ELECTRICITY HAZARDS: SAFETY MEASURES & PRECAUTIONS

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Electricity operates in various categories of voltage, where it is as low as 5 volts at the lower end to a medium phase of as low as 11 kV and a high phase of up to 500kV. At each category of electrification, it has its own measures of safety. To cater for these protections, it is necessary to look into its design parameters and experience of a competent person is required.

The main hazard when it comes to electricity is that contact with live parts can cause shock and burns. Faults which could cause fires or explosions normally begins with electrical faults, i.e. source of ignition from a flammable or explosive atmosphere.

Electric shock depends on the magnitude of the current. A small shock is harmless but stronger, more intense currents may induce involuntary muscle contractions and cause tissue damage as well as trigger fibrillation of the heart or a general cardiac arrest which, in many cases, prove fatal (i.e. electrocution).

Electrical distribution systems generate, store and transmit extremely large amounts of energy. Unmonitored, uncontrolled and/ or unprotected electrical energy from equipment failure or poorly designed or maintained equipment, may be resulted in electrical fires and explosions that are dangerous in themselves that can be also initiated major accidents.

Effective measures such as compliance to National Electrical Code (NEC), Standard for Electricity Safety, Arc Fault Circuit Interrupter (AFCI), Continuous Thermal Monitoring Technology and other monitoring solutions are available to protect against electrical fires.

Many designers fail to understand the equipment installed in their system plays against its level of protection. Key role in a safety of an establishment with respect to fire, shall be a vital link between emergency equipment and their power or control source. It is also crucial that these measures must remain functional even during a fire.

The energy providers, in general, are more concerned with reducing fire incidents in an industrial usage as this may contribute to a major loss in income. Nevertheless, they also need to look at electrical protection on the distribution system to avoid fire occurrence. These providers need a good system isolation to avoid overloading cascade down to a lower distribution system. There are many protection devices in the market to tackle this issue and these vary in costs.

Typical Power Transformer Fire

Typical Example of Protection Method

PCBs (*Polychlorinated biphenyls*), a transformer coolant and lubricant, was widely used for small power transformers as it had non-burning properties. Later, PCBs were banned because this released dioxins into the atmosphere when burnt at high temperatures. The gaseous insulation using SF6 is a successful design of the transformer because it is used in critical or strategic substations in a conducive area. This design is generally not subjected to the fire hazards or explosions. Despite the prevalent use of transformers and the need to be constantly alert to their condition and the need for regular maintenance, it remains a power device that is least understood and poorly managed among all high voltage equipment in the power system network.

In general, most electrical accidents are the results by one of the following:

- Unsafe equipment or installation,
- Unsafe environment, and/ or
- Unsafe work practices.

Some ways to prevent these accidents are the use of insulation, guarding, grounding, and electrical protective devices as well as safe work practices.

In the event of a distribution fire hazard occurrence, a corona discharge is an electrical discharge brought on by the ionisation of a fluid such as air surrounding a conductor that is electrically charged. Spontaneous corona discharge occurs naturally in high-voltage systems unless care is taken to limit the electric field strength.

Electrical power transmission generally deals with high voltages as a bulk amount of electrical energy has to be transmitted from generating stations to load centres. At this level of voltage, an effect called corona effect takes place. Hissing noise is frequently heard if one is standing below a high voltage transmission line due to corona discharge. Normally this hissing or cracking audible noise, visual violet glow, production of ozone gas around the conductor, power loss, and radio interference are results of corona discharge.

Hazards on transmission lines and the chronology effects:

- potential gradient or electrical field is set up in the air,
- free electrons in the air acquire greater velocities,
- large potential gradient approx. 30kV/cm,
- cumulative ionisation of air near conductor surface occurs,
- electric discharge occurs through sparks,
- air insulation breaks down,
- visual critical voltage, and
- power losses.

Methods to overcome the above hazards are:

- deciding on the correct size of conductor,
- solid conductor with smooth surface rather than stranded reduces corona discharge,
- conductor with larger diameter for lower electric field gradient
- bundled conductor increases diameter,
- larger spacing between the conductors reduces electric stresses, and
- electric discharge occurs at the sharp points, edges and corners
- to mitigate this, corona rings are employed at high voltage terminals.

These hazards can only be reduced to a minimum level and eliminated due to other mechanisms and interferences. However, the protection and technology introduced into the system may mitigate the majority of occurrences. The level & stage of protection depends on the investment or overhead spent against the protection plan.

Typical gas used by energy providers are FM200 for bigger installations and CO_2 for smaller installation. FM200 is classed as a clean agent which means it is safe for use within occupied spaces. FM200 systems require less storage space than most other fire suppressants. CO_2 is a colourless, odourless, and electrically non-conductive gas that is highly efficient as a fire suppression agent.

Firefighting systems installed by most energy provider on its installation shall be referred the recommended standards given below:

1. Suppression system
    a. MS ISO 14520 - Gases Fire Extinguishing System
    b. NFPA 2001 - Clean Agent Fire Extinguishing System
    c. NFPA 2010 - Aerosol System

2. Alarm and detection system
    a. ISO 7240 - Fire Detection and Alarm System
    b. NFPA 72 - Standards for Protective Signalling
    c. EN 54 - Standardization for All Component Parts of a Fire System

The practice of safety and effective hazard management is highly recommended for all categories of installations. However, the effectiveness and levels of security depends mainly on the category of installations.