

# PERTAMINA GEOTHERMAL ENERGY BUSINESS OPERATION: AN UPDATE ON JOINT OPERATION CONTRACTS

Doddy S. Gunawan<sup>1</sup>, Reza Rahman<sup>1</sup>

<sup>1</sup>Pertamina Geothermal Energy, Skyline Building, 14<sup>th</sup> Floor, Jl. M.H. Thamrin No. 9 Jakarta, 10340, Indonesia

<sup>1</sup>[doddy\\_s@pertamina.com](mailto:doddy_s@pertamina.com), <sup>1</sup>[reza.rahman.pge@pertamina.com](mailto:reza.rahman.pge@pertamina.com)

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## ABSTRACT

Pertamina Geothermal Energy (PGE) as a subsidiary of Pertamina (Persero), which is engaged in the geothermal business, is authorized by the Indonesian government for several working areas. Some of these work areas are managed by PGE directly and the others are managed by contractors in form of a Joint Operation Contract (JOC). Until now there are 5 (five) JOC that are still running, namely JOC Salak (West Java), JOC Darajat (West Java), JOC Wayang Windu (West Java), JOC Sarulla (North Sumatera), and JOC Bedugul (Bali).

From 2017 until mid-2019, there were several important changes in the management of JOC, including: the changes of JOC Salak and JOC Darajat management contractors in 2017, and Commercial Operation Date (COD) of 3 power plant units @110 MW by Sarulla JOC contractor which increased installed capacity of geothermal power plants in Indonesia to 1,948.5 MW in 2017-2018.

## 1. INTRODUCTIONS

### 1.1 Joint Operation Contract

Joint Operation Contract (JOC) is a joint operation agreement between PERTAMINA and CONTRACTOR where PERTAMINA shall have and be responsible for management of the geothermal operations and CONTRACTOR shall finance expenditures for geothermal operation. In JOC, PERTAMINA have responsibility as the management of the geothermal area and the CONTRACTOR as the operator of geothermal area who produces the geothermal steam and/or generates electricity.

Based on Government Regulation No. 31/2003, PERTAMINA transformed to Pertamina (Persero), and its geothermal business had to be transferred to a subsidiary. So, Pertamina (Persero) established a subsidiary called Pertamina Geothermal Energy (PGE) in 2006 to manage the geothermal business, including the management of JOC.

Currently, there are five JOCs in Indonesia four of which have produced and generated electricity (1205 MW total installed capacity ; See Table 1).

Salak, the first commercial JOC was established in March 1994, then Darajat in November 1994, Wayang Windu in June 2000, and finally Sarulla on March 2017.

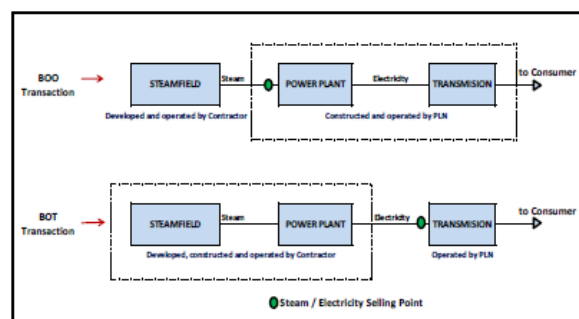
Bedugul contract area, has still yet to produce any power, due to several problems under the current conditions with local government regulations, and internal disputes over share(s ?) in Bali Energy Limited.

Tabel.1 : JOC Installed Capacity per December 2018 (source : PGE/authors ?).

No.	JOC	Installed Capacity	Contractor
1	Salak	377 MW	Unocal Geothermal Indonesia -> Chevron Geothermal Salak -> Star Energy Geothermal Salak
2	Darajat	271 MW	Amoseas Indonesia Inc.-> Chevron Geothermal Indonesia -> Star Energy Geothermal Darajat
3	Wayang Windu	227 MW	Magma Nusantara Ltd. -> Star Energy Wayang Windu Limited
4	Sarulla	330 MW	Unocal North Sumatra Geothermal -> Sarulla Operation Limited
5	Bedugul	-	Bali Energy Limited

### 1.2 JOC Business Models

There are two kinds of business models in JOC, the first is Built Own and Operate (BOO) for which each individual contractor develops the upstream side, produces the geothermal steam and then sells the steam to a buyer under a fixed price contract for x years? The second is Built Own and Transfer (BOT) for which the contractor develops the upstream and downstream side, generates electricity and then sells the electricity to buyer.



**Figure.1: Geothermal Business Transaction (Pramono, 2010)**

The BOO model has been used in Salak Geothermal Power Plant Unit 1, 2, and 3, and Darajat Geothermal Power Plant Unit 1, which SEGS and SEG II sell the steam to PT. Indonesia Power (PT. IP) which is a subsidiary company of State Electricity Company (Perusahaan Listrik Negara – PLN).

The BOT model has been used in Salak Geothermal Power Plant Unit 4, 5, and 6, Darajat Geothermal Power Plant Unit 2 and 3, Wayang Windu Geothermal Power Plant Unit 1 and 2, Sarulla Geothermal Power Plant Unit SIL, NIL-1, and NIL-2, which SEGs, SEG II, SEGWWL, and SOL sell the electricity to State Electricity Company (Perusahaan Listrik Negara – PLN).

## 2. UPDATE ON JOINT OPERATION CONTRACTS

Since the beginning of 2016 until Mid-2019, there were several important events in the management of JOC

### 2.1 Acquisition Salak and Darajat geothermal asset.

Due to the low oil price which hits Chevron oil business, Chevron sold its assets, cutting jobs around the world and slashed capital spending to save cash in a bid to preserve its dividend. In February 2016, Chevron was considering a sale of its geothermal assets in Indonesia and the Philippines. In Indonesia, Chevron operated the Darajat and Salak geothermal fields in West Java, with a combined capacity of 235 MW equivalent of steam and 402 MW of electricity.

After going through several stages of a bidding process, in December 2016, a consortium led by Star Energy won a tender of the sales of Chevron Geothermal assets in Indonesia and the Philippines. The Indonesian operations owned by Chevron then were sold to a consortium of Star Energy through their joint venture company, Star Energy Geothermal (Salak-Darajat) B.V.

The 31 March 2017, Chevron subsidiary transferred their share to Star Energy.

Along with the acquisition of assets in Salak and Darajat, there was a change in the name of the contractor. For JOC Salak, Chevron Geothermal Salak (CGS) becomes Star Energy Geothermal Salak (SEGS), and for JOC Darajat, Chevron Geothermal Indonesia (CGI) becomes Star Energy Geothermal Darajat (SEG D).

### 2.2 JOC Sarulla

Sarulla geothermal area is located in North Tapanuli district, North Sumatra, and is operated by Sarulla Operation Limited.

#### 2.2.1 Development by Sarulla Operation Limited

After the Consortium achieved the Financial Close on 23 May 2014, Sarulla Operational Limited started the development of the Sarulla geothermal contract area. Initially Sarulla geothermal power project development was to produce up to 330 MW of electricity (3 x 110 MW). The initial development of Sarulla included :

1. Development of Silangkitang (SIL) field and Namora-I-Langit (NIL) field.
2. Construction and operation of its 3 x 110 MW power plants.

The unit 1 (SIL-1) at Silangkitang area was operational on the Commercial Operation Date (COD) March 18, 2017. Then, Unit 2 (NIL-1) and Unit 3 (NIL-2) at Namora-I-Langit area reached COD on October 2, 2017 and May 4, 2018.

#### 2.2.2 Integrated Geothermal Combine Cycle IGCC

Sarulla geothermal project is the first project in Indonesia which use Integrated Geothermal Combined Cycle (IGCC) power plant. This project combines geothermal steam

turbines and binary cycle systems to generate electricity. A photograph of Unit 1 (SIL-1) at Silangkitang, is shown in figure 2.



Figure 2. Unit 1 (SIL-1) at Silangkitang. (source: Sarulla Operation Limited (date : 2017, i.e. from publication/presentation in your references ?).

A schematic of the IGCC is shown in figure 3 below.

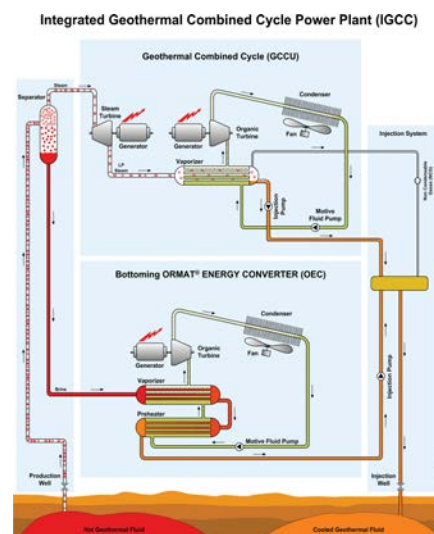


Figure 3. Schematic diagram of the Geothermal combined cycle schematic diagram. (modified from Ormat Technologies inc., personal communication dateXX)

Steam from geothermal wells is delivered to separators for dry steam and hot water (brine) separation. Then, the dry steam is used to drive the steam turbine-generator (STG) to produce electricity.

The low pressure steam exiting the topping steam turbine is delivered to the binary cycle system where the remaining heat from the steam is used to vaporize the working fluid into the vaporizer. Working fluid vapor is used to drive the binary cycle turbine-generator and produce electricity. The steam condensate from the vaporizer is then injected to reinjection wells.

Additionally, the separated hot brine is also fed into the vaporizer of the binary cycle system to vaporize binary cycle working fluid and generate electricity. The used brine is delivered to reinjection wells.

Both binary cycle systems are closed systems. After drive the turbine, working fluid is delivered to air fan cooler for decrease temperature and to condense the fluid before being sent back to vaporizer.

At Sarulla, steam turbine and generator (STG) are supplied by Toshiba, while the binary cycle system is supplied by Ormat (Ormat Energy Converter, OEC). Pentane is the working fluid in the OEC.

Each power plant consist of 1 steam turbine (STG) that produce around 60 MW, 4 OEC for condensing steam (bottoming) which produce a total around 20 MW and 2 OEC for brine with a total generation of around 30 MW. (See Figure 4)

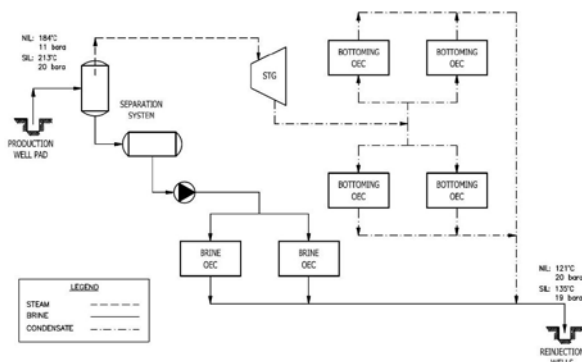


Figure 4. SIL and NIL Process Scheme (Wolf, 2017)

### 3. CONCLUSION

As of mid-2019, four of the five geothermal JOCs that still exist in Indonesia, are operating and generating electricity. After the commercialisation of the 3 geothermal power plants in Sarulla in 2017 and 2018, the total installed capacity under JOC is 1205 MW, or 62% of the total installed capacity of geothermal power plants in Indonesia.

As of March 31, 2017, Star Energy Group took over the JOCs for Salak and Darajat geothermal fields from Chevron Geothermal. Thus, Star Energy Group is now the company with the highest installed geothermal infrastructure in Indonesia with a total of 875 MW or around 45% of the total installed capacity in Indonesia.

Sarulla geothermal area became the first geothermal area in Indonesia to use Integrated Geothermal Combine Cycle (IGCC) power plant (including binary cycle by using heat from brine). Three IGCC power plants have total installed capacity of 330 MW. With the proven application of binary cycle technology in Sarulla, it is not impossible the binary cycle power plant will be the choice to generate electricity for the other geothermal area, both to increase installed capacity for existing area, and geothermal working area that are still green fields.

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