


Optimization of Generator Set (Genset) Capacity to Supply Electrical Load For Palm Harvesters' Barracks In Marike

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Article Info	ABSTRACT
<p>Keywords: Optimization of Generator Set (Genset) Capacity. Electrical Load</p>	<p>Good management of electrical loads from distribution substations will greatly affect the performance and reliability as well as continuity of installed load services. Related components include transformer capacity, conductors, safety devices, and so on. backup power supply source in case of blackout from PLN, then the harvester barracks in Marike have a standby generator. This generator is expected to be able to supply the electrical load in the palm oil harvester barracks area during the transfer from the main power source/PLN to the backup power source/generator. When PLN goes out, the generator will supply the load in the palm oil harvester barracks area of 65,000 Watts. The maximum load installed in each Harvester barracks in Marike reaches 2200 watts for 1 barrack, while the Harvester barracks in Marike have 17 barracks, so the total installed load reaches $2200 \times 17 = 37,400$ Watts. The total load installed as street lighting and the Harvester barracks area in Marike is = 2700 watts. The total load installed on Palm Oil Harvesters Barracks In Marike is 50,125 VA. Maximum load + 20%. Generator capacity = $50,125 \text{ VA} + (20\% \times 50,125 \text{ VA}) = 50,125 \text{ VA} + 10,025 \text{ VA} = 60,150 \text{ VA}$ (65 kVA). So it is calculated as $171.05 \text{ A} : 3 \text{ (Core)} = 57.01 \text{ A}$. So the protection used is worth 57 A. The size of the conductor with a current value of 57.01 A, then the diameter of the conductor needed is a NYY 35 mm² conductor.</p>
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INTRODUCTION

To provide good service to all activities in the oil palm harvester barracks, a reliable electricity supply is needed. This system is related to the fulfillment of electricity needs and its continuity must always be maintained. This is very important considering that in fulfilling the electricity needs in the residences and transit places of the workers, one of which is the harvester barracks in Marike, so that the workers and their families can do activities and rest as they wish while in the barracks.

The reliability of power supply in the power distribution network plays a very important role in meeting the electricity needs of installed loads or consumers. Good management of electrical loads from distribution substations will greatly affect the performance and reliability and continuity of installed load services. Related components include transformer capacity, conductors, safety devices, and so on.

As a backup power supply source in the event of a blackout from PLN, the harvester barracks in Marike have been provided with a standby generator. This generator is expected to be able to supply the electrical load in the palm oil harvester barracks area during the transfer from the main power source/PLN to the backup power source/generator. When PLN goes out, the generator will supply the load in the palm oil harvester barracks area of 65,000 Watts. Therefore Things that must be studied are the condition of the generator, the capacity of the generator in providing emergency supply.

Literature Review

Generator Set

To anticipate the occurrence of power outages from PLN caused by disturbances, the building must provide a power generator that also works as a backup for electrical energy. Generators that are widely used as backups are generally generator sets (gensets). A genset is a machine or device that functions as a generator of electrical energy. Why a genset, because this device is a combination of two different equipment, namely an engine and a generator. An engine is a driving device while a generator is a device that produces electrical energy.

Genset Working Principle

The working principle of this tool is to convert kinetic or mechanical energy into electricity, where the engine will rotate the generator with the help of fuel in the form of diesel or gasoline. The maximum electrical energy output, if the generator rotation is stable. Therefore, this drive system greatly affects the performance of the generator. In a building, this tool is very much needed because it is useful for meeting electricity needs if the electricity supply from PLN is disrupted. In a building, this type of generator is more suitable for backup electrical energy when compared to other types of generators. The hall is because its maintenance and care are easier. The two components in the generator are: Prime mover or often known as the initial mover, in this case in the form of a diesel engine and Synchronous generator, which is a main component used as a generator of electrical energy. The rating of the generator is divided into several ratings, namely:

a. Continuous Power Rating

This rating carries a constant or slightly varying load with a normal load factor rating reaching 70% - 100% for an unlimited time per year. Engines with this rating can be continuously loaded with 100% load (Ekw). This rating is recommended for main power plants (utility power supplies) that work continuously to supply electrical energy.

b. Standby power Rating

This standby power rating is applied to varying loads. Normal Load Factor reaches 70%. The total operating time per year is 200 hours and a maximum of 500 hours. This rating is usually used as a back-up generator for electrical energy if the main energy source goes out.

c. Prime Power Rating

Prime Power Rating is usually applied for variable loads with Load Factor reaching 70% in unlimited time per year. Maximum load of 100% with additional 10% overload

capability may only be operated for 1 hour in 12 hours of oppression. When operating overload should not exceed 25 hours per year. This rating is recommended for power plants for industry

d. Emergency Standby Power Rating (ESP rating)

Emergency Standby Power normally has a load factor of 70% with an operational amount of 50 hours per year and a maximum of 200 hours per year. This rating is suitable for use in building service standby.

The efficiency of an electrical power installation can be measured from the power factor or known as the term $\cos\phi$. The existence of a power factor in an AC voltage system is caused by the load and its magnitude depends on its characteristics. The sinusoidal magnitude of $\cos\phi$ shows the level of reactive power, namely $0 \leq \cos\phi \leq 1$ with the power factor equation can be seen as follows:

$$\cos\phi = \frac{P}{S} \dots\dots\dots (1)$$

Where power can be formulated with the following equation:

$$P = \sqrt{3}xVxIx\cos\phi \text{ (Watt)} \dots\dots\dots (2)$$

Likewise, apparent power can be formulated as follows:

$$S = \sqrt{3}xVxI \text{ (VA)} \dots\dots\dots (3)$$

Meanwhile, reactive power can be formulated in the following equation:

$$Q = \sqrt{3}xVxIx\sin\phi \text{ (VAR)} \dots\dots\dots (4)$$

Where:

- P = Real Power (watts)
- S = Apparent Power (VA)
- $\cos\phi$ = Power Factor
- V = Line to line voltage (V)
- I = Current (A)
- Q = Reactive Power (VAR)

Load Characteristics and Factors

Considering that electrical energy cannot be stored, it needs to be adjusted so that the power generated by the generator is the same as the load requirement. The load is always changing so that the power generated by the generator. The characteristics of the electrical load are needed so that the voltage system and the thermal effects of the loading can be analyzed properly. This analysis is included in determining the initial conditions that will be projected in the next design.

The demand factor is the comparison between the peak load and the installed load on an electrical load. The amount of demand factor can be known using the equation

$$\text{DemandFactor } DF = \frac{\text{TotalBebanPuncak}}{\text{TotalBebanYangTerpasang}} \dots\dots\dots (5)$$

The demand factor is used to determine the capacity of electrical equipment. Such as the generator needed. So the demand factor is very important to determine the cost. Demon Factor (DF) is used to find the power capacity of the generator used. After the value of the Demon Factor is obtained, the large capacity of the generator can be known by the equation

$$\text{KapasitasDayaxDFxTotalBebanTerpasangxFaktorKeamananTrafo} \dots\dots\dots (6)$$

The magnitude of the performance rating can be determined from the following equation:

$$RatingKinerjaGenset = KapasitasDaya \frac{Genset}{Cos\phi} \dots\dots\dots (7)$$

RESEARCH METHODS

The research method in this study uses 2 methods. The first stage uses the observation method and field measurements. The results obtained are the specifications of the current generator, the size of the installed load, the size of the safety used and the size of the conductor cable. The second method is the literature method by doing manual calculations, using a predetermined formula to calculate the total load installed, the size of the safety used, and the size of the conductor to be used.

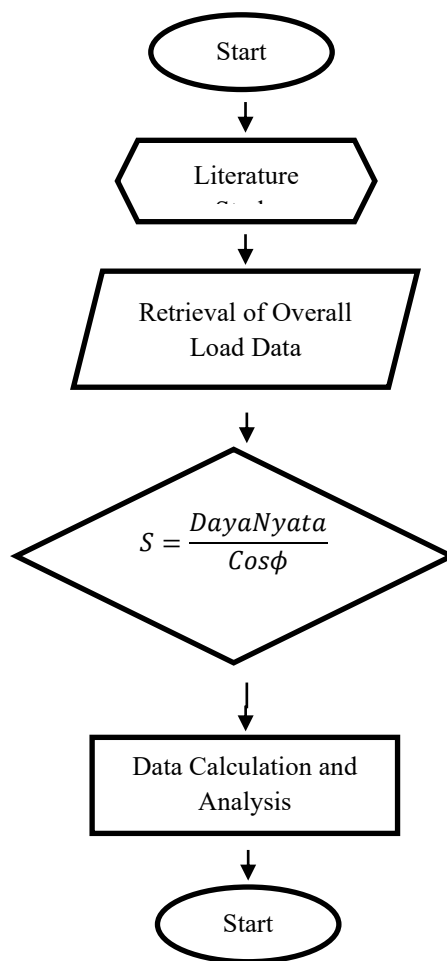


Figure 1. Research Flow Diagram

RESULTS

Load Instalation

Load Installed in Oil Palm Harvester Barracks

- a. The MCB installed in each barrack uses each MCB 10 A, or the same as the maximum load installed in each Harvester barrack in Marike reaching 2200 watts for 1 barrack, while the Harvester barrack in Marike has 17 barracks, so the total installed load reaches $2200 \times 17 = 37,400$ Watts.
- b. The total load installed as street lighting and the Harvester barracks area in Marike is = 2700 watts

$$\begin{aligned} \text{DayaSemu}/S &= \frac{\text{DayaNyata}}{\text{Cos}\phi} \\ &= \frac{40.100}{0,8} \\ &= 50.125VA \end{aligned}$$

After data collection and calculations are carried out, the total load installed on the Palm Oil Harvesters Barracks In Marike is 50,125 VA, thus the capacity of the existing generator can be calculated. The currently installed generator capacity is 10 kVA, which is insufficient to back up the installed load.

$$\begin{aligned} \text{Generator capacity} &= \text{Bmaximum load} + 20\% \\ \text{Generator capacity} &= 50.125VA + (20\% \times 50.125VA) \\ &= 50,125 VA + 10,025 VA \\ &= 60,150 VA (65 kVA) \end{aligned}$$

After analyzing and calculating all the loads installed on the Palm Oil Harvesters Barracks In Marikethen the generator capacity can be determined, so that the generator can back up the entire load on the Palm Oil Harvesters Barracks In Marikeminimum capacity of 65 kVA or optimizing the generator capacity only to back up priority loads. Such as: lighting, electrical outlets, and pumps in each barracks, so that the 65 kVA generator is able to serve essential loads at Palm Oil Harvesters Barracks In Marikeand designed a new Low Voltage panel inside the substation.

After data collection and calculations are carried out, the total load installed on the Palm Oil Harvesters Barracks In Marike is 50,125 VA, thus to optimize the generator capacity, it is necessary to design a new Low Voltage panel in the substation to distribute the Voltage to each barracks panel.

Load connected to the safety

Genset = 1 unit = 65,000 VA

$$\begin{aligned} I_{GENSET} &= \frac{p}{V} \\ I_{GENSET} &= \frac{65.000Watt}{380} \\ I_{GENSET} &= 171.05A \end{aligned}$$

Then it can be calculated $171.05 A : 3 (\text{Core}) = 57.01A$. So the protection used is worth 57 A. The size of the conductor with a current value of 57.01 A, then the diameter of the conductor needed is a NYY 35 mm² conductor.

Contact Stock = 90 units = 1500 Watts

$$I_{GENSET} = \frac{p}{V}$$

$$I_{GENSET} = \frac{1500Watt}{220}$$
$$I_{GENSET} = 6.81A$$

So the safety used is worth 10 A. The size of the conductor with a current value of 6.81 A, then the diameter of the conductor is NYY 4 mm²

Water Pump = 11 units = 3,300 Watts

$$I_{GENSET} = \frac{p}{V}$$
$$I_{GENSET} = \frac{3300Watt}{220}$$
$$I_{GENSET} = 15A$$

So the safety used is 16 A. The size of the conductor with a current value of 15 A means the diameter of the conductor is NYY 2.5 mm².

LED lights = 710 pieces = 21,300 Watts

$$I_{GENSET} = \frac{p}{V}$$
$$I_{GENSET} = \frac{21.300Watt}{220}$$
$$I_{GENSET} = 96.81A$$

So the safety used is 100 A. The size of the conductor with a current value of 96.81 A means the diameter of the conductor is NYY 35 mm²

CONCLUSION

Based on the discussion that has been outlined previously and the results of the studies that have been conducted, the following conclusions can be drawn: The total load that has been measured at the Barracks reaches 6500 watts with a maximum current of 171.05 A, this calculation is carried out for the overall peak load in the barracks area in order to determine the long-term generator capacity. Current 171.05 A divided by 3 RST then the total current in each phase reaches 57.01A. while the safety used is worth 57 A. The size of the conductor with a current value of 57.01 A then the diameter of the conductor needed is NYY conductor 35 mm². To meet the use of all installed loads at the Palm Oil Harvester Barracks in Marike, this can be done by designing a low voltage panel and optimizing the generator capacity for essential loads at the barracks. With the design changes, the loads in the JTR substation were separated, so a new panel was created to serve the generator and priority loads such as socket lights and pumps, while the other installed loads were still supplied by PLN.

REFERENCE

Dino Erivianto, Ahmad Dani, Haris Gunawan. 2020. "Electrical Energy Conversion System as Alternative Energy for Household Needs" Seminar of Social Sciences Engineering & Humanities Medan - Saturday, December 26, 2020, e-ISSN 2775-4049 SCENARIO 2020

- Dino Erivianto, Ahmad Dani, Haris Gunawan, 2022 "Processing of Oil Palm Empty Fruit Bunches Biomass as Fuel for Steam Power Plants" *Jurnal Indonesia Sosial Teknologi* Vol. 3, No.1 January 2022, p-ISSN: 2723 - 6609 e-ISSN: 2745-5254
- Silviharyani Mendrofa, Muhammad Erpandi Dalimunthe, Rahmaniar, 2025 "The Analysis of Performance Reliability Electric Power System in 20 Kv Distribution Network in PT. PLN" *Journal of Computer Science, Information Technology and Telecommunication Engineering (JCoSITTE)* Vol. 6, no. 1, March 2025, pp. 835~845 ISSN: 2721-3838, DOI: 10.30596/jcositte.v6i1.23677
- Agus Junaidi, Rahmaniar, 2022 "Effectiveness of Learning Electric Power System Transmission using Higher Order Thinking Skill based Simulation" *Journal of Education* Vol.14, 3 (September, 2022), pp. 4105-4116 ISSN: 2087-9490 EISSN: 2597-940X, DOI: 10.35445/alishlah.v14i3.1227
<http://journal.staihubbulwathan.id/index.php/alishlah>
- Hutomo Muhamad Putra, Suse Lamtiar S., Yon Afonda. 2020 "Optimizing Generator Capacity to Serve Essential Loads at Curug 1 Dormitory of Indonesian Aviation College (STPI)" *Jurnal Ilmiah Aviation Langit Biru* Vol. 13 No.1 February 2020 Page 1 : 282
- 2021 "Improving Understanding of PUIL 2000 and Illumination Calculation at Deli Serdang Museum" *Abdidas Journal* Volume 2 Number 3 Year 2021 Pages 646-651 ISSN 2721-9224 (Print Media) ISSN 2721-9216 (Online Media)
- The Grace of Pandapotan Siagian, Muhammad Erpandi Dalimunthe, Parlin Siagian. 2024 "Performance Analysis of Modification of Single Phase Measuring and Limiting Devices in Customers Which Causes Non-Technical Losses in Pt.PIn ULP Meulaboh" *JITET (Journal of Informatics and Applied Electrical Engineering)* Vol. 12 No. 3, pISSN: 2303-0577 eISSN: 2830-7062
- Bambang Nurdiyansyah, Zuraidah Tharo, Solly Aryza, 2023 "Analysis of Electrical Energy Consumption in The Office Building CV. Karya Sembilan Medan City" *Journal of Electrical and Computer Engineering* vol . 12 no. 3 September-December 2023, pp. 181 -1881-188 p-ISSN : 2301-8402, e-ISSN : 2685 -368X
- Zuraidah Tharo¹, Hamdani, Melly Andriana³), Siti Anisah, 2022 "Design and Implementation of 450 Va Generator Based on Solar Panels" *Journal of Electrical and System Control Engineering JESUS*,6 (1) August 2022 ISSN 2549-628X (Print) ISSN 2549-6298 (Online)
- Afidah Zuroida, Galuh Prawetri Citra Handani, Hanifiyah Darna Fidya Amaral, Rohmanita Duanaputri, Bayu Prasetyo, 2025 "Evaluation of Generator Capacity as an Electrical Energy Back-Up System in the Regional Secretariat Building" *Electrical Systems Journal* Vol. 12 No. 1, ISSN: 2407-232X, E-ISSN: 2407-2338
- Cherry Andre Putra*, Budiman, Yani Ridal. 2024 "Analysis of Generator Set Utilization with 200 kVA Capacity at RSUD M. Natsir, Solok City" *Jurnal Mesil (Civil Electro Machines)* Vol. 5, No. 2, December 2024, Pages 139-146, E-ISSN: 2723-7052

- Siagian, P., Hamdani, H., & Dalimunthe, M. E. Pengaruh Tabir Filter Film Terhadap Tegangan Output Solar Sel Jenis Polycrystalline. *SITEKIN: Jurnal Sains, Teknologi dan Industri*, 19(2), 414-418.
- Wibowo, P., Satria, B., Dalimunthe, M. E., & Muflih, A. (2024). Pengembangan Charging System Untuk Kendaraan Listrik. *Sinergi Multidisiplin Sosial Humaniora dan Sains Teknologi*, 1(1), 101-109.