Webinar 7 | National Electrical Safety Campaign 2020

Electrical Fire & Fatalities in Buildings – How to prevent?

Friday, 4 Dec 2020 | 4 to 5:30pm

PROTECT YOURSELF

You’ve got the power

Organised by

In association with

International Copper Association India
IEEMA

Chola MS
Introduction
LEADERS IN RISK ENGINEERING
AND EHS SOLUTIONS
AN ISO 9001:2015 CERTIFIED CONSULTING ORGANISATION
Twenty five years of experience in HSSR
Executed over 10000 risk consultancy projects
Spanning 42 industrial sectors world wide
Many things to many people
A legacy of over a century marked by milestones across the world. 28 businesses, comprising of market leaders and best sellers, in a robust portfolio.

Everlasting bonds created by impacting lives in myriad ways. Welcome to the many splendored INR 300 billion Murugappa group.

The Murugappa Group founded in 1900 is one of India’s largest diversified conglomerates, with 28 business and 32,000 employees in 234 cities.
• MS&AD Insurance Group contributes to the development of a vibrant society and help secure a sound future for the earth, by bringing security and safety through the global insurance and financial services business.

• Mitsui Sumitomo Insurance Group, Japan is one of the largest insurance groups in the world & biggest in Asia.

• Today, the group operates in non-life insurance, life insurance, financial services and risk management services.

• Carrying out overseas business through an international network of 42 countries and regions.

• Making full use of over 50 years’ experience in overseas business, it provides products and services to alleviate the wide variety of risks occurring throughout the world.

<table>
<thead>
<tr>
<th>Date Established</th>
<th>October 21, 1918</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paid-in Capital</td>
<td>¥139,595 million</td>
</tr>
<tr>
<td>Employees</td>
<td>14,691 (Non-consolidated basis)</td>
</tr>
<tr>
<td>Domestic Agents</td>
<td>42,198</td>
</tr>
</tbody>
</table>
SCOPE OF OUR RISK ENGINEERING SERVICES

Our expertise blends with clients’ technical requirements, resulting in a spectrum of services across the lifecycle of a project from the conceptualizing stage till decommissioning.

We Partner with clients to manage the Risk Profitably
ELECTRICAL SAFETY : PORTFOLIO OF SERVICES

- Power Quality Study
- Static Electricity Hazards Study
- E-Hazop
- Arc Flash and Relay Coordination Study
- Lightning Protection Design and Review
- Thermography Study
- Electrical Safety Audit
- Hazardous Area Classification
CHOLA MS SAFETY ACADEMY

20 years of experience in EHS Consulting across multidisciplinary domains & industries with a strong grounding in both domestic & international markets gives us an edge over others in offering training. 5,000 training hours clocked till date.

TRAINING MODELS

E - Learning
These courses are designed as short but powerful Competency building blocks which can be accessed at your convenience. We have distilled and captured our expertise and experience into concise modules which are highly informative and constructive.

Custom built E - Learning
Many organizations are using e-learning or technology enabled learning because of its benefits over traditional classroom training. Of course, you have to collaborate with the best to maximize the benefits. Our Instructional Designers and Domain Experts can build customized e-courses to specifically cater to your training requirements, policies & practices.

In Company Training
We are able to address complex problems and convey solutions using simple and easy to comprehend language. Programs are designed as stepping stones or Certification Enablers to acquire industry recognized Credentials in EHS. Our experienced team can bring out the best outcomes and participation.

Centre for Excellence
If you are an ambitious HSE professional and wish to gain from our experience and interact with our Senior Domain Experts, join us for specialized learning programs offered only at our Centre for Excellence. Learn from the Leader and stay ahead of the rest.
CHANGING ECONOMIC SCENARIO & RISING FATALITIES AND FIRE
Increase in Load?

The market for white goods* and televisions has been growing, but remains underpenetrated.

* White goods include washing machines, refrigerators, air conditioners, and televisions.

Source: JP Morgan, Technavio, Spark Capital estimates, EY analysis.
The Importance of Electrical Safety

India looses about

- 7960 lives annually due to electrocution
- 2315 lives annually due to lightning
- 1290 fire incidents reported annually due to electrical
- 4563 animals lives annually due to electrocution
- Around 3031 non fatal electrical incidents reported annually
India loses about 25,000 lives annually to fire...

*Stats for 2008 from The Geneva Association World Fire Statistics 2011,

India faces one of the highest rates of deaths due to fires in the world.

Russia sees significantly high deaths predominantly due to large wild fires.

India’s topping the list in fire related deaths is owing to a combination of high population, and higher incidence. Countries like China and Brazil could be benchmarks for India to reduce the incidence.

European nations are “top of the range” benchmarks for reducing incidents.

Despite a population higher than India, China loses fewer lives to fire.
Loss of life due to Electrical and fire

Source data: NCRB reports (2001-2015)
Printing and binding work of budget documents, including that of the Chief Minister’s and Governor’s speeches, was done in the building. Photo: B. Jothi Ramalingam.
HAZARDS OF ELECTRICITY
Electrical Hazards

Be safe with electricity

- Burns
- Electrocuton
- Shock
- Associated hazard (secondary)
- Explosion
- Fire
KEY REASONS
1. Failure to de energize circuit or Accidental charging (LOTO)
2. Failure to guard live parts from accidental worker contact
3. Failure to maintain clearance distance from energized conductor like overhead lines
4. Using defective tools, cables and equipments
5. Insulation failure
6. Not using shock protection devices RCCB/RCBO or Earth fault devices
7. Improper installation/missing earth/temporary installation
8. Not using PPE or using defective/unsuitable PPE
9. Unqualified employees/Lack of training & knowledge
Various causes for electrical fires:

- Skilled manpower
- Overload & short circuit
- Insulation failures
- Loosen conductors
- Inferior grade materials
- Poor designs & code violations
- Passive fire protection
- Electrical heat
- Maintenance
- Old installations
Electrical safety  Core issues

Old Installations
- Addition of loads - Modification
- Degradation of insulation & Components - Ageing
- Poor maintenance practices
- Technology upgradation
- Obsolescence of components

Design Issues
- Code violations
- Competent designer
- Adequate sizing
- Selection of reputed make
- Cost reduction
- Coordination among various Departments
- Active & Passive fire systems
- Protective device coordination

Workmanship
- High attrition due to globalization
- Training & Skill level
- Multi skill level - Non competence person
- Outsourcing
- Maintenance Man power Vs Cost reduction

Based on CMSRS 600 building projects
LIFE
Extension Strategies For Ageing Assets

Ageing is not about how old your equipment is; it's about what you know about its condition, and how that's changing over time.”
You upgrade Your

- Gadgets
- Home appliances
- Office communication systems
- Security systems
- Office fitouts
- Lifts
- Fire systems

Around 40% Indians want to change mobile phones within a year: Study

Around 40% people want to change their mobile phones within a year of purchase and almost that many Indian consumers are open to buying refurbished smartphones, according to a study.

Average Indian customer will upgrade to bigger cars: Hyundai India MD Young Key Koo

Energy efficient equipments-
LED’s & motion sensor’s
Have you reviewed your MCB rating?
You fail to upgrade Your

- Wiring systems
- Protection systems
- Technological advancements (safety)
- Knowledge on new equipments
- Common trunking/shafts/cables
- Emergency rescue/PPE’s
- Code and standard requirements
What about safety if protective devices are not appropriate?

Energy efficient
SAFETY BY DESIGN
SHOCK PROTECTION
Safety

IS 732 – Section 3

- Shock
- Thermal effects
- Over voltage
- Over current
- Short circuit
- Isolation and switching

Safe systems
Direct contact

SELV

By disconnect ion

Placing out of reach

Primary insulation

Limiting discharge energy

Obstacles

Barriers Or enclosures

IS 732 – 5.1.2
25v ac or 60v dc

PVC covered overhead line - 2.5 m

Basic insulation

RCCB's

Panel shrouds and barriers

Switch yard fence

Solar fence

IS 732 – 5.1.2
MITIGATION MEASURES - SHOCK
SHOCK & ELECTROCUTION MITIGATION MEASURES

- Shrouds
- Fence barrier
- Gloves
- Mat
- Shoes
- RCCB
- RCBO
- MCB
- Double insulation
- <50 V Isolation transformer
- Shocks & Earth connections
  >415 V =2
- LOTO & Try out
- RCCB RCBO MCB
- Shock
- Electrocution
- Grounding
- Disconnection
  by protective devices
- Insulation
  primary & secondary
- Safe extra low voltage
- Power voltage
- Accessible barriers, obstacles or enclosures
- Sound earth connections
  >415 V =2
Mitigation Measures for Shock and Electrocution

Shock Protective Devices - RCCB/RCD/RCBO

RCCB (Residual Current Circuit Breaker)
RCD (Residual-current device)
RCBO (Residual Current Circuit , Breaker with Over Current Protection)
MITIGATION MEASURES - FIRE
01 Avoid overloading

04 Fire retardant low smoke cables/wires shall be used

07 Fire detectors at all locations

02 Use appropriate protective devices – MCB, Earth fault detection and appropriate rating

05 Avoid cable/wire joints

08 Passive fire protection (fire sealant) for electrical rooms

03 Avoid Combustible materials near electrical installations

06 Conduct thermography

09 Maintain with care

Don’t Forget...

100 mA RCCB shall be used to protect against fire
PROTECTIVE DEVICES

Selection of Earth Leakage Protective Devices

RCCB/RCBO selection should be based on:

1. Rated current (In)
2. Rated residual operating currents
3. Short circuit withstanding capacity
4. Number of poles
## PROTECTIVE DEVICES

### Selection of MCB – Utilization Category

<table>
<thead>
<tr>
<th>MCB/ MCCB type</th>
<th>Operating current (In) rated current</th>
<th>Operating Time</th>
<th>Application</th>
<th>Installation at</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>3 to 5 times</td>
<td>04 To 13 Sec</td>
<td>Resistive load and lighting circuits</td>
<td>At Sub feeder of Distribution Board</td>
</tr>
<tr>
<td>C</td>
<td>5 and 10 times</td>
<td>04 To 5 Sec</td>
<td>Inductive Load application (Pumps, Motor, fluorescent lighting)</td>
<td>At incoming / Outgoing of Distribution Board</td>
</tr>
<tr>
<td>D</td>
<td>10 and 20 times</td>
<td>04 To 3 Sec</td>
<td>Inductive- Capacitive Load application (Transformers or X-ray machines, large winding motors, discharge lighting, large battery charging)</td>
<td>At incoming of Distribution Board / Panels</td>
</tr>
</tbody>
</table>
Cables & Wiring
Separate dedicated and fire compartmented shaft should be provided for carrying such high voltage cables to upper floors in a building.

Suitable fire detection and suppression measures shall be provided throughout the length of the cable on each floor.
Aluminium conductor cables in sizes less than 16 mm$^2$ cause termination problems leading to heating at the terminals and enhance the possibility of a fire.

For conductor sizes less than or equal to 16 mm$^2$, only copper conductor cables should be used.
Only the given types of wires should be used as per applicability and requirement.

- Fire Retardant (FR)
- Heat Resistant Fire Retardant (HRFR), HR-PVC
- Halogen Free Flame Retardant (HFFR)
- Cross linked polyethylene (XLPE)

Cables Insulation Types
It is desirable to use flame retardant cables and wires in electrical distribution systems.

It is recommended to use 4 core cable in place of 3.5 core to minimize heating of neutral core due to harmonic content and to avoid overload failure.
Conductors

- The conductor for final sub-circuit for fan and light wiring shall have a nominal cross-sectional area not less than 1.50 mm$^2$ copper.

- The cross-sectional area of conductor for power wiring shall be not less than 2.5 mm$^2$ copper.

- The minimum cross-sectional area of conductor of flexible cord shall be 1.50 mm$^2$ copper.
NEUTRAL CONDUCTORS

IR IMAGE SHOWS HIGHER TEMPERATURE IN NEUTRAL CONDUCTOR.
Distribution of Supply
Use of busbar trunking system is ideal for high load density in modern large buildings and high rise buildings demands compact and safe.

Busbar trunking can be installed in vertical risers shafts or horizontally in passages for transmission and distribution of power.
Busbar trunking is preferred in buildings for distribution for following reasons:

- Reduced fire load
- Reduced maintenance over its entire lifetime
- Longer service lifetime in comparison with a cable distribution; and
- Enhanced reliability due to rigid bolted joints and terminations and extremely low possibility of insulation failure.
Compact and sandwich type Bus system
SPECIAL WIRING REQUIREMENTS
SPECIAL WIRING REQUIREMENTS

• Emergency Lighting circuits
  • Inherently high resistance to attack of fire (FR rated wires)
  • Segregation from other circuits
  • Adequate mechanical strength

• Fire Alarm and Detection
  • Inherently high resistance to attack of fire (FR rated wires)
  • Segregation from other circuits
  • Adequate mechanical strength

• Normal lighting & Power circuits
  • FRLS preferred instead of PVC
  • Segregation of very low, communication and low voltage cables

NEC 2011 Part 1 - Section 9 – 4.12.1

FR rated Cables for Fire detection circuits

Metallic conduits were Used

FRLS WIRES
FIRE SPREAD
- Wiring and Cabling shall have flame retardant property.

- MV and LV wiring running in shafts and false ceiling shall run in metal conduits.

- 230V wiring for lighting and other services in false ceiling shall have 660V grade insulation.

- HV, MV & LV wire running in shafts and in false ceiling shall run in separate shafts.
Electrical distribution cables/wiring shall be laid in separate shaft

Shaft shall be sealed at every floor by fire stop materials.

Water mains, gas pipes, telecom lines, intercom lines or any other service line shall not be laid in duct for electrical cable.

All metallic items shall be bonded to the earthing system
Cable trench shall be backfilled to cover the cable initially by 200 mm of sand fill; and then a plastic marker strip shall be put over the full length of cable in the trench to identify the cable entering or leaving the building.

If the cables rise above ground to enter a building or other structure, a mechanical protection such as a GI pipe or PVC pipe for the cable from the trench depth to a height of 2.0 m above ground shall be provided.
RISK OF SPREAD OF FIRE

- Wiring system passes through walls, roofs, the openings remaining after the passage shall be sealed with fire resistant material.
- Cable terminations shall be coated up to length of 1m and up to a length of 1m in cross over points.

NEC 2011 Part 1- Section 9 – 4.12.1
Fire & Oil filled Apparatus
Shall be separated from the adjoining buildings including the main building by at least 6 m clear distance to allow passage of fire tender.

There shall be no interconnecting basement with the main building underneath the oil-filled transformers.
Substation equipment having more than 2000 litres shall have baffle walls of 4 hours fire rating between apparatus.

NBC Part-8 Clause- 4.2.1.12 (v)
Provisions shall be made for suitable oil soak-pit, and where use of more than 9000 litre of oil in any one oil tank, receptacle or chamber is involved.

NBC Part-8 Clause- 4.2.1.12 (vi)
Baffle wall requirement for Substation equipment having oil capacity > 2000 litres:

- Fire rating of 240 mins
- Raised to at least 600mm above the height of the equipment
- Exceeding 300 mm on each side of the equipment
Fire & oil filled apparatus

**NBC Part-4 Clause-3.4**

**Clause 3.4.6.3.1**

All Transformers having capacity > 10MVA shall be provided with High Velocity Water spray system or Nitrogen Injection System.

- **High Velocity Water spray system**
- **Nitrogen Injection System**
HV/MV/LV Switchgear
When 2 or more Transformers feeds a MV distribution system:

- Distribution system shall be divided into separate sections, each of which shall be normally fed from one transformer.

- Separate sections can be interconnected by use of bus coupler.

**MV/LV Switchgear**

NBC Part-8 Clause-5.3.6.3
For installations supplied with electric power from remote transformer substations,

- to ensure effective earth fault protection, main circuits with circuit-breakers shall be operated by earth fault,

**MV/LV Switchgear**

**NBC Part-8 Clause-5.3.6.4**
Panel room Requirements
MV/LV Switchgear

Panel room Requirements

**NBC Part-8 Clause-5.3.6.7**

- Shall be **under lock, and key shall be accessible to authorized persons only.**

- Shall be efficiently protected by wall/fencing not less than 1800 mm in height and fence shall be earthed efficiently.

Where the switchboard is erected in a room of a building isolated from the source of supply or at a distance from it,

- Adequate means of control and isolation shall be provided both near the boards and at the origin of supply.
- Independent, **Ventilated** or MV panel room shall be provided on ground level or 1st Basement.

- MV panel room shall be provided with fire resistant walls and doors of fire resistance not less than 120 mins.
Electrical MV main distribution panel and lift panels shall be provided with CO$_2$/inert gas flooding system for all panel compartments with a cylinder beside the panel.
REGULATIONS
Regulations governing electrical safety in Buildings in India

- CEA 2010 & Its amendments
- NBC 2016
- IS 732 – Code of Practice for wiring installations (under revision)
- IS/IEC 62305- Code of Practice for protection against lightning (under revision)
- IS 3043- Code of Practice for earthing
- IS 4648- Guide for Electrical layout in residential buildings
- SP 30:2011 – National Electrical Code
REGULATIONS
THANK YOU

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