ANALYSIS OF SAIDI SAIFI'S VALUE AS AN INDEX OF THE RELIABILITY OF THE ELECTRIC POWER SYSTEM AT PT PLN ULP SINABANG

Abdilla Naufal¹, Hamdani², Pristisal Wibowo³

^{1,2,3}Universitas Pembangunan Panca Budi

ABSTRACT

The need for electrical energy that continues to increase in line with economic growth and community welfare demands optimal electricity distribution system reliability. Disruptions to the distribution network are often the main cause of power outages, which impact the quality of service to customers. PT. PLN (Persero) ULP Sinabang seeks to improve the efficiency and effectiveness of the distribution system to minimize blackouts and improve service quality. The evaluation of network reliability was carried out by analyzing the System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) as the main parameters in measuring the performance of electricity distribution. The higher the value of these two indices, the worse the performance of the distribution system in maintaining the continuity of electricity supply. Through the analysis of the SAIDI and SAIFI values in 2023, this study aims to provide recommendations to reduce the rate of blackouts and improve the reliability of the power grid in the PT. PLN (Persero) ULP Sinabang.

Keyword : Distribution Network Reliability; Power Outages.

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Email : abdillanaufal@gmail.com			

1. INTRODUCTION Background

The need for electricity will continue to increase along with economic growth and community welfare. Upgrading power plants and existing infrastructure capabilities is needed to ensure the distribution of electricity to consumers is smooth and meets standards.

If there is a power outage, there is usually a disruption in the distribution system lines. As a company engaged in the provision of electrical energy, PT PLN (Persero) ULP Sinabang strives to make a profit, so that effectiveness and efficiency are needed to reduce losses caused by the use of equipment or materials in the electricity system. By conducting an evaluation, it is hoped that the high level of blackouts can be reduced to improve service and electricity quality to consumers. The Index Interruption Average Duration (SAIDI) and Index Interruption Frequency (SAIFI) values of the distribution network system are one of the management performance parameters in the field of electricity, especially related to distribution. This value will indicate the number of failures or power outages that bothered customers. The increasing value of SAIDI and SAIFI of the system indicates poor management performance. The values of SAIDI and SAIFI are affected by the failure rate of the distribution network system, which comes from the probability of failure of the distribution network equipment or the probability of failure at the point of load.

This study aims to compare the results of the calculation of the reliability index values of SAIDI and SAIFI PT PLN (Persero) ULP Sinabang in 2023 to determine the reliability of the distribution network of PT PLN (Persero) ULP Sinabang regarding the evaluation of blackouts, with the hope of reducing high levels of blackouts and improving consumer service.

RESEARCH METHODS

This final project is a type of quantitative research, which means collecting data based on measurements and solving the results mathematically. This study will analyze the calculation of the reliability of the distribution network of PT PLN (Persero) ULP Sinabang using the SAIDI and SAIFI values taken from the Integrated Complaints and Complaints Application (APKT) in 2023. In addition, the author will calculate the loss of undistributed power and financial losses due to the interruption of the outage.

RESULTS AND DISCUSSION

The following is the data required for the analysis of the calculation of the reliability index of the electricity distribution system at PT PLN (Persero) Sinabang Customer Service Unit:

Table 1. Data monitoring of distribution system disruptions of PT PLN (Persero) ULP Sinabang in 2023
(Source: PT PLN (Persero) ULP Sinabang)

Moon	Data Monitoring				
	Number of	Number of	Jam x Plgn	Number of	Long Outage
	Customers	Customers	Extinguished	Distractions	(Hours)
		Deleted			
January	26.009	15.260	32.059,98	22	16,89
February	26.052	5.042	4.230,46	30	16,71
March	26.102	4.137	2.501,52	21	12,92
April	26.125	3.096	1.952,69	26	16,41
May	26.126	11.573	5.720,40	38	19,36
June	26.153	4.369	5.003,55	21	20,8
July	26.198	8.151	9.343,67	38	27,11
August	26.247	1.826	3.227,67	38	20,89
September	26.276	18.840	25.259,74	24	22,9
October	26.326	7.590	5.178,81	32	17,71
November	26.404	16.356	24.711,76	46	37,49
December	26.457	9.401	4.460,03	37	17,05

Analysis of the value of the SAIDI and SAIFI indices

The reliability index value of the SAIDI and SAIFI systems of PT. PLN (Persero) ULP Sinabang from January to December 2023 is presented in the following table 4.2, based on the results of the calculations that have been carried out:

Table 2. The recapitulation of the results of the calculation of the system reliability index (SAIDI and SAIFI) in 2023 on the 20 kV distribution system of PT. PLN (Persero) ULP Sinabang

Moon	System Reliability Index			
MOOII	SAIDI (hours/plg)	SAIDI (min/plg)	SAIFI (times/plg)	
January	1,2326	73,956	0,5867	
February	0,1624	9,744	0,1935	
March	0,0958	5,748	0,1585	
April	0,0747	4,482	0,1185	
Мау	0,219	13,14	0,443	
June	0,1913	11,478	0,1671	
July	0,3567	21,402	0,3111	
August	0,123	7,38	0,0696	
September	0,9613	57,678	0,717	

October	0,1967	11,802	0,2883
November	0,9359	56,154	0,6195
December	0,1686	10,116	0,3553



Figure 1. SAIDI Index Chart for 2023

The SAIDI index goes up and down every month from January to December, as shown in chart 4.1, which shows that the index peaked at 73,956 in January, which shows that the higher the index value, the lower the level of system reliability. The value of the SAIDI index itself is obtained from the average duration of blackouts multiplied by the number of customers who are blacked out divided by the number of customers recorded in the pad, so that the value increases. These figures show the highest numbers for the SAIDI index this month, as shown in table 4.2. The cause of the surge in SAIDI value in January was due to a fire at one of the plants in the Sinabang ULP area, namely PLTD Kampung Aie. The fire at the plant had an impact on the lack of affordable power at the Sinabang ULP which was originally 7 MW to 3.5 MW, resulting in the length of the duration of the power outage and the frequency of power outages in the Simeulue islands where the Simeulue electricity system is an Isolated System.

In April, the SAIDI index reached 4,482. The value of the SAIDI index itself is obtained from the average duration of blackouts multiplied by the number of blackouts divided by the lowest number of customers. The value of this index this month is influenced by the smallest or lowest number of customers outage during the 2023 period (see table 4.1).

Meanwhile, the comparison of the SAIFI index for 1 (one) year period from January to December 2023 can be illustrated with the following graph:

0,8

0,7

0,6

0,5

0,4

0,3

0,2

0,1 0



Figure 2. SAIFI Index Chart for 2023

SAIFI

For the SAIFI Index itself, its value goes up and down every month, as shown in graph 4.2, which shows that it peaked in September, with a value of 0.717, which indicates that the month will have the highest value of the SAIFI index during 2023. A higher value of the index indicates a lower level of system reliability. This month has a higher frequency of outages than the previous month, which results in the size of the SAIFI index.

Analysis of the Reliability of the Distribution System of PT PLN ULP Sinabang

To see the reliability of the distribution system at PT PLN ULP Sinabang, it can be compared with the cumulative target data with the cumulative realization data. Where the cumulative target has been determined by the Meulaboh Customer Service Implementation Unit (UP3) which directly oversees the Sinabang Customer Service Unit (ULP). A comparison of these data can be seen in table 4.3.

Table 3. comparison of cumulative target data with SAIDI and SAIFI cumulative realization data in 2023

	SAIDI		SA	IFI
Moon	Target	Cumulative	Target	Cumulative
	Cumulative	Realization	Cumulative	Realization
January	32,41	73,956	0,32	0,5867
February	61,66	83,7	0,63	0,7802
March	94,07	89,448	0,98	0,9387
April	124,72	93,93	1,29	1,0572
May	156,95	107,07	1,62	1,5002
June	188,14	118,548	1,94	1,6673
July	219,15	139,95	2,26	1,9784
August	251,19	147,33	2,6	2,048
September	282,22	205,008	2,91	2,765
October	313,39	216,81	3,23	3,0533
November	344,31	272,964	3,55	3,6728
December	376,27	283,08	3,88	4,0281



Figure 4. Comparison chart of cumulative targets with cumulative realization of SAIFI in 2023

As shown in graphs 4.3 and 4.4, the cumulative targets of SAIDI and SAIFI are directly proportional to time. The rate of cumulative realization also moves directly with time.

One way to find out if the distribution system of PT. PLN (Persero) ULP Sinabang reliably SAIDI is by comparing the value of the cumulative realization index to the cumulative target. As shown in graph 4.3, the cumulative realization chart of the SAIDI index is on average below its cumulative target chart, which means that the distribution system of PT. PLN (Persero) ULP Sinabang is reliable in SAIDI. However, in January and February, the cumulative realization chart of the SAIFI index passed its cumulative target point. From March to October, the cumulative realization chart of the SAIFI index crossed its cumulative target point. In November, the cumulative realization chart of the SAIFI index crossed its cumulative target point through December. Figure 4.4 shows this, with a cumulative target of 3.88 and a realization of 4.02.

Based on SPLN 59:1985, SUTM networks with automatic separators in the middle of the network are considered reliable with SAIFI \leq 2,415 outages/subscriber/year and SAIDI \leq 12,842 hours/subscriber/year. However, the reliability index of PT PL ULP Sinabang is 4.0281 outages/customer/year and SAIDI is 4.718 hours/customer/year. This shows that the distribution system of PT PLN ULP Sinabang is less reliable.

Power Loss Cost Analysis

After analyzing the reliability value of the distribution network at PT PLN (Persero) ULP Sinabang using the SAIDI and SAIFI indices, the next step is to analyze the economic value in the form of losses from energy that is not distributed due to power outages using a formula. At this stage, the value of undistributed energy (ENS) is calculated with the basic electricity tariff that has been set by the Minister of Energy and Mineral Resources and PT PLN (Persero) in 2023, taking the average price of IDR 1440.70. The calculation method can be seen as follows:

Economic Loss = ENS x Basic Electricity Tariff (TDL)

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= ENS x Rp 1440.70
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Table 4. Results of the analysis of cost losses due to undistributed energy of ULP Sinabang in 2023

Moon	Unchanneled power	Cost Loss
	(kWh)	(Rs)
January	5359	IDR 7,720,711,30
February	605	IDR 871.623,50
March	332	IDR 478,312,40
April	224	IDR 322,716,80
May	726	IDR 1,045,948,20
June	735	IDR 1,058,914,50
July	1293	IDR 1,862,825,10
August	673	IDR 969.591,10
September	4068	IDR 5,860,767,60
October	947	IDR 1,364,342,90
November	4007	IDR 5,772,884,90
December	596	IDR 858,657,20
Total	19565	IDR 28,187,295,50

Based on the calculation of PT PLN (Persero) ULP Sinabang's power losses in 2023, the author found that the total undistributed power was 19565 kWh due to blackouts in that year in 2023, and PT PLN (Persero) ULP Sinabang suffered a total loss of IDR 28,187,295.50 in that year. Table 4.4 shows the amount of undistributed power in January due to the factor of the number of customers outages although the cost of the greatest loss occurred in June, it was also affected by the number of customers who went out and the length of the outage; More customers are out and longer outages mean greater cost of loss.

Efforts to Maintain the Distribution Network of PT PLN ULP Sinabang

The author classifies the different types of maintenance after analyzing the distribution reliability index of PT PLN ULP Sinabang. Medium voltage networks (JTMs) and distribution substations will receive subsequent maintenance.

Maintenance on medium-voltage networks

• Conveyor Cable

Conveyor cables often have problems due to the large number of animals roaming around the SUTM network and nearby twigs or trees will be affected by the cable. As a result, a short circuit occurs with one of the phases usually touching the tree branches. So trees serve as a barrier to the flow of electricity to the earth. Thus, maintenance is carried out by cutting trees along the network that can touch cables at a distance of 2m from the SUTM network. With automatic tree pruning, the chances of animals touching SUTM will be reduced. In addition, the conductor cables in the work area of PT PLN ULP Sinabang are still A3C on average. Therefore, to improve reliability in the future, especially in locations prone to interference, the conductive cable was replaced to A3CS.

• Insulator

One of the most common interferences is when the insulator is subjected to excessive heat exceeding the safe threshold. This heat causes damage to the insulators so that they cannot function properly. Maintenance of a faulty insulator is to replace a faulty one.

Post

One of the frequent disturbances that occur with poles is when many animals try to climb the poles to reach the SUTM cables, which causes a disturbance in the distribution network and one of the impacts of such interference is that it can cause the power grid to go out. Climbing animals will be prevented from climbing the rope by installing a climbing barrier as part of the pole maintenance.

Maintenance on distribution substations

• NH-FUSE

Often, NH-Fuse is disconnected as a result of system interference or overload. Overload occurs due to unbalanced loads at distribution substations, which causes this disruption. NH-Fuse maintenance consists of load balancing at the distribution substation and replacement of the damaged NH-Fuse with a new NH-Fuse that corresponds to its rating.

Box Panel

One of the problems that often occur with box panels is that some of the cables inside are subjected to excessive temperatures and become unstable due to loose bolts and the absence of joints at the end of the cables. To remedy this problem, loose bolts are eased and box panels are cleaned.

APG Installation

Disturbances in the transformer often also occur due to animals or foreign objects touching the transformer body, resulting in a short circuit in the transformer which results in a power outage. To prevent this, Substation Protective Equipment (APG) is installed which will later include FCO protectors, arresters, and primary and secondary bushings on the transformer.

CONCLUSION

Based on the data and analysis results, the following conclusions can be drawn:

- 1. Based on the calculation of the reliability index at PT PLN ULP Sinaña, it can be known that the SAIDI is 4.178 hours/customer/year and the SAIFI is 4.0281 blackouts/customer/year.
- 2. In accordance with SPLN 59:1985 regarding the reliability of 20 kV, with the network indicator said to be reliable is SAIDI ≤ 12,842 hours/customer/year and SAIFI ≤ 2,415 blackouts/customer/year,

the results of the SAIDI SAIFI analysis at PT PLN ULP Sinabang are less reliable because the SAIFI is not in accordance with the provisions of SPLN.

- 3. Cost losses due to unchanneled energy due to blackouts in 2023 at PT PLN ULP Sinabang amounted to IDR 28,187,295.50,-
- 4. Regular maintenance of distribution system components can increase the reliability index, because equipment that functions optimally will result in minimal outages, which can reduce the value of SAIFI (system average interruption frequency index).

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