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Geothermal Education for Supporting Geothermal Development in Indonesia

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ABSTRACT

The government of Indonesia has set up a progressive target for geothermal development that is to increase the capacity of geothermal power plant to 9500 MW by 2025, almost eight times of today's capacity. To meet manpower needs for supporting geothermal exploration and development in Indonesia, local universities have been expected to provide geothermal education programs and research facilities.

To support this plan, starting in the middle of 2008 (Semester I/2008-2009) ITB, stands for *Institut Teknologi Bandung* (Bandung Institute of Technology), offers a Master Degree Program in Geothermal Technology. Prior to 2008, geothermal courses have been given at ITB in four programs of study, that is Geology, Geophysics, Mining and Petroleum Engineering, with a number of courses varying in each program of study from one or two courses for undergraduates and two to four courses for graduate programs.

The Master Degree Program in Geothermal Technology at ITB is a four semester intensive program. The main emphasis of the program is to provide the students with sufficient understanding on technical and practical aspects of geological, geochemical and geophysical exploration, reservoir engineering, drilling technique, well testing, production engineering, monitoring techniques, and utilization of Geothermal Energy, both for power generation and for direct uses. The program also emphasizes environmental matters as they relate to energy use, as well as sustainable energy development and economics. In the first year, 18 students attended this program. Further description about the program, teaching staff, facilities and selection of participants will be discussed in this paper. This paper will also discuss other capacity building activities at ITB.

1. INTRODUCTION

Indonesia has a big potential of geothermal energy, as the country lies along the Ring of Fire where most of the volcanoes are located. There are 256 geothermal areas that have been identified in Indonesia, of which 84 geothermal areas have been identified in Sumatera, 76 areas in Java, 51 areas in Sulawesi, 21 areas in Nusa Tenggara, 3 areas in Irian, 15 areas in Maluku and 5 areas in Kalimantan. Most geothermal systems in Indonesia have high temperature, mostly above 225^{o}C, very suitable for electricity generation. The potential of geothermal energy is estimated at 27,510 MW, including 14,172 MW reserves, with proven of 2,287 MW, probable of 1,050 MW and possible of 10,835 MW (Setiawan, 2009).

Out of 256 geothermal areas in Indonesia only 7 areas have been utilized for electricity generation. Total installed capacity is 1189 Megawatts, i.e. Kamojang – West Java (200 MW), Darajat – West Java (260 MW), Awibengkok, Gunung Salak – West Java (375 MW), Wayang Windu – West Java (217 MW), Sibayak – North Sumatera (12 MW), Lahendong – North Sulawesi (60 MW) and Dieng - Central Java (60 MW). Status of other areas has been summarized by the Department of Energy and Mineral Resources as the following: 163 areas (63.7%) at preliminary survey stage, 78 areas (30.5%) at exploration stage and 8 areas (3.1%) ready for development.

The government of Indonesia plans to increase the capacity of geothermal power plants to 9500 MW by 2025, almost eight times of today's capacity. Until 2008, geothermal development in Indonesia has been hindered by various problems and caused the total capacity by the end of 2008 to be about 50% short of the goal set in the Blueprint for National Energy Management of 2005-2025. The Indonesian Government has revised the development target for the period of 2009-2014 (Table 1); however the goal for the year 2025 remains at 9500 MW.

Table 1: Plan of Additional Capacity of Geothermal Power Plant in Indonesia from 2010 to 2014 (Praptono, 2009).

Area	Additional Capacity of Geothermal Power Plant (MW), Year				
	2010	2011	2012	2013	2014
Java & Bali	5	-	330	445	1240
Other Islands	65	158	698	295	1380
Indonesia (Total)	70	158	1028	740	2620

By the year of 2014 the capacity of geothermal power plant will increased by 4733 MW, about four times of today's capacity. To meet the 2010 target, new geothermal power plants will be constructed at Sarulla (Sumatra), Ulumbu (Nusa Tenggara) and Tangkuban Perahu (Java), each with a capacity of 60 MW, 5 MW and 5 MW respectively. By the year of 2011 additional capacity would be generated from Ulumbu (8 MW), Lahendong (45 MW), Sarulla (50 MW) and Ulubelu (55 MW) power plants.

The plan of development to meet the 2012-2014 target has been described in detail by Praptono (2009). To gain an additional 1028 MW by 2012, as well as to gain additional 740 MW by 2013 and 2620 MW by 2014, a large number of geothermal fields will be developed in Java, Sumatra, Sulawesi, Maluku and Nusa Tenggara. Fields that will be developed in Java are Karaha Bodas, Patuha, Tangkuban Perahu, Wilis/Ngebel, Baturaden, Guci, Rawa Dano, Tampomas, Iyang Argopuro, Arjuno Welirang and Guci. A number of fields will also be developed in Sumatera Island. They include Sungai Penuh, Lumut Balai, Hulu Lais, Rajabasa, Seulawah Agam, Gunung Talang, Muaralaboh, Bukit Kili, Rantau Dadap, Suoh Sekincau, Danau Ranau, Wai Ratai, Sipaholon, Sorik Merapi and Pusuk Bukit. Several fields will also be developed in other islands, such as at Jaboi (Sabang Island), Sembalun (Nusa Tenggara), Jailolo (Maluku) and Kotamubagu (Sulawesi).

2. MANPOWER NEEDS FOR SUPPORTING GEOTHERMAL DEVELOPMENT IN INDONESIA

A large number of skilled people will be needed to support geothermal development in Indonesia. Freeston & Bolton (1993), geothermal experts from New Zealand, estimated that 30 to 50 people per year consisting of geothermal engineers and earth scientists, are needed for supporting geothermal development of 1000 MW in Indonesia. The Indonesian Geothermal Association (INAGA) estimated a higher number, that is 70 people per year. Sjafra Dwipa from Department of Energy and Mineral Resources (ref. Letter No. 179/PB/2005) support the establishment of the Master Degree Program in Geothermal Technology at ITB and estimated that 50 – 60 people per year would be needed for supporting geothermal development in Indonesia.

With an assumption that 30 – 50 people per year are required to support geothermal development of 1000 MW in Indonesia, hence to develop 4733 MW in Indonesia by the year 2014, Indonesia will need at least 120 people per year, including both geothermal engineers and earth scientists. This number does not include the number of people needed for conducting exploration at 163 geothermal areas which at present are still at a preliminary survey stage and for conducting further exploration at 78 areas which at present are still at the exploration stage.

3. GEOTHERMAL EDUCATION AT ITB

3.1 Geothermal Eduaction at ITB from 1985 to 2007

Since the recognition of a large number of geothermal prospects in Indonesia in 1972, which was followed by detailed exploration and development of Kamojang field in the beginning of the 1980, geothermal energy has received considerable attention in Indonesia, including from earth scientists and engineers at ITB. They realized that for supporting geothermal exploration and development in the future, earth scientists and engineers graduated from the Institute need to have basic understanding about geothermal systems and technology, including geological, geochemical and geophysical exploration, reservoir assessment, drilling, well testing, production and utilization of geothermal energy. A first effort has been made by sending several junior staff to study geothermal technology in New Zealand. Simultaneously, starting from 1985 one or two courses about geothermal was included in the undergraduate program of studies of Geology, Geophysics, Mining and Petroleum Engineering. Later on, ITB sent several junior staff to study geothermal in Japan and included one or two geothermal papers in the curriculum of graduate program of studies of Geology, Geophysics, Mining and Petroleum Engineering.

In 1996, a plan was made at ITB to integrate geothermal courses in one program of study by establishing Master Degree Program in Geothermal Technology. The plan, however, was cancelled, as in 1997 all geothermal projects in Indonesia were shelved by the Indonesian government due to the financial crisis. Nevertheless, geothermal courses continued at those four programs of study, with one or two courses for undergraduate and two to five courses for graduate programs.

The Geology program of study has two geothermal related courses in the undergraduate program, i.e. (1) Volcanology and Geothermal and (2) Geochemistry Exploration. Three courses were offered for the postgraduate program, i.e. (1) Mineral Hydrothermal, (2) Geothermal Geochemistry and (3) Hydrogeology for Geothermal. The program of study in Mining on the other hand, has similar courses, namely (1) Exploration and Exploitation of Geothermal Resources for the undergraduate program and (2) Hydrochemistry for the graduate program.

The Geophysical Engineering program of study offered four geothermal related courses to postgraduate students, they are (1) Geothermal Exploration, (2) Gravity and Magnetic Exploration, (3) Geoelectrical Exploration, (4) Gravity and Geomagnetic Methods.

Petroleum engineering program of study offered two geothermal courses to undergraduate students, namely (1) Geothermal Technology and (2) Geothermal Field Development. Four geothermal courses were also offered to post graduate students, namely (1) Geothermal Reservoir Engineering, (2) Geothermal Reservoir Simulation, (3) Geothermal Production Engineering and (4) Geothermal Energy Utilization.

Having solved most of the problems caused by the cancellation of geothermal projects in 1997, the Indonesian government issued the Blueprint for Geothermal Development in 2004. To support this plan, in May 2005 a team was formed by the Dean of the Faculty of Science and Mineral Technology at ITB to prepare a proposal for the establishment of Master Degree Program in Geothermal. Two years later this proposal was approved and starting in May 2008 (Semester I/2008-2009) ITB has offered a Master Degree Program in Geothermal Technology.

3.2 Master Degree Program in Geothermal Technology

The Master Degree Program in Geothermal Technology is a four-semesters intensive program, putting strong emphasis on technical and practical aspects (professions) of geothermal energy exploration, exploitation, utilization, economics, management and environmental.

3.2.1 Curriculum

The postgraduate training program of the Geothermal Institute and master program of the University of Auckland have been used as references in developing the curriculum of the Master Degree Program in Geothermal Technology at ITB. Training program in Iceland, Italy and Japan were also considered.

As in the program at the Geothermal Institute-University of Auckland, the Master Degree Program in Geothermal Technology of ITB also consists of two majors, namely Exploration and Engineering Programs. The exploration program will focus on geothermal energy exploration, covering geology structure, petrology, hydrology, volcano-stratigraphy, geothermal geochemistry and geophysics. The engineering program will focus on geothermal exploitation and utilization, covering reservoir engineering, drilling engineering, well testing, production engineering, monitoring technique, utilization of geothermal energy, both for power generation and for direct uses. Table 2 shows the curriculum for the Master Degree Program in Geothermal Technology. Information about this program can be obtained from http://www.geothermal.itb.ac.id,

3.2.2 Syllabus

All students attend several core courses, titled (1) Geothermal System and Technology, (2) Analysis of Geothermal Environment, (3) Management and Economics of Geothermal and (4) Evaluation of Geothermal Prospect.

Table 2: The curriculum for Four Semester Master Degree Program in Geothermal Technology of ITB

Exploration Program	**Engineering Program**
First Semester	
Geothermal System and Technology	
Volc, & Geothermal System	Heat and Mass Transfer
Expl. of Geology Geothermal	Geoth. Reservoir Eng.
Analysis of Geothermal Environment	
Second Semester	
Rock Alteration	Drilling Plan
Geochemistry Expl. for Geoth.	Geothermal Prod. Eng.
Geothermal Geophysical Expl.	Geoth. Energy Utilization
Third Semester	
Management and Economics of Geothermal	
Elective Course 1	Elective Course 1
Elective Course 2	Elective Course 1
Fourth Semester	
Evaluation of Geothermal Prospect	
Final Project	

Table 3: Elective Courses

Elective Course Offered by
– Micro seismology
– Monitoring and Expansion of Geothermal Prod.
– Geochemistry of Geothermal Gas
– Geothermal Reservoir Simulation
– Flow Modeling in Wells and Pipes
– Geothermal Power Plant
– Direct Use of Geothermal Energy
Elective Course Offered by Other Program of Study of Geology and Geophysics
– Fracture and Geomechanic
– Modelling Geology
– Mineral Chemistry
– Isotope Geochemistry
– Geostatistic
– Geology Remote Sensing
– Gravity and Magnetic Method
– Geoelectrical Method
– Geoelectromagnetic Method
– Selected Topics in Geophysics
– Hidrology for Geothermal

'Geothermal System and Technology' course aims to provide background knowledge on most aspects of geothermal energy resources and technology, including characteristics and types of geothermal systems, main components of hydrothermal systems, types and characteristics of surface manifestations, conceptual models, differences between geothermal systems and petroleum systems, geothermal areas, rock and fluid properties, scope of geothermal projects, overview of preliminary surveys, geothermal exploration, covering geology, geochemistry and geophysical exploration, drilling and reservoir engineering, well testing, production facilities, production engineering, utilization of geothermal energy for electricity generation, geothermal heat for direct use, legal aspects.

'Analysis of Geothermal Environment' course covers environmental issue of geothermal field development and utilization, regulations, land usage, possible environmental impacts of geothermal exploration, exploitation and utilization of geothermal energy: disturbances of natural surface features, gas emissions to the atmosphere, noise pollution, water pollution, reinjection of water to the subsurface, land subsidence, heat emissions, disturbances ecosystem, flora and fauna; mitigation and monitoring techniques; Clean Development Mechanism (CDM).

'Management and Economics of Geothermal' covers contractual arrangements, regulations, scope of projects from upstream to downstream, planning of activities, cost for exploration, steam field development, power plant construction, risk analysis, time schedule, control, economic analysis, revenue analysis, calculation of electricity price, cash flow, sensitivity analysis, project financing, project implementation, case study.

All students also attend 'Evaluation of Geothermal Prospect'. In this course the students are given a case study to evaluate feasibility of a geothermal project, starting from integrated analysis of geology, geochemistry, geophysical, measured- well data to determine type, depth, thickness, pressure and temperature of reservoir, rocks type and properties, reservoir boundary, estimation of reserve and electricity potential, planning of steam field, power plant, cost, time scheduling, economic analysis, determination of electricity prices and sensitivity analysis

For students who choose exploration as their major, they have to attend specialized courses, titled (1) Volcanology and Geothermal System, (2) Exploration of Geology Geothermal, (3) Rock Alteration, (4) Geochemistry Exploration for Geothermal, (5) Geothermal Geophysical Exploration. In addition, they have to choose 2-3 elective courses listed in Table 3.

'Volcanology and Geothermal System' course covers about volcanoes, including their tectonic setting, magmatic, classification, type of eruption, heat flow, physical and chemical aspects. The lectures also give knowledge of volcano stratigraphy, field investigation methods, monitoring of volcanoes, and hazard mitigation. At the end half semester, the relation between volcano, tectonics, and geothermal system is given. The influence of magmatism to the geothermal system setting is also reviewed.

'Exploration of Geology Geothermal' course covers various methods of geology, geophysics and geochemistry used during exploration of geothermal or hydrothermal system. Geology overviews various surveys used during geothermal exploration. Furthermore, the course gives knowledge about alteration minerals, especially ones which are common in geothermal systems. Geophysical study overviews various surveys used during geothermal exploration. It gives knowledge how to compile geological condition and geophysics anomalies and physical properties of rock to understand subsurface structure or reservoir. Geochemistry overviews various surveys used during geothermal exploration, type and distribution of geothermal fluids and interpretation of reservoir condition.

'Geochemistry Exploration for Geothermal' course covers all aspects of chemistry at geothermal systems. It explains type, composition, source and distribution of geothermal fluids; and the effects of boiling, mixing and condensation to the composition of water. How to understand the reservoir condition is then discussed, followed by the behavior of gas and stable isotope in geothermal systems. In the last mid semester, the course will point out: monitoring of production wells, including scaling and corrosion formation in production pipes, environmental aspects and interaction between rock and geothermal fluids.

'Geothermal Geophysical Exploration' course covers geothermal systems, types of geothermal systems, review of geology and geochemistry of geothermal systems, exploration strategy, geophysical anomalies of geothermal prospects, review of geophysical exploration methods: gravity, magnetic, geo-electrics (Schlumberger, Mise-a-la-

masse, Head-on), magnetotellurics (including CSAMT and transient EM), monitoring of geothermal production (Self-Potential, micro-seismic, micro-gravity), discussion on case studies of geothermal exploration in Indonesia.

For students who choose engineering as their major, they have to attend specialized courses, titled (1) Heat and Mass Transfer, (2) Geothermal Reservoir Engineering, (3) Drilling Plan, (4) Geothermal Production Engineering and (5) Geothermal Energy Utilization. In addition, they have to choose 2-3 elective courses listed in Table 3.

'Heat and Mass Transfer' course covers principles of heat and mass transfer, boiling and condensation, their application to geothermal energy technology, from reservoir to the well, to the steam, water and two-phase transmission pipelines, condensate traps, to the power plant, including condensers, cooling tower, heat exchangers, their types and selection, and their application in direct use of geothermal fluid for heating, cooling and drying.

'Geothermal Reservoir Engineering' course covers **c**haracteristics of geothermal systems, main components of hydrothermal systems, conceptual models, reservoir parameters, fluid flow within the reservoir, mass and heat flow, pressure and temperature gradient, measured data, integrated data analysis to determine type, depth, pressure and temperature of reservoirs, estimation of reserve and electricity potential, pressure transient analysis interference test, reservoir simulation, reservoir performance forecast, monitoring, reservoir management.

'Drilling Plan' course covers well site preparation, planning of well target, well geometry, drilling equipment, casing design, drilling fluid, cementing, rock mechanics, directional drilling, measurements and monitoring during drilling and well control.

'Geothermal Production Engineering' course covers completion of geothermal wells, production facilities in vapor-dominated fields and water-dominated fields, production facilities in a number of geothermal fields in Indonesia, measurements of pressure, temperature and flow rates, application of fluid mechanic, thermodynamic, mass and heat transfer for calculating pressure drop and heat loss in wells and surface transmission line, problems of corrosion and scaling, material selection, monitoring well performance, well modeling, well bore simulation.

'Geothermal Energy Utilization' course covers utilization of geothermal energy for electricity generation and for direct uses, types of energy conversion cycles/system applied in a number of geothermal power plants in the world and in Indonesia, types of turbine, condenser, cooling tower, gas extraction system, calculation of power output or steam consumption for power plant with dry steam cycle, separated steam cycle, single flash cycle, double flash cycle, binary cycle, exergy analysis; direct uses of geothermal energy for drying agricultural product, green house , soil heating and others.

Apart from those compulsory courses, a number of elective papers are offered. Students may choose 2-3 courses listed in Table 3. The syllabus of each course is described in the following section.

'Micro Seismology' course covers **s**tudy of micro-earthquake activities (1-3 Richter scale) that occur in volcanic and geothermal areas. Discussion of micro-earthquakes and their association with structures and more specifically fracture, stress/strain, fluid movement, and other aspects that can be developed to imaging of a geothermal reservoir and its change due to production and reinjection processes.

'Monitoring and Expansion of Geothermal Production' course covers periodic monitoring of geothermal surface manifestation activities, chemical monitoring, reservoir performance, groundwater monitoring, subsidence and hydrothermal eruption, environment, monitoring of production well and hypodermic well, performance monitoring PLTP, periodic monitoring conducted in a number of geothermal fields, reservoir management and field development.

'Geochemistry of Geothermal Gas' course studies characteristics of gas commonly occurred in geothermal system (e.g. CO_2, H_2, He, Ar, etc.). Their occurrences and application in a geothermal system are discussed. Gas geothermometers and source of geothermal fluids assessed from gas content are given in this lecture. This lecture also introduces several methods regarding to gas used during geothermal exploration. The lecture also reviews a vapor-dominated geothermal system, especially on how the system occurred and changed.

'Geothermal Reservoir Simulation' course covers basic concepts and objectives also to conduct various development scenarios in the future.

'Flow Modeling in Wells and Pipes' course covers development of flow model analytically, empirically and mechanistically, as the basic of development of methods to estimate pressure loss in two-phase pipelines and development of flow patterns, and their application in geothermal fields. The validity of the model is tested using field-measured data or laboratory data.

'Geothermal Power Plant' course gives detailed discussion of power plant facilities: turbine, condenser, gas extractor, cooling tower and other facilities, their operation, types, selection and planning concept.

'Direct Use of Geothermal Energy' course covers development of conceptual model, mathematical model and computer model for utilization of geothermal energy for drying tea, tobacco, rice or other topic of student's interest by implementation the principle of heat transfer and using heat exchanger.

'Final Project' is the investigation of a practical project related to aspects of geothermal exploration (earth scientist) or geothermal technology (engineering).

3.2.3 Selection of Participants

At ITB, the academic course of the first semester begins in August. For those who are interested to study toward the magister degree, application forms can be downloaded from http://www.sps.itb.ac.id. For those who applied for scholarship, the submission of the application ends on the first week of April, otherwise on the third week of June. The application form should be enclosed with Curriculum Vitae and letter of recommendation.

The candidates must have a university degree in science or engineering, or in other major but they need to have a minimum of two years of practical experience in geothermal work. Courses are given in Indonesian language; however the candidates have to take the English Proficiency Test. In addition they also have to take Academic Potential Test.

In the first year 18 students attended. They are from the Geology Agency of the Department of Energy and Mineral Resources, PT PLN (Persero), PT Indonesia Power, PT Rekayasa Industri, Magma Nusantara Ltd (Star Energy), University of Sriwijaya (West Sumatra) and from the forestry section of the Government of Lampung Barat. Out of 18 students, there are four students who attended this program directly after they graduated from Geophysics, Physics and Petroleum Engineering programs of ITB.

3.2.4 Teaching Staff

Teaching staff is professors and researchers from the Faculty of Mining and Petroleum Technology (FTTM-ITB) and from the Faculty of Earth Science and Technology (FITB). They hold PhD or Doctoral degrees, mostly from overseas such as United State of America, Japan, New Zealand, France and Germany. To provide practical knowledge, ITB invites guest lecturers from relevant and prominent institutions and from geothermal industries. For the 2008-2009 program, ITB invited guest lecturers from PT Pertamina Geothermal Energy and from the Agency for the Assessment and Application of Technology (BPPT). Moreover, PT Pertamina Geothermal Energy also offered one-month practical job training in the field.

3.2.5 Laboratory Facilities

The laboratory facilities for supporting academic and research activities are available at the Faculty of Mining and Petroleum Technology (FTTM) and the Faculty of Earth Science and Technology (FITB). They are:

a. Petrology and Mineral Deposit Laboratory
b. Petrography Laboratory
c. Optical Crystallography and Ore Mineral Laboratory
d. Mineral and Industrial-Constructional Material Laboratory
e. Volcanology and Geothermal Laboratory
f. Hydrogeology Laboratory
g. Geochemistry Laboratory
h. Earth Resources Exploration Laboratory
i. Applied Geophysics Laboratory
j. Drilling Laboratory
k. Computer Laboratory
l. Geothermal Laboratory

Since 1997, the Geothermal Laboratory of ITB has developed a number of software programs for geothermal application. Software may be used for supporting academic and research activities such as the following.

GES stands for Geothermal Engineering Software, to facilitate (i) the storage of data and the calculation of output from geothermal wells, from production tests (lip pressure, calorimeter and separator tests) (ii) the calculation of pressure drop in a well and in transmission lines (steam-water line and steam line), (iii) the prediction of the output from geothermal wells, (iv) the analysis of data resulting from transient tests (pressure build-up, pressure draw down) and (v) the calculation of power output and steam consumption.

SAR-Geothermal, stands for “Sistem Analisa Resiko” Geothermal, or in English “Risk Analysis System”. This software was developed in 1999 to provide a tool for users to determine the price of generated electricity, rates of return and other economic parameters of the invested capital of the proposed geothermal projects. The software program is designed to have eight categories of information and function, namely general project information, geothermal resources data, exploration data, plan of development, including power plant and steam field, cost, project scheduling and economic analysis. This information software was developed for Ministry of Mining (now Ministry of Energy and Mineral Resources).

IRIS stands for Integrated Reservoir Analysis System. IRIS was developed for Kamojang geothermal field (PERTAMINA), the first geothermal field developed in Indonesia. With this system, engineers and earth scientists may share the same information. The use of IRIS may lead to the success of geothermal management. To help the engineers work more effectively and efficiently in conducting various analyses, a number of independent application modules were installed and called GeTools, which stands for Geothermal Engineering Tools. It consists of four tool boxes: (1) drilling toolbox, (2) reservoir engineering toolbox, (3) production engineering toolbox and (4) fluid properties and geochemistry toolbox. In 2003 GeTools was further developed to help the engineers work more effectively and efficiently in conducting various analyses.

Smart Tough2 (Tough2 postprocessor) Version 2.0 and Tough2 Interface were developed to help users in analyzing the results of reservoir modeling for predicting the reservoir performance during production period and also for investigating the best production-injection scenario. Smart Tough2 (Tough2 postprocessor) Version 2.0 and Tough2 Interface have been used by PERTAMINA for modeling Kamojang (West Java) and Lahendong (North Sulawesi) geothermal fields.

Apart from developing software and conducting research, ITB has been active in providing educational materials, developing short courses and responding to inquiries from the industries and government. An interactive_CD has been developed for interactive study.

3.3 Geothermal Short Courses

The most essential course run at ITB in the 1990s was the "Geothermal Technology, Teaching the Teachers” course. The course consisted of three parts; each part was delivered in 1994, 1995 and 1996 by the lecturers from the Geothermal Institute, University of Auckland (New Zealand) and from ITB. Each year this two-week course was attended by 25-30 lecturers (earth scientists and engineers) from various universities in Indonesia, including ITB, University of Gajah Mada (Yogyakarta, Central Java), University of Indonesia (Jakarta), University of Trisakti (Jakarta), University of Pembangunan Nasional (Yogyakarta, Central Java) and University of Islam Riau (Riau, Sumatra). These courses were possible through the funding from the New Zealand Government, for the transportation and lodging of the lecturers from New Zealand, and from the Agency for the Assessment and Application of Technology (BPPT), for the transportation and lodging of the participants. After the completion of those courses, an MOU between ITB and University of Auckland was signed. Unfortunately, collaboration to pursue geothermal trainings was not possible because all geothermal projects in Indonesia were cancelled in 1997.

Request to deliver geothermal short courses was put forward to ITB in 2000; since then a number of geothermal short courses has been conducted by ITB staff members. Duration of courses vary from few days to four weeks.

In August 2000, ITB provided professional assistance to Amoseas Indonesia in using Simulator for Geothermal Reservoir Simulation. Furthermore, in 2001 ITB staff members delivered in-house training at Darajat field, titled

'Basic Geothermal Engineering' attended by 22 fellows; and in 2004 provided 'Competency Level Training' for steam field operators of Chevron Texaco Energy Indonesia Ltd at Darajat Field, attended by 22 fellows.

Request to deliver geothermal short courses were also put forward by PT Pertamina Geothermal Energy. A number of short courses have been conducted for PT Pertamina Geothermal Energy, including the following courses 'Geothermal Reservoir Management' in 2001, 'Geothermal Reservoir Engineering and Geothermal Reservoir Simulation' in 2003 and 2005, 'Integrated Reservoir Analysis' in 2004, 'Macro Excel Programming for Geothermal Applications' in 2005.

ITB conducted 'Macro Excel Programming for Geothermal Applications' course every year or twice a year since 2002, with participants from Unocal Geothermal Indonesia, Amoseas Indonesia, Pertamina, GeoDipa, Chevron and Indonesia Power. The number of participants in each course varies from 8 to 12 fellows. Another short course that has been delivered was 'Wellbore Simulation' course in 2004 for Bali Energy Limited.

In 2005 a Memorandum of Understanding (MoU) to pursue geothermal trainings has been signed among three Universities, namely ITB, UGM and UI, with PT PERTAMINA (Persero) and PT Rekayasa Industri. Since then, three courses have been conducted. The course in 2005 was attended by 30 participants, mostly from PT Pertamina Geothermal Energy, PT Geo Dipa and PT Rekayasa Industri. The second course was conducted in May 2007 for 30 new employees of PT Pertamina Geothermal Energy who are being trained to operate Unit 4 of Kamojang Geothermal Power Plant. The third course was conducted on May 2008 for 20 new employees of PT Pertamina Geothermal Energy. All courses were an introductory course titled 'Geothermal System and Technology'. Trainers were lecturers from ITB, University of Indonesia and University of Gajah Mada.

To support geothermal development in Indonesia, since 2007 the Department of Energy and Mineral Resources has an annual geothermal training program for their staff and also for the staff of the local governments. Every year ITB staff members have been invited to participate as guest lecturers in a two-week course about 'Reconnaissance Survey in Geothermal Area'. Another course that has been delivered by the earth scientists of ITB was 'Introduction to Geothermal System'. In 2008 this one-week course has been delivered three times, that is for Energy and Mineral Resources of West Java, Central java and East Nusa Tenggara offices.

4. GEOTHERMAL EDUCATION AT OTHER UNIVERSITIES IN INDONESIA

Geothermal related courses have been built-in in the curriculum of undergraduate program at a number of universities in Indonesia, such as at University of Gajah Made at Yogyakarta (Central Java), University of Indonesia at Jakarta (capital city of Indonesia), University of Trisakti at Jakarta, University of Pembangunan Nasional at Yogyakarta (Central Java) and University of Padjajaran at Bandung (West Java). One to three courses are generally built-in in the program of study of geology, geophysics, mining or petroleum engineering.

For supporting geothermal development in Indonesia, geothermal related courses need to be built-in in the curriculum of other universities, particularly if the universities have one of the following programs of study, namely geology, geophysics, mining, petroleum, mechanical or chemical engineering. For this purposes, it is important that course similar to "Geothermal Technology, Teaching the Teachers" course to be carried out again. Strong support from the government is needed, at least to run courses for the next three years.

4. CAPACITY BUILDING AT ITB

Various efforts in capacity building have been carried out at ITB with the primary goal of establishing ITB as an institution for human resources development. In Indonesia, ITB has a strong reputation in engineering fields and at present ITB is the only university in Indonesia offering an integrated graduate geothermal program. From time to time ITB has been conducting trainings and seminars, developing data bases and software. Since 1990 ITB has also been involved in collaborative research and study programs, mostly with PT Pertamina Geothermal Energy, which at present has 15 geothermal working areas.

A plan to establish a Centre of Geothermal Studies and Research at ITB is being discussed. This centre will provide help in finding information, conducting resource assessment and economic evaluation, trainings, researches; and developing database and software.

CONCLUSION

A large number of people need to be trained to support geothermal development in Indonesia. ITB will continue on-going work in capacity building. As capacity building is a long-term continuing process, ITB needs a continous support from the stake holders.

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