

SHORT COMMUNICATION

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

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Manuscript Info

Abstract

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*Key words:-*Electric Power, Short Outages, Transient Phenomena 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.

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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:

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- 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.

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| 5 7 2500,2013 LOAE A SOTUTOLES Dejencion financh Definanch aus comportement humain 1.62 157 8.38 Defailance Matériele Pérens soutamini, IETA 6 8 500,0018 LOAE A AGE Dejencion financh Parte de au comportement humain 1.42 290 14.31 Responsabilit éens Eléseu soutamini, IETA IETA 7 500,0018 LOAE A GAEL Dejencion financh Belo pincion financh Parte de au comportement humain 0.33 118 0.00 Defailance Matériele Exemu contamini, IETA 9 10 20,0018 LOAE A SOTOTOLES Dejencion financh Parte de au comportement humain 0.33 118 0.00 Belainnon Matériele Exemu contamini, IETA 11 0.002018 LOAE A SOTOTOLES Dejencion financh Parte de conducter 5.47 114 0.10 43 0.14 Défailance Matériele Exemu contamini, IETA | 10 | 16/01/2018 | LOME A | SOTOTOLES | Disjonction franche | Boite jonction défect | 0,37 | 149 | 1,80 | Défaillance Matérielle | Réseau souterrain_HTA | | | | | |
| 6 8 250 (1)81 LONE A AGGE Disjenction finanche Pann dur au comportinent human 1,45 299 14,31 Responsabilité sins Essens stotemini, ITTA 7 5 50 (1)81 LONE A GARLI Disjenction finanche Responsabilité sins Essens attein, ITTA Essens attein, ITTA 9 11 270 (1)81 LONE A GARLI DESCT Disjenction finanche Bels postion finanche Panne due au comportensent humain 0,32 119 0,00 Defaliance Atlantable Estens automini, JTTA 1 400 02018 LONE A ASTITOTICES Disposicion finanche Rame due au comportensent humain 0,42 122 292 Responsabilité sins Estens automini, JTTA 2 400 02018 LONE A ASTITOTICES Disposicion finanche Anorgag du tableau FITA 0,10 43 0,11 Defaliance Atlantable Estens automini, JTTA 3 5 | 10 | 16/01/2018 | LOME B | CABLE DIRECT | Disjonction franche | Boite jonction défect | 1,25 | 147 | 6,06 | Défaillance Matérielle | Réseau souterrain_HTA | | | | | |
| 7 9 250 0/2018 LOME A 6AXL1 Dejonction finche Rupture du conductoru 0.33 226 2,49 Défailance Matériale Pásena atrim, HTA 10 270 0/2018 LOME A CARE DURCT Dejonction finche Beiponcion finche </td <td>25</td> <td>25/01/2018</td> <td>LOME A</td> <td>SOTOTOLES</td> <td>Disjonction franche</td> <td>Défaut plein câble souterrain</td> <td>1,62</td> <td>157</td> <td>8,38</td> <td>Défaillance Matérielle</td> <td>Réseau souterrain_HTA</td> <td></td> <td></td> <td></td> <td></td> <td></td> | 25 | 25/01/2018 | LOME A | SOTOTOLES | Disjonction franche | Défaut plein câble souterrain | 1,62 | 157 | 8,38 | Défaillance Matérielle | Réseau souterrain_HTA | | | | | |
| 8 In 27:00.018 LONE B CABLE DESCT Disjonation function Bodie jonation function Delay jonation Disponsion function Delay jonation Disponsion function Delay jonation Disponsion | 25 | 25/01/2018 | LOME A | AGOE | Disjonction franche | Panne due au comportement humain | 1,45 | 299 | 14,31 | Responsabilité tiers | Réseau souterrain_HTA | | | | | |
| 11 27.01.0318 LOME A SOTOTOLES Dejection function Parter due au comportement humain 0,32 119 0,00 Reperturbité tiers Zéseus ioutamini, HTA 12 29.01.0318 LOME A ASSERDEEDE EDE Dejección function Reparte da conducturar 5,47 1348 33.19 Defalinero Altariade Zéseus ioutamini, HTA 12 29.01.0318 LOME A ASSERDEEDE EDE Dejección function Parter due conducturar 5,47 1348 33.19 Defalinero Altariade Zéseus ioutamini, HTA 12 04.00.2018 LOME A ASSERDEEDE EDE Dejección function Anonga de talebase HTA 0,10 43 0,41 Defalinero Altariade Point de transformation HTA, BT 2 04.00.2018 LOME A ADDOCOME Dejección function Belaga incidinati 0,19 63 1.21 Anonga de talena Nativalia 4 060.2018 LOME A ADDOCOME Dejección function Belaga incidinati 0,18 63 1.21 Anonga de talena Nativalia Assess adrim, HTA 5 66.00.2018 LOME A ADDOCOME Dejección function Belaga incidinati 0,18 64 1.25 Defalinero Altariade Esseu soutemini, HTA 6 60.00.2018 | 25 | 25/01/2018 | LOME A | GAKLI | Disjonction franche | Rupture du conducteur | 0,33 | 226 | 2,49 | Défaillance Matérielle | Réseau aérien_HTA | | | | | |
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| 1 0.00 2018 LOME A ASSEMBLE DE DIEU Dojoncion funche Pane due su compontement humain 0,42 212 2,92 Responsabilité tirs Zérens contamin, HTA 2 0.400 2018 LOME A FOTER DES.FILLES Dojoncion funche Amorga du tables ITA 0,10 0.43 0,44 0,41 0.44 0,41 Defailures Attained Porto de numformation HTA ST 3 0.400 2018 LOME A SOTOTOLES Digoncion funche Dagas du tables ITA 0,10 0.43 0.41 1.042 Defailures Attained Reseau compani, HTA 4 660 2018 LOME A SOTOTOLES Digoncion funche Dagas du tables ITA 1.04 Amorga du tables TA 0.01 Attained Réseau contamin, HTA 0.01 Amorga du tables TA 0.01 Attained Réseau contamin, HTA 0.01 Amorga du tables TA 0.01 TA Amorga du tables TA Defailures Attained Réseau contamin, HTA 0.01 TA TA Amorga du tables TA | 1 27 | 27/01/2018 | LOME A | SOTOTOLES | Disjonction franche | Panne due au comportement humain | 0,32 | 119 | 0,00 | Responsabilité tiers | Réseau souterrain_HTA | | | | | |
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| 3 0 400,2018 LOME B SOTOTOLES Dejencion funch. Belague insufficient 0,71 64 1,42 Defailance Materiale Reseau souterini, JETA 4 6 600,2018 LOME B CAME D Dejenction funch. Elague insufficient 0,58 63 1,11 Amorgage risem ETA Reseau souterini, JETA 5 6 600,2018 LOME B CAME DDDOCOME Dejencicon funch. Deligneric clibe souterini 0,88 63 1,21 Amorgage risem ETA Reseau souterini, JETA 6 6 000,2018 LOME B CAME DDOCOME Dejencicon funch. Eduary inclusion 1,051 90 3,12 Defailance Materiale Reseau souterini, JETA 7 010,2018 LOME B MONENNEXTERPISE Dejencicon funch. Eduary inclusion 1,051 90 3,33 Defailance Materiale Reseau souterini, JETA 9 60,02018 LOME B SOTOTOLES Dejencicon funch. Default elevatorian 0,23 140 1,48 Defailance Materiale Reseau souterini, JETA 9 60,02018 LOME B SOTOTOLES Dejenci | 02 | 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 | | | | | |
| 4 6 60 02018 LOME A ADDOCOME Dejonction financh Elagas insuffisant 0,58 63 1.21 Annopsgerferen HTA Résens action, HTA 5 6 60 02018 LOME A ADDOCOME Dejonction financh Defaunte halfen es banches d'abre 0,88 64 2.45 Defaultance Alastinde Résens action, HTA 6 6 010 2018 LOME A ADDOCOME Dejonction financh Defaute nachine attraction 0,88 84 2.45 Defautere Alastinde Résens action, HTA 7 010 2018 LOME A ADDOCOME Dejonction financh Belo jonction financh 0,80 93 3.12 Defallance Alastinde Résens action, HTA 8 0 100 2018 LOME A MONE NE XIFERPINE Dejonction financh Defau d'entretien 0,80 17 1,72 Defallance Alastinde Résens action, HTA 9 0 400 2018 LOME B S01070128 Dejonction financh Defau d'entretien 0,23 140 1,08 Defallance Alastinde Résens action, HTA 9 0 400 2018 LOME B S01070128 Dejonction financh Defau d'entretien 0,23 140 1,08 Defallance Alastinde Résens action, HTA 10 nt montaue LOME A | 04 | 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 | | | | | |
| 5 600/0018 LONE B CASE E DESCT Dejonction function Defun plote clibb statemain 0.88 84 2.45 Defailures Materials Resensation RTA 6 0100.2018 LONE B CASE E DESCT Dejonction function Default plote clibb statemain 0.88 84 2.45 Defaultness Materials Resensation RTA 7 0100.2018 LONE B LONE B LONE B Dejonction function Chart , After op bunches during 0.71 2.05 Statume Materials Resensation RTA 8 0100.2018 LONE B LONE B LONE B Dejonction function Chart defaut 0.71 2.05 Defaultance Materials Resensation RTA 9 6600.2018 LONE B SOTOTOLES Dejonction function Defaut devaluation 0.23 140 1.08 Defaultance Materials Resensation RTA 10 RATTIME Table in able statemain 0.77 305 7.12 Defaultance Materials Resensation Resensation Resensation Resens | 04 | 04/02/2018 | LOME B | SOTOTOLES | Disjonction franche | Boite jonction défect | 0,77 | 64 | 1,62 | Défaillance Matérielle | Réseau souterrain_HTA | | | | | |
| 5 6 01002018 LOME A ADDOCKME Dejorction finanche Chafa Arber ou branches d'atver 1,05 90 3,12 Defailance Materialle Résens atrim, HTA 7 01002018 LOME B LOME B LOME B Digorction finanche Bels jonction finanche Bels jonction | 00 | 06/02/2018 | LOME A | ADIDOGOME | Disjonction franche | Elagage insuffisant | 0,58 | 63 | 1,21 | Amorçage réseau HTA | Réseau aérien_HTA | | | | | |
| 7 0 0.002.81 LOME A LOME A.B Despection finance Belts precision finance Belts precision finance Belts precision finance 0.018 1.33 Defailures: Materiale Reseasurement precision Preci | 00 | 06/02/2018 | LOME B | CABLE DIRECT | Disjonction franche | Défaut plein câble souterrain | 0,88 | \$4 | 2,45 | Défaillance Matérielle | Réseau souterrain_HTA | | | | | |
| 8 0 01023018 LOME B MOTENSE ENTERPENSE Despension finanche Defaut d'ententim 0,60 87 1,72 Defailance- Matériale Résens adrim, HTA 9 0 02.0218 LOME B S01070028 Depainer finance Defaut d'ententim 0,23 140 1.08 Defailance- Matériale Résens adrim, HTA 10 ant more trainer LOME A Trainer Defaut d'ententim 0,23 140 1.08 Defailance- Matériale Résens adrim, HTA 10 ant more trainer LOME A Trainer Defaut d'ententim 0,23 140 1.08 Defailance- Matériale Résens adrim, HTA 10 ant more trainer Defaut d'ententim 0,23 140 1.08 Defaut d'ententime National 2014 2015 2016 2017 2016 Feuil 4 Provide advector 172 Defaut d'ententime 141 | 0 | 07/02/2018 | LOME A | ADIDOGOME | Disjonction franche | Chute_Arbre ou branches d'arbre | 1,05 | 90 | 3,12 | Défaillance Matérielle | Réseau aérien_HTA | | | | | |
| 9 0 0.00.2016 LONE B SOTOTOLES Dejonction function Default plein clible souternin 0.23 140 L/B Defaultance Materialle Research and material Re | 0 | 07/02/2018 | LOME B | LOME A-B | Disjonction franche | Boîte jonction défect | 0,78 | 206 | 5,33 | Défaillance Matérielle | Réseau souterrain_HTA | | | | | |
| 1 in ns.cm/mits LONE A TENE Descention function Default oblig No.cm/mits Default oblig Parameter HTA > 2014 2015 2016 2017 2018 Feuil 4 ⊕ ⋮ i <td>07</td> <td>07/02/2018</td> <td>LOME B</td> <td>MOYENNE ENTREPRISE</td> <td>Disjonction franche</td> <td>Défaut d'entretien</td> <td>0,60</td> <td>87</td> <td>1,72</td> <td>Défaillance Matérielle</td> <td>Réseau aérien_HTA</td> <td></td> <td></td> <td></td> <td></td> <td></td> | 07 | 07/02/2018 | LOME B | MOYENNE ENTREPRISE | Disjonction franche | Défaut d'entretien | 0,60 | 87 | 1,72 | Défaillance Matérielle | Réseau aérien_HTA | | | | | |
| < 2014 2015 2016 2017 2018 Feuil4 | 08 | 08/02/2018 | LOME B | SOTOTOLES | Disjonction franche | Défaut plein câble souterrain | 0,23 | 140 | 1,08 | Défaillance Matérielle | Réseau souterrain_HTA | | | | | |
| | | | | | | Défaut plein câble souterrain | 0.77 | 305 | 1.72 | | Récess sérien HTA | | | | | • |
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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.

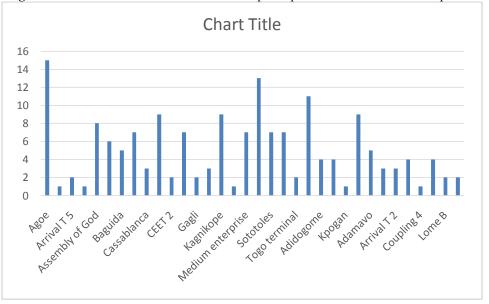
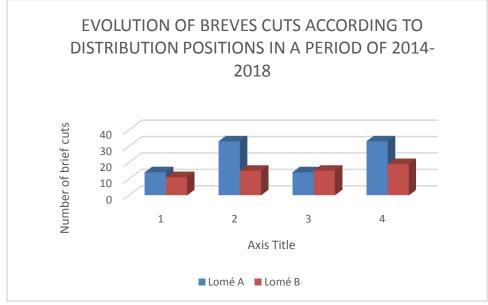
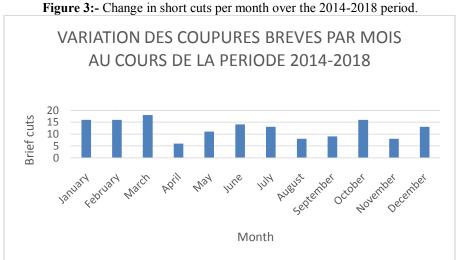


Figure 2:- Evolution of short cutbacks by distribution items in the 2014-2018 period.



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



We also presented the histogram of the driver insulation class.

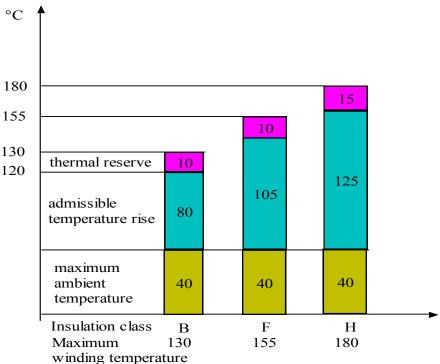


Figure 4:- Insulation class of conductors.

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 relocker 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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