Environmental Management 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)

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

In compliance with the applicable regulations in Indonesia, this Environmental Management Plan (Rencana Pengelolaan Lingkungan = RKL) shall be submitted with Environmental Impact Statement (Analisis Dampak Lingkungan Hidup = ANDAL) and Environmental Monitoring Plan (Rencana Pemantauan Lingkungan Hidup = RPL). This RKL was prepared in accordance with Minister of Environment Regulation No. 08 of 2006 concerning guidance on the preparation of Environmental Impact Analysis (Analisis Mengenai Dampak Lingkungan = AMDAL).

The development of Sarulla geothermal field and power plant Sarulla PLTP is located ± 40 km south of the city of Tarutung on the Trans-Sumatra highway (Tarutung-Sipirok) with Sarulla Operations Ltd (hereafter referred to as SOL) as the project proponent. Administratively this project is located in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency, North Sumatera Province (see Map 1-1).

1.1 AIMS AND OBJECTIVES

1.1.1 Aims

The ANDAL document identified positive and negative significant impacts on the environment due to the activities of developing Sarulla geothermal field and power plant. Aims of the Environmental Management Plan are:

- To comply with all applicable regulations in relation to pollution control, waste management and environmental quality monitoring;
- To ensure that SOL activities are environmentally sound and sustainable i.e. effective management of natural resources to support economic and social developments in Indonesia, in particular to support economic and social developments in North Tapanuli Regency, North Sumatera Province;
- To manage environmental changes resulting from the activities of developing Sarulla geothermal field and power plant hence safeguarding environmental quality;
- To increase the positive impacts (benefits) and to prevent, control and manage the negative impacts (risk).
The Environmental Management Plan was prepared to maintain the equilibrium between environmental components in the vicinity of the project area by:

- Determining preventive, management and control measures on the negative impacts and enhance the positive impacts from the activities of developing Sarulla geothermal field and power plant;
- Involving relevant government agencies and authorities in the environmental management in North Tapanuli Regency, North Sumatera Province;
- Providing sufficient funds to implement the Environmental Management Plan and the Environmental Monitoring Plan to preserve current environmental conditions.

1.1.2 Objectives

Objectives of the Environmental Management Plan are as follow:

- To provide guidelines and directions to implement the environmental management and monitoring of the development of Sarulla geothermal field and power plant;
- To ensure that any environmental changes due to the activities of developing Sarulla geothermal field and power plant in North Tapanuli Regency, North Sumatera Province does not decrease environmental quality;
- To preserve and maintain environmental quality around the development of Sarulla geothermal field and power plant project area in North Tapanuli Regency, North Sumatera Province;
- To enhance and further develop the positive impacts and to control the negative impacts arising from the development of Sarulla geothermal field and power plant;
- To establish mechanisms to coordinate environmental management activities with relevant government agencies.

1.2 ENVIRONMENTAL POLICY

According to SOL’s environmental policy, SOL is obliged to adhere to all applicable regulations concerning the environment, and health and safety, as well as to contribute to community development in the vicinity of the development of Sarulla geothermal field and power plant project area. SOL is committed to implement international standard best practice on environmental management, and health and safety (lingkungan, kesehatan dan keselamatan kerja = K3L). SOL acknowledges that its environmental management system must be integrated in each stage of the development of Sarulla geothermal field and power station. The success of its management system is measured by the following key points:

- Existence of work environment where employees are able to fulfill their obligations without risks of having accidents or work-related injuries;
• Pollution prevention;
• Compliance with applicable Government regulations and SOL’s commitments to the environment, and health and safety;
• Fulfillment of stakeholders’ expectations which include employees, local communities, governments, shareholders, and SOL customers;
• Efficient use of natural resources;
• Continuous improvements.

To achieve all of the above points, SOL is committed to implement a management system on the environment, health and safety as follows:

• To identify environmental, health and safety risks in all activities of developing Sarulla geothermal field and power plant;
• To establish objectives and targets for each significant risk;
• To implement plans, standards, and procedures to manage and monitor such risks;
• To carry out audits, evaluate and report the performance on the environment, health and safety on a regular basis;
• To undertake continuous improvements in order to achieve compliance with applicable regulations and SOL’s commitments.

SOL organization structure to develop Sarulla geothermal field and power plant is presented in Appendix 2.

1.3 THE PURPOSES OF ENVIRONMENTAL MANAGEMENT PLAN (RKL)

One of the purposes of environmental management is to maintain environmental carrying capacity while achieving the schedule targeted to develop Sarulla geothermal field and power plant.

The Environmental Management Plan serves as directions and guidelines for SOL as the project proponent, and also for government agencies. The purposes of the Environmental Management Plan are:

• To provide directions for the project proponent to managing the environment in the vicinity of the project area;
• To serve as guidelines for the project proponent, government agencies and institutions in the implementation on environmental management in accordance to one’s functions and responsibilities;
• To assist the government in environmental decision-making, planning and management;
• To assist regional/local governments in environmental monitoring and development in order to preserve the environment;
• To avoid conflicts between local communities and the project proponent;
• To prevent environmental degradation and to focus on enhancing the positive impacts for local communities and regional/local governments.
CHAPTER II
ENVIRONMENTAL MANAGEMENT APPROACH

2.1 TECHNOLOGICAL APPROACH

Process and technical approach, in accordance with currently available technology, is to be used to prevent, control, minimize and manage the negative impacts of the project activities. As much as possible, efforts are directed to preserve the environment and not to exceed environmental carrying capacity. Specific technical program includes:

2.1.1 Power plant technology

The development of Sarulla power plant employs air cooling system from Ormat Energy Converter (OEC). Hence, the development does not require make-up water. Brine and steam are to be re-injected into reinjection wells.

2.1.2 Drilling technology

Drilling includes production wells and reinjection wells. The drilling process will use water base mud (WBM) to prevent the borehole walls from caving during drilling. At certain depths, well casing will be installed to prevent caving of the borehole, and to prevent leakage from or to soil and rock formations. After the drilling is completed, well head will be equipped with tools to control fluid flow rate from the well. It is anticipated that drilling will utilize water from Batang Toru River approximately 400m$^3$ for each well.

Chemicals required for drilling activity consist of WBM and cementing materials. The types and the amounts of the chemical required depend on the depth and the characteristics of the drilled formations. The typical chemicals required are as follow:

- Barite;
- Bentonite;
- Caustic soda;
- Sodium bicarbonate;
- Hightemp defloculent;
- Hightemp fluid (control additive).

Each chemical has its own MSDS and most of the chemicals are categorized as non-hazardous and non-toxic (non-B3) based on a list published by the United States...
Environmental Protection Agency (US-EPA). Storage and treatment of these chemicals and their residuals will refer to the associated MSDS.

Directional drilling technology will be employed to ensure an efficient use of drilling well pads during well development.

2.1.3 Air pollution control technology

Non-condensable gases (NCG) in the steam (mostly CO₂ and a small amount of H₂S) will be piped from Bottoming OECs heat exchangers to top of air cooled condenser fan and released to atmosphere.

2.1.4 Waste management technology

- Oil and chemical waste

The oil and chemical waste from the geothermal field and the power plant will be treated according to Government Regulation No. 85 of 1999 concerning changes to Government Regulation No. 18 of 1999 concerning the management of hazardous and toxic wastes. Used lubricant oil will be temporarily stored in a drum before handled by a licensed waste management contractor.

- Liquid waste

Liquid waste from the power plant operation is originated from domestic waste and steam. Domestic waste is transferred to septic tanks whilst steam is re-injected into reinjection wells and if required, H₂SO₄ is to be added to control pH.

- Solid waste

Solid waste in forms of metals and cables are to be collected and transferred to a temporary storage near the project area. The temporary storage area is to be integrated with the temporary storage area for the installation of transmission network.

Domestic solid waste is biodegradable and to be collected in a temporary storage area at the project location. The waste will be handled by a licensed waste management contractor and transferred into the nearest licensed final disposal area.

2.2 SOCIO-ECONOMIC APPROACH

This approach includes steps for the project proponent to manage significant impacts by undertaking activities based on social interactions and collaborations with central/regional/local governments. The approach is specified as follows:

1. To involve local communities in the vicinity of the project area to actively participate in environmental management activities;
2. To prioritize local workforce recruitment according to skills possessed and to pass SOL selection process;

3. To collaborate with third-party in providing goods and services thus improving local economy;

4. To provide public facilities to local communities in the vicinity of the project area according to project proponent’s capability;

5. To create and maintain harmonized social interaction with local communities in the vicinity of the project area to avoid social problems.

2.2.1 Anticipative Approach

This approach is identical to preventative efforts to avoid negative impacts (that can be predicted) as early as possible, or if unavoidable, to minimize the impacts as much as possible.

The initial step is to provide transparent information on the project activities. Information shall be presented in a clear and simple format, easily understood by local communities in order to minimize discrepancies between the project proponent and the local communities.

The anticipative approach shall be undertaken periodically in the form of consultation.

2.2.2 Direct and indirect approaches

Direct approach: directly towards local communities interested in the project.

Indirect approach: by approaching informal leaders i.e. community, religious and traditional leaders who lead non governmental institutions and considered as role models in the communities.

2.2.3 Segmentary approach

This is a segmented approach to be undertaken when complicated and interconnected problems occur.

A mediator with the ability to carry out segmentary approach proportionally and not to ignore issues between different stakeholders is necessary to reach a solution.

This approach is effective to manage community unrest in relation to workforce mobilization prior to and following the end of construction stage.

2.2.4 Stimulative approach

This approach focuses on managing socio-economic-cultural impacts as construction stage ends. The process of social adaption within the local communities with the project existence in their life does not stop as operation stage commences.
The local communities still have to seek their new identity i.e. integration between the traditional and geothermal industry styles.

Stimulus shall be provided to put an end to gaps that exist due to discontinued primary impacts and to create secondary impacts.

2.2.5 Qualitative and quantitative approaches

**Qualitative approach**: the focus of this approach is to measure the success of the environmental management system related to socio-cultural parameters. Exact science cannot approach parameters such as cultural, custom, community perception, etc. Thus analogical methods and value judgment play an important role as qualitative approach.

**Quantitative approach**: can be used as guidelines to evaluate the success of the environmental management system related to socio-economic parameters. Quantitative calculations can be implemented to measure increase and decrease of community income before and after the project, business growth and decline, number of assets, turnover, capital, etc.

2.2.6 Community development approach

In order to manage the environmental impacts due to project activities, the project proponent shall undertake community development programs. The programs are expected to accommodate community participation together with the project proponent in environmental management.

2.3 INSTITUTIONAL APPROACH

Environmental management activities are not solely project proponent’s responsibilities but require involvement and integration between relevant institutions. It is therefore important to:

- Coordinate with relevant institutions to develop and monitor the environment, and health and safety;
- Coordinate with North Tapanuli Regency and relevant institutions in managing potential social issues;
- Cooperate with various stakeholders including Non Governmental Organizations and local community leaders in undertaking community development programs;
- Inform local communities on the objectives and benefits of the development of Sarulla geothermal field and power plant.
2.4 ENVIRONMENTAL MANAGEMENT APPROACH

As a commitment to the highest environmental management standard, the project proponent plans to implement an environmental management system such as ISO 14001 or similar standard.
CHAPTER III
ENVIRONMENTAL MANAGEMENT PLAN

3.1 PRE-CONSTRUCTION STAGE

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

3.1.1.1 Land ownership and occupancy

1. Significant impact and source of significant impact
   a) Significant impact
      Land ownership
   b) Source of significant impact
      Land acquisition

2. Impact indicator
   • Changes in land ownership that used to be owned by local community in the vicinity of the project areas
   • Community unrest due to the land acquisition

3. Environmental management objective
   To avoid and minimize community unrest due to land acquisition process

4. Environmental management plan
   • Prepare a project plan and to coordinate with relevant authorities on areas which will be acquired
   • Undertake public consultation for each land acquisition activity
   • Persuasively approach land owners/users in order to obtain information on land ownership status and size of land
   • Investigate, ensure and record the land ownership information
   • Coordinate with relevant local authorities (National Land Agency North Tapanuli Regency, Head of District (camat) and village heads (kepala desa) during the land acquisition process
   • Obtain mutual agreements between the project proponent and land owners on the values and forms of compensation towards land and vegetation acquisitions in accordance with applicable laws and regulations
5. **Environmental management location**
   The development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

6. **Environmental management period**
   During the pre-construction stage

7. **Environmental management institutions**
   - Implementer: SOL
   - Supervisor: National Land Agency (BPN), 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

3.1.1.2 **Community unrest**

1. **Significant impact and source of significant impact**
   - **a) Significant impact**
     Community unrest
   - **b) Source of significant impact**
     Land acquisition

2. **Impact indicator**
   - Complaints from the community regarding boundaries and size of land
   - Different opinions in land value and compensation types for land and/or vegetation acquisitions

3. **Environmental management objective**
   To avoid and minimize community unrest due to land acquisition process

4. **Environmental management plan**
   - Prepare a work plan consisting of land acquisition mechanism, land compensation system and monitoring plan
   - Consult and disseminate accurate information regarding land acquisition activities
   - Carry out land acquisition activities fairly and openly
5. **Environmental management location**
   Villages in the vicinity of the development of geothermal fields and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

6. **Environmental management period**
   During the pre-construction stage

7. **Environmental management 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

3.2 **CONSTRUCTION STAGE**

3.2.1 Geophysical and chemical components

3.2.1.1 **H₂S**

1. **Significant impact and source of significant impact**
   a) **Significant impact**
      H₂S concentrations in ambient air
   b) **Source of significant impact**
      Well drilling and production testing

2. **Impact indicator**

3. **Environmental management objective**
   To minimize H₂S concentration in ambient air

4. **Environmental management plan**
   - Secure well locations and limit access for local communities
• Workers nearby well locations must be equipped with PPE (Personal Protective Equipment)
• Production test locations will be equipped with H₂S monitoring equipment
• Maintenance of construction vehicles
• Reduce vehicles speed to a maximum of 40 km/hour
• Put ‘Do Not Enter’ signs for unauthorized personnel during the drilling and test production
• Evacuate personnel and residents around well locations if H₂S concentration is exceeded
• If based on monitoring results the H₂S concentration exceeds the threshold, production wells will be reduced to ensure achievement of H₂S concentration standard

5. Environmental management location
   Around the area of well drilling and production testing

6. Environmental management period
   During the construction stage

7. Environmental management 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

3.2.1.2 Noise

1. Significant impact and source of significant impact
   a) Significant impact
      Noise
   b) Source of significant impact
      • Mobilization of equipment and material
      • Well drilling and production testing
• Power plant construction

2. **Impact indicator**
   Minister of Environment Decree No Kep-48/MENLH/11/1996

3. **Environmental management objective**
   To minimize an increased in noise level

4. **Environmental management plan**
   • Maintenance of construction vehicles
   • Reduce vehicles speed to a maximum of 40 km/hour
   • Install silencer to reduce noise
   • Workers nearby production test well to use ear muff
   • Put ‘Do Not Enter’ signs for unauthorized personnel during the drilling
   • Plant trees with wide canopies to reduce noise level
   • Consultation with communities close to the project location

5. **Environmental management location**
   • Road access within the development of Sarulla geothermal fields and power plant project area
   • Well locations
   • Power plant construction area

6. **Environmental management period**
   During the construction stage

7. **Environmental management 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
3.2.2  Socio-economic, socio-cultural, and public health components

3.2.2.1  Job opportunities

1. Significant impact and source of significant impact
   a) Significant impact
      Job opportunities
   b) Source of significant impact
      Workforce recruitment

2. Impact indicator
   Numbers of local and non-local workers recruited by SOL and its contractors

3. Environmental management objective
   • To optimize job opportunities for local communities
   • To prioritize local communities in workforce recruitment

4. Environmental management plan
   • Provide job opportunities for local communities who fulfill company’s requirements and qualifications
   • Encourage contractors to hire as many local workers as possible

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

6. Environmental management period
   During the construction stage

7. Environmental management 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
3.2.2.2  **Business opportunities**

1. **Significant impact and source of significant impact**
   
a) **Significant impact**
   
   Business opportunities

b) **Source of significant impact**
   
   Construction activities

2. **Impact indicator**
   
   Creation of business opportunities for local communities

3. **Environmental management objective**
   
   To increase local communities’ participation in project activities

4. **Environmental management plan**
   
   - Provide job opportunities for local communities who fulfill company’s requirements and qualifications
   - Encourage contractors to hire as many local workers as possible

5. **Environmental management location**
   
   Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

6. **Environmental management period**
   
   During the construction stage

7. **Environmental management 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

3.2.2.3  **Community income**

1. **Significant impact and source of significant impact**
   
a) **Significant impact**
   
   Community income
b) Source of significant impact

Construction activities

2. Impact indicator

Household income

3. Environmental management objective

- To optimize job opportunities for local communities
- To prioritize local communities in workforce recruitment
- To increase the level of participation of local businesses in the project

4. Environmental management plan

- Provide job opportunities for local communities who fulfill company’s requirements and qualifications
- Provide opportunities for local businesses to participate in the provision of goods and services

5. Environmental management location

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

6. Environmental management period

During the construction stage

7. Environmental management 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

3.2.2.4 Community unrest

1. Significant impact and source of significant impact
   
a) Significant impact

   Community unrest

b) Source of significant impact

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

2. Impact indicator
• Community complaints regarding workforce recruitment
• Local concerns toward well drilling and production testing
• Local concerns toward transmission network

3. Environmental management objective
• To avoid and minimize community unrest towards workforce recruitment during the construction stage
• To avoid community unrest towards well drilling activity
• To avoid community unrest towards installation of transmission network

4. Environmental management plan
• Prepare a work plan on local workforce recruitment during drilling and installation of transmission network
• Consult and disseminate accurate information on workforce recruitment and its requirements fairly and openly
• Public consultation on the drilling plan
• Public consultation on the plan to install transmission network

5. Environmental management location
• Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
• Villages in the transmission network area

6. Environmental management period
During the construction stage

7. Environmental management 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...
3.2.2.5 Transportation

1. Significant impact and source of significant impact
   a) Significant impact
      Ground traffic disruption
   b) Source of significant impact
      Mobilization of equipment and materials

2. Impact indicator
   • PHF (Peak Hours Factors)
   • Number of traffic accidents

3. Environmental management objective
   • To minimize traffic congestion
   • To minimize traffic accidents
   • To increase traffic safety

4. Environmental management plan
   • Installation and maintenance of traffic signals
   • Cover trucks properly to avoid spillage of materials onto the road
   • Collaborate with professional contractors in the provision of transportation services for equipment and materials
   • Routine and scheduled maintenance for heavy duty vehicles
   • Routine road inspections with relevant government authorities to ensure safe and good road conditions, and that local communities’ activities do not endanger traffic conditions
   • Operation of heavy duty vehicles during non-peak hours

5. Environmental management location
   Roads accessed by project vehicles in North Tapanuli Regency

6. Environmental management period
   During the construction stage

7. Environmental management 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

3.3 OPERATION STAGE

3.3.1 Geophysical and chemical components

3.3.1.1 H₂S

1. Significant impact and source of significant impact
   a) Significant impact
      H₂S concentrations in ambient air
   b) Source of significant impact
      Power plant operation

2. Impact indicator

3. Environmental management objective
   To minimize H₂S concentrations in the ambient air

4. Environmental management plan
   • If the H₂S concentration at the monitoring locations exceed the odor quality standard of 0.02 ppm, emission of H₂S from power plant will be controlled using technologies such as LO-CAT sulfur recovery unit until the concentration meets the odor quality standard
   • Secure power plant location and limit access for local communities
   • Workers working in the surrounding power plant area must be equipped with PPE (Personal Protective Equipment)
   • Equip power plant with H₂S monitoring equipment

5. Environmental management location
   Around power plant locations

6. Environmental management period
   During the operation stage

7. Environmental management 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

3.3.1.2 Noise

1. Significant impact and source of significant impact
   a) Significant impact
      Noise level
   b) Source of significant impact
      Power plant operation

2. Impact indicator

3. Environmental management objective
   To minimize an increase in noise level

4. Environmental management plan
   • Workers in and around power plant to use ear muff
   • Install silencer to reduce noise
   • Plant trees with wide canopies to reduce noise level

5. Environmental management location
   Around power plant locations

6. Environmental management period
   During the operation stage

7. Environmental management 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
3.3.2 Socio-economic, socio-cultural, and public health components

3.3.2.1 Job opportunities

1. Significant impact and source of significant impact
   a) Significant impact
      Job opportunities
   b) Source of significant impact
      Workforce recruitment

2. Impact indicator
   Numbers of local and non-local workers recruited by SOL and its contractors

3. Environmental management objective
   • To optimize job opportunities for local communities
   • To prioritize local communities in workforce recruitment

4. Environmental management plan
   • Provide job opportunities for local communities who fulfill company’s requirements and qualification
   • Encourage contractors to hire as many local workers as possible

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

6. Environmental management period
   During the operation stage

7. Environmental management 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
3.3.2.2 Business opportunities

1. Significant impact and source of significant impact
   a) Significant impact
      Business opportunities
   b) Source of significant impact
      Operation activities

2. Impact indicator
   Creation of business opportunities for the local communities

3. Environmental management objective
   To increase local communities’ participation in the project

4. Environmental management plan
   • Provide opportunities for local businesses to participate in the provision of goods and services
   • Provide guidance for local businesses in order to fulfill company’s standards

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

6. Environmental management period
   During the operation stage

7. Environmental management 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
3.3.2.3 Community income

1. Significant impact and source of significant impact
   a) Significant impact
      Community income
   b) Source of significant impact
      Operation activities

2. Impact indicator
   Household income

3. Environmental management objective
   • To optimize job opportunities for local communities
   • To prioritize local communities in workforce recruitment
   • To increase the level of participation of local businesses in the project

4. Environmental management plan
   • Provide job opportunities for local communities who fulfill company’s requirements and qualifications
   • Provide opportunities for local workers to grow and expand

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

6. Environmental management period
   During the operation stage

7. Environmental management 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
3.3.2.4 Community unrest

1. Significant impact and source of significant impact
   a) Significant impact
      Community unrest
   b) Source of significant impact
      Workforce recruitment
      Operation of transmission network

2. Impact indicator
   - Community complaints regarding workforce recruitment
   - Local concerns toward operation of transmission network

3. Environmental management objective
   - To avoid and minimize community unrest towards workforce recruitment during the operation stage
   - To avoid community unrest towards operation of transmission network

4. Environmental management plan
   - Prepare a work plan on local workforce recruitment in fair and open ways
   - Public consultation on the operation of transmission network

5. Environmental management location
   - Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
   - Villages in the transmission network area

6. Environmental management period
   During the operation stage

7. Environmental management 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
3.4 OTHER MONITORING

3.4.1 Solid and liquid waste monitoring

3.4.1.1 Surface water quality

1. Significant impact and source of significant impact
   a) Significant impact
      Heavy metals, hazardous and toxic (B3) wastes
   b) Source of significant impact
      Drilling wells, sump pit, well production (during production test) which potentially produce both B3 and non-B3 wastes

2. Impact indicator
   • Compliance with waste water quality standards
   • 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)

3. Environmental management objective
   • To reduce impacts to surface and ground water qualities
   • To ensure proper management of B3 wastes according to the applicable B3 regulations

4. Environmental management plan
   a) Domestic solid waste:
      Solid waste disposal to landfills
   b) Liquid waste:
      • Liquid domestic waste water treatment from all project activities in domestic waste water treatment plant
      • Condensate and brine generated during the power plant production testing and operational to be injected into reinjection wells
      • Construction of sump pit that is coated with waterproof layer. Collected water in the sump pit, used in the drilling process as drilling mud component to be returned into the wells
c) **B3 waste:**

- Fragments in the drilling mud to be stored in the sump pit
- Drilling mud to be stored in the sump pit
- Ensure that equipment and materials purchased by SOL do not contain PCBs, asbestos, ozone depleting substances and other prohibited materials according to relevant regulations
- Neutralize and securely store used lead acid batteries
- Collection of used oil, which then stored into drums and handed over to registered B3 management companies for further process
- Installation of secondary containments around flammable and hazardous materials as required
- Regular training on B3 waste management for employees

5. **Environmental management location**

- Sarulla project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
- B3 wastes temporary storage
- Domestic waste water treatment plant.
- Non B3 waste landfill
- Well locations

6. **Environmental management period**

During the operation stage

7. **Environmental management 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
3.4.2 Community development programs

3.4.2.1 Provision of education services and facilities

1. Significant impact and source of significant impact
   a) Significant impact
      Provision of education services and facilities for local communities
   b) Source of significant impact
      Increased demands for education services and facilities

2. Impact indicator
   Distribution of education facilities around the project area in Pahe Jae and Pahe Julu Districts, North Tapanuli Regency

3. Environmental management objective
   - To assist local governments in the provision of required education services and facilities under Community Development Program
   - To ensure responsible and effective use of Community Development Program funds

4. Environmental management plan
   Cooperation with relevant stakeholders in formal education and training to improve the qualities of local community resources

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

6. Environmental management period
   During the operation stage

7. Environmental management 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
3.4.2.2 Provision of public health services

1. Significant impact and source of significant impact
   a) Significant impact
      Provision of public health services and facilities
   b) Source of significant impact
      Increased demands for health services and facilities

2. Impact indicator
   Distribution of health facilities around the project area in Pahe Jae and Pahe Julu Districts, North Tapanuli Regency

3. Environmental management objective
   To assist local governments in the provision of required health services and facilities under Community Development Program

4. Environmental management plan
   Cooperation with relevant stakeholders in health services

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

6. Environmental management period
   During the operation stage

7. Environmental management 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

3.4.2.3 Initiatives for improving farming and agriculture cultivation techniques

1. Significant impact and source of significant impact
   a) Significant impact
      Agriculture productivity in Pahe Jae and Pahe Julu Districts, North Tapanuli Regency
b) **Source of significant impact**

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

2. **Impact indicator**

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

3. **Environmental management objective**

- To maintain and increase production level and agriculture commodity types
- To increase competitiveness of local agriculture commodities

4. **Environmental management plan**

Cooperation with relevant stakeholders in local agriculture

5. **Environmental management location**

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

6. **Environmental management period**

During the operation stage

7. **Environmental management 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

### 3.4.2.4 Local business opportunities

1. **Significant impact and source of significant impact**

a) **Significant impact**
Local communities’ participation level in various economic activities

b) Source of significant impact
- Level of local community participation integrally and equally in local business opportunities
- Level of local community’s business skill
- Availability of access to sources of funding and capitals

2. Impact indicator
- Number of locally owned and managed businesses
- Types of goods and services provided
- Local economic activities value

3. Environmental management objective
To increase participation of local communities in economic activities

4. Environmental management plan
- Encourage the use and purchase of local products and services by SOL and its contractors
- Provide assistance in training and opportunities to participate in local business activities
- Increase local communities’ involvement in entrepreneurship through local business activities
- Cooperation with local communities to improve the qualities of local goods and services

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

6. Environmental management period
During the operation stage

7. Environmental management 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
3.4.2.5 Provision of public infrastructures

1. Significant impact and source of significant impact
   a) Significant impact
      Local communities' needs and demands for public services
   b) Source of significant impact
      • Rapid growth and development rates
      • Local communities' increased demands for public services

2. Impact indicator
   Local governments' request to provide public infrastructures

3. Environmental management objective
   To support local governments in its efforts to provide adequate public services to local communities

4. Environmental management plan
   • Cooperation with local governments to determine public infrastructures to be provided
   • Encourage and assist local governments to develop its own social service initiatives

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

6. Environmental management period
   During the operation stage

7. Environmental management institutions
   • Implementer: SOL
   • Supervisor: Public Work 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
3.4.2.6 Cultural preservation

1. Significant impact and source of significant impact
   a) Significant impact
      Changes in traditional, cultural values and customs
   b) Source of significant impact
      Increasing presence of modern society and its associated infrastructures and materials

2. Impact indicator
   Traditional activities, cultural festivals, books and monographs on language, history, sociology and local anthropology

3. Environmental management objective
   To assist local communities in keeping their traditional cultures intact

4. Environmental management plan
   Support local ethnic programs and activities, preserve local culture including traditional activities (dances), cultural festivals, seminars and conferences, books and monographs on language, history, sociology and local anthropology

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

6. Environmental management period
   During the operation stage

7. Environmental management 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
3.4.2.7 Awareness of SOL activities

1. Significant impact and source of significant impact
   c) Significant impact
   Accuracy and completeness of information about SOL activities within the local communities
   d) Source of significant impact
   Misinformation circulating in the local communities concerning SOL activities

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

3. Environmental management objective
   To ensure accuracy and completeness of information about SOL activities

4. Environmental management plan
   Regular information dissemination related to SOL activities to community leaders and local government

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

6. Environmental management period
   During the operation stage

7. Environmental management 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
3.5 POST-OPERATION STAGE

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

3.5.1.1 Job opportunities

1. **Significant impact and source of significant impact**
   a) Significant impact
      Community unrest
   b) Source of significant impact
      Employee release

2. **Impact indicator**
   Unemployment due to employee release

3. **Environmental management objective**
   To prevent high level of unemployment to occur by the end of the project

4. **Environmental management plan**
   Consultation with workers on the plan to release employees

5. **Environmental management location**
   Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

6. **Environmental management period**
   During the post-operation stage

7. **Environmental management 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
3.5.1.2 Business opportunities

1. Significant impact and source of significant impact
   a) Significant impact
      Business opportunities
   b) Source of significant impact
      Completion of the operation stage

2. Impact indicator
   Reduction of business opportunities for local communities

3. Environmental management objective
   To maintain business opportunities for local communities

4. Environmental management plan
   Public consultation on the completion of project activities

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

6. Environmental management period
   During the post-operation stage

7. Environmental management 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

3.5.1.3 Community income

1. Significant impact and source of significant impact
   a) Significant impact
      Community income
   b) Source of significant impact
      Completion of the operation stage
2. **Impact indicator**
   - Reduction of business opportunities for local communities
   - Reduction of community income around project location

3. **Environmental management objective**
   To avoid a decrease in community income

4. **Environmental management plan**
   - Consultation with workers on the plan to release employees
   - Provide adequate compensation to workers in accordance with applicable regulations
   - Public consultation on the completion of project activities

5. **Environmental management location**
   Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency

6. **Environmental management period**
   During the post-operation stage

7. **Environmental management 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

3.5.1.4 **Community unrest**

1. **Significant impact and source of significant impact**
   a) Significant impact
      Community unrest
   b) Source of significant impact
      Workforce release

2. **Impact indicator**
   Community unrest due to workforce release
3. **Environmental management objective**
   To avoid and minimize community unrest due to workforce release

4. **Environmental management plan**
   - Prepare a work plan on workforce release
   - Consultation with workers on the plan to release employees

5. **Environmental management location**
   Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency
   Villages in the transmission network area

6. **Environmental management period**
   During the post-operation stage

7. **Environmental management 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

3.6 **POST-OPERATION ENVIRONMENTAL MANAGEMENT PLANS**

The post-operation stage occurs if and when transmission line or power plant equipment cannot serve its economic function, and therefore shall be deactivated. The deactivation process is anticipated to last 6 to 8 months prior to decommissioning. Local industries (especially PT. PLN) will be notified to assess the possibility to utilize the geothermal energy.

3.6.1 **Closure of production and reinjection wells**

Wells will be deactivated by following well closure procedure and areas around the wells will be rehabilitated. Reclamation of the wells area will be conducted with planting local plants. Well closure procedure is as follows:
• To block the borehole with cement with a minimum of 30 m thickness placed on top of productions casing shoe and another layer of cement on top. Mud with similar or greater density than those used as drilling mud will be used as filling between the cement layers;
• Production and reinjection wells closure will follow the procedure for permanent well closure.

3.6.2 Deactivation of pipelines and supporting facilities

All pipelines, pumps and separators will be deactivated in this stage following the procedure specified below:
• Pipelines and other supporting facilities will be dismantled, loaded onto trucks then sold to scrap metal buyers, or disposed to a licensed disposal area;
• Well pads will be replanted with grass and local plants.

3.6.3 Deactivation of geothermal power plants

As the operation stage is completed, all power plants will ceased to operate and will be demolished.
• All functional equipment will be dismantled to be reused in other projects in Indonesia or abroad, or to be sold;
• The remainder of equipment and buildings will be demolished. The debris will be sold to debris buyer or loaded onto trucks to be disposed to a licensed disposal area;
• Power plant locations will be rehabilitated i.e. replanted with grass and local vegetation;
• Unused land will be sold;
• SOL workforce release will work follow the applicable law and regulations, and will comply with work contracts.

A summary of matrix of project closure is provided in Appendix 1.
BIBLIOGRAPHY


Appendix 1

ENVIRONMENTAL MANAGEMENT PLAN
MATRIX SUMMARY
### Environmental Management Plan Summary Matrix

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<td>Changes in land ownership that are owned by local community in the vicinity of the project areas</td>
<td>To avoid and minimize community unrest due to land acquisition process</td>
<td>The development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>During the pre-construction stage</td>
<td>National Land Agency (BPH), North Tapanuli Regency</td>
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<td>Community unrest due to the land acquisition</td>
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<td>National Land Agency (Bapedalda) of North Sumatera Province</td>
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<td>Mining and Energy Agency of North Sumatera Province</td>
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<td>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</td>
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<td>Community unrest</td>
<td>Community unrest</td>
<td>Land acquisition</td>
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<td>Complaints from the community regarding boundaries and size of land</td>
<td>To avoid and minimize community unrest due to land acquisition process</td>
<td>Villages in the vicinity of the development of geothermal fields and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>During the pre-construction stage</td>
<td>National Land Agency (BPH), North Tapanuli Regency</td>
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<td>Different opinions in land value and compensation types for land and/or vegetation acquisitions</td>
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<td>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</td>
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</table>
| **H₂S**                         | H₂S concentrations in ambient air | Well drilling and production testing | Minister of Environment Decree No. Kep-50/MENLH/11/1996 | To minimize H₂S concentration in ambient air | • Secure well locations and limit access for local communities  
  • Workers nearby well locations must be equipped with PPE (Personal Protective Equipment)  
  • Production test locations will be equipped with H₂S monitoring equipment  
  • Maintenance of construction vehicles  
  • Reduce vehicles speed to a maximum of 40 km/hour  
  • Put 'Do Not Enter' signs for unauthorized personnel during the drilling and test production  
  • Evacuate personnel and residents around well locations if H₂S concentration is exceeded  
  • If based on monitoring results the H₂S concentration exceeds the threshold, production wells will be reduced to ensure achievement of H₂S concentration standard | Around the area of well drilling and production testing | During the 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 |
| **Noise**                       | Noise | Mobilization of equipment and materials  
  • Well drilling and production testing  
  • Power plant construction | Minister of Environment Decree No. Kep-48/MENLH/11/1996 | To minimize an increased noise level | • Maintenance of construction vehicles  
  • Reduce vehicles speed to a maximum of 40 km/hour  
  • Install silencer to reduce noise  
  • Workers nearby production test well to use ear muff  
  • Put 'Do Not Enter' signs for unauthorized personnel during the drilling  
  • Plant trees with wide canopies to reduce noise level  
  • Consultation with communities close to the project location | • Road access within the development of Sarulla geothermal fields and power plant project area  
  • Well locations  
  • Power plant construction area | During the 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 Management Plan Summary Matrix

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</thead>
<tbody>
<tr>
<td><strong>Socio-economic, socio-cultural, and public health components</strong></td>
<td>Job opportunities</td>
<td>Job opportunities</td>
<td>Workforce recruitment</td>
<td>Numbers of local and non-local workers recruited by SOL and its contractors</td>
<td>• To optimize job opportunities for local communities • To prioritize local communities in workforce recruitment</td>
<td>• Provide job opportunities for local communities who fulfill company's requirements and qualifications • Encourage contractors to hire as many local workers as possible</td>
<td>Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>During the construction stage</td>
<td>SOL</td>
<td>Labor Agency of North Tapanuli Regency</td>
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<tr>
<td><strong>Business opportunities</strong></td>
<td>Business opportunities</td>
<td>Construction activities</td>
<td>Creation of business opportunities for local communities</td>
<td>To increase local communities’ participation in project activities</td>
<td>Provide opportunities for local businesses to participate in the provision of goods and services</td>
<td>Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>During the construction stage</td>
<td>SOL</td>
<td>Labor Agency of North Tapanuli Regency</td>
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</tr>
</tbody>
</table>

**Environmental Management Institution**

- 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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<tbody>
<tr>
<td>Community income</td>
<td>Community income</td>
<td>Construction activities</td>
<td>Household income</td>
<td>To optimize job opportunities for local communities</td>
<td>Provide job opportunities for local communities who fulfill company’s requirements and qualifications</td>
<td>Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>During the construction stage</td>
<td>SOL</td>
<td>Labor Agency of North Tapanuli Regency</td>
<td>- Environmental Impact Management Agency (Bapedalda) of North Sumatera Province</td>
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<td>To prioritize local communities in workforce recruitment</td>
<td>Provide opportunities for local businesses to participate in the provision of goods and services</td>
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<td>To increase the level of participation of local businesses in the project</td>
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<tr>
<td>Community unrest</td>
<td>Community unrest</td>
<td>Workforce recruitment</td>
<td></td>
<td>To avoid and minimize community unrest towards workforce recruitment during the construction stage</td>
<td>Prepare a work plan on local workforce recruitment during drilling and installation of transmission network</td>
<td>Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>During the construction stage</td>
<td>SOL</td>
<td>Labor Agency of North Tapanuli Regency</td>
<td>- Environmental Impact Management Agency (Bapedalda) of North Sumatera Province</td>
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<tr>
<td></td>
<td></td>
<td>Well drilling and production testing</td>
<td></td>
<td>To avoid community unrest towards well drilling activity</td>
<td>Consult and disseminate accurate information on workforce recruitment and its requirements fairly and openly</td>
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<tr>
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<td></td>
<td>Installation of transmission network</td>
<td></td>
<td>To avoid community unrest towards installation of transmission network</td>
<td>Public consultation on the drilling plan</td>
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<td>Public consultation on the plan to install transmission network</td>
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## Transportation

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<tbody>
<tr>
<td>Ground traffic disruption</td>
<td>Mobilization of equipment and materials</td>
<td>PHF (Peak Hours Factors) • Number of traffic accidents • To minimize traffic congestion • To minimize traffic accidents • To increase traffic safety</td>
<td>To minimize traffic congestion • Cover trucks properly to avoid spillage of materials onto the road • Collaborate with professional contractors in the provision of transportation services for equipment and materials • Routine and scheduled maintenance for heavy duty vehicles • Routine road inspections with relevant government authorities to ensure safe and good road conditions, and that local communities' activities do not endanger traffic conditions • Operation of heavy duty vehicles during non-peak hours</td>
<td>Installation and maintenance of traffic signals • PHF (Peak Hours Factors) • Number of traffic accidents • To minimize traffic congestion • To increase traffic safety</td>
<td>Roads accessed by project vehicles in North Tapanuli Regency During the construction stage</td>
<td>SOL Traffic and Road Transportation Agency of North Tapanuli Regency</td>
<td>Environmental Impact Management Agency (Bapedaldal) 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</td>
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</table>

### C. Operation stage

#### Geophysical and chemical components

<table>
<thead>
<tr>
<th>H₂S</th>
<th>H₂S concentrations in ambient air</th>
<th>Power plant operation</th>
<th>Minister of Environment Decree No. Kep-50/MENLH/11/1996</th>
<th>To minimize H₂S concentrations in the ambient air</th>
<th>If the H₂S concentration at the monitoring locations exceed the odor quality standard of 0.02 ppm, emission of H₂S from power plant will be controlled using technologies such as LO-CAT sulfur recovery unit until the concentration meets the odor quality standard • Secure power plant location and limit access for local communities • Workers working in the surrounding power plant area must be equipped with PPE (Personal Protective Equipment) • Equip power plant with H₂S monitoring equipment</th>
<th>Around power plant locations During the operation stage</th>
<th>SOL</th>
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<tr>
<td>Noise</td>
<td>Noise level</td>
<td>Power plant operation</td>
<td>Minister of Environment Decree No. Kep-48/MENLH/11/1996</td>
<td>To minimize an increase in noise level</td>
<td>• Workers in and around power plant to use ear muff • Install silencer to reduce noise • Plant trees with wide canopies to reduce noise level</td>
<td>Around power plant locations</td>
<td>During the operation stage</td>
</tr>
</tbody>
</table>

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

| Job opportunities | Workforce recruitment | Numbers of local and non-local workers recruited by SOL and its contractors | To optimize job opportunities for local communities • To prioritize local communities in workforce recruitment | To provide job opportunities for local communities who fulfill company’s requirements and qualification • Encourage contractors to hire as many local workers as possible | Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | During the operation stage | SOL       | Labor Agency of North Tapanuli Regency |             |

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

| Job opportunities | Workforce recruitment | Numbers of local and non-local workers recruited by SOL and its contractors | To optimize job opportunities for local communities • To prioritize local communities in workforce recruitment | To provide job opportunities for local communities who fulfill company’s requirements and qualification • Encourage contractors to hire as many local workers as possible | Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | During the operation stage | SOL       | Labor Agency of North Tapanuli Regency |             |

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

| Job opportunities | Workforce recruitment | Numbers of local and non-local workers recruited by SOL and its contractors | To optimize job opportunities for local communities • To prioritize local communities in workforce recruitment | To provide job opportunities for local communities who fulfill company’s requirements and qualification • Encourage contractors to hire as many local workers as possible | Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | During the operation stage | SOL       | Labor Agency of North Tapanuli Regency |             |

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

| Job opportunities | Workforce recruitment | Numbers of local and non-local workers recruited by SOL and its contractors | To optimize job opportunities for local communities • To prioritize local communities in workforce recruitment | To provide job opportunities for local communities who fulfill company’s requirements and qualification • Encourage contractors to hire as many local workers as possible | Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | During the operation stage | SOL       | Labor Agency of North Tapanuli Regency |             |

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

| Job opportunities | Workforce recruitment | Numbers of local and non-local workers recruited by SOL and its contractors | To optimize job opportunities for local communities • To prioritize local communities in workforce recruitment | To provide job opportunities for local communities who fulfill company’s requirements and qualification • Encourage contractors to hire as many local workers as possible | Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | During the operation stage | SOL       | Labor Agency of North Tapanuli Regency |             |
|----------------------------------|-----------------------------|------------------------------|------------------|-----------------------------------|-------------------------------|---------------------------------|---------------------------------|------------|------------|-------------|
| Business opportunities           | Business opportunities      | Operation activities         | Creation of business opportunities for the local communities | To increase local communities' participation in the project | • Provide opportunities for local businesses to participate in the provision of goods and services  
• Provide guidance for local businesses in order to fulfill company's standards | Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | During the operation stage | SOL | Labor Agency of North Tapanuli Regency | • Environmental Impact Management Agency (Bapedaldu) 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 income                 | Community income            | Operation activities         | Household income | • To optimize job opportunities for local communities  
• To prioritize local communities in workforce recruitment  
• To increase the level of participation of local businesses in the project | • Provide job opportunities for local communities who fulfill company’s requirements and qualifications  
• Provide opportunities for local workers to grow and expand | Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | During the operation stage | SOL | Labor Agency and Industrial Agency of North Tapanuli Regency | • Environmental Impact Management Agency (Bapedaldu) 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 Management Plan Summary Matrix

<table>
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<tr>
<th>Environmental Component/ Activity</th>
<th>Significant Impact Parameter</th>
<th>Source of Significant Impact</th>
<th>Impact Indicator</th>
<th>Environmental Management Objective</th>
<th>Environmental Management Plan</th>
<th>Environmental Management Institution</th>
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<tbody>
<tr>
<td>Community unrest</td>
<td>Community unrest</td>
<td>Workforce recruitment</td>
<td>Community unrest towards workforce recruitment</td>
<td>To avoid and minimize community unrest towards workforce recruitment during the operation stage</td>
<td>Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>Environmental Management Agency (Bapedalda) of North Sumatera Province, Environmental Office of North Tapanuli Regency</td>
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<td></td>
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<td>Operation of transmission network</td>
<td>Local concerns toward operation of transmission network</td>
<td>Public consultation on the operation of transmission network</td>
<td>Villages in the transmission network area</td>
<td>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>During the operation stage</td>
<td>Reporting to</td>
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<td>SOL</td>
<td>Environmental Impact Management Agency (Bapedalda) of North Sumatera Province, Mining and Energy Agency of North Tapanuli Regency, Director of General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</td>
</tr>
</tbody>
</table>

- Environmental Impact Management Agency (Bapedalda) of North Sumatera Province
- Environmental Office 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
## Environmental Management Plan Summary Matrix

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<tbody>
<tr>
<td>Surface water quality</td>
<td>Heavy metals, hazardous and toxic (B3) wastes</td>
<td>Drilling wells, sump pit, well production (during production test) which potentially produce both B3 and non-B3 wastes</td>
<td>Domestic solid waste:</td>
<td>To reduce impacts to surface and ground water qualities</td>
<td></td>
<td>Sarulla project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>During the operation stage</td>
<td>SOL</td>
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<td>Liquid waste:</td>
<td>To ensure proper management of B3 wastes according to the applicable B3 regulations</td>
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<td>B3 wastes temporary storage</td>
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<td>Domestic solid waste:</td>
<td>Domestic waste water treatment plant.</td>
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<td>Domestic waste water treatment plant.</td>
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<td>Non-B3 waste landfill</td>
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<td>Mining and Energy Agency of North Tapanuli Regency</td>
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<td>Well locations</td>
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<td>Directorate General of Mineral, Coal and Geothermal of Department of Mineral and Energy Resources</td>
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### Other monitoring

<table>
<thead>
<tr>
<th>Solid and liquid waste monitoring</th>
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</thead>
<tbody>
<tr>
<td>Heavy metals, hazardous and toxic (B3) wastes</td>
</tr>
<tr>
<td>Drilling wells, sump pit, well production (during production test) which potentially produce both B3 and non-B3 wastes</td>
</tr>
</tbody>
</table>

- Compliance with waste water quality standards
- 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)

- To reduce impacts to surface and ground water qualities
- To ensure proper management of B3 wastes according to the applicable B3 regulations

- Domestic solid waste:
  - Solid waste disposal to landfills

- Liquid waste:
  - Liquid domestic waste water treatment from all project activities in domestic waste water treatment plant
  - Condensate and brine generated during the power plant production testing and operational to be injected into reinjection wells
  - Construction of sump pit that is coated with waterproof layer. Collected water in the sump pit, used in the drilling process as drilling mud component to be returned into the wells

- B3 waste:
  - Fragments in the drilling mud to be stored in the sump pit
  - Drilling mud to be stored in the sump pit
  - Ensure that equipment and materials purchased by SOL do not contain PCBs, asbestos, ozone depleting substances and other prohibited materials according to relevant regulations
  - Neutralize and securely store used lead acid batteries
  - Collection of used oil, which then stored into drums and handed over to registered B3 management companies for further process
  - Installation of secondary containments around flammable and hazardous materials as required
  - Regular training on B3 waste management for employees

- SOL
  - Environmental Impact Management Agency (Bapedaldo) of North Sumatera Province
  - Environmental Office of North Tapanuli Regency
## Environmental Management Plan Summary Matrix

<table>
<thead>
<tr>
<th>Community Development Programs</th>
<th>Source of Significant Impact</th>
<th>Impact Indicator</th>
<th>Environmental Management Objective</th>
<th>Environmental Management Plan</th>
<th>Environmental Management Location</th>
<th>Environmental Management Period</th>
<th>Environmental Management Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision of education services and facilities</td>
<td>Provision of education services and facilities for local communities</td>
<td>Increased demands for education services and facilities</td>
<td>Distribution of education facilities around the project area in Pahe Jae and Pahe Julu Districts, North Tapanuli Regency</td>
<td>To assist local governments in the provision of required education services and facilities under Community Development Program</td>
<td>Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahe Jae and Pahe Julu Districts, North Tapanuli Regency</td>
<td>During the operation stage</td>
<td>SOL Education Agency of North Tapanuli Regency</td>
</tr>
</tbody>
</table>

- Environmental Monitoring Plan/RKL: SARULLA OPERATIONS LTD (SOL)

### Provision of education services and facilities

- **Impact: Environmental**
- **Supervisor: Environmental Reporting**
- **Institution: Environmental Management Plan Summary Matrix**

### Provision of public health services

- **Impact: Environmental**
- **Supervisor: Environmental Reporting**
- **Institution: Environmental Management Plan Summary Matrix**

- To assist local governments in the provision of required education services and facilities under Community Development Program

- Cooperation with relevant stakeholders in formal education and training to improve the qualities of local community resources

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

- During the operation stage

- SOL Education Agency 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 Resources

- • 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 Resources
## Initiatives for improving farming and agriculture cultivation techniques

|---------------------------------|-------------------------------|-----------------------------|------------------|------------------------------------|-------------------------------|---------------------------------|---------------------------------|
| Agriculture productivity in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | • Limited knowledge on agricultural commodities with high economic values amongst young farmers  
• Low level of interest on agricultural activities amongst younger generation  
• Shortage of agriculture production  
• Limited high quality agricultural production facilities  
• Limited skills in using agricultural machineries amongst farmers | Production level and types of agricultural commodities around the project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | • To maintain and increase production level and agriculture commodity types  
• To increase competitiveness of local agriculture commodities | Cooperation with relevant stakeholders in local agriculture | Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | During the operation stage |

## Local business opportunities

| Local communities’ participation level in various economic activities | Level of local community participation integrally and equally in local business opportunities  
• Level of local community’s business skill  
• Availability of access to sources of funding and capitals | • Number of locally owned and managed businesses  
• Types of goods and services provided  
• Local economic activities value | To increase participation of local communities in economic activities | • Encourage the use and purchase of local products and services by SOL and its contractors  
• Provide assistance in training and opportunities to participate in local business activities  
• Increase local communities’ involvement in entrepreneurship through local business activities  
• Cooperation with local communities to improve the qualities of local goods and services | Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | During the operation stage |

### Implementer
- SOL
- Agriculture Agency of North Tapanuli Regency

### Supervisor
- Environment 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

### Reporting to
- SOL
- Industrial Agency of North Tapanuli Regency

### Relevant Stakeholders
- Agriculture Agency of North Tapanuli Regency
- Environment 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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<tbody>
<tr>
<td>Provision of public infrastructures</td>
<td>Local communities’ needs and demands for public services</td>
<td>• Rapid growth and development rates • Local communities’ increased demands for public services</td>
<td>Local governments’ request to provide public infrastructures</td>
<td>To support local governments in efforts to provide adequate public services to local communities</td>
<td>• Cooperation with local governments to determine public infrastructures to be provided • Encourage and assist local governments to develop its own social service initiatives</td>
<td>Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>During the operation stage</td>
<td>SOL</td>
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<tr>
<td>Cultural preservation</td>
<td>Changes in traditional cultural values and customs</td>
<td>Increasing presence of modern society and its associated infrastructures and materials</td>
<td>Traditional activities, cultural festivals, books and monographs on language, history, sociology and local anthropology</td>
<td>To assist local communities in keeping their traditional cultures intact</td>
<td>Support local ethnics program s and activities, preserve local culture including traditional activities (dances), 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 geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>During the operation stage</td>
<td>SOL</td>
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</tbody>
</table>
## Environmental Management Plan Summary Matrix

|------------------------------------|-------------------------------|-----------------------------|-----------------|-----------------------------------|-------------------------------|---------------------------------|-------------------------------|-------------|------------|--------------|
| Awareness of SOL activities        | Accuracy and completeness of information about SOL activities within the local communities | Misinformation circulating in the local communities concerning SOL activities | Lack of awareness and understanding of SOL activities (such as employment, training and business opportunities) within the workforce and local communities | To ensure accuracy and completeness of information about SOL activities | Regular information dissemination related to SOL activities to community leaders and local government | 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 operation stage | 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 |

### E. Post-operation stage

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

| Job opportunities | Community unrest | Employee release | Unemployment due to employee release | To prevent high level of unemployment to occur by the end of the project | Consultation with workers on the plan to release employees | Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency | During the post-operation stage | SOL |  | Labor Agency 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 |
<table>
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<tr>
<th>Environmental Component/ Activity</th>
<th>Environmental Management Objective</th>
<th>Environmental Management Plan</th>
<th>Environmental Management Location</th>
<th>Environmental Management Period</th>
<th>Environmental Management Institution</th>
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<tbody>
<tr>
<td>Business opportunities</td>
<td>To maintain business opportunities for local communities</td>
<td>Public consultation on the completion of project activities</td>
<td>Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>During the post-operation stage</td>
<td>SOL, Labor Agency and Industrial Agency of North Tapanuli Regency</td>
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<tr>
<td>Community income</td>
<td>To avoid a decrease in community income</td>
<td>Consultation with workers on the plan to release employees</td>
<td>Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency</td>
<td>During the post-operation stage</td>
<td>SOL, Labor Agency and Industrial Agency of North Tapanuli Regency</td>
</tr>
</tbody>
</table>

**Significant Impact Parameter**
- Reduction of business opportunities for local communities
- Reduction of community income around project location
- Consultation with workers on the plan to release employees
- Provide adequate compensation to workers in accordance with applicable regulations
- Public consultation on the completion of project activities

**Source of Significant Impact**
- Business opportunities
- Community income
### Environmental Management Plan Summary Matrix

<table>
<thead>
<tr>
<th>Environmental Component/Activity</th>
<th>Significant Impact Parameter</th>
<th>Source of Significant Impact</th>
<th>Impact Indicator</th>
<th>Environmental Management Objective</th>
<th>Environmental Management Plan</th>
<th>Environmental Management Location</th>
<th>Environmental Management Period</th>
<th>Reporting to</th>
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<tbody>
<tr>
<td>Community unrest</td>
<td>Community unrest</td>
<td>Workforce release</td>
<td>Community unrest due to workforce release</td>
<td>To avoid and minimize community unrest due to workforce release</td>
<td>• Prepare a work plan on workforce release • Consultation with workers on the plan to release employees</td>
<td>• Villages in the vicinity of the development of geothermal field and Sarulla power plant project area in Pahae Jae and Pahae Julu Districts, North Tapanuli Regency • Villages in the transmission network area</td>
<td>During the post-operation stage</td>
<td>SOL</td>
</tr>
</tbody>
</table>

- **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
Appendix 2

SOL ORGANIZATION CHART
Sarulla Operations Ltd. Organization Structure