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Assessment of Energy not Distributed due to Faults in the Ceet Electricity Network in Lomé, Togo and its Impacts

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Abstract Electrical faults create power outages which cause devastation to populations and losses to societies. This work presents the evaluation of non-distributed energies and their impacts in the CEET electricity network. We considered the operating data of the HTA network of the city of Lomé during the year 2022. The information processed concerns departures, sections and the types of faults observed; all considered in the jargon of CEET technicians. The important factors taken into account are: Undistributed Energy (END) during the research and repair period; the interruption current and the departures concerned. An application called TR DATA 2000 was developed to facilitate the evaluation. The results are as follows: burnt junction box defects and overhead conductor breakage generated ENDs of 324.12 MWh and 279.51 MWh. The research and repair times vary greatly for burnt exterior end, disconnected insulator, network foreign body and MV panel priming faults. They are well known and limited for some, namely: Busbar priming, mobile socket priming, conductor attached to LV pole, burnt DHP, blown MV fuse at the station and broken insulator clip. The results also show that there were 560.32 hours of interruptions to this MV network. This generated 2705.93 MWh of undistributed energy for the year 2022 corresponding to a loss of 324,711,600 CFA francs for the country. Modeling these defects will generate user satisfaction and enormous savings for companies.

Keywords Assessment, Electrical fault, Undistributed energy, Repair, Research

1. Introduction

The preponderance of electrical equipment is driving the ever-increasing evolution of electrical networks. Indeed, the electrical network is made up of all the devices intended for the production, transport, distribution and use of electricity from the generation plants to the most distant country houses [1]. Some generation plants use fossil primary energy sources such as oil, natural gas, coal, which contribute to intense pollution of nature [2], through the release of greenhouse gases [3]. Unfortunately, it is these power plants that provide the vast majority of electrical energy in the world [4], [5], [6], [7], [8]; apart from nuclear power plants which also use these fossil fuel sources such as uranium and also meet a quantity of energy needs. Taking into account climate disruption [9], ever-increasing floods observed throughout the world [10], [11], [12], unexpected and devastating bush fires [13], [14], etc.; actors are turning to renewable energy sources to meet electrical energy needs [15].

Thus, at COP 27 in Egypt [16], and at COP 28 in Dubai [17], conclusions are drawn more towards non-polluting fossil primary energy sources (geothermal energy) [18], [19], and renewable wind, solar, and especially photovoltaic, [20]. It is clear that the share of these sources in the energy mix is modest and almost insignificant throughout the world, [21], [22]. These parks or fields occupy quite large areas, but it is rare to find any that produce Gigawatt hours. This generates small quantities of energy at the destination if we take into account line losses [23]. These losses are already generating financial waste; worse, if there is no adequacy between production and consumption, and consumption falls in relation to production, the gains decrease. In these cases, we encounter bankruptcies among electrical energy producers.

Furthermore, the observation of breakdowns in the network causes the absence of consumption and accentuates financial losses. Like all other countries, Togo is not exempt from this situation. The Electric Energy Company of Togo (CEET), responsible for the distribution of electrical energy in the country, obtains its supplies from the Electrical Community of Benin (CEB), which covers transport between Togo and its neighbor Benin. The forecasts made in the short term allow it to have at its disposal a quantity of energy produced in order to satisfy needs [24]. In the event of a breakdown on the CEET network, we find Non-Distributed Energy (END) which impacts turnover and the balance between production and consumption. It is within this framework that the work we present in this document is located. In reality the objective of this work is to evaluate the impacts of breakdowns on Non-Distributed Energy through their types and their repair times in the CEET network. The aim is to take stock through the operating data of the HTA network of the city of Lomé during the year 2022 in order to assess the impacts.

2. Materials

During network operations, incidents are always recorded by the CEET. From these data collected (on the HTA network of the city of Lomé), the information to be processed in this manuscript concerns departures, sections and equipment (cables, transformers, cells, protection devices, etc.). The expressions used to indicate certain types of faults only concern, throughout this work, the language used between CEET technicians. When processing data, important factors taken into account are:

- energy not distributed during the duration of the fault;
- the duration of the search and repair of the defect;
- the cut-off current or the intensity requested when the fault appears;
- the departures concerned;

The window in Figure 1 shows the data recording page through an Excel spreadsheet.

Division BCC

STATISTIQUES DES INCIDENTS_DEPART

N°	DATE	POSTE	DEPART	TRONCON / DERIVATION	INCIDENT	DESCRIPTION	HEURE_DEBUT (H)	DATE_FIN	HEURE_FIN (H)	DUREE (H)	IC (A)	END (MWH)	CAUSE	SIEGE (équipement)	LIEU (Géographique)
1	05/01/2022	POSTE LOME A	TOYOTA	TOYOTA - BASSADJI	Disjonction franche	Défaut plein câble	13:14	05/01/2022	13:56	0,70	103	2,47	Défaillance matérielle	Réseau souterrain HTA	Bassadji
2	26/03/2022	POSTE LOME B	ADAMAVO	ABOUKOPE - ADAKPAME	Disjonction franche	Défaut plein câble	16:06	26/03/2022	18:07	2,02	137	9,45	Défaillance matérielle	Réseau souterrain HTA	Adakpamé
3	17/03/2022	POSTE LOME B	KAGNIKOPE	AKODESSEWA - AVELIME	Disjonction franche	Boîte de jonction_Cramé	12:54	17/03/2022	13:48	0,90	190	5,85	Défaillance matérielle	Réseau souterrain HTA	Akodessewa
4	23/03/2022	POSTE LOME B	KAGNIKOPE	AKODESSEWA - AVELIME	Disjonction franche	Défaut plein câble	15:07	23/03/2022	15:54	0,78	193	5,17	Défaillance matérielle	Réseau souterrain HTA	Akodessewa
5	21/02/2022	POSTE LOME B	KAGNIKOPE	AKODESSEWA - AVELIME	Disjonction franche	Défaut plein câble	08:26	21/02/2022	11:41	3,25	100	11,12	Défaillance matérielle	Réseau souterrain HTA	Zone portuaire
6	05/03/2022	POSTE LOME B	KAGNIKOPE	AKODESSEWA - AVELIME	Disjonction franche	Défaut plein câble	14:25	05/01/2022	17:19	2,90	0	0,00	Défaillance matérielle	Réseau souterrain HTA	Akodessewa
7	05/03/2022	POSTE LOME B	LOME AB	AKODESSEWA - KAGNIKOPE	Disjonction franche	Boîte de jonction_Cramé	05:26	05/01/2022	07:50	2,40	204	16,74	Défaillance matérielle	Réseau souterrain HTA	Akodessewa
8	31/03/2022	POSTE LOME A	ASS. DE DIEU	AMB. USA - DGI	Disjonction franche	Défaut plein câble	09:42	31/03/2022	11:40	1,97	154	10,36	Défaillance matérielle	Réseau souterrain HTA	Cité OUA
9	19/03/2022	POSTE LOME A	ARRIVEE T3	ARRIVEE T3	Manque de tension	Boîte de jonction_Cramé	21:35	20/03/2022	01:51	4,27	973	141,98	Défaillance matérielle	Poste source Lomé Aflao	CEB
10	12/02/2022	POSTE LOME B	ADAMAVO	BE LAGUNE - GBENYEDJI	Disjonction franche	Défaut plein câble	20:07	12/02/2022	21:53	1,77	175	10,57	Défaillance matérielle	Réseau souterrain HTA	Bè
11	31/01/2022	POSTE LOME A	2 FEVRIER	BIT - CFT2	Disjonction franche	Défaut plein câble	06:39	31/01/2022	07:42	1,05	34	1,22	Défaillance matérielle	Réseau souterrain HTA	Nyékonakpoè
12	23/02/2022	POSTE LOME B	CABLE DIRECT	CACTUS - CITE DU PORT	Disjonction franche	Boîte de jonction_Cramé	10:57	23/02/2022	12:08	1,18	257	10,40	Défaillance matérielle	Réseau souterrain HTA	Zone portuaire
13	30/03/2022	POSTE LOME A	DIR EAMAU	CCI - ASSEMBLEE NATIONALE	Disjonction franche	Câble pioché	10:50	30/03/2022	12:34	1,73	144	8,54	Responsabilité tiers	Réseau souterrain HTA	Kégué
14	29/03/2022	POSTE LOME C	LEGBASSITO	DARAKOPE - AHONKPE	Disjonction franche	Défaut plein câble	00:18	29/03/2022	01:22	1,07	242	8,83	Défaillance matérielle	Réseau souterrain HTA	Darakopé
15	26/01/2022	POSTE LOME D	TSEVIE_DAVIE	DERIVATION DALAVE	Disjonction franche	Isolateur_Décroché	15:08	26/01/2022	17:27	2,32	282	22,34	Défaillance matérielle	Réseau aérien HTA	Dalavé
16	09/01/2022	POSTE LOME C	KOVIE	DERIVATION MIPAZ SEGBE	Disjonction franche	Amorçage_Intérupteur Aé	10:30	09/01/2022	10:40	0,17	126	0,72	Défaillance matérielle	Réseau aérien HTA	Mipaz Ségbé
17	03/03/2022	POSTE LOME C	LEGBASSITO	DERIVATION NYAMASSI	Disjonction franche	Isolateur_Décroché	10:41	03/03/2022	11:25	0,73	222	5,57	Défaillance matérielle	Réseau aérien HTA	Nyamassi
18	12/01/2022	POSTE LOME D	TSEVIE_DAVIE	DERIVATION AEROSOUTERRAIN T	Disjonction franche	Défaut plein câble	09:00	12/01/2022	12:27	3,45	268	31,62	Défaillance matérielle	Réseau aérien HTA	Tsévié
19	29/01/2022	POSTE LOME A	TOYOTA	DERIVATION AGENCE HEDZRANAW	Disjonction franche	Isolateur_Décroché	13:24	29/01/2022	15:44	2,33	127	10,13	Défaillance matérielle	Réseau aérien HTA	Hedzranawoé
20	13/01/2022	POSTE LOME A	N'DANIDA	DERIVATION AMANDAHOME	Disjonction franche	Rupture_Conducteur aéri	22:03	13/01/2022	23:32	1,48	0	0,00	Défaillance matérielle	Réseau aérien HTA	Cité mokpokpo
21	07/03/2022	POSTE LOME D	TSEVIE_DAVIE	DERIVATION EL SHADAI	Disjonction franche	Câble pioché	10:56	07/01/2022	13:35	2,65	162	14,68	Responsabilité tiers	Réseau souterrain HTA	Tsevié
22	08/03/2022	POSTE LOME D	TSEVIE_DAVIE	DERIVATION H61 PIA	Disjonction franche	Câble pioché	18:56	08/01/2022	19:03	0,12	257	1,03	Responsabilité tiers	Réseau souterrain HTA	Adetikopé
23	16/01/2022	POSTE LOME C	KOVIE	DERIVATION KOVIE	Disjonction franche	Poteau cassé	17:34	16/01/2022	18:16	0,70	144	3,45	Responsabilité tiers	Réseau aérien HTA	Kovié
24	30/03/2022	POSTE LOME A	TOYOTA	DERIVATION MOOV ATTIEGOU	Disjonction franche	Câble pioché	14:01	30/03/2022	16:13	2,20	209	15,73	Responsabilité tiers	Réseau souterrain HTA	Attiégou
25	09/03/2022	POSTE LOME C	LEGBASSITO	DERIVATION NYAMASSI	Disjonction franche	Rupture_Attache Isolateu	18:43	09/03/2022	20:03	1,33	304	13,86	Défaillance matérielle	Réseau aérien HTA	Sogbossito
26	01/01/2022	POSTE LOME A	TSEVIE_LOME	Dérivation Togblé	Disjonction franche	Rupture_Conducteur aéri	04:34	01/01/2022	05:30	0,93	190	6,06	Défaillance matérielle	Réseau aérien HTA	Togblé
27	12/03/2022	POSTE LOME D	TSEVIE_DAVIE	DERIVATION TSEVIE VILLE	Disjonction franche	Corps étranger_Réseau	03:59	12/03/2022	06:20	2,35	136	10,93	Origine externe	Réseau aérien HTA	Tsévié
28	03/03/2022	POSTE LOME A	ASS. DE DIEU	DIR CICA-RE - AMBASSADE USA	Disjonction franche	Défaut plein câble	22:45	03/03/2022	23:59	1,23	91	3,84	Défaillance matérielle	Réseau souterrain HTA	Cité OUA
29	30/03/2022	POSTE LOME A	AVENOU	DOUANE ADIDOGOME - WONYOME	Disjonction franche	Câble pioché	18:37	30/03/2022	20:01	1,40	245	11,73	Responsabilité tiers	Réseau souterrain HTA	Wonyomé
30	05/03/2022	POSTE LOME A	AVENOU	E. CATH ADIDOGOME - DOUANE AD	Disjonction franche	Défaut plein câble	10:18	05/01/2022	11:12	0,90	153	4,71	Défaillance matérielle	Réseau souterrain HTA	Adidogomé
31	23/02/2022	POSTE LOME A	FOYER JEUNES	EPMC - ANIKO PALAKO	Disjonction franche	Boîte de jonction_Cramé	13:02	23/02/2022	14:21	1,32	181	8,15	Défaillance matérielle	Réseau souterrain HTA	Assivito
32	07/01/2022	POSTE LOME B	ADAMAVO	EPP BE KPOTA - DEPOTOIR KPOT	Disjonction franche	Défaut plein câble	15:24	07/01/2022	17:43	2,32	135	10,70	Défaillance matérielle	Réseau souterrain HTA	Zone de Kpota
33	[illegible]	POSTE LOME B	ADAMAVO	EPP BE KPOTA - DEPOTOIR KPOT	Disjonction franche	Défaut plein câble	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Défaillance matérielle	Réseau souterrain HTA	[illegible]

Figure 1: Operating data recording page

3. Methods

To succeed in this work, we began by analyzing the operating data by carefully recording the interruption current, the duration required for restarting and the quantity of undistributed energy. In addition, the number of

appearances of defects is noted during the study periods and all this collected on a departure by departure basis. Another part of this work took into account the types of faults that created the interruptions.
In order to extract from the Excel file the information necessary to process in this work, and to facilitate our task of calculating undistributed energies, we have developed an application called TR DATA 2000 in a python environment. The latter offers an intuitive and user-friendly interface with a multitude of features, requiring no programming skills for its use. The home page looks as shown in Figure 2.

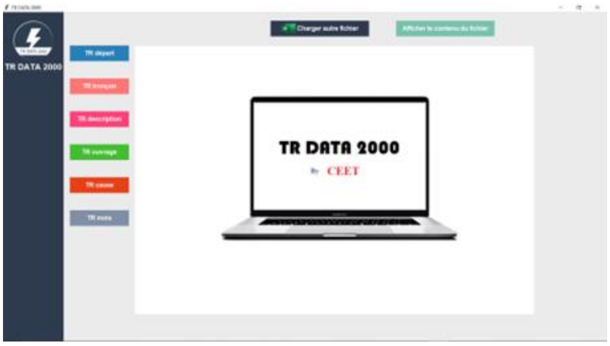

Figure 2: TR DATA 2000 home page

The application operation steps are described in Table 1. The operation of the application is explained by the flowchart in Figure 3. The features of each session are detailed in Table 1.

Table 1: Details of the functionalities of each program session

N°	Option	Details
1	TR départ	Summary of departures according to undistributed energies and appearance rate
2	TR Tronçon	Synthèse des actions suivant les tronçons
3	TR Description	Descriptions of recorded fault types
4	TR Ouvrage	Description according to the type of structure (aerial or underground)
5	TR Cause	Summary of operating failures at the time of processing
6	TR mois	Monthly processing of recorded operating data

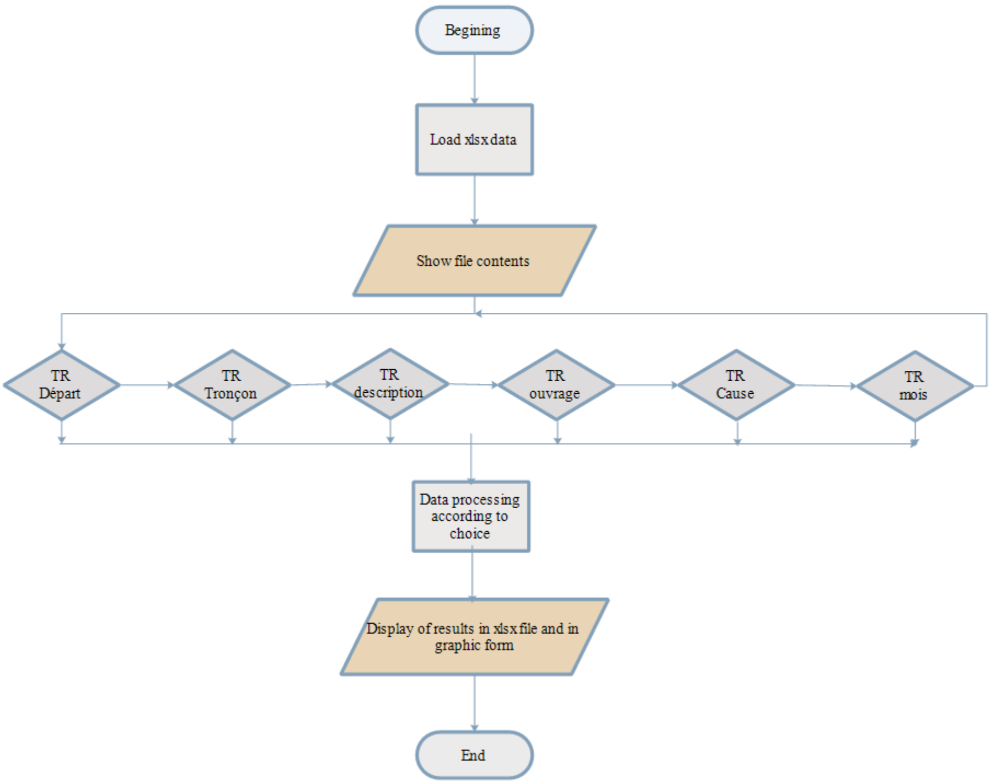

Figure 3: Operating organization chart of the TR DATA 2000 Program

4. Results

The results of the evaluation come in two forms. First, the results of data analysis by summary of departures (see table 1). Then the results of the characterization grouped according to the types of failures, the current at the origin of the fault, the durations and the causes as grouped in table 2.

Table 2: Data analysis by summary of departures

Name of Departures	Number of Appearances	Disturbance Rate (%)	Interruption Current (In A)	Duration (In Hours)	Non-Distributed Energy (In Mwh)
Adidogome	23	6.725	2526	23.2	88.933
Ass. De Dieu	21	6.140	1823	39.426	118.876
Tsevie_Lome	19	5.555	4558	30.863	223.021
Kagnikope	17	4.970	2050	28.503	108.391
Cable Direct	16	4.678	1974	22.976	94.388
Kovie	15	4.385	2096	34.273	160.592
Adamavo	14	4.093	1937	21.8233	108.946
Agouenyive	13	3.801	2127	14.240	81.068
Lome Ab	13	3.801	1997	21.173	108.992
Tsevie_Davie	12	3.508	2521	27.54	192.386
Dir Eamau	12	3.508	1886	21.4	119.158
Toyota	12	3.508	1624	20.293	104.773
Garage Central	10	2.923	1056	12.426	51.959
N'danida	9	2.631	888	12.070	42.310
Casablanca	9	2.631	833	11.953	34.285
Dogbeavou	9	2.631	825	17.783	55.565
Sototoles	9	2.631	1368	15.57	74.343
Avenou	9	2.631	1485	11.42	64.701
Legbassito	9	2.631	1704	18.183	111.885
Kpogan	9	2.631	1456	22.08	117.558
Cimtogo	8	2.339	991	4.7133	19.186
Camp Gp	7	2.046	1245	18.213	115.304
Ceet 2	7	2.046	569	16.46	12.424
Saint Kizito	6	1.754	419	8.456	26.161
Gakli	6	1.754	932	9.6	54.091
Terminal Clinker	5	1.461	652	7.85	41.025
Centre	4	1.169	914	6.696	48.167
Cooperative	4	1.169	403	6.476	21.206
2 Fevrier	3	0.877	259	2.633	7.624
Moy. Entreprise	3	0.877	549	4.863	28.458
Baguida	3	0.877	238	5.66	10.940
Phare	3	0.877	218	3.8	7.305
Cimco	3	0.877	328	4.103	12.821
Adewi	3	0.877	228	1.446	4.717
Cimtogo 2	2	0.584	386	0.983	6.792
Stade	2	0.584	86	3.72	6.324
Lct 1	2	0.584	52	2.37	0.09
Foyer Jeunes Filles	2	0.584	297	1.416	8.547
Lct2	1	0.292	0	0.05	0
Sggg	1	0.292	64	2.283	4.997
Ceet1	1	0.292	88	7.1	21.368
Arrivee T3	1	0.292	973	4.266	141.980
Hygiene	1	0.292	90	1.25	3.8475
Moyenne Entreprise	1	0.292	196	2.466	16.534
Manu Metal	1	0.292	0	0.07	0
Ceet 1	1	0.292	204	1.17	8.14
Sogbossito	1	0.292	92	5	15.732
Total				**560.32**	2705.91

The distribution linked to the analysis of the summary of departures is clearly seen in Figures 4, 5 and 6.

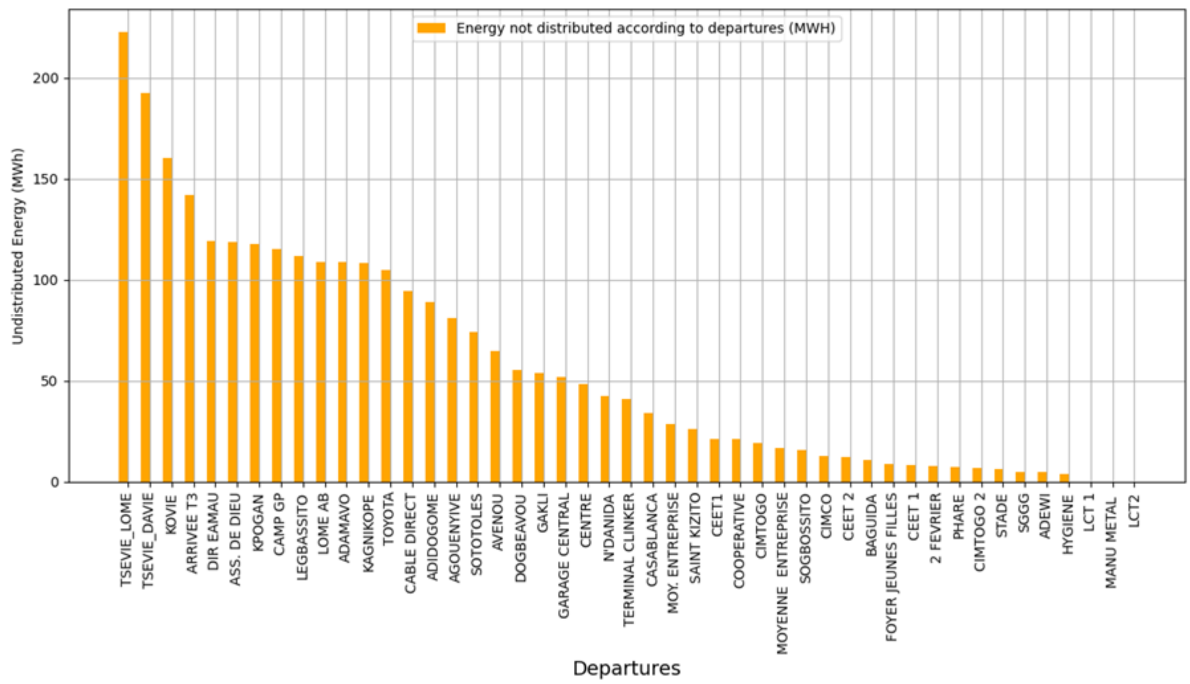

Figure 4: Summary of departures in relation to undistributed energy

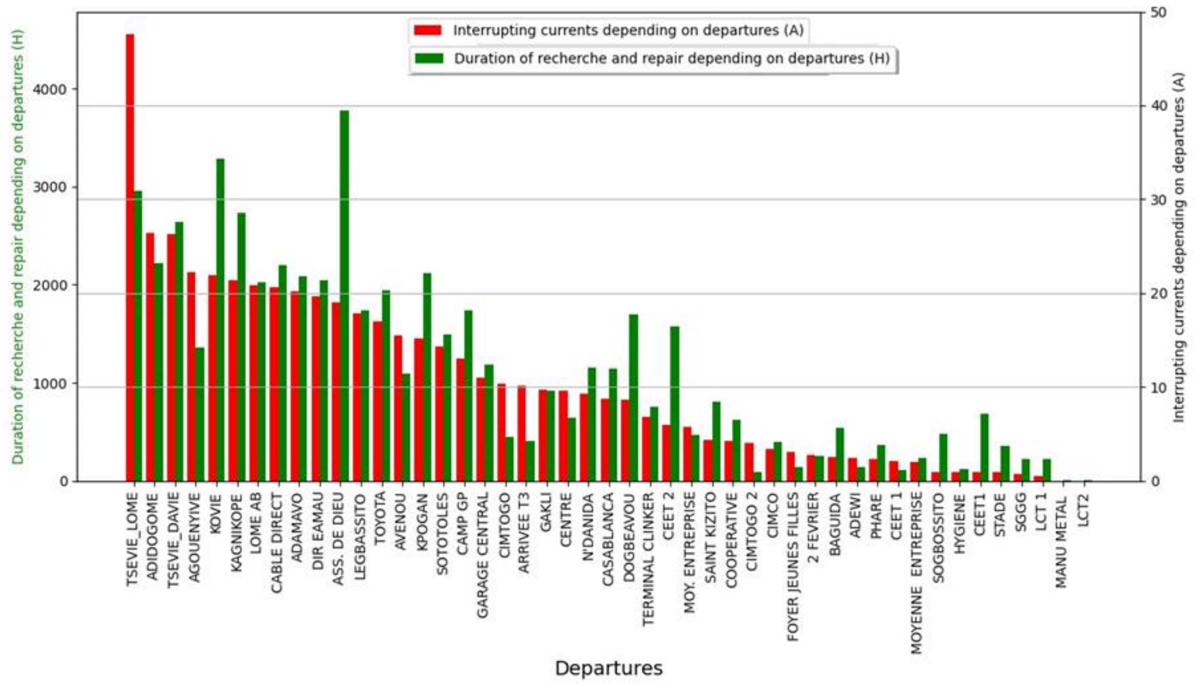

Figure 5: Graphical view of interruption currents and search/repair times according to departures

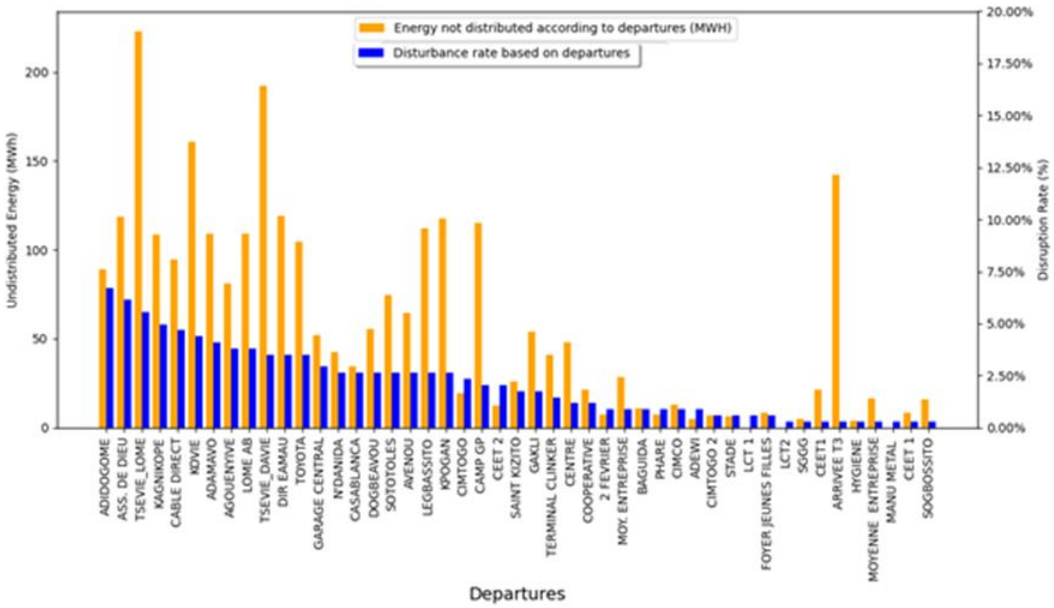

Figure 6: Graphical view of appearance rates and undistributed energy based on departures

Table 3 shows the results relating to the types of fault in relation to the interruption current, the non-distributed energies then their search and repair duration.

Table 3: Results of the characterization of the types of failures

Types of Defects	Interruption current (in A)	Undistributed energy (in MWh)	Duration of research and repair (in hours)
Busbar priming	62	5.43	2.52
Priming Mobile sockets	88	4.41	1.47
Conductor Hanging on LV pole	130	6.45	1.45
DHP_Burned	175	26.53	4.43
High voltage fuses blown at the transformer station	44	0.13	0.08
Fire MV/LV substation	282	2.89	0.30
Insulator Clip Breakage	304	13.86	1.33
Priming Overhead Switch	126 ; 215	12.36	0.17 ; 1.58
Lightning protection operation	153 ; 175 ; 188	52.39	2.03 ; 4.63 ; 2.18
Broken post	144 ; 205 ; 295	20.88	0.70 ; 1.17 ; 0.92
Falling Tree	92 ; 135 ; 168 ; 185	39.28	5.00 ; 1.58 ; 1.67 ; 1.05
Inner end Burned	99 ; 110 ; 118 ; 135	33.89	2.73 ; 6.22 ; 1.13 ; 1.83
Priming HTA Table	75 ; 79 ; 88 ; 101 ; 110 ; 116 ; 152 ; 165	83.61	2.08 ; 1.52 ; 7.10 ; 3.20 ; 0.10 ; 4.42 ; 3.05
Foreign body Network	54 ; 96 ; 122 ; 129 ; 136 ;160 ;189	58.57	1.38 ; 3.17 ; 0.60 ; 0.85 ; 2.35 ; 1.72 ; 1.85 ; 1.60
Unhooked Insulator	97 ; 127 ; 138 ; 160 ; 174 ; 222 ; 265 ;282	114.83	1.30 ; 2.33 ; 3.73 ; 2.90 ; 0.73 ; 3.07 ; 2.32
Damaged Transformer	71 ; 89 ; 103 ; 113 ; 145 ; 159 ; 173 ; 186 ; 249 ; 250	179.62	35.55
Outer end Burned	0 ; 87 ; 147 ; 155 ; 156 ; 169 ; 172 ; 174 ; 177 ; 185 ; 245 ; 672	151.2	0.07 ; 2.35 ; 0.13 ; 2.15 ; 1.07 ; 4.77 ; 1.45 ; 1.33 ; 2.43 ; 2.08 ; 2.13 ; 1.45
Burned junction box	[12 ; 973]	324.12	[0.05 ; 2.85]
Breakage Overhead conductor	[0 ; 260]	279.51	[0.05 ; 4.40]
Cable drawn	[0 ; 257]	364.44	[0.05 ; 375]

Regarding undistributed energies versus fault types, Figure 7 outlines the setup.

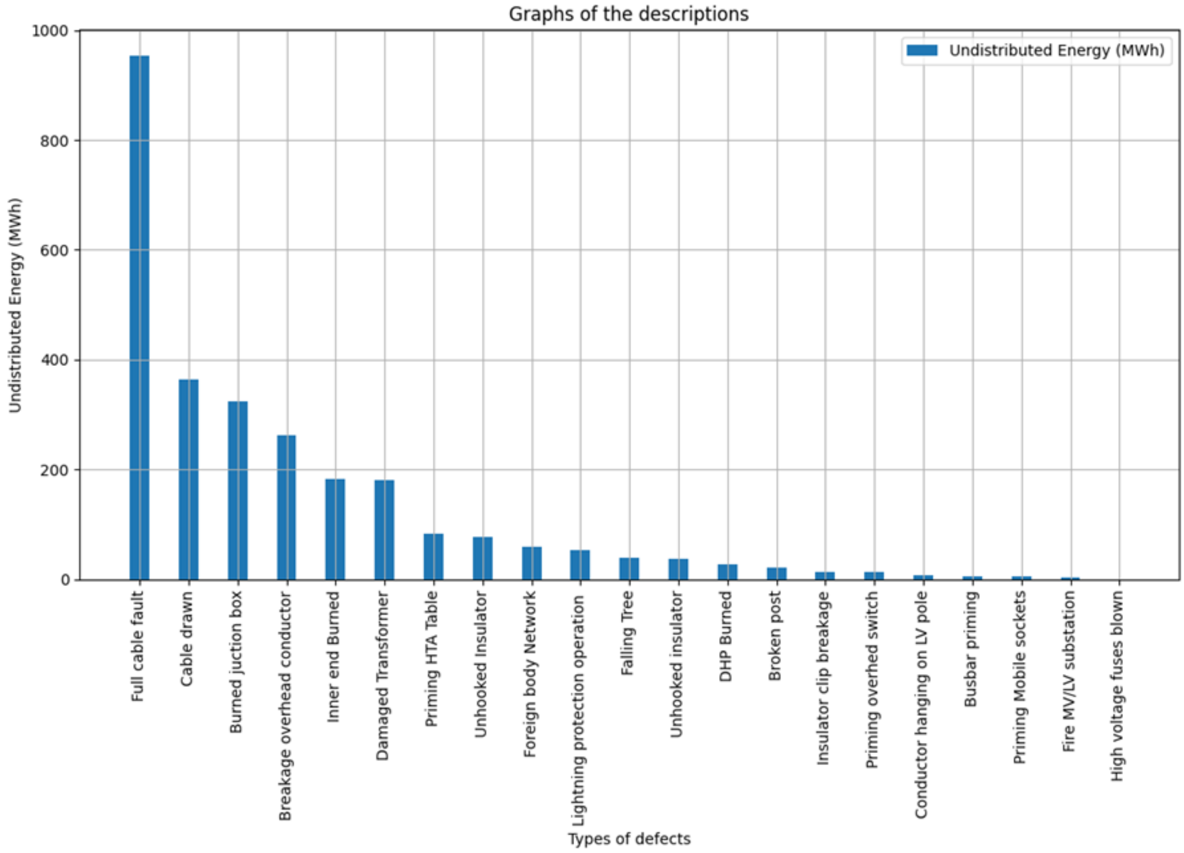

Figure 7: Variation of undistributed energy versus fault types

5. Analysis and Discussion

Subscription to the national electricity network continues to be a luxury for the populations of our sub-region and particularly the Togolese. The electricity bill that consumers in Togo receive is the last link in a chain that connects companies from four distinct trades which are grouped succinctly by Figure 8, [25].

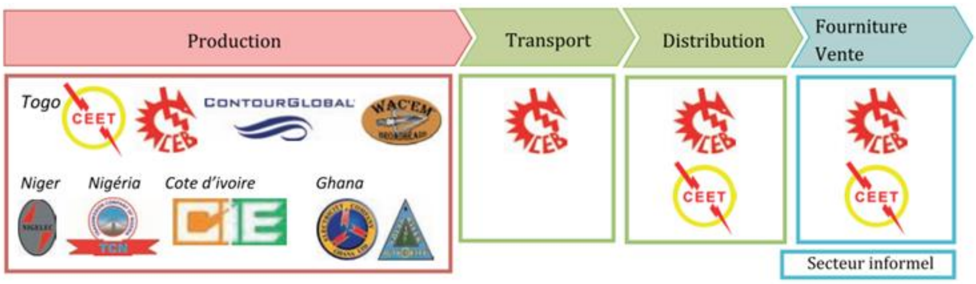

Figure 8: Companies in the value chain of electricity sold in Togo [25]

If we refer to this chain, it is clear that the delivery of electricity to subscribers is carried out through a very large network. For this reason, breakdowns or defects can appear anywhere. In the context of this work, which only concerns the CEET network, several types of faults that could interrupt electricity consumption were noted. Unfortunately, for some downtime, where consumption is suspended, production continues. The detection and repair time is sometimes long, sometimes leading to undistributed energy (END) for the distribution company. Although this work does not deal with NDT, in fact for customers, the power outage can cause the shutdown of collective transport systems and traffic lights. Others may be stuck in tall buildings with broken air conditioning, elevators and hydraulic pumps. By nightfall, the city would be plunged into darkness. A power outage in the hot season can also lead to chronic kidney failure, organ failure via subsequent dehydration or exposure to heat (air conditioning breakdown). A sufficiently extensive and/or lasting interruption of service may also lead to an influx of people with respiratory failure who are deprived of their home assistance device into the emergency room.

In table 1, we find up to 223.02111 MWh of END on the Tsévié -Lomé departure for an interruption duration of 30.86333 hours during the year 2022. The observed interruption current amounts to at 4558 A with a disturbance rate of 5.55%. On these network routes, we can understand that consumption is more domestic, not creating too much enthusiasm among agents for the detection and repair of faults. On the other hand, at CIMTOGO, one of the large consumers, the END is only 18.18681 MWh for an interruption duration of 4.71333 hours, explaining that particular attention is reserved for industries. The disturbance rate at this level is 2.339% and an interruption current of 991 A. observations confirmed through the MANU METAL, LCT2 departures where although there was a single fault, the ENDs are zero. Same for LCT1 which has 0.09 MWh of END for a duration of 2.37 hours. On the SOTOTOLES departure, we observe the same phenomenon through the interruption current (1368 A), 15.57 hours as detection and repair duration and an END of 74.3436 MWh for the account of the year of study. Let us nevertheless emphasize that the ADIDOGOME departure takes precedence over the number of appearances raised to 23 for a rate of 6.7251%, 2526 A for interruption current, a duration of 23.2 hours and an END of 88.9338 MWh. Which is not the case for the departure of FEBRUARY 2 which only had a disturbance rate of 0.8771%, an END of 7.624 MWh, 05 appearances and 2.633 hours of detection and repair, but which is supplied residential areas and no businesses per se on the latter. We deduce here the random nature of the breakdowns or defects of which there are 20 identified in this work and detailed in table 2.

In this table 2, the drawn cable fault, which is an operation of human action during public works often, occurred at currents between a very wide interval: from 0 to 257 A. The duration of research and repair varies between 0.05 hours to 375 hours. The faults: burnt junction box and broken overhead conductor which also caused enormous ENDs (324.12 MWh and 279.51 MWh) are also seen at currents ranging from 12 to 973 A and 0 to 260 A. The durations of research and repair are very varied for burnt exterior end defects. The same applies to the faults: Unhooked insulator, network foreign body and MV panel priming. The duration of research and repair are still well known and limited for certain faults, namely: Busbar priming, mobile socket priming, conductor attached to LV pole, burnt DHP, blown MV fuse at the station and rupture of insulator clip. These cases can be explained by the fact that these faults are visible since the network is overhead and that the beginnings can be noticed before getting worse. Figure 7 presents in graphic view the behavior of the faults identified in relation to the undistributed energies.

From all of the above, the results of the evaluation show that there were 560.32 hours of interruptions on the CEET HTA network in the city of Lomé. This generated 2705.93 MWh of undistributed energy for the year 2022. In terms of cost, if we consider the average electricity rate at 120 CFA Franc per kilowatt hour, we find a loss of 324,711,600 CFA Franc per kilowatt hour. year. The results confirm that the financial impact is very exorbitant.

6. Conclusion

This manuscript focuses on the evaluation of undistributed energies and their impacts, during breakdowns in the CEET electrical network. To achieve this, we considered the operating data of the HTA network of the city of Lomé during the year 2022. The information processed concerns departures, sections and the types of faults observed; all considered with expressions or language used between CEET technicians. The important factors taken into account are: the energy not distributed during the duration of the fault; the duration of the search and repair of the defect; the interruption current when the fault appears and the departures concerned.

To succeed, two types of grouping are carried out. The first concerns departures and the second the types of faults encountered. Factors such as departures, number of occurrences, disturbance rate, interruption current, detection and repair duration and undistributed energy are considered.

An application named TR DATA 2000 was developed in Python 3.10 for this purpose. It made it possible to extract from the Excel file the information necessary to process in this work by facilitating sorting, calculations and graphic representations.

The results show that there were 560.32 hours of interruptions on the network studied during the year 2022. This generated 2705.93 MWh of undistributed energy. In terms of cost, if we take the average electricity rate at 120 CFA Franc per kilowatt hour, we find a loss of 324,711,600 CFA Franc for the year considered. The results confirm that the financial impact is very exorbitant. It is then necessary to extend the work first to all CEET HTA networks in Togo. Then find solutions to spontaneous interruptions of production at the moment when breakdowns occur in order to avoid financial losses linked to undistributed energy. A final aspect would be to take steps to avoid these types of faults or at least close off the network.

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