ASSET MANAGEMENT IMPROVEMENT IN DISTRIBUTION STATION

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ABSTRACT

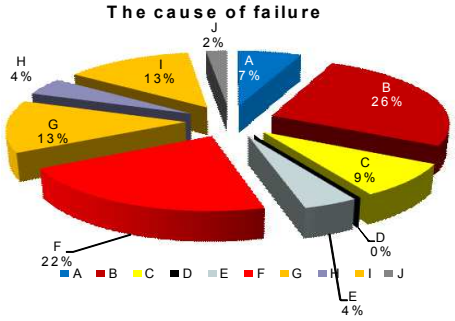
In the last three years, numbers of distribution transformer failure in Jakarta area were still deem high accounting for 54 units per year or 2 % of the total distribution transformer asset (2749 units) in Gambir Distribution System. Most of the faults were caused by isolation breakdown, mainly on the bushing, windings and insulation oil media, due to inadequate maintenance activities and also excessive loading of distribution transformer. The limited number and quality of human resources that are not proportional to power distribution assets and the limited operations and maintenance budget for distribution network have become the main cause of inadequate maintenance activities. Transformer's excessive loading is due to high growth of electricity demand which is around 8-10% and worsened per year which could not be counterbalanced by limited investments in distribution equipments, delays in the development of power distribution systems and other technical matters.

This paper presents the implementation of asset management program on distribution transformer operation and maintenance with the objective to decrease the rate of distribution transformer failures. The activities include capturing and collecting data of distribution substation and transformer, diagnosing of latest equipments conditions, enhancement of proper maintenance methodologies and implementation of integrated conditional based maintenance program (CBM). The implementation of integrated CBM is the most difficult part due to the fact that the process of updating the database was not optimal, limitation on human resource capabilities and there was ~~is~~ no integrated application system. The methodologies and procedures are also applied in technical system, management infrastructure and mindset capabilities and leadership.
The early result shows that the number failures have been significantly declined approximately 10 % compared to the first quarter of 2010. Due to the profound result, this approach will be extended to the whole distribution network area.

INTRODUCTION

The need to provide the electric power supply with efficient and effective manner is inevitable in a modern electricity industry in which the customer's demand for better service in term realibility and power quality grows in very fashionable ways. It is emparative for the Electric power supplier to meet such demand. One of the ways achieving it is to improve the electric distribution system and strenghten the realibility. System monitoring and maintenance of distribution transformers has a great influence in the continuity of electricity supply to customers. Reliable operation of distribution transformer with with a balanced and appropriate loading capacity of the transformer, will maintain the quality and quantity of supply of electricity to consumers. Conversely, when a distribution transformer is operated with many like poor reliability, high line and transformer loss, low / high voltage profile, overloading of the transformers, poor maintenance, no supervision and monitoring, then the operating reliability of distribution transformers will be low resulting in low reliability of supply electric power to customers.

The rate of distribution transformers failure at PLN Gambir tends to increase since 2007. The number of transformer failure in 2009 is 71, increasing 9,2 % from 2008. This number is equels to 2,8 % to the total asset owned. But in 2010, the trend decline due to the improvemnet in transformer treatment and proper maintanance. In 2010 the failure is 46 unit. In addition to causing damage to the transformer, the transformer failure also causes the increase of energy not serve (ENS) and transformer replacement costs each year. Majority of the fault were caused by short circuit between body and Medium Voltage side (21 %). The second bigger cause was due to the protection failure (14 %) and 12 % of the cause was due to leakage leading to oil drain. Further inestagation to each of failure led to the problem of excessive loading of distribution transformer and inadequate maintenance activities on distribution substations and transformers. To that end, numbers of efforts have been taken in order to reduce the number of distribution transformer faults with the implementation of asset management in operations and maintenance activities



Legend :

A	: Short Circuit of MV-LV	B	: Short circuit MV-Body
C	: Short Circuit of LV-Body	D	: Short circuit MV-LV-Body
E	: Winding Ins. Breakdown	F	: Oil leaks
G	: Breakdown of Accesories (Bushing, etc)	H	: Overheat (Body blown up, etc)
I	: Protection failure	J	Others

This paper presents the implementation of asset management programs on monitoring and maintenance of distribution transformers in PLN Gambir which intended to reduce the number of disturbance / damage of distribution transformers. The methods carried out are revamping the distribution transformer asset data, procedure development for monitoring, evaluation and analysis of transformer condition, enhancement of proper maintenance methodologies and implement condition based maintenance program (CBM). Implementation of this method has been proven to reduce the rate of distribution transformer failure and also to increase reliability of power supply to customers.

ASSET MANAGEMENT IN GAMBIR DISTRIBUTION SYSTEM

PLN Gambir is a branch unit of Jakarta distribution unit (JEDU) that has the responsibility of electric power distribution operations in the area of Central Jakarta, Indonesia. Customers in Area Gambir mainly consists of government offices, VIP customers, private offices and business centers. In particular, customers in this area is very sensitive to power supply disruptions and deserve to receive priority services.

In distributing electricity to customers, PLN Gambir perform the operation and maintenance of power distribution equipment. The electricity distribution assets include the 20kV substation, distribution substations, 20kV network, distribution transformers and low voltage network. Power distribution transformers assets of PLN Gambir is as much as 2.571 units with the details shown in table 1. In applying the asset management, PLN Gambir has used Simdis (Disitribution Information System) as an application based on GIS AM/FM. The Simdis was put in the business process of operating and maintaing the electricity network asset.

In Electricity Distribution Utility, asset management can be defined as a systematic process of, cost-effectively, operating, maintaining and upgrading of electrical assets by combining engineering practices and economic analysis with sound business practice [1]. The aim of asset management in power distribution utility is to handle physical assets in an optimal way in order to fulfill utility goal whilst considering risk [2].

OPI (OPERATIONAL PERFORMANCE IMPROVEMENT)

In order to improve the performance of the operation of the distribution branch unit (AJ) PLN launched the Operational Performance Improvement Project. The project implementation was assisted by McKynsey. The OPI used the approach of 3 perspective of improvement method. It was (1) Technical System which handled the technical matter in network betterment. (2) Management Infrastructure which dealt with the performance management reporting, evaluation and analysis tool, (3) Mindest, Capabilities and leadership which stimulate the awareness of human resoucer.

In running down eacah approach, PLN developed step by step action. The first step started with the forming the coach as agents of change AJ gambir. Next step, the coach together with all the human resources in department of maintanance and operation of the asset did the diagnostic and valuation of the existing condition and establisehed Focus Group Discussion (FGD). The diagnotics covered a wide range of activities from conducting gap analysis, identifying main value of business and key drivers, to capturing opportunity. After diagnosing and valuating, the focus group discussion (FGD) brainstormed the idea or generating ideas. This step was used to align aspiration and select and prioritize the activities to be conducted. Then FGD prepared for the implementation of initiatives by setting up the targets, cretaing the team and workplan and coordinating the available resources. They also proposed the budgeting and approval from the managements. In proritizing they set up the short term target as a quick win and long term for sustainable achievement.

TRANSFORMER INSPECTION

One of the quickwin to be conducted was inspecting the health condition of the Tranformer. It was firstly done because within the last two years due to the the lack of budget and technical careness of the field crew, it was a little attetion given to the transformer. Besides, the database of Distribution Information System (SIMDIS) was not updated.

The inspection was done hoslistically from visual to checking the oil acidity. So thetransformer inspectors were equipped with thermovision, multitester, earth tester, and megger, microohm meter and also BDV. Beside that the health and safety equipment like helmet, grounding set, etc was provided. The inspection of the transformers was conducted as follows

1. Visual check of the equipment to asses physic such as the bushing (any crack, or peel over)
2. Visual check of the cleaness and room temeperature of distribution station (transformer vicinity area)
3. Thermal Vision Check with Thermo vision to find out any excessive heat indicating the overload,

loose connection.

4. Measuring electrical data of loading, (A,V, Pf)

These checkup was done on line. After doing so, the next is measuring off line.

5. Mesuring the earth resistance.
6. Measuring the insulation capability (by using megger)
7. Taken an oil sample to be tested by BDV test (DGA test)

The data of the inspection was analyzed and clasiffied into 4 catagory according to critical and urgency to be follwed up for corrective action.

Catagory	Max periode to be followed up	Remark
Urgent	2 Weeks	• BDV < 15 kV / 2,5mm • Acidity >0,3 mg KOH / g Oil • Oil Color dark lack/ grey • SUHU PENGUKURAN PADA BEBAN MAX > 85oC (dt < 50oC) • UNBALANCE SANGAT TINGGI > 25 % • GROUNDING > 1,73 OHM TM; >5 TR • OVERLOAD >100 % • TEMPERATUR RUANGAN >40\C • dt (THERMAL) PERALATAN > 50\C
Dangerous	One Month	• BDV 15 - 30 kV / 2,5mm • Acidity 0,2-0,3 mg KOH / g Oil • WARNA OLI TRAFO COKLAT • SUHU PENGUKURAN PADA BEBAN MAX < 85oC (dt < 50oC) • OVERLOAD 80-100 %
Bad	3 month	• BDV 30 - 40 kV / 2.5mm • Acidity 0,1-0,2mg KOH / g Oil • WARNA OLI TRAFO KUNING • UNBALANCE 25 %
Good	NA	• BDV > 40 kV / 2,5mm • Acidity< 0,1 mg KOH / g Oil • WARNA OLI TRAFO JERNIH • SUHU PENGUKURAN THERMAL TIDAK MELEBIHI STANDAR • UNBALANCE < 25 % • GROUNDING < 1,73 OHM TM; <5 TR • PEMBEBANAN <80 % • TEMPERATUR RUANGAN <40\C • dt (THERMAL) PERALATAN <50\C

Table 1. Clasification of inspection result

LONG TERM STRATEGY

Fostering the proper maintenance and sustanaibility of the action, it was realized that The 4 dimension of strategy (operations, monitoring, maintanance, spares) had to be implemented. There were 3 main leverage to improve the overall strategy. The first one is equipment strategy. The strategy approached was applied using ECA (Equipment Critical Analysis). The second one was maintanance optimization and the last is total life time cost optimazation.

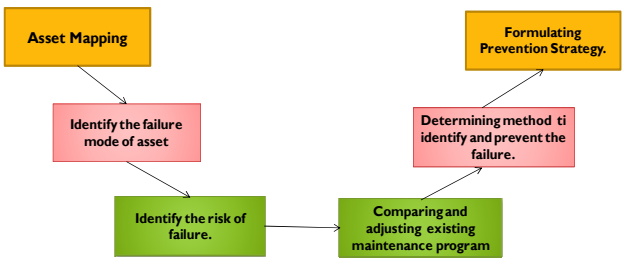


Figure 1 Equipment Critical Analysis Process

In the ECA, Asset Mapping was used to analyze and overviwe all the equipment criticality in distribution station. It included the metalclad MV switches, transformer itself, MV panel, and the civil building. After mapping the asset. Mapping The asset was done by the routine inspection as decribed above. The next step was identifying the failure mode, looking up the root cause of the failure. The root cause was also compared to the statistical data from failure events log. Then it was emparative, to identify all the risk of failure by making risk failure matrix. The matrix covered both economical aspect, political aspect and operational and maintanance aspect. The other things to be conducted was to compare the existing program relating to the number of failure and location, whether any relevence between the maintance to the failure prevention. In our case, due to the shortage of financial support and the decreasing number of the workforce together with the improper policy of outsourcing. We came up with the conclusion that that our maintance program was not properly conducted. After that, we resoluted using the CBM with the strong inspection and monitoring as the way to performed the maintanance and also prevention measure. Other measure taken according to 4 dimension described earlier was streghtening the operation procedure, monitoring and spare management.

THE FINDING AND FOLLOW UP

After doing the inspection of 1000 unit of transformer, it was found that 100 unit (10 %) fell into “urgent” type transformers. There were 4 primary concerns.

1. Excessive heat in transformer body. The root cause was the excessive loading (from the load measure), lack of ventilation in the station, less oil volume. For the excessive loading, there were two quick measure conducted, namely replacing the transformer with the higher capacity and reallocating some load to the nearest station (load balancing). But for most of the cases, the nearest transformer was also full loaded, so the need of new installment of transformer was conducted. For the lack of ventilation, it was added with extra fan and remodified the ventilation arrangement in the station. Some time it was found the volume of oil was not full as specified. Then the oil will be added.
2. Excessive heat in joint and connectors. The coorective action was conducted by tightening the loose connection. In some casses the connectors were repaecd by the appropriate class.
3. Bad Acidity (DGA test) and BDV test, for oil insulation strength. If the test shows that it was to acid and the insulation strength of the Gas showed high carbon monoxide and high carbon dioxide or methane and ethylene at higher levels, the transformer was replaced by the new one. Out of 100 units of transformer there were 40 units that must be replaced due to high ethylene, and carbon monoxide.
4. The leakeage around seal. If there was a sing of oil spilled over through sealed, the transformer was then replaced with the new one. The one that leaked then

refurbished using the thitd party workshop.

UPDATING THE DATA BASE

After doing the inspection and following up with the corrective measures, then the focus was directed to the SIMDIS data updating. The data was updated according to data collected in the worksheet and the action that was taken as the follow up. As stated earlier, SIMDIS was incorporated in the business process of asset operation. There were some obstacle faced in running this. Firstly, it was the lack of complete data collection from the field due to HR shortage in numbers. This problem was overcomed by hiring specific outsource doing the data collection from the field. The hires personel was equipped with the necessary tools for the job. The other thing to be done was mindset shifting program in order to enhance the employee's careness and awareness for updated data. The second challenge was that the disciplines of the employee involving in the operation, planning, maintenance to put their job in SIMDIS as a part of process business. To tackle this obstacle, PLN implemented MCL (mindsets capability, and leadership) in OPI initiative to build up the awareness.

Implementation of the above programs have been undertaken and resulted in decreasing numbers of transformer failure in PLN Gambir as shown in Figure 3 below.

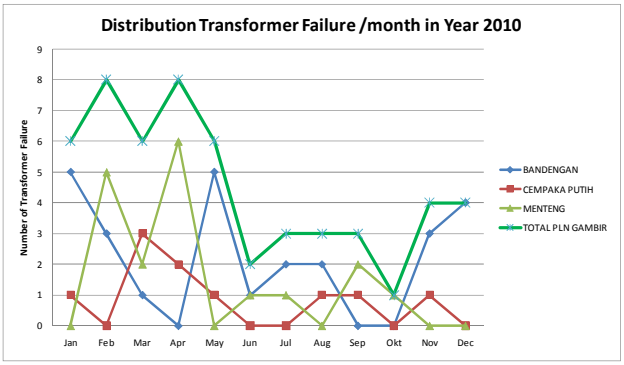


Figure 2 Distribution Transformer Failure

In figure 3 are shown in the graph disturbance distribution transformers per month in the Year 2010, which occurred in the PLN Gambir. The number of distribution transformers disorders seen showing a downward trend. This downward trend indicates an early indication of the improvement in the asset management of distribution transformers.

CONCLUSION

Implementing the asset management needed the step by step action which was guided by a good strategy. The asset management of transformer incorporated the dimension from the operation, monitoring, maintenance, and spare. All this aspect should be supported by computerized application with up to date database and the human resource connected to the asset . The improvement of asset management could be pursued by introducing the Operation Performance Improvement (OPI) program which handling three main aspects. Since the launching of OPI program in Gambir, the number of transformer failure declined, and the healthiness of transformer can be enhanced.

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BIOGRAPHY

Doddy B. Pangaribuan was born in Kuningan, Indonesia in 1969. Graduated from Institute Technology of Bandung in 1992 and join PLN since 1993. He completed his Master Business Administration in Energy Management in HEC (Ecole des haute etudes commerciales) Montreal, Canada in 2002. He is currently working as Senior Manager of Corporate Planning, PLN Head Office.

Bob Saril was born in Palembang, Indonesia in 1968. He graduated from Sriwijaya University - Palembang in 1993 and served as electrical engineer in PLN since 1994. During his duty and career, he completed numbers of expertise trainings in electro technical engineering. He also completed his Master Degree in New South Wales University - Australia, in 2002 and awarded M.Eng.ScM degree. He is currently working as Senior Distribution System Expert for PLN. He was a member of organizing commitee of Indonesian Engineers Association.

Ignatius Rendroyoko graduated from the Institute Technology of Bandung, in 1994 and joined PLN in 1995 as an electrical engineer. He completed his Master of Engineering Science Degree in Monash University - Australia in 2002 and currently working as power system senior engineer in PLN Head Office.