

EVALUATION OF DISTRIBUTION TRANSFORMER LOADING ON THE AMBON CITY EXPRESS REPEATER

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ABSTRACT

Power system distribution, reliability and stability of the system is very important in order to provide convenience in service to consumers. This can be fulfilled by paying attention to the condition of the existing power equipment. One of the most important equipment in power system operation is transformer. Distribution transformers will work optimally if the electrical load carried in the transformer network area does not exceed the capacity of the distribution transformer. When there is an overload on a transformer, the insulation inside the transformer becomes overheated due to the current loaded on the transformer is very large or exceeds the nominal current of the transformer. The solution to overcome the overload on the transformer is if the location between transformers is far apart, it can be done by inserting the transformer by referring to the transformer rating that will supply the load. If the load supplied by the transformer on the network is getting bigger, then a transformer with a large capacity is used to supply the large load, otherwise the transformer will experience an over load which can cause the transformer to trip. At the KTAEXK007 and KTAEXK009 substations, both load shifting is carried out to one of the nearest transformers, namely the KTAEXK008 Amans Hotel substation. Then in the existing calculations, there are two transformers that will be used for transformer insertion, namely a transformer with a rating of 315 kVA and a 100 kVA transformer.

Keywords: Overload, Transformer, Low Voltage Network

INTRODUCTION

Power system distribution, reliability and stability of the system is very important in order to provide convenience in service to consumers. This can be fulfilled by paying attention to the condition of the existing power equipment. One of the most important equipment in power system operation is transformer.

Distribution transformers will work optimally if the electrical load carried in the transformer network area does not exceed the capacity of the distribution transformer. When there is an overload on a transformer, the insulation inside the transformer becomes overheated due to the current loaded on the transformer is very large or exceeds the nominal current of the transformer.

Electric power distribution transformers function to reduce high voltage to low voltage, so that the voltage used is in accordance with the rating of consumer electrical equipment. Transformers are expensive electrical equipment, so they must be maintained and maintained to

have a long service life. Transformer life can be reduced due to several things.

One of the causes of reduced transformer life is loading, loading results in an increase in temperature in the transformer. The heat generated results in the decomposition of transformer materials which can accelerate the aging process of a transformer. The occurrence of too high heat will be able to change the construction properties of the transformer parts. Every increase of about 60C from the permissible limit will result in reduced life.

Therefore, this temperature rise must be limited. Insulation of the conductor in the transformer winding will cause damage if subjected to high temperatures. Based on the results of transformer measurements on the city express feeder, out of 16 substations there are five substations that experience an increase in load above 80% and a loading evaluation must be carried out so as not to adversely affect the existing transformer. Because of the problems that exist above, an evaluation is needed, so the authors decided to carry out a final project with the title Evaluation of Loading on Distribution Transformers, the transformer that will be evaluated is the substation in the city express repeater which has an increase in load above 80%.

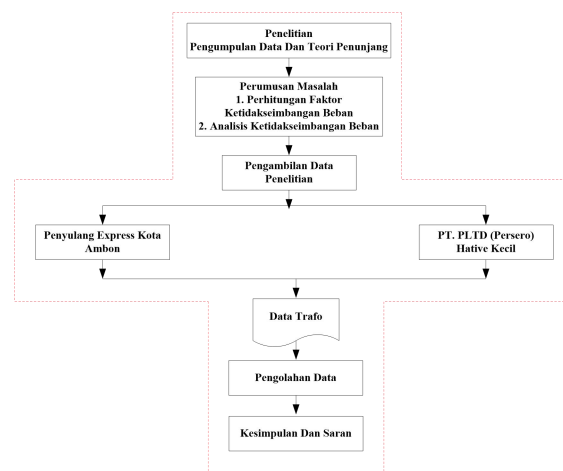
METHODS

Research Methods

The method used in this research is Quantitative Analysis in which the author analyses to determine the cause and effect of this research. Based on the background description, theoretical studies and problem formulation, to achieve efficient electrical energy needs in load sharing, several ways are needed, namely by increasing the number of transformers and resetting transformer loading because the ideal loading for a power transformer is 80%.

Thinking Framework

Research on load sharing is very important to do in determining the need for electrical energy, so that the supply of electrical energy in accordance with the needs of consumers / customers. This research will be carried out Evaluation of Distribution Transformer Loading on City Express Repeater, with the aim of knowing the need for electrical load balance on City Express Repeater in Ambon City. The research framework can be seen in the following figure:



Research Stages

The author collects data at the Express City substation in the company archive via online in the PLN Simaurits application, as well as retrieving substation location data using location markers on smartphones, determining what problems will be researched for the preparation of the final project, studying supporting theories related to the research to be carried out from various sources. The literature study that will be carried out is to learn about overloads, distribution transformers and journals related to the research title. After the data is obtained, then perform data processing, namely by referring to the systematic writing of the final project report, analysing the data in the form of values obtained by mathematical formula calculations and the results include discussions and conclusions that aim to show the results of the research in accordance with the methods used.

DISCUSSION

Results

PT PLN (Persero) Ambon Kota Customer Service Unit, according to the data obtained, the City Express Repository supplies electrical energy to the Tanjakan Batu Merah, Rijali and surrounding areas. The type of conductor used in this extension is aerial cable (A3C-S and A3C with sizes 150 mm² and 70 mm²) with a total network length of 7.53 kmsircuit. Asset data owned by this extension includes 16 transformers with a total installed power of 3,970 kVA. The following is a table of substation details on the City Express Repository:

Table Repository Data

No	Substation Name	Address	Merk Trafo
1	KTAEXK001	Depan Ambon 5	Voltra
2	KTAEXK002	Taspen	B&D
3	KTAEXK003	Jl. Telukabessy	Travindo
4	KTAEXK004	Hotel Pasifik	Starlite
5	KTAEXK005	Hotel Golden Palace	Sintra
6	KTAEXK006	Hotel Everbright	Travindo
7	KTAEXK007	41B Jl. Mutiara	B&D
8	KTAEXK008	Hotel Amans	B&D
9	KTAEXK009	41D Parkiran Hotel Amans	Sintra
10	KTAEXK010	GH A3	Unindo
11	KTAEXK011	Pasar Mardika (Sisipan)	Travindo
12	KTAEXK012	Pasar Mardika	Travindo
13	KTAEXK013	Kantor Agraria	Travindo
14	KTAEXK014	Hotel The City	Travindo
15	KTARJL019	34B Tanjakan Batu Merah	B&D
16	KTATNT050	Pengadilan Militer	Kalla Trafo

Express of City repository gets power supply from 1 PLTD then goes to substations KTAEXK013, KTATNT050, KTARJL019 KTAEXK001 and then enters the incoming Rijali Substation. Then outgoing from GH Rijali goes to substations KTAEXK002, KAEXK014 and to concrete substation KTAEXK003 and enters GH A3 incoming which includes substation KTAEXK010. Furthermore, the Amans substation supplies to the KTAEXK008 substation through the disconnecting switch and fuse cut out to two concrete substations, namely KTAEXK011 and KTAEXK012, then supplies to the KAEXK009, KTAEXK007, KTAEXK005, KTAEXK004 and finally to the KTAEXK006 substation.

Load Condition on City Express Substation

Table:Transformer Load Data on City Express Repository

No.	Nama Gardu	kVA Trafo	Arus Nominal	Data Pengukuran			Tanggal Pengukuran
				Phasa R	Phasa S	Phasa T	
1	KTAEXK001	200	289	89,6	44,7	24,01	01/04/2019 - 19.38
2	KTAEXK002	200	289	133,3	141,1	112,4	11/08/2019 - 13.19
3	KTAEXK003	315	455	126,5	88,1	97,9	09/08/2019 - 12.54
4	KTAEXK004	200	289	53,59	47,81	65,3	12/08/2019 - 19.05
5	KTAEXK005	200	289	43,15	30,26	29,1	12/08/2019 - 18.54
6	KTAEXK006	250	361	37,73	24,32	27,96	12/08/2019 - 19.15
7	KTAEXK007	250	361	269,8	240,4	180	12/08/2019 - 19.27
8	KTAEXK008	315	455	47,56	47,53	54,85	09/08/2019 - 12.18
9	KTAEXK009	160	231	171,7	127,2	127,9	12/08/2019 - 19.37
10	KTAEXK010	630	909	220,7	209,8	244,1	09/08/2019 - 11.40
11	KTAEXK011	250	361	264,4	208,7	233	09/08/2019 - 12.31
12	KTAEXK012	250	361	361,5	293,2	301,6	09/08/2019 - 12.39
13	KTAEXK013	100	144	24,72	62,2	18,05	02/04/2019 - 11.03
14	KTAEXK014	250	361	102,4	76,6	70,3	09/08/2019 - 13.08
15	KTARJL019	250	361	256,5	211	226,6	01/04/2019 - 19.54
16	KTATNT050	100	144	12,22	12,8	21,91	08/08/2019 - 12.51

(Source: Ambon City ULP Archive Data)

Table: 4.3. Substation Load Data before Load Switching

Sebelum Pengalihan Beban									
KTAEXK007					KTAEXK005				
Kapasitas Trafo	Phasa R	Phasa S	Phasa T	% Beban	Kapasitas Trafo	Phasa R	Phasa S	Phasa T	% Beban
250 kVA	269,8	240,4	180	92,02%	200 kVA	43,15	30,26	29,1	17,08%
KTAEXK009					KATEXK008				
Kapasitas Trafo	Phasa R	Phasa S	Phasa T	% Beban	Kapasitas Trafo	Phasa R	Phasa S	Phasa T	% Beban
160 kVA	171,7	127,2	127,9	88,91%	315 kVA	47,56	47,53	54,85	15,86%
KTAEXK011					KATEXK008				
Kapasitas Trafo	Phasa R	Phasa S	Phasa T	% Beban	Kapasitas Trafo	Phasa R	Phasa S	Phasa T	% Beban
250	264,4	208,7	233	96,41%	315 kVA	47,56	47,53	54,85	15,86%
KTAEXK012					Sisip Trafo				
Kapasitas Trafo	Phasa R	Phasa S	Phasa T	% Beban	Kapasitas Trafo	Phasa R	Phasa S	Phasa T	% Beban
250	361,5	293,2	301,6	127,50%	315 kVA	0	0	0	0%
KTARJL019					Sisip Trafo				
Kapasitas Trafo	Phasa R	Phasa S	Phasa T	% Beban	Kapasitas Trafo	Phasa R	Phasa S	Phasa T	% Beban
250	256,5	211	226,6	92,54%	100 kVA	0	0	0	0%

Discussion

From the calculation results, the transformer will not be able to supply loads above its ideal limit. If forced, of course the transformer will be damaged, because it is forced to supply loads beyond its capacity and the transformer can be at the "warning" level where at this level the load must be transferred to a lower load transformer so as not to reduce the efficiency of the transformer.

Table: 4.3 Recap of load calculation results

No.	Nama Gardu	Kapasitas Trafo 80%	Kelebihan Beban (OL)			I Rata-rata	% Keseimbangan Beban
			Fasa R	Fasa S	Fasa T		
1	KTAEXK007	200 kVA	69,8 kVA	40,4 kVA	0 kVA	230,06 A	0,30%
2	KTAEXK009	128 kVA	43,7 kVA	0 kVA	0 kVA	142,26 A	0,60%
3	KTAEXK011	200 kVA	64,4 kVA	8,7 kVA	33 kVA	235,36 A	0,60%
4	KTAEXK012	200 kVA	161,5 kVA	93,2 kVA	101,5 kVA	318,7 A	0,60%
5	KTARJL019	200 kVA	56,5 kVA	11 kVA	26,6 kVA	231,3 A	3%

Loading Solution

Based on the load calculation above, it can be analysed that the transformer whose load is more than 80% must be manoeuvred to the nearest transformer to avoid things that can reduce the efficiency level of the transformer.

CONCLUSION

After analysing the calculations from the data obtained, the authors can draw conclusions, namely based on the results of the calculation, the solution to overcome the overload on the transformer is that if the location between the transformers is far apart, it can be done by inserting the transformer by referring to the transformer rating that will supply the load. If the load supplied by the transformer on the network is getting bigger, then a transformer with a large capacity is used to supply the large load, otherwise the transformer will experience an overload which can cause the transformer to trip. At the KTAEXK007 and KTAEXK009 substations, both load shifting is carried out to one of the nearest transformers, namely the KTAEXK008 Amans Hotel substation. Then in the existing calculations, there are two transformers that will be used for transformer insertion, namely a transformer with a rating of 315 kVA and a 100 kVA transformer.

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