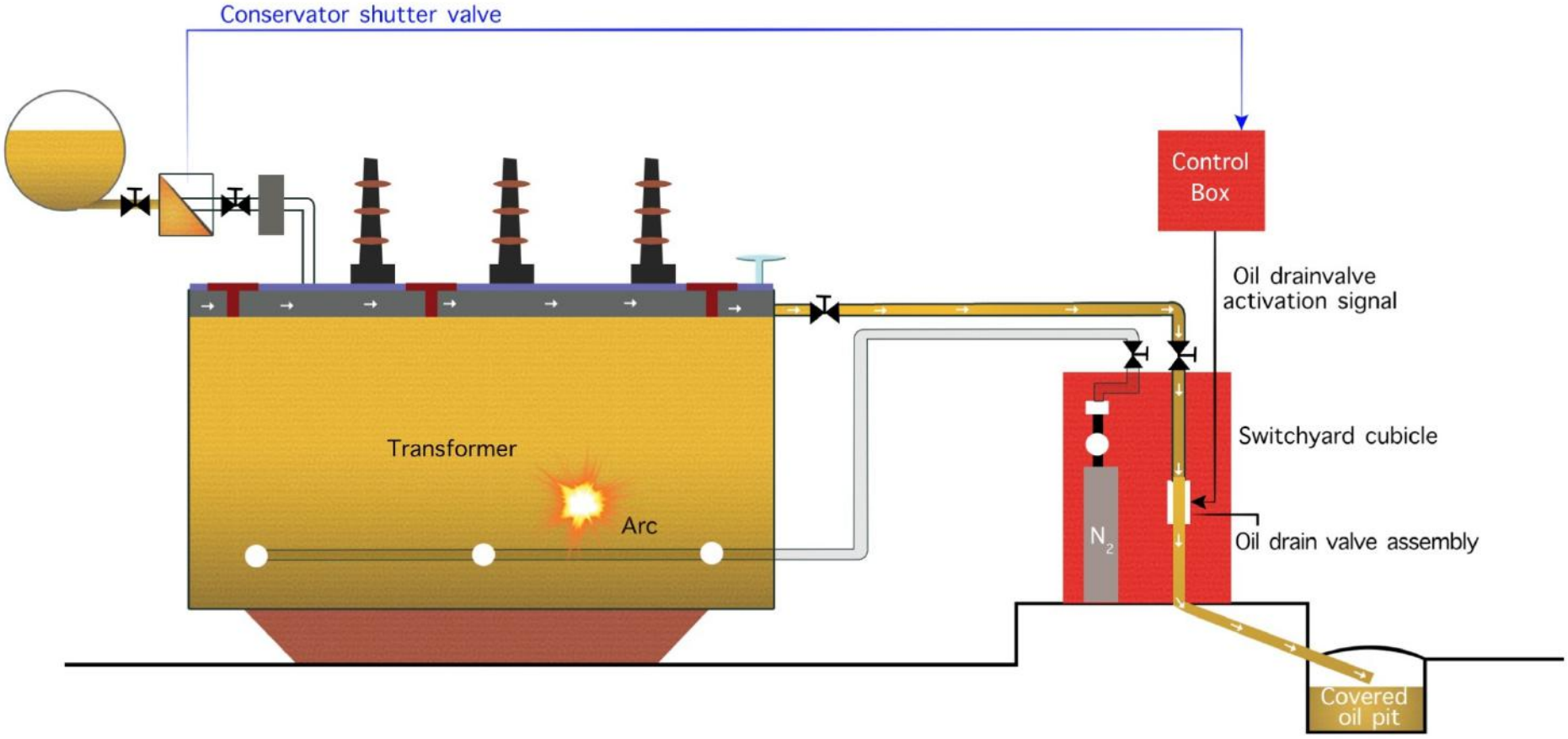
Prevention Mode



Along with it, If the any other Transformer Trip is activated,

10% Oil Evacuation Begins.. Preventing the Possibility of Fire

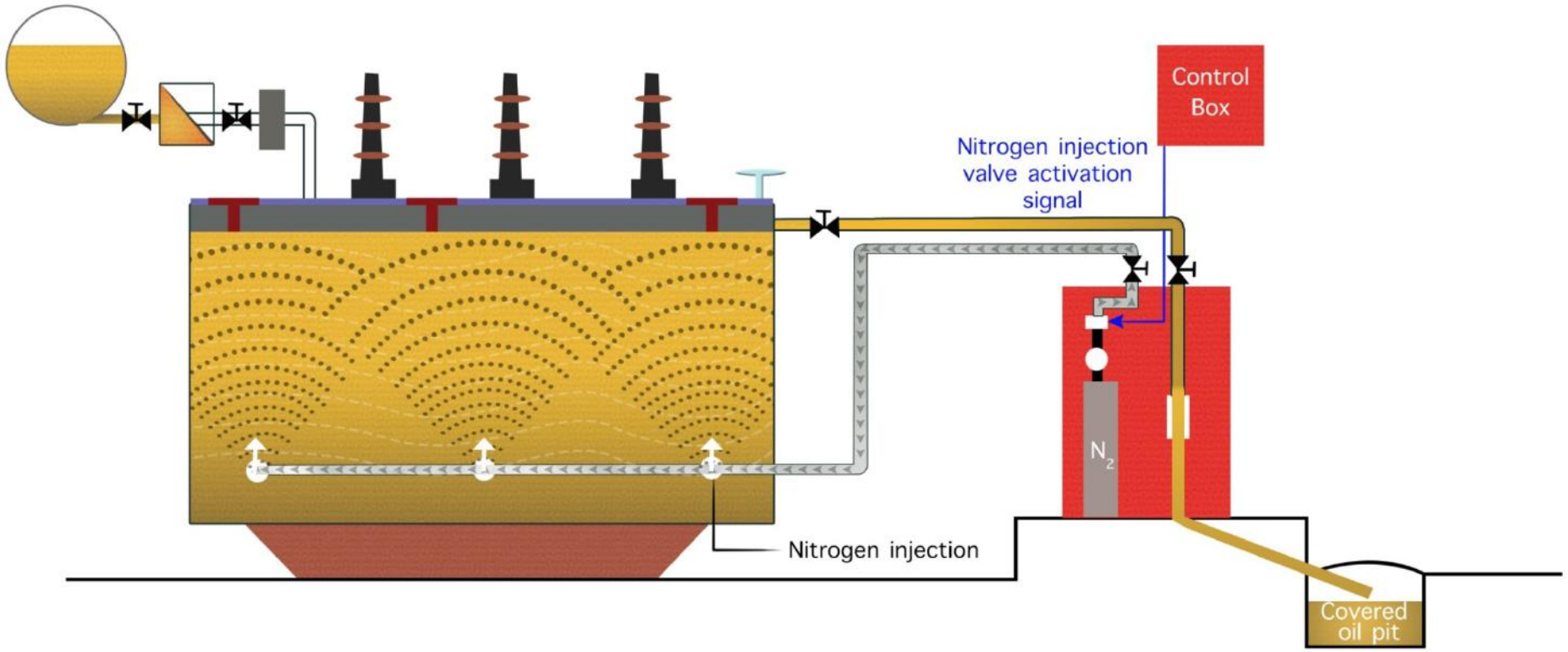
PREVENTION MODE



10% of Oil has been evacuated

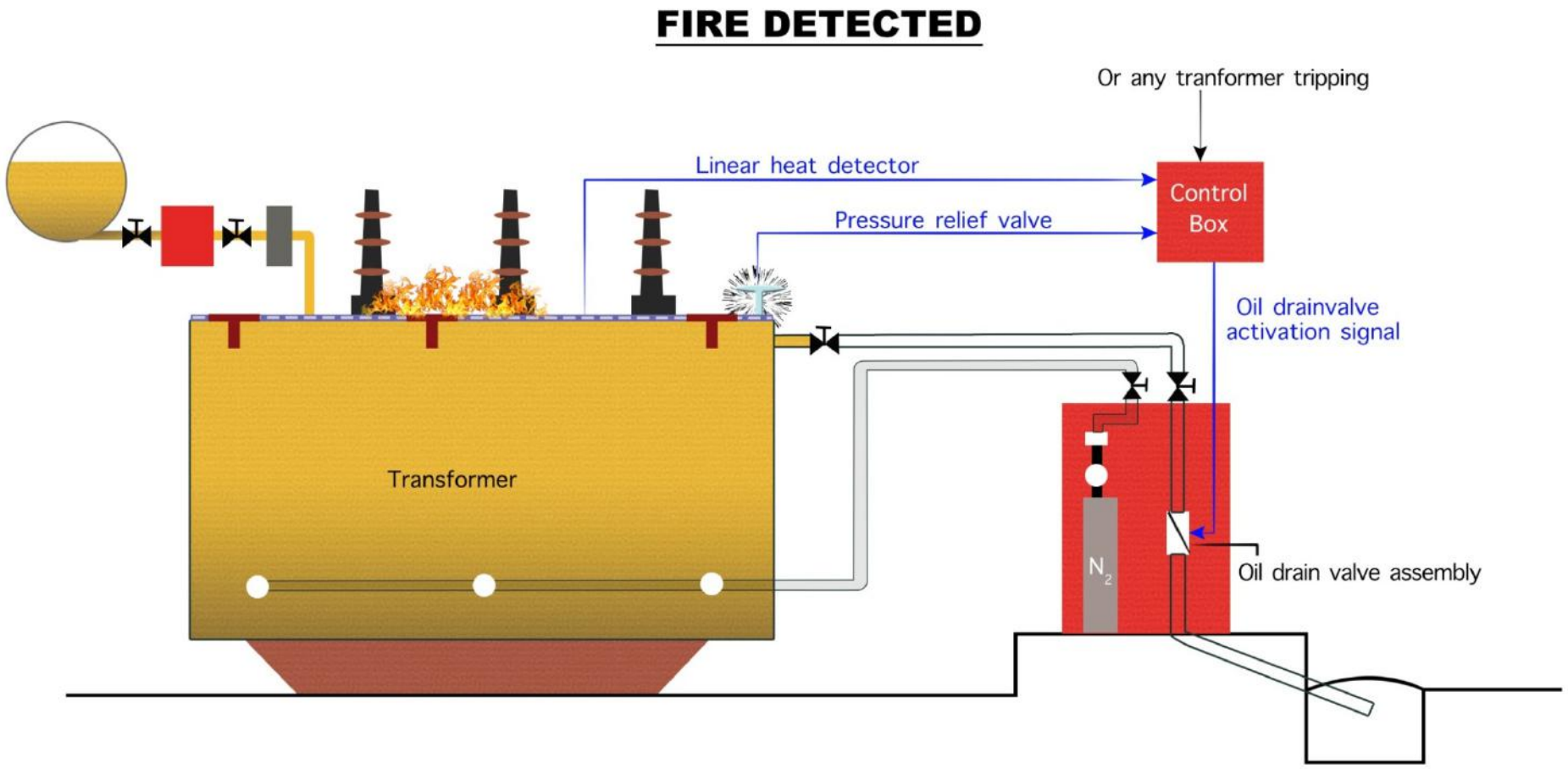
Conservator Oil Flow stopped using our Conservator Shutter,

Nitrogen is ready for Injection



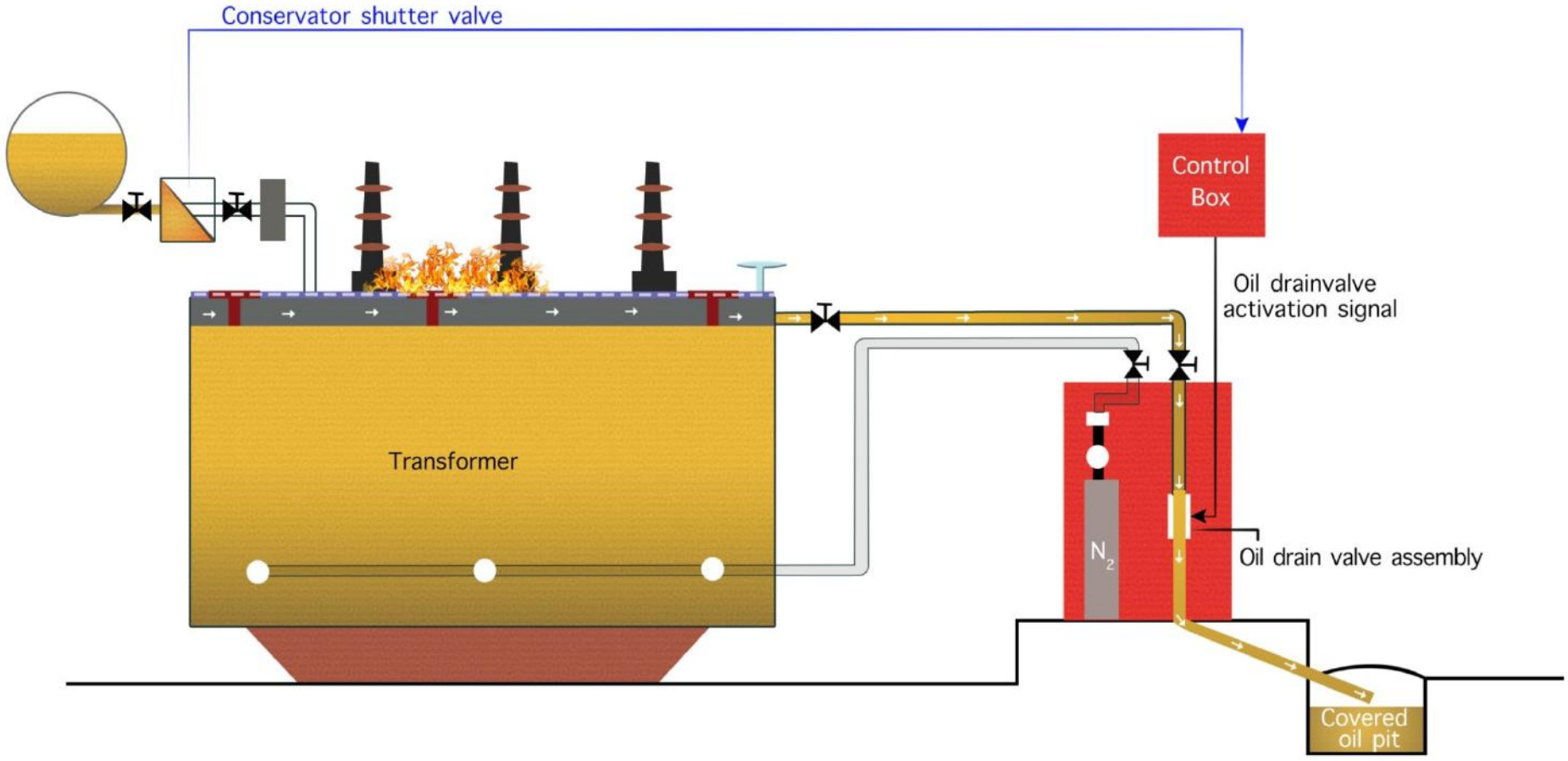
Nitrogen is being Injected and the Fire Possibility is fully Eliminated

Extinguishing Mode

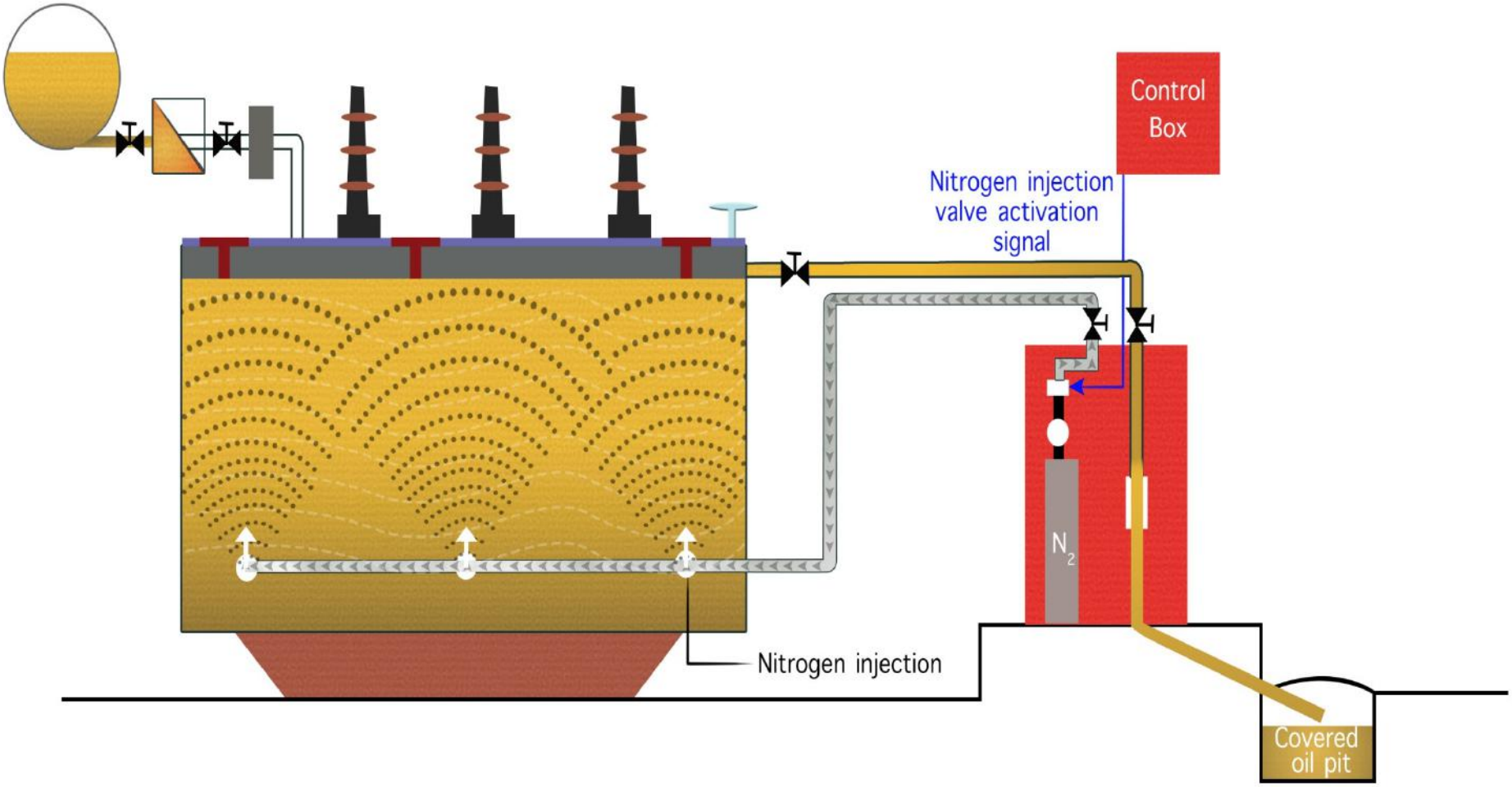


Whenever there is a Fire, Linear Heat Detectors instantly recognizes it and trips the Master Circuit Breaker

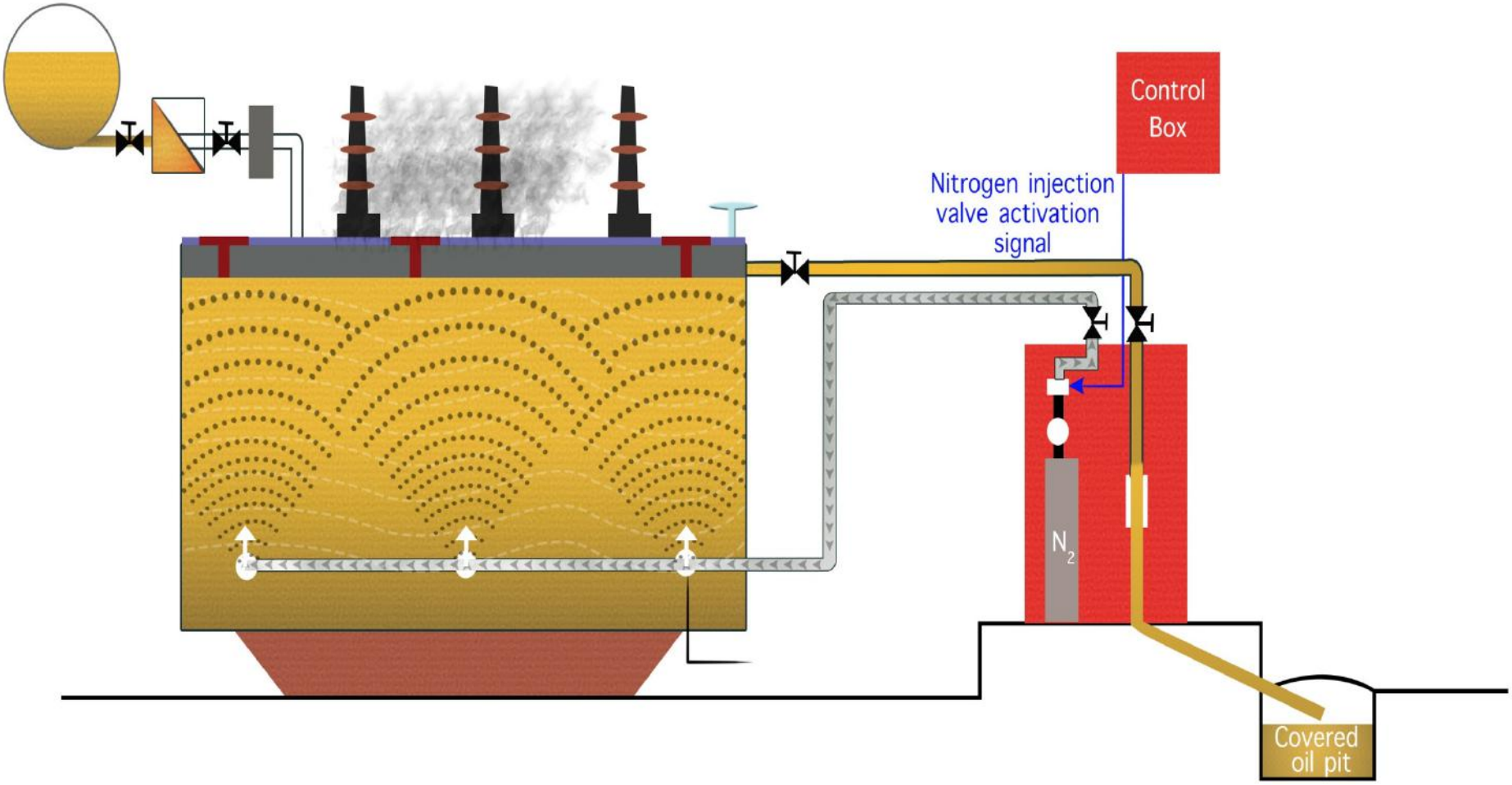
EXTINGUISHING MODE



When both Linear Heat Detectors and any of the transformer trip operates , 10% Oil Evacuation Begin.

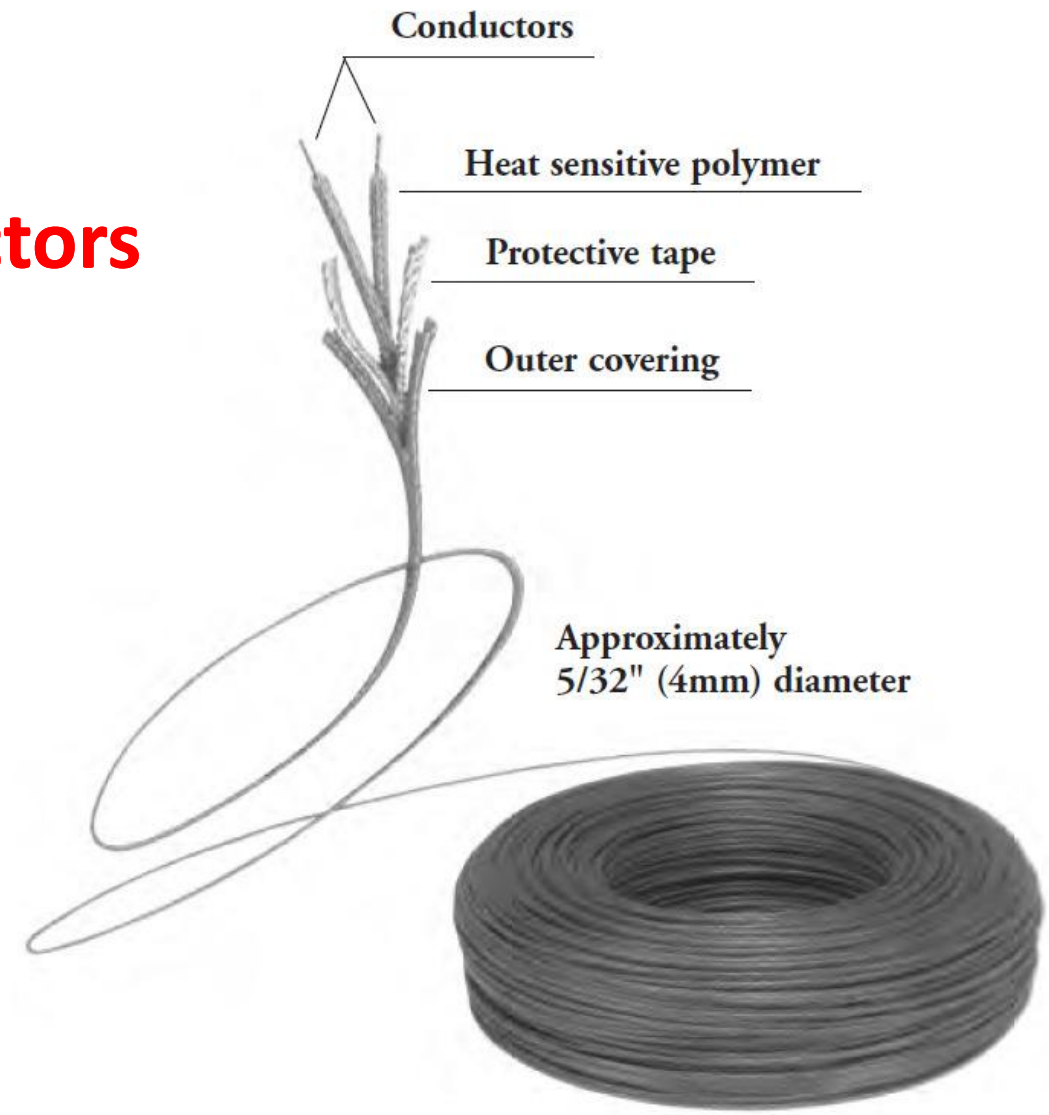


Nitrogen is being Injected and the Fire is doused thereby saving the high value asset Transformer.


Control Box
Nitrogen injection valve activation signal
N_2
Covered oil pit

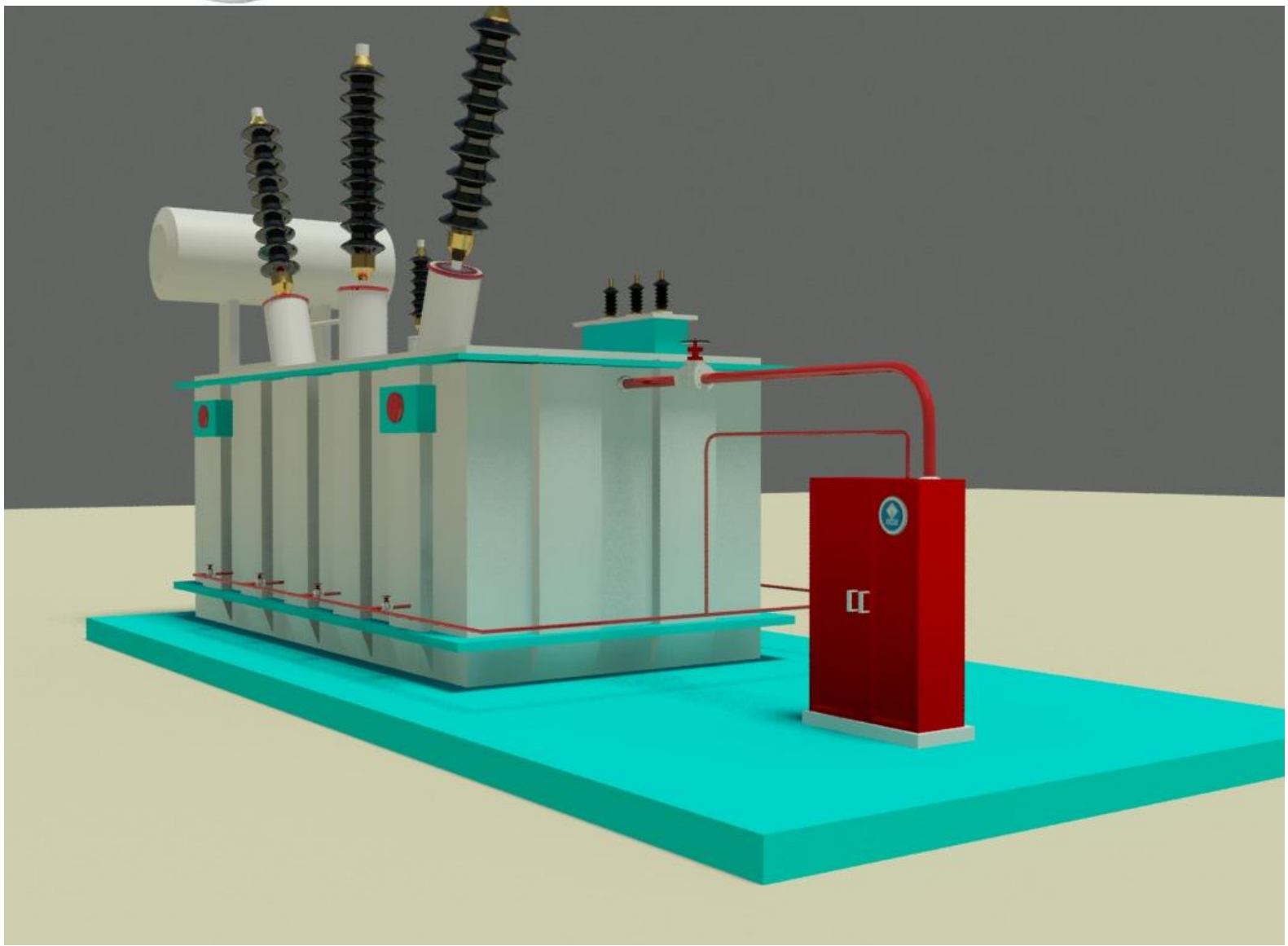
Arc Sensors

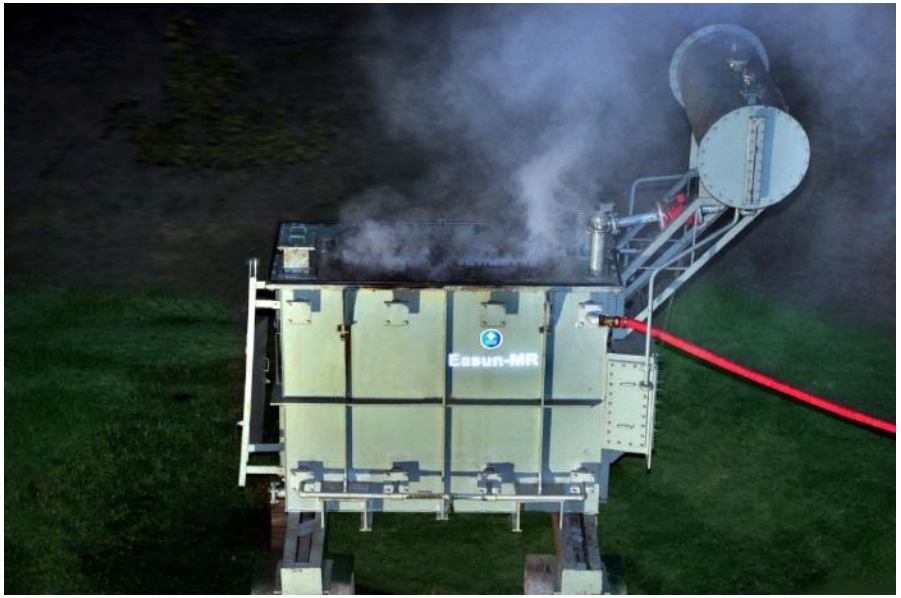
Linear Heat Detectors



View of Shutter Valve and Linear Heat Detector


DANGER





Fire & Extinguishing

Live Demonstration and Testing facility

Pit as an Option

Test Reports

FORM NO : NTH/CHN/F5

भारत सरकार Government of India
राष्ट्रीय परीक्षण शाला (द.क्षे.)
NATIONAL TEST HOUSE (SR)
तरमणी, चेन्नई - 600 113. Taramani, Chennai - 600 113.
Phone : 22432374, 22431157 Fax : 22433158 email : nthsr@tn.nic.in

350172

परीक्षण प्रमाण पत्र
TEST CERTIFICATE

INTERIM/FINAL REPORT

परीक्षण प्रमाण पत्र सं. Test Certificate No	जारी होने की तिथि Date of Issue	कोड नं Code No	पृष्ठ Page	पृष्ठों की संख्या No of Pages
NTH(SR)/EL(C)/2016/00365	04/01/2017	1481789857584	1	2

जिसे जारी करना है / Issued To : EASUN-MR TAP CHANGERS(P) LTD,

पता / Address : #612,M.T.H Road,Thiruninravur,Chennai-602024

ग्राहक का सन्दर्भ सं एवं दिनांक / Customer's Ref. No. : E-Mail Date: 15/12/2016

पंजिका सं एवं दिनांक / Register No & Date : 00365/NTH(SR)/EL(C)/15/12/2016

परीक्षण सामग्री का विवरण / Description of Test Item : Nitrogen Injection Fire Prevention System.

परीक्षण सामग्री का पहचान / Identification of Test Item :
Model No: NFPS 150
Sl. No. : NFPS 1
Manufacturer:Easun-MR Tap changers (P) Ltd.,

24 x 7 Installation, AMC, Service Support

Thank You !

CTR

Transformer Explosion Prevention and Fire Extinguishing System for Oil Filled Transformer/ Reactors.

CEA GUIDELINES FOR POWER TRANSFORMERS TO PREVENT FIRE AND EXPLOSION:

TRANSFORMER EXPLOSION PREVENTION SYSTEM

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

सत्यमेव जयते

भारत का राजपत्र

The Gazette of India

असाधारण

EXTRAORDINARY

भाग III—खण्ड 4

PART III—Section 4

प्राधिकार से प्रकाशित

PUBLISHED BY AUTHORITY

सं. 244] नई दिल्ली, शुक्रवार, सितम्बर 24, 2010/आश्विन 2, 1932

No. 244] NEW DELHI, FRIDAY, SEPTEMBER 24, 2010/ASVINA 2, 1932

(ix) he shall ensure that the transformers of 10 MVA and above rating or in case of oil filled transformers with oil capacity of more than 2000 liters are provided with fire fighting system as per IS - 3034: 1993 or with Nitrogen Injection Fire Protection system;

REF NR :

CTR

USUAL SEQUENCE OF TRANSFORMER EXPLOSION AND FIRE, WITHOUT CTR'S NIFPES:

TRANSFORMER EXPLOSION PREVENTION SYSTEM

FAULT

↓

SHORT CIRCUIT/ARC

↓

OIL SURGE/TURBULANCE

↓

SUDDEN PRESSURE BUILTUP

↓

TRANSFORMER EXPLOSION
(THROUGH THE WEAKEST PART)

↓

FIRE

↓

SPREAD OF FIRE
(DUE TO CONSERVATOR OIL FEEDING THE UNCONTROLLED OIL SPILLAGE)

REF NR :

CTR

DIFFERENT TYPES OF FAULTS CAUSED TRANSFORMER FIRE/ EXPLOSION.

TRANSFORMER EXPLOSION PREVENTION SYSTEM

INTERNAL SEC DAMAGE

EXTERNAL

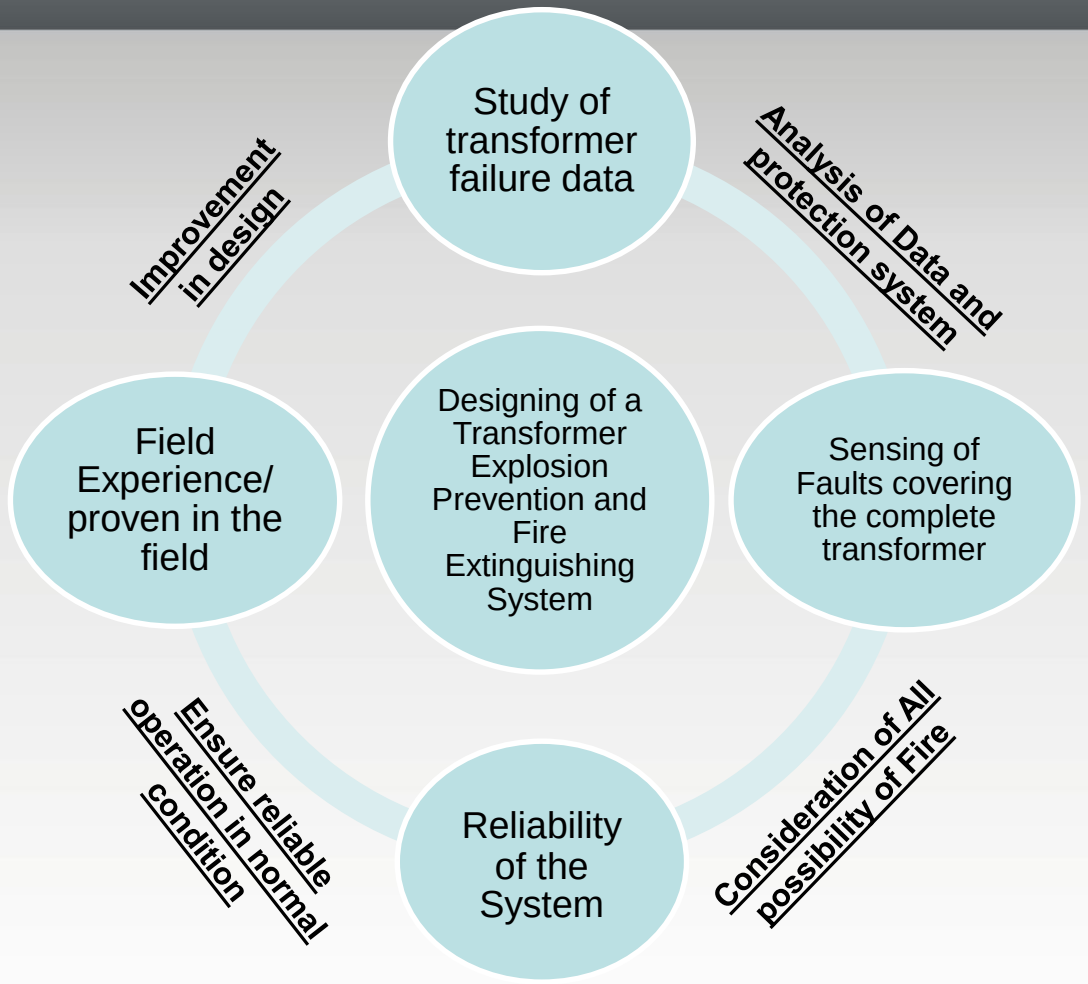
BUSHING FIRE

REF NR :

CTR

DESIGN PHILOSOPHY OF EPFES

TRANSFORMER EXPLOSION PREVENTION SYSTEM



REF NR :

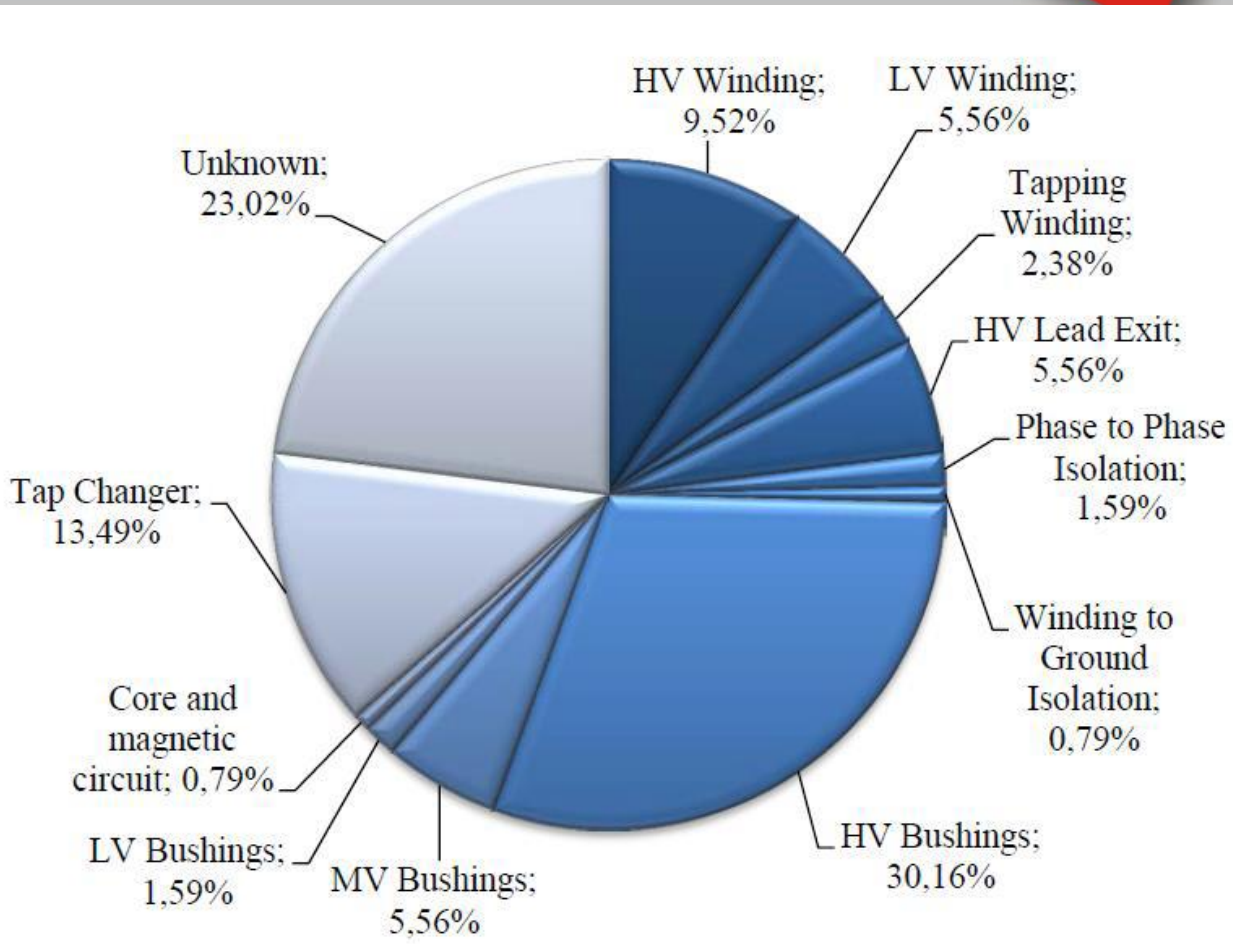
CTR

TRANSFORMER FAILURE WITH FIRE OR EXPLOSION

TRANSFORMER EXPLOSION PREVENTION SYSTEM

- **MAXIMUM CASES OF FIRE OR EXPLOSIONS, AS CAN BE SEEN, ARE DUE TO BUSHINGS OR TAPCHANGERS FAILURES.**

- **NECESSITY OF PROVEN TECHNOLOGY THEREFORE TO PREVENT FROM THE ABOVE 2 TYPES OF FAILURES, WHICH ONLY CTR TECHNOLOGY HAS DELIVERED SUCCESSFULLY.**



REF NR :

CTR

CTR SYSTEM COMPRISES OF:

TRANSFORMER EXPLOSION PREVENTION SYSTEM

Cubicle

Control Box

Signal box

Transformer
Conservator
Isolation Valve

Fire Detectors

REF NR :

CTR

SEQUENCE OF PROCESS OF CTR EPFES TO PROTECT FROM EXPLOSION

TRANSFORMER EXPLOSION PREVENTION SYSTEM

- **DETECTS THE FAULT WITH IMPECCABLE LOGIC, WHICH COULD OTHERWISE LEAD TO EXPLOSION/ FIRE.**
- **DEPRESSURIZES THE TRANSFORMER WITHIN MILLISECONDS.**
- **ISOLATES THE CONSERVATOR OIL TO PREVENT AGGRAVATION OF 'FEEDING-FAULT' SITUATION.**
- **INJECTS SPECIFIED NITROGEN AT DESIGNED PRESSURE FOR SPECIFIC DESIGN DATA OF TRANSFORMER, WHICH IS THE REAL KEY.**

CTR NIFPES COMPLIES 100% WITH IEEMA'S TECH SPECS PUBLISHED.

TRANSFORMER EXPLOSION PREVENTION SYSTEM

POWER TRANSFORMER
STANDARDISATION MANUAL
JANUARY 2014

IEEMA-25-2014

ieema
your link to electricity

Auto Mode

a) For Prevention of Fire, signals in series :

- Differential Relay Operation,
- Buchholz Relay paralleled with Pressure Relief Valve or RPRR (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,
- Buchholz Relay paralleled with Pressure Relief Valve or RPRR.
- Tripping of all connected breakers (HV & LV/N side) is a pre-requisite for initiation of system activation.

Manual Mode (Remote)

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

Manual Mode (Mechanical)

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

The system shall be designed to be operated manually (oil draining and N_2 injection) in case of failure of power supply to the system.

REF NR : **POWER TRANSFORMER STANDARDISATION MANUAL**

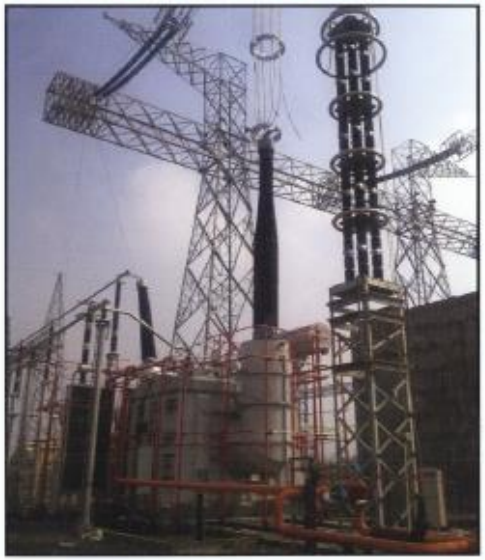
CTR

CTR NIFPES COMPLIES 100% WITH CBIP'S TECH SPECS PUBLISHED.

TRANSFORMER EXPLOSION PREVENTION SYSTEM

Publication No. 317

MANUAL ON TRANSFORMERS



Editors

M. Vijayakumaran, V.K. Lakhiani, V.K. Kanjlia, P.P. Wahi

CENTRAL BOARD OF IRRIGATION & POWER

Malcha Marg, Chanakyapuri, New Delhi 110021

April 2013

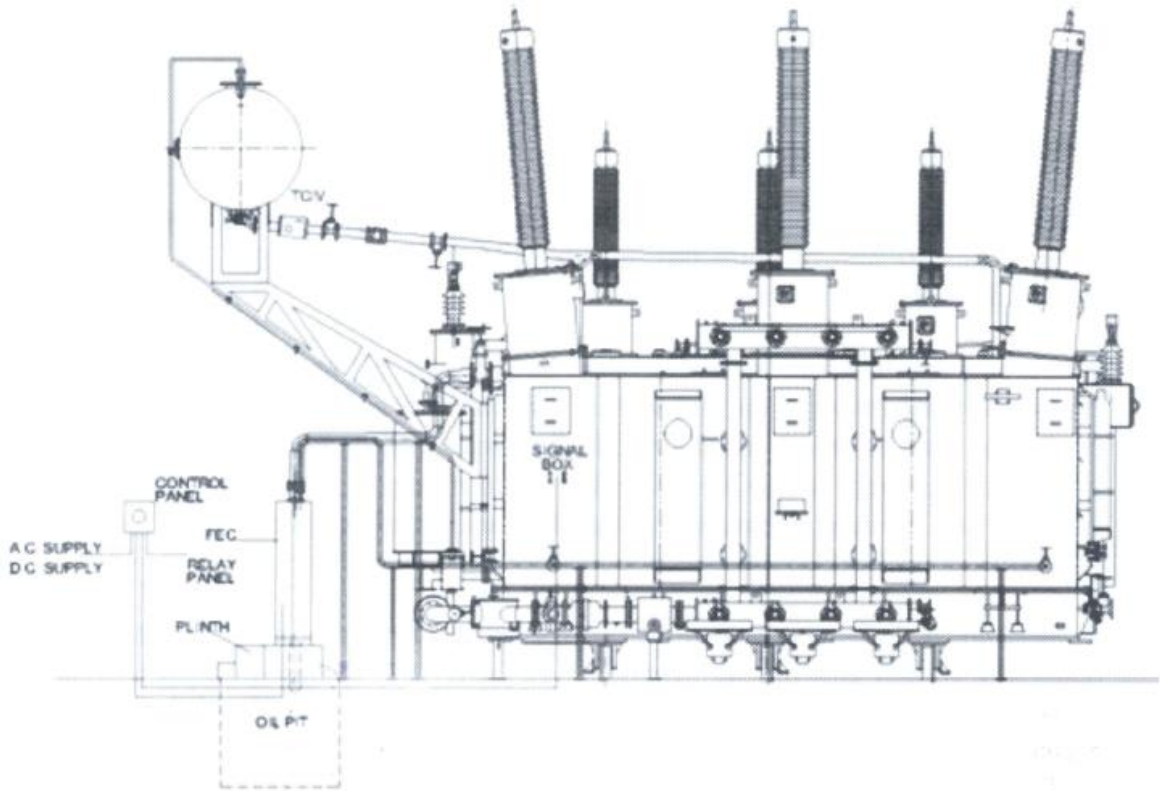


Fig.1

REF NR :

CENTRAL BOARD OF IRRIGATION AND POWER

CTR

CTR NIFPES COMPLIES 100% WITH CIGRE PAPER 537 PUBLISHED IN JUNE 2013.

TRANSFORMER EXPLOSION PREVENTION SYSTEM

537

Guide for Transformer Fire Safety Practices

Working Group A2.33

June 2013

The manufacturer has named the system describe above as "Fast Tank Depressurisation Technique [FTDT]" [58] [59] [60].

"Fast Tank Depressurization" is recognised as a method of fire protection for transformers in NFPA codes 850 and 851. NFPA describes Fast Depressurisation Systems "as a passive mechanical system designed to depressurise the transformer within a few milliseconds after the occurrence of an electrical fault". The is no specific quantitative measure given in the NFPA documents for what venting capacity is required to qualify for being a "Fast Depressurisation System".

Other suppliers also offer variants of this type of transformer fire protection system. One of these suppliers offers a system which pro-actively opens a large oil drain valve and initiates nitrogen injection in response to an internal fault detected by the transformer differential or the master trip relay, in addition to trip signal from a Rapid Pressure Rise Relay, a PRV or a Buchholz Relay. Whilst such a protection system may cause dumping of oil and injection of nitrogen for internal arcing fault,

REF NR :

CIGRE PAPER 537 PUBLISHED IN JUNE 2013

CTR

QUICK COMPARISON OF PREVALENT TRANSFORMER EXPLOSION PREVENTION TECHNOLOGIES BASED ON STANDARDS.

TRANSFORMER EXPLOSION PREVENTION SYSTEM

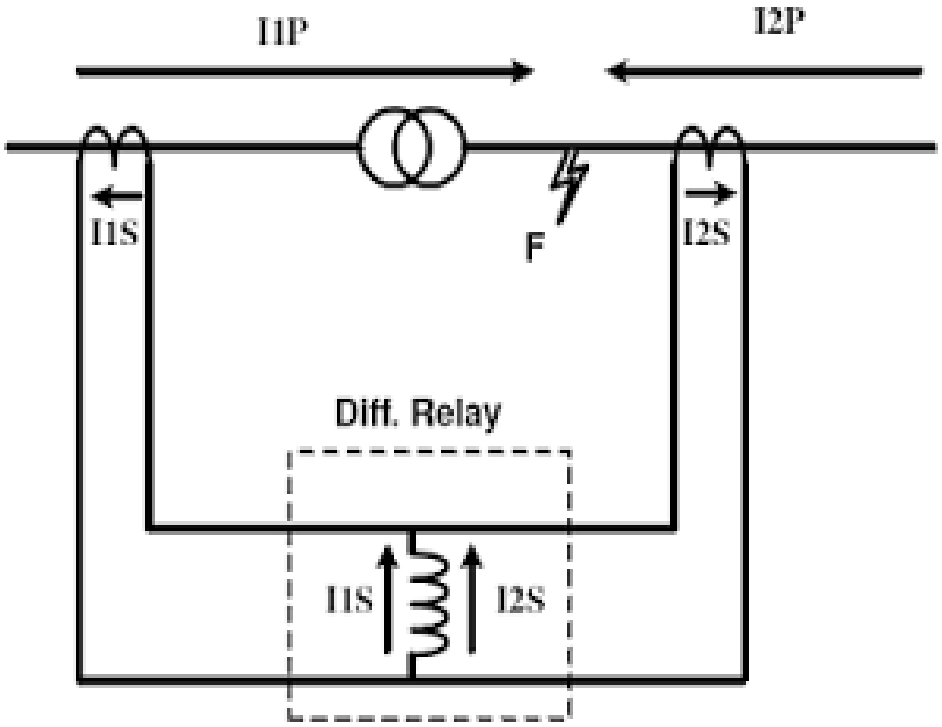
1. **DIFFERENTIAL RELAY BASED CTR TECHNOLOGY: COMPLIES WITH IEEMA PUBLICATIONS, CBIP SPECIFICATIONS AND IS IN LINE WITH CIGRE 537.**

2. **RUPTURE DISC BASED: DOES NOT COMPLY WITH ANY.**

3. **ARC SENSOR BASED: DOES NOT COMPLY WITH ANY.**

PROVEN SUCCESSFUL FACTS USING DIFFERENTIAL RELAY:

TRANSFORMER EXPLOSION PREVENTION SYSTEM



Differetial Relay With Internal Fault Condition

The scheme of differential relay is based on the principle of that the power input to the transformer under normal conditions is equal to the power out.

An internal fault shown in the figure. Now there are 2 anticipated conditions:

There's other supply to feed the fault thus I2P includes a nonzero value Idiff = I1S + I2S which can be terribly high and sufficient to function the differential relay

Radial system, I2P = 0. So, Idiff = I1S and additionally the relay can work and disconnect the breaker.

REF NR :

CTR

COVERING AREA OF DIFFERENTIAL RELAY:

TRANSFORMER EXPLOSION PREVENTION SYSTEM

DIFFERENTIAL RELAY CONNECTED MEASURING THE CURRENT FROM HV-CT TO LV-CT WHICH COVERS FOLLOWING FAULTS:

1. **INTERNAL FAULTS**
2. **EXTERNAL FAULTS**
3. **THROUGH FAULTS**
4. **MAGNETIZING INRUSH CURRENT**

NOTE: DIFFERENTIAL RELAY COVERS ALL LIVE PARTS OF TRANSFORMER FOR ANY KIND OF FAULT, HENCE MOST RELIABLE PROTECTION INPUT WHILE FIRE/ EXPLOSION PREVENTION, WHICH IS USED **ONLY BY CTR SYSTEMS.**

BENEFITS OF USING DIFFERENTIAL RELAY IN FIRE PREVENTION SYSTEM:

- **PROVEN TECHNOLOGY**
- **WORLDWIDE ACCEPTANCE ESTABLISHED.**
- **STANDARDS ARE AVAILABLE.**
- **USED IN EVERY SINGLE SUB-STATION.**
- **MANY MNC'S HAVE CONDUCTED R&D ON DIFFERENTIAL RELAY.**
- **FASTEST SOLUTION FOR IN-TURN-FAULT TRIPPING.**
- **EVENTS CAN BE RECORDED.**
- **TESTING CAN BE DONE AT SITES, NOT JUST AT LABS.**
- **RELIABLE, SAFE, USER FRIENDLY.**
- **RECOGNIZED BY ALL ENGINEERING INSTITUTION SUCH AS: IEEE, CIGRE.**

QUICK COMPARISON OF PREVALENT TRANSFORMER EXPLOSION PREVENTION TECHNOLOGIES BASED ON MOST IMPORTANT TECHNICAL ASPECTS:

TRANSFORMER EXPLOSION PREVENTION SYSTEM

SR. NR.	ASPECT	SYSTEM WITH DIFFERENTIAL	SYSTEM WITH RUPTURE DISC	SYSTEM WITH ARC-SENSOR
1	BUSHING FIRE	EFFECTIVELY WORKS	DOES NOT OPERATE	DOES NOT OPERATE
2	TESTING IN INSTALLED CONDITION	ENTIRELY POSSIBLE AT ANY POINT ANY MOMENT	NOT POSSIBLE	NOT POSSIBLE
3	RETROFITTING	POSSIBLE (ALREADY RETROFITTED MORE THAN 1000 SYSTEMS)	NOT POSSIBLE WITH RUPTURE DISC.	NOT POSSIBLE WITH ARC-FLASH SENSOR.

QUICK COMPARISON OF PREVALENT TRANSFORMER EXPLOSION PREVENTION TECHNOLOGIES BASED ON MOST IMPORTANT TECHNICAL ASPECTS:

TRANSFORMER EXPLOSION PREVENTION SYSTEM

SR. NR.	ASPECT	SYSTEM WITH DIFFERENTIAL	SYSTEM WITH RUPTURE DISC	SYSTEM WITH ARC-SENSOR
4	FIRE SENSING METHOD	MOST TRUSTED FIRE DETECTORS WITH QUARTZ BULBS.	UNRELIABLE LHD, UNSUITABLE AT UNMANNED PLACES.	UNRELIABLE LHD PRONE TO LIGHTENING, SPURIOUS I/Ps.
5	SENSING AREA	800 MM RADIUS, HENCE ARE PLACED STRATEGICALLY TO COVER ENTIRE TOP SURFACE.	NO DEFINED AREA FOR LHD	NO DEFINED AREA FOR LHD, ALSO INEFFECTIVE SINCE LAID INSIDE CONDUITS.
6	CALCULATIONS BACKED N2 PRESSURE/ FLOW	TOTALLY BACKED BY DESIGN CALCULATIONS.	POSSIBLE TO SOME EXTENT, ALTHOUGH RDs WOULD HAVE OTHER SIDE EFFECTS.	NOT KNOWN DESIGN BACKUP.

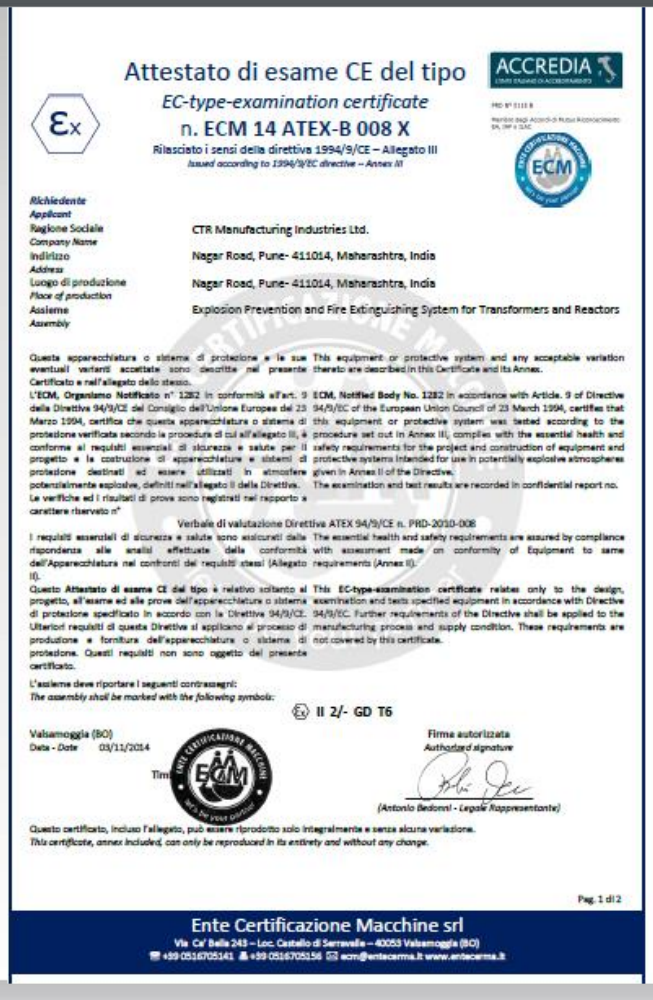
QUICK COMPARISON OF PREVALENT TRANSFORMER EXPLOSION PREVENTION TECHNOLOGIES BASED ON MOST IMPORTANT TECHNICAL ASPECTS:

TRANSFORMER EXPLOSION PREVENTION SYSTEM

SR. NR.	ASPECT	SYSTEM WITH DIFFERENTIAL	SYSTEM WITH RUPTURE DISC	SYSTEM WITH ARC-SENSOR
7	TRANSFORMER DESIGN MODIFICATIONS.	NO ADDITIONAL EXPENSIVE PROVISIONS. WORKS ON BASIC PROTECTIONS.	30% EVACUATION OF FAULT GASES' PEAK PRESSURE, 8 NRS OF RDs ARE REQUIRED.	ADDITIONAL 8 TO 12 OPENINGS ARE REQUIRED ON TRANSFORMERS, BASED ON RATING
8	N2 INJECTION VALVE.	EVEN AFTER AGING, SEEPAGE OR LEAKAGE PROOF DESIGN.	NO SUCH SEEPAGE/ LEAKAGE PROTECTION KNOWN.	NO SUCH SEEPAGE/ LEAKAGE PROTECTION KNOWN. IN FACT, MAY CAUSE IN LIVE TRANSFORMER.
9	APPLICABILITY OF PRINCIPLE	USES ORIGINAL TRANSFORMER PROTECTIONS LIKE DIFFERENTIAL, PRV, BUCHHOLZ, HENCE SAFE AND RELIABLE.	RUPTURE DISC DISCONTINUED EVEN IN TRANSFORMER PROTECTION DUE TO INHARENT ISSUES.	ARC SENSOR IS IN QUESTIONS DUE TO THEIR 'LINE OF SIGHT' PRINCIPLE AND QUICK, HEAVY MAINTENANCE.

INTERNATIONAL CERTIFICATES:
ATEX MARKING:

TRANSFORMER EXPLOSION PREVENTION SYSTEM



Attestato di esame CE del tipo

EC-type-examination certificate

n. ECM 14 ATEX-B 008 X

Rilasciato i sensi della direttiva 1994/9/CE – Allegato III

Issued according to 1994/9/EC directive – Annex III

ACCREDIA

Richiedente
Applicant

Ragione Sociale *Company Name*	CTR Manufacturing Industries Ltd.
Indirizzo *Address*	Nagar Road, Pune- 411014, Maharashtra, India
Luogo di produzione *Place of production*	Nagar Road, Pune- 411014, Maharashtra, India
Assieme *Assembly*	Explosion Prevention and Fire Extinguishing System for Transformers and Reactors

Questa apparecchiatura o sistema di protezione e le sue eventuali varianti accettate sono descritte nel presente Certificato e nell'allegato dello stesso.

This equipment or protective system and any acceptable variation thereto are described in this Certificate and its Annex.

L'**ECM, Organismo Notificato n° 1282** in conformità all'art. 9 della Direttiva 94/9/CE del Consiglio dell'Unione Europea del 23 Marzo 1994, certifica che questa apparecchiatura o sistema di protezione verificata secondo la procedura di cui all'allegato III, è conforme ai requisiti essenziali di sicurezza e salute per il progetto e la costruzione di apparecchiature e sistemi di protezione destinati ad essere utilizzati in atmosfere potenzialmente esplosive, definiti nell'allegato II della Direttiva. Le verifiche ed i risultati di prova sono registrati nel rapporto a carattere riservato n°

ECM, Notified Body No. 1282 in accordance with Article. 9 of Directive 94/9/EC of the European Union Council of 23 March 1994, certifies that this equipment or protective system was tested according to the procedure set out in Annex III, complies with the essential health and safety requirements for the project and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II of the Directive. The examination and test results are recorded in confidential report no.

Verbale di valutazione Direttiva ATEX 94/9/CE n. PRD-2010-008

I requisiti essenziali di sicurezza e salute sono assicurati dalla rispondenza alle analisi effettuate della conformità dell'Apparecchiatura nei confronti dei requisiti stessi (Allegato II).

The essential health and safety requirements are assured by compliance with assessment made on conformity of Equipment to same requirements (Annex II).

Questo **Attestato di esame CE del tipo** è relativo soltanto al progetto, all'esame ed alle prove dell'apparecchiatura o sistema di protezione specificato in accordo con la Direttiva 94/9/CE. Ulteriori requisiti di questa Direttiva si applicano al processo di produzione e fornitura dell'apparecchiatura o sistema di protezione. Questi requisiti non sono oggetto del presente certificato.

This **EC-type-examination certificate** relates only to the design, examination and tests specified equipment in accordance with Directive 94/9/EC. Further requirements of the Directive shall be applied to the manufacturing process and supply condition. These requirements are not covered by this certificate.

L'assieme deve riportare i seguenti contrassegni:
The assembly shall be marked with the following symbols:

Ex II 2/- GD T6

Valsamoggia (BO)
Data - *Date* 03/11/2014

Firma autorizzata
Authorized signature

(Antonio Bedonni - Legale Rappresentante)

Questo certificato, incluso l'allegato, può essere riprodotto solo integralmente e senza alcuna variazione.
This certificate, annex included, can only be reproduced in its entirety and without any change.

Pag. 1 di 2

Ente Certificazione Macchine srl
Via Ca' Bella 243 – Loc. Castello di Serravalle – 40053 Valsamoggia (BO)
☎ +39 0516705141 🖷 +39 0516705156 ✉ ecm@entecerma.it www.entecerma.it

ACCREDIA

Allegato I /Annex I

al Attestato di esame CE del tipo n°

to EC-type-examination certificate no.

ECM 14 ATEX-B 008 X

Descrizione dell'assieme
Assembly description

Explosion Prevention and Fire Extinguishing System for Transformers and Reactors

Type PNT, PNO, PNOB and PNB for Transformers rating form 1 MVA to above 250 MVA
Type PNR for Reactor rating 1MVAr to above 250 MVAr
Number of fire detectors from 8 to 38

The System is designed to operate on oil filled transformers and reactors to prevent tank explosion and fire during internal faults resulting in an arc.
When the system is activated it drains oil from the tank to reduce pressure and injects nitrogen gas in the tank to reduce the temperature of oil and to extinguish the fire.
Parts of the Assembly (Cubicle & Control Box) are located in safe area, parts (fire detectors, transformer conservator isolation valves (TCIV), bushing / cable box / terminal box conservator isolation valve (BCIV), signal box) are located in Zone 1 or Zone 21.

Main components

Heat Sensor (Sprinkler)
Bushing / Cable Box / Terminal Box Conservator Isolation Valve (BCIV)
Transformer Conservator Isolation Valve (TCIV)
Limit Switch (ATEX II GD T6)
Proximity Switch (ATEX II GD T6)
Enclosure Terminal Box (Signal Box) (ATEX II GD T6)
Enclosure Terminal Box (TCIV/BCIV) (ATEX II GD T6)
Cubicle & Control Box (Located in safe area)

Technical File content

Rif.	Document	Ref. Document (name, rev., date)
1	Product description	FP/DIT/I/04 – Rev 7 – 29.09.2014
2	Bill of material	FP/DIT/I/01 – Rev. 4 – 04.09.2014
3	Components	FP/DIT/I/03 – Rev 7 – 08.10.2014
4	Manual	FP/DIT/D/01 – Rev. 7 – 08.10.2014
5	Labelling instruction	FP/DIT/D/02 – Rev. 5 – 29.10.2014
6	Explosion risk assessment	FP/DIT/D/03 – Rev 7 – 04.09.2014
7	Declaration of conformity	FP/DIT/D/04 – Rev. 5 – 29.10.2014
8	Detailed Bill of Material	Annexure I – Rev. 1 – 29.10.2014
9	Product test report	Annexure III – Rev. 1 - 25.07.2014
10	Product Drawings	Annexure VI – Rev 5 - 04.09.2014

Rapporto di verifica e di prova
Verification and test report

Verbale di valutazione Direttiva ATEX 94/9/CE n. PRD-2010-008

Condizioni speciali per un utilizzo sicuro (X)
Special conditions for safe use (X)

The present ATEX certificate is confirming that the described Equipment can be safely used in some classified areas, but it is not an assessment of its suitability according to standards like EN 14373, EN 14491, EN 14460, EN 14797, EN 14994, EN 15080, EN 16009.
Other components are used in the system assembly in classified areas, but they are not part of this certification (e.g. Buchholz relay), the transformer itself or the reactor are not part of this certification.

Pag. 2 di 2

Ente Certificazione Macchine srl
Via Ca' Bella 243 – Loc. Castello di Serravalle – 40053 Valsamoggia (BO)
☎ +39 0516705141 🖷 +39 0516705156 ✉ ecm@entecerma.it www.entecerma.it

REF NR :

CTR

INTERNATIONAL CERTIFICATES:
CE MARKING:

TRANSFORMER EXPLOSION PREVENTION SYSTEM

Notifica della Garanzia di Qualità della Produzione

Notification of the Production Quality Assurance

n. ECM 14 ATEX-QS 009

Rilasciato i sensi della direttiva 1994/9/CE – Allegato IV

Issued according to 1994/9/EC directive – Annex IV

Richiedente ***Applicant*** Ragione Sociale *Company Name*	CTR Manufacturing Industries Ltd.
Indirizzo *Address*	Nagar Road, Pune- 411014, Maharashtra, India
Sito produttivo *Place of production*	Nagar Road, Pune- 411014, Maharashtra, India
Tipo di componente o prodotto *Type of component or product*	Explosion Prevention and Fire Extinguishing System for Transformers and Reactors

L'ECM, Organismo Notificato n° 1282 in conformità all'art. 9 della Direttiva 94/9/CE del Consiglio dell'Unione Europea del 23 Marzo 1994, notifica al richiedente che il costruttore ha un sistema di qualità della produzione conforme a quanto previsto dall'allegato IV della Direttiva.
Nell'allegato aggiornato sono elencati tutti gli apparecchi ed i sistemi di protezione con i numeri dei certificati.
Questo certificato è basato sul rapporto di verifica ispettiva n. V_Is_60 – PRD-ATEX2014-009 emesso il 30/09/2014.
I risultati delle verifiche periodiche del sistema qualità sono parte integrante di questa notifica.
Questo Certificato di Notifica della garanzia di qualità della produzione è valido fino al 16/10/2017 e può essere ritirato se dalle verifiche ispettive di sorveglianza risulta che il sistema di qualità della produzione non è più conforme a quanto previsto dall'allegato IV.
In accordo con l'articolo 10 paragrafo 1 della Direttiva 94/9/CE la marcatura CE sul prodotto deve essere seguita dal n. 1282 che identifica ECM come l'Organismo Notificato incaricato della sorveglianza della produzione.

ECM, Notified Body No. 1282 in accordance with Article. 9 of Directive 94/9/EC of the European Union Council of 23 March 1994, notifies to the applicant that the manufacturer has a production quality system complies with Annex IV of the Directive.
Updated Annex lists all equipment and protective systems with the numbers of certificates.
This certificate is based on the audit report no. V_Is_60 – PRD-ATEX2014-009 issued on 30/09/2014.
The results of periodic audits of the quality system is an integral part of this notification.
This Certificate of Notification of production quality assurance is valid until 16/10/2017 and can be withdrawn if surveillance audits show that the quality system of production no longer complies with the provisions in Annex IV.
In accordance with Article 10 paragraph 1 of Directive 94/9/EC the CE marking must be followed by n. 1282 that identifies ECM as Notified Body responsible for supervising the production.

Esempio di marcatura **Marking example** CE 1282

Data di prima emissione *Date of first issue* 17/10/2014 ☐ Estensione - Extension ☐ Rinnovo - Renewal

Valsamoggia (BO) Data - Date 07/11/2014

Timbro

Firma autorizzata *Authorized signature*

Scadenza- Expiry date 06/11/2017 *(Antonio Bedonni - Legale Rappresentante)*

Questo certificato, compreso l'allegato, può essere riprodotto solo integralmente e senza alcuna variazione.
This certificate, annex included, may only be reproduced in its entirety and without any change.

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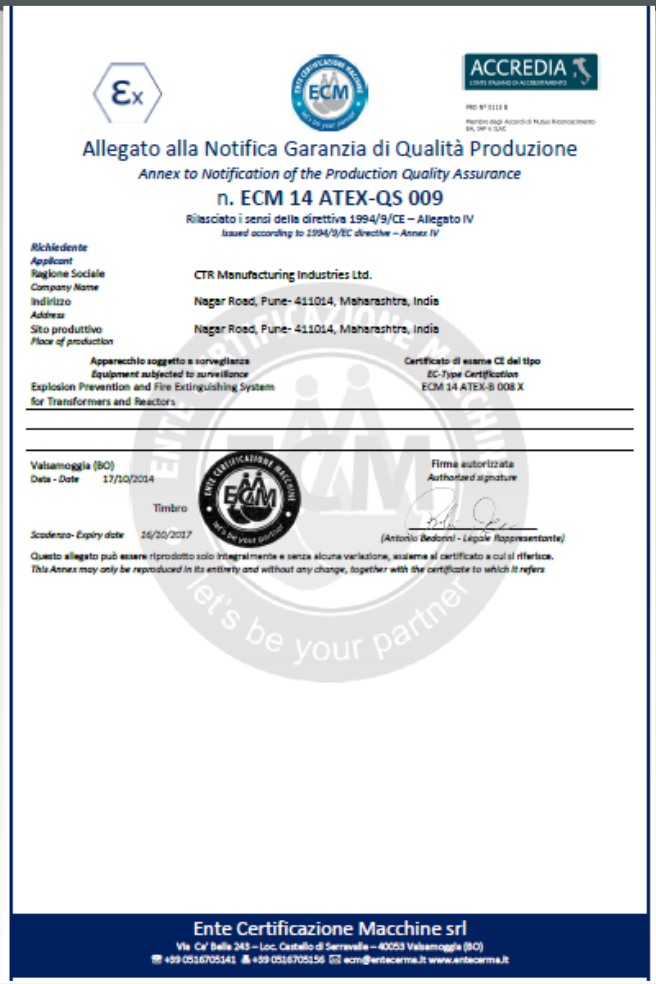

Allegato alla Notifica Garanzia di Qualità Produzione

Annex to Notification of the Production Quality Assurance

n. ECM 14 ATEX-QS 009

Rilasciato i sensi della direttiva 1994/9/CE – Allegato IV

Issued according to 1994/9/EC directive – Annex IV

Richiedente ***Applicant*** Ragione Sociale *Company Name*	CTR Manufacturing Industries Ltd.
Indirizzo *Address*	Nagar Road, Pune- 411014, Maharashtra, India
Sito produttivo *Place of production*	Nagar Road, Pune- 411014, Maharashtra, India

Apparecchio soggetto a sorveglianza *Equipment subjected to surveillance*	Certificato di esame CE del tipo *EC-Type Certification*
Explosion Prevention and Fire Extinguishing System for Transformers and Reactors	ECM 14 ATEX-S 008 X

Valsamoggia (BO) Data - Date 17/10/2014

Timbro

Firma autorizzata *Authorized signature*

Scadenza- Expiry date 16/10/2017 *(Antonio Bedonni - Legale Rappresentante)*

Questo allegato può essere riprodotto solo integralmente e senza alcuna variazione, assieme al certificato a cui si riferisce.
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REF NR :

CTR

IMPORTANT DESIGN CONSIDERATIONS:

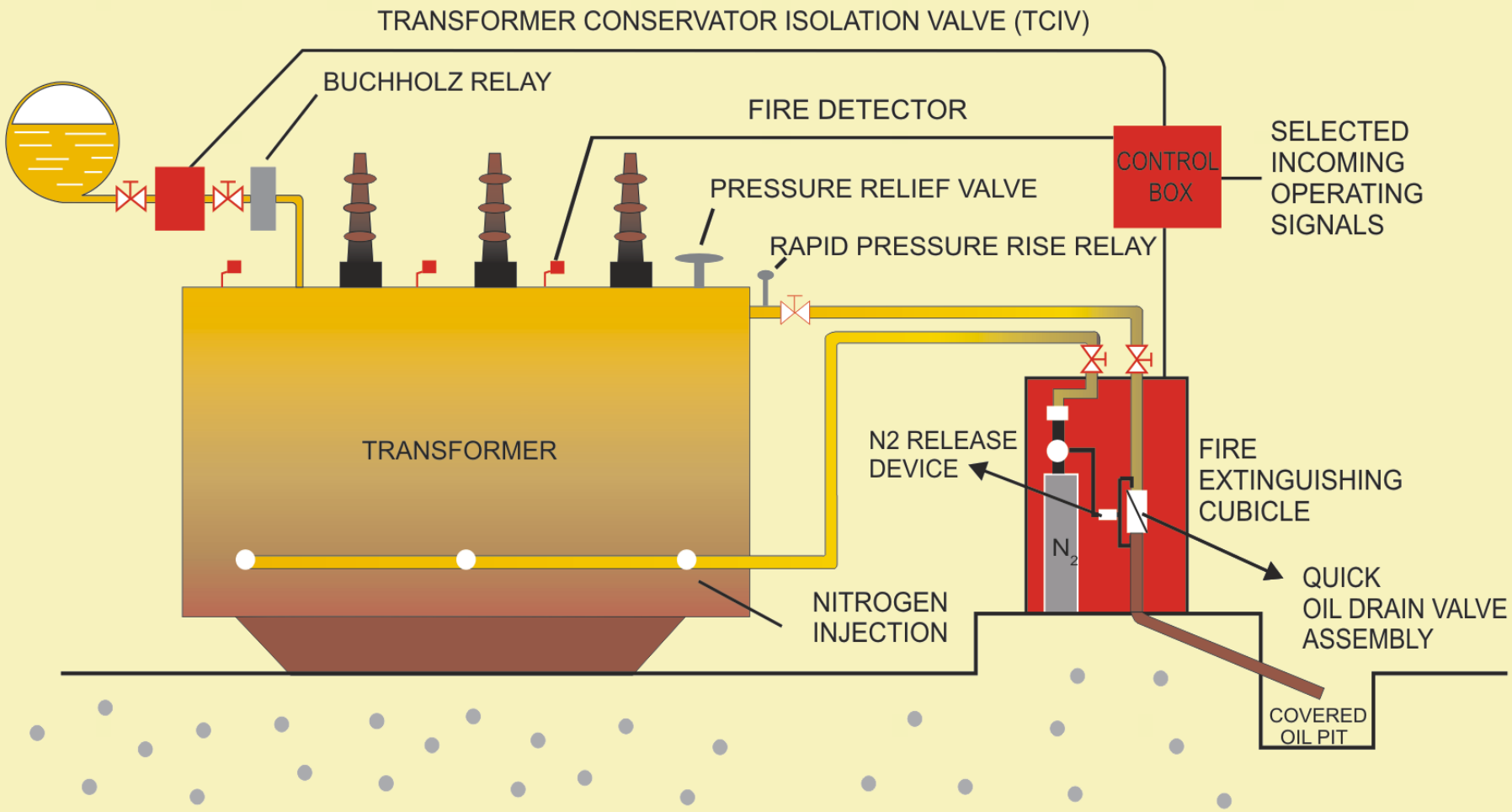
TRANSFORMER EXPLOSION PREVENTION SYSTEM

ANY EFFECTIVE TRANSFORMER FIRE PREVENTION SYSTEM MUST HAVE THE FOLLOWING DESIGN CONSIDERATIONS:

1. **NO INGRESS OF N2 GAS IN LIVE TRANSFORMER**
2. **CALCULATIONS OF QUANTITY OF GAS**
3. **CALCULATIONS OF GAS PRESSURE FLOW**
4. **OIL DRAIN PIPE SIZE JUSTIFICATIONS**
5. **NUMBER OF FIRE DETECTORS**
6. **ESTABLISH THE FLOW RATE FOR TCIV**

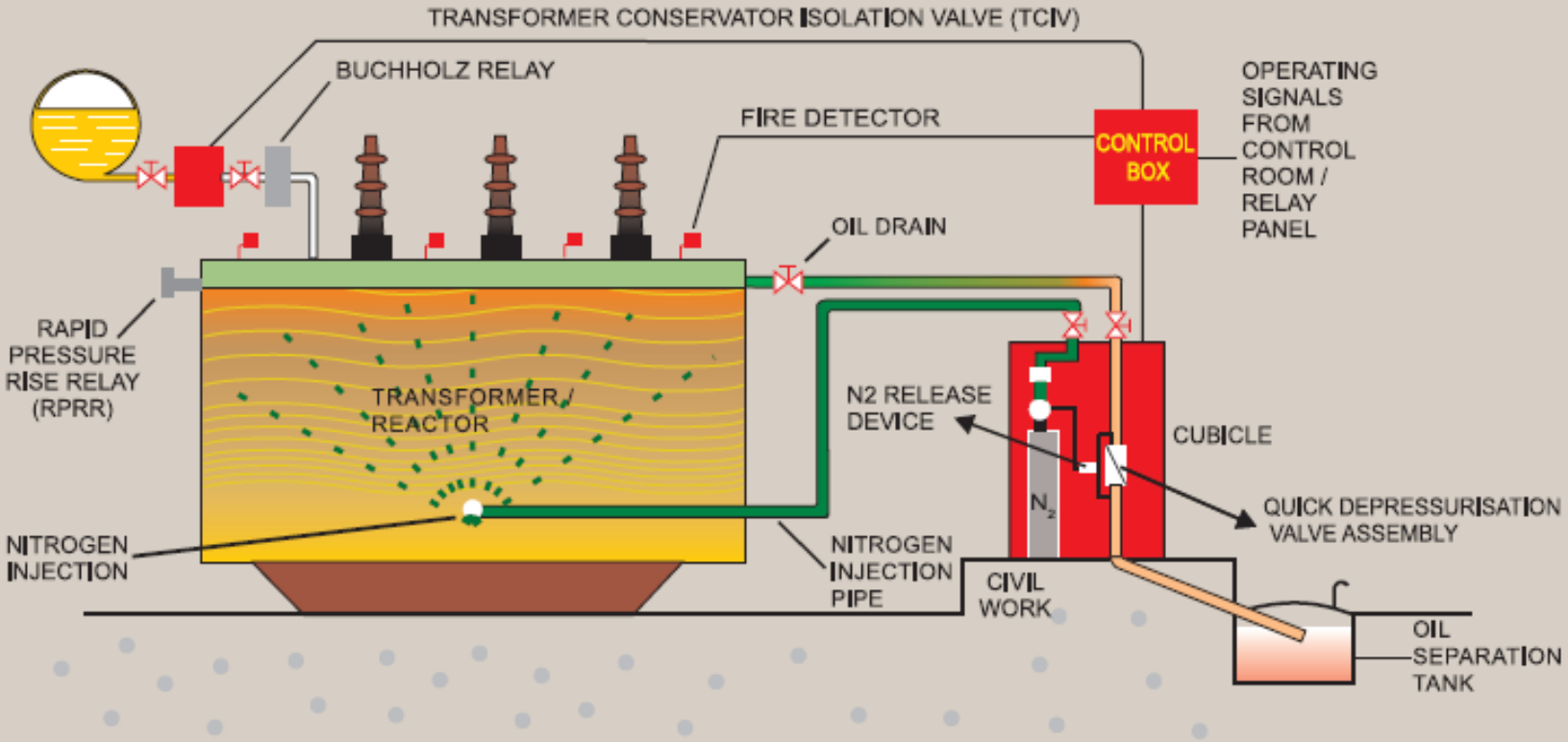
TYPICAL LAYOUT

TRANSFORMER EXPLOSION PREVENTION SYSTEM



TRANSFORMER TANK PROTECTION

TRANSFORMER EXPLOSION PREVENTION SYSTEM

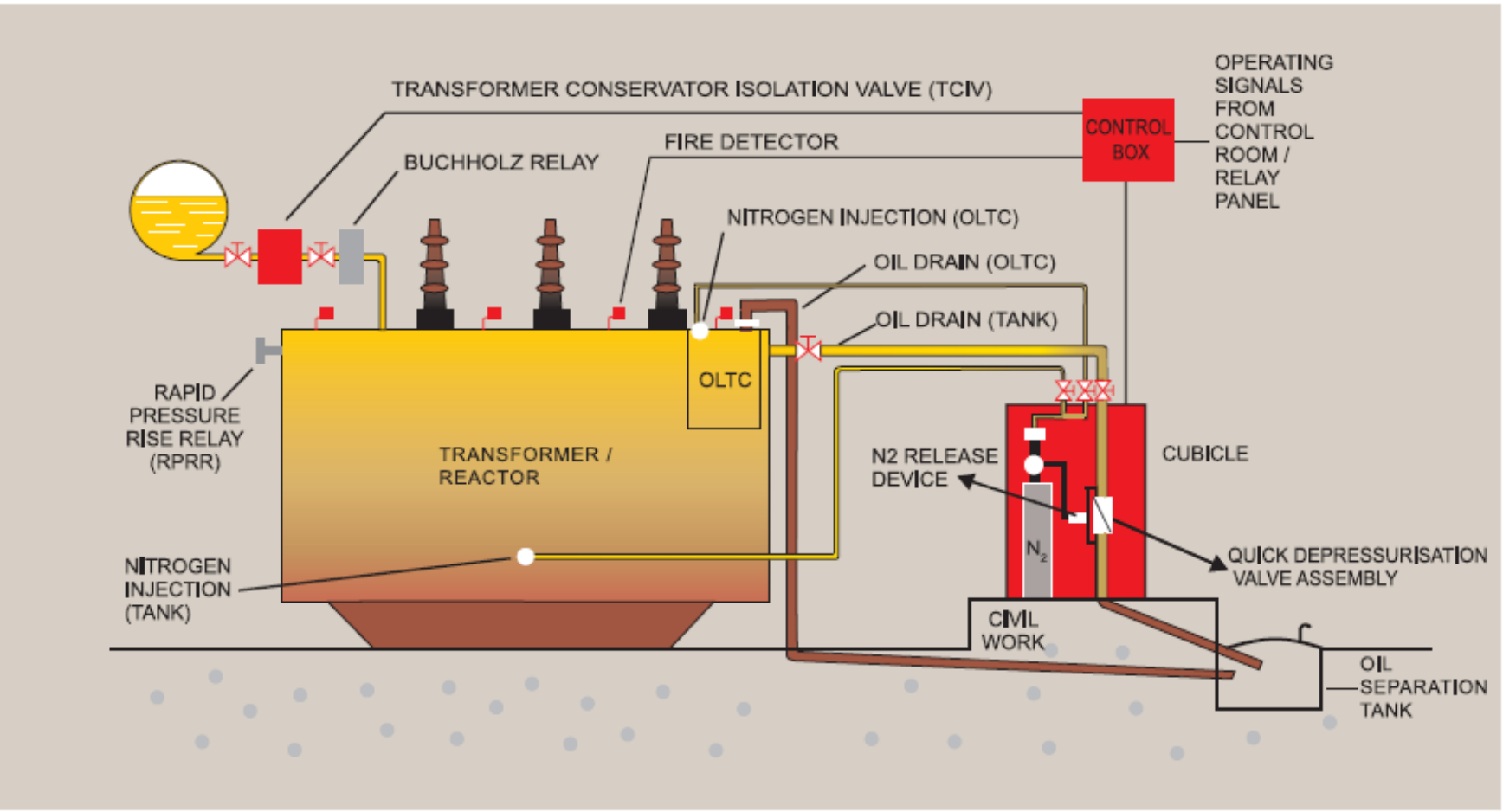


REF NR :

CTR

TRANSFORMER TANK AND OLTC

TRANSFORMER EXPLOSION PREVENTION SYSTEM

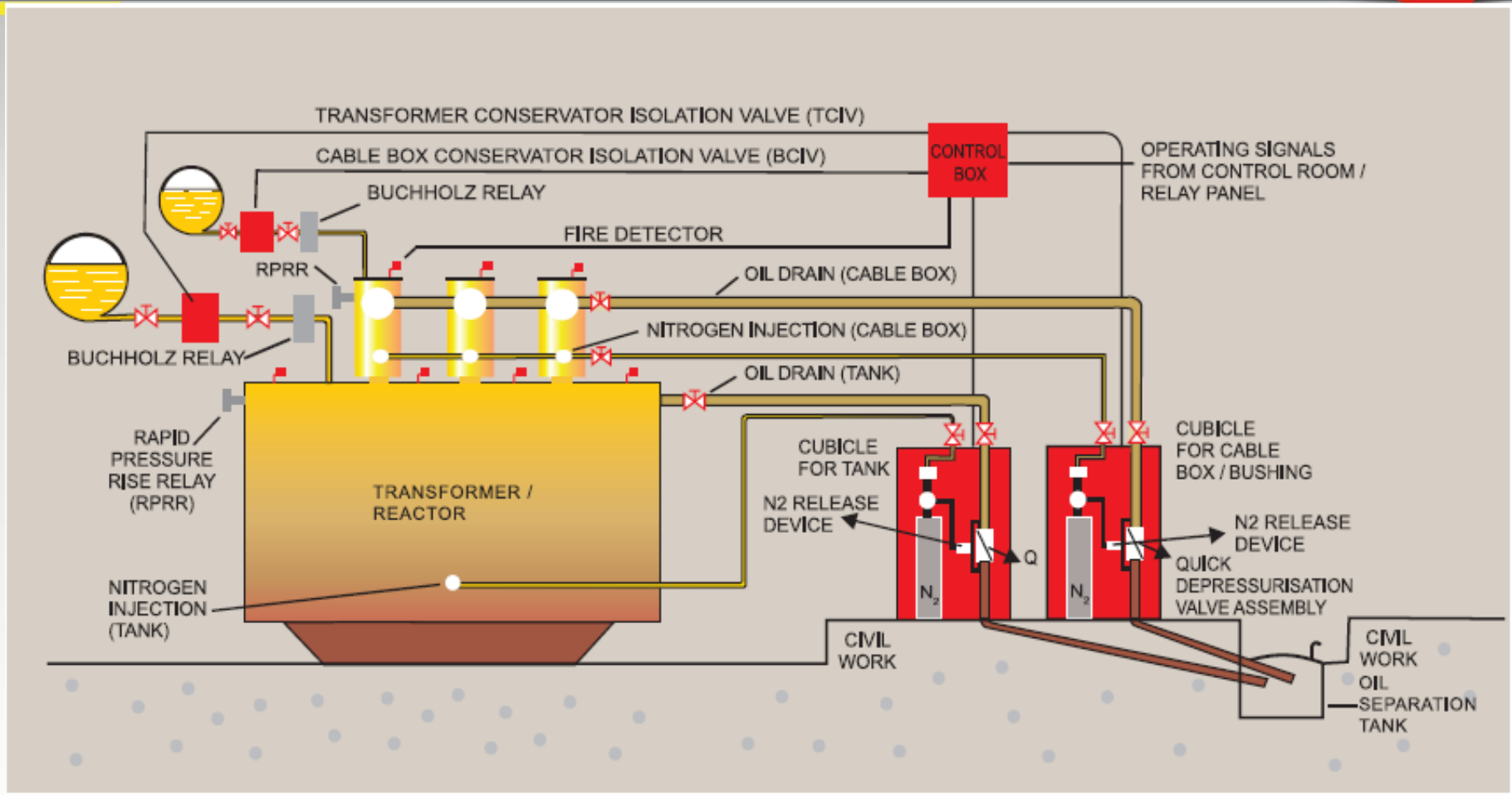


REF NR :

CTR

SYSTEM FOR TRANSFORMER TANK AND OIL FILLED CABLE BOXES

TRANSFORMER EXPLOSION PREVENTION SYSTEM

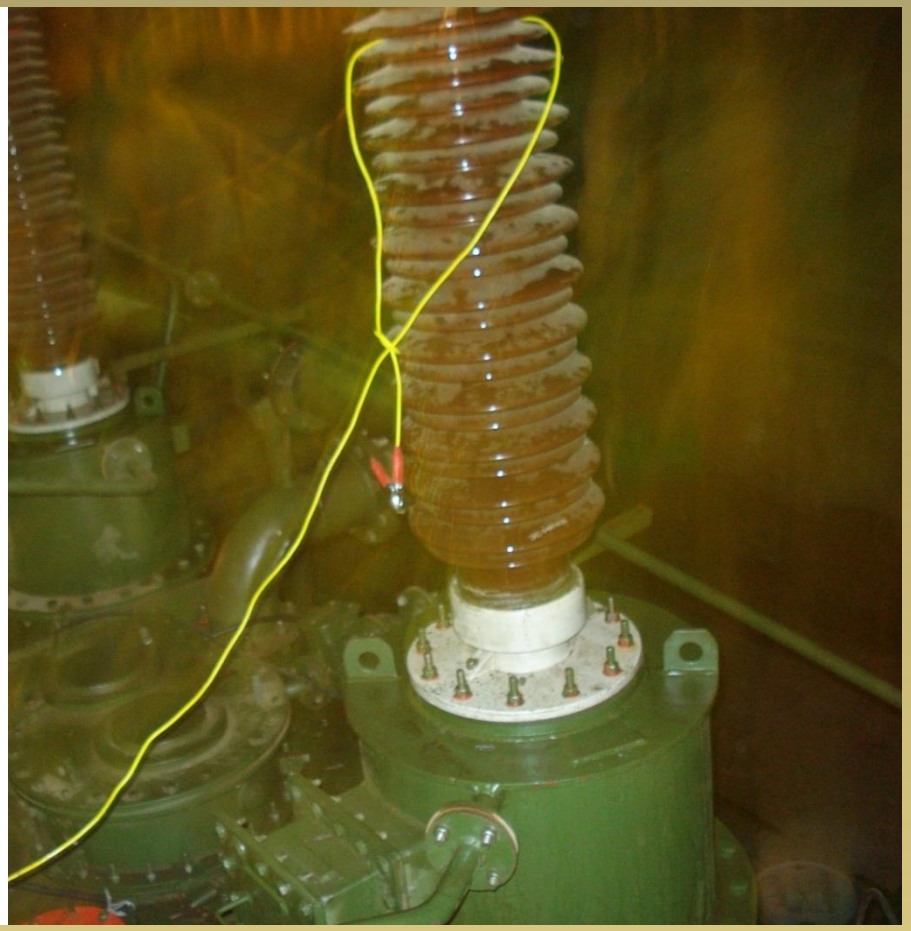


REF NR :

CTR

ABB MAKE 315 MVA TRANSFORMER SAVED FROM EXPLOSION BY CTR TECHNOLOGY.

200 MVA TRANSFORMER SAVED FROM EXPLOSION DURING PHASE TO PHASE FAULT BY CTR TECHNOLOGY



REF NR : 50

TESTIMONIAL: TRANSFORMER SAVED DESPITE PHASE TO PHASE FAULT 200 MVA 220 KV

TRANSFORMER EXPLOSION PREVENTION SYSTEM

MAHARASHTRA STATE ELECTRICITY TRANSMESSION CO.LTD.
400kV RS (O&M) Division, Padgha

Office of the
EXECUTIVE ENGINEER
400kV RS (O&M) Divn, MSETCL
PADGHE – 421 101
Tah. Bhiwandi, Dist. Thane

Phone No. (02522) 268255, 268381
Fax No. 268152

No. EE/400kV/RS (O&M)/Dn/PDG/498 Date: 11.05.2007

TO WHOM-SO-EVER IT MAY CONCERN

This is to certify that, CTR make Nitrogen Injection Fire Protection System bearing sn. 2460002 has been operated successfully in prevention mode on 200MVA, transformer bearing sn. HT -1583/1 during fault on 03.04.2007 at 400/220kV S/stn., Padghe.

Executive Engineer
400kv. RS(O&M) Dn., Padgha.

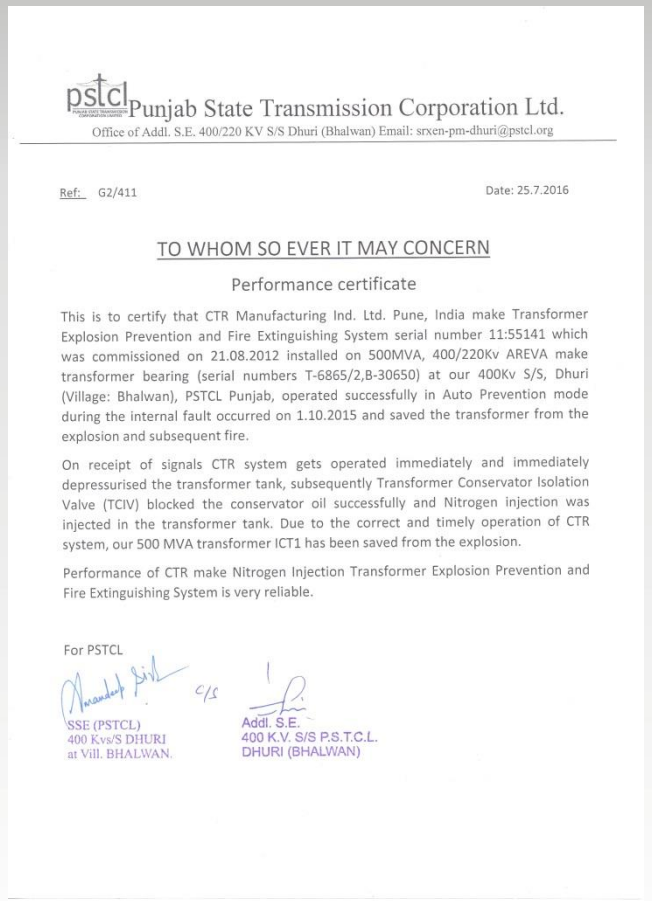
REF NR :

CTR

TESTIMONIALS

TRANSFORMER EXPLOSION PREVENTION SYSTEM

500MVA



pstcl Punjab State Transmission Corporation Ltd.
Office of Addl. S.E. 400/220 KV S/S Dhuri (Bhalwan) Email: srxen-pm-dhuri@pstcl.org

Ref: G2/411 Date: 25.7.2016

TO WHOM SO EVER IT MAY CONCERN

Performance certificate

This is to certify that CTR Manufacturing Ind. Ltd. Pune, India make Transformer Explosion Prevention and Fire Extinguishing System serial number 11:55141 which was commissioned on 21.08.2012 installed on 500MVA, 400/220Kv AREVA make transformer bearing (serial numbers T-6865/2,B-30650) at our 400Kv S/S, Dhuri (Village: Bhalwan), PSTCL Punjab, operated successfully in Auto Prevention mode during the internal fault occurred on 1.10.2015 and saved the transformer from the explosion and subsequent fire.

On receipt of signals CTR system gets operated immediately and immediately depressurised the transformer tank, subsequently Transformer Conservator Isolation Valve (TCIV) blocked the conservator oil successfully and Nitrogen injection was injected in the transformer tank. Due to the correct and timely operation of CTR system, our 500 MVA transformer ICT1 has been saved from the explosion.

Performance of CTR make Nitrogen Injection Transformer Explosion Prevention and Fire Extinguishing System is very reliable.

For PSTCL

SSE (PSTCL)
400 Kvs/S DHURI
at Vill. BHALWAN.

Addl. S.E.
400 K.V. S/S P.S.T.C.L.
DHURI (BHALWAN)

8MVA

ACC

ACC Limited
Tikaria Cement Works
P O Gauriganj
Sultanpur-227409
U P, India

Phone +91 5368 244096/279
Fax +91 5368 244479
www.acclimited.com

Date : 07.01.2012

To,

CTR Manufacturing Industries Limited
Nagar Road,
Pune 411014

Dear Sir,

Subject: Successful operation of CTR make Nitrogen Injection Fire Protection System

We are pleased to inform you that Nitrogen Injection Fire Protection System bearing serial number 22:67552 operated successfully on 19.09.2011 and saved 132/6.9kV, 8/10 MVA transformer during severe OLTC fault and transformer is saved from explosion and possible fire, secondary damage at our Tikaria (UP) Cement plant .

Transformer protections Differential relay trip, Buchholz relay trip and Transformer trip (master relay trip) signals observed on transformer control / relay panel as well on CTR Control box in control room. After getting these three signals system operated and oil drained from top portion of transformer tank, nitrogen gas injection from bottom side. Simultaneously PNRV valve in conservator pipe acted correctly and blocked the conservator oil.

We appreciate performance given by CTR system.

Thanking you,

Yours faithfully

Ashish Kumar Pandey
HOD – ELECTRICAL & INSTRUMENTATION
ACC LIMITED
TIKARIA CEMENT WORKS

Registered Office : Cement House, 121 Maharshi Karve Road, Mumbai 400 020, India

REF NR :

SAVED FROM EXPLOSION

CTR

TESTIMONIAL

TRANSFORMER EXPLOSION PREVENTION SYSTEM

PHILIPPINES

MIESCOR / ASIAPHIL – ROMAGO JV

MIESCOR
5th Floor Renaissance Tower 1000,
Mecalco Avenue, Pasig City
Tel. No. (632) 635-5901 to 10
Fax No. (632) 635-5911

August 07, 2013

CERTIFICATE

Successful Operation of CTR Make Transformer Explosion Prevention System

This is to certify that CTR Manufacturing Industries Limited India make Transformer Explosion Prevention System bearing serial number 10:55218 commissioned on 230/69Kv, 100MVA transformer of Alstom (AREVA) make at our Clark Development Corporation substation Philippines, operated successfully in Auto Prevention mode as per approved scheme during internal fault in the transformer on 06th April 2013 and saved the transformer from explosion and subsequent fire.

After the internal fault, following relay signals received on CTR control panel and immediately transformer tank depressurized by quick depressurization valve by operation of heavy duty lifting magnet and subsequently conservator oil was isolated by auto operation of Transformer Conservator Isolation Valve (TCIV), and Nitrogen gas was injected into the transformer tank. Due to the correct and timely operation of CTR Transformer Explosion Prevention System, our 100MVA transformer number 3 at Clark sub-station has been saved from explosion.

REF NR :

SAVED FROM EXPLOSION AND FIRE

CTR

TESTIMONIAL

TRANSFORMER EXPLOSION PREVENTION SYSTEM

PHILIPPINES

MIESCOR / ASIAPHIL – ROMAGO JV

MIESCOR
5th Floor Renaissance Tower 1000,
Meralco Avenue, Pasig City
Tel. No. (632) 635-5900 to 10
Fax No. (632) 635-5911

Summary of transformer protection operation observed on relay panel:

- Differential Relay
- Rapid Pressure Rise Relay (Sudden Pressure Rise Relay)
- Buchholz Surge Relay
- Master (86) Relay

Summary of operation signals observed on CTR Control box Panel:

- Differential Trip
- Buchholz Trip
- Transformer Trip
- TCIV Closed

CTR Make system was installed on 12th March 2011. Performance of CTR make Transformer Explosion Prevention system is very satisfactory.

REYNALDO E. BORCES

Project Director

REF NR :

SAVED FROM EXPLOSION AND FIRE

CTR

TYPICAL INSTALLATION PHOTO

TRANSFORMER EXPLOSION

REF NR :

CTR

PROVEN TRACK RECORD: RELIABILITY

TRANSFORMER EXPLOSION PREVENTION SYSTEM

- OVER 9600 SYSTEMS SUPPLIED WORLDWIDE.
- MORE THAN 1200 TRANSFORMERS RETROFITTED.
- SUITABLE FOR MINIMUM 750 KVA, UPTO 1500 MVA UPTO 765 KV VOLTAGE CLASS.
- TECHNOLOGY PATENTED IN OVER 95 COUNTRIES.
- OVER 10600 MVA SAVED FROM EXPLOSION AND SUBSEQUENT FIRE. (8 MVA UPTO 500 MVA)
- NO INCIDENTS OF SYSTEM OPERATION WHEN NOT DESIRED (MALFUNCTIONING) REPORTED.

TRANSFORMER
EXPLOSION
PREVENTION
SYSTEM

Thank you

ELECTRICAL SAFETY

Fault Protection in LV system

Fire & Electrocution

Referance

IS 3043: Code practice of Earthing
IS 732 – 2016 (draft): Code practice of Electrical Wiring Installations
IS/IEC 62305: Lightning Protection
IEC 60364-5-53, 54 & 4-44

Your options

Video of fire in a junction box
Removed due to big file

Call for help

Find out an extinguisher and use it

Wait until the fire fighting system operates

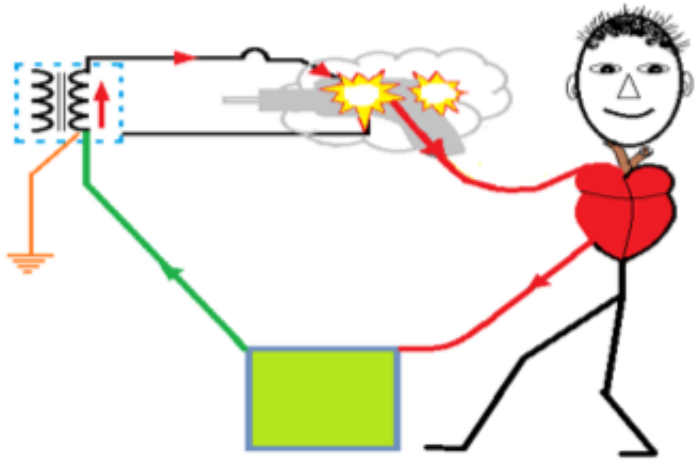
Switch-off power

If no one notices???

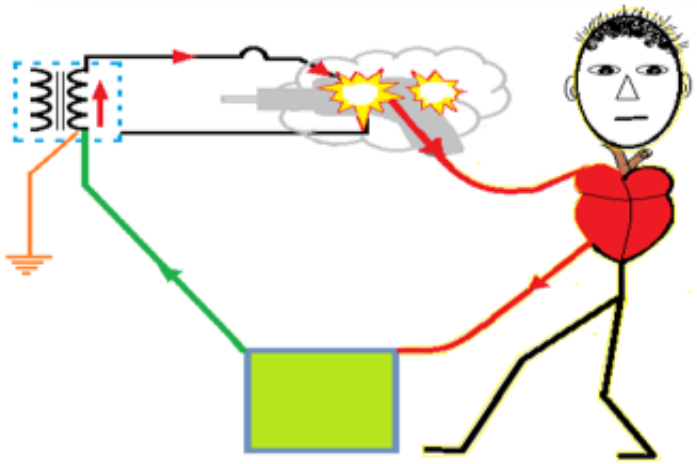
Electric Shock Values in Humans

CAPE ELECTRIC

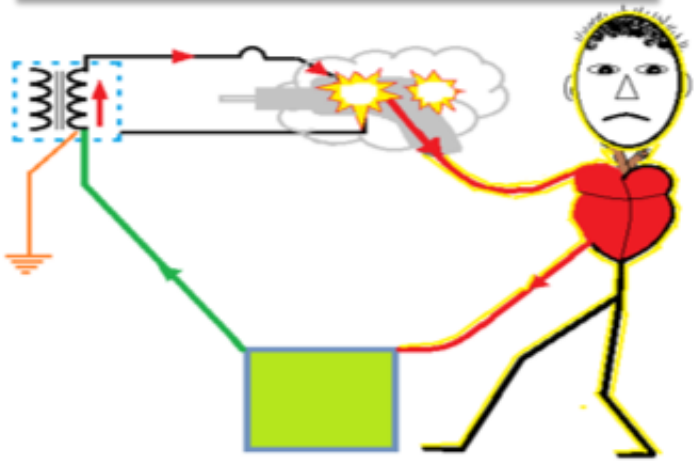
Electrical Sensation – 0.3 mA to 0.4 mA



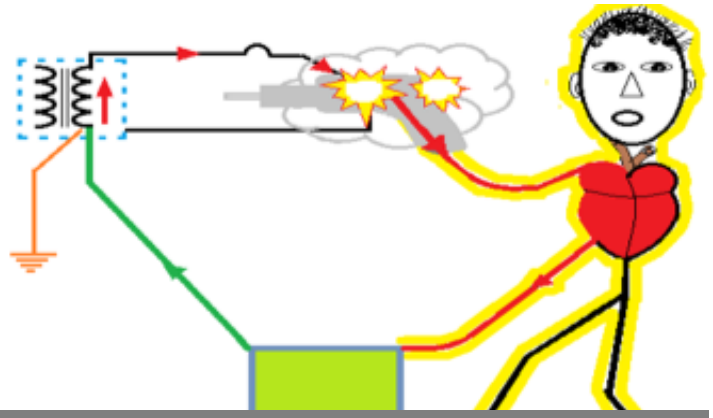
Perception Let- Go - 0.7 mA to 1.1 mA



Maximum Let - Go Level
10 mA (Female); 16 mA (Male)



Fibrillation Level
50 mA for 0.2 Secs (female)
75 mA for 0.5 Secs (Male)



Solution: Automatic Disconnection of Power Supply before the prescribed time

TABLE 8 DISCONNECTING TIMES FOR DIFFERENT TOUCH VOLTAGES

PROSPECTIVE TOUCH VOLTAGE U_c	CONDITION 1*			CONDITION 2†		
	Z_1	I	t	Z_2	I	t
(V)	(Ω)	(mA)	(s)	(Ω)	(mA)	(s)
25	—	—	—	075	23	5
50	1 725	29	5	925	54	0·47
75	1 625	46	0·60	825	91	0·30
90	1 600	56	0·45	780	115	0·25
110	1 535	72	0·36	730	151	0·18
150	1 475	102	0·27	660	227	0·10
220	1 375	160	0·17	575	383	0·035
280	1 370	204	0·12	570	491	0 020
350	1 365	256	0·08	565	620	—
500	1 360	368	0·04	560	893	—

*Dry or moist locations, dry skin and significant floor resistance.22

†Wet locations, wet skin and low floor resistance.

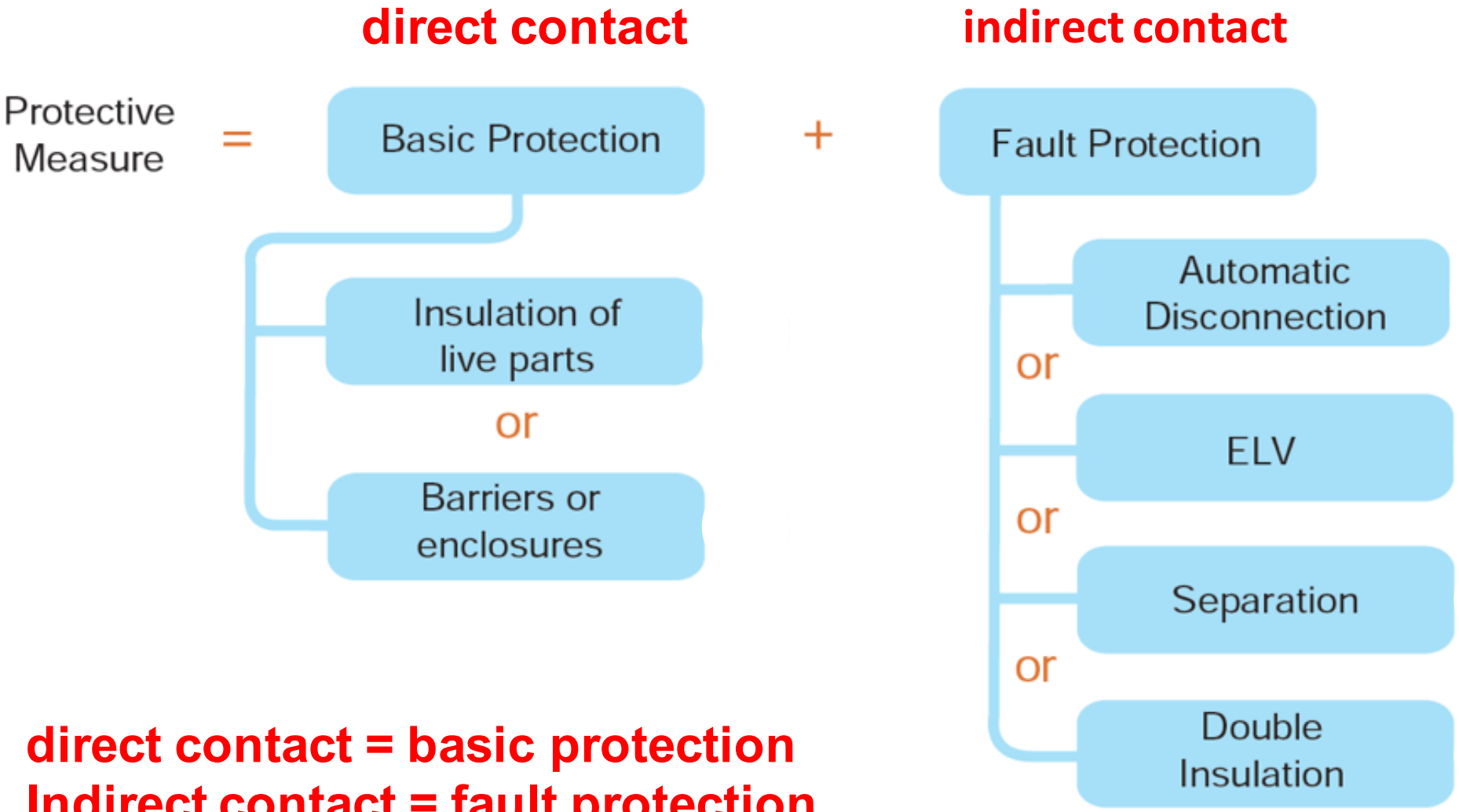
CAPE ELECTRIC

IS732 & IS3043

220 volt fault
Final circuit

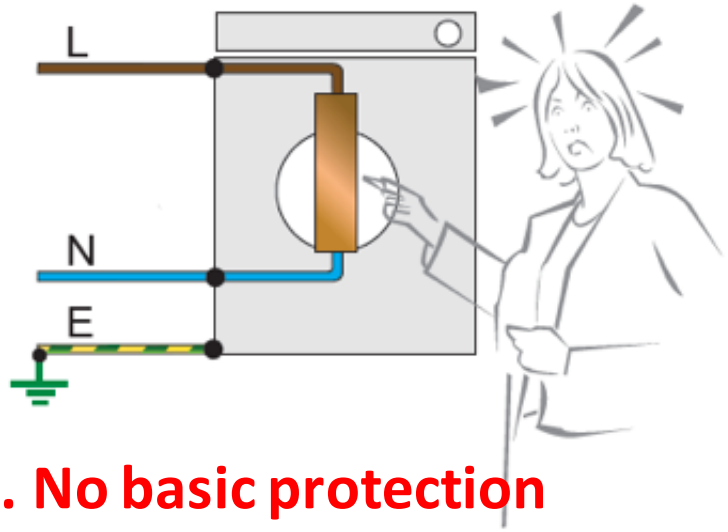
0.17 sec - dry condition
o.032 sec - wet condition

Terminology and method of protection

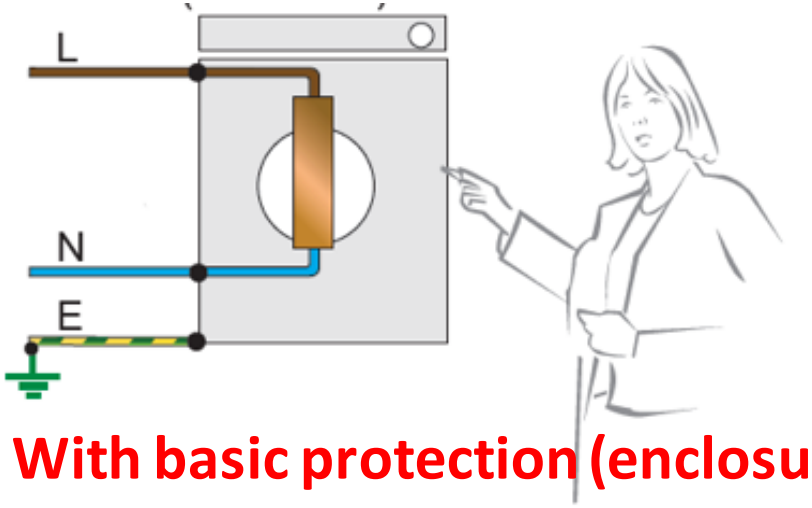


direct contact = basic protection
Indirect contact = fault protection

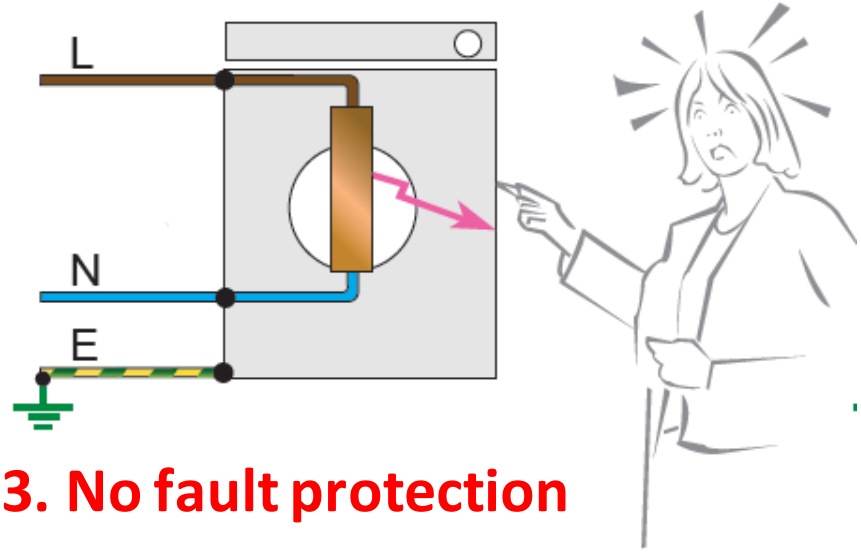
Concept: Shock Protection (IS732: 4.1.2)



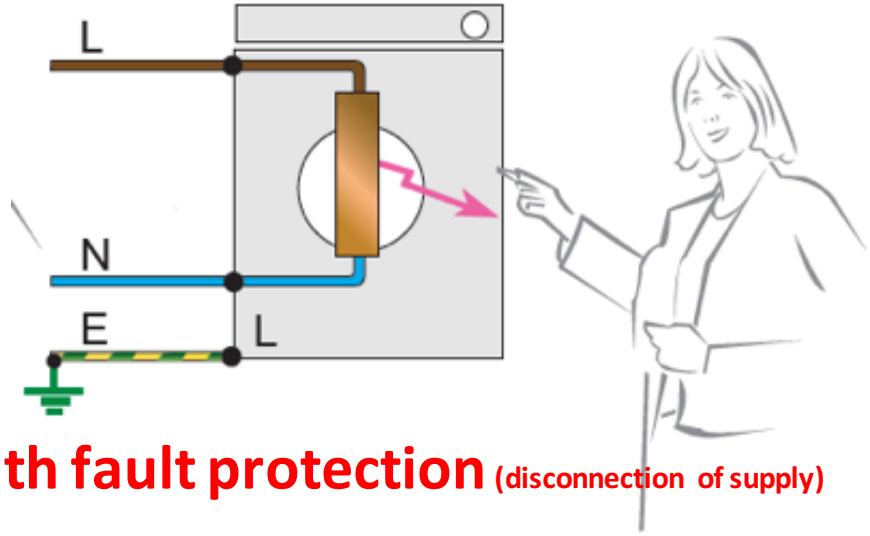
1. No basic protection



2. With basic protection (enclosure)



3. No fault protection

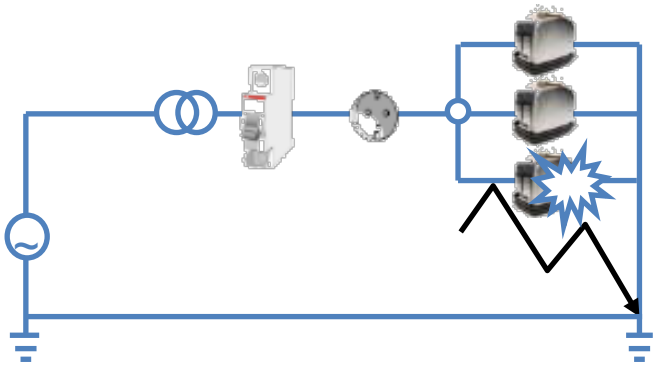


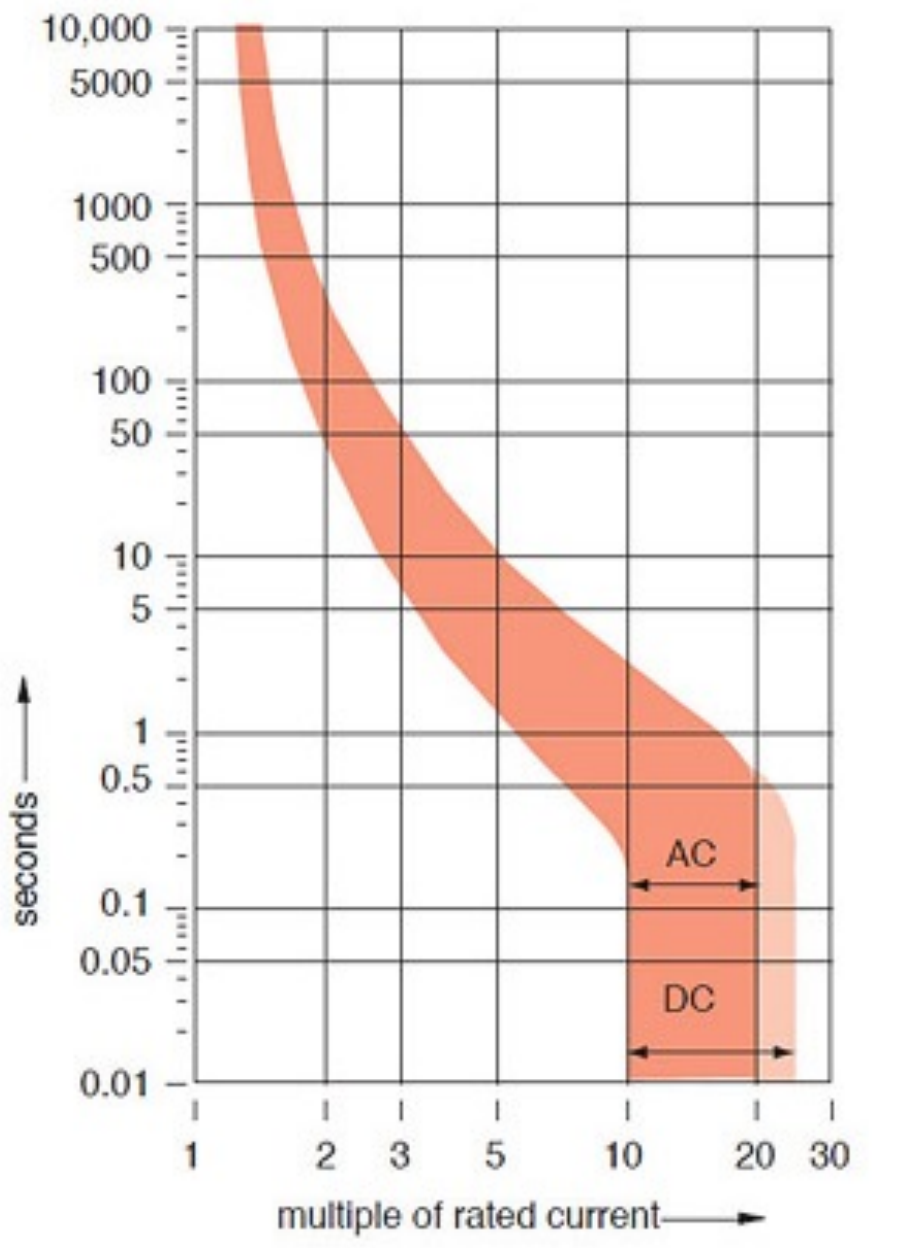
4. With fault protection (disconnection of supply)

IS 732 & IS 3043: Primary Protective Device is an OCPD

Short-circuit

Occurs when any lines come in contact with each other or the earth





IS 3043 & IS732 – Fault Protection -TN system

CAPE ELECTRIC

TN – Metallic connection between Neutral of source and Exposed conductive part

This metallic connection offer low resistance path resulting in high fault current ensuring quick disconnection of supply

Primary protective device – fuse, cutout fuse, MCB, MCCB, ACB

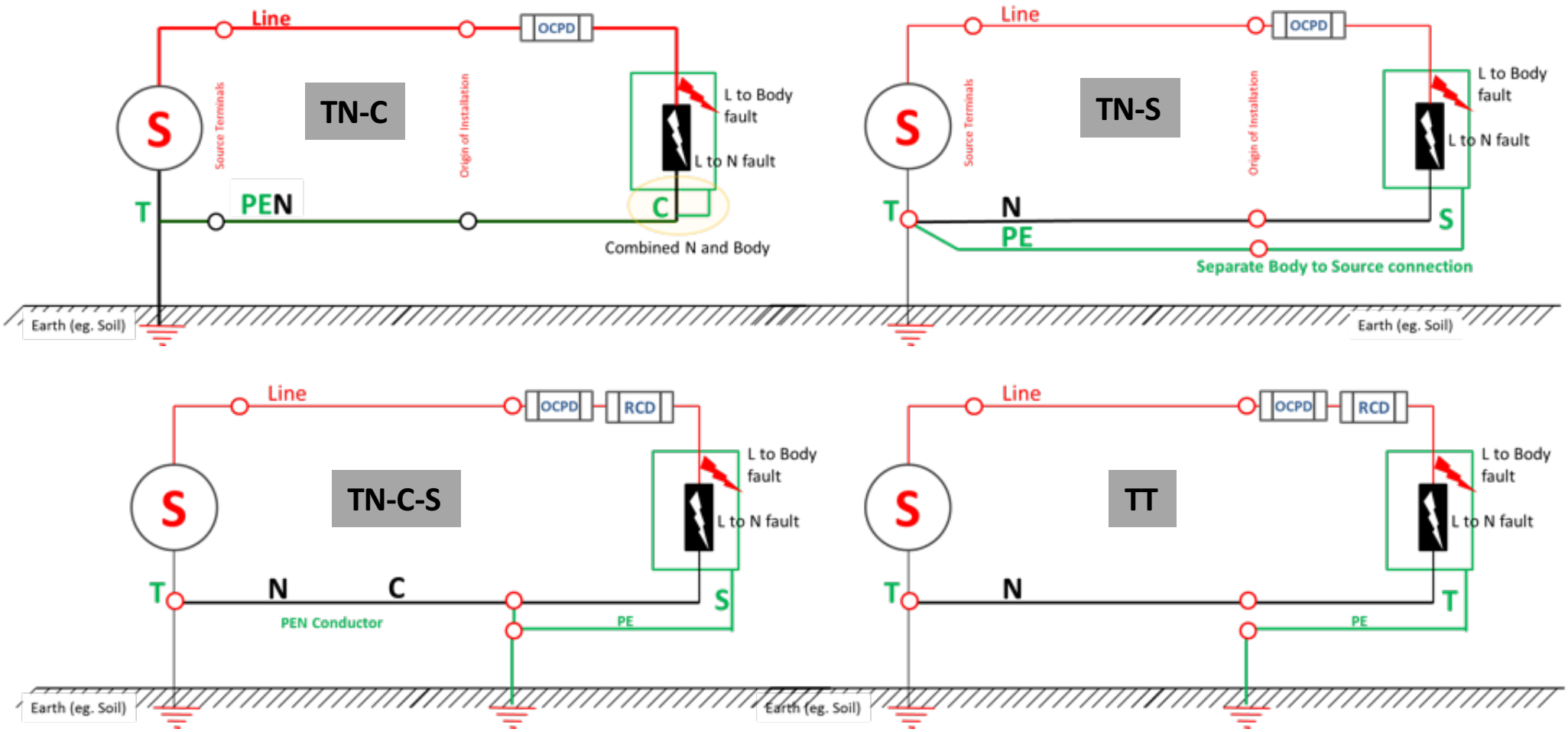
Fault loop impedance shall be lower enough to ensure enough fault current flow

If fault loop impedance is not low, install a PME system to reduce fault loop impedance

Industrial system follow TN-S with PME

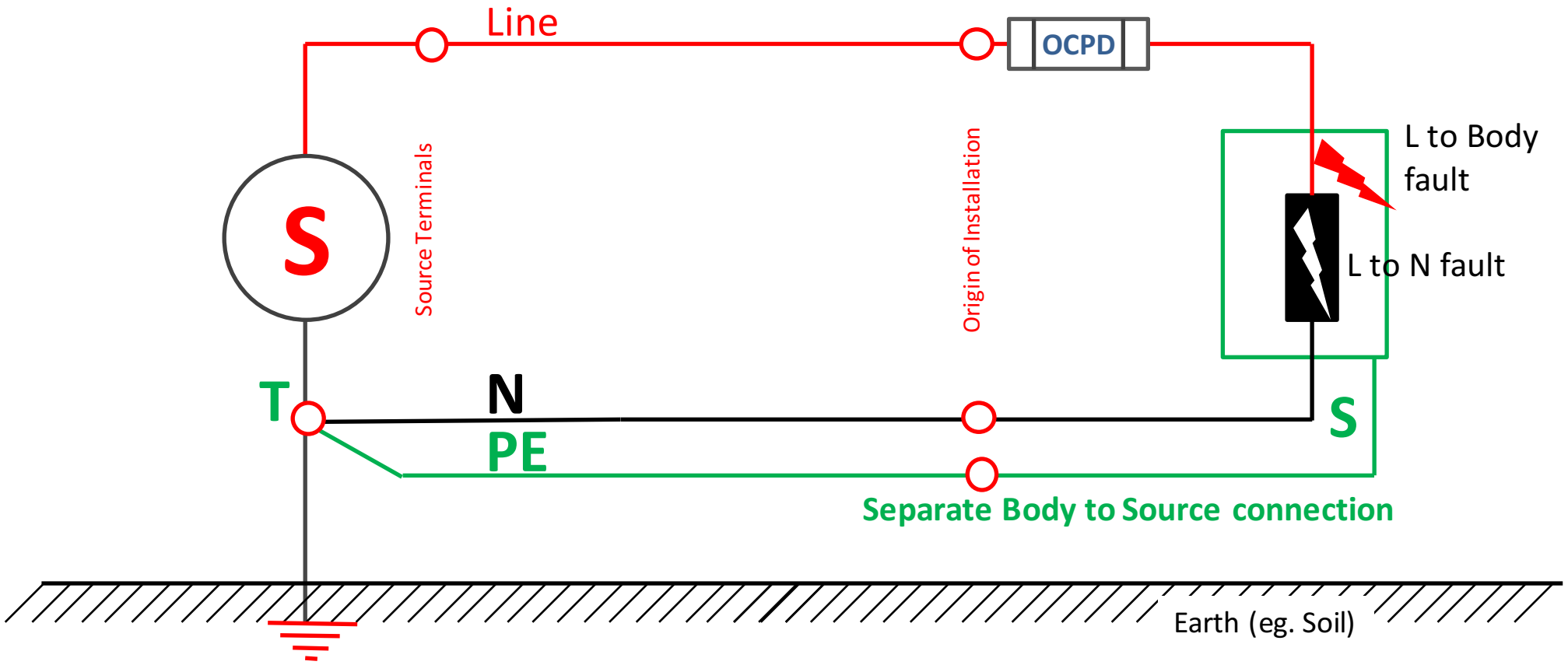
Public distribution TN-C-S with PME

Typical L.V System: TN-C, TN-S, TN-C-S, TT, IT



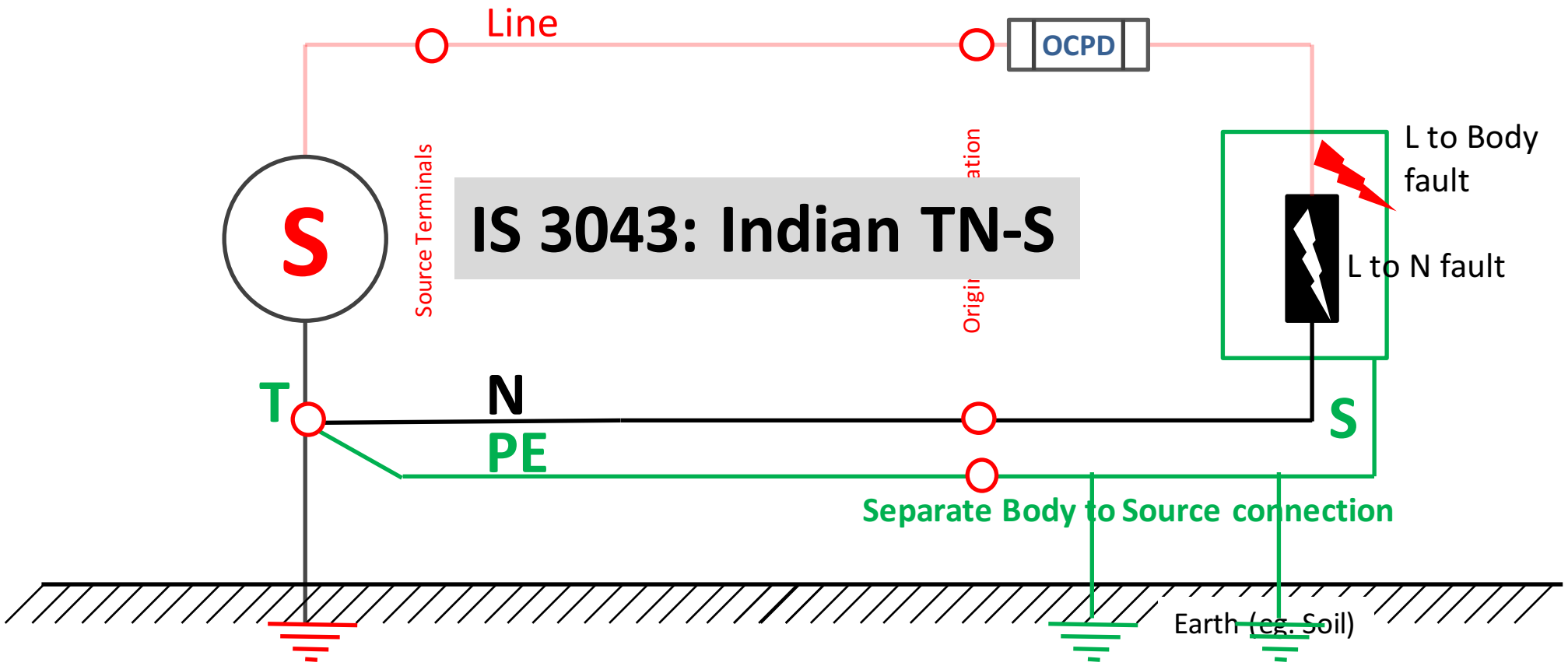
- Safety – Automatic disconnection of Supply during a fault
- How – Loop impedance shall be adequately lesser so that enough fault current flows within a short time so that protective device operate faster

TN-S System



TN-S Network – OCPD is the primary protector
Separate Neutral and Protective conductor (PE) throughout

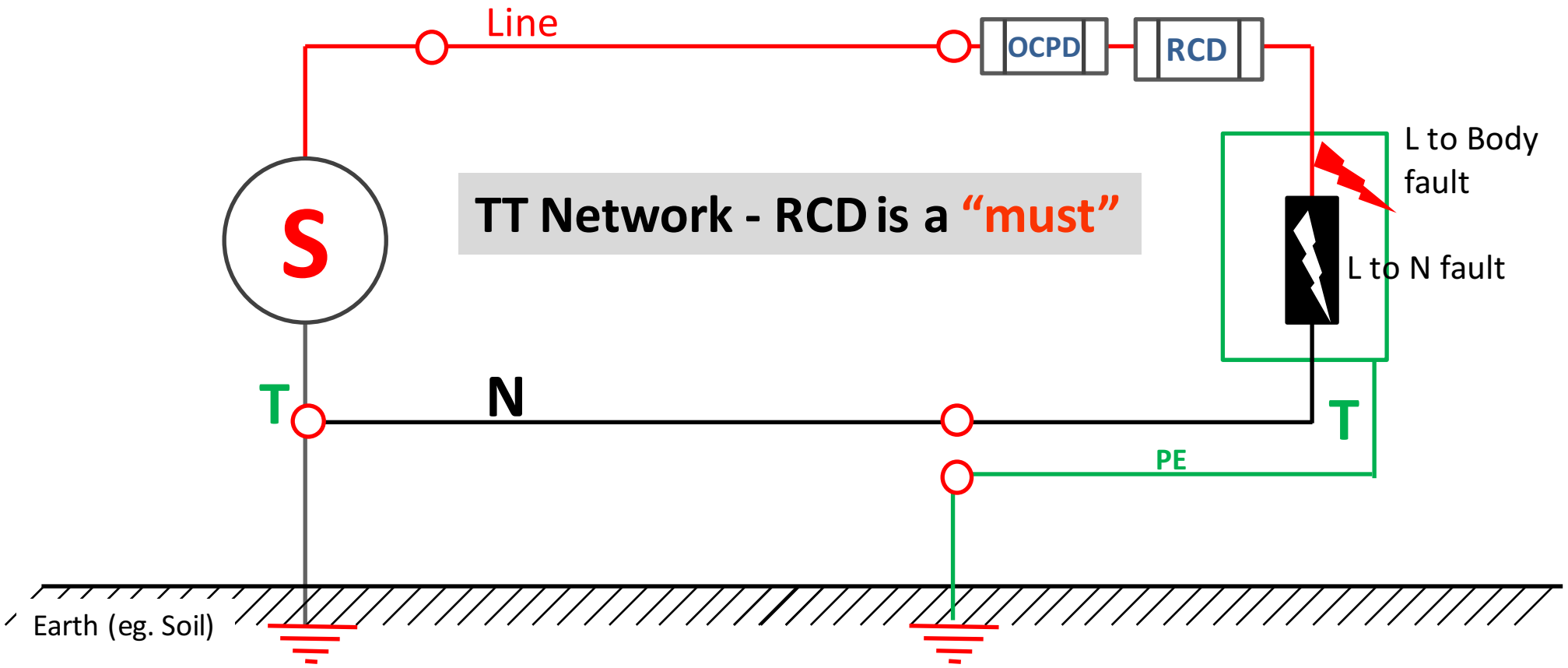
TN-S System with PME



Indian TN-S reduces Fault Voltage (△U) in PE conductor

△U - created between Exposed conductive parts and Extraneous conductive parts

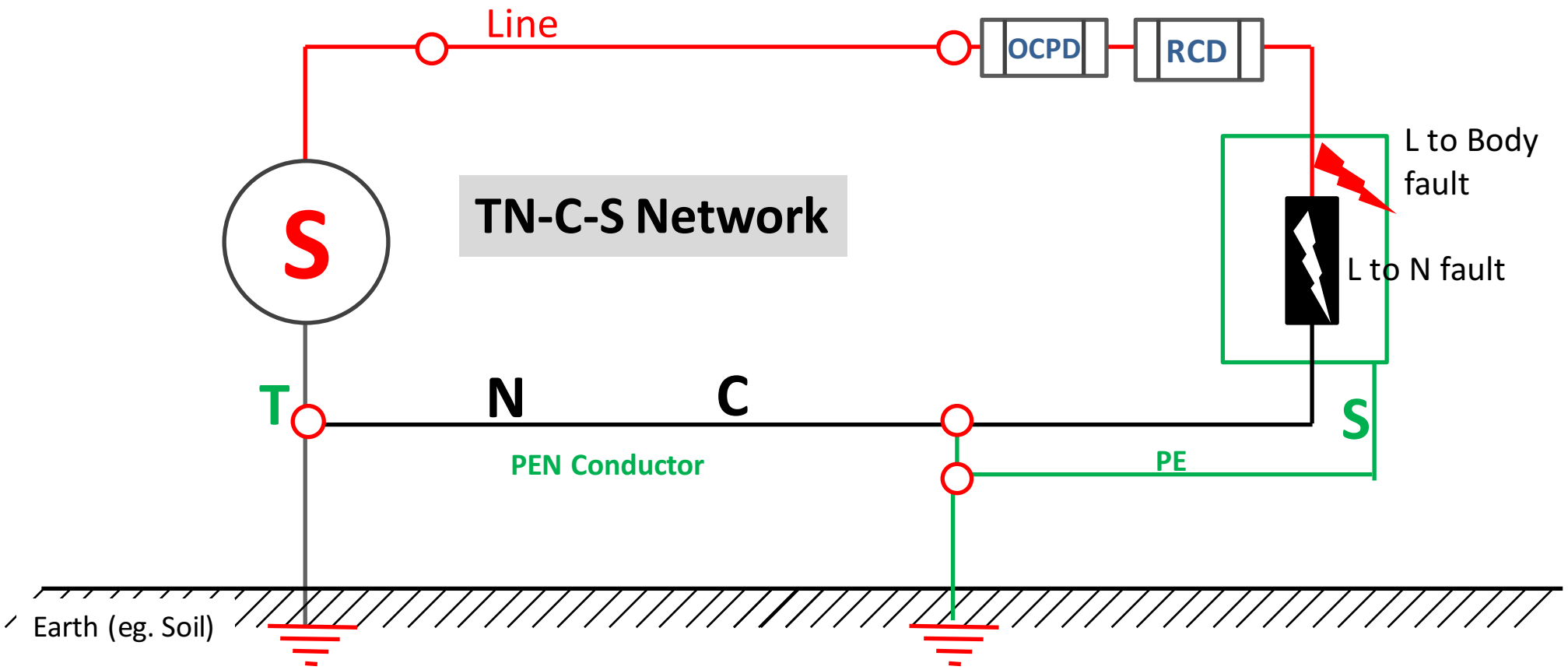
TT System



Source and installation are earthed separately

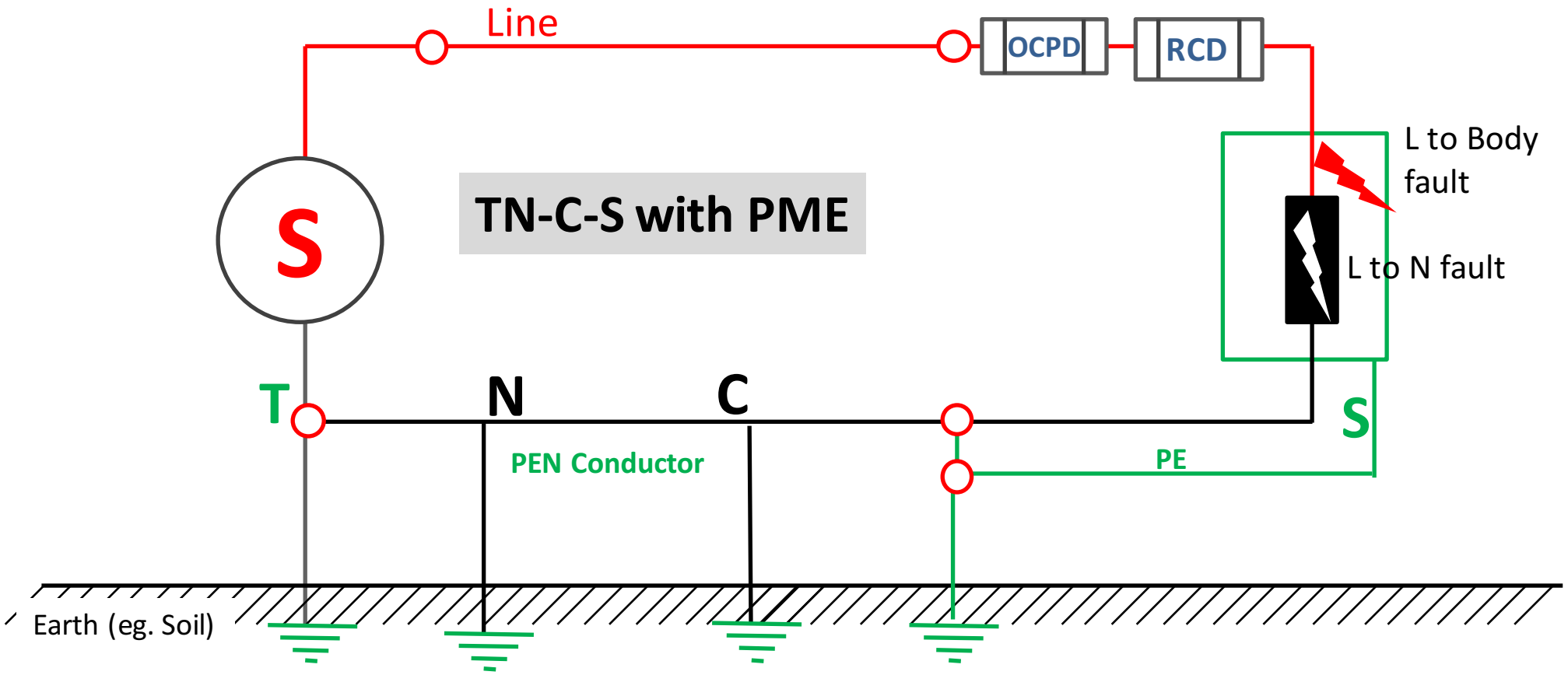
OCPD and RCD are primary protective device

TN-C-S System



TN-C-S is used in Public Electricity Network
Combined Neutral and PE conductor in distribution (PEN conductor)
At the origin of installation, PEN is divided to PE and N
OCPD is the primary protection & RCD is additional protection

TN-C-S System with PME



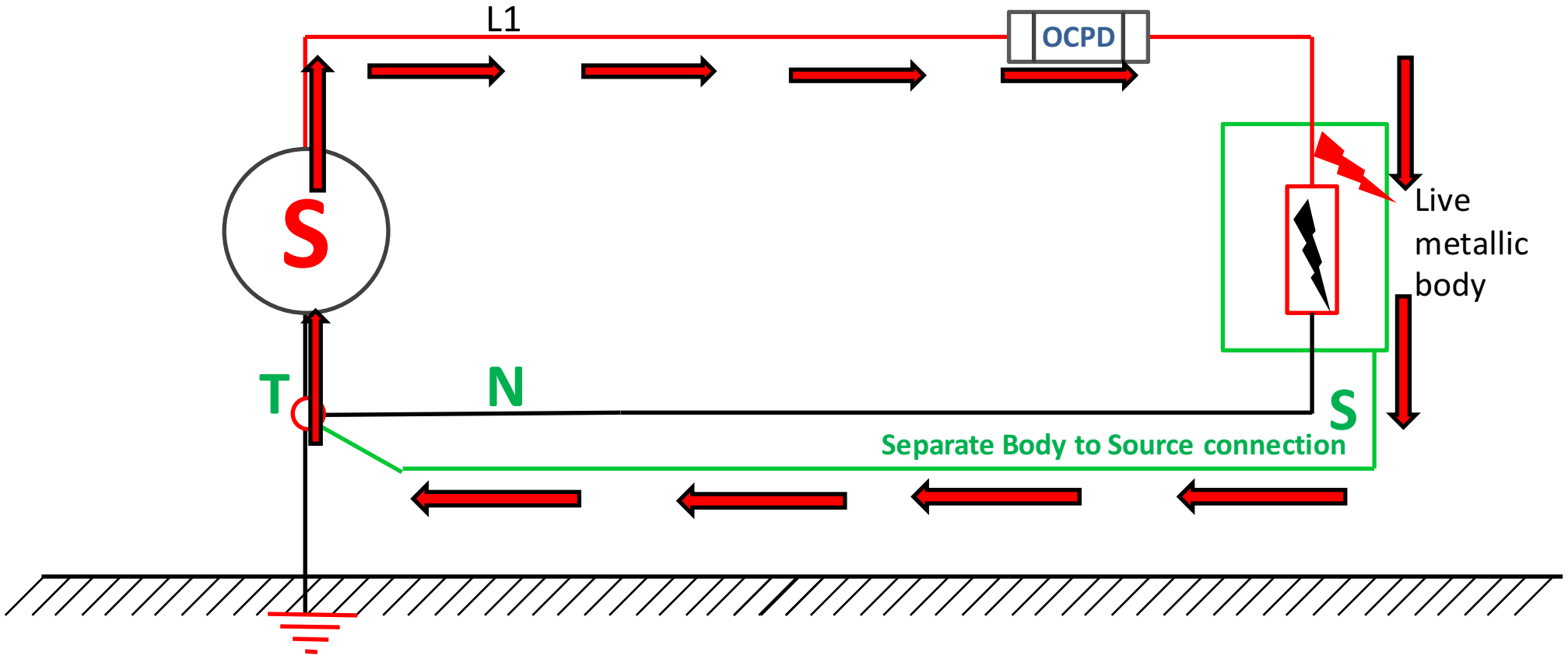
Important – Link between N and PE at the origin of installation

Earthed Neutral reduce problem due to Neutral breaking

Additional RCD as a secondary protector improves safety in TN-C-S.

Additional earth electrode at origin of installation further improves safety.

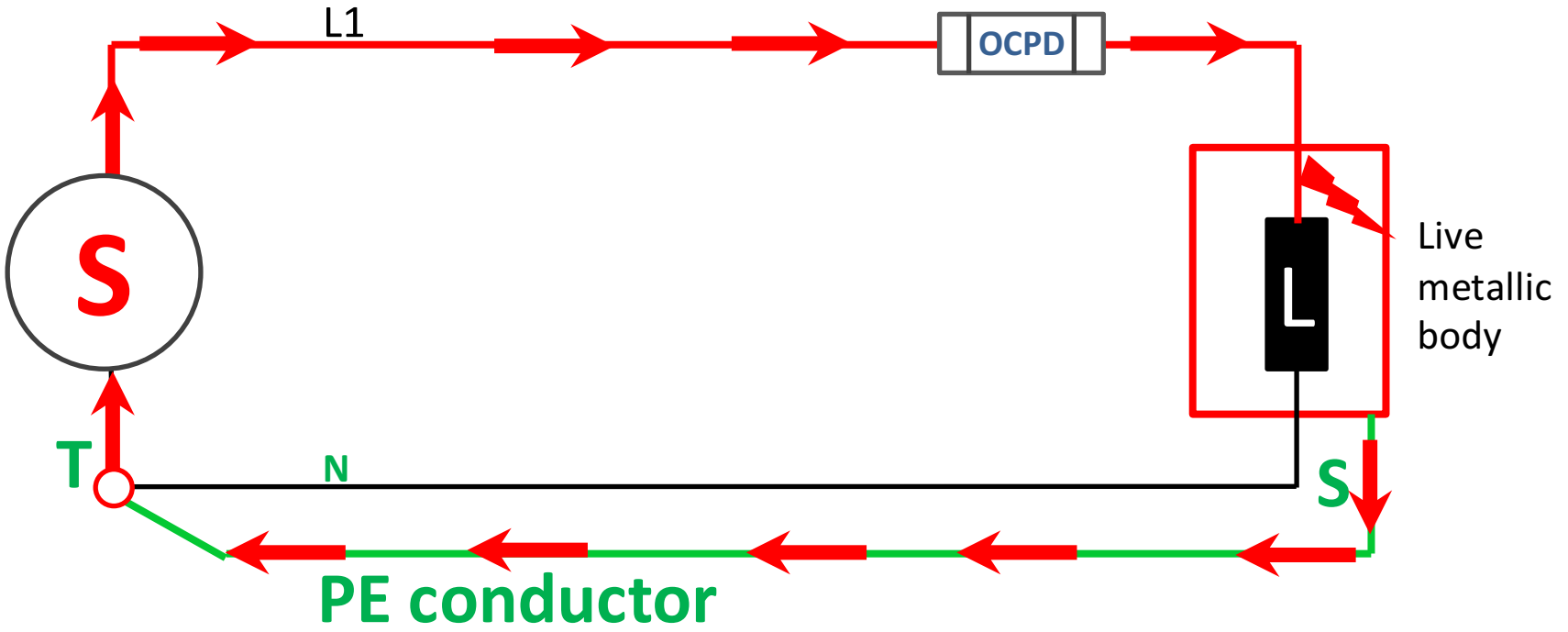
TN-S System – Loop impedance (eg earth fault)



$Z_s \times I_a \leq U_o$ or $Z_s \leq U_o / I_a$

Z_s = fault loop impedance,
I_a = current ensuring the automatic operation of disconnecting device
U_o = conventional voltage limits.

Maximum Permissible Earth Resistance norm – IS3043



OCPD = 250 amps MCCB.

Z_s = 1.0 Ω	I_{sc} = 230 amps.	Device will never trip.	Danger
Z_s = 0.5 Ω	I_{sc} = 460 amps.	Device will trip after long time	Danger
Z_s = 0.1 Ω	I_{sc} = 2300 amps.	Device will trip quickly.	Safe

Low Loop resistance = More Fault current = Fast operation of Protective Device

Resistance of PE conductor plays major role in TN-S Network during an earth fault

MPERN – IS3043 (New introduction)

11.5.1 *Earth Fault Loop (MPERN-1)*

To generate sufficiently high fault current so as to blow / trip Fuse / Miniature Circuit Breakers (MCBs) within 'Safe Time Limit' specified in IS 8437, while IS/IEC 60898-1, gives Tripping Time-Current Characteristics of MCBS. Both have a common 'TIME' axis. Coordinating these two Indian standards, MPERN have been arrived at as under:

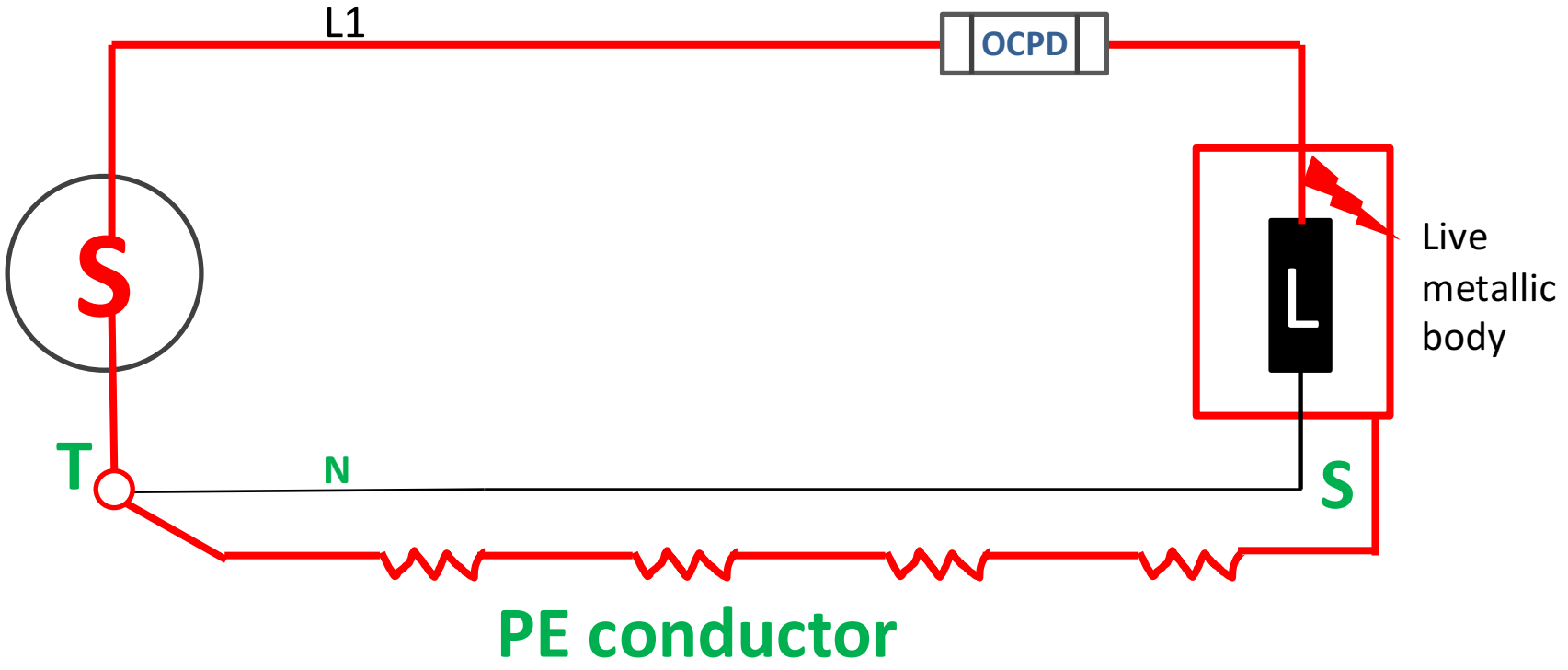
Table-9 gives the aggregate value of MPERN-1 in fault loop for various ratings of MCBs.

TV	T	SHK	X	CURRENT RATING OF MCB IN AMPERES						
Ref Table-8, IS 3043 & IS/IEC 60898-1				6	10	16	25	32	63	100
				REQUIRED EARTH RES (ER) IN OHMS						
50	5.00	29	4.0	2.08	1.25	0.78	0.50	0.39	0.198	0.125
75	0.60	45	10.0	1.25	0.75	0.469	0.30	0.234	0.119	0.075
90	0.45	56	12.0	1.25	0.75	0.469	0.30	0.234	0.119	0.075
110	0.36	72	12.5	1.47	0.88	0.55	0.35	0.275	0.14	0.088
150	0.27	102	13.0	1.92	1.15	0.72	0.46	0.361	0.183	0.115
220	0.17	160	13.0	2.82	1.69	1.058	0.68	0.529	0.269	0.169
240	0.15	175	13.2	3.04	1.82	1.137	0.73	0.569	0.208	0.182

Where TV= Touch Voltages, **T** = 'Safe Time Limit' in seconds, **SHK** = Electric Shock intensity in milli amps, **FC** = Fault Current = X * MCB Rating, **ER** = Aggregate Earth Res in fault loop in ohms = TV / FC, E = Earthed Terminal, L = Phase, N = Neutral, SE = Source Earth, CE= Consumer / Equipment Earth, EF = Earth Fault.

Table-9 : Max Permissible Earth Resistance Norm, MPERN-1
(Dry Location, Significant Floor Resistance, Dry Skin)

Accident - Example

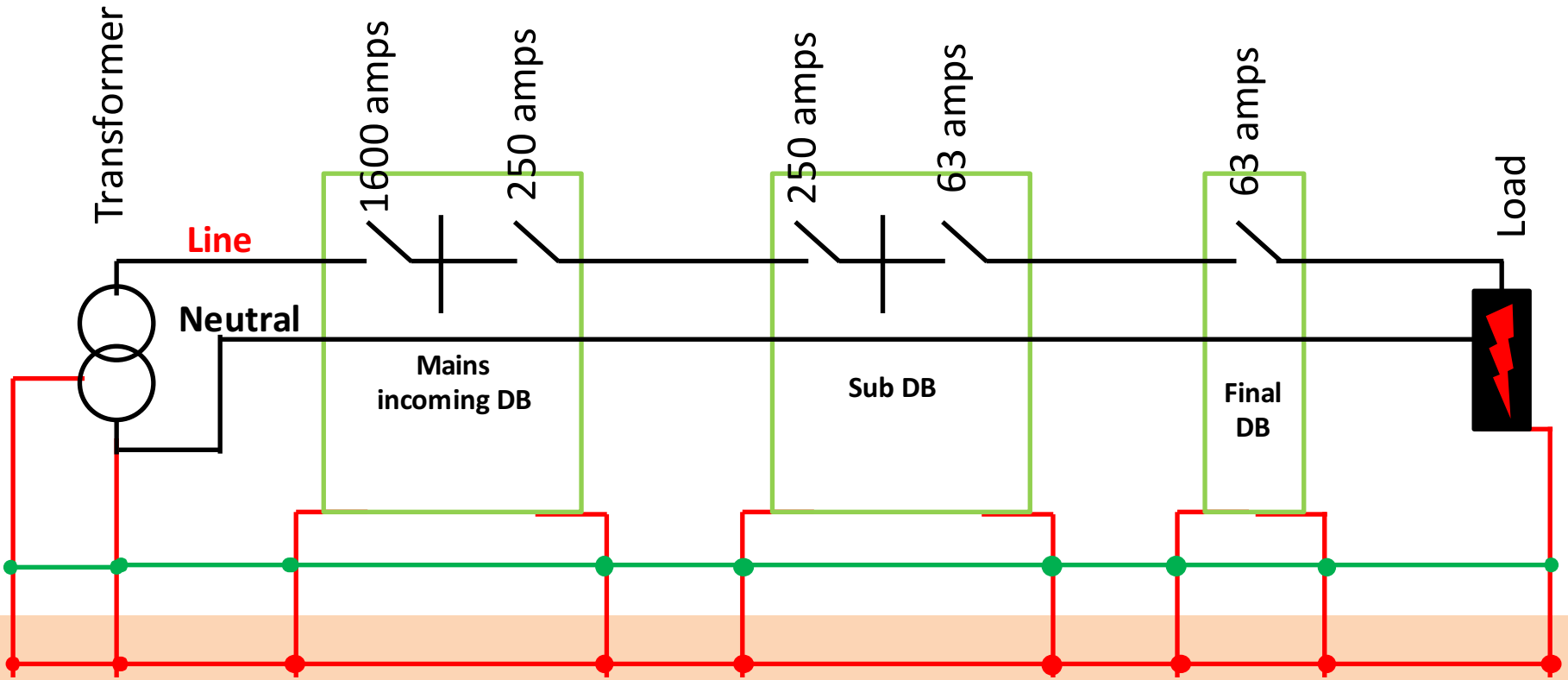


Corroded joints will increase the resistance of PE conductor (eg. 0.5 Ω)

Problem No – 1: OCPD will take more time to trip
Problem no – 2: Joints are not strong enough to handle Short Circuit current

(result – fire, flash over, accident)

IS 3043 - TN - S with PME for industrial system



TN-S system

Where there is a separate Neutral and protective conductor through out the system

TN-S system with PME

Grid interconnects Neutral of the source and exposed conductive parts

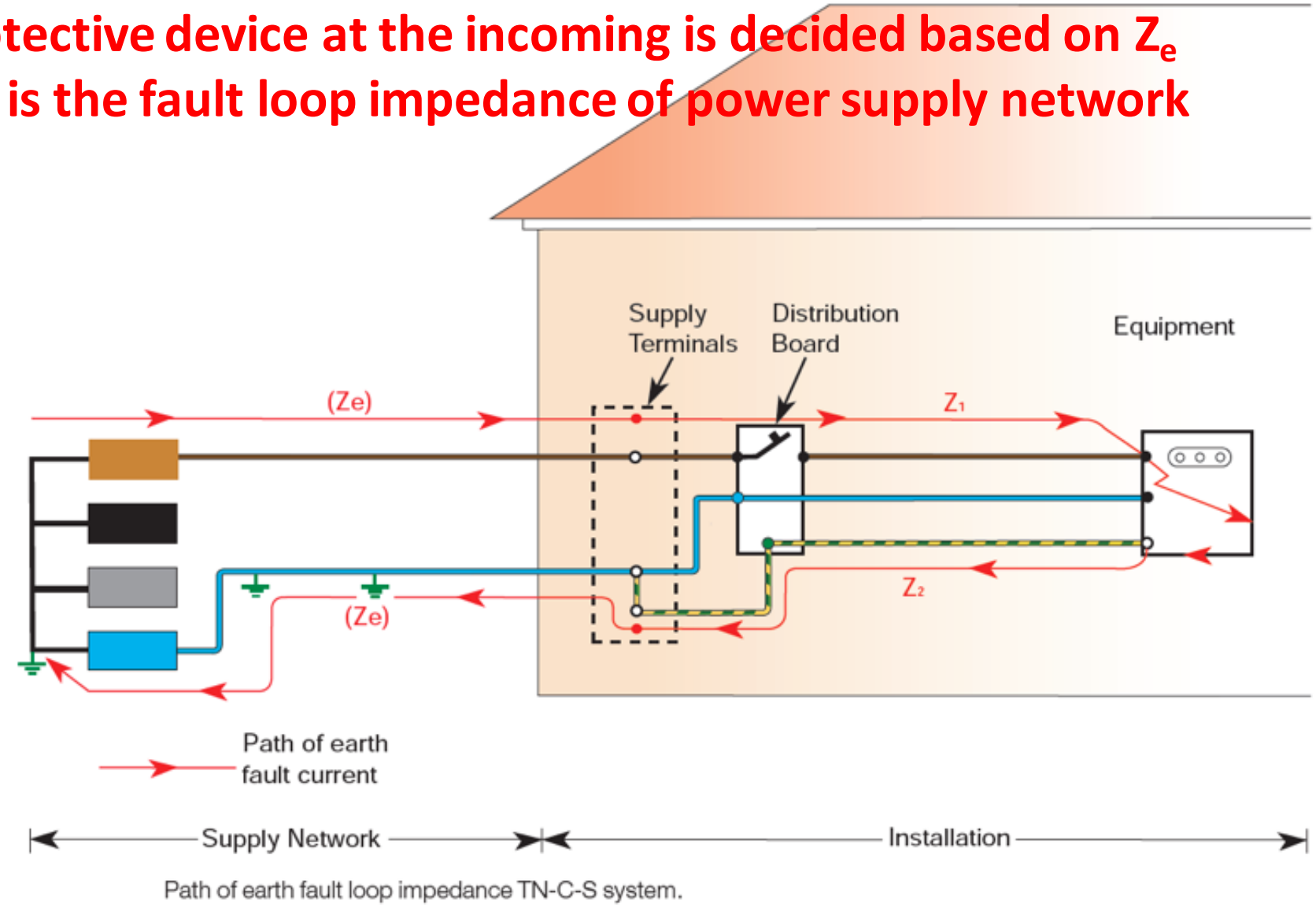
Vertical electrodes are additional

Public LV supply: Regulation in UK & in Europe

Z_e is provided by the Utility (supplier)

Protective device at the incoming is decided based on Z_e

Z_e _ is the fault loop impedance of power supply network



Path of earth fault loop impedance TN-C-S system.

Regulation: 16

(4) Save as otherwise provided in these regulations, TN system of earthing as per IS 732 shall be followed by the Supplier to carry out the purpose of this regulation.

Regulation 43

(i) neutral conductor of a 3-phase, 4-wire system and the middle conductor of a 2-phase, 3-wire system shall be earthed by not less than two separate and distinct connections with a minimum of two different earth electrodes or such large number as may be necessary to bring the earth resistance to a satisfactory value as per IS: 3043 both at the generating station and at the sub-station.

19. SELECTION OF DEVICES FOR AUTOMATIC DISCONNECTION OF SUPPLY

19.1 General - In general, every circuit is provided with a means of overcurrent protection. If the earth fault loop impedance is low enough to cause these devices to operate within the specified times (that is, sufficient current can flow to earth under fault conditions), such devices may be relied upon to give the requisite automatic disconnection of supply. If the earth fault loop impedance does not permit the overcurrent protective devices to give automatic disconnection of the supply under earth fault conditions, the first option is to reduce that impedance. It may be permissible for this to be achieved by the use of protective multiple earthing or by additional earth electrodes. There are practical limitations to both approaches.

1. Scope
2. Reference
3. Terminology
4. Fundamental Principles, Assessment of General Characteristics
5. Selection and Erection of Electrical Equipment
6. Initial Verification and Periodic Verification of an Electrical Installation

Section 6. VERIFICATION

6.2.1.1 Every installation or change(namely addition or changes) to an existing installation shall be verified during erection, as far as reasonably practicable, and on completion, before being put into service by the user.

Single party certificate, Two party certificate, Three party certificate

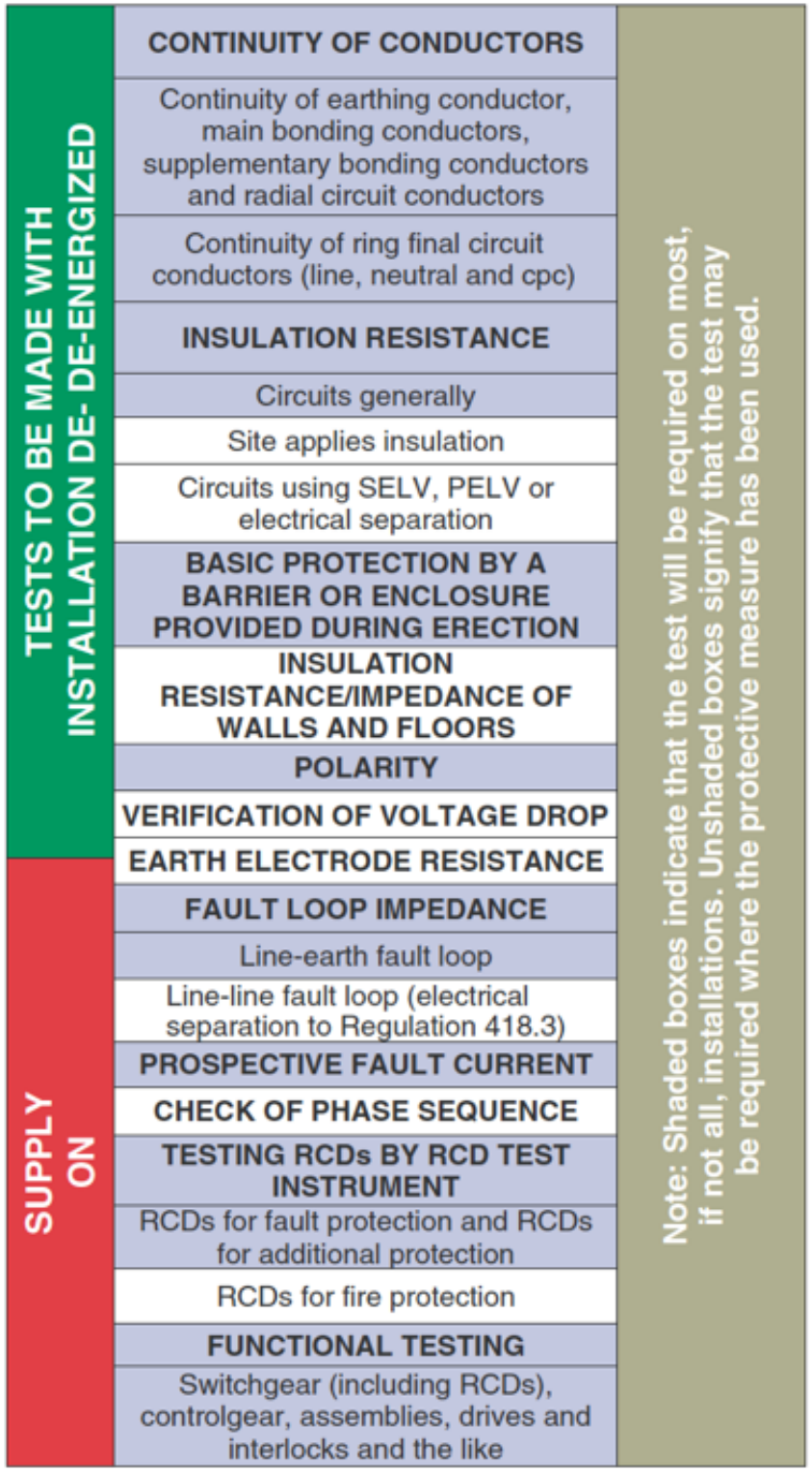
Building classifications by the authority
Seperate wiring rules for corridors in case of difficulty in evacuation
Models forms for testing
Specified meters

Sequence of test for initial testing

In Europe and USA – L.V System is energized after this test

Test Report formats are uniform which is provided in relevant National Standards / IEC standards

In case of an electrical accident, if it is found due to wrong testing or wrong operation of protective device, the person who conduct test is liable to pay compensation



- **Fault loop impedance measures for industrial and commercial installtions**
- **Double earthing for redundancy and reduction of fault loop resistance**
- **IS3043**

Protection against shock

SECTION 3 EARTH FAULT PROTECTION IN CONSUMER'S PREMISES

18. EARTH FAULT PROTECTION IN INSTALLATIONS

18.0 Basic Philosophy of Earth Fault Protection

18.0.1 The rules given in this Section are applicable to installation below 1 000 V ac.

18.0.2 Amongst other things, protection against shock in case of a fault (protection against indirect contact) is provided by automatic disconnection of supply. This protective measure necessitates coordination of the types of system earthing and the characteristics of the protective devices. This Section discusses the basic criteria for achieving this protection.

18.0.3 Protection against electric shock both in normal service (protection against direct contact) and in case of fault (protection against indirect contact) can be achieved by several measures. Details of achieving protection through the choice of an appropriate protective measure is the subject of IS : 732*. One of such measures is protection by automatic disconnection of supply. Automatic disconnection is intended to prevent a touch voltage persisting for such time that a danger could arise. This method necessitates co-ordination of (a) the type of system earthing, and (b) characteristics of protective devices. Description of the types of system earthing permitted and the requirements for earthing arrangements and protective conductors *vis-a vis* protection against shock is the subject of this code.

18.0.4 Protective measure by automatic disconnection of supply following an insulation fault relies on the association of two conditions given below:

a) The existence of a conducting path (falt loop) to provide for circulation of fault current (this depends on type of system earthing); and

b) The disconnection of this current by an appropriate device in a given time.

The determination of this time depends on various parameters, such as probability of fault, probability of a person touching the equipment during the fault and the touch voltage to which a person might thereby be subjected.

Limits of touch voltage are based on studies on the effects of current on human body (*see* IS : 8437-1977†).

18.0.5 The study of the electrical impedance of the human body as a function of touch voltage and magnitude of current flow in the body as a function of its duration likely to produce a given effect are two components which help in establishing a relationship between prospective touch voltage and its duration which will not result in harmful physiological effects for any person.

Table 8 shows the values of disconnecting times t for given touch voltages for two most common conditions.

TABLE 8 DISCONNECTING TIMES FOR DIFFERENT TOUCH VOLTAGES

PROSPECTIVE TOUCH VOLTAGE U_c	CONDITION 1*			CONDITION 2†		
	Z_1	I	t	Z_2	I	t
(V)	(Ω)	(mA)	(s)	(Ω)	(mA)	(s)
25	—	—	—	075	23	5
50	1 725	29	5	925	54	0·47
75	1 625	46	0·60	825	91	0·30
90	1 600	56	0·45	780	115	0·25
110	1 535	72	0·36	730	151	0·18
150	1 475	102	0·27	660	227	0·10
220	1 375	160	0·17	575	383	0·035
280	1 370	204	0·12	570	491	0 020
350	1 365	256	0·08	565	620	—
500	1 360	368	0·04	560	893	—

*Dry or moist locations, dry skin and significant floor resistance.22

†Wet locations, wet skin and low floor resistance.

18.0.6 It is necessary, therefore, to apply these results emanating out of IS : 8437-1977* to the various earthing systems. The disconnecting times specified for different circuits in this code follows basically the summary in Table 8, in addition taking into account the likelihood of faults and likelihood of contact.

18.0.7 *TN Systems* — All exposed conductive parts shall be connected to the earthed point of the lower system by protective conductors. The protective conductors shall be earthed near each power transformer or generator of the installation. If other effective earth connections exist, it is recommended that the protective conductors also be connected to such points, wherever possible. Earthing at additional points as evenly as possible is desirable. It is also recommended that protective conductors should be earthed where they enter any buildings or premises.

The characteristics of the protective devices and the cross-sectional area of conductors shall be so chosen that if a fault of negligible impedance occurs any where between a phase conductor and

*Code of practice for wiring installations.

†Guide on effects of currents passing through the human body.

*Guide on effects of currents passing through the human body.

TABLE 8 DISCONNECTING TIMES FOR DIFFERENT TOUCH VOLTAGES

PROSPECTIVE TOUCH VOLTAGE U_c	CONDITION 1*			CONDITION 2†		
	Z_1	I	t	Z_2	I	t
(V)	(Ω)	(mA)	(s)	(Ω)	(mA)	(s)
25	—	—	—	075	23	5
50	1 725	29	5	925	54	0·47
75	1 625	46	0·60	825	91	0·30
90	1 600	56	0·45	780	115	0·25
110	1 535	72	0·36	730	151	0·18
150	1 475	102	0·27	660	227	0·10
220	1 375	160	0·17	575	383	0·035
280	1 370	204	0·12	570	491	0 020
350	1 365	256	0·08	565	620	—
500	1 360	368	0·04	560	893	—

*Dry or moist locations, dry skin and significant floor resistance.22

†Wet locations, wet skin and low floor resistance.

220 volt fault

0.17 sec for dry condition

o.32 sec for wet condition

Method of Protection against shock

18.2 Earthing of Installations

18.2.1 *Protection Against Indirect Contact (Against Electric Shock in Case of a Fault)* — Protection against indirect contact is achieved by the adoption of one of the following protective measures:

a) Safety extra low voltage;

b) The use of Glass II equipment or by equivalent insulation;

c) A non-conducting location;

d) Earth free local equipotential bonding;

e) Electrical separation; and

f) Earthed equipotential bonding and automatic disconnection of the supply.

NOTE 1 — The primary concern of this Code is (d)

18.2.2 *Earthed Equipotential Bonding and Automatic Disconnection of the Supply* — The two aims of this protective measure are to:

a) ensure that when an earth fault occurs, the voltages appearing between exposed conductive parts and extraneous conductive parts in the location served by the installation concerned are minimized; and

b) ensure rapid disconnection of the circuit in which that earth fault occurs.

In order to meet (a), a zone is created by first connecting all extraneous conductive parts by means of equipotential bonding conductors to the main earthing terminal or earth electrode(s) of the installation.

The zone is completed by the connection of all exposed conductive parts of the circuits in the installation and of current-using equipment fed from those circuits to the main earthing terminal (or installation earth electrode) using circuit protective conductors.

Whilst such a zone is called an equipotential zone, this does not mean that voltages cannot exist between conductive parts in that zone when an earth fault occurs. The voltages referred to earlier (*see* **18.1**) will still exist between the exposed conductive parts of perfectly sound equip-

The second aim of this protective measure is met by limiting the upper value of the earth fault loop impedance of each circuit to a value determined by the type and current rating of the protective device concerned such that, on the occurrence of an earth fault (assumed to be of negligible impedance), disconnection will occur before the prospective touch voltage reaches a harmful value.

Method of Protection against shock

18.2.4 *Exposed Conductive Parts* — Exposed conductive parts that are required to be connected by means of protective conductors to the main earthing terminal (or earth electrode) of the installation are as follows:

a) All metalwork associated with wiring system (other than current-carrying parts) including cable sheaths and armour, conduit, ducting, trunking, boxes and catenary wires;

tive conductors of the circuits concerned.

c) The exposed metalwork of transformers used in the installation other than those that are an integral part of equipment. The secondary windings of transformers should also be earthed at one point of the winding, unless the transformer is a safety isolating transformer supplying a part of the installation where the protective measure 'electrical separation' is being used).

Exposed conductive parts that (because of

Important points

TN-S Neutral must be connected to earth only at one place STRICTLY TO AVOID Neutral circulation current and functional reference shifting

TN-C-S Neutral shall not be connected to earth in the building

Transformer body shall be connected to (MET) Main Earth Terminal

Neutral connected to MET

MET connected to earth electrode

This means Transformer Neutral is not connected to earth electrode directly.

What is followed due to regulation 43 is in conflict with IS3043

19. SELECTION OF DEVICES FOR AUTOMATIC DISCONNECTION OF SUPPLY

19.1 General - In general, every circuit is provided with a means of overcurrent protection. If the earth fault loop impedance is low enough to cause these devices to operate within the specified times (that is, sufficient current can flow to earth under fault conditions), such devices may be relied upon to give the requisite automatic disconnection of supply. If the earth fault loop impedance does not permit the overcurrent protective devices to give automatic disconnection of the supply under earth fault conditions, the first option is to reduce that impedance. It may be permissible for this to be achieved by the use of protective multiple earthing or by additional earth electrodes. There are practical limitations to both approaches.

IS 3043: Industrial and commercial Installation

22.1.2 Above 240 V should be designed as a PME system with separate protective conductor. The neutral of the transformer should be connected to be earth electrodes by duplicate connections and adequate number of earth electrodes should be provided with interlinking earth bus for getting an optimum value of the earth resistance depending upon the setting of the earth fault/earth leakage relays and also to limit the extent of rise of potential. The earth fault current can be of the order of symmetrical short-circuit current and hence the thermal design of the earth bus and the earthing system should depend upon the maximum symmetrical short circuit current available. The duration of the earth fault current according to the existing design practice is 3 seconds. However, in case of installations where adequate protective arrangements have been incorporated so as to instantaneously isolate the system in the event of an earth fault, a lesser duration can be considered for design purposes.

TN-S with PME

Transformer "Neutral" 2 connections to Earth "Double Earthing"

Interlinking Earth Bus

Short Circuit duration can be less than 3 seconds

IS 3043: Industrial and commercial Installation

22.1.3 As far as the value of the earth resistance is concerned, the objective from the point of **safety** consideration is **not** to attain **minimum value** of the **earth resistance** as is sometimes understood. But the consideration should be whether there is **adequate co-ordination** between the practically **obtainable value** of the earth resistance and **setting of the protective devices**. ….. Placement of electrode, area and size of grid depend on electrical installation, earth grid continuity resistance with in the limit. …… However, in the case of a protective multiple earthing system where the **neutral of the supply transformer and the non-current carrying metal parts** in the system **are interconnected by the common earth grid**, which is designed for the prospective fault current, there is no reason to design the earth electrodes assuming that total earth fault current is dissipated through the earth electrodes. However, depending upon the value of the earth resistivity, a percentage of the current may flow through the mass of the earth as well……

Earth resistance…… coordinated to tripping of protective device

Common Earth Grid interconnects Neutral of transformer and Body of load

No need to design earth electrode for total fault current

IS 3043: Industrial and commercial Installation

22.2.1 The main earthing conductor will be run in between standard earth electrodes conforming to specifications and distributed uniformly around the working area. **All the non-current carrying metal parts of the equipment, switchboards, etc., will be solidly connected to this earth grid and equipotential bonding conductor by duplicate earth connections of adequate size**. For interconnecting switchboards protected by HRC fuses to this earth grid, the size of interconnection need not be more than 75 mm^2 copper or its equivalent. In laying out the earth electrodes and the earth conductors, all efforts should be made to maintain a uniform potential gradient in and around the work area. **The transformer neutral should be solidly connected to this grid by duplicate earth connections, one going directly to earth electrodes and other going to the common earth bus**. The size of the neutral earthing conductor should in no case be less than that of the size of the main earthing conductor.

Double Earthing of equipment and switchboards
One to Grid, another to Earth Bonding Conductor (PE conductor)

Double Earthing of Transformer
One to Grid, another to Earth Bus bar

IS 3043: Industrial and commercial Installation

22.2.2 The earth grid should be run at a minimum depth of 50 cm below ground. When bare conductors are used as earth grid, this can also be assumed to dissipate the fault current to the mass of the earth

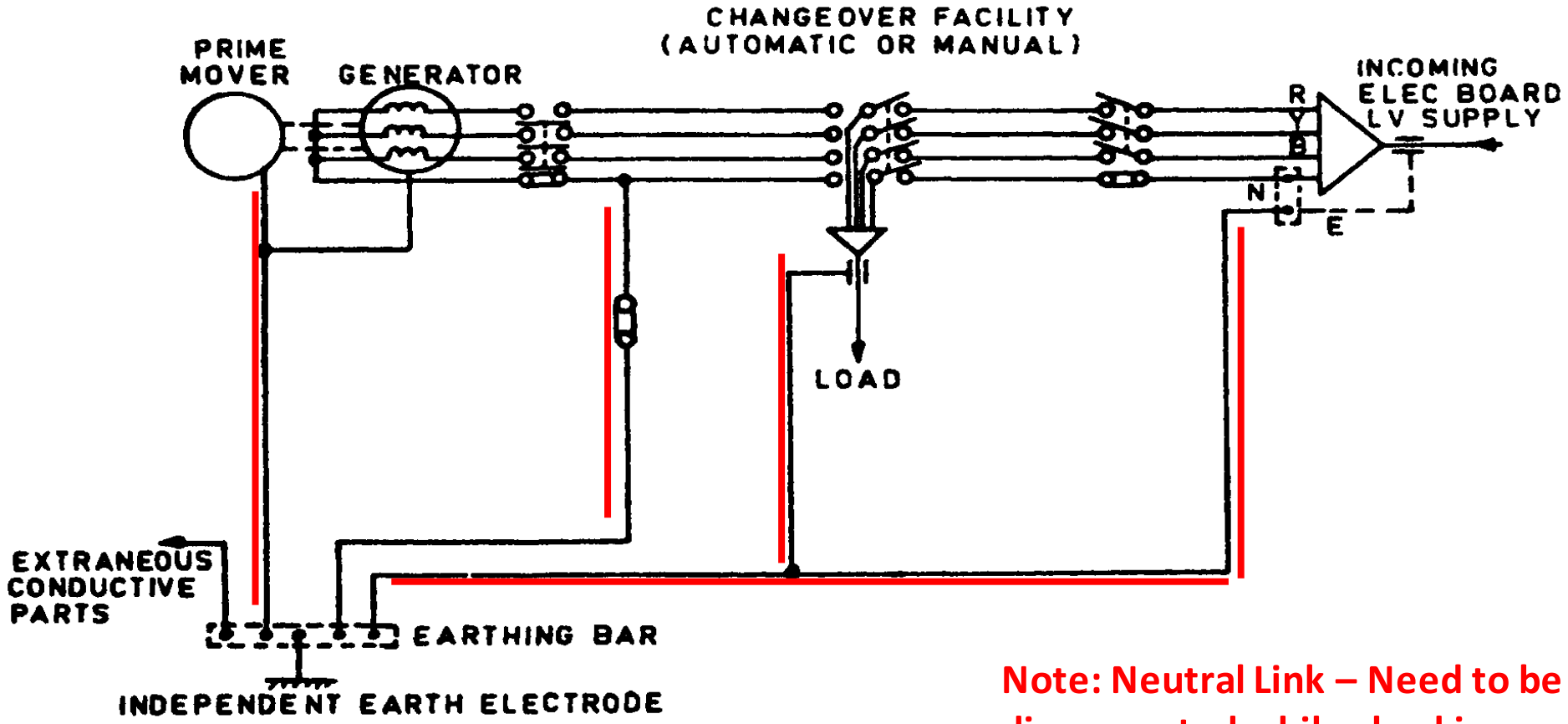
22.2.3 The continuity resistance of the earth return path through the earth grid should be maintained as low as possible and in no case greater than one ohm.

22.2.4 In the case of EHT substations, where there is possibility of the ground potential attaining very high values (of the order of 5 kV and above) in the event of an earth fault, the earth grid design should be based on the tolerable limits of the potential gradient in the substation area, and the step and touch potential due to fault conditions.

Earth Grid is the Earth Electrode

Periodic inspection of Continuity Resistance of Earth grid ensures the metal grid in soil is not corroded and disconnected

Earthing of Generator: IS 3043 Single LV DG (without Synchronizing facility)



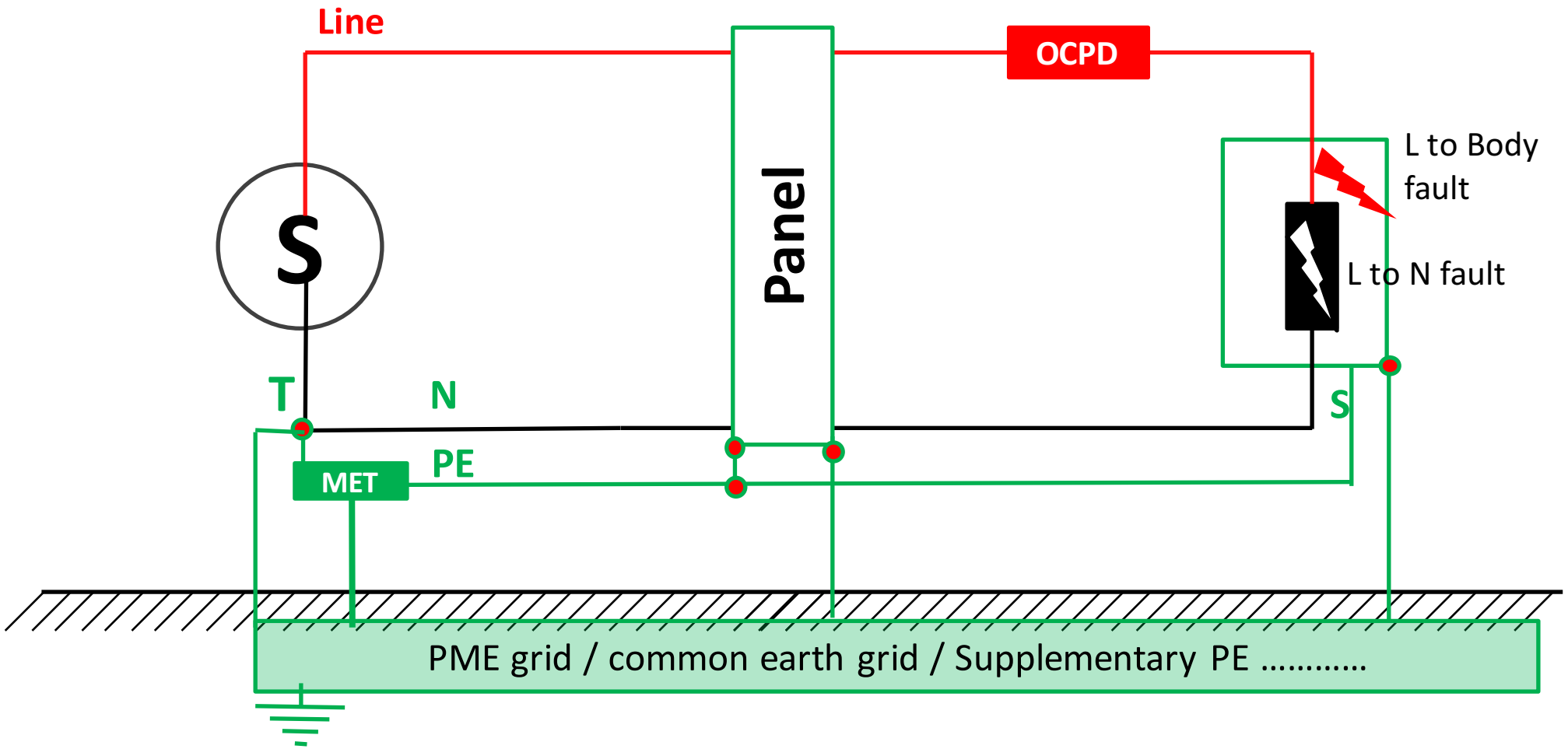
1. Cable sheath earth if provided/ shown - - -
2. PNE link if provided/shown
3. Changeover switch could be 3-pole with linked neutral.

Note: Neutral Link – Need to be disconnected while checking loop impedance Line to Neutral

Connected to an Earthing Bus Bar

Bus Bar is connected to Earth Electrode

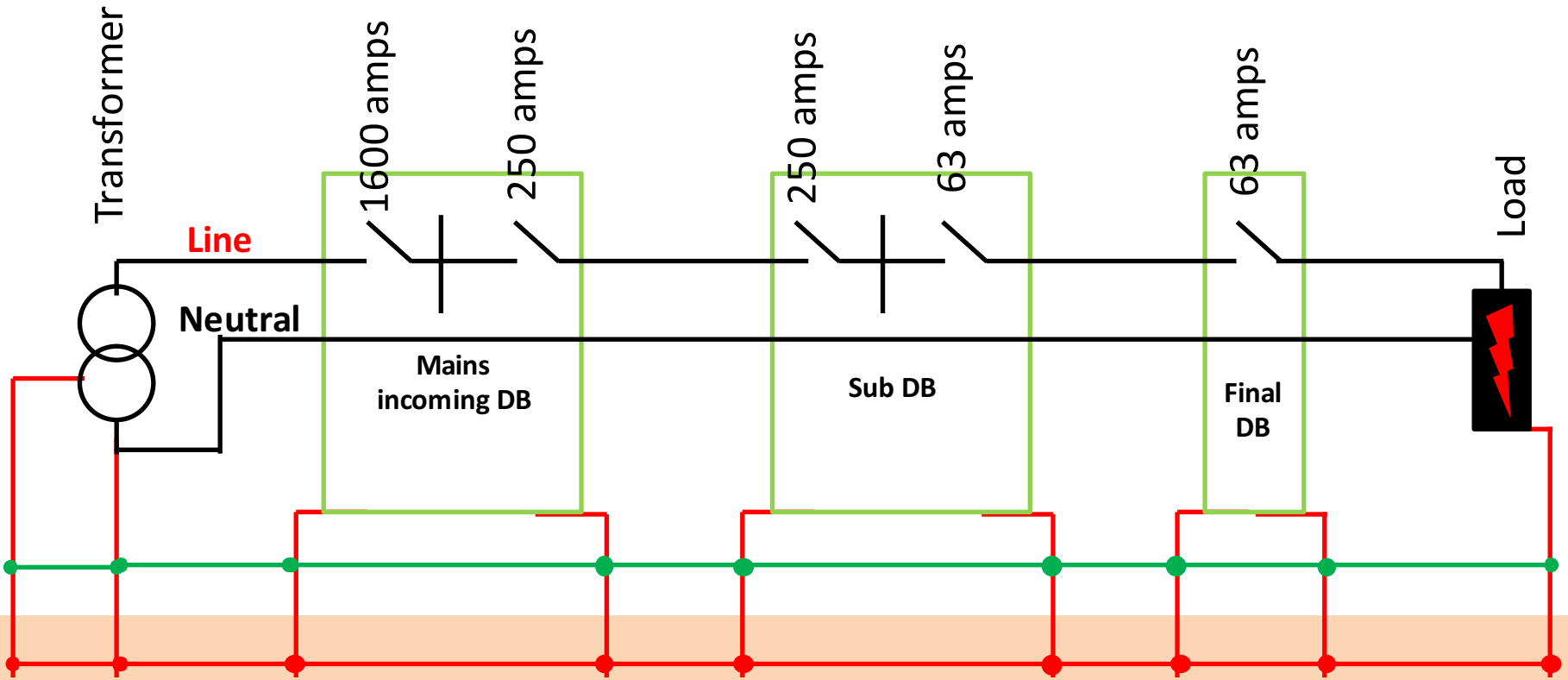
TN-S with PME



Two distinct and separate fault return path which reduce loop impedance and fast tripping of protective device

PE conductors should be installed in close proximity (i.e. in the same conduits, on the same cable tray, etc.) along with the live cables of the related circuit

TN - S with PME



TN-S system
Where there is a separate Neutral and protective conductor through out the system

TN-S system with PME
Grid interconnects Neutral of the source and exposed conductive parts

Vertical electrodes are additional

1. TN –C-S systems are not followed by utilities
2. TN –S systems are not followed in industries
3. Fault loop impedance is unknown
4. Fault loop impedance is never measured
5. Non operation of protective device due to 1 to 5 result in accidents and fire

Solution:

- Few small changes in CEA regulation
- Awareness about the way of achieving "earthed equipotential bonding and automatic disconnection of supply"
- Standard installation guideline by CEA in line with IS732 and IS3043

THANK YOU

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