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Research Article

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Statement of the Existence and Values of Land Takes in Housing in Togo: Special Case of Certain Localities

Apaloo Bara K. K.[*][1], Ouedraogo S.[2], Bokovi Y[1], Palanga Y. T. G.[1], Salami A.A.[1], Bedja K.[1]

[1]Equipe de Recherche en Sciences de l'Ingénieur (ERSI), Laboratoire de Recherches en Sciences de l'Ingénieur (LARSI)
[2]Département de Génie Électrique, Institut Universitaire de Technologie, Université Nazi BONI, Burkina Faso

Abstract In this paper, we present the results of a survey aimed at exploring households with earth connections in their electrical installations and superimposing them on those whose measured values can work well for optimal protection. First, we appreciated the grounding values and then we evaluated them against the standardized values of the differential devices. The approach was a collection of information from door to door in some localities fed during the project of standardization of the anarchic connections of the CEET during the year 2016. In this sample, some localities of the Maritime region of Togo as Avédji, Wessomé, Djidjolé, Ségbé, Akato, Lankouvi and Cacaveli are targeted. The technique used to measure the earth is the so-called 62 %. The results show that the percentages vary from one locality to another. In general, for the 620 homes visited, only 68 or 10.97% have earth connections. Of these 68, 37 corresponding to 54.41 % are considered good if one refers to the standard currents of residual differential devices. We also note that 33 homes out of 620 have earth values between 1.335 Ω and 100 Ω. It shows that 5.97 % of the 620 homes visited have good protection. A very low percentage. In lighter terms, only about 6 out of 100 homes are electrically protected, a very disturbing result. Also, the results show that 45.98 % of dwellings with a grounding, have values whose differential devices cannot play their role effectively.

Keywords Sounding, measured values, grounding, differential devices, dwellings

1. Introduction

The security of energy delivery between places of production and consumption requires an infrastructure called a network, which is a visible part of the electricity system. Its structure, whose vocation is to ensure energy transits, must necessarily be secure. The continuity of supply, the quality of the electrical wave, the safety of goods and people as well as the preservation of the environment must play an important role in the design and construction of electrical energy installations and networks.

Nowadays, developing countries and especially those of the tropical zone still have deficits in electrification rate.

On the other hand in recent years, we have witnessed a settling of this situation in Togo especially, in the city of Lomé and its surroundings by the creation of the Anarchic Branching Standardization Agency, innovated by the Togo Electric Energy Company (CEET) [15].

This project included 32,000 consumers from the Zanguéra, Adétikopé, Djagblé, Kégué, Agbodrafo, Djassémé, Kpéssi, Agovodou, Agbata, Dévikémé, and Togokomé localities in 2017, compared to 1,600 anarchic connections that were standardized in 2016 [15].

However, it is not clear that, in areas where electrification is effective, checks on the incorporation of protection systems are not carried out before connection. As a result, many connections do not comply with the installation rules, especially in terms of protection. Consequently, electrical networks experience numerous disturbances due to protection problems and therefore present risks to people and property [1], [2], [3], [4], [9]. Studies have shown that the effectiveness of protective devices depends on the value of the earth electrode resistance and the associated differential device. This resistance can be estimated by calculation or by direct measurement.

The earth connection is an essential element of the electrical installation. A good earthing system reduces damage caused by lightning or fault currents and therefore provides a safety function against the risks of electrocution in the event of an insulation fault and also ensures high reliability of the devices [12], [7].

The concepts of correct earthing and correct earth resistance value are not clearly defined. Ideally, the earth should have a resistance of zero ohms. There is no standard earth resistance threshold recognized by all organizations [6]. The goal is to achieve the lowest value of earth resistance that is reasonably achievable economically and physically. Nevertheless, standard NF C15-100 [15], fixes as the maximum resistance of the socket, a value of 100 ohms.

Unfortunately, improper grounding results in unnecessary downtime. It is also a hazard and increases the risk of equipment failure. Thus, due to a large number of incidents, grounding systems have been the subject of much research [7], [8], [10].

Given the importance of grounding systems, Hachimenum NyebuchiAmadi set out to determine the possible causes of grounding system failures in the Niger Delta, [8]. At the end of its work, it notifies factors it considers hamper the effectiveness and sustainability of grounding systems and makes recommendations to improve grounding in the region. A study carried out by Colominas I. et al, set out to set up a numerical method for the analysis of grounding on horizontally and vertically stratified soils, [6]. According to the authors, in order for the earthing system to achieve its objectives, the distribution of the potential on the earth's surface and the equivalent resistance of the earthing system should be determined in a reliable and efficient manner. The relevance of the subject on grounding led Lukong Pius Nyuykonge et al., [10], to propose a method which contributes to reduce the resistance of the ground over long periods. This method treats the soil by replacing a volume of the grounded part with organic charcoal, [10].

In the context of the importance of earthing, we decided to investigate earthing systems in some localities in the Maritime region of Togo. The objective of this study is to provide an update on the existence and condition of earthenings in the dwellings of certain localities in the Maritime region of Togo. The localities concerned by this study are Avédji, Wessomé, Djidjolé, Ségbé, Akato, Lankouvi, Cacaveli. During this work, the values of existing earth electrodes were measured.

2. Materials and Methods

There are several methods of measuring the resistance value of an earth electrode. Among others we can cite: the two-point method, the three-point method, the tightening method, the strong current injection method, the computerized grounding multimeter method, the potential drop method with earth tester…, [12].

Among these methods, the best known and the most adapted to the voltage level concerned by our work is the potential drop method with an earth tester, also called the 62% method. This method consists of placing a current injection electrode at a distance D from the measuring strip. At 0.62 D from the measuring bar, a second voltage measuring electrode is placed. The quotient of the voltage thus measured by the constant current injected corresponds to the value of the resistance sought. Figure 1 illustrates the principle of this method.

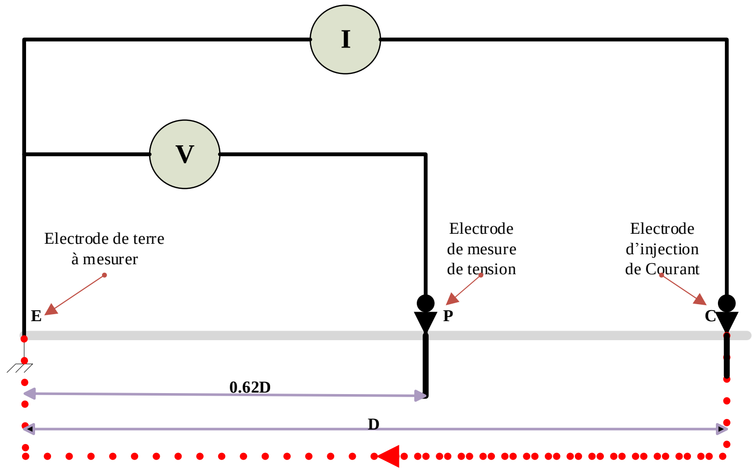

Figure 1: 62% Method

Figure 2 shows one of the measurement operations. The device used is the tellurometer. In this figure:
a) presents the arrangements of the stakes and their connection to the measuring device by cables, then
b) the earth electrode value displayed by the tellurometer.

a) Arrangement of stakes and cables on the device b) Earthing resistance value displayed by the device

Figure 2: An earth electrode measurement operation

3. Results

During the survey, the homes visited are chosen at random. The measured values thus constitute a statistical variable. These data can be processed according to several
Criteria. In this work, we will use three criteria namely:

- ✓ the number of earthenings per quarter;
- ✓ the value of the measured earth electrode;
- ✓ the comparison of the value of the earth connection with the value of the standard and associated differential devices, capable of effectively playing their protective role.

At the end of the survey, 620 homes were visited in total. Out of the 620, the presence of earth electrodes was notified in only 68 dwellings. The distribution by locality is presented in Table 1. The values of the earth electrodes measured are grouped by class (see Table 4). The classes are chosen taking into account the sensitivities of the standardized and associated residual current devices (see Table 3).

Table 1: Presentation of survey data

Localities	**Number of homes visited**	**Number of dwellings with earth connections**
Avédji	115	**16**
Djidjolé	70	**10**
Wessomé	100	**9**
Cacaveli	95	**9**
Ségbé	80	**7**
Akato	40	**6**
Lankouvi	120	**11**
All localities	**620**	**68**

4. Discussion

Table 1 presented statistics on the homes visited. We observe that out of 620, only 68 dwellings or 10.97% have earth connections in their installations. Which represents a very low percentage. Table 2 shows the percentage distribution for the localities.

Table 2: Percentage of existence of landings by locality

Localities	Percentage of existence of earth
Avédji	13.91%
Djidjolé	14.29%
Wessomé	9.00%
Cacaveli	9.47%
Ségbé	8.75%
Akato	15.00%
Lankouvi	9.17%
All localities	**10.97%**

According to these results, the locality of Akato has more earthenware installations than other localities.

To judge the existing earth connections, we referred to Table 3 [13], [15], which presents standardized values of the earth connection values with respect to the current of the rated residual devices. The data obtained are then grouped into a class as shown in Table 4.

Table 3: Maximum value of the earth connection according to the current assigned to the RCD [13]

Maximum differential-residual current assigned to RCD (IΔn)		Maximum value of the earth electrode resistance (in Ohms)
Low sensitivity	20 A	**2,5**
	10 A	**5**
	5 A	**10**
	3 A	**17**
Medium Sensitivity	1 A	**50**
	650mA	**77**
	500 mA	**100**
	300 mA	**167**
	100 mA	**500**
High sensitivity	≤30 mA	**>500**

Table 4: Grouping of the earth electrodes recorded by value class

Measured earth electrode resistance class (Rt)	Number of resistance values belonging to the class	Frequency
$0 \leq R_t < 2{,}5$	5	7.35%
$2{,}5 \leq R_t < 5$	3	4.41%
$5 \leq R_t < 10$	2	2.94%
$10 \leq R_t < 17$	7	10.29%
$17 \leq R_t < 50$	12	17.65%
$50 \leq R_t < 77$	1	1.47%
$77 \leq R_t < 100$	3	4.41%
$100 \leq R_t < 166$	3	4.41%
$166 \leq R_t < 500$	1	1.47%
$500 \leq R_t$	31	45.59%
Total	**68**	**100,00%**

Thus, from table 4, we were able to identify the earth connections that we consider good by referring to the prescriptions given in table 3. Tables 5 and 6 provide information on the values obtained.

Table 5: Presentation of survey data including good land catches

Localités	Nombre de maisons visitées	Nombre d'habitations ayant des prises de terre	Nombre d'habitations dont les prises de terre sont jugées bonnes.
Avédji	115	16	12
Djidjolé	70	10	8
Wessomé	100	9	5
Cacaveli	95	9	7
Ségbé	80	7	5
Akato	40	6	4
Lankouvi	120	11	7
All localities	**620**	**68**	**48**

Table 6: Percentage of survey data broken down by locality

Localities	Percentage of existence of earth	Percentage of dwellings with good earth connections (relative to the number of dwellings visited)	Percentage of good earthenings (relative to the number of homes visited with earthenings)
Avédji	13.91%	10.43%	75.00%
Djidjolé	14.29%	11.43%	80.00%
Wessomé	9.00%	5.00%	55.56%
Cacaveli	9.47%	7.37%	77.78%
Ségbé	8.75%	6.25%	71.43%
Akato	15.00%	10.00%	66.67%
Lankouvi	9.17%	5.83%	63.64%
All localities	**10.97%**	**7.74%**	**70.59%**

It therefore appears that the percentages vary from one locality to another. In general, for the 620 homes visited, only 68 or 10.97% have earth connections. Of these 68, 48 correspondents at 70.59% are considered good. This result shows that 7.74% of the 620 homes visited have good protection. A very low percentage. In clearer terms, only about 8 out of 100 homes are electrically protected, a very worrying result. The distribution by locality can be seen clearly in figure 3.

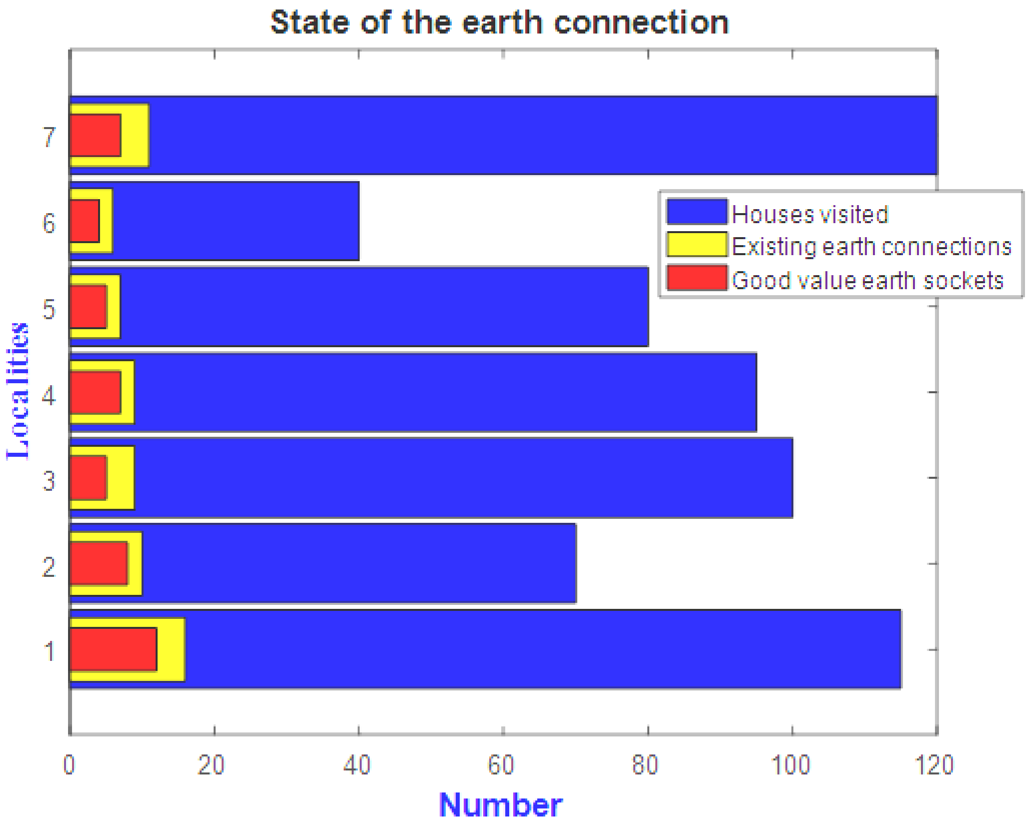

Figure 3: Inventory of earth electrodes in the localities visited

5. Conclusion

This article presents the situation of landings in households in Togo. As a sample, we used some localities in the Maritime region of Togo which is a country in Humid and Coastal West Africa. Particular emphasis is placed on areas newly supplied with electrical energy by the projects of the standardization agency for anarchic connections. In particular, a few localities connected to the CEET networks during this project in 2016 are targeted. In this sample, 620 households made up the population during the survey and seven different neighborhoods are visited. The results show that 89.03% have no household earth. Among the households that have earth electrodes, 26.47% have values for which the differential protection devices cannot play their role effectively. In addition, there are only 48.53% having an earth connection whose value is between 1.335 Ω and 100 Ω; normally very interesting values. Taking into account the quality of the soils observed in the studied areas, there would be no complication during the design and installation of the earth electrodes because most of the soils explored in this work have low electrical resistivities [1]. The situation presented in this article is alarming in terms of protection against electrical hazards. This situation is due, in most cases to the ignorance of the population, to the lack of protection standards to be respected before connection to the electricity network and to the lack of professionalism of the technicians responsible for carrying out the electrical installations. A solution to these problems can greatly reduce the risks associated with the exploitation of electric energy in our regions.

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