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The Indonesian Air Force Uses Solar Power as a Reserve Source of Electricity

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Abstract

This study uses qualitative research methodologies to examine the elements that affect and contribute to the usage of solar energy as a source of backup electrical energy within the Air Force. The study's goal is to assess how solar energy is used by the Air Force to support air operations. In order to demonstrate the accuracy of information on solar science as a source of backup electrical energy for the Indonesian Air Force, this research was conducted to support data that was collected as a result of skepticism over certain facts or knowledge.

Keywords: *Utilization of Solar Power; Backup Electricity; Indonesian Air Force*

Introduction

The task of actively handling numerous possible threats falls on the Indonesian National Armed Forces (TNI). The TNI's primary responsibilities include upholding state sovereignty, defending the Pancasila-based Unitary State of the Republic of Indonesia's territorial integrity, and guarding the entire country and all of Indonesia's bloodshed from threats and disturbances to the integrity of the state and nation (Law No 34, 2004). According to recent advancements, the Indonesian Air Force has adapted to the use of existing technology and uses it to support operational activities in the field, work on office administration tasks, and complete regular tasks and exercises.

The State Electricity Company (PLN), if the source of electrical energy is from PLN and is required to support the work/activities of air operations, currently provides or supplies electrical energy to the existing facilities and infrastructure at each air base or service unit under the Indonesian Air Force. There is only a backup generator (genset) accessible at each airbase, which uses fuel oil as a support to turn on the generator if the equipment is currently out of commission.

With so many tasks and projects currently falling under the purview of the Indonesian Air Force to support air operations, there is an increase in the amount of equipment requiring dependable or stable electric power. If the electric power is unstable, tasks and projects will frequently be disrupted due to a cut off or shutdown. While the backup electricity produced by the generator cannot be maximized in fulfilling electrical energy to support the electricity needs for the entire air base, the abrupt loss of the PLN electricity source will impair air operations at the air base. The phenomenon from many results is that the potential uses existing energy, has been employed in numerous agencies, and is presently being used as an alternative to electric power provided by PLN or backup electric power coming from backup generators.

Currently, the Energy Policy is governed by Prioritizing new energy sources and renewable energy must be done in order to use primary energy (Law No 30, 2009). In order to achieve this energy security, the government continues to develop the usage of EBT (New and Renewable Energy), one of which is the Solar Power Plant (PLTS) (Thamrin. S, 2020).

Sunlight is a natural source of energy. Solar cells, which can produce an infinite amount of electrical energy and are directly powered by the sun without the requirement of rotating parts or fuel, have been widely employed to supply electrical power. The technology that is currently available and in use is not optimal because it has not been used as the primary force and because it has not been integrated into the Indonesian Air Force's operational and maintenance plans, which must be ready if this technology is to be used to its fullest potential.

The simplest form of solar power plants (PLTS) is created by mounting photovoltaic panels on the roofs of homes and buildings. These panels collect sunlight exposure throughout the day and use it to power the home or building in question, making PLTS an effective and environmentally responsible source of electricity (Modjo. S, 2019). Looking at the potential that exists in Indonesia and the physical location of the islands on the equator and lots of sunlight, the use of photovoltaic solar panels is already common in many sectors, such as houses (originally as a water heater), government buildings, and public amenities (Ministry of Energy and Mineral Resources, 2019).

This PLTS has been used by the Indonesian Air Force in a limited capacity, but it needs to be used more frequently at locations where the Indonesian Air Force currently uses PLN and generators. Because it requires human resources, technology, and studies-one of which is now being assembled by researchers as input to stakeholders-the utilization of solar power technology inside the Indonesian Air Force is not simple.

The Air Force Construction Service (Diskonsau) is one Indonesian Air Force organization with specific duties and responsibilities pertaining to the use of a Solar Power Plant (PLTS). In addition to implementing a program for facility building within the Indonesian Air Force, Diskonsau is entrusted with cultivating and carrying out the logistical development function within the context of building facilities, construction, and base installation (Indonesian Air Force Headquarters, 2020). It will work to make the most of the current Solar Electricity Plant (PLTS) and boost its use as a source of backup electrical energy within the Indonesian Air Force by employing power Diskonsau that can be transferred fast and supported by specific capabilities.

Research Method

Researchers employed qualitative research techniques for this investigation. Due to the fact that the Indonesian Air Force, which is based in Diskonsau, uses solar power as a source of backup electrical energy, researchers use these methods and approaches to describe, explore, and analyze carefully, in detail, and in depth this topic. In order to collect in-depth data for this study, researchers used a variety of procedures or data collection techniques, including in-depth interviews, literature studies, and a survey.

A strategy for studying and comprehending the significance that various people or groups of people attach to social or humanitarian situations is qualitative research. The method of qualitative research includes crucial steps including interviewing study participants, gathering data from them, inductively evaluating the data, and interpreting the results. The qualitative research process requires participants to adopt an inductive research perspective, concentrate on personal meanings, and interpret the complexity of a topic. The final report of qualitative research has a flexible framework (Creswell, John W, 2017).

Result and Discussion

Energy supports national economic activity and is crucial to accomplishing social, economic, and environmental goals for sustainable development. Renewable and non-renewable energy sources make up the two categories of energy sources. Among the sources of renewable energy include the sun, waves, wind, and water. Nuclear, coal, natural gas, and petroleum are examples of non-renewable energy sources. Alternative energy sources include those that are renewable. Since no pollution is created during the energy conversion process, alternative energy is defined as any energy source that can be used and aims to replace conventional fuels. Additionally, energy sources are abundant in nature, particularly sunlight, which is especially prevalent in tropical nations like Indonesia where sunlight is available throughout the year (Permadi. W, 2008).

In order to meet human energy needs, solar energy is utilized by turning light into heat or electricity. Solar energy is produced by directly converting sunlight into heat or electrical energy. Sunlight and solar energy, which is photovoltaic, are the two main types of solar energy. Because Indonesia doesn't experience winter, there isn't a high need for energy in the form of heat, and the country is gifted with natural and social landscapes that encourage the growth of renewable energy potential (Wahyudi. E, 2017).

Energy independence and security are goals of Indonesia's National Energy Policy, as stated in the Government Regulation of the Republic of Indonesia Number 79 of 2014 (PP RI No. 79/2014) (Republic of Indonesia Government Regulation No 79, 2014). These goals are realized by realizing eight things, four of which are managing energy resources in an optimal, integrated, and sustainable manner, ensuring fair and equitable access to energy for the community, creating jobs, and maintaining environmental functions. In particular, PP RI No. 79/2014 aims to address a number of crucial issues, including electrification ratios of 85% in 2015 and nearly 100% in 2020, as well as the contribution of new and renewable energy to the primary energy mix, which will reach 23% in 2025 and 31% in 2050.

Theoretically, Indonesia's vast solar energy potential is offset by its geographic location, where the sun shines continuously throughout the year, the lower cost of the electrical parts used in solar power plants (PLTS), and the existence of a "solar-rooftop" scheme in every home. - Solar-powered roadway and household illumination (Ministry of Energy and Mineral Resources, 2019). Solar power plants (PLTS) are devices for producing electricity by converting solar energy. PLTS, also known as solar cells,

solar photovoltaic systems, or solar energy, generates direct current (DC) electricity from sunlight that can be converted to AC electricity if necessary. Solar photon energy will be transformed into electrical energy using a generator called PLTS. Solar cells, which are made up of thin layers of pure silicon (Si) and other semi-conducting materials, undergo this conversion in PV modules. If the material absorbs photon energy, the excited electrons will break free from their atomic connections, become free-moving electrons, and eventually produce an electric voltage.

Technically, commercially, and socially, everyone can use solar energy because solar power plants themselves can be developed on a modest scale. For instance, a 50 Megawatt generator can already use solar energy (Hasanuddin. T, 2017). In addition to being used independently, solar energy can also be included into hybrid or combination systems by employing other sources of energy or specific technologies as needed (Kurniawan. E. R, 2018).

Based on the system, there are three varieties of PLTS. The first type is PLTS Solar Thermal, which uses solar thermal energy to power a heat engine. A heat engine is a device that transforms heat energy into motion (work) energy, which is then used to drive a generator to generate electricity. A power grid already in place, such as PLN, is required for the on-grid kind of PLTS to operate. This type of PLTS does not use the energy (storage of electric current) produced by solar modules. The last option is PLTS Off Grid (centralized), which can also be referred to as an independent system because it is a power generation system that only uses solar energy as its only source of electrical energy (Waqfi. R.R, 2017).

Table 1. Solar Panel Installation Tilt Position

Latitude	Tilt Angle
0 – 15 degrees	15 degrees
15 – 25 degrees	25 degrees
30-35 degrees	30 degrees
35 – 40 degrees	40 degrees
40 – 45 degrees	45 degrees

It is intended that every community would be able to benefit from solar energy's potential and contribute to national energy security by using it to power their homes, businesses, farms, fisheries, plantations, small industries, and sources of clean water (Kurniawan. E. R, 2018). If the solar module is aligned with a tilt angle of the latitude where the PLTS is located in Indonesia, the most electrical energy will be produced (Rahayuningtyas. A, 2014).

The fact that Indonesia is in the tropics gives it a significant edge, as the country enjoys year-round sunshine. Unfortunately, it appears that only natural uses are being made of this energy (Hasan. A, 2012). Additionally, with the aid of other machinery, specifically by converting solar radiation into various forms, solar energy can be employed. Solar cells and collectors are two methods for converting solar radiation into different forms of energy (Karmiathi. N.M, 2011). The principle of a simple solar power plant is shown below.

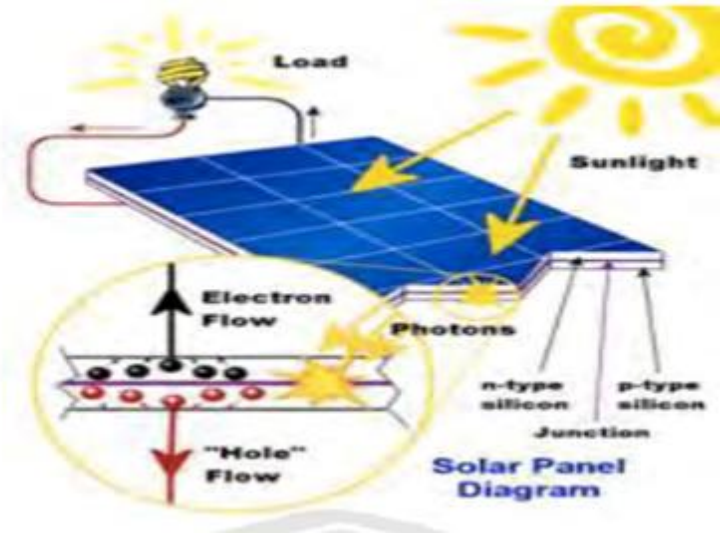

Figure 1. The process of converting light energy into electrical energy

The process of turning light energy into electrical energy is visible in the image above. Silicon, a substance frequently present in sand, is the semiconductor material most frequently utilized in photovoltaics. A minimum of two semiconductor layers, one of which is positively charged and the other of which is negatively charged, are present in every solar cell. The electron charge will move to a high potential charge when a photovoltaic cell is exposed to sunshine. DC current is produced as a result of electricity moving across the connection between the two layers. The amount of power generated increases with the intensity of the light received (Ivan. Z, 2018).

It can be explained that the use of new and renewable energy sources needs to be developed given the role and price of fuel continue to increase and soar as a substitute for sustainable energy providers by carrying out this research to describe and analyze the utilization of PLTS within the Indonesian Air Force. The potential of Indonesia's energy resources is assessed using a variety of techniques. Only about 10 MWp have been used out of Indonesia's enormous solar energy potential, which is approximately 4.8 KWh/m2 or the equivalent of 112,000 GWp. In general, we can consider Indonesia's solar power potential as a baseline for future planning of the growth of PLTS energy sources because it is at a satisfactory (adequate) level.

The leadership of the Indonesian Air Force has a policy of using solar power plants (PLTS) to power air operations inside the Indonesian Air Force. As part of the process of using solar power plants (PLTS) as renewable energy or alternative energy to obtain electrical energy, they can be used within the scope of the Indonesian Air Force, especially at ai. In addition to providing input for the development of science, especially in providing options in the use of power other than that provided by PLN or Generators so that they can plan the construction of PLTS facilities and infrastructure supported by software as a legal basis.

Based on the framework below, a proposition can be drawn up that the use of solar power technology will be very useful as a source of backup electrical energy within the Indonesian Air Force at the Indonesian Air Force Construction Service (Diskonsau) using supporting theories such as Energy Utilization, PLTS Utilization, Solar Power Technology and Electrical Energy Sources in order to support the Air Force's air operations and training.

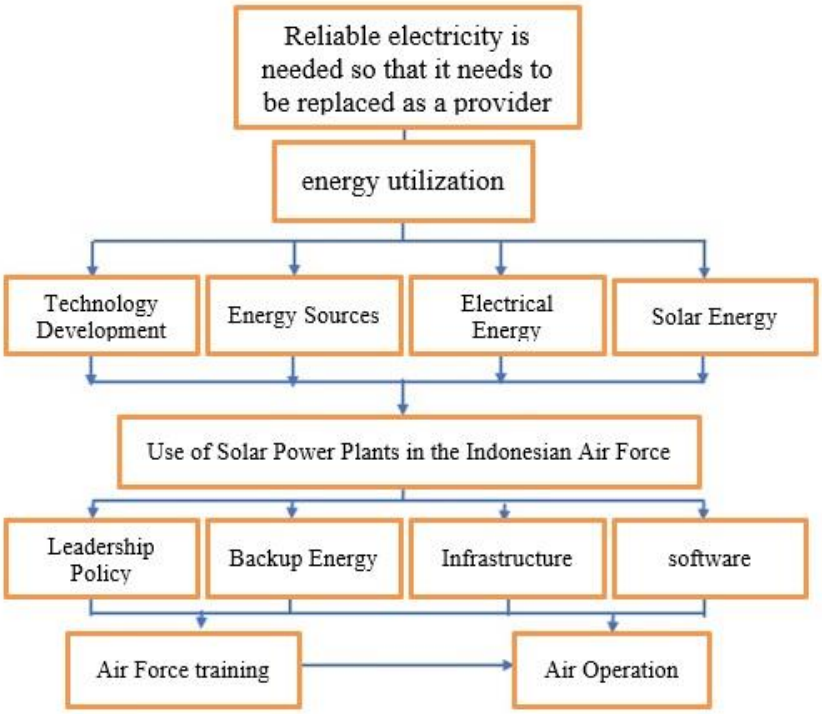

Figure 2. Framework

To enable the efficient execution of the operational tasks required to carry out national defense missions by the Indonesian National Armed Forces, electrical energy is crucial. For bases and units, especially those on the border and located far from PLN energy sources, electrical energy is critically needed to maintain operational performance. In general, diesel power plants (gensets) provide the majority of the electrical energy required by bases and radar units in Indonesia. This is especially true for the radar unit, where the use of sensitive equipment is feared to damage the equipment due to the unstable electricity flow provided by PLN.

The findings demonstrated that Indonesia has a very substantial solar energy potential, measuring at about 4.8 KWh/m2 or 112,000 GWp, but that only about 10 MWp has been used. Currently, the government has published a roadmap for the use of solar energy that sets the installed PLTS capacity by 2025 at 0.87 GW, or roughly 50 MWp/year. This figure demonstrates the significant market opportunity for the future growth of solar energy. A solar cell is the primary part of a photovoltaic solar power production system (PLTS). The following are the three different types of solar power plants (PLTS):

a. On Grid Solar Power Plant

A technique known as an on-grid solar power plant (PLTS) transforms solar energy into electrical energy by using photovoltaic cells. An example of a PLTS that can be directly connected to a PLN power plant in order to be connected to the grid is an on-grid solar power plant (PLTS). The majority of the energy produced by solar panels will be fed into the PLN network, with the remainder being used to load.

b. Solar Power Plant Off Grid System

Off Grid Solar Power Plant (PLTS) is a type of solar power plant that uses solar energy exclusively as its source of power. Because it cannot be synchronized with PLN electricity, it differs from

the On-Grid variant. It is typically accompanied by a battery or generator to store energy as a backup. Due to its independence and reliance on batteries, this system, which is also known as Stand Alone PV (Photovoltaic), is ideal for locations that are challenging for the PLN network to access.

c. Hybrid Solar Power Plant System

A hybrid power plant is a power plant that uses two or more sources of electrical energy. Its use attempts to balance out the shortcomings of each source of energy and is anticipated to provide reliable electricity supply at specific loads continuously and more effectively. This hybrid power plant uses renewable energy sources like sun, wind, water, and biomass as the major (primary) source and combines it with diesel as a backup (secondary) energy source for places that are challenging for the PLN network to reach.

Apart from being used for operational support of equipment, solar power is also used in this study as a source of electrical energy at bases or radar units, so it is anticipated that in use it will be able to effectively use fuel in generators and minimize the risk of equipment operation stopping due to a lack of fuel oil stocks in the border area.

Due to significant investments and constrained funds, the Indonesian Air Force, in this case Diskonsau, is still limited in generating and utilizing solar power. When it comes to runway lighting, specifically runway lights, apron lights, and taxiway lights, the Indonesian Air Force currently uses solar electricity at air bases that have a true need for it. Because the base lights held by the Indonesian Air Force rely only on solar energy as a source of electricity, the Indonesian Air Force uses solar power using the Off Grid Solar Power Plant (PLTS) type.

Through the use of government policy instruments, renewable energy has been constrained from a regulatory perspective in Indonesia. By cutting back on oil subsidies, these policies promote the development of innovative alternative energy. The Presidential Regulation No. 5 of 2006 regarding National Energy Policy is one of the existing legal basis (Regulation of the President of the Republic of Indonesia No. 5, 2006).

The Indonesian Air Force leadership has assessed the usage of solar power plants (PLTS) to support air operations within the TNI Air Force utilizing renewable energy, according to the findings of research pertaining to the policies of the TNI leadership. The focus of the Indonesian Air Force's strategy is on border-based units, like radar stations, which receive little power from PLN and must run their defense machinery mostly on generators.

PLTS will be widely used to meet the requirements of TNI institutions, in this example the Air Force, in order to save money and energy. It has also been demonstrated that using alternative energy for Indonesian Air Force units, including office buildings and others, is more cost-effective, efficient, and effective. In order to assist infrastructure or development activities, the government has begun deploying solar power facilities that provide renewable energy.

There must be a concept to start using alternative energy from sunlight for the needs of the Indonesian Air Force office units in order to facilitate the usage of innovative and renewable energy within the Indonesian Air Force. The Indonesian Air Force unit's use of PLTS makes it simple to access the source of electrical energy generated. Of course, the bases will receive additional energy supply through this PLTS in addition to the primary energy source from PLN. When compared to other forms of new and renewable energy, PLTS is the most popular alternative energy source due to its relatively straightforward technology and accessible knowledge regarding operating systems.

The glare effect brought on by light reflection off of solar panel glass prevents the application of PLTS at air bases utilized by the Indonesian Air Force. This may result in flash blindness, which is potentially dangerous for pilots. The fact that these issues exist does not necessarily imply that PLTS is unsuitable at the air base, though. Many air bases across the world have used PLTS as a support for the primary energy source.

Utilizing a technology system known as the Solar Energy System, one method of supplying alternative or backup electrical energy that is ready to be implemented in the Air Force today is the utilization of solar energy. Photovoltaic Solar Power Plant, also referred to as Photovoltaic (SESF), The government has standardized the word SESF, which is used to refer to energy generation systems that utilise photovoltaic technology and solar energy.

Figure 3. Solar-powered runway lights

In order to sustain aviation operations, the Indonesian Air Force has thus far utilised solar power technology, namely solar photovoltaic technology, such those found in the runway lights at many of the air bases currently operated by the Indonesian Air Force.

the incorporation of PLTS into Air Force units by creating a power source that is simple to use. Of course, in addition to the main energy source from PLN, TNI units in remote locations like this satellite unit can acquire additional energy supply through PLTS. Systematic, organized, and integrated efforts are required to protect domestic energy sources and improve their utilization as nonrenewable energy supplies that underpin the nation's electrical energy supply are depleted.

Conclusion

The Indonesian Air Force implemented the country's current renewable energy policy, planning specifically for issues like maintenance, but all of this is necessary. Diskonsau, as the entity in charge of this control, is in line with the findings of research conducted by the Indonesian Air Force, utilizing human resources. Solar is already used by the Indonesian Air Force to support air operations, although it still relies on generators and PLN for backup power.

The idea of using solar power as a backup source of electrical energy within the Air Force is crucial to ensuring the smooth operation of the TNI in supporting national defense activities. As a result, electricity is required to support the operational performance of every air base or radar unit, particularly units in the regions. borders, especially for Radar units so that they can be supported to support national defense activities.

The Indonesian Air Force frequently uses solar power technology as a backup voltage source to assist air operations connected to energy sources in the running of the Air Field Lighting System as a manner to support air operations, in this instance aviation. specifically, Solar Power Plant.

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