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PREFACE

The MICES (Medan International Conference on Energy and Sustainability) 2020 is the 5th ITB and Indonesian Higher Education of Engineering Centennial International Conference. *'Energy, Covid-19, and The Changing World'* was chosen as the theme for the conference due to recent pandemic condition. We attempted to choose the theme that would cope with the current global changing world caused by the pandemic, particularly in the energy sector.

This pandemic situation also has changed the way the conference was held. Before the pandemic, we planned to hold the conference via face-to-face meeting. But since we wanted to hold the conference internationally (where participants would travel from different countries and regions globally) while the pandemic has occurred globally and then, as to eliminate the risk to virus transmission, we finally anticipated to hold the conference virtually via online platform. Further, we actually have decided to postpone the conference from March 2020 to October 2020 while still waiting for the pandemic situation went better, and expecting that the conference can be held through offline setting. However, since the cases trend still increased significantly in Indonesia, thus, we decided to hold it virtually. In this virtual conference, the organizer was based in JW Mariott Hotel, Medan, North Sumatra, Indonesia.

This conference was held in two days, on October 27-28, 2020. The conference was conducted in a plenary and parallel session presentation. In each day, it was started with the plenary session, from 8am-1pm, and was followed by 3-5 parallel invited speaker sessions (1pm-3pm), and followed by 5 parallel presenter sessions (3pm-5pm). The plenary session was allocated for keynote speakers and keynote lecturers, where 30-40 minutes was allocated for each session. In the afternoon session, in the parallel invited speaker sessions, there were 2-3 speakers in each session and every invited speaker had 20 minutes of presentation and followed by 10 minutes of Q&A. In the parallel presenter session, there were two sessions of presentation, where in each session, there were 2-3 presenters where all of which was given 10 minutes of presentation and 5 minutes of Q&A. More detail about the name of speakers and presenters, and the process during the conference can be seen in the conference program handbook, which can be accessed via the conference website (http://100tahunitb-iaitbsumut.info/).

In this conference, we had: 3 keynote speakers, 6 keynote lecturers, 20 invited speakers, 49 presenters (with 43 published paper and 6 non-published presenters) and 590 registered participants. In this conference we had speakers, presenters and participants from governments, state-owned enterprises, private companies, academics, and students from different countries. We organized the topics of the conference into 8 different tracks of energy issues: *Fossil Fuel / Conventional Energy, New and Renewable Energy, SDGs and Environmental Challenges in Energy Sector, Energy and Regional Development, Energy Economics, Energy Security and Defence, Energy Education, and Decentralized Energy Development.*

What was so interesting in organizing this conference was the use of online platform to facilitate the conference processes. Since we organized this conference virtually, the committee gathered together in one place (JW Mariott Hotel, Medan), to ensure internet connectivity as well as to ensure

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coordination and communication between committees during the 2 (two) day session. We used two meeting rooms in the hotel, which was closed to each other. Room 1 as the main room, as commando room, used for main host and main committee. Room 2 was used for co-hosts and note-taker of each virtual room.

We used ZOOM platform that can facilitate up to 1000 participants in this conference. In the plenary session, we set the zoom as **webinar setting** where only speakers, moderators and several other committee members can communicate orally. Other participants can join the conference and ask questions by writing in the chat room. In the parallel invited speaker sessions and parallel presenter sessions, we set the zoom into **meeting setting**, where everyone can ask questions orally. What is very interesting here was when we want to separate the online room into five parallel rooms and distributed the participants into rooms that they wanted to join. Since we used a new version of zoom, it is not difficult for participants to enter the room they wanted to. Participants only needed to click the room number (shown in the zoom) that they wish.

To ensure the process runs well in each virtual room, we appointed and distributed one co-host in each virtual room. These co-hosts must manage, monitor and control every process and solve any technical issues in their room. One host (main host) was addressed to monitor all co-hosts in each room.

As hopefully, we have anticipated most of the technical issues, and we might consider that we have delivered the conference successfully. Many colleagues gave good appreciation to the way the conference was conducted. To know more on the process in the conference, please visit the video of all session of the conference at this link: http://bit.ly/VideoPlaylistMICES2020.

Finally, I want to thank all of my colleagues in the conference committee who have prepared this conference with their heart. And also, to our sponsor, the diamond, platinum, gold, silver and bronze. Without their sponsorship this conference would not be the same. And also, to IOP Publisher, as our partner to publish our conference papers.

With warm regards,

Zaid P. Nasution, Ph.D.
(Chair of MICES 2020)

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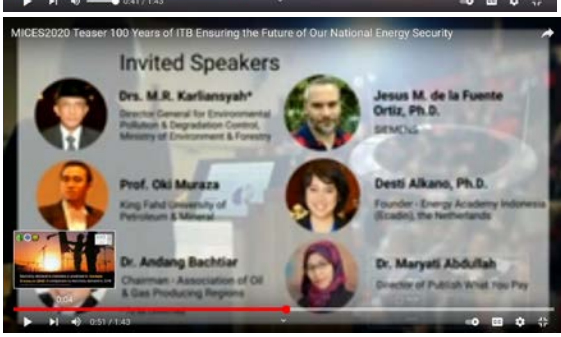

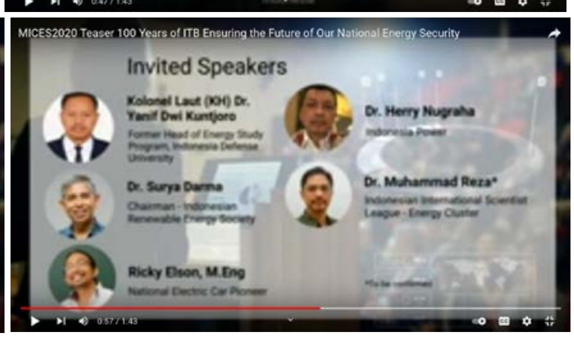

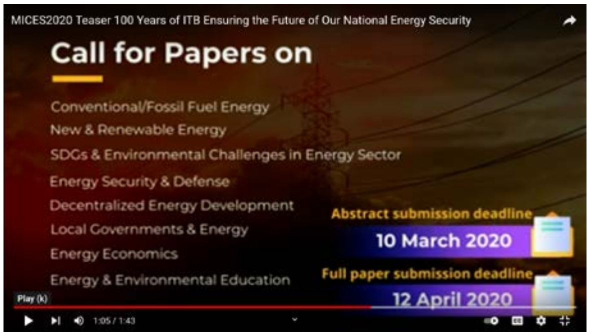
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The influence of alternative sources on the efficiency of smart grid systems on campus buildings

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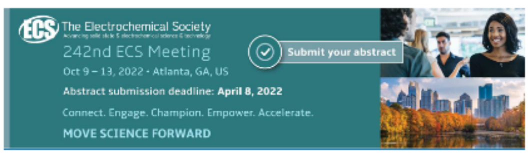

The influence of alternative sources on the efficiency of smart grid systems on campus buildings

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Abstract. This paper tells about a smart grid system. The system uses electrical energy sources through the National Electricity Company, PV Solar Systems and Batteries as a backup. For the load, the rector building, lecture building, hostel and mosque are used. The method of calculating efficiency values uses conventional methods. In the analysis of the efficiency of the use of electrical energy found the highest efficiency value when there is excess energy from the National Electricity Company and as an additional load used batteries to store the excess energy. Demonstrate that the efficiency of electrical energy in smart grid is not only influenced by dynamic loads but also by the addition of other sources of electrical energy. The fluctuations in the use of electric power it will cause variations in efficiency in the system. The highest average value of efficiency is obtained in the third condition of 98.582% where the system experiences excess energy on Saturdays and Sundays and the excess energy is stored on the battery. The addition of the network may be done to anticipate the excess and lack of electrical energy from one network.

1. Introduction

The resource of renewable energy comes from nature such as sunlight, wind, water, geothermal, and garbage. This is then processed by humans who can be used as a source of electrical energy. The use of fuel oil and coal to drive generator turbine in generating electrical energy is increasingly limited. The State Electricity Company (PLN) is a company that supplies electrical energy to consumers and has set electricity rates for customers to maintain the continuity of electricity use by this State-Owned Enterprises (BUMN). Customers who need a large electricity capacity can build new and renewable sources of electrical energy as an addition to existing sources of electricity sourced from PLN. In synchronizing the work of distributing electricity from different sources, it is necessary to build a smart grid to provide satisfactory results and the system can work smoothly. And Government has been produce policies and regulations in the use of renewable energy sources for customers.

The transition from conventional networks to the smart grid system is a popular electrical energy management system in millennial times. Where other investigators have been conducted research on the use of the smart grid system [1, 2].

In the management of electrical energy in the smart grid system, there is a process of excess and lack of electrical energy caused by the use of dynamic loads .[3] This means that the system must function properly to handle any changes due to dynamic loads. In addition, there is the effect of adding other sources of electrical energy such as the use of wind energy [4, 5], solar PV [4, 7, 8], microhydro [8], and

hybrids [9]. Which can overcome the shortcomings of the provision of electrical energy and batteries can be used to anticipate the excess of electrical energy.

Due to the advantages and disadvantages of the use of electrical energy, it will affect the efficiency of the use of electrical energy in the system [2, 10].

The problem is how dynamic loads and the addition of electrical resources can affect the efficiency of smart grid systems. And this will be analyzed later. The purpose of this investigation is to analyze the efficiency of energy use in smart grid systems.

2. Method

This investigation was carried out on campus 1 of the University of Medan Area where the fixed electricity resources used were taken from the State electricity company (PLN) and solar cell systems in addition. Loads are chosen from several buildings such as the rector building, the lecture building, the mosque and the hostel. While for excess electrical energy, batteries are used as storage and at any time can also be used as an alternative source. The design of an energy system in the form of a system circuit is shown in Figure 1.

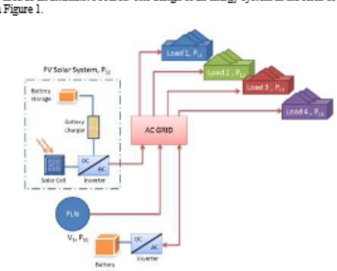

Figure 1. Power system design for smart grid system

Sources from PLN provide power like P_{s1}, from PV Solar System like P_{s2} and storage batteries depend on excess energy from PLN and stored to batteries like P_o. Each load is marked by P_{L1} for the rector building, P_{L2} for lecture building, P_{L3} for mosque and P_{L4} for hostel.

So that basic equations can be formed as follows:

$$P_{s1} = P_{L1} + P_{L2} + P_{L3} + P_{L4} \quad (1)$$

Where the source of the PLN will flow to all loads based on installing power and fixed size. In this case there is a possibility that the power used by the load will exceed the installed power capacity. For that reason, the power from PV solar systems will provide additional power, the amount of which can be limited at any time based on weather conditions in charge energy to the battery or directly to the system.

As a conductor, large cables are used based on current flow capability. So that power loss will occur and can be considered through the following equation:
From PLN to AC grid, the power supplied is equal to

$$P_{s1} + \Delta P_{s1}.$$

From the PV solar system to the ac grid, power if needed is equal to,

$$P_{s2} + \Delta P_{s2}$$

From the storage battery to the AC grid, sending power when needed will produce an equation,

$$P_o + \Delta P_o.$$

For each load to AC grid, the power sent is,

$$P_{L1}+\Delta P_{L1};\ P_{L2}+\Delta P_{L2};\ P_{L3}+\Delta P_{L3};\ \text{dan}\ P_{L4}+\Delta P_{L4}.$$

And if the flowing power from the PLN is sufficient for all loads then equation (1) becomes:

$$P_{s1} - \Delta P_{s1} = P_{L1} + \Delta P_{L1} + P_{L2} + \Delta P_{L2} + P_{L3} + \Delta P_{L3} + P_{L4} + \Delta P_{L4} \quad (2)$$

Or,

$$P_{s1} = (P_{L1} + P_{L2} + P_{L3} + P_{L4}) + (\Delta P_{s1} + \Delta P_{L1} + \Delta P_{L2} + \Delta P_{L3} + \Delta P_{L4}) \quad (3)$$

If there is an overload and the PLN source is not enough to provide the entire load power as additional power obtained through the Solar PV system then the equation (3) becomes:

$$P_{s1} + P_{s2} = (P_{L1} + P_{L2} + P_{L3} + P_{L4}) + (\Delta P_{s1} + \Delta P_{s2} + \Delta P_{L1} + \Delta P_{L2} + \Delta P_{L3} + \Delta P_{L4}) \quad (4)$$

If the load is reduced then the resources of the National Electric Company will be excessive, so in this system the excess power from the PLN will be saved to the battery or so that the equation (3) becomes

$$P_{s1} = (P_{L1} + P_{L2} + P_{L3} + P_{L4} + P_o) + (\Delta P_{s1} + \Delta P_{L1} + \Delta P_{L2} + \Delta P_{L3} + \Delta P_{L4} + \Delta P_o) \quad (5)$$

If PLN and PV solar systems are not sufficient to meet the power requirements as an alternative energy storage batteries can provide supporting power so that the equation (4) becomes:

$$P_{s1} + P_{s2} + P_o = (P_{L1}+P_{L2}+P_{L3}+P_{L4})+(\Delta P_{s1}+\Delta P_{s2}+\Delta P_o+\Delta P_{L1}+\Delta P_{L2}+\Delta P_{L3}+\Delta P_{L4}) \quad (6)$$

It will produce 6 power equations from the smart grid systems Figure 1.To determine the efficiency of the system, the following equation is used:

$$\eta = \frac{P_{out}}{P_{in}} \times 100\% \quad (7)$$

where
$P_{in} = P_{out} + \Delta P$.
η = eficiency
P_{in} = input power
P_{out} = output power
ΔP = power loss

If it is assumed:

$$P_{L1} + P_{L2} + P_{L3} + P_{L4} = a$$
$$\Delta P_{L1} + \Delta P_{L2} + \Delta P_{L3} + \Delta P_{L4} = \Delta a$$

Then equations 3, 4, 5 and 6 become:

$$P_{s1} = a + (P_{s1} + \Delta a);$$
$$P_{s1} + P_{s2} = a + (\Delta P_{s1} + \Delta P_{s2} + \Delta a);$$

$$P_{s1} = (a + P_o) + (\Delta P_{s1} + \Delta P_o + \Delta a);$$
$$P_{s1} + P_{s2} + P_o = a + (\Delta P_{s1} + \Delta P_{s2} + \Delta P_o + \Delta a); \quad (8)$$

Then produced several efficiency equations from equation 8 based on the conditions given above as follows:

$$\eta_1 = \frac{a}{a + \Delta P_{s1} + \Delta a}$$

$$\eta_2 = \frac{a}{a + \Delta P_{s1} + \Delta P_{s2} + \Delta a}$$

$$\eta_3 = \frac{a + P_a}{a + P_a + \Delta P_{s1} + \Delta P_a + \Delta a}$$

$$\eta_4 = \frac{a}{a + \Delta P_{s1} + \Delta P_{s2} + \Delta P_a + \Delta a} \quad (9)$$

A value is dynamic including losses resulting from the channel to the load and made varied. From the above equation, some curves are generated and explained in the results section and discussion.

3. Results and Discussions

Based on the use of electric power, it shows the power usage as shown in Figure 1. Data collection for 2 weeks and losses are considered 0.01 times with the power used. In Figure 2 the power consumption varies due to dynamic loads. The highest use of such power is on Tuesday the first week and Thursday the second week. Which is the source is not only from PLN but also from PV solar systems and storage batteries.

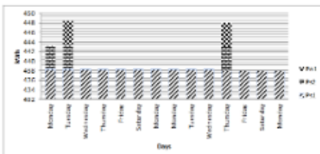

Figure 2. Total power supply vs days.

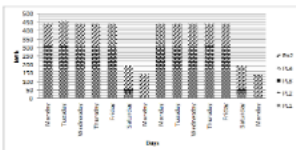

Figure 3. Total load vs days.

Figure 3 shows the variation in the use of electric power by the load, the lowest power usage occurs on Sundays because there are no activities on campus. Power is only channeled to the dormitory and a small portion of the mosque and the remaining power is supplied to the battery. But on the Tuesday of

the first week and Thursday of the second week there was an excessive use of power due to the addition of campus activities outside the usual schedule.

Comparison of the overall power usage by the load on PLN electricity resources Figure 4. shows that on Tuesday 1 week and Thursday the second week shows the difference in power between the PLN supply and the load so that to overcome power shortages the power is taken from the PV solar system. If the available power is not enough, then the electrical power is taken from the energy storage battery so that the power will not apply. For a moment on Saturdays and Sundays excess electricity will be saved back to the storage battery.

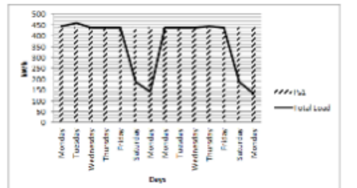

Figure 4. Comparison the total power supply and total load in normal condition

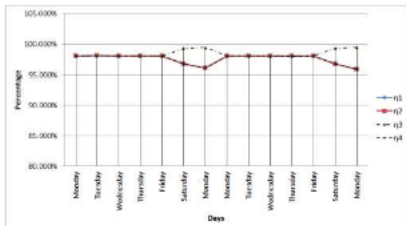

Figure 5. The efficiency comparison

Due to fluctuations in the use of electric power it will cause variations in efficiency in the system see Figure 5. The highest value of efficiency applies to the state of the state electricity is not enough to supply energy to the load due to overload, so that PV solar systems and batteries as an option for additional energy. For the low efficiency value occurs where the supply from the PLN exceeds the load and the excess is stored in the battery.

From the efficiency curve generated, the average value is taken and shown in Table 1. The highest average value of efficiency is obtained in the third condition of 98.582% where the system experiences excess energy on Saturdays and Sundays and the excess energy is stored on the battery. In these circumstances the battery as a load and power losses that need to be taken into account are load power losses, power losses from the source of PLN and power losses from the storage battery conduit. So that the output of the system is quite large with the battery. For other efficiency values, the battery is also included as input power. And output is limited to normal load.

Table 1. The average of eficiency

The efficiency average	Value (%)
η_1	97.565
η_2	97.563
η_3	98.582
η_4	97.515

4. Conclusions

The efficiency of the use of electrical energy in smart grid systems is influenced by dynamic loads and also the addition of electrical energy sources outside of the fixed electrical energy sources.

The highest efficiency occurs when the load is low and the excess energy is stored in the battery and the battery is considered a load.

The addition of the network may be done to anticipate the excess and lack of electrical energy from one network.

Acknowledgment: The author would like to thank the University of Medan Area for helping us to carry out this investigation.

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Analysis of smart grid power flow system with Gauss-Seidel method

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Abstract. The use of smart grid systems is a good opportunity for the future of electric energy resilience in the future. The design of smart grid systems that use electrical energy sources through the PLN (National Power Plant), PV Solar System and Battery as a backup can improve efficiency in the electricity grid. To ensure that the system is feasible, it is necessary to analyze the power flow in the system. The analysis is performed on each case contained in the network with Gauss-Seidel Method. The analysis shows that case 1 is the most optimal power supply from PLN and RE (Renewable Energy).

1. Introduction

The provision of electrical energy through solar cells to increase the capacity of electric power is one way so that the availability of electrical energy sources is guaranteed. Combining electrical energy sources PLN (National Power Plant) with a solar cell is a lot to do now. This requires electrical energy conversion management to produce optimal energy usage. The problem of instability is important to be eliminated because instability in the supply of electrical energy sources in a combination of PLN and solar cells will affect the stability of power usage.

If a system experiences a situation of instability such as voltage stability, that is a decrease in voltage within a few minutes, there will be interference. And if this reduction is too noticeable, it will cause the integrity of the system to close to extinction, especially in protecting devices such as the generation, transmission, or loading of equipment. This degradation process will cause a power outage in the form of a decrease in voltage [1].

Power flow analysis is needed to determine the operating conditions of the power system in a steady, through solving the power flow equation on the network. The main objective of the power flow study is to determine the voltage magnitude, voltage angle, active power flow and reactive power in the line, and transmission losses that arise in the power system [2,3].

Research on power flow has been done by several researchers using the Gauss-Seidel method [4, 5], Neuton Raphson method [6], and Fast Decouple [7]. In completing some applications used through the Matlab Program such as the use of genetic algorithms [8], artificial neural networks [5], or using other applications such as ETAP stands for Electrical Transient Analyser Program [9]. The objective of this paper is to analyze the power flow in a smart grid system using the Gauss-Seidel method.

2. Methodology

Power flow calculation is performed on a smart grid system consisting of 3 buses as shown in Figure 1. with two types of data quantities. Channel admission data is shown in Table 1, Table 2, Table 3, Table

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4 and Table 5. The Table shows the load and load data for each case. Admittance of channels in units per unit on a 100 kVA basis.

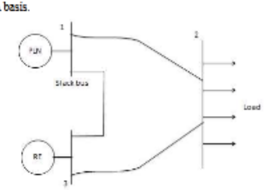

Figure 1. Diagram of One Line with 3 Buses

Table 1. Network Wire Data

Channel	Channel Admittance (PU)	Shunt Admittance
1 - 2	-j10	0
1 – 3	-j10	0
2 – 3	-j10	0

Table 2. Bus Generation and Load and Voltage Data in case 1

Bus	Voltage (pu)	Generating power		Load power	
		kW	kVar	kW	kVar
1	1.01	---	---	0	0
2	1	---	---	443	0
3	1	5	---	0	0

Table 3. Bus Generation and Load and Voltage Data in case 2

Bus	Voltage (pu)	Generating power		Load power	
		kW	kVar	kW	kVar
1	1.01	---	---	0	0
2	1	---	---	443	0
3	1	0	---	0	0

Table 4. Bus Generation and Load and Voltage Data in case 3

Bus	Voltage (pu)	Generating power		Load power	
		kW	kVar	kW	kVar
1	1.01	---	---	0	0
2	1	---	---	400	0
3	1	0	---	0	0

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Table 5. Bus Generation and Load and Voltage Data in case 4

Bus	Voltage (pu)	Generating power		Load power	
		kW	kVar	kW	kVar
1	1.01	---	---	0	0
2	1	---	---	400	0
3	1	5	---	0	0

If there are problems in the system, surely undesirable things can happen as follows:
Case 1; The PV solar system does not respond to communication calls.
Case 2; Battery is not functioning.
Case 3; If there is a lack of energy, but the PV solar system is not functioning, and the battery is also not functioning.

In the power flow analysis, some buses manage an electric power system, and there are three types of buses, namely P-Q buses or load buses, P-V buses are called generator buses, swing buses or slack buses. Applications of Kirchhoff's current laws on buses can be given:

$$I_i = \sum_{j=0}^{n} y_{ij} - \sum_{j=1}^{n} y_{ij} v_j \quad ,j \neq i \tag{1}$$

Active power and reactive power:

$$\frac{P_i + jQ_i}{V_i^*} = v_i \sum_{j=0}^{n} y_{ij} - \sum_{j=1}^{n} y_{ij} v_j \quad ,j \neq i \tag{2}$$

From the above equation, the calculation of power flow can be done by iteration.

The simulation process uses MatLab software using the Gauss-Seidel method. [10]

To solve Vi iteratively, then:

$$V_i^{(k+1)} = \frac{\frac{P_i^{sch} + jQ_i^{sch}}{V_i^{*(k)}} - \sum_{j=1}^{n} y_{ij} v_j^{(k)}}{\Sigma y_{ij}} \quad ,j \neq i \tag{3}$$

With y_{ij} the channel admittance in the per unit, P_i^{sch} and Q_i^{sch} are the active and reactive power expressed in the per unit, the current entering the bus is assumed to be positive. For loaded buses, active and reactive power away from the bus. Active and reactive power, P_i^{sch} ,and Q_i^{sch} are negative. For equation P_i and Q_i are as follows:

$$P_i^{(k+1)} = R\{V_i^{*(k)}[v_i^{(k)} \sum_{j=0}^{n} y_{ij} - \sum_{j=1}^{n} y_{ij} v_j^{(k)}]\}, j \neq i \tag{4}$$

$$Q_i^{(k+1)} = -Im\{V_i^{*(k)}[v_i^{(k)} \sum_{j=0}^{n} y_{ij} - \sum_{j=1}^{n} y_{ij} v_j^{(k)}]\}, j \neq i \tag{5}$$

Iteration starts from k = 0. The criteria for PQ bus are:

$$|v_i^{(k+1)} - v_i^{(k)}| \leq \varepsilon \tag{6}$$

3. Results and discussion

Table 6. Simulation result

	Case 1 (pu)	Case 2 (pu)	Case 3(pu)	Case 4 (pu)
V1	1.01	1.01	1.01	1.01
V21	1.005-0.2215i	1.005-0.2215i	1.005-0.2i	1.005-0.2i
V22	0.95574-0.26431i	0.9556-0.26556i	0.9644-0.24142i	0.96452-0.24017i
V23	0.9413-0.27966i	0.94084-0.28109i	0.95252-0.25523i	0.95294-0.25377i
V24	0.9366-0.2806i	0.93606-0.28205i	0.94889-0.25598i	0.94937-0.2545i
V25	0.93537-0.28476i	0.93481-0.28625i	0.94799-0.25965i	0.94851-0.25813i
V31	0.99412-0.10825i	0.99385-0.11075i	0.99499-0.1i	0.99524-0.0975i
V32	0.99168-0.12874i	0.99127-0.13184i	0.99276-0.12014i	0.99313-0.11704i

V33	0.99168-0.12874i	0.99127-0.13184i	0.99276-0.12014i	0.99313-0.11704i
V34	0.99078-0.13549i	0.99034-0.13863i	0.99199-0.12635i	0.99238-0.12318i
V35	0.99049-0.1376i	0.99005-0.14075i	0.99174-0.12825i	0.99215-0.12507i
Load	-4.43	-4.43	-4	-4
RE	0.05-0.33983 i	0-0.3429i	0-0.24894i	0.05-0.24613i
PLN	4.2659-0.9508i	4.3126-0.961i	3.9178-0.8107i	3.8703-0.8014i
		Power Flow		
S12	2.8761+0.75373i	2.8911+0.75946i	2.6225+0.62629i	2.6071+0.6211i
S21	-2.8761+0.11285i	-2.8911+0.11645i	-2.6225+0.086341i	-2.6071+0.083044i
S13	1.3898+0.19707i	1.4215+0.20154i	1.2953+0.18441i	1.2632+0.18031i
S31	-1.3898-0.0039259i	-1.4215+0.00053871i	-1.2953-0.01659i	-1.2632-0.020695i
S23	-1.5334-0.096474i	-1.5183-0.099894i	-1.3592-0.073578i	-1.3748-0.070473i
S32	1.5334+0.34341i	1.5183+0.34211i	1.3592+0.26537i	1.3748+0.26658i
		Losses		
SL12	0+0.86658i	4.4409e-016+0.87591i	-4.4409e-016+0.71263i	0+0.70414i
SL13	0+0.19315i	0+0.20208i	0+0.16782i	0+0.15961i
SL23	0+0.24694i	0+0.24222i	0+0.19179i	0+0.1961i

From Table 6, iteration can be seen as many as 5 iterations and the voltage values on bus 2 and bus 3 can be determined. The reactive power value on bus 3 can be searched including the value of power supplied through PLN. The value of the power flow through each bus can be calculated and subsequently, the value of the losses of each channel is also determined.

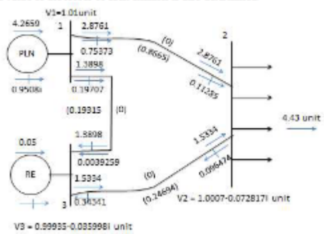

Figure 2. Power flow for case 1

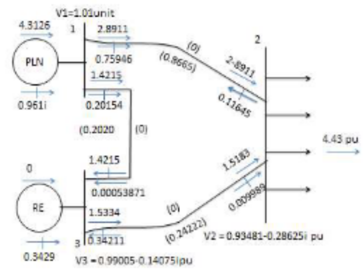

Figure 3. Power flow for case 2

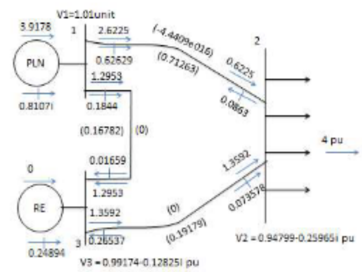

Figure 4. Power flow for case 3

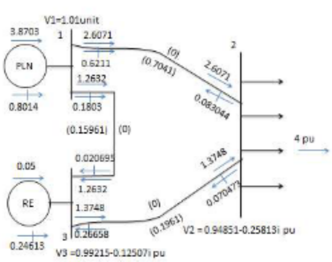

Figure 5. Power flow for case 4

From Figure 1 it can be seen that to fulfill the supply of loads, electrical energy from PLN and RE is needed. Losses that arise are reactive power losses. With the Gauss-Seidel method, the value of reactive power from RE sources can be calculated. Figures 2, 3, 4, and 5 show the different voltage and power quantities for each different case. Power flow is indicated by the direction of the arrow. In all cases the same power flow is indicated. The data in Table 1 shows a comparison between several cases, namely:

Cases 1 and 2
Where in case 1 Power RE = 0.05 pu and in case 2 the value of Power RE = 0. From the simulation results, it can be seen that the load power supply flows entirely from PLN for case 2. The power flowing from bus 1 to 2 and bus 1 to 3 increases in active power while in the power flow from bus 3 to 2 the opposite occurs. The reactive power losses from bus 1 to 2 and bus 1 to 3 are greater in case 2 than case 1. But from bus 2 to 3 the reactive power losses in case 1 are greater than case 2. Active power losses appear in case 2 for power flow from bus 1 to 2, although the value is very small compared to the value of reactive power losses.

Case 1 and 4
There was a reduction in load and power supply from PLN and RE for both cases. From the simulation results obtained in case 4 a decrease in power flowing from one bus channel to another bus. This is due to the reduced load on case 4. Reactive power losses are also reduced for all channels. Only a few reactive power losses are seen in the channel from bus 1 to bus 2, from bus 1 to bus 3, and from bus 2 to bus 3 and this also appears in case 2 where the power to the load remains but the supply of power from RE = 0

Case 2 and 3
There is a decrease in load in case 3. In cases 2 and 3 the power supply to the load is taken only from PLN. From the simulation results, it can be seen that in case 3 there is a decrease in power flow from each bus to another bus. The active power losses that arise in the power line from bus 1 to 2 in case 3 are the same as the active power losses in case 2 even though the value is very small compared to the reactive power losses.

4. Conclusion
Power flow simulation using the Gauss-Seidel method can be carried out. To supply power to the maximum load obtained from PLN and RE in case 1 where the simulation results show no active power losses that arise, only reactive power losses arise as in case 4 with load reduction. Active power losses occur in the power line from bus 1 to bus 2 for cases 2 and 3 which occur due to load changes and changes in power supply from RE. With the reduction in load and power supply only obtained by PLN, there will be active power losses from buses 1 to 2 and buses 2 to 3.

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