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Analysis of Reliability-based Systems of 20 kV Distribution Network Disturbance on PT. PLN Rayon Panam

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Abstract - *Electricity needs for each year have increased, this is due to an increase in people's lives. Reliability is an essential factor in the operation of a distribution system and is an essential factor in the continuity of the waiter to the consumer. Several parameters are used as a reference to measure the level of reliability of a distribution system, i.e., SAIFI (average interruption of frequency index system) and SAIDI (System of interruption Duration Index). In this study, it was also performed calculations EENS (Expected Energy Not Supplied). This calculation is done because of a disturbance at each feeder; there is an energy that can not be transmitted; it can happen losses. Based on the calculation and analysis that the reliability index is obtained, there are some feeder Rayon Panam categorized as not reliable because it has a high SAIFI value not following the target SPLN No. 68-2 1986 and IEEE std 1366-2003. Energy losses that can not be distributed annually sizeable each feeder. This fact indicates a feeder located at Panam Rayon considered less reliable, to the need for repairs and maintenance.*

Keywords: *Reliability, Interruption, Loss, SAIFI, SAIDI, EENS*

I. Introduction

In the developing world today, electric energy is a very important aspect in life. Electrical energy is energy that is very important because it indirectly to the welfare of human life and also can affect the economic growth in modern times [1]. The higher the welfare of one's life, the higher the dependence on electrical energy sufficient and quality. Similarly, the more developed a industry, the role of electric energy will be even greater for industrial progress in the future [2].

Based on Law No.30 of 2009 on electricity power article 28, says that the license holders compulsory provision of electric power supply electric power that meets the applicable quality standards of reliability and provide the best possible service to customers and communities. This requires electricity providers to improve the quality of its products and services, so as to minimize outages to maintain customer satisfaction. PT. PLN (Persero) is the only State-Owned Enterprises engaged in the provision of services to the distribution of electrical power. With the development of technology, industry, and the increasing demand for electricity, it is in need of electrical energy supply and distribution excellence.

Distribution system reliability is the probability distribution of a component or system in fulfilling the functions required in a particular period. Increasing demand of electricity demand of electric power distribution system having a good level of reliability. In the distribution system, quality reliability can be seen from the length of the blackout and how often outage occurs in one unit of

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time, say in a year. With a level of reliability in accordance with the standards, community users can enjoy continuous electrical energy. To deliver electricity from the substation to load centers distribution system is required. A distribution system must have a certain reliability value, which depends on the reliability of the distribution system, which is obtained by calculating the index level of reliability. Reliability index is a measure of the reliability of the distribution system which is expressed in a probability scale. In the distribution of electricity, reliability level (Medium Voltage Network) JTM is necessary because these are factors that greatly affect the sustainability of the distribution of electrical energy to the consumer [3].

Here are some related research that is used as reference in this study, such as Ahmad Fajar Sayidul Yaom (2015) conducted a study on Analysis of System Reliability Electricity Distribution at PT PLN UPJ Rayon Brits, explained that only two *feeder*s that have a value of SAIFI and SAIDI reliable. This means that at each substation must be analyzed in order to determine how much the value of reliability, because it affects the quality of the electricity supplied to customers [4].

In 2013, Okki doing research on network analysis 20 kV medium voltage distribution system is by using RIA method. From the calculation with ETAP simulation SAIFI index is highest in zone 4 is 0.0363 times/year and greatest value indices SAIFI with RIA methods are in zone 1 is 0.0275 times/year. For the calculation of the required parameters single-line ETAP software diagram, capacity transformer, cable length and number of customers while RIA method requires a failure rate parameters [5].

Endra Heri Sulino UGM researches the Evaluation and Study of Reliability for Distribution System 4 kV Lex Plant Santan Terminal, Chevron Indonesia Company. He describes SAIFI, SAIDI, and CAIDI that those three things are a reliability index to determine whether the system is in the state according to expectations or not [6].

Based on related research, the authors are interested in doing research thesis titled "Analysis of Reliability-Based Systems and EENS (Expected energy not supplied) at 20kV Distribution Network Based Operation Disruption in PLN (Persero) Rayon Panam".

II. Methods

Flowchart for the study are presented in Fig. 1.

The steps undertaken to conduct this research can be obtained as a flow chart as follows:

1. Preliminary studies

Preliminary study is the first stage in the methodology of writing. At this stage of study and direct observation in the field to collect data in the PT. PLN rayon Panam.

2. Problem Identification and Formulation

After a preliminary study, the problem in the system area distribution Garuda Sakti electricity substation can be identified. Then the cause of the problem can be traced. In tracing the root cause of the problem, done by collecting data on the electricity distribution system.

Issues raised in this research as the topic is the analysis of Reliability-Based Systems and eens (Expected Energy Not Supplid) at 20kV Distribution Network by interruption of operations at PT. PLN (Persero) Rayon Panam.

3. Literature review

Studies conducted to obtain references - references relating to searching for information - information about the theory SAIDI, SAIFI, CAIDI, CAIFI, system of electric power transmission, distribution systems electrical components in substations, the reliability of the electricity distribution system 20 kV, standards reliability index values, methods and concepts that are relevant to the problem in this study. So with the information - that information can be used as a reference in the resolution of problems.

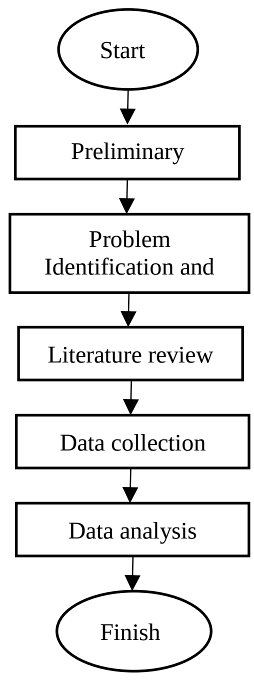

Fig. 1. Research flow chart

4. Data collection

The type of data in this study there are two (2) types, namely primary data and secondary data. Where the primary data can be obtained from the results of the study and direct observation of the research object. One of the methods used to obtain primary data is interview while in the field. The primary data required in this study between her, the amount of power transformer and the power capacity of each transformer at 150/20 kV substations Garuda Sakti and Number of *feeder*s 20 kV at 150/20 kV substations Garuda Sakti Parent.

While data Secondary used in this study is a result of documentation which aims to obtain data - data related to the thesis that will analyze how reliable power distribution system 20 kV in each - each *feeder* 20 kV at the substation Garuda magic.

5. Data analysis

Based on the data obtained in the development of this research, the analysis will be performed to get the value of SAIDI, SAIFI, and CAIDI to know how big the actual reliability of the electrical distribution system in each feeder 20 kV in 150/20 kV Substation Garuda Way. They also compare with the standard of reliability index value that is used in this thesis. The standard reliability index value used is the IEEE std 1366 - 2003, SPLN 68-2: 1986.

III. Results and Discussion

III.1. Number of Subscribers Every Feeder of Rayon Panam

To facilitate the observation and calculation, the data are grouped in subscribers *feeder* on Rayon Panam and obtained the total number of 130,000 customers. Data on the number of customers in Rayon Panam *feeder* can be seen in Table 1.

TABLE I
THE NUMBER OF SUBSCRIBERS OF EACH FEEDER RAYON PANAM

No.	Feeder	Number of Customers
1	*feeder* 3 Coast Mirror	6.896
2	*feeder* 4 Radish	14.165
3	*feeder* 12 Kualu	16.140
4	*feeder* 15 Herons Way	19.062
5	*feeder* 18 Wildlife Works	11.332
6	*feeder* 21 Tarai	10.897
7	*feeder* 22 Stadium - UNRI	15.639
8	*feeder* 7 Sukarno Hatta	8.619
9	*feeder* 14 Panam	8.692
10	*feeder* 26 Settlements	9.884
11	*feeder* 25 Likes Work	8.675
	TOTAL	130.000

III.2. The length of each Feeder Rayon Panam

To facilitate the observation and calculation of the amount of data grouped at Rayon Panam *feeder* length and the total number of subscribers gained 533.74 kms. Table 2 represents data in Rayon Panam *feeder* length.

TABLE II
THE LENGTH OF EACH *FEEDER* RAYON PANAM

No.	Name *feeder*	LONG SUTM (KMS)	LONG SKTM (KMS)	TOTAL (SKTM + SUTM)
1	*feeder*3 Coast Mirror	92.3	2.5	94.8
2	*feeder*4 Radish	35.91	5.2	41.11
3	*feeder*12 Kualu	61.4	2,94	64.34
4	*feeder*15 Herons Way	46.55	4.6	51.5
5	*feeder*18 Wildlife Works	12.85	9.8	22.65
6	*feeder*21 Tarai	71.8	14.38	86.18
7	*feeder*22 Stadium - UNRI	17.2	9.98	27.18
8	*feeder*7 Sukarno Hatta	14.7	6.6	21.3
9	*feeder*14 Panam	22.73	2.6	25.33
10	*feeder*26 Settlements	42.59	16.6	59.19
11	*feeder*25 Likes Work	23.4	12.76	36.16
	TOTAL	441.43	87.96	529.39

TABLE III
DISTURBANCE OF RAYON PANAM FEEDER

No.	*Name Of Feeder*	Disturbance Data *Feeder*	
		Frequency/Numbers Failure (Time)	Duration Off (Hour)
1	*feeder* 3 Coast Mirror	26	1.14
2	*feeder* 4 Radish	11	5.44
3	*feeder* 12 Kualu	52	21.95
4	*feeder* 15 Herons Way	28	11.61
5	*feeder* 18 Wildlife Works	25	9.92
6	*feeder* 21 Tarai	35	14.84
7	*feeder* 22 Stadium - UNRI	14	2.54
8	*feeder* 7 Sukarno Hatta	15	4.2
9	*feeder* 14 Panam	28	5.14
10	*feeder* 26 Settlements	7	0.3
11	*feeder* 25 Likes Work	12	5

TABLE IV
SAIFI OF RAYON PANAM FEEDER

No.	Name *Feeder*	VALUE SAIFI			
		Ni	Nt	λi (times/year)	SAIFI (times / subscriber / year)
1	*feeder*3 Coast Mirror	6896	130.000	26	1.3792
2	*feeder*4 Radish	14 165	130.000	11	1.198577
3	*feeder*12 Kualu	16140	130.000	52	6.456
4	*feeder*15 Herons Way	19062	130.000	28	4.105662
5	*feeder*18 Wildlife Works	11332	130.000	25	2.179231
6	*feeder*21 Tarai	10897	130.000	35	2.933808
7	*feeder*22 Stadium - UNRI	15639	130.000	14	1.6842
8	*feeder*7 Sukarno Hatta	8619	130.000	15	0.9945
9	*feeder*14 Panam	8692	130.000	28	1.872123
10	*feeder*26 Settlements	9884	130.000	7	0.532215
11	*feeder*25 Likes Work	8675	130.000	12	0.800769

III.3. Disturbance Data of Feeder on Rayon Panam

Data *feeder* interruption for one year in 2016 include data:

1. Duration of black-out (total length)
2. The frequency of failures (total amount of how much time of black-out)

The data will then be known how long the duration of outages and frequency of failure at each feeder. In calculating the length of time, it will be identified in a matter of minutes, while the failure rate only counts the total number of times each feeder trip or goes out in 2016. The disruption data on the Feeder of Rayon Panam for 2016 can be seen in Table 3.

III.4. SAIFI Calculation and Analysis of Feeder on Panam Rayon

Based on data from Table 3 and 1, the value of SAIFI for each *feeder* can be calculated using Equation 1.

$$SAIFI = \frac{\text{Frequency of Disturbance x Customer in a Feeder}}{Total\ of\ Customer} \quad (1)$$

$$SAIFI = \frac{\sum \lambda i.Ni}{\sum Nt} \quad (2)$$

Where,
λi = Frequency interference/Failure Score
Ni = Number of Subscribers in *Feeder*
Nt = Number of Subscribers in System

From Table 4, it can be seen on every feeder SAIFI different values - different, there is a feeder that has a high-reliability value. Its SAIFI value as belonging to the number of frequency interference that much. But there is also a feeder that has a small SAIFI value; this means that the feeder has a frequency value slightly disorder. SAIFI value can be affected by many frequency disruptions and the number of customers who are on a feeder. In Table

4 two feeders are included in the category are not reliable because the value of SAIFI both the feeder has a value of SAIFI is high, i.e., feeder Kualu which has a value of SAIFI the most elevated of 6.456 times/customers/year and feeder Stork Way with the benefit of SAIFI amounted to 4.105662 times/customer/year.

III.5. SAIDI Value Calculation and Analysis of Feeder On Panam Rayon

Based on data from Table 3 and one for each *feeder* SAIDI value can be calculated using Equation 2.

$$SAIDI = \frac{\text{Duration of Disturbance x Customer in a Feeder}}{Total\ of\ Customer}$$

$$SAIFI = \frac{\sum Ui.Ni}{\sum Nt} \quad (3)$$

where, Ui = Length Disorders / Length Failure
Ni = Number of Subscribers In *Feeder*
Nt= Number of Subscribers In System

From Table 5 it can be seen on every *feeder* SAIDI different values - different, there is a *feeder* that has a value of high reliability, high in question is its SAIDI value belonging to the total duration for many disorders. But there is also a *feeder* that has a small SAIDI value, this means that the *feeder* has a duration of disruptions little value. Effect of duration much interference, affect the value of SAIDI, but not only that, the number of subscribers that are on a *feeder* also affects the value of SAIDI. If a *feeder* has a duration of many amount of interference while the number of customers a little bit then it will have little value SAIDI, than when the value of the duration of the disruption slightly while the number of customers who are on a lot of the *feeder* SAIDI values obtained will be high. From the above table there is a *feeder* that is included in the category are not reliable, because the *feeder* SAIDI value is large enough, the *feeder* Kualu which has the highest SAIDI value of 2.725177 hours/customer/year.

TABLE V
SAIDI OF RAYON PANAM FEEDER

No.	Name *Feeder*	VALUE SAIDI			
		Ni	Nt	Ui (hours/year)	SAIDI (hours/ subscriber/year)
1	*feeder*3 Coast Mirror	6896	130.000	1.140	0.060473
2	*feeder*4 Radish	14165	130.000	5.440	0.592751
3	*feeder*12 Kualu	16140	130.000	21.95	2.725177
4	*feeder*15 Herons Way	19062	130.000	11.61	1.702383
5	*feeder*18 Wildlife Works	11332	130.000	9.920	0.864719
6	*feeder*21 Tarai	10897	130.000	14.84	1.243934
7	*feeder*22 Stadium - UNRI	15639	130.000	2.540	0.305562
8	*feeder*7 Sukarno Hatta	8619	130.000	4.20	0.278460
9	*feeder*14 Panam	8692	130.000	5.14	0.343668
10	*feeder*26 Settlements	9884	130.000	0.30	0.022809
11	*feeder*25 Likes Work	8675	130.000	5.00	0.027804

III.6. Calculation and Analysis of CAIFI of Panam Rayon Feeder

Based on data from Table 4 and 5, CAIFI value for each *feeder* can be determined by using the formula in Equation 4.

$$CAIFI = \frac{SAIFI}{SAIDI} \quad (4)$$

Based on Equation 4, it can be seen the value of its CAIFI on each feeder that can be seen in Table 6 that there is some feeder experiencing CAIFI very high cost. Value - the value exceeds the importance of other feeders. Feeder 3 Pantai Cermin has a CAIFI value of 22.80702 times/hour/year and 26 Settlements Feeder that has a value of 23.33333 CAIFI times/hour/year. It is influenced by SAIDI values that are not directly proportional to the amount of SAIFI. SAIDI value obtained is very much lower than the amount of SAIFI, so if doing a calculation for CAIFI value, resulting in CAIFI great value.

TABLE VI
CAIFI OF RAYON PANAM FEEDER

No.	Name *feeder*	VALUE CAIFI		
		SAIFI (times/ subscriber/year)	SAIDI (hours/ subscriber/year)	CAIFI (time/ hours/year)
1	*feeder*3 Coast Mirror	1.37920	0.06047	22.8070
2	*feeder*4 Radish	1.19858	0.59275	2.02206
3	*feeder*12 Kualu	6.45600	2.72518	2.36902
4	*feeder*15 Herons Way	4.10566	1.70238	2.41171
5	*feeder*18 Wildlife Works	2.17923	0.86472	2.52016
6	*feeder*21 Tarai	2.93381	1.24393	2.35849
7	*feeder*22 Stadium - UNRI	1.68420	0.30556	5.51181
8	*feeder*7 Sukarno Hatta	0.99450	0.27846	3.57143
9	*feeder*14 Panam	1.87212	0.34367	5.44747
10	*feeder*26 Settlements	0.53222	0.02281	23.3333
11	*feeder*25 Likes Work	0.80077	0.02780	28.8000

TABLE VII
CAIDI OF RAYON PANAM FEEDER

No.	Name *feeder*	VALUE CAIDI		
		SAIFI (times/ subscriber/year)	SAIDI (hours/ subscriber/year)	CAIDI (hours/ times/year)
1	*feeder*3 Coast Mirror	1.37920	0.060473	0.04385
2	*feeder*4 Radish	1.19858	0.592751	0.49455
3	*feeder*12 Kualu	6.45600	2.725177	0.42212
4	*feeder*15 Herons Way	4.10566	1.702383	0.41464
5	*feeder*18 Wildlife Works	2.17923	0.864719	0.39680
6	*feeder*21 Tarai	2.93381	1.243934	0.42400
7	*feeder*22 Stadium - UNRI	1.68420	0.305562	0.18143
8	*feeder*7 Sukarno Hatta	0.99450	0.278460	0.28000
9	*feeder*14 Panam	1.87212	0.343668	0.18357
10	*feeder*26 Settlements	0.53222	0.022809	0.04286
11	*feeder*25 Likes Work	0.80077	0.027804	0.03472

III.7. Calculation and Analysis of Value CAIDI Feeder On Panam Rayon

Based on data from Table 4 and 5, CAIDI value for each *feeder* can be determined by using the formula in Equation 4.

$$CAIDI = \frac{SAIDI}{SAIFI}$$

Based on Equation 4, it can obtained the value of CAIDI by performing calculations on each *feeder* it can be seen in Table 7 that the values CAIDI obtained can be considered reliable because of its value to reach the target that has been set by the IEEE std 1366-2003 amounted to 1:47 hours/times/year.

III.8. Effect of Impaired Operation Against Network Reliability

The value of reliability can be determined by calculating several aspects such as SAIFI and SAIDI. Both of these aspects is used as a reference to assess how much value the reliability of a not distribution. To calculate this aspect takes several factors in order to determine whether the value of SAIFI and SAIDI can be said to be reliable. SAIFI and SAIDI can be determined from the distractions of operations that occur. This disorder can be frequency interference or say how much disruption that occurs on a *feeder* and duration of the disruption.

There are two factors causing faults in operating i.e., internal factors and external factors. Internal factors generally permanent, such equipment does not match the standard set, installation of equipment that is not appropriate or wrong and aging equipment. If the internal disturbance occurs it will affect the number of customers being extinguished, the more equipment is damaged, the customer outages will be growing, and this will have an impact on the value of SAIFI. While external factors, namely weather such as rain, high winds, earthquakes and lightning, living organisms, for example humans, animals and plants. These disturbances will affect the duration of the interruption, because this disorder require considerable time to return to normal state. So it will have an impact on the value of SAIDI.

Therefore, interruption of operations greatly affect the reliability of the network. If the reliability of a network distribution system is not good then the continuity of electricity waiter to customer can be said is not good anyway. To overcome that continuity of service can be served well, then the response by installing equipment in order to reduce the poor service to consumers. Such equipment as Recloser, Recloser function as a useful tool in the event of disruption to the Recloser will work to restore normal services after disruption by the not too distant future. Then LBS (Load Break Switch) is useful as a barrier and fault location This tool also functions as a switch between the *feeder* circuit to the other *feeder*s in an emergency on a primary distribution network operating system type circumference (Loop / ring). So that the continuity of electrical service can still be served well despite the distractions.

III.9. Comparison Values With SPLN No. 68-2 SAIFI 1986 and IEEE std 1366-2003

Based on SAIFI values obtained in Table 4, it can be compared to the value in SPLN No. 68-2, 1986, with a target of 3.2 times/customers/year and IEEE std. 1366-2003 with a target of 1.45 times/customer/year. Is Rayon Panam distribution network in each *feeder* has reached the predetermined targets or have not yet reached the target can be seen in terms of the charter Table 8

Each *feeder* has SAIFI values are different, this is because the disturbance on each *feeder* is different. After calculating the importance of the two *feeder* Rayon Panam experiencing high or SAIFI value of the target SPLN 68-2 No. 1986. *Feeder - feeder* experiencing a low level of reliability is that the *feeder* 12 Kualu with SAIFI value of 6.456 times/customer/year, and *Feeder* 15 Herons Way with SAIFI value of 4.105.662 times/customer/year. Since both of these experienced *feeder* SAIFI value that exceeds the target SPLN No. 68-2 in 1986 amounted to 3.2 times/customer/year, then the second is said to be unreliable *feeder*. As for the value SAIFI targeted by IEEE std 1366-2003 of 1.45 times/customer/year.

Based on Table 8 it can be seen that there are six *feeder*s that have SAIFI value that is not in accordance with IEEE std 1366-2003 targets. *Feeder* - the *feeder* is a *feeder* 12 Kualu with SAIFI value of 6.456 times/customer/year, *feeder* 15 Herons Way with SAIFI value of 4.105662 times/customer/year, *feeder* 18 Garden work with SAIFI value of 2.179231 times/customer/year, *feeder* 21 Tarai with SAIFI value of 2.933808 times/customer/year, 22 Stadion *feeder* SAIFI value of Riau with 1.6842 times/customer/year, *feeder* 14 Panam with SAIFI value of 1.872123 times/customer/year. *Feeder* - The *feeder* can be said to be not reliable according to IEEE std 1366-2003 standard because it does not reach the set targets.

TABLE VIII
COMPARISON VALUES WITH SPLN NO. 68-2 SAIFI 1986 AND IEEE STD 1366-2003

No.	*feeder*	Reliability Index	SPLN	IEEE	Number of Subscribers	Length Channels
		SAIFI	SAIFI 3.2 (k/p/t)	SAIFI 1.45 (k/p/t)		
1	*feeder*3	1.3792	√	√	6896	94.8
2	*feeder*4	1.19858	√	√	14 165	41.11
3	*feeder*12	6.456	x	x	16140	64.34
4	*feeder*15	4.10566	x	x	19062	51.5
5	*feeder*18	2.17923	√	x	11332	22.65
6	*feeder*21	2.93381	√	x	10897	86.18
7	*feeder*22	1.6842	√	x	15 639	27.18
8	*feeder*7	0.9945	√	√	8619	21.3
9	*feeder*14	1.87212	√	x	8692	25.33
10	*feeder*26	0.53222	√	√	9884	59.19
11	*feeder*25	0.80077	√	√	8675	36.16

III.10. Comparison Values With SPLN No. 68-2 SAIDI 1986 and IEEE std 1366-2003

Based on SAIDI values obtained in Table 5, it can be compared with the value of SPLN No. 68-2 in 1986 with a target of 21.09 hours/customer/year and IEEE std 1366-2003 with a target of 2.3 hours/customer/year. Is Rayon Panam distribution network in each *feeder* has reached the predetermined targets or not that can be seen from

Table 9.

Based on Table 9 it can be seen that the entire *feeder* exist in Panam Rayon has reached the target set by SPLN No. 68-2, 1986. The market value of SAIDI targeted by IEEE std 1366-2003 amounted to 2.3 hours/customer/year. After calculation of the obtained results as shown in Table 9. There is one *feeder* that has a value of SAIDI are not in accordance with IEEE std 1366-2003 targets. The *feeder* is a *feeder* 12 Kualu with SAIDI value of 2.725177 hours/customer/year. The *feeder* can be said to be not reliable according to IEEE std 1366-2003 standard because it does not reach the set targets.

III.11.Analysis EENS (Expected energy not supplied)

Data of EENS (Expected energy not supplied) in the form of energy data that can not be distributed by each *feeder* in one year. From these data it will be known how much harm has been gained because energy can not be transmitted. Table 10 is a data EENS (Expected energy not supplied) every *feeder* Rayon Panam 2016.

Based on Table 10 it can be seen that the value EENS (Expected energy not supplied), the largest found in the *feeder* 12 Kualu amounted to 93.934 kWh/year. As for EENS (Expected energy not supplied), the smallest found on the *feeder* 26 Settlements of 1,449 kWh/year. Large or small EENS (Expected energy not supplied) can be influenced by the amount of interference frequency and duration of interruption. The more the number of frequency interference and interruption duration, the number EENS (Expected energy not supplied) will be greater, and vice versa if the fewer number of frequency interference and interruption duration, the number EENS (Expected energy not supplied) will be small.

TABLE IX
COMPARISON VALUE SAIDI WITH SPLN NO. 68-2 1986 AND IEEE STD 1366-2003

No.	*feeder*	Reliability Index	SPLN	IEEE	number of Subscribers	Length Channels
		SAIDI	SAIDI 21.09 (j / p / t)	SAIDI 2.3 (j / p / t)		
1	*feeder*3	0.06047	√	√	6896	94.80
2	*feeder*4	0.59275	√	√	14 165	41.11
3	*feeder*12	2.72518	√	x	16140	64.34
4	*feeder*15	1.70238	√	√	19062	51.5
5	*feeder*18	0.86472	√	√	11332	22.65
6	*feeder*21	1.24393	√	√	10897	86.18
7	*feeder*22	0.30556	√	√	15 639	27.18
8	*feeder*7	0.27846	√	√	8619	21.30
9	*feeder*14	0.34367	√	√	8692	25.33
10	*feeder*26	0.02281	√	√	9884	59.19
11	*feeder*25	0.02780	√	√	8675	36.16

TABLE X
VALUE EENS AND AENS *FEEDER* ON RAYON PANAM

No.	Name *feeder*	*AENS (Average energy not supplied)*		
		The number of subscribers	EENS KWh/year	AENS KWh/customer/year
1	*feeder*3 Coast Mirror	6896	2524	0.36601
2	*feeder*4 Radish	14165	32067	2.26382
3	*feeder*12 Kualu	16140	93934	5.81995
4	*feeder*15 Herons Way	19062	90136	4.72857
5	*feeder*18 Wildlife Works	11332	51595	4.55304
6	*feeder*21 Tarai	10897	67573	6.20106
7	*feeder*22 Stadium - UNRI	15639	5711	0.36518
8	*feeder*7 Sukarno Hatta	8619	13353	1.54925
9	*feeder*14 Panam	8692	11032	1.26921
10	*feeder*26 Settlements	9884	1449	0.14660
11	*feeder*25 Likes Work	8675	3777	0.43539

While the value - average total of AENS (Average energy not supplied) is obtained, which reached 6.2010645 kWh/customer/year. AENS value (Average energy not supplied) obtained from the total EENS (Expected energy not supplied) for one year each *feeder* divided by the total number of subscribers *feeder*.

IV. Conclusion

Based on calculations SAIFI value, the entire *feeder* in Panam Rayon has not met the standards SPLN 68-2: SAIFI in 1986 that is by 3.2 times/ customer/year. The *feeder* is a *feeder* 12 Kualu of 6.456 times/customers/year and 15 Herons Way *Feeder* at 4.105662 times/customer/year. As for the standard IEEE std 1366 - 2003 is to SAIFI 1:45 time/customer/year No 6 *feeder*s that do not fit into its standard *feeder* 12 Kualu of 6.456 times/customer/year, *feeder* 15 Herons Way of 4.105662 times/customer/years, the *feeder* 18 Wildlife Works at 2.179231 times/customer/year, *feeder* 21 Tarai at 2.933808 times/customer/year, *feeder* 22 Stadium - UNRI of 1.6842 times/customers/year and *feeder* 14 Panam by 1.872123 times/customer/year. *Feeder* - *feeder*s that do not reach the standards that can not reliable. Factor number of customers and long-lines also affects the value of SAIFI. SAIDI value calculation based on each *feeder* in Panam Rayon, the entire *feeder* has met the standards SPLN 68-2: 1986 is the SAIDI 21.09 hour/customer/year and for the standard of IEEE std 1366-2003 is the SAIDI 2.3 hours/customer/year No one who experienced *feeder* SAIDI values outside the standard IEEE std 1366 - 2003 is *feeder* 12 Kualu amounted to 2.725177 hours/customer/year.

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