

STEAM FIELD CONCEPT AND GOTHERMAL POWER PLANT DEVELOPMENT: CASE STUDY AT WAY RATAI GEOTHERMAL FIELD

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ABSTRACT

High demand for electricity energy in Indonesia forces government to develop various energy resources. The one of energy resources is geothermal energy. Way Ratai is the one area in Lampung Province that have potential 105 MW. To develop geothermal power plant, it takes perfect plans to get maximum production result from the exploration. Therefore, to offer some point of view about developing power plant, we make a basic development concept in Way Ratai geothermal field. At this paper, we proposed one development stages for this area with capacity 55 MW. With this concept, all power plants will produce 433.620 GWh total energy in one year.

INTRODUCTION

High demand for electricity energy in Indonesia forces government to develop various energy resources. In 2015, peak electric load in Lampung Province reached 854 MW while the installed capacity 593.5 MW. Electricity energy demand increases 10.4% per year. In 2025, the electricity demand become 10,682 GWh. These conditions required the addition of power plant with minimum capacity 1343.5 MWh to meet the needs of electrical energy in the Lampung Province in 2025 (RUPTL 2016-2025).

Due to of that cases the construction of power plants (in this case is PLTP) in various potential areas must be implemented immediately. Lampung Province is one of the regions with high geothermal potency. One of the geothermal potential area in Lampung Province which is still yet to be developed is Way Ratai area, Pesawaran Regency. The temperature of Way Ratai reservoir is about 210°C and its total geothermal potency is about 105 MW (KESDM, 2015). At this paper, the development stage that proposed is one stages with capacity 55 MW.

METHOD

Research methods that used in the preparation of this paper were by literature study of all important aspects for constructing the geothermal project development. With the data obtained, then we determining the total capacity of the power plant which wants to be developed. Proceed with the determination of the assumptions that support the development of 1 unit of PLTP and continued calculation of the number of wells and total production which can be generated from the unit development.

STEAM FIELD DEVELOPMENT

Calculating The Amount of Development Well

The assumptions in calculating the number of production wells, injection wells and replacement wells in the area of Way Ratai geothermal field are as follows:

1. Two phase reservoir type
2. Steam : brine percentage = 30%:70%
3. The temperature of the reservoir is 210°C
4. Drilling Success Ratio 80%
5. Production wells capacity 9 MW Production wells capacity 9 MW
6. Electrical capacity plant target is 55 MW
7. Excess steam in well head is 10%

Table 1: Calculation of wells amount for PLTP Unit-1 (1 x 55 MW)

Explanation	Unit	PLTP Unit-1 (1X55 MW)
ASSUMPTION		
Steam per MW	ton/jam	8
Well Capacity	MW	9
Steam Presentation	%	30
Steam Production	ton/jam	55 x 8 = 440
Brine Production	ton/jam	1467 x 70% = 1027
Separator Capacity	ton/jam	200
Success Ratio	%	80

RESULT		
Steam Production per well	ton/jam	15 x 8 = 120
Brine Production per well	ton/jam	400 x 70% = 280
Total Production per Well	ton/jam	120 : 30% = 400
Production Wells	Wells	7
Replacement Well	Well	1
Injection Wells	Wells	6
Total Separator	Wells	400 : 200 = 2

Calculating the amount of make-up wells

Table 2: Calculation of Make-up well

No	Production Year	Steam Production (ton/jam)	Depresiation (ton/jam)	Production After Depresiation (ton/jam)	Make-up Well	Make-up Well Capacity	Total Steam Production	Description
1.	2017	600.00	18.00	582.00	-	-	582.00	Make-up well
2.	2018	582.00	17.46	564.54	1	120	684.54	
3.	2019	684.54	20.54	664.00	-	-	664.00	
4.	2020	664.00	19.92	644.08	-	-	644.08	
5.	2021	644.00	19.32	624.76	-	-	624.76	
6.	2022	624.76	18.74	606.02	-	-	606.02	Make-up well
7.	2023	606.02	18.18	587.84	-	-	587.84	
8.	2024	587.84	17.64	570.20	2	240	810.20	
9.	2025	810.20	24.31	785.90	-	-	785.90	
10.	2026	785.90	23.58	762.32	-	-	762.32	
11.	2027	762.32	22.87	739.45	-	-	739.45	Make-up well
12.	2028	739.45	22.18	717.27	-	-	717.27	
13.	2029	717.27	21.52	695.75	-	-	695.75	
14.	2030	695.75	20.87	674.88	-	-	674.88	
15.	2031	674.88	20.25	654.63	-	-	654.63	
16.	2032	654.63	19.64	634.99	-	-	634.99	Make-up well
17.	2033	634.99	19.05	615.94	-	-	615.94	
18.	2034	615.94	18.48	597.46	-	-	597.46	
19.	2035	597.46	17.92	579.54	1	120	699.54	
20.	2036	699.54	20.99	678.55	-	-	678.55	
21.	2037	678.55	20.36	658.20	-	-	658.20	Make-up well
22.	2038	658.20	19.75	638.45	-	-	638.45	
23.	2039	638.45	19.15	619.30	-	-	619.30	
24.	2040	619.30	18.58	600.72	-	-	600.72	
25.	2041	600.72	18.02	582.70	2	240	822.70	
26.	2042	822.70	24.68	798.02	-	-	798.02	Make-up well
27.	2043	798.02	23.94	774.08	-	-	774.08	
28.	2044	774.08	23.22	750.85	-	-	750.85	
29.	2045	750.85	22.53	728.33	-	-	728.33	
30.	2046	728.33	21.85	706.48	-	-	706.48	

Steam field development costs plan

Suharno (2010) team field development costs consist of the costs of preparation; supporting infrastructure construction drilling activities include land acquisition costs for piping, pad wells, construction of new access roads and repair of roads, base camp, warehouse and yard equipment; and the costs of drilling development wells which include fees paid to drilling production wells and injection wells, and material procurement costs as well wellhead, casing and accessories, and rock bits. This fee has added the cost of test wells and equipment. The calculation of the cost of drilling a well is determined by looking at a number of wells to be drilled and the depth of the well. In the calculation of these costs are added to the cost of project management, which amount is a percentage of the total cost of the steam field development.

GEOTHERMAL POWER PLANT (PLTP) DEVELOPMENT

Cost plan

Cost plans for calculating the amount of investment in the development of Geothermal Power Plant (PLTP) based on Suharno (2010) are as follows:

- 1) Engineering costs.
- 2) Procurement of civil and mechanical equipment costs
- 3) Acquisition of land for Geothermal Power Plant, auxiliary buildings and land pipelines costs
- 4) Construction and installation costs
- 5) Project management costs.

PLTP capacity factor

The total production of one PLTP unit is calculated as follows:

Production = 55 MW x 24 hours x 365 days x 90% = 433620 Mwh or 433.620 Gwh.

So for three power plant that will be developed can produce 1734.48 Gwh in one year.

CONCLUSION

1. Way Ratai geothermal power plant will be developed in one stages to reach 55 MW with capacity of production well reach 9 MW per well
2. The amount of production wells, injection wells, and replacement well are 10 wells.
3. The amount of make-up wells that need to be made over 30 years as many as 6 wells
4. Total power plant that will be developed can produce 433.620 Gwh in one year.

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