



## Project Document

# Surface Exploration and Capacity Building for Geothermal Development in Tanzania

Sub-Project of the ICEIDA/NDF Geothermal Exploration Project

ICE23066-1301

Implementing Agency: Tanzania Geothermal Development Company Limited (Under the  
Ministry of Energy and Minerals)

Funded by the ICEIDA/NDF Geothermal Exploration Project

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## Agronyms

ARGeo	African Rift Geothermal Development Facility Programme
AUC	Africa Union Commission
ICEIDA	Icelandic International Development Agency
JICA	Japan International Cooperation Agency
KFW	Kreditanstalt für Wiederaufbau
MEM	Ministry of Energy and Minerals
MT	Magneto Telluric
NDF	Nordic Development Fund
SREP	Scaling Up Renewable Energy Program
TANESCO	Tanzania Electric Supply Company
TGDC	Tanzania Geothermal Development Company
TEM	Transient Electro Magnetic
UNEP	United Nations Environment Programme
UNU-GTP	United Nations University Geothermal Training Programme
WB	World Bank

## 1. Introduction

The government of Tanzania aims at transforming the nation into a middle income and semi-industrialised country by 2025. Energy has been identified as one of the critical inputs for stimulation of investments and creation of wealth and generation of employment. Thus, availing adequate, reliable, affordable and environmentally friendly electricity supply is a priority for Tanzania as a means to improve basic social services such as education and health, and powering industries and businesses which support income generation activities.

The Ministry of Energy and Minerals has the responsibility of ensuring that adequate, reliable, affordable and environmentally friendly energy is available. Development of geothermal resource is one of the government's efforts to diversify power generation sources as well as enhancing base load power generation. Geothermal resources are an indigenous and affordable energy source which is neither vulnerable to weather nor fuel price variations thus making it a suitable source for base load power generation. It is a clean, safe, and proven technology with a high degree of availability, and therefore suitable source of power in the country's energy mix.

In order to fast-track geothermal development, the government in December 2013 established the Tanzania Geothermal Development Company Limited (TGDC) as a public company with an institutional mandate to facilitate geothermal energy development in the country. TGDC has made significant progress in the areas of geothermal exploration including advancing Ngozi to the test drilling stage and Kisaki to a pre-feasibility/Surface Exploration level. The next sites which have been prioritized for further investigation are Luhoi, Lake Natron, Kiejo-Mbaka and Songwe.

Lack of reliable resource information is the main challenge as most of geothermal prospects are also not yet fully explored, remaining in early stages of the investment cycle. This challenge can be overcome by developing local capacities and experiences in dealing with the problems associated with geothermal resource exploration through technical support from development partners.

The Icelandic International Development Agency (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 geothermal knowledge and capacity in order to enable further actions on geothermal utilization in the respective countries. This includes support during the high risk exploratory phase of geothermal development and capacity building in the field of geothermal research and utilization. Support for geothermal development is outlined as a priority area in the Strategy for Iceland's Development Cooperation.

In 2012 the Government of Tanzania, through the Ministry of Energy and Minerals, expressed interest for cooperation with the ICEIDA/NDF Geothermal Exploration Project under the World Bank - Iceland compact on geothermal energy. Subsequently, in 2014 a request was submitted to ICEIDA by the TGDC. Copy of the letter to that reference is attached herein as Annex 2.

Following this request a process was initiated with the authorities in Tanzania to define the scope and extent of the cooperation. This involved meetings, field visits, and collaboration in preparing this project document. The outcome of these discussions was that further efforts were required to continue with detailed surface explorations in priority areas for geothermal energy production, as well as to strengthen the capacity of TGDC for geothermal development, in particular in relation to geothermal surface exploration.

The overall objective of this project is to assist the Government of Tanzania to increase the renewable energy contribution to the generation mix through low emissions geothermal energy development for the social and economic benefit of the country. The immediate objective of this project is to identify potential sites for exploration drilling in the target area and develop capacity in Tanzania to advance geothermal energy production in the country.

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

## **2. Background and Rationale**

### **2.1. The Energy Sector in Tanzania**

Access to energy is among the key elements for the economic and social development of Tanzania. Until June 2015, the access to electricity in Tanzania was approximately 36% while the connection rate was 24% for urban and 7% for rural areas in mainland Tanzania. To achieve the desired socio-economic transformation, Tanzania aims to increase connection levels to 30% by end of 2015, 50% by 2025 and more than 75% by 2033. Strategies for increasing access to affordable, modern and reliable energy services as well as expanding renewable energy are a part of the Tanzania Poverty Reduction Strategy Paper.

Tanzania has traditionally depended on hydropower and fossil fuel for power generation but this generation mix has been unsustainable largely due to persistent and frequent droughts and fossil fuel price variations which have adversely resulted in severe power supply shortages in the country. Therefore Tanzania was forced to do electricity load shedding and at times hiring of expensive and environmentally unfriendly emergency power generation facilities. Tanzania started using natural gas in 2004 to reduce dependency on hydro-generation for power production. Unfortunately, the demand for natural gas grew exponentially over the years leading to same being inadequate for power generation to the detrimental effect of Tanzania Electric Supply Company (TANESCO) cash flow and the national economic performance in general. Tanzania being endowed with a number of good power source potentials decided to diversify its power generation sources to include among others, renewable generation options like solar, wind, biomass, geothermal, etc. Due to this challenge, the government has decided to improve the generation mix by including other sources, including geothermal, which is independent of the influence of weather cycles and fossil fuel price variations.

Following above strategic decision, the government of Tanzania established the Tanzania Geothermal Development Company, mandated to expedite development of the geothermal resource. The government intends to harness its geothermal energy, with potential estimated to be considerable, for power generation and other direct uses so as to enhance effective support of socio-economic

development, thereby effectively supporting the Tanzania development vision 2025 in which it envisages to become a middle income and a middle industrialised country.

However, there are some key challenges that need to be resolved so as to accelerate the development of this energy resource. One of the challenges is to develop adequate and able professional and skilled manpower that is required to effectively support a sustained implementation of resource mapping and development of planned projects and the geothermal industry in general. Also acquiring the required equipment, tools and instruments is also considered a key necessity for effective development of the geothermal resource.

Assessment of previous reconnaissance studies that were done in the effort of developing geothermal resources, indicates limited information resulting from studies that were done with the exception of Ngozi – Songwe prospect area that has been studied to a prefeasibility level, while some geo-scientific gaps have been noted. Developing geothermal resources involves various risks and therefore requires adequate studies and interpretation of data to develop effective and meaningful geological models that can lead to siting potential locations of exploratory wells hence leading to successful development of the respective potential prospects.

TGDC has identified and prioritized other prospective areas of Luhoi, Lake Natron, Kisaki, Kiejo - Mbaka for detailed prefeasibility studies to assess the geothermal potential as well as locate the potential reservoirs in the respective prospect areas. It is for this reason that the Tanzania government through TGDC approached various development partners to assist in realizing its endeavour.

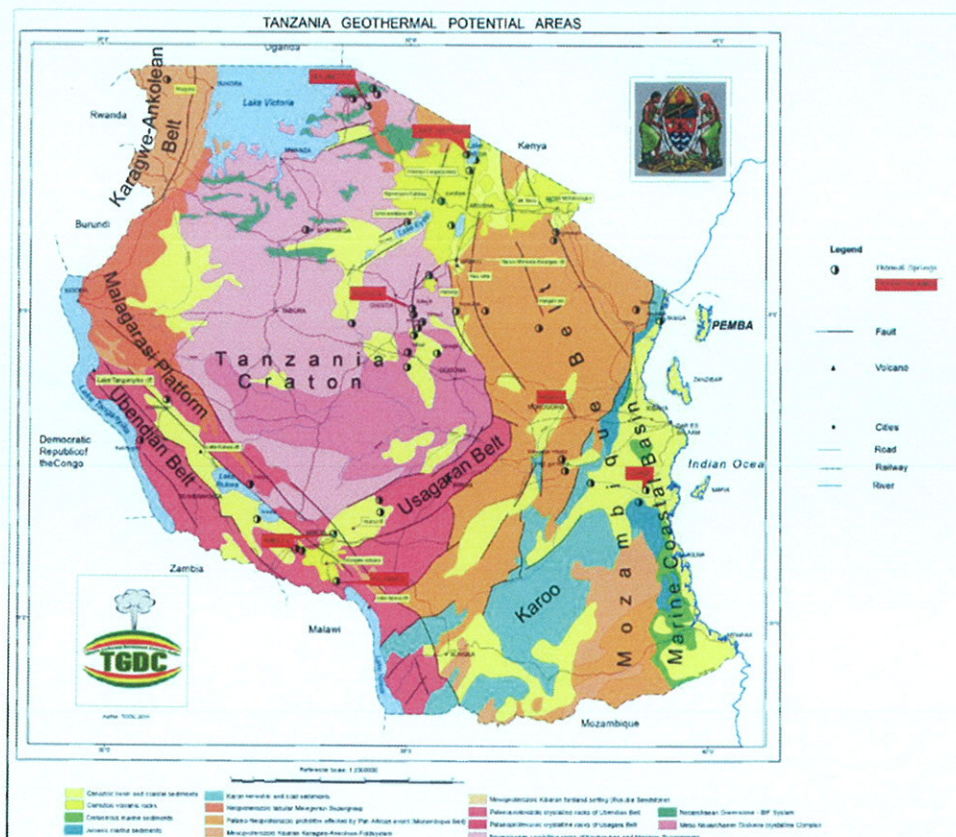


Figure 1. A geological/geothermal map of Tanzania ( TGDC), 2014).

## **2.2. Project Preparations**

The ICEIDA/NDF Geothermal Exploration Project is demand-driven and activities funded by the project are based on specific needs and requests from governments in the countries of the region. In 2012 The Government of Tanzania first expressed an interest in participating in the project under the Iceland World Bank Compact and in August 2013 an initial mission to Tanzania was carried out where the initial scope and potential for cooperation was discussed with the Ministry of Energy and Minerals and other stakeholders, including TANESCO and the African Development Bank. The status of surface exploration was unclear at that time and further steps in project preparations were not taken until TGDC when was established in December 2013, with a clear mandate to expedite development of the geothermal resources. Subsequently, TGDC submitted an expression for participation in the project and this request was followed up with meetings between TGDC and ICEIDA in Arusha in October 2014, during the ARGeo C5 conference.

It was agreed that the ICEIDA/NDF programme would support an initial reconnaissance study in three areas in Tanzania, as well as take stock of required needs for capacity building and equipment. The aim of that study was to identify viable areas for detailed surface exploration study, as well as make recommendation on training components. In June 2015 another ICEIDA mission visited Tanzania to discuss the results of the reconnaissance study and outline the scope for a cooperation project. These discussions resulted in the outline for project components as listed in this project document. This document has been jointly prepared by ICEIDA, TGDC and technical consultants from Iceland Geosurvey (ISOR).

## **2.3. Target areas for surface explorations**

Under the ICEIDA/NDF project two geothermal experts (geophysicist and geologist) from ISOR, acting consultants for ICEIDA, visited Tanzania from 18<sup>th</sup> to 31<sup>st</sup> January 2015, for the purpose of gathering data and assessing sites for surface exploration study which might be warranted within the ICEIDA/NDF Geothermal Exploration Project. The scope of the visit included reconnaissance studies of three sites (Natron, Luhoi and Kisaki), assisting ICEIDA and TGDC to select suitable geothermal prospects for surface studies and assessing human and institutional capacity building needs and recommend equipment requirements for surface exploration studies.

The objective was to conduct a preliminary (reconnaissance) geothermal resource assessment for these three areas in Tanzania, and as may be applicable in light of the results, develop an exploration strategy and ToR for a detailed surface exploration study in one area. To this end the required initial geothermal data have been gathered and assessed in order to define the potential of these areas and ascertain if a surface exploration study may be warranted within the ICEIDA/NDF Geothermal Exploration Project. On 18<sup>th</sup> June 2015, ISOR experts presented to TGDC and ICEIDA the study findings and recommendations upon which Luhoi was selected for detailed surface studies. The Songwe area and Kiejo-Mbaka area were added for further consideration under the project preparations. After review of existing data on these areas, mainly from the BGR and JICA reports, it was the recommendations of ISOR to include some additional studies for the Kiejo-Mbaka area under the project, which would be implemented with a strong training component for TGDC staff.

### 2.3.1. Luhoi

The Luhoi geothermal prospect is in the Rufiji area, and has not previously been the subject of detailed surface exploration studies. The result of the reconnaissance report by ISOR recommended further surface exploration in Luhoi area on technical merits as follows:

- The size of the area as measured in areal extent of hot springs is substantially larger than in the case of Lake Natron and Kisaki and the flow rate of geothermal fluid is significantly higher
- Clear signs of precipitation deposits are found around the hot springs of Luhoi
- Slight smell of sulphur was noted in Luhoi but not in the other two areas.
- The temperature in Luhoi exceeded 70°C but was significantly lower in the Lake Natron area.

The temperatures expected in Luhoi are intermediate and may presumably be sufficient for binary power production. The surface exploration study for Luhoi under this project will include detailed studies in geology, geochemistry and geophysics. Detailed exploration plans will be prepared and form a part of the ToR for the assignment to be undertaken. The final result of the assignment will be a conceptual model for the area based on an integrated interpretation of all available geoscientific results and will include proposed target(s) for an exploratory well(s) if applicable in light of the results. Should the surface explorations lead to recommended drilling target(s), a preliminary environmental and social impact assessment would also be carried out as a part of the assignment. A new volumetric assessment of the Luhoi area will be made based on these new results. As noted below a strong capacity building component will be an integral part of the surface exploration project in all aspects, from data collection in the field to the processing and interpretation of the acquired data as well as the conceptual modelling and well's locations.



Figure 2. Overview maps of Luhoi and Kiejo-Mbaka geothermal areas.

### 2.3.2. Kiejo-Mbaka area.

During the 18<sup>th</sup> June 2015 meeting, TGDC requested ICEIDA/NDF to consider supporting additional geothermal areas of interest which have not been fully studied to date. The result of these discussions was that the ICEIDA/NDF programme would take a further look at the main hot springs in Songwe area and Kiejo-Mbaka for potential inclusion under the ICEIDA/NDF programme. Studies carried out earlier in the Songwe area led to the belief that the Ngozi and Songwe systems were the same, i.e. that the Songwe hot springs were the discharge of the Ngozi system. After review of existing studies for the Songwe area, including studies carried out by BGR, further exploration studies



were not recommended by the ISOR experts, who regard the Songwe area as an outflow from Ngozi, with the heat source located under Ngozi. Further knowledge of this relationship is also expected to be revealed through more studies (to be done under UNEP funding) and drilling at Ngozi.

The result of the ISOR review, documented in a Memo on the Rungwe Volcanic Region, was to recommend limited surface exploration studies in the in Kiejo-Mabaka geothermal area between the Mbaka and the Livingstone faults. These studies will be implemented subsequent to the Luhoi study and would be used as further training ground for TGDC personnel, with the supervision of experienced experts. The results of these studies, would include a preliminary conceptual model, and advice on further studies at selected areas, as might be applicable.

### **3. Project description**

#### **3.1. Strategy**

- The ICEIDA/NDF Geothermal Exploration Project will, through material, technical and financial support contribute to the efforts of the Government of Tanzania to develop geothermal energy production in accordance with the plans and priorities of the Government of Tanzania.
- The project will be closely aligned with other initiatives and donor support undertaken for the development of geothermal energy in Tanzania, including the SREP programme and projects initiated under the ARGeo programme and BGR. This will ensure relevance of the project interventions, avoid duplication of efforts and provide linkages of project activities to further stages of geothermal energy development.
- For the purpose of conducting exploration studies the project will ensure that highly qualified geothermal consultants will be available to assist TGDC to carry out surface exploration field surveys, research and modelling to identify potential sites for exploration drilling and further studies. It is expected that in all cases where explorations are conducted with input from external experts, knowledge and technology transfer will take place with TGDC to ensure that capacity is strengthened as a part of the process.
- Procurement of equipment to carry out geothermal exploration will be included in the project. As Tanzania will be implementing several surface exploration studies over the next few years, it is deemed feasible to provide certain equipment and associated training on their operations. The equipment purchased for the exploration studies under this project should also be used for future exploration activities by TGDC.
- Technical assistance will be provided in relation to this project to assist TGDC to advance the development of the Ngozi geothermal prospect. This technical assistance could address imminent needs and gap-filling related to studies in the area, review and advice on existing studies, assistance with drill plans, reviews and implementation.
- For outputs and activities, as applicable, defined under this project document, detailed Terms of Reference will be prepared and agreed upon by ICEIDA/NDF, as well as the implementing agency prior to implementation.

#### **3.2. Beneficiaries**

In the short term the implementing agency, TGDC and the Ministry of Energy and Minerals will benefit from the project through increased capacity to develop and utilize the geothermal resources.

In the long run it is expected that the population of Tanzania will benefit from activities implemented within the project, through increased availability of clean renewable energy in the country.

### **3.3. Challenges to be addressed**

This project aims to contribute to the efforts of the Government of Tanzania to further the development of geothermal energy in the country, by addressing two main challenges which are considered to be of key importance in order to move forward:

1. Lack of detailed surface exploration studies in key geothermal prospects and identification of potential exploration drill sites within those areas if viable.
2. Need for increased capacity and human resources in Tanzania to take on the growing work in scientific and managerial aspects of geothermal development.

Due to the uncertainty associated with geothermal energy development, in particular in the early stages, public resources are required for resource identification, including research on geochemistry, geophysics through surface exploration studies and subsequent test drilling. In light of the potential for the development of geothermal energy in the country, investment in local capacity building and knowledge transfer to advance geothermal development is further considered of great importance.

The focus of this project will thus both address the needs for TGDC and MEM to build capacity to handle further growth and development in geothermal energy production, as well as assist with finalizing geothermal surface explorations and associated geophysical, geological and geochemical studies in order to identify locations for drilling of exploration and production wells in target sites as may be viable.

### **3.4. Objectives**

The **overall objective** of this project is to assist the Government of Tanzania 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 this project is enhanced knowledge of selected geothermal areas in Tanzania with identification of potential sites for exploration drilling if applicable and improved capacity in Tanzania to advance geothermal energy production in the country.

At the end of the project it is expected that Tanzania will have detailed knowledge of potential geothermal areas and, if viable, defined drill sites. Equipment for geophysical and geochemical surveys will be in place, and knowledge to operate this equipment in subsequent studies. The experts at TGDC will further have gained knowledge on management and planning of geothermal projects, which will enhance their capacity to plan and implement subsequent activities.

### **3.5. Outputs**

1. **Surface exploration conducted and up to 3 drilling targets identified, if geothermal potential allows, in the Luhoi geothermal prospect. This will include the following components:**
  - Geology/hydrogeology
  - Geochemical studies
  - Soil Gas study
  - TEM-MT survey

- Gravity survey
  - Conceptual modelling
  - Elaboration of well design and drilling program if applicable
  - Preliminary social and environmental impact assessment in relation to proposed drilling targets, if applicable
  - Transfer of knowledge and techniques for geothermal surveys and modelling to TGDC.
- 2. Training in surface exploration conducted in Kiejo-Mbaka geothermal area and a preliminary conceptual model developed. This will include increased involvement and responsibility of TGDC staff, under the supervision of experienced experts to be hired under the ICIEDA/NDF project:**
- Geology/hydrogeology
  - Geochemical studies
  - Soil Gas study
  - TEM and MT surveys
  - Preliminary conceptual modelling
  - Transfer of knowledge and techniques for geothermal surveys and modelling to the implementing agencies.
- 3. Quality monitoring of surface studies and follow up**
- 3.1. Support to quality monitoring and supervision of surface studies under output 1 and 2.
- 3.2. Review of final reports under output 1 and 2, by external reviewers and technical meeting held.
- 4. Technical Assistance for TGDC to support the advancement of the development of the Ngozi geothermal prospect.** This technical assistance could address imminent needs and gap-filling related to studies in the area, review and advice on existing studies, assistance with drill plans, reviews and training related to analysis and monitoring of drilling. This component will be further defined in a ToR once the on-going gap-filling studies in Ngozi have been finalized end of year 2015, and it has become clear which aspects the assistance from ESMAP will cover.
- 5. Equipment to conduct field surveys provided and relevant training for operations and maintainance implemented (in relation with other donor funding).** It is expected, in line with the needs assessment as presented in the reconnaissance report from ISOR, that the equipment purchased will include 1 MT equipment, 1 TEM unit, and CO2 flux meter, other equipment may be considered if budget allows. Combined with equipment purchased under the UNEP/Argeo programme it is expected that TGDC will have available a set of equipment which can be deployed for multiple surface exploration studies.
- 6. Improved capacity of TGDC staff for management and planning of geothermal projects**
- 6.1. Training provided for TGDC staff through regional training courses in Kenya or elsewhere. The focus will be on geothermal project planning and management, as well as other specific areas as may be identified as necessary by ICEIDA and TGDC. This training will be aligned to the extent possible with the proposed Africa Geothermal Centre of Excellence which is being planned for the region. The assumption is that 10-15 TGDC experts would attend an average of 2 training courses each.

### **3.6. Cross cutting issues – Gender and Environment**

Where potential sites have been identified for exploration drilling a preliminary environmental and social impact assessment will be carried out. This will ensure that environmental and social aspects are addressed as required in relation to potential exploration drilling. As part of the social impact analysis of these studies, gender aspects will be addressed. Gender ratio of trainees will be observed and participation of both genders in any training conducted will be encouraged.

## 4. Implementation and Management

### 4.1. Institutional set-up

TGDC was incorporated in December 2013, as a subsidiary Company of TANESCO, with institutional mandate to foster geothermal energy development in Tanzania. TGDC's core business is amongst others, assessment, exploration, drilling and development of geothermal resources for power generation and direct uses. The mandate provides for collaboration or partnership with other public entities and private organizations that have technological and professional capability to assist in development of expertise through research, training and knowledge skills transfer and resource development.

In particular, TGDC is mandated to:

- (a) To promote geothermal energy resources development
- (b) To undertake upstream geothermal resources assessment including reconnaissance, surface exploration, drilling, pre-feasibility, geothermal field development to feasibility level, thus opening up opportunities for private sector participation
- (c) To efficiently and effectively mobilize funds from both private and public sources for accelerating geothermal energy development in the country
- (d) To sell steam to state and private owned generation companies
- (e) To manage geothermal fields for sustaining steam flow to generating plants owned by public and IPPs
- (f) To promote direct uses of geothermal energy
- (g) To participate in early power generation through wellheads either independently or in partnership with public or private investors

This project will be implemented under the patronages of the Ministry of Energy and Minerals which is the sector Ministry responsible for overseeing the project implementation including monitoring and evaluation. TGDC will be the project implementing agency.

Detailed Terms of Reference will be prepared for outputs outlined in this project document, which will define the objective, scope, deliverables and timeframe for the activities to be undertaken in relation to the respective outputs. Such documents shall be agreed to in writing by both parties prior to implementation of respective project components.

The Ministry of Energy and Minerals and TGDC will make the required logistical arrangements and facilitate the processing of required permits for contractors to carry out the work according to plans.

TGDC will ensure that:

- Contractors have access to the necessary documents and data in order to conduct project activities effectively.
- It has enough staff with basic qualifications to undertake the training and field survey activities. For the field survey training activities in Kiejo-Mbaka, TGDC must have available at least 3 geophysicists, 2 geochemists and 2 geologists.
- Transportation and required logistics are provided and managed effectively in relation to project activities as required.

- Facilitate the import of equipment purchased under the project and its exemption from import duties.

ICEIDA, in cooperation with TGDC, will carry out tenders for services for surface exploration studies, under NDF procurement guideline as applicable for outputs one and two. It is expected that these two assignments will be procured under one tender. For other consultancy services ICEIDA procedures apply. For procurement of equipment, international shopping shall be used. It is, however, noted that as UNEP/Argeo will procure 2 MT units for TGDC and the purchase of MT equipment under this project may be included under that tender, as it is necessary for all MT units to be of the same type.

Estimated procurement plan for surface exploration studies under output 1 and 2:

<b>Expression of Interest published</b>	27 November 2015
<b>RFP sent out to shortlisted companies</b>	8 January 2015
<b>Finalization of evaluation and invitation of negotiate</b>	14 March 2016
<b>Contract signing</b>	7 April 2016

ICEIDA is responsible for funding project activities and will disburse all funds directly to suppliers of goods and services in accordance with the respective agreed agreements including prior certification of invoices and certificates by the Implementing Agency.

TGDC will provide local transport for surface exploration studies and cover the cost of its own experts and local assistants as may be required to carry out the surface exploration studies.

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

#### **4.2. Points of Contact for the Project Management:**

##### **For TGDC**

Eng. Boniface Njombe  
General Manager  
Tel: +255 787 669 266 / +255 687833855  
Email: boniface.njombe@tanesco.co.tz;  
gm.tgdc@tanesco.co.tz

##### **For Ministry of Energy and Minerals**

Permanent Secretary  
Ministry of Energy and Minerals  
P.O. Box 2000  
Dar es salaam

##### **For ICEIDA**

Dr. David Bjarnason  
Programme Manager  
Tel: +354 5457974  
Email: david@iceida.is

### **4.3. Reporting, meetings and coordination**

TGDC and ICEIDA shall establish regular communication through the points of contact regarding the progress and implementation of project activities. Bi-annual progress meetings shall be held to discuss the progress of implementation and minutes of such meetings will document the progress. This may also involve ICEIDA/NDF visits to the project sites.

In addition, ICEIDA shall receive such other information from TGDC regarding the implementation and administration of the Project as ICEIDA shall reasonably request from time to time.

TGDC and ICEIDA will collectively work together to coordinate the activities of this project with other relevant donors and stakeholders working in geothermal development. This includes the World Bank, African Development Bank, the ARGeo/UNEP programme as well as the AUC-KfW GRMF programme. Such coordination shall ensure that activities are complementary and not overlapping and enhance synergies between the activities of the different programs.

The Implementing Agency shall produce and submit to ICEIDA a completion report within 6 months of the completion of the Project. The completion report shall provide an overview of all activities implemented under the programme, and review the overall process and deliverables achieved.

### **4.4. Other donor activities and coordination**

There are several geothermal projects being planned in the Tanzania, with different development partners.

#### **4.4.1 The World Bank**

The World Bank through ESMAP is considering capacity building support that will enable TGDC to undertake the first exploration drilling in the country. The areas in which ESMAP has shown interest to support include:

- 1) Environmental and Social Impact Assessment and Environmental Management Plan
- 2) Drilling Planning (including procurement documents preparation including specifications of rigs and preparation of the drilling program)
- 3) Packaging of Ngozi geothermal financing plan

#### **4.4.2 SREP**

The Scaling up Renewable Energy Program (SREP) is led by the African Development Bank has granted 25 MUSD for establishment of legal and regulatory framework, geothermal resource assessment and test drilling. It is envisioned that this project will create linkages with this funding and other donor funded programmes so as to enhance synergy and avoid overlapping of activities.

#### **4.4.3 ARGeo/UNEP**

The UNEP ARGeo programme has allocated 400,000 USD grant for additional surface exploration at Ngozi to increase knowledge and certainty about the resources and proposed test drilling targets. ARGeo/UNEP support will include basic exploration equipment such as two MT and one Radon meter, technical consultancy services and international peer review to ensure that the planned drilling is successful. It is noted that the equipment purchased under the Argeo/UNEP and

ICEIDA/NDF programmes, will jointly form a full set of MT and TEM equipment to be used in exploration studies.

#### **4.4.4 GRMF - AUC**

Tanzania through TGDC has submitted grant applications to GRMF-AUC for co-financing of technical surface studies of Kisasi geothermal prospect and drilling of two test wells and infrastructure at Ngozi geothermal prospect. The evaluation of the application for grant is in progress.

#### **4.4.5 BGR**

The German government, through the BGR, has promised to support capacity building and resource characterisation. BGR has expressed interest to support site exploration of one green field to a feasibility level by providing experts and required field equipment for carrying out studies (geology, geophysics, and geochemistry).

#### **4.4.6 JICA**

In 2013, JICA supported satellite-based geothermal resource characterisation coupled with limited surface surveys to identify promising fields for pre-feasibility assessments and exploratory drilling to confirm the availability of geothermal resource. In addition, JICA has expressed interest in supporting the feasibility study of Ngozi and capacity building in terms of human skills development.

## **5. Risk and Assumptions**

- There is considerable uncertainty and risk associated with geothermal exploration, thus the results from surface exploration may be such that further exploration and drilling is not deemed feasible in the particular target areas.
- It is assumed that the UNEP/ARGeo programme will provide certain equipment support to TGDC which will together with the support under this programme provide a set of equipment for TGDC.
- In order to keep with timeframe of surface exploration studies it is assumed that custom clearance of equipment will proceed in accordance with agreement.
- Political and economic stability in Tanzania and Iceland

## 6. Estimated Budget USD

Output	2015	2016	2017	Total
<b>1. Up to 3 drill targets identified in the Luhoi geothermal prospect</b>				
1.1. Geothermal surface exploration conducted in Luhoi, including preliminary ESIA for drilling targets if applicable		750.000		<b>750.000</b>
<b>2. Training in surface exploration conducted in Kiejo-Mbaka area and preliminary conceptual model developed</b>				
2.1. Consultancy for training and interpretations for the Kiejo-Mbaka area		100.000	100.000	<b>200.000</b>
<b>3. Supervision/monitoring of the surface exploration and technical assistance for follow up if applicable</b>				
3.1. Support for quality monitoring and supervision under output 1 and 2.		35.000	15.000	<b>50.000</b>
3.2. Review of final exploration report and conceptual models by external reviewers.		20.000		<b>20.000</b>
<b>4. Technical Assistance for advancing the development of the Ngozi geothermal prospect</b>		100.000	50.000	<b>150.000</b>
<b>5. Equipment to conduct field surveys provided along with relevant training for operations and maintenance (coordinated with other donor funding)</b>				
5.1. Procurement, tender and purchase of equipment	200.000	50.000		<b>250.000</b>
<b>6. Improved capacity of TGDC staff</b>				
6.1. TGDC experts attend regional training courses. The assumption is that 10-15 TGDC experts would attend an average of 2 training courses each.		60.000	20.000	<b>80.000</b>
<b>7. Miscellaneous (consultants input for preparations of ToR, procurement costs, implementation advice, travel and meetings)</b>	30.000	25.000	10.000	<b>65.000</b>
Total:	230.000	1.140.000	195.000	<b>1.565.000</b>



## 7. Timeframe and work plan

The timeframe of the activities outlined in this project document is expected to be 2 years, from September 2015 – September 2017. The progress of project implementation is planned as outlined in the table below.

Expected Results (Outputs) and Activities	2015		2016				2017	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
<b>1.1. Geothermal surface exploration conducted in Luhoi.</b>								
1.1.1. Finalize ToR and tender documents								
1.1.2. Finalize contract with consultants								
1.1.3. Implementation of surface exploration contract								
1.1.4. Technical review of results								
<b>2.1. Training in surface exploration conducted in Kilambo at Kiejo-Mbaka geothermal area and a preliminary conceptual model developed.</b>								
2.1.2 Implementation of surface exploration training contract								
2.1.3 Technical review of results								
3.1. Support for quality monitoring and supervision under output 1 and 2.								
3.2. Review of final exploration report and conceptual models by external reviewers.								
<b>4. Technical Assistance for TGDC to support the advancement Ngozi geothermal prospect</b>								
<b>5.1. Procurement, tender and purchase of equipment</b>								
5.1.1. Finalization of technical specifications for equipment								
5.1.2. Tender and purchase of equipment								
5.1.3. Training on equipment operations								
<b>6.1. Participation of 10-15 TGDC experts in regional training courses as applicable.</b>								

Any delays in project implementation foreseen or experienced by the Implementing Agency should be communicated to ICEIDA as soon as practically possible.

## 8. Monitoring and Evaluation

Monitoring of project activities will be carried out through bi-annual meetings by ICEIDA and TGDC, progress and final reports from contractors as will be defined in the respective ToRs, and with site visits from ICEIDA.

In training programs carried out, all participants shall be independently evaluated and all such evaluations will be assessed by the ICEIDA monitoring and evaluation unit.

Monitoring and quality assurance related to geothermal exploration studies and modelling, will be managed by Iceland GeoSurvey. As a part of this monitoring, capacity building will be carried out in Tanzania related to the supervision and monitoring of surface exploration activities.

Final geothermal exploration reports for the two respective geothermal prospects will be reviewed by external experts and findings discussed at a technical review meeting.

An external evaluation of the geothermal support to Tanzania will 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/Risks
<b>Overall Objective (Impact)</b>			
Assist the Government of Tanzania to increase access to renewable energy through low emissions geothermal energy development.	<ul style="list-style-type: none"> <li>• Knowledge on the suitability of geothermal areas for power production</li> <li>• MWs of geothermal energy produced in Tanzania (10-15 years).</li> </ul>	<ul style="list-style-type: none"> <li>• Exploration reports</li> <li>• Installed capacity of geothermal power plants.</li> </ul>	
<b>Immediate Objective (Outcome)</b>			
Enhanced knowledge of selected geothermal areas in Tanzania with identification of potential sites for exploration drilling if applicable and improved capacity in Tanzania to advance geothermal energy production in the country.	<ul style="list-style-type: none"> <li>• # of sites identified for exploration drilling and expected MW production</li> <li>• Increased capacity of TGDC and MEM staff to undertake relevant aspects of geothermal development, from exploration to utilization.</li> </ul>	<ul style="list-style-type: none"> <li>• Exploration reports</li> <li>• External reviews</li> <li>• Training reports and assessment of performance</li> </ul>	<ul style="list-style-type: none"> <li>• Uncertainty associated with geothermal resources</li> <li>• Qualified staff available for training</li> <li>•</li> </ul>
<b>Expected Results (Outputs)</b>			
<b>1. Up to 3 drill targets identified in the Luhoi geothermal prospect</b>	<ul style="list-style-type: none"> <li>• 3 sites for geothermal drilling identified</li> </ul>		
1.1. Geothermal surface exploration conducted in Luhoi, including ESIA for potential drilling targets if applicable.	<ul style="list-style-type: none"> <li>• Conceptual model</li> <li>• Identification of drilling sites</li> <li>• Preliminary ESIA is applicable</li> </ul>	<ul style="list-style-type: none"> <li>• Exploration reports</li> </ul>	<ul style="list-style-type: none"> <li>• Geothermal potential existing</li> <li>• Temporary import of equipment</li> </ul>
<b>2. Training in surface exploration conducted in Kiejo-Mbaka geothermal area and a preliminary conceptual model developed.</b>			
2.1. Geothermal surface exploration training conducted in Kiejo-Mbaka.	<ul style="list-style-type: none"> <li>• Training conducted</li> <li>• Preliminary conceptual model</li> <li>• Recommendations on next studies if viable</li> </ul>	<ul style="list-style-type: none"> <li>• Exploration reports</li> </ul>	<ul style="list-style-type: none"> <li>• Geothermal potential existing</li> </ul>
<b>3. Supervision/monitoring of the surface exploration</b>			
3.1. Support for quality monitoring and supervision under output 1 and 2.	<ul style="list-style-type: none"> <li>• Quality of analysis</li> <li>• Capacity of TGDC to supervise and monitor</li> </ul>	<ul style="list-style-type: none"> <li>• Report</li> <li>•</li> </ul>	
3.2. Review of final exploration report and conceptual models by external reviewers.	<ul style="list-style-type: none"> <li>• Results of review</li> </ul>	<ul style="list-style-type: none"> <li>• Review memos</li> </ul>	
<b>4. Technical Assistance for TGDC to support the advancement of the</b>	<ul style="list-style-type: none"> <li>• Progress of development of Ngozi</li> </ul>	<ul style="list-style-type: none"> <li>• ToR for technical</li> </ul>	

<b>development of the Ngozi geothermal prospect.</b>	geothermal prospect	assistance • Reports	
<b>5. Equipment to conduct field surveys provided along with relevant training for operations and maintenance (coordinated with other donor funding)</b>	• Equipment in place and staff capable of operating equipment	• Progress reports	
5.1. Procurement, tender and purchase of equipment	• Tender for equipment • Equipment in use in exploration	• Tender documents • Reports	• Custom clearance of equipment
<b>6. Improved capacity of TGDC experts for management and planning of geothermal projects</b>			
6.1. 10-15 TGDC staff attend regional training courses in applicable subjects, including project management and planning. The assumption is that each will attend on average 2 training courses.	• Improved capacity for project management and planning • IPMA accreditation	• Training reports • Capacity assessment	• Arrangements for regional training provisions are in place

## Annex 2 – Request from TGDC

"Tunayangaza Maisha Yako"



"We light Up Your Life"

### SHIRIKA LA UMEME TANZANIA TANZANIA ELECTRIC SUPPLY COMPANY LIMITED

Ubungo Head Office, "Umeme Park", P.O. Box 9024, Dar Es Salaam, Tanzania, Tel: +255 22 2451130/9, Fax: +255 22 2452026

Our Ref:

TGDC/GM/1/9/14

Date:

29<sup>th</sup> September 2014

Programme Director,  
Icelandic International Development Agency (iceida),  
Raudararstigur 27,  
IS-105 Reykjavik,  
ICELAND  
E-mail: arnih@iceida.is

Dear Sir/Madam,

**RE: INTRODUCING OUR COMPANY AND SEEKING COOPERATION IN  
GEOTHERMAL DEVELOPMENT IN TANZANIA**

The above heading refers.

Tanzania, located in East Africa has an estimated total population of 48 million and a total grid connected installed capacity of 1396.24MW from hydro (561.84MW), natural gas (501MW) and fossil fuels (333.4MW) from 1583.24MW after retiring hired emergency power generators. Power demand is projected to increase at 10% annually. Tanzania development agenda, 2025 envisages to be a semi-industrialised and middle income country. To achieve this goal, reliable and affordable energy has been identified as a key requirement. It is for this reason that a diversified power generation system is planned to involve renewable energy sources including geothermal.

To enable effective and efficient harnessing of the geothermal resource, the Government of the United Republic of Tanzania (URT) established the Tanzania Geothermal Development Company Limited (TGDC), a Subsidiary Company of the national electricity utility (Tanzania Electric Supply Company Limited – TANESCO) as a starting point.

I therefore wish to introduce our Company, Tanzania Geothermal Company Limited (TGDC) that was incorporated in December 2013 by the Government of Tanzania for the purpose of fostering and accelerating geothermal development. TGDC is a 100% owned by the government but has mandate for collaboration or partnering with other entities and organizations that have technological and professional capability in developing the geothermal resource or to receive assistance in capacity building including development of expertise through research, training and knowledge and transfer of skills.

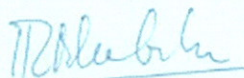
TGDC intends to become an established and popular company with an excellent track record in geothermal resources development and utilization in the East African Region and beyond. We understand that Iceland has long history and experience in developing geothermal. We wish to share the knowledge; experience and expertise by establishing collaborative relationship between our two institutions. Currently, TGDC has twelve (12) employees mostly geoscientists among which two of them are currently attending Masters Degree course at UNU-GTP in Iceland.

We understand that Iceida has long and reputable experience in supporting geothermal development and capacity building in East Africa with the purpose of enhancing geothermal knowledge and capacity to enable further actions towards geothermal utilization. We, also recognize that ICEIDA has established working cooperation with governmental institutions in the region to carry out surface exploration studies and drilling works.

In view of that, TGDC is seeking cooperation with Iceida in resource assessment, exploration, development and utilization of geothermal resources of Tanzania, which is estimated to be over 4,000MW. We are ready to visit you in Iceland at your convenient date to discuss with you areas, terms and modalities of cooperation in geothermal resources development and utilization in Tanzania. Please do not hesitate to contact us should you require more information from us.

Yours faithfully,

For: TANZANIA ELECTRIC SUPPLY COMPANY LIMITED



Eng. Kato T. Kabaka  
For: MANAGING DIRECTOR

This Project Document has been signed on the date first above written.

**SIGNED AND DELIVERED** at Dar es Salaam  
On behalf of the said **TANZANIA GEOTHERMAL  
DEVELOPMENT COMPANY LIMITED**

on this 2<sup>nd</sup> day of DECEMBER, 2015

Signature ..... 

Name: **Boniface S. Njombe**

Designation: **GENERAL MANAGER**

Witnessed by

Name: MERSHIL L. KIUUYO

Signature: ..... 

Date: 2<sup>nd</sup> DECEMBER, 2015

Title: MANAGER LEGAL AFFAIRS

**SIGNED AND DELIVERED** at Dar es Salaam  
on behalf of the said **ICELANDIC INTERNATIONAL  
DEVELOPMENT AGENCY** on

this 2 day of December, 2015

Signature ..... 

Name: **Engilbert Guðmundsson**

Designation: **DIRECTOR GENERAL**

Witnessed by

Name: David Bjarnason

Signature: ..... 

Date: 2/17/2015

Title: Programme Manager