PERAN STRATEGIS SARJANA TEKNIK MESIN PADA INDUSTRI PANAS BUMI DI INDONESIA (THE ROLE OF MECHANICAL ENGINEERS ON THE GEOTHERMAL INDUSTRY IN INDONESIA)

Khasani
Jurusan Teknik Mesin dan Industri
Fakultas Teknik, Universitas Gadjah Mada
E-mail: khasani@ugm.ac.id

ABSTRACT

Indonesia is the largest potential geothermal energy country in the world, which is predicted, can produce about 19,000 MW. However, only 3% of which has been utilized. Due to the increase in the electricity demand, the government needs to make the energy diversification policy, mainly for the renewable and environmentally clean resources, where geothermal energy is one of the alternatives. Geothermal industry is a business that involves many kinds of expertise since the exploration stage up to the exploitation stage. Up to the year of 2000, the number of the professional human resources involved in this business was 526 for the installed capacity of 769 MWe. In the year of 2020, it is projected that the contribution of the geothermal energy to the national energy consumption is about 6,000MWe. Therefore, in order to fulfill that demand many professional human skills are urgently required, moreover for those who have mechanical engineering background.

Key Words: Strategic Role, Mechanical Engineers, Geothermal

ABSTRAK

Indonesia diperkirakan mempunyai cadangan energi panas bumi terbesar di dunia sebesar kurang lebih 19.000 MW. Namun demikian, dari sejumlah itu yang baru bisa dimanfaatkan baru mencapai 3%. Mengingat kebutuhan listrik yang semakin meningkat, pemerintah memandang perlu untuk melakukan diversifikasi energi terutama yang bersifat terbarukan dan ramah lingkungan, di mana energi panas bumi merupakan salah satu alternatifnya. Industri panas bumi merupakan sebuah bisnis yang membutuhkan keahlian dari berbagai disiplin ilmu mulai dari tahap eksplorasi sampai dengan tahap eksploitasi. Sampai dengan tahun 2000, tenaga profesional yang terlibat dalam industri ini sebanyak 526 orang untuk kapasitas terpasang sebesar 769 MWe. Pada tahun 2020, diproyeksikan bahwa kontribusi energi panas bumi terhadap konsumsi energi nasional adalah sebesar 6.000 MWe. Dengan demikian, maka dibutuhkan banyak tenaga profesional untuk mengisi kebutuhan tersebut, tidak terkecuali bagi mereka yang berkualifikasi sarjana teknik (mesin).

Kata Kunci: Peran Strategis, Sarjana Teknik Mesin, Panas Bumi

1. INTRODUCTION

Energy demands has been increasing in developing countries in the last several years whereas those in developed countries remain rather stable (BP, 2003). Energy demands as a total is, however, expected to increase with time. Thus, development of energy resources has been realized as one of the urgent problems to be solved worldwide. In order to respond to these demands, various energy sources should be developed including conventional carbon sources such as coal and oil, and natural energy sources.

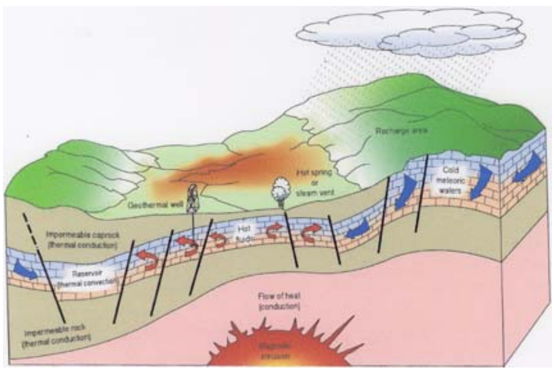
However, more consumption of coal and oil leads to higher concentration of carbon dioxide in atmosphere, and subsequently accelerate global warming phenomena. In order to avoid more discharge of CO_2, development and utilization of natural energies should be enhanced such as wind and solar energies. Among the natural energy resources, geothermal energy has been utilized for years in various ways from bathing and heating houses to power generation depending on its energy level.

Nowadays, geothermal energy is utilized in more than 50 countries and 21 of them utilize it for power generation as of the year 2000 (Hutter, 2000). In particular, developing countries being poor with hydrocarbon resources but rich in geothermal resources have advantages for utilization of this resource. For example, the amount of electricity generated using geothermal steam reaches to 10 to 20% of total consumption of electricity in countries such as Kenya (8.4%), Nicaragua (17.2%), and El Salvador (20.0%). Among others, the Philippines has the largest installed capacity of 1909 MWe in the world and it supplies 21.5% of the total energy consumption in the country. Geothermal resources are still abundant worldwide and more development is expected in the future. For example, Indonesia, situated along the chain volcanic region, has abundant geothermal resources.

2. GEOTHERMAL SYSTEM OVERVIEW

Figure 1 illustrates a simplified representation of a geothermal system. Geothermal system means convecting water in the upper crust of the Earth, which, a confined in space, transfer heat from a heat source to a heat sink, usually the free surface (Hochstein, 1990). Therefore, the geothermal system should be made up of three elements: a heat source, a reservoir, and a fluid. The heat source can be either a very high temperature (>600 ^{o}C) magmatic intrusion or as in certain low temperature system, the Earth's normal temperature that increases with depth. The reservoir is a volume of hot permeable rocks from which the circulating fluids extract heat. A cover of impermeable rocks generally overlay this reservoir. When the bore is drilled into the reservoir the fluid can be extracted or when there is a channel/fault extending from the reservoir to the surface the fluid escapes through springs. The extracted fluid can be replaced by the meteoric waters from a recharge area. The geothermal fluid is water, in the liquid or vapor phase depending on its temperature and pressure. Sometimes, the geothermal fluid contains chemicals and gases, such as CO_2 and H_2S.

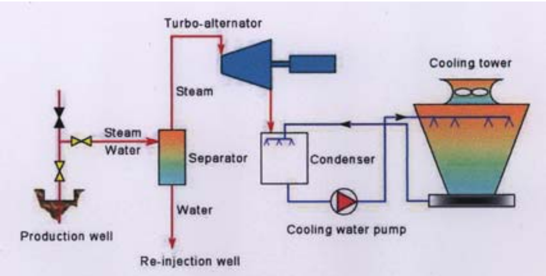
Figure 1. An idealized geothermal system



3. UTILIZATION OF GEOTHERMAL RESOURCES

The most important form of utilization of high temperature geothermal resources is the electricity generation. Electricity generation mainly takes place in conventional steam turbines or binary power plants, depending on the characteristics of the geothermal resource. Conventional steam turbines require fluids at temperature of at least 150 ^{o}C. There are two types of steam turbines, either atmospheric (back-pressure) or condensing exhausts. Figure 2 shows the electricity generation in conventional steam turbines with condensing exhausts type (Dickson and Fanelli, 2004).

Figure 2. Schematic diagram of a condensing geothermal power plant.



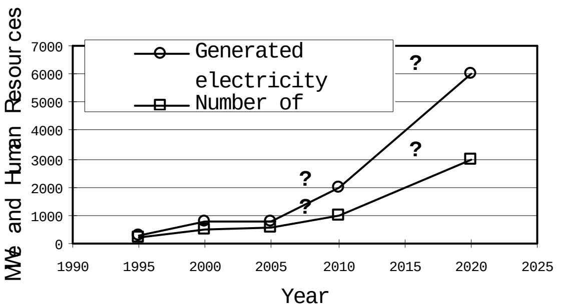
The fluid produced by a production well takes the water-steam two-phase condition at wellhead. Therefore, the steam must be separated at a separator from the liquid-water phase. The steam enters the turbine which is connected to an electric generator. The liquid water is injected into the reservoir through a re-injection well to maintain the mass balance in the reservoir. The steam from the turbine is passed through the condenser and the condensate is circulated to the cooling tower to reduce its temperature. This condensed water is used for condensing the steam and part of it must be re-injected into the reservoir.

4. GEOTHERMAL RESOURCES IN INDONESIA

By January 2000, the installed capacity for generating electricity from high enthalpy hydrothermal systems was 769.5 MWe (Sudarman *et al*., 2000). Seven geothermal fields are in various stages of operation and development, including Kamojang, Salak, Darajat, Wayang Windu, and Dieng which are all in Java, Sibayak in Sumatra, and Lahendong in Sulawesi (Fauzi *et al*., 2000). Other three geothermal resources that have been confirmed through exploration drilling are Sarulla in North Sumatra, and Patuha and Karaha in West Java. Additional exploration drillings in other prospects now are in progress.

Indonesia is one of the developing countries that consumed the total energy of 29,000 MWe in 2000, while it is expected to reach at about 100,000 MWe in 2020 (Djamin and Atmojo, 2005). In the same time, the contributions of the geothermal energy were 769 MWe and 6,000 MWe, respectively. The number of the professional human resources involved in this business was 526 for the above installed capacity of 769 MWe as shown in Fig. 3.

Figure 3. Prediction of human resources number for generated electricity.



Therefore, in order to fulfill the installed capacity of 6,000 MWe in 2020, many professional human resources are urgently required, moreover for those who have mechanical engineering background.

5. THE AREAS IN WHICH MECHANICAL ENGINEERS CAN CONTRIBUTE

Geothermal science is a multi discipline science that involves many aspects of expertise. Basically, it can be categorized into two major groups: earth science and engineering. Earth science group is responsible, especially during exploration stage. Geologists, geophysicists, and geochemists are the main members of this group. Some of the objectives of the exploration are to identify geothermal phenomena, to estimate the size of the source, to determine the type of geothermal field, to locate productive zones, to determine the heat content of the fluids, and to acquire the knowledge of any characteristics that might cause problems during field development.

The engineers, on the other hand, are responsible especially during power plant construction and exploitation. The typical works during construction stage include pipe design, housing, equipments installation, etc. The main activities of this group during the exploitation stage are related to the well testing, production, and utilization. The main objective of the well testing is to obtain the reservoir and well characteristics due to fluid production. The reservoir engineers are usually involved in this activity. The production engineers' task is to ensure that the supply of the steam to turbine to be in a stable condition. The people in the utilization section are responsible in the maintenance of the equipments in the power plant, such as turbine, cooling tower, heat exchanger, pump, etc.

From the above explanation, we can realize that the contribution of mechanical engineers in geothermal industry is especially on the production and utilization even though they may contribute on other fields.

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