Accident Prevention in Electrical Installations at Construction Sites in Manaus - Amazonas

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Abstract

Electricity brings great benefits to the population, but when misused can pose a great danger especially with regard to safety.Safety is risk fre.Despite several safety standards and standards in place to ensure safety in work involving electricity, there are still many accidents that range from minor injuries to fatalities.The present work aims to propose preventive measures for the risks existing in building electrical installations, in order to guarantee the safety and health of workers who perform activities and services of electrical installations, by explaining the origin of the causes of accidents in buildings. electrical installations, workers' awareness of the importance of safety and the main risks in electrical services. Subsequent to this, preventive and corrective measures will be suggested to reduce work accidents in building electrical installations. In the development of this study, a direct observation field research was carried out in three construction sites of Manaus City, where relevant aspects related to work safety were observed, with works involving electricity.In partnership with the field research, bibliographical researches were carried out in order to strengthen the data collected in the sites of the researched works.According to the bibliographic survey and direct observation field research, the main consequences of not complying with the recommendations prescribed in NR1O and NBR 5410 are accidents and occupational diseases.Accidents are caused by unsafe acts and unsafe condition.The importance of DDS (Safety Dialogue) was pointed out to show the importance of equipment to workers, the percentage of personal protective equipment used at construction sites and the reasons that lead workers not to use PPE, among others. Through the lecture, it was possible to clarify to workers about the importance of using preventive measures so that they change their attitudes and there is a transformation and behavioral changes on

safety measures.Therefore, although companies have accident prevention measures, it is confirmed that the maximum of protective measures has their flaws. There is no work environment completely free of hazards and risks. Risks will always exist, even if in minimal proportions. Most workers have positive conceptions of improvements and benefits from the prevention of accidents in electricity.

Keywords: security measures; electricity; construction sites;

1. Introduction

The importance of electricity is so great that its absence can cause disruption to society, from small homes to large companies. Electricity work has been done for over a century. Over time, the way to accomplish it has undergone modifications to make it agile and safe.

Security is a risk waiver. Despite several existing safety standards and parameters to ensure safety in work involving electricity, there are still many accidents that cause from minor injuries to fatal victims. Electricity brings great benefits to the population, but when poorly employed can bring a great danger, and may cause various types of injuries: mild, medium and severe can cause even the death of people if the necessary care is not taken. Therefore, to prevent accidents, every electrical installation must be performed and maintained safely by a qualified professional and in the supervision of a legally authorised professional [1]. Every year, there are several hundred injured or dead workers due to the contact with energized conductors [2].

The reduction of accident rates involving services with electricity and improvement of the safety methods of the existing BT (low voltage) electrical installations, before repairs and renovations, disconnect the general key. For activities involving electricity in BT, two standards are consulted: ABNT NBR 5410 (low voltage electrical installations) and NR 10 (electricity services).

The objective of this work is to propose preventive measures for the risks existing in electrical installations in order to ensure the safety and health of workers working in electrical installations activities and services, through Explanation of the origin of the causes of accidents in electrical installations, awareness of workers about the importance of safety and the main risks existing in services with electricity. After that, preventive and corrective measures will be suggested to reduce occupational accidents in electrical installations.

2. Theoretical framework

2.1 Electrical installations

Electrical installations are the structures that deal with the transport of electricity from a generating source, its transformation and its use points [3]. Predictive electrical installations must be made by qualified professionals with experience in the type of service to be provided, because any error or slip can culminate in problems with accidents and even fires. [3].

2.2 Brazilian Association of Technical Standards

ABNT - Brazilian Association of Technical Standards - is the body responsible for technical standardization in Brazil. Brazilian Standards, providing inputs to Brazilian technological development. It is a private, non-profit and public utility entity founded in 1940.

2.2.1 NBR 5410:2004 – LowvoltageElectricalInstallations

In the 1.1 paragraph of NBR 5410:2004, it is said that this standard lays down the specific requirements for electrical installations at public influent sites in order to ensure their proper functioning, the safety of persons and domestic animals and the conservation of goods [4]. Low voltage electrical installations are regulated by ABNT standard NBR-5410.

2.2.2 NR 10 Regulatory norm 10

The regulatory norm N ° 10 is a standard of the Ministry of Labor and Employment that establishes the control measures, preventive systems, techniques and practices of services related to services performed in electrical installations and services with Electricity. [5].

The NR-10/2008 is supported and supported by some NRs such as: NR 6 (PPE-Personal protection equipment), NR9 (PPRA-Environmental Risk Prevention Program), NR 17 (ergonomics), NR23 (Fire protection), NR 26 (Safety signs) and NR 33 (safety and health in confined spaces) [6].

2.3 Main Electricity Risks

2.3.1 The Eletric Shock

Electric shock is the disturbance, of various nature and effects, manifested in the human or animal organism when it is traversed by an electric current [7]. The electric shock occurs when the body of a person allows the passage of electric current between two conductors energized from an electrical circuit orinterumconductorenergizedandumperfícieobjectomisobject.Istoé, when there is the difference of potential between one part of the body and another, the electric current will flow and with it arises the phenomenon of electric shock [8].

In most cases of accidents evolving electricity, the victims present burns, because the electric current reaches the body through the cutaneous coating. Due to the high resistance of the skin, the passage of the electric current produces structural alterations in the organism [9].

Accidents occur from the execution of unsafe acts or the existence of unsafe conditions, constituting these, the determinant causes in the occurrence of risks. For this, it is necessary to identify and evaluate the risks, through the techniques of risk analysis, evaluating all stages and elements of the work, rationalizing and developing sequences of operations.

2.3.2 Causesofelectricshock

Several factors considerably increase the chance of an electric shock, such as: the Wear of materials and equipment in the old electrical installations, lack of periodic maintenance and adequate in electrical installations; Inadequate implementation of electrical installations; Use of low-quality electrical materials; Development of electrical projects in an inadequate way without contemplating safety and quality required by the relevant technical standards, etc. [10].

2.4Electrical Risk control measures

The control measures can be interpreted as a set of strategic preventive actions in order to reduce or eliminate the risks, or still keep under control the possible undesirable events. The new NR-10 requires the control of electric risk, through preventive measures duly planned before its implantation in companies that perform interventions in electrical installations, or in its vicinity [11]. Despite the control measures covering the collective protection systems, the collective protection measures and the individual protection measures, the latter should always be adopted mainly when the adoption of the previous measures is not possible.

Also, during the realization of the work with electricity should be adopted appropriate safety signage, in the vicinity of the workplace aimed at the warning and identification of the type of work, as well as the responsible for the services. [7].

The main measure of protection for the worker is the use of PPE, and PPE means the equipment or devices of individual use and that possess CA (certificate of Approval) and CRF (Certificate of registration of the manufacturer), issued by the MTE (Ministry of Work and employment).

NR-10 refers to NR-6 the regulatory responsibility that specifically deals with PPE, thus maintaining its ethical integrity. With this it is up to the MTE to update and change the NR-6, so that it contemplates other EPIs inherent to the electrical hazards, according to the NR-10 [7].

2.5 Accident Preventions

Accident prevention should begin at the stage of the elaboration of an electrical project of any installation, through maintenance and use. Some measures to avoid or minimize accidents are: the proper sizing of the components, the use of insulation and electrical separation, the use of circuit protection devices, the use of grounding in the installations and detection devices Of leakage currents, the installation of lightning bolts and, also, appropriate operational procedures and defensive behaviors before the imminence or in the face of an electrical accident [12].

3. Methodology

This study is based on the methodology of direct observation field study. The phases of field research require, firstly, the realization of a bibliographic research on the topic prevention of accidents in electrical installations in construction sites of the city of Manaus. As for the methods employed, the research is classified as: bibliographic research, from sources based on materials published in books, published articles, dissertations and theses, legislation, which describe the safety and prevention of accidents in Electrical installations of BT (low voltage). It is documentary because they use documents considered normative, which are the NRs and ABNT NBR 5410 [13].

The research is classified as a descriptive research, since they study and describe preventive protection measures, the consequences of not observing the procedures and recommendations described in the NRs, NR10, NR 06, NR9, NR17, NR23, NR26, NR33, and ABNT NBR 5410, which indicates the most appropriate procedures for a low-voltage building electrical installation.

3.1 Study Area

The object of study of this research will be 3 construction sites, where one corresponds to building a commercial building of 4,638 m2 of area and two galleries of 2.520 m2 of area each, with a total of 200 people working in the places, where they are being held Activities related to civil engineering and electrical engineering.

The first stage of the research is to conduct a survey of information about electrical accidents in the workplace, i.e., construction site. The information obtained will allow the knowledge about the main risk situations of electrical accidents which employees are exposed, such as: Fall, electric shock, arc, confinements, magnetic field accidents, induction Electrical installations.

After the survey of information relevant to the risks caused by electrical accidents, it will be possible to present the appropriate procedures for the protection/prevention of these accidents.

Field visits will allow to identify the main consequences of non-compliance with the recommendations prescribed in the NRs cited at work and NBR 5410.

A lecture will be made on accident prevention in electrical installations to raise awareness of the preventive measures established by the NR10, NR6, NR9, NR17, NR23, NR26, NR33 that aim to prevent accidents and the life of Employees. Awareness of the importance of following the standards required for services with electricity.

4. Analysis and discussion of results

According to the bibliographical survey and direct Observation field research, the main consequences of not complying with the recommendations prescribed in NR1O and ABNT NBR 5410 are accidents and occupational diseases. Accidents are caused by unsafe acts and unsafe conditions. Therefore, the most appropriate procedures for a residential electrical installation were found.

In the works, it was found that the main unsafe acts of workers are: resistance to the use of some Ppe such as helmets, seat belts and gloves; False steps when climbing the scaffold, disobedience in the correct handling of tools, uses of the famous "technical adjustments", self-confidence, inappropriate postures, misfortunes and lack of attention. As for unsafe conditions, the main are: not providing PPE, inadequate tools and lack of training. In one of these works, training, lectures, provision of Ppe (personal protective equipment), tools in good conditions of use, requirement of the use of PPE, use of signaling in a correct way, among other conditions provided. However, in other works, some of these measures are absent. Such absent measures are: training, lectures and use of signalling properly.

The practice of unsafe acts or the existence of unsafe conditions in electricity services are responsible for the main accidents that occur, since the activity is conducive to dangerous situations. The activities performed in electrical installations expose the worker to the risks arising from the principle of electricity operation, mainly because such risks can be detected through a visual inspection, since they do not present Smell, color, noise or visible movements, that is, they do not provide easily detectable warnings [5]. The concern with the high numbers of accidents with electricity, caused mostly by ignorance of people or even by recklessness of professionals, was the great motivator for the creation of the Brazilian Association of Awareness for the Dangers of electricity. – ABRACOPEL, since unsafe acts can be conscious and

unconscious.

Based on direct observation, it was found that although many workers perform activities related directly to electricity, not everyone knows the recommendations described in NBR 5410 and NR 10, as shown in Figure 1.

Figure 1 – Knowledge of the workers of NBR 5410 and NR 10.

Although 90% of the workers know the norms described above, there are a total of 10% who are unaware. This quantitative is relevant for occupational safety and risk management, since they are exposed to hazards and risks of activity due to lack of knowledge, training, lectures or for being persons of foreign nationality. The probability of occurrence of accidents with collaborators with this profile is very expressive, because the behavioral deviations emitted by them in the accomplishment of the work configures an unconscious act and because it has this characteristic, can be practiced several During the execution of an activity, which compromises security and makes it critical. Once a fortuitous event occurs, it is not only the employee who suffers physical damage, the material and financial losses that will be suffered by both the employer and the employee. Of a total of 200 employees, this percentage corresponds to 20 workers who do not know the recommendations of the norms.

Based on a survey carried out in the three construction sites, it is possible to observe the occurrence of some accidents more frequently, as shown in Figure 2.

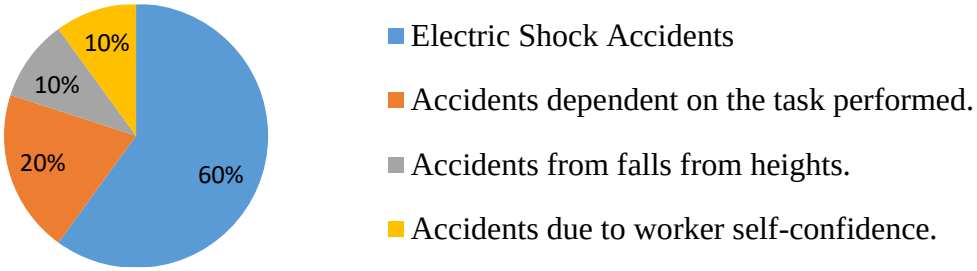

Figure 2 – Main accidents occurring with electricity.

As shown in Figure 2, it is observed that the most frequent accidents in construction sites are electric shocks with 60%, followed by 20% of accidents that depend on the activity performed as accidents due to stumps in materials, inadequate postures and slides in Activities in which there is the transport of materials and accidents caused by falls of objects on the collaborator in works involving the loosening of the upper parts of the construction work; 10% for jobs in heights and 10% by employee self-confidence. When comparing these data with Abracopel's 2018 data, it is observed that in Brazil the electric shock leads to the indices of

accidents with electricity, followed by other accidents not located in this study.

According to Abracopel's 2018 data, events with electric shock lead to the ranking of electrical accidents in the country, with 836 records, followed by overload fires, with 537 occurrences and accidents caused by atmospheric discharges, which totaled 51 episodes. These numbers add up to fatal, non-fatal cases. The most common causes attributed to accidents are the technical adjustments (popularly known as Gambiarras), the old electrical installations, the lack of maintenance and the use of the same socket to connect several equipments at the same time [2].

In the north, there was an evolution of accidents with electric shock electricity, where the number of deaths by electric shock between the years 2013 to 2018 increased according to data obtained by the Abracopel Yearbook in 2019 [2].

In 2018, Abracopel reported the occurrence of several electric shock deaths in the northern region. There were 68 cases of accidents, and the state of Pará was where the greatest number of accidents occurred with 21 fatal cases; The state of Amazonas and Rondônia had 11 cases; Tocantins 9 cases; Acre and Amapá with 7 cases and Roraima with 2 cases, with the smallest number of accidents [2].

In 2018, the numbers of accidents with electric shock involving electrician or autonomous technician were recorded 85 cases being 57 fatal. This number is reduced when compared with professional electricians who work in companies, because for these professionals to be hired is indispensable basic course of electrical installations, NR10, NR35, SEP among other courses with at least 40 hours, Qualification and professional habilitation. Companies provide Ppe for professionals to exercise their profession using all possible security measures. These safety measures are reflected in the non-occurrence of accidents with professional electrician in companies [2].

According to researches obtained through Abracopel, it was possible to realize that in the years of 2014 and 2017 the number of accidents of electrical origin and electric shocks had a significant increase, where there were 627 fatal accidents in Brazil. In 2015, it was the year that there was a slight drop in the accident index [2].

In the researches made with data obtained from Abracopel, it is possible to observe that there was an increase in ascending scale in the number of accidents of electrical origin since the year of 2013, when the research began. From 2013 to 2018, the following quantitative quantities were recorded: 2013 – 1038 cases, 2014 – 1223 cases, 2015 – 1248 cases, 2016 – 1319 cases, 2017 – 1387 cases and 2018 – 1424 cases. The recorded increases were as follows: 2013A 2014-185 cases, 2014 to 2015-25 cases, 2015 to 2016-71 cases, 2016 to 2017-68 cases and 2017 to 2018-37 cases. The highest and lowest indices recorded were 2013 to 2014, respectively, with 185 cases and 2014 to 2015 with 25 cases.

In the works under study, it was observed that companies provide PPE to all its employees, thus obeying item 6.3 of NR 6 on the obligation of the employer regarding its supply. The most commonly used EPIs are described in Figure 8.

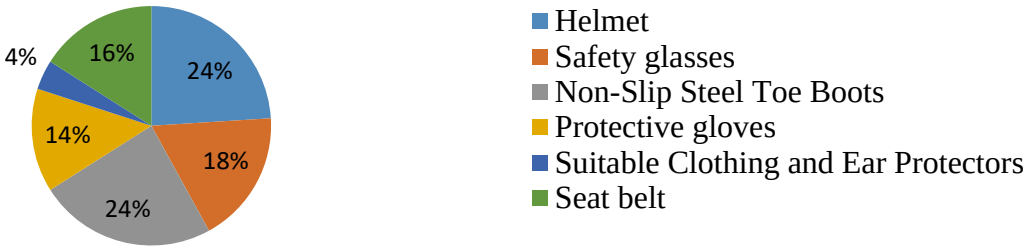

Figure 3 – Use of personal protective equipment

Although the company provides the appropriate protections equipment for the activities, the worker does not always use. As shown in Figure 3, the most useful equipment is the helmet and the toe-cap of non-slip steel. In the works, it was found that the other EPIs are less used in relation to these two. Some EPIs are used only in specific situations such as the seat belt. As for the garments, very few collaborators were seen wearing costumes considered EPIS by NR 06. Most workers used their own clothes to perform activities. Moreover, it was found the main reasons why workers do not like to make use of personal protective equipment. These reports are described in Figure 9. Among the reports described, it is verified that although companies provide PPE, there are workers who do not use the device, because they claim absence of this.

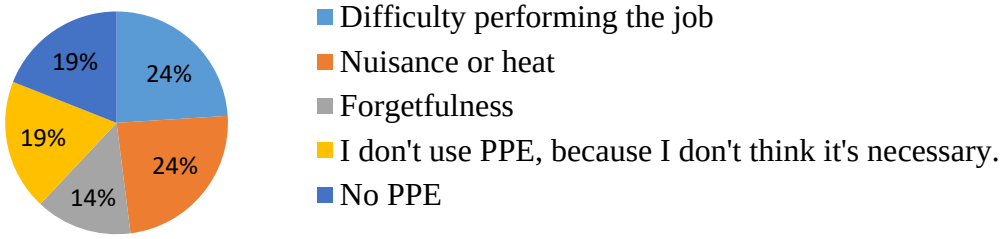

Figure 4 – Use of personal protective equipment in the works.

Data referring to Figure 4 were obtained in situations where the worker was questioned to use the Ppe provided to them. Complaints and non-use of PPE is frequent in construction sites. Based on this, it is important to supervise the work to assess the measures of securities being used.

From the data exposed in this context, observations were made to understand the profile of workers in the environment where they perform their work, so as to distinguish factors that contribute directly and indirectly to accidents. It is believed that by making the RPA, (Accident prevention meeting), with the workers of a work, through the lecture, the data of accidents were shown along with the NRs that deal with the safety standards, showing the common situations that provoked the Accidents with electricity. The dangers and risks arise from acts of choice of persons or, groups of people who often make decisions, without the proper possession of sufficient information regarding the potential consequences of certain actions.

In activities involving electricity, it is important to perform the DDS (daily safety dialogue), because the goal of DDS is to raise awareness about safety practices and to guide the correct practices, since the lack of Knowledge is still one of the main factors for the occurrence of occupational accidents. In the

construction sites in study, the DDS was performed every day.

Through the lecture, it was possible to clarify to the workers the importance of using preventive measures so that they change their attitudes and there is a transformation and behavioral changes on the necessary security measures to They develop their activities with the utmost security possible.

The power of hierarchy and the leadership exercised by a supervisor is of great importance. Leadership exerts great influence on the capacity of transformation, the imposition of habits and behaviors of workers. The guardians who require the electricians and their auxiliary habits and behaviors that seek the organization and actions to prevent accidents in the work [14].

For preventive and corrective measures, the safety engineering of the work states that when preventing hazards and risks, these must be controlled at the source, in the trajectory and last that is done in the worker. In order to meet this, in the construction sites, the use of EPCs (collective protection equipment) and PPE is verified. EPCs are used to prevent all people who develop some activity in the work. The most used are: signalling, scaffolding, ladders, first aid kit, lighting, protection barriers against luminosity, protection of the moving parts of machines, among others. The EPIs serve to protect only the individual. Figure 3 describes the main EPIs used in the construction sites under study. In construction sites, according to the risk it is not always possible to prevent at the source, since the site does not allow this or because the investment to treat risks at the source is more expensive than the value of the work.

5. Conclusion

Given the above, it confirms the importance of security when performing any activity, whether it is the electrical sector or any other. The electrical activity sector is one of the sectors with high hazard level.Hence the need to increasingly improve security measures.The prevention of accidents in low voltage electrical installations has to happen in a serious way and with the commitment and collaboration of all, so that we can preserve the life and integrity of all.

Workers should increasingly have the preventive notion through the correct use of equipment, procedures and safety standards. Companies in turn, besides having a preventive notion, also use the corrective notions. Preventive notions are to prevent an accident or incident. Corrective notions are to correct some erroneous safety procedure or measure.

It is also noted that these companies have measures to prevent accidents. However, to manage accident, always the maximum of protective measures has its flaws. There is no work environment entirely free from hazards and risks. Always the risks will exist, even if it is in minimal proportions. Most workers have positive conceptions of improvements and benefits of prevention.

Therefore, the awareness and sensitivity of all is the way to draw a working environment with the least possible accidents and productive, thus guaranteeing benefits for both the worker and the company.

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