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Electrical Distribution Reliability

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ABSTRACT: The continuous power outages and interruptions in the instantaneous electrical parts distribution network always adversely affect the health, safety and economic activity and the low level of production in the industrial sector .the paper discusses the reliability of the electric distribution network through the study of indicators of reliability analysis technology which is characterized as a fast, efficient and know that by SAIFI, SAIDI, CAIDI, MAIFI, CTAIDI, in order to repeat the failures at different times for Lines 33KV and 11KV, from readings to the control station for the automated distribution network for the Omdurman area.

KEYWORDS: SAIFI, SAIDI, CAIDI, CAIFI, MAIFI, CTAIDI, distribution, reliability**.**

I.INTRODUCTION

Provide consumers with electric power in the range of distribution of electrical networks in a way that the quality of service and high reliability, and that the importance of the reliability of electrical distribution networks as a factor of development and economic growth, as studies have shown which confirmed that 80% of interruptions in the supply of electric power resulting from the problems and breakdowns in the electrical distribution networks [1,2] .

Electrical distribution systems are usually radially so exposed to the rates of interruption because of system components of transformers and breakers and switching devices, the growing demand for customers to provide high-quality service makes requirements for improvements in the electrical distribution network.

The main objective of assessing the reliability of the electrical distribution network, a qualitative analysis of indicators of to improve the reliability of supply voltage and planning system after analysis, there are two types of analysis: -

1 Monte Carlo approach to simulate the user to calculate the reliability indices.
2 Bayesian network approach, a more effective way of theoretical models to see replacement based on theoretical possibilities.

The main problems in the supply of energy are the consequences of errors in one or part of the components of a network failure overhead lines or cables[1,2,10,11,13,14].

II. METHODOLOGY

Using the analysis of the automatic control system for electrical distribution networks by using reliability indices in the case study area of Omdurman distribution network by describing the data readings and analytical tables.

Collect data failure rate of the distribution system to calculate the reliability in addition to collect all the data from all the interruptions caused by shedding load and the breakdown of the system scheduled maintenance or unscheduled.
Data were used to calculate the reliability of the network indices city of Omdurman.

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III. RELIABILITY INDICES

The main reason for power outages due to the fact that there are errors in the distribution network, such as wind, rain, trees, animals, and called for all the mistakes claim indirectly for the disappearance of electrical disappear either ill unforced errors such as car accidents, equipment breakdowns .

Indicators are used to assess the reliability of the electric distribution network and analyse the data set of network, The indicators used in the analysis of the electrical distribution network[3,4,5] .

1- System Average Interruption Frequency Index (SAIFI):-
Represents the average frequency of interruptions faced by every consumer subscribers in the electrical distribution system in a specific area and a specific time.

$$SAIFI = \frac{\text{Total Number of Customer Interruptions}}{\text{Total Number of Customers Served}} \quad \dots (1)$$

$$= \frac{\sum N_i}{N_T} \quad \dots(2)$$

$N_i \equiv$ The number of consumers affected by the rupture of nutrition during the time period studied
$N_T \equiv$ The total number of consumers associated the studied area.

2- System Average Interruption Duration Index (SAIDI) :-
Is an indication of the time required to restore electricity to consumers affected by the electrical interruption.

$$SAIDI = \frac{\text{Total Duration of Customer Interruptions}}{\text{Total Number of Customer Served}} \quad \dots(3)$$

$$= \frac{\sum r_i N_i}{N_T} \quad \dots(4)$$

$r_i \equiv$ Duration of interruption of nutrition in each case interruption

3- Customer Average Interruption Duration Index (CAIDI) :-
Index shows the average time required to restore electric current to consumers affected by the interruption.

$$CAIDI = \frac{\text{Total Duration of Interruptions}}{\text{Total Number of Interruptions}} \quad \dots(5)$$

$$= \frac{\sum r_i N_i}{\sum N_i} = \frac{SAIDi}{SAIFI} \quad \dots(6)$$

4- Customer Total Average Interruption Duration Index (CTAIDI):-
Represents the average amount of time consumers have suffered a interruption
.

$$CTAIDI = \frac{\text{Total Duration of Customer interruptions}}{\text{Total Number of Customer Interruptions}} \quad \dots (7)$$

5- Customer Average Interruption Frequency Index (CAIFI):-

Measures the average number of interruptions per.

$$CAIFI = \frac{\text{Total Number of Customer Interruptions}}{\text{Total Noumber of Customer Interrupted}} \quad (8)$$

6- Momentary Average Interruption Frequency Index (MAIFI):-
Is an indicator of the average interruption frequency for a moment and measures the average number of interruptions during the interim period of time.

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$$\text{MAIFI} = \frac{\text{Total Number of Momentary Customer Interruptions}}{\text{Total Number of Customers Served}} \quad \ldots(9)$$

$$= \frac{\sum \text{IDN}_i}{N_T} \quad \ldots(10)$$

ID ≡ Number of interrupting device operations.

7- Average Service Availability Index (ASAI):-

The average service availability index is the ratio of the number of hours that the service is available to consumers on the total hours required to be provided to consumers during a specific time period. This is sometimes called the service reliability index [6,12,15].

$$\text{ASAI} = \frac{\text{Customer Houer Service Availability}}{\text{Customer Houer Service Demand}} \quad \ldots(11)$$

$$= \frac{\text{SAIDI}}{\text{SAIFI}} = \frac{8760-\text{SAIDI}}{8760} \quad \ldots(12)$$

$$= \left(\frac{1-(\sum r_i N_i)}{N_T T}\right) 100 \quad \ldots(13)$$

T = Time period under study, hours.

IV. CASE STUDY OF ELECTRICAL DISTRIBUTION OMDURMAN AREA RELIABILITY

Electricity distribution network consists of Omdurman stations distributional represents the link between the transmission and distribution lines, and these stations of different capacities are converted 110kv to 33kv and 11kv. Consider the study to the distribution system through the network reliability medium voltage lines 110kv to 33kv and 11kv, 33kv lines that supply the transformers reduction to 11kv and at distribution sub-stations. The 11kv lines that supply the transformers reduction to 240v and 415v line to line.

Network and the distribution of Omdurman area exposed some areas where interruption .
where it is to drop the following cases :-

1- transient errors
2- maintenance work
3- commends the work
4- equipment failures and breakdowns General (Faults directly) [7,8].

The following table(1) shows illustrates the inter drop to 33kv lines during the year (2011).

The table(2) shows the values of readings CAIDI during the year to 33KV lines. Paper find that the system of distribution network in Omdurman area with high reliability during the month of January and February and then declining in March and then start with increase reliability and so decrease the values CAIDI and affected by the change in the values of SAIFI and SAIDI and that in the months of April and May until you reach the highest reliability during the year in June to start downward in July to reach its lowest value in the months of August and September, and that with the highest value for Said. The value remains CAIDI the seesaw in the average rate in the months October, November and December shown that at Figure (3) and Figure (4) .

Table (1) 33kv Lines readings in 2011 from the control room of Omdurman

month	The total time of the breakdowns	Runtime total	Outage	The total number	The total number of interruptions
January	26:47:00	11904	12	16	19
February	65:16:00	37632	12	16	16

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March	90:02:00	11904	8	16	16
April	33:08:00	11520	12	16	20
May	33:07:00	11904	14	16	32
June	19:13:00	12240	9	17	25
July	107:03:00	46128	31	62	36
August	65:09:00	12240	11	17	42
September	117:38:00	12240	12	17	29
October	28:55:00	12648	8	17	18
November	51:08:00	12960	9	18	16
December	73:39:00	14136	11	19	33

Figure (1):- The proportion of the total number to the total number of interruptions at 33kv

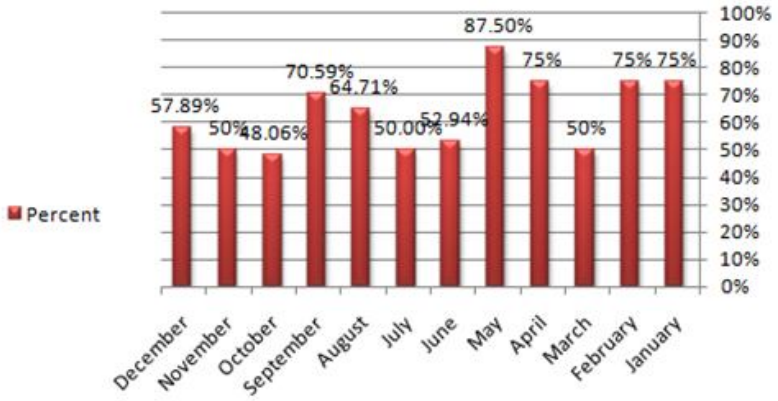

Figure (2):- The proportion of the total time of interruptions to the total operation time

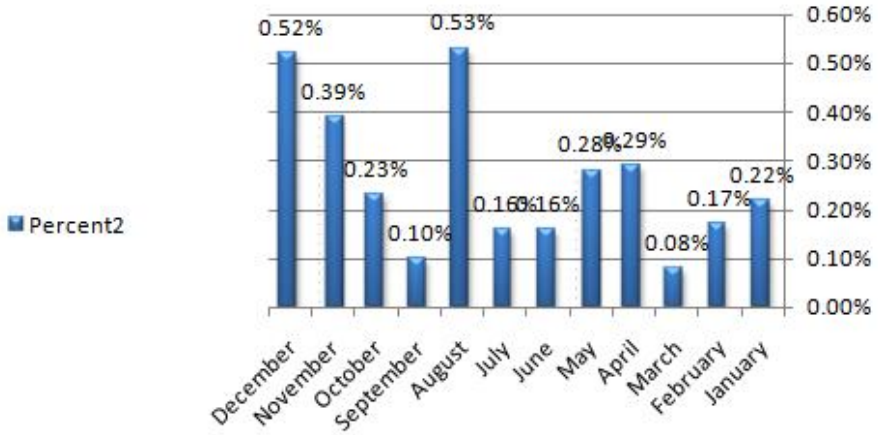

Table (2) CAIFI ,MAIFI ,CTAIDI ,CAIDI ,SAIDI ,SAIFI For 33kv of the distribution network Omdurman

Month	CAIFI	MAIFI	CTAIDI	CAIDI	SAIDI	SAIFI
January	1.583	.75	1.41	.00189	.00225	1.1875
February	1.333	.75	4.079	.00173	.00173	1
March	2	.5	5.63	.00756	.00756	1
April	1.667	.75	1.66	.002296	.00287	1.25
May	2.29	.875	1.035	.00139	.002781	2

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June	2.78	.529	.769	.00107	.00157	1.47
July	1.161	.5	2.97	.004	.002320	.58
August	3.818	.647	1.55	.00822	.005322	2.47
September	2.417	.706	4.07	.00565	.00961	1.7
October	2.25	.47	1.521	.0021567	.002286	1.06
November	1.778	.5	3.196	.00444	.003945	.889
December	3	.5789	2.23	.00299	.00521	1.7368

Figure (3):- SAIFI ,CTAIDI ,CAIFI Sketch shows during the year 2011 to lines 33kv

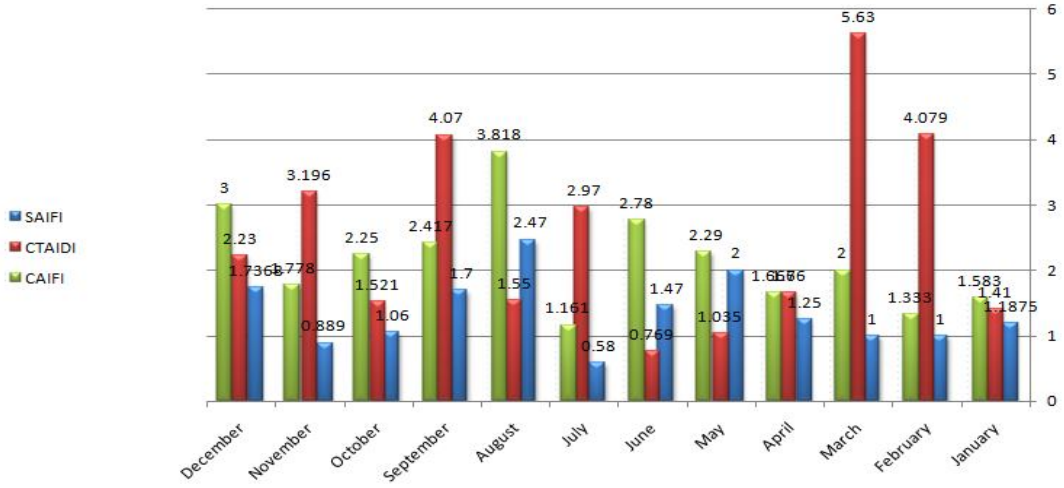
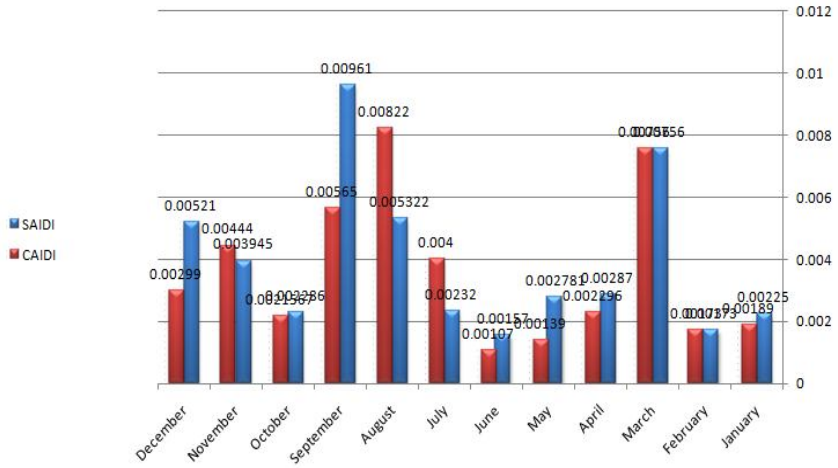


Figure (4):- SAIDI ,CAIDI Sketch shows during the year 2011 to lines 33kv



As for the lines of 11 kV, the values of CAIDI are not rising, but in two months, November and December, the lowest reliability of months during the year, and that the values of SAIFA and SAIDI stable and the stability of these values lead to stability values CAIDI thus decrease the period of interruption at consumers. Table (3) ,Table (4), Figure (7) and figure (8).

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Table (3) 11kv Lines readings in 2011 from the control room of Omdurman

Month	The total time of the breakdowns	Runtime total	Outage	The total number	The total number of interruptions
January	131:39:00	61008	52	82	131
February	191:31:00	55104	49	82	141
March	210:23:00	61008	58	82	209
April	326:00:00	59040	63	82	255
May	348:42:00	61008	65	82	347
June	254:24:00	66960	65	93	284
July	508:58:00	159216	130	214	384
August	412:46:00	66960	75	93	398
September	209:20:00	66960	57	93	269
October	138:47:00	69936	64	94	237
November	128:10:00	67680	46	94	124
December	287:45:00	72912	57	98	159

Figure (5):- The proportion of the total number to the total number of interruptions at 11kv

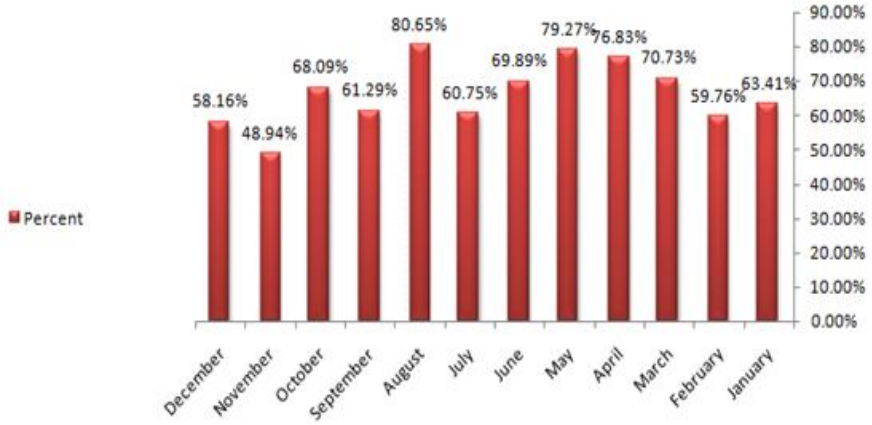

Figure (6):- The proportion of the total time of interruptions to the total operation time at 33kv

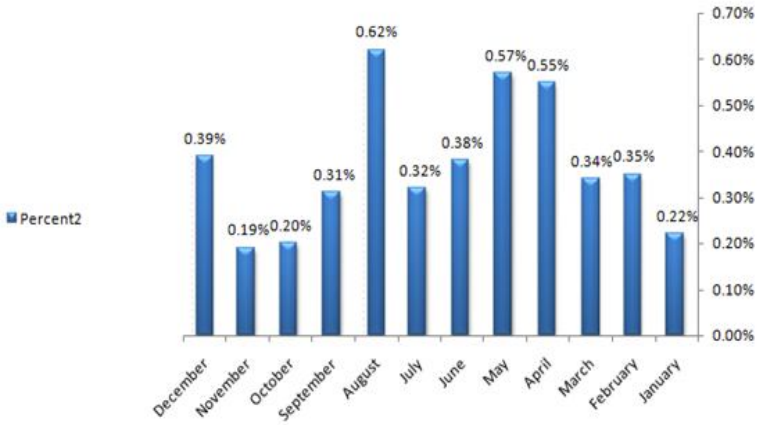

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Table (4) CAIFI ,MAIFI ,CTAIDI ,CAIDI ,SAIDI ,SAIFI For 33kv of the distribution network Omdurman

month	CAIFI	MAIFI	CTAIDI	CAIDI	SAIDI	SAIFI
January	2.52	.634	1.005	.00135	.002157	1.5976
February	2.878	.598	1.36	.00202	.003476	1.7196
March	3.6	.7	1.007	.00135	.00345	2.549
April	4.05	.768	1.28	.00177	.00552	3.11
May	5.34	.79	1.005	.00135	.0057	4.23
June	4.37	.69 9	.896	.00126	.003799	3.0212
July	2.95	.6	1.325	.00178	.0032	1.7935
August	5.3	.8	1.052	.00144	.006165	4.279
September	4.72	.613	.778	.0011	.003126	2.892
October	3.7	.68	.586	.000787	.001984	2.521
November	2.696	.489	1.034	.007187	.00948	1.319
December	2.78	.58	1.81	.00235	.00395	1.622

Figure (7):- SAIFI ,CTAIDI ,CAIFI Sketch shows during the year 2011 to lines 11kv

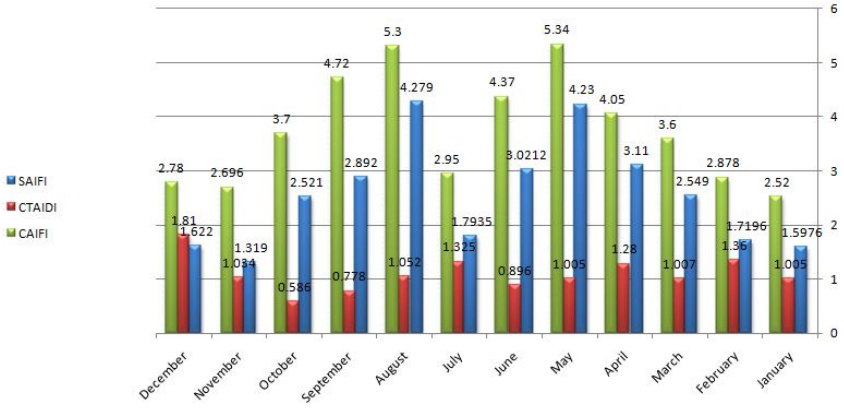
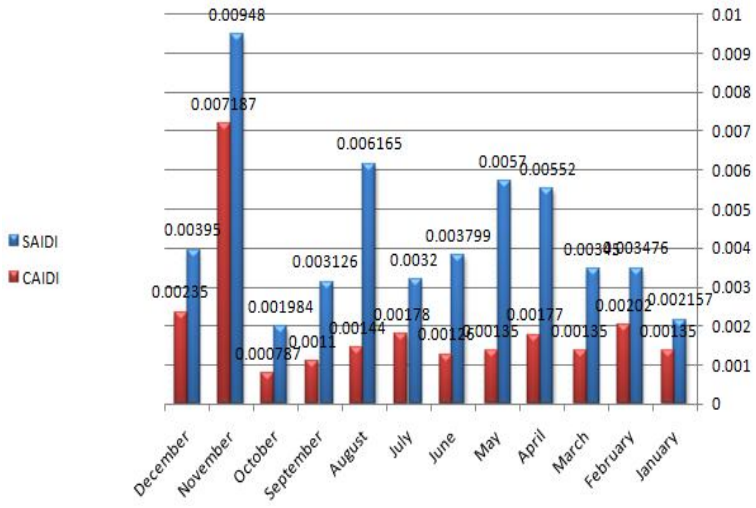


Figure (8):- SAIDI ,CAIDI Sketch shows during the year 2011 to lines 33kv



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V.CONCLUSION

The study observed that CAIDI representing an indicator to measure the automated transformation of the electricity supply interruptions for customers and automated transformation process reduces the number of consumers affected by the interruptions.

Also, for the automated control a prominent role in the operation more efficient and by isolating and shutting down and restarting the affected areas interruptions , The transformation process in the feed Power Supply divided into sections according to consumer areas can reduce the interruptions thereby increasing reliability as measured by MAIFI , SAIFI. The reliability study will help in the work of the future plans in network expansion and rehabilitation, as well as maintenance of the lines with a number of times the most interruption.

VI .RECOMMENDATIONS

To increase the reliability of the distribution network Omdurman This means reducing the period of interruption for consumers and that corrective maintenance and preventive maintenance of the lines most of the time of interruption during the study and the establishment of a secondary feed lines to minimize outage time.

VII .ACKNOWLEDGEMENT

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