

Capacity Building in the Geothermal Sector in Indonesia, a Unique Collaboration

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ABSTRACT

Prior to WGC 2010 in Bali, the President of the Republic of Indonesia, issued decree No. 04/2010 in January 2010 to establish the 2nd phase fast track development program, to construct another 10,000 MW of electricity generation capacity to support the burgeoning growth of the Indonesian nation. The President specifically defined that 49% of this capacity, or 4,900 MWe, must be produced from Indonesia's vast geothermal resources, to support his commitment to move forward with programs to meet the Country's Greenhouse Gas (GHG) emissions reduction targets and reduce dependence on fossil fuels. In order to achieve such a dramatic increase in geothermal generation capacity, there was a need for a huge increase in geothermal human resources of all disciplines, but notably in geology, geophysics, and geochemistry to support the vision. Star Energy, the operator of the Wayang Windu Geothermal Power Plant in West Java, a Joint Operating Contract with Pertamina Geothermal Energy (PGE), saw an opportunity, and took the initiative to collaborate with Institut Teknologi Bandung (ITB) and the University of Southern California (USC) to create a program to build the needed geothermal educational capacity. Funding to support the program was requested in a formal submission to the United States Agency for International Development (USAID) in Indonesia, with Star Energy providing co-funding, and a two year program was commenced in January 2012. This paper is intended to share the capacity building program and its collaboration with industry and other universities throughout Indonesia, and how it has stimulated a much needed increase in geothermal specialization

1. INTRODUCTION

Prior to WGC 2010 in Bali, the President of the Republic of Indonesia, issued decree No. 04/2010 in January 2010 to establish the 2nd phase fast track development program, to construct another 10,000 MW of electricity generation capacity to support the burgeoning growth of the Indonesian nation. The President specifically defined that 49% of this capacity, or equal to 4,900 MWe, must be produced from Indonesia's vast geothermal resources, to support his commitment to move forward with programs to achieve Greenhouse Gas (GHG) emission reduction targets, as part of climate change mitigation efforts, and reduce dependence on fossil fuels. However, considering that in the last 30 year period in Indonesia, only approximately 1,200 MWe of geothermal capacity had been implemented, this meant that there was need for dramatic change to the approach of geothermal development.

A major aspect which had not been addressed with the decree was the need for a huge increase in geothermal human resources – notably in geology, geophysics and geochemistry – in order to achieve such a dramatic increase in geothermal generation capacity. Star Energy, the operator of the Wayang Windu Geothermal Power Plant in West Java, a Joint Operating Contract with Pertamina Geothermal Energy (PGE), saw an opportunity, and took the initiative to collaborate with Institut Teknologi Bandung (ITB) and the University of Southern California (USC) to create a program to build the much needed geothermal educational capacity. Funding to support the program was requested in a formal submission to the United States Agency for International Development (USAID), with Star Energy providing co-funding, and a two year program was commenced in January 2012.

A major tenet of the program was to establish an Advisory Board consisting of representatives from industries directly involved in the geothermal business, to ensure that the program was effectively focused on meeting the geothermal business sector's requirements. The success of the program, which amongst other aspects, includes an established Masters program specializing in geothermal technology, has led to its extension with USAID's continuous support into 2014 and beyond, with many new initiatives proposed. This paper is intended to share the capacity building program and its collaboration with industry and other universities throughout Indonesia, and how it has stimulated a much needed increase in geothermal specialization

2. GEOTHERMAL DEVELOPMENT IN INDONESIA

The Geological Agency (Badan Geologi) of the Ministry of Energy and Mineral Resources has identified 299 geothermal areas in Indonesia (Des 2012) with a total electricity potential of about 29 GWe including 16,482 MWe of reserves, consists of 2,288 MW eproven reserve, 823 MWe of possible reserve and 13,373 MWe of probable reserve (Yunus, February 2013; Hindiarto, November 2013)

In 2005, the government of Indonesia (GOI) set a road map with a target to increase the capacity of geothermal power plants from 807 MWe to 9,500 MWe by 2025. Although geothermal development is high in Government of Indonesia priority, long lead times and ineffective development framework have slowed progress. This road map has been revised several times. Projects were delayed due to various reasons, but mainly because of the electricity price, overlapping land use regulations between geothermal and forests, legal aspects and financing.

Despite these challenges, in order to meet electricity demand in Indonesia, development of geothermal energy resources in the next 10 years, will continue to play a major role. Current geothermal power plant capacity is 1,341 MWe, while the expected additional capacity in the next 10 years is about 6,300 MWe (Hindiarto, Ditjen EBTKE of Ministry of Energy and Mineral Resources, November 2013). For further development, currently there are 20 areas in early exploration stage and 6 areas are ready to be developed, including Patuha, Karaha Bodas, Lumut Balai, Bedugul, and Tompaso geothermal fields; recently the 330MWe Sarulla

project closed finance and will now be rapidly developed, and Unit-1 of Patuha Geothermal Power Plant with a capacity of 55 MWs will start operation in July, 2014.

3. HUMAN RESOURCES CAPACITY DEVELOPMENT

One of the challenges to support the development of geothermal energy source in Indonesia is meeting the demand for geothermal engineers and earth scientists. Since geothermal energy has not been consistently developed in Indonesia, the “market forces” to identify and then satisfy a demand for technical staff have not existed within Indonesia, and as a result, there is no pool of capability from which to draw to support the proposed new developments. Freeston & Bolton (1993), geothermal experts from New Zealand, estimated that between 30 to 50 geothermal engineers and earth scientists are needed to support 1,000 MWe of geothermal development in Indonesia. The Indonesian Geothermal Association (INAGA) estimated a higher number, i.e. 70 full-time staff. Based on this, the development of the currently planned 6,300 MWe can be anticipated to demand some 4 to 5 hundred qualified engineers and scientists. A 2004 survey of geothermal employment in the USA predicted that each additional MWe of installed capacity creates 1.7 full-time jobs for technical personnel. Geologists, drillers, engineers, hydrologists, and other skilled personnel will be in particular demand. There is therefore a good reason to be concerned about the potential source of these skilled workers. To aggravate this problem further, these figures do not take account the necessary O&M staff who will need to be qualified and experienced to meet the foreseen challenges once the new plants are built.

Sjafra Dwipa from the office of Ministry of Energy and Mineral Resources (MEMR) was supportive of the idea to establish a Master Degree Program in Geothermal Technology at ITB, and estimated that between 50 to 60 full-time staffs were needed to support geothermal development in Indonesia. Furthermore, based on the assumption that between 30 to 50 full-time staffs are required to support 1,000 MWe of geothermal development in Indonesia, ITB projected that at least 120 skilled workers - consisting of geothermal engineers and earth scientists - will be required for the operation and maintenance of 4,733 MWe capacity until the year 2014.

To start to meet part of this demand, commencing in mid 2008 (Semester I/2008-2009), Institut Teknologi Bandung (ITB) offers a Master Degree Program in Geothermal Engineering (Saptadji, 2010). This program is a four semester program with the objective 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 technique, and utilization of geothermal energy, both for power generation and for direct uses. The program also emphasizes environmental issues related to energy use, sustainable energy development and economics.

During the WGC 2010, Star Energy, the operator of the Wayang Windu Geothermal Power Plant in West Java, a Joint Operating Contract (JOC) with Pertamina Geothermal Energy (PGE) stated to ITB that an acceleration program in capacity building is needed for supporting geothermal development in Indonesia. Star Energy directly took the initiative to collaborate with Institut Teknologi Bandung (ITB) and the University of Southern California (USC) to create a program to build the much needed geothermal educational capacity. Funding to support the program was requested in a formal submission to USAID, with Star Energy providing support funding. USAID Bilateral Mission has been present in Indonesia for more than 50 years, working closely with the GOI and various development institutions in many sectors, including environment, education, health, democracy and governance, and economic growth. Star Energy’s proposal attracted USAID’s support since the overall objective was well aligned with the Agency’s priorities in supporting university partnerships to enhance higher education and climate change mitigation efforts through the development of clean energy, including geothermal.

Under the University Partnership Program, USAID supports collaboration between U.S. and Indonesian institutions of higher education (university level) with the following goals: (1) promote student and faculty exchange between US and Indonesian universities and increase the number of Indonesians studying in the U.S., (2) improve teaching, research, and extension services, and (3) enable Indonesian universities to engage with private sector and other stakeholders. Through end of 2013, the Agency has supported 15 partnerships with 18 Indonesian universities from 11 provinces and 12 U.S. institutions from 9 states, covering a wide range of topics, including public health, education, environmental protection, climate change, economic growth and agriculture.

Following the proposal submission and subsequent review, in January 2012, USAID awarded funds to the University of Southern California (USC) and Institut Teknologi Bandung (ITB) to support a program entitled “U.S.- Indonesian Geothermal Education Capacity Building” for the period of January 1, 2012 to January 31, 2014. Private sector support for this project was obtained from Star Energy Ltd. A two year program was commenced in January 2012 with the following objectives:

1. Build capacity for the geothermal education program
2. Broaden exposure of students/faculty to geothermal energy
3. Provide opportunities for USC to further develop/expand its geothermal program
4. Provide direct industry input into education initiatives (e.g. advisory board)
5. Build on experience base of both ITB and USC on geothermal related education and R & D

4. ACTIVITIES OF CAPACITY BUILDING

Specific activities of capacity building for the year 2012 and 2013 to achieve the objectives are the following.

1. Establishment of Advisory Board
2. Scholarship for Master Degree Program in ITB

3. Geothermal Seminar
4. Attendance of ITB Faculty and Students in Conferences, Seminars and Workshops
5. Sabbatical Program from ITB to USC and from USC to ITB.
6. Course Development/Training
7. Developing a new college course on recent advances in geothermal technologies
8. USC Center for Geothermal Studies Annual Technology Workshop with an Indonesian Focus

4.1 Advisory Board

A major initiative of the proposal which was sent to USAID for funding was to establish an advisory board made up of representatives of government, geothermal developers and key service industries. It was established, with members from the Ministry of Energy and Mineral Resources (MEMR), INAGA (Indonesian Geothermal Association), PT Pertamina Geothermal Energy Star Energy Geothermal Wayang Windu Ltd., Chevron Geothermal Indonesia Ltd., Schlumberger Ltd., Supreme Energy Ltd., Halliburton Ltd., PT Thermochem and ITB.

The main task of this advisory board is to provide strategic advice on the direction of the project and to develop a road map for long term sustainability of this project partnership for geothermal education. Star Energy will act as the secretariat of the advisory board. In this way it was hoped to avoid many of the pitfalls of other initiatives by being effectively driven by the industry itself. Not only is this likely to provide a more successful result in achieving the necessary quantities of academically qualified people, it also provides a framework for industry to offer internships and other forms of technical apprenticeships to provide this new workforce with the essential work-experience – “raw graduates” alone would never solve the upcoming problem.

The Advisory Board conducted three meetings in 2012 and four meetings in 2013, and provided guidance to: (1) the overall approach, timeline and activities for program implementation; (2) the requirements for scholarship applications which must be completed by applicants and (3) the selection process, the requirements and the recipient of the scholarship. The Board also provided direct industry input into education initiatives as the following: (1) industry provided several trainers and course materials for a number of topics; (2) industry provided speakers and seminar materials for topics discussed in trainings and (3) industry gave opportunities for fieldtrips and internship program.

The most important outcomes from these activities is a more permanent network established among ITB, Star Energy and members of the advisory board, i.e. Ministry of Energy and Mineral Resources, Star Energy Ltd., Indonesian Geothermal Association (INAGA/API), PT Pertamina Geothermal Energy (PGE), Chevron Geothermal Indonesia Ltd., Schlumberger, Haliburton, Supreme Energy, and PT Thermochem. The program supported by the Advisory Board is in line with the “Roadmap of the Graduate Program in Geothermal Engineering of ITB 2008-2018”.

The network allows ITB to coordinate the internship program conducted in Star Energy, PT PGE, Chevron, and Supreme Energy at ease, providing more opportunities for students from the geothermal master program to conduct their research with those companies/developers. With the help from industry, students can now produce papers or research based on what they experience from internship or short visitation to the existing geothermal areas.

4.2 Scholarship for Master Geothermal Program at ITB

A number of students of the Master Geothermal Program at ITB received scholarships through this project. It covered full tuition fee, including books, field trip, seminar, and trainee program or internship program for the period of two years. Students were selected based on their academic record (GPA), Institutional TOEFL/IELTS, TPA (similar to GRE) scores, interviews and other documents for the admission. Interviews were conducted by the Advisory Board as part of the candidate selection process. A total of twenty scholarships – or ten scholarships a year - was available for applicants to Master Geothermal Program at ITB and open to both fresh graduates from bachelor degree programs and employees from companies. The criteria for applicant selection included:

1. GPA minimum 3.00/4.00
2. Institutional TOEFL minimum 550 or equivalent IELTS of 6.5
3. Academic Potential Test, similar to GRE with minimum score of 500
4. All applicants have to provide letter of statement that they will enroll as full time students in the ITB Master Program.
5. For applicants that are currently employed, they must provide a formal letter of permission from their employer to leave work and study full time at the ITB Master Program.
6. All applicants have to pass the test and interview.
7. By the time of admission the applicants must be less than 40 years of age.

The announcement of the scholarship was conveyed to the public through posters and leaflets. Posters were distributed to a number of universities, including the University of Padjadjaran (Bandung), University of Indonesia (Jakarta), Gajah Mada University (Yogyakarta), University of Lampung (Lampung), Institute of Technology Surabaya (Surabaya). Leaflets were generally released during ITB's Geothermal Seminar or when faculty members and students attended seminars on geothermal or renewable energy,

such as the Annual Scientific Meeting organized by the Geothermal Energy Association and annual meeting organized by the Directorate General for New, Renewable Energy and Energy Conservation from the MEMR's office.

Following suggestions from the advisory board, a roadshow was carried out in 2013 to increase the number of applicants, not only from ITB but also from other universities. The purpose of the roadshow was to give information to the general public, especially among academics, about the opportunity to obtain a scholarship, for those who are interested to study at the Graduate (Master) Programme in Geothermal Technology of ITB. The roadshow was carried out by some graduate students of the Geothermal Engineering Program ITB, led by executive coordinator of cooperation USAID-SE-USC-ITB. The team visited six universities in Java island, namely University of Diponegoro (Central Java), University Pembangunan Nasional and University of Gajahmada at Yogyakarta, University of Padjajaran (West Java), Institut Teknologi Surabaya at Surabaya, and University of Indonesia.

As part of the scholarship program, an internship program was implemented for 1-2 months in several geothermal companies, namely Wayang Windu Geothermal Energy Star Ltd., PT Pertamina Geothermal Energy and Supreme Energy. After completing an internship program, students were asked to report on the activities carried out in the field at the Geothermal Forum of ITB.

In total, twenty students received scholarship through this program, approximately 33% of Master's students enrolled in 2012 and 2013. Besides the USAID/Star Energy's supported scholarship, two other types of scholarship programs were also available for students. The first one granted by the Ministry of Education of Indonesia (Beasiswa Unggulan for a maximum of 20 students) covered the same proportion as USAID/Star Energy one. Another partial or Voucher scholarship was available for students who have financial problems for supporting their study in the form of tuition fees waiver for up to two semesters. However it came with a requirement to the recipients to work as part time tutors. In average 3-5 students per year received this voucher scholarship.

In addition, scholarship funding was also used to support other academic activities, such as (a) partial sponsorship for sending a student conducting laboratory work at the Kyushu University for his Master Thesis, (b) partial sponsorship for sending a student to present her paper at the NZ Geothermal Workshop 2013, and (c) partial sponsorship for sending a student to participate in the "School on the Move Program" at the Kyushu University as part as the joint program among Universities of Kyushu (Japan), Chulalongkorn (Thailand), ITB (Indonesia) and UGM (Indonesia).

The scholarship program provided access to higher education for students of all income levels and allowed students to focus on their studies. Since the scholarship was also available for company employees, to ensure the effectiveness of the program, applications from this category were required to provide a formal letter of permission from their employer to leave the work and study full time at ITB master program. This additional requirement was considered crucial since past experiences indicated that many part-time students had difficulties in facing stress in doing both study and work, and consequently were not able to graduate on time and/or with the high grades despite their academic potential. For other students, the combined work/study life could not be maintained together and they had to discontinue their studies all together. Beside the benefits mentioned, it is expected in the future that the students will become philanthropic themselves and "give back" when they are financially able. In addition to that, by being the student recipient of a scholarship, they are more responsible to represent themselves in public as they are expected to excel which makes them study harder to prove what they are appointed to be.

The scholarship program supported ITB in building capacity for the geothermal education program. ITB benefited quantitatively through increasing the number of graduate level students in geothermal energy technology and increasing the competitive level of the ITB's geothermal master program. Industries benefited through increasing the number of available professional manpower in the geothermal sector.

4.3 ITB Geothermal Seminars

As part of the geothermal capacity building program, six geothermal seminars were conducted in 2012 and 2013 in five cities in Indonesia, including Bandung (West Java), Padang (West Java), Manado (North Sulawesi), Aceh (North Sumatera) and Surabaya (East Java). The objective of a seminar is to disseminate the activities (especially a success story) of the geothermal exploration and exploitation activities in the development of a specific area. Detail programs are as the following:

Program	Number of Participants	Spekears and Topics
ITB Geothermal Seminar held twice in Bandung (West Java) in 2012	Total of + 260 participants, from the Ministry of Energy, ITB, University of Trisakti, University of Education, University of Padjadjaran, University of National Development, Chevron Geothermal Ltd., Mineral Resources, PT Samudra Indonesia	<ul style="list-style-type: none"> • INAGA: Geothermal energy potential in Indonesia and the role of the Indonesian Geothermal Association in supporting geothermal development in Indonesia. • Star Energy Geothermal (Wayang Windu) Ltd.: Geothermal exploration and development at the Wayang Windu geothermal field. • Chevron Geothermal Indonesia Ltd.: Darajat and Salak geothermal fields. • ITB: Geothermal Master Program at ITB and Scholarship.

Program	Number of Participants	Speakears and Topics
ITB Geothermal Seminar held in Padang (West Sumatera) in 2012	±200 participants from representatives of local government, geothermal developers, and lecturers and students from the University of Andalas, the University of Padang, and the University of Bung Hatta	<ul style="list-style-type: none"> • Governor of West Sumatera Province: Geothermal energy potential in West Sumatera Province and local government support. • INAGA: the role of the Indonesian Geothermal Association in supporting geothermal development in Indonesia. • Supreme Energy Ltd. Geothermal Exploration Risk: Key Point to Meet GOI Geothermal Target. • PT Pertamina Geothermal Energy: Geothermal exploration and development project in PGE geothermal working area. • ITB: Geothermal Master Program at ITB and Scholarship.
ITB Geothermal Seminar held in Manado (North Sulawesi) in 2013.	±250 participants from University of Manado (UNIMA), University of Samratulangi and staff of local government	<ul style="list-style-type: none"> • MEMR of Indonesia: Geothermal energy potential in Indonesia, current status, regulation and challenges/barriers to meet the target • INAGA: the role of the Indonesian Geothermal Association in supporting geothermal development in Indonesia. • PT Pertamina Geothermal Energy: Geothermal potential and activities at Lahendong, Tomposo and Kotamobagu geothermal fields. • Star Energy Geothermal (Jailolo) Ltd.: Jailolo geothermal area at Ternate Province. • Star Energy Geothermal (Wayang Windu) Ltd.: Wayang Windu geothermal field. • ITB: Geothermal Master Program at ITB and Scholarship.
ITB Geothermal Seminar held in Surabaya (East Java) in 2013.	±200 participants from Institut Teknologi Sepuluh November (ITS), Institut Teknologi Aditya Surabaya (ITADS), Politeknik Negeri Jember, Universitas Airlangga (Unair), and staff of local government,	<ul style="list-style-type: none"> • Head of Mineral Resources Energy East Java Province: Geothermal potential in East Java Province. • INAGA: the role of the Indonesian Geothermal Association in supporting geothermal development in Indonesia. • PT Medco Cahaya Geothermal: Geothermal potential and activities at the Ijen geothermal area. • Star Energy Geothermal (Wayang Windu) Ltd.: Wayang Windu geothermal field. • ITB: Geothermal Master Program at ITB and Scholarship.
ITB Geothermal Seminar held in Banda Aceh (Nanggroe Aceh Darussalam) on February 6, 2014.	±200 participants from Univeristy of Syiah Kuala (UNSYIAH) and staff of local government	<ul style="list-style-type: none"> • MEMR of Indonesia: Geothermal energy potential in Indonesia, current status, regulation and challenges/barriers to meet the target • INAGA: the role of the Indonesian Geothermal Association in supporting geothermal development in Indonesia. • PT Pertamina Geothermal Energy: Geothermal potential and activities at Seulawah Agam geothermal area. • Univeristy of Syiah Kuala: The business scheme that is currently being discussed among local government, PT Pertamina Geothermal Company and KfW (Germany investor?) in order to include local company participation in Seulawah Agam Project. • ITB: geophysical techniques for exploration and monitoring geothermal fields • ITB: Geothermal Master Program at ITB and Scholarship.

A total number of people impacted by the Geothermal Seminar activity is approximately 1,300 people. By attending the seminars, it is expected that they become more aware of geothermal activities across Indonesia, understand different aspects of geothermal exploration and exploitation, and subsequently help inform others. In turn, it is expected that the geothermal industries get more support from the community to develop geothermal fields in their area.

Several notable outcomes of the Geothermal Seminars include:

1. Improvements have been achieved in the understanding of geothermal energy potential in Indonesia, current status and challenges/barriers to meet the target.
2. Improvements have been achieved in understanding the role of the Indonesian Geothermal Association in supporting geothermal development in Indonesia.
3. Improvements have been achieved in the understanding of the geothermal potential and activities in the development in the following area:
 - a. Lahendong geothermal field (North Sulawesi), the first geothermal field developed in North Sulawesi Province by PT Pertamina Geothermal Energy, which today has an operating geothermal power plant with total capacity of 80 MWe.

- b. Ijen geothermal area (East Java) which is currently being explored by PT Medco Cahaya Geothermal.
 - c. Seulawah Agam (Aceh-North Sumatera) geothermal area which will be explored by PT Pertamina Geothermal Energy, Wayang Windu geothermal field, developed by Star Energy Geothermal (Wayang Windu) Ltd.
 - d. Wayang Windu geothermal field, developed by Star Energy Geothermal (Wayang Windu) Ltd, which today has an operating geothermal power plant with total capacity of 227 MWe.
 - e. Jailolo geothermal area at Ternate Province, that is currently being explored by Star Energy Geothermal (Jailolo) Ltd.
 - f. Darajat and Salak geothermal area which are developed by Chevron Geothermal Ltd.
4. Networks are strengthened amongs ITB, PT Pertamina Geothermal Energy, Star Energy Geothermal Ltd., and local universities in Indonesia.
 5. The availability of the USAID-StarEnergy Scholarship to study at the geothermal master program of ITB has been informed, including the requirements and registration procedure to get the scholarship.

A key innovation implemented by this program was to involve local communities in certain activities, from organizing the seminar to giving a presentation. For example, during a seminar in Aceh, the lectures of University of Syiah Kuala and ITB spoke in the same panel of their respective reseachers in geothermal. This has led to an upcoming research collaboration program between University of Syiah Kuala and ITB, for which a Memorandum of Agreement is still being prepared for both parties. The collaborative research and educational activities will aim to support geothermal exploration and development of the Seulawah Agam geothermal field.

The seminar is one of many ways to enhance communication among universities, developers/industries, local/central government, and local communities who have interests in geothermal energy development. Many questions or comments from lecturers, students, local government or people regarding geothermal development in their areas emerged in those seminars which required answers from the invited speakers. This has proved to be an effective form of communication, in which people from different areas of knowledge or background were able to share their ideas, thoughts, or information of geothermal energy to many people in an audience, and learn from each other in a lively discussion.

4.4 Geothermal Train the Trainers Program

As part of this program, five trainings were conducted in 2012 and 2013. The participants were university lecturers and local government officials responsible for exploration and development of various of geothermal areas. For academicians, priority was given to lecturers from thirteen universities in Java, Sumatera and Sulawesi islands, which have established a geothermal energy major or are in the progress to build a similar program. These included Institut Teknologi Bandung (ITB), University of Padjajaran (UNPAD), University of Indonesia, University of Trisakti, UPI (Universitas Pendidikan Indonesia), University of Gajah Mada (UGM), University of Pembangunan Nasional (UPN), University of Dipenogoro (UNDIP), Institut Teknologi Surabaya (ITS), University of Syah Kuala, University of Sriwijaya, and University of Lampung (UNILA)

Apart from Universities, there were also participants from the government such as representative from the Center of Education and Training of Ministry of Energy and Mineral Resources, from the industry such as staff of PT Geo Dipa, developer of Dieng (Central Java) and Patuha (West Java) geothermal fields, Star Energy Geothermal Wayang Windu Ltd., and Chevron Geothermal Indonesia Ltd. One of the courses was also attended by the local government of Lampung and West Java provinces.

The trainings covered a complete set of specific topics as follows:

1. Introduction to Geothermal System and Technology Course (7 days-course)
2. Detailed Exploration Select a Test Site for Geothermal Resources (10 days course)
3. Environmental Impact And Risk Assessment Course (5 days course)
4. Geothermal Well Design and Drilling Course (5 days course)
5. Geoscience and Data Evaluation Course (5 days course)

Feedback was solicited from participants after completing the course. All participants agreed that the course had increased their knowledge of geothermal systems, reservoirs, exploration, drilling, well testing, and estimation of power potential. Participants also agreed that the time allotted to delivering all course materials was too short; they suggested adding three to four days more for completing exercises and assignments. Participants who attended the whole course received a certificate signed by the Dean of the Faculty of Mining and Petroleum Engineering of ITB and a representative of Star Energy Ltd.

Through this program, improvements have been achieved by lecturers of ten universities in Indonesia in the understanding of geothermal systems and technology, in particular technology use in geothermal exploration, development and utilization, as well as methodology use in resource assesment, environmental analysis and impact assesment. In the future, they are expected to further transform the knowledge they gained to enhance human resources development needed for supporting geothermal development in the nearby area of their respective university. The list includes:

1. University of Syiah Kuala (Aceh - Sumatera)

2. University of Padjadjaran (Bandung – West Java)
3. University of Education Indonesia/UPI (Bandung-West Java)
4. University of Diponegoro (Central Java)
5. University of Lampung (Lampung – Sumatera)
6. University of Trisakti (Jakarta)
7. Institut Teknologi Surabaya (ITS - Surabaya)
8. University of Manado (North Sulawesi)
9. University of Jenderal Soedirman in Purwokerto
10. University of Pembangunan Nasional in Yogyakarta

The unintended results of this program was a total of fourteen papers were published by the participants of “Geothermal Training the Trainers” course during the ITB Geothermal Workshop in 2013. Moreover, collaborative research and educational activities will be established between ITB and University of Syiah Kuala (Aceh), for supporting geothermal exploration and development of Seulawah Agam geothermal field.

4.5 Attendance of ITB Faculty, Staff and Students in Conferences, Seminars, and Workshops

As part of this program, lecturers and students of ITB were provided supports to attend various international and national seminars with an objective to broaden exposure of students/faculty to geothermal energy. Expected outcomes are higher participation of ITB students and faculty in geothermal related conferences, seminars or workshops and improved the quality of lecturers through seminars and workshop, in strong partnership with other international institutions.

In 2012 and 2013 respectively, lecturers and students of ITB attended the following conferences/workshop: (1) the New Renewable Energy and Energy Conservation Conference (EBTKE CONEX), (2) the Indonesian Geothermal Association (INAGA)’s Annual Conference 2012, (3) the Indonesia International Geothermal Conference and Exhibition 2013 and (4) ITB’s Annual Geothermal Workshop 2012 and 2013. For international events, one lecturer attended the Geothermal Resources Council (GRC) Conference 2012, one lecturer attended the New Zealand Geothermal workshop 2012 and two students attended the New Zealand Geothermal workshop 2012. Participation in these events was not limited in mere attendance but also in direct contribution, for example:

- Twenty one papers were presented by lecturers and students of ITB in the Indonesian Geothermal Association Annual Conference 2012.
- Twenty one papers were presented in IIGCE 2013 (Indonesia International Geothermal Convention and Exhibition 2013),
- Eight papers presented in ITB Geothermal Workshop 2013.
- Three papers published in the New Zealand Geothermal Workshop 2013

The unintended results of the program are as the following:

- First, during the Indonesia International Geothermal Convention and Exhibition 2013 (IIGCE 2013), the Indonesian Geothermal Assosiation gave awards to one of the ITB students of the 2011 batch for 2nd Winner of Essay Writing Contest, one of the ITB students of the 2010 batch for Best Paper of Reservoir Engineering Category and to the Chairman of Graduate Program in Geothermal Technology of ITB for her continuing efforts in geothermal education.
- Second, a network is established between ITB and the Geothermal Resources Council (GRC) based in the U.S. During the ITB Geothermal Workshop 2013, GRC contributed to the program by giving a two day pre-workshop course titled “Exploration Drilling and Early Stage of Geothermal Reservoir Characterization”.

5. EVALUATION OF THE PARTNERSHIP PROGRAM

In early 2014, USAID carried out the third round of evaluation of its University Partnership program. Four partnerships, including the partnership in geothermal capacity building, were selected. The objective of the evaluation is to provide feedback to USAID and its partners of the effectiveness of the partnerships and recommendation for improvement and enhancement of the current and future collaborations. USAID appointed International Business & Technical Consultants, Inc. (IBTCI), a U.S. based institution, to carry out the evaluation. The result of the evaluation was submitted to USAID in the unpublished report, titled “Evaluation of the Indonesia University Partnerships Program Phase Three – Partnerships #5-#8, Final Report April 4, 2014”. The report was shared with the respective institution partners.

IBTCI in their report concluded that the partnership objectives of this program were succesfully achieved. Through the seminars, short courses and attendance at conferences /workshops, the program improved participant knowledge and skills. Participation targets were exceeded. Based on the evaluation team’s interviews with lecturers and students, monitoring reports, and Program Implementation 2013 Report, the seminars/workshops, conferences and short-courses were well received and further demonstrates that demand for geothermal short-courses exceeds ITB’s ability to offer the trainings. Participant interviews and monitoring data

showed high quality and satisfaction with the geothermal seminar and short-course. The respondents surveyed expressed 100% satisfaction with the technical knowledge and skill training provided. Gender-sensitive and gender-balance was at 57% satisfaction.

Moreover IBTCI concluded that the scholarship and course development program overall improved geothermal education capacity. IBTCI found that ITB demonstrated strong self-initiative and leadership in implementing the capacity building activities. The average number of masters students enrolled per year in geothermal has more than doubled over the past three years, and the percentage of women has increased from 14.0% to 26.4% in a traditionally male-dominated program.

The ratings on the partnership practices of planning, communication/coordination, implementation, and monitoring and evaluation with Star Energy were very good to excellent. The overall ratings on the Partnership outcomes of achievement of objectives, sustainability, production/dissemination, and unanticipated outcomes were excellent. The strength of the Partnership was in the joint collaboration and coordination with the private sector and the quality and number of seminars/trainings provided. The weakness of the Partnership was a lack of consistent communication and coordination with the U.S. Partner. In addition, there was a lack of up-to-date communication technology and laboratory equipment at ITB along with a need for improved teaching/learning materials and assistance on preparing professional papers/publications.

To strengthen the partnership, IBTCI provided several recommendations, including: (1) develop a research consortium with industry, (2) improve teaching and curriculum guides, (3) develop linkage to the Geothermal Resource Council (GRC) for improved opportunities, (4) improve responsiveness to the Polytechnics, (5) increase student support – scholarships, industry linkage, employment and (6) develop ITB financial and management capability to receive donor funding directly.

6. EXTENSION PROGRAM

Following the successful implementation, the partners – USAID, USC, ITB and the industry – have agreed to extend the collaboration program for one more year, with the estimated completion date of January 31, 2015. The scope of the program is also expanded to now include both existing and new activities, as follows: (1) Expansion and Restructuring of the Geothermal Advisory Board, (2) Scholarship for Master Students at ITB, (3) ITB-USC Geothermal Seminar: Distinguished Lecture Program, (4) ITB-USC Annual Geothermal Workshop (AGW), (5) Selection of a test site for geothermal resources course development, (6) Environmental Impact and Risk Assessment course development., 6) Development of semester-long courses on two topics: (a) New Techniques and Approaches in Geothermal Exploration; (b) Training modules for geothermal technicians for use by technical colleges, and (7) Initiation of Geothermal Research Centre at ITB.

7. CONCLUSIONS

The joint collaboration and coordination between American and Indonesian universities with the private sector in geothermal education capacity building program in Indonesia has proven to be a successful model of partnership. The target has been achieved with the following outcomes:

1. Improvements have been achieved in the understanding of geothermal systems and technology, in particular technology use in geothermal exploration, development and utilization, as well as methodology use in resource assesment, environmental analysis and impact assesment.
2. More permanent network established among ITB, Star Energy and members of the advisory board, i.e. Ministry of Energy and Mineral Resources, Indonesian Geothermal Association (INAGA/API), PT Pertamina Geothermal Energy (PGE), Chevron Geothermal Indonesia Ltd., Schlumberger, Haliburton, Supreme Energy, and PT Thermochem.
3. A network has been strengthened among ITB and a number of universities in Indonesia, which in the future is expected to contribute in human resources development needed for supporting geothermal development in a number of geothermal fields in Indonesia.
4. Increased competitive level of the ITB's geothermal master program. ITB benefits quantitatively through increasing the number of graduate level students in geothermal energy technology and the geothermal industry benefits through increasing the number of available professional manpower in the geothermal sector.

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