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RE-Konnect

Risk Engineering Bulletin

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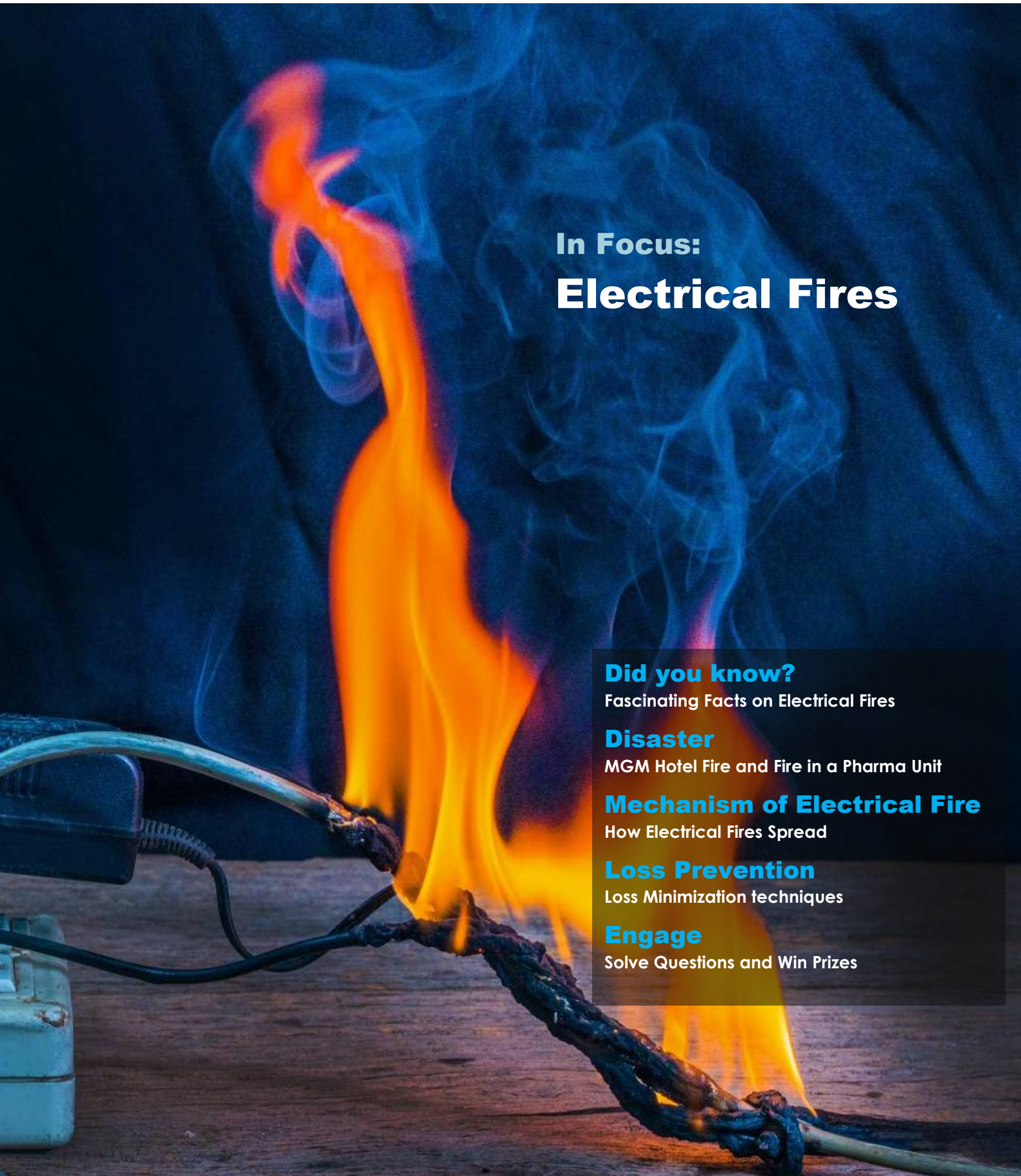


In Focus:

Electrical Fires

Preface

In July 2018, a short-circuit in an Environmental Monitoring Room – a relatively low hazard place – of a manufacturing facility caused a large fire resulting into losses of more than INR 100 Crores. There have been examples of many such fires with an electrical origin where the entire factory or godown was gutted.

In fact, more than fifty percent of fires have Electrical origin and yet the discussions on loss prevention efforts for these fires are comparatively rare. Most of the Electrical fires – fires directly caused by the flow of electric current or by static electricity – are easily preventable and often do not require sophisticated understanding and methods employed in other causes of fires.

It is therefore important to understand the basic checks, mechanism and loss prevention techniques for Electrical fires. In this Issue of RE-Konnect we will briefly touch upon these topics.

Did You Know?

- Electrical arcs produce some of the highest temperatures known to occur on earth; up to 35,000°F which is 4 times the temperature of surface of the Sun.
- In Mumbai, over the past three years, 12,000 out of 15,000 fire incidents originated from electrical sources.
- NFPA reported that 57% of home fire incidents were generated from electrical sources in USA during 2010-14.
- Every year an average of 37,000 electrical fire incidents occurs at industrial and manufacturing units in USA.
- In 2015, about 2,255 persons died due to accidental fire caused by electrical short circuit in India.

Disasters

MGM Grand Hotel, Las Vegas

On November 21, 1980, a fire erupted at the MGM Grand Hotel and Casino, killing 85 people and causing widespread property damage. The tragedy remains as one of the worst hotel fires in the modern US history.

At 7:00 am on the day of the incident, an employee heard a "crackling" sound and saw flames shooting up from a service station to the ceiling. MGM Security was immediately advised of the situation, and alerted the nearby Fire Department. Fire Department received a call reporting the fire at 7:17 am, with the first engine arriving on site at 7:19 am.

The flames spread rapidly, fed by the glue used for the decorative wallpaper and tiles throughout the building, which in turn filled the casino and hotel corridors with toxic fumes. The tunnel above the casino lacked any smoke dampers, which enabled black clouds to quickly permeate the building's air circulation system, spreading deadly fumes into the high-rise section of the complex. A massive helicopter rescue effort from nearby Air Force base pulled 1,000 people from the roof of hotel. Of the 85 people who perished, only four died from burns; the rest died of smoke inhalation, many in their sleep (due to the lack of audible alarms).

It was later determined that the fire had started inside a wall by faulty wiring used to refrigerate a food display cabinet. The flames would have been extinguished quickly if the hotel had been outfitted with a sprinkler system. As a result, a new law went into effect in Las Vegas that required every casino to be retro-fitted with sprinkler systems. Additionally, stricter regulations were put into place regarding functional smoke dampers in all ductwork, as well as a proviso mandating that all public facilities in the county undergo a thorough fire safety inspection every two years.

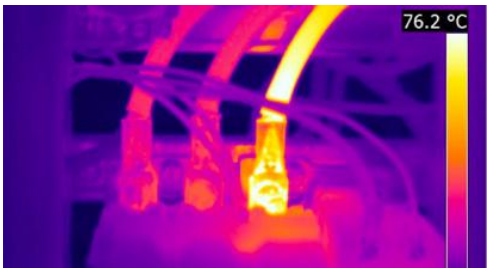
Fire in a Pharmaceutical Plant

In the mid of 2018 around night hours, a large Indian pharmaceutical facility caught fire. Fire started in Environment Monitoring System room located on the second floor and spread to Ground and Utility rooms of Production block. The fire originated due to short circuit and spread to other areas through interconnecting ducts. Raw materials, finished goods and WIP were damaged by smoke and by water used to extinguish fire. Utilities and machineries installed on first floor and ground floor were also damaged. Overall loss to the facility is estimated to be more than INR 100 Cr.

Mechanism of Electrical Fire

Major physical mechanisms and causes of electrical fires are discussed below.

Poor Terminations

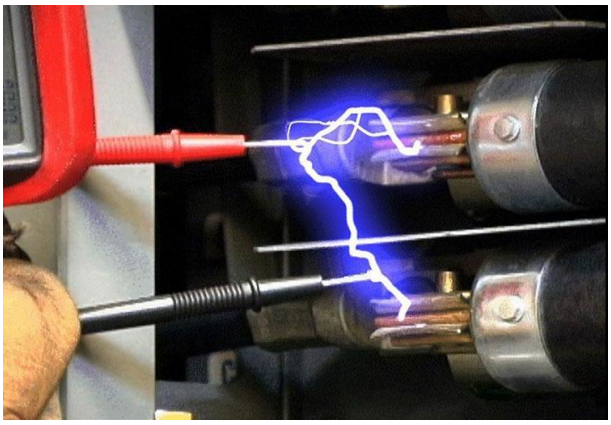


Electrical circuits including the end use device have many connections/terminations. Improper termination/connection may lead to temperature rise and even ignition. In extreme cases, the temperature can cross 1200°C between two mating metallic surfaces. The issue of poor connections (overheating or glowing connections) is the single most important mechanism for electrical fires.

Arcing Across Carbonized Path

Momentary short-circuit arcs between a defective insulated wire and another conductor may thermally char the insulating material. The charred material, being conductive, is capable of sustaining the short-circuit arc. The sustained arc may propagate along the wire through continuous charring which is known as 'arc tracking'. If the arcing wire is part of a multiple wire bundle, the insulation of other wires within the bundle may become thermally charred and start to 'arc track' (flash over). Therefore, arc tracking may lead to complete failure of an entire wire bundle or harness and further lead to fire.

Arcing in Air



When considering circuits of 240 V or lower, arcing in air is often the end result of another mechanism and not an independent event. However, by opening the live circuit in any voltage level, it is possible to make arcing in circuits. Such an opening of a circuit can occur because someone or something shorted two conductors together or racking in/out operation of the breaker or live maintenance on electrical panels. Extremely high-energy arcs can damage equipment causing fragmented metal to fly in all directions. Low-energy arcs can cause violent explosions or blasts in atmospheres containing explosive gases, vapors or combustible dusts. Electrical arc produces a temperature of 35,000°F and can ignite tinder type fuels.

Overloading

An electric overload occurs when existing current exceeds the ampacity of conductor. The wires may heat up and can melt, with the risk of starting a fire. The internal temperature rise will be due to resistive heating of the conductor caused by a current overload incident. If the magnitude and direction of the overcurrent is sufficient to heat the wire to a temperature that ignites surrounding combustibles, the overcurrent would cause a fire

Loss Prevention

Mitigating risks associated with electrical fires are relatively easier. Some prominent loss prevention measures are discussed here to mitigate or evade electrical fires.

Inspection and Maintenance Programs

The quality and operation of electrical systems is important is paramount in this regard. An unseen electrical issue may be a dangerous fire hazard. Loose parts, faulty connections, dirty electrical panels and moisture contribute to electrical failures. These problems can be easily solved with preventive electrical maintenance. Regular inspection and maintenance of electrical equipments reduce chances of breakdown and fire hazard.

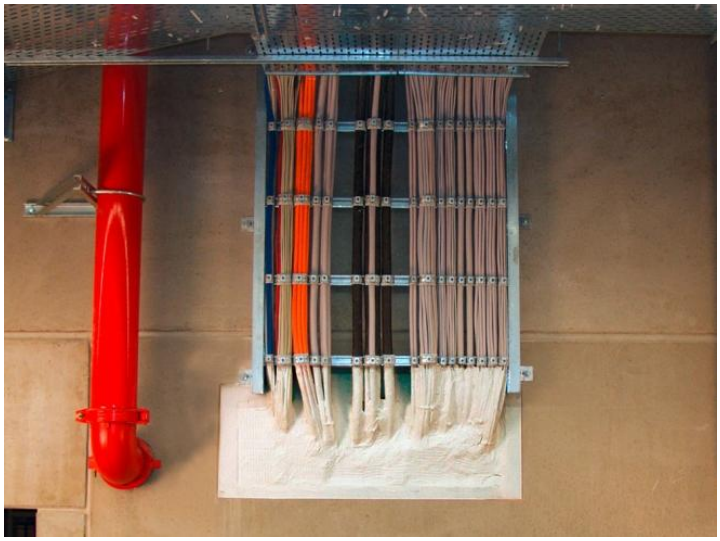
Fire Suppression System

NFPA 70 states water sprinkler system is allowed in electrical rooms of less than 600 Volts. Due to concerns of unwanted water discharge or leakage where there is no actual fire, gaseous suppression system and panel mounted fire extinguishers can be considered. Clean agents like nitrogen, FM200 are widely used. UL listed gases like HFC227ea and HFC236fa used inside panel mounted fire extinguishers automatically get released and suppress fire inside panels. High velocity water spraying system or Nitrogen injection system in transformers prevents fire and explosion in transformer.

Smoke/Fire Detection System

Smoke which is an indicator of fire needs to be detected at early stage. Working smoke detectors are a key factor in surviving a fire. Automatic alarm actuation during smoke generation helps to avoid fire incident or lessen spreading of fire by automatic or manual fire fighting. Linear heat detection cables laid along the length of bunch of cables helps in early detection of fire or overheating in cables.

Passive Fire Protection



Cable acts as a medium to transfer fire from one area to another. Cables coated with fire rated compounds restrict the spread of fire from termination point inside the electrical panels or equipments. Spreading of fire needs to be contained within the origination area. Firestops prevent unprotected horizontal and vertical penetrations in a fire-resistance-rated wall or floor assembly, which can diminish the fire-resistance rating of these structures and are the leading cause of rapid, erratic spreading of smoke and fire.

Guidelines

Following codes and standards can be referred for further reading:

- **NFPA 70:** National Electric Code
- **NFPA 77:** Recommended Practice on Static Electricity
- **OISD STD 173:** Fire prevention and protection system for electrical installations

Engage

Answer the following question and win Amazon coupons worth Rs 500 each. Send the answer to *editor.bulletin@tataaig.com* . Five winners for this quiz will be announced in the next issue.

Q1. What percentage of fires has electrical origin?

a) Greater than 50%
b) Less than 50%
c) 90%
d) 30%

Q2. Which of the following cause electrical fire?

a) Static Electricity
b) Overloading
b) Poor maintenance
d) All of the Above

Q3. What is the maximum temperature that can generate during arc flash?

a) 35,000°F
b) 3,500°F
c) 35,000°C
d) 3,500°C

Winners of the previous issue are as follows:

- **Rajendra Prasad L** – Greenkogroup
- **Sameer Gupta** – GIC of India, Mumbai
- **Aseem Agarwal** – Global Insurance Brokers, Mumbai
- **Ujwal Nagdeote** – Willis Towers Watson India Insurance Brokers
- **Girish G** – GIC of India, Mumbai

Answers to previous questions: 1. Waste Water Facility 2. All of the Above 3. Replacement in Kind

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