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Performance Analysis Of Generator Set Simulator Maintenance Type Cat C32 To Support Electricity Needs In Simulator, Workshop, Mosque And Class Room I, Ii, Iii And Iv

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Abstract

The existence of a generator set is very important if there is a reduction in the main electricity supply from PLN which is conducting a blackout or under repair, then the generator set becomes an alternative power supply for electricity backup that ensures all service units at PIP Makassar are not hampered. So the role of generator facility maintenance in supplying electricity sources is very much needed to support performance, so efficiency is needed in the maintenance management process, especially on the CAT C.32 type generator set with a power capacity of 800 KVA which supports all activities in the simulator and other units. The purpose of this study is to analyze the burden of electricity supply needs on the service unit and to find out the right actions in maintaining the generator set engine components in the simulator so as not to hinder activities towards the learning process. However, other rooms do not have adequate generator supply or are not even available at all maximally based on the needs of the room/unit but are only concentrated on the simulator generator set supply unit. This results in an overload on the generator set which can cause serious damage to its internal component system, which makes the engine and alternator work harder, and are at risk of overheating, decreased efficiency, and even functional failure. That there has been a use of electric current of 401,370 watts or 1,825 amperes (50%), the simulator of 267,320 watts or 1,215 watts (33%), the Workshop of 114,088 or 519 amperes (14%) and the Mosque of 37,600 watts or 171 amperes (5%), so that the availability of generator power is 800 KW and has exceeded the use of 94 amperes or 102% with the category of Attention or overload.

Keywords: Generator Set, Power Supply, Maintenance.

1. INTRODUCTION

The use of large amounts of electrical energy is certainly very much needed by the Makassar Polytechnic of Maritime Affairs and Fisheries Vocational Education Institution in maximizing services in the main building, dormitory, classroom and simulator as well as units in other facilities. In optimizing the use of electrical sources that are the mainstay, AC, LCD and Projectors in the classroom, as well as the availability in practical learning simulators. However, the availability of electrical source availability services from the State Electricity Company (PLN) does not always work constantly without interference problems or as the main source in the field and the electrical path so that a solution is needed that can overcome this problem, namely by using a generator set (Genset).

The modern industrial era that continues to develop and continues to compete to satisfy consumer needs in increasing the needs of educational institutions, offices and companies to immediately make decisions to remain productive in serving various customer needs. So that the role of generator facility maintenance in supplying electricity sources is very necessary to support performance. A generator is a machine that produces electrical power with mechanical power input. The working principle of a synchronous generator is based on electromagnetic induction, after the rotor is rotated by the prime mover, thus the poles on the rotor will rotate.

Machine equipment maintenance management is a basic need to support user activities, especially in operational activities of transportation machines, production machines, and other household equipment

machines [1]. Especially in Indonesia, efforts to maintain machine equipment are very important considering the large comparison between the productivity side of machine use and maintenance) [2]. Meanwhile, from the user's side, all activities are highly dependent on the help of machines. This condition causes a lack of user knowledge in managing the maintenance of the machines they own, so that the machines they own are always in optimal condition when used.

Maintenance is one of the activities that plays a fairly important role in a company or factory, and is as important as other activities such as procurement and supervision of raw material supplies, all of which are intended to ensure that production machines can always be operated properly in the process of producing goods. Meanwhile, according to another opinion, the definition of maintenance is all activities including maintaining equipment and machine systems that can always carry out work orders [3].

Maintenance activities in a company can be divided into two types, namely as follows:

a. Preventive maintenance, maintenance to prevent sudden (unexpected) damage and maintain performance according to/close to that guaranteed. Preventive maintenance will keep the equipment clean from liquid, solid and surrounding air dirt.
b. Routine Maintenance, Maintenance activities carried out routinely.
c. Periodic Maintenance, is maintenance and care that is carried out periodically.
d. Corrective breakdown maintenance,

This is a maintenance or care activity carried out after damage occurs to a facility or equipment so that it cannot function properly.

Said the types of generator failure and their causes [4]:

a. Overloaded overvoltage causes excessive heating, which can damage the ship's insulation. If this continues, it can cause a fire. For example, a production machine requires 110 volts of electricity, but because of the overvoltage, the machine can no longer work due to a fire.
b. Instability: The generator rotor connected to the system rotates synchronously, meaning it rotates with the rotating magnetic field.

The existence of a generator set is very important if there is a reduction in the main electricity supply from PLN which is conducting a blackout or under repair, then the generator set becomes an alternative Power Supply for electricity reserves that ensure all service units at PIP Makassar are not hampered. The size of the generator set has and produces a large amount of electrical power, with components consisting of a power generator with a series of driving engines that work together to produce electricity of a certain power using fuel.

The generator set operated on the simulator unit has qualifications with a CAT C32 engine type with an electric power capacity of 800 kva, manufactured in 2018. So the generator set maintenance process needs to be carried out periodically by adjusting the CAT C32 type. Then the maintenance process, checking and controlling the generator set is carried out with several important components such as battery condition, fuel availability, radiator water, and engine oil, the responsibility of which lies with the maintenance manager. In addition, the generator set engine will be turned on as a step to warm up the engine and also record data that can be seen on the control panel. In maximizing further maintenance, it is carried out based on operational hours and following the maintenance process following the procedure [5].

This research is motivated by the phenomenon of rolling blackouts from the main PLN service center, then the load of electric current that should only be on the supply of electric current needs in the simulator, but in reality in the field the electricity supply is also allocated to several parts, namely, classrooms I, II, III and IV, cooperatives, mosques, polyclinics, dormitories and workshops at PIP Makassar where all of its work devices are electrical equipment that has now become a basic need to support the operational performance of employees and lecturers. So this blackout has an impact on the availability and readiness of generators as temporary electricity suppliers to support activities in the simulator and others. With these conditions, efficiency is needed in the maintenance management process, especially on the CAT C.32 type generator engine with a power capacity of 800 KVA which supports all activities in the simulator and other units. The purpose of this study is to analyze the burden of electricity supply requirements on the service unit and to determine the appropriate actions for maintaining generator engine components in the simulator so as not to hinder activities that provide added value to the learning process and can solve problems in generator engine maintenance management in the Plaza Mandiri building by producing a generator engine maintenance schedule which is divided into two, namely, component checking schedule and component replacement schedule [6].

According to the results of data analysis (Deni Rosiyanto P, et.el. 2023) engine failure is not effective in

engine repair so that it is necessary to make changes to maintenance or maintenance for the generator engine is MTBF 201.54 hours, MTTR 3.5 hours and availability 94% of the calculation results, generator maintenance is carried out once a day. With consistent and correct implementation of TPM, the performance of the generator will be better and can minimize damage.

2. METHOD

This study will use qualitative analysis by collecting data from field observations and special interviews with respondents/informants who are competent in the methods and procedures for operating generator sets with the CAT type, especially generators in simulators as providers of electricity supply.
The data used are primary data and secondary data sourced from the use of generator set simulators at the Makassar Maritime Polytechnic. In solving this research problem, the research team created a flowchart as a guideline.

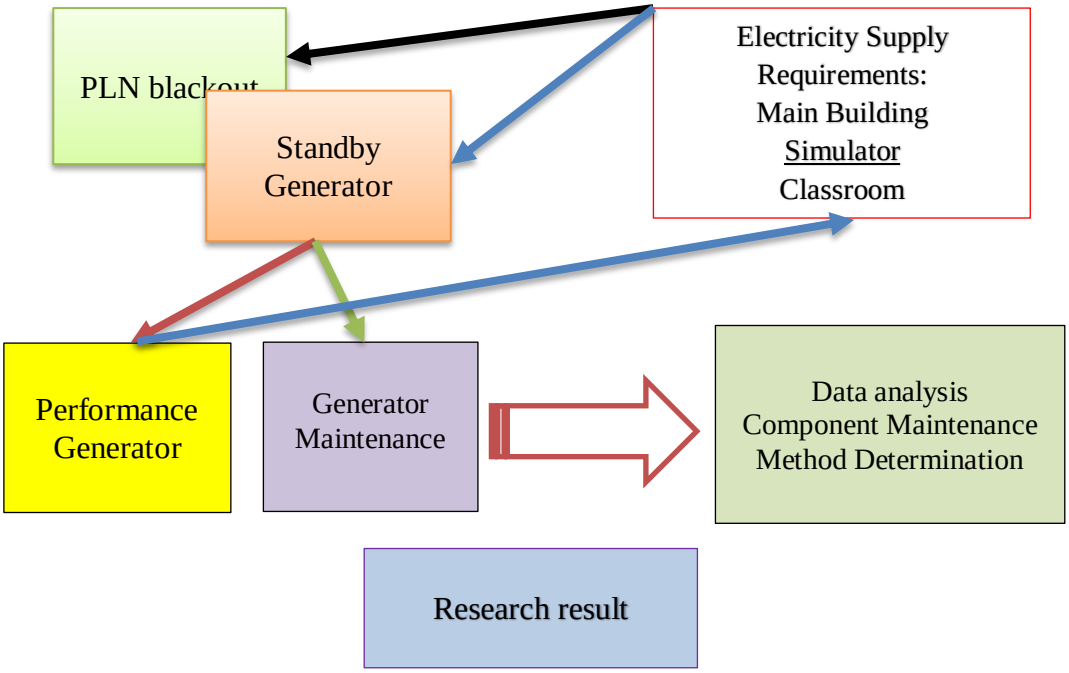

Figure 1. Flowchart of Thought

3. RESULTS AND DISCUSSION

This research was conducted at Campus 2 of the Makassar Maritime Polytechnic (PIP), Jl Salodong, on 25-27 July 2024. With several observation and interview locations related to solving problems in the Performance Maintenance Genset Simulator to Support Electricity Needs in the Simulator, Workshop, Mosque and Classrooms 1,2,3 and 4 at:

a. Generator Simulator

Figure 2. Genset Simulator

b. Workshop

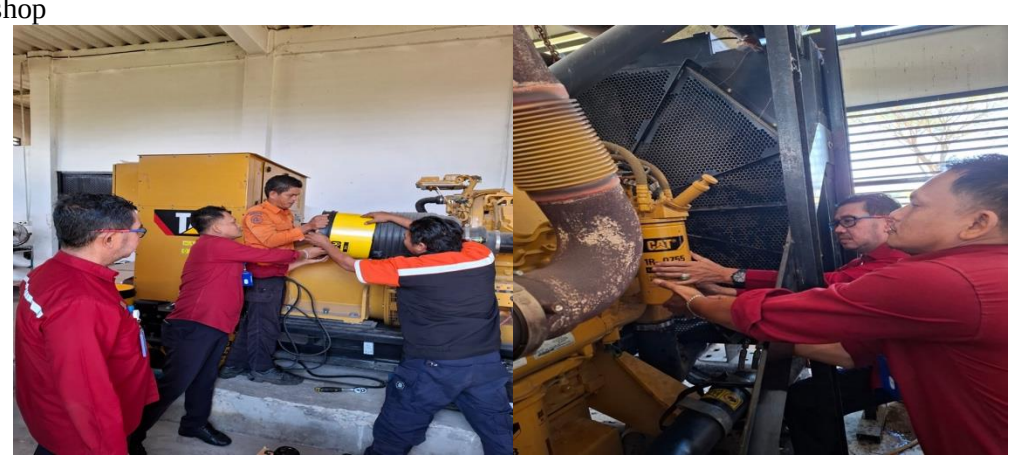

Figure 3. Workshop

c. Mosque

Figure 4. Mosque

d. Class Room 1, 2, 3 and 4

Figure 5. Class Room

When testing (running) an empty generator set simulator without a load of 1500 rpm, the generator runs normally, but when given a load, the generator experiences problems, namely abnormal rotation so that it cannot supply electric current. After the research team made the first observation, it was read on the warning indicator: Maintenance Interval (as in the attached photo), then research actions were taken and then the generator was turned off. In approximately 15 minutes, after that the generator was restarted with a rotation of 1500 rpm, and given an electric load, it turned out that the results were still not capable because the rotation dropped (not normal).

Figure 6. Indicator check by Trankindo technician

The next step taken by the research team was to re-check the digital system on the laptop, as shown in the attached photo, but the results showed that the problem was in the fuel system.

Figure 7. Checking via Computer

With these instructions, the fuel system was observed and checked starting from the fuel filter, fuel pipe and fuel tank. It was true that the fuel was dirty. The next step was to replace the fuel filter and clean the tank, as in the attached photo.

In every activity or operation in the Makassar Maritime Polytechnic building, the need for a stable and reliable electricity supply is very important to support the smooth running of activities. Electricity is not only needed to operate electronic equipment, but also to maintain security, lighting, and the smooth running of ventilation and communication systems. One way to ensure the availability of uninterrupted electricity is to provide a generator as a backup power source when there is a blackout or disruption to the main power grid.

Based on the results of observations, interviews and several reviews of referenced articles, the researcher and team made a description of the impact of the unavailability of generator supplies as follows:

1) Operational Failure and Productivity

The unavailability of generator supply can cause operational failure when the power goes out. Equipment that relies on electrical power, such as computers, projectors, medical equipment, and communication devices, will not be able to function. This will of course reduce productivity because planned activities must be stopped or postponed until the power comes back on.

2) Safety Risks

Without a generator, emergency lighting systems and security devices such as CCTV, fire alarms, and automatic doors will not function properly during a power outage. This can increase the security and safety risks of students, staff or occupants of the room. In an emergency situation, safe access and lighting are essential to ensure evacuation and safety of users.

3) Disturbances in the Cooling and Ventilation System

Many rooms, especially those that are closed or large in capacity, require good ventilation and air conditioning (AC) to maintain comfort and air quality. When the power supply is cut off, the cooling and ventilation systems will stop working, which can make the room uncomfortable or even unfit for use.

4) Potential Equipment Damage

Without a generator, electronic equipment or machinery that suddenly stops due to a power outage is at risk of damage. Equipment such as servers, sensitive electronics, or laboratory equipment may require a safe shutdown process to prevent damage.

5) Constraints in Communication Systems

In situations where the room is used for meetings, training, or other activities that rely on electronic communications (such as the internet, teleconferencing, or digital presentations), a generator supply is essential to keep the activity running smoothly. The lack of this backup supply can cut off communication access and cause confusion and delays to planned activities.

On July 25-27, 2024, the research team conducted direct observations in the field, and conducted unstructured interviews with resource persons who are experts in their fields regarding the operation of the CAT type generator. Direct observation in the field is a research method that involves observing and recording phenomena or behavior in their original context. When conducting this observation, researchers go directly to the research location to see in real time how the object or subject of research interacts with its environment.

During observations, researchers record all relevant details, such as interactions between individuals, activity patterns, and environmental conditions that influence observed behavior or outcomes. Researchers use tools such as field notes, cameras, or voice recorders to document information. In addition, researchers also try not to intervene too much in the situation so that the observed phenomena occur naturally.

Field observations allow researchers to obtain authentic and contextual data, which often cannot be obtained through other research methods such as surveys or interviews. The results of these observations are then further analyzed to answer research questions or test previously formulated hypotheses.

The following is a description of the findings according to the location of data collection, which is adjusted to the needs, level of convenience and availability of time in observation. The use of electric current in the classroom includes various devices and equipment that support learning activities and the comfort of students and teachers. The following is a description of the use of electric current in the classroom:

1) Lighting

Lighting is the primary use of electricity in the classroom. Ceiling lights provide sufficient light, especially if the room lacks natural lighting. The use of LED lights or energy-saving lights is often prioritized to reduce electricity consumption.

2) Technology Devices

Modern classrooms are usually equipped with various electronic devices such as projectors, computers, interactive monitors, and speakers. The projector is used to display learning materials, while the teacher's computer or laptop is connected to the device to operate presentations or videos. This equipment requires a stable electric current to operate properly.

3) Ventilation and Air Conditioning

Some classrooms are equipped with fans or air conditioners (AC) that require electricity to maintain a comfortable temperature in the classroom. The use of ventilation or AC is important especially in areas with hot weather so that students can study comfortably.

4) Charging Facilities

Electricity is also used to charge personal devices, such as students' and teachers' laptops and cell phones. Some classrooms are equipped with additional power outlets or charging stations to facilitate this.

5) Security and Safety

Security systems, such as fire alarms or CCTV cameras, installed around the classroom also require electricity. This helps to keep the school environment safe and provides additional protection for students and staff.

6) Additional Learning Tools

Other tools such as electronic whiteboards, printers, or speakers for audio lessons also use electricity. The use of these tools supports a more interactive and effective learning process.

Overall, the electric current in the classroom is used to support the functionality, comfort, and efficiency of the learning process, while maintaining the safety and security of all classroom occupants.

Table 1. Description of Electric Current Usage in Classroom I on Floors 1, 2, and 3, at Campus II Salodong

No.	Description of the Explanation	Electric Current Usage		Number of Usage	Ampere
		Unit	Watt		

1	Class Room, TL Lamp	324	18	5,832	
2	LCD	15	50	750	
3	Incandescent Lamp Theatre	37	10	370	35
4	Incandescent Light Toilet	30	10	300	
5	TL Lamp Cooperative	37	10	370	
6	AC Class Room 2 PK	30	1,800	54,000	
7	2 PK Cooperative AC	3	1,800	5,400	413
8	AC Theater 5 PK	7	4,500	31,500	
	TOTAL			98,522	448

Data processed, 2024.

Table 2. Description of Electric Current Usage in Classroom II on Floors 1, 2, and 3 at Campus II Salodong

No.	Description of the Explanation	Electric Current Usage		Number of Usage	Ampere
		Unit	Watt		
1	Class Room, TL Lamp	324	18	5,832	
2	LCD	15	50	750	33
3	Incandescent Lamp Theatre	37	10	370	
4	Incandescent Light Toilet	30	10	300	
5	AC Class Room 2 PK	30	1,800	54,000	389
6	AC Theater 5 PK	7	4,500	31,500	
	TOTAL			92,752	442

Data, processed 2024

Table 3. Description of Electric Current Usage in Classroom III on Floors 1, 2, and 3 at Campus II Salodong

No.	Description of the Explanation	Electric Current Usage		Number of Usage	Ampere
		Unit	Watt		
1	Class Room, TL Lamp	324	18	5,832	
2	LCD	15	50	750	
3	Incandescent Lamp Theatre	37	10	370	36
4	Incandescent Light Toilet	30	10	300	
5	Christian Place of Worship	20	18	370	
6	Water pump	2	160	320	
6	AC Class Room 2 PK	30	1,800	54,000	
7	2 PK Worship Place AC	3	1,800	5,400	413
8	AC Theater 5 PK	7	4,500	31,500	
	TOTAL			98,832	449

Data, processed 2024

Table 4. Description of Electric Current Usage in Classroom IV on Floors 1, 2, and 3 at Campus II Salodong

No.	Description of the Explanation	Electric Current Usage		Number of Usage	Ampere
		Unit	Watt		
1	Class Room, TL Lamp	324	18	5,832	
2	LCD	15	50	750	
3	Incandescent Lamp Theatre	37	10	370	52
4	Incandescent Light Toilet	30	10	300	
5	Dormitory Unit T5	14	28	392	
6	AC Class Room 2 PK	30	1,800	54,000	
7	5 PK Theater AC	7	4,500	31,500	454
8	2 PK Health Unit AC	5	1,800	9,000	
9	2 PK Dormitory Unit AC	3	1,800	5,400	
	TOTAL			111,264	506

Data, processed 2024

Overall, electricity in the mosque is used to support comfort, security and smooth running.various worship activities and other operational activities. A mosque that has a good electrical system will provide a comfortable environment for worshipers.

Table 5. Description of Current Usage at the Mosque on Campus II Salodong

No.	Description of the	Electric Current Usage	Number of	Ampere

	Explanation	Unit	Watt	Usage	
1	Down Light Lamp	50	12	600	
2	Loudspeaker	1	100	100	3
3	2 PK AC	8	1,800	14,400	168
4	5 PK AC	5	4,500	22,500	
	TOTAL			37,600	171

Data, processed 2024

The use of electrical power supply needs in workshops and simulators is very important to support various technical and training activities. In the use of workshop units, especially in Vocational Colleges that have a lot of practical learning materials, it requires a very large and stable electrical power supply to run various equipment in practical learning activities.

Table 6. Description of Electric Current Usage on Floor 1 and 2 Simulators at Campus II Salodong

No.	Description of the Explanation	Electric Current Usage		Number of Usage	Ampere
		Unit	Watt		
1	Floor 1				
2	TL Lamp	426	18	7,668	
3	Toilet and Corridor	52	10	520	
4	Genset House, TL	40	36	1,400	821
5	Water pump	1	600	600	
6	2 PK AC	58	1800	104,400	
7	Simulator Equipment			66,000	
1	2nd Floor				
2	TL Lamp	354	1,800	54,000	
3	Toilet and Corridor	52	1,800	5,400	394
4	LCD	4	4,500	31,500	
5	2 PK AC	32			
6	Simulator Equipment				
	TOTAL			98,522	448

Data, processed 2024

Table 7. Description of Electric Current Usage in the Workshop at Campus II Salodong

No.	Description of the Explanation	Electric Current Usage		Number of Usage	Ampere
		Unit	Watt		
1	Room T5	192	18	3.456	
2	Down Light Room	74	18	1,332	
3	Automatic Door Dynamo	1	100	100	
4	Water pump	2	600	1,200	519
5	2 PK AC	16	1,800	28,800	
6	Welding machine	10	6,600	66,000	
7	Lathe	3	4,400	13,200	
	TOTAL			114,088	519

Data, processed 2024

Simulators are devices used for training for learners/students, especially to simulate certain situations or environments that are difficult to access or risky if done directly. Overall, the need for electrical power in workshops and simulators is used to run mechanical devices, support digital technology, and ensure operational safety and efficiency. Proper and efficient use of electricity is essential to support technical and operational training activities in both environments.
Table 8 illustrates the use of electric current in all rooms supplied by a generator in a particular system or device within a specified time period.

Table 8. Overall Description of Electric Current Usage in Rooms at Campus II Salodong

No.	Power Usage Description	Electric Current Usage		Percentage (%)
		Watt	Ampere	

1	Class Room, I, II, III, and IV	401,370	1,825	50
2	Simulator	267,320	1.215	33
3	Workshop	114,088	519	14
4	Mosque	37,600	171	5
	Total Usage	820,378	3,730	
5	Power Availability 800 KW Generator	800,000	3.636	
	Power Availability		-94	102

Data processed, 2024

In some rooms in the description of devices or tools that use power on the generator, it shows the amount of current consumed in Ampere (A). This provides information about the electrical voltage used by each device in Volt (V). The electrical power used by the device is in Watt (W), which is the result of multiplying the current and voltage. In addition, there are detailed results of the length of time the device is used in hours (h), making it easier to calculate the total electrical energy consumed in kilowatt-hour (kWh).

The results of the analysis in table 8 in the description of the use of power that has been distributed to the rooms, explain that classrooms 1, 2, 3 and 4 have used an electric current of 401,370 watts or 1,825 amperes, (50%), the simulator of 267,320 watts or 1,215 watts (33%), the Workshop of 114,088 or 519 amperes (14%) and the Mosque of 37,600 watts or 171 amperes (5%), so that the availability of 800 KW generator power has an excess power load of 94 amperes or 102% and the category of Attention or overload.

In table 8 above, it provides an overview of the use of electric current in several rooms on campus 2 salodong with the availability of available electricity supply. However, in this case, the room to be used does not have an adequate generator supply or is not available at all maximally based on the needs of the room/unit but is only concentrated on the simulator generator supply unit.

Overloading a generator is a condition that can cause serious damage to the power generation system. When a generator is operated beyond its capacity, its internal components, such as the engine and alternator, will work harder, thus risking overheating, decreased efficiency, and even failure.

Based on the analysis results, classrooms 1, 2, 3 and 4 have used an electric current of 401,370 watts or 1,825 amperes (50%), the simulator of 267,320 watts or 1,215 watts (33%), the Workshop of 114,088 or 519 amperes (14%) and the Mosque of 37,600 watts or 171 amperes (5%), so that the availability of generator power is 800 KW and has exceeded the usage of 94 amperes or 102% with the category of Attention or overload.

When the generator supply exceeds its available power, it can cause serious damage to the generator, reduce operational efficiency, and disrupt a stable power supply. Overloading can also accelerate component wear, trigger overheating, and cause the generator to suddenly shut down or even be permanently damaged. This condition risks causing disruption to activities that depend on the electricity supply, both on a small and large scale.

4. CONCLUSION

The existence of a generator set is very important if there is a reduction in the main electricity supply from PLN which is conducting a blackout or under repair, then the generator set becomes an alternative power supply for electricity backup which ensures that all service units at PIP Makassar are not hampered. So that the role of generator facility maintenance in supplying electricity sources is very much needed to support performance, so efficiency is needed in the maintenance management process, especially on the CAT C.32 type generator set with a power capacity of 800 KVA which supports all activities in the simulator and other units. The purpose of this study is to analyze the burden of electricity supply needs on the service unit and to find out the right actions in maintaining the generator set components in the simulator so as not to hinder activities in the learning process.

However, other rooms do not have adequate generator supply or are not available at all based on the needs of the room/unit but are only concentrated on the simulator generator supply unit. This results in an overload on the generator which can cause serious damage to its internal component system, which makes the engine and alternator work harder, and are at risk of overheating, decreased efficiency, and even failure.

That there has been a use of electric current of 401,370 watts or 1,825 amperes, (50%), the simulator of 267,320 watts or 1,215 watts (33%), the Workshop of 114,088 or 519 amperes (14%) and the Mosque of 37,600 watts or 171 amperes (5%), so that the availability of generator power is 800 KW and has exceeded

the use of 94 amperes or 102% with the category of Attention or overload.

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