



**Sarulla**  
Operations Ltd

**Environmental Monitoring Plan**

**Development of Sarulla Geothermal Field and  
Power Plant of 330 MW Capacity**

**North Tapanuli Regency,  
North Sumatera Province**

**August 2009**

# VALIDATION SHEET

**GOVERNOR OF NORTH SUMATERA DECREE**

**NUMBER: 671.26/3067/K/2009**

**ON 12 AUGUST 2009**

**CONCERNING**

**ENVIRONMENTAL FEASIBILITY OF THE  
DEVELOPMENT OF SARULLA GEOTHERMAL FIELD  
AND POWER PLANT WITH CAPACITY OF 330 MW IN**

**NORTH TAPANULI REGENCY**

**NORTH SUMATERA PROVINCE**



**Sarulla Operations Ltd (SOL)  
2009**

**STATEMENT**

No: SOL-092/DIR/VII/2009

The undersigned,

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Position : Director  
Company : Sarulla Operations Ltd. (SOL)  
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As the project proponent for the Development of Sarulla Geothermal Field and Power Plant of 330 MW Capacity in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency, North Sumatera Province, states that:

1. We will implement the commitments on environmental management and monitoring as specified in Environmental Management Plan and Environmental Monitoring Plan for the Development of Sarulla Geothermal Field and Power Plant of 330 MW Capacity in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency, North Sumatera Province.
2. We will undertake environmental management and monitoring as appropriate in accordance with relevant regulations.

This statement is prepared truthfully and to be used appropriately.

Jakarta, June 2009

**Sarulla Operations Ltd. (SOL)**



**Aries Pardjianto**

*Director*

## FOREWORD

SARULLA OPERATIONS LTD., (SOL) a consortium between PT MEDCO GEOPOWER SARULLA, ORSARULLA INC., SARULLA POWER ASSET LTD., and KYUDEN SARULLA PTE LTD, plans to develop Sarulla geothermal field and 330 MW power plant in Pahae Jae and Pahae Julu Districts of Tapanuli Utara Regency, Sumatera Utara Province.

The development of this project will bring positive impacts but on the other hand possibilities of negative impacts on physical-chemical components, biological components, and socio-economic, socio-cultural, and public health components.

AMDAL documents of Sarulla geothermal field development were approved in November 2005 by the Governor of Sumatera Utara. Considering (a) additional activities like production well operation and drilling; (b) changes in vapor and brine cooling system from water to air, which is more environmentally friendly; (c) constructions and operations of internal electricity transmission from Silangkitang (SIL) to Namora I Langit NIL; (d) changes of project proponent from PT PLN (Persero) to Sarulla Operations Ltd. (SOL), the 2005 AMDAL documents have been revised in order to continue the development of Sarulla geothermal field and power plant.

Following an approval of Term of Reference Document by the Environmental Impact Control Agency of North Sumatera Province No: 973/BPDL-SU/BTL/2008 on 8 August 2008, the Environmental Impact Statement (ANDAL), Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) documents have been prepared. These documents have been prepared in accordance to Minister of Environment Decree No. 08 of 2006 regarding Guidance for Preparing Environmental Impact Assessment Documents.

Sarulla Operations Ltd. is committed to environment, health and safety (HSE) in conducting its activities. It is expected that this project will give benefits to the stakeholders, especially to local communities, local government, employees and its shareholders.

To those who have helped in the completions of ANDAL, RKL, and RPL documents, we express our gratitude.

Jakarta, June 2009

Project Proponent,  
**Sarulla Operations Ltd., (SOL)**

**Aries Pardjimanto**  
*Director*

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# CHAPTER I

## INTRODUCTION

### 1.1 BACKGROUND

This Environmental Monitoring Plan (*Rencana Pemantauan Lingkungan Hidup* = RPL) is an effort to monitor environmental components significantly impacted by the activities of developing Sarulla geothermal field and power plant in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency, North Sumatera Province proposed by Sarulla Operations Ltd (hereafter referred to as SOL) (see **Map 1-1 for project location**). The Environmental Monitoring Plan consists of a set of activities performed continuously, systematically and planned. Monitoring will be carried out for relevant environmental components used as indicators for (1) compliance evaluation of relevant laws and regulations related to the activities in developing geothermal field and Sarulla power plant, (2) determining conformance towards SOL's commitments and other SOL's operational conditions, (3) determining long-term trends of monitored environmental indicator.

In principle, the Environmental Monitoring Plan can be used as:

- Operational guidelines, directions and instructions in environmental monitoring of activities in the development of Sarulla geothermal field and power plant;
- Guidelines and directions for SOL as the project proponent and relevant institutions in carrying out and inspection of environmental monitoring in North Tapanuli Regency, North Sumatera Province.

### 1.2 ENVIRONMENTAL MONITORING PLAN (RPL) OBJECTIVES

The main objective of this Environmental Monitoring Plan is to monitor all activities to be undertaken by SOL, especially activities impacting the following environmental components: physical-chemical, biological, social, economical, and public health. SOL is obliged and responsible for the prevention and the mitigation of such negative impacts caused by the activities. Objectives of the Environmental Monitoring Plan are:

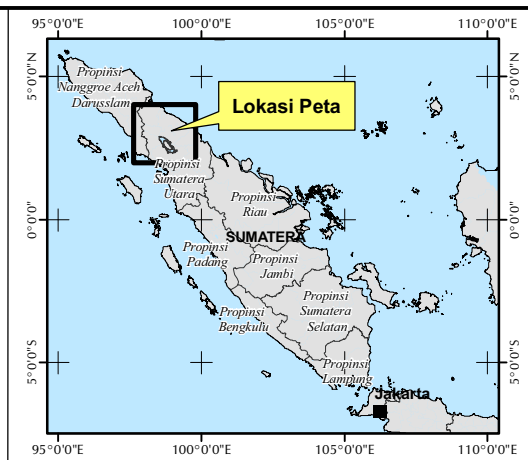
- To monitor environmental components affected by the activities of the development of Sarulla geothermal field and power plant in accordance to the ANDAL study undertaken;
- To ensure that the implementation of the Environmental Monitoring Plan is on target, and minimize the negative impacts and maximize the positive impacts of the proposed activities.



### 1.3 THE PURPOSES OF ENVIRONMENTAL MONITORING PLAN (RPL)

This Environmental Monitoring Plan serves as directions to guide the environmental decision-making process in environmental monitoring of SOL activities for the government, project proponent (SOL) and the local community:

- For the Project Proponent (SOL), the RPL will be used as guidelines in the implementation of the environmental monitoring program in order to achieve environmentally sound activities. For the project proponent, the results of environmental monitoring can be used as an early warning system in the case of unpredicted events;
- For the government, the RPL is a source of information and as a guideline in observation and guidelines in environmental management, inspection and conservation of the development of Sarulla geothermal field and power plant areas;
- For the local community, the RPL is a source of information to understand the activities in developing Sarulla geothermal field and power plant that are environmentally sound. Thus, to minimize misunderstanding and to create mutual cooperation between SOL and the local community.



**LEGENDA**  
Legend

- Ibukota Propinsi  
Provincial Capital
- Ibu Kota Kabupaten/Kotamadya  
Regency Capital/Municipality
- Ibu Kota Kecamatan dll  
District Capital
- ▲ Gunung  
Mountain
- Jalan  
Road
- +— Rel Kereta Api  
Railway
- +— Batas administrasi Propinsi  
Province Administrative Boundary
- +— Batas Administratif Kabupaten  
Regency Administrative Boundary
- Sungai  
River

N

0 12.5 25 50 Kilometers

Sumber (Source) :  
 Peta Rupa Bumi Indonesia (BAKOSURTANAL)  
 The Shuttle Radar Topography Mission (SRTM), Resolusi 90 meter  
 Universal Transverse Mercator (UTM), Zona 47 Utara, Datum Reference WGS 84

<b>RENCANA PEMANTAUAN LINGKUNGAN</b> ENVIRONMENTAL MONITORING PLAN			
<b>LOKASI PROYEK PENGEMBANGAN PANAS BUMI DAN PEMBANGUNAN PLTP SARULLA</b> PROJECT LOCATION OF GEOTHERMAL POWER PLANT			
Skala Scale	1:300.000	Digambar Oleh Drawn By	GGG
Peta Map	I - 1	Diperiksa Oleh Proofreader	ABU
Tanggal Revisi Revision Date	25/10/08	Digabung Oleh Compilation	ERM

## CHAPTER II ENVIRONMENTAL MONITORING PLAN

### 2.1 PRE-CONSTRUCTION STAGE

#### 2.1.1 Socio-economic, socio-cultural and public health components

##### 2.1.1.1 Land ownership and occupancy

1. *Significant impact monitored*

a) *Impact parameter*

Area and lay out of the land required by SOL

b) *Significant impact indicator*

- Changes in land ownership that used to be owned by local communities in the vicinity of the project areas
- Community unrest due to land acquisition

2. *Source of significant impact*

Land acquisition

3. *Environmental monitoring objective*

To ensure that land acquisition process complies with the applicable regulations on compensations toward land and vegetation

4. *Environmental monitoring plan*

a) *Data collection and analysis*

- To calculate the amount of land required for the project
- To acquire data on land ownership, area, legal status of the land to be acquired and from the National Land Agency (BPN) of North Tapanuli Regency
- To create a map of land ownership in collaboration with the BPN of North Tapanuli Regency

b) *Environmental monitoring location*

The development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

c) *Environmental monitoring period and frequency*

During pre-construction stage

5. *Environmental monitoring institutions*

- Implementer: SOL

- Supervisor: BPN of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

#### 2.1.1.2 *Community unrest*

##### 1. *Significant impact monitored*

###### a) *Impact parameter*

Community unrest

###### b) *Significant impact indicator*

- Communities' complaints regarding boundaries and size of land
- Different opinions in land value and compensation types for land and/or vegetation acquisitions

##### 2. *Source of significant impact*

Land acquisition

##### 3. *Environmental monitoring objective*

To ensure that the land acquisition process complies with the applicable regulations on compensations toward land and vegetation

##### 4. *Environmental monitoring plan*

###### a) *Data collection and analysis*

To collect data and to record complaints arising from the land acquisition process

###### b) *Environmental monitoring location*

Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

###### c) *Environmental monitoring period and frequency*

During the pre-construction stage

##### 5. *Environmental monitoring institutions*

- Implementer: SOL

- Supervisor: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

## 2.2 CONSTRUCTION STAGE

### 2.2.1 Geophysical and chemical components

#### 2.2.1.1 *Air quality*

##### 1. *Significant impact monitored*

###### a) *Impact parameter*

H<sub>2</sub>S concentrations in ambient air

###### b) *Significant impact indicator*

Minister of Environment Decree No. Kep-50/MENLH/11/ 1996

##### 2) *Source of significant impact*

Well drilling and production testing

##### 3) *Environmental monitoring objective*

To monitor changes in H<sub>2</sub>S concentrations in ambient air

##### 4) *Environmental monitoring plan*

###### a) *Data collection and analysis*

Measurement of H<sub>2</sub>S concentrations in ambient air using H<sub>2</sub>S monitoring equipment according to Indonesian National Standard (SNI)

###### b) *Environmental monitoring location*

Well locations and villages around the well locations

###### c) *Environmental monitoring period and frequency*

Once a week during well drilling and production testing

##### 5) *Environmental monitoring institutions*

- Implementer: SOL

- Supervisor: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

#### 2.2.1.2 Noise

##### 1. Significant impact monitored

###### a) Impact parameter

Noise level

###### b) Significant impact indicator

Minister of Environment Decree No. Kep-48/MENLH/11/1996

##### 2. Source of significant impact

- Well drilling and production testing
- Mobilization of equipment and materials

##### 3. Environmental monitoring objective

To determine the noise level

##### 4. Environmental monitoring plan

###### a) Data collection and analysis

Measurement of noise levels in ambient air using equipment according to Indonesian National Standard (SNI)

###### b) Environmental monitoring location

- Well locations
- Villages around the well locations

###### c) Environmental monitoring period and frequency

Once a week during production testing

##### 5. Environmental monitoring institutions

- Implementer: SOL

- Supervisor: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

## 2.2.2 Socio-economic, socio-cultural and public health components

### 2.2.2.1 Job opportunities

#### 1. Significant impact monitored

##### a) Impact parameter

Job opportunities

##### b) Significant impact indicator

Numbers of local and non-local workers recruited by SOL and its contractors

#### 2. Source of significant impact

Workforce recruitment

#### 3. Environmental monitoring objective

To ensure that the optimum number of local workers are hired by SOL and its contractors

#### 4. Environmental monitoring plan

##### a) Data collection and analysis

To record the numbers, percentages, areas of origin of SOL and its contractors employees using available employee data from SOL and its contractors

##### b) Environmental monitoring location

- Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
- SOL office at project location

##### c) Environmental monitoring period and frequency

Once a year during construction stage

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Labor Agency of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

2.2.2.2 *Business opportunities*

1. *Significant impact monitored*

a) *Impact parameter*

Business opportunities

b) *Significant impact indicator*

Creation of business opportunities for local communities

2. *Source of significant impact*

Construction activities

3. *Environmental monitoring objective*

To monitor local communities' participation level in the project activities

4. *Environmental monitoring plan*

a) *Data collection and analysis*

- To collect data on purchases of goods and services carried out by SOL and its contractors, and contracts awarded to local companies
- To collect data on the growth of local businesses before, during and after construction stage

b) *Environmental monitoring location*

North Tapanuli Regency

c) *Environmental monitoring period and frequency*

Once a year during construction stage

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Industrial Agency of North Tapanuli Regency



- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

### 2.2.2.3 *Community income*

#### 1. *Significant impact monitored*

##### a) *Impact parameter*

Community income

##### b) *Significant impact indicator*

Household income

#### 2. *Source of significant impact*

Job and business opportunities during construction period

#### 3. *Environmental monitoring objective*

To evaluate the household income levels surrounding the project area

#### 4. *Environmental monitoring plan*

##### a) *Data collection and analysis*

- To collect community income data from local agencies

##### b) *Environmental monitoring location*

Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

##### c) *Environmental monitoring period and frequency*

Once a year during construction stage

#### 5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Labor Agency and Industrial Agency of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate

2.2.2.4 *Community unrest*

1. *Significant impact monitored*

a) *Impact parameter*

Community unrest

b) *Significant impact indicator*

- Communities' complaints regarding workforce recruitment
- Local concerns toward well drilling and production testing
- Local concerns toward the transmission network

2. *Source of significant impact*

- Workforce recruitment
- Well drilling and production testing
- Installation of transmission network

3. *Environmental monitoring objective*

To identify local communities' complaints regarding local workforce recruitment, well drilling and production testing, and installation of transmission network

4. *Environmental monitoring plan*

a) *Data collection and analysis*

To record complaints regarding the use of the local workers, well drilling and production testing, and installation of transmission network

b) *Environmental monitoring location*

Villages in the vicinity of project area (Sibaganding, Lumban Jaean, Simataniari, Silangkitang, Sigurung-gurung, Pardomuan Nainggolan, Pardamean Nainggolan)

c) *Environmental monitoring period and frequency*

Once a year during construction stage

5. *Environmental monitoring institutions*

- Implementer: SOL

- Supervisor: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province and Environmental Office of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

#### 2.2.2.5 *Transportation*

##### 1. *Significant impact monitored*

###### a) *Impact parameter*

Ground traffic disruption

###### b) *Significant impact indicator*

- Peak Hours Factors (PHF)
- Number of traffic accidents

##### 2. *Source of significant impact*

Mobilization of equipment and materials

##### 3. *Environmental monitoring objective*

To collect data on the number of traffic accidents and matters related to traffic safety

##### 4. *Environmental monitoring plan*

###### a) *Data collection and analysis*

To record data on the number of traffic accidents experienced by SOL staff and its contractors, and to record accidents along the roads accessed by project vehicles

###### b) *Environmental monitoring location*

Roads accessed by project vehicles in North Tapanuli Regency

###### c) *Environmental monitoring period and frequency*

Once a year during construction stage

##### 5. *Environmental monitoring institutions*

- Implementer: SOL

- Supervisor: Traffic and Road Transportation Agency of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

## 2.3 OPERATION STAGE

### 2.3.1 Geophysical and chemical components

#### 2.3.1.1 $H_2S$

##### 1. Significant impact monitored

###### a) Impact parameter

$H_2S$  concentrations in ambient air

###### b) Significant impact indicator

Minister of Environment Decree No. Kep-50/MENLH/11/ 1996

##### 2. Source of significant impact

Power plant operation

##### 3. Environmental monitoring objective

To monitor changes in  $H_2S$  concentrations in ambient air

##### 4. Environmental monitoring plan

###### a) Data collection and analysis

Measurement of  $H_2S$  concentrations in ambient air using  $H_2S$  monitoring equipment according to Indonesian National Standard (SNI)

###### b) Environmental monitoring location

- Well locations
- Power plant locations
- Villages around well drilling and production location

###### c) Environmental monitoring period and frequency

- Well locations: once every three months
- Power plant locations: once every three months

- Villages around well drilling and production testing locations: once every three months

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province and Environmental Office of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

2.3.1.2 *Noise*

1. *Significant impact monitored*

a) *Impact parameter*

Noise level

b) *Significant impact indicator*

Minister of Environment Decree No. Kep-48/MENLH/11/ 1996

2. *Source of significant impact*

Power plant operation

3. *Environmental monitoring objective*

To determine noise level

4. *Environmental monitoring plan*

a) *Data collection and analysis*

Measurement of noise levels in ambient air using equipment according to Indonesian National Standard (SNI)

b) *Environmental monitoring location*

- Well locations
- Power plant locations
- Villages around well drilling and production testing locations

c) *Environmental monitoring period and frequency*

- Well locations: once every three months during operation stage (24 hours monitoring)
- Power plant locations: once every three months during operation stage (24 hours monitoring)
- Villages around well drilling and production testing: once every three months during operation stage (24 hours monitoring)

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province and Environmental Office of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

## **2.3.2 Socio-economic, socio-cultural and public health components**

### *2.3.2.1 Job opportunities*

1. *Significant impact monitored*

a) *Impact parameter*

Job opportunities

b) *Significant impact indicator*

Numbers of local and non-local workers recruited by SOL and its contractors

2. *Source of significant impact*

Workforce recruitment

3. *Environmental monitoring objective*

To ensure that the optimum number of local workers are hired by SOL and its contractors

4. *Environmental monitoring plan*

a) *Data collection and analysis*

To record the numbers, percentages, areas of origin of SOL and its contractors employees using available employee data from SOL and its contractors

b) *Environmental monitoring location*

- Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
- SOL office at project location

c) *Environmental monitoring period and frequency*

Once a year during operation stage

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Labor Agency of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

2.3.2.2 *Business opportunities*

1. *Significant impact monitored*

a) *Impact parameter*

Business opportunities

b) *Significant impact indicator*

Creation of business opportunities for local communities

2. *Source of significant impact*

Construction activities

3. *Environmental monitoring objective*

To monitor local communities' participation level in project activities

4. *Environmental monitoring plan*

a) *Data collection and analysis*

- To collect data on purchases of goods and services carried out by SOL and its contractors, and contracts that SOL awarded to local companies
- To collect data on the growth of local businesses before, during and after construction period

b) *Environmental monitoring location*

- North Tapanuli Regency
- SOL office at project location

c) *Environmental monitoring period and frequency*

- Once a year during operation stage

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Industrial Agency of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

2.3.2.3 *Community income*

1. *Significant impact monitored*

a) *Impact parameter*

Community income

b) *Significant impact indicator*

Household income

2. *Source of significant impact*

Job and business opportunities during operation stage

3. *Environmental monitoring objective*

To evaluate the household income levels in the surrounding project area



4. *Environmental monitoring plan*

a) *Data collection and analysis*

To collect community income data from local agencies

b) *Environmental monitoring location*

- Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
- SOL office at project location

c) *Environmental monitoring period and frequency*

- Once a year during operation stage

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Labor Agency and Industrial Agency of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

2.3.2.4 *Community unrest*

1. *Significant impact monitored*

a) *Impact parameter*

Community unrest

b) *Significant impact indicator*

- Communities' complaints regarding workforce recruitment
- Local concerns toward transmission network

2. *Source of significant impact*

- Workforce recruitment
- Operation of transmission network

3. *Environmental monitoring objective*

To identify local communities' complaints regarding local workforce recruitment, well drilling and production testing, and operations of transmission network

4. *Environmental monitoring plan*

a) *Data collection and analysis*

To record complaints regarding the use of local workers, well drilling and production testing, and operation of transmission network

b) *Environmental monitoring location*

- Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
- SOL office at project location

c) *Environmental monitoring period and frequency*

- Once a year during operation stage

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province and Environmental Office of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

**2.3.3 Other monitoring**

2.3.3.1 *Solid and liquid waste monitoring*

1. *Significant impact monitored*

a) *Impact parameter*

- Solid waste: types and quantities of waste collected, transported, disposed to landfills, and recycled
- Domestic liquid waste effluent: BOD, COD, TSS, and pH
- Types and quantities of hazardous and toxic (B3) wastes
- Spillage: type and quantities of spillage

b) *Significant impact indicator*

- Compliance with Minister of Energy and Mineral Resources Decree No. 45 of 2006 regarding the Management of Drilling Reservoir, Slurry Waste and Drill Powder in Oil and Gas Drilling Activities
- Compliance with B3 waste regulation (Government Regulations No. 18 of 1999 and No. 85 of 1999)

2. *Source of significant impact*

- Domestic liquid waste
- Water discharges from domestic wastewater treatment plant
- Drilling wells, sump pit, well production (during production test) which potentially producing both B3 or non-B3 waste

3. *Environmental monitoring objective*

- To identify the types and quantities of solid waste generated by SOL
- To find out if surface water quality is affected by effluent discharge from the domestic wastewater treatment plant
- To determine the performance of the wastewater treatment plant
- To ensure correct handling and disposal of B3 wastes

4. *Environmental monitoring plan*

a) *Data collection and analysis*

- To measure the quantities of solid waste generated by counting the number of trucks coming in and out of waste disposal area
- To sample, prepare and analyze water samples from domestic wastewater treatment plant outlets according to SOL protocols (which are based on Indonesian National Standards (SNI)) and to measure pH, conductivity, and in situ
- To monitor the implementation of standard operational procedures (SOP) for oil spill prevention
- To monitor the correct implementation of SOP for B3 wastes handling and disposal
- To carry out TCLP Test for drilling sludge, slurry waste and drill powder

b) *Environmental monitoring location*

- Domestic solid waste disposal area
- Domestic wastewater treatment plant location
- Well locations (sump pit and slurry disposal)

- Community wells at SIL and NIL
  - Batang Toru River
- c) *Environmental monitoring period and frequency*
- Solid waste: each time solid waste is being disposed
  - Domestic wastewater treatment plant: once a month
  - Well locations: during and after drilling
5. *Environmental monitoring institutions*
- Implementer: SOL
  - Supervisor: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province and Environmental Office of North Tapanuli Regency
  - Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

#### 2.3.3.2 *Provision of education service and facility*

1. *Significant impact monitored*
  - a) *Impact parameter*  
Provision of education services and facilities for local communities
  - b) *Significant impact indicator*  
Distribution of provision educational facilities around the project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
2. *Source of significant impact*  
Increased demands for education services and facilities
3. *Environmental monitoring objective*  
To monitor and evaluate SOL community development program and to ensure that funding for the program is used responsibly and effectively
4. *Environmental monitoring plan*
  - a) *Data collection and analysis*  
To evaluate the effectiveness of all projects funded by SOL

b) *Environmental monitoring location*

Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

c) *Environmental monitoring period and frequency*

Once a year during the implementation of community development program

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Education Agency of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

2.3.3.3 *Provision of public health service*

1. *Significant impact monitored*

a) *Impact parameter*

Provision of public health service and facilities

b) *Significant impact indicator*

Distribution of provision of health facilities around the project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

2. *Source of significant impact*

Increased demands for health services and facilities

3. *Environmental monitoring objective*

To monitor the effectiveness of the distribution of health services and facilities within the community development program

4. *Environmental monitoring plan*

a) *Data collection and analysis*

To evaluate the effectiveness of all projects funded by SOL

b) *Environmental monitoring location*

- Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
- Public health centers in the vicinity of the project area

c) *Environmental monitoring period and frequency*

Once a year during the implementation of community development program

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Health Agency of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

2.3.3.4 *Initiatives for improving farming and agriculture cultivation techniques*

1. *Significant impact monitored*

a) *Impact parameter*

Agriculture productivity in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

b) *Significant impact indicators*

Production level and types of agriculture commodities around the project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

2. *Sources of significant impacts*

- Limited knowledge on agriculture commodities with high economic values amongst young farmers
- Low level of interest on agriculture activities amongst younger generation
- Shortage of agriculture products
- Limited high quality agriculture production facilities
- Limited skills in using agriculture machineries amongst farmers

3. *Environmental monitoring objectives*
  - To monitor the understanding of significant factors affecting agriculture production
  - To monitor production level of significant local agriculture products
4. *Environmental monitoring plan*
  - a) *Data collection and analysis*  
To evaluate the effectiveness of all projects funded by SOL
  - b) *Environmental monitoring location*  
Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
  - c) *Environmental monitoring period and frequency*  
Once a year during the implementation of community development program
5. *Environmental monitoring institutions*
  - Implementer: SOL
  - Supervisor: Agriculture Agency of North Tapanuli Regency
  - Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

#### 2.3.3.5 *Local business opportunities*

1. *Significant impact monitored*
  - a) *Impact parameter*  
Local communities' participation level in various economic activities
  - b) *Significant impact indicator*
    - Number of locally owned and managed businesses
    - Types of goods and services provided
    - Local economic activities value
2. *Source of significant impact*
  - Level of local communities participation integrally and equally in local business opportunities

- Level of local communities business skill
- Availability of access to sources of funding and capitals

3. *Environmental monitoring objective*

To monitor local communities participation in the economic development of the project area in North Tapanuli Regency

4. *Environmental monitoring plan*

a) *Data collection and analysis*

- To collect data on purchases of goods and services carried out by SOL and its contractors, and contracts awarded to local companies
- To record the number of economic facilities managed by the local communities
- To record data on economic and business development initiatives undertaken by SOL

b) *Environmental monitoring location*

Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

c) *Environmental monitoring period and frequency*

Once a year during the implementation of community development program

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Industrial Agency of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

2.3.3.6 *Provision of public infrastructures*

1. *Significant impact monitored*

a) *Impact parameter*

Local communities' needs and demands for public services



- b) *Significant impact indicator*  
Local governments' request to provide public infrastructures
- 2. *Source of significant impact*
  - Rapid growth and development rates
  - Local communities' increased demands for public services
- 3. *Environmental monitoring objective*  
To support local governments in its efforts to provide adequate public services to local communities
- 4. *Environmental monitoring plan*
  - a) *Data collection and analysis*  
To collect data on the availability of public infrastructures and evaluate the effectiveness of all projects funded by SOL
  - b) *Environmental monitoring location*  
Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
  - c) *Environmental monitoring period and frequency*  
Once a year during the implementation of community development program
- 5. *Environmental monitoring institutions*
  - Implementer: SOL
  - Supervisor: Public Works Agency of North Tapanuli, Regency
  - Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

#### 2.3.3.7 *Cultural preservation*

- 1. *Significant impact monitored*
  - a) *Impact parameter*  
Traditional activities, cultural festivals, books and monographs on language, history, sociology and local anthropology

- b) *Significant impact indicator*  
Changes in traditional and cultural values and customs
2. *Source of significant impact*  
Increasing presence of modern society and its associated infrastructures and materials
3. *Environmental monitoring objective*  
To assist the local community in maintaining their traditional cultures intact
4. *Environmental monitoring plan*
- a) *Data collection and analysis*
- To document and report on programs and activities of local ethnic groups
  - Cultural preservation, including traditional activities (dancing), cultural festivals, seminars and conferences, books and monographs on language, history, sociology and local anthropology
- b) *Environmental monitoring location*  
Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
- c) *Environmental monitoring period and frequency*  
Once a year during the implementation of community development program
5. *Environmental monitoring institutions*
- Implementer: SOL
  - Supervisor: Education Agency of North Tapanuli, Regency
  - Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

### 2.3.3.8 Awareness of SOL activities

#### 1. Significant impact monitored

##### a) Impact parameter

Accuracy and completeness of information about SOL activities within the local communities

##### b) Significant impact indicator

Lack of awareness and understanding of SOL activities (such as employment, training and business opportunities) within the workforce and local communities

#### 2. Source of significant impact

Misinformation circulating in the local communities concerning SOL activities

#### 3. Environmental monitoring objective

- To monitor the effectiveness of SOL programs in disseminating information about SOL activities and to rectify inaccurate information
- To gain feedback from employees and the local communities on how to disseminate accurate and useful information

#### 4. Environmental monitoring plan

##### a) Data collection and analysis

- To discuss and review the discussions with employees and community leaders about information dissemination to employees and the local communities
- To discuss and review the discussions with local governments about dissemination of information to the local communities

##### b) Environmental monitoring location

Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

##### c) Environmental monitoring period and frequency

Once every three years during operational stage

#### 5. Environmental monitoring institutions

- Implementer: SOL
- Supervisor: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province and Environmental Office of North Tapanuli Regency

- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

## 2.4 POST-OPERATION STAGE

### 2.4.1 Socio-economic, socio-cultural and public health components

#### 2.4.1.1 *Job opportunities*

##### 1. *Significant impact monitored*

###### a) *Impact parameter*

Job opportunities

###### b) *Significant impact indicator*

Numbers of local and non-local workers affected by employee release

##### 2. *Source of significant impact*

Employee release

##### 3. *Environmental monitoring objective*

To ensure that SOL and its contractors fulfill the rights of employees released

##### 4. *Environmental monitoring plan*

###### c) *Data collection and analysis*

To record the numbers, percentages, areas of origin of SOL and its contractors employees using available employee data from SOL and its contractors

###### d) *Environmental monitoring location*

Villages in the vicinity of project area (Sibaganding, Lumban Jaean, Simataniari, Silangkitang, Sigurung-gurung, Pardomuan Nainggolan, Pardamean Nainggolan)

###### e) *Environmental monitoring period and frequency*

Once during post operation stage

##### 5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Labor Agency of North Tapanuli Regency.

- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

#### 2.4.1.2 *Community income*

##### 1. *Significant impact monitored*

###### a) *Impact parameter*

Community income

###### b) *Significant impact indicator*

Household income

##### 2. *Source of significant impact*

Business opportunities during post-operation stage

##### 3. *Environmental monitoring objective*

To determine household income of the communities in the surrounding project area

##### 4. *Environmental monitoring plan*

###### a) *Data collection and analysis*

To collect community income data from local agencies

###### b) *Environmental monitoring location*

The development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahe Julu Districts, North Tapanuli Regency

###### c) *Environmental monitoring period and frequency*

Once during post-operation stage

##### 5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Labor Agency and Industrial Agency of North Tapanuli Regency.
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

### 2.4.1.3 *Community unrest*

1. *Significant impact monitored*

a) *Impact parameter*

Community unrest

b) *Significant impact indicator*

Complaint from local communities regarding employee release

2. *Source of significant impact*

- Employee release

3. *Environmental monitoring objective*

To determine specific complaints from the local communities regarding employee release

4. *Environmental monitoring plan*

a) *Data collection and analysis*

Documenting complaints from the local communities regarding employee release

b) *Environmental monitoring location*

The development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

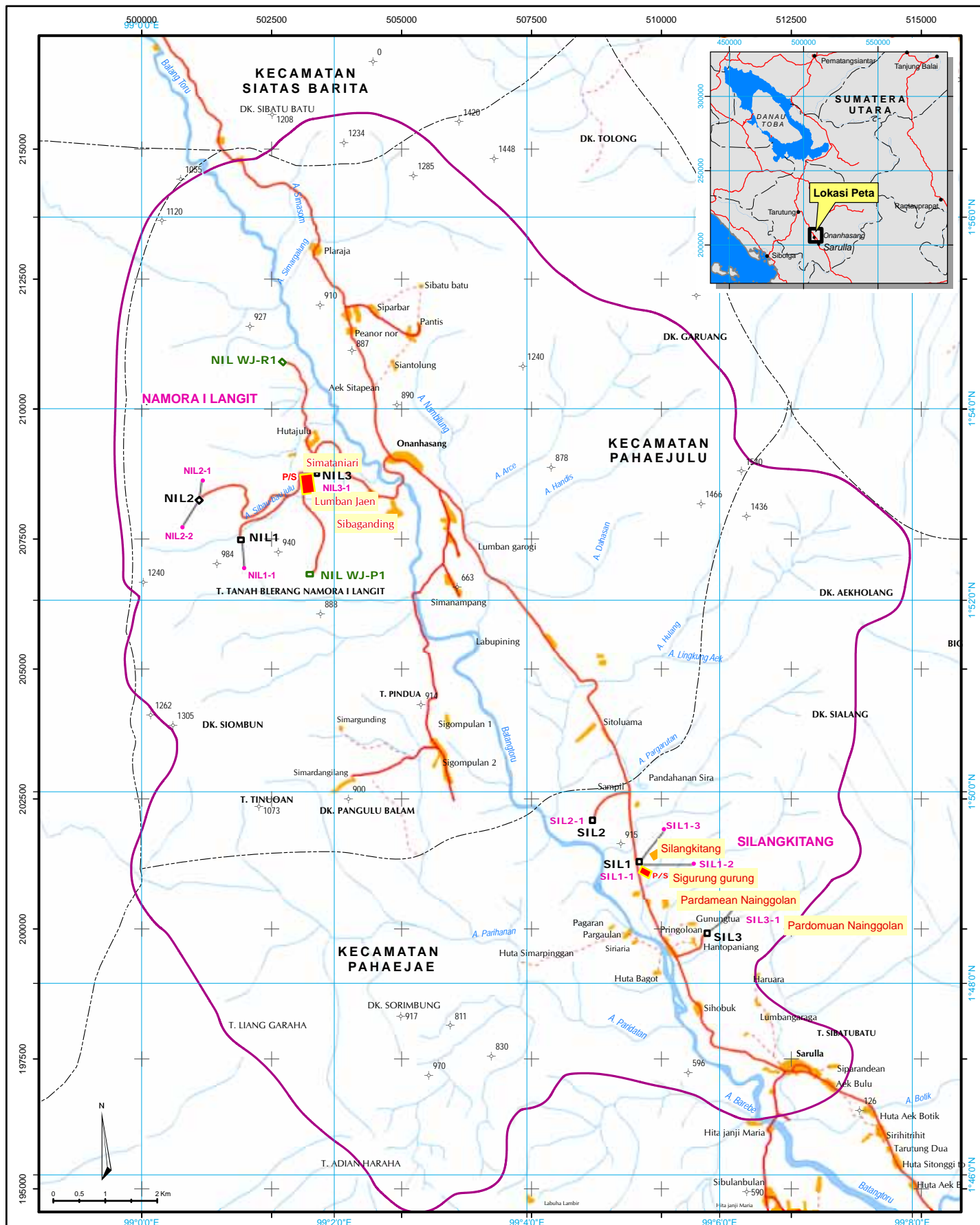
c) *Environmental monitoring period and frequency*

Once during post-operation stage

5. *Environmental monitoring institutions*

- Implementer: SOL
- Supervisor: Environmental Impact Management Agency (Bapedalda) of North Sumatera Province and Environmental Office of North Tapanuli Regency
- Reporting to: Environmental Impact Management Agency (*Bapedalda*) of North Sumatera Province, Environmental Office of North Tapanuli Regency, Mining and Energy Agency of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources

The Environmental Monitoring Plan Summary Matrix is shown in **Appendix 1**.



**Legenda**  
Legend

- Titik Ketinggian  
Elevation Point
- Jalan Arteri  
Arteri Road
- Jalan Kolektor  
Collector Road
- Jalan Lokal  
Local Road
- Batas Kecamatan  
Kecamatan Boundary
- Sungai  
River
- Permukiman  
Village
- Sumur Eksplorasi Namora I Langit dan Silangkitang  
Namora I Langit and Silangkitang Exploration Wells
- Lokasi Sumur Baru (West JEC)  
New Well Site (West JEC)
- Pembangkit Listrik  
Power Station
- Batas Studi  
Study Boundary
- Pardomuan Nainggolan  
Lokasi Pemantauan Lingkungan  
Sosial Ekonomi dan Budaya  
Monitoring Plan Site of  
Socio Economic and Cultural

**Keterangan :**  
Note :

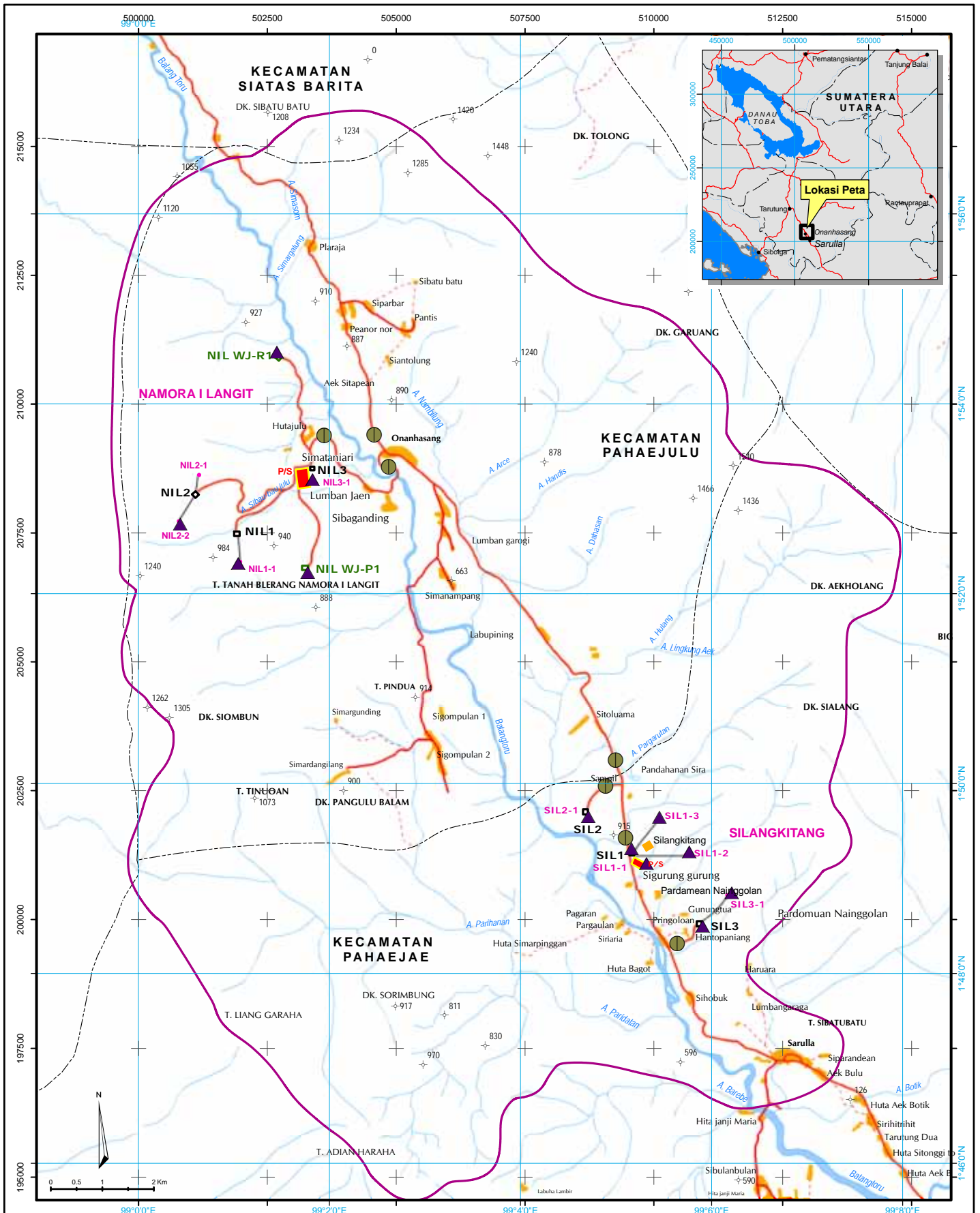
DK : Bukit  
Hill  
Aek : Sungai  
River  
T. :Tinggi  
Elevation

Sumber (Source) :  
Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50.000.  
Medco Geothermal Indonesia

**RENCANA PEMANTAUAN LINGKUNGAN**  
ENVIRONMENTAL MONITORING PLAN

**LOKASI PEMANTAUAN LINGKUNGAN  
SOSIAL EKONOMI DAN BUDAYA**  
MONITORING PLAN SITE  
OF SOCIO ECONOMIC AND CULTURAL

Skala Scale	1 : 100.000	Digambar Oleh Drafter	GGG
Peta Map	II - 1	Diperiksa Oleh Proofreader	ABU
Tanggal Revisi Date Revision	23/10/08	Digabung Oleh Compilation	ERM



**Legenda**  
Legend

- Titik Ketinggian  
Elevation Point
- Jalan Arteri  
Arteri Road
- Jalan Kolektor  
Collector Road
- Jalan Lokal  
Local Road
- Batas Kecamatan  
Kecamatan Boundary
- Sungai  
River
- Permukiman  
Village
- Sumur Eksplorasi Namora I Langit dan Silangkitang  
Namora I Langit and Silangkitang Exploration Wells
- Lokasi Sumur Baru (West JEC)  
New Well Site (West JEC)
- Pembangkit Listrik  
Power Station
- Batas Studi  
Study Boundary
- Lokasi Pemantauan Kualitas Udara dan Kebisingan  
Monitoring Plan Site of Air Quality and Noise
- Lokasi Pemantauan Gangguan Lalu Lintas  
Monitoring Plan Site of Land Traffic Disturbance

**Keterangan :**  
Note :

DK : Bukit  
Hill

Aek : Sungai  
River

T. :Tinggi  
Elevation

Sumber (Source) :  
Peta Topografi - BAKOSURTANAL, 1977, Skala 1 : 50.000.  
Medco Geothermal Indonesia

**RENCANA PEMANTAUAN LINGKUNGAN**  
ENVIRONMENTAL MONITORING PLAN

**LOKASI PEMANTAUAN LINGKUNGAN**  
FISIKA - KIMIA  
ENVIRONMENTAL MANAGEMENT SITE OF  
PHYSICAL CHEMICAL

Skala Scale	1 : 100.000	Digambar Oleh Drafter	GGG
Peta Map	II - 2	Diperiksa Oleh Proofreader	ABU
Tanggal Revisi Date Revision	23/10/08	Digabung Oleh Compilation	ERM



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**APPENDIX 1**  
**ENVIRONMENTAL MONITORING PLAN**  
**MATRIX SUMMARY**

## Environmental Monitoring Plan Summary Matrix

Environmental Component / Activity	Significant Impact Monitored		Source of Significant Impact	Environmental Monitoring Objective	Environmental Monitoring Plan			Environmental Monitoring Institutions		
	Impact Parameter	Impact Indicator			Data Collection and Analysis	Environmental Monitoring Location	Monitoring Period and Frequency	Implementer	Supervisor	Reporting to
<b>A. Pre-construction stage</b>										
<b>Socio-economic, socio-cultural, and public health components</b>										
<b>Land ownership and occupancy</b>	Area and lay out of the land required by SOL	<ul style="list-style-type: none"> <li>Changes in land ownership that used to be owned by local communities in the vicinity of the project areas</li> <li>Community unrest due to land acquisition</li> </ul>	Land acquisition	To ensure that the land acquisition process complies with the applicable regulations on compensations toward land and vegetation	<ul style="list-style-type: none"> <li>To calculate the amount of land required for the project</li> <li>To acquire data on land ownership, area, legal status of the land to be acquired and from the National Land Agency (BPN) of North Tapanuli Regency</li> <li>To create a map of land ownership in collaboration with the BPN of North Tapanuli Regency</li> </ul>	The development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	During the pre-construction stage	SOL	National Land Agency (BPN) of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Community unrest</b>	Community unrest	<ul style="list-style-type: none"> <li>Communities' complaints regarding boundaries and size of land</li> <li>Different opinions in land value and compensation types for land and/or vegetation acquisitions</li> </ul>	Land acquisition	To ensure that the land acquisition process complies with the applicable regulations on compensations toward land and vegetation	To collect data and to record complaints arising from the land acquisition process	Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	During the pre-construction stage	SOL	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> </ul>	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency;</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>

## Environmental Monitoring Plan Summary Matrix

Environmental Component / Activity	Significant Impact Monitored		Source of Significant Impact	Environmental Monitoring Objective	Environmental Monitoring Plan			Environmental Monitoring Institutions		
	Impact Parameter	Impact Indicator			Data Collection and Analysis	Environmental Monitoring Location	Monitoring Period and Frequency	Implementer	Supervisor	Reporting to
<b>B. Construction stage</b>										
<b>Geophysical and chemical components</b>										
<b>Air quality</b>										
<b>H<sub>2</sub>S</b>	H <sub>2</sub> S concentrations in ambient air	Minister of Environment Decree No. Kep-50/MENLH/11/ 1996	Well drilling and production testing	To monitor changes in H <sub>2</sub> S concentrations in ambient air	Measurement of H <sub>2</sub> S concentrations in ambient air using H <sub>2</sub> S monitoring equipment according to Indonesian National Standard (SNI)	Well locations and villages around the well locations	Once a week during well drilling and production testing	SOL	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> </ul>	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Noise</b>	Noise level	Minister of Environment Decree No. Kep-48/MENLH/11/1996	<ul style="list-style-type: none"> <li>Well drilling and production testing</li> <li>Mobilization of equipment and materials</li> </ul>	To determine noise level	Measurement of noise levels in ambient air using equipment according to Indonesian National Standard (SNI)	<ul style="list-style-type: none"> <li>Well locations</li> <li>Villages around the well locations</li> </ul>	Once a week during production testing	SOL	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> </ul>	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>

## Environmental Monitoring Plan Summary Matrix

Environmental Component / Activity	Significant Impact Monitored		Source of Significant Impact	Environmental Monitoring Objective	Environmental Monitoring Plan			Environmental Monitoring Institutions		
	Impact Parameter	Impact Indicator			Data Collection and Analysis	Environmental Monitoring Location	Monitoring Period and Frequency	Implementer	Supervisor	Reporting to
<b>Socio-economic, socio-cultural, and public health components</b>										
<b>Job opportunities</b>	Job opportunities	Numbers of local and non-local workers recruited by SOL and its contractors	Workforce recruitment	To ensure that the optimum number of local workers are hired by SOL and its contractors	To record the numbers, percentages, areas of origin of SOL and its contractors employees using available employee data from SOL and its contractors	<ul style="list-style-type: none"> <li>Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</li> <li>SOL office at project location</li> </ul>	Once a year during construction stage	SOL	Labor Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Business opportunities</b>	Business opportunities	Creation of business opportunities for local communities	Construction activities	To monitor local communities' participation level in project activities	<ul style="list-style-type: none"> <li>To collect data on purchases of goods and services carried out by SOL and its contractors, and contracts that SOL awarded to local companies</li> <li>To collect data on the growth of local businesses before, during and after construction stage</li> </ul>	North Tapanuli Regency	Once a year during construction stage	SOL	Industrial Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency;</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Community income</b>	Community income	Household income	Job and business opportunities during construction stage	To evaluate the household income levels in the surrounding project area	To collect community income data from local agencies	Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Once a year during construction stage	SOL	Labor Agency and Industrial Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy</li> </ul>

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	Impact Parameter	Impact Indicator			Data Collection and Analysis	Environmental Monitoring Location	Monitoring Period and Frequency	Implementer	Supervisor	Reporting to
										Agency of North Tapanuli Regency • Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources
<b>Community unrest</b>	Community unrest	<ul style="list-style-type: none"> <li>Communities' complaints regarding workforce recruitment</li> <li>Local concerns toward well drilling and production testing</li> <li>Local concerns toward transmission network</li> </ul>	<ul style="list-style-type: none"> <li>Workforce recruitment</li> <li>Well drilling and production testing</li> <li>Installation of transmission network</li> </ul>	To identify local communities' complaints regarding local workforce recruitment, well drilling and production testing, and installation of transmission network	To record complaints regarding the use of local workers, well drilling and production testing, and installation of transmission network	Villages in the vicinity of project area (Sibaganding, Lumban Jaeen, Simataniari, Silangkitang, Sigurung-gurung, Pardomuan Nainggolan, Pardamean Nainggolan)	Once a year during construction stage	SOL	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> </ul>	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Transportation</b>	Ground traffic disruption	<ul style="list-style-type: none"> <li>Peak Hours Factors (PHF)</li> <li>Number of traffic accidents</li> </ul>	Mobilization of equipment and materials	To collect data on the number of traffic accidents and matters related to traffic safety	To record data on the number of traffic accidents experienced by SOL staff and its contractors, and to record accidents along the roads accessed by project vehicles	Roads accessed by project vehicles in North Tapanuli Regency	Once a year during construction stage	SOL	Traffic and Road Transportation Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>C. Operation stage</b>										
<b>Geophysical and chemical components</b>										
<b>H<sub>2</sub>S</b>	H <sub>2</sub> S concentrations in ambient air	Minister of Environment Decree No. Kep-	Power plant operation	To monitor changes in H <sub>2</sub> S concentrations in ambient air	Measurement of H <sub>2</sub> S concentrations in ambient air using H <sub>2</sub> S monitoring	<ul style="list-style-type: none"> <li>Well locations</li> <li>Power plant locations</li> </ul>	<ul style="list-style-type: none"> <li>Well locations: once every three months</li> </ul>	SOL	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North</li> </ul>	<ul style="list-style-type: none"> <li>Environmental Impact Management</li> </ul>

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Environmental Component / Activity	Significant Impact Monitored		Source of Significant Impact	Environmental Monitoring Objective	Environmental Monitoring Plan			Environmental Monitoring Institutions		
	Impact Parameter	Impact Indicator			Data Collection and Analysis	Environmental Monitoring Location	Monitoring Period and Frequency	Implementer	Supervisor	Reporting to
		50/MENLH/11/ 1996			equipment according to Indonesian National Standard (SNI)	<ul style="list-style-type: none"> <li>Villages around well drilling and production testing locations</li> </ul>	<ul style="list-style-type: none"> <li>Power plant locations: once every three months</li> <li>Villages around well drilling and production testing locations: once every three months</li> </ul>		Sumatera Province <ul style="list-style-type: none"> <li>Environmental Office of North Tapanuli Regency</li> </ul>	Agency ( <i>Bapedalda</i> ) of North Sumatera Province <ul style="list-style-type: none"> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Noise</b>	Noise level	Minister of Environment Decree No. Kep-48/MENLH/11/ 1996	Power plant operation	To determine noise level	Measurement of noise levels in ambient air using equipment according to Indonesian National Standard (SNI)	<ul style="list-style-type: none"> <li>Well locations</li> <li>Power plant locations</li> <li>Villages around well drilling and production testing locations</li> </ul>	<ul style="list-style-type: none"> <li>Well locations: once every three months during operation stage (24 hours monitoring)</li> <li>Power plant locations: once every three months during operation stage (24 hours monitoring)</li> <li>Villages around well drilling and production testing locations: once every three months during operation stage (24 hours monitoring)</li> </ul>	SOL	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> </ul>	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>

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	Impact Parameter	Impact Indicator			Data Collection and Analysis	Environmental Monitoring Location	Monitoring Period and Frequency	Implementer	Supervisor	Reporting to
<b>Socio-economic, socio-cultural, and public health components</b>										
<b>Job opportunities</b>	Job opportunities	Numbers of local and non-local workers recruited by SOL and its contractors	Workforce recruitment	To ensure that the optimum number of local workers are hired by SOL and its contractors	To record the numbers, percentages, areas of origin of SOL and its contractors employees using available employee data from SOL and its contractors	<ul style="list-style-type: none"> <li>Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</li> <li>SOL office at project location</li> </ul>	Once a year during operation stage	SOL	Labor Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency;</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Business opportunities</b>	Business opportunities	Creation of business opportunities for local communities	Operation activities	To monitor local communities' participation level in project activities	<ul style="list-style-type: none"> <li>To collect data on purchases of goods and services carried out by SOL and its contractors, and contracts that SOL awarded to local companies</li> <li>To collect data on the growth of local businesses before, during and after construction period</li> </ul>	<ul style="list-style-type: none"> <li>North Tapanuli Regency</li> <li>SOL office at project location</li> </ul>	Once a year during operation stage	SOL	Industrial Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Community income</b>	Community income	Household income	Job and business opportunities during operation stage	To evaluate the household income levels in the surrounding project area	To collect community income data from local agencies	<ul style="list-style-type: none"> <li>Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</li> <li>SOL office at project location</li> </ul>	Once a year during construction stage	SOL	Labor Agency and Industrial Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy</li> </ul>



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	Impact Parameter	Impact Indicator			Data Collection and Analysis	Environmental Monitoring Location	Monitoring Period and Frequency	Implementer	Supervisor	Reporting to
										Agency of North Tapanuli Regency • Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources
<b>Community unrest</b>	Community unrest	<ul style="list-style-type: none"> <li>Communities' complaints regarding workforce recruitment</li> <li>Local concerns toward transmission network</li> </ul>	<ul style="list-style-type: none"> <li>Workforce recruitment</li> <li>Operation of transmission network</li> </ul>	To identify local communities' complaints regarding local workforce recruitment, well drilling and production testing, and operation of transmission network	To record complaints regarding the use of local workers, well drilling and production testing, and operation of transmission network	<ul style="list-style-type: none"> <li>Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</li> <li>SOL office at project location</li> </ul>	Once a year during construction period	SOL	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> </ul>	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Other monitoring</b>										
<b>Solid and liquid waste monitoring</b>										
<b>Surface water quality</b>	<ul style="list-style-type: none"> <li>Solid waste: types and quantities of waste collected, transported, disposed to landfills, and recycled</li> <li>Domestic liquid waste effluent: BOD, COD, TSS, and pH</li> <li>Types and quantities of hazardous and toxic (B3) wastes</li> <li>Spillage: types and quantities of spillage</li> </ul>	<ul style="list-style-type: none"> <li>Compliance with Minister of Energy and Mineral Resources Decree No. 45 of 2006 regarding the Management of Drilling Reservoir, Slurry Waste and Drill Powder in Oil and Gas Drilling Activities</li> <li>Compliance with B3 waste regulations (Government Regulations No. 18 of 1999 and No. 85 of 1999)</li> </ul>	<ul style="list-style-type: none"> <li>Domestic liquid waste</li> <li>Water discharges from domestic wastewater treatment plant</li> <li>Drilling well, sump pit, well production (during production test) which potentially producing both hazardous and non-hazardous wastes</li> </ul>	<ul style="list-style-type: none"> <li>To identify the types and quantities of solid waste generated by SOL</li> <li>To find out if surface water quality is affected by effluent discharge from the domestic wastewater treatment plant</li> <li>To determine the performance of the wastewater treatment plant</li> <li>To ensure correct handling and disposal of B3 wastes</li> </ul>	<ul style="list-style-type: none"> <li>To measure the quantities of solid waste generated by counting the number of trucks coming in and out of waste disposal area</li> <li>To sample, prepare and analyze water samples from domestic wastewater treatment plant outlets according to SOL protocols (which are based on Indonesian National Standards (SNI)) and to measure pH, conductivity, and <i>in situ</i></li> <li>To monitor the implementation of standard operational procedures (SOP) for oil spill prevention</li> <li>To monitor the correct implementation of SOP for B3 wastes handling and disposal</li> <li>To carry out TCLP Test for drilling sludge, slurry</li> </ul>	<ul style="list-style-type: none"> <li>Domestic solid waste disposal area</li> <li>Domestic wastewater treatment plant location</li> <li>Well locations (sump pit and slurry disposal)</li> <li>Community wells at SIL and NIL</li> <li>Batang Toru River</li> </ul>	<ul style="list-style-type: none"> <li>Solid waste: each time solid waste is being disposed</li> <li>Domestic wastewater treatment plant: once a month</li> <li>Well locations: during and after drilling</li> </ul>	SOL	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> </ul>	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>

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Environmental Component / Activity	Significant Impact Monitored		Source of Significant Impact	Environmental Monitoring Objective	Environmental Monitoring Plan			Environmental Monitoring Institutions		
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					waste and drill powder					
<b>Community Development Programs</b>										
<b>Provision of education services and facilities</b>	Provision of education services and facilities for local communities	Distribution of education facilities around the project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Increased demands for education services and facilities	To monitor and evaluate SOL community development program and to ensure that funding for the program is used responsibly and effectively	To evaluate the effectiveness of all projects funded by SOL	Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Once a year during the implementation of community development program	SOL	Education Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>• Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>• Environmental Office of North Tapanuli Regency;</li> <li>• Mining and Energy Agency of North Sumatera Province</li> <li>• Mining and Energy Agency of North Tapanuli Regency</li> <li>• Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Provision of public health services</b>	Provision of public health services and facilities	Distribution of health facilities around the project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Increased demands for health services and facilities	To monitor the effectiveness of the distribution of health services and facilities within the community development program	To evaluate the effectiveness of all projects funded by SOL	<ul style="list-style-type: none"> <li>• Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</li> <li>• Public health centers in the vicinity of the project area</li> </ul>	Once a year during the implementation of community development program	SOL	Health Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>• Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>• Environmental Office of North Tapanuli Regency</li> <li>• Mining and Energy Agency of North Sumatera Province</li> <li>• Mining and Energy Agency of North Tapanuli Regency</li> <li>• Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>

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<b>Initiatives for improving farming and agriculture techniques</b>	Agriculture productivity in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Production level and types of agriculture commodities around the project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	<ul style="list-style-type: none"> <li>Limited knowledge on agriculture commodities with high economic values amongst young farmers</li> <li>Low level of interest on agriculture activities amongst younger generation</li> <li>Shortage of agriculture products</li> <li>Limited high quality agriculture production facilities</li> <li>Limited skills in using agriculture machineries amongst farmers</li> </ul>	<ul style="list-style-type: none"> <li>To monitor the understanding of significant factors affecting agriculture production</li> <li>To monitor production level of significant local agriculture products</li> </ul>	To evaluate the effectiveness of all projects funded by SOL	Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Once a year during the implementation of community development program	SOL	Agriculture Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province;</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Local business opportunities</b>	Local communities' participation level in various economic activities	<ul style="list-style-type: none"> <li>Number of locally owned and managed businesses</li> <li>Types of goods and services provided</li> <li>Local economic activities value</li> </ul>	<ul style="list-style-type: none"> <li>Level of local communities participation integrally and equally in local business opportunities</li> <li>Level of local communities' business skill</li> <li>Availability of access to sources of funding and capitals</li> </ul>	To monitor local communities' participation of in the economic development of the project area in North Tapanuli Regency	<ul style="list-style-type: none"> <li>To collect data on purchases of goods and services carried out by SOL and its contractors, and contracts that SOL awarded to local companies</li> <li>To record the number of economic facilities managed by the local communities</li> <li>To record data on economic and business development initiatives undertaken by SOL</li> </ul>	Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Once a year during the implementation of community development program	SOL	Industrial Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Provision of public infrastructures</b>	Local communities' needs and demands for public services	Local governments' request to provide public infrastructures	<ul style="list-style-type: none"> <li>Rapid growth and development rates</li> <li>Local communities' increased demands for public services</li> </ul>	To support local governments in its efforts to provide adequate public services to local communities	To collect data on the availability of public infrastructures and evaluate the effectiveness of all projects funded by SOL	Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Once a year during the implementation of community development program	SOL	Public Works Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> </ul>

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										<ul style="list-style-type: none"> <li>• Mining and Energy Agency of North Tapanuli Regency</li> <li>• Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources.</li> </ul>
<b>Cultural preservation</b>	Traditional activities, cultural festivals, books and monographs on language, history, sociology and local anthropology	Changes in traditional and cultural values and customs	Increasing presence of modern society and its associated infrastructures and materials	To assist the local communities in maintaining their traditional cultures intact	<ul style="list-style-type: none"> <li>• To document and report on programs and activities of local ethnic groups</li> <li>• Cultural preservation, including traditional activities (dancing), cultural festivals, seminars and conferences, books and monographs on language, history, sociology and local anthropology</li> </ul>	Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Once a year during the implementation of community development program	SOL	Education Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>• Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>• Environmental Office of North Tapanuli Regency</li> <li>• Mining and Energy Agency of North Sumatera Province</li> <li>• Mining and Energy Agency of North Tapanuli Regency</li> <li>• Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Awareness of SOL activities</b>	Accuracy and completeness of information about SOL activities within the local communities	Lack of awareness and understanding of SOL activities (such as employment, training and business opportunities) within the workforce and local communities	Misinformation circulating in the local communities concerning SOL activities	<ul style="list-style-type: none"> <li>• To monitor the effectiveness of SOL programs in disseminating information about SOL activities and to rectify inaccurate information</li> <li>• To gain feedback from employees and the local communities on how to disseminate accurate and useful information</li> </ul>	<ul style="list-style-type: none"> <li>• To review the discussions with employees and community leaders about information dissemination to employees and the local communities</li> <li>• To review the discussions with local government about information dissemination to the local communities</li> </ul>	Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Once every three years during operational stage	SOL	<ul style="list-style-type: none"> <li>• Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>• Environmental Office of North Tapanuli Regency</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>• Environmental Office of North Tapanuli Regency</li> <li>• Mining and Energy Agency of North Sumatera Province</li> <li>• Mining and Energy Agency of North Tapanuli Regency</li> <li>• Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>

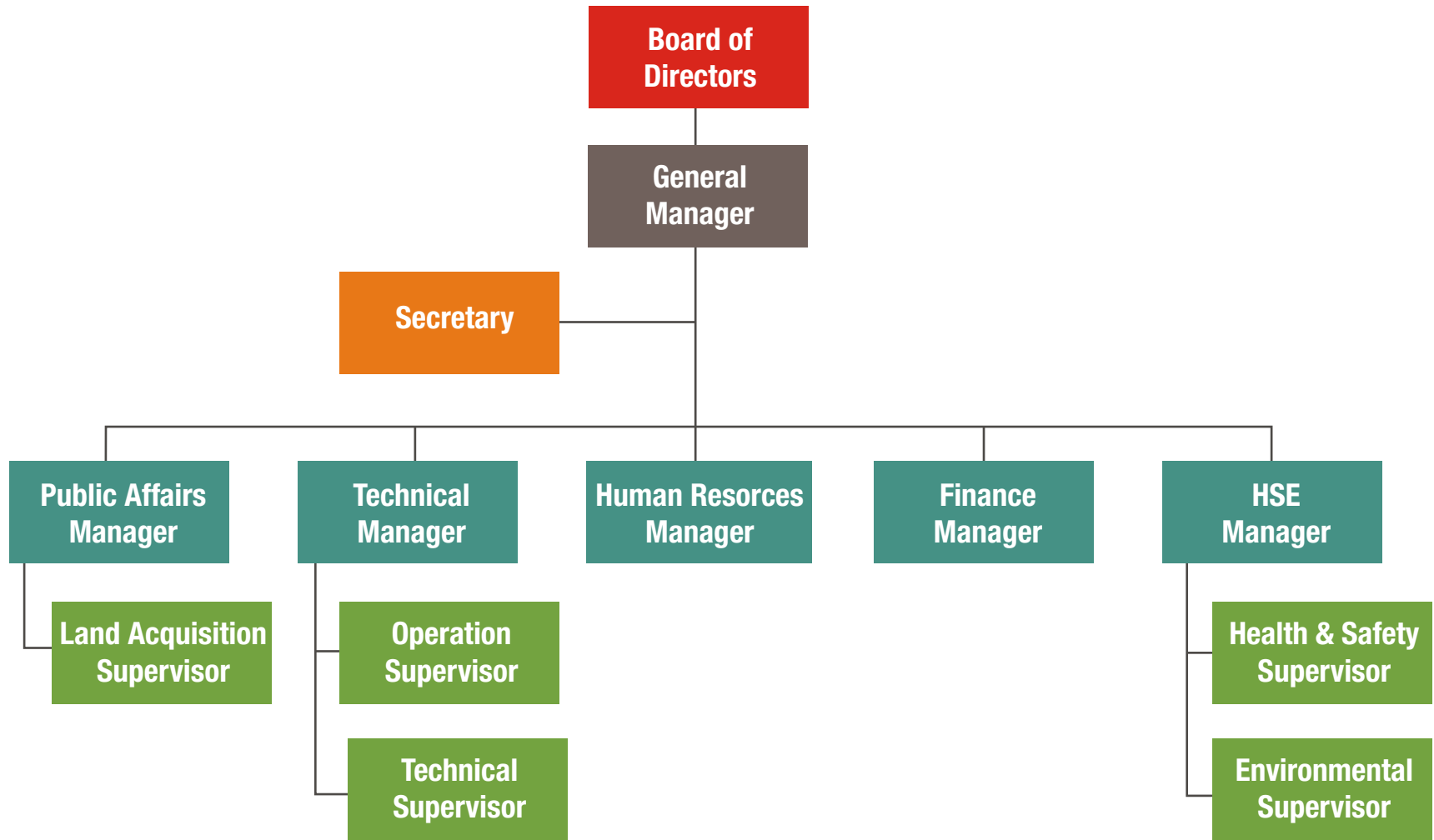
## Environmental Monitoring Plan Summary Matrix

Environmental Component / Activity	Significant Impact Monitored		Source of Significant Impact	Environmental Monitoring Objective	Environmental Monitoring Plan			Environmental Monitoring Institutions		
	Impact Parameter	Impact Indicator			Data Collection and Analysis	Environmental Monitoring Location	Monitoring Period and Frequency	Implementer	Supervisor	Reporting to
<b>D. Post-operation stage</b>										
<b>Socio-economic, social-cultural and public health components</b>										
<b>Job opportunities</b>	Job opportunities	Numbers of local and non-local workers affected by employee release	Employee release	To ensure that SOL and its contractors fulfill the rights of employees released	To record the numbers, percentages, areas of origin of SOL and its contractors employees using available employee data from SOL and its contractors	Villages in the vicinity of project area (Sibaganding, Lumban Jaean, Simataniari, Silangkitang, Sigurung-gurung, Pardomuan Nainggolan, Pardamean Nainggolan)	Once during post-operation stage	SOL	Labor Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Community income</b>	Community income	Household income	Business opportunities during post-operation stage	To determine household income of the communities in the surrounding project area	To collect community income data from local agencies	The development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Once in post-operation stage	SOL	Labor Agency and Industrial Agency of North Tapanuli Regency	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> <li>Mining and Energy Agency of North Tapanuli Regency</li> <li>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>
<b>Community unrest</b>	Community unrest	Complaint from local communities regarding employee release.	Employee release	To determine specific complaints from local communities regarding employee release	Documenting complaints from local communities regarding employee release	The development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency	Once in post-operation stage	SOL	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> </ul>	<ul style="list-style-type: none"> <li>Environmental Impact Management Agency (<i>Bapedalda</i>) of North Sumatera Province</li> <li>Environmental Office of North Tapanuli Regency</li> <li>Mining and Energy Agency of North Sumatera Province</li> </ul>

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Environmental Component / Activity	Significant Impact Monitored		Source of Significant Impact	Environmental Monitoring Objective	Environmental Monitoring Plan			Environmental Monitoring Institutions		
	Impact Parameter	Impact Indicator			Data Collection and Analysis	Environmental Monitoring Location	Monitoring Period and Frequency	Implementer	Supervisor	Reporting to
										Agency of North Sumatera Province <ul style="list-style-type: none"> <li>• Mining and Energy Agency of North Tapanuli Regency</li> <li>• Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</li> </ul>

**APPENDIX 2**  
**SOL ORGANIZATION CHART**



**Sarulla Operations Ltd. Organization Structure**