Analysis Reliability Distribution System Uses The Method of Reliability Index Assessment (RIA)

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***Abstract*— Reliability can be seen the extent to which electric power can supply continuously in one year to consumers. This research aims to know the index of the reliability distribution system network 20 kV at PT PLN (Persero) Rayon Panam Pekanbaru Feeder 12 Kualu. The calculations and analysis use RIA (Reliability Index Assessment) method, the first analysis, system is assumed in perfect switching condition, and the second in imperfect switching. Based on calculation and analysis, the conditions in perfect switching, the value of SAIFI 0.30 times/year, SAIDI hour/year 1.19, CAIDI 6.63 hours/year. the conditions in imperfect switching, the value of SAIFI 0.63 times/year, SAIDI 4.19 hours/year, CAIDI 6.65 hours/year. Thus the distribution network feeder 12 Kualu still reliable. The value of SAIFI and SAIDI is smaller than specified by PLN. Based on standard PLN for the value are SAIFI 3.2 times/year and SAIDI 21 hours/year.**

Keywords*— *index of the realibility; distribution system, RIA method, perfect switching, imperfect switching

I. INTRODUCTION

Demand of Electrical energy from year to year increasing in line with the growing needs of the economy and the welfare of society. The growing demand for electrical energy is balanced with the need to improve the power generation and the capabilities of infrasturucture, resulting in the distribution of electrical energy to consumers goes well with the quality of the distribution of electrical energy that meets the standards. In electric power distribution system, the level of reliability is the most important thing in determining the performance of the system. Reliability can be measured by the extent to which electric power system could supply energy to the load in one year. Disruption or damage of electric power distribution system will affect the value of the reliability of the distribution system [2].

To be able to determine the level of reliability of a system, it must be held by way of examination through a calculation as well as the analysis of the success rate of the performance or operation of the system. There are three basic parameters in reliability that can be used to evaluate the radial distribution systems i.e. number average failure (λ), the average extinguishing time (r), and the annual extinguishing time (U).

In the analysis of the reliability of the distribution network of 20 kV, to determine the level of possibly the author uses the method of Reliability Index Assessmen (RIA) which is an approach to predict the failure of distribution system based on the topology of the system and the data concerning the reliability of the components. RIA method logs a failure that occurred on the equipment in a comprehensive manner, and then identify the failure so that the resulting reliability indexes that include the system Average Intruption frequency index (SAIFI), system Average Intruption Duration index (SAIDI), Customer Average Intruption Duration index (CAIDI) [2].

II. RELIABILTY OF RIA METHOD

A. *Reliability of Distribution System*

Electric power distribution system of functioning distributed electric power to the constumer through a network of low voltage, whereas a transimi channel serves to channel the extra high-voltage power ke load centers in the great power (via the distribution network) [7].

Reliability is the success rate of the performance of a system or part of the system, to be able to give better results in a period of time and in certain operating conditions, determine from a system the examination should be held by way of calculations or analysis of the success rate of the performance or operation of the systems reviewed, in a certain period and then compare it to the previous standards established [4].

There are a few things to know before calculating system reliability index that is by knowing the value of equipment reliability data. These data were obtained from the SPLN 59 in 1985 for equipment reliability data [12]. As shown in TABLE 1. Index of reliability on radial SUTM SPLN 68-2 in 1986 where for SAIFI was 3.2 times/year and SAIDI of 21 hours/year [14].

TABLE 1. DATA RELIABILITY EQUIPMENT

Equipment	Failure Rate	Repair Time
Circuit Breaker	0,004 failure/unit/year	10
Overhead System	0,2 failure/km/year	3
Distribution Transformer	0,005 failure/unit/year	10
Recloser	0,005 failure/unit/year	0,25
Underground System	0,07 failure/km/year	

B. Method of Reliability Index Assessment (RIA)

RIA method is an approach used to predict the failure of distribution system based on the topology of the system and the data concerning the reliability of the components. Functionally RIA log failures that occur on equipment in a comprehensive manner, and then identify the failure, and analyzing the failure mode. The philosophy of the RIA method is a system of modes that involve the analysis of bottom-up in which a specific failure mode analysis of sub system, seen its effect on the whole system so that it can be generated index of reliability that has contributed to the index of the reliability of the entire system. The data required in the RIA method is [5].

a. Data feeder 20 kV distribution network system broughly with load points.
b. the number of Data customers at any point of the load
c. Parameters data system reliability

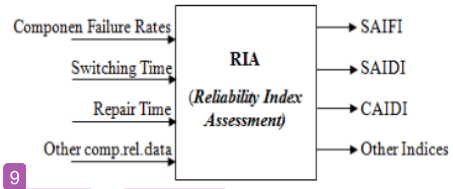

Fig.1. *Input* dan *Output of RIA Method* [4]

Stage of RIA Method is

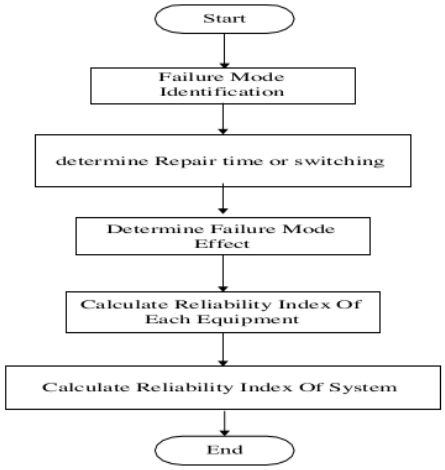

Fig. 2. RIA Method

C. Value Reliability Factors

Factors that must be known and counted before doing the calculation and analysis of reliability are: MTTF, MTTR, failure rate, and downtime rate.

a. Mean Time To Failure (MTTF)

the average time the failure occurs during operation of a system [4]

$$MTTF = \frac{T1+T2+T3....Tn}{n} \quad (1)$$

Where T is up time and n is the number of failure. From the data obtained then performed the calculation penyulang each for MTTF each year.

b. Mean Time To Repair (MTTR)

The average time it takes to do the repairs against the occurrence of the failure of a system

$$MTTR = \frac{L1+L2+L3....+Ln}{N} \quad (2)$$

Where L is repair time and N is number of repair. From the results obtained could be seen whether damage or disturbances in the feeder could be handled quickly or not.

c. Rate of Failure (λ)

The frequency of a system or component failed to work

$$\lambda = \frac{1}{MTTF} \quad (3)$$

d. Downtime Rate (μ)

length frequency of a system/component in a time of repair (condition OFF)

$$\mu = \frac{1}{MTTR} \quad (4)$$

So the larger the value of μ then the sooner repair time also means getting good value the reliability of a system.

Calculation of system reliability index assumed to be on condition of imperfect switching. There are three steps that are used to get the value of SAIFI, SAIDI, and CAIDI [9]

a. System Average Interruption Frequency Index (SAIFI)

Rate of failures that occurred per customer served each time (generally annual). This index is determined by dividing the number of all failures in one year with the number of customer served by the system.

$$SAIFI = \frac{\sum \lambda k.\, Mk}{\sum M} \quad (5)$$

Where λk is failure rate of line, Mk is load number failure of line, and M is load number of line.

b. System Average Interruption Duration Indeks (SAIDI)

the average value of length of failure for each customer during one year. This index is determined by division number and length of continuous failure to customers over a period of time determined by the number of customers served for a year.

$$SAIDI = \frac{\sum \mu k.Mk}{\sum M} \quad (6)$$

Where μk is downtime rate of line

c. Customer Average Interruption Duration Index (CAIDI)

The index duration disturbance of the average consumer each year, inform the average time for recovery of failure each customer in one year.

$$CAIDI = \frac{SAIDI}{SAIFI} \quad (7)$$

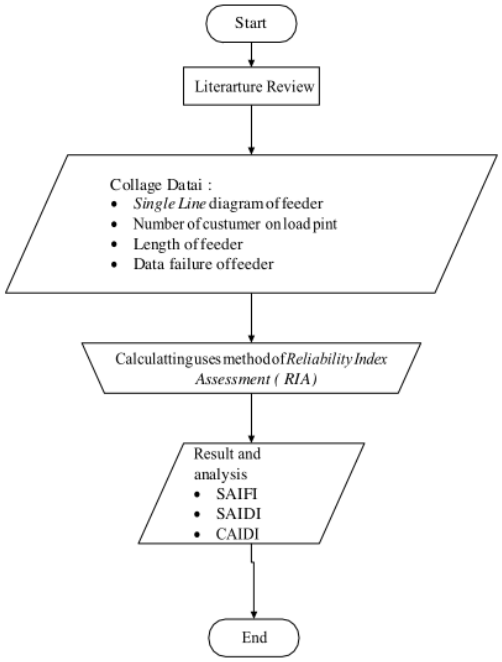

Fig.3. Stage og Research with RIA Method

There are a few things to know before calculating system reliability index that is by knowing the value of equipment reliability data. These data were obtained from the SPLN 59 in 1985 for equipment reliability data [12]. Index of reliability on radial SUTM SPLN 68-2 in 1986 where for SAIFI was 3.2 times/year and SAIDI of 21 hours/year [14].

III. RESULT AND ANALYSIS OF REALIBILITY

TABLE 2. MTTF AND MTTR OF FEEDER 12 KUALU

Bus Station	Feeder	MTTF (day)	MTTR (hour)
Pekanbaru	12 Kualu	6,1	1,064

The results in TABLE 2 can be seen the average value of the failures that occurred during the operation of the system (MTTF) is 6.1 day. While the value of the average time required to perform the repairs against the occurrence of the failure of a system (MTTR) is 1.064 hours.

A. *Perfect Switching*

TABEL 3. INDEX OF REALIBILITY

Bus Station	Feeder	SAIFI	SAIDI	CAIDI
Pekanbaru	12 Kualu	0,30	1,19	6,63

From TABEL 3.can be seen the results of the analysis and calculation for the reliability value of SAIFI 0.30 times/year, SAIDI 1,19 hour/year, CAIDI 6.63 hours/year. Based on the calculation RIA method for the reliability of the value SAIFI, SAIDI, CAIDI and feeder 12 Kualu still reliable. This is because the value of reliability of SAIFI, SAIDI is smaller than the maximum limits set by the standards of the PLN.

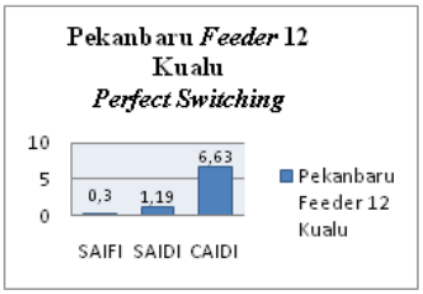

Fig.4.SAIFI, SAIDI, and CAIDI of Realibility in Perfect Switching

B. *Imperfect Switching*

TABLE 4. INDEX OF REALIBILITY

Bus Station	Feeder	SAIFI	SAIDI	CAIDI
Pekanbaru	*Feeder* 12 Kualu	0,63	4,19	6,65

From TABLE 4 can be seen the results of the analysis and calculation for the reliability value of 0.63 times/year SAIFI, SAIDI 4.19 hours/year, CAIDI 6.65 hours/year. Based on the calculation RIA method for the reliability of the value SAIFI, SAIDI, CAIDI and feeder 12 Kualu still reliable. This is because the value of reliability of SAIFI, SAIDI is smaller than the value specified by the standards of the PLN.

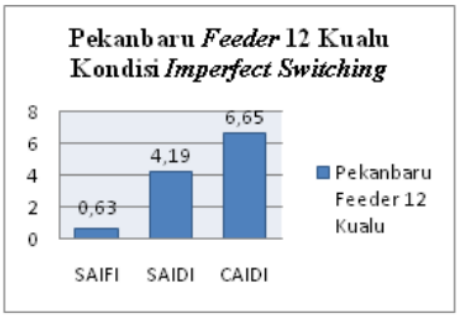

Fig.5 SAIFI, SAIDI, and CAIDI of Realibility in Imperfect Switching

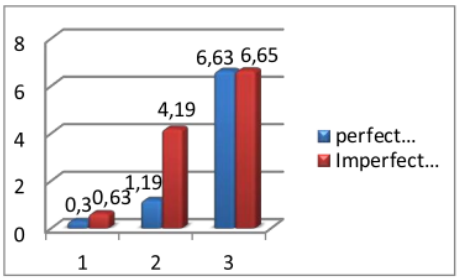

Fig. 6.Comparison chart value SAIFI, SAIDI, CAIDI Perfect and Imperfect Switching

In determining the level of reliability by using RIA method, there are two conditions, where the first condition is perfect and the second is imperfect switching. To get the index value of the reliability of SAIFI, SAIDI, CAIDI in perfect switching, component that exists on a network system is assumed to be working perfectly so the index failure on component can be ignored, then the calculated only failure on the line.

Whereas, in the conditions of imperfect switching to get value of SAIFI, SAIDI, CAIDI can be known and by which a piece of equipment on the network distribution is assumed not perfect, the index of failure any equipment the distribution system provide impact on overall reliability system.

From TABLE 3, 4 and Fig. 4. can be seen comparison condition of perfect switching and imperfect switching. For the value of SAIFI, SAIDI, CAIDI larger in conditions of imperfect switching. It is because in the distribution network at feeder 12 Kualu each component is failure give impact on the reliability of the index. Nevertheless the difference for good reliability index condition of Perfect and Imperfect switching for SAIFI, SAIDI, CAIDI and still reliable. Because the value obtained in the calculation method of RIA smaller than standard from the standard PLN. PLN 68-2 in 1986 for SAIFI i.e. 3.2 times/year, and SAIDI 21 hours/year.

IV. Conclusions

Index of reliability in PT. PLN (Persero) Rayon Panam feeder 12 kualu for SAIFI and SAIDI value still reliable in condition Perfect Switching as well as the conditions of Imperfect Switching. The value obtained is still smaller than the maximum limit by PLN. As for the value of the Perfect Switching conditions for SAIFI 0.30 times/year, SAIDI 1.19 hours/year and CAIDI 6.63 hours/year. Whereas the conditions of Imperfect Switching SAIFI 0.63 times/year, SAIDI 4.19 hours/year, and CAIDI 6.65 hours/year.

Reliability index value Differences not significant between the Perfect Switching and Imperfect Switching condition. This is because the conditions of Perfect Switching index calculated on the line, while the conditions of Imperfect Switching of index are calculated every distribution equipment that provides the value of the index failure throughly.

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