VOL. 12, NO. 11, JUNE 2017 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

THE IMPACT OF THE OPERATION PLANNING OF POWER PLANTS FOR ENVIRONMENTAL EMISSIONS IN SOUTH SULAWESI

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ABSTRACT

Plan provision of power generation by the Indonesian government will be dominated by thermal power plants, one of which is a coal-fired power plant, where the process of electricity production at the plant are coal combustion process that produces electrical energy and also the ash and smoke. Ash and smoke is a potential environmental pollution. Therefore, this study aimed to get a prediction of the amount of the value of emissions due to the operation of power plants in South Sulawesi.

Keywords: power plant, electrical energy, environmental emission, South Sulawesi.

INTRODUCTION

Generally, on power plant systems in particular generating conventional or non-renewable, consideration of a request country active power and reactive power by expenses. It should be noted for review maintain system operates with factors power good because it is not forever can be fulfilled by the power plant in the system. And effect expenses the changing, active and reactive current will flow uncontrolled on networks, a subsequent drop in power factor, the increase reversal networks, particularly at slew edge channel, and deteriorated voltage regulation. It will cause disadvantage power factors on consumer and electricity power plants. It lay what should be noted is the problem of stability because stability of an electric power system has now become a concern. In order system efforts quality, reliable, continuous, and safe and stability and quality of electric power system being very important [1]. With behaviour problems related to stability from a synchronous machine taxable income suffered disorders. If input imbalance between generation and needs expenses occurred through changes, evocation, or in network conditions, so what's new operating conditions is essential. In different case, all interconnected synchronous machines must be on its synchronous conditions.

Given the supply of active power and reactive power of the power plant is directly proportional to the combustion of fuel in the center of power of non-renewable (coal-fired power plant, diesel engine power plant, and gas turbine power plant), which use oil, coal and gas as a fuel, has the potential for very great for polluting our air and water. The coal fired power plants emission of NO_x, SO_2, CO, CO_2, and particulates are also significantly high as compared to gas turbine power plants [2]. To control the level of environmental emission generated by waste disposal in the thermal power plants need a system that can control the fuel combustion optimization of power supply in the form of active and reactive power generation.

In the process of producing electricity from coal at the power plant are coal combustion processes. As with other fossil fuels, in addition to coal combustion process resulting release of energy in the form of heat is also generated ash and smoke [3]. Dust and smoke are pollutants generated from coal power [4]. Here are the main pollutants produced by coal power: (1) SO_2 an emission is known as a source of lung disorders and can cause a variety of respiratory diseases. (2) the NO_x emissions at the same time issued by the drop in coal along with SO_2 gas, both of which are causes of "acid rain" that occurred in many developed and developing countries, especially those dependent production of electricity from coal power. Acid rain can negatively impact the livestock industry and agriculture. (3) CO is exhaust emissions that can form a layer in the atmosphere that can envelop the earth's surface so as to cause the greenhouse effect; it may affect the global climate change. And (4) fly ash [5] [6].

The damage that causes the air pollution originating from the power plant will damage the ocean biota and a beach close to the plant. Damage originated from damage to coral reefs are becoming a rare proliferating fish and other marine life. Destruction of coral reefs will certainly lead to reduced populations of fish and other marine life in the region. As a result, the income of the local fishermen would be decreased. Power plants using sources of energy derived from fossil coal in a different area. This requires facilities such as docks and transport. In the construction of the power plant requires rock and soil. Rock and soil that is intended for the construction of the dock was taken out of the mountains or the high plains. It was very damaging nature and prone to landslides.

Therefore, hassle to suppress the effects of pollution arising in fulfilling the needs of the load that is highly correlated with plant limitations, this study takes the theme of study is influence of the operation of thermal power plants against environmental pollution.

LITERATURE AND METHODOLOGY

This type of research used in this research is a case study on the operation of South Sulawesi Electrical Systems by RUPTL PLN [7]. This research was conducted in South Sulawesi, Indonesia, which is an administrative region PT. PLN (Persero) Sulselrabar region. The location was chosen because of the location system interconnect of South Sulawesi there is the addition of new power plants

are the power plant to the South Sulawesi Electrical Systems. This research analyses using software LEAP [8].

The amount of electricity demand can be calculated by using a forecasting model of energy needs. In this study the model that will be used to predict the future power needs of electricity is the model LEAP. LEAP is a modelling methodology in accounting. Supplying the energy in this accounting method calculated by summing the consumption and supply of energy of each type of activity. LEAP software supplied in 4 main modules, namely: Driver Variable, Demand, Transformation and Resources. The fourth module (or the main branch of the "tree") are "default", can't be changed. In this main module (except for Resources) can be made branches again in accordance with the needs of modellers. The number of branches is not restricted.

The above arrangement module is standard. LEAP will simulate a model based on the structures, from top to bottom. Simulation LEAP is straight forward, no feedback between demand and supply of energy. Always considered energy needs met by the supply of energy coming from the transformation of domestic energy and imported energy.

MODEL ON ENVIRONMENTAL IMPACT ASSESSMENT POWER PLANT

Results estimates power supplies

Forecast of electricity demand in 2016 and 2030 in the province of South Sulawesi prepared using macro-economic assumptions. It is estimated that the annual GDP growth of 6.6% [9]. Preparation of forecasts of electricity demand based on the assumptions noted earlier with regard to equitable development policies that have been imposed in the area of South Sulawesi. In 2015, the system peak load in South Sulawesi at 1046 MW [7]. From the results forecast electricity needs in total, it appears that the need for electricity in terms of peak load rose 130% since 2015, which amounted to 1344 MW with an average growth of 13% per year whereas in 2030 the peak load of 2390 MW. The development of electricity demand by sector for the baseline scenario can be seen in Figure-1.

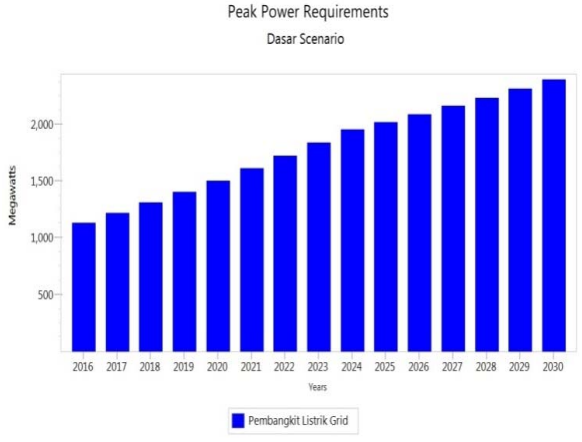

Figure-1. Peak load forecast system in South Sulawesi.

Results estimates power demands

To offset the electricity demand continues to increase is necessary to plan the development of power plants. Basic considerations plant additions, namely: (1) Exploiting the potential of hydropower is pretty much available, which are located near the estimated transmission. (2) Maximizing the potential use of natural gas. (3) For the balance of the system in the wake of coal-fired power plant in the southern part of South Sulawesi [7]. Moreover, in determining the type of plants to be developed, it is expected from the composition of the plant also need to consider the energy consumption of water in order to avoid power shortage during the dry season arrives where water supplies for power generation is much reduced. One way of coping is powered generating hydro operated at peak load is enabled on the thermal generating base load. As far as possible in this plan avoids the use of fuel oil reserves diminishing in Indonesia, except for generating the isolated area unreached transmission network. BBM, in addition to reserve is low, its price will result in high operating costs.

Before we discuss about the types of plants that will be developed in the area of South Sulawesi, the first discussed about the existing system of South Sulawesi. Power installed power generation PLN South Sulawesi until 2015 amounted to 1414 MW. At this time the system needs electrical energy in South Sulawesi in the supply of systems and sub-systems with different sources of generation plants, namely; Hydroelectric Power Plant, Diesel Power Plant, Gas Power plant and Steam power plant. Power generation is managed by PLN, Independent Power Producer and plant Rental Company [4].

Development of power plant in South Sulawesi province was assessed by PT PLN (Persero) Sulselrabar region in a report written in RUPTL, so to meet the needs of electrical energy generation plan that will be developed by PLN used as a technology that will be built by the province of South Sulawesi. The demands for electricity in South Sulawesi province are mostly located in the southern part of the area that is in the city of Makassar. Meanwhile potential of primary energy (water and natural gas) are in the northern part. This condition makes stability of the system become an issue as the distance between power plants location and load centre is very far. The new hydropower plant planned to be built is Bakaru-II hydropower plant, and Bonto Malea Stone hydropower plant. In addition, to meet the rapidly growing electricity demand, planned to be built non-fuel power plants with a location closer to the load centre is in coal in Jeneponto, and Peaker Gas Engine Power Plant in Maros. Expenses in the province will also be met from plants which are outside the province of South Sulawesi as Poso hydropower plant, Poko hydropower plant, Seko hydropower plant, and several other hydropower plants. In 2013, the new plant operating in South Sulawesi province is Barru power plant (2x50 MW) and Sengkang power plant (2 x 60 MW). Additional new power plants in South Sulawesi province until 2020 to reach about 1740 MW as shown in Figure-2.

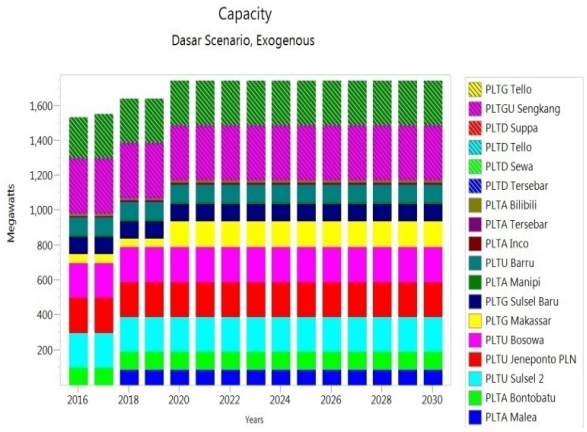

Figure-2. Plans new power plant in South Sulawesi.

The addition of these power plants strived able to cover the needs of the electrical load level with reserves between 10% to 30%.

Primary energy for electricity generation

In harmony with the growth of demand to be met by the development of plants, the production of energy by type of primary energy is as follows: (1) Role of diesel oil will decline significantly by the inclusion of new power plants with coal-fired power plant and gas turbine power plant. They will also be entered hydropower plant for peak loads that have been borne by the diesel oil and oil power plant. (2) The role of coal-fired power plant will increase. (3) The role of gas turbine power plant will be in 2030; this is because natural gas is projected to be a backup energy for an abundance of electricity from energy hydro power plant and energy coal-fired power plant either from the energy of South Sulawesi and energy from outside the other provinces. (4) The role of water (hydropower plants) has increased as shown in Table-1, where the role of hydropower plants are increasing with time.

It is estimated that since the operation of the Bosowa coal-fired power plant, Barru coal-fired power plant, Jeneponto coal-fired power plant and Poso hydropower plant, Sengkang combine cycle power plant is as a backup for power plants.

Table-1. Projected production of electrical energy in South Sulawesi (GWh).

Primer energy	2016	2020	2025	2030
Solid Fuels	8462	10452	13051	14193
Natural Gas	3332	4115	5139	5588
Hydropower	1943	3105	3877	4216
Biomass	-	-	-	-
Oil Products	-	-	2207	3480
Total	13737	17672	24273	27477

Primary predicted emissions

Table-2. Projected global warming potential in South Sulawesi (Thousands of Metric Tonnes of CO_2).

Effect	2016	2020	2025	2030
Carbon Dioxide	4785	5606	6678	7150
Methane	6.	7	9	10
Nitrous Oxide	20	23	28	31
Total	4811	5636	6716.	7190

Results of Exhaust Emissions projections from 2016 to 2030 with the kind of Carbon Dioxide Non Biogenic emissions can be seen in the Table-2. A result of the exhaust gas emission projections in 2016 for Carbon Dioxide Non Biogenic is 4785 thousand Metric Tonnes, Methane 6 thousand Metric Tonnes and nitrogen Oxides 20 thousand Metric Tonnes. In 2030, emissions of Carbon Dioxide Non Biogenic rose to 7150 thousand Metric Tonnes. Exhaust emissions such as Methane is 10 thousand Metric Tonnes and Nitrogen Oxides 31 thousand Metric Tonnes.

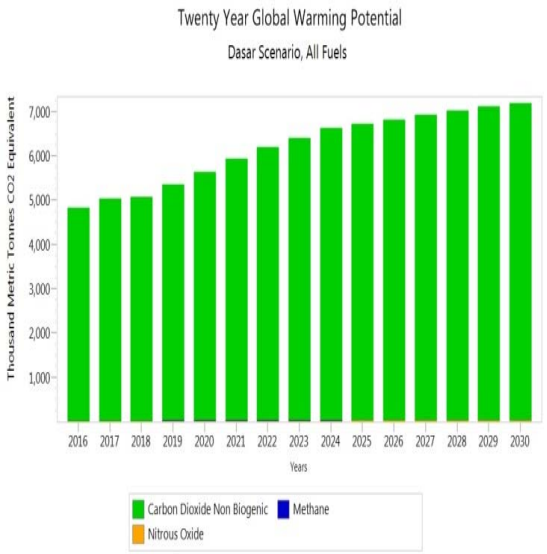

Figure-3. Number of global warming potential in South Sulawesi (Thousands of Metric Tonnes of CO_2).

Total Carbon Dioxide Non Biogenic in Figure-3 continues to increase in numbers until the end of the year the prediction is 2030. This is due to the methods used in environmental loading for exhaust emissions of Carbon Dioxide Non Biogenic emissions per energy is produced, where production continues to rise as the number electrical energy consumption continues to grow. On the environmental loading, a method of emissions per energy produced is selected only for exhaust emissions of Carbon

Dioxide Non Biogenic for Carbon Dioxide Non Biogenic emissions are produced by any combustion process.

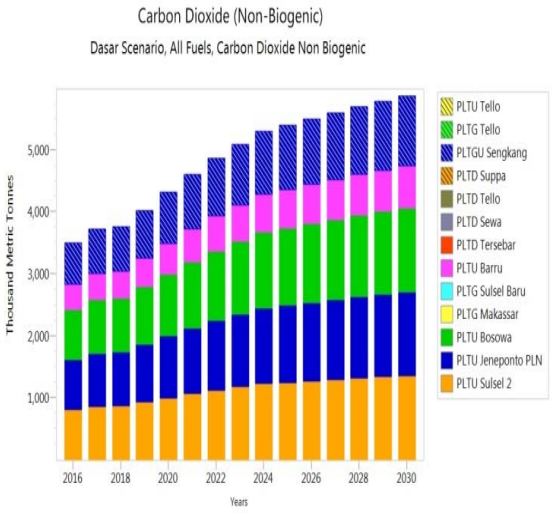

Figure-4. Carbon dioxide non biogenic every plant in South Sulawesi (Thousands of Metric Tons of CO_2).

The projection for exhaust emissions Methane and Nitrogen Oxides very small until the end of the forecast is 2030. This is caused by the diesel does not operate when the power plant is already available, thus affecting the amount of proceeds of Methane and Nitrogen Oxides as a whole as shown in Figure-4.

Or if the terms of the type of power generation is coal based power plant and a power plant / Natural Gas Combined Cycle Power Plant, the Table-3 provides information about the number of Carbon Dioxide Non Biogenic emissions generated both types of these plants.

Table-3. Projected non biogenic carbon dioxide in South Sulawesi (Thousands of metric tonnes of CO_2).

Fuel	2016	2020	2025	2030
Solid Fuels	4116	4780	5647	6027
Natural Gas	669	826	1032	1122
Oil Products	-	-	-	-
Total	4785	5606	6678	7150

The projection shows that the power plant by 2016 to produce exhaust emissions of Carbon Dioxide Non Biogenic amounted to 4116 thousand Metric Tons, power plant / power plant amounted to 669 thousand Metric Tons. And in 2030 exhaust emissions of Carbon Dioxide Non Biogenic produced by the Solid Fuels power plant (coal-fired power plants) amounted to 6027 thousand Metric Tones and Natural Gas power plant (Gas Turbine and Combine Cycle power plants) as many as 1122 thousand Metric Tons.

CONCLUSIONS

The electric power plants in South Sulawesi (Indonesia) in 2016 in addition to producing as many as 13737 GWh of electrical energy also produces emissions of Carbon Dioxide Non Biogenic amounted to 4785 thousand Metric Tons, where coal-fired power plants amounted to 4116 thousand Metric Tons, and gas turbine and combine cycle power plants amounted to 669 thousand Metric Tons.

And so was in 2030 where the electrical energy produced by the power plants in South Sulawesi amounted to 27477 GWh will exhaust emissions of Carbon Dioxide Non Biogenic produced by the coal-fired power plants amounted to 6027 thousand Metric Tones, and gas turbine and combine cycle power plants as many as 1122 thousand Metric Tons.

ACKNOWLEDGEMENT

The authors gratefully acknowledge Indonesia Government of Ministry of Research and Higher Education for financial support of this research.

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