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SHORT COMMUNICATION

BREVES CUTS ON THE POWER GRID OF ELECTRIC ENERGY AND ITS CONSEQUENCES: CASE OF TOGO

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Abstract

This study looked at brief electric outages based on data from 2014 to 2019 of power grid. These outages follow incidents that occurred on the power grid. We found that short outages represent 1% of the outages observed on the power grid and depend on the number of departures from distribution stations. The period during which these cuts are observed coincides with the dry period which goes from December to March with a maximum in March which is the hottest month. March is also the month when electricity consumption is at its maximum. These interruptions are accompanied by the return of electrical power to a transient overvoltage. This overvoltage is influenced by atmospheric conditions. This transient phenomenon is detrimental to the life of electrical devices.In this article we looked first at the distribution of brief denominations by departures in dispatch items, the evolution of brief cuts by distribution items, and the variation in short denominations over time. The consequence of its cuts was developed. This work was completed by proposals for a solution to the brief cuts.

Introduction:-

During the transport, dispatchand distribution of electrical energy incidents can arise. These incidents most often result in outages during the supply of electrical power. A break is cut when the voltage of the distribution network is less than 10% of the contractual voltage for a duration of 1 second or more. These cuts according to their durations are catalogued into three groups. We've got:

1. Microcut when the duration of the cut is between a few milliseconds to a second,
2. The short break when it lasts from one second to three minutes,
3. The long break with a duration that is more than three minutes.

The electrical grid carries the electrical energy generated to the distribution stations under a voltage of 161 kV. From these stations the power supply is sent to various parts of the country in the distribution stations for the distributor's customers.

This process can be disrupted by incidents of various kinds. Some of these disruptions do not require a halt to supply, as is the case with voltage troughs. On the other hand, others are accompanied by a power cut. As soon as

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the disturbance is resolved and conditions permit, the power is delivered by circuit breakers. The time between power outage and delivery can have an impact on electrical appliances.

In our work we are interested not only in short cuts but also in their consequences.

In fact, during the feeding process, there is a transient phenomenon in which the tension takes very high values sometimes beyond the disruptive tensions before stabilizing. The insulators of these coils are put to the test and can know the slamming [1]. The most distressing cases for electrical appliances in general are repeated short cuts.

Materials And Method:-

Material:-

The electricity grid covers the entire city of Lomé and its suburbs. The distribution network is powered by 20 kV between processing stations. Ordinary customers are powered in 380/220 V. From the dispatch stations the 2050 HTA/BT distribution stations are fed. Customers are served through 2804 km of HTA network and 5693 km of LOW voltage NETWORK BT [2] for the year 2018.

Sample:-

Based on data collected from the energy distributor, we have information on the incidents that occurred and the duration of the outages. We also have information on the departures of the lines that serve the different neighbourhoods, the dates on which the incidents took place, and the distribution posts over a period from 2014 to 2018. In total we have 2061 data on the cuts and on the MT network which are recorded as in Table 1.

Table 1:- Sample Data Presentation.

N°	DATE	POSTE	DEPART	INCIDENT	DESCRIPTION	DUREE (H)	IC (A)	END (MWH)	CAUSE	SIEGE (équipement)
1	06/01/2018	LOME A	N'DANIDA	Disjonction franche	Chute_Arbre ou branches d'arbre	0,77	123	3,11		Réseau aérien_HTA
2	08/01/2018	LOMEA	DOGBEAVOU	Disjonction franche	Panne due au comportement humain	1,20	141	5,58	Responsabilité tiers	Réseau souterrain_HTA
3	13/01/2018	LOME B	CABLE DIRECT	Disjonction franche	Défaut plein câble souterrain	0,85	143	4,01	Défaillance Matérielle	Réseau souterrain_HTA
4	14/01/2018	LOME B	LOME AB	Disjonction franche	Défaut plein câble souterrain	0,75	27	0,67	Défaillance Matérielle	Réseau souterrain_HTA
5	16/01/2018	LOME A	SOTOTOLES	Disjonction franche	Boite jonction défect	0,37	149	1,80	Défaillance Matérielle	Réseau souterrain_HTA
6	16/01/2018	LOME B	CABLE DIRECT	Disjonction franche	Boite jonction défect	1,25	147	6,06	Défaillance Matérielle	Réseau souterrain_HTA
7	25/01/2018	LOME A	SOTOTOLES	Disjonction franche	Défaut plein câble souterrain	1,62	157	8,38	Défaillance Matérielle	Réseau souterrain_HTA
8	25/01/2018	LOME A	AGOE	Disjonction franche	Panne due au comportement humain	1,45	299	14,31	Responsabilité tiers	Réseau souterrain_HTA
9	25/01/2018	LOME A	GAKLI	Disjonction franche	Rupture du conducteur	0,33	226	2,49	Défaillance Matérielle	Réseau aérien_HTA
10	27/01/2018	LOME B	CABLE DIRECT	Disjonction franche	Boite jonction défect	0,97	134	0,00	Défaillance Matérielle	Réseau souterrain_HTA
11	27/01/2018	LOME A	SOTOTOLES	Disjonction franche	Panne due au comportement humain	0,32	119	0,00	Responsabilité tiers	Réseau souterrain_HTA
12	29/01/2018	LOME B	MOYENNE ENTREPRISE	Disjonction franche	Rupture du conducteur	5,47	184	33,19	Défaillance Matérielle	Réseau aérien_HTA
1	02/02/2018	LOME A	ASSEMBLEE DE DIEU	Disjonction franche	Panne due au comportement humain	0,42	212	2,92	Responsabilité tiers	Réseau souterrain_HTA
2	04/02/2018	LOME A	FOYER DES JEUNES FILLES	Disjonction franche	Amorçage du tableau HTA	0,10	43	0,14	Défaillance Matérielle	Poste de transformation HTA_BT
3	04/02/2018	LOME B	SOTOTOLES	Disjonction franche	Boite jonction défect	0,77	64	1,62	Défaillance Matérielle	Réseau souterrain_HTA
4	06/02/2018	LOME A	ADIDOGOME	Disjonction franche	Elagage insuffisant	0,58	63	1,21	Amorçage réseau HTA	Réseau aérien_HTA
5	06/02/2018	LOME B	CABLE DIRECT	Disjonction franche	Défaut plein câble souterrain	0,88	84	2,45	Défaillance Matérielle	Réseau souterrain_HTA
6	07/02/2018	LOME A	ADIDOGOME	Disjonction franche	Chute_Arbre ou branches d'arbre	1,05	90	3,12	Défaillance Matérielle	Réseau aérien_HTA
7	07/02/2018	LOME B	LOME A-B	Disjonction franche	Boite jonction défect	0,78	206	5,33	Défaillance Matérielle	Réseau souterrain_HTA
8	07/02/2018	LOME B	MOYENNE ENTREPRISE	Disjonction franche	Défaut d'entretien	0,60	87	1,72	Défaillance Matérielle	Réseau aérien_HTA
9	08/02/2018	LOME B	SOTOTOLES	Disjonction franche	Défaut plein câble souterrain	0,23	140	1,08	Défaillance Matérielle	Réseau souterrain_HTA
10	08/02/2018	LOME A	TSEVIE	Disjonction franche	Défaut plein câble souterrain	0,77	305	7,72	Défaillance Matérielle	Réseau aérien_HTA

We have in the first column the order numbers of the occurrences of the cuts. The second column concerns the dates of the outages. The third column is reserved for the distribution stations concerned. The next is the departure on which the incident occurred. The fifth reports the incident on the network. The sixth column reports the description of the cause of the cut. Theseventh indicates the duration of the cut. The eighth indicates the power outage. The ninth gives un distributed energy. The tenth column mentions the origin of the problem and the eleventh indicates where the incident occurred.

Data processing:-

We used statistical processing. After a formatting of the data that allowed us to remove the unlikely values, we have using the Excel software done a series of sorting. Indeed after selecting from the second to the seventh column we did a sorting in ascending order on the column of duration. This allowed us to count the durations of 3 minutes or less with the corresponding departures. The same sorting also allowed us to identify the allocation items for the departures on which we had the brief cuts. At the same time, we have noted the dates for the brief denominations. Subsequently the brief cuts of the same month were collected and counted. Different histograms have been made. First, we have the histogram of distribution of brief denominations per departure over the period 2014-2018 (Figure 1). We also realized the histogram of the evolution of short cuts by distribution items in the period 2014-2018 (Figure 2).

Figure 1:- Breakdown of short denominations per departure over the 2014-2018 period.

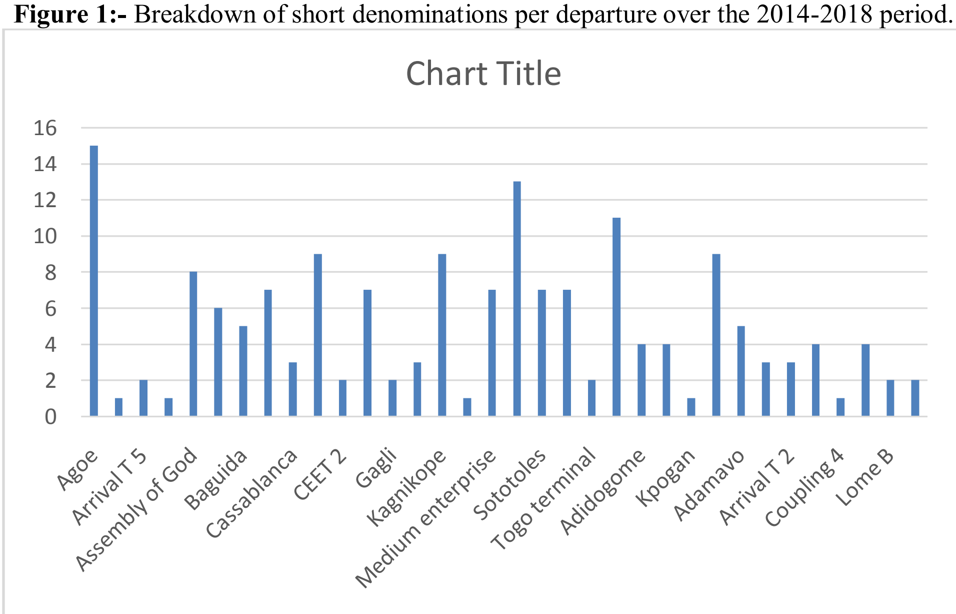
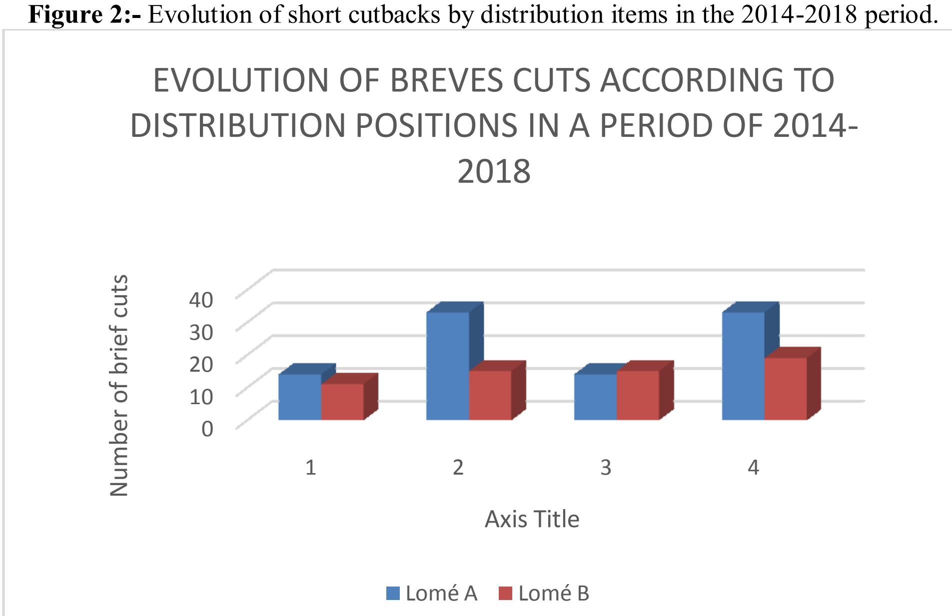
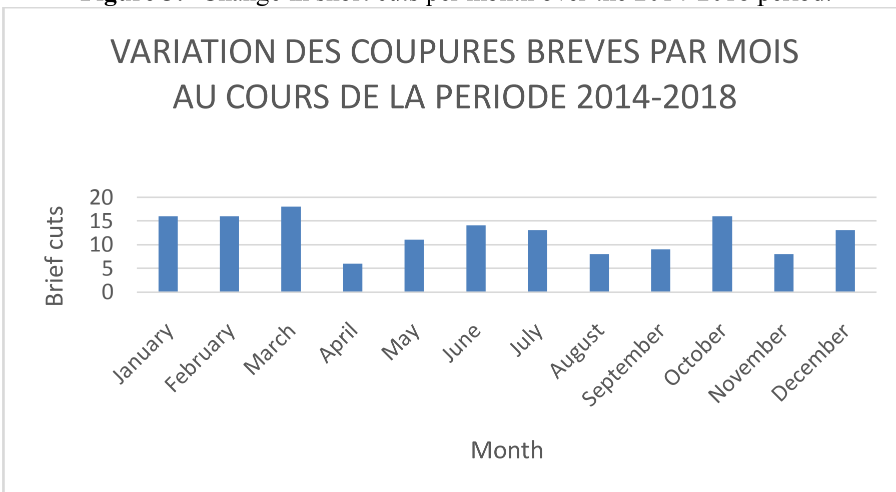


Figure 2:- Evolution of short cutbacks by distribution items in the 2014-2018 period.



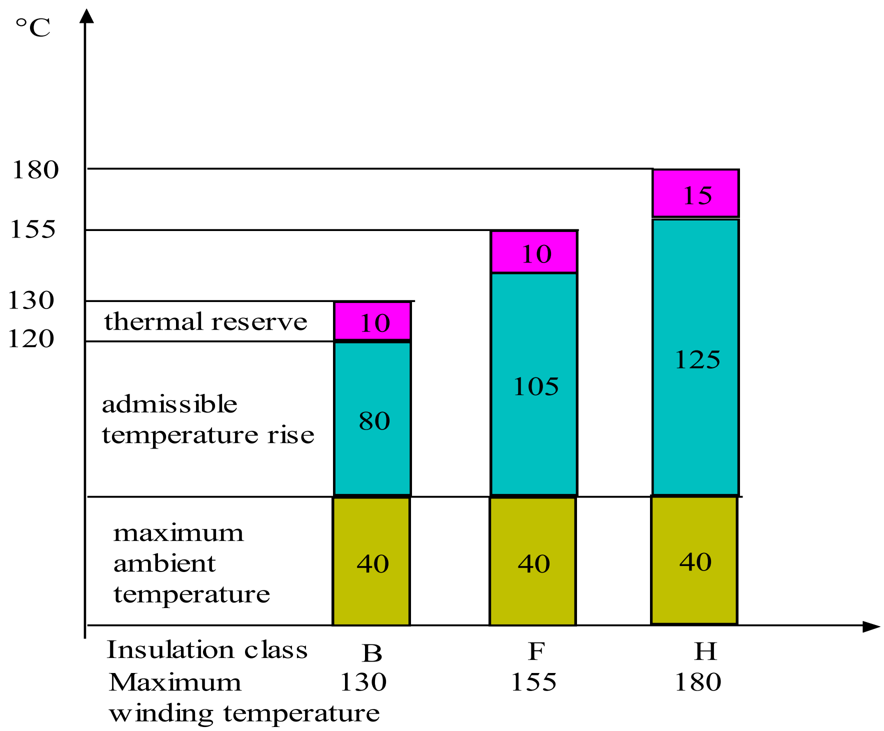
A third histogram was performed, which is the variation of the brief cuts by the months during the period 2014-2018.

Figure 3:- Change in short cuts per month over the 2014-2018 period.



We also presented the histogram of the driver insulation class.

Figure 4:- Insulation class of conductors.



Results and interpretation:-

Short cuts account for about 1% of all denominations recorded. The causes of brief cuts are essentially fugitive fects such as short-circuits due to tree branches. These defects take place on the network of The Medium Tension which is naked.

There are also repeated brief cuts. This is due to the operation of the automatic re-trigger. Indeed when there is a short circuit the circuit breaker unthring. The automatic re-trigger after eight seconds reactivates the circuit breaker.

If the defect persists, it unseats again. After two minutes it automatically reactivates. After five attempts, the re-locker hangs on the stop.

We have identified brief denominations by departures Figure 1. For each direction we have a departure assigned to him.

We can see that the brief cuts relate to 34 departures. Virtually all of Lomé's neighbourhoods are included. The Agoé departure recorded more brief cuts than other departures. It totals 15 brief cuts. This can be explained by the fact that Agoé is very large. The departure N'Danida recorded 13 brief cuts followed by the departure of Tsévié.

We also looked at distribution positions. Figure 2 shows the variation in short denominations per allocation item.

We note that dispatch item A has seen more brief cuts. This can be explained by the scope of this position. It covers 18 departures while dispatch station B has 12.

We looked at the distribution of short cuts per month as shown in Figure 3.

We find that the period from December to March corresponds to the dry season with The month of March the warmest month and also the month when the consumption of electrical energy is at its maximum. This month saw a large number of brief cuts to 18 cases. The April-November period experienced relatively fewer brief cuts.

The transient phenomena, complex and difficult to predict, are related to the non-linear characteristic of the transformer. They are characterized by dangerous surges sometimes reaching the level of isolation of the devices; this then imposes both dielectric and thermal stresses on electrical equipment [3], [4].

When resuming service, the activation of an empty transformer on a low-power grid can lead to surprising oscillatory phenomena for the electrical grid operator. Low-frequency non-linear voltage oscillations appear at the transformer terminals, which may be much greater than the rated voltage of the network. Due to the passive nature of the circuit and the losses of the system, these oscillations are necessarily cushioned, they can be maintained for several seconds and then disappear and the network returns to normal functioning. It is referred to as Ferro transient resonance [5], [6].

It should be noted that the surges that accompany power releases are influenced by atmospheric conditions The crown effect in particular mitigates surges.

This mitigation exceeds 5% in dry weather and 12% in wet weather. It can be noted, on the other hand, that the crown effect significantly reduces the amplitude of maximum harmonic impedance (hence maximum harmonic overtension) by no more than 25% in dry weather and 52% in wet weather, on the other hand, the corresponding clean (or resonance) frequency remains unchanged [7].

Conclusion:-

Our study found that there were brief cuts. They account for 1% of cuts to Togo's electricity grid. Virtually all line departures have at least once been briefly cut off. These cuts were more noticeable in the period from December to March, particularly in March. The more departures the distribution items have, the more cuts they experience.

Short cuts affect the lifespan of electrical appliances. In order to avoid brief cuts, the electrical energy distributor must give special importance to pruning branches or felling trees that are too close to the electrical grid. Replacing automatic re-unloading circuit breakers with simple circuit breakers will reduce short cuts.

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