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Analysis of Electrocution Hazards in Stringing of High Voltage Transmission Lines – A Review

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Abstract

In our country extra high voltage transmission line projects are executed with the help of manual and semi automated work. The serious hazards such as electrocution fall from heights which causes high fatal injuries. To avoid these hazards de-energized power lines can be used but since it involves huge losses which can be overcome by installation of spacer trolley. This review presents the reported work on the hazards due to electrocution and fall from height while performing the stringing work and the issues related to spacer trolley installation

Keywords: *Electrocution, Spacer trolley, Transmission line, Stringing*

Introduction

An overhead power line is a structure used in electric power transmission and distribution to transmit electrical energy along large distances. It consists of one or more conductors (commonly multiples of three) suspended by towers or poles. Since most of the insulation is provided by air, overhead power lines are generally the lowest-cost method of power transmission for large quantities of electric energy.

Towers for support of the lines are made of wood (as-grown or laminated), steel (either lattice structures or tubular poles), concrete, aluminum, and occasionally reinforced plastics. The bare wire conductors on the line are generally made of aluminum (either plain or reinforced with steel or composite materials such as carbon and glass fiber) though some copper wires are used in medium-voltage distribution and low-voltage connections to customer premises.

A major goal of overhead power line design is to maintain adequate clearance between energized conductors and the ground so as to prevent dangerous contact with the line, and to provide reliable support for the conductors, resilient to storms, ice load, earthquakes and other potential causes of damage. Today overhead lines are routinely operated at voltages exceeding 765,000 volts between conductors, with even higher voltages possible in some cases.

Every day four construction workers die on the job in USA. Think about construction fatalities and probably the first things that come to mind are accidents, or falls. Yet the second leading cause of worker deaths in construction is electrocution. Many workers are unaware of the potential electrical hazards in their work environment, making them more vulnerable to the danger of electrocution . Inorder to avoid these electrocution issues, while performing stringing operations we usually de energize our lines.

But de energizing the high voltage lines would result in huge losses and therefore to avoid this loss spacer trolleys are installed which provide a safe operating platform.

Electrocution Hazards

ManuelSuárez-Cebador et al. [1] did a analyzes the severity of work place accidents involving electricity in the Spanish construction sector comprising 2,776 accidents from2003 to 2008.The investigation considered the impact of 13 variables, classified into 5 categories: Personal, Business, Temporal, Material, and Spatial. The findings showed that electrical accidents are almost five times more likely to have serious consequences than the average accident in the sector and it also showed how the variables of age, occupation, company size, length of service, preventive measures, time of day, days of absence, physical activity, material agent, type of injury, body part injured, accident location, and type of location are related to the severity of the electrical accidents under consideration.

Sachil Kumar et al. [2] did a research death rates due to electrocution. Electrical burns are associated with significant morbidity and mortality, which are usually preventable with simple safety measures.An observational retrospective study of non-lightening electrocution deaths was conductedin Lucknow, India between 2008 and 2012. About 65 (78%) were males andthe rest were females. The upper extremity was the most frequently involved contact site in 51deaths (61%).Death rates from electrocution among all medico-legal deaths were found to be lower in this study than in previous reports, most of them were work-related and preventable. Workers and their employers should be educated to avoid such accidents with safety measures.

LiangTian et al. [3] research on the composite material of Al/Ca to improve strength and conductivity of conductors. Aluminum-conductor steel-reinforced (ACSR) . The uniform Ca Nano filaments lying parallel to the wire axis act as parallel conductive pathways should lead to the high conductivity of Al/Ca composite. Moreover, the excellent resistance to corrosion. The properties of Al–Ca composites should lead to a substantial reduction in construction cost, energy losscost and an increase in reliability and service life of the trans-mission line. A simple economic analysis was done to show how a low density, high strength, high conductivity conductor wouldreduce construction and energy loss cost.

Yunxiao Fan et al. [4] did a research on power transmission line construction accidents survey and analysis of accidents from 1961 to 2008 – 324 accidents occurred Workers involved in power transmission line construction and maintenance are exposed to high risk of electrocution and fall from height.

According to electrical safety foundation international 43% of electrocution due to contact with power lines from 1992 to 2008. 27% of electrocution due to Contact with other electrical components.17% of electrocution due to contact with machine, tool, equipment hazard condition unsafe act.

Alex Albert and Matthew R. Hallowell [5] did a Prior research has established that electrical contractors involved in the construction and maintenance of electrical transmission and distribution (T&D) lines are at extremely high risk of electrocution.

To reduce this disproportionate injury rate, electrical contractors implement many strategies

such as the use of rubber insulating equipment, and locking devices. Unfortunately, these strategies are often cost-prohibitive in certain construction and maintenance scenarios

The results indicate that many of the effective strategies implemented to reduce T&D electrical injuries are very costly (e.g., de-energizing lines). Consequently, under most conditions, the costs of injury prevention far outweigh the cost savings associated with the reduction of injury rates.The Bureau of Labor Statistics (2010a) estimated that among the 192 recorded electrocution fatalities in 2008, 53% involved T&D workers who contacted overhead power lines .The National Institute for Occupational Safety and Health 2009. 80% of fatalities among linemen have occurred due to direct contact with T&D power lines. Installing dampers to control vibrations in the cables that may be caused by winds. Using tools and equipment to install spacers to avoid contact power lines. Using hot sticks Use of insulated hot stick poles that allow workers to manipulate and move energized lines from a safe distance. Use of proper flash/thermal rated clothing. Use of flash/thermal protective equipment when working within the flash boundary distance.

James C. Cawley and P.E. Brett C. Brenner [6] did a analysis the occupational injuries between 2003 to 2009 ongoing effort to promote electrical safety in the workplace U.S. Bureau of Labor Statistics (BLS) Electrical injuries are classified into different categories 3100 - Contact with electric current, unspecified; 3110 - Contact with electric current of machines, tools, appliances, or light fixtures; 3120 - Contact with wiring, transformers, or other electrical components; 3130 Contact with overhead power lines; 3140 - Contact with underground, buried power lines; 3150 - Struck by lightning; and 3190 - Contact with electric current. Nearly 70% of power line contact resulted in death.

Witold Brostow et al. [7] A commercial epoxy diglycidylether of biphenyl-A (DGEBA) was modified by adding fluorinated poly (aryl ether ketone) fluoropolymer and in turn metal micro powders. When cured at 30 Dynamic friction and wear decrease significantly due to phase separation reaction being favored between the fluoropolymer and the epoxy.

Chia-Fen Chi, et al. [8] a detailed study and analysis of 255 electrical fatalities occurred in construction industry. Analysis of fatal falls, each electrical fatality was analyzed in terms of individual factors such as age, source of injury and cause of accidents Electrocution accidents were divided into five accident patterns: Direct contact with energized power line, Boomed vehicle contact with an energized power line, Conductive equipment with energized power line, Directly worker contact with energized equipment/improperly installed or damaged equipment/ failure to maintain safe distance or improper use of PPE's.

Umberto Cosmai [9] did a study on transmission line, may contain thousands of spacer and damper clamps and if just one of them get loose the relevant conductor will be seriously damaged. The looseness of a spacer clamp is very dangerous because normally the spacer remain in place and the sustained hammering between the loose clamp and the conductor insists on the same conductor zone leading to strand failure. The design of spacer and damper clamps shall carefully consider the installation procedure making it as easy as possible and univocal.

Pete Kines [10] study was to examine individual workers' cognitive, behavioral, and motivational processes leading up to occupational falls from heights. A greater number of workers carrying out no routine compared to routine tasks perceived, identified, interpreted, and attempted to control a fall hazard. Two cases are presented illustrating how cognition and behavior in context progresses from a lesser to a greater active role in the incident processes. t for treatment of injuries due to falls from heights.

Paraskevi E. Batra [11] did a study to investigate the situation in electric companies worldwide. A review of the scientific literature concerned with electric accidents is conducted. The aims of this review are to offer perspectives on the types and kinds of statistics available; the factors,presented in the literature, that have been regarded as influencing the occurring of electric accidents; the consequences of electric accidents; several methods proposed for analysis of electric accidents. An attempt is made to adopt a method combining both technical and medical aspects.

Robert D. Castro [12] did a study to outlines various procedures followed in the construction of transmission lines designed by Los Angeles Department of Water and Power (LADWP). The transmission line network designed or constructed by LADWP spans about 3500 circuit miles with voltages ranging from 115 kV AC to 1000 kV DC. Since most lines constructed by LADWP in recent years have been extra-high-voltage AC, this paper emphasizes the construction of 500 kV AC transmission lines built in the southwest United States. The paper presents some concepts and empirically developed practices that have proven successful over many years of transmission line construction by LADWP.

Spacer Trolley

Wilford caulkins et al.[13] said that the purpose is to give an general overview of what is necessary in the planning and execution of the construction of a typical overhead transmission line. The significance is to give a newcomer to the trade a general format to follow and to familiarize the transmission design engineer to further his understanding of how this line, that he is preparing to design.

Discussions and Conclusions

In our country extra high voltage transmission line projects are executed with the help of manual and semi-automated work. Presence of serious hazards such as electrocution and fall from heights causes high fatal injuries.

These hazards can be minimized by de-energized power lines but since it involves huge losses, installation of spacer trolley is preferred.

There is scope of improvising this by installing glass fiber epoxy composite spacer trolley for reduction of costs and for improving the durability.

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