

Summary of Terminal Evaluation

I. Outline of the Project		
Country: Republic of Indonesia		Project title: The project for capacity building for enhancement of the geothermal exploration technologies
Issue/Sector: Energy/Mining		Cooperation scheme: Technical Cooperation
Division in charge: Energy and Mining Division 1, Industrial Development and Public Policy Department		Total cost: 303,176 Thousand JPY
Period of Cooperation	(R/D) July 7, 2010 October 1, 2010 to September 30, 2013	Partner Country's Implementing Organization: Center for Geological Resources (CGR), Geological Agency (GA) Ministry of Energy and Mineral Resources (MEMR)
		Supporting Organization in Japan:
Related Cooperation:		
<p>1 Background of the Project</p> <p>The Government of Indonesia (GOI) announced “Fast-track Program (Crash Program II)” in January 2010. The program aimed to develop about 10,000 MW of new power by 2014, out of which 3,977 MW was planned through geothermal power. The country is endowed with about 27,000 MW of geothermal development potentials, the largest in the world. However, only about 1,200 MW was developed as of 2010. It is deemed important to expedite geothermal development.</p> <p>With a view to promoting geothermal development, the Geothermal Law was enacted in 2003. At the beginning stage of the geothermal resource development, the Center for Geological Resources (CGR) of Geological Agency (GA), a Government agency to conduct geothermal resource survey, is responsible for regional and detailed resource survey in order to identify prospective geothermal fields. However, prior to the technical cooperation, CGR faced difficulties in terms of using integrated data formats, collecting highly accurate resource data and conducting quantitative evaluation of geothermal reservoirs. In addition, concerned agencies did not necessarily have sufficient understandings over geothermal development. Therefore, even though prospective geothermal areas were identified, sufficient resource information, which would lead to increases in the number of developers that would be actually engaged in geothermal development, was not provided. Under these circumstances, the Indonesian side desired to increase accuracy of information on surveyed areas through capacity development of CGR and thus requested the Japanese side to extend technical cooperation in 2009. Having received the request, JICA dispatched the detailed planning survey mission in April 2009 and exchanged the Record of Discussions (R/D) with GA in July 2010. “The Project for Capacity Building for Enhancement of the Geothermal Exploration Technologies (hereinafter referred to as “the Project”)” was launched in October 2010 and is currently in progress (the planned cooperation period from October 2010 to September 2013).</p> <p>On the other hand, “the Project to Develop Medium and Long Term Geothermal Development Policies in Indonesia (hereinafter referred to as “the new project”),” which is a successor of the Project, was requested and approved in the fiscal year 2012. Aiming to promote geothermal development in Indonesia, the new project proposes to adopt a more comprehensive approach by having both MEMR and Ministry of Finance (MOF) as counterparts. The new project is expected to be comprised of the following three sub-projects with</p>		

the three implementing agencies:

Sub-project 1: Policy development/refinement for geothermal development projects concerning Directorate General of New and Renewable Energy and Energy Conservation (EBTKE)/Directorate of Geothermal;

Sub-project 2: Sustainable operation of Geothermal Fund concerning Government Investment Agency (PIP); and

Sub-project 3: Capacity enhancement of the geothermal exploration technologies concerning GA/CGR.

The terminal evaluation study was conducted to evaluate the Project. Based on the terminal evaluation results, recommendations were prepared for the Project during the remaining cooperation period as well as for implementation of the new project. Lessons learned were taken for future projects.

2 Project Overview

(1) Overall Goal

To accelerate geothermal power development in Indonesia

(2) Project Purpose

Center for Geological Resources (CGR) of Geological Agency (GA) provides geothermal resource information for both government and companies to develop geothermal power.

(3) Outputs

Output 1: Capacity of regional geothermal resource exploration of CGR scientists/engineers is empowered for extracting the WKP Note study area.

Output 2: Capacity of detailed geothermal resource exploration of CGR scientists/engineers is empowered for setting the WKP.

Output 3: Capacity of integrated interpretation including geothermal modeling, and resource assessment of CGR scientists/engineers is empowered.

Output 4: Knowledge and skills on geothermal resource study using exploratory well (well drilling, well logging and well test) are acquired by CGR scientists/engineers.

Output 5: Technologies and barriers for geothermal resource development are understood through seminars for capacity development and technology sharing and workshops for reporting the activities of the capacity building project.

Note: WKP means geothermal working areas. Based on the survey results prepared by CGR, etc. MEMR approves WKP. For the purpose of geothermal power development, developers are supposed to acquire a mining geothermal business permit (IUP) in the geothermal working area through tender process, which is conducted based on the information from the survey.

(4) Inputs (at the time of the terminal evaluation study)

Japanese side:

Short-term Experts: 20 persons Equipment: 69.4 Million Yen

Local cost: 3.1 Million Yen (general expenses only)

Trainees received: 12 persons

Total Cost 303.2 Million JPY

<p>Indonesian Side:</p> <p>Counterpart: 29 persons Equipment for survey and analysis: NA</p> <p>Land and Facilities: Office space</p> <p>Local Cost 1,385 Million IDR</p> <p>(5) Beneficiaries</p> <p>Direct beneficiaries: CGR</p> <p>Indirect beneficiaries: Geothermal developers including private developers</p>		
<p>II. Evaluation Team</p>		
<p>Members of Evaluation Team</p>	<p>Team Leader: Teruyuki ITO</p> <p>Director</p> <p>Energy and Mining Division I, Energy and Mining Group, Industrial Development and Public Policy Department, Japan International Cooperation Agency (JICA)</p> <p>Cooperation Planning: Kenji OGASAHARA</p> <p>Assistant Director</p> <p>Energy and Mining Division I, Energy and Mining Group, Industrial Development and Public Policy Department, JICA</p> <p>Evaluation and Analysis: Tomoo MOCHIDA</p> <p>Executive Director/ General Manager</p> <p>Business Promotion Department,</p> <p>OPMAC Corporation</p>	
<p>Period of Evaluation</p>	<p>2/6/2013 ~ 18/6/2013</p>	<p>Type of Evaluation: Terminal evaluation</p>
<p>III. Results of Evaluation</p>		
<p>3-1 Confirmation of Results</p> <p>(1) Achievement of Outputs</p> <p><Output 1></p> <p>“Capacity of regional geothermal resource exploration of CGR scientists/engineers is empowered for extracting the WKP Note study area.”</p> <p>(Indicator 1-1)</p> <p>The number of CGR reports for regional geothermal resource exploration including necessary study results by newly applied technologies (geology, geochemistry, and geophysics).</p> <p>(Indicator 1-2)</p> <p>The number of CGR scientists/engineers who participated in the technical seminars and OJT</p> <p>(Indicator 1-1) Seven reports were prepared in 2011 and 2012 for the purpose of preparing WPK candidates. As for the contents of the reports, for example, CGR commented that they had improved their ways of deciding the detailed survey area and their interpretations in lineament by using new remote sensing software from JICA. Among the advanced survey and analysis equipment provided under the Project, the isotope water analyzer, for example, contributed to improvement of quality and quantity of the data. At the same time, it substantially shortened the time required for the analysis. CP also appreciated the analytical method of integrating survey results in different research fields (geology, geochemistry and geophysics), which had been</p>		

introduced by JICA experts. At the time of the terminal evaluation study, preparation works of a geothermal handbook, which covers survey technologies, were underway.

(Indicator 1-2) OJT and three seminars were conducted. The number of participants in the seminars was 30, 30 and 70, respectively. It is judged that nearly all the Output 1 has been achieved.

<Output 2>

“Capacity of detailed geothermal resource exploration of CGR scientists/engineers is empowered for setting the WKP.”

(Indicator 2-1)

The number of CGR reports for detailed geothermal resource exploration including necessary study results by newly applied technologies (geology, geochemistry, and geophysics).

(Indicator 2-2)

The number of CGR scientists/engineers who participated in the technical seminars and OJT

(Indicator 2-1) 12 reports were prepared from 2011 to 2013 for the purpose of preparing WPK candidates. As for the contents of the reports, for example, CGR mentioned a trial of MT three-dimensional analysis by CGR personnel in charge of geophysics. Ion chromatograph was installed for chemical analysis. The equipment contributed to substantial improvement of the accuracy of the analysis and reduction of time and costs required for the analysis.

(Indicator 2-2) OJT and two seminars were conducted. The number of participants in the seminars was 30 and 70, respectively. In order to achieve Output 2, training needs to be continued on the three-dimensional analysis for MT exploration data due to such reasons as delayed delivery of MT equipment. In order to cope with the delay in the schedule of the technology transfer, the Project cooperation period was extended up to September 2013. Output 2 is expected to be achieved by the end of the Project cooperation period.

<Output 3>

“Capacity of integrated interpretation including geothermal modeling, and resource assessment of CGR scientists/engineers is empowered.”

(Indicator 3-1)

The number of CGR reports for geothermal resource evaluation including modeling and integrated interpretation

(Indicator 3-2)

The number of CGR scientists/engineers who participated in the technical seminars and technical transfer program of reservoir simulation technology

(Indicator 3-1) Two reports were prepared in 2012 for the purpose of preparing WPK candidates: one for the site at Gunung Talang, West Sumatera and the other for the site at Lainea in Southeast Sulawesi. The report refers to the fluid inclusion method, which was applied to a well in Lainea located in non-volcanic areas. The method helped CP improve their ways of determining reservoir temperatures.

(Indicator 3-2) OJT and two seminars were conducted. The number of participants in the seminars was 30 and 70, respectively. During the remaining cooperation period, the comprehensive modeling and resource evaluation integrated from the survey, data-analysis, modeling to the reservoir simulation is scheduled to be conducted. Although there is a shortage of resource data from deep wells, the total capacity regarding the integrated interpretation and resource assessment has been improved. Hence, by the end of the cooperation period, nearly all the Output 3 is expected to be completed.

<Output 4>

“Knowledge and skills on geothermal resource study using exploratory well (well drilling, well logging and well test) are acquired by CGR scientists/engineers.”

(Indicator 4)

The number of CGR scientists/engineers who participated in the technical seminars and technical transfer program (training course) at Japanese geothermal sites

(Indicator 4) Because of the limited availability of well-drilling sites in Indonesia, the OJT of well-drilling, logging and testing was conducted at the well-drilling sites in Japan in the first year. In the second year, the OJT was held at the well-drilling site in Indonesia. Two seminars and two study tours in Japan were organized. The number of participants in the seminars was 30 and 70, respectively. The number of participants in the study tours in Japan was six each time. CGR comments that they acquired knowledge of drilling technology, well geological analysis, fluid inclusions, spectrum mineral analyzer experiment, etc. Output 4 is expected to be achieved by the end of the Project cooperation period.

<Output 5>

“Technologies and barriers for geothermal resource development are understood through seminars for capacity development and technology sharing and workshops for reporting the activities of the capacity building project.”

(Indicator 5)

The number of participants and organizations of seminars and workshops

(Indicator 5) Three seminars and one workshop were organized. The number of participants in the seminars was 30, 200 and 70, respectively. The workshop was attended by 100 participants. The final workshop is scheduled in 2013. CGR comments that the seminars had good impact on young staff, especially staff in geochemistry, and participants from Local Governments and universities. It is judged that Output 5 will be achieved by the end of the cooperation period.

According to the self-evaluation of the CP of CGR, the achievement levels of Outputs 1 to 5 range from 3 (middle) to 4 (between middle and high) on a five-point scale. As described above, all the Outputs are expected to be achieved by the end of the Project cooperation period.

(2) Achievement of the Project Purpose

With regard to the “geothermal resource information” of the Project Purpose “Center for Geological Resources (CGR) of Geological Agency (GA) provides geothermal resource information for both government and companies to develop geothermal power,” it has been confirmed with CGR and JICA experts that the geothermal resource information would be the data and information to be collected through the surface survey and the gradient geothermal drilling. “The number of studied areas by CGR” (Indicator 1) shows an increasing trend from 14 in 2010 to 18 in 2013. “The number of data used for setting WKP” (Indicator 2) that was provided by CGR was not the number of data but the number of fields used for setting WKP. According to the data from CGR, the number of fields was 2 in 2012 and 5 in 2012. “The number of newly approved working areas” (Indicator 3) indicates the number of WKP newly approved by EBTKE, out of the number of WKP candidates surveyed and proposed by CGR. The number increased from zero in 2010 to 6 in 2012. “The number of access by private developers to the data collected by CGR” (Indicator 4) shows the number of inquiries to CGR through direct visits and/or through letters. The number was 45 in 2010, 50 in 2011 and

36 in 2012. Out of these indicators, Indicators 1 and 3 could be used, to a certain extent, as indicators to measure changes in the quality and quantity of the geothermal resource information as well. While CGR used to provide resource information even before the Project started, it is considered that CGR has been improving the quality and quantity of the information through implementation of the Project. CGR pointed out that the number of data utilized for setting WKP and the number of data contents in each report had increased. Their observations are supported with achievements of Outputs 1 to 3 and relevant comments described above. GA and CGR highly appreciate the facts that the mutual trust has been forged between JICA experts and CGR, the equipment mounted with cutting-edge technologies was introduced, capacity of interpretations by using the equipment has been enhanced and the trustworthiness of the resource information CGR provides is being increased. The Project Purpose is expected to be achieved by the end of the Project cooperation period when all the Outputs are scheduled to be completed.

(3) Possibility that the Overall Goal of the Project will be achieved

The achievement of the Project Purpose is considered as one of the contributing factors to the Overall Goal of the Project, i.e., “To accelerate geothermal power development in Indonesia.” However, in order to achieve the Overall Goal, it will be important to make appropriate revisions over relevant policies and institutional arrangements to reduce risks associated with exploratory well-drilling by private developers, to establish a financial mechanism in order to conduct deep-well drilling and to provide sufficient geothermal resource information including the data to be acquired through deep-well drilling.

3-2 Summary of Evaluation Results

(1) Relevance

The Project is judged to be of high relevance although the approach to address the development issue is considered not sufficient.

Indonesia is endowed with large geothermal potentials. Geothermal power development is expected to play quite an important role in the country from now on in order to meet increasing electricity demands, decrease dependency on fossil fuels and reduce emissions of greenhouse gases, aiming to achieve an energy mix with a higher share of renewable energies. Meanwhile, the Government of Japan set forth its ODA policy towards Indonesia in April 2012. In its policy, the geothermal development takes its position in the programs to achieve a stable supply of electricity to the nation’s capital and surrounding areas, to achieve rural development and improvement of major local cities (through rural electricity supply and resource development) and to address climate changes (through reduction of greenhouse gas (GHG) emissions). Thus, the Project is found consistent with the Indonesia’s development policy as well as Japan’s ODA policy. However, although the Project aims to enhance CGR’s technological capacity to conduct surface survey, only technological improvement is not sufficient as a measure to promote geothermal development in Indonesia. With regard to the geothermal structure, characteristics of the structure in Indonesia are similar to those in Japan to some extent, such as the role of the faults for forming geothermal reservoirs. Japanese technologies have advantages in supporting geothermal development in the country.

(2) Effectiveness

As described in 3-1 above, it is considered that most of the planned Outputs and the Project Purpose are likely to be achieved by the end of the Project cooperation period with additional inputs and extension of the Project

cooperation period. The Project promises to be effective.

The important assumption for the Project Purpose is “roles/functions of GA (CGR) within the Government remain unchanged.” The roles/functions of CGR within the Government have not been changed.

(3) Efficiency

For the following reasons, efficiency of the Project is considered fair.

- In order to cope with delay in technology transfer due to delayed delivery of some equipment, to meet increased needs of capacity enhancement in the field of resource evaluations and so on, inputs of JICA experts were increased and the Project cooperation period was extended.
- Although changes in CGR’s routine survey schedules often posed difficulties in coordinating the technology transfer schedule under the Project, highly professional and experienced experts were assigned to carry out the technology transfer under which lectures, OJT, seminars and workshops were combined. The flexible and intensive technology transfer was conducted in short periods by adjusting with the survey schedule of CP.
- CGR assigned 29 CP. CP proactively received technology transfer while JICA experts worked in Indonesia.
- With regard to the new areas for CGR concerning deep-well drilling, necessity of increases in OJT under the technology transfer was pointed out. There were some areas for technology transfer where the number of CP was short.
- Although comparison was not made with other projects for the analysis of the cost efficiency, the measurement and analysis equipment and software were procured through requesting quotations to several agents and/or competitive bidding process except some software, which is dealt with by specialized agents.

(4) Impact

As described in 3-1 above, the achievement of the Project Purpose will contribute to the realization of the Overall Goal. However, in order to achieve the Overall Goal, the number of measures need to be taken to address technical as well as non-technical issues in addition to the achievement of the Project Purpose.

The important assumption for the Overall Goal is “Governmental policies and methods for the introduction of geothermal power generation by companies remain unchanged.” As there have been no major changes over the Government policies and methods, the important assumption for the Overall Goal at the time of the Project planning in 2009 is still applicable at the time of the terminal evaluation study. However, if the new project is successfully implemented, Government methods to introduce geothermal power generation could be affected favorably in a direction to accelerate the geothermal power development.

A geothermal handbook is currently under preparation. The handbook will contain technical guidelines on the practical survey and analysis of geothermal resources. The handbook is scheduled to be issued by MEMR and utilized not only by CGR personnel but also widely by private developers, private survey companies, experts at universities, and so on. It is considered that the handbook will have positive impacts on geothermal development in Indonesia. No negative impacts were identified at the time of the terminal evaluation study.

(5) Sustainability

The sustainability of the Project effects is expected to be ensured, but attention should be paid to the organizational aspect and budgetary appropriation for deep-well drilling.

- Policy /institutional aspect

In order to develop geothermal resources, the Government set forth the long-term plan (the Geothermal Road Map) by Year 2025 and the “Fast-track Program (Crash Program II)” by Year 2014. It is considered that the Government basic policy to promote geothermal development mainly by engaging private developers will remain unchanged. CGR is also expected to continuously play a role of providing information for setting WKP in the foreseeable future.

- Organizational aspect

CGR has substantially reduced the number of the staff members. On the other hand, it collaborates with universities and will proceed to outsource a part of its activities in order to meet increasing survey needs. CGR needs to classify activities to keep within its organization and those to outsource to other organizations. It is necessary to pay attention to the direction of CGR’s human resource development in order to keep enhancing its strength in its survey, analysis and evaluations in the long run.

- Technical aspect

The technology transfer has been directed towards regular tasks of the CP. The technology level acquired by CGR is considered to be maintained and further improved through their routine survey works. In addition, preparation works of the geothermal handbook is underway. The handbook is being adjusted so as to reflect geothermal characteristics of Indonesia. Preparation works have been carried out under the joint efforts of CGR and JICA experts. Therefore, the CP are able to make necessary revisions and adjustments of the handbook. Thus, technical sustainability is expected to be high.

- Financial aspect

As no major changes are foreseen over the policy to promote geothermal development, Government fiscal supports for geothermal development are expected to continue. Project-related budgets of CGR have increased so far. As far as their regular surface survey works are concerned, there will be no serious constraint against the sustainability of the financial aspects. However, there is a concern about how CGR could secure a large amount of budgets required for exploration drilling of deeper wells if they are asked to do so on a routine basis. In this regard, attention needs to be paid to financial sustainability.

3-3 Factors that promoted realization of effects

(1) Factors concerning to Planning

- The technology transfer has been directed towards improvement of technologies required for the survey, analysis and evaluation of geothermal resources, which are regular tasks assigned to CGR.
- The technology transfer has been carried out by improving abilities of the survey, analysis and evaluation together with the introduction of advanced measurement and research equipment to CGR. Improvement of technologies is also expected to increase trustworthiness of information to be provided by CGR.

(2) Factors concerning to the Implementation Process

CP was able to deepen their understandings of technologies transferred from JICA short-term experts during their self-trial process in the fields and/or laboratories. Some CP had chances to teach their knowledge and practical experiences at workshops, etc. The three-stage technology transfer (“learning”=> “self-trial”=>”teaching”) has contributed to effectiveness of the Project.

3-4 Factors that impeded realization of effects

(1) Factors concerning to Planning

CGR’s survey activities were often re-scheduled. As a coordinator at CGR was busy, it was extremely difficult to coordinate technology transfer schedules between JICA short-term experts and CP who conduct field surveys on a routine basis.

(2) Factors concerning to the Implementation Process

- Delay in delivery of some equipment caused delay in technology transfer.
- The number of CP was less in some technical fields like reservoir simulations and well-production tests.

3-5 Conclusion

Government development policy of the geothermal sector is expected to continue and the technical level acquired by CGR is considered to be maintained and further improved through their routine survey works. Although sustainability of the intended effects and benefits of the Project is expected, attention should be paid to the direction of human resource development at CGR and the budgetary aspect if CGR is tasked to do exploration drilling of deep wells as part of their regular survey works.

Increase of inputs and extension of the Project cooperation period are likely to produce the planned Outputs, leading to achievement of the Project Purpose. On the other hand, although the achievement of the Project Purpose shall contribute to realization of the Overall Goal, the number of issues consisting of technical and non-technical aspects seems to lie ahead towards the acceleration of the geothermal development in Indonesia. For example, exploration risks being faced by private developers should be mitigated in order to accelerate the geothermal development. The risk mitigation could be done through provision of information on resource potentials for geothermal power generations, which would be acquired through exploration drilling of deep wells. For this purpose, it is important to further increase the quantity and quality of the information that CGR provides, to set up funding mechanisms for costly drilling of deep wells and to reconsider the tender process for IUP (mining geothermal business permits) and stable price-setting mechanisms of geothermal power plants. It should be noted that the new project is expected to address these issues.

3-6 Recommendations

For the Project during the remaining Project cooperation period

(1) Revision of objectively verifiable indicators to measure the achievement of the Overall Goal

The Overall The Overall Goal and the state of achievement, which is envisioned with the indicators corresponding to the Overall Goal, are considered a bit high if the state is expected to be realized as an effect of the Project. It is recommended that indicators be reconsidered and targeted values for a period of five years (i.e., up to Year 2018) be projected so as for the concerned parties to clearly share the understandings on the state where the Overall Goal is achieved as a result of the Project implementation. During the ex-

post evaluation scheduled later, the indicators and targeted values to be agreed will be used to examine the achievements of the Overall Goal.

For the new project

(2) Use of the mid-term review and JCC as a management tool of the new project

It is desirable to utilize the mid-term review, JCC meetings and preparation processes towards them in order to review the plan and the progress of the new project and make necessary revisions. It is recommended that the concerned parties use the mid-term review and JCC meetings as a venue to coordinate activities and schedules of the new project and confirm the states of achievements in terms of the Outputs, the Project Purpose and the Overall Goal.

For JICA on the implementation of the new project

(3) Timely procurement of equipment

It is recommended that critical equipment for the technology transfer be procured in a timely manner in consideration of the overall implementation schedule of the new project.

(4) Assignment of longer-term coordinator(s)/local consultant(s)

It was found very difficult to coordinate the schedules of the technology transfer between JICA short-term experts and the CP because the CP of CGR had to carry out regular survey activities in the fields. It is recommended that in addition to short-term experts, coordinator(s) or local consultant(s) in charge of coordination be assigned for a longer period of time in order to coordinate activities and schedules under the new project.

(5) Increase of OJT

Because of difficulties in identifying appropriate sites for OJT of well tests and well production tests in Indonesia, OJT in these fields were limited. As exploration drillings of deep wells is planned under the new project, it is recommended that OJT be increased in these fields.

For CGR on the implementation of the new project

(6) Assignment of a coordinator specific to the new project, etc.

It was found very difficult to coordinate schedules of the technology transfer between JICA experts and the CP because a coordinator of CGR was not assigned on a full-time basis for the Project. In addition, shortage or lack of the CP was reported in some technical fields (reservoir simulations and well production test) as these fields were new to CGR. It is recommended that under the new project, a coordinator be placed (on a full-time basis, if possible) and the CP be assigned in the fields of reservoir simulations and well production test. It is also recommended that more specific tasks be assigned to each of the CP at CGR in receiving the technology transfer.

3-7 Lessons Learned

The technology transfer has been provided to improve the capacity required for the survey, i.e., regular tasks assigned to CGR. This has contributed to effective implementation of the Project and at the same time, is likely to result in enhancement of financial and technical sustainability.

3-8 Follow-up Situation

The new project is under preparation as a successor of the Project. Issues concerning geothermal development have been identified in the policy and institutional aspect relating to the bidding process and the price-setting mechanism, the financial aspect relating to exploration drilling and the technical aspect relating to provision of information acquired from drilling of deep wells. In order to address these issues simultaneously, the new project will be comprised of the three sub-projects: (1) policy development and refinement; (2) sustainable operation of the Geothermal Fund; and (3) capacity enhancement of technologies at CGR.