The Democratic Republic of Timor-Leste

E1463

Environmental Management Plan For Gas Seep Harvesting Project[1]

August, 2006

[1] This Resettlement Policy Framework for Gas Seep Harvesting Project is only applicable for Aliambata Gas Seep Project.

1. Introduction

This Environment Management Plan (EMP) was developed by EDTL on behalf of the government for the proposed project. The objectives of this EMP are to identify the potential effects of the gas collection, electrical generation facilities and electrical distribution lines on the local population and environment, develop a management methodology to minimize the risks and potentially adverse environmental effects beyond the perimeter of the site. It will provide guidelines to both EDTL and its contractors during the construction and operation of the proposed project in the aspects of environment, health and safety associated with the project (both power generation and distribution lines)

2 The Project

The principal project involves the collection of natural gas from the Aliambata gas seep and the use of this gas for electrical generation. Electrical distribution to the villages of Aliambata, Borolalo and Babulo, and the electrical interconnection with the Uatolari distribution system, will be regarded as sub-projects. The project comprises two major components:

Component A: A demonstration project at around 450 kW in Aliambata to demonstrate the technical feasibility and economic viability of gas seep for power generation in Timor-Leste.

This component will be implemented by EDTL. Its major activities would include:

- Construction of a dual-fuel power plant at Aliambata, using the gas from the seeps and diesel oil for power generation. The capacity of the proposed power plant will be 3x150 kW. One of the generators would be a new gas generator set. The other two would be existing units operating on diesel oil and the proposed project would modify them to operate on both indigenous gas and diesel. The two converted generators would have engines that would automatically adjust the gas/diesel oil ratio, which would vary depending on gas quality, quantity available and local ambient conditions. However about 70-80 percent the fuel would come from gas. The 20-30 percent would come from diesel oil only to ensure the capability of the system to meet peak demand.

- Building of 20 kV distribution lines to connect the proposed power plant to the existing EDTL systems at Uatolari and Uatocarabau and to new consumers in the rural communities near the proposed power plant, including Aliambata, Babula and Borolalo. This connection would increase the availability of power supply at Uatulari and Uatucarabao from 6 hours to 24 hours per day. Overall, the gas-based power generators at Aliambata would supply electricity to approximately 1,000 households currently connected to the power system and about 2,000 new households as well as some small commercial customers. The electrical distribution route will be agreed between EDTL and the local communities, but

will largely follow existing roads to reduce the intrusion onto private property as much as possible. Trees may need to be removed or trimmed in some areas of the route.

Component B: A demonstration of electricity fee collection system based on pre-paid meters and community engagement.

- Testing of a system of revenue collection using cost effective prepaid metering system to ensure the financial sustainability of the project. The system would apply the standard tariffs that EDTL charges and, as in the case of the Dili system, consumers would receive prepaid meters, free of charge. New customers also would pay EDTL standard connection charges, less the cost of the prepayment meter. A community awareness creation and consultation campaign will be undertaken during the implementation of the project based the public consultation carried out during the project preparation to ensure the proposed system can be implemented properly.

Table 1: Technical parameters of the electrical distribution sub-project.

		Medium Voltage			Low Voltage	
Village	House Hold	20 kV Line (km)	Number of Poles	Number of Transformers	0.4 kV Line (m)	Number of Poles
Aliambata	80	1	13	1	290	4
Borolalo	333	3	53	1	1,200	15
Babulo	474	2	27	1	1,710	21
Uatolari	3761	0.2	4	N/A	N/A	N/A

3. Existing Environment

The climate in Timor Leste is typical for a tropical monsoon climate. It is hot and dry from July to November with the western monsoon bring the rains from December to March. It is cooler and more humid in the mountain area.

The natural gas seeps are located approximately 1 km from the village of Aliambata in the east part of Timor-Leste, approximately 100 m from the main coastal road, on elevated land at the end of a short track. The terrain is mountainous covered with bush/jungle. There is no one living at the site, with the nearest village being Aliambata. The land is owned by the local government.

The ground surrounding the immediate site is bare as a result of past gas emissions. Natural forest vegetation lies within 10-15 m of the seeps on all sides. The seep area lies on sloping terrain, directly adjacent to an area of flat land downslope. No fauna were seen during the recent site visit although domestic buffalo are known to be grazed in the area.

Figure 3.1 Gas Seep Site

The gas from the gas seep is comprised of methane (CH4), carbon dioxide (CO2), nitrogen and oxygen with trace amounts of non-methane organic compounds and other substances.

- methane is a colourless, odourless gas that is flammable (and potentially explosive) in concentrations ranging from 5% to 15% in air (the lower (LEL) and upper (UEL) explosive limits respectively)

- carbon dioxide is a colourless, odourless and non-combustible gas that is a minor component of the atmosphere.

The principal products resulting from the combustion of methane are water vapour (H2O), carbon monoxide and carbon dioxide. The gas used in a gas engine will emit carbon monoxide (CO) which is potentially lethal if vented into a confined space so the gas engine installation will ensure that all exhaust gases are appropriately vented outside the enclosure.

Local villagers are understood to ignite the gas in the seeps so products of combustion are already present at the site in varying concentrations.

4 Potential Effects and Risks Associated with the Proposed Project

The gas collection facility, electrical generation facilities and power distribution line have been designed to minimize the potential effects of on the surrounding environment and to ensure personal and environmental safety. These elements are discussed below.

4.1 Collection device and flare

The gas collection structure consists of a perimeter wall buried to around 1.5 m below ground level and a fully sealed cover to ensure that methane is collected with a minimum of oxygen (O_2) ingress to limit the risk of an explosive mixture. The permanent gas collection system will cover an area of approximately 50 m^2.

An explosion vent in the cover will ensure that the structure is not irreparably damaged should an explosion occur, and that the risk to site personnel is minimised. The design of the entire gas collection system will ensure that the risks to people and the environment are not significant.

Water condensate generated from the collection system and associated pipework will be allowed to drain into the soil beneath the site.

The flare tip will be located at least 2.5 m above ground level and will be located behind a security fence at a distance of at least 10 m from the nearest vegetation. This will ensure that people do not come into close contact with the stack and that any potential heat or combustion gas effects on nearby vegetation are minimized.

The API guidelines for flare stack design identify the need to consider radiant heat exposure of personnel. The flare will be suitably designed and of adequate height to prevent a hazard to workers or the public. The flare will also incorporate suitable systems and design features to prevent flashback and maintain ignition of the flame so that the risks to people and the environment as a result of the location and operation of the flare will be minimal.

4.2 Electrical generation facilities and distribution line

It is proposed to establish the generating plant on the area of flat land immediately below the gas seep. The equipment will be mounted on a concrete slab base and housed in a weather-proof structure. The electrical distribution system is likely to follow the road along the coast from the generating plant to the villages with the cable being suspended on pole structures. This design is similar to existing systems which have avoided land ownership issues. The line will cross a river, the Sungai Bebui, with a single span and will therefore have no adverse effect. No adverse environmental effects are anticipated in relation to the design of the electrical generation facilities and distribution line.

5 Construction Effects and Risks

Health and Safety operational requirements and specific procedures (Health and Safety Plan) will be developed for the proposed project. Before any staff member of EDTL or contractor undertakes any construction, operation, maintenance or repair on the system they will be trained in the health and safety requirements and follow the procedures set out in the Site Health and Safety Plan.

5.1 Potential impacts

The key environmental impacts of the construction and operation of the proposed project primarily relates to:

- Vegetation clearance at the gas collection site prior to construction to establish facilities, and along the proposed distribution line route;
- Runoff of soils and concrete during construction related to minor earthworks required at the gas collection site and during pole structure installation.
- Spillage of fuels or lubricants used for engine-generators and vehicles at the site or along the distribution line route.

Earthworks that are required will probably be undertaken largely by hand and construction of the facility is expected to take no more than a few weeks. The principal construction activities consist of:

- a 1.5 m deep trench excavated around the perimeter of the seeps and the installation of power plant foundations.
- holes for the installation of pole structures to support the power cables.

Overall, the potential impacts are not considered to be significant since no major works will be undertaken. Construction activities at the site are likely to fall within the already clear area adjacent to the burning gas seeps. The collection structure installed over the seeps will effectively reduce that area of exposed soil.

All fuels and lubricants stored on site, whether temporarily during construction or longer term for power plant use, will be held in appropriately sealed containers and stored in bunded areas. Engine-generator units will be installed such that spilled lubricants are contained and collected.

5.2 Roles and responsibilities

Electrical generation facilities in the Viqueque Province are almost entirely under the ownership and control of EDTL and EDTL will assume ownership of the new generation and distribution facilities to be constructed under the project. The roles and responsibilities during the construction and operational phases are as follows:

- SKM, the consultant hired by the government for Gas Seep Sampling and Use of Natural Gas studies, has responsibility for the preliminary design and specification of safe gas collection, electrical generation and distribution facilities,
- The contractors are responsible for environmental protection as well as the safety of local villagers and construction personnel during construction,
- The client and eventual owner of the facilities (EDTL) will assume responsibility for the ongoing protection of the local environment and also the safety of their operating staff and the local population when the facilities are taken over from the main contractor.

6 Operational Risks and Effects

Operational guidelines under which the gas will be collected and either used or flared will be dealt with in the site Health and Safety Plan. The key details in relation to design and operation as they relate to potential effects on the environment and the ways in which these risks /effects will be managed are described below.

6.1 Gas and combustion products

The development of the Aliambata gas seeps will involve the combustion of the gas, resulting in combustion products as identified above. The potential effects of these products are minimal due to the following:

- the key combustion products, H2O and CO2, are harmless
- other trace elements and gases, if present, are at undetectable concentrations
- the nearest local villages are located a considerable distance from the site.

Gas has been discharged from the seeps for many years with no reported incidences of adverse effects of nearby sensitive receptors such as people, vegetation or animals. The removal of methane, a significantly more potent greenhouse gas than carbon dioxide, is considered to be a major benefit of the proposed project.

One tonne of methane has a Greenhouse Warming Potential equivalent to 23 tonnes of carbon dioxide. Burning the methane from the Aliambata gas seeps may be conservatively estimated to have the effect of a net reduction of around 7,000 t/year of CO2 emission.

6.2 Visual effects and noise

The visual effect of the proposed gas collection and electrical generation facilities is expected to be minimal since:

- the facility will be approximately 100 m from the main coastal road and will not be visible from this key viewpoint,

- the proposed facility is small in scale with the collection system itself being low to the ground.

The only components of the system of any height will be the gen-set enclosure and the flare. The power distribution lines suspended between pole structures will be visible from the roadside. This view will be similar to other areas of Timor with similar distribution line systems. Although the proposed generation plant is likely to emit a significant amount of noise, this is expected to have a limited effect on the environment as:

- the nearest village is located a considerable distance (approximately 1 km) from the site,
- the surrounding dense vegetation affords natural attenuation properties, and
- noisy equipment (engine generators, etc) will be housed in sound-attenuating enclosures to reduce the amount of noise generated.

6.3 Local population

The potential risks to local personnel associated with the operation of the plant are most likely to be limited to injury caused by combustion or explosion of gases contained within the plant.

There are no people living in close proximity to the site. In the event of a significant gas consuming development on the site, security personnel would be stationed at the site to both monitor site safety and to ensure that no unauthorized persons are able to get close to the facility.

6.4 Operational and maintenance criteria

Operational criteria have been established based on engineering judgment and operational experience. Operational objectives for the proposed system include:

- maximize gas extraction consistent with minimizing the entrainment of air,
- maintain fugitive gas emissions to substantially less than the LEL of methane.

The gas collection system is intended to operate continuously and the operational and maintenance procedures for the facility will be minimal.

6.5 Roles and responsibilities

In addition to identifying appropriate personnel to run the proposed facility, EDTLwill need to develop a table of organization to identify the roles and responsibilities of both sitebased and managerial personnel associated with the gas collection and electrical generation facilities. A possible table of organization might include the following:

- Operations Manager, with overall responsibility for the operation and maintenance of the facility
- Operations Engineer, with technical responsibility for the operation and maintenance of the facility. In the absence of the Operations Manager, the Operations Engineer will be consulted
- Site Operating Team, responsible for routine operational activities and collection of data for record keeping.

The Site Operating Team will be required to regularly liaise with the Operations Manager and Operations Engineer to advise of routine activities, incidents and developments pertinent to safe management of the site.

7 Plant Monitoring and Records

7.1 Plant Monitoring

Monitoring the condition and performance of the gas collection and electrical generation facilities will be necessary to avoid environmental damage and to provide safe working conditions, largely by identifying the flammable hazard posed by methane and ensuring that the explosive conditions are minimized. Monitoring of the structures and equipment at the site will be performed regularly to identify any repair work needed to maintain safe working conditions on the site.

Site personnel would be expected to maintain a manual of Plant Operating and Maintenance Procedures, containing vendor's reference material, and operation and maintenance schedules with formal checklists. They should develop formal checklists for operation and maintenance associated with the flare stack, gas collection facility and power plant, and up-date these as required.

7.2 Records

Monitoring results and observations should be recorded either on a data logger or in the operators' log. Senior Department personnel, in order to maintain a safe site and to identify any changes in the performance of the gas delivery system, should evaluate the data collected and incidents recorded. After each monitored event a team leader or manager should identify any incident requiring immediate response in accordance with the contingency plan.

Site records should be maintained to document all operational activities at the site as well as the performance of the gas resource, including gas pressure, flowrate and composition.

A site plan will be maintained showing the 'as-built' layout of the gas collection system, power plant and electrical equipment, and documenting all changes made to the facility.

7.3 Effects Mitigation Plan

The construction of distribution line does not present significant social or environmental problems as the route will run on public land alongside existing roads. These roads skirt the coast line for some distance and also pass through forested areas and rice paddy fields. There will nevertheless be some effects and the responsibility for identifying and mitigating these is presented in Table 2.

Table 2: Environmental effects mitigation plan

Phase	Issues	Mitigation Measures	Responsible Authority
Construction	Cutting the trees from the construction right of way.	Before clearing, the route shall be clearly marked, including trees to be cut All clearing of vegetation will be done manually or mechanically. No pesticides will be used	Surveyor/Contractor
	Runoff of soils and concrete	Trenches and/or embankments will be dug around construction sites to contain any erosion or runoff solids. Construction will be conducted during dry season	Surveyor/Contractor
	Soil/water contamination from lubricant and fuel spillage	Fuels and lubricants will be stored in sealed containers in designated areas on impervious (e.g. concrete) pads. Areas will be bunded to contain spills	Surveyor/Contractor
	Noise	Construction will take place during normal daytime hours	Contractor
	Injury	The contractor will provide safety wear such as safety helmets, shoes, etc., and will provide training and advice for all employees	Contractor
	Risk from construction work to communities	Contractor will monitor work and install warning signs as appropriate.	Contractor
Operation	Carbon monoxide emissions	Flare will be 2.5 m above ground and a security fence at a distance of 10 m from flare to insure no hazard to workers or public	Contractor
	Soil/water contamination from lubricant and fuel spillage	Fuels and lubricants will be stored in sealed containers in designated areas on impervious (e.g. concrete) pads. Areas will be bunded to contain spills	Surveyor/Contractor
	Clearing and cutting the trees along right of way	Contractor will take care when cutting trees and will not burn and cut material near the power line. All clearing of vegetation will be done manually or mechanically. No pesticides will be used	EDTL
	Transformer insulating and cooling oils leaks to contaminate water courses or soils	6-month inspections to identify and leaking of transformer oil or lubricants. Clean out and disposal of any spilled insulating/cooling oils. Transformers placed on impervious (e.g. concrete) pads. Areas will be bunded to contain spills	EDTL
	Noise	Noisy equipment will be housed in sound-attenuating enclosures to reduce the amount of noise generated	EDTL

7.4 Monitoring Plan

Monitoring of social and environmental issues associated with the project will become the responsibility of the appropriate RDTL agency, with an Environment Unit associated with EDTL assuming responsibility for implementing environmental issues in the project. Social issues will be resolved at the regional and village levels as appropriate. The monitoring plan is presented below:

Phase	Issue	How it will be monitored	When it will be monitored	Who will monitor
Construction	Cutting the trees from the construction right of way.	Visual inspection of route marking Visual inspection of vegetative removal	Prior to tree cutting Weekly, during vegetative removal	Contractor
	Runoff of soils and concrete	Visual inspection of sediment containment systems	After completion and after rainstorm	Contractor
	Soil/water contamination from lubricant and fuel spillage	Visual inspection of lubricant and fuel storage containers and storage area	Weekly	Contractor
	Noise	dB[A] meter	Weekly or if there are complaints	Contractor
	Injury	Visual inspection of workers wearing safety equipment and observing safe practices	Weekly or more frequently if violations are observed	Contractor
	Risk from construction work to communities	Visual inspection of warning signs	Weekly	Contractor
Operation	Carbon monoxide emissions	Measurement of flare height and visual inspection of surrounding fence	Once, after construction is complete	EDTL
	Soil/water contamination from lubricant and fuel spillage	Visual inspection of lubricant and fuel storage containers and storage area	Weekly	EDTL
	Cutting the trees from the construction right of way.	Visual inspection of vegetative removal and visual inspection of disposal procedures		EDTL
	Transformer insulating and cooling oils leaks to contaminate water courses or soils	Visual inspection of transformer location and base structure Inspections to identify and leaking of transformer oil or lubricants. Clean out and disposal of any spilled insulating/cooling oils	Once, after construction is complete Every six months	EDTL
	Noise	Visual inspection of housing dB[A] meter	Once, after construction is complete If there are complaints	EDTL