

## **APPENDIX-8**

議事録

**THE PROJECT FOR FORMULATING MASTER PLAN  
ON DEVELOPMENT OF GEOTHERMAL ENERGY IN ETHIOPIA**

**MINUTES OF MEETING  
BETWEEN  
JOINT COORDINATION COMMITTEE  
AND  
THE JICA PROJECT TEAM  
ON  
THE INCEPTION REPORT  
FOR  
THE PROJECT FOR FORMULATING MASTER PLAN  
ON DEVELOPMENT OF GEOTHERMAL ENERGY IN ETHIOPIA**

The Project Team organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA"), headed by Mr. Shinya TAKAHASHI arrived the Federal Democratic Republic of Ethiopia (hereinafter referred to as "Ethiopia") on 13<sup>th</sup> October 2013 for the purpose of conducting the captioned project.

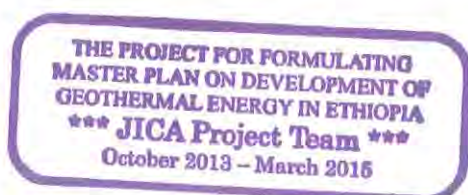
The Inception Report Meeting was held on 14<sup>th</sup> October 2013 at the head quarter of the Geological Survey of Ethiopia (hereinafter referred to as "GSE") with the participants listed in the attachment-1.

After the through discussions and follow-up meetings, the contents of the Inception Report was generally agreed as recorded in the Minutes of Meeting attached hereto.

Addis Ababa, 18<sup>th</sup> October 2013

**Mr. Shinya TAKAHASHI**  
Team Leader  
JICA Project Team  
Japan

**Mr. Masresha G. SELASSIE**  
Director General  
Geological Survey of Ethiopia  
Ethiopia



**RECORD OF DISCUSSION**  
**ON**  
**INCEPTION REPORT**  
**FOR THE PROJECT FOR FORMULATING MASTER PLAN ON DEVELOPMENT OF**  
**GEOTHERMAL ENERGY IN ETHIOPIA**

1. Selection of Target Area

<JICA Project team> We understand that ICEIDA's target sites and Reykjavik Geothermal (RG) concession sites are included in JICA's 16 target sites; however the Project Team intends to carry out the Master Plan for all the 16 sites as described in R/D. Therefore we would like to request GSE to coordinate with above organizations/agencies in order to avoid duplication/conflicts of surveys.

<GSE> We will coordinate with them in order to avoid duplication/conflicts. For the sites licensed to RG, we will confirm the license periods. If the licenses should still be effective, we will request RG that the Team shall conduct the survey in their fields.

<GSE> We would like to request the Team to include Corbetti geothermal sites to this M/P.

<JICA Project team> We think it is not suitable to include Corbetti geothermal site to the M/P for the following reasons:

- It is understood that RG holds the license of Corbetti site and plans to conduct test drilling within this year, and
- The objective of M/P is to prioritize all the geothermal sites to be newly developed; therefore it is not necessary to include the geothermal site where the development is ongoing.

<GSE> We understood.

<JICA Project team> The JICA Project Team will bring this issue back to Japan for the final approval by the JICA head office.

2. Accessibility of Target Area

<GSE> The following areas are not accessible by vehicle, very difficult even on foot; a helicopter would be necessary. We recommend the Project Team to conduct the survey with existing data/information of 1986 only.

- Damali (Damhali)
- Teo
- Danab

<JICA Project team> For the above-mentioned sites, it is also difficult for us to conduct that field survey in such sites due to security reasons. While we will review the existing data as thoroughly as possible, we would like to recommend GSE to conduct the field survey by the GSE-self for this M/P; otherwise GSE may miss a good opportunity to acquire the latest data of those sites.

<GSE> We will consider the survey in above sites. In case GSE conducts the survey, JICA shall assist in Logistics and equipment.

<JICA Project Team> We will discuss on Logistics with JICA. We will conduct a remote-sensing analysis for the all 16 sites before the next visit (January 2013); based on the results we will propose GSE the sites that are considered worth conducting site survey.

Further discussions were made between Mr. Solomon and Mr. Takahashi and the results of the discussion were as follows/

<GSE> If the above mentioned three sites should be excluded from the field survey due to the reason of difficult accessibility, GSE would like you to include two other sites, Fentale and Boseti in the Master plan.

<JICA Project Team> We will consider the possibility, in this case the three sites should be excluded from the prioritization analysis because the difficult accessibility may hinder the development, which will result in very low priority. We note that Fantale is located in Awash National park, we would like to discuss on this matter with JICA.

<GSE> GSE understood the case, but we still request you to evaluate the potential of the three sites with the existing information in any case remote sensing interpretation and rough estimation of potential shall be conducted on the bases of previous surveys and these areas shall be included in the maps to be produced for potential prospects in Ethiopia.

<JICA Project Team> We note that your requests will result in 18 sites for potential analysis, and 15 sites for prioritization analysis, and we agree in principle; subject to further discussion and approval of JICA head office.

<GSE> For the information to JICA Project team, GSE indicates that it is on grant negotiation to obtain partial funds from GRMF for detail surface exploration of one of the target areas (Dofan) to be conducted by GSE. If the grant finance is to be obtained it would be coordinated with JICA activity in this target area as input from GSE side.

<JICA Project Team> We understood and we will coordinate if the time schedule can be adjusted.

### 3. Laboratory Analysis by GSE

<GSE> While the technicians in the laboratory are well experienced and the results are accurate; some of reagents are not sufficient in stock. We would like to request the Team to procure necessary reagents for the Project.

<JICA Project team> Please inform us the type and quantity of reagents necessary. We will report to JICA head office for their consideration. If procurement should not be possible within the scope of the work of the Project, the samples that are not analyzed in GSE will be brought to Japan and/or South Africa to be analyzed.

#### 4. Equipment for MT Survey

<JICA Project Team> For the MT/TEM survey to be conducted during the Project, we would like to request you to provide us with two teams to assist the Japanese consultants including the survey facilities for one each, total four (4) sets. (Two sets will be granted by JICA)

<GSE> We will provide the Team and staffs of GSE for the Project at GSE's expense. In addition, we would like to request the JICA Team to provide one analysis software of MT survey (WinGLink), in order to analyze MT data in the satellite office.

<JICA Project team> Please inform us of the details of the software. We will bring this issue back to Japan for JICA's approval.

<GSE> We will provide necessary information on it.

#### 5. Analysis of Remote Sensing Data

<GSE> The analysis of remote sensing data is fundamental for us and we have a software for analysis. We would like to request the Project team to carry out On-The-Job training for analysis of target sites in Ethiopia as the part of technical transfer.

<JICA Project Team> Due to a constraint from the overall schedule, we will conduct that remote sensing analysis in Japan before the next visit. We are planning to explain the results to GSE at the initial period of the next visit; the explanation will include the methodology and interpretation as well. We do not assign a Japanese remote sensing expert, to Ethiopia. Instead, we will conduct a training for the analysis during the one month training period that is scheduled in June 2014 within the scope of this Project. Thus, we would like to request GSE to nominate one analysis expert for the one month training in Japan..

<GSE> Agreed.

#### 6. Evaluation Criteria for Selection of Prioritized area

<GSE> Geothermal generation is considered as environmental-friendly generation. However, why are environmental/social considerations included as evaluation criteria?

<JICA Project team> Large-scale developments sometimes need resettlement of people, cause adverse impacts on ethnic minorities and so on in/around the project sites, which is an world-wide issues of interest. Therefore, careful approach of above issues should be a part of success of the Project. Furthermore, the project site shall be secured from security-related problems such as terrorism. Thus, the above-mentioned issues are indispensable for the criteria.

<GSE> We understood.

#### 7. Reporting

<GSE> We understand the Interim Report (IT/R) will not be prepared by the Project Team.

However, as we think progress information to be shared within GSE, we would like to request you to prepare some documents for reporting the progress of the work at the end of the second site work in Ethiopia.

<JICA Project team> We think that much information will have not be accumulated by that time. Therefore, we would like to prepare a simple progress report that simply describes items that have been completed by that time and that will be conducted in the next steps, to share progress information.

<GSE> We would appreciate you to prepare such a short reports..

<GSE> In IC/R report, it is unclear that the soft copy of each report will be submitted or not. Please provide a soft copy of each report.

<JICA Project team> We will provide the soft copy on a CD-ROM or DVD for each report.

#### 8. Undertakings by GSE

<JICA Project team> We would like you to conduct necessary arrangement for the following issues:

- Custom Clearance of survey equipment (e.g. sampling equipment) to be delivered to Ethiopia
- Custom Clearance for taking out of samples (e.g. rocks and water samples) to other countries
- Custom Clearance of Satellite Phones to be brought to Ethiopia
- Others necessary

<GSE> We will do our best to do so.

(End of Discussion)

**THE PROJECT  
FOR  
FORMULATING MASTER PLAN ON DEVELOPMENT OF GEOTHERMAL  
ENERGY IN ETHIOPIA**

Meeting on Discussion of IC/R

**LIST OF ATTENDANCE**

Date and time: 2:00PM 14th Oct Venue GSE Meeting Room

	Name	Position and Organization	E-mail Address	Mobile
1	Masresh G/ Selassie	Director General		
2	Solomon Kibret	Geoth. Director (GSE)		
3	Mulugeta Asaye	Geothermal Projects Manager EEPCC		
4	Hundie Melke	Chief Geologist, GSE		
5	Assefa Zerihun	Planning Director, GSE		
6	Temina Menna	Public Relation p.c.c.o		
7	Ephrem Fufa	Program officer/JICA		
8	Yoshi Ichikawa	Representative, JICA Ethiopia		
9	Masahito Takeda	Geophysicist, SRED		
10	Toshiaki Hosoda	Deputy team leader/Geology		
11	Naoki Kawahara	Electric Power Development / Database		
12	Shunyo TAKAHASHI	Team Leader Geothermal Development		
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**THE PROJECT FOR FORMULATING MASTER PLAN  
ON DEVELOPMENT OF GEOTHERMAL ENERGY IN ETHIOPIA**

MINUTES OF MEETING  
BETWEEN  
JOINT COORDINATION COMMITTEE  
AND  
THE JICA PROJECT TEAM  
ON  
THE PROGRESS REPORT  
FOR

THE PROJECT FOR FORMULATING MASTER PLAN  
ON DEVELOPMENT OF GEOTHERMAL ENERGY IN ETHIOPIA

The Project Team organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA"), headed by Mr. TAKAHASHI Shinya arrived the Federal Democratic Republic of Ethiopia (hereinafter referred to as "Ethiopia") on 2nd April 2014 for the purpose of conducting the captioned project.

The Progress Report Meeting was held on 29<sup>th</sup> April 2014 at the head office of the Geological Survey of Ethiopia (hereinafter referred to as "GSE") with the participants listed in the attachment-1.

After the through discussions, the contents of the Progress Report were generally agreed as recorded in the Minutes of Meeting attached hereto.

Addis Ababa, 6th May, 2014

for 細田 年晃

Mr. TAKAHASHI Shinya

Team Leader

JICA Project Team

Hundie Melka  
Chief Geologist

Mr. Hundie Melka

Chief Geologist

Geological Survey of Ethiopia

THE PROJECT FOR FORMULATING  
MASTER PLAN ON DEVELOPMENT OF  
GEOTHERMAL ENERGY IN ETHIOPIA  
\*\*\* JICA Project Team \*\*\*  
October 2013 - March 2015



THE 2<sup>ND</sup> JOINT COORDINATION COMMITTEE

FOR

PROJECT FOR THE FORMULATING MASTER PLAN ON DEVELOPMENT OF GEOTHERMAL ENERGY IN ETHIOPIA

(PROGRESS REPORT)

DATE AND TIME: 29<sup>TH</sup> APRIL 2014 (TUE), 10:00-12:00

VENUE: CONFERENCE ROOM, GEOLOGICAL SURVEY OF ETHIOPIA (GSE)

LIST OF PARTICIPANT

Name	Position/ Organization	Signature
Yikeyi's Elhatu	Ministry of Water, Irrigation & Energy	[Signature]
Seblewengel Alemu	Drilling Service Directorate	[Signature]
Aikalwold Sirfan	S. Reservoir Engineer	[Signature]
Asfaw Beclu	Senior Geochemist	[Signature]
Tesfaye Kassa	Senior Geophysicist (Mineral Licensing and Administration)	[Signature]
Solomon Kebede	Director, GSE (Geothermal dept)	[Signature]
Manabu Momita	Project Manager of Alto Langano Pj	[Signature]
Mayumi Hayashi	JICA	[Signature]
Yuichi Ichikawa	JICA Ethiopia	[Signature]
Takusaburo Kimura	?	[Signature]
Daisuke Fukuda	JICA Study Team	[Signature]
Toshiaki Hosoda	JICA Study Team	[Signature]
Shinya TAKAHASHI	"	[Signature]
Naoki KAWAHARA	JICA Study Team	[Signature]
Shinsuke Sato	JICA Study Team	[Signature]
Tsukasa Yoshimura	"	[Signature]
Mulugeta Asaye	EEP, Geothermal Proj. Manager	[Signature]
Yoshihisa Shirashi	Embassy of Japan	[Signature]
Salahadin Ali	GSE (Geothermal)	[Signature]
Habte Berhanu	ESA	[Signature]
Hunise melki Assefa Zerihun	GSE	[Signature]

Name	Organization	Signature
Sabele Tamias	Ministry of Water, Irrigation	<del>Signature</del>
Betru Haile	Energy M.O.P	Signature

**RECORD OF DISCUSSION  
ON  
THE PROGRESS REPORT  
FOR  
THE PROJECT FOR FORMULATING MASTER PLAN  
ON DEVELOPMENT OF GEOTHERMAL ENERGY IN ETHIOPIA**

Mr. Solomon Kebede, the Director of Geothermal Department, Geological Survey of Ethiopia opened the meeting on behalf of Mr. Hunde, the Chief Geologist of GSE, followed by self-introduction of each participant and the subsequent presentation by the Project Team.

The presentation was made in accordance with the program attached hereto; and the presentation materials are also attached.

After the presentation, discussions and questions were invited by Mr. Hunde; the following is a record of the discussions.

1. Ministry of Water, Irrigation and Energy (MoWIE) questioned how the rejection temperature of 150°C was proposed; it might be too high. Mr. Yoshimura answered that The Project team assumed that the geothermal energy would be used for conventional steam turbines, and the temperature was taken from a results of a previous project.
2. GSE asked the Project team first, if the scope of the M/P includes drilling operations (of any kind) and second, how about the results of comparison of costs of hydro power and geothermal power.

Mr. Takahashi answered to the first question that this M/P is not able to cover all the detailed investigations; the Project team conducted supplemental survey for geological and geochemical aspects as well as collecting existing information. Using this information, the Project team will carry out potential evaluation.

Mr. Kawahara answered to the second question that this M/P will review the cost of hydropower by EEP, and geothermal from a case of Aluto-Langano concerning some case in other countries.

Mr. Yoshimura added that the installation cost of geothermal plant is higher than that of hydropower, but utilization rate of geothermal plant is much higher than that of hydropower, so running cost of geothermal plant is cheaper in many cases. It depends on the site conditions.

3. MoWIE mentioned that the Ethiopian government presently proceeds with hydropower development aiming at an electric energy supply of 80,000 GWh by the year of 2025, but that even if all the planned projects will be completed, the hydropower will cover only one third of the total demands expected, therefore, geothermal energy will definitely be necessary as second base load energy. In this M/P, the aim is 5,000 MW, but the aim is not limited.
  
4. MoWIE intends that the Project team will offer estimations of geothermal resource potential that is useful for their strategy of development.  
Mr. Takahashi answered that MW for each prospect would be estimated though the limited information.  
GSE proposed to share the data to be input to this M/P between MoWE and the Project Team, and it was agreed.
  
5. GSE questioned on the progress of the survey on direct use of geothermal.  
Mr. Takahashi answered that the Project team is now getting information and experience of direct use, and intends to propose direct use that is socially/economically suitable for a region.
  
6. GSE questioned about MT survey; the Project team explained what the MT survey is and how the survey would be conducted.

Mr. Kimura, vice resident representative of JICA Ethiopia Office, expressed his appreciation for the cooperation to the Master plan project.

Mr. Shiraishi, Embassy of Japan, mentioned that the geothermal technology of Japan has well advanced and therefore GoJ would like to support Ethiopia in geothermal field.

Finally, Mr. Hunde thanked to all participants for their attendance and closed the meeting.

(End of Discussion)



MINUTES OF MEETING  
OF  
THE 4<sup>TH</sup> JOINT COORDINATION COMMITTEE  
FOR  
THE PROJECT FOR FORMULATING MASTER PLAN  
ON DEVELOPMENT OF GEOTHERMAL ENERGY IN ETHIOPIA

The Project Team organized by the Japan International Cooperation Agency (hereinafter referred to as “JICA”), headed by Mr. TAKAHASHI Shinya arrived the Federal Democratic Republic of Ethiopia (hereinafter referred to as “Ethiopia”) on 3rd October 2014 for the purpose of conducting the captioned project.

The Joint Coordination Committee Meeting was held on 17<sup>th</sup> October 2014 at the head office of the Geological Survey of Ethiopia (hereinafter referred to as “GSE”) with the participants listed in the attachment.

After the through discussions, the prioritization of target sites was generally agreed as recorded in the Record of Discussion attached hereto.

Addis Ababa, 20th October, 2014

**Mr. TAKAHASHI Shinya**

Team Leader

JICA Project Team

**Hundie Melka**  
**Chief Geologist**

**Mr. Hunde Melka**

Chief Geologist

Geological Survey of Ethiopia

**Mr. JIN Kimiaki**

Chief Representative

JICA Ethiopia Office

## **The 4<sup>th</sup> Joint Coordination Committee Meeting**

**on**

### **The Project for Formulating Master Plan on Development of Geothermal Energy in Ethiopia**

Date and Time: 17<sup>th</sup> October 2014, 10:00 – 13:00

Venue: Conference Room, GSE Head office

#### **Agenda**

- |             |   |
|-------------|---|
| 10:00-10:05 | Opening Remarks by GSE  |
| 10:05-10:10 | Introduction  |
| 10:10-10:40 | Result of Field Survey at Dallol and Arabi                                      |
| 10:40-10:55 | Result of Geological and Geochemical Analysis                                   |
| 10:55-11:20 | Estimation of Geothermal Potential  |
| 11:20-11:30 | <Tea Break>   |
| 11:30-11:45 | Environmental Prioritization of Prospective Geothermal Energy Development Sites |
| 11:45-12:05 | Prioritization of Geothermal Power Plants                                       |
| 12:05-12:15 | Institutional Issues  |
| 12:15-12:20 | Direct use of Geothermal Resources  |
| 12:20-12:25 | Way Forward of the Project  |
| 12:25-12:50 | Discussion  |
| 12:50-12:55 | Inviting Comments from JICA   |
| 12:55-13:00 | Closing Address by GSE  |

**\*\* End of the Document \*\***

THE 4<sup>TH</sup> JOINT COORDINATION COMMITTEE MEETING

FOR

THE PROJECT FOR FORMULATING MASTER PLAN ON DEVELOPMENT OF GEOTHERMAL ENERGY IN ETHIOPIA

DATE AND TIME: 17<sup>TH</sup> OCTOBER 2014 (FRID), 10:00-13:00

VENUE: CONFERENCE ROOM, GEOLOGICAL SURVEY OF ETHIOPIA (GSE)

LIST OF PARTICIPANT <sup>(12/10/14)</sup>

Name	Position/ Organization	Signature
Masrasse G/selassie	Director General	
Alejandro Moreno	International Finance Corp.	
P. KLAAKIS	IFC	
Enayenta melaku	Director, ministry of water	
Sisay Ayalew	Director, ministry of mines	
Tesfaye Kassa	Sen. Expert, Ministry of Mines	
Habte Bestaie	License Sector Chief/Lead	
Salim Abd. Ali	Senior geochemist	
Befekadu Ohme	Director, Geothermal	
Asfaw Gechu	Senior Geochemist - Geothermal	
Bayu Wedaj	Drilling team leader	
Mulugeta Asaye	maintenance coordinator (ARU)	
Mulugeta Asaye	GSDP project Manager	
MERCA TASSER	Contract City Manager (CEP)	
Tessema Urgessa	IEEP,	
Tsukasa Yoshimura	Nippon Koei (JICA <del>Team</del> )	
Shinsuke SATO	Nippon Koei ( " )	
Nobuhiro MORI	Nippon Koei ( " )	
Naoki Kawahara	Nippon Koei ( " )	
Daisuke Fukuda	Geothermal Engineering Co.Ltd.	
Shinya TAKAHASHI	Team Leader of JICA Team	
Toshiaki Hosoda	JICA Project Team	

**RECORD OF DISCUSSION**  
**ON**  
**THE 4<sup>TH</sup> JOINT COORDINATION COMMITTEE**  
**FOR**  
**THE PROJECT FOR FORMULATING MASTER PLAN**  
**ON DEVELOPMENT OF GEOTHERMAL ENERGY IN ETHIOPIA**

Upon the opening of the Joint Coordination Committee (JCC) meeting, Mr. Masresia Gebreselasie, the Director General of Geological Survey of Ethiopia (GSE), delivered the opening address to all the participants therein, and Mr. Hundie, the Chief Geologist of GSE made his declaration with a welcoming address. Thereafter, Mr. Hundie, as the chairman of the meeting, invited the JICA Project Team for its presentations on the survey results achieved up to date.

The presentations were made in accordance with the program attached hereto; the presentation materials are also attached herewith.

After the presentations, the discussions and questions were invited by the chairman, Mr. Hundie; the following is the record of the discussions, with supplemental notes by the JICA Project Team.

1. Mr. Oluma, the Head of Geoscience Data Center of GSE, made various questions and comments, and the JICA Project Team responded as follows:

(a) Mr. Oluma suggested that the existing gravity and infrared data of 1970s should be taken into account for reservoir estimation.

Mr. Takahashi, the Team Leader of the JICA Project Team, replied him that the team considered as much information as possible, but some information might not come into the sights of the JICA Project Team. He requested Mr. Oluma to share information with the Project Team for the estimation.

(b) Mr. Oluma asked why the survey was not conducted in Tulu Moye and Wondo Genet geothermal sites.

Mr. Takahashi replied that the Project Team proposed GSE to excluded Tulu Moye from the field survey sites because the site is now under concession of a private firm, and that the proposal was accepted.

Mr. Solomon, the Director of Geothermal Resource Assessment Directorate of GSE, explained that Wonde Genet was considered not having enough potential for power generation though the site has hot spring site; therefore the site was



excluded from the Master Plan Project.

- (c) Mr. Oluma commented that the wide area of Aluto-1 (Aluto-Langano), Aluto-2 (Finkilo), and Aluto-3 (Bobessa) including the Oitu spring at Lake Langano should be considered to be one continuous body and be evaluated as a single geothermal reservoir.

Mr. Solomon explained that the target sites given to the JICA Project Team were defined by GSE; the three sites in the Aluto area under the question were separately defined as Aluto-1, Aluto-2 and Aluto-3.

- (d) Mr. Oluma pointed out that the Project did not include the Lake Abhe site, though it is considered to be a good potential site.

Mr. Takahashi replied that the border zone of the neighboring countries is designated as a "keep-off zone" by the Government of Japan due to security reasons; therefore the Lake Abhe site was excluded from the Project.

- (e) Mr. Oluma suggested that the permeability of reservoir rock and cap rock should also be reviewed with the previous results of Alto-Langano and Tendaho sites where test wells were provided.

Mr. Takahashi replied that the Project team reviewed the latest review results of both sites.

- (f) Mr. Oluma commented that the priority has to be given to non-electrified rural areas such as Dallol where geothermal energy is available.

Mr. Takahashi replied that the concept of "local-production and local-consumption" would be an ideal development option, but this Master Plan has been programmed to work-out the development program that should be most beneficial to the country of Ethiopia as a whole. He also commented that rural electrification, though it should be also important, shall be considered separately.

- (g) Mr. Oluma pointed out that the Dallol site is characterized by very high-salinity geothermal fluid like that of Djibouti, and that the Aluto-Langano experienced silica and carbonate scaling problems. He suggested that these should be considered in the Master Plan formulation.

Mr. Takahashi informed that in Djibouti, test wells are to be drilled at a different area from the area of high-salinity geothermal fluid instead of utilizing the fluid of high-salinity. That updated cost estimation has been available for Aluto-Langano and Tendaho. He also said that the JICA Master

Plan has taken into account those points as cost impacts.

2. Mr. Hundie of GSE and Ms. Enerhenta of Ministry of Mines (MoM) asked whether the Environmental and Social Considerations conducted by the JICA Master Plan Project is based on the IEE regulations of Ethiopia, and how the scoping were decided for the evaluation.

Mr. Sato answered that the JICA Master Plan Project conducted the Environmental and Social Impact Assessment (ESIA) survey to collect information on socio/natural-environmental matters of all target sites; the information necessary for prioritization of geothermal sites. He added that this is not necessarily in compliance with the Ethiopian IEE regulations that has to be followed when a specific project is to be implemented, though the results of this study could be referred to, for the IEE or EIA; that if any projects identified by this JICA Master Plan Projects to be implemented, the EIA followed by IEE for the identified has to be conducted in accordance with the Ethiopian regulations. The results of IEE obtained through the ESIA survey have been utilized limited to the prioritization or the rating of the prospective geothermal energy development sites in this Master Plan. Regarding the rating criteria, he explained that the Project Team applied appropriate rating based on experiences together with local knowledge by the national consultant who conducted the survey.

3. Mr. Salahadin of GSE asked the reason why the project team used a quartz geothermometer for estimating reservoir temperature, instead other geochemical thermometers reported in previous reports.

Mr. Fukuda, the Geochemist of the Project Team, answered that he had examined the results of various thermometers (quartz and alkaline thermometers) using the Project Team's and reference data. He observed that the quartz temperature indicated an almost uniform value for hot springs within each of the survey site, and a plausible temperature of the Aluto reservoir by the data of LA-8. With correction of a difference in the estimated temperature between the reservoir (LA-8) and neighboring hot springs (Oiutu), the use of a single geothermometer, as a standard procedure, is practically applicable to evaluate the entire survey sites.

4. Mr. Sahel of Ministry of Water, Irrigation and Energy (MoWIE) stated that the project period seemed to be too short for Aluto and Tendaho where the construction periods were announced as 2020 and 2021, respectively.

Mr. Kawahara, the Electric development planner of the Project Team, responded to him that the periods for the Aluto-Langano and Tendaho project were quoted from

the existing documents, and an implementation period of six years is considered for the other sites.

Mr. Sahel mentioned that a period of six years seemed to be short as a project period of a green field for the construction of a geothermal power station.

Mr. Kawahara responded that the project team adopted the shortest period of time that can be achieved for the realization of a project.

5. Mr. Takahashi requested the participants for their comments on the proposal that some of geothermal development sites are prioritized over other renewable energy projects, i.e. solar and wind power, listed by the EEPCO master plan.

Mr. Sahel of MOWIE responded that the first priority should be given to hydropower in Ethiopia at this moment, and that geothermal should be the next if it should be economically viable before the development of other renewable energy.

Mr. Issa of World Bank commented that, the prioritization for development is based on the least cost approach, but should include the cost for transmission line.

Mr. Takahashi replied that accessibility to the transmission line was considered in the prioritization as access road construction costs, and thereby the cost for transmission line is implicitly considered for the prioritization.

6. Through the discussions above, the contents of the presentation are generally accepted and appreciated by the participants.

Mr. Jin, the chief representative of JICA Ethiopia Office, commented that this master plan project was highlighted in the official Communiqué agreed upon by the prime ministers of Japan and Ethiopia, as one of the prioritized projects assisted by Japan, and that JICA intends to continue its support for the development of the geothermal energy in Ethiopia. He also commented that the proposal of “strategic enterprise” is a good idea to expedite the geothermal energy development in Ethiopia. As the closing of his comment, he expressed his appreciation to both GSE and the JICA Project team for the successful execution of this JICA Master Plan project up to date, and he requested the JICA project team that the JICA Master Plan project should be completed to the satisfaction to the both Governments of Japan and Ethiopia.

At the end of the JCC meeting, Mr. Hundie closed the meeting together with his thanks to all the participants for their attendance and various productive comments on the results of the JICA Master Plan Project.

(End of Document)

**THE PROJECT FOR FORMULATING MASTER PLAN  
ON DEVELOPMENT OF GEOTHERMAL ENERGY IN ETHIOPIA**

Date: <sup>05</sup> 11 November, 2013

To: Geological Survey of Ethiopia

Your ref. *Clarification on queries by JICA*  
*(October 24, 2013)*

Our ref. *JA12G1014-131105*

**Subject Target Sites for the JICA Master Plan Formulation Project**

Dear Sir,

Having reviewed your letter addressed to Mr. Ichikawa, JICA Ethiopia office, MM and RD, with the concept of this Project in mind; our observations and recommendations are as follows:

Observations:

1. It is understood that the sixteen (16) sites agreed in MM and RD were the sites where various surveys including remote sensing analysis and site surveys were to be conducted; for the Master Plan formulation under this Project;
2. It is also understood that all recognized geothermal sites including such sites that are being developed, under preparation for development, green fields or etc should be included for the consideration under this Project, as this Project is to formulate the national geothermal development Master Plan that should consider an overall plan of geothermal power generation toward a target year. It is thus the Team agrees that the sites that GSE has recently proposed should be included in the Project;
3. We have also noted as a result of the first survey in Ethiopia, that the present conditions regarding geothermal development have changed from the time of MM/RD. We therefore reviewed them and prepared our recommendations for the necessary activities to be conducted by the Project;
4. Our recommendations together with the summary table are as follows.

Recommendations:

1. Prioritization will be examined with consideration of project development stages for the all the 22 sites as shown in the table;
2. Remote sensing analysis will be conducted for the 21 sites; and for the Corbetti site, the area will be analyzed where the satellite images already ordered for this project encompass;
3. Site survey will not be conducted in the following seven (7) sites; i.e. three (3) where a private firm has the concessions (Corbett, Abaya and Tulu Moya), and the three (3) where F/S has been or will have been completed (Aluto-langano-1, Tendaho-1 (Dubti), Tendaho-2 (Ayro Beda)), as well as one (1) site in a



National Park (Fantale). Analysis will be conducted of these sites with existing data to be made available to the Team.

4. As a result, site survey will be conducted in 15 sites (22 sites minus 7 sites); among those, GSE should undertake the survey in 6 sites where JICA Team is advised not to enter, as shown in the table;
5. MT/TEM survey will be conducted in two (2) sites to be selected from the 9 sites in the table below. Coordination will be made with a donor (ICEIDA/NDF) for the selection of the sites for TM/TEM survey to avoid duplication.

**Summary of Target Sites**

Geothermal Sites		Prioritization / Data base	Remote Sensing (within images already purchased)	Site Survey	Candidates for MT/TEM survey (2 sites from the below)
1	Dallol	☑	☑	GSE	-
2	Tendaho-3 (Allalo Beda)	☑	☑	☑	☑
3	Boina	☑	☑	GSE	-
4	Damali	☑	☑	GSE	-
5	Teo	☑	☑	GSE	-
6	Danab	☑	☑	GSE	-
7	Meteka	☑	☑	☑	☑
8	Arabi	☑	☑	GSE	-
9	Dofan	☑	☑	☑	☑
10	Kone	☑	☑	☑	☑
11	Nazareth	☑	☑	☑	☑
12	Gedemsa	☑	☑	☑	☑
13	Tulu Moya	☑	☑	-	-
14	Aluto-2 (Finkilo)	☑	☑	☑	☑
15	Aluto-3 (Bobesa)	☑	☑	☑	☑
16	Abaya	☑	☑	-	-
(17)	Fantale	☑	☑	-	-
(18)	Boseti	☑	☑	☑	☑
(19)	Corbetti	☑	▲	-	-
(20)	Aluto-1	☑	☑	-	-
(21)	Tendaho-1 (Dubti)	☑	☑	-	-
(22)	Tendaho-2 (Ayro Beda)	☑	☑	-	-

☑: Target for the M/P formulation project

▲: Analyses only for areas where the purchased satellite images encompass.

GSE: The sites where GSE should undertake the site survey.

Sincerely yours,

TAKAHASHI Shinya

Team Leader

The Project for Formulating Master  
Plan on Development of Geothermal Energy in Ethiopia  
(JICA Assistance)

THE PROJECT FOR FORMULATING  
MASTER PLAN ON DEVELOPMENT OF  
GEOTHERMAL ENERGY IN ETHIOPIA  
\*\*\* JICA Project Team \*\*\*  
October 2013 – March 2015

**APPENDIX-9**

写真集

**No.2 AllaloBeda (Tendaho-2)**

	
<p>Overview</p>	<p>Hot spring and silica deposits beside the springs</p>
	
<p>Geysers and fumaroles from the ground; There are more than 20 geysers at the site.</p>	<p>Measuring the temperature of geyser</p>
	
<p>Fumalore from rocky slope.</p>	<p>Gate in Awash River for irrigation</p>

No.7 Meteka (1/2)



Overview of site; the area is composed of swampy area (right) and fault scarp (right).



Awash River; the river is flown in the swampy area.



Meteka Spring; hot spring is welling from the foot of fault scarp.



Sampling of hot spring from the bath beside National Road



Sampling of hot spring at the roadside ditch



Termination of site survey due to bad road condition.



No.7 Meteka (2/2)



Sampling of hot spring beside Awash River



Outcrop at fault scarp; basaltic and andesitic rock is commonly observed.



Outcrop at fault scarp; clay veins with gypsum are observed.



Gypsum vein taken from the outcrop



Termination of site survey due to bad road condition.



Dense bush with rocky ground in upland; it is difficult to conduct MT/TEM survey.

No.9 Dofan (1/2)



Termination of site survey due to bad road condition after heavy rain.



Overview of the Site



Dofan Basalt; Basalt lava is observed on the way to manifestation area.



Large hot spring; plenty amount of water is flown out.



Measuring temperature at hot spring



Measuring temperature of fumarole used for bathing

No.9 Dofan (2/2)



Fumaroles in basalt lava; white clay and sulfur are observed at the fumaroles.



Altered basalt/ Trachytic andesite; white clay and sulfur are common.



Yellow sulfur vein is developed in white clay zone.



Measuring ground temperature



Crystallized sulfur; local peoples are mining and extracting sulfur for selling.



Extracted sulfur by local miner for selling

**No.10 Kone (1/2)**



Overview of Korke Caldera; East of Kone Caldera, Surrounded by caldera scarp.



Korke Caldera; filled by basalt lava.



Geological survey at the north of Kone Caldera



Obsidian pyroclastic rock was found at the north of Kone Caldera



Western Rim of Kone Caldera



Very recent basalt lava is erupted in Kone Caldera

**No.10 Kone (2/2)**



Overview of Kone Caldera; dense bush is grown and difficult to walk through.



Entering Kone Caldera; footpath is only available and vehicle cannot enter inside.



Ropy wrinkles of basalt lava  
(Pahoehoe lava)



Basalt lava cave



Small crater of basalt lava



Fumalore from basalt lava  
(Gur Fumarole)

No.11 Nazreth (1/2)



Entrance of Boko Sanatorium; fumaroles are used for medicine



Fumaroles are observed at the front cliff; Wonji Fault scarp.



Steam bath house constructed closer to the cliff.



Fumarole is found at the fracture in the cliff; local peoples put bottles to collect water.



Gas sampling from the fracture



Amorphous quartz (agate) sub-originated at the cliff.

No.11 Nazreth (2/2)



Entrance of Sodole Hot Spring; pools, baths and cottages are constructed for customers.



One of the source of Sodole hot springs



Geochemical survey of Sodole hot springs



Awash River flow beside Sodole hot springs



Another source of Sodole hot springs; algae is grown in the spring,



Sampling at another source of Sodole hot springs

No.12 Gedemsa (1/2)



Asking the way to local peoples



Going to climb up caldera wall



Inside the caldera from caldera wall



Amorphous Quartz (agate) was found in acidic welded tuff layer, outcropped at caldera wall.



Seeing south caldera wall



Seeing east caldera wall and Lake Koka



No.12 Gedemsa (2/2)



Warm water from the borehole at the south of Gedemsa Caldera



Fumarole at the south of Gedemsa Caldera; local peoples dig the cave (left) for bathing.



Basalt lava observed at the south of Gedemsa Caldera (front)



Hot spring in Gergedi (Hippo Pool); located beside Awash River



Bathing facility



Source of Hot Spring; the Spring is located on Wonji Fault.

**No.14 Finkilo (1/2)**



Overview; the site is composed of slopes and terraces.



Pumice tuff is commonly observed at the surface.



Deep valley in the site; many fumaroles are observed.



Fumaroles in dense bush



Shore of Lake Langano; many hot springs are observed.



Hot spring at the shore of Lake Langano;  
Local peoples are used for bathing.

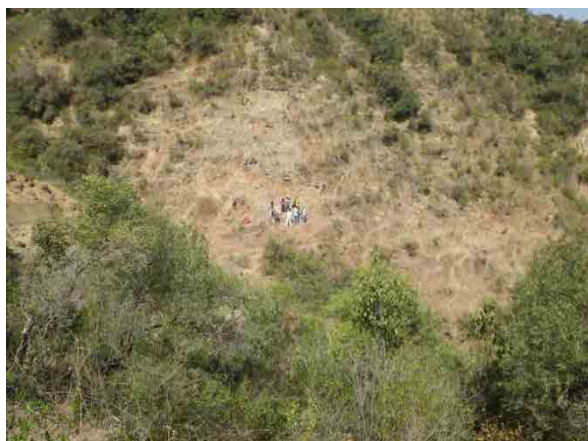
**No.15 Finkilo (2/2)**



Overview of Finkilo; thick pumice tuff layer covered the surface.



Closer view of pumice tuff layer; sedimentation shows pumice fall deposit.



Fumaroles at the slope (center)



Altered reddish clay observed at the fumaroles area.



Viewing the north of Aluto Volcanic Complex



Thermal Gradient Well (TG Well) found at the foot of Finkilo site

**No.15 Bobesa (1/2)**



Overview of Bobesa; many fumaroles are found.



Closer view of Bobesa; fumaroles are spouted out from fractures.



Closer view of fumaroles; color of rock is changed into reddish.



Closer view of fumaroles; many fumaroles are spurted out with sounds.



Sampling of gas from fumaroles



Stratified volcanic tuff observed on the way to the site

**No.15 Bobesa (2/2)**



Small fumaroles from fracture in outcrop



Fumaroles in Gebiba, approx 9km SSW from Bobesa, outside of Aluto Volcano



Water collecting by local peoples in Gebiba;  
They put grass to cool down the steams.



Altered reddish clay observed at around fumaroles area.



Welded tuff in Gebiba



Trachytic Andesite lava at Gebiba,  
covered by welded tuff

No.18 Boseti (1/2)



Site investigation of fumaroles (Steam bath) in Kintano; fumaroles is from fracture of basalt lava.



White pumice tuff is observed at some part of the ground.



Fault scarp (right) with open crack in Kintano; fumaroles are observed along the faultline.



Fault scarp (right) and obsidian lava (left)



Measuring temperature of fumarole



Gas sampling from fumarole

No.18 Boseti (2/2)



Overview of MT/TEM Site and Boseti Bericha mountain (left); The area covered by Obsidian lava.



An end of obsidian lava flow.



Obsidian lava block; lava looks viscous and flow structure is developed.



Topographic survey for MT survey



Setting of electrode below the ground



Moving to the next measurement point

No.20 Aluto-1 (Aluto-Langano)



Drilling rig at LA-9D test well site



Geothermal well and separator in LA-4



Gas sampling in LA-6



Setting sampling ornament at LA-8



Turbine and Generator in Aluto-Langano  
Geothermal Power Plant



Operation room in Aluto-Langano Geothermal  
Power Plant



No.21 Dubti (1/2)



Well head of TD-1



Well head of TD-1 (BOP)



Hot spring in Dubti; the hot water contains mud and bubbles.



Mud pool in Dubti



Small Fumarole in Dubti



The color of sample shows Containing of Sulfur in collected gas

No.21 Dubti (2/2)



Well head of TD-6; BOP is tilting.



Opening the valve of TD-6



Overview of TD-4 Test well



TD-4 Test well; mud is frown out beside the well.



Well head of TD-5



Silencer of TD-5

No.22 Ayrobera (1/2)



Overview of Ayrobera Site; Fumaroles are at the mounds in Alluvial Plain.



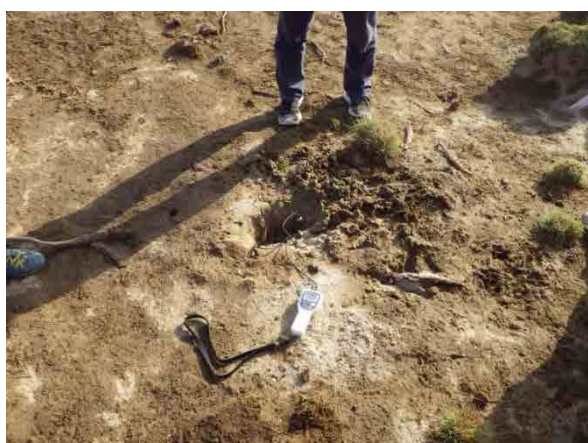
A Major Fault scarp; which runs through the direction of NW-SE.



Wet ground due to fumaroles



Wet ground due to fumaroles; many wet grounds are observed.



Measuring the temperature of fumarole from the ground



Gas Sampling of the fumaroles from the ground

No.22 Ayrobera (2/2)



Gypsum (White stone) and Gas Samples



Setting of Induction Coil for MT Survey



Completion of MT Survey Setting



Setting of Inductor Coil for TEM Survey



Topographic Survey and Setting of TEM Survey  
Equipment



TEM Survey Measurement

**Additional Site Survey: Seha, North of Tendaho (1/2)**



Overview; Surface is covered by basalt lava.



Collapsed basalt lava cave; weak fumaroles was found from the cave.



Steep and sharp fault; the trend is NW-SE, concordant with Manda- Harraro Graven.



Top view from fault scarp; water is spouted out from the foot of the fault.



View along the fault scarp; water is spouted out from the foot of the fault.



Sampling of water in hot spring located at the foot of the fault scarp.

**Additional Site Survey: Lake Loma, North of Tendaho (2/2)**

 <p>Fault scarps and Alluvial plain</p>	 <p>Basalt lava is observed at fault scarp</p>
 <p>Caldera lake (Lake Loma)</p>	 <p>Water Sampling at Crater lake; water is cold.</p>
 <p>Climbing up the caldera wall</p>	 <p>Recent basalt lava flow</p>

### Additional Site Survey: Butajira



Crater Lake in the south of Butajira (Lake Ar Shetan)



Butajira Geothermal Site; hot water was splashed out at the depth of approx. 200m when water well was drilled.



Water well drilling point; small pond was performed.



Butajira hot spring; hot spring is located at low land of the area.



Butajira hot spring; local peoples are fetching water and cooking maize.