Study of the implementation of SPDA (Atmospheric Discharge Protection System) in a school in Manaus city – AM

Gabriel Matos dos Santos
gabrielmatos.santos@hotmail.com
Centro Universitário FAMETRO – Manaus, Amazonas – Brasil

Abstract

Brazil is a country with high incidences of atmospheric discharges and during the year, several people are killed by these discharges. The main known discharge protection measure is the SPDA (Atmospheric Discharge Protection System). In this sense, this work proposes to present the measurements of SPDA (atmospheric Discharge Protection System) in a school located in the city of Manaus and its role for local security, by measuring the variables of an SPDA system, demonstration of the technical conditions of the SPDA and arguments that point out the relevance of the correct procedure for the realization of this process and importance of spda. For this, bibliographic research and on-site field study of the entire spda installation process was carried out in the buildings, multi-sport court and school water box. According to the studies conducted, it was observed that as measurements of ohmic resistances measured were low, very close to 0 ohms. The stress measures were collected, which were also low. The installed SPDA went to the Cage of Faraday and Franklin. For the school under study, the implanted SPDA obeyed all the standards that regulate it. The college is an environment frequented by many people of different age groups, the installation of SPDA implanted and sized ensures the protection of heritage, as well as safety and protection to life, because in case of an atmospheric discharge, there is a system who will receive it and lead it there is a path designed for it. If there were no, the building would be fully exposed to this risk and so would people. Therefore, even if SPDA does not guarantee absolute protection, the protection range it meets is representative, thus ensuring in a certain way the safety of people and protection of building and people. It was also found that the maintenance of the SPDA should be done annually from the start date of the technical report, to ensure the effectiveness of the system.

Keywords: atmospheric discharges, electric grounding, spda;

1. Introduction

Brazil is a country with high incidences of atmospheric discharges and during the year, several people are killed by these discharges [1]. To ensure the protection of certain types of buildings considered conducive to this risk, ABNT (Brazilian Association of Technical Standards) created ABNT NBR 5419 – Protection Against Atmospheric Discharges, which explains the protection parameters against these phenomena [2]. The main known protection measure is the SPDA (Atmospheric Discharge Protection System). In addition to ABNT NBR 5419, ABNT NBR 5410 (Low Voltage Electrical Installations) and NR 10 (Electricity Safety) also regulate on the importance of grounding, which is a mechanism used in SPDA to dissipate the electrical current captured by the electricity system capture [3.4].

The SPDA has methods that are used to protect buildings and comprises steps ranging from the capture subsystem, subsystem of descent to the grounding subsystem.

In the building under study, two methods of protection of the SPDA were used, which were considered more appropriate for the building due to some aspects that will be explained later. For the design and installation of SPDA, there are several items that must be taken into account. These items include: degree of risk of building, soil, area and height of the building, among others.

The choice of the appropriate type of captor is important in an SPDA project, since they are the ones who capture atmospheric discharges, as well as descents also play a fundamental role in transporting these discharges to the ground.

In view of this, this work aims to present the measurements of SPDA (Atmospheric Discharge Protection System) in a school located in the city of Manaus and its role for local security. The steps of description of the steps for measuring SPDA variables; demonstration of the technical conditions of the SPDA and arguments that point out the relevance of the correct procedure for the realization of this process and importance of SPDA (Atmospheric Discharge Protection system) for the school will be essential for the realization of this study.

2. Theoretical Framework

2.2 The installation of SPDA

SPDA - Protection system against atmospheric discharges, these systems serve to protect buildings, antennas, industrial facilities, tanks, pipes and people against atmospheric discharges and their effects. Atmospheric discharge protection systems (SPDA) are composed of devices installed at the highest points of installations and structures, they provide a path to land offering the lowest possible electrical resistance to this way, offer a path to current created by atmospheric discharge flow toward the ground, without damaging equipment or structures, in addition to protecting people within the facility [5].

2.2.1 Electric grounding

Electrical grounding is the safest means of intervention in the electric current to protect and ensure the proper functioning of the electrical installation, in addition to meeting the requirements of the standards for electrical installations [6]. The grounding of a building electrical installation and the connection of a phase conductor or a ground neutral conductor aims to reduce ground stress within the limits set by the standards[6]. Every electrical installation should have the appropriate grounding system according to each project to be performed, thus all electrical equipment and metal parts must be connected to the grounding mesh [7]. Grounding allows a control of the stresses developed in the ground (pitch, touch and transferred) when a phase-ground short circuit returns by the ground to the nearby source or when an atmospheric discharge occurs at the site [8].

2.2.3 Brazilian Association of Technical Standards

According to ABNT NBR 5410-2008, electrical grounding consists of placing the facilities and equipment at the same potential, so that the potential difference between the land and the equipment is as small as possible [3]. The earth is the connector with a potential difference equal to zero, the difference between it and the neutral is that it does not change its value by means of pollution so on the contrary, through the earth these dirtes are eliminated, which does not allow power leaks to stay on the surface electrical appliances. These dirtis misthers are eliminated to land, hence the name [3].

The protection system against atmospheric discharges-SPDA aims to protect structures, equipment and individuals from atmospheric discharges, in addition to reducing their effects. NBR 5419-2015 recognizes three methods for protecting atmospheric discharges: Electrogeometric Model, Franklin method and faraday cage method [2].

2.2.4 Methods of Air Discharge Protection System

2.2.4.1. Franklin Method

This method was conceived by the discovery of scientist Benjamin Franklin. This method uses a raised rod above the structure to which it wants to protect, thus minimizing the distance and thus to the dielectric rigidity of the air between the supply of electrical discharge (charged clouds) and soil [7].

2.2.4.2. Faraday cage method

This method consists of covering the building as a metal cage where everything on the inside of the cage is not exposed to atmospheric discharge, the radius hits the chord and descends through the cables of the subsystem of descents and is discharged into the ground, but for this system to work the grid has to be very well grounded [7].

2.2.4.3 Method rolling spheres

This method consists of rotating a fictitious sphere, with radius determined by the norm, in all directions and directions on the top and facades of the building [7].

2.2.5. Ground resistance measurements

The grounding resistance meter is constructed in the form of a two-core broken pliers with dimensions to engage the drivers of the grounding system. [6].

3. Methodology

The methodology used for the construction of this article is based on field survey and study, since data collection is done on site and then analyze so [9] and bibliographic research, which is effective trying to solve a problem or acquire knowledge from the predominant use of graphic, sound and computerized material information [10].

The area under study consists of a private elementary and high school, located in the Cachoeirinha neighborhood in the city of Manaus, in the state of Amazonas. The establishment is attended by more than 2000 students. Its degree of risk is 2, described according to Chart 1 of NR 04 - Specialized Services in Safety Engineering and Occupational Medicine [11].

To perform the school's SPDA (Atmospheric Discharge Protection System) system, it was necessary to analyze some aspects of the environment such as verifying the activity that works in the environment, measuring the height and area of the building under study for the elaboration of the SPDA project of the building, if the soil has space to carry out a grounding system and the type of roof. In the installation phase of the SPDA project, it was necessary to measure the pH (hydrogenonic potential) of the soil, make the pits and insert the covered rods 5/8" x 2.4 meters in the soil to make the grounding system, installation of PVC boxes and installation of SPDA methods.

For installation of the Faraday cage method, the insulator supports were first implanted, then the 50 mm² nude copper cable was launched, closing the Faraday cage. With the mesh system ready, the subsystem of descent was made, which were fixed the insulating brackets, then 1" PCV tubes were connected.

For the installation of the Franklin type captor method, a 6 m high mast was implanted, then simple guide clamps were placed to attach to the top of the water box, PVC electroduate pipe to support the 50 mm² nu copper cable for the two Descents. At the top of the mast, a Franklin captor was fixed four-pointed and 30 cm tall.

For measurements of the omnimic resistances and tension, we used Digital Terrometer Model Minipa MTR 1520D Calibration AM06523/17, resistance ranges:0-20 ohms;0-200 ohms.0/2000 and tensã:0-200 VCA scale as described in figure 01.

Figura 01 – Terrometer Minipa MTR 1520D.

With the termeter, measurements of resistance and tension of the building were measured in the inspection boxes. Nine descents from the descentsubsystems were made in buildings 1 and 2. Six descents were made on the multi-sport court. Two descents were made in the water box.

The soil resistance measurement with the termeter was made from the displacement of point A to point B 20 m away, from point B to point C, the electrode had a distance of 15 meters, from point C to the termeter was detected a distance of 5 meters s. The electrode was implanted at a depth of 1500 mm, according to figure 02 [12].

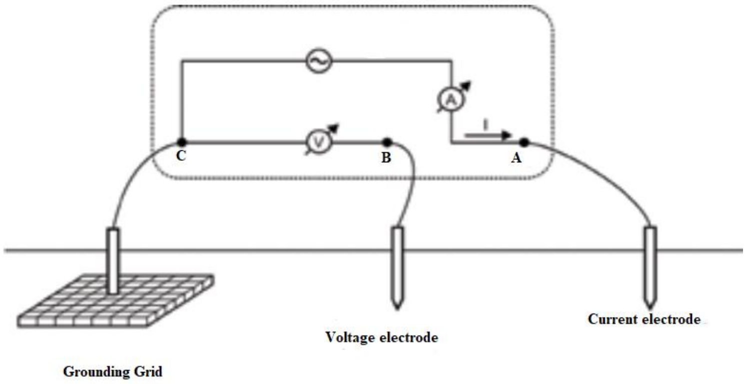

Figure 02 - Groundmeasurement.

The technical conditions of the site SPDA will be described in the results. The steps of arguing the relevance of the correct procedure of the SPDA and its importance to the school under study were achieved through knowledge derived from the direct observation of the process in partnership with bibliographic research on the subject.

4. Analysis and Discussion of Results

According to the study conducted in locus for the installation of SPDA, the school has classrooms, library, multi-sports court, cafeteria, bathrooms, water box system and secretariat. The school consists of two buildings and a multi-sport court. In building 1, the high school works and in building 2, works the school of early childhood education, library, food court and secretariat. The building has 2,680m² of built area being, distributed as follows: building 1 is 40 m wide and 15 m long, totaling an area of 600 m2 and 13 m high. Building 2 measures: 17 m wide and 40 m long, resulting in an area of 680 m2 and 13 m high. The multi-sport court has measures 35 m x 40, with an area of 1400 m^2 and 15 meters high. The water box has a circumference of 4x4x6 with 20 meters high. Meeting the requirement of the Fireman's Body, a building with height above 15 meters vertically and area above 700 m^2 horizontal, is necessary for the installation of spda. When analyzing the building as a whole, it is observed that its area and height exceed these reference values, then it was necessary to install the SPDA.

After the analysis in square meters, it was identified that the soil presented the spacing necessary for the realization of the grounding with the triangle method.

In the installation phase of the project, after soil analysis, it was stated that it is of mixed type: sandy clay, with the following pH (hydrogenionic potential): the soil present near school building 1 is alkaline type and the other part the soil was confirmed to be acidic , which represents a soil to some point ideal for the implementation of the spda grounding, because for soils with these levels of pH the conductivity of the soil is good.

In the implantation of copperweld rods in 5/8" x 2.40 m copper welded steel, the cavas made were 25cm in diameter by 60 cm deep and for the cordoalha, the excavation was 25 cm wide by 50cm deep; at the connection points, the installed PCV boxes were 30 cm in diameter and 40 cm deep with galvanized iron slap. The grounding was made with the triangle method.

As for the roof, it was identified that the tiles of building 1 and 2 are of galvalume aluminum type with 5 mm2 thickness. With this thickness, faraday cage method is necessary. On the other hand, the roof of the multi-sport court is zinc, 8 mm² thick serving as a captor. The SPDA methods installed were Faraday and Franklin cage methods. Faraday's cage method was used for the entire building of the buildings where the school operates, the multi-sport court used the roof as a captor. In the structure of the water box, the Franklin captor was used, because its height is greater than 15 meters vertically the circumference of the 4x4x6 water box, making it easy to place a mast to attach the lightning rod, obeying the requirement of the body's standards of Firemen.

The results of measurements of omnimic resistances performed in the grounding of each descent of the school are represented in figure 03. Ninety values were obtained for resistance measurements, because since the school building has 9 descent systems, measurements were carried out in the grounding of each. These results are expressed by R1P, R2P, R3P, R4P, R5P, R6P, R7P, R8P and R9P.

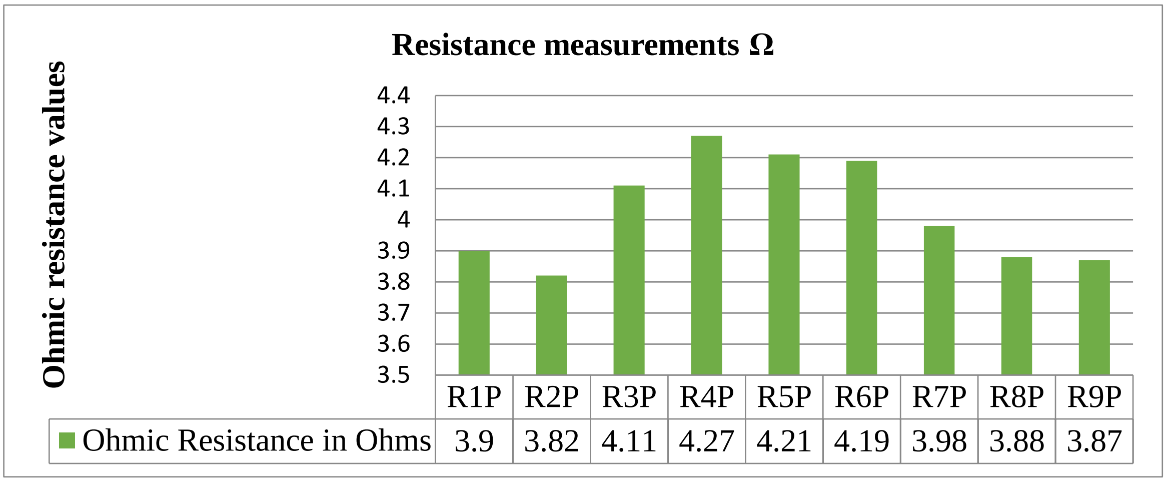

Figure 03 – Values of Omnimic Resistances of the grounding of building 1 and 2.

To perform the voltage measurement in V (Volts), where a voltage level up to 200 V was played, this voltage is discharged to the ground, the leakage of ground stress always vary between 0.00 and 0.12V, as shown in figure 04 carried out in building 1 and 2.

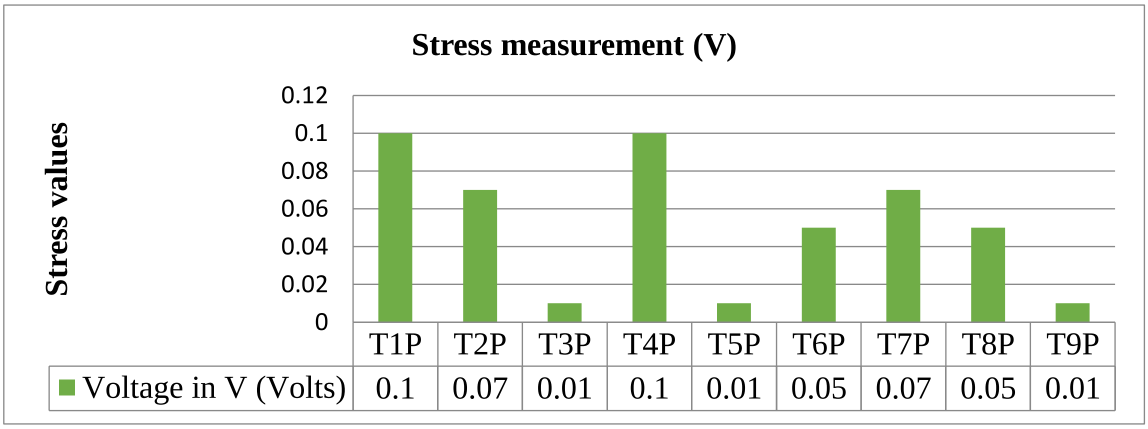

Figure 04 - Stress Values in building grounding 1 and 2.

It is observed that the values measured are very low, which configures a good SPDA system, because NBR 5410:2008 states that the lower the values of thethic resistance, the more effective the protection system.

This applies to situations of electrical grounding, substation grounding and SPDA [3]. For the court, the values for resistances and stresses are described in figures 05 and 06, respectively:

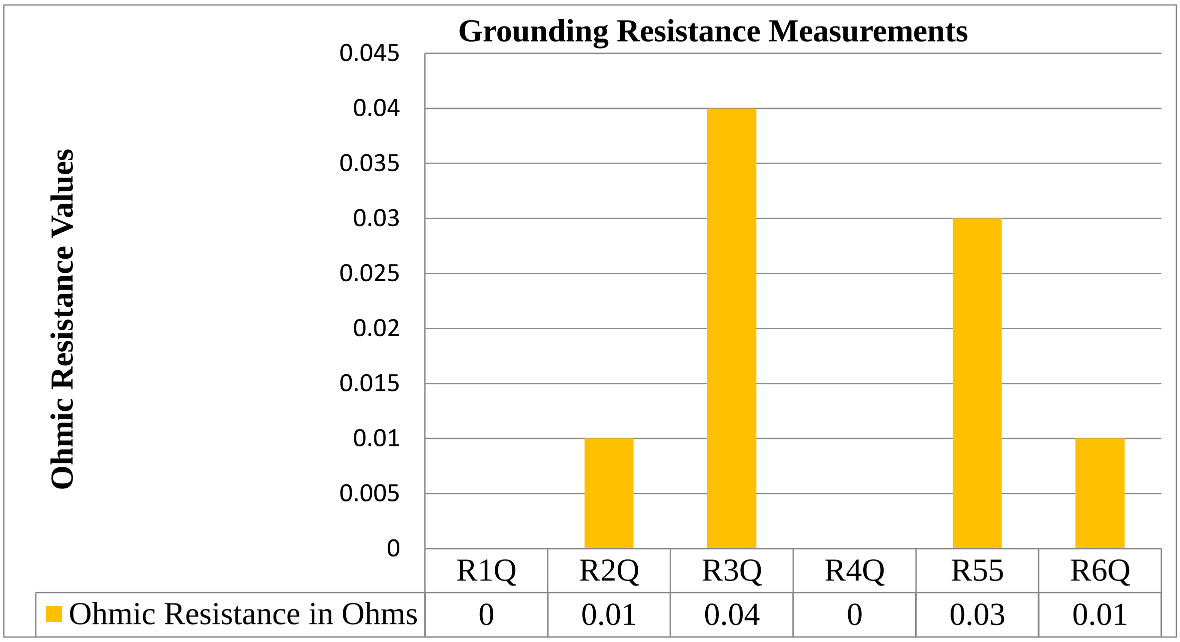

Figure 05 – Values of Omnimic Resistances of the grounding of the multi-sport court.

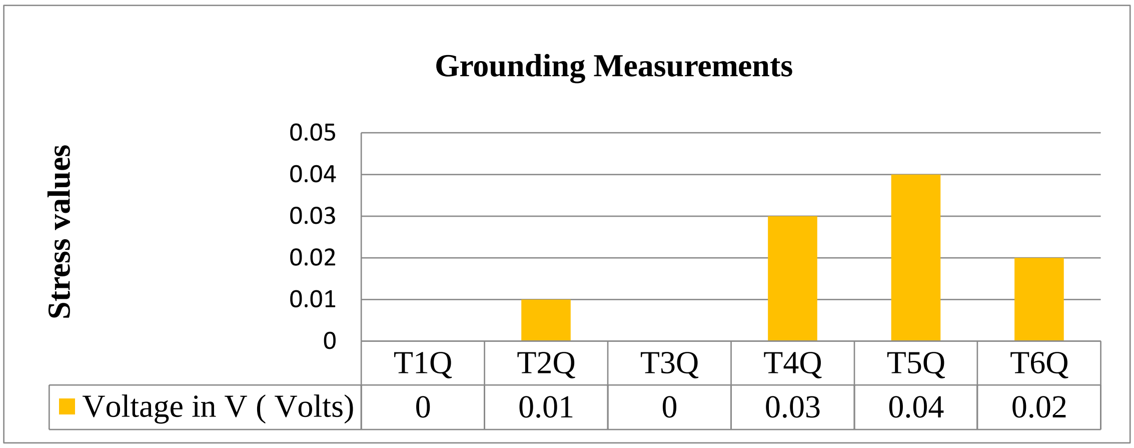

Figure 06 - Stress Values of the grounding of the multi-sport court.

The results show homogeneity and, consequently, electrical equipotentialization existing in the grounding mesh. The small variations are likely to stem from the various references adopted by the measuring instrument.

For measurements of omnimic resistance and tension in the water box, the following results were collected that illustrated by figures 07 and 08.

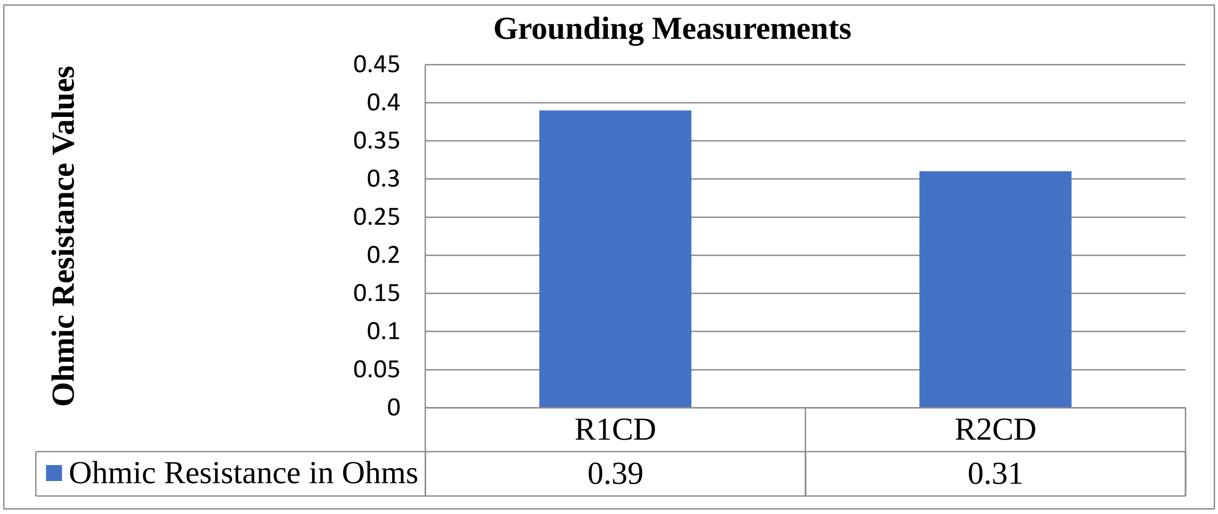

Figure 07 – Values of Ohmic Resistances of waterbox grounding.

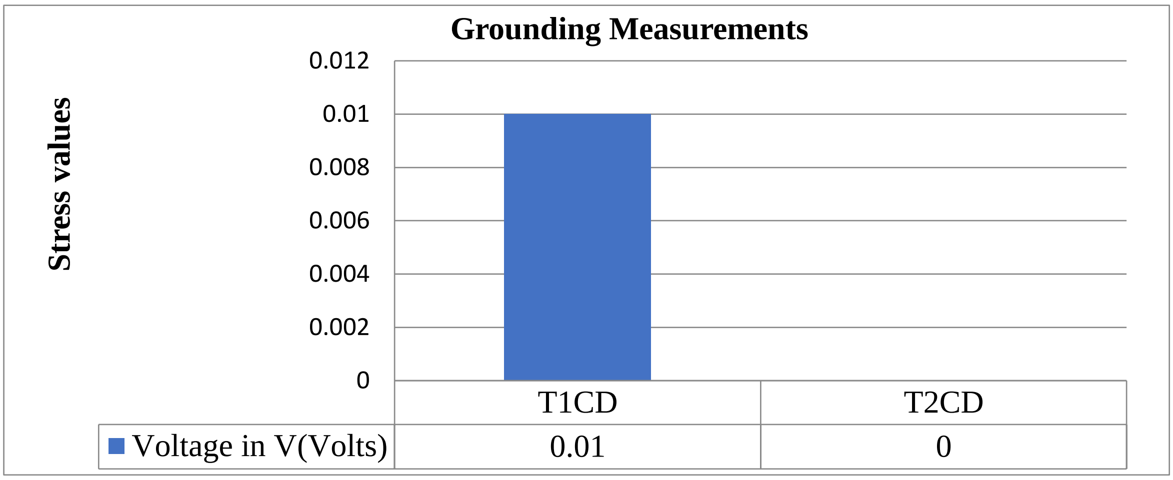

Figure 08 - Waterbox ground stress values.

It is important to highlight that all the onhmic resistance measured in the grounding system or school buildings, the multi-sport court or the water box presented very low values. Some values are very close to 0 ohms. This given is essential for a grounding system, especially SPDA, because the low ground resistance facilitates the dissipation of the electric current by it. A high onymic resistance represents an obstruction to this dissipation of electric current, which is not a good condition for the installed protection system. Therefore, ABNT NBR 5410:2008 recommends that groundresistance be as low as possible.

In addition to being a requirement of the fireman's body, SPDA is a determination of ABNT NBR 5419, which determines all parameters for the configuration and installation of SPDA in Brazil. On the other hand, the ABNT NBR 5410 determines some conditions for grounding. NR 10 in turn determines that in addition to establishments with installed load greater than 75 kW constitute and maintain the Medical Records of Electrical Installations, they must have the documentation of inspections and measurements of the protection system against atmospheric discharges and electrical grounding [4].

The correct installation of SPDA is fundamental to the quality of the installed system. It is important that the system scales correctly, so that there are no future failures. In addition, you must comply with all the requirements required by ABNT, NR and always observe whether there are municipal standards to be obeyed. For the school under study, the implanted SPDA obeyed all the standards that regulate it. The college is an environment frequented by many people of different age groups and a well-deployed and sized SPDA ensures the protection of heritage, as well as safety and protection to life, because in case of an atmospheric discharge, there is a system that will receive it and lead it there is a path designed for it. If there were no, the building would be exposed to this risk and so would people.

Because it is an environment frequented by people, the level of protection adopted for SPDA was level II that according to ABNT NBR 5419 is for buildings with high value goods or housing a large number of people [2].

The SPDA report of the building portrayed the good technical conditions of the SPDA, such as the resistance values already described, descent quantity, well-positioned captors, level of protection, calibration of the measuring equipment and validity of the SPDA which is one year, between Other.

5. Conclusion

Given the above, we reached the understanding of the importance of performing the SPDA for the school, as well as its level of protection and the technical conditions of such a system. It is important to emphasize that SPDA does not prevent atmospheric discharges from occurring, since they are a natural phenomenon. Although the system is a protective and safety measure, it does not ensure absolute building protection (80% to 95% - ABNT NBR 5419).

The school's grounding system has been installed and evaluated based on requirements and tested for compliance with the updated ABNT NBR 5419-2015, does not include protection of electrical and electronic equipment against electromagnetic interference caused by atmospheric discharges. Nor does it ensure the absolute protection of a structure, people and goods. Serves four protection points: capture conduction, absorption and equalization.

Therefore, even if an SPDA does not guarantee absolute protection, the protection range it meets is representative, thus ensuring in a certain way the safety of people and protection of building and people. It was also found that the maintenance of the SPDA system should be done annually from the start date of the technical report, to ensure the effectiveness of the system.

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