iceida ICELANDIC INTERNATIONAL DEVELOPMENT AGENCY
ÞRÓUNARSAMVINNUSTOFNUN ÍSLANDS

Appendix 1

Project Document

Capacity Building and Technical Assistance for Geothermal Development in Djibouti

Sub-Project of the Geothermal Exploration Project

ICE23066-1301

Implementing Agency: Djiboutian Office for Geothermal Energy Development, under the Presidency of the Republic of Djibouti

Funded by ICEIDA

Estimated Budget: 650.000 USD

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1. Introduction

The government of Djibouti is committed to develop geothermal energy to overcome the growing energy demand and to support economic development in the country. In November 2013 the government of Djibouti created a new agency focusing on geothermal exploration and development, ODDEG (Office Djiboutien de Développement de l'Energie Geothermique) under the Presidency of the Republic of Djibouti. Against this background, the Government of Djibouti has submitted a request for support to geothermal development to the Icelandic International Development Agency (ICEIDA).

ICEIDA and the Nordic Development Fund (NDF) are implementing a project to support geothermal exploration and capacity building in East Africa. ICEIDA is the Lead Agency in the Geothermal Exploration Project with joint co-financing of NDF. The project is the initial phase of the Geothermal Compact partnership, initiated jointly by Iceland and the World Bank.

Support for geothermal development is outlined as a priority area in the Strategy for Iceland's Development Cooperation. The main objective of the Geothermal Exploration Project is to assist countries in East Africa to enhance knowledge of geothermal resources and capacity in order to enable further actions on geothermal utilization in the respective countries. This includes completing the exploratory phase of geothermal development for particular sites and build capacity and expertise in the field of geothermal exploration and utilization.

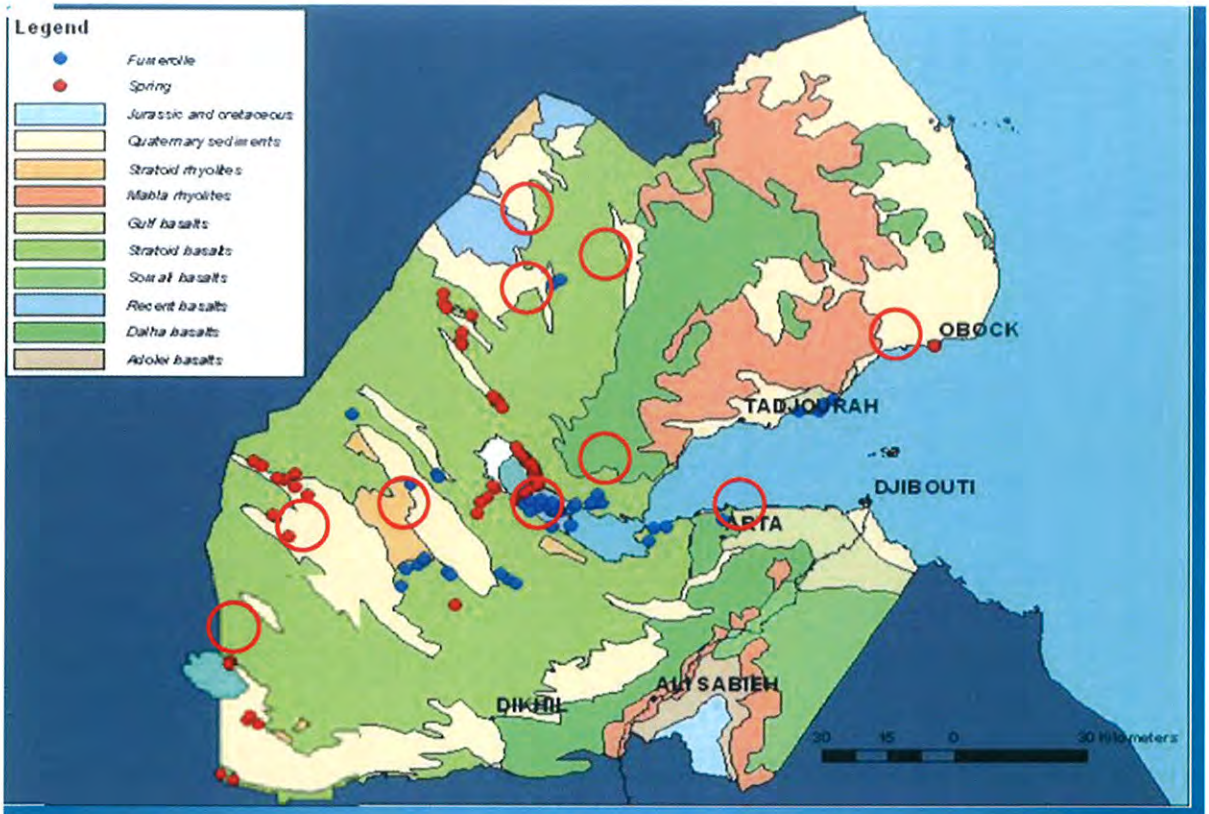
The objective of this sub-project is to build capacity within the recently established Djibouti Office for Geothermal Energy Development (ODDEG) in geothermal exploration and drilling as well as assist with institutional development of the ODDEG through training in geothermal projects management. At the end of the project it is expected that the targeted staff at ODDEG, The Ministry of Energy and other institutions, as may be applicable, will have gained enhanced capacity and understanding of geothermal surface exploration and drilling projects, and have in place a defined structure for project management of their geothermal projects.

The implementation of this Project Document is subject to the Partnership Agreement between The Government of Djibouti, and ICEIDA for the Geothermal Exploration Project.

2. Background and Rational

It is a part of the Djibouti Government's *Vision for the Horizon 2035* to develop renewable energy and achieve energy self-sufficiency with the development of locally available renewable energy including geothermal for which the country is deemed to have good potential. Djibouti has at least 10 geothermal prospects of interest which have been studied to varying degrees in the past decades. In addition to the Lake Assal Fiale area, at the moment three sites have been identified as having geological characteristics sufficiently promising in terms of geothermal potential for the production of electricity (Lake Abhe, North-Ghoubet and Obock). For these three sites the Centre of Studies and Research of Djibouti (CERD) has done an initial pre-feasibility study and the well siting.

The World Bank (WB), together with African Development Bank (AfDB) and other donors, approved in 2013 support to geothermal development in the Lake Assal Fiale area. The first phase will be focused on geothermal exploration drilling. The total funding for this project is estimated around 31 MUSD and the project will support Djibouti in assessing the commercial viability of the geothermal resource in Fiale Caldera within the Lake Assal region with the drilling of four exploration wells for an



Simplified geological map of the Republic of Djibouti, indicating hydrothermal events: Potential sites (red circles), hot springs (red dots) and fumaroles (blue points).

generation capacity could help Djibouti fully meet its peak demand, alleviate energy dependency and reduce electricity production costs by 70 percent. Clean geothermal energy would also mean a reduction in carbon dioxide emissions and a healthier environment for the population.[1]Djibouti currently relies on production of energy from fossil fuels at high costs, and import of electricity from Ethiopia, which constitutes large part, or around 65%, of its electricity consumption.

Lack of human capacity to undertake technical studies and field work has been identified as one of the barriers for Djibouti to carry on with development of its geothermal resources. Of key importance in this regard is strengthening of management and technical staff within the new agency ODDEG, to manage and implement geothermal projects.

After initial discussion between ICEIDA and authorities in Djibouti, and a request submitted by the Government of Djibouti, it was proposed that the support from the ICEIDA Geothermal Exploration Project would focus on capacity building for the new agency ODDEG. It was understood that to some degree surface exploration studies already been conducted in key prospects, and plans were underway to commence exploration drilling with funding from World Bank, AfDB and other donors. Enhanced capacity to engage effectively in these projects was deemed of key importance by the Djibouti government, and through discussions, the key areas for a capacity building and technical assistance were outlined, as presented in this project document.

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[1] http://www.worldbank.org/en/news/press-release/2013/10/13/world-bank-and-djibouti-sign-agreement-to-explore-geothermal-energy

Djibouti government, and through discussions, the key areas for a capacity building and technical assistance were outlined, as presented in this project document.

2.1. Challenges to be addressed

This project aims to contribute to the efforts of the Government of Djibouti to further the development of geothermal energy in the country, by addressing challenges related to availability of qualified human resources, which are considered by the Djibouti Government of key importance to move forward with geothermal development. This project will therefore contribute to addressing the need for increased capacity and human resources in Djibouti to take on the growing work in scientific and managerial aspects of geothermal development.

2.2. Beneficiaries

In the short term the implementing agency, ODDEG and the Ministry of Energy will benefit from the project through increased capacity to develop and utilize the geothermal resource. In the long run it is expected that the population of Djibouti will benefit from activities implemented within the project, through increased availability of clean renewable energy in the country.

3. Project description

3.1. Strategy

1. The ICEIDA/NDF Geothermal Exploration Project will, through technical and capacity building support contribute to the efforts of the Government of Djibouti to develop geothermal energy in accordance with the plans and priorities of the Government of Djibouti.
2. To assist ODDEG in its institutional capacity building training courses on geothermal project management and preparations of bankable geothermal documents will be conducted. The courses will enhance the knowledge of staff of project management and planning in general and in geothermal projects, planning and financing in particular.
3. To enhance the capacity of ODDEG in surface exploration a training programme for ODDEG will be implemented in surface exploration methods. This training programme will focus on creating tangible outputs and knowledge as required for the Lake Abhe area.
4. For the purpose of providing capacity building support to ODDEG within the scope of the Geothermal Exploration Project, the UNU-GTP will implement a training program for geothermal drilling technology and well design.
5. The implementation of activities will also emphasize the sharing regional expertise and knowledge by creating opportunities, for instance, for Djibouti to learn from neighbouring countries, including Kenya and Ethiopia. This may include a hands-on drilling programme for 8 ODDEG staff in drilling operation in Kenya. This will be subject to cooperation established with GDC for this purpose.
6. Additional technical assistance will provided to ODDEG in relation to this project, to address imminent needs and gap-filling related to project activities and geothermal development in target areas. This will mainly include assistance to improve and finalize applications for funding of exploration and drilling projects. Any such technical assistance shall be clearly defined and agreed upon in seperate ToRs.

3.2. Objectives

The **overall objective** of this project is to assist the Government of Djibouti to increase their renewable energy access through low emissions geothermal energy development for the social and economic benefit of the country.

The **immediate objective** of the project is improved knowledge and skills for ODDEG staff on geothermal surface exploration and management of geothermal projects, in order to enable further actions on geothermal energy development in Djibouti.

3.3. Expected Results (Outputs) - with associated activities

1. Improved project management and planning capacity for geothermal projects

1.1.1. 2 weeks geothermal project management training course, organized by the UNU-GTP. The objective of the course is that participants will learn about general aspects of project management, specific aspects of management of geothermal projects, key concepts of IPMA – ICM competence baseline, risk, HSE, scope, change, cost, time, procurement, contracts, quality, negotiation, project management systems, case examples and more.

1.1.2. IPMA accreditation for ODDEG staff in project management.

1.1.3. Enhanced local capacity in preparation of bankable geothermal project documents for external finance institutions (donors and lenders), through a training program designed at UNU-GTP in Iceland, targeting at least 15 top and middle managers, project coordinators and senior technical staff. The course objective is that participants will be able to identify key elements of bankable documents, outline an exploration program and the contents of project design documents, recognize different types of drilling contracts, describe various ways of financing geothermal projects, lead workshops to determine geothermal project risks, and assess the main financial parameters of a geothermal project.

2. Increased capacity for monitoring and supervision of geothermal drilling established at ODDEG

2.1.1. 2 weeks short course **Well Design and Geothermal Drilling Technology** conducted in Djibouti. The expected outcome of this training is that participants will be able to identify the main parts of the drilling rig, know where to locate information sources on geothermal drilling, appreciate what lessons may be learned from geothermal drilling in other countries, gain specific knowledge on how to anticipate and analyse drilling problems, understand drill string design and bottom hole assembly, recognize applicable casing programs, check casing designs, understand wellhead design and what design options there are, identify the risk of steam eruptions and blow-outs during drilling, decide on drilling fluid selection, understand directional drilling programs, equipment and procedures, understand the cementing of geothermal wells, describe rig instrumentation systems, understand influences on drilling duration, describe down-hole logging, the content of daily drilling reports and the main causes of fishing and how it is avoided.

2.1.2. The project will aim to develop opportunities for Djibouti experts to learn from on-going drilling operations in Kenya. The aim is that this would include hands-on training in Kenya for up to 8 ODDEG staff in various aspects of geothermal drilling. This training would be carried out by GDC in Kenya, and is this subject to an arrangement with GDC. At the time of

preparing this project document this option has been discussed with GDC, but no arrangements have been finalized.

3. **Improved knowledge of geothermal surface exploration methods and conceptual modelling**

3.1. Training programme for ODDEG in surface exploration methods and modelling. This training will focus on creating tangible outputs and knowledge as required for the Lake Abhe area through a training programme with ODDEG experts. The objective will be to increase the capacity of ODDEG scientists in surface exploration methods and finalize exploration surveys required for Lake Abhe for identification of potential exploration drillings targets. Further information on the Lake Abhe geothermal prospect is provided in Appendix 3. It is expected that this training programme will include the following main components:

a) Preparations and review of existing data from the area
b) 3 day workshop in Djibouti on surface exploration methods with a review of geophysics, geology and geochemistry data for Lake Abhe and to present the work as to be done on the field.
c) 6 weeks on-site training in geophysics to cover required soundings in Lake Abhe (MT, TEM, Gravity)
d) 1 week field training (if required) for geologist and geochemist to cover additional studies as may be required in Lake Abhe (geologist and geochemist).
e) 1 month training of 2 ODDEG geophysicists and 1 geologist in Iceland for analyzing geophysical data and modelling.
f) Finalize work in geology and geochemistry as may be required
g) Joint revision of the conceptual model for Lake Abhe by ODDEG and ISOR

3.2. One candidate from Djibouti undertakes 6 months training at the UNU-GTP in Iceland on geothermal surface exploration in relation to the Lake Abhe training programme.

3.3. One expert trained in Iceland for a period of 4-8 weeks in reservoir engineering modelling. It is expected that the output of this training will be a preliminary Tough model for the Lake Assal Fiale area, and that the trainee will be capable of developing this model further as the drilling continues.

4. **Short term technical assistance provided to ODDEG in relation to this project, to address imminent needs and gap-filling in geothermal development.** It is expeted that this will mainly include assistance for improving and finalizing funding applications for surface exploration and drilling projects. Through this assistance it is also expected that ODDEGG staff will gain competencies in preparing proposals and funding applications.

For outputs and activities, as applicable, defined under this project document, a detailed Terms of Reference will be prepared and agreed upon by ICEIDA and the implementing agency prior to implementation. Learning outcomes will be clearly defined for all capacity building activities.

3.4. Cross cutting issues – Gender and Environment

Gender ratio of trainees will be observed, an application from a female trainee for the UNU-GTP 6 months program will be encouraged. Environmental aspects of geothermal projects will be discussed and covered during training courses.

4. Other donor activities and coordination

There are several geothermal projects being planned in the Republic of Djibouti, with different development partners.

The most advanced project is the Assal-Fiale geothermal project financing under the leadership of the World Bank and African Development Bank and other donors. Under this project four production wells will be drilled, in order to generate about 50 MW.

The government of Djibouti is under discussions to acquire a geothermal drilling rig from a private company. This drilling rig will allow to the ODDEG staff the capacity to undertake drilling operations.

ODDEG is also in discussion with JICA (Japan International Cooperation Agency) to undertake a geothermal resource assessment in Djibouti. ODDEG has also started discussions with the BGR (German Geological Survey) under GEOTHERM program early this year.

Finally, there are also private developers that have expressed interests to invest in the geothermal sector on three main prospects areas, The North Goubbet, Lake Abhe and Obock.

In order to undertake this development ODDEG will need a lot of expertise and manpower to explore and develop the geothermal fields. In the first instance, the training of drilling staff of ODDEG under the ICEIDA programme is clearly meant to contribute to the Assal-Fiale geothermal project through the drilling service to gain more experience before undertaking its own drilling projects.

ICEIDA and ODDEG will actively seek to align the capacity building support under the programme with other donors. Meetings with the World Bank and Africa Development Bank may be scheduled for this purpose. It is important that capacity building program have a clear linkage with further activities, or is linked directly through hands-on training once activities commence. In this manner it is foreseen that the ICEIDA support for capacity building will add value and strengthen the planned activities of other donors.

5. Implementation and Management

The Ministry of Energy in charge of Natural Resources is responsible for overall policy formulation in the energy sector. Within the policy framework defined by the Government, ODDEG is a new agency, which operates under the Presidency of Republic.
The agency has these main tasks:

- Identification of the various types of geothermal resources of the country
- The completion of reconnaissance and exploration studies
- Conducting pre-feasibility studies and feasibility studies for the industrial development of these resources and the diversification of their uses
- The identification, with appropriate partners, public and private operators likely to ensure the development of geothermal energy, and any associated products

ODDEG is empowered to undertake the following actions:

- To promote the rapid development of geothermal resources through surface exploration, well drilling and finally exploitation of the resource;
- Make available geothermal resource for independent power producers (IPP);
- Technology, research and skills dissemination through training and capacity building ;
- The development, demonstration and dissemination of applicable techniques for geothermal development;
- The execution of all work , construction or operation of works relating to geothermal development;
- The collection of data, information and advice to public and private sector;
- Participation in the development and implementation of international agreements and bilateral cooperation over prerogatives.

ODDEG is the main agency working on the geothermal field in Republic of Djibouti and will constitute the main interlocutor for the geothermal exploration project financed by ICEIDA.

The Government of Djibouti and ODDEG will make the required logistical arrangements and make available the required permits for the UNU-GTP and other contractors to carry out the work according to plans. ODDEG will further ensure that:

- UNU-GTP and other contractors have access to the necessary documents related to the surface exploration and drilling activities in order to conduct project activities effectively.
- It has available qualified staff available to undertake the training.
- Transportation for its staff, lodging, venues and meals are provided in relation to project and training activities in Djibouti.
- ODDEG will cover cost related to local transport for both ODDEG and Consultants in relation to surface exploration training in Lake Abhe.
- ODDEG will cover the cost of its all its experts and local staff in relation to training for surface exploration in Lake Abhe.
- Arrange for the provision of translators for French, for training activities as required.

United Nations University – Geothermal Training Programme (UNU-GTP) is a key partner in the project relating to geothermal training and capacity building.

ICEIDA is responsible for funding project activities and will disburse all funds directly to suppliers of services in accordance with the respective agreements.

- In relation to training activities which may be carried out in Kenya, ICEIDA will cover travel expenses, hotels, meals and local transportation. Additional DSA will not be provided by ICEIDA.
- ICEIDA will cover costs of translators to French, for training that is carried out in Djibouti.

The responsibilities of the parties are further stipulated in the Partnership Agreement.

5.1. Points of Contact for the Project Management:

For ODDEG
Address: Immeuble de la Plaine
Attention: Abdou Mohamed Houmed

P. Box : 1279, Djibouti
Tel: +253 77855823
Fax: +253 21358673
Email: abdou_med05@yahoo.fr

For ICEIDA
Address: Raudararstigur 27, 105 Reykjavik
Attention: David Bjarnason
Programme Manager
Email: david@iceida.is
Tel: +354 5457974

5.2. Reporting and meetings

ODDEG and ICEIDA shall establish regular communication through the points of contact regarding the progress of project activities. This may involve visits from ICEIDA to the project sites and meetings with ODDEG regarding the progress of implementation.

ICEIDA shall be provided with semi-annual progress reports from ODDEG for the Project under this Agreement. In addition, ICEIDA shall receive such other information from ODDEG regarding the implementation and administration of the Project as ICEIDA shall reasonably request.

ODDEG shall produce and submit to ICEIDA a completion report within 6 months of the completion of the Project.

6. Estimated Budget

The project will be carried out in accordance with the estimated budget provided below:

Output		2014	2015	2016	Total
1.	**Improved project management and planning capacity for geothermal projects**				
1.1.	Short course on geothermal project management implemented in Djibouti		60.000		60.000
1.2.	Follow up on project management training and IPMA accreditation			30.000	30.000
1.3.	Short course on Preparation of bankable geothermal documents implemented in Djibouti		55.000		55.000
	Subtotal:				**145.000**
2.	**Increased capacity for geothermal drilling established at ODDEG**				
	Short course on geothermal well design and drilling technology implemented in Djibouti			60.000	60.000
	Hands on drill training for up to 8 experts conducted in Kenya in cooperation with GDC (4-8 weeks)			65.000	65.000
	Subtotal:				**125.000**
3.	**Improved knowledge of geothermal surface exploration methods and conceptual model for Lake Abhe revised**				
3.1.	3.1. Training programme for ODDEG in surface exploration methods and modelling to review conceptual model and identify drilling targets for Lake Abhe.		100.000	75.000	175.000
3.1.1.	1 month training of 2 ODDEG geophysicists and 1 geologist in Iceland for analyzing geophysical data and modelling for Lake Abhe.			35.000	
3.2.	UNU-GTP one candiate for geothermal exploration in relation to studies at Lake Abhe			40.000	40.000
3.3.	Training in reservoir engineering model (Tough) for Lake Assal (1 expert)		12.500	12.500	25.000
	Subtotal:				**250.000**
4.	Technical assistance (finalization of GRFM applications and other matters as might be applicable)	25.000	25.000	25.000	**75.000**
5.	**Other costs**				
5.1.	Miscellaneous (consultants input for preparations of ToR, implementation advice, travel and meetings)	5.000	15.000	10.000	**30.000**
	Total:	**30.000**	**267.500**	**352.500**	**650.000**

7. Risk and Assumptions

There is considerable uncertainty regarding the results of geothermal surface exploration and drilling. This needs to be taken into account with the implementation of the planned training activities.

- It is assumed that various issues can interfere with geothermal exploration and drilling activities which may result in required changes in the training programs. Thus a flexible schedule is required and has been taken into account in the planning of activities in this project.
- It is assumed that qualified staff is employed at the ODDEG to undertake the training. This is a prerequisite for carrying out relevant training.
- The candidate for the UNU-GTP fellowship in Iceland needs to fulfil similar conditions as other candidates for training at UNU-GTP in Iceland.
- The geothermal fluids produced from wells drilled in Asal in the 1980's have a challenging chemical composition with respect to scaling and corrosion. The fluids in other Djibouti geothermal fields may have more favourable chemical composition. Advances in geothermal production technologies, specifically development of scaling inhibitors, may now allow production of the Asal fluids.

8. Timeframe

The expected timeframe of this project for a total period of 2 years, expected to start in May 2015. Some aspects of the cooperation with technical assistance for ODDEG is already being implemented and has been approved separately. The project will be implemented in line with the budget allocations each year. It is recognized that delays may be experienced in project implementation.

9. Monitoring and Evaluation

Monitoring of project activities will be carried out through semi-annual progress reports from ODDEG, reports from UNU-GTP and with site visits from ICEIDA. The training program and all trainees will be evaluated by the UNU-GTP and all such evaluations will be assessed by the ICEIDA monitoring and evaluation unit in relation to a framework for evaluations of capacity building activities. An external evaluation of the geothermal support to Djibouti be carried out, supervised by ICEIDA Head of Monitoring and Evaluation.

Annex 1 – Logical Framework Matrix

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Assumptions
Overall Objective (Impact) (Geothermal Compact)			
Assist the Government of Djibouti to increase access to renewable energy through low emissions geothermal energy development.	• MWs of geothermal energy produced in Djibouti (10-15 years).	• Installed capacity of geothermal power plants.	
Immediate Objective (Outcome)			
Improved knowledge and skills for ODDEG staff on geothermal surface exploration and management of geothermalprojects, in order to enable further actions on geothermal energy development in Djibouti.	• Revised conceptual model for Lake Abhe • Drilling targets identified for Lake Abhe • Improved capacity to plan and manage geothermal projects at ODDEG	• Training reports and assessment • Exploration Review report • Project management report from ODDEG	
Expected Results (Outputs)			
1. Improved project management and planning capacity for geothermal projects at ODDEG			
1.1. 2 weeks Short course on ***Geothermal Project Management*** implemented in Djibouti by UNU-GTP	• Project management workshop conducted with at least 15 participants	• UNU-GTP training reports and exams	•
1.2. Follow up on project management training and IPMA accreditation	• IPMA accreditation	• Accreditation report, verification from PMA Iceland	• ODDEG has made progress in implementation of PM structure
1.3. Short course on ***Preparation of bankable geothermal documents*** implemented in Djibouti with at least 15 participants	• At least 15 participant attend training course • Enhanced capacity to prepare bankable geothermal documents	• UNU-GTP training reports and assessment • Presentations prepared by ODDEG	•
2. Increased capacity for geothermal drilling established at ODDEG			
2.1. 2 weeks short course ***Well Design and Geothermal Drilling Technology***conducted in Djibouti for at least 20 participants	• At least 20 participants attend the short course • Improved knowledge at ODDEG of the	• UNU-GTP training report • Participation of ODDEG staff in	• Availability of staff for training

	geothermal drilling process in accordance with outcomes in course	subsequent drilling activities.	
2.2. Hands on drill training for up to 8 experts conducted in Kenya in cooperation with GDC (4-8 weeks). Subject to cooperation established with GDC.	• 8 participants received hands on training in Kenya • Performance of candidates	• Training reports from trainers and participants on specific drilling subjects	• Appropriate candidates nominated
3. Improved knowledge of geothermal surface exploration methods and conceptual model for Lake Abhe revised			
3.1. Training programme for ODDEG in surface exploration methods and modelling to review conceptual model and identify drilling targets for Lake Abhe.	• Revised conceptual model of Lake Abhe area • Drilling targets identified • Improved capacity in surface exploration.	• Surface exploration report • Revised conceptual model • Training report	• Availability of staff
3.1.1. 1 month training of 2 ODDEG geophysicists and 1 geologist in Iceland for analyzing geophysical data and modelling for Lake Abhe.	• Revised conceptual model of Lake Abhe area	• Training report	• Availability of staff for training
3.2. 1 UNU-GTP 6 months candidate for geothermal exploration in relation to studies at Lake Abhe as defined applicable	• Further knowledge generated on Lake Abhe area	• Final paper by candidate	•
3.3. One expert trained in Iceland for a period of 4-8 weeks in reservoir engineering modelling.	• Preliminary "Tough" model for the Lake Assal Fiale area • Trainee capable of "Tough" modelling	• Training report and model	•
4. **Short term technical assistance provided to ODDEG (finalization of GRFM applications and other matters as might be applicable)**	• ToR prepared for each instance of technical instance and reports. • GRMF applications submitted and approved+ • Improved capacity at ODDEG in applications	• ToR in places • GRMF application review reports • Applications submitted by ODDEG	

Annex 2 – Request from Government of Djibouti

REPUBLIQUE DE DJIBOUTI
UNITE - EGALITE - PAIX

MINISTERE DE L'ENERGIE CHARGE
DES RESSOURCES NATURELLES

LE MINISTRE

No : 2501/ME&RN/2013

Date : 12 OCT 2013

جمهورية جيبوتي
الوحدة – المساواة – السلام

وزارة الطاقة المكلفة
بالثروة الطبيعية

الوزير

الرقم: .....

التاريخ: .....

To
The Director General
Of Icelandic International Development Agency ICEIDA
Mr.Engilbert Gudmundssoon

Subject: Express of Interest to the ICEIDA/NDF Geothermal Exploration Project.

Dear Mr. Gudmundssoon,

The Ministry of Energy in charge of Natural Resources of the Republic of Djibouti is delighted to start a technical cooperation with Icelandic International Development Agency (ICEIDA) on the ICEIDA and Nordic Development Fund geothermal exploration project.

Regarding to the launching from The ICEIDA/ Nordic Development Fund (NDF) on new project to support Geothermal Exploration in East African Countries, and concerning 13 countries from Eritrea to the North to Mozambique and the Republic of Djibouti is part of it; the government of Djibouti (GoD) expresses a great interest to participate on this program.

As you aware, the Government of Djibouti (GoD) set up a national program of geothermal development, due to the political commitment to promote the huge geothermal potential estimated around 1000MW and to reduce the green houses gases and increase electricity access in the country.

The Asal-Fiale geothermal project is the result of this strong political involvement; this program have a financial support from the World Bank (WB) and African development Bank (Afdb) ,SEFA, GEF, OFID, ESMAP, AFD.

The Asal-Fiale geothermal project has already launched one month ago, and the selection of key person of the project is on the process.

Tel :(253) 21 32 54 31 -21 32 54 34 – Fax : 253 21 35 86 73- P.O.BOX : 10010 Djibouti
تليفون: ٢١ ٣٢ ٥٤ ٣١ فاكس: ٢١ ٣٥ ٨٦ ٧٣ (٢٥٣) رقم ص.ب: ١٠٠١٠ جيبوتى
Email : ministereenergie@gmail.com

The Ministry of Energy in Charge of Natural Resource takes this opportunity to kindly request the ICEIDA to participate on the EARS ICEIDA/NDF geothermal exploration project from exploration and through drilling until to the geothermal resource confirmation.

The Government of Djibouti is willing to have support on human capacity strengthen through different training program and also a complete technical assistance programme.

I look forward to working with you and your organization towards the realization of the objectives of accelerating geothermal energy development in the Republic of Djibouti.

ALI YACOUB MAHAMOUD

APPENDIX 2

Synthesis on Lake Abhe Geothermal Prospect

The Lake Abhe is the area with one of the most geothermal potential of the country. Located in the southwest of the country, the Lake named Abheis shared between Djibouti and Ethiopia. The geological structural is related to the tectonic plates associated with the movement of the Arabian plate from 3.4 M.y and the areas was mainly composed by stratoid basalt limited by E-W faults.

Surface hydrothermal manifestations are numerous around the lake along with a rich variety of fumaroles, hot springs and many travertine constructions. Some of the travertine was higher than 60 m.a.b.s.l. The hot spring manifestations are mainly located in the bottom of the travertine with high temperatures of more than 95°C. The chemical profiles of the hydrothermal source are alkaline-chloride in general and some bicarbonate from the previous studies.

The prospect of Lake ABHE is also in the region of the regional volcanic aquifer on which several studies were conducted (BGR 1982; BGR 1990; Aquater 1981; Aquater 1989; Geothermica 1983). In 2012, the CERD started has done a surface exploratory studies, using new methods like MT, TDEM and gravimetric methods. Following that survey the Japan Cooperation team undertake a data collection survey with mainly geology and geochemistry in this site in 2014.

The geophysical survey done by CERD in 2012 were with several equipment like TDEM, MT (Metronix) and gravimeter. TDEM method has reflected the geology observed at the surface mainly high resistivity volcanic rocks on the eastern flank and clay and silty sedimentary rock of the Lake Abhe and Gobaad plain that would differ along a tectonic discontinuity probably oriented NS.

The MT survey shows the existence of conductive zones tend to generalize up to 900/1500 meters before showing higher resistivity. Gradually at high depth high resistivity dominate from the West and restrict low resistivity in the far east of the study area. The interpretation of the resistivity maps and therefore enable the selection of three resistivity anomaly zones, one in the west of the study area, the second to third in the North and Southeast. It should be noted that the first two anomalies occur in travertine fireplaces and hydrothermal manifestations surface which is not the case for the third zone. Also the gravimetric method reveals an anomaly more or less elongated in the east-west direction and seems pretty well coincide with the travertine area and hot springs in the northern part.

The geochemistry of the water surface using silica and alkaline geothermometers after checking the ripeness of water sampled surface reveals reservoir temperatures would range between 120 ° C and 160 ° C.

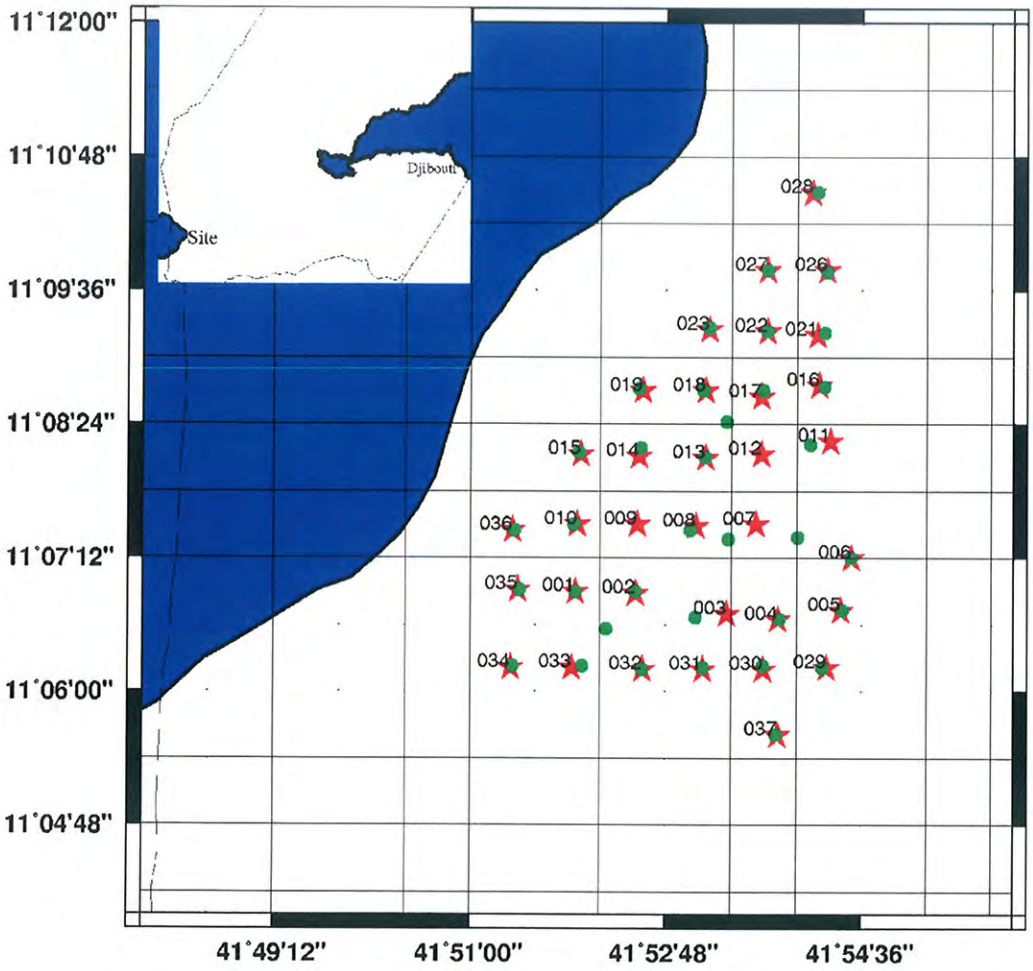

Figure: location Maps for MT (Red star) soundings and TDEM (green star).