Environmental and Social Impact Assessment (Draft)

April 2018

THA: Chonburi Power Plant Project (Annex)

Prepared by Gulf SRC Company Limited for the Asian Development Bank.

ANNEX 1

ENVIRONMENTAL IMPACT ASSESSMENT

NATURAL GAS PIPELINE TO SRIRACHA POWER PLANT PROJECT

OF GULF SRC COMPANY LIMITED

The Gulf SRC Co., Ltd. has a project to construct Sriracha Power Plant. The project has capacity of 2,650 Mega Watts (MW) and uses natural gas a main fuel. Thus the company has a plan to construct Natural Gas Pipeline (NGP) to Sriracha Power Plant with a diameter of 28 inchs. The NGP will be joined to natural gas pipeline No.5 of the Petroluem Authority of Thailand (PTT) at Sale Tap Valve in Moo 3, Nong Kang Kow village, Ta Sit, Pluak Dang district, Rayong Province. The NGP project will be ended at the metering and regulating station (MRS) of thr Sriracha Power Plant. Total length of the project is 2.67 kilometers. The study areas was covering in Ta Sit Sub-district and Chomphon Chao Phraya Sub-District Municipality in Pluak Daeng District, Rayong Province and Khao Khansong Sub-district in Si Racha District Chon Buri Province.

1. Natural Gas Pipeline of the Project

The natural gas pipeline alignment of the project with 28 inch diameter has the initial point at Moo 3, Nong Kang Kow village, Ta Sit, Pluak Dang district, Rayong Province from the Sale Tap Valve connecting point of natural gas system on ground no.5 which is under the Pluak dang-Nong Chok-Wang Noi high voltage power line no.2 with 500 kV. The pipeline 81 m. length will be placed in the area under the high voltage power line which is constructed by open cut method with 1.50 m. deep from ground. Then, the pipeline will be placed underneath the high voltage power line along the backside fence of MGC Electronic (Thailand) Company limited before entering to the block valve station of the project in Gulf SRC Company limited area. Its length is around 364 m. which is constructed by open cut method with 1.50 m. depth from ground. After that the pipeline will be placed underneath the industrial estate road no. HRE-R3/3 by boring method in the inbound of Kiet Roum Mitr 9 road direction. The backside of pipeline will be deep 3.50 m. from ground with 20 m. until its meet the T-intersection that connect with HRE-R3/2 road. Next, the pipeline will be placed underneath the industrial estate road no. HRE-R3/2 and HRE-R3/3 which construct by open

cut method with 2.50 m. depth from ground. After that the pipeline will be constructed by Horizontal Directional Drilling (HDD) method along with the road of wastewater treatment plant no.3. Then, the pipeline will pass through Krum canal with 6.0 m. depth from canal bed, and the pipeline will be placed across the border of wastewater treatment plant no.2 with 6.0 m. depth from the plant ground. The following pipeline will pass through the rural road no. RorYor0403 (Kiet Roum Mitr 9 road) for entering to Sriracha power plant project with 3.50 m. depth from road surface by open cut method from Sriracha power plant area until the Metering and Regulation Station (MRS) with open cut method, 1.5 m. depth and 101 m. length. The major characteristic of area around pipeline are road and public utility area of the industrial estate without buildings in 5 m. from pipeline, pass through 3 roads and 1 water resource.

The current characteristic of pipeline is shown in **Figure 1-1**. The construction methods are consist of 1,791 m. of open cut, 20 m. of boring and 855 m. of HDD depending on area characteristic and mitigation method in each area. The conclusion of construction method in each period is shown in **Table 1-1** and **Photo 1-1**.

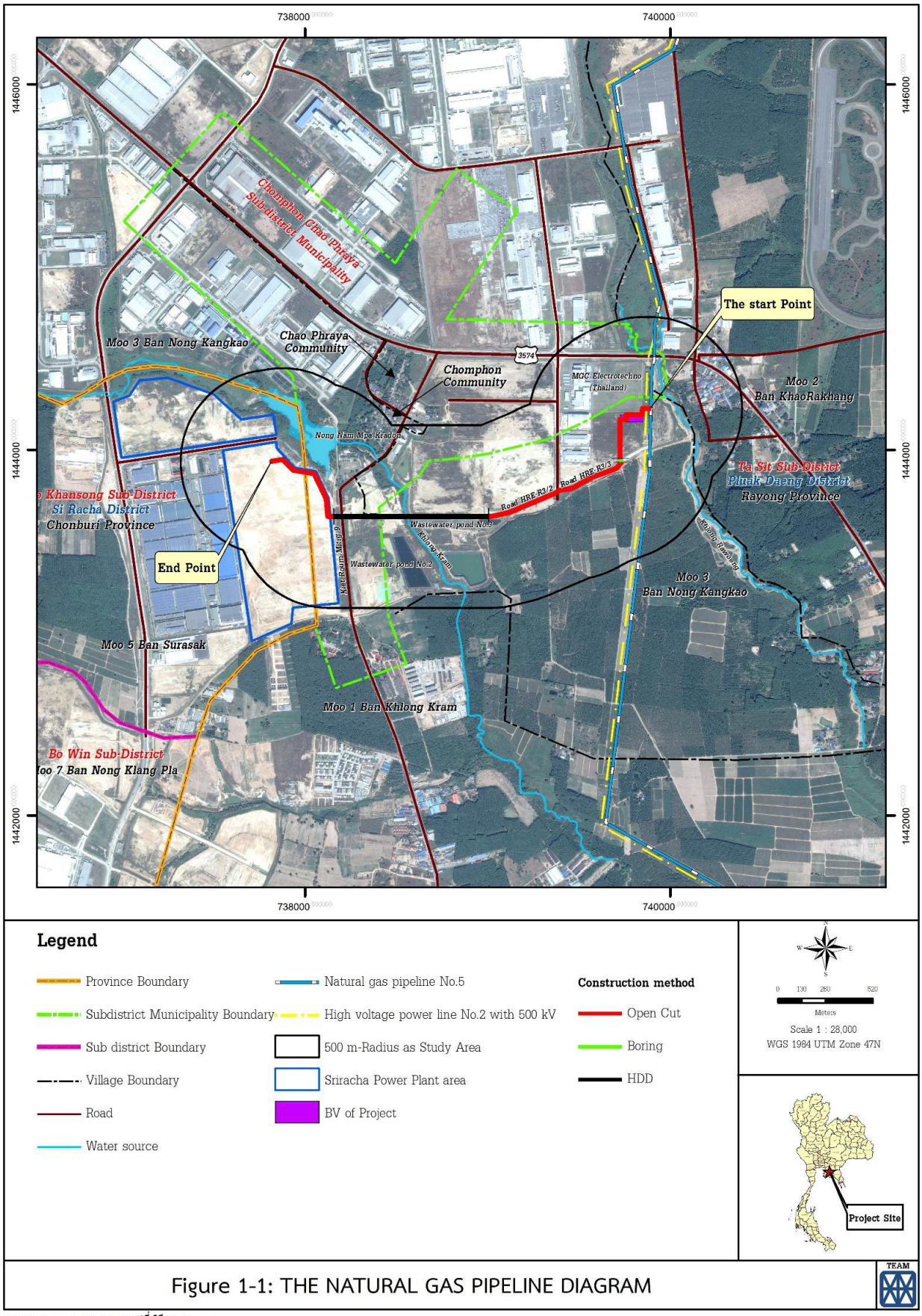

Figure 1-1: THE NATURAL GAS PIPELINE DIAGRAM

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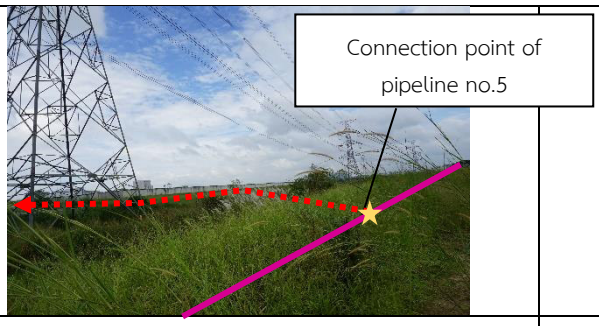
TABLE 1-1

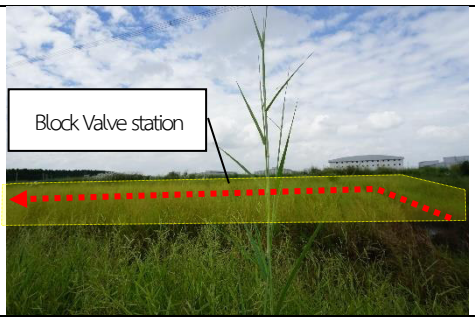
OBSTACLE CROSSING CONSTRUCTION METHOD

Approximately KP	Construction Method	Length (m.)	Natural Gas Pipeline Location
0+000 – 0+081	Open Cut	81	- High voltage power transmission line with 500 kV. area (Pluak dang-Nong Chok-Wang Noi)
0+081 – 0+168	Open Cut	87	- Gulf SRC Company limited area
0+168 – 0+194	Open Cut	26	- MRS area
0+194 – 0+445	Open Cut	251	- MRS road entrance area
0+445 – 0+465	Boring	20	- Industrial estate road no. HRE-R3/3
0+465 – 0+860	Open Cut	395	- Area of the Industrial estate road no. HRE-R3/3
0+860 – 1+263	Open Cut	403	- Area of the Industrial estate road no. HRE-R3/2
1+263 – 2+118	HDD	855	- Area of the wastewater treatment plant road no. 3
			- Krum canal
			- Area of the wastewater treatment plant no. 2
			- Rural road no. RorYor0403 (Kiet Roum Mitr 9 road)
2+118 – 2+146	Open Cut	28	- Hemaraj ESIE area
2+146 – 2+666	Open Cut	520	- Sriracha power planr project area
Approximately Total Length		**2,666**	

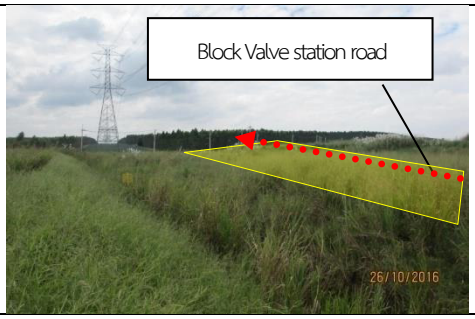
Source: Gulf SRC Company limited, 2016



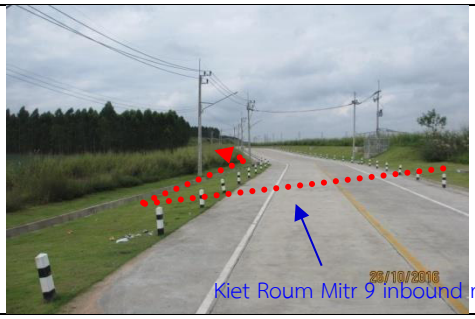
(1) Pipe line size 28 inch start from Sale Tap Valve of pipeline no.5 to Block Valve Station



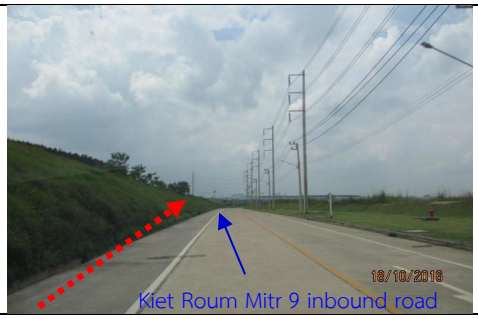
(2) Pipeline direction in Block Valve Station area of the project



(3) Pipeline direction from Block Valve Station for entering to Hemaraj ESIE



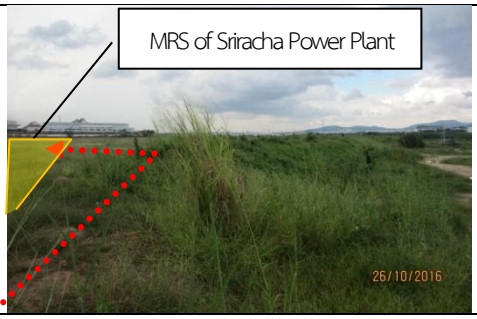
(4) Pipeline pass through HRE-R3/3 road for placing the pipe into Kiet Roum Mitr 9 inbound road



(5) Pipeline in HRE-R3/3 road area in inbound direction of the Kiet Roum Mitr 9 road until the end

(6) Pipeline pass through Krum canal and across the border of wastewater treatment plant no.2

(7) Pipeline pass through Kiet Roum Mitr 9 road to the Sriracha power plant area



(8) The end point of project around MRS area of the Sriracha power plant

PHOTO 1-1: THE CURRENT CHARACTERISTIC OF THE NATURAL GAS PIPELINE

2. Natural Gas Pipeline Design

2.1 Criterion of the design

The natural gas pipeline of the project is 28 inch diameter with 22.25 mm. thickness metal pipe API 5L PSL2-X65 grade which is designed accordance with ASME B31.8 standard (American Society of Mechanical Engineering, Gas Transmission and Distribution Piping Systems). It is designed to be able to use at Maximum Allowable Operating Pressure (MAOP) 1,250 psig (86.18 bar) and Normal Operating Pressure around 1,100 psig (75.84 bar). The Specific Minimum Yield Strength of pipe is around 65,000 psig (4,481.59 bar). The extension of the communities in the future is considered for safety, so all of the pipeline will be designed in Location Class 4 with 12 m. for each pipe. Each pipe will be connected together in horizontal line except a road area and an entrance of house along the pipeline. The welding equipment will be used for welding each pipe to be 100% homogeneously, and examine by X-ray. The outer layer of pipes will be coated by 3 layers of Polyethylene (PE) for protecting the corrosion as following the standard. Before coating, the pipes must be scrubbed its rust by Sand Blast method follows SA.2.5 (NEAR WHITE) standard which is the newest technology for rusty protection. The pipes will be coated until its thickness is equal to the factory coating material or thicker than 3.0 mm. includes the robustness testing in accordance with ASME B31.8 and general international standards.

3. Hazard Assessment from Natural Gas Leakage

The impact from leakage and igniting area can be identified by mathematical model named BREEZE HAZ which is developed by Trinity Consultants Inc., USA. The damage from thermal radiation calculate from volume of passive thermal heat which is measured in watt per a unit of fired area.

(1) Natural gas leakage hypothesis specification

When considering the chance of leakage hole in various sizes, it found that 1 inch hole has the most possibility, and the worst case is broken pipe. Moreover, when considering the chance of natural gas leakage area, there are highly opportunities in the

connection points and the area above the ground which allow people to access easily include Sale Tap Valve area, Block Valve Station and Metering and Regulation Station (MRS).

(2) Risk Assessment

Risk assessment of severe incident is conducted by following the API guideline (2000). Consideration is on the probability, frequency and severity. The matrix is used for assessment process, where the x-axis represents frequency and y-axis is the severity level (**Figure 3-1**).

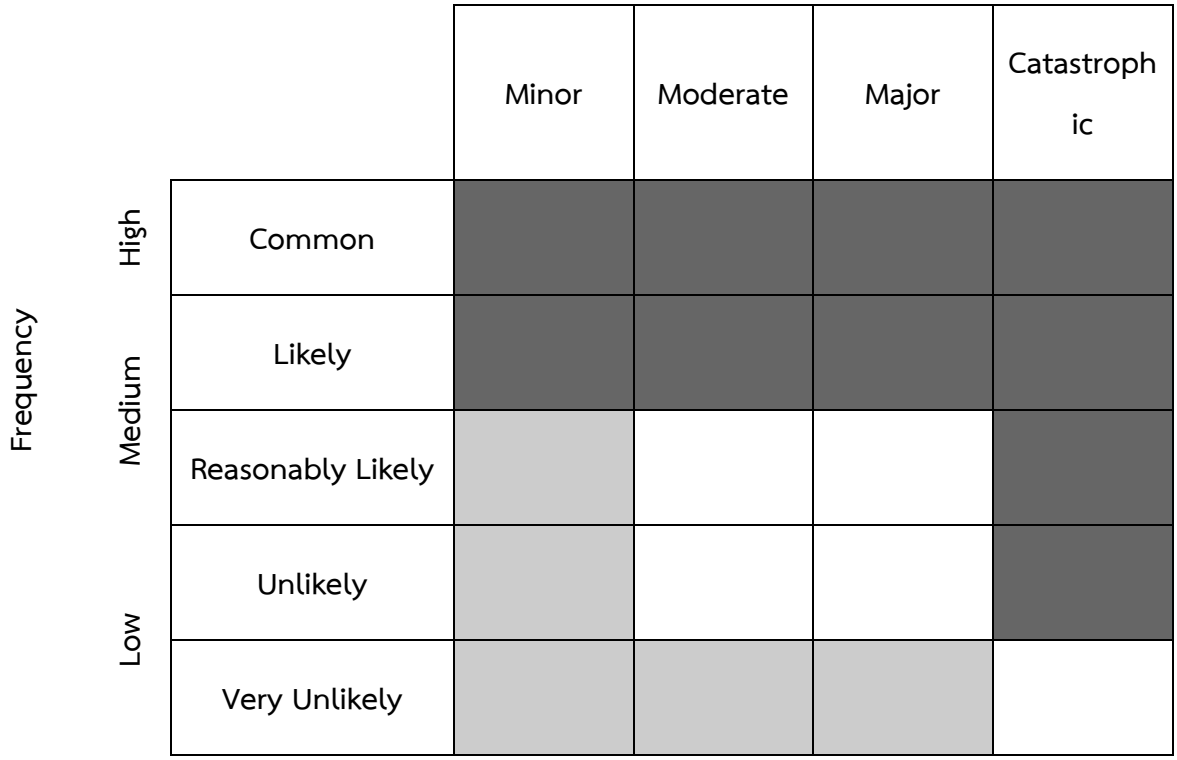
Risk assessment on severity level of the accident is carried out with consideration on 1 inch leakage which has the most occurrence probability, together with pipe rupture which causes the highest impact. Consideration is also in combination with the most probably ignition or Jet Fire at the energy level of 12.5 kilowatt/square meter. This is the level that starts to impact on human until death. The death probability is 1 per cent in case of staying in the area one minute or longer, and/or skin burned in 10 seconds. The risk can be summarized as follows:

The study reveals that in case of accidental release of natural gas which results in ignition, the radius of the heat radiation is mostly within the compound of the industrial estate. Furthermore, from the risk probability analysis, the project's risk level is considered low. Hence, probability of major hazards owing to this cause is very low.

The above risk assessment is based on probability and severity, with the use of matrix for analysis process. Findings showed that the risk assessment of the Project in accordance with the United States Environmental Protection Agency (US.EPA, 1990) does not require preventive or mitigation plan. However, the Project strictly complies with ASME B31.8 since the design, construction and operation stages, including maintenance system at the operation stage. Furthermore, the project has prepared emergency plan and being alerted all the time. Therefore, the risk of the Project is expected at the relatively low level.

4. Environmental Action Plan

The project have prepared environmental prevention, mitigation and monitoring measurement as shown in **Table 4-1** to **Table 4-4**.



Remark:

Comprehensive planning and preparedness are essentially mandatory at The appropriate levels of government of industry

Comprehensive planning is optional and does not necessarily warrant Any major effects or costs. Give consideration to sharing any necessary special response resources on a regional basis

Comprehensive planning may be unwarranted and unnecessary

Source: Handbook of Chemical Hazard Analysis Procedures, Federal Emergency Management Agency, U.S. Department of Transportation, THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (US.EPA), 1990.

FIGURE 3-1 : RELATIONSHIP BETWEEN FREQUENCY OF INCIDENT AND SEVERITY LEVEL

Table 4-1

Environmental Action Plan during the Construction Periods of the Natural Gas Pipeline to Sriracha Power Plant Project

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
1. Air Quality	- Spray water at least twice a day when open cut method is used at the construction areas and transportation road near construction site. Number of spraying must be increased when there is more dust for reducing dust dispersion. - Speed limit of trucks carrying construction materials and all project vehicles to be not over 30 km/hr when passing communities and construction area, and not over 80 km/hr when passing other areas. Signs of speed limit have to be installed in construction area. - Cover construction materials along transportation route in order to prevent dust dispersion and material falling. - Not excavate the soil surface of entire alignment in the same time. Backfilling has to be conducted after finishing construction, day by day. - Clean truck's tires before leaving the construction site - Stop engine when not use. - Maintenance and checking of equipment, machines and engines used for construction to be in good conditions in order to reduce emitted pollutants.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
2. Noise	- The project must inform the construction plan to local administrative organizations, Hemaraj ESIE and village leader at least 1 month in advance. - Work that generates noise is permitted between 8:00 to 18:00 hrs and work that generates noise continuously must be avoided. Communities within the proximity must be informed of the noisy at least 2 weeks in advance. - The workers working in an area with noisy equipment must work in shift of maximum of 8 hour per day. Workers must wear personal protective equipment such as ear plug or ear muff, etc. which can reduce 15 and 25 Decibel (A) of noise levels as followed the regulation. - For construction with open cut method around KP 0+000, KP 2+300, and boring/HDD method around 0+445**,** KP 1+263 and KP 2+118, the project plans must install temporary noise barriers made of steel sheet 0.64 mm thick (Steel 24 ga) and high 2.5 m. from ground which can absorb noise about 18 decibel (A) or other material that have same noise reduction ability. - Operation of high noise level machinery must be done and complete rapidly**.** Machinery must be operated only for working and immediately shut down after finished working. - Site engineer must inspect equipment, machinery and tools to be always in the good condition. They have to be maintained regularly in order to minimize noise level. Repair has to be done immediately when any of them damage.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
3. Soil Resource	- Remove cover crops only at the area to be constructed - Top soil and sub soil must be separated. For backfilling, sub soil must be put at the bottom and followed by the top soil so that the soil will not be mixed. - For backfilling, the ordinary soil has to be spread over the pipeline alignment. In order to protect soil subsidence, the crown has to be conducted at the back of pipeline. - Backfilling must be conducted immediately after pipe lying and pipe inspection completed in each period. - Backfilling must be conducted immediately after pipe lying and pipe inspection completed. After backfilling, cover crops must be planted so that they can revitalize the area to be the same or better, as soon as possible. The used materials must be removed from area. Also, signs of caution have to be installed along with pipeline. - After pipe lying and pipe inspection completed at HRE 3/3 and 3/2 road, accelerate improvement and re-instatement area to be the same as ordinary condition. - Provide proper preventive measures of soil erosion for operators/workers safety; e.g. installation of sheet pile surrounding open cut area or adjust slope of trench's walls to be suitable. - Avoid constructing during heavy rain in order to prevent soil leaching into nearby the drainage pipeline.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
3. Soil Resource (cont'd)	- Preventive and mitigation measures for sodium bentonite leakage • Provision of 24-hr inspector in the nearby area and community of using sodium bentonite • For the entire period of construction by HDD method, it is necessary to provide staffs and materials such as sand bags to maintain the site and blocking the area to prevent bentonite dispersion into the surrounding areas. • Before drilling the soil must be collected at the receiving and pumping sites of the project throughout the pipe length. By the distance from the receiving pit - not more than the distance of penetration in each area. If the pit area is on the same set of land and the same land use. Choose at least one sampling area (equal to the number of HDD) at a depth of 0-5 cm to analyze the soil properties. To compare the differences in exchangeable sodium content and SAR will be used for improvement of soil and remove it, in case there is sodium bentonite left over to nearby area. Parameters to be measured are Electrical Conductivity, Bulk Density, Hydraulic Conductivity, Cation Exchange Capacity (CEC), Exchangeable Sodium, Exchangeable Magnesium and Exchangeable Calcium.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.
	- Leaks often occur on the surface soil layer about 5 meters depth because of loosen soil, and it is usually at the beginning of pilot drilling , so the project will be explored soil layer for HDD profile design to be in stable soil layer. This information will be used to determine the maximum sodium bentonite usage during drilling, and assess leaking opportunities. To determine the pressure that should be used for drilling. Because of too high voltage, the chances of a leak would be greater.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
3. Soil Resource (cont'd)	- In the case of land that is drilled in a very liquid or crumbly soil, the casting will be considered. Then, the drilling head will be followed until meet the tightness of soil then the chance of Frac Out will be reduced. - Install the "Pressure Sub" on the HDD machine to monitor Sodium Bentonite pressure in real time. The down hole pressure transmitter sends a signal to the driller's monitor in the control room when the pressure drop starts. Driller will be able to stop drilling suddenly. And reduce the pressure from Sodium Bentonite Pump immediately without fracing up the surface. - Observe and monitor the pressure / volume / continuity of the return flow of mud return line. If the pressure is reduced or the flow rate is discontinuous, controller must stop drilling to further investigate and resolve the problem. - Evaluate the situation and proceed to the next stage of Sodium Bentonite leaks.			
	- Sodium Bentonite leaks measures • For the entire period of construction by HDD method, it is necessary to provide staffs and materials such as sand bags to maintain the site and blocking the area to prevent Sodium Bentonite dispersion into the surrounding area or pumping by truck. The Sodium Bentonite waste will be dispose in landfill by a company authorized by the government. Moreover, the project must note time period since leaking until finish removal.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
3. Soil Resource (cont'd)	• Dissolve the sodium water-soluble form before using sodium exchange in an exchangeable form. By making a temporary channel depth of about 10-15 cm. By a channel width of about 30 cm. the distance of about 1 meter, or the overflow of water over the surface. Build a sump pond to support the drainage, and the temporary channel that have to be built must flow to the Sump pond, which is at the bottom of the area. Consideration of the location and contour lines of the alignment sheet and then discharge the water through the overflow drainage. Then, pump the water containing sodium in soluble form for sending to a company authorized by the government. • Use sodium exchange in exchangeable form. In case of using gypsum, calculate the quantity needed to excess sodium exchange. Show the above details by sowing, tillage with gypsum and adding water to catalyze the chemical reaction. Leave for 1-2 weeks. • Because of the use of sodium exchanger, in the case of gypsum. When the ion exchange reaction ends. The soil will have increased calcium exchangeable. Sodium sulfate is the result of the reaction that is the soluble salt, so sodium sulfate should be washed out of the area. Because it is a substance that still contains sodium. There is a procedure in the affected area when the gypsum is exchanged for sodium exchange and then left for about 1-2 weeks by discharge of water along the groove and flow to the Sump, and then pumping water containing sodium sulfate to eliminate. And, temporary drainage and Sump ponds to restore the current condition. Afterwards, SAR will be measured and compared with the current values. The value of the various elements must have a percentage difference of not more than 10 percent with the pre-construction measured value, and add plant nutrients to the soil, such as adding organic fertilizers, etc. In the case of agricultural areas.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
4. **Surface Water Quality and Aquatic Ecology**	**(a) Overall Measures** - Avoid constructing during heavy rain in order to prevent soil leaching into nearby the drainage pipeline. - Prepare spare pumps for use throughout the construction period. To prevent and solve flooding or drainage problems in the construction area. - Disposal of construction material residues into drainage system is strictly prohibited. - Provide sufficient number of toilets for workers in construction site with septic tank. Including demolition of the area when the construction is completed. - Provision of rubbish containers for oil and lubricant in the construction area to collect and take them out for disposal every day. - Avoid soil piles caused by open cut areas near drainage. These will prevent water flow obstruction. - Backfilling must be conducted immediately after pipe lying and pipe inspection completed. The site must be the same as ordinary condition or even better, including installation of warning signs and/or clear sign of natural gas pipeline alignment.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.
	- Provision wastewater treatment and grease trap in office building and temporary worker house area, and holding pond for 1 day capacity for monitor the effluent water quality in accordance with effluent quality from building type Kor follows Notification of Ministy of Natural Resource and Environment on determination of some type of building effluent standards topic	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
4. **Surface Water Quality and Aquatic Ecology (cont'd)**	**(b) Measures for effluent from hydrostatic test** - Not putting any chemicals that are harmful to environment into the water used for hydrostatic test. - Water discharge from Hydrostatic Test will be examined such as testing acidity-alkalinity (pH), temperature, suspended solid (SS) and Oil&Grease to ensure that it complies with the water characteristics discharged into irrigation system under the Hemaraj ESIE wastewater standard. The solution to drainage of low quality discharged water into irrigation system, it will be discharged by outsource. - Before discharge into wastewater treatment, the Hydrostatic test will then be reported to Industrial Park before draining, and it must follow the conditions. - Fine mesh will be installed to trap debris and contaminated solids flowing with drained water from hydrostatic test before discharging the water. - In case of complaints about discharging of effluent from hydrostatic test, quick action of problem solving has to be conducted.			
5. Transportation	- The project must inform the construction plan to local administrative organizations, Hemaraj ESIE industries and village leader at least 1 month in advance. - The project must inform the construction plan to local administrative organizations. The board shows construction plan, project owner and hot line number must be installed along main highway 1 month in advance.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
5. Transportation (cont'd)	- Contractor must prepare traffic plan, schedule and location of construction site, including identify route of transportation materials and equipment before implementation. - Preparation of construction area by demarcation of the area from traffic lanes with the use of concretes, fences or plastic cones. Warning signs and blinking light have to be installed at day and night at least 150 meters before the construction site or as specified by authorized agencies. The traffic signs should be reflected materials. And, quick action of problem solving has to be conducted immediately. - Traffic facilitators must be provided during construction and local organizations/police stations must be coordinated as well.			
	- Avoid piling construction materials to obstruct traffic and immediately move the unused ones out of construction area. Limit number of pipes to be hauled and strung at each place within a day. Pipe stringing needs to be tidily and not obstruct the traffic. - Blocking the construction area around the area of pit. Provide safe and appropriate space with clearly visible warning signs showing potentially hazardous areas or the machine operating area. - Training and controlling drivers related to all types of construction to follow traffic laws and regulations, including to practice following traffic management requirements of the Department of Highways seriously, for the entire construction period. And, examination the equipment engine before using.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
5. Transportation (cont'd)	- Accelerate improvement and re-instatement area or traffic surface being affected by construction to be the same as ordinary condition or even better. - Backfilling must be conducted immediately after pipe lying and pipe inspection completed. The site must be the same as ordinary condition or even better, including installation of warning signs and/or clear sign of natural gas pipeline alignment. - Provision parking area for equipment and workers transportation is not in a blocking position.			
6. Waste Management	**(a) Measures for Overall Management** - Designate the contractors to follow the Notification of the Ministry of Industry on Disposal of Waste or Unusable Materials B.E.2548 (2005) which requires to separate hazardous waste (such as lubricant oil, solvents, absorbent or cleaning substances, spilled oil and used battery, etc.) from general wastes. These wastes will be collected and sent to agencies authorized by the Department of Industrial works for disposal - The contractor must provide sufficient rubbish containers with lids and garbage bags at working area and coordinate with local organizations for disposal. **(b) Measures for Sodium Bentonite Management** - Mix sufficient quantity of Sodium Bentonite for the use only in order to reduce disposal quantity and disposal area.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
6. Waste Management (cont'd)	- Build receiving-sending pond nearby the public water source and blocking area by sand bags at least 60 cm. height to maintain the site and prevent mud dispersion into the surrounding area and prevent soil erosion. Include fence / trap installation in the construction area to prevent the soil leach into the water - Sodium bentonite used in excavation and soil contamination. It will be re-circulated to the container for settling and re-use. The soil and rock sediment are collected and disposed of by landfill by authorized agencies. - In the case of left sodium bentonite, it must be collected and disposed of by landfill by authorized agencies.			
7. **Socio-Economic and Public Participation**	**(a) Public Relations and Establishment Understandings about the Project: before construction period** - Meeting with communities' leaders and local organizations/police station executives before construction at least 1 month in advance to inform about the construction plan and methods that may cause impacts to communities, e.g., ground excavation for construction of receiving and drilling pits, noise from working machines and construction period. This includes discussion on preventive and mitigation measures for impact, and to get cooperation during construction period. The emphasis is on reducing impact on obstruction at entry and exit of the local roads, and public relations to communities about the construction plan.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
7. Socio-Economic and Public Participation (cont'd)	- Enhancement of community understanding by proactive public relations and increase learning on different issues of the project at least 1 month before construction by organizing exhibition, public relation boards of the project, leaflets about construction plan, construction methods, preventive and mitigation measures for construction impacts and channels for communication with responsible persons in case of accidents. - Public relations to passers-by at the project construction site, at least 1 month in advance. The project public relation board should be installed along the pipeline alignment so that the people will be cautious or take the other routes. - The project must coordinate with Hemeraj ESIE before starting the construction	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.
	(b) Mitigation of Impact on Public Peace Disturbance - Enhancement of community understanding by proactive public relations and increase learning on different issues of the project by organizing exhibition, public relation boards of the project, leaflets to community leader. - The project must inform the construction plan to local administrative organizations. The board shows construction plan, project owner and hot line number for communication with responsible persons in case of accidents. - Coordinate with communities' leaders and relevant agencies in order to assist and solve problems for people who are affected by project construction. And, establish the "Complaint Center" for public relation of the project implementation, prevention and mitigation measures for the project impact, including opinions, recommendations and complaints from communities. Complaints must be investigated everyday and inform solutions.			

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
7. Socio-Economic and Public Participation (cont'd)	- Specify the complaints which have certain period for solving problems, both of general and emergency cases, including preparation of the company complaint form. - Provision of staffs to monitor, control and maintenance areas after construction, including receiving people complaints and solving problems promptly. - Provision of public insurances to protect life and property damages caused by the project construction. - In case of property or buildings damages, the contractors must report the damage causes and their effects to company in every case. Record with details has to be done to prevent damage duplication and check tidiness of implementation. - After receiving complaints, they must be investigated by responsible agencies. In case the complaints are related to property compensation, the relevant agencies must inform about implementation procedures and proper recommendations to complainants. For any other issues, the responsible agencies must investigate causes of complaints together with complainants, and then report to executives. - Control the workers' behaviors closely in order to prevent them from making disturbance to communities around.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.
	- Provision of staffs to monitor, control and maintenance areas after construction, including receiving people complaints and solving problems promptly.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
7. Socio-Economic and Public Participation (cont'd)	- Support activities for public benefits, including sustainable developments in various aspects. The promoted activities include public relation activity and strengthening people capacities, life quality development project, activities related to religions, culture, education, sport, health and environment. - Creating good relationship and coordinating with relevant organizations, both of governmental and private sectors continuously in order to have good relationship and solving problem together in the future.			
8. Occupational Health and Safety	**(a) Overall Measures** - Contractor must provide the safety and occupational health action plan - Demarcate the construction site by suitable materials for the safety of passers-by and nearby people, including fencing the site office and control the enter-exit at the front gate only. - Determine open-close duration of the entrance	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.
	- The contractors' staffs must put on staff tag during entire working hours. - Control the workers' behaviors closely in order to prevent them from making disturbance to communities around. - Setting up punishment for workers who practice against regulations. - Coordinate with local policemen, and requesting for cooperation in controlling workers' behaviors and disciplines.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
8. Occupational Health and Safety (cont'd)	- Install sufficient mobile fire extinguishers in the site office, and at precise visible area. - Provision of qualified and well-trained personnel such as occupational health and safety officers to inspect the work safety. - Provision of safety officer for responsible for safety during construction. To control the practice following occupational health and environment policy, as well as manuals on rules and regulations related to working safety - Provision of sufficient and suitable PPE to staffs in accordance to nature of work; e.g. safety shoes, helmet, gloves and glasses. The staffs must be controlled to use personal protective equipment during working. - During mixing sodium bentonite, staffs must wear dust mask, gloves and goggles. - Allocate machinery boundary to be in the good order. - Put warning signs at the danger areas, and the staffs must wear PPE during working. - Prohibit people who is not involving to enter the construction zone. - Using of work permit system for welding and welding inspection by radiation. - Organize a meeting for those who are responsible for implementation, including operation, maintenance and safety in order to have mutual understandings. Briefing on welding procedure has to be provided to responsible persons before operation.	Construction area	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
8. Occupational Health and Safety (cont'd)	- Prohibition of making fire at working place, except cases allowed in relation to heat. Provision of fire extinguishers to be enough and ready for emergency case. - Maintenance equipment and machinery to be always in a good condition and ready for work. It some problem is found, the equipment must be fix well before using. - Report immediately to the supervisor when injuries or accidents occurring from work. And, make an accident report that explains the cause, how to fix it, and how the damage is done. - Site selection and construction of a temporary office (Site Office) must be approved by the owner or responsible agency before implementation. - Getting first aid kits installed at the site office. Provision of vehicles ready for taking injured people to nearby hospitals immediately, in case of accidents during working. - Provision of security guards to control the access at an entrance–exit gates for 24 hours. - Provision medical check up to operators/workers, annually. - Consider for getting qualified locals people by demand to work first. - Make a list of construction workers to report the number and diseases of construction workers to the health service in the area responsible at least 1 month before construction.			

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
8. Occupational Health and Safety (cont'd)	- Backfilling must be conducted immediately after pipe lying and pipe inspection completed. The site must be the same as ordinary condition or even better, including installation of warning signs and/or clear sign of natural gas pipeline alignment. - Control the contractors to strictly follow environmental protection measures and environmental monitoring measures. Include an impact monitoring officer due to the pipeline of the project. If problems or damage occurs, solve the problem quickly.			
	(b) Excavation and backfilling - The company must coordinate with the owner of the public utilities system along the gas pipeline. For detailed information about the utility system, location, depth, and safety practices in operation, close to or likely to affect current infrastructure prior to operation. - Before working, checked-up backhoes to be within a ready condition. - Prohibition the workers into the receiving – sending tank or nearby areas when digging by machine, the accident may occur. - Around the receiving – sending tank must be provided equipment to protect falls. And, provide a light and flashing warning light all the time. - Demarcate excavating area, and install warning sign as danger and restricted area during backhoes working period.	Constructing receiving – sending tank and landfill area	During Constructing receiving – sending tank and landfill Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
8. Occupational Health and Safety (cont'd)	- Control workers to wear protective personal equipment (PPE) during entire working period.			
	- During open cut, preventive measures will be put in place, e.g, installation of sheet pile, etc. depending on slope, to prevent soil erosion in the essential area.			
	(c) Welding of natural gas pipeline - Inspect details on readiness of equipment and devices used for welding the gas pipeline, and it must immediately fix if found a problem.	Welding area	During welding pipe	Gulf SRC Co., Ltd.
	- Provision of personal protective equipment for workers who work on welding; e.g. safety shoes, helmet, gloves and glasses.			
	- Demarcate welding area, and install warning sign as danger and restricted area without fire working.			
	- Metal pieces or sparks must be limited to the work area of the welded pipe and be careful not to allow metal or sparks to come into contact with combustible materials.			
	- Provision of fire extinguishers, ready at the welding area for emergency case			
	(d) Welding inspection - Having experts to work on welding inspection by using non-destructive testing (Non Destructive Testing; NDT).	Welding inspector by x-ray area	During welding inspector by x-ray period	Gulf SRC Co., Ltd.
	- Control operators to wear protective personal equipment (PPE) during working; e.g. gloves, helmet and safety shoes.			

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
	- Demarcate area for welding inspection by using radiation and install warning signs of danger and restricted area, including use of work permit system.			
	- Operators have to be inspected and put on film badge, before working.			
8.Occupational Health and Safety (cont'd)	- The welding inspection area that use X-ray must have a sign of radiation showing a message and symbols as given below:  	Welding inspector by x-ray area	During welding inspector by x-ray period	Gulf SRC Co., Ltd.
	(e) Welding of natural gas pipeline at the beginning of the alignment - Preparation of personnel responsible for welding of natural gas pipeline, comprising responsible persons from the Gulf SRC Co., Ltd., contractor company and the PTT.	Welding pipeline at the beginning of the alignment area	During welding period	
	- Before wielding process, the contactors must prepare Tie-in Procedure, Safety Procedure and Emergency Response Procedure to company for permission.			
	- Preparation of personnel responsible for welding of natural gas pipeline, both from the Gulf SRC Co., Ltd. and contractor company.			
	- Organize a meeting for those who are responsible for implementation, including operation, maintenance and safety in order to have mutual understandings. Briefing on welding procedure has to be provided to responsible persons before operation.			

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
	- Specify the contractor to operate following term of reference regarding safety strictly.			
	- Inspect details on readiness of equipment and devices used for welding the gas pipeline, under the supervision of Gulf JP UT Co., Ltd staffs.			
8.Occupational Health and Safety (cont'd)	- Provision and examination to be ready for emergency case response • Coordinate with police fire and local disaster relief centers for assistance in emergency case, as specified in the emergency procedure, and provide a fire truck. • Coordinate with nearby hospitals for providing ambulances including 1 nurse at least during the welding of natural gas pipeline • Provide 2 sets of dry chemical fire extinguishers • Provide 1 set pf gas detector - Demarcate area by installing warning signs of danger, metal fence or concrete wall for protecting other worker. Coordinate with gas control about pressure in pipe during welding of pipeline to control in proper range.	Welding pipeline at the beginning of the alignment area	During welding period	Gulf SRC Co., Ltd.
	(f) Pipe lower-in to a trench - Before working, checked-up backhoes and lifting devices to be within a ready condition.	Pipe lower-in to a trench area	During pipe lower-in to a trench period	
	- Inspection of not having barricade or people in unsafe distance from pipe lifting.			
	- Control workers to wear safety helmet, rubber floor shoes and ear plugs during entire working period.			

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
8.Occupational Health and Safety (cont'd)	**(g) Pipe lower-in to a trench nearby public utility** - The company must coordinate with the owner of the public utilities system along the gas pipeline. For detailed information about the utility system, location, depth, and safety practices in operation, close to or likely to affect current infrastructure prior to operation. - Provision of staffs to monitor, control and maintenance areas after construction, including receiving people complaints and solving problems promptly. - Backfilling must be conducted immediately after pipe lying and pipe inspection completed. The site must be the same as ordinary condition or even better, including installation of warning signs and/or clear sign of natural gas pipeline alignment.	Pipe lower-in to a trench nearby public utility area	During pipe lower-in to a trench nearby public utility period	Gulf SRC Co., Ltd.
	(h) Commissioning - Operators who work on air flushing out of the pipeline by nitrogen gas must wear ear plugs before gas delivering.	Nitrogen gas usage area	Commissioning Period	Gulf SRC Co., Ltd.
	(i) Measures for safety and prevention of accidents by the third party At the position of pipeline placed warning message and sign must be installed, and also telephone number for informing the emergency case.	Construction area	During the Construction Periods	Gulf SRC Co., Ltd.
8.Occupational Health and Safety (cont'd)	**(j) Hauling and stock of natural gas pipes** - Pipes must be kept following agreement with the Gulf SRC Co., Ltd. They must be good maintained in order to avoid damages.	Pipe storage and entire gas pipeline alignment area	During the Construction Periods	Gulf SRC Co., Ltd.

Table 4-1 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
	- The contractors are responsible for expenses of secondary wood pipe and must adjust their levels before lower-in the pipes, including provision of wooden wedges to prevent the collapse of pipe pile and to ensure stability of contact between pipes and secondary wood pipe. - For re-instatement, the contractors must collect materials and rubbishes so the area is tidied up before handling back. - Control the contactor to align the pipeline in the construction area only. Construction activities will only use on the road shoulder for safety.			

Table 4-2

Environmental Action Plan during Operation Periods of the Natural Gas Pipeline to Sriracha Power Plant Project

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
1. **Socio-economic and public participation**	- Organize grievance redress mechanism for project affected persons and accelerate to solve problems.	Along the entire gas pipeline alignment	During the Construction Periods	Gulf SRC Co., Ltd.
	- Organize public relations to disseminate emergency suppression manual and the hotline number to various agencies, nearby communities and interested people via various channels; e.g. • project public relation officers, • website, • disseminated documents, • public relation board, • communities' leaders			
	- Build up good relationships with communities by participation in communities' activities and support their activities; e.g. traditional festival, traditional important days, supporting sport, education, public health and public facilities, etc.			
	- Disseminate information about natural gas and safety. Build up knowledge, understanding and confidence on system and organization via various medias; i.e. provision of natural gas knowledge, importance of warning sign along alignment, communication channels between communities and the project, including information dissemination through pamphlet and leaflet.			

Table 4-2 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
1. Occupational Health and Safety	**(a) Public Health/Occupational Health and Safety** - Provision of training on knowledge related to occupational health and safety to concerned operators/workers. Training will be subject to: • Rules and regulations related to safety and working safety in the area of gas piping system • The use of personal protective equipments • Practice in case of emergency • First aid care, etc.	Along pipeline alignment area	Operation Periods	Gulf SRC Co., Ltd.
	(b) Prevention and control of gas leakage and ignition - Regular inspect and maintain gas piping system by the following approaches: (1) Pipeline inspection • Survey pipeline patrolling area fourth a year, to be in accordance with ASME B31.8 standard topic 851.2 and 852.1 by surveying the activities which can cause impact such as construction above pipeline patrolling, pile driving and open cut. • Survey and maintenance warning sign, pipeline markers and pipeline patrolling fourth a year, to be in accordance with ASME B31.8 standard topic 851.7 by walk through and driving survey. Examine the clarity, broken or moving of warning massages.			

Table 4-2 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
2.Occupational Health and Safety (cont'd)	(2) Pipeline patrolling maintenance • Survey and observe pipeline subsidence and soil erosion at backfilling area with the soft soil, waterways or slope, once a year. (3) Leakage survey • Survey gas leakage and gas detector once a year, to be in accordance with ASME B31.8 standard topic 851.3 and 852.2 by walk through survey. (4) Corrosion maintenance and prevention • Inspect the extent of voltage used to prevent corrosion of pipeline twice a year, to be in accordance with NACE RP 0169 standard. Corrosion prevention system at Test Post must enough of protecting and not damaging the insulator. • Inspect the extent of voltage used to prevent corrosion at underground pipeline tenth a year, to find out the area where voltage value is lower than NACE RP 0169 standard (conduct only at the significant area).	Along pipeline alignment area	Operation Periods	Gulf SRC Co., Ltd.
	- Control the practice following occupational health and environment policy, as well as manuals on rules and regulations related to working safety in gas piping system area.			
	- Maintenance the message at warning signs related to pipeline position, and hot line number to be tangible visible.			
	- Coordinate with agencies who own lands and responsible for infrastructure near the pipeline alignment and inform them about implementation in their areas in advance. - Provide work permit system at pipeline alignment area before implementation.			

Table 4-2 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
2.Occupational Health and Safety (cont'd)	**(c) Preparedness and operation in case of gas leakage** - Provide emergency suppression plan in order to control an emergency situations from gas leakage immediately. - After transferring natural gas piping system to PTT Plc. Co., Ltd., the project emergency plan will be adapted to the PTT emergency plan. - Organize exercise on emergency suppression plan, at least once a year. - Review, improve and assess the efficiency of emergency suppression plan periodically. - Provide telephone number list of agencies that must be coordinated in emergency situation such as police station, public disaster relief uni, hospital and Hemaraj SEIE etc. - Install dry chemical powder fire extinguishers at MRS. - Provision of well-trained officers to control gas leakage situation. - Provision of insurance for life and properties which are damaged by project implementation. **(d) Preparedness and operation in case of gas leakage** - Provide emergency suppression plan in order to control an emergency situations from gas leakage immediately. - After transferring natural gas piping system to PTT Plc. Co., Ltd., the project emergency plan will be adapted to the PTT emergency plan. - Organize exercise on emergency suppression plan, at least once a year. - Review, improve and assess the efficiency of emergency suppression plan periodically.			

Table 4-2 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
2.Occupational Health and Safety (cont'd)	- Provide telephone number list of agencies that must be coordinated in emergency situation such as police station, public disaster relief uni, hospital and Hemaraj SEIE etc. - Install dry chemical powder fire extinguishers at MRS. - Provision of well-trained officers to control gas leakage situation. - Provision of insurance for life and properties which are damaged by project implementation.			
	(e) Preventive measures for accident from third party and sabotage – Provision of 24-hr security system at MRS of Sriracha power plant. – Inspect and maintain gas leakage protective equipment, personal protective equipment and fire control equipment installed at MRS regularly. – Inspect the condition of warning signs which specify gas pipeline positions or symbols, including the hotline numbers to be tangible visible. – Public relations and ask for coordination from nearby agencies, communities and entrepreneurs to assist on watching / observation, not letting the others to damage the pipeline alignment. In case any agencies will construct, improve or work related to infrastructure system in the area such as the repaired road, electricity, tap water, telephone, etc. must inform in advance. Coordinated officers must be provided during the entire operation period.			
	(f) Occupational health and safety for operators/ workers Control the use of proper personal protective equipment for each type of work.			

Table 4-2 (Cont'd)

Environmental Issues	Preventive and Mitigation Measures	Operation Place	Processing Period	Responsible Authority
	– Control inspection of equipment, tools before using. – Implementation during repair leakage of pipelines is as follows: • Provide work permit system to work in the area of welding and weld inspection by x-ray. • Control operators/workers wear to wear personal protective equipments such as gloves, safety helmet, safety shoes, etc. • Demarcate the welding area and install warning sign to identify the restricted area. • Always measure gas at workplace by Gas Detector • Demarcate the weld inspection area, not permit unconcerned persons to be in the area. • Install radiation sign at working place of weld inspection, showing messages and symbols as given below:  • Operators/workers who inspect welding by x-ray must be inspected and put on film badge before working – In case the repair of gas piping system is performed at soft soil area, the open cut excavation must be controlled by means of proper preventive measures of soil erosion for operators/workers safety; e.g. installation of sheet pile surrounding open cut area or adjust slope of trench's walls to be suitable.	Along pipeline alignment area	Operation Periods	Gulf SRC Co., Ltd.

Table 4-3

Environmental Monitoring Measures in Construction Period of the Natural Gas Pipeline to Sriracha Power Plant Project Conclusion Table

Environmental Indicators	Monitoring Index	Analysis/Measurement method	Monitoring Station	Frequency	Authority
1. Air Quality	- TSP (24 hours) - PM 10 (24 hours) - Wind Speed, direction and temperature	- Collect samples with high volume air sampler to be analysed for TSP using gravimetric method according to US.EPA standards. - Samples to be analysed for PM-10, collect with high volume PM-10 air sampler and analysed using gravimetric method according to PA 076 standards.	- 1 station • Chumchonborisatnamtaltawanaok School	Once for seven consecutive days, covering work days and holidays at the time when the construction activities are carried out near the Measurement Station.	Gulf SRC Co., Ltd.
2. Noise	- $L_{eq\ 24\ hr}$ - $L_{eq\ 8\ hr}$ - $L_{eq\ 1\ hr}$ - L_{max} - L_{90}	- Sound pressure level measurement method as prescribed in Notification of the National Environmental Board, Volume 15 B.E.2540 re: Specification of Standards for Sound Pressure Level.	- 1 station • Chumchonborisatnamtaltawanaok School	Once for seven consecutive days, covering work days and holidays at the time when the construction activities are carried out near the Measurement Station.	Gulf SRC Co., Ltd.

Table 4-3 (Cont'd)

Environmental Indicators	Monitoring Index	Analysis/Measurement method	Monitoring Station	Frequency	Authority
3.Soil Resource	- Cation Exchange Capacity: CEC - Total Sodium - Soil Bulk density - Exchangeable Sodium - Exchangeable Magnesium - Exchangeable Calcium - Soluble Sodium - Soluble Magnesium - Soluble Calcium - Sodium Adsorption Ratio (SAR)		2.sampling 1 point at 0-5 cm. depth from pipeline before construction		

Table 4-3 (Cont'd)

Environmental Indicators	Monitoring Index	Analysis/Measurement method	Monitoring Station	Frequency	Authority
3.Soil Resource	(a) Sodium bentonite impact from HDD to nearby area - Acidity-Alkalinity (pH) - Electrial Conductivity - Cation Exchange Capacity: CEC - Total Sodium - Soil Bulk density - Exchangeable Sodium - Exchangeable Magnesium - Exchangeable Calcium - Soluble Sodium - Soluble Magnesium - Soluble Calcium - Sodium Adsorption Ratio (SAR)	Soil monitoring method as follow National Environmental Board Notification no.25 B.E.2547 soil standard topic	Sodium bentonite leakage area	Sampling 1 time in the case of Sodium bentonite leakage after disposal	Gulf SRC Co., Ltd.

Table 4-3 (Cont'd)

Environmental Indicators	Monitoring Index	Analysis/Measurement method	Monitoring Station	Frequency	Authority
3. Surface water quality and aquatic ecology	(a) wastewater from temporary building - pH - BOD_5 - Suspended Solids (SS) - Sulfide - Total Dissolved Solids - Settleable Solids - Oil & Grease - TKN	- Follows Standard Methods for the Examination of Water and Wastewater	- Water quality monitoring pond for 1 day capacity near temporary building	Once a month during construction period	Gulf SRC Co., Ltd.
	(b) Hydrostatic Test - pH - Temperature - Suspended Solids (SS) - Oil & Grease	- Follows Standard Methods for the Examination of Water and Wastewater	- Effluent point from Hydrostatic Test	- Effluent water from Hydrostatic Test	Gulf SRC Co., Ltd.
	(c) Drainage condition in construction area - Drainage and flood in construction area	- Note the drainage and flood in construction area cause by construction	- Construction area	- Daily	Gulf SRC Co., Ltd.

Table 4-3 (Cont'd)

Environmental Indicators	Monitoring Index	Analysis/Measurement method	Monitoring Station	Frequency	Authority
4. Transportation	- Accidental statistic in construction area - Complain from road user	- Always note the number of accidents from transportation, construction, material pile with causes, place, time, complains and mitigation	- Construction area	- Daily note and report monthly statistic	Gulf SRC Co., Ltd.
5. Socio-economic and public participation	- Comments and complains from community - Comments from people about impact from construction	- Note comments and complains - Note the community meeting and report the mitigation	- Community leader, household and business around 500 m. from pipeline construction area	- Always note comments and complains	Gulf SRC Co., Ltd.
6. Occupational health and safety	- Accidental statistic - Illness - occupational injury	- Note and conclude accidental statistic include causes, mitigation measures and damage of health	- Pipeline construction area	- Periodically, at least once a month in construction period	Gulf SRC Co., Ltd.

Table 4-4

Environmental Monitoring Measures in Operation Period of the Natural Gas Pipeline to Sriracha Power Plant Project Conclusion Table

Environmental Indicators	Monitoring Index	Analysis/Measurement method	Monitoring Station	Frequency	Authority
1. Socio-economic and public participation	- Comments from people about pipeline system operation	- Evaluate the awareness, Knowledge of the project, Impacts, comments, suggestions, mitigation and complaints from industries in Hemaraj ESIE, community leaders, institute, organizations and people	- Community leader, household and business around 500 m. from pipeline area	Once for first year of operation. After that, fifth a year all operation period	Gulf SRC Co., Ltd.
2. Occupational health and safety					
2.1 Leakage and emergency	- Gas leakage and emergency case	- Note Gas leakage and emergency case include causes, mitigations and impact to workers and nearby area	- Natural gas pipeline area	- Every case and conclude every 6 month	Gulf SRC Co., Ltd.
2.2 Pipeline survey	- Inspect Pipeline Patrolling area to be in accordance with ASME B31.8 standard topic 851.1 and 851.2	- Survey any activities around Pipeline Patrolling area which can cause impact such as construction above pipeline, pile driving, open cut and agriculture	- Natural gas pipeline area	Fourth a year	Gulf SRC Co., Ltd.
	- Pipeline Markers maintenance follows ASME B31.8 topic 851.7 standard	- Survey and maintenance warning sign, pipeline markers above pipeline patrolling by walk through and driving survey to examine the clarity, broken or moving of warning massages.	- Natural gas pipeline area	Fourth a year	Gulf SRC Co., Ltd.

Table 4-4 (Cont'd)

Environmental Indicators	Monitoring Index	Analysis/Measurement method	Monitoring Station	Frequency	Authority
2.3 Pipeline maintenance	- Observe the Pipe Settlement and Soil Erosion around soft soil area, slope area and drainage channel	- Observe and survey the Pipe Settlement and Soil Erosion	- Natural gas pipeline area	Once a year	Gulf SRC Co., Ltd.
2.4 Pipeline Leakage Surveys	- Survey Pipeline Leakage follows ASME B31.8 topic 851.3 standard	- Survey gas leakage and gas detector	- Natural gas pipeline area	Once a year	Gulf SRC Co., Ltd.
	- Survey Coating Defect	- Survey Coating Defect by Voltage Gradient with DCVG method in soil for defect size and location along pipe length	-Natural gas pipeline area	Once per 10 years	Gulf SRC Co., Ltd.
2.5 Decay Protection system maintenance	- Measure voltage at Test Post (Pipe to Soil Potential) as follows NACE SP 0169 standard	- Measure by voltage measuring device of decay protection system	- At Test Post	Twice a year	Gulf SRC Co., Ltd.
	- Measure voltage at Close Interval Pipe to Soil Potential Survey (CIPs) for find area which has lower voltage than NACE SP 0169 standard	- Measure by voltage measuring device of decay protection system	-Along pipeline alignment	Once per 10 years	Gulf SRC Co., Ltd.