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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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)

[Signature]
Aries Pardjimanto
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.
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
2.2 CONSTRUCTION STAGE

2.2.1 Geophysical and chemical components

2.2.1.1 Air quality

1. Significant impact monitored
   a) Impact parameter
      H₂S concentrations in ambient air
   b) Significant impact indicator

2) Source of significant impact
   Well drilling and production testing

3) Environmental monitoring objective
   To monitor changes in H₂S concentrations in ambient air

4) Environmental monitoring plan
   a) Data collection and analysis
      Measurement of H₂S concentrations in ambient air using H₂S 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

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
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 General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources
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
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
2.3 OPERATION STAGE

2.3.1 Geophysical and chemical components

2.3.1.1 H2S

1. Significant impact monitored
   a) Impact parameter
      H2S concentrations in ambient air
   b) Significant impact indicator

2. Source of significant impact
   Power plant operation

3. Environmental monitoring objective
   To monitor changes in H2S concentrations in ambient air

4. Environmental monitoring plan
   a) Data collection and analysis
      Measurement of H2S concentrations in ambient air using H2S 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
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**

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

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### 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
2. 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.
BIBLIOGRAPHY


APPENDIX 1

ENVIRONMENTAL MONITORING PLAN
MATRIX SUMMARY
## Environmental Monitoring Plan Summary Matrix

### A. Pre-construction stage

#### Land ownership and occupancy

| Area and lay out of the land required by SOL | 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 | Land acquisition | To ensure that the land acquisition process complies with the applicable regulations on compensations toward land and vegetation | 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 | The development of Sarulla geothermal field and power plant project area in Pahae Jau and Pahae Julu Districts, North Tapanuli Regency | During the pre-construction stage | SOL | National Land Agency (BPN) of North Tapanuli Regency | 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 |

#### Community unrest

| Community unrest | Communities’ complaints regarding boundaries and size of land | Different opinions in land value and compensation types for land and/or vegetation acquisitions | 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 Jau and Pahae Julu Districts, North Tapanuli Regency | During the pre-construction stage | SOL | Environmental Impact Management Agency (Bapedalda) of North Sumatera Province | Environmental Office of North Tapanuli Regency | 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 |
## Environmental Monitoring Plan Summary Matrix

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<th>Source of Significant Impact</th>
<th>Environmental Monitoring Objective</th>
<th>Data Collection and Analysis</th>
<th>Environmental Monitoring Location and Frequency</th>
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| H₂S                               | H₂S concentrations in ambient air | Minister of Environment Decree No. Kep-50/MENUH/11/1996 | Well drilling and production testing | To monitor changes in H₂S concentrations in ambient air | Measurement of H₂S concentrations in ambient air using H₂S 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 | • 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 |
Mobilization of equipment and materials | To determine noise level | Measurement of noise levels in ambient air using equipment according to Indonesian National Standard (SNI) | Well locations  
Villages around the well locations | Once a week during production testing | SOL | • 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 |
### Environmental Monitoring Plan Summary Matrix

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<th>Socio-economic, socio-cultural, and public health components</th>
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<td><strong>Job opportunities</strong></td>
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<td><strong>Significant Impact Monitored</strong></td>
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<td>Job opportunities</td>
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<td>Numbers of local and non-local workers recruited by SOL and its contractors</td>
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<td>To record the numbers, percentages, areas of origin of SOL and its contractors employees using available employee data from SOL and its contractors</td>
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<td>Environmental Monitoring Location</td>
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<td>SOL office at project location</td>
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<td><strong>Business opportunities</strong></td>
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<td>Creation of business opportunities for local communities</td>
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<td>Construction activities</td>
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<td>Environmental Monitoring Objective</td>
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<td>To collect data on purchases of goods and services carried out by SOL and its contractors, and contracts that SOL awarded to local companies</td>
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<td>Monitoring Period and Frequency</td>
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<td>To collect data on the growth of local businesses before, during and after construction stage</td>
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<td>North Tapanuli Regency</td>
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<td>Industrial Agency of North Tapanuli Regency</td>
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<td><strong>Community income</strong></td>
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<td>Job and business opportunities during construction stage</td>
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<td>To evaluate the household income levels in the surrounding project area</td>
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<td>Labor Agency and Industrial Agency of North Tapanuli Regency</td>
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<td><strong>Environmental Monitoring Plan</strong></td>
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<td>RPL Sarulla Operations Limited (SOL)</td>
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**Sarulla Operations Limited (SOL)**
## Environmental Monitoring Plan Summary Matrix

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<td>To identify local communities’ complaints regarding workforce recruitment, well drilling and production testing, and installation of transmission network</td>
<td>To record complaints regarding the use of local workers, well drilling and production testing, and installation of transmission network</td>
<td>Villages in the vicinity of project area (Sibaganding, Lumban Jaean, Simatani, Silangkitang, Sigurung-gurung, Paridomuain Nainggolan, Pardamean Nainggolan)</td>
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<td>Roads accessed by project vehicles in North Tapanuli Regency</td>
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### C. Operation stage

#### Geophysical and chemical components

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<th>Impact Parameter</th>
<th>Impact Indicator</th>
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<td>H₂S</td>
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<td>MINISTER OF ENVIRONMENT DECREE NO. KEP</td>
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<td>Noise</td>
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<td>Power plant operation</td>
<td>To determine noise level</td>
<td>Measurement of noise levels in ambient air using equipment according to Indonesian National Standard (SNI)</td>
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## Environmental Monitoring Plan Summary Matrix

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

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<th>Environmental Monitoring Objective</th>
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<td><strong>Job opportunities</strong></td>
<td>Job opportunities</td>
<td>Numbers of local and non-local workers recruited by SOL and its contractors</td>
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<td>To ensure that the optimum number of local workers are hired by SOL and its contractors employees using available employee data from SOL and its contractors</td>
<td>To record the numbers, percentages, areas of origin of SOL and its contractors</td>
<td>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</td>
<td>SOL</td>
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<td><strong>Community income</strong></td>
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<td>Household income</td>
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<td>To evaluate the household income levels in the surrounding project area</td>
<td>To collect community income data from local agencies</td>
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<tr>
<th>Environmental Component / Activity</th>
<th>Significant Impact Monitored</th>
<th>Source of Significant Impact</th>
<th>Environmental Monitoring Objective</th>
<th>Environmental Monitoring Plan Data Collection and Analysis</th>
<th>Environmental Monitoring Plan Location</th>
<th>Monitoring Period and Frequency</th>
<th>Environmental Monitoring Institutions</th>
<th>Reporting to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community unrest</td>
<td>Community unrest</td>
<td>• Communities’ complaints regarding workforce recruitment</td>
<td>To identify local communities’ complaints regarding local workforce recruitment, well drilling and production testing, and operation of transmission network</td>
<td>To record complaints regarding the use of local workers, well drilling and production testing, and operation of transmission network</td>
<td>• Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jie and Pahae Julu Districts, North Tapanuli Regency</td>
<td>Once a year during construction period</td>
<td>SOL</td>
<td>Agency of North Tapanuli Regency • Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</td>
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<tr>
<td>Other monitoring</td>
<td></td>
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<td>Environmental Impact Management Agency (Bapedalda) of North Sumatera Province • Environmental Office of North Tapanuli Regency • Mining and Energy Agency of North Tapanuli Regency • Mining and Energy Agency of North Tapanuli Regency • Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</td>
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<tr>
<td>Solid and liquid waste monitoring</td>
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<tr>
<td>Surface water quality</td>
<td>• Solid waste: types and quantities of waste collected, transported, disposed to landfills, and recycled</td>
<td>• Domestic liquid waste</td>
<td>• To identify the types and quantities of solid waste generated by SOL</td>
<td>• To measure the quantities of solid waste generated by counting the number of trucks coming in and out of waste disposal area</td>
<td>• Domestic solid waste disposal area and Domestic wastewater treatment plant location</td>
<td>SOL</td>
<td>Environmental Impact Management Agency (Bapedalda) of North Sumatera Province • Environmental Office of North Tapanuli Regency</td>
<td>Environmental Impact Management Agency (Bapedalda) of North Sumatera Province • Environmental Office of North Tapanuli Regency • Mining and Energy Agency of North Tapanuli Regency • Mining and Energy Agency of North Tapanuli Regency • Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</td>
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<td>• Water discharges from domestic wastewater treatment plant</td>
<td>• To determine the performance of the wastewater treatment plant</td>
<td>• To ensure correct handling and disposal of B3 wastes</td>
<td>• Domestic wastewater treatment plant outlets according to SOL protocols (which are based on Indonesian National Standards (SNIII)) and to measure pH, conductivity, and in situ</td>
<td>• To monitor the implementation of standard operational procedures (SOP) for oil spill prevention</td>
<td>• To monitor the correct implementation of SOP for B3 wastes handling and disposal</td>
<td>• To carry out TCLP Test for drilling sludge, slurry</td>
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<td>• Drilling well, sump pit, well production (during production test) which potentially producing both hazardous and non-hazardous wastes</td>
<td>• To monitor the operation of the wastewater treatment plant</td>
<td>• Domestic solid waste disposal area and Domestic wastewater treatment plant location</td>
<td>• Well locations (sump pit and slurry disposal) and Community wells at SIL and NIL</td>
<td>• To sample, prepare and analyze water samples from domestic wastewater treatment plant</td>
<td>• To monitor the correction of B3 wastes handling and disposal</td>
<td>• To carry out TCLP Test for drilling sludge, slurry</td>
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<tr>
<td></td>
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<td>• 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</td>
<td>• Compliance with B3 waste regulations (Government Regulations No. 18 of 1999 and No. 85 of 1999)</td>
<td>• To ensure correct handling and disposal of B3 wastes</td>
<td>• Batang Toru River</td>
<td>• Solid waste: each time solid waste is being disposed</td>
<td>• Domestic wastewater treatment plant: once a month</td>
<td>• Well locations: during and after drilling</td>
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<td></td>
<td>• Compliance with B3 waste regulations (Government Regulations No. 18 of 1999 and No. 85 of 1999)</td>
<td>• To measure the quantities of solid waste generated by counting the number of trucks coming in and out of waste disposal area</td>
<td>• Domestic wastewater treatment plant</td>
<td>• Water discharges from domestic wastewater treatment plant</td>
<td>• To sample, prepare and analyze water samples from domestic wastewater treatment plant</td>
<td>• To monitor the correct implementation of SOP for B3 wastes handling and disposal</td>
<td>• To carry out TCLP Test for drilling sludge, slurry</td>
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</table>

**Environmental Monitoring Plan Summary Matrix**

**Environmental Component / Activity**
- Community unrest
- Other monitoring
- Solid and liquid waste monitoring
- Surface water quality

**Significant Impact Monitored**
- Community unrest
- Other monitoring
- Solid and liquid waste monitoring

**Source of Significant Impact**
- 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 regulations (Government Regulations No. 18 of 1999 and No. 85 of 1999)
- Compliance with B3 waste regulations

**Environmental Monitoring Objective**
- 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
- To identify the types and quantities of solid waste generated by SOL
- To determine the performance of the wastewater treatment plant
- To ensure correct handling and disposal of B3 wastes

**Environmental Monitoring Plan 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 (SNIII)) 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

**Environmental Monitoring Plan Location**
- Villages in the vicinity of the development of Sarulla geothermal field and power plant project area in Pahae Jie and Pahae Julu Districts, North Tapanuli Regency
- SOL office at project location
- Domestic solid waste disposal area and Domestic wastewater treatment plant location
- Well locations (sump pit and slurry disposal) and Community wells at SIL and NIL
- Batang Toru River

**Monitoring Period and Frequency**
- Once a year during construction period
- Domestic wastewater treatment plant: once a month
- Well locations: during and after drilling

**Environmental Monitoring Institutions**
- SOL
- SOL
- Environmental Impact Management Agency (Bapedalda) of North Sumatera Province • Environmental Office of North Tapanuli Regency

**Reporting to**
- Agency of North Tapanuli Regency • Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources
- Environmental Impact Management Agency (Bapedalda) of North Sumatera Province • Environmental Office of North Tapanuli Regency • Mining and Energy Agency of North Tapanuli Regency • Mining and Energy Agency of North Tapanuli Regency • Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources
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<th>Supervisor</th>
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<tr>
<td>Community Development Programs</td>
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<tr>
<td>Provision of education services and facilities</td>
<td>Provision of education services and facilities for local communities</td>
<td>Distribution of education facilities around the project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>Increased demands for education services and facilities</td>
<td>To monitor and evaluate SOL community development program and to ensure that funding for the program is used responsibly and effectively</td>
<td>To evaluate the effectiveness of all projects funded by SOL</td>
<td>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</td>
<td>Once a year during the implementation of community development program</td>
<td>SOL</td>
<td>Education Agency of North Tapanuli Regency</td>
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<tr>
<td>Provision of public health services</td>
<td>Provision of public health services and facilities</td>
<td>Distribution of health facilities around the project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>Increased demands for health services and facilities</td>
<td>To monitor the effectiveness of the distribution of health services and facilities within the community development program</td>
<td>To evaluate the effectiveness of all projects funded by SOL</td>
<td>• 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</td>
<td>• Public health centers in the vicinity of the project area</td>
<td>Once a year during the implementation of community development program</td>
<td>SOL</td>
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Sarulla Operations Limited (SOL)
### Environmental Monitoring Plan Summary Matrix

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<tr>
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<th>Environmental Monitoring Institutions</th>
<th>Reporting to</th>
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</thead>
<tbody>
<tr>
<td>Initiatives for improving farming and agriculture cultivation techniques</td>
<td>Agriculture productivity in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>Low level of interest on agriculture activities amongst younger generation</td>
<td>To monitor the understanding of significant factors affecting agriculture production</td>
<td>To evaluate the effectiveness of all projects funded by SOL</td>
<td>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</td>
<td>Once a year during the implementation of community development program</td>
<td>SOL</td>
<td>Agriculture Agency of North Tapanuli Regency</td>
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<tr>
<td></td>
<td>Production level and types of agriculture commodities around the project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>Limited knowledge on agriculture commodities with high economic values amongst young farmers</td>
<td>To monitor production level of significant local agriculture products</td>
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<td>Low level of interest on agriculture activities amongst younger generation</td>
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<td>Shortage of agricultural products</td>
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<td></td>
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<td>Limited high quality agriculture production facilities</td>
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<td>Limited skills in using agriculture machineries amongst farmers</td>
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<tr>
<td>Local business opportunities</td>
<td>Local communities’ participation level in various economic activities</td>
<td>Number of locally owned and managed businesses</td>
<td>To monitor local communities’ participation in the economic development of the project area in North Tapanuli Regency</td>
<td>To collect data on purchases of goods and services carried out by SOL and its contractors, and contracts that SOL awarded to local companies</td>
<td>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</td>
<td>Once a year during the implementation of community development program</td>
<td>SOL</td>
<td>Industrial Agency of North Tapanuli Regency</td>
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<td>Types of goods and services provided</td>
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<td>Local economic activities value</td>
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<td>Level of local communities participation integrated and equally in local business opportunities</td>
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<td></td>
<td>Level of local communities’ business skill</td>
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<td>Availability of access to sources of funding and capital</td>
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<tr>
<td>Provision of public infrastructures</td>
<td>Local communities’ needs and demands for public services</td>
<td>Rapid growth and development rates</td>
<td>To support local governments in its efforts to provide adequate public services to local communities</td>
<td>To collect data on the availability of public infrastructures and evaluate the effectiveness of all projects funded by SOL</td>
<td>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</td>
<td>Once a year during the implementation of community development program</td>
<td>SOL</td>
<td>Public Works Agency of North Tapanuli Regency</td>
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<td></td>
<td>Local governments’ request to provide public infrastructures</td>
<td>Local communities’ increased demands for public services</td>
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</table>

**ENVIROMENTAL MONITORING PLAN/RPL SARULLA OPERATIONS LIMITED (SOL)**

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

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

**North Sumatera Province**
- Environmental Impact Management Agency (Bapedalda) of North Sumatera Province
- Environmental Office of North Tapanuli Regency
- Mining and Energy Agency of North Sumatera Province
- Director General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources
## Environmental Monitoring Plan Summary Matrix

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<th>Monitoring Period and Frequency</th>
<th>Environmental Monitoring Institutions</th>
<th>Reporting to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural preservation</td>
<td>Traditional activities, cultural festivals, books and monographs on language, history, sociology and local anthropology</td>
<td>Changes in traditional and cultural values and customs</td>
<td>Increasing presence of modern society and its associated infrastructures and materials</td>
<td>To assist the local communities in maintaining their traditional cultures intact</td>
<td>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</td>
<td>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</td>
<td>Once a year during the implementation of community development program</td>
<td>SOL Education Agency of North Tapanuli Regency</td>
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<tr>
<td>Awareness of SOL activities</td>
<td>Accuracy and completeness of information about SOL activities within the local communities</td>
<td>Lack of awareness and understanding of SOL activities (such as employment/ training and business opportunities) within the workforce and local communities</td>
<td>Misinformation circulating in the local communities concerning SOL activities</td>
<td>To monitor the effectiveness of SOL programs in disseminating information about SOL activities and to rectify inaccurate information</td>
<td>To review the discussions with employees and community leaders about information dissemination to employees and the local communities</td>
<td>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</td>
<td>Once every three years during operational stage</td>
<td>SOL Environmental Impact Management Agency (Bapedalda) of North Sumatera Province</td>
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- Mining and Energy Agency of North Tapanuli Regency
- Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources.
## Environmental Monitoring Plan Summary Matrix

### D. Post-operation stage

#### Socio-economic, social-cultural and public health components

<table>
<thead>
<tr>
<th>Component</th>
<th>Impact</th>
<th>Objective</th>
<th>Location and Frequency</th>
<th>Implementer</th>
<th>Supervisor</th>
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</thead>
<tbody>
<tr>
<td>Job opportunities</td>
<td>Job opportunities</td>
<td>To ensure that SOL and its contractors fulfill the rights of employees released</td>
<td>Villages in the vicinity of project area (Sibagading, Lumban Jaen, Simatanari, Silangkitang, Sipung-gusirng, Pardomuan Nainggolan, Pardamean Nainggolan)</td>
<td>Once during post-operation stage</td>
<td>SOL</td>
</tr>
<tr>
<td>Community income</td>
<td>Community income</td>
<td>To determine household income of the communities in the surrounding project area</td>
<td>The development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julo Districts, North Tapanuli Regency</td>
<td>Once in post-operation stage</td>
<td>SOL</td>
</tr>
<tr>
<td>Community unrest</td>
<td>Community unrest</td>
<td>To determine specific complaints from local communities regarding employee release</td>
<td>The development of Sarulla geothermal field and power plant project area in Pahae Jae and Pahae Julo Districts, North Tapanuli Regency</td>
<td>Once in post-operation stage</td>
<td>SOL</td>
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#### SOL
- **Environmental Impact Management Agency (Bopedaldsia) 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**
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<td>Agency of North Sumatera Province</td>
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<td>• Mining and Energy Agency of North Tapanuli Regency</td>
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APPENDIX 2

SOL ORGANIZATION CHART