

Electrical Safety Issues & probable solutions in Industries

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Abstract: An effective electrical safety program and work practices are the key to reducing electrical injuries at the workplace. Often overlooked on a company's Electrical Safety Program, the audit for the Electrical Safety Program and awareness of the workers about the implemented preventive and protective control measures is needed to mitigate or reduce the risk of exposure to the electrical hazards of arc flash and shock to as low as reasonably practicable (ALARP). The safety is first priority, therefore as per the observation a number of suggestions are given in the end, which could be suggested to the people in the industry for better working environment.

Keywords: Electrical Safety, electrical hazard classification, errors, PPE, electrical safety standards

I. INTRODUCTION

We use electricity to carry out a large range of everyday activities from the smallest electrical motor of 200 nanometers to the biggest industrial plants for the manufacture of goods for local use and to export. Electric energy is an essential part of our day-to-day life because it is the main source of social and economic development which helps to do more with the time given us.

The man has tried to control and make use of the power of electricity for more than a century and undoubtedly succeed in many areas but the hazards are still parallel with it. The use of electricity is dangerous and we have just come to learn how dangerous it is. Ever since in 1897, the first electrocution was recorded an electrical safety has been an issue. The first recognized hazard was not the electrical shock issue of electricity because when the electricity shorts out or overheat, it can cause fires slowly, over the years, the electrical shock hazard became clear, and to address it the practices were developed. That is why it took decades for us to recognize what was actually happening around us.

Electrical injuries are also disproportionately costly if we compare it to other causes of lost time injuries. A study by Wyzga and Lindroos on electric utility companies found that electrical injuries comprised < 2% of total injuries of any given year, yet the cost of worker's injuries accounted for 28%–52% of the total medical cost. In 2010, a major underwriter of workers compensation insurance found that the electrical injuries were the second most expensive workers compensation claim. This means that the risk of financial loss from electrical injuries is unavoidable.

The electrical hazards should take seriously in the workplace because a small mistake can take the life of

yours and your colleagues so every organization has to conduct an electrical safety programme for all its workers. Apart from informing them about the hazards, the workers should also take a safety workshop because many workers in the workplace do not pay much heed towards electricity hazards. Some think that electrical related incidents are a part of life and some even believe that they are perfect and accident can never happen to them. Some of them think that the health risk is a part of their job and it cannot be avoided. Such type of careless & negative attitude among workers results in more work-related injuries and they mentally prepare themselves that it will happen to them. To bring effective changes in the worker's perspective, a safety program is of paramount importance.

In the field of electrical engineering, engineers and other professionals get exposed to electricity indirectly during generation, transportation, installation and usage. Such conditions might cause hazards if accurate safety measures are not taken. Therefore we should follow the safety guidelines and standards according to the country because standards are different for different countries according to the environment and many conditions. For the purpose of the safety and the right usage of equipment, there are certain rules and regulations formulated by the Bureau of Indian Standards (BIS) which follows the following five principles such as safety, Ease of use and adaptability, Simple technology, Value for money products, Energy efficiency and environment.

II. INDIAN ELECTRICAL SAFETY STANDARDS

The systems are divided according to the voltage it requires. In Accordance to IE Rules'56 there are further types of systems.

Table 1: Division of System Voltages according to IE Rules'56:

Low Voltage (LV)	Not Exceed 250 V
Medium Voltage (MV)	Not Exceed 650V
High Voltage (HV)	Not Exceed 33000 V

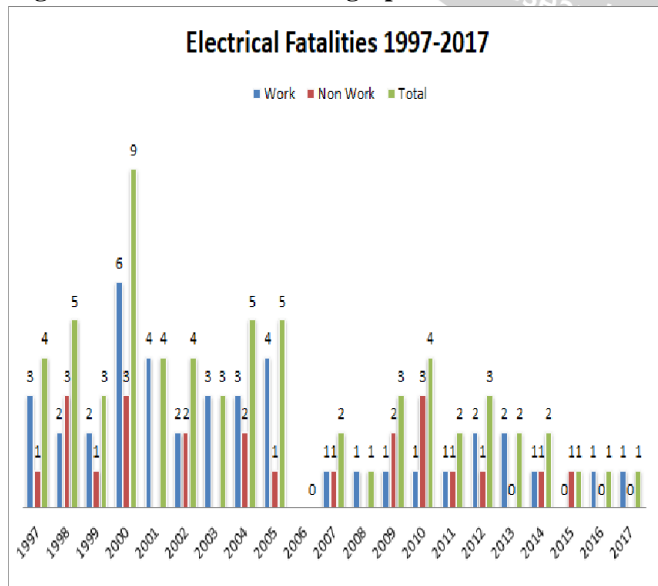
CEA (Measures relating to Safety and Electricity Supply) Regulations, 2010: instead of LT, MV, HV or EHV in IER, 1956 with CEA Safety Regulations, 2010 respective voltage ranges used with regulations. When a person is working on different lines and carrying a different amount of voltage that time a particular clearance area should keep between them. Table 2 shows the least clearance between the working person and the line at different voltages.

Table 2: Minimum Clearance between Line and Workman

0-750 V insulated or polythenecovered conductors	300 mm
6.6 kV	0.6 m
12kV	0.9 m
33 kV	1.2 m
69 kV	2.0 m
72 kV	3.5 m
138 kV	4.0 m
230 kV	5.0 m
500 kV	7.0 m

Even after so many regulations at times, electrical safety neglected by the people and unfortunately, they get harmed. Especially on roads when an EHV line crosses another EHV or a low and medium voltage line cross each other.

A general Electrical fatalities graph:



According to the above graph, we got to know that the fatalities are very high from 2000 to 2001 and even average it is much higher as compared to the fatalities of 2015 to 2017. The fatalities are reducing which shows that safety is better now but still not perfect because there are some fatalities are happening.

2.1 Importance of Electrical Safety in Human Life:

Because we all rely on electricity to go about our everyday lives, it's easy to forget that electricity is, in fact, a potentially dangerous thing. It takes a lot of energy to power a building, or even a single room. It's no exaggeration to say that lives are at stake with electrical safety; a strong enough current passing through someone's body can kill them in an instant or cause serious injury In an industry where generators are made electrical safety is more important, because we could not apparently realize that, what amount of current is actually harmful for a person who is dealing with it.

Electrically powered equipment can pose a significant hazard to workers, particularly when mishandled or not maintained. Many electrical devices have high voltage or high power requirements, carrying even more risk.

The voltage of the electricity and the available electric current in regular businesses and homes has enough power to cause death by electrocution. Even changing a light bulb without unplugging the lamp is hazardous because coming in contact with the "hot", "energized" or "live" part of the socket can kill a person. Working with electricity is dangerous.

Engineers, electricians, and other professionals work with electricity directly, including working on overhead lines, cable harnesses, and circuit assemblies. Others, such as office workers and salespeople, work with electricity indirectly and may also be exposed to electrical hazards. The major hazards associated with electricity are the electrical shock, fire and arc flash.

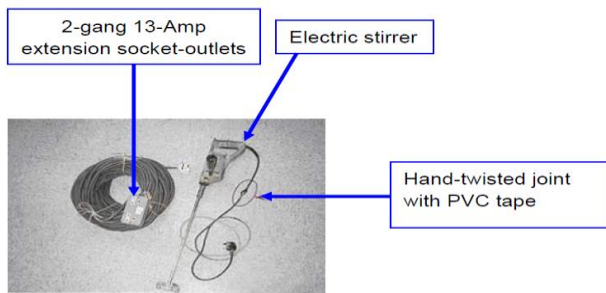
III. CASE STUDY

The electrical accident occurs when the equipment is being maintained or when not maintained properly. This may be electrical equipment that uses electrical power such as switchgear or equipment. Generally, the accidents happen when the workers have been insufficient trained, poorly skilled and supervised and because of improper risk assessment. The incidents may be costly and life taker.

Case Study:-1

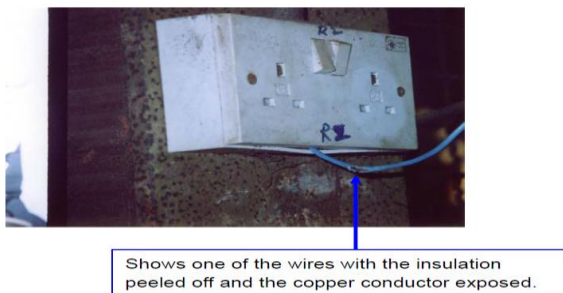
A worker gets an electrical shock while attempting to operate an electrical stirrer at a construction work site to mix some cement for plastering. The worker got an injury in his hand and sent for medical help. The investigation discloses that there was a hand-twisted joint taped with PVC insulation tape on the power cord of the electric

stirrer. The exposed was due to some loose strands of wires. These strands of wire lived at the time of the accident.



Case Study:- 2

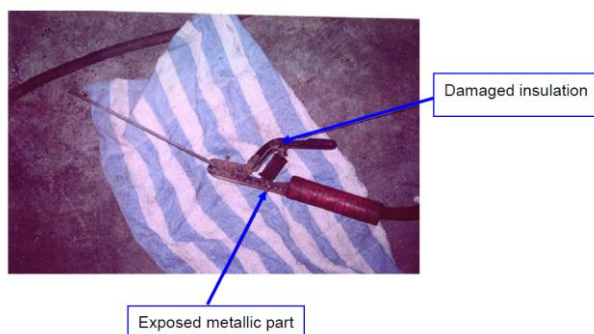
A worker was disassembling the wires connected to a 13-amp socket outlet and received a fatal electric shock in a factory. The worker was pulling the wires to remove them from the molded box while he was dismantling the 2 Nos. of 1.5mm² PVC insulated wires from the socket outlet, and results in part of insulation of both wires peeled off with the live conductor of the wires exposed. The wire was live at the time of dismantling. The worker received a fatal electric shock when he came in contact with the exposed part of the wire.



Case Study:-3

A worker was carrying out a job on electrical arc welding on a metal sheet and set on an Alternate current. The worker received a fatal electric shock. The investigation revealed some points that are:

- The welding electrode holder was not fully insulated;
- The insulation on the handle of the welding electrode holder was damaged;
- There was no low voltage shock preventer incorporated in the welding set.



Case Study: 4

A 29 Year young male welder assigned to work on an outside concrete platform attached to the main factory building. He used a portable arc welding machine with an extension cord due to no presence of an electrical outlet nearby at the particular site. The male end was the four-pronged type and the female end was the spring-loaded type of the cord. The worker plugged the male end of the cord into the outlet. At that instant, the metal case around the power cord plug became energized and electrocuted the worker.

An investigation revealed that the female end of the extension cord was ruptured. The spring, cover plate, and part of the casing were missing from the face of the female connector. The grounding prong on the welder power cord plug was bent very badly so that it slipped outside the connection. Therefore, the arc welder was not grounded properly. Generally, it happens in rare cases to insert the plug incorrectly or due to human error.

IV. INSPECTION AND RESULT

Electrical devices, which produce energy in the form of electricity using high speed diesel as a fuel are required everywhere like house residence, hospitality, industries, hospitals, retails stores for the purpose of power backup.

Despite this periodic maintenance there are numerous safety aspects which work person in the industry follow. They are like; wearing personal protective equipment while working on different machines, different sign boards for each machine were provided with warning details, the workers were told about the 5S+safety model for their easy working, pigeon reflectors were hanged for preventing entrance of pigeon in the industry, different regions were marked to make the transportation in the industry easy and secure and in every section of the industry an authorized person was appointed for making the process safe and secure specially at the time of testing the gensets. Signal signs were given to inform the workers about the moving machinery part from one place to another with the help of lifting devices.

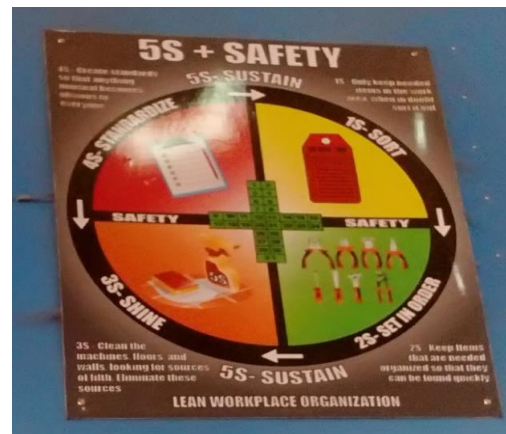


Figure 1: 5S+Safety Board in the Industry

But, with time people working in the industry actually got habitual with their work and started neglecting the safety measures which should be taken by them on regular basis like not wearing the personal protective equipment regularly, workers were not following the specific path to move from one place to the another place and also few gensets and machinery was in this safe walking path, availability of the authorized people in the appointed region, not following the 5S+Safety module in the industry and the people working on the bending and welding machine were actually working without any PPE.



Figure 2: PPE used in the Industry



Figure 3: Mishandling of the equipment (1)

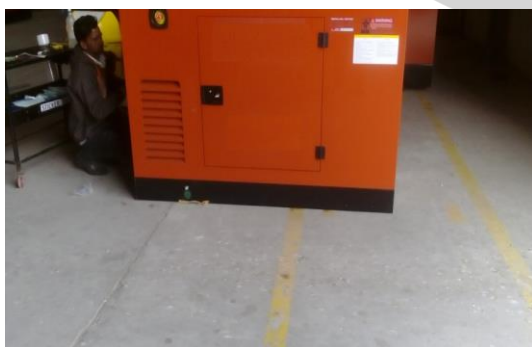


Figure 4: Genset in the Walking Path for the worker

During these observations it was noticed that mishandling of the equipment in the industry was done like: the excess waste of the metal sheet was lying on the walking path, the cylinders were not tied up with a chain for holding them at

one place in the store room, the wire and plugs were not maintained properly and last but not the least the fumes which were generated will the testing of the genset was very near to the main supply which was very dangerous.

V. SUGGESTIONS

Different suggestions which could be given after this inspection are:

1. Removing the equipment from the path assign for walking.
2. All the personal protective equipment and proper training should be provided to the worker to build their skills for the worker's safety.
3. Regular tools, machine and medical check-up for preventing before the accident.
4. Ensure you are not using the damaged or rejected PPEs and not working on faulty equipment, inform to the supervisor first if you find any problem.
5. Attend all the workshops and training where you will be aware of the types of hazards, risks, and their prevention plan deeply.
6. Maintaining a safe work environment and ensuring that health and safety regulations, legislation, policies and minimizing occupational risk in the workplace are followed.

VI. CONCLUSIONS

Electrical safety audits and brainstorming are effective tools for identifying and examining a comprehensive safety management program. The risk assessment can save life & property of the organization and reduce compensation cost and life-threatening. The proper training never removes the hazard but it develops confidence and improves the skills to face it and solve it. The philosophy of the industry is to remove the stress of the customer by providing the best quality manufactured in the state of the art plant.

There are certain rules and regulations formulated by the Bureau of Indian Standards (BIS) and some desired international standards codes which should be followed by the industries. The equipment should be maintained and checked-up regularly to prevent accidents. According to standards, if you use the desired equipment, that will reduce the power consumption and also prevents accidents. Therefore we should also focus on sustainable development. Apart from this, we should also focus on the waste management of rejected equipment and tools.

VII. ACKNOWLEDGMENT

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