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Table of Contents

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Optimal Simulation Network with Energy Go Green, New Quadruple and Newton-Raphson to Minimize Losses

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Keywords: Line; Energy go green; New quadruple; Newton-Raphson; Losses; Optimal

Abstract. High voltage transmission line 500 KV is part distribution of electrical energy which have a direct impact on changes in the system, the variable system in result of the occurrence of a pattern of over load, under load and interference load. The load could be saving because of Energy Go Green Light, Go Green technology changes all times, be same with variable load, but not in time, so make the system unstable, if all load has change with Go Green Light. Go Green Lights could be save energy at least 30% of energy consumption. These changes will certainly affect the line transmission, if all the load for instance Residence and Industrial used. Because of between load and line of energy is always changing. By using the Newton-Raphson method, which energy use patterns can be seen to Go Green Lights by using a data network PT PLN (Persero) sub Jawa Barat (2011), Transmission line Region Jawa Barat taken consist of five buses and five lines, when the load changes can be taken into account losses at network. New Quadruple method to minimize ripple current, overcome disable so that the efficiency can be improved. And also able to minimize the loss of the output power, can be automatically.

Introduction

Optimal transmission line 500 KV, Electric Power in Jawa Barat with 5 buses and 5 transmission line. This data was taken in 2011. Data obtained from PT. PLN (Persero). Data is analyzed using analysis of power flow with the Newton-Raphson method, assuming the pattern of energy consumption for lighting. To analysis the changes in load flow using Matlab 2014. Power flow analysis is applied to the system for normal condition, and the state of load changes. The variable load are always changing for 24 hours in normal condition, as well as the load changes when consumers start using the device Go Green, energy-efficient appliances to. So that when the load that consumes electrical energy began to turn adds equipment such as DIMMER Go Green, use OCCUPANCY sensor , then replace the lighting with LED light, resulting in energy savings, to improve the quality of electric energy installed New Quadruple (NQ) side before the load. Prediction of energy consumption pattern changes, performed with several stages, add equipment e.g. installing DIMMERS Go Green lights without changing the existing system.

1. By adding Dimmer able to save 20 percent of energy consumption are commonly used, Dimmer is a tool to regulate and stabilize voltage lumen. So have direct impact on changes in the system.
2. When using sensors OCCUPANCY, for example in place, room, or hallway when passing or the area in need of energy lighting, the light goes on, after not used, it automatically turns off the lights. With OCCUPANCY sensor is able to save energy consumption by 50 percent.
3. Dimmer and sensors installed simultaneously OCCUPANCY will use electrical energy capable of saving electrical energy usage 60 percent of the original.
4. When all the lights replaced with LED lights. Where the current LED lights can save electrical energy at least 75 percent, meaning LED light consumes only electrical energy at most 25 percent of energy consumption before it was replaced with LEDs.
5. In addition tech tools Go Green and use LED lights, predicted the losses still high, because the transmission system still has losses [6]. Added New Quadruple losses mounted so that the output current ripple becomes small so that clicking optimize load needs. New Quadruple NQ Boost converter is integrated with a permanent magnet that is as high permeability filters can be

able to function as a low pass filter, high pass filter or a band pass filter in accordance with changes in the load is capacitive reactive, or inductive reactive, but are lumped. NQ specially designed according to the needs of high capacity. By using NQ able to reduce the output ripple current 0.03 percent with an efficiency of approximately 99 percent. NQ will interact to corresponding changes in load and transmission patterns as input.

If the pattern above it can be taken into account savings will produce suppression pattern of energy up to 135 percent of the electrical energy consumption.

Review of Literature

Electric power system and energy needs. Transmission system Java Bali region of Jawa Barat has five buses and five line are Cibinong, Muaratawar, Cibatu, Cirata, and Saguling. Generating busbar in positions 1,3 and 5, busbar Cibinong and Cibatu are load, of data obtained from PLN see Fig.1 and Table 1.

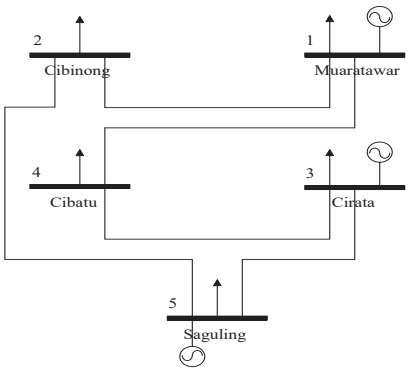

Fig.1. Single line diagram of the system interconnect 500 KV Jawa-Bali region of Jawa Barat in 2011 (source: PLN)

Table 1. Data transmissions 500 KV region Jawa Barat in 2011

No	Location		Volt	I nominal	R0	X0	R1	X1
	From	To	(KV)	(Amp)	(ohm/Km)	(ohm/km)	(ohm/Km)	(ohm/Km)
1	SGLNG	CRATA 1a	500	2,500	0.179	0.846	0.029	0.282
	SGLNG	CRATA 1b	500	2,500	0.179	0.846	0.029	0.282
	SGLN	CRATA 2a	500	2,500	0.179	0.846	0.029	0.282
	SGLNG	CRATA 2b	500	2,500	0.179	0.846	0.029	0.282
2	SGLNG	CIBNG 1a	500	2,400	0.175	0.843	0.025	0.281
	SGLNG	CIBNG 1b	500	2,400	0.175	0.843	0.025	0.281
	SGLNG	CIBNG 2a	500	2,400	0.175	0.843	0.025	0.281
	SGLNG	CIBNG 2b	500	2,400	0.175	0.843	0.025	0.281
3	MTWAR	CIBNG 1a	500	2,500	0.179	0.846	0.029	0.282
	MTWAR	CIBNG 1a	500	2,500	0.179	0.846	0.029	0.282
4	CRATA	CBATU 1a	500	2,500	0.179	0.846	0.029	0.282
	CRATA	CBATU 1b	500	2,500	0.179	0.846	0.029	0.282
	CRATA	CBATU 2a	500	2,500	0.179	0.846	0.029	0.282
	CRATA	CBATU 2b	500	2,500	0.179	0.846	0.029	0.282
5	CBATU	MTWAR 1a	500	2,500	0.179	0.846	0.029	0.282
	CBATU	MTWAR 1b	500	2,500	0.179	0.846	0.029	0.282
	CBATU	MTWAR 2a	500	2,500	0.179	0.846	0.029	0.282
	CBATU	MTWAR 2b	500	2,500	0.179	0.846	0.029	0.282

Generating and loading capacity is obtained from the PLN, the following data in Table 1 (PLN, 2011): From Fig. 1 Single line diagram of the system interconnect 500 KV Jawa-Bali region of Jawa Barat in 2011, modeled in a distributed load on each busbar but it rings or through a centralized system P3JB Gandul. Loss occurred from the generation, transmission high voltage, medium voltage to the load. Manish N. Sinha, Dr.BR Parekh [1] on the transmission of losses much going on 500 KV transmission lines, losses occur as a result of the fault system load variations

which always variable change, occur in parallel, in the network due to the system, transmission errors and faults on own circuit, faults on parallel and transmission see Fig. 2 [1].

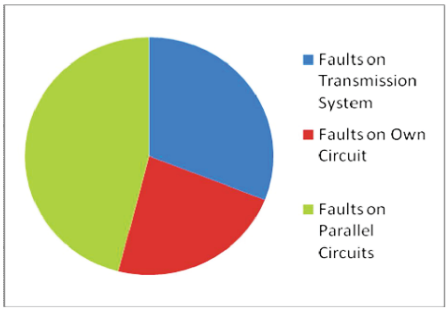

Fig. 2. Diagram of transmission line losses [1]

The biggest loss in the transmission system are 23% [1], the biggest mistake when parallel. Taaqiyuddin, Sasengko Pramong Hadi. "Optimal power flow studies in the electrical system of 500 KV Jawa Bali by using particle swarm optimization (PSD). Journal JNTETI Vol. 2 No. 3, 2011 transmission loss 17.85% [2]. Losses and loss expenses incurred in loading Industrial, commercial, residence, social homes, houses of worship. The losses could be accumulated to minimize the losses can be carried out by several methods, such as by arranging the infrastructure in order to achieve optimization.

BAU KEN and electrical energy needs will continue to increase in accordance with the GNP, the electrical energy needs (KEN) will continue to increase by about 8.2% per year, and based on the BAU would increase by 7.6% per year, based on the prediction curve 2011 to 2030 [4]. Can be seen as follows Fig. 3.

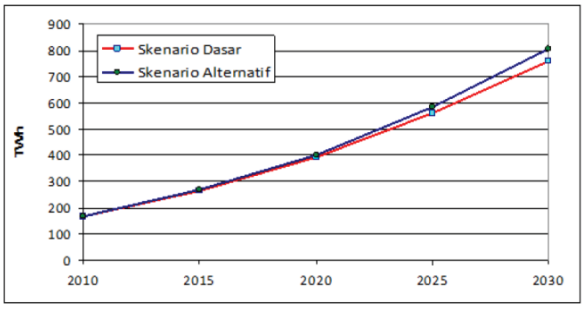

Fig. 3. Electrical energy curve 2010 to 2030, basic low consumption and alternative (data and information centers of energy and mineral resources ministry of energy and mineral resources. "Indonesian study energy outlook".2012) [3]

From Fig. 3, needs total electrical energy will continue to rise. The increasing need for Electrical Energy certainly accompanied by the need for fuel to generate Electrical Energy, base on the research world that unrenewable alternative fuel, so that the whole world will think about fuel exhaustion. One alternative to overcome the problem of un-ending energy that is renewable fuel Go Green technology which uses technology with energy-efficient lighting, low losses, high lumen, high efficiency, with voltage regulation (DIMMER), install OCCUPANCY sensors, DIMMERS and OCCUPANCY, and replacing light bulbs with LED for example, and to add New Quadruple. Increasing efficiency can address a variety of needed, Lisa Ryan and Nina champ ball [4] see Fig. 4.

Fig. 4. Multiple benefits of energy efficiency [4]

From Fig. 4 Multiple benefits of energy efficiency [4]. The efficiency is source any kindly of resources so its could increase the demand, by increasing the efficiency of the output power is certainly greater, made smaller the losses, loss of income the less the electrical energy that is used in accordance with the needs and of course usage fee in accordance with the capacity energy, the efficiency of the fuel can be used emit a low, efficiency will rise, electrical energy into quality, cost-effective and reliable [4].

Optimize the system

a. Dimmer, OCCUPANCY sensor, Dimmer and Occu, LED lights.

The pattern of side load optimization is done is done mechanically and electrically. Mechanically done by installing DIMMERS (installation thermostat lumen) without changing the system, it can save 20%, with to add OCCUPANCY sensor is able to save 50%, combining Dimmers and OCCUPANCY able to save 60% [5], to replace the lights in the room by using LED lights at least be able to save at least 75% [6] when the street lights were replaced with street lights with LED lights which can improve high lumen efficiency with power consumption ratio 70 Watt replace 250 Watt LED street lamps, the lumen efficiency reaches at least 2 fold. Nishanth L1,Nirmala Kumari K2, Ramesh S M3 [7].

b. Newton Raphson and New Quadruple (NQ)

To account for changes in load predicted by the electrical energy needs [3], according KEN need for electrical energy increases with the increase of 8.2 percent per year, while the BAU will increase 7.8 percent each year, until 2030 [3]. By [1] and [2] loss of network losses will also increase with the increasing burden every year. This data is one of the parameters in order to elevate the efficiency [4]. Taking into account the network disturbance, load changes that may occur at any time used Newton Raphson [11] as below. Eq. 6.

Newton-Raphson method

$$P_i = V_i \sum_{j=1}^{N} V_j (G_{ij} \cos\delta_{ij} + B_{ij} \sin\delta_{ij}) \quad ; i = \overline{1,N} \tag{1}$$

$$P_i = V_i \sum_{j=1}^{N} V_j (G_{ij} \cos\delta_{ij} + B_{ij} \sin\delta_{ij}) \tag{2}$$

$$Q_i = V_i \sum_{j=1}^{N} V_j (G_{ij} \sin\delta_{ij} + B_{ij} \cos\delta_{ij}) \quad ; i = \overline{1,N} \tag{3}$$

where

V_i, V_j : Voltage magnitudes at buses i and j
δ_i, δ_j : Angle magnitudes at buses i and j
P_i : Real power injection at bus i
Q_i : Reactive power injection at bus i
$G_{ij} + B_{ij}$: Entry (i,j) of the nodal admittance matrix

$$P_{ij} = V_i V_j (G_{ij} \cos \delta_{ij} + B_{ij} \sin \delta_{ij}) - V_i^2 G_{ij} \quad (4)$$

$$Q_{ij} = V_i V_j (G_{ij} \sin \delta_{ij} - B_{ij} \cos \delta_{ij}) + V_i^2 (B_{ij} - b_{ij}^{shunt}) \quad (5)$$

$$\begin{bmatrix} \Delta P \\ \Delta Q \end{bmatrix}^k = J(X)^k \begin{bmatrix} \Delta P \\ \Delta Q \end{bmatrix}^k \quad (6)$$

where

P_{ij} : real power flow through branch $i-j$

Q_{ij} : reactive power flow through branch $i-j$

b_{ij}^{shunt}: shunt susceptance of branch i- j

K : the iteration counter

$J(x^k)$: the problem's jacobian matrik given by $J(x^k) = \begin{bmatrix} J_1 & J_3 \\ J_2 & J_4 \end{bmatrix}^k$ (7)

New quadruple. NQ could be minimize output ripple current [8] about 0.003% [8, 10] NQ is modeling magnetic to electrical circuit as shown in Fig. 5 [8]

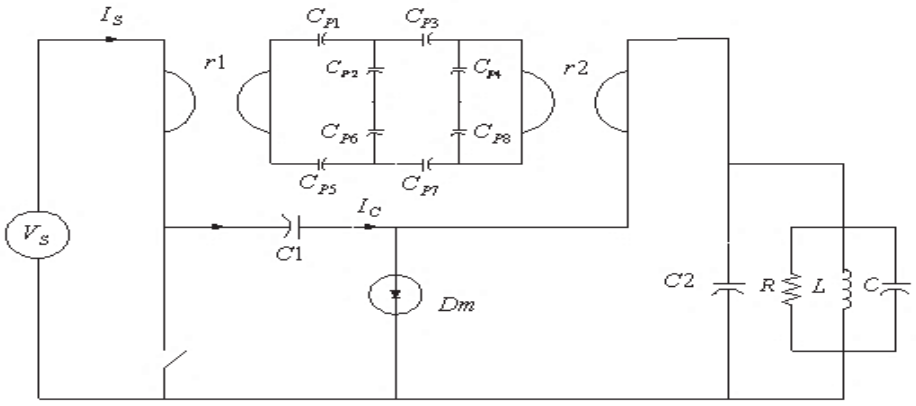

Fig. 5. New quadruple (NQ) E-transformers in Cuk Slobodan Converter [8]

where *Dm* is diode, *R* is Resistivity, *L* is inductance, *C* is capacitance, CP_1, CP_2, CP_3, CP_4, CP_5, CP_6, CP_7, CP_8 is capacitance approach of permanent magnets, R_1 is gyrator.

Fig. 5 New Quadruple E transformers on Slobodan Cuk converter is a series of approaches from the magnetic circuit to electric circuit, geometry could reduce, air gap, number of turns, the magnetic material has a very high relative permeability so as to have a very small capacitance value. magnetic core with increasing energy in order to balance the load and input power changes so as to improve the efficiency [9].

New Quadruple Fig. 5 as a voltage control current source VCCS and current control voltage source CCVS. From the above modeling it found source flows as follows (9) [8]:

$$i_S = V_S g^2 r_P + gE \quad (8)$$

So NQ has Sensitivity current source to voltage source such as the equation:

$$S_{V_S}^{i_S} = \frac{g^2 r_P \frac{i_S - gE}{g^2 r_P}}{i_S} = 1 - g\left(\frac{E}{i_S}\right) \quad (9)$$

Sensitivity io source current to a voltage source Vs, the motion of the electric force E of the gyrator g is:

$$S_{V_S}^{i_O} = 1$$

$$S_{E}^{i_O} = 0$$

$$S_g^{i_O} = 1$$
$$\mathbf{S_g^{i_O} = 1} \quad (10)$$

Transmission line with variable loads, there are Industrial, Resident, concerned with the lighting load, almost all industrial used motor so that transmission has losses. Optimization line described as follows Fig. 6.

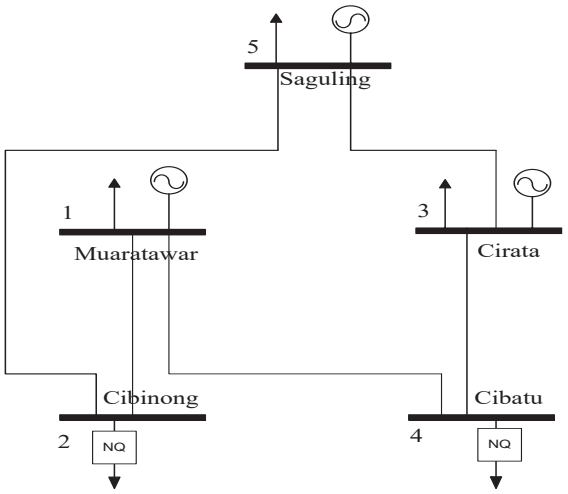

Fig. 6. 500 KV Transmission line with New Quadruple (NQ)

Optimize system 500 KV transmission in Fig. 6 with add the NQ is model with a block diagram like Fig. 7.

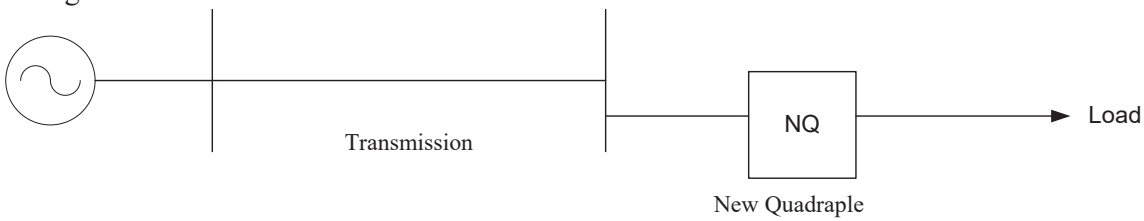

Fig. 7. Position NQ in the Jawa-Bali interconnection system region of Jawa Barat

From Fig. 7 can be written in block diagram as the optimization system NQ like Fig. 8.

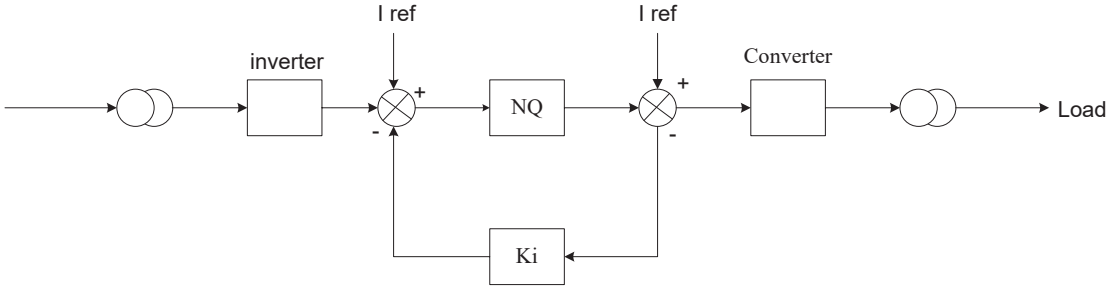

Fig. 8. Blok diagram network optimization using energy go green and new quadruple

This study is an evaluation of the electrical energy needs in accordance with the predictions of the electrical energy needs from 2011 to 2030, the data are reviewed in the power system network of 500 KV PT. PLN Region Jawa Barat. With improving reliability by simulating the effect of changes in the load on the current changes in the branch channel and bus voltage in the system by the method of Newton-Raphson power flow.

The design and framework of this research is planned through several stages as follows:

a. Studying the data PLN Java-Bali region of Jawa Barat, and energy needs in the years 2011 to 2030, studying technologies Go Green. Among outdoor and indoor LED lamp.
b. NQ could be control the power system and load of 500 KV PLN Jawa Barat.
c. Taking into account the gradual change of the load transmission system.
d. Perform the power flow analysis of the power system PLN Jawa Barat before and after use conditions Go Green technology.
e. After loss taking into account the use of technology Go Green.
f. Account the influence of the electrical energy needs of a growing [3] and inversely proportional to the energy consumption of electricity Go Green [2],[4],[6],[9].
g. Modeling NQ according to the voltage capacity of 500 KV. Stages of research can be apply on the following flow chart Fig. 9.

The integration of Flowchart stages research the optimal simulation line with Energy Go Green, New Quadruple and Newton-Raphson to Minimize Losses as Fig. 9.

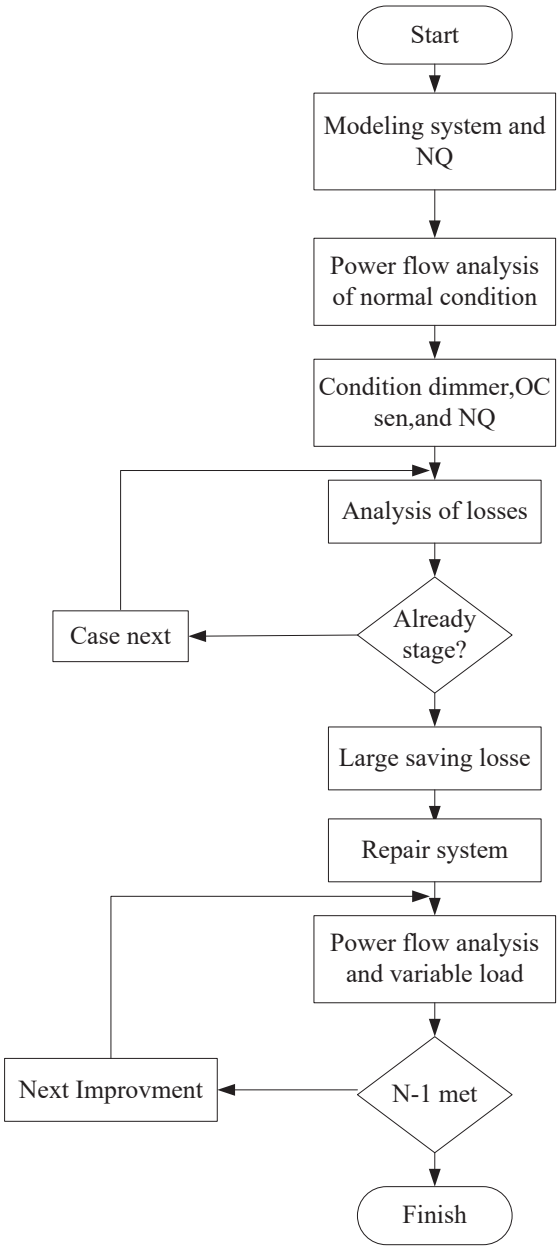

Fig. 9. Flowchart stages research

Data analysis was performed with the simulation program of power flow analysis (load flow analysis) using Matlab.

Analysis and Result

From the data of 500 KV high-voltage transmission region of western Java, simulated by adding components Dimmer Go Green can save energy 20%, by adding sensors occupancy it will save 50%, combining Dimmers and occupancy sensor is able to save 60%, replace all the lights in the area Jawa Barat with LED lights can save at least 75%, by using NQ able to improve the efficiency of more than 90 percent. when the data is the data of energy savings Go Green as above do can save up to 135 percent.

Go Green technique is proposed phased so that in 2030 the use of electric energy decreases, although every year there was an additional burden of 8.2 percent (KEN), electric energy consumption reached 137.4% in 2030. If in predicting the electrical energy that will come up with a technology Go Green see Fig. 12 Curve Energy consumption prediction Year 2011-203.

From simulation Newton Rapson after using DIMMERS, OCCUPANCY sensors, and using LEDs, the losses are still quite large. But the power savings seen by the reduction in power consumption see Fig. 10.

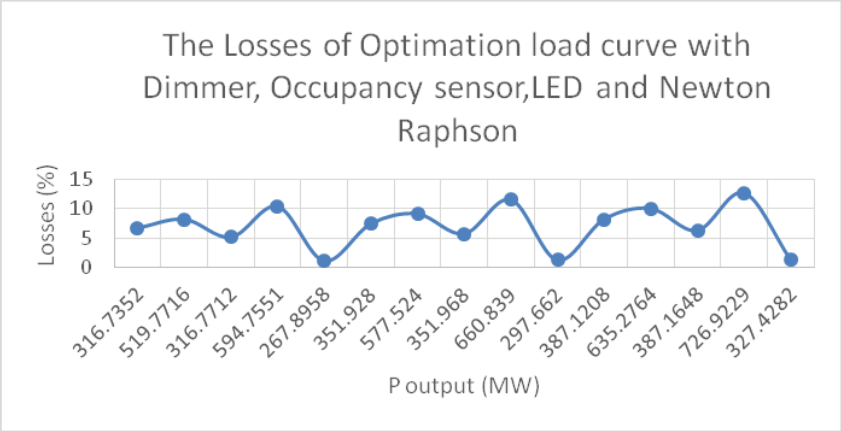

Fig.10. Load optimized with the use of DIMMERS, OCCUPANCY sensors, LEDs with NQ

Output losses of Fig. 10 must be small with the NQ, so that the output current ripple becomes smallest see Fig. 11. So the efficiency almost 100% (see Tables 2 and 3).

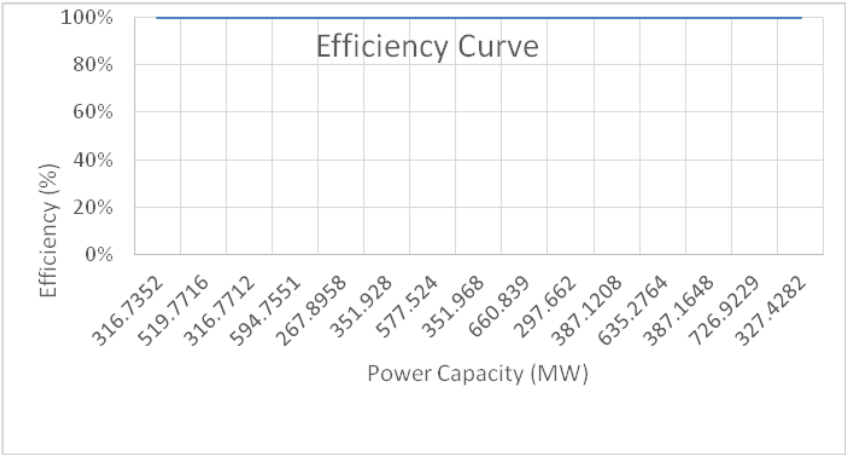

Fig. 11. The optimal efficiency curve

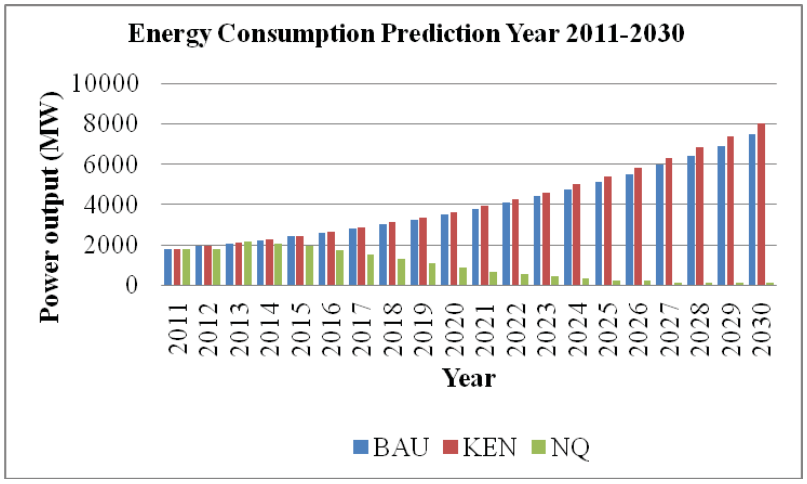

Fig. 12. Curve energy consumption prediction year 2011-2030

Table 2. analysis Newton Raphson

Newton Raphson Loadflow Analysis								
Bus	V	Angle	New Quadruple		Generation		Load	
No	pu	Degree	(MW)	(Mvar)	(MW)	(Mvar)	(MW)	(Mvar)
1	1.0000	0.0000	-918.865	140.576	-918.909	140.576	0.000	0.000
2	1.0000	1.2099	0.000	0.000	0.000	0.000	0.000	0.000
3	1.0000	1.8982	365.000	5.065	5.065	5.065	0.000	0.000
4	0.9990	0.9016	-89.584	-54.950	0.000	0.000	89.540	54.950
5	1.0000	2.1412	647.000	-58.774	647.000	-58.774	0.000	0.000
Total			3.551	31.915	93.135	86.868	89.584	54.953

Table 3. The result efficiency and losses

Line Flow and Losses									
From	To	P	Q	From	To	P	Q	Line Losses	
Bus	Bus	MW	MVar]	Bus	Bus	MW	MVar	MW	Mvar
1	2	-349.581	40.623	2	1	350.350	-33.231	0.7694	7.3915
1	4	-569.284	100.381	4	1	570.227	-91.320	0.9430	9.0601
2	5	-350.350	33.539	5	2	350.860	-27.841	0.5093	5.6978
3	4	661.010	-25.510	4	3	-659.811	36.967	1.1985	11.4570
3	5	-296.010	31.449	5	3	296.140	-30.194	0.1307	1.2555
Total Loss								3.551	34.862

Conclusion

By used Go Green Lights technology could be decrease consumption electrical Energy with GNP 2030, about 10% from electrical energy 2013. Losses will be decrease depend on loads. NQ could be optimization efficiency will be in nearly 100%.

Sugestion

1. Increase the rate of introduction and education to people about the usage and advantages of Go Green technology devices/appliances that have lower power than conventional appliances.
2. These optimization is not yet calculate the possibility if all transmission cable line replaced by another cable that has lower losses.
3. This optimization uncalculated with the losses transmission line.
4. The calculation in this paper is not yet to calculate included with the saving energy for electric machine.

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