SUBSEQUENT STATE OF DEVELOPMENT IN THE MATALOKO GEOTHERMAL FIELD, FLORES, INDONESIA

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ABSTRACT

The research cooperation project of the Exploration of Small Scale Geothermal Resources in the Eastern part of Indonesia (ESSEI) in 1997 – 2002 has resulted in more detailed surface and subsurface geoscientific data of the Mataloko Geothermal Field. The promising area of the Mataloko Geothermal Field is well delineated by the integrated exploration and has been proven by the Well MT-1 and MT-2. The MT-2 drilled until the TD of 180.02m can produce steam of 16 ton per hour. This paper describes subsequent state of development in the Mataloko Geothermal Field since the Indonesia-Japan cooperation research program finished. This includes MT-2 well monitoring, well drilling of MT-3 and MT-4, Well Testing of MT-3 and MT-4, planning of development of the 2.5 MW geothermal power plant.

Keywords: Development, Geothermal Field, Mataloko, MT-2, MT-3, MT-4, Monitoring, Drilling, Indonesia.

1. INTRODUCTION

The Mataloko Geothermal Field (MGF) is located in the central part of Flores Island (Figure 1). This is the first Eastern Indonesia geothermal field drilled by the Indonesia-Japan Cooperation Research Program. During the cooperation which was started in April 1997 and ended in March 2002, more detailed Mataloko geoscientific data including surface and subsurface geology, geochemistry and geophysics have been resulted.

The surface geoscientific survey delineated the Mataloko prospect area very well (Figure 2). The Mataloko reservoir was inferred to be shallower close to Todabelu Village. The Wells MT-1 and MT-2 which are slim holes with the total depths of 207.26 m and 180.02m, respectively were drilled within the prospect area (Figure 3). The wells encountered steam zone at a depths of about 207 m in MT-1 and 162 m in MT-2. The MT-1 was plugged with cement because of steam blow out, the MT-2 can produce dry steam of about 16 ton/hour at commercial well head pressure of 5.5 Kscg and is still monitored.

Figure 1. Location map of Mataloko geothermal field.
Recently, there is a Memorandum of Understanding (MoU) signed on July 16, 2004 by three parties between the Directorate General of Geology and Mineral Resources (DGGMR), Local Government of Ngada District and State Electricity Company (PLN). The MoU is a commitment to develop a small scale power plant (~2.5 MWe) generated from the Mataloko Geothermal Field. This geothermal power plant can reduce a lack of electricity in the district and incrementally can replace the former Diesel power plant in the region.

This paper describes the subsequent development state in the Mataloko Geothermal Field since the Joint cooperation finished in 2002, including the MT-2 well monitoring, drilling and well flow testing of MT-3 and MT-4, and planning of development of the 2.5 MW geothermal power plant.
2. MT-2 WELL MONITORING

To understand fluid composition changes in the MT-2, well monitoring has been conducting since a completion of the MT-2 flow test. Monitoring of the well is carried out periodically of six times per year. These include collecting and analyzing well fluid, wellhead pressure and temperature and also observation to the surface discharges at around the well. During the monitoring for almost three years, there are no significantly changes in the fluid composition, wellhead pressure and temperature. The fluid is still characterized by the low NCG steam with temperatures at bleeding line in a range of 90-106 °C at the wellhead pressure of about 5 Kscg (Figure 4 and Figure 5).
3. MT-3 AND MT-4 WELL DRILLING

During the FY 2003, two wells, MT-3 and MT-4, have been drilled within the prospect area (Figure 3). The MT-3 and MT-4 are standard holes (Figure 6 and Figure 7). The MT-3 is situated at about 120 m north of MT-2 or located at the UTM position of X = 286878.868 m, Y = 9022854.446 m and Z = 963.445 m above sea level (asl). Whereas, the MT-4 is at about 300 m North West of MT-3 or at the UTM position of X = 286612.122 m, Y = 9023021.146 m and Z = 983.498 m asl.

Figure 6. Delineation Well MT-3: Lithological Log, Casing Design, and P-T Logging of MT-3 Mataloko Geothermal Field, Flores, Indonesia.

Figure 7. Delineation Well MT-4: Lithological Log, Casing Design and P-T Logging of MT-4 Mataloko Geothermal Field, Flores, Indonesia.
The MT-3 and MT-4 were drilled with the total depth (TD) of 613 m and 756.47 m respectively (Figure 6 and Figure 7). These wells encountered three main rock layers which are overburden, argillics and propilitics. The argillic alteration rocks which represent the clay cap occur at depts. of 6 - 536 m in MT-3 and 3 – 493 m in MT-4. Below this is propilitic zone which is likely the top of the reservoir. The differential temperature of mud circulation was high (12.8 °C) when drilling of MT-3 penetrated to 180 m. The down hole temperatures at depth of 150 m and 210 m were 127.3 °C and 159.2 °C giving extrapolated temperatures in stable condition of 165 and 186 °C, respectively. There was no total circulation loss (TLC) observed in MT-3 during the drilling. TLC was observed at shallow depth in MT-4, particularly at 47 – 51 m depth, and PLC occurred at 659 m and 702 m depth. MT-3 started flowing steam by swabbing on 7 January 2004, whereas MT-4 was flowing on 15 April 2004.

4. MT-3 AND MT-4 WELL TESTING

Well testing is conducted to get optimum well data such as energy potential, electric energy capacity, stability and draw down of steam production. Two methods applied to the MT-3 and MT-4 well testing are lip pressure and orifice plate. Maximum steam flow rate of well MT-3 (superheated steam) at wellhead pressure of 4.5 barg is 6.57-7.5 tons/hours. Well MT-3 is characterized by low permeability of rocks with measured down hole temperatures up to 204 °C at 540 m depth. Temperature profiles show that increasing temperature will follow increasing depth. Because Well MT4 flows two phase fluid, therefore, high pressure separator were applied during well testing. Steam flow rate of well MT-4 at wellhead pressure 4 barg is 1.91 – 2.3 tons/hour (water fraction flow rate ~ 0.036 ton/hour). Measured down hole temperature was up to 205.5 °C at 747 m depth.

5. DEVELOPMENT OF 2.5 MW GEOTHERMAL POWER PLANT

Government in joint cooperation with local government of Ngada District and PLN will develop a small scale power plant generated from the Mataloko Geothermal Field. The government is responsible to the steam supply by exploration or drilling, whereas the PLN task is to develop and operate the power plant. The land for the site will be prepared and given the local government. The geothermal power plant capacity is planned to be 2.5 MW and will be commissioning in the end of year 2005. However, the steam supply from the existing well is not enough to generate of 2.5 MW if fully commissioning. Total steam supply from three wells is only about 25 ton/hour. To generate 2.5 MW power plant needs steam of about 40 tons/hour (PLN staff, Pers. Comm.2004). The Government plans to increase steam supply by additional well drilling in FY 2005.

6. CONCLUSIONS

1. There is a subsequent development of the Mataloko Geothermal Field after the Indonesia–Japan Cooperation Research Program finished in 2002, including well monitoring, MT-3 and well drilling and testing, and planning to develop a small scale geothermal power plant.
2. There is no significantly changes in wellhead pressure and temperature of the steam flowed from the shallow MT-2 for almost three years in monitoring.
3. MT –3 and MT-4 which were drilled much deeper than and close to MT-2 give steam flowing much less then those occur in MT-2 because of probably poor permeability.
4. Government in joint - cooperation with local government of Ngada District and PLN will develop a 2.5 MW power plant generated from the Mataloko Geothermal Field.

REFERENCES


