

Energy Storage and Battery Technology in Indonesia

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Abstract:- After we produce energy, we are faced with two choices, namely directly using the energy, or we can store the energy. One of the technologies that can be used to store energy is batteries. Energy storage technology can also assist the application of renewable energy, with the nature of renewable energy being intermittent or not always available 24 hours, energy storage technology is needed. In other words, even though what we use is a renewable energy source and then combined with energy storage technology, the availability of energy will be maintained even though the energy source is not optimal, based on this problem humans create energy storage technology, with the initiation of Net Zero Emission in 2060, Indonesia should start building and utilizing renewable energy along with the development of storage technology so that it will release dependence on fossil energy in the future, the development of storage technology is currently still classified as high cost but over time the cost will definitely be reduced by itself because many are developing energy storage technology.

Keywords:- New Energy, Renewable Energy, Energy Storage.

I. INTRODUCTION

At present, the use of energy is an inseparable need of all human activities. For example, all household furniture currently uses electricity almost entirely, and currently as a Base Load, electricity flow in Indonesia is generally still handled by power plants. Steam which as the driving force uses coal combustion, plus the quality of the coal used uses poor quality, causing pollution with high levels of NOx and SOx so that it is not good for the environment, especially for human life, in addition to the content that is bad for the environment because of the greenhouse effect. It also causes global warming, acid rain, the destruction of the ozone layer and the loss of tropical forests as the lungs of the world.

With conditions that demand higher availability of energy, plus fossil energy that is not environmentally friendly and its availability is dwindling day by day, it would be wise for humans to start looking for alternative energy that is more environmentally friendly and easier to obtain, new and renewable energy sources, for example, are solar panels. which utilizes heat or sunlight which is then converted into electrical energy, hydroelectric power plants which use the movement of water which is then converted into electricity, and geothermal power plants which utilize pressure from geothermal energy to generate electricity.

However, there are new problems that arise along with the discovery of energy sources that are more environmentally friendly, namely the nature of energy that is intermittent or

inconsistent always produces energy, for example solar power will not produce electricity if there is no sunlight, hydroelectric power will not produce electricity. will generate electricity if the volume of dammed water is not sufficient, and the geothermal heat that every time an earthquake occurs must be deactivated.

Due to this nature, new and renewable energy is still not widely developed, especially in Indonesia, many doubt the ability and potential of this new and renewable energy. currently developing is energy storage technology, the aim is of course to cover the weakness of the nature of this new and renewable energy, with the continued development of energy storage technology, it is hoped that in the future when fossil energy sources are considered irrelevant, new and renewable energy sources can replace the role of new and renewable energy sources. fossil energy sources and make the environment healthier, better and minimize the Climate change that continues to occur recently and can have an impact on the loss of some major cities on the coast, if this happens it will cause chaos in various countries and will harm many as a good sector of the economy and government of a country.

II. MATERIALS AND METHOD

The writing of this research uses the research method of Literature Studies or Library Research (Library Research). This literature study was conducted to collect various selected references that were most relevant to the problems at hand. From the references that have been collected, they will then be examined carefully to obtain new findings or new theories from these various references. (Pratikno et al., 2020)

The purpose of choosing this writing method is to support this research in depth. Literature study is a study that utilizes references in the literature. These references can be found in books, articles, research activity report articles, journals, and internet sites. The output of this literature study is the collection of relevant references related to research problems.

III. DISCUSSIONS

➤ Chemical Battery

The battery is an energy storage element that relies on chemical materials, the chemical energy is used to store electrical energy, the chemical energy can be reacted into electron jumps which can then produce electricity. Results The output of battery storage is usually a direct current or what we know as DC (Direct Current) voltage. The advantage of the battery-shaped electrical energy storage technology is that the chemical reactions that occur do not only run in one direction,

the reaction will release, but can also charge, so that this battery electrical energy storage technology can be recharged. Basically there are some chemicals that are the battery products that we use today are;

- *Lithium ion* (Li-Ion)
- *Lithium Polymer* (Li-Po)
- *Nickel-metal hydride*
- *Lead-acid*
- *Nickel-cadmium* (NiCd)

This rechargeable battery is combined with chemicals, such as chemical reactions and reactants which form the basis for the formation of energy storage mechanisms. This electrical energy storage technology is a technology that is very common and widely known by the public so that its use is inherent in everyday human life, term to define the performance of the battery, we will meet with terms that are often referred to, including: charge, self-discharge, which means that the battery can reduce the energy it stores even though the energy in the battery is not being used, then there is the term energy density which means it is the energy density against the volume that can be accommodated in the capacity of a battery, then there is the term Specific energy, namely the capacity of a battery that can be stored in it against the weight of the battery, then lastly there is Cycle life, which is an understanding of how strong and how strong the battery life is. a lot of these batteries can charge until they can no longer receive power.

➤ *Thermal Energy Storage*

Thermal energy is energy generated from heat or heat that comes from several sources, one of the large and free sources is solar heat, solar heat can be used for drying, to generate electricity with Photovoltaic systems which have recently gained popularity due to the use of solar panels that increasingly massive among the people, because the energy produced is clean energy without producing pollutants such as fossil-based energy.

Of the many methods developed in this heat storage technology, the most commonly used is the Sensible Heat Storage method, this method is very commonly found in Solar Heating System Technology, namely water is used to store heat in water-based systems, for air-based systems we will usually use In the Rock Bed method, the solid-liquid phase change in the liquid and solidification processes can store large amounts of energy from heat and cold. Melting process is characterized by smaller volume changes generally more than 10% based on the previous volume. After the melting process, heat will be transferred to the storage material so that the material can still maintain a constant temperature.

The temperature in this phase change is often referred to as the phase change material. In the process, when the liquefaction material has been completed or complete, the trapped heat is transferred to the Sensible heat storage, the heat used in the liquefaction process is Latent heat and is usually referred to as the Latent Heat Storage process.

Then there is another method of storing thermal energy, namely CSP (Concentrated Solar Power) which is the method

of using a mirror that captures the sun's heat, then the sun's heat is converted into hot fluid, which will later create steam to drive a turbine and the end result is electricity. This power plant with the CSP method has advantages compared to ordinary solar panel power plants, one of the main advantages is that CSP is equipped with molten salt where the heat will be stored, and allows it to continue to produce electricity even though it is dark and the mirror does not get hot anymore.

On the working principle, Thermal energy has a directly proportional relationship with temperature, in other words when the temperature increases there will be an increase in energy which is as large as temperature.

(E) Required to heat the Volume (V) a substance from temperature T1 to temperature T2 we can know through the formula:

$$E = mC(T_2 - T_1) = \rho VC(T_2 - T_1)$$

Based on the above formula, (C) is the specific heat of the substance, the value of C can vary from about 1 kkal/kg°C for water up to 0,0001 kkal/kg°C for some materials at very low temperatures.

➤ *Compressed air energy storage*

Basically, this method utilizes trapped air to be used as an energy source. The working principle of Compressed air energy storage (CAES) has 4 simple keywords, namely:

- Motor and compressor.
- Turbin and generator.
- Underground compressed-air tank.
- Off-peak or energy surplus

Compressed air energy storage or CAES is one of the electrical energy storage media that uses compressed air. When the air is compressed or pressed, the air pressure will be used to drive the turbine, the turbine will channel its power to the generator and the end result is electricity.

CAES obtains air pressure in the atmosphere which will be compressed into the compressed air chamber. CAES technology will be very functional when juxtaposed with several other alternative energy sources, this is aimed at achieving efficiency, energy density, and energy capacitance. This has been proven by Germany precisely at Huntorf in 1978 by producing 290 MW. In addition to its simple and uncomplicated working principle, CAES also has a fairly high efficiency value against energy losses of around 70-80% and a relatively long service life, up to 60 years.

➤ *Superconducting Magnetic Energy Storage*

Superconducting magnets can be energy storage, because the input terminal stores energy in the magnetic solid flux (B) which is created from the flow of direct current or Direct Current (DC), the current will remain constant because there is no resistance in the superconductor, the stored energy (Wmag) is given by the self-inductance (L) of the coil and its current (I):

$$W_{mag} = \frac{1}{2} L I^2 = \frac{1}{2\mu_0} \iiint_{Space} B^2 dx dy dz$$

Superconductors can come from a conducting material, a semiconductor, or from an insulator material. Whatever type of material is used, it can be transformed into a superconductor when it reaches a critical temperature. The current can be delivered even in the absence of voltage, for superconducting materials it will not have a magnetic field or value 0.

The characteristics of superconductors were first discovered by Heike Kamerlingh Onnes (1911), Onnes was a scientist from the University of Leiden, the Netherlands. The beginning of this experiment was carried out in 1908 by melting helium by cooling it to a temperature of 4°K or equal for -269°C.

➤ Potential Energy Storage

Using the gravitational potential energy of an object as a solution for storing energy is not a new invention, Pumped Hydroelectric Storage (PHES) is a method of storing potential energy caused by gravity that is widely used in the world, especially for long-term energy storage. There are many variations in the application of PHES, but now the same system has been developed but does not use water, mathematically the concept of large potential energy is formulated as follows:

E_p = mgh Ketentuan:
 E_p = Gravitation Energy Potential
 m = Mass (kg)
 g = Gravitation (m/S²)
 h = Height (m)

If you refer to the formula described above, the conclusion from the formula is that the amount of potential energy is affected by the mass and also the height of an object.

The working principle of this PHES uses a piston that is inserted into a water tube that is connected to a turbine. When the water pressure rises due to the gravitational force generated, the piston will automatically move and the movement of this piston will result in pressure on the water and the compressed water will move to create a current, this moving current will rotate the turbine which is connected by the water tube and if the turbine rotating it will move the generator and will produce electrical energy, of course this energy source is intermittent and will not be available continuously for 24 hours.

IV. CURRENT AND FUTURE ISSUES

➤ Energy Storage Technology

With the development of technology and human needs and the times, this increase can be seen from the number of users and devices that have been used and the amount of energy needed, now there is also a lot of discussion about energy storage technology, because the issue that is currently developing is reducing greenhouse gas emissions. (GHG) and

reduce the use of fossil-based energy sources that are less environmentally friendly, and most importantly slow down the Climate Change that we cannot avoid.

Therefore, scientists are currently competing in creating alternative energy that is more environmentally friendly and fulfills 5 principles in resource exploitation, namely 4A + 1S, namely Affordability (Affordable), Accessibility (Ease of access), Acceptability (community acceptance), Availability. (Availability) and Sustainable (Sustainable).

If all these concepts have been fulfilled, it is mandatory to develop new energy sources or new renewable energy, and be accompanied by the development of energy storage technology that makes these energy sources productive even though the nature of the energy is intermittent. Thus the future of new and renewable energy sources will be easier and will slowly replace fossil energy sources.

V. CONCLUSION AND RECOMMENDATION

At the end of this writing, the author can finally conclude that New and Renewable energy sources will slowly replace the role of fossil energy sources, because of the nature of fossil energy which will run out and cannot be renewed, but the development of NRE will be very rapid if energy storage technology is mature, because will cover its weakness which is Intermittent and can serve electricity for 24 hours.

The recommendation that the author can convey is that the development of storage technology should be more mature, and involve more government agencies so that future regulations will also be clearer.

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