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MONITORING PLTS BATTERY ENERGY STORAGE ON SALT PRODUCTION TOOLS

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ABSTRACT

Indonesia, being on the equator, possesses significant solar energy potential with an average radiation intensity of 4.8 kWh/m² per day. This potential can be utilised for various sectors, including the salt production industry which requires a stable electricity supply. Solar Power Plant (PLTS) is a strategic alternative in increasing the efficiency of salt production, especially in the drying stage. This study aims to analyse the performance of the energy storage system in the solar power plant battery used in the salt production process. The research method involved measuring the voltage from the solar panel stored in the battery through three daily testing sessions. The test results showed that the highest voltage, 12.59 Volts, was reached in the morning and afternoon, while in the afternoon it decreased as the intensity of sunlight decreased. The results of this study show that solar power plants play an important role in maintaining a stable supply of electrical energy to support salt production. However, voltage fluctuations due to changes in sunlight intensity emphasise the importance of optimising the energy storage system. Therefore, the development of more efficient storage technologies is needed to increase the effectiveness of renewable energy-based salt production.

Keywords**:** PLTS, Solar Energy, Salt Production, Energy Storage, Batteries.

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INTRODUCTION

Indonesia, located along the equator, has great potential in solar energy utilisation due to its abundant sunlight exposure throughout the year (Zebua, 2024). With a land area of 2 million km² (Ahfas *et al.*, 2022), the country has the potential to generate up to 5.10 mW or the equivalent of 112,000 GWp, making it a strategic energy source for sustainable development (Anshory *et al.*, 2024).

Solar radiation in Indonesia is divided into two regions, where the western part receives 4.5 kWh/m² per day, while the eastern part gets 5.1 kWh/m² per day, with a national average of 4.8 kWh/m² per day (Rossoleh *et al.*, 2025). This potential opens up great opportunities for the development of renewable energy that is more environmentally friendly (Wisaksono & Mokhtar, 2022; Aafi, 2022) .

The development of Solar Power Plants (PLTS) is a strategic solution in meeting the increasing energy needs, including in the salt production industry which requires a stable and efficient electricity supply (Jamaaluddin *et al.*, 2023; Anshory *et al.*, 2018).

Salt has significant economic value due to its role in various sectors, such as the chemical industry, culinary, and traditional preservation (Susilowati *et al*, 2021). With Indonesia's population exceeding 200 million, domestic demand for salt is very high. In the production process, the drying stage plays a crucial role to ensure optimal salt crystallisation (Putra *et al.*, 2021). Typically, the method used is water jetting into the tunnel with the help of sunlight. However, this technique is less efficient as it requires a relatively long time to complete. (Maurina *et al.*, 2021).

The battery is the main element in the PLTS system that functions to store electrical energy from solar panels (Jamaaluddin *et al.*, 2024; Ibrahim *et al.*, 2022). This energy is used as a backup when the solar panels are not operating, such as at night or in cloudy conditions (Prasetyo *et al.*, 2022). Therefore, the selection and optimisation of an appropriate energy storage system is a crucial factor in improving the efficiency of solar power plants to support salt production (Ayuni *et al.*, 2021; Getahun *et al.*, 2021).

The energy storage system in solar power plants requires special attention because it is related to the continuous availability of energy (Balatif, 2024), especially during cloudy weather or at night when there is no sunlight (Jamaaluddin, 2023). The use of batteries or other energy storage technologies is an important solution to ensure a stable electricity supply (Jamaaluddin,2020; Fudholi *et al.*, 2018).

This research aims to analyse the characteristics of energy storage in PLTS batteries which are influenced by various factors such as weather conditions (Simamora *et al.*, 2025), duration of irradiation, voltage generated, so in this study a 'PLTS Battery Energy Storage Monitoring on salt production equipment' was made (Syahrorini *et al.*, 2022; Simatupang *et al.*, 2023; Mohamadi *et al.*, 2021; Assadeg *et al.*, 2020). With this research, it is hoped that it can determine the effectiveness of solar power plant energy storage and the Salt production process. (Sulistiyowati *et al.*, 2018).

METHODS

The design and preparation of the research 'Monitoring PLTS Battery Energy Storage on salt production tools' was conducted at the Electrical Engineering Laboratory of Muhammadiyah Sidoarjo University. This tool research was carried out from February to August 2024.

The components needed in the research process 'Monitoring PLTS Battery Energy Storage on salt production tools' are: Solar Panel, MPPT (Maximum Power Point Tracking), MCB (Miniature Circuit Breaker), 100 Ah Battery. This method is used during the research process to collect data on system performance. One example is the measurement of the solar panel's voltage entering the battery, as shown in Figure 1. This measurement is carried out with the aim of knowing the voltage results obtained by the solar panel entering the battery.

Figure 1. Battery charging process from solar panel

Blok diagram

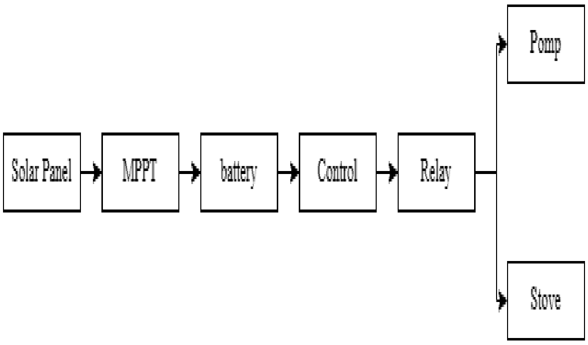

Figure 2. System Block Diagram

The block diagram above shows the solar energy utilisation system in the salt production process. The solar panel functions to convert sunlight into electrical energy, which is then optimised by MPPT to ensure the power obtained is at the maximum level before being stored in the battery. This stored energy is then controlled by the control system to distribute power as needed. The relay acts as an automatic switch that channels electricity to two main devices, namely the pump and the stove. The pump is used to deliver water to the production vessel, while the stove heats the water to a certain temperature to support the salt crystallisation process. This system increases the efficiency of salt production by utilising renewable energy, thereby reducing dependence on conventional electricity sources.

Flowchart

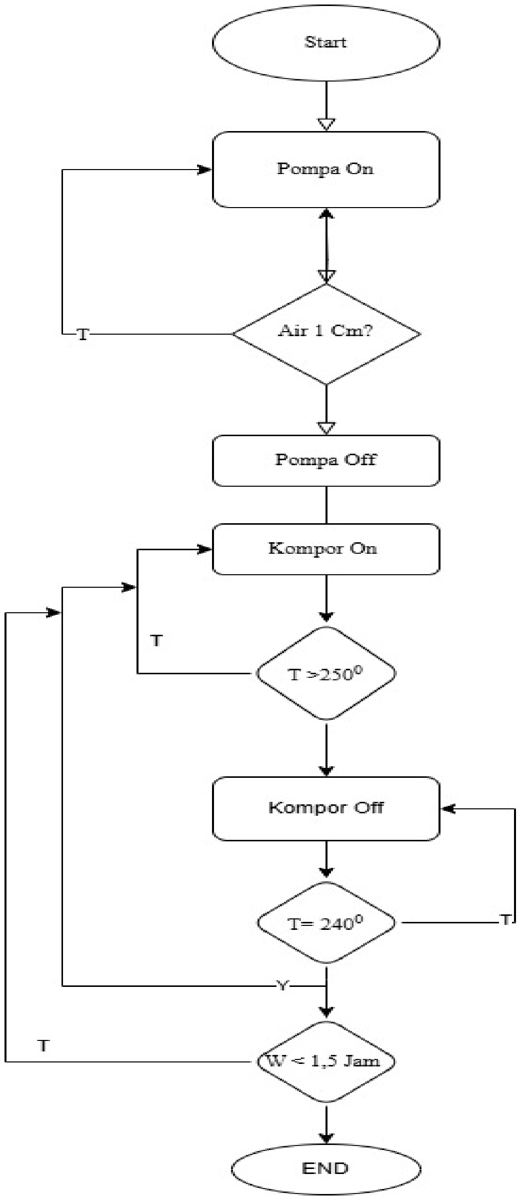

Figure 3. System flow of the salt cooking process.

Based on Figure 3, the salt production process starts with turning on the pump (Pump On) to fill water into the pot until the volume reaches 1 cm² (Water 1 Cm²). Once the water is sufficiently filled, the pump automatically switches off (Pump Off), then the stove switches on (Stove On) to heat the water to a maximum temperature limit of 250°C (T>250°C). If the temperature exceeds this limit, the stove will switch itself off (Stove Off) to prevent overheating, and will switch back on

(Stove On) when the temperature drops to 240°C (T = 240°C) to maintain heat stability. This heating process lasts a maximum of 1 hour (W < 1 Hour), and once the time is up, the entire system stops automatically (END) signalling production is complete. The energy to run the pump and stove comes entirely from the PLTS battery, so the system can work independently without human intervention. With careful temperature regulation, time limitation, and full automation, the process not only saves energy but also produces consistent quality salt throughout the day.

RESULTS AND DISCUSSION

Data was collected over two days, with two tests. The morning test took place from 08.30 to 10.00 am, the afternoon test occurred from 11.00 am to 12.30 pm, and the afternoon test took place from 13.30 to 15.00 pm. Tables 1 2 and 3 show the test results of the voltage entering the battery from the solar panel.

Tablel 1. The first test of the voltage entering the battery from the solar panel

Solar Panel	
Time	Voltage
08.30	10.40 Volt
08.40	10.45 Volt
08.50	10.50 Volt
09.00	11.30 Volt
09.10	11.45 Volt
09.20	11.56 Volt
09.30	12.55 Volt
09.40	12.55 Volt
09.50	12.55 Volt
10.00	12.57 Volt

The first test conducted in the morning showed an increasing trend in the output voltage of the solar panel as time increased. The initial voltage recorded at 08.30 am amounting to 10.40 Volts continued to increase gradually until it reached 12.57 Volts at 10.00 am. The pattern shows that the higher the intensity of sunlight received by the solar panel, the greater its contribution to the increase in voltage produced. In addition, starting at 09.50 a.m., the voltage tends to stabilise at around 12.55 Volts, which indicates that the solar panel has reached the optimal point in absorbing and converting solar energy under the conditions of this trial.

Table 2. Second test of the voltage coming into the battery from the solar panel

Solar Panel	
Time	**Voltage**
11.00	12.57 Volt
11.10	12.57 Volt
11.20	12.58 Volt
11.30	12.58 Volt
11.40	12.59 Volt
11.50	12.59 Volt
12.00	12.59 Volt
12.10	12.59 Volt
12.20	12.59 Volt
12.30	12.59 Volt

Table 3. The third test of the voltage coming into the battery from the solar panel

Solar Panel	
Time	Voltage
13.30	12.55 Volt
13.40	12.50 Volt
13.50	12.45 Volt
14.00	12.40 Volt
14.10	12.35 Volt
14.20	12.20 Volt
14.30	12.10 Volt
14.40	11.50 Volt
14.50	11.30 Volt
15.00	11.10 Volt

The second test during the day showed that the output voltage from the solar panel was relatively stable with a slight increase. At 11.00 am, the voltage recorded at 12.57 volts experienced a minor increase until it reached 12.59 volts at 11.40 am, then remained constant until 12.30 pm. This voltage consistency indicates that the solar panel has been operating at optimal conditions, where the intensity of sunlight is at its peak, so that the voltage variation becomes insignificant. This indicates that the battery obtained a stable power supply from the solar panel during the testing process.

The third test in the afternoon showed that the output voltage of the solar panel decreased over time. At 1.30pm, the voltage was recorded at 12.55 volts and continued to decrease

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gradually until it reached 11.10 volts at 3pm. This decrease was caused by the reduced intensity of sunlight, which was further exacerbated by cloudy weather conditions. Clouds that block sunlight limit the energy that can be absorbed by solar panels, so the voltage produced continues to decrease. These results show that the performance of solar panels is strongly influenced by weather conditions, especially in the afternoon when sunlight begins to weaken.

CONCLUSIONS

This research shows that solar power plants play a crucial role in providing a stable energy supply for salt production. The test results indicated that the voltage of the solar panel reached optimal conditions in the morning and afternoon with the highest value of 12.59 Volts, while in the afternoon it decreased due to reduced sunlight intensity. Therefore, optimising the energy storage system in the battery is an important aspect to ensure the continuous availability of electricity, so that salt production can run more efficiently.

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