GLOW ENERGY PUBLIC CO., LTD.

ENVIRONMENTAL IMPACT ASSESSMENT

SUMMARY REPORT

COMBINED CYCLE COGENERATION POWER PLANT PROJECT

MAP TA PHUT INDUSTRIAL ESTATE

MUEANG DISTRICT, RAYONG PROVINCE

PREPARED BY

AIR SAVE CO., Ltd.

NOVEMBER 2007

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CHAPTER 1
INTRODUCTION

1.1 PROJECT BACKGROUND

In response to the continuous and rapid expansion of domestic and industrial sectors which requires an increasing amount of public utilities especially for electricity which is one of the basic needs to driving such development, Glow Energy Public Co., Ltd. (GLOW) has therefore planned to establish a new power plant project with a gross power output of 381 megawatts. The project is expected to start its construction in early 2008, taking up to 32 months for construction, and start commissioning the operation in late 2011. The project construction plan is illustrated in Table 1.1-1. In order to get an approval for the project implementation, the company is required to prepare an Environmental Impact Assessment (EIA) report and submit to the Office of Natural Resources and Environmental Policy and Planning (ONEP).

1.2 EIA METHODOLOGY

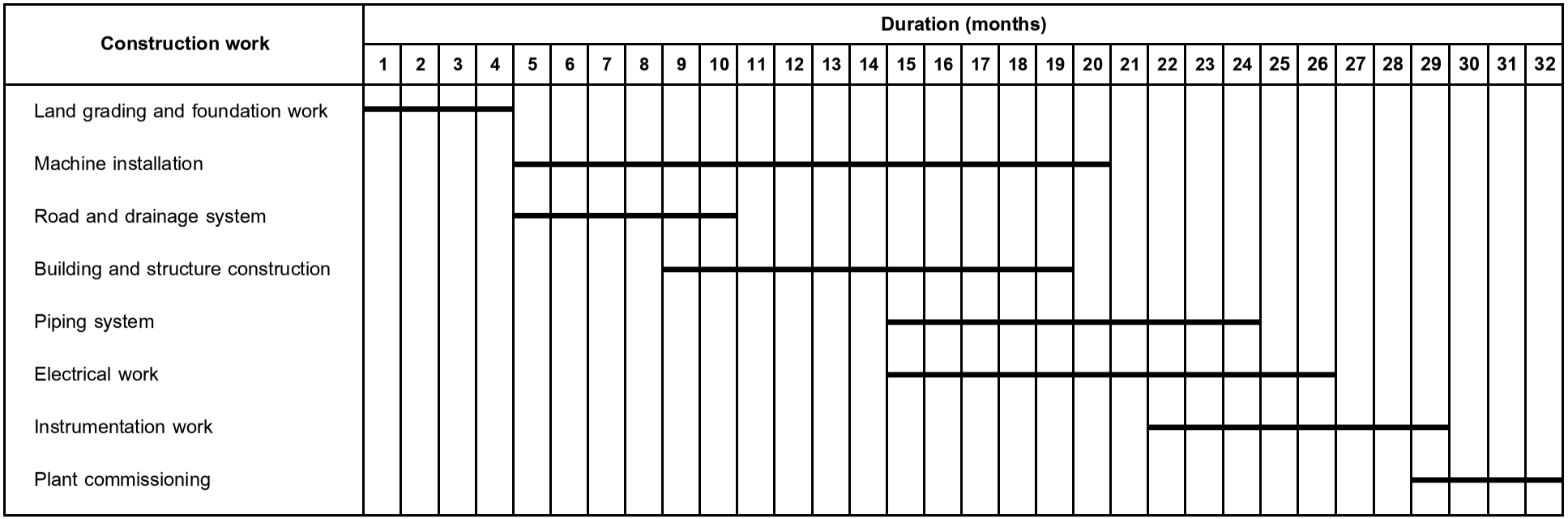
The following procedures have been carried out for conducting this EIA, including compilation of background information, writing project description, describing the existing environmental conditions, assessing the environmental impacts and proposing mitigation measures and monitoring programs for air quality, water quality, solid wastes, occupational health and safety, and socio-economics aspects.

1.3 ACKNOWLEDGEMENT

Air Save Co., Ltd. would like to express deep appreciation and sincere gratitude to GLOW staffs for their great support and valuable assistance in providing required information and comments for conducting this EIA.

FIGURE 1.2-1

CONSTRUCTION PLAN



Source : Glow Energy Public Co., Ltd., 2008

CHAPTER 2
PROJECT DESCRIPTION

2.1 LOCATION AND SIZE

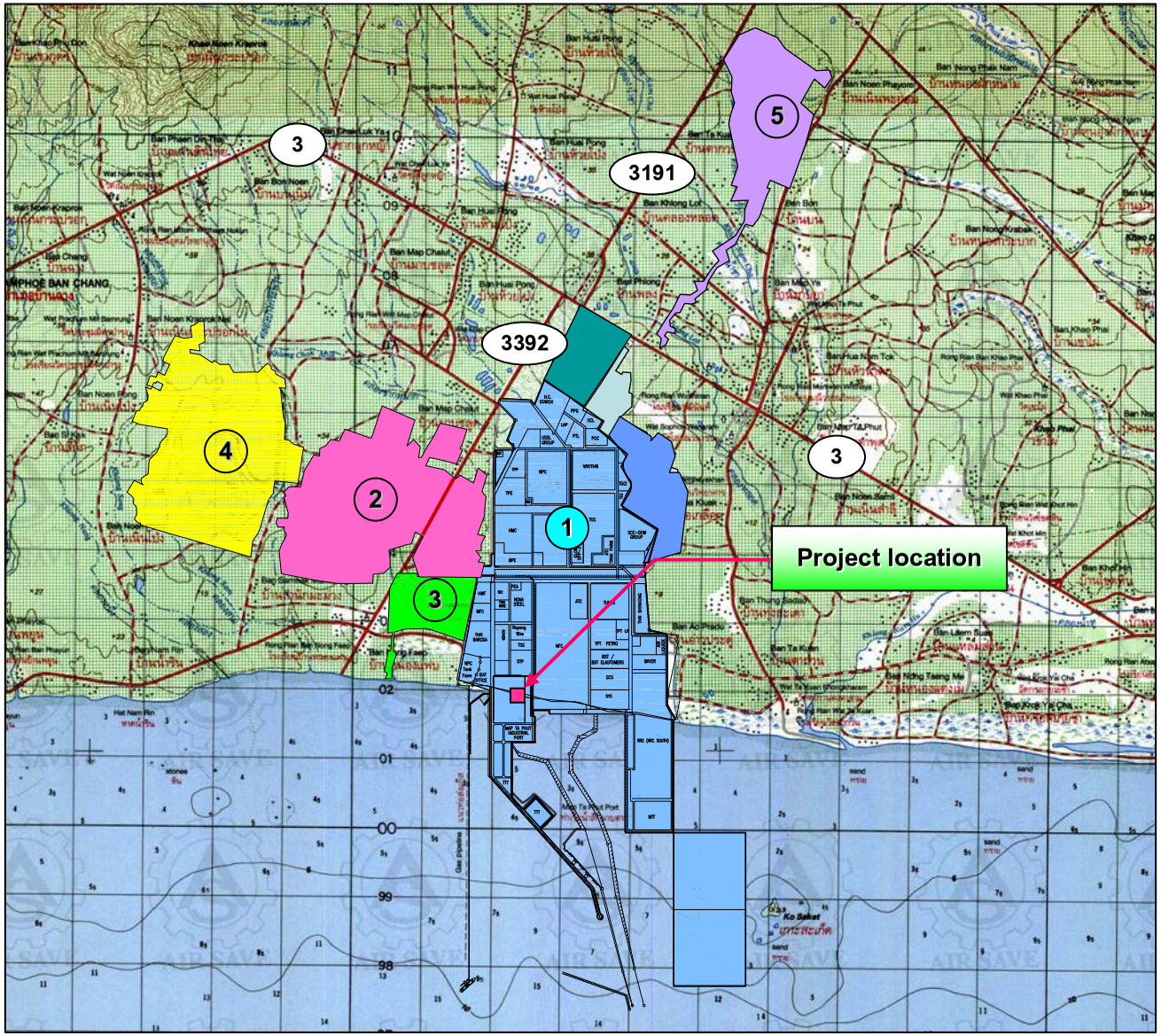
The project is located in Map Ta Phut Industrial Estate (as showed in Figure 2.1-1) in the future planned area of the existing power plants of Glow SPP3 Co., Ltd. (as showed in Figure 2.1-2). The surrounding area of the project includes the manufacturing units as well as utility systems of the power plant as showed in Figure 2.1-3. Glow SPP3 Co., Ltd. has total area of 180 rais. The project layout according to Figure 2.1-4 includes an area of 4.98 rais covering areas of electricity and steam generation, transformers and control building. MRS station, which supplies natural gas for the project is located near the MRS of the existing power plant (refer to Figure 2.1-2). The project purchases clarified water and demineralized water from Glow SPP3. Some utility systems, e.g. water pumps for fire fighting, cooling water discharge canal, wastewater draining system,as well as green area will be used together with those of the Glow SPP3 Co., Ltd.

2.2 FUELS

Natural gas will be used as the major fuel for combustion of combustion turbine generator (CTG). It is transferred via natural gas pipeline, which is of 10 inches in diameter and branched out of the Glow SPP3's 16 inches existing pipeline with a distance of approximately 250 meters away. The consumption rate of natural gas used is about 63 x 10^6 cu. ft./day. Natural gas carried to the project is regulated and measured at metering and regulating station (MRS). The natural gas properties are showed in Table 2.2-1.

2.3 CHEMICALS

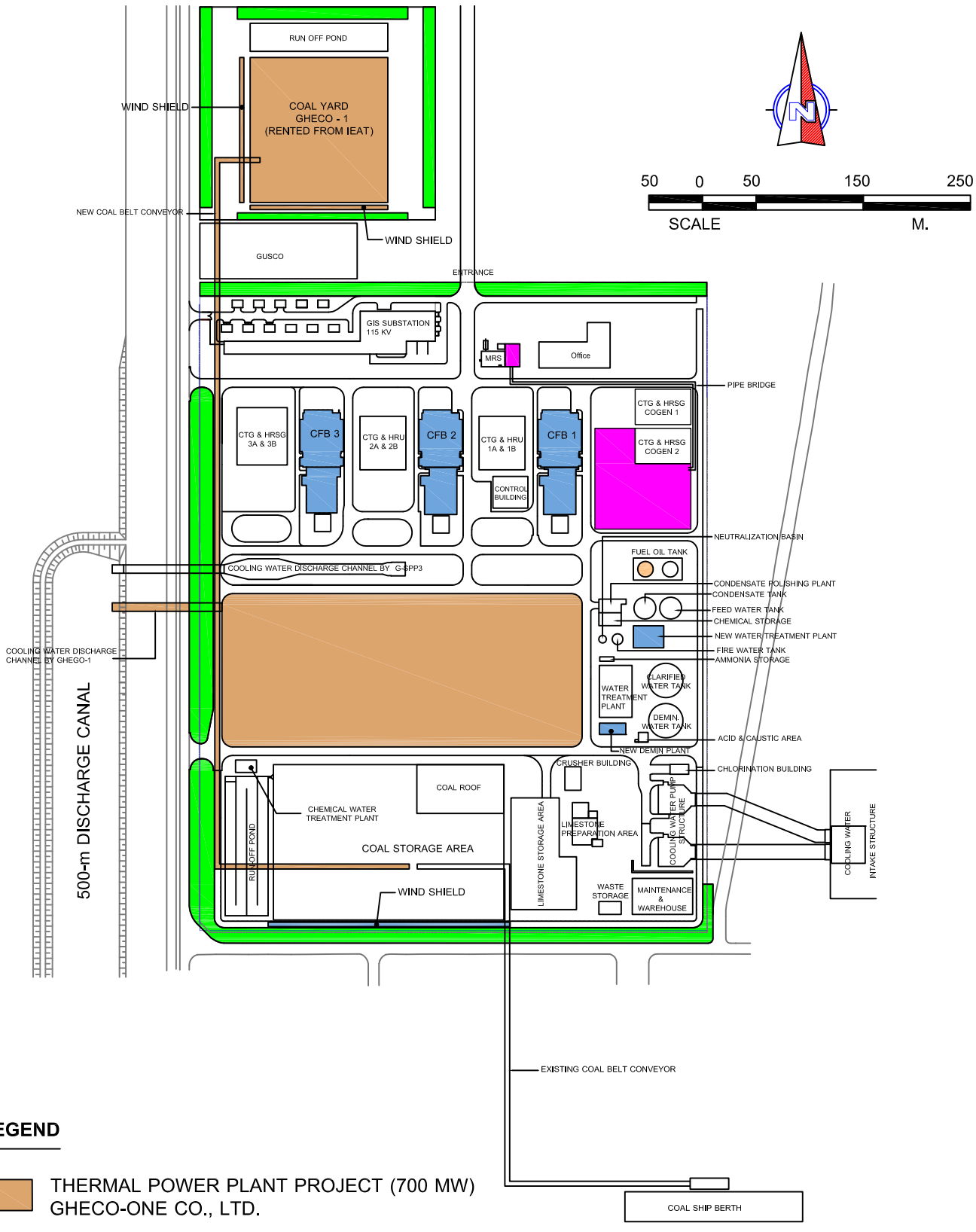
There are usages of chemicals in the production process and utility systems. Details of chemicals in terms of quantity, transportation and storage are showed in Table 2.3-1.



Source : Air Save Co., Ltd., 2008

FIGURE 2.1-1 PROJECT LOCATION

5037A/EIA/F211_ F-class



LEGEND

THERMAL POWER PLANT PROJECT (700 MW)
GHECO-ONE CO., LTD.

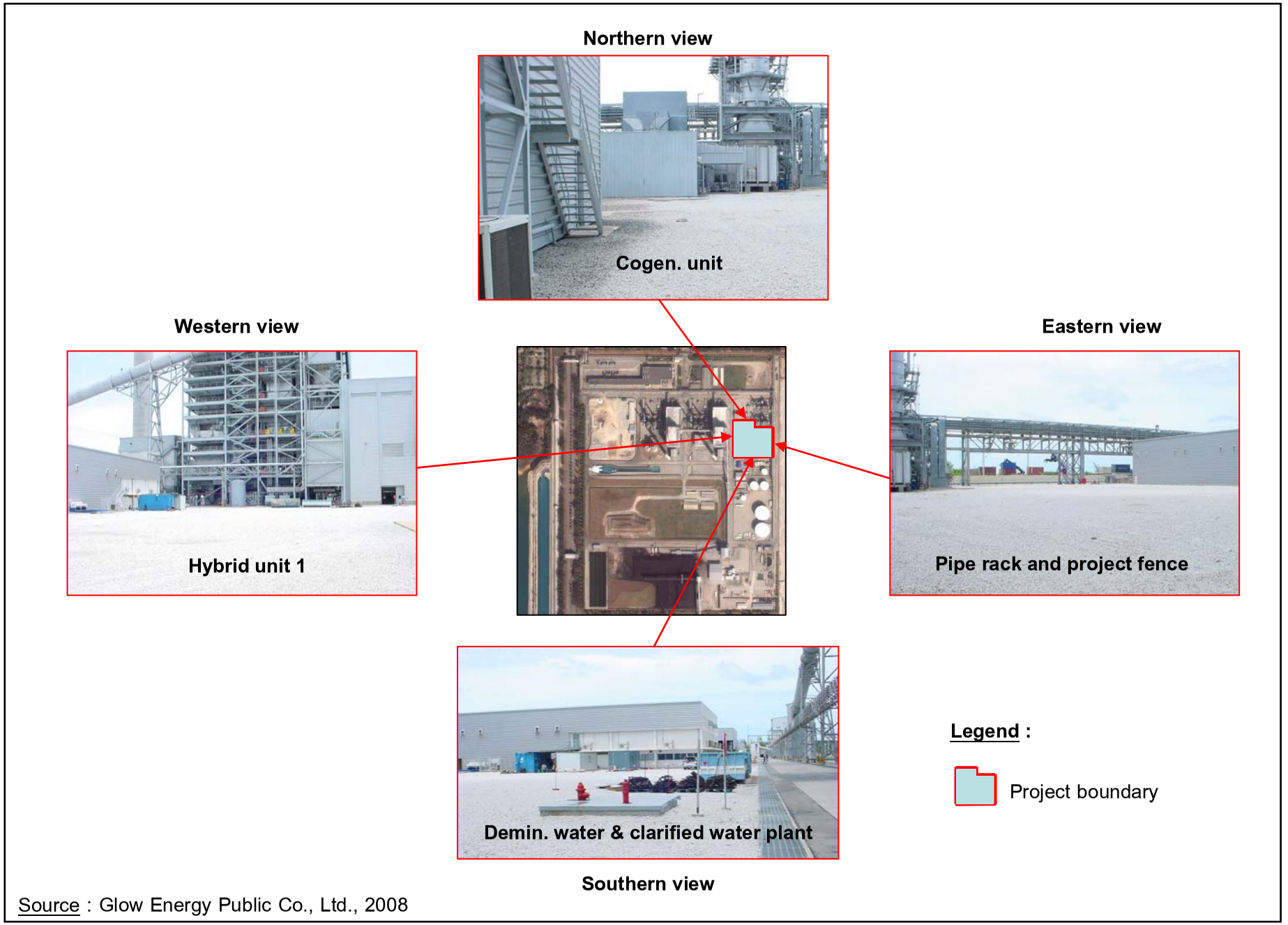
COGENERATION POWER PLANT PROJECT (401 MW)
GLOW ENERGY PUBLIC CO., LTD.

GREEN AREAS

AIR SAVE CO., LTD.
15th FL. ITALTHAI TOWER
2034/70-71 NEW PETCHABURI RD.
BANGKAPI, HUAY KWANG
BANGKOK 10310

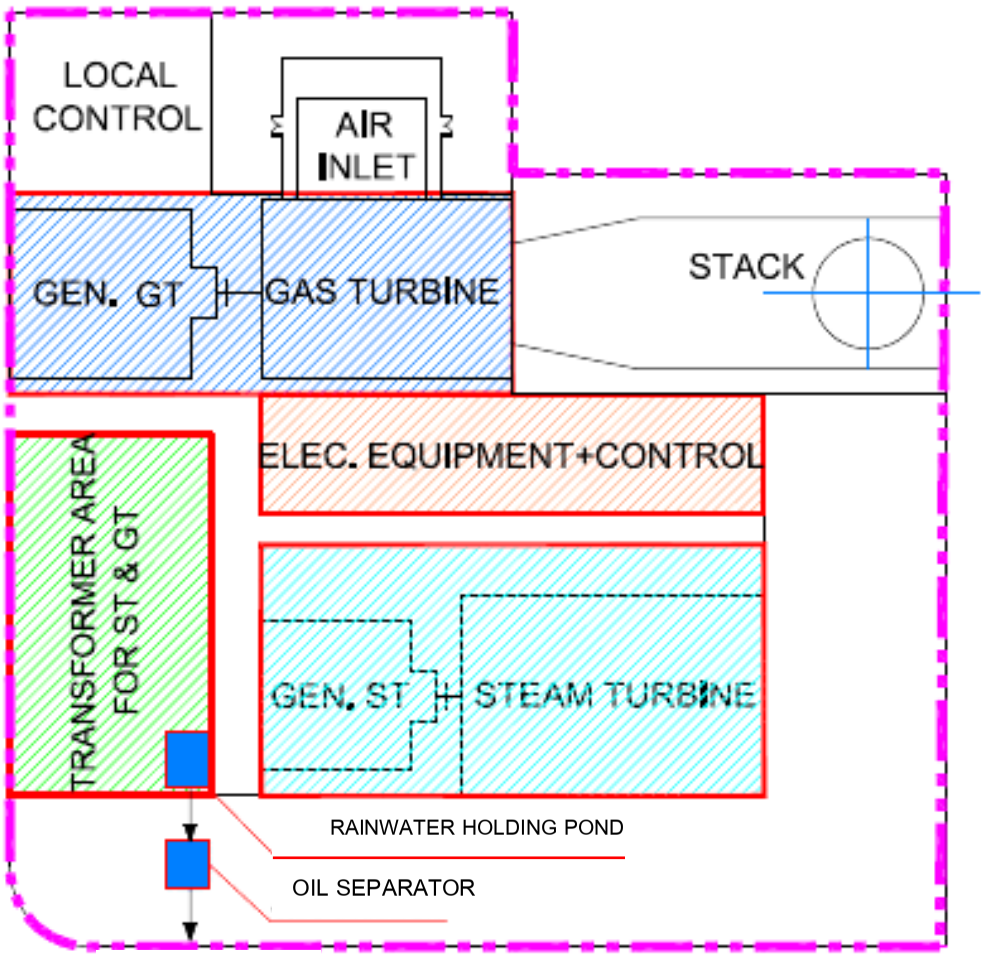
FIGURE 2.1-2 PROJECT LOCATION INSIDE THE EXISTING POWER PLANT BOUNDARY

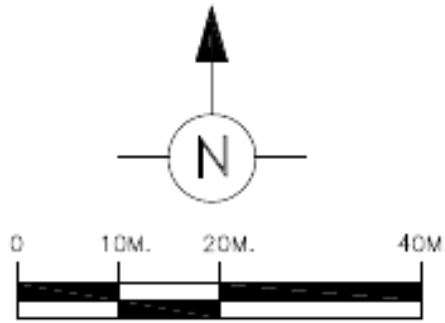
5037A/EIA/F212_F-class



Source : Glow Energy Public Co., Ltd., 2008

FIGURE 2.1-3 PHOTOGRAPHS TAKEN FROM 4 DIRECTIONS OF PROJECT LOCATION





Legend :

- COMBUSTION GAS TURBINE BUILDING
- STEAM TURBINE BUILDING
- TRANSFORMER AREA (CONTAMINATE AREA)
- ELECTRICE EQULPMINT CONTROL

Source : Glow Energy Public Co., Ltd., 2008

FIGURE 2.1-4 PLANT LAYOUT

TABLE 2.2-1

COMPOSITION AND PROPERTY OF NATURAL GAS USED BY THE PROJECT

NATURAL GAS COMPONENTS		2010 CHANGEOVER	DESIGN 2011	2013 ONWARD
Methane : C_1	(%)	89.86	84.79	93.20
Ethane : C_2	(%)	2.50	3.77	2.64
Propane : C_3	(%)	1.18	1.88	1.05
ISO-butane : i-C_4	(%)	0.22	0.37	0.20
Normal-butane : n-C_4	(%)	0.18	0.30	0.03
ISO-pentane : i-C_5	(%)	0.08	0.12	0.01
Normal-pentane : n-C_5	(%)	0.03	0.04	0.00
Hexane : C_6	(%)	0.01	0.015	0.00
Nitrogen : N_2	(%)	2.46	2.17	1.98
Carbondioxide : CO_2	(%)	3.50	6.55	0.88
NATURAL GAS QUALITY		**MIN.**	**NORMAL**	**MAX.**
specific gravity		0.63	0.68	0.60
LHV (dry) (BTU/SCF)		904	905	925
LHV (sat) (BTU/SCF)		888	889	909
HHV (dry) (BTU/SCF)		1001	1002	1025
HHV (sat) (BTU/SCF)		984	984	1007

Source : Gheco-One Co., Ltd., 2008

TABLE 2.3-1

PROJECT CHEMICALS

CHEMICAL	FREQUENCY (TRIPS/YEAR)	TRANSPORT TYPE		TANK CAPACITY	STORAGE QUANTITY	PURPOSES
		TYPE	TRIPS/YEAR			
1. Sodium phosphate solution	13	truck	3	3.8 m^3 storage tank	3.0 m^3	- for treatment of boiler water and scale
2. Ammonium hydroxide solution	12	truck	6	2.5 m^3 storage tank	2.0 m^3	- for treatment of boiler water and pH adjustment
3. Diethylhydroxylamine; DEHA	20	truck	14	1.9 m^3 storage tank	1.5 m^3	- for tratment of boiler water and preventing oxygen soluble
4. Sodium hypochlorite	120	truck	32	3.8 m^3 storage tank	3.0 m^3	- for treatment of intake seawater

Source : Gheco-One Co., Ltd., 2008

2.4 PRODUCTS

The main products of the project are electricity and steam. The project has a production capacity of 381 MW. gross power output. Since the power required by the project itself is 4 MW., the project's net power output will be 377 MW. The electricity produced will be distributed to industrial customers and Electricity Generating Authority of Thailand (EGAT) afterward. For steam, The project plans to supply 70 tons/hour of steam produced to customers. Details of the project's products are illustrated in Table 2.4-1.

2.5 TRANSPORTATION

(1) Construction period

The construction will be conducted within 32 months. Hauling trucks will be used for carrying construction materials, equipment and machines. Construction workers will be transported by small trucks or buses. The frequency of vehicles used during construction period will be 48 times per day approximately. The major route of transportation to and from the project site is Highway no. 3.

(2) Operation period

Transportation activities during operation period are mainly on fuels, chemicals and products to and from the project. Details are as follows:

- **Natural Gas :** NG is transferred to the project via natural gas pipeline, which is of 10 inches in diameter and branched out of the Glow SPP3's 16 inches existing pipeline with a distance of approximately 250 meters away. The consumption rate of natural gas used is about 63 x 10^6 cu. ft./day. Natural gas carried to the project is regulated and measured at metering and regulating station; MRS.

- **Chemicals :** Types and quantities of chemicals used are referred to Section 2.3. Such chemicals are transported to the project via trucks with frequency of about 55 times per year. The major route of transportation to and from the project site for those chemicals is Highway no. 3.

- **Electricity :** The electricity supplied to industrial factories in Map Ta Phut area is supplied through underground transmission lines (layout of

TABLE 2.4-1

PROJECT'S PRODUCTS

PRODUCT	UNIT	QUANTITY		TRANSPORT MEANS
		WITH STEAM SELLING	WITHOUT STEAM SELLING	
1. Electritcitiy				
- Gross power output	MW	349	401	
- Net power output	MW	345	397	- Existing underground transmission line system (Figure 2.4-1)
2. Steam				
- Steam (58 bar and 490°C)	tons/h	120	-	- Existing pipeline system (Figure 2.4-1)

Source : Glow Energy Public Co., Ltd., 2008

transmission lines is illustrated in Figure 2.5-1). Part of electricity supplied to EGAT is connected to the Rayong 2 Substation.

- **Steam** : The steam produced from the project will be supplied through steam pipelines of the existing power plant of Glow SPP3 for the customers in Map Ta Phut area. The steam pipelines are installed on the pipe rack.

2.6 PRODUCTION PROCESS

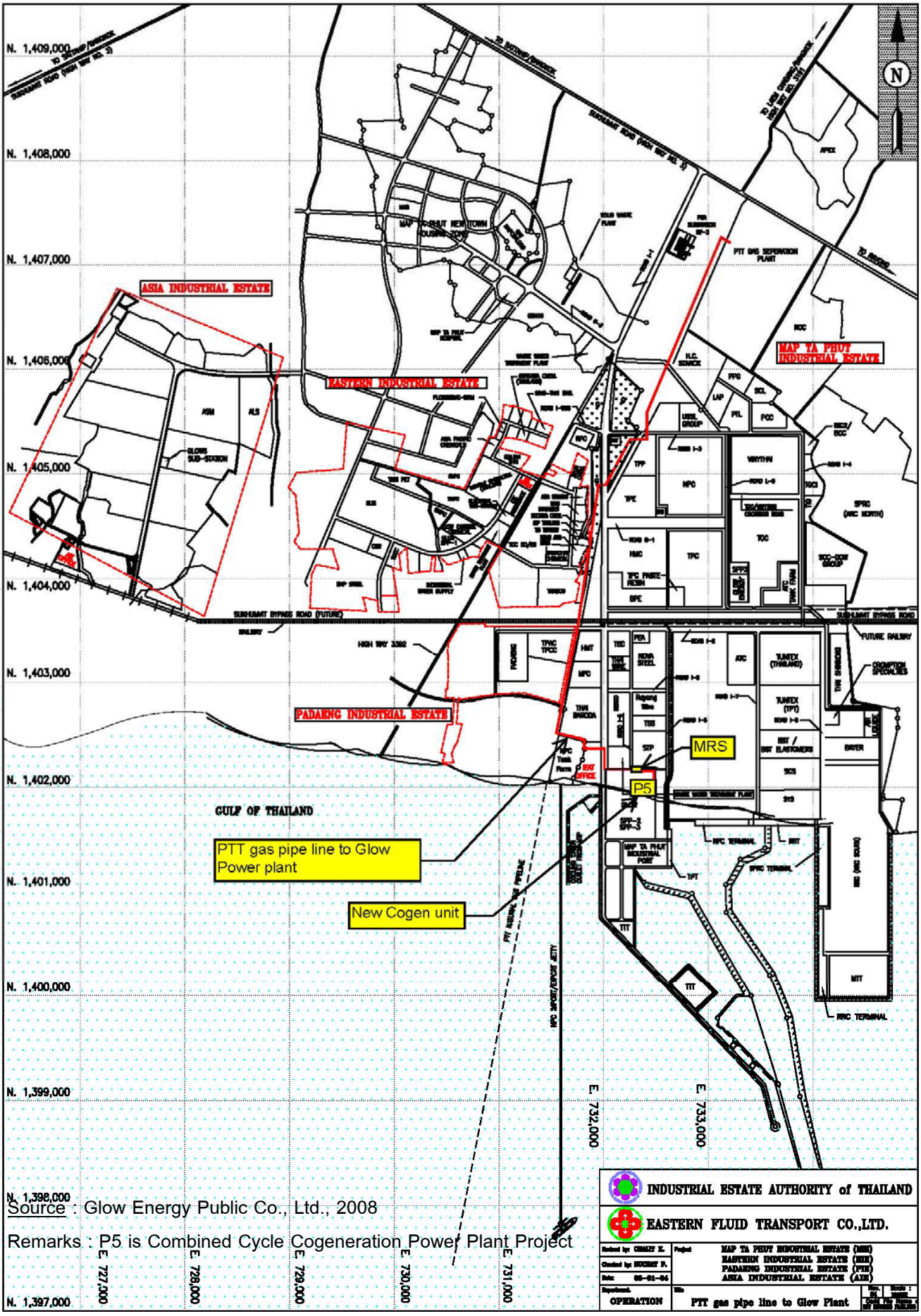
The project's production process is a combined cycle system (cogeneration type), comprising 2 generating units called there are 2 generators which are combustion gas turbine generator (CTG) and steam turbine generator (STG) generating electricity for this project (Project equipment is summarized in Table 2.6.2-1). The production process and the heat balance of this project are showed / proceeded in 2 casesi.e. (1) with steam supplied to outside, and (2) without steam supplied to outside (Figure 2.6.1-1 and Figure 2.6.1-2) with the following details.

(1) Combustion gas turbine generator; CTG

Combustion gas turbine generator (use natural gas as fuel) can generate 256 MW of electricity. The temperature in the combustion room is controlled to reduce oxides of nitrogen (NO_x). The process starts while the exhausted gas from the combustion flowing through the gas turbine then generates electricity. After that, the heat in the exhausted gas will be recovered to produce steam at the heat recovery steam generators (HRSG).

(2) Heat recovery steam generator: HRSG

Exhausted gas from CTG will flow into HRSG to exchange heat energy with the demineralized water to become steam. The produced steam is used for electricity production via STG, and the electricity is distributed to clients. After heat transfer process, the hot gas shall be vented through the stack.



Source : Glow Energy Public Co., Ltd., 2008

Remarks : P5 is Combined Cycle Cogeneration Power Plant Project

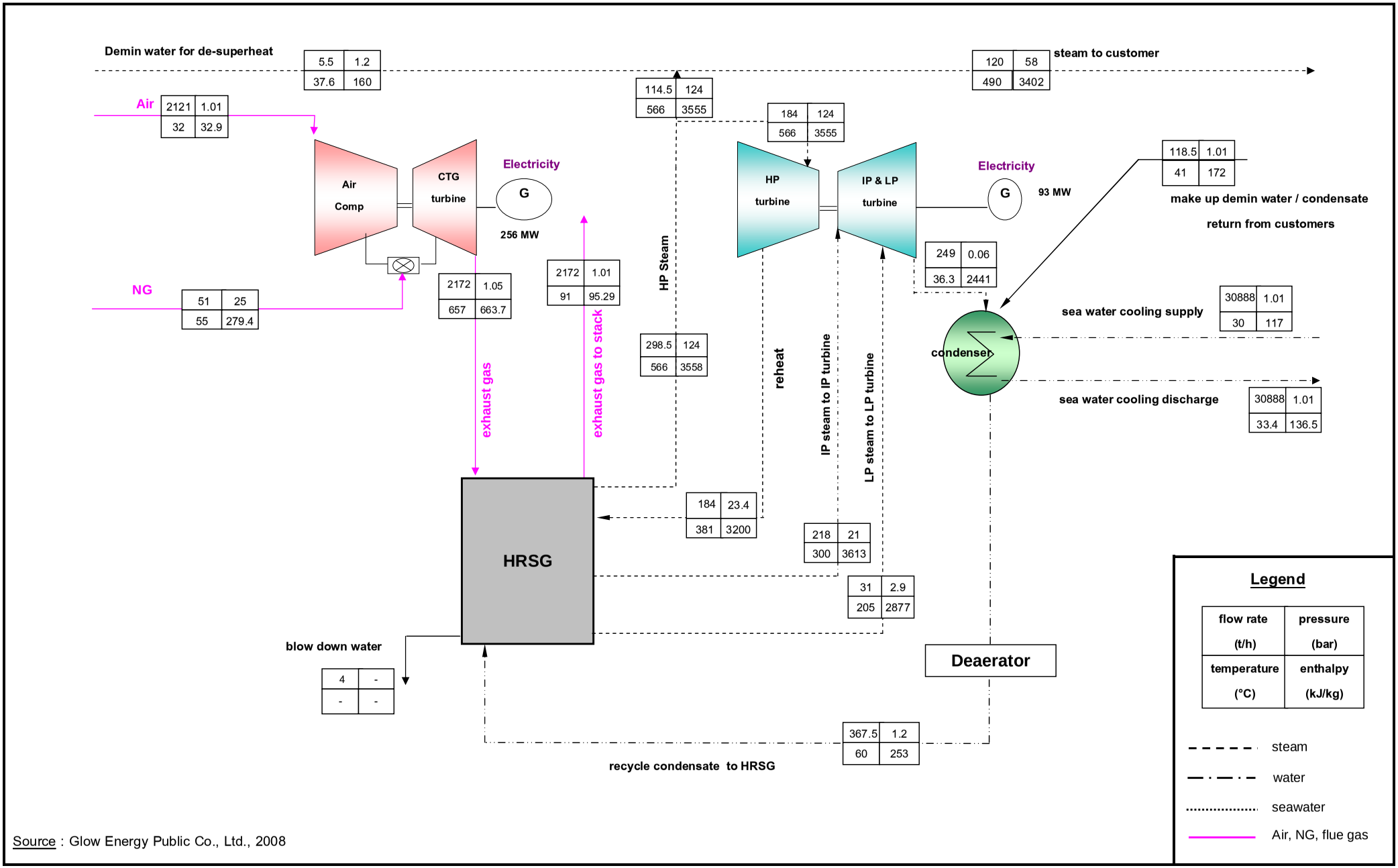
FIGURE 2.5-1 TRANSPORT NETWORK FOR NATURAL GAS TO THE PROJECT 5037A/EIA/F251_F-class

TABLE 2.6.2-1

EQUIPMENT/MACHINE OF THE PROJECT

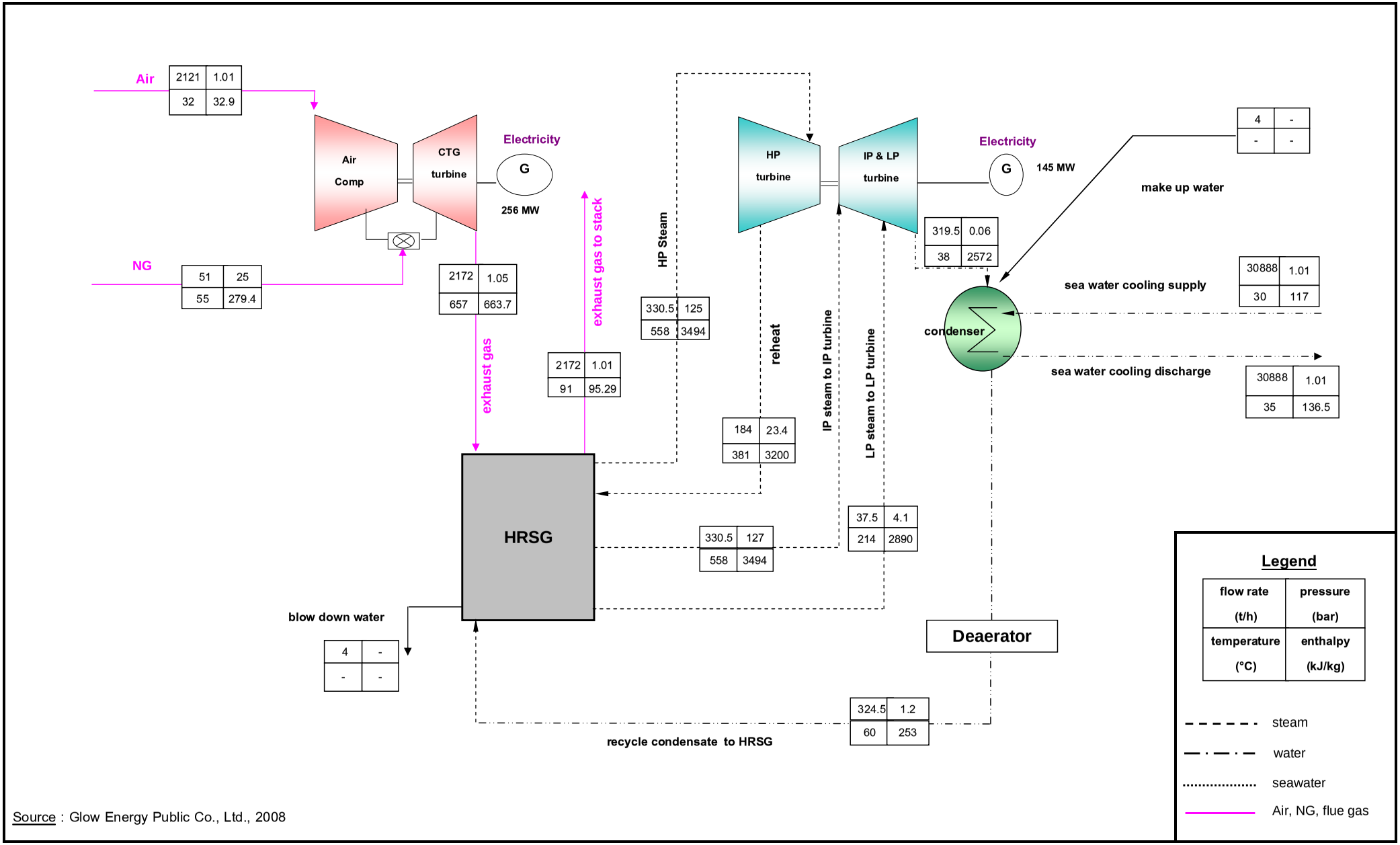
EQUIPMENT/MACHINE	UNIT	QUANTITY
1. Combustion gas turbine generator		
Number	set	1
Fuel type	-	natural gas
NO_x suppression	-	dry low NOx burner
Voltage	kV	17
Gross power output	MW	256
2. Steam turbine generator		
Number	set	1
Shaft speed	rpm	3000
Voltage	kV	11.5
Gross power output	MW	145
3. Heat recovery steam generator	set	1
3.1 HP steam		
Steam output flow	t/h	330.5
Steam output temperature	^{o}C	566.0
Steam output pressure	bar	124
3.2 IP steam		
Steam output flow	t/h	282.2
Steam output temperature	^{o}C	566.0
Steam output pressure	bar	27.6
3.3 LP steam		
Steam output flow	t/h	45.7
Steam output temperature	^{o}C	292.0
Steam output pressure	bar	3.4

Source : Glow Energy Public Co., Ltd., 2008



Source : Glow Energy Public Co., Ltd., 2008

FIGURE 2.6.1-1 MASS BALANCE FOR NORMAL OPERATION (WITH STEAM SELLING)



Source : Glow Energy Public Co., Ltd., 2008

FIGURE 2.6.1-2 MASS BALANCE FOR THE CASE WITHOUT STEAM SELLING

(3) Steam turbine generator; STG

Steam from HRSG will flow to steam turbine generator (STG), which could generate 145 MW. of electricity in case no steam supplied to outside, and 125 MW. in case with steam supplied to outside. The steam from the STG will then flow through condenser, where it is condensed from vapor phase to liquid phase, as condensate. The condensate will be re-circulated to the HRSG and reheated back to steam afterward.

2.7 UTILITY AND SUPPORTING SYSTEM

2.7.1 Water Use System

(1) Construction period

During construction period, the maximum number of employees is expected to be around 300 people. Water consumption rate is 55 liters/person-day or 16.5 m^3/day and water required for construction is 10 m^3/day. Consequently, total amount of water used during construction is 26.5 m^3/day. Source of water is from Glow SPP3 CO., LTD. the water treatment plant, Drinking water for employees is from bottle drinking water which contractors will provide for themselves sufficiently.

(2) Operation period

Water use of the project is divided into 3 parts, namely water for domestic use, steam process and cooling system. Details of water consumption are showed/given in Figure 2.7.1-1 and Table 2.7.1-1.

2.7.2 Cooling System

Cooling system function is mainly to control temperature mostly in the condensing system. The project utilizes sea water as cooling water, by taking into consideration the following criteria:

(1) The project location is geographically advantageous because it is located near the sea and therefore it has potential to utilize the sea water.

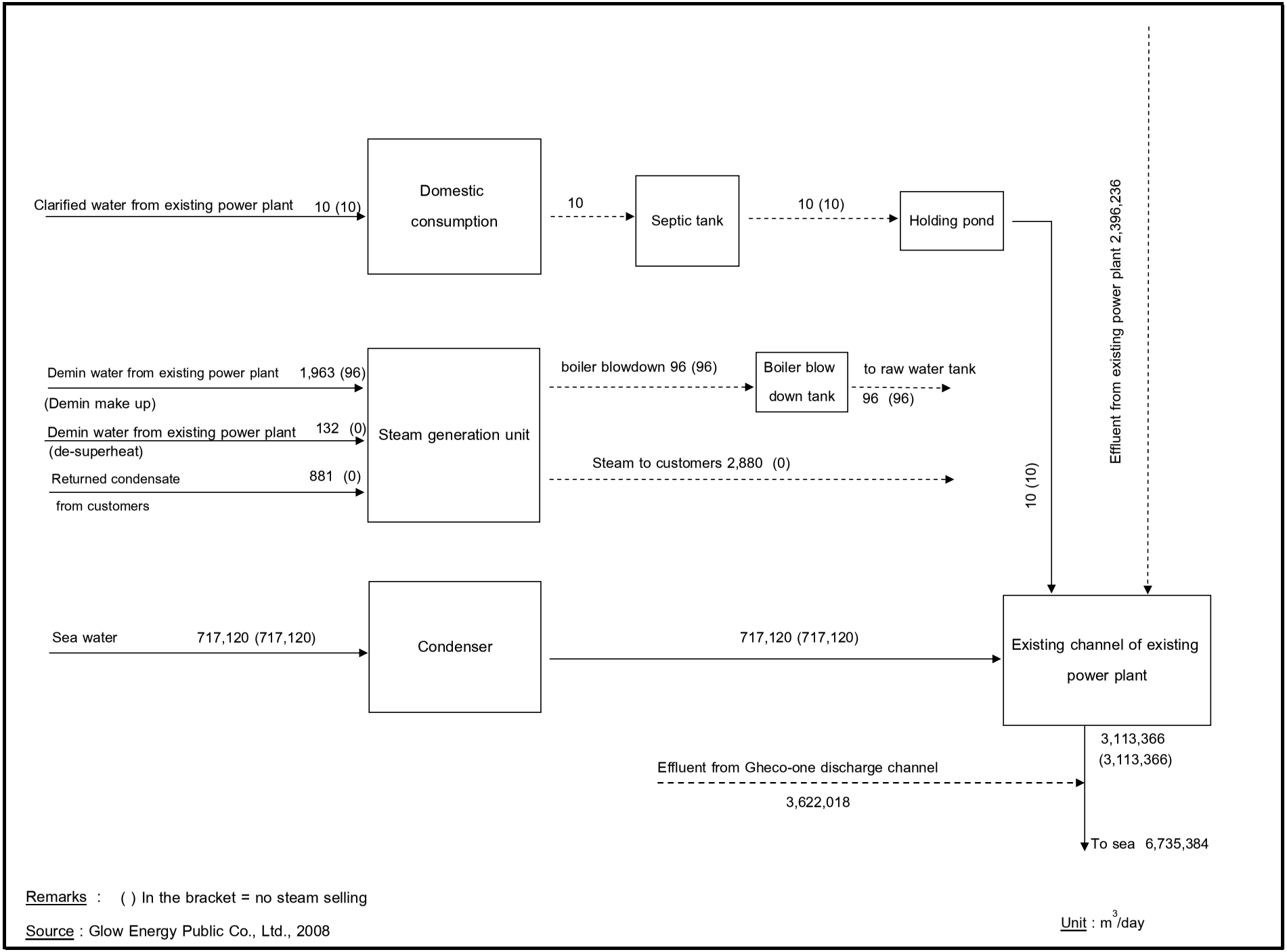


FIGURE 2.7.1-1 WATER BALANCE

TABLE 2.7.1-1

WATER CONSUMPTION

ACTIVITY	QUANTITY (m^3/DAY)					
	WITH STEAM SELLING (NORMAL OPERATION)			WITHOUT STEAM SELLING		
	CLARIFIED WATER	DEMINERALIZED WATER	SEAWATER	CLARIFIED WATER	DEMINERALIZED WATER	SEAWATER
1. DOMESTIC USE	10	-	-	10	-	-
2. PROCESS CONSUMPTION						
- HRSG water make up	-	1,963	-	-	96	-
- de-superheat	-	132	-	-	-	-
3. CONDENSER	-	-	717,120	-	-	717,120
Total	**10**	**2,095**	**717,120**	**10**	**96**	**717,120**

Source : Glow Energy Public Co., Ltd., 2008

(2) It lessens the impact on use of fresh water of the whole Eastern sea region.

(3) In comparison with other systems i.e. wet cooling tower and dry cooling with air-cooled condenser, it is found that the once-through cooling system with seawater acquires highest efficiency.

(4) The project has applied this type of cooling system to be working at the highest efficiency in order to minimize the use of seawater. Thus, the seawater of about 10 cubic meter / second is required.

2.7.3 Water Drainage and Flood Protection System

(1) Construction period

The project is located on the future open ground planned area of Glow SPP3. area Installation Construction of water drainage system has been done before commencing the project construction. Therefore, during the project construction, rainwater shall be drained through the existing drainage system.

(2) Operation period

Drainage system of the project separates its storm water from wastewater Besides,The storm water drainage system is also divided into 2 sections, contaminated and non-contaminated ones. Details are as the following:

- Non-contaminated storm water includes the rain falling on the roofs of the buildings. It is collected and trained into the project drainage channel prior to be discharged, into the existing drainage system of the Glow SPP3 CO., LTD.

- Contaminated storm water is the rain off falling on the electricity transformer housing unit which occupies an area of 380 sq.m. For the first 30 mm., which is about 11.4 cu.m. (enough volume to wash out the contaminated) of its amount substance (oil & grease in particulate) then it will be drained to the rainwater holding pond/pit whose capacity is not less than 12 cu.m.. If the analysed was found to be contaminated with oil, it has to be discharged into a water oil separator with a size of not less than 3 cu.m.

2.8 POLLUTION AND CONTROL

2.8.1 Air Pollution

- Sources and rates of air pollution emissions from the project are illustrated in Table 2.8.1-1. The source of air pollution is from CTG & HRSG only. Air pollution is created by combustion of natural gas in CTG. Thereafter, the exhausted gas shall be used for producing steam at HRSG prior to further emitted through stack.

- The main pollution caused by natural gas combustion is NO_x (referred to the Compilation of Air Pollution Emission Factor, AP-42 10^{th} Edition, Volume 1: Stationary Point and Area Source).

- Taking into account the impacts on air quality of Map Ta Phut Area, the project applies dry low NO_x burner for CTG as a proper technology at present time. It is efficient to decrease NO_x by 70-85 percent. This technology is used for decreasing thermal NO_x by designing the burner to have proper combustion to lessen the peak flame temperature. This regarding clean technology is considered a propro one, because no chemical is used for decreasing NO_x. The project can control NO_x emission not to exceed 55 ppm or 45.8 percent of the controlled standard value (30.09 g/s).

- In addition the existing Glow SPP3 shall improve its pollution control devices to lessen NO_x emission prior to commencing operation of the new power plant project. The new project shall have NO_x emission of not exceeding 80 percent of the reduced emission load of the existing ones. Therefore, the operation of this project shall not increase the entire pollution emission loads (oxides of nitrogen and sulfur dioxide) of the Map Ta Phut area.

- At present, Glow SPP3 has submitted the Environmental Impact Assessment repost to ONEPP, for reducing pollution emission load from the

TABLE 2.8.1-1

CONCENTRATION AND LOADING OF AIR POLLUTION

STACK	FUEL TYPE	STACK CHARACTERISTIC		EXHAUST GAS				CONCENTRATION[1/]	LOADING
		HEIGHT (m)	DIAMETER (m)	TEMP.[2/] (K)	VELOCITY[2/] (m/s)	$\%O_2$[2/]	FLOW RATE[1/] (Nm^3/s)	NO_x (ppm)	NO_x (g/s)
CTG-HRSG	NG (17.5 kg/s)	60	6.4	364	26.00	15.00	270.00	55	27.92
STANDARD[3/]								**120**	

Remarks [1/]At 1 atm, 760 mm.Hg, 25 ^{0}C dry condition and 7% O_2

[2/]At actual condition

[3/]Standard from Ministry of Industrail Works : concentration of exhausted gas from power plant, 2004

Source : Glow Energy Public Co., Ltd., 2008

existing power plant in order to take 80% of the margin for (1) the power plant project of 700 MW, which will be constructed in the future, and (2) for this project.

- Reductions of pollution emissions of the existing power plant of Glow SPP3 Co., Ltd. are detailed as follows:

(1) The existing actual emissions of NO_x and SO_2 are 310.53 and 343.87 g/s, respectively.

(2) The existing power plant has managed to lessen the emissions of NO_x and SO_2 , from the 3 CFB units , up to 130.91 and 122.66 g/s, respectively.

(3) The power plant project of 700 megawatts to be developed in the future will emit NO_x and SO_2 up to 74.07 and 97.53 g/s, respectively.

(4) This project emits NO_x of 30.09 g/s.

(5) Both power plant projects to be developed in the future planned area of the existing power plant emit NO_x and SO_2 of 104.16 and 97.53 g/s, respectively, accounting for 79.57 and 79.51 percent of the reduced pollution emission loads from the existing power plant's (as showed in Table 2.8.1-1). Therefore, this is consistent with the Declaration of the National Environment Board (NEB) that allows the new projects to emit air pollution of not exceeding 80 percent of the reduced load.

- The emission rates of NO_x and SO_2 of the existing power plant plus the two projects after developed in the future equals to 283.78 and 318.74 g/s, respectively, which are less than the actual emission rate of the existing power plant by 26.75 and 25.13 g/s, respectively.

- The project installs CEMs for NO_x and SO_2 at its stack.

2.8.2 Wastewater Management

Wastewater produced during the operation period can be separated into 2 main sources: domestic wastewater and wastewater from process supporting system. Wastewater generation rates and management system are as showed in Table 2.8.2-1 with details as the following:

- Domestic wastewater, including wastewater from office building and canteen, will be initially treated with septic tank before being discharged into holding pond subsequently.

- Wastewater from process supporting systems includes blow down water from HRSG and cooling towers. The former will be reduced its temperature in boiler blow down tank prior to discharging into raw water tank of the existing Glow SPP3, while the later will be discharged to the discharging canal and mixed with the seawater.

2.8.3 Solid Waste Management

Glow Energy Public Co., Ltd. has adopted the policy of pollution reduction at sources as the main guideline in management of solid waste generated from the project. It includes an application introduction of technology that minimizes waste generation by using reuse/recycle approach, the selection of high grade fuel, improvement and selection of efficient equipment /machinery, arrangement of preventive maintenance plan on machinery to protect the unexpected breaking off in the operation system, etc. The guideline aims to have the least quantity of waste left, and if there are wastes still, the project will seek method to bring those wastes for reuse at its most benefit (to leave the least quantity for treatment). This is the principal of cleaner technology, CT. Type, amount and management of the project solid wastes can be summarized in Table 2.8.3-1.

TABLE 2.8.2.1

WASTEWATER QUANTITY AND TREATMENT

SOURCE	QUANTITY (M^3/DAY)		TREATMENT
	FRESH WATER	SEAWATER	
1 **Domestic wastewater**	10	-	- septic tank (aeration type) and discharge to holding pond
2 **Process wastewater** (boiler blow down water)	96	-	- Discharge to boiler blow down tank to reduce temperature and then send to raw water tank of existing power plant
3 **Cooling system**	-	717,120	- Control seawater consumption, temperature at condenser outlet not to increase by 5°C, chlorine concentration not to exceed 0.1 mg/l
TOTAL	**106**	**717,120**	

Source : Glow Energy Public Co., Ltd., 2008

TABLE 2.8.3-1

SOLID WASTE MANAGEMENT

TYPE	WASTE CODE	WASTE TYPE	QUANTITY ton/year	MANAGEMENT
1 Solid waste from processes				
- Metal scraps	170405	-	1	- Stored in a covered building prior to being transported out for recycling by a contractor
- Air filter of CTG	150203	-	0.5	- Stored in a covered building prior to being transported out for disposal by a DIW licensed agency
- Waste oil from oil separator	130899	HA	0.2	- Stored in 200-liter containers prior to transported out by firms authorized by government agency for further eradication.
- Expired lube oil	130899	HA	0.5	- Kept it in existing modules all the time prior to transported out by firms authorized by DIWStored in 200-liter containers prior to transported out by firms authorized by DIW for further eradication or fuel blending in cement factories.
2 Domestic solid waste				
- decomposable waste	-	-	3.5	- Collect in garbage bins placed at various locations, and transported out for disposal by licensed disposal agencies.
- Recyclable waste	-	-	2.0	- Collect in recyclable-waste garbage bins placed at various locations, and sort out in different types, prior to contact buyers to remove for reuse/recycling.
- Hazardous waste	-	-	0.3	- Collect in garbage bins placed at various locations, and transported out for disposal by firms authorized by DIW.

Remark : Notification of Ministry of Industry B.E. 2548 (2005) : Disposal of waste and unusable material

HM = Hazardous waste-minor entry

HA = Hazardous waste-absolute entry

Source : Gheco-One Co., Ltd., 2008

2.8.4 Noise Management

(1) Construction period

- Avoid any construction activities which generate loud noise between 07.00 pm - 07.00 am.
- Provide noise protective equipments such as ear plugs or ear muffs to construction workers working in the area with loud noise.
- Inspect and maintain hand tools, machinery and construction equipment to be in good condition all times.

(2) Operation period

- For the area where noise level is higher than 85 dB(A), it should be specified as the area of loud noise.
- Provide warning sign to wear noise prevention devices in noisy area.
- Provide personal noise protection equipment, i.e. ear plugs or ear muffs, to adequate number for the employees.
- Provide preventive maintenance program on the machines according to the machine's manual.
- Have officers work in the control room with air conditioning system to avoid direct contact to noise.

2.9 MANPOWER

For the 32 months of construction period, there will be the maximum of 300 workers (only for the short-peak period). All the workers will reside outside the project area. For the operation period, there will be 20 staff working for the project's production in 3 shifts (8 hours per shift).

2.10 OCCUPATIONAL HEALTH AND SAFETY

(1) Construction period

The construction contractors are responsible for implementing these measures.

(1.1) Safety in working area

- Set up apparent construction boundary and mark with signs, and put in order the equipment and tools.

- Install safety warning signs such as “construction area”, “do not switch on”, “wear helmet in this area”, etc. The warning signs must be clearly visible.
- Apply the work permit procedures for any risky works such as confine space, heat work, etc.
- Apply housekeeping for the working area.
- Provide safety officers to be responsible for safety inspection in the construction area.
- Record keeping of accidents statistic, type of accidents, location of accident, degree of seriousness, cause and solutions. Any injuries or death occurred must be informed to the project immediately.

(1.2) Personal safety

- Specify in the contract document that the contractor defines equipment definitions and procedures to be conducted as safety measures.
- Provide and enforce the use of personal protective equipments to be suitable with work types.
- Issue safety regulations for construction works
- Organize orientation to new workers on proper equipment use and safety issue.
- Provide first aid unit and enough basic medicines for workers, as well as an ambulance for the emergency case.

(1.3) Safety on equipment and machine use

- Organize orientation to new workers on proper equipment use and safety issue.
- Take good care for equipment or machines that deal with fuels or electricity. The workers using them need to strictly follow the regulations.
- Inspection of such equipment and machines is needed every time before and after the use.

(1.4) Safety inspection

Safety officers are responsible for safety inspection in the construction area and enforce safety regulations. If unsafe condition is found, they shall report and give suggestions to the construction supervisor.

(2) Operation period

(2.1) General safety measures during operation period are as follows:

- Establish the safety policy to be performed by all employees.
- Establish a safety committee to stipulate policy and procedure for safety as well as report on results of performance to the top management. There shall be meeting at least once a month.
- Establish safety implementation plan to reduce risks of accident.
- Provide security guards for 24 hours with radios for communication between different points within the project area. In addition, the security officers shall be trained both theoretically and practically on fire accident prevention.
- For safety management, organize different safety activities to help achieve safety target.
- Provide appropriate and sufficient personal protective equipment, i.e. safety helmet, safety shoes, noise protective equipments.
- Provide training (in accordance with relevant type of work) on safety at work for new employees, and follow-up training periodically.
- Prepare a safety manual for the employees to understand and comply with the safety regulations.
- Regularly maintain and inspect equipments and machines as well as protective equipment to be in good condition.
- Provide employee's health check up once a year.
- Have the safety officers check for unsafe condition to improve immediately.
- Record keeping of accidents statistic, type of accidents, location of accident, degree of seriousness, causes and solutions.
- Organize health promoting activities, provide chemical safety data, and prepare notice board on health and safety issues.

(2.2) Emergency response plan

- Emergency plan is provided to control and recover the emergency situations that may occur to subside as soon as possible. The plan can be classified into 3 levels.

  - Level 1 – the situations that happen in the project area, and do not affect the areas nearby. They can be controlled by the project's emergency team.
  - Level 2 – the situations that happen in the project area and tend to enlarge to the level that may affect the employees and the areas nearby. They cannot be controlled by the project's

emergency team and need for support from the outside departments.

- Level 3 – the situations that happen in the project area and enlarge to the level that critically affect the employees and the areas nearby. They need for urgent support from outside departments including the provincial emergency plan.

- The project shall also install a well designed fire alarm systems and provide appropriate and sufficient fire extinguishers throughout the project area in order to prevent fire incident at most effectiveness. Fire protection systems in the project are illustrated in Table 2.10-1.

2.11 IMPLEMENTATION PLAN IN CASE OF COMMUNITY PETITION / APPEAL

The procedure to handle community petition and method to resolve (problem / conflict) involve all issues caused by the project activities. Whenever there is a petition from people (both inside and outside the project site), the project will concern those petitions and seek for solutions immediately. The communication between the project and the community and the operation for implementation plan will be processed systematically. The procedure of petition from inside and outside will be defined, together with identification of authorized organization and officer to receive the petition. There shall also be a petition center at the project site office. Petition can be received via telephone, memo, and self-complain. Figure 2.11-1 illustrated the procedure of community petition.

The Project shall establish an information center and public relations team in order to help support the communities in various ways, for example, opinion sharing and information dissemination. The project will support in any activities such as environment, sanitation or education. This will lead to a good quality of life and attitude to the project. These plans, however, can be applied and revised depending on actual situation.

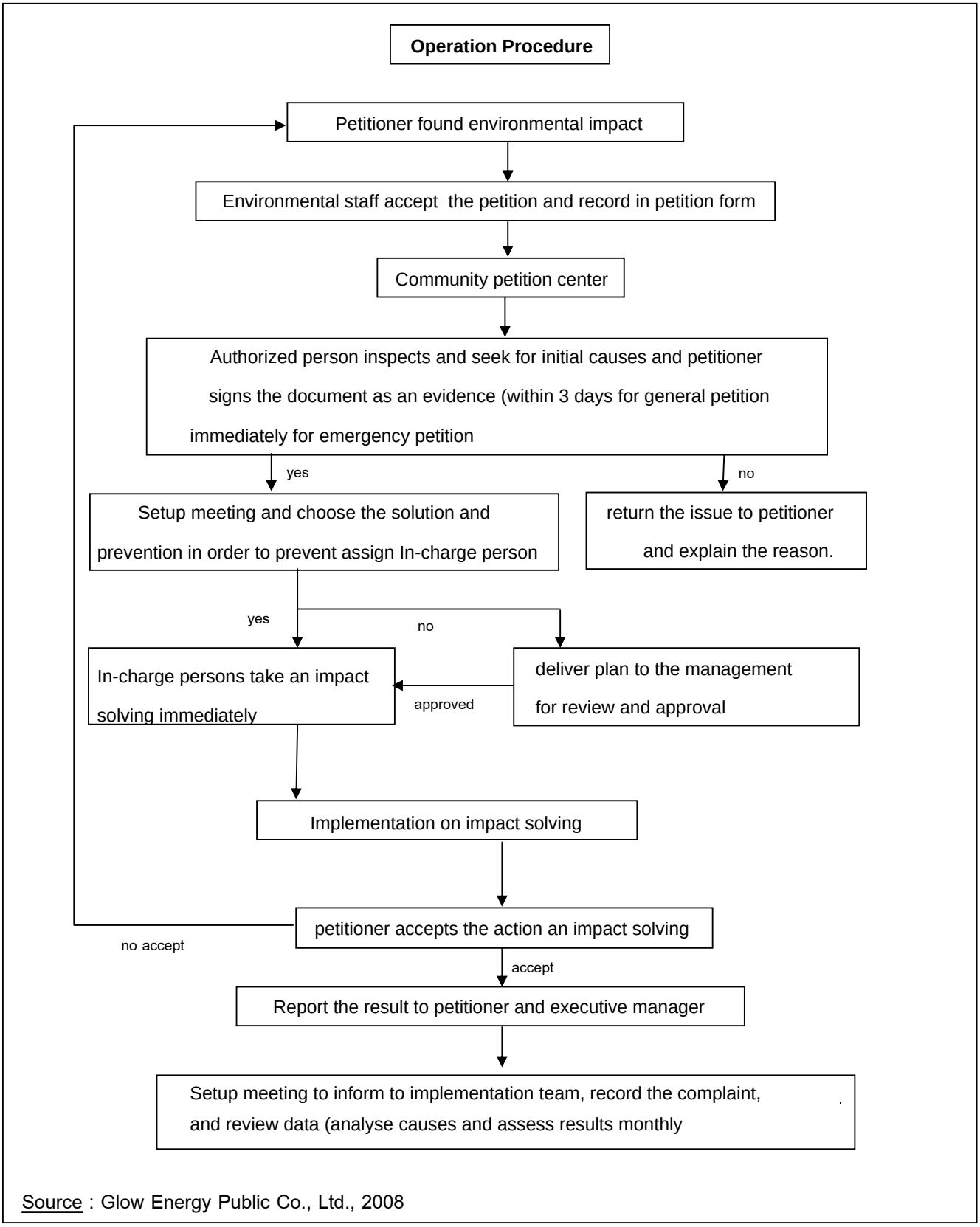
TABLE 2.10-1

FIRE EQUIPMENT

TYPE	LOCATION	QUANTITY (SETS)
(1) Fire alarm system		
1.1 fire detector	- Process area	8
1.2 fire alarm	- Process area	8
1.3 heat detector	- workshop, control room & process area	8
1.4 gas detector	- process area & MRS	2
(2) Fire extinguishing system		
2.1 water spray (deludge sprinkler)	- transformer	4
2.2 sprinkler system	- Process area	8
2.3 fire hydrant & hose cabinet	- Plant boundary	2
2.4 fire hose reel	- Process area	4
2.5 fire extinguisher	- Process area	4
2.6 foam mobile unit	- turbine hell	1
2.7 CO_2 system (automatic)	- Process area	4

Remark : Detailed design of fire equipment refers to NFPA standard

Source : Glow Energy Public Co., Ltd., 2008



Source : Glow Energy Public Co., Ltd., 2008

FIGURE 2.11-1 ACTION PLAN FOR COMMUNITY PETITION ON ENVIRONMENTAL IMPACT

2.12 GREEN AREA

The project will share its green area with the existing Glow SPP3 power plants'. The Glow SPP3 has provided 9.1 rais for the green area from its total area of 180 rais. The ratio of green area to the total area is approximately 5.1 percent.

CHAPTER 3
EXISTING ENVIRONMENT

3.1 PHYSICAL RESOURCES

3.1.1 Topography and Geology

The study area is mainly coastal plain with the height of around 3 meters above the mean sea level and slope of 0-3%. Geological characteristic is accumulated sediments in high and low step area such as laterite, gravel, sand, silt and clay.

There are 9 soil series found in the project area. Particularly area around the project site is of Rayong series. The general soil property is good drainage with low mineral contained.

3.1.2 Climate and Meteorology

Data from Sattahip Meteorological Monitoring Station have been collected by the consultant with the following details:

- Annual average temperature is 27.9° C
- Annual average barometric pressure is 1,009.42 Hecto Pascal
- Annual average relative humidity is 76%
- Range of wind speed is 3.6-6.0 knots
- Annual average rainfall is 1,286 mm
- Average cloud value is 4.9 - 8.7 parts by 10 parts.
- Abnormal condition, thunderstorm is found 69 days in a year.

3.1.3 Air Quality

Information was collected from 4 sources namely Map Ta Phut Industrial Estate monitoring stations, including Ban Nong Fab, Estate office, Wat Map Chalood, Ban Map Ta Phut and Wat So Phon Wanaram during 2004-2006; Glow SPP3 Co., Ltd. monitoring stations; Map Ta Phut Health Center and Wat Map Chalood during 2004-2006; and from the Pollution Control Department (PCD) monitoring stations, including Mab Ta Phut Health Center and Rayong Cropping

Pilot Center (monitoring stations are depicted in Figure 3.1.3-1). The results are shown in Table 3.1.3-1.

3.1.4 Noise Level

The consultant had collected monitoring data from Map Ta Phut Industrial Estate during 2004-2006 at 4 stations, namely Wat Nong Fab, Wat Ta Kwuan, Youth Center and Wat Mab Chalood, as well as from Glow SPP3 monitoring station at Wat Nong Fab (an monitoring stations are referred to Figure 3.1.3-1). The results are shown in Table 3.1.4-1.

3.1.5 Hydrology and Surface Water Quality

(1) Hydrology

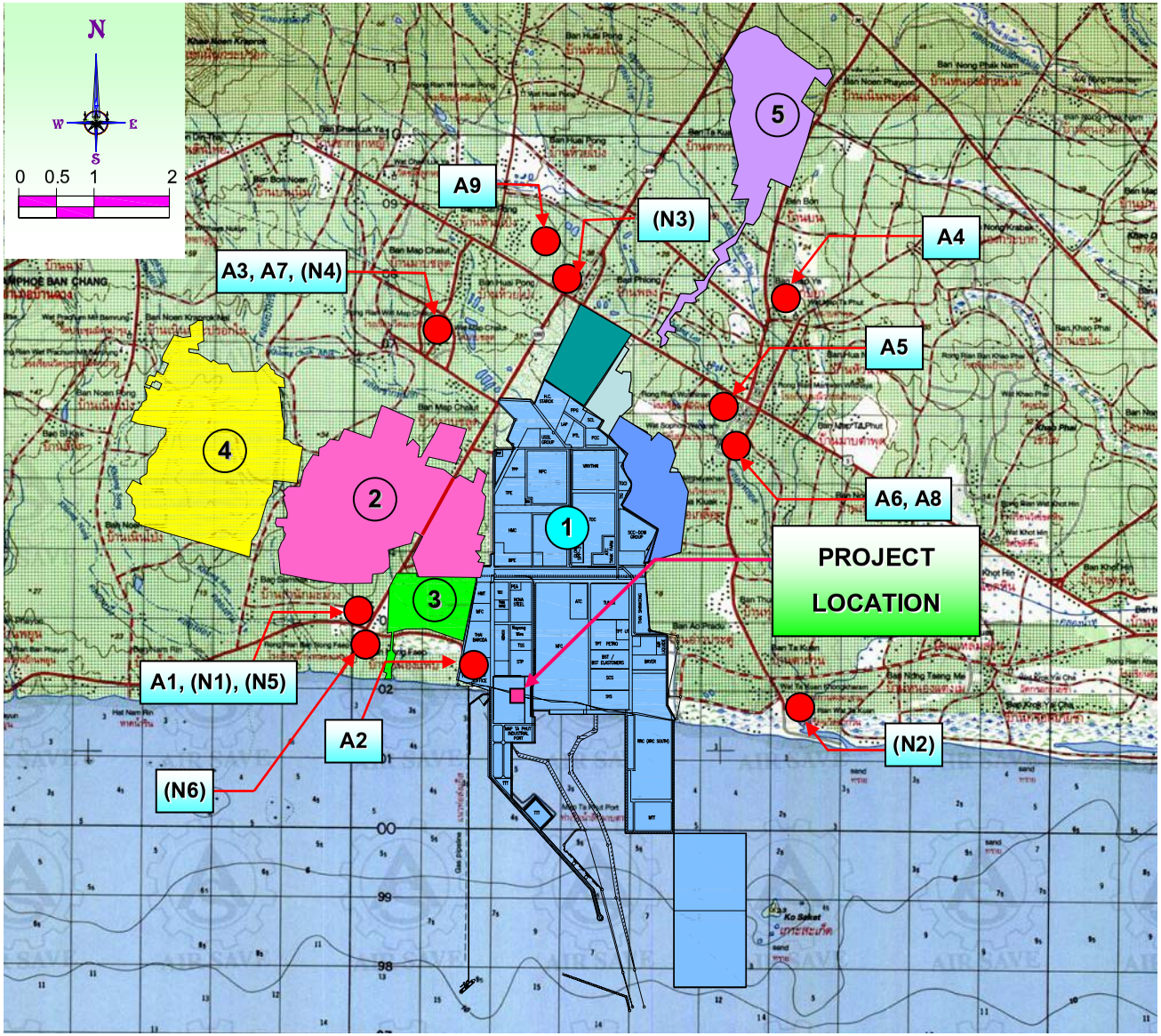
Surface water sources in the study area can be classified into 2 sources including coastal sea water and fresh water. The coast al seawater source is in-land bay, while the fresh water sources are in canals found in Rayong basin area namely Khlong Nam Cha, Khlong Yay Cha, and Khlong Lod. Most of them are normally less than 4 meters wide, 0.6 meter deep. In addition, there are some concrete canals which catch drainage water from factories. At presents, almost none of this water is consumed due to the canal characteristic and inconsistent flow of water in these watercourses.

(2) Surface fresh water quality

The consultant has collected surface fresh water quality data from the monitoring results of Map Ta Phut Industrial Estate during 2004-2006 for 4 stations (Figure 3.1.5-1). The results are shown in Table 3.1.5-1.

(3) Seawater quality

The consultant had collected seawater samples from the monitoring stations in Map Ta Phut Industrial Estate and Glow SPP3 Co., Ltd. during 2004-2006 at 12 stations (refered to Figure 3.1.5-1). The seawater quality data are give in Table 3.1.5-2 and 3.1.5-3.



Legend

1. Mab Ta Phut Industrial Estate
2. Hemaraj Eastern Industrial Estate (Mab Ta Phut)
3. Pa Dang Industrial Estate
4. Asia Industrial Estate
5. R.I.L Industrial Estate

A : AIR QUALITY MONITORING STATIONS

A1 : Ban Nong Fab
A2 : MIE office
A3 : Wat Mab Chalood
A4 : Ban Mab Ta Phut
A5 : Wat So Pon Wanaram
A6 : Mab Ta Phut health center
A7 : Wat Mab Chalood
A8 : Mab Ta Phut health center
A9 : Rayong crop center

N : Noise quality sampling stations

N1,N5 : Wat Nong Fab
N2 : Wat Ta Kwuan
N3 : Youth center
N4 : Wat Mab Chalood

Source : Air Save Co., Ltd., 2007

FIGURE 3.1.3-1 AIR QUALITY MONITORING STATIONS

TABLE 3.1.3-1

AIR QUALITY MONITORING RESULTS FOR 2004-2006

MONITORING STATIONS	CONCENTRATION ($\mu g/m^3$)			
	TSP	SO_2		NO_2
	(24-hr average)	(1-hr average)	(24-hr average)	(1-hr average)
BAN NONG FAB (A1)[1/]	14-187	-	<1-187	0-170
ESTATE OFFICE (A2)[1/]	13-60	-	<1-33	0-158
WAT MAB CHALOOD (A3)[1/]	10-134	-	<1-5	0-170
BAN MAB TA PHUT (A4)[1/]	3-65	-	<1-3	1-110
WAT SO PHON WANARAM (A5)[1/]	10-72	-	<1-4	1-92
MAB TA PHUT HEALTH CENTER (A6)[2/]	29-127	0-221	2-67	1-75
WAT MAB CHALOOD (A7)[2/]	20-100	0-75	1-21	0-69
MAB TA PHUT HEALTH CENTER (A8)[3/]	-	5.8-32.5	-	9.8-36.9
RAYONG CROP CENTER (A9)[3/]	-	2.3-16.2	-	6.6-33.7
STANDARD	**330**[6/]	**780**[5/]	**300**[6/]	**320**[4/]

Remarks :

[4/] Standard from National Environmental Board Announcement Vol.10 (1995); standard for ambient air quality

[5/] Standard from National Environmental Board Announcement Vol.21 (2001); standard for 1 hour average of sulfer dioxide in ambient air

[6/] Standard from National Environmental Board Announcement Vol.24 (2004); standard for ambient air quality

Source : [1/] Map Ta Phut Industrial Estate Monitoring Report, 2004-2006

[2/] Glow SPP2 and Glow SPP3 Co., Ltd. Monitoring Report, 2004-2006

[3/] Pollution Control Department (PCD) Air Quality Monitoring Report, 2004-2006

TABLE 3.1.4-1

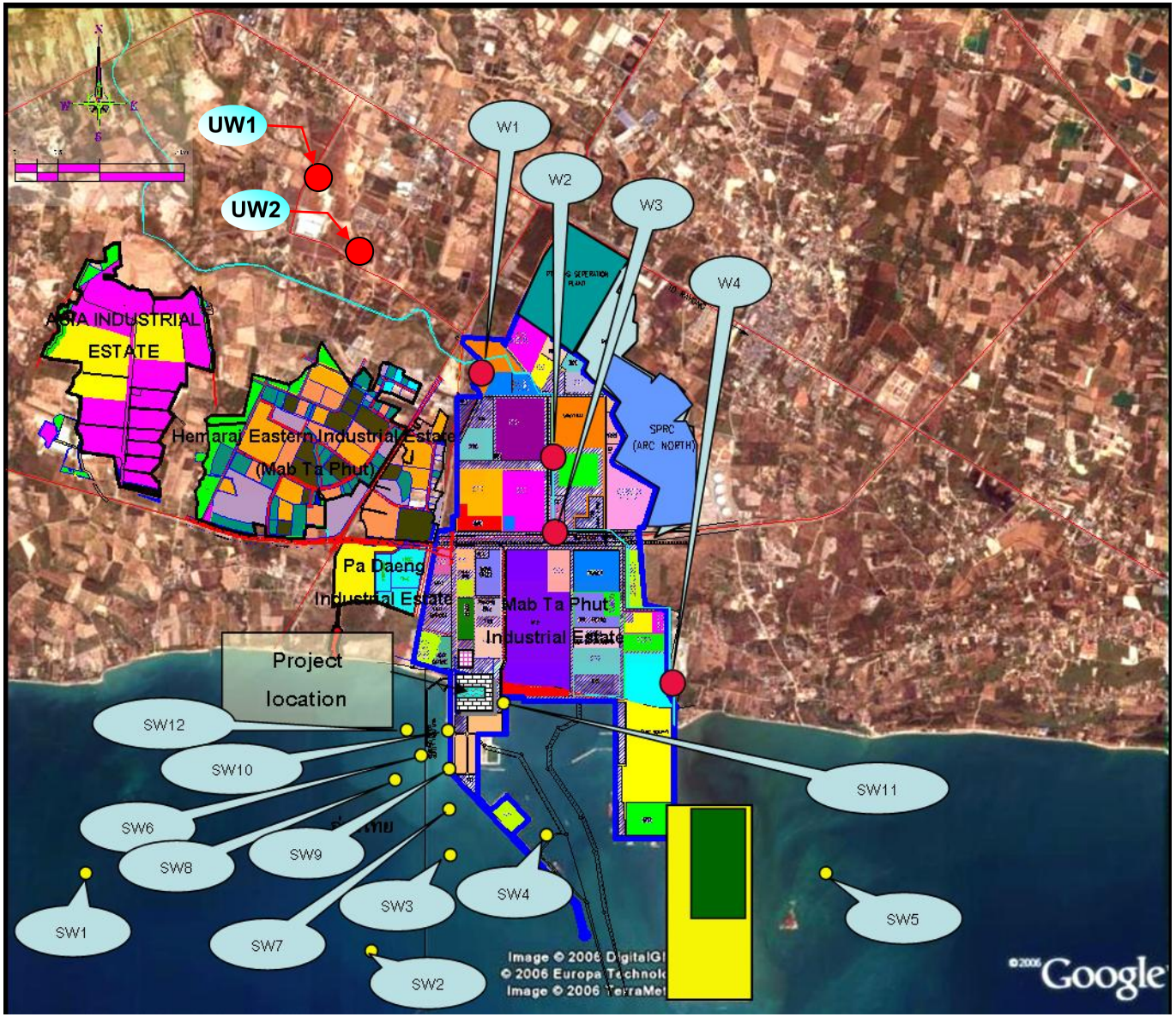
NOISE LEVEL RESULTS (Leq-24 HOURS and L_{90}) FOR 2004-2006

STATIONS	SAMPLING YEAR	Leq-24 hr dB (A)	L_{90} dB (A)
Wat Nong Fab (N1)[1/]	2004	54-63	-
	2005	56-65	-
	2006	61-66	-
Wat Nong Fab (N5)[2/]	2004	52-65	-
	2005	55-69	44-58
	2006	52-69	46-59
Wat Ta Kwuan (N2)[1/]	2004	55-61	-
	2005	52-66	-
	2006	51-62	-
Youth center (N3)[1/]	2004	53-61	-
	2005	55-59	-
	2006	53-58	-
Wat Mab Chalood (N4)[1/]	2004	56-70	-
	2005	60-65	-
	2006	54-59	-
STANDARD[3/]		**≤ 70**	

Remark : [3/] Stanadard from National Environmen Board Vol.15 (1997);
Standard of general noise level

Source : [1/] Mab Ta Phut Industrail Estate Monitoring Report, 2004-2006

[2/] Glow SPP2 and Glow SPP3 Co., Ltd. Monitoring Report, 2004-2006



LEGEND

W : SURFACE WATER MONITORING STATIONS

W1: Chak Mak canal before entering the estate

W2: Chak Mak canal after passing PTTCHEM

W3: Chak Mak canal after passing TPC

W4: Chak Mak canal before discharge to the sea

SW: SEAWATER MONITORING STATIONS

SW1-SW5: Mab Ta Phut Industrial Estate offshore

SW6 : South-West direction 500 m. from water gate

SW7 : South direction 1,000 m. from discharged point

SW8 : South-West direction 1,000 m. from discharged point.

SW9 : South direction 500 m. from water gate

SW10 : Glow Water gate

SW11 : Seawater intake

SW12 : West direction 500 m. from water gate

UW: UNDERGROUND WATER MONITORING STATIONS

UW1: Muang Mai community

UW2: Wat Mab Chalood

Source : Air Save Co., Ltd., 2007

FIGURE 3.1.5-1 SURFACE WATER AND SEAWATER MONITORING STATIONS

TABLE 3.1.5-1

SURFACE WATER QUALITY RESULTS FOR 2004-2006

INDICES	UNIT	STANDARD[1/]	SAMPLING STATIONS			
			W1	W2	W3	W4
pH	-	5.0-9.0	6.7-7.6	7.65-8.9	7.39-8.11	7.32-8.1
Temperature	°C	-	29.3-30.9	29.3-37.2	28.3-34.2	29.6-33.7
Turbidity	NTU	-	6-50	10-102	1-114	2-30
Salinity	ppt	-	0.03-0.15	3.01-6.75	1.19-26.7	4.89-24
DO	mg/l	> 2.0	4.1-8.0	6.0-9.0	1.7-10.7	3.7-8.3
BOD	mg/l	< 4.0	1-4	3-7	2-6	4-8
COD	mg/l	-	4-49	22-62	16-89	28-96
SS	mg/l	-	3-78	27-113	14-200	24-87
TS	mg/l	-	103-907	682-6,755	2,358-41,191	4,998-36,472
PO_4-P	mg/l	-	0-0.5	0.1-5.8	0.1-2.1	0.2-4.2
NH_3-N	mg/l	0.5	0-2	0.3-7.7	0.3-2.3	0-11.1
NO_3-N	mg/l	5	0.1-4.2	0.1-2.2	0-3.7	0-6.8
Oil & grease	mg/l	-	1-4	0-4	1-3	2-3
Hg	µg/l	2	<0.1	<0.1-0.4	<0.1-0.9	<0.1-0.7
Cd	µg/l	5	<3	<3	<3	<3
Pb	µg/l	50	<1-21	<1-64	<1-50	<1-59
Zn	µg/l	1,000	16-60	16-640	75-350	73-290
Fecal coliform bacteria	MPN/100 ml	-	30-22,000	30-79,000	130-33,000	49-24,000

Reamrk : [1/] Standard from National Environmental Board Announcement Vol.8 (1994); standard for surface water quality type 4

W1 : Chak Mak Canal before entering the estate.

W2 : Chak Mak canal after passing PTTCHEM.

W3 : Chak Mak Canal after passing TPC.

W4 : Chak Mak Canal before discharge to the sea

Source : Mab Ta Phut Industrial Estate Monitoring Report, 2004-2006

TABLE 3.1.5-2

SEAWATER QUALITY RESULTS FOR 2004-2006

INDICES	UNITS	SAMPLING STATIONS				
		SW1	SW2	SW3	SW4	SW5
pH	-	7.9-8.2	8.0-8.2	8.0-8.2	8.0-8.2	8.1-8.3
Temperature	°C	25.6-31.1	29.5-31.0	29.8-31.3	30.0-31.6	29.8-30.9
Transparency	m	2.0-8.5	3.4-8.8	2.2-4.0	1.5-5.5	1.5-3.2
Turbidity	NTU	0.4-1.0	0.7-1	0.8-1.3	1.4-5.8	3.0-5.5
Salinity	ppt	29.8-35.7	30.5-35.3	29.5-35.0	30.2-34.8	29.9-34.2
DO	mg/l	5.6-8.0	5.5-8.1	5.2-8.1	4.9-8.0	6.2-8.1
BOD_5	mg/l	<1-4	<1-2	<1-3	<1-3	<1-3
Suspended Solid	mg/l	1.1-31.3	0.7-30.3	4-39.8	6.8-36.8	5-21.2
Oil & grease	mg/l	0.6-1.3	0.6-1.1	0.7-1.2	0.6-1.7	0.7-1.6
Phosphate-Phosphorus	mg/l	<0.01-0.22	<0.01-0.41	<0.01-0.42	<0.01-0.29	<0.01-0.30
Ammonia-Nitrogen	mg/l	0.04-0.19	<0.01-1.02	<0.01-0.15	<0.01-0.13	0.04-0.13
Nitrate-Nitrogen	mg/l	0.03-14.61	0.11-14.59	0.04-14.60	0.25-13.97	0.24-14.11
Mercury (Hg)	µg/l	0.002-0.052	0.002-0.021	0.0001-0.026	0.0002-0.040	0.0003-0.097
Cadmium (Cd)	µg/l	<1	<1	<1	<1	<1
Lead (Pb)	µg/l	<1-96	<1-84	<1-69	<1-75	<1-72
Zinc (Zn)	µg/l	20-100	30-80	30-60	<20-60	<30-70
Phenol	µg/l	<10-90	<10-60	<10-60	<10-70	<10-70
Fecal coliform bacteria	MPN/100 ml	<1.8-70	<1.8-33	<1.8-130	<1.8-13	<1.8-11

Source : Mab Ta Phut Industrial Estate Monitoring Report, 2004-2006

TABLE 3.1.5-3

SEAWATER QUALITY RESULT FOR 2004-2006

INDICES	UNITS	SAMPLING STATIONS						
		SW6	SW7	SW8	SW9	SW10	SW11	SW12
pH	-	6.8-8.7	6.1-8.7	6.9-8.8	7.0-8.8	6.8-8.5	7.8-8.8	7.4-8.8
Temperature	°C	25.0-34.8	28.2-36.9	25.0-33.7	25.7-33.8	26.0-34.6	25.0-33.2	25.3-33.2
Transparency	m	0.4-5.9	0.5-5.4	0.3-3.5	0.5-4.8	0.3-3.5	0.3-5.5	0.8-5.5
Turbidity	NTU	0.5-12.9	0.3-15.2	0.9-93.4	0.4-45.6	1.7-44.2	0.7-44.5	0.7-25.0
Salinity	ppt	27.4-33.7	28.8-33.6	26.6-33.5	28.7-33.7	27.2-33.7	26.8-33.8	27.5-39.5
DO	mg/l	4.2-7.9	4.3-7.8	4.4-7.6	4.0-7.8	4.6-7.7	4.5-8.1	4.4-7.9
BOD	mg/l	1.0-3.5	1.0-1.4	1.0-2.7	1.0-2.0	1.0-1.8	1.0-1.7	1.0-1.6
SS	mg/l	2.5-15.3	3.2-14.5	1.2-39.2	1.2-27.3	2.8-48.3	2.4-14.0	N.D.-63.7
Hg	µg/l	N.D.-0.2	N.D.-0.2	N.D.-0.2	N.D.-0.16	N.D.-0.26	N.D.-0.13	N.D.-0.15
Pb	µg/l	N.D.-3	N.D.-4	N.D.-5	N.D.-6	N.D.-5	N.D.-9	N.D.-6

Source : Glow SPP 3 Co., Ltd. Monitoring Report, 2004-2006

3.1.6 Hydrology and Underground Water Quality

(1) Hydrology

Underground water ghydrology consists of colluvial aquifer layer and alluvial aquifer layer. Groundwater table for both layers are less than 50 meters with the supplying capacity less than 5 cu.m./hr. There is also beach sand aquifer layer with the water table of 3 meters and supplying capacity of 1-2 cu.m./hr. Water flow direction is from north to south. The usage of shallow well for domestic purpose is enough.

(2) Underground water quality

Analytical data monitored from IEAT collected by the consultant during 2004-2006 (2 stations : Muang Mai Community and Wat Mab Chalood - Figure 3.1.5-1) are expressed in terms of 5 essential parameters with different ranges of values including (5.8-7), COD (2-38 mg/l), TKN (0-5 mg/l), TDS (43-1,603 mg/l) and total hardness (16-73 mg/l).

3.2 BIOLOGICAL RESOURCES

3.2.1 Terrestrial Biological Resources

(1) Forest

(The type of forest is mostly dry-evergreen forest. It is non-shed leaves such as Takian Hin, Maka Mong.) There are 8 National Preservation Forests and 2 National Parks in Rayong Province.

(2) Wildlife

Rare and extinct wildlife species have not been found in Rayong, except at wildlife preservation zone/watershed and conservation research station. Only reptiles and birds have been found in the study area.

3.2.2 Marine Resources

General biological resources in the area of study is found that there is only a small waterway, which is currently of a very little usage due to the waterway condition is not very wide and deep together with the water flowing is not

consistent throughout the year. It is therefore not appropriate for living things. From the monitoring station there are 1,020-118,000 cells/liter of phytoplankton and 78- 2,112 cells/liter of zooplankton.

3.3 HUMAN USE VALUE

3.3.1 Land Use

The land use in the project area has been studied for totally 78 square kilometers. The study area consists of industrial area, residential area, agricultural area and others, such as diminished forest, vacant area as well as sea.

3.3.2 Transportation

Transportation network of the Eastern Seaboard area consists of roads, seaports, commercial airport and railways as shown in Figure 3.3.2-1.

(1) Road network

The main transportation network is road network. The most important route is Highway Number 3. The traffic volume during 2004-2006 were 35,301 - 43,910 cars/day.

(2) Map Ta Phut Industrial port

Map Ta Phut Industrial port is one of the national main industrial ports, which is surrounded by various industrial estates in the Eastern region. Most of the ports are constructed and operated by private companies such as RBT, NFC, ARC, Glow Group and MTT. During 2005, there were 7,682 shipments using these ports which were equivalent to 21.21 million tons of goods.

(3) Commercial airport

U Ta Pao International Airport is located at Pla Sub-district, Ban Chang District, 30 kilometers from the Rayong City. However, the air transportation is still very limited. Most of the goods using air transportation are not very large in size and weight but of a high unit value.

FIGURE 3.3.2-1 TRANSPORTATION NETWORK FOR MAB TA PHUT INDUSTRIAL ESTATE

(4) Railway

Rayong Province has a railway route from Bangkok via Cha Choeng Sao Province, whose part of route from Laem Chabang Industrial Estate to Map Ta Phut Industrial Estate is used as the route for transportation of raw materials, products for factories in the area of Map Ta Phut Industrial area.

3.3.3 Water Usage

(1) Domestic water usage

It is a responsibility of Rayong PWA to supply water for Rayong Municipality. Its capacity is 51,031 m^3/day while the actual consumption is 34,075 m^3/day. Water source is from Khlong Yai and Dok Krai reservoirs.

(2) Industrial water usage

The study area is located in the Map Ta Phut area which uses water for both domestic and industrial purposes. Water sources are from Nong Pla Lai and Dok Krai reservoirs under the management of East Water Public Co. Ltd. At present, only Map Ta Phut area consumes 265,000 cu.m./day or 96.7 million cu.m./year, while the supplying system of the East Water could supply around 150 million cu.m./year.

However, in order to support the industrial expansion and community under the development plan of the Eastern Seaboard in the future and to prevent the scarcity of water from being shortage of rainfall in the Eastern region,the government sector has developed plan management to provide raw water from sources for several projects in the area of Map Ta Phut (both emergency plan and short/ long-term plan) in order to solve the problem of water shortage.

3.3.4 Electrical Power Supply

As the project area is in Map Ta Phut area, it is the responsibility of Rayong PEA to provide electrical power supply. whose maximum capacity is 87.5 MW with the present supply capacity of 45.5 MW.

3.3.5 Water Drainage and Flood Protection

The slope of area is from north to south direction with natural canals that help in water drainage to the sea. In addition, IEAT also provides rainfall drainage system to avoid flood inside the industrial estate and its surrounding areas.

In the community area, rainfall drainage system is provided by local authority. In rural area, there is no drainage system. The rainfall will be drained and permeated naturally through to ground.

3.3.6 Solid Waste Management

(1) Domestic waste management under the responsibility of Map Ta Phut Municipality and Ban Chang Municipality.

(2) Map Ta Phut Municipality is employed for industrial waste management and disposal, except hazardous waste that is under DIW authorized service providers, such as GENCO

3.4 QUALITY OF LIFE

3.4.1 Public Health

Statistical data for public health and illness in 2004-2006 was collected from local authority, Map Ta Phut Sanitary Station and Map Ta Phut Hospital. It was found that respiratory diseases are dominant. The others are digestive diseases, oral diseases, infections, and parasite.

3.4.2 Aesthetics and Tourism

Tourism sites in Ban Chang and Muang District are Had Sai Thong, Ko Saket, Had Payoon, Had Namrin, Taksin the Great's Shrine, Wat Pa Pradu, Mid-water Pagoda, City Shrine, Suan Si Muang, Ban Pae, Suan Son and Had Mae Rampueng.

CHAPTER 4
ENVIRONMENTAL IMPACT ASSESSMENT

4.1. IMPACT ON PHYSICAL RESOURCES

4.1.1 Topography and Geology

The Project area is located in the vacant area inside the boundary of Glow SPP3 Co., Ltd. factory which has already been developed. There will then be no difference in geological condition as well as waste disposal practice in the area. Therefore, the effect is expected to be low.

4.1.2 Air Quality

(1) Construction phase

Air pollutant like dust from transportation and land preparation has been expected, but this causes the low level of impact due to the proper mitigation measures such as provision of water spray on construction areas, provision of blanket cover to hauling trucks to prevent spillage during hauling, etc.

(2) Operation phase

1) The principle of air quality assessment

According to the Declaration of the National Environment Board on April 9, 2007, which granted the approval for the principle of air quality assessment in the area of Map Ta Phut, Rayong Province based on the proposal of the Ministry of Natural Resource and Environment, the details are as follows:

1.1) Cancellation of the Declaration of the National Environment Board of the year 2001, which allowed the concentration of the oxides of nitrogen derived from mathematical air modeling to exceed the air quality standards by 60 percent (oxides of nitrogen as NO_2 in average 1 hour at the maximum value / concentration not exceeding 512 mg/m^3)

1.2) The project shall not increase the emission loads of pollutant (oxides of nitrogen and sulfur dioxide) in Map Ta Phut Area.

1.3) Reduction of the pollutant emission load must be based on the actual emissions.

1.4) If there is reduction of air pollutant emissions, an expansion project of the existing plant or a new project shall have air pollutant emission rates of not exceeding 80 percent of the reduced rates.

1.5) The air modeling result must not present the increase of the maximum concentration of the existing air quality at ground level caused 2 by air pollutant emissions of the new project. For example, the maximum concentration of oxides of nitrogen at ground level in the existing environment derived from the air model equals to 600 mg/m^3. With this assumption, the air pollutant emissions, from air modeling result, after the new project established must not exceed 600 mg/m^3. It shows that no impacts are caused by the new project.

1.6) At the area with the highest impacts caused by the project, the air quality must not exceed the air quality standard in the atmosphere i.e. the maximum concentration of nitrogen dioxide averagely 1 hour not exceeding 320 $mg/m^3$and the maximum concentration of sulfur dioxide averagely 1 and 24 hours not exceeding 780 and 300 mg/m^3, respectively.

1.7) Air pollutant emission, as derived from the air modeling result, from the project shall not cause an increase of air pollutant concentration in any area whose air quality already exceeded the emission standards.

1.8) After the operation of the Industrial Estate Authority of Thailand regarding update of imported data and other imported factors to make the mathematical model reliable and accurate is approved, those data and factors shall be used for assessing the ambient air quality.

1.9) The project, which applies the above-mentioned criteria, is located in Map Ta Phut Sub-district and Huay Pong Sub-district, Muang District and Baan Chang Sub-district, Baan Chang District (especially Asia Industrial Estate, which covers the area of 3 sub-districts, consisting of Map Ta Phut, Huay Pong and Baan Chang Sub-districts).

Since this project is located in Map Ta Phut Area (Map Ta Phut Sub-district), the assessment of the ambient air quality in the atmosphere by means of the model have to meet the above criteria.

2) Pollutant emission rates of the project

2.1) CTG of the project has dry low NO_x burner which is a suitable technology of NO_x emission control. It is efficient to decrease NO_x by 70-85 percent.

2.2) Emission rate of NO_x from CTG does not exceed 55 ppm or 30.9 gram/second.

2.3) The existing power plant of Glow SPP3 has planned to decrease the actual pollutant emission to accommodate the development of this project as well as the project of thermal power plant of 700 megawatts to be developed in the future.

2.4) This project and the project of thermal power plant of 700 megawatts have the total emission rate of not exceeding 80 percent of the decreased pollution rate from the existing power plant.

2.5) According to reduced pollutant emission of the existing power plant, the operation of the new proposed project and the thermal power plant of 700 megawatts shall not increase the air emission rate of NO_x (in terms of NO_2) of the whole Map Ta Phut Area.

3) Air quality assessment by mathematical air modeling

The mathematical model used for this study is ISCST (Industrial Source Complex Short Term), which is developed from the theory of 3 direction-dispersion as well as movement by the influence of wind, together with prediction of concentration changes by the equation of Fickian and prediction of capability of dispersion of pollutant in the ambient air conditions, which has been edited and compiled by Pasquill & Gifford using the basic theory of Gaussian. This can be used to evaluate the concentration of air pollutant in the atmosphere ambient air quality caused by the complex sources emitted continuously. ISCST is used for short range transport of less than 50 kilometers.

The air quality assessment are interms of NO_x emission concerns 3 conditions as follows:

(1) For the assessment of NO_x emission based on mathematical air modding, the new proposed project emits NOx (as NO_2)30.09 grams/second.

(2) For the assessment of NO_x emission (as NO_2) from the existing plants prior to the proposed project commencement, the existing plants emit NO_x(as NO_2) 2,498.74 grams/second.

(3) For the assessment of NO_x emission produced by the proposed project and the existing plants in the study area altogether, the combined / mixed emission rate of NO_x equals to 2,471.99 grams/second.

3.1) Study results

The assessment of air quality interms of NO_2 emission can be summarized as in Figure 4.1.2-1, and Table 4.1.2-1 with the following details:

- NO_2 value (average in 1 hour) with the maximum emission under the first condition equals to 12 mg/m^3. Position (A), having the highest concentration, and a distance from the power plant' stack to (A) is in the northeast direction about 1.4 kilometers away.

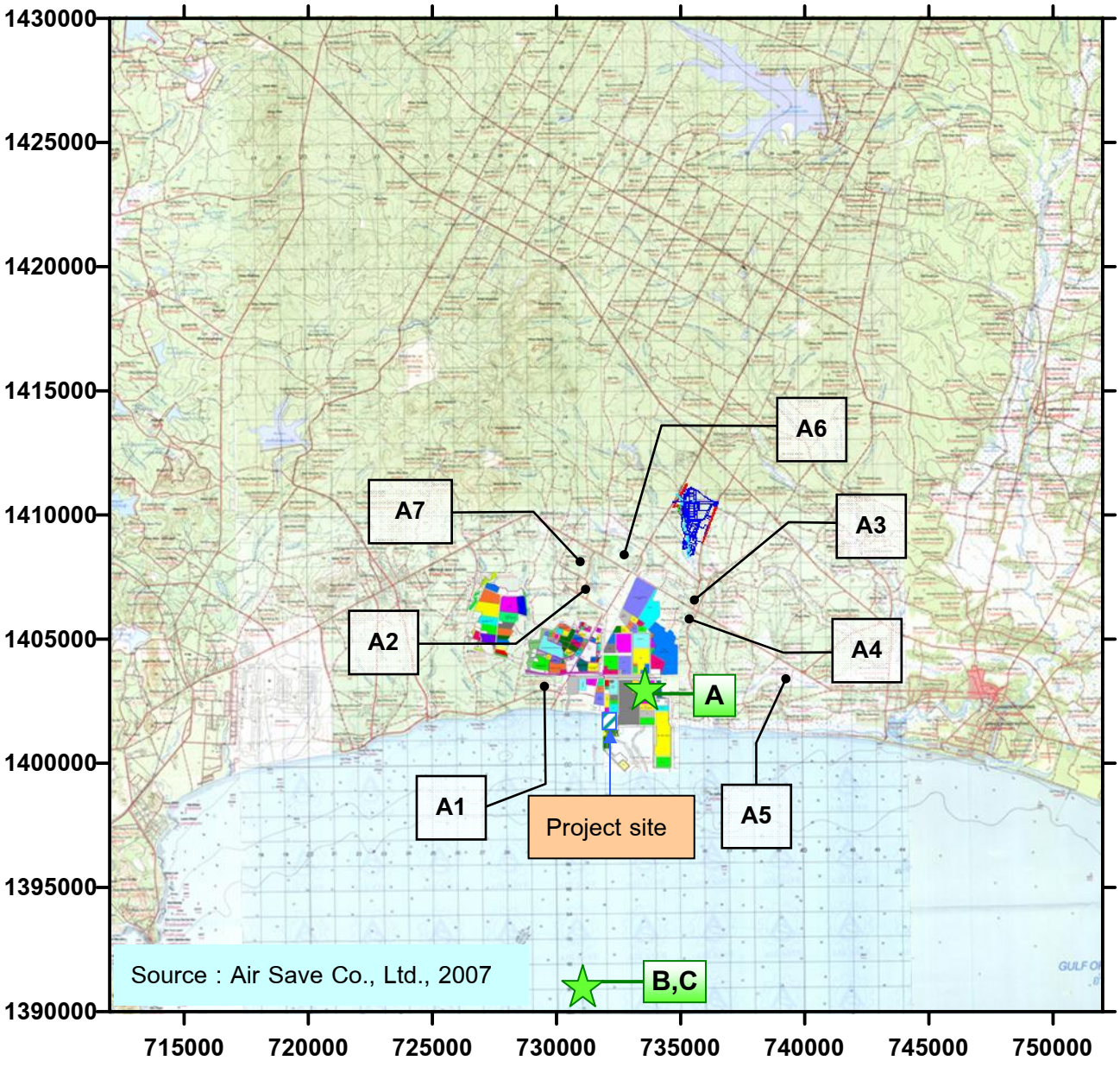
- NO_2 value (average in 1 hour) with the maximum emission under the 2nd condition, equals to 614 mg/m^3. Position (B), having the highest concentration, is located in the sea, about 10.5 kilometers. distance from the power plant 'stack in the southwest direction .

- NO_2 value (average in 1 hour) with the maximum under the 2rdcondition, equals to 610 mg/m^3. Position (C), having the highest concentration is at the same point as (B) in the sea.

- After the proposed project commencement, NO_x value (average in 1 hour) is not increased in comparison to the period prior to the new power plant commencement. (After the proposed project commencement, the maximum NO_x value (average in 1 hour) will be lessened from 614 to 610 mg/m^3.)

- After the proposed project commencement, NO_x value (average in 1 hour) in any area, which already exceeds the standard of the air ambient, shall not be increased from the existing concentration.

- The maximum value of NO_2 emission (average in 1 hour) from the new power plant or the proposed project (condition) equals to 12 µg/m^3 (0.006 ppm). Upon combining of the emissions from other sources, it is found that the area most affected from the proposed project has NO_2 value (average in 1 hour) of 119 µg/m^3 (0.006 ppm), which doesn't exceed the standard values of air the ambient quality. (350 ppm for coal , 180 ppm for oil , 120 ppm for gas). For emission standards.



Observed points for air quality assessment

A1 = Ban Nong Fab
A2 = Wat Map Chalude
A3 = Ban Map Ta Phut
A4 = Map Ta Phut Health Center
A5 = Telephone Junction
A6 = Crop Research Center, Rayong
A7 = Map Ta Phut new town

Max concentration points

A = NOx emission caused by the project only (case 1)
B = NOx emission from the existing plants prior to the project commencement. (case 2)
C = NOx emission caused by the project and the existing plants in the study area altogether (case 3)

FIGURE 4.1.2-1 MAX CONCENTRATION POINTS OF NO_2 AVERAGE 1 HOUR FOR EACH CASE

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TABLE 4.1.2-1

NO_x EMISSION RESULTS OF AVERAGE 1 HOUR IN DIFFERENT CASES

DETAIL	NO_2 1 HOUR ($\mu g/m^3$)		
	CASE 1	CASE 2	CASE 3
MAX CONCENTRATION	12	614	610
COORDINATE	(733500, 1403000)	(731000 , 1391000)	(731000 , 1391000)
MAX CONCENTRATION POINT	IN MAP TA PHUT ESTATE, 1.4 KM NORTH EAST OF PROJECT AREA	IN THE SEA, 10.5 KM SOUTHWEST OF PROJECT AREA	IN THE SEA, 10.5 KM SOUTHWEST OF PROJECT AREA
A1 : BAN NONG FAB	4	227	227
A2 : MAB CHALUDE TEMPLE	6	256	256
A3 : BAN MAP TA PHUT	5	219	219
A4 : MAP TA PHUT HEALTH CENTER	5	201	201
A5 : TELEPHONE JUNCTION	4	328	328
A6 : CROP RESEARCH CENTER, RAYONG	5	238	238
A7 : MAP TA PHUT NEW TOWN	6	270	270

Remarks: Ambient air quality standard in accordance with Notification of the National Environment Board Vol. 10 B.E. 2538 -- nitrogen dioxide in ambient air average 1 hour shall not exceed 320 µg/m3

Case 1: the assessment of NOx emission caused by the project only.

Case 2: the assessment of NOx emission from the existing plants prior to the project commencement. (From actual emission rate)

Case 3: the assessment of NOx emission caused by the project and the existing plants in the study area altogether. (After reduction of emission in the existing plant and the 2 new project has commissioned)

Source: Air Save Co., Ltd., 2550

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3.2) Summary of air quality assessment

From air quality assessment, it can be summarized that by means of the mathematical air model used the emission results are consistent with the criteria of the air quality assessment in Map Ta Phut Area based on the Declaration of the National Environment Board, Volume 6, April 9, 2007.

4.1.3 Noise Level

(1) General impact on local people

Noise level from the construction measuring at the distance of 2,000 meters away is 57.4 dB(A) (only 1.4% louder than what without construction). While during the operation period, the combined noise level at Ban Nong Fab is approximately 56.60 dB(A), which is not different from the background noise level. This noise level is persisted almost of the time, which it is well within the community noise standard in terms of Leq 24 not exceeding 70 dB(A).

(2) Nuisance noise level

Nuisance noise level during the construction period is around 0.9 - 2.6 dB(A) which do not exceed the standard of 10 dB(A), while during the operation period there will be no effect from the nuisance noise. The consultant provides mitigation measures for employees in normal working hours (8 hr) during the construction period as given in Chapter 5.

4.1.4 Hydrology and Surface Water Quality

(1) Construction phase / period

There is no offensive construction that affects the water current and flow rate. None of waste from the project activities will be discharged to the surface water sources. As a result, it is expected that impact on surface water. water quality is very low.

(2) Operation phase/ period

1) The appropriation in the management of wastewater

The wastewater incurred will be classified as per each consumption type in order to be brought for proper type of treatment. Details are as follows:

- Domestic wastewater, including from toilet, is wastewater of mixed organic substances, which will be treated by septic tank and will be later discharged to wastewater treatment plant (WWTP).

- Processing wastewater includes the following description.

- The project discharges wastewater of 2,586 m^3/day. While the project's design wastewater treatment plant can treat wastewater up to 4,800 m^3/day, therefore, its WWTP has capability for treating the total produced wastewater from the project.

- Wastewater from The project will be collected from equalization tank where holding wastewater for reducing variable flow rate and wastewater characteristic before discharging to an aeration tank. Therefore, if the project's effluent water quality exceeds the AIE's standards, it will be retreated again.

- The project builds an inspection manhole before discharging its effluent to holding pond 1 for monitoring BOD, COD , SS and TDS every week, if the effluent water quality exceeds the effluent standards, the project will stop discharging and retreat it once again until it meets the AIE standard.

The consultant provides the following procedures.

* Boiler blow down water does not contain organic contamination (but cooling water with high temperature) will be drained to boiler blow down tank and recycled it to return in back to the existing raw water storage tank of Glow SPP3 Co., Ltd.

* Cooling water blow down is designed to acquire water temperature not more than 35 degree Celsius (C^0) and later being drained to the existing discharge canal of Glow SPP3 Co., Ltd.

2) The assessment of wastewater management

After being treated, the treated wastewater will be discharged to the designated channel (containing wastewater from Glow SPP3 Co., Ltd.) which is designed like a waterfall in order to maximize the exchange of heat between the

water and air. In releasing such wastewater to the sea, the water outlet or the exit channel is also designed as a bottleneck shape in order to accelerate the flow of the discharged wastewater thereby achieving optimum rate of mixing water between the discharged water and seawater.

From the study results of the wastewater dispersion from the project as well as those from the existing power plant and from the proposed project thermal power plant of 700 megawatts (to be developed in the future), it is found that the temperature of seawater at the distance of 1,000 meters away (from the discharge point) increased only 1.1 + 0.32 °C. In addition, no residual chorine at such distance is found This phenomena is consistent, under the controlled process, and it is in accordance with the Declaration of the National Environment Board Vol. 27, 2006 (the temperature rise of seawater shall not exceed 2.0 °C and the residual chlorine shall be controlled not to exceed 0.01 milligram/litre). The study details are as follows:

1. Indicators used for studying impacts on seawater quality include temperature and residual chlorine because they are main pollutants from the project's cooling system.

2. Study of wastewater discharged into the sea includes wastewater discharged from the existing power plant and the project's thermal power plant of 700 megawatts (to be developed in the future) of Glow SPP3 Co., Ltd. The discharge rates of wastewater from the project, the power plant project of 700 megawatts and the existing power plant are equal to 10.1, 42.785 and 30 cubic meters/second, respectively. In the future, the above wastewater sources will be combined and drained to the canal of 500 meters long of Glow SPP3 Co., Ltd. prior to the sea.

3. The study is based on 2 conditions as follows:

1) The wastewater drained from the existing power plant and the project's thermal power plant of 700 MW of Glow SPP3 Co., Ltd., whose rate of cooling water blow down equals to 72.785 cubic meters/second.

TABLE 4.1.4-1

SEAWATER QUALITY ASSESSMENT RESULTS BY MATHEMATIC MODELING

POSITION	INCREASED TEMPERATURE (DEGREE CELCIUS)		INCREASED RESIDUAL CHLORINE (MG/L)	
	CASE 1[2/]	CASE 2[3/]	CASE 1[2/]	CASE 2[3/]
1000 M. SOUTH OF DISCHARGE POINT	0.99 ± 0.30	1.10 ± 0.32	0.00 ± 0.00	0.00 ± 0.00
1000 M. SOUTHWEST OF DISCHARGE POINT	0.56 ± 0.15	0.63 ± 0.17	0.00 ± 0.00	0.00 ± 0.00
STANDARD[1/]	LESS THAN 2 DEGREE INCREASE		LESS THAN 0.01 MG/L INCREASE	

Remarks: [1/] standard in accordance with Notification of the National Environment Board Vol. 27 B.E. 2549 on seawater quality

: [2/] Case 1: wastewater drained from the existing power plant and project of thermal power plant of 700 MW of Glow SPP3 Co., Ltd. The total cooling water blow down equals to 72.785 cubic meters/second.

: [3/] Case 2: Consider the wastewater drained from the project together with that from the existing power plant and project of thermal power plant of 700 MW of Glow SPP3 Co., Ltd. In this case, the discharge rate equals to 82.885 cubic meters/second.

Source: Air Save Co., Ltd., 2550

2) The wastewater drained from the project together with that from the existing power plant the said of thermal power plant of 700 MW of Glow SPP3 Co., Ltd. will the discharge rate equals to 82.885 cubic meters/second.

4. From the study, the results of temperature dispersion by means of mathematical model are showed in Table 4.1.4-1, whose details are as follows:

1) For the rate of cooling water discharged (72.785 m^3/sec), it is found that the temperature of seawater, at the distance of 1,000 meters to the south of the discharge point increases up to the maximum (0.99 + 0.30 °C).

2) For the rate of cooling water discharged (82.885 m^3/sec), the temperature of seawater at the distance of 1,000 meters to the south of the discharge point increases up to the maximum (1.10 + 0.32 °C).

5. From the study, the results of residual chlorine by means of mathematical model (with reference to Table 4.1.4-1), it is found that both of the 2 cooling water discharge rates (72.785 and 82.885 m^3/sec, respectively), contain no residual chlorine d at the distance of 1,000 meters from the discharge point.

As considering the suitable treatment systems as well as the wastewater management mentioned earlier, the impact on water quality from the project operation is expected to be acceptable.

4.1.5 Hydrology and Underground Water Quality

(1) Construction phase

During construction phase, groundwater is not used and activities of the project are above the ground. It can be concluded that none of hydrological groundwater impact is found. In order to minimize the groundwater impact, mobile lavatories with septic tanks would be provided for worker. As a result, the impact is negligible

(2) Operation phase

During operation phase, no groundwater will be used and no activities will involve the groundwater. It can be concluded that none of hydrological groundwater impact will be found in the future.

4.2 BIOLOGICAL RESOURCES

After the study area became industrial zone, wildlife and forest disappeared. In addition, the project will be inside the boundary of the existing power plant in compliance with the industrial laws and regulation. So impact on biological resources is expected to be none.

4.3 HUMAN USE VALUE

4.3.1 Land Use

The project area is located inside Glow SPP3 Co., Ltd. in Map Ta Phut Industrial Estate. The areas were mainly provided for industrial development in accordance with industrial beneficial use attempt. As a result, impact on land use is expected to be very low.

4.3.2 Transportation

(1) Construction phase

It is expected that 8 passenger car units (PCU) hourly of vehicle (only during the peak time) enter the construction site during 2008-2010. The V/C ratio of Highway No.3 between is 0.257-0.264 which is rather low. When comparing to the same period of without this project, the VIC radio of the same highway is between 0.256-0.263, the V/C ratio is not much different. As a result, the impact from the project construction on road traffic is expected to be very slight.

(2) Operation phase

There will be an additional traffic loading from transportation of chemicals and other materials. Traffic density is expected to be 18.5 PCU/hr. The V/C ratio of Highway No.3 in 2011 is expected to be 0.269. When comparing to the same period of without this project, (0.267) the V/C ratio is not much different.

Therefore, the impact during the project operation on road traffic is expected to be very low.

4.3.3 Water Usage

(1) Construction phase

The main water supply is distributed through the existing piping network (from Glow SPP3), while drinking water is provided by the supplier. The water source, therefore, is different from the community's. As a result, the impact on water supply is rather low.

(2) Operation Phase

Most of water usage for the project operation will be taken from seawater / coastal water (as cooling water), while other types of water (clarified water, demineralized water, portable water) will be mainly taken from the Glow SPP3 supplying system. As for the raw water availability, the government sector has a development and management plans of raw water sources for several projects in the area of Map Ta Phut (both emergency plan and short and long-term plans) in order to support the availability of water. The impact is expected to be low.

4.3.4 Electrical Power Supply

(1) Construction phase

During construction phase, the electrical power system in public area will not be affected because the project obtains electricity from Glow SPP3 Co., Ltd.

(2) Operation phase

The project will produce electricity of 381 megawatts (gross output) which will be sold to industrial customers and EGAT (excluding 4 megawatts to be use within the project), therefore it is a benefit because the consumers will have more reliable supply in terms of availability and stability as well.

4.3.5 Water Drainage and Flood Protection

(1) Construction phase

Temporary drainage system will be provided on the same plot as the designed for the permanent system in order to collect rainfall and drain to the discharged canal. The impact is expect to be a slight impact.

(2) Operation phase

Storm water drainage system will be apparently separated from wastewater drainage system. The project's water drainage system will be located around the buildings and production area to gather the rainfall (non-contaminated) and drain it to the discharged canal. For possibly contaminated rainwater which is collected from the open area, the project will collect it into the provided checking pit. If found contaminated, such rain water will be discharged to oil-water separator. The impact is likely to be low.

4.3.6 Solid Waste Management

(1) Construction phase

Solid waste from domestic consumption is generated by construction workers which will later be disposed by municipality service. Therefore, the impact is expected to be low.

(2) Operation phase

The project introduces solid waste management method on various types of waste by sorting and storing in specific waste containers. The waste stored is then carried on for disposal by the Department of Industrial Works' licensed agencies. In addition, the project is also required to have record keeping on type and quantity of wastes, and the report on this shall be submitted to the appropriate authority every 6 months. Therefore, the impact from the project's solid wastes is expected to be low.

4.4 QUALITY OF LIFE

4.4.1 Socio-economic

(1) Construction phase

1) Impact on local economy

For 32 months of construction period, there are needs for manpower for the construction. So this is the positive impact on local community since it causes local economic growth in terms of commerce and service.

2) Impact on the existing environment

The project is located inside the existing power plant area and environment quality will be controlled by engineers and specific experts, so levels of impacts on local communities are rather low.

(2) Operation phase

1) Impact on local economy

As considering the operation of the project which makes the public utility more stable and of better availability, together with the numbers of staff required, local communities would benefit from the project.

2) Impacts on the existing environment

As realizing the impacts which might arise during the project operation, the stringent mitigation measures and monitoring programs are therefore indicated. The company will strongly comply with such measures together with the installation of control systems in processes so there might be low impact on the community. In emergency case, the project will rapidly cooperate with other related sectors to solve the problems.

4.4.2 Public Health

(1) Construction phase

Impact mitigation measures will be provided. Dust will be controlled by water spraying. Lavatories and garbage containers must be sufficient for workers.

(2) Operation phase

It is found that health and public health service in the study area is good. Most of illness is respiratory disease that might be caused by air pollution. It is

realized that the mitigation and monitoring plans are necessary. The Project has environmental and pollution management policies aimed to control pollution of air, water and solid wastes. The Project also has environmental quality monitoring programs to control pollution that can affect the area's environmental quality. As a result, it is expected that the impact will be slight.

4.4.3 Aesthetics and Tourism

There is no important archaeological site for tourism around the project area. The nearest attraction sites are Had Payoon and Had Namrin which have very slight opportunity to receive the impact. In addition, the project provides green area around the area for aesthetic vision.

4.4.4 Occupational Health and Safety

(1) Construction phase

1) Noise

Noise from operation machines and equipments can be minimized by work breaking and using of ear plugs, ear muffs, etc.

2) Accident

Working environment without safety measures may lead to accident. It is necessary to realize about accident and provide personnel safety equipment sufficiently for workers, and also to inspect the contractor's work practices to follow the safety rules strictly.

3) Fire Protection

The risk of fire is caused by welding and short circuit. Strictly inspection and monitoring must be performed.

As a result, the impact of occupation, health and safety for the construction period will likely to be minimized.

(2) Operation phase

1) Chemical hazards in the production process.

There are uses of chemical substances with some specific activities. The may be hazardous to body if exposed. Therefore, the project has provided the storage with entirely covered, using the durable material against the corrosion and physical damage. The project also provides eye and body emergency showers closed to the working sites. At the occurrence of leakage or breakage of a container, there should be an area to store all chemical substances. In addition, for safety of the staff, the project subsequently has stipulated standards and arranged personal safety protection equipments to the staff, who work with chemical substances. Warning signs are also posted in the working areas.

2) Fire protection

The project managed to have appropriate and sufficient number of fire extinguishers both inside and outside the buildings. These include fire alarm system, portable extinguishers, extensive hose and fire hose cabinet, sprinkler system, fire water pump, extinguisher reservation water tank and carbon dioxide system. For which, various systems mentioned above are designed by licensed engineer of the relevant engineering professions under the standards of NFPA. In addition, the project will stipulate the inspection plan on the condition and working test of various fire extinguisher systems consistently for the readiness in case of / potential actual emergency.

3) Emergency operational plan

The emergency plan is divided into 3 levels, for which all staff must observe to take action when an emergency situation is found in order to control and be able to immediately stop the incident on time and to protect the hazard including damage which may incur to its most efficiency.

CHAPTER 5
ENVIRONMENTAL ACTION PLAN

Introduction

The combined cycle cogeneration power plant project of Glow Energy Public Company Limited is located in the boundary of the existing power plant of Glow SPP 3 Co., Ltd. in the Map Ta Phut Industrial Estate, Muang district, Rayong province. It covers the area of about 2.0 acre (4.98 rai). The major products of the project are electricity and steam. The targeted customer group is industries in the Map Ta Phut area. The project uses some utilities, infrastructures and process supporting facilities of the existing power plant under legal relations of buying or renting from the owner.

The project is a cogeneration power plant, operating in 2 modes depending on customer's demand. For normal operation, the project produces and sells electricity in concurrent with steam. Under this mode, the project's electricity generating capacity is 349 Megawatt (MW) (divided into 256 MW and 93 MW generated from combustion turbine generator (CTG) and steam turbine generator (STG), respectively) with steam production of 120 tons/hour. The production process uses natural gas (bought from PTT Public Company Limited) as fuel. The natural gas is transferred through the existing pipeline to the project's metering and regulating station (MRS) prior to being supplied to the combustion chamber of CTG. Exhausted gas generated from the combustion will be fed to exchange its heat energy to demineralized water at heat recovery steam generator (HRSG) in order to produce steam. The high pressure steam is sent to STG for electricity generation. In this mode, some portion of the high pressure steam from the HRSG will be de-superheated by spraying with demineralized water to obtain suitable steam condition (pressure and temperature) for selling to the industrial customers. For the mode of no steam selling (occasionally occurred), the project can operate with maximum power generation capacity of 401 MW (divided into 256 MW and 145 MW generated from CTG and STG, respectively). The total steam produced from HRSG under this mode will be used for electricity generation at STG.

As NO_x is the major air pollutant generated from the project which is fueled with solely natural gas, the project installs low NO_x burners as NO_x control equipment to keep NO_x emissions within the standard. It applies once through cooling system with seawater as heat exchanging media at the condenser whose cooling water requirement is maximum at 8.33 m^3/sec. The seawater existing the system will be drained through the existing power plant's effluent discharge channel and further through 500-m discharge canal to the sea.

Since the project location is in Map Ta Phut area, its air emissions must be conformed to the National Environmental Board's criteria on emission standard issued at the 6th/2550 meeting held on 9th April 2007. The criteria requires that any new project or expansion project developed in Map Ta Phut area shall not contribute to the increase in Map Ta Phut area's existing total air emission rates (for NO_x and SO_2). If there is a reduction of air emission rate of the existing plant in the area, a new project or expansion project is permitted with a controlled air emission rate of not exceeding 80% of the emission rate reduced. Therefore, prior to the commissioning of the new power plant projects of the Glow Group, the existing power plant needs to lower its emission rates (NO_x and SO_2) so that the new projects are able to employ such reduction rates of not exceeding 80% for their development. The management of air emissions mentioned above is undertaken in cooperation of companies under the Glow Group; Glow SPP3 reduces its air emission rates and donates such reductions for the development of the new projects (this project and the 700 MW project of Gheco-One Co., Ltd.).

The operation of the project consists of activities that might have adverse effect on the environment, public health and ways of live of local people living nearby the project site at different levels. Hence, Glow Energy Public Co., Ltd. will implement the project activities in accordance with the environmental action plan to prevent and mitigate environmental impacts as follows:

1. Strictly follow the environmental impact mitigation measures and monitoring measures presented in the form of environmental action plan. Submit the report of action plan implementation results to Office of Natural Resources and Environmental Policy and Planning for reviewing within the period as specified in the action plan. This report shall conform to the Office's reporting guideline.

2. Control air emission rates from the power plant project in accordance with the air emission reduction plan of Glow SPP3 Co., Ltd. and in conjunctions with the thermal power plant project of Gheco-One Co., Ltd. In order to conform to the National Environmental Board's criteria on emission standard issued at the 6th/2550 meeting held on 9th April 2007. The emission results from the three plants shall be presented on a display board at the entrance of existing power plant, and linked to other involved parties.

3. After the mathematical model's input data has been corrected to be reliable by the Industrial Estate Authority of Thailand, this set of input data shall be used for air quality assessment. If the air quality assessment results from such model are higher than the air quality standard, Glow Energy Public Co., Ltd. shall reduce its air emissions to meet the standard.

4. Create an air emission database from the project's actual air emissions to be used for air quality's monitoring and problem solving by other related parties.

5. Create a database of volume of cooling water consumed within the project, and set up a plan to reduce the consumption of cooling water.

6. Cooperate, support and promote any organizations specialized in marine resource conservation and revitalization throughout the project operation.

7. To remove solid waste out of the project site, Glow Energy Public Co., Ltd. shall be obliged to the notification of the Ministry of Industry: Disposal of Waste and Unusable Materials B.E. 2548 (2005), or related regulations enforced by the government.

8. In case that Glow Energy Public Co., Ltd. hires a contracting company to design/construct/operate its power plant project, Glow Energy shall address its environmental action plan within the contract condition and ensure the contracting company to strictly comply with the action plan.

9. If the monitoring results from project operation expose a sign of environmental problem, Glow Energy Public Co., Ltd. shall solve and improve the

problem immediately. If there is any incident that might effect the environmental quality, the company shall inform to Rayong province, Industrial Estate Authority of Thailand, Office of Natural Resources and Environmental Policy and Planning and other related parties so that these parties can participate in solving those problems.

10. If Glow Energy Public Co., Ltd. needs to change/modify project details and/or its environmental action plan to be different from those said in the company's EIA report, the company shall submit the corrected versions of EIA report, detailing the changed parts and results of environmental impact study originating from the changed parts, to the EIA expert committee for reviewing and giving approval prior to the modification.

11. If there are any problems or concerns from local communities regarding the project operation, Glow Energy Public Co., Ltd. shall solve such problems in order to minimize conflicts in the communities.

12. If the project has not been constructed within 2 years since Office of Natural Resources and Environmental Policy and Planning approved the project's EIA report, the project shall review the environmental impact and action plan in the EIA report, and submit the report to the Office of Natural Resources and Environmental Policy and Planning for reviewing.

Therefore, to follow the environmental mitigation measures and monitoring measures in the form of environmental action plan, Glow Energy Public Co., Ltd. has created action plans in eight aspects regarding the project's major environmental impacts as follows:

1) Action plan on air quality
2) Action plan on water quality
3) Action plan on marine biological resources
4) Action plan on noise level
5) Action plan on solid waste management
6) Action plan on social aspect and public participations
7) Action plan on occupational health and safety
8) Action plan on public health

1. Action Plan for Air Quality

1.1 Rationale

During construction phase, air quality impact will be induced by dust dispersion generated from soil surface opening. Dust quantity is estimated to be increased to 8.7 microgram/m^3 (worst case). The highest dust concentration measured in the study area at Nong Fab community in 2004-2006 was 187 microgram/m^3. Therefore, during the project's construction period the total dust concentration will be 195.7 microgram/m^3 (worst case), which is within the ambient air standard of 330 microgram/m^3. Impact on air quality is expected to be substantially low.

During operation phase, the significant air pollution is air emissions from natural gas combustion. Oxide of nitrogen (NO_x) is the major air pollutant. Other minor pollutants including sulfur dioxide (SO_2) and total suspended particulates (TSP) might also be emitted. With NO_x emission control system namely dry low NO_x burner of CTG unit, NO_x concentration will be within the emission standard as well as the criteria imposed by the National Environment Board from the 6^{th}/2007 meeting held on April 9^{th}, 2007. From the ambient air quality assessment, the impact on air quality from the project will be at acceptable level.

To ensure and monitor the air quality that might be impacted from the project's activities, the project has set up environmental measures on air quality to be strictly followed for both construction and operation phases.

1.2 Objectives

1. To control the air pollution during both construction and operation phase in order to minimize the impact on the air quality of the surrounding area.

2. To monitor the results from the project implementation of mitigation measures on air quality, and to ensure the efficiency and continuity of the measures implemented.

1.3 Procedures/ operation areas

1.3.1 Mitigation measures

1) Construction phase

Transportation of workers and construction materials

- The trucks must be properly covered in order to prevent spilling of the loaded materials and dust dispersion.
- Limit the speed of the vehicles in the construction area of not exceeding 40 km/hr.
- Remove dirt and soil that might be stuck on the truck's wheels before leaving the construction area.

Construction area

- Spray water over the construction area to prevent dust dispersion from construction activities at least 2 times per day (except in raining period).
- Inspect and maintain the machines and engines used for construction to be in good condition and in accordance with the instruction manual of each unit.
- Prohibit burning of residues or garbage in construction area.
- Provide adequate dust protective equipment to the workers working in dusty areas.

2) Operation phase

Control of air emissions from HRSG stack

- Control air emissions from the project's HRSG stack as follows:
  - NO_X not exceeding 55 ppm and 27.92 grams/second
  - SO_2 not exceeding 0.95 ppm and 0.67 grams/second
  - TSP not exceeding 5 mg/Nm^3 and 1.35 grams/second
- Air emissions from the project's HRSG stack are allowed after the existing power plant has reduced their emission rates to be under the criteria approved by the National Environmental Board as shown in Table 5-1.

TABLE 5-1

AIR EMISSIONS FROM EXISTING POWER PLANT AREA AFTER OPERATIONS OF 2 POWER PLANT PROJECTS

NO.	UNIT	Coordinate		STACK		EXIT	EXIT	FLOW[1/]	CONCENTRATION[1/]			EMISSION RATE (g/s)		
		X	Y	HEIGHT (m)	DIA. (m)	TEMP (K)	VELOCITY (m/s)	RATE (Nm^3/s)	NO_X (ppm)	SO_2 (ppm)	TSP (mg/Nm^3)	NO_X	SO_2	TSP
	Existing plant[2/]													
1	cogen HRSG1	732469.4	1402060	35	3.06	466.8	25.19	49.46	111	0.95	5.0	10.33	0.12	0.25
2	cogen HRSG2	732469.4	1402014	35	3.06	487.0	26.42	46.45	118	0.95	5.0	10.31	0.12	0.23
3	CTG HRU 1A	732295.5	1402000	60	2.78	402.0	28.57	49.83	107	0.95	5.0	10.03	0.12	0.25
4	CTG HRU 1B	732310.8	1402000	60	2.78	398.2	29.19	52.74	104	0.95	5.0	10.32	0.13	0.26
5	CFB1	732343.6	1401931	100	2.82	448	31.0	152.9	100	180	55	28.77	72.06	8.41
6	CTG HRU 2A	732184.5	1402000	60	2.78	398.2	27.14	52.51	104	0.95	5.0	10.27	0.13	0.26
7	CTG HRU 2B	732199.8	1402000	60	2.78	405.0	29.99	54.02	101	0.95	5.0	10.26	0.13	0.27
8	CFB2	732232.6	1401931	100	2.82	448	31.0	152.9	100	180	55	28.77	72.06	8.41
9	Cogen HRSG 3A	732073.5	1402000	35	3.06	428.6	24.06	50.72	105	0.95	5.0	10.02	0.13	0.25
10	Cogen HRSG 3B	732088.8	1402000	35	3.06	429.8	24.57	52.89	103	0.95	5.0	10.25	0.13	0.26
11	CFB3[2/]	732121.6	1401931	100	2.82	448	31.0	152.9	100	170	55	28.77	68.06	8.41
12	700 MW project[3/]	732071	1401838	150	6.8	353	17.8	703.04	56	53	55	74.07	97.53	38.67
13	401 MW project[4/]	732473	1401993	60	6.4	364	26.0	270	55	0.95	5.0	27.92	0.67	1.35
Total												**270.09**	**311.39**	**67.28**

Remarks :

[1/] 1 atm, 25 °C & dry condition (at 7% excess O_2)

[2/] Cogeneration power plant 640 MW -- operated by Glow SPP 3 Co., Ltd. (use bituminous coal and natural gas as fuels)

[3/] Thermal power plant project 700 MW -- operated by Gheco-One Co., Ltd. (use bitumonous coal as fuel)

[4/] Combined cycle cogeneration power plant project 401 MW -- operated by Glow Energy Plc. (use natural gas as fuel)

Source : Glow SPP 3 Co., Ltd., 2008

- Set up alarm signals for the air emission level to be heard in the control room. These alarms can be divided into 2 levels: high level alarm and high high level alarm. After the alarm has been heard, the following practices shall be done:

  ■ For the “high level alarm” (set up at 90% of the controlled emission rate), the operators have to inspect the conditions of operation unit and emission control system. The maintenance or adjustment must be done immediately.

  ■ For the “high high level alarm” (set up at 98% of the controlled emission rate), the operators have to reduce or stop the production. The maintenance of the emission control systems must be done and ensured the emission rates before restart-up the operation.

- In the case that the rate of emissions from the stack exceeds the limitation, the values of emission rate that exceed the limitation and period of exceeding emissions must be recorded, and also root cause analysis and preventive plan must be undertaken.

- Appoint a skilled person to control the combustion and emission control systems.

Air pollution control equipments and management

- Provide the CTG with dry low-NO_x burner
- Prepare sufficient spare parts of air emission control systems in order to immediately replace when encountering the failure.
- Provide a condensate circulating system at low pressure economizer of HRSG to increase temperature of exhausted gas prior to emitting through stack in case of appearance of SO_2 concentration in the exhausted gas (as indicated by CEMs) in order to prevent dew point of sulfuric acid.
- Set up preventive maintenance program for the machines related to air emission control systems. The plan shall be set in accordance with the system manuals.

Measurement and presentation of air emission values

- Install continuous emission monitoring system (CEMs) and record the measurement data derived from CEMs.
- Present the measurement results of air emission rates from CEMs, including NO_x, SO_2, and TSP, to the public via emissions display board of the existing power plant located at the front gate of the plant.

- Present the project's operating result regarding environmental measures (especially air emissions) to the public and involved agencies in order to enhance public participations (in monitoring the project's environmental implementation) through various channels such as emission display board, air quality monitoring center of IEAT, newsletter, the project's environmental annual report or website, etc.

- In case the CEMs have a problem, the project has to apply a portable gas detector to measure air emissions in every 2 hours, and fix the CEMs immediately.

1.3.2 Monitoring measures

1) Construction phase

Ambient air quality

Parameters	:	Inspect TSP dust and PM-10 (averaged 24 hours)
Sampling stations	:	2 stations * At the fence of existing power plant * Ban Nong Fab
Frequency	:	2 times a year, 7 consecutive days per each time

2) Operation phase

Ambient air quality

Parameters	:	NO_x (1 hr.), SO_2 (1 and 24 hrs.), TSP (24 hrs.), PM-10, wind speed and direction
Sampling stations	:	4 stations (Figure 5-1) * Map Ta Phut Health Care Station * Map Chalood Temple * Muang Mai Map Ta Phut * Ban Nong Fab
Frequency	:	2 times a year, 7 consecutive days per each time

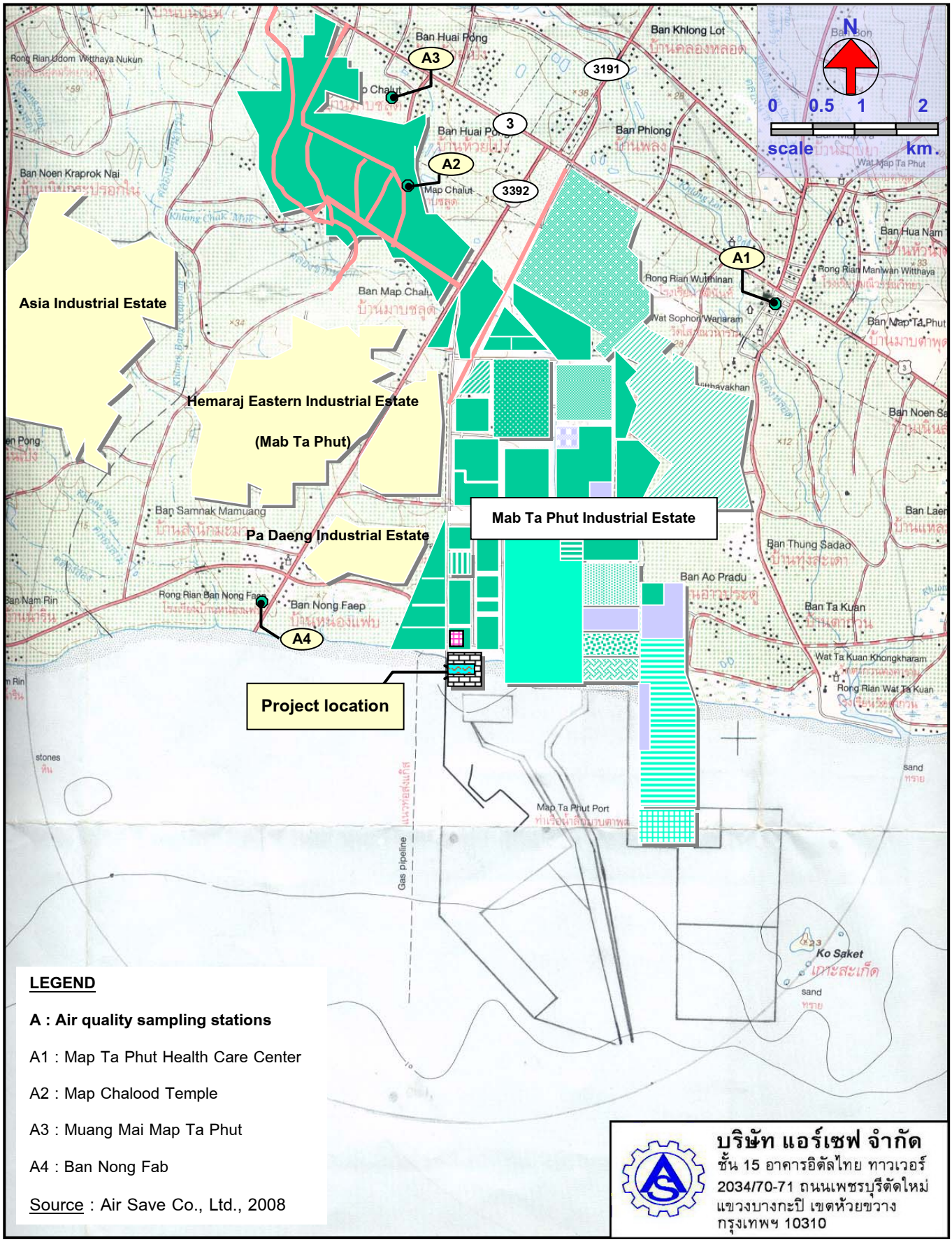


FIGURE 5-1 AIR QUALITY SAMPLING STATIONS

5037A/E/A/F51_F-Class

Air emissions at sources

Measured with CEMs

Parameters	:	NO_x, SO_2, TSP
Sampling stations	:	CTG-HRSG stack (Figure 5-2)
Frequency	:	Continuous

Measured by stack sampling

Parameters	:	NO_x, SO_2, TSP
Sampling stations	:	CTG-HRSG stack (Figure 5-2)
Frequency	:	2 times a year

Greenhouse gas emission assessment

Parameters	:	CO_2
Method	:	UNFCCC assessment method
Frequency	:	Once a year

1.4 Operation period

Throughout the operation period

1.5 Responsible company

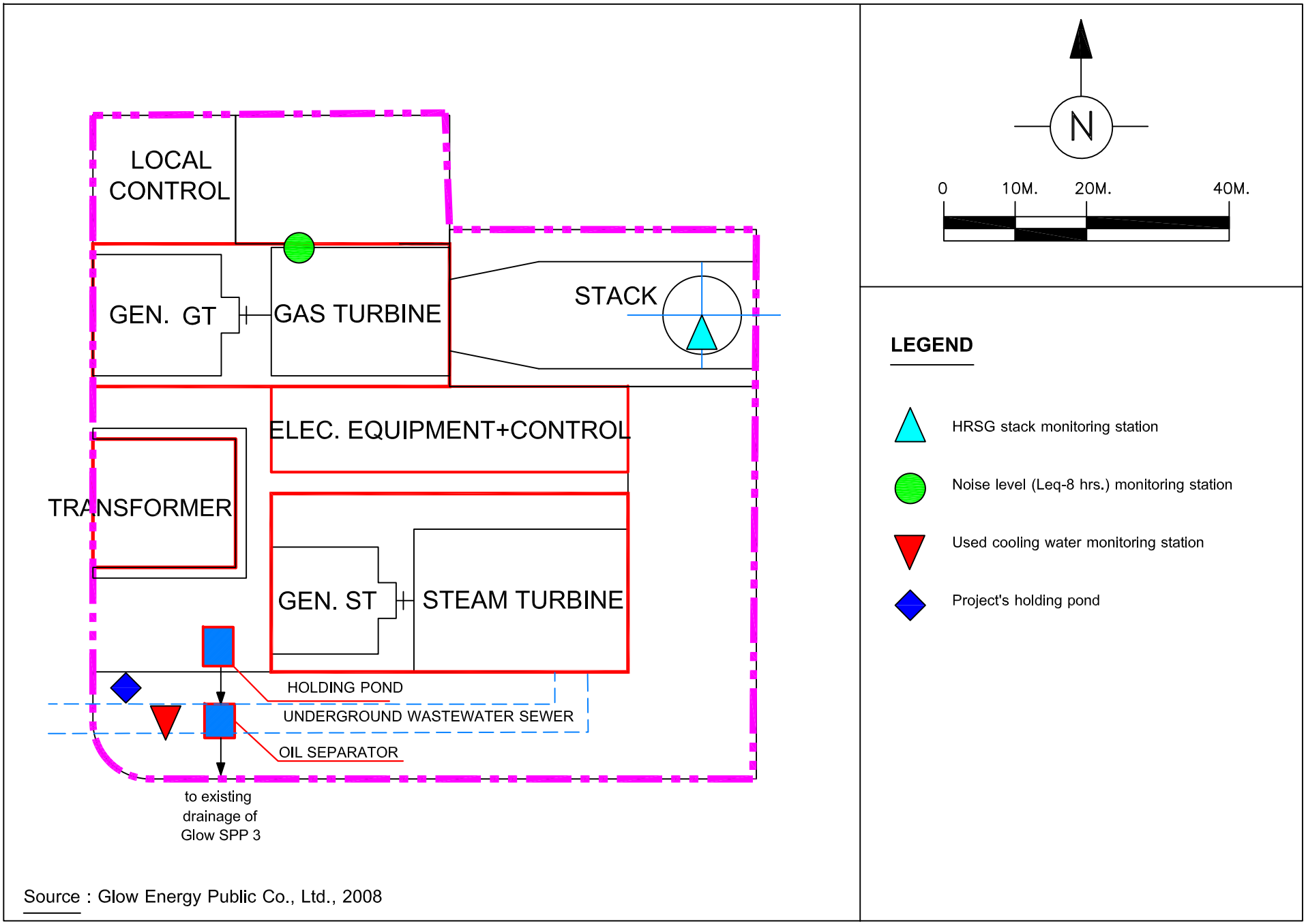
Glow Energy Public Co., Ltd.

1.6 Operation results evaluation

Glow Energy Public Co., Ltd. submits the results of environmental action plan implementation, together with problems, obstacles, and recommendations, to Office of Natural Resources and Environmental Policy and Planning and Industrial Estate Authority of Thailand in every 6 months.

1.7 Budget

Included in Glow Energy Public Co., Ltd.'s budget



Source : Glow Energy Public Co., Ltd., 2008

FIGURE 5-2 MONITORING STATIONS FOR AIR EMISSION, NOISE LEVEL AND WASTEWATER FROM THE PROJECT

5037A/EIA/F52_F-Class

2. Action Plan on Water Quality

2.1 Rationale

Wastewater from the project during construction period is from construction activities and the construction workers' domestic use which is generated at approximately 16.5 m^3/day. Wastewater that occurred during the operation is mainly from seawater that is used in the cooling system to condense the used steam from turbine. The project requires seawater at the maximum flow rate of 8.33 m^3/second. Main pollutants occurred from the cooling process are the higher temperature and residual chlorine. By using mathematical model to analyze the effect of used seawater drainage from the existing power plant area in the future (with a total volume of 77.96 m^3/second), it is found out that the temperature of seawater at the end of the 500-meter canal is higher than the inlet point of 4.24 °C at most, and increases not exceeding 2 °C at the 1,000-meter distance from the canal outlet. The residual chlorine is not found at such distance which conforms to the seawater quality standards for industry and sea port. Therefore, the effect to the water quality from temperature and chlorine volume is slight.

Glow Energy Public Co., Ltd. has established environmental mitigation plan for the project to strictly follow during both construction and operation phases to minimize the impact on water quality.

2.2 Objectives

1. To ensure proper and efficient management of wastewater from the project, resulting in minimum impact on the environment.

2. To monitor the results from the project implementation of mitigation measures on water quality, and to ensure the efficiency and continuity of the measures implemented.

2.3 Procedures/ operation areas

2.3.1 Mitigation measures

1) Construction phase

- Provide sufficient toilets for the workers in accordance with the public health standard.
- Make sure that there is no blockage to the sewer.
- Prohibit discarding waste in the sewer.
- Install a screen to collect solid waste out of the rainwater before releasing to the rain gutter.
- Occasionally remove dirt and construction materials from the sewer to prevent blocking.

2) Operation phase

Wastewater (fresh water)

Process area and office

- Collect wastewater from domestic use into a septic tank before releasing to the holding pond.
- Establish a maintenance procedure for all the wastewater treatment systems, and regularly follow the plan.
- Collect boiler blow down water to raw water basin of the existing power plant for further use in clarified water plant.
- Collect wastewater from cleaning processes to oil separation tank and drain to the project's holding pond.
- Install a holding pond of at least 1 m^3 for storing treated wastewater and inspecting its quality. The water whose quality is within the standard is drained out to the 500-meter canal and further to the sea.

Wastewater (seawater)

- Limit the consumption of seawater for the project's cooling system at the maximum rate of 8.33 m^3/second.
- Install automatic temperature and chlorine measuring devices at the cooling water outfall. The results are to be displayed at the control room, and also to be recorded.

- Control the temperature difference of the seawater used in the project's condenser of not exceeding 5°C as follows:

* Install continuous temperature measuring devices at the seawater pumping station and after the condenser of the project. The results are displayed at the central control room.

* The operator is to control seawater consumption at the optimum rate in relation to the seawater temperature difference before and after the project and to the production capacity. If the temperature difference tends to exceed 5°C, the project has to increase the seawater flow rate but not exceeding 8.33 m^3/second totally, or reduce the production capacity if the maximum usage of water is reached.

- Control the concentration of chlorine in the seawater drain of not exceeding 0.1 mg/liter as follows:

* Install a continuous measuring device of chlorine concentration in the project's seawater outfall. The result will be displayed at the central control room.

* The operator is to control sodium hypochlorite usage at appropriate rate in relation to the measured result. The concentration must be sufficient to control the microorganisms but not exceeding 0.1 mg/liter. If the concentration of chlorine tends to exceed 0.1 mg/liter, the operator has to lower the amount of used sodium hypochlorite in order to control the chlorine concentration to be within the limit.

2.3.2 Monitoring measures

Operation phase

Wastewater (fresh water)

Parameters	:	BOD, SS, temperature, pH, TDS and DO
Sampling stations	:	Holding pond (Figure 5-2)
Frequency	:	Once a month

Wastewater (seawater)

Parameters	:	temperature, pH, Salinity, conductivity, TDS, turbidity and DO

Sampling stations : Project wastewater sampling station (Figure 5-2)
Frequency : Once a week

Parameters : BOD and SS
Sampling stations : Project wastewater sampling station (Figure 5-2)
Frequency : Once a month

Seawater quality at sea

Parameters : temperature, pH, Salinity, conductivity, TDS, turbidity, DO and transparency
Sampling stations : 7 stations (Figure 5-3)
* Station I, near the seawater intake station
* Station E, near 500-meter canal outfall
* Station A, D and O, 500 meters from 500-meter canal outfall
* Station B and C, 1,000 meters from 500-meter canal outfall
Frequency : Once a week

Parameters : BOD, SS and residual chlorine
Sampling stations : 7 stations (Figure 5-3)
* Station I, near the seawater intake station
* Station E, near 500-meter canal outfall
* Station A, D and O, 500 meters from 500-meter canal outfall
* Station B and C, 1,000 meters from 500-meter canal outfall
Frequency : Once a month

2.4 Operation period

Throughout the operation period

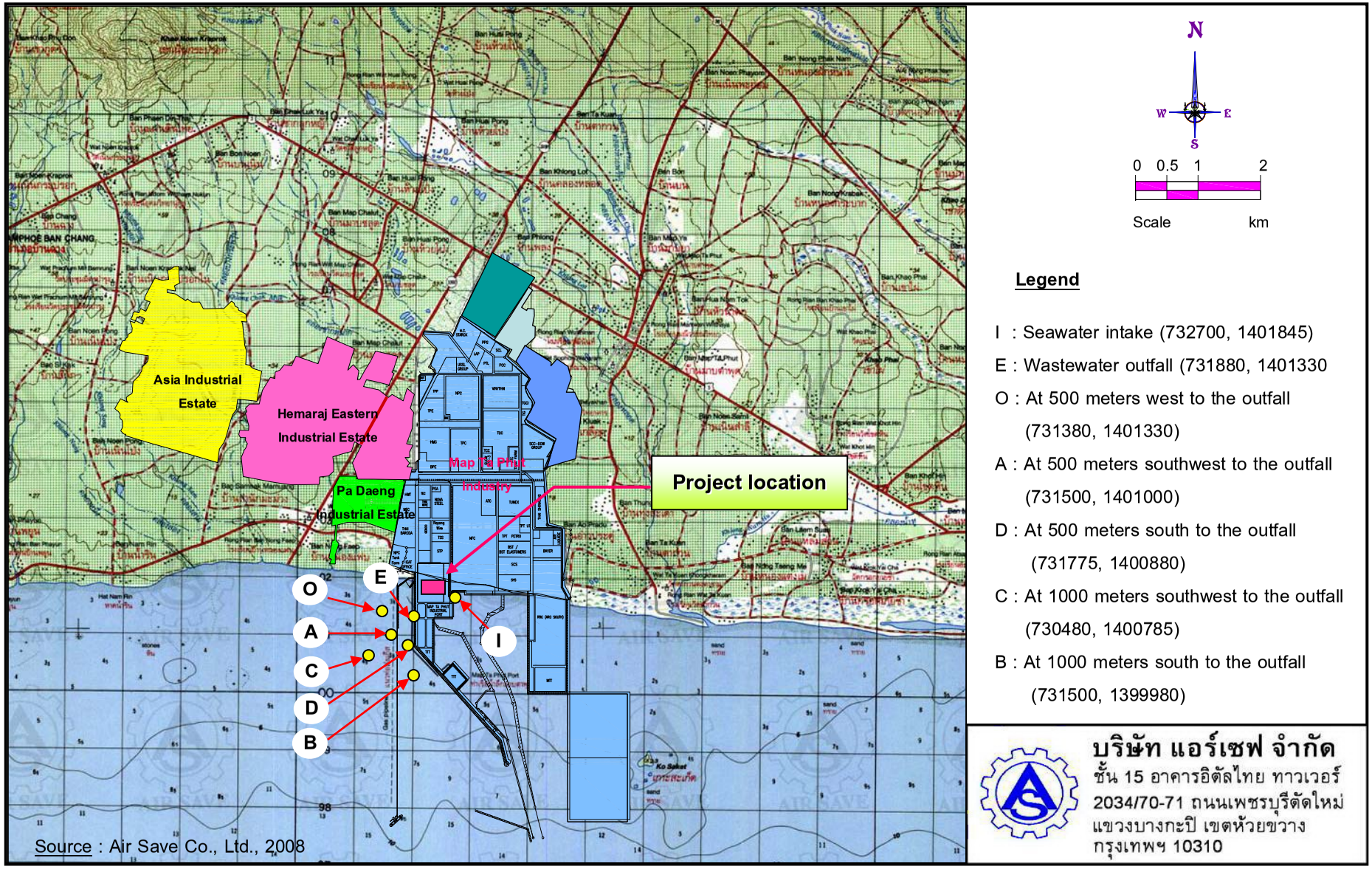


FIGURE 5-3 SEAWATER AND MARINE BIOLOGICAL RESOURCES MONITORING STATIONS

5037A/EIA/F22_F-Class

2.5 Responsible company

Glow Energy Public Co., Ltd.

2.6 Operation results evaluation

Glow Energy Public Co., Ltd. submits the results of environmental action plan implementation, together with problems, obstacles, and recommendations, to Office of Natural Resources and Environmental Policy and Planning and Industrial Estate Authority of Thailand in every 6 months.

2.7 Budget

Included in Glow Energy Public Co., Ltd.'s budget

3. Action Plan on Marine Biological Resources

3.1 Rationale

During the operation of the 2 new power plant projects, the consumption of seawater for the cooling systems of all the users in the existing power plant area will be at maximum of 77.96 m^3/second. An environmental impact assessment on marine biological resources, taking into account changes in the number of phytoplankton, zooplankton and marine animals at the sea near the power plant due to the area's seawater consumption, has been conducted. The reduction of plankton is found in a considerable amount. However, the life cycle of the plankton is about 3-4 days and it will restore itself in a very short period of time through photosynthesis. This kind of plankton reduction should be acceptable. The reduction of large sea animal numbers is in minimum because the power plant has a screening mesh to reduce the water velocity and to prevent marine animals to enter the inlet pipe. In the other way, this may affect small sea animals which can go through the screening mesh. However, as the project is located in a reclaimed land of Map Ta Put Seaboard; the sea in this area is classified as for industrial and sea port purposes, causing the water quality and the environment in this area being unsuitable for spawning of general marine fauna. This is matching with the findings of the project sea analysis, which indicates that no premature economic marine animals are found at the project sea (only sea worms are found). Therefore, the impact on economic marine animals is slight. For the impact on the seawater temperature regarding the cooling water outfall, a study of the project indicates that

the temperature may rise to 34.3±0.32 °C (based on 2005 results). This temperature level does not affect the survival of plankton. Moreover, this level helps increase its growth rate. The impact on the biological marine resources is therefore acceptable.

The project has set up an action plan on marine biological resources for undertaking during its operation. This is to minimize the negative impact on the seashore ecology and restore the marine life at most effective manner.

3.2 Objectives

1. To minimize the impact on marine biological resources resulted from the project's seawater consumption in the cooling system.

2. To offset and restore the negative impact on marine biological resources resulted from the project's seawater consumption in the cooling system.

3. To monitor the results from the project implementation of mitigation measures on marine biological resources, and to ensure the efficiency and continuity of the measures implemented.

3.3 Procedures/ operation areas

3.3.1 Mitigation measures

Operation phase

- Control the velocity of the seawater in front of the intake tunnel of not more than 0.3 m/s to help sea animals escape from the suction.

- The seawater intake tunnel shall be designed to be at least 2 meters deep from the seawater surface to reduce the loss of plankton, which mostly stay at 30 cm to 2 meters in depth.

3.3.2 Restoration and supplemental measures for biological marine resources

- Coordinate with local communities and related academic institutes to set up a proper procedure/plan to supplement economic marine species at sea. At first, the project plan to release as many as 250,000 culture marine juveniles per year for the first three years during operation.

- Follow up the supplemental plan implementing results through various means including interviewing the local fishermen on the total catch and income, and so on. The results will be analyzed for further improvement of the plan, while the plan improvement is to be undertaken in every 2-3 years.

- Follow up the changes in numbers of early-stage marine animals at the project's seawater intake station in order to evaluate for appropriate number of marine lives to be released.

- Support the local fishermen to create "crab bank" in order to hatch crab eggs from crab parents to increase crab numbers in the natural sea.

- Support the local fishermen to create "squid bank" in order to hatch squid eggs collected from fishery devices to increase squid numbers in the natural sea.

- Interview and survey the opinions of local fishery villagers on pros, cons, obstacles and achievements owing to the restoration and supplemental measures. The results will be used for improving the measures to be most effective.

- Evaluate the achievements and obstacles of the restoring and supplemental measures by coordinating with experts and academic institutes in order to improve the measures to be most effective and suitable for the project location.

- Interview the local communities in 5-km radius around the power plant, especially those practicing aquaculture on the production statistics and water quality since the past to present times.

3.3.3 Monitoring measures

Parameters	:	Type, quantity, diversity and density of phytoplankton, zooplankton and benthos
Sampling stations	:	6 stations (Figure 5-3) * Station I, near the seawater intake station * Station A, D and O, 500 meters from 500-meter canal outfall * Station B and C, 1,000 meters from 500-meter canal outfall
Frequency	:	3 times a year

Parameters	:	Type, quantity, diversity and density of early-stage marine animals
Sampling stations	:	2 stations (Figure 5-3) * Station I, near the seawater intake station * Station B, 1,000 meters from 500-meter canal outfall
Frequency	:	3 times a year

3.4 Operation period

Throughout the operation period

3.5 Responsible company

Glow Energy Public Co., Ltd.

3.6 Operation results evaluation

Glow Energy Public Co., Ltd. submits the results of environmental action plan implementation, together with problems, obstacles, and recommendations, to Office of Natural Resources and Environmental Policy and Planning and Industrial Estate Authority of Thailand in every 6 months.

3.7 Budget

Included in Glow Energy Public Co., Ltd.'s budget

4. Action Plan on Noise Level

4.1 Rationale

The nuisance noise is from the construction activities and machines, especially from piling, backhoe truck, grader truck etc. This noise is expected to transmit to Ban Nong Fab (the closest sensitive area from the project) at a level of around 57.4 dB(A) (slightly increased from 56.6 dB(A) in normal condition). The impact should be at low level. In the operation period, the major noise sources are from steam turbine, turbine generator, boiler feed water pumps and cooling water pumps. Even this, the noise level at Ban Nong Fab is still unchanged. The impact is minimal on the community.

However, in order to minimize noise pollution induced by the project implementation, mitigation and monitoring measures for construction and operation phases have to be strictly performed.

4.2 Objectives

1. To minimize the noise impact on the sensitive areas during the construction period.
2. To minimize the noise impact generated from plant operation on the sensitive areas and workers during the operation period.
3. To monitor the results from the project implementation of mitigation measures on noise level, and to ensure the efficiency and continuity of the measures implemented.

4.3 Procedures/ operation areas

4.3.1 Mitigation measures

1) Construction phase

- Prohibit any construction activities that generate the loud noise between 19.00-07.00 hrs.
- Construct temporary fences around the construction area.
- Inspect and maintain the machines and equipment used for construction to be in good condition and in accordance with the instruction manual of each unit.
- Conduct public relations to the communities closed to the project on the project construction plan prior to beginning the construction work.

2) Operation phase

- Install a silencer at the HRSG's steam vent to reduce noise level.

4.3.2 Mitigation measures

1) Construction phase

Parameters	:	Leq-24 hour and L_{90}
Sampling stations	:	2 stations * Fence in front of the existing power plant

		* Ban Nong Fab
Frequency	:	2 times a year, 5 consecutive days each time

2) Operation phase

Parameters	:	Leq-24 hour and L_{90}
Sampling stations	:	2 stations * Fence in front of the existing power plant * Ban Nong Fab
Frequency	:	Every 3 months, 5 consecutive days each time

4.4 Operation period

Throughout the operation period

4.5 Responsible company

Glow Energy Public Co., Ltd.

4.6 Operation results evaluation

Glow Energy Public Co., Ltd. submits the results of environmental action plan implementation, together with problems, obstacles, and recommendations, to Office of Natural Resources and Environmental Policy and Planning and Industrial Estate Authority of Thailand in every 6 months.

4.7 Budget

Included in Glow Energy Public Co., Ltd.'s budget

5. Action Plan on Waste Management

5.1 Rationale

Waste generated in the construction phase can be divided into 2 parts including municipal waste from the workers' consumption about 0.4 ton/day and residues from construction which can be partially recycled. In the operation

phase, waste is generated from the production process and office building. Waste from the production process consists of iron scrap, used air filter of CTG and used lubricant, of which a total amount is about 2 tons/year. Waste generated from the office consists of municipal waste and recyclable waste including paper, plastic and hazardous waste (ink, fluorescence, flash light battery), of which is totally about 6 tons/year. Mitigation measures for waste management are proposed as follows.

5.2 Objectives

1. To minimize the waste to be disposed of and maximize the waste for recycling.

2. To treat, dispose of and transport the waste by using proper methods and processes, and in compliance with the related laws and regulations.

3. To minimize the impact from solid waste on public health and the environment.

4. To monitor the results from the project implementation of mitigation measures on solid waste management, and to ensure the efficiency and continuity of the measures implemented.

5.3 Procedure/ operation area

5.3.1 Mitigation measures

1) Construction phase

- Provide sufficient numbers of garbage bags and bins to store waste from the worker.
- Provide sufficient numbers of closed containers to store oily cloth.
- Prohibit littering of waste into the sewers.
- Appoint responsible persons for waste management during construction period.
- Sort out recyclable waste for further selling to recycling companies.
- Contact the government licensed agencies to transport the waste out of the project for disposal.

2) Operation phase

Domestic waste

- Provide 3 different types of waste containers for different types of waste, including degradable waste, recyclable waste and hazardous waste.
- Collect the degradable waste in a proper waste container with a lid, and contact Map Ta Phut Municipality to remove such waste.
- Collect the recyclable waste to be recycled within the project, or sold to the recycling companies.
- Provide a waste storage building with roof covered to temporarily store the waste, before being removed out of the project site for disposal by the government licensed agencies.
- Promote 3R principles for the project waste management; these include reduce, reuse and recycling of waste.
- Collect the hazardous waste in proper containers with lids, and contact the DIW licensed agencies to remove such waste.

Process waste

- Collect hazardous waste from the production process such as lubricant, heat insulator into a proper container with cover, bring such container to the roofed storage area prior to further dispose of which is serviced by licensed agencies (from the Ministry of Industry).

5.3.2 Monitoring measures

Record the information of waste from the project in terms of type, quantity, transportation method and types of disposal, for every month.

5.4 Operation period

Throughout the operation period

5.5 Responsible company

Glow Energy Public Co., Ltd.

5.6 Operation results evaluation

Glow Energy Public Co., Ltd. submits the results of environmental action plan implementation, together with problems, obstacles, and recommendations, to Office of Natural Resources and Environmental Policy and Planning and Industrial Estate Authority of Thailand in every 6 months.

5.7 Budget

Included in Glow Energy Public Co., Ltd.'s budget

6. Action Plan on Social Aspect and Public Participations

6.1 Rationale

From the socio-economic survey in 5 communities surrounding the project area – Takuan AO Pradoo, Wat Sopon, Soi Ruam Patthana, Map Chalood and Nong Fab, it is found that the majority of the interviewees are moderately satisfied with their living conditions, e.g. home location, environment, transportation, public utility, medical service, government agency contact, school, sport field, etc. Most of the interviewees earn enough income for the household expenses. Toward the project operation, most of the interviewees are satisfied at moderate level with the project's technology, safety measure, transportation system, and air and water pollution control systems. The majority of them agree to the project's environmental measure development as well as continuous dissemination of project information.

In addition, the activities of public participations has been carried out by inviting communities around the project area and stakeholders such as government agencies, NGO, education institutes, etc. for the meeting to express comments, concerns toward the project. Issues drawn from the public participations include the possible impacts on air quality, wastewater management (fresh and seawater), biological marine resources, noise level, waste management, and the project information disclosure. The participants gave recommendations on the project to strict follow environmental measures, disclose environmental operation results to public, listen to community's comments, promote public participations, recruit local people to work for the project and support to local education and public health.

From the findings above, the project has created an action plan on social aspect and public participations in order to strengthen the relationship between the project and nearby communities during both the construction and operation phases.

6.2 Objectives

1. To elevate the quality of life of the nearby communities.

2. To promote public participations of the nearby communities during the operation phase.

3. To disclose the project information to the nearby communities in order to strengthen the understanding of the communities regarding the project operation.

6.3 Operation Method

6.3.1 Mitigation measures

1) Construction phase

- Strictly comply with the project environmental policy in order to preserve the surrounding community interests.

- Monitor the construction workers in order to prevent illegal activities such as theft, narcotics, gambling, etc. by imposing rules and punishment.

- Create good relationship with the surrounding communities by meeting with the target communities together with the industrial estate public relations team, and preparing the project's public relations media, such as brochures, newsletters, etc. to announce the project progress or movements.

- Appoint the Tribunal Committee comprised of representatives from the project, the governmental agencies and communities, to monitor the project operation.

2) Operation phase

Social aspect

- Consider employing the local people who possess the qualifications that suit the project requirement as first priority and as many as possible.

- Participate in activities with the nearby communities in order to create good relationship.

- Prepare a pubic relations plan in order to inform the nearby communities about the project details and related information strengthen their understanding to the project operation.

- Arrange community relations activities to cover the development plan for quality of life, health, education and career. The said plans can be revised and improved continuously in order to be consistent with the changing environment in order to elevate the life quality of the nearby communities. Examples of such activities are:

* Community sanitation promotion project

* Medical technology development and Map Ta Phut Hospital development plans

* Public park development and community green area enhancement project

* Primary and secondary education scholarship project

* Community and school career development project

* Academic institute development project in nearby communities.

Public participations

- Arrange a plan for environmental petition (as shown in Figure 5-4).

- Appoint the Tribunal Committee comprised of representatives from the project, the governmental agencies and communities, to monitor the project operation.

6.3.2 Monitoring measures

- Keep records of concerns and petitions from the nearby communities, including the action taken to solve problems and the results.

- Survey opinions from the nearby community toward the implementation of action plan on social aspect and public participations at least once in every 2 years.

6.4 Operation period

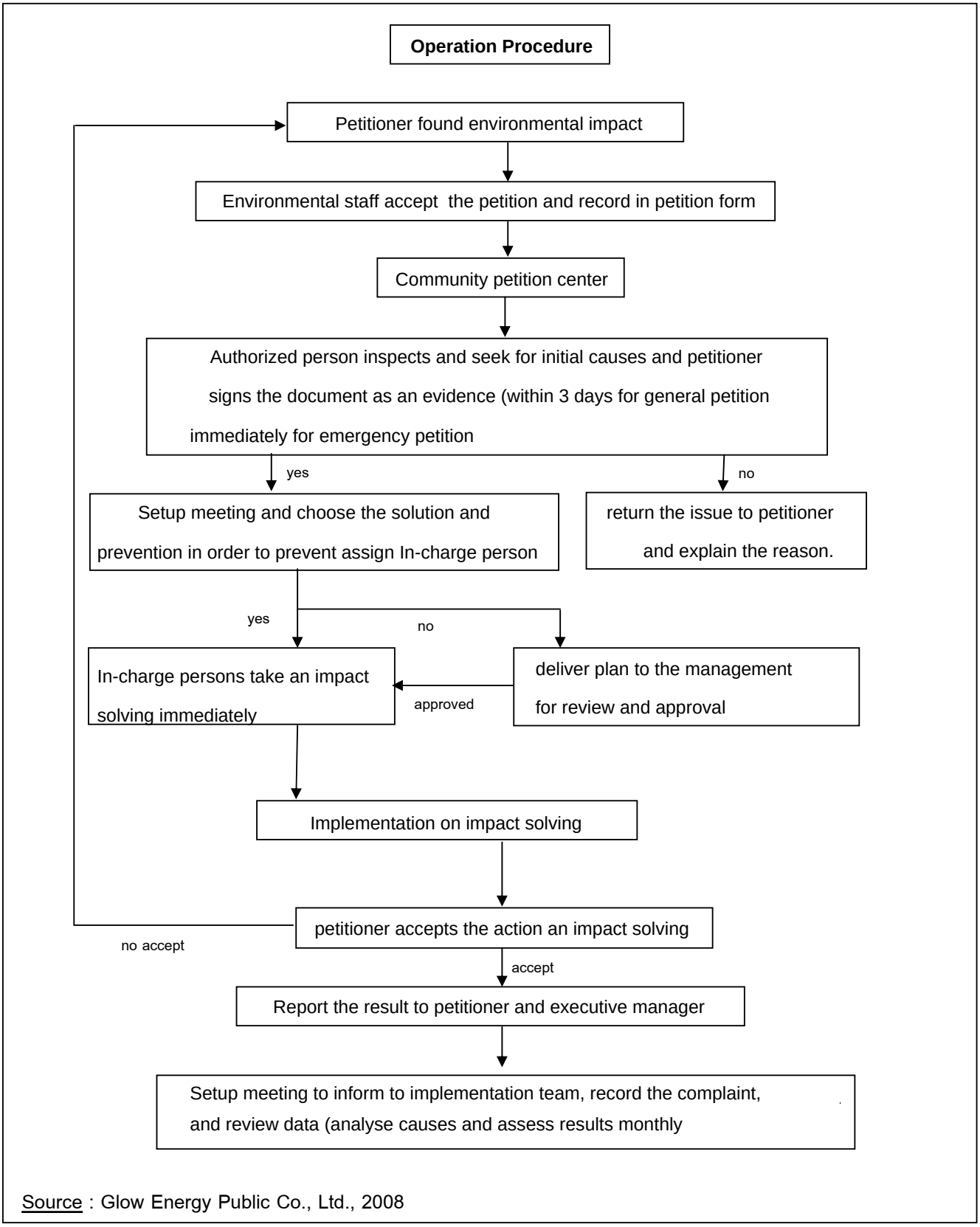
Throughout the operation period

6.5 Responsible company

Glow Energy Public Co., Ltd.

6.6 Operation results evaluation

Glow Energy Public Co., Ltd. submits the results of environmental action plan implementation, together with problems, obstacles, and recommendations, to Office of Natural Resources and Environmental Policy and Planning and Industrial Estate Authority of Thailand in every 6 months.



Source : Glow Energy Public Co., Ltd., 2008

FIGURE 5-4 ACTION PLAN FOR COMMUNITY PETITION ON ENVIRONMENTAL IMPACT

6.7 Budget

Included in Glow Energy Public Co., Ltd.'s budget

7. Action Plan for Occupational Health and Safety

7.1 Rationale

In construction period, impact on occupational health and safety of operating staffs would be induced by the major causes including noise level from the construction machines, accident from unsafe working condition and environment, fire risk from metal welding or electrical short circuit.

In operation phase, impact on occupational health and safety would be induced from unsuitable working condition including noise, light, heat, accident and fire. The operational staffs have to strictly perform in accordance with the action plan on occupational health and safety. In addition, the potential risks of major hazard might possibly occur at two sections; leakage of natural gas pipeline leading to fire, and explosion of boiler owing to high pressure steam. Both hazards lead to adverse impact on human life and property. Hazard assessment from the leakage of natural gas pipeline of 1 inch diameter shows that in case of leaking and immediate firing, jet fire with heat radiation level of 37.5 kW/m^2 would occur within the existing power plant area. For the case of leaking and later firing, the explosion pressure of 0.34 atmospheres would occur in within an area of 49.9-m radius, which is still in the existing power plant area. For hazard assessment from the explosion of HRSG boiler, it indicates that the explosion possibility is at low level. This would affect people at moderate level (since there is a few staffs on-site). The impact on community and the environment would be at low level, and on the property at high level. In conclusion, the risk is at acceptable level.

Even though there could be risks of unexpected incidents during the operation of power plant, which may cause damage on the properties and lives, the project thus proposes programs to prevent the unsafe conditions which may causes accidents and damages on lives, properties and the environment. To ensure proper implementation on occupational health and safety as well as the emergency plans of the project, therefore the project proposes mitigation and monitoring measures on occupational health and safety to be strictly followed.

7.2 Objectives

1. To prevent and reduce the risk of accident and major hazard, and reduce the severity from such accident during the operation.

2. To ensure the safety of lives and properties of the nearby communities and industries from the project operation.

3. To build good relationships among the project, communities, and organizations related to occupational health and safety.

4. To assess the results from implementing the mitigation measures and ensure the implementation of these measures strictly and effectively.

7.3 Operation Method

7.3.1 Mitigation measures

1) Construction phase

Power plant construction site

- Ensure that there is occupational health and safety management indicated in contract which covers the occupational health and safety for the employees.

- Comply with occupational health and safety regulations, such as Labor Protection Act B.E. 2541, Ministry of Interior Notification concerning work safety in the construction, etc.

- The area with machine installation must be isolated, and the equipment and machinery must be placed tidily.

- Post warning signs in the area which is at risk to accident, for example “machine being installed”, “do not turn on the switch”, “construction zone”, “helmet wearing zone”, etc.

- Assign security officers to facilitate the traffic and generally inspect within the construction areas throughout 24 hours everyday.

- Arrange orientation and training for the construction workers concerning safety rules and equipment usage.

- Provide personal protective equipment for the construction workers and enforce the usage of such equipment.

- Designate the supervisor to inspect and ensure the compliance with the safety regulations.

Pipeline system and MRS

- Design the piping system by using construction materials, equipments, machines and procedures as referred to international standards such as ASTM, ASME or API.

- Monitor joints or connecting points of pipelines by applying non-destroying monitoring method using radiation for detecting leaking spots and fractures.

- Welders have to pass a training program and examination from a recognized institute to ensure their skill before actual performing the project works. They are to work under close supervision and control by the expert throughout the process.

- Designate the welding area as dangerous area, and ban any activities causing hazard in such area.

- Prior to actual operation or job delivery from the contractor, testing of natural gas pipeline shall be carried out to ensure the designed performance, particularly the emergency system of natural gas distribution shut off.

2) Operation phase

Safety policy and plan

- Designate a safety policy to be followed by all employees.

- Establish the safety committee to create the plan and procedures on safety action. The committee shall report the results of safety plan implementation to the executive board, and set up the safety meeting at least once a month.

- Prepare safety plan to prevent accident by eliminating or reducing conditions that may cause accidents from employees, machine, or work environments.

- Practice the safety management plan by implementing various safety activities to achieve the objectives of accident prevention.

- Establish risk assessment between the contractor and project at detail designing stage. This is to analyze, study and review the assessment in order to identify potential circumstance and unsafe condition that may lead to major hazard, and to find solutions.

- Provide 24-hour security officers equipped with communication devices to inspect the project area. Such security officers shall be trained and involved in fire fighting rehearsal.

- Arrange various forms of safety activities within the project, such as safety announcement, poster and exhibition.

- Arrange an orientation for new employees before starting work to understand and realize the importance of work safety. The training shall be held periodically.

- Prepare a safety manual for the employees to better understand about safety regulations.

- Provide medical check-up for the new employees prior to starting work, and for all the employees annually.

- Provide first-aid facility, including the referral system, within the project.

Management of working environment

- Design the work environment within the project in accordance with the ministerial rules on Management and Administration of Safety, Occupation Health and Working Environment related to heat, brightness, and noise B.E. 2549 (2006), as follows:

Noise

* Create noise contour to determine the area where noise level is higher than 85 dB(A) and personal protective equipment is to be used.

* Provide a control room with air-conditioned system for the employees to prevent a direct noise exposure.

Brightness

* Ensure sufficient brightness in the workplace and traffic routes.

Heat

* Ensure the workplace is at appropriate temperature.

* Designate the employees who work in high temperature areas to wear personal protective suits.

Safety systems/ equipment

- Provide a sufficient amount of personal protective equipment such as helmets, safety shoes, earmuffs or earplugs, etc.

- Provide sufficient and proper fire extinguishing systems, consisting of sprinkle system, deluge water system, CO_2 system, fire hydrants, mobile foam unit, fire extinguishers and fire detector, to be in accordance with the National Fire Protection Association (NFPA) standard.

- Install various measuring devices to inspect the boiler performance such as pressure, temperature, flow rate, water level, etc. These devices must be linked to control room to report the results and warnings.

- Install the safety or protective equipment at the boiler, including the installation of 2 safety valves at minimum in order to safely release the steam when the pressure level is higher than the limit.

Working with chemicals

- Prepare a safety document of each chemical substance, and post it at the working area.

- Educate the employees about the chemical hazard in case it leaks and spills, and solution guidelines.

- Provide emergency showers in the process area and chemical storage building sufficiently and appropriately.

Natural gas pipeline and MRS

- Prepare a report on risk analysis from potentially risky activities, such as HAZOP study of natural gas pipeline during detailed design stage.

- Provide safety systems of natural gas pipeline including pressure and temperature control systems to prevent over pressure or temperature in the pipeline by using such devices as safety valves, pressure control disc, flow meters, vent valves, check valves, control valves and shut-off valves. These devices can either automatically shut off or manually shut off from the central control room the natural gas distribution (if leakage of the pipeline is found).

- Inspect and test welding points as part of the maintenance plan following the international standard.

- Install pressure measuring devices in natural gas pipelines.

- Install gas detector devices in MRS station.

- Establish emergency control system as a backup system to control the pipeline in case of failure other control systems.

- Assign well trained staffs to be responsible for command and control in case of leakage of natural gas pipelines.

- Organize training to and raise awareness of the staffs on hazard protection of natural gas pipelines.

- Establish an emergency response team prepared for any major hazard occurrences on the pipeline system, and collaborate with PTT Public Company Limited on the response practice.

- Monitor unsafe operations and conditions by providing safety inspectors and operators to inspect along the piping structure.

- Install firewall at the transformer and MRS area (referring to Figures 5-5 and 5-6).

Steam generation unit

- The boiler used shall be in compliance with international standards such as ASME (The American Society of Mechanical Engineering), BS (British Standard), DIN (Deutsches Institute Fur Normung), JIS (Japanese Industrial Standard).

- Provide boiler control operators in compliance with related laws and regulations e.g. Ministerial Regulation No. 2 B.E. 2535 (1992) issued under the Factory Act B.E. 2535 (1992).

- Test boiler's safety equipment/systems at least once a year or as indicated in the related Ministry of Industry notifications, for example the notification No. 26 B.E. 2534 (1991).

- Install various measuring devices to inspect the boiler performance such as pressure, temperature, flow rate, water level, etc. These devices must be linked to control room to report the results and warnings.

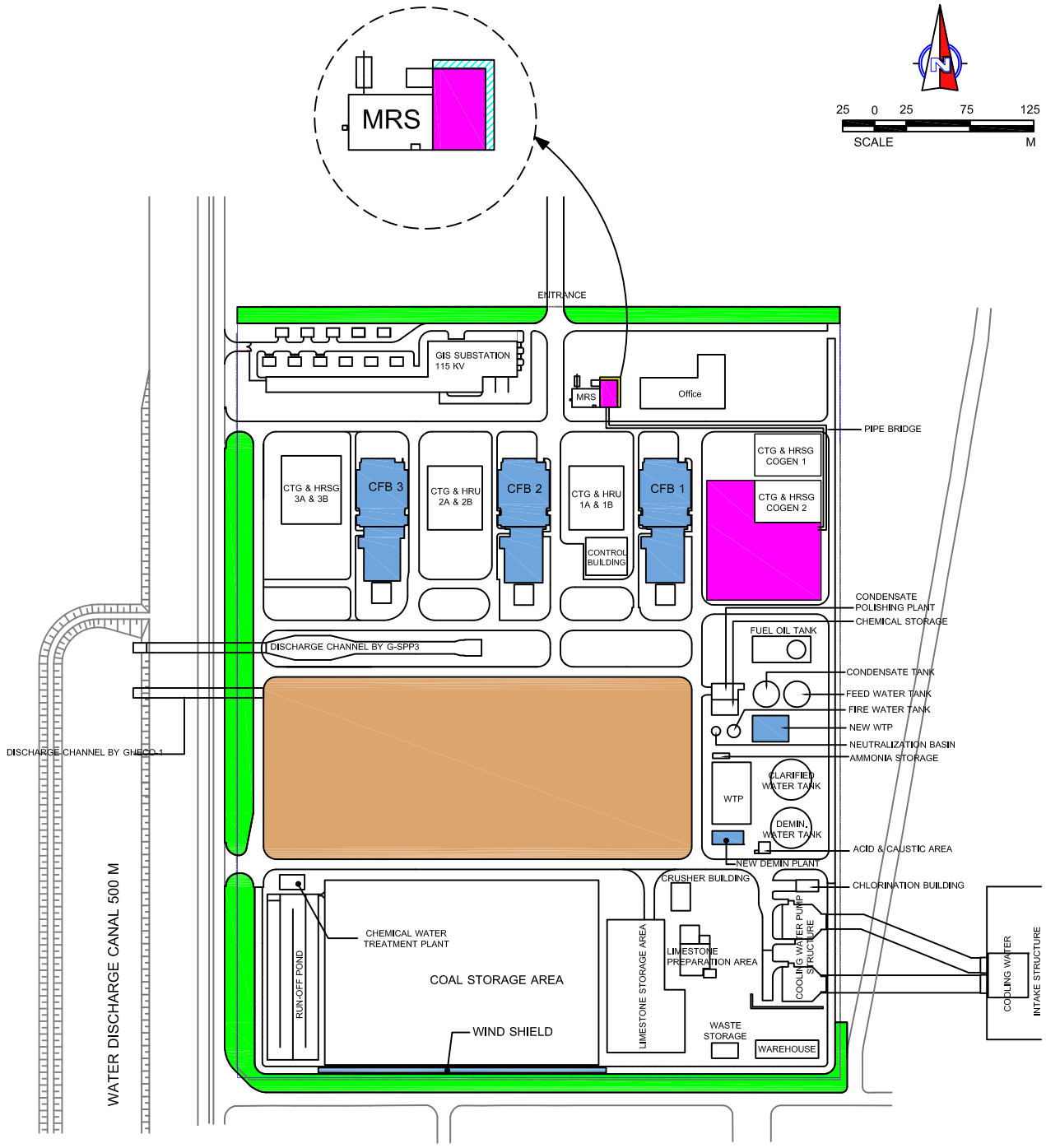
- Install safety protective equipment of the boiler, including the installation of 2 safety valves at minimum in order to safely release the steam when the pressure level is higher than the limit.

- Provide a preventive maintenance plan for the equipment/ systems related to the boiler.

Emergency response plan/preventive maintenance and inspection plan

- Provide emergency response plans as follows:
    * 1st level emergency plan (shown in Figure 5-7)
    * 2nd level emergency plan (shown in Figure 5-8)
    * 3rd level emergency plan (shown in Figure 5-9)

- Arrange an emergency drill for the 1st level emergency plan, together with those from the existing power plant and the 401 MW power plant project, at least once a year, and cooperate with the industrial estate for the 2nd and 3rd level emergency plan drills.



REMARKS

WTP : WATER TREATMENT PLANT

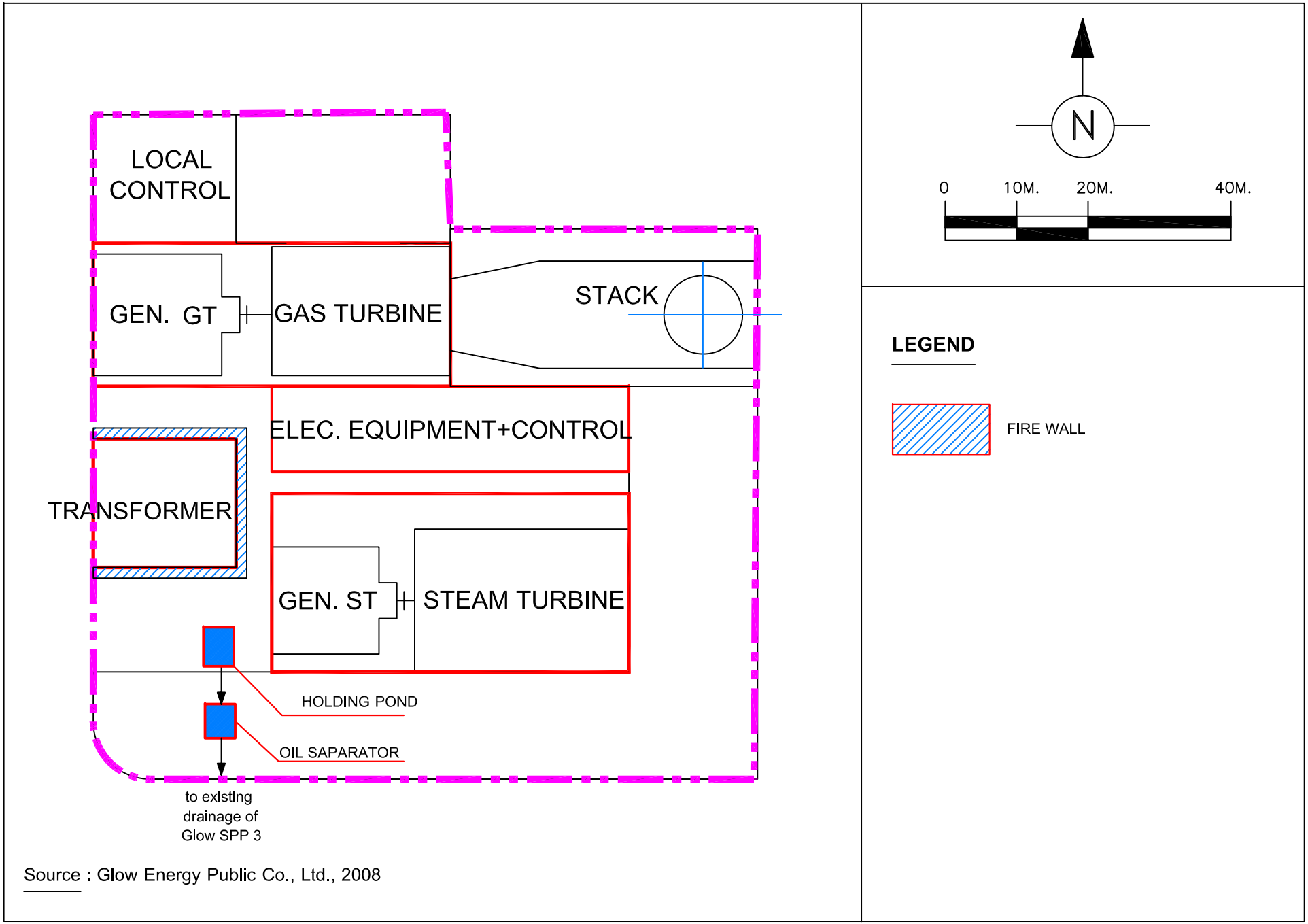
LEGEND

- THERMAL POWER PLANT PROJECT (700 MW) GHECO-ONE CO., LTD.
- COMBINED CYCLE COGENERATION POWER PLANT PROJECT (401 MW) GLOW ENERGY PUBLIC CO., LTD.
- GREEN AREA
- MODIFICATION AREAS : CFB, WIND SHIELD
- FIRE WALL

Source : Glow Energy Public Co., Ltd., 2008

FIGURE 5-5 PROJECT LAYOUT INSIDE THE EXISTING POWER PLANT BOUNDARY

5037A/EIA/F55_F-Class



Source : Glow Energy Public Co., Ltd., 2008

FIGURE 5-6 PROJECT LAND USE AND FIRE WALL

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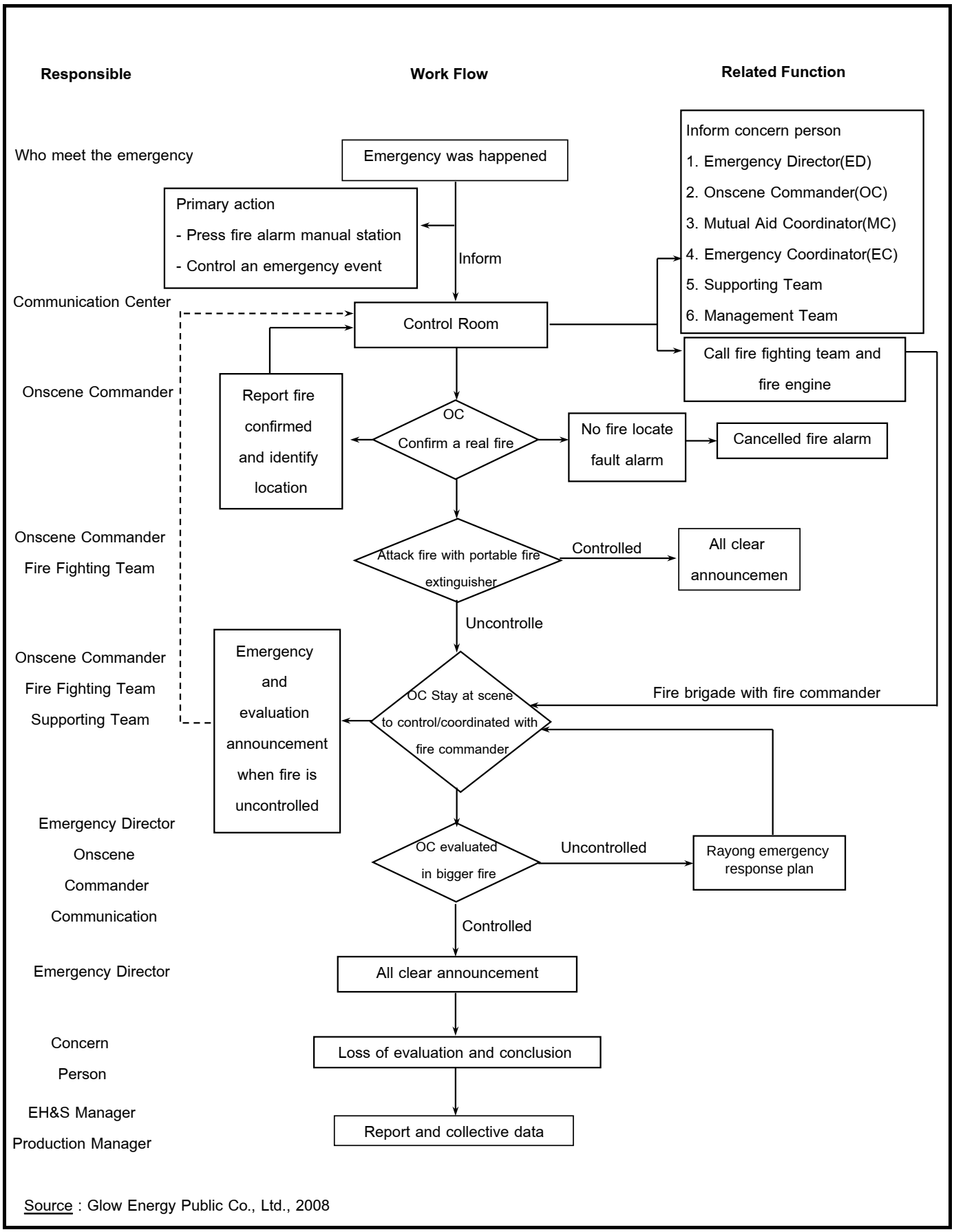
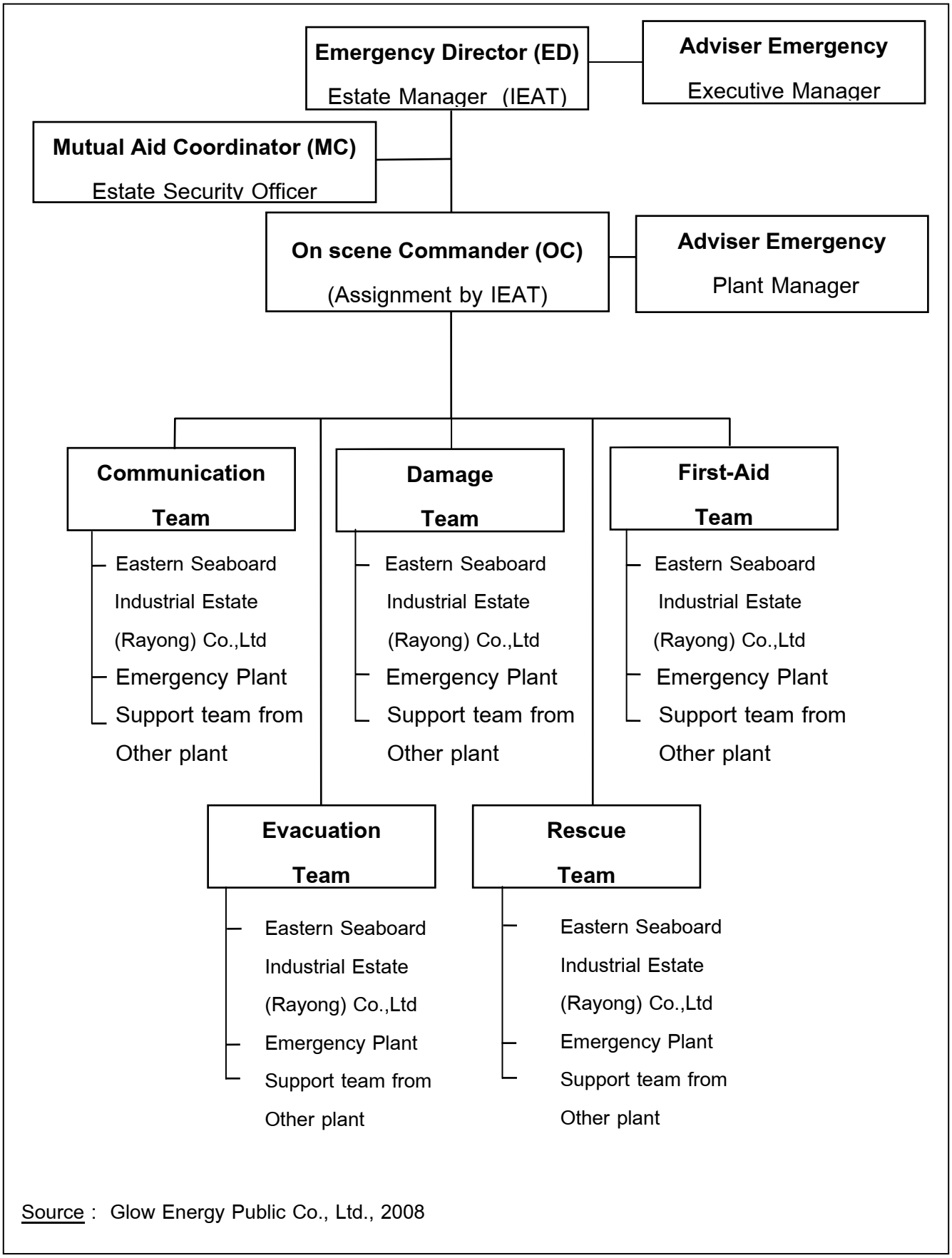


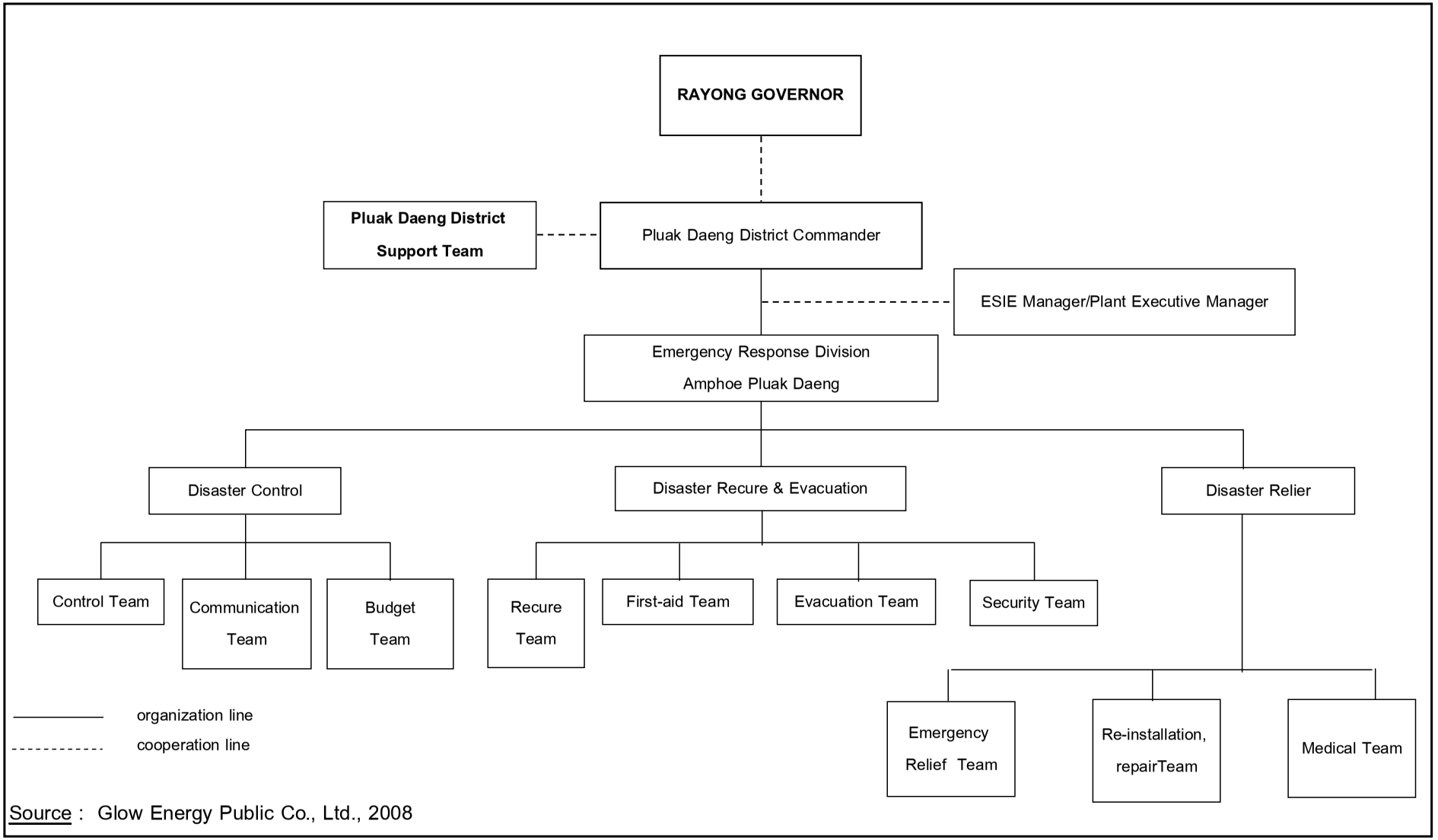
Source : Glow Energy Public Co., Ltd., 2008

FIGURE 5-7 EMERGENCY RESPONSE PLAN LEVEL 1



Source : Glow Energy Public Co., Ltd., 2008

FIGURE 5-8 EMERGENCY RESPONSE PLAN LEVEL 2



Source : Glow Energy Public Co., Ltd., 2008

FIGURE 5-9 EMERGENCY RESPONSE PLAN LEVEL 3

- Daily inspect and seek for unsafe conditions by security officers. If found, they shall correct and improve such conditions immediately.

- Set up a plan for inspection of the fire control systems/equipment. Set up a preventive maintenance plan for the boiler equipment/system.

- Provide a preventive maintenance plan for the equipment/ systems related to the boiler.

7.3.2 Monitoring measure

1) Construction phase

Record the type, area, severity, cause and solution of all accidents within the project.

2) Operation phase

- Monitor the safety parameters as follows

Parameters	:	Heat stress index (WBGT)
Sampling stations	:	Gas turbine generator
Frequency	:	Every 6 months
Parameters	:	Brightness
Sampling stations	:	Production areas
Frequency	:	Every 6 months
Parameters	:	Noise (Leq-8 hrs.)
Sampling stations	:	Gas turbine closure (Figure 5-2)
Frequency	:	Every 3 months, 5 consecutive days each time

- Conduct employee annual check-up as follows:

  * General physical and lung check-up for all employees

  * Hearing ability inspection for the employees working in the area of noise level above 85 dB(A).

  * Visual ability and lung condition inspections for the employees working as welders or associated with heat.

- Collect accident and damage statistics related to the project operation.
- Collect statistics on illness and annual physical check-up.
- Report the emergency drill results

7.4 Operation period

Throughout the operation period

7.5 Responsible company

Glow Energy Public Co., Ltd.

7.6 Operation results evaluation

Glow Energy Public Co., Ltd. submits the results of environmental action plan implementation, together with problems, obstacles, and recommendations, to Office of Natural Resources and Environmental Policy and Planning and Industrial Estate Authority of Thailand in every 6 months.

7.7 Budget

Included in Glow Energy Public Co., Ltd.'s budget

8. Action Plan on Public Health

8.1 Rationale

During construction period, public health impact may be caused by unsanitary practices of the workers, resulting in infectious diseases, and dusts from construction activities which potentially cause respiratory disorders. Hence, the project will have the contractors strictly follow the action plan on public health during the construction period. During the project operation, the impact on public health is potentially caused by the emissions of air pollutants from natural gas burning in the CTG which comprises mainly NO_x and small amounts of SO_2 and TSP. These air emissions may irritate the respiratory system. For example, NO_x at the density of 0.1 ppm or 190 micrograms/m^3 increases the resistance of respiratory system immunity and increases the constriction of the airways in the respiratory system of asthma patients, SO_2 at the density of 0.11-0.19 ppm or 300-500 micrograms/m^3 increases the hospitalization rate due to respiratory disorders, and TSP emission density in the atmosphere is related to asthma and reduction of lung efficiency. According to the results of air quality assessment from the project operation (including the 700 MW power plant project), it is found that the maximum concentrations of NO_2, SO_2, and TSP from the project's emissions do not exceed the national standards, and the areas impacted by the maximum concentrations are not the sensitive areas, such as communities. Therefore, the health impact from the project operation is acceptable.

However, the project has created action plan on public health in order to mitigate the impacts on public health, and monitor the public health quality of the nearby communities during both the construction and operation periods.

8.2 Objectives

1. To minimize the impacts on public health to the nearby communities during both the construction and operation phases.

2. To assess the impacts on health and public health of the nearby communities which may be resulted from the project's operation.

8.3 Procedure/operation area

8.3.1 Mitigation measures

- Follow the following measures to prevent the spread of diseases:
    * Provide clean drinking water for the construction workers.
    * Manage the waste in accordance with the sanitary principals.
    * Provide a sufficient number of toilets for the construction workers.
- Strictly comply with the measures on air quality, water quality, noise level, waste management, and occupational health and safety.
- Provide enough first-aid kits and pharmacies, along with the arrangement of ambulance stand-by in case of emergency.

2) Operation phase

- Set up a plan for regular health impact assessment for the nearby communities.
- Coordinate with the local public health agencies in obtaining the statistics on health quality of the communities, and information on disease prevention and treatments of illnesses resulting from the effects of power plant operation.
- Arrange annual physical check-up for the nearby communities, especially those of a high potential to be affected by the power plant operation (risky group), and keep those records.

8.3.2 Monitoring measure

Operation phase

Parameters	:	Frequency and seriousness of illnesses that may be affected by the power plant operation, such as respiratory disorders, skin diseases, etc.
Sampling stations	:	Within communities potentially affected by the power plant operation
Frequency	:	Once a year, repeat sampling at the same community except when the location impacted tends to change.

8.4 Operation period

Throughout the operation period

8.5 Responsible company

Glow Energy Public Co., Ltd.

8.6 Operation results evaluation

Glow Energy Public Co., Ltd. submits the results of environmental action plan implementation, together with problems, obstacles, and recommendations, to Office of Natural Resources and Environmental Policy and Planning and Industrial Estate Authority of Thailand in every 6 months.

8.7 Budget

Included in Glow Energy Public Co., Ltd.'s budget

TABLE OF ENVIRONMENTAL ACTION PLAN

THE COMBINED CYCLE COGENERATION POWER PLANT OF GLOW ENERGY PUBLIC CO., LTD.

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	GENERAL MEASURES 1. Strictly follow the environmental impact mitigation measures and monitoring measures presented in the form of environmental action plan. Submit the report of action plan implementation results to Office of Natural Resources and Environmental Policy and Planning for reviewing within the period as specified in the action plan. This report shall conform to the Office's reporting guideline. 2. Control air emission rates from the power plant project in accordance with the air emission reduction plan of Glow SPP3 Co., Ltd. and in conjunctions with the thermal power plant project of Gheco-One Co., Ltd. In order to conform to the National Environmental Board's criteria on emission standard issued at the 6th/2550 meeting held on 9th April 2007. The emission results from the three plants shall be presented on a display board at the entrance of existing power plant, and linked to other involved parties.		Glow Energy Public Co., Ltd.

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	3. After the mathematical model's input data has been corrected to be reliable by the Industrial Estate Authority of Thailand, this set of input data shall be used for air quality assessment. If the air quality assessment results from such model are higher than the air quality standard, Glow Energy Public Co., Ltd. shall reduce its air emissions to meet the standard. 4. Create an air emission database from the project's actual air emissions to be used for air quality's monitoring and problem solving by other related parties. 5. Create a database of volume of cooling water consumed within the project, and set up a plan to reduce the consumption of cooling water. 6. Cooperate, support and promote any organizations specialized in marine resource conservation and revitalization throughout the project operation. 7. To remove solid waste out of the project site, Glow Energy Public Co., Ltd. shall be obliged		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	to the notification of the Ministry of Industry: Disposal of Waste and Unusable Materials B.E. 2548 (2005), or related regulations enforced by the government. 8. In case that Glow Energy Public Co., Ltd. hires a contracting company to design/construct/ operate its power plant project, Glow Energy shall address its environmental action plan within the contract condition and ensure the contracting company to strictly comply with the action plan. 9. If the monitoring results from project operation expose a sign of environmental problem, Glow Energy Public Co., Ltd. shall solve and improve the problem immediately. If there is any incident that might effect the environmental quality, the company shall inform to Rayong province, Industrial Estate Authority of Thailand, Office of Natural Resources and Environmental Policy and Planning and other related parties so that these parties can participate in solving those problems.		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	10. If Glow Energy Public Co., Ltd. needs to change/modify project details and/or its environmental action plan to be different from those said in the company's EIA report, the company shall submit the corrected versions of EIA report, detailing the changed parts and results of environmental impact study originating from the changed parts, to the EIA expert committee for reviewing and giving approval prior to the modification. 11. If there are any problems or concerns from local communities regarding the project operation, Glow Energy Public Co., Ltd. shall solve such problems in order to minimize conflicts in the communities. 12. If the project has not been constructed within 2 years since Office of Natural Resources and Environmental Policy and Planning approved the project's EIA report, the project shall review the environmental impact and action plan in the EIA report, and submit the report to the Office of Natural Resources and Environmental Policy and Planning for reviewing.		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
1. Action Plan on Air Quality During construction phase, air quality impact will be induced by dust dispersion generated from soil surface opening. Dust quantity is estimated to be increased to 8.7 microgram/m^3 (worst case). The highest dust concentration measured in the study area at Nong Fab community in 2004-2006 was 187 microgram/m^3. Therefore, during the project's construction period the total dust concentration will be 195.7 microgram/m^3 (worst case), which is within the ambient air standard of 330 microgram/m^3. Impact on air quality is expected to be substantially low. During operation phase, the significant air pollution is air emissions from natural gas combustion. Oxide of nitrogen (NO_x) is the major air pollutant. Other minor pollutants including sulfur	**1) Construction phase** **Transportation of workers and construction materials** - The trucks must be properly covered in order to prevent spilling of the loaded materials and dust dispersion. - Limit the speed of the vehicles in the construction area of not exceeding 40 km/hr. - Remove dirt and soil that might be stuck on the truck's wheels before leaving the construction area. **Construction area** - Spray water over the construction area to prevent dust dispersion from construction activities at least 2 times per day (except in raining period). - Inspect and maintain the machines and engines used for construction to be in good condition and in accordance with the instruction manual of each unit.	**1) Construction phase** **Ambient air quality** Parameters : Inspect TSP dust and PM-10 (averaged 24 hours) Sampling stations : 2 stations * At the fence of existing power plant * Ban Nong Fab Frequency : 2 times a year, 7 consecutive days per each time	Glow Energy Public Co., Ltd.

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
dioxide (SO_2) and total suspended particulates (TSP) might also be emitted. With NO_x emission control system namely dry low NO_x burner of CTG unit, NO_x concentration will be within the emission standard as well as the criteria imposed by the National Environment Board from the 6th/2007 meeting held on April 9th, 2007. From the ambient air quality assessment, the impact on air quality from the project will be at acceptable level. To ensure and monitor the air quality that might be impacted from the project's activities, the project has set up environmental measures on air quality to be strictly followed for both construction and operation phases.	- Prohibit burning of residues or garbage in construction area. - Provide adequate dust protective equipment to the workers working in dusty areas. **2) Operation phase** **Control of air emissions from HRSG stack** - Control air emissions from the project's HRSG stack as follows: ▪ NO_X not exceeding 55 ppm and 27.92 grams/second ▪ SO_2 not exceeding 0.95 ppm and 0.67 grams/second ▪ TSP not exceeding 5 mg/Nm^3 and 1.35 grams/second - Air emissions from the project's HRSG stack are allowed after the existing power plant has reduced their emission rates to be under the criteria approved by the National Environmental Board as shown in Table 5-1. - Set up alarm signals for the air emission level to be heard in the control room. These alarms	**2) Operation phase** **Ambient air quality** Parameters : NO_x (1 hr.), SO_2 (1 and 24 hrs.), TSP (24 hrs.), PM-10, wind speed and direction Sampling stations : 4 stations (Figure 5-1) * Map Ta Phut Health Care Station * Map Chalood Temple * Muang Mai Map Ta Phut * Ban Nong Fab Frequency : 2 times a year, 7 consecutive days per each time **Air emissions at sources** <u>Measured with CEMs</u> Parameters : NO_x, SO_2, TSP	

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	can be divided into 2 levels: high level alarm and high high level alarm. After the alarm has been heard, the following practices shall be done: ■ For the "high level alarm" (set up at 90% of the controlled emission rate), the operators have to inspect the conditions of operation unit and emission control system. The maintenance or adjustment must be done immediately. ■ For the "high high level alarm" (set up at 98% of the controlled emission rate), the operators have to reduce or stop the production. The maintenance of the emission control systems must be done and ensured the emission rates before restart-up the operation. - In the case that the rate of emissions from the stack exceeds the limitation, the values of emission rate that exceed the limitation and period of exceeding emissions must be recorded, and also root cause analysis and preventive plan must be undertaken.	Sampling stations : CTG-HRSG stack (Figure 5-2) Frequency : Continuous <u>Measured by stack sampling</u> Parameters : NO_x, SO_2, TSP Sampling stations : CTG-HRSG stack (Figure 5-2) Frequency : 2 times a year <u>Greenhouse gas emission assessment</u> Parameters : CO_2 Method : UNFCCC assessment method Frequency : Once a year	

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	- Appoint a skilled person to control the combustion and emission control systems. **Air pollution control equipments and management** - Provide the CTG with dry low-NO_x burner - Prepare sufficient spare parts of air emission control systems in order to immediately replace when encountering the failure. - Provide a condensate circulating system at low pressure economizer of HRSG to increase temperature of exhausted gas prior to emitting through stack in case of appearance of SO_2 concentration in the exhausted gas (as indicated by CEMs) in order to prevent dew point of sulfuric acid. - Set up preventive maintenance program for the machines related to air emission control systems. The plan shall be set in accordance with the system manuals.		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	Measurement and presentation of air emission values - Install continuous emission monitoring system (CEMs) and record the measurement data derived from CEMs. - Present the measurement results of air emission rates from CEMs, including NO_x, SO_2, and TSP, to the public via emissions display board of the existing power plant located at the front gate of the plant. - Present the project's operating result regarding environmental measures (especially air emissions) to the public and involved agencies in order to enhance public participations (in monitoring the project's environmental implementation) through various channels such as emission display board, air quality monitoring center of IEAT, newsletter, the project's environmental annual report or website, etc. - In case the CEMs have a problem, the project has to apply a portable gas detector to measure air emissions in every 2 hours, and fix the CEMs immediately.		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
2. Action Plan on Water Quality Wastewater from the project during construction period is from construction activities and the construction workers' domestic use which is generated at approximately 16.5 m^3/day. Wastewater that occurred during the operation is mainly from seawater that is used in the cooling system to condense the used steam from turbine. The project requires seawater at the maximum flow rate of 8.33 m^3/second. Main pollutants occurred from the cooling process are the higher temperature and residual chlorine. By using mathematical model to analyze the effect of used seawater drainage from the existing power plant area in the future (with a total volume of 77.96 m^3/second), it is found out that the temperature of seawater at the end of the 500-meter canal is higher than the	**1) Construction phase** - Provide sufficient toilets for the workers in accordance with the public health standard. - Make sure that there is no blockage to the sewer. - Prohibit discarding waste in the sewer. - Install a screen to collect solid waste out of the rainwater before releasing to the rain gutter. - Occasionally remove dirt and construction materials from the sewer to prevent blocking. **2) Operation phase** **Wastewater (fresh water)** <u>Process area and office</u> - Collect wastewater from domestic use into a septic tank before releasing to the holding pond. - Establish a maintenance procedure for all the wastewater treatment systems, and regularly follow the plan. - Collect boiler blow down water to raw water basin of the existing power plant for further use in clarified water plant.	**1) Construction phase** -	Glow Energy Public Co., Ltd.
		2) Operation phase **Wastewater (fresh water)** Parameters : BOD, SS, temperature, pH, TDS and DO Sampling stations : Holding pond (Figure 5-2) Frequency : Once a month **Wastewater (seawater)** Parameters : temperature, pH, Salinity, conductivity,	

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
inlet point of 4.24 °C at most, and increases not exceeding 2 °C at the 1,000-meter distance from the canal outlet. The residual chlorine is not found at such distance which conforms to the seawater quality standards for industry and sea port. Therefore, the effect to the water quality from temperature and chlorine volume is slight. Glow Energy Public Co., Ltd. has established environmental mitigation plan for the project to strictly follow during both construction and operation phases to minimize the impact on water quality.	- Collect wastewater from cleaning processes to oil separation tank and drain to the project's holding pond. - Install a holding pond of at least 1 m^3 for storing treated wastewater and inspecting its quality. The water whose quality is within the standard is drained out to the 500-meter canal and further to the seawater **Wastewater (seawater)** - Limit the consumption of seawater for the project's cooling system at the maximum rate of 8.33 m^3/second. - Install automatic temperature and chlorine measuring devices at the cooling water outfall. The results are to be displayed at the control room, and also to be recorded. - Control the temperature difference of the seawater used in the project's condenser of not exceeding 5°C as follows: * Install continuous temperature measuring devices at the seawater pumping station and after	TDS, turbidity and DO Sampling stations : Project wastewater sampling station (Figure 5-2) Frequency : Once a week Parameters : BOD and SS Sampling stations : Project wastewater sampling station (Figure 5-2) Frequency : Once a month **Seawater quality at sea** Parameters : temperature, pH, Salinity,conductivity, TDS, turbidity, DO and transparency. Sampling stations : 7 stations (Figure5-3) * Station I, near the seawater intake station * Station E, near 500-meter canal	

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	the condenser of the project. The results are displayed at the central control room. * The operator is to control seawater consumption at the optimum rate in relation to the seawater temperature difference before and after the project and to the production capacity. If the temperature difference tends to exceed 5°C, the project has to increase the seawater flow rate but not exceeding 8.33 m^3/second totally, or reduce the production capacity if the maximum usage of water is reached. - Control the concentration of chlorine in the seawater drain of not exceeding 0.1 mg/liter as follows: * Install a continuous measuring device of chlorine concentration in the project's seawater outfall. The result will be displayed at the central control room. * The operator is to control sodium hypochlorite usage at appropriate rate in relation to the measured result. The concentration must	outfall * Station A, D and O, 500 meters from 500-meter canal outfall * Station B and C, 1,000 meters from 500-ter canal outfall Frequency : Once a week Parameters : BOD, SS and residual chlorine Sampling stations : 7 stations (Figure 5-3) * Station I, near the seawater intake station. * Station E, near 500-meter canal outfall * Station A, D and O, 500 meters from 500-meter canal outfall * Station B and C, 1,000 meters from 500-meter canal outfall Frequency : Once a month	

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	be sufficient to control the microorganisms but not exceeding 0.1 mg/liter. If the concentration of chlorine tends to exceed 0.1 mg/liter, the operator has to lower the amount of used sodium hypochlorite in order to control the chlorine concentration to be within the limit. - Provide sufficient toilets for the workers in accordance with the public health standard. - Make sure that there is no blockage to the sewer. - Prohibit discarding waste in the sewer. - Install a screen to collect solid waste out of the rainwater before releasing to the rain gutter. - Occasionally remove dirt and construction materials from the sewer to prevent blocking.		
3. Action Plan on Marine Biological Resources During the operation of the 2 new power plant projects, the consumption of seawater for the cooling systems of all the	**Operation phase** **Mitigation measures** - Control the velocity of the seawater in front of the intake tunnel of not more than 0.3 m/s to help sea animals escape from the suction.	**Operation phase** Parameters : Type, quantity, diversity and density of phytoplankton, zooplankton and benthos	Glow Energy Public Co., Ltd.

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
users in the existing power plant area will be at maximum of 77.96 m^3/second. An environmental impact assessment on marine biological resources, taking into account changes in the number of phytoplankton, zooplankton and marine animals at the sea near the power plant due to the area's seawater consumption, has been conducted. The reduction of plankton is found in a considerable amount. However, the life cycle of the plankton is about 3-4 days and it will restore itself in a very short period of time through photosynthesis. This kind of plankton reduction should be acceptable. The reduction of large sea animal numbers is in minimum because the power plant has a screening mesh to reduce the water velocity and to prevent marine animals to enter the inlet pipe. In the other way, this may affect small sea animals which can go through the	- The seawater intake tunnel shall be designed to be at least 2 meters deep from the seawater surface to reduce the loss of plankton, which mostly stay at 30 cm to 2 meters in depth. **Restoration and supplemental measures for biological marine resources** - Coordinate with local communities and related academic institutes to set up a proper procedure/plan to supplement economic marine species at sea. At first, the project plan to release as many as 250,000 culture marine juveniles per year for the first three years during operation. - Follow up the supplemental plan implementing results through various means including interviewing the local fishermen on the total catch and income, and so on. The results will be analyzed for further improvement of the plan, while the plan improvement is to be undertaken in every 2-3 years.	Sampling stations : 6 stations (Figure 5-3) * Station I, near the seawater intake station * Station A, D and O, 500 meters from 500-meter canal outfall * Station B and C, 1,000 meters from 500-meter canal outfall Frequency : 3 times a year Parameters : Type, quantity, diversity and density of early-stage marine animals Sampling stations : 2 stations (Figure 5-3) * Station I, near the seawater intake station * Station B, 1,000 meters from 500-meter canal outfall Frequency : 3 times a year	

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
screening mesh. However, as the project is located in a reclaimed land of Map Ta Put Seaboard; the sea in this area is classified as for industrial and sea port purposes, causing the water quality and the environment in this area being unsuitable for spawning of general marine fauna. This is matching with the findings of the project sea analysis, which indicates that no premature economic marine animals are found at the project sea (only sea worms are found). Therefore, the impact on economic marine animals is slight. For the impact on the seawater temperature regarding the cooling water outfall, a study of the project indicates that the temperature may rise to 34.3±0.32 ^{o}C (based on 2005 results). This temperature level does not affect the survival of plankton. Moreover, this level helps increase its growth rate. The impact on the biological marine resources is	- Follow up the changes in numbers of early-stage marine animals at the project's seawater intake station in order to evaluate for appropriate number of marine lives to be released. - Support the local fishermen to create "crab bank" in order to hatch crab eggs from crab parents to increase crab numbers in the natural sea. - Support the local fishermen to create "squid bank" in order to hatch squid eggs collected from fishery devices to increase squid numbers in the natural sea. - Interview and survey the opinions of local fishery villagers on pros, cons, obstacles and achievements owing to the restoration and supplemental measures. The results will be used for improving the measures to be most effective. - Evaluate the achievements and obstacles of the restoring and supplemental measures by coordinating with experts and academic institutes in order to improve the measures to be most		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
therefore acceptable. The project has set up an action plan on marine biological resources for undertaking during its operation. This is to minimize the negative impact on the seashore ecology and restore the marine life at most effective manner.	effective and suitable for the project location. - Interview the local communities in 5-km radius around the power plant, especially those practicing aquaculture on the production statistics and water quality since the past to present times.		
4. Action Plan on Noise Level The nuisance noise is from the construction activities and machines, especially from piling, backhoe truck, grader truck etc. This noise is expected to transmit to Ban Nong Fab (the closest sensitive area from the project) at a level of around 57.4 dB(A) (slightly increased from 56.6 dB(A) in normal condition). The impact should be at low level. In the operation period, the major noise sources are from steam turbine, turbine generator, boiler feed water pumps and	**1) Construction phase** - Prohibit any construction activities that generate the loud noise between 19.00-07.00 hrs. - Construct temporary fences around the construction area. - Inspect and maintain the machines and equipment used for construction to be in good condition and in accordance with the instruction manual of each unit. - Conduct public relations to the communities closed to the project on the project construction plan prior to beginning the construction work.	**1) Construction phase** Parameters : Leq-24 hour and L_{90} Sampling stations : 2 stations * Fence in front of the existing power plant * Ban Nong Fab Frequency : 2 times a year, 5 consecutive days each time	Glow Energy Public Co., Ltd.

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
cooling water pumps. Even this, the noise level at Ban Nong Fab is still unchanged. The impact is minimal on the community. However, in order to minimize noise pollution induced by the project implementation, mitigation and monitoring measures for construction and operation phases have to be strictly performed.	**2) Operation phase** - Install a silencer at the HRSG's steam vent to reduce noise level.	**2) Operation phase** Parameters : Leq-24 hour and L_{90} Sampling stations : 2 stations * Fence in front of the existing power plant * Ban Nong Fab Frequency : Every 3 months, 5 consecutive days each time	
5. Action Plan on Waste Management Waste generated in the construction phase can be divided into 2 parts including municipal waste from the workers' consumption about 0.4 ton/day and residues from construction which can be partially recycled. In the operation phase, waste is generated from the production process and office building. Waste from the production process	**1) Construction phase** - Provide sufficient numbers of garbage bags and bins to store waste from the worker. - Provide sufficient numbers of closed containers to store oily cloth. - Prohibit littering of waste into the sewers. - Appoint responsible persons for waste management during construction period. - Sort out recyclable waste for further selling to recycling companies.	**1) Construction phase** -	Glow Energy Public Co., Ltd.

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
consists of iron scrap, used air filter of CTG and used lubricant, of which a total amount is about 2 tons/year. Waste generated from the office consists of municipal waste and recyclable waste including paper, plastic and hazardous waste (ink, fluorescence, flash light battery), of which is totally about 6 tons/year. Mitigation measures for waste management are proposed as follows.	- Contact the government licensed agencies to transport the waste out of the project for disposal. **2) Operation phase** **Domestic waste** - Provide 3 different types of waste containers for different types of waste, including degradable waste, recyclable waste and hazardous waste. - Collect the degradable waste in a proper waste container with a lid, and contact Map Ta Phut Municipality to remove such waste. - Collect the recyclable waste to be recycled within the project, or sold to the recycling companies. - Provide a waste storage building with roof covered to temporarily store the waste, before being removed out of the project site for disposal by the government licensed agencies. - Promote 3R principles for the project waste management; these include reduce, reuse and recycling of waste.		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	- Collect the hazardous waste in proper containers with lids, and contact the DIW licensed agencies to remove such waste. **Process waste** - Collect hazardous waste from the production process such as lubricant, heat insulator into a proper container with cover, bring such container to the roofed storage area prior to further dispose of which is serviced by licensed agencies (from the Ministry of Industry).		
6. Action Plan on Social Aspect and Public Participations From the socio-economic survey in 5 communities surrounding the project area - Takuan AO Pradoo, Wat Sopon, Soi Ruam Patthana, Map Chalood and Nong Fab, it is found that the majority of the interviewees are moderately satisfied with their living conditions, e.g. home location, environment, transportation, public utility,	**1) Construction phase** - Strictly comply with the project environmental policy in order to preserve the surrounding community interests. - Monitor the construction workers in order to prevent illegal activities such as theft, narcotics, gambling, etc. by imposing rules and punishment. - Create good relationship with the surrounding communities by meeting with the target communities together with the industrial estate public relations	- Keep records of concerns and petitions from the nearby communities, including the action taken to solve problems and the results. - Survey opinions from the nearby community toward the implementation of action plan on social aspect and public participations at least once in every 2 years.	Glow Energy Public Co., Ltd

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
medical service, government agency contact, school, sport field, etc. Most of the interviewees earn enough income for the household expenses. Toward the project operation, most of the interviewees are satisfied at moderate level with the project's technology, safety measure, transportation system, and air and water pollution control systems. The majority of them agree to the project's environmental measure development as well as continuous dissemination of project information. In addition, the activities of public participations has been carried out by inviting communities around the project area and stakeholders such as government agencies, NGO, education institutes, etc. for the meeting to express comments, concerns toward the project. Issues drawn from the public participations include the possible impacts on air quality, wastewater management (fresh and	team, and preparing the project's public relations media, such as brochures, newsletters, etc. to announce the project progress or movements. - Appoint the Tribunal Committee comprised of representatives from the project, the governmental agencies and communities, to monitor the project operation.. **2) Operation phase** **Social aspect** - Consider employing the local people who possess the qualifications that suit the project requirement as first priority and as many as possible. - Participate in activities with the nearby communities in order to create good relationship. - Prepare a pubic relations plan in order to inform the nearby communities about the project details and related information strengthen their understanding to the project operation. - Arrange community relations activities to cover the development plan for quality of life,		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
seawater), biological marine resources, noise level, waste management, and the project information disclosure. The participants gave recommendations on the project to strict follow environmental measures, disclose environmental operation results to public, listen to community's comments, promote public participations, recruit local people to work for the project and support to local education and public health. From the findings above, the project has created an action plan on social aspect and public participations in order to strengthen the relationship between the project and nearby communities during both the construction and operation phases.	health, education and career. The said plans can be revised and improved continuously in order to be consistent with the changing environment in order to elevate the life quality of the nearby communities. Examples of such activities are: * Community sanitation promotion project * Medical technology development and Map Ta Phut Hospital development plans * Public park development and community green area enhancement project * Primary and secondary education scholarship project * Community and school career development project * Academic institute development project in nearby communities. **Public participations** - Arrange a plan for environmental petition (as shown in Figure 5-4). - Appoint the Tribunal Committee comprised of representatives from the project, the governmental agencies and communities, to monitor the project operation.		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
7. Action Plan for Occupational Health and Safety In construction period, impact on occupational health and safety of operating staffs would be induced by the major causes including noise level from the construction machines, accident from unsafe working condition and environment, fire risk from metal welding or electrical short circuit. In operation phase, impact on occupational health and safety would be induced from unsuitable working condition including noise, light, heat, accident and fire. The operational staffs have to strictly perform in accordance with the action plan on occupational health and safety. In addition, the potential risks of major hazard might possibly occur at two sections; leakage of natural gas pipeline leading to fire,	**1) Construction phase** **Power plant construction site** - Ensure that there is occupational health and safety management indicated in contract which covers the occupational health and safety for the employees. - Comply with occupational health and safety regulations, such as Labor Protection Act B.E. 2541, Ministry of Interior Notification concerning work safety in the construction, etc. - The area with machine installation must be isolated, and the equipment and machinery must be placed tidily. - Post warning signs in the area which is at risk to accident, for example “machine being installed”, “do not turn on the switch”, “construction zone”, “helmet wearing zone”, etc. - Assign security officers to facilitate the traffic and generally inspect within the construction areas throughout 24 hours everyday. - Arrange orientation and training for the	**1) Construction phase** Record the type, area, severity, cause and solution of all accidents within the project.	Glow Energy Public Co., Ltd

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
and explosion of boiler owing to high pressure steam. Both hazards lead to adverse impact on human life and property. Hazard assessment from the leakage of natural gas pipeline of 1 inch diameter shows that in case of leaking and immediate firing, jet fire with heat radiation level of 37.5 kW/m^2 would occur within the existing power plant area. For the case of leaking and later firing, the explosion pressure of 0.34 atmospheres would occur in within an area of 49.9-m radius, which is still in the existing power plant area. For hazard assessment from the explosion of HRSG boiler, it indicates that the explosion possibility is at low level. This would affect people at moderate level (since there is a few staffs on-site). The impact on community and the environment would be at low level, and on the	construction workers concerning safety rules and equipment usage. - Provide personal protective equipment for the construction workers and enforce the usage of such equipment. - Designate the supervisor to inspect and ensure the compliance with the safety regulations. **Pipeline system and MRS** - Design the piping system by using construction materials, equipments, machines and procedures as referred to international standards such as ASTM, ASME or API. - Monitor joints or connecting points of pipelines by applying non-destroying monitoring method using radiation for detecting leaking spots and fractures. - Welders have to pass a training program and examination from a recognized institute to ensure their skill before actual performing the project works. They are to work under close supervision and control by the expert throughout		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
property at high level. In conclusion, the risk is at acceptable level. Even though there could be risks of unexpected incidents during the operation of power plant, which may cause damage on the properties and lives, the project thus proposes programs to prevent the unsafe conditions which may causes accidents and damages on lives, properties and the environment. To ensure proper implementation on occupational health and safety as well as the emergency plans of the project, therefore the project proposes mitigation and monitoring measures on occupational health and safety to be strictly followed.	the process. - Designate the welding area as dangerous area, and ban any activities causing hazard in such area. - Prior to actual operation or job delivery from the contractor, testing of natural gas pipeline shall be carried out to ensure the designed performance, particularly the emergency system of natural gas distribution shut off. **2) Operation phase** **Safety policy and plan** - Designate a safety policy to be followed by all employees. - Establish the safety committee to create the plan and procedures on safety action. The committee shall report the results of safety plan implementation to the executive board, and set up the safety meeting at least once a month. - Prepare safety plan to prevent accident by eliminating or reducing conditions that may cause accidents from employees, machine, or work	**2) Operation phase** - Monitor the safety parameters as follows Parameters : Heat stress index (WBGT) Sampling stations : Gas turbine generator Frequency : Every 6 months Parameters : Brightness Sampling stations : Production areas	

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	environments. - Practice the safety management plan by implementing various safety activities to achieve the objectives of accident prevention. - Establish risk assessment between the contractor and project at detail designing stage. This is to analyze, study and review the assessment in order to identify potential circumstance and unsafe condition that may lead to major hazard, and to find solutions. - Provide 24-hour security officers equipped with communication devices to inspect the project area. Such security officers shall be trained and involved in fire fighting rehearsal. - Arrange various forms of safety activities within the project, such as safety announcement, poster and exhibition. - Arrange an orientation for new employees before starting work to understand and realize the importance of work safety. The training shall be held periodically.	Frequency : Every 6 months Parameters : Noise (Leq-8 hrs.) Sampling stations : Gas turbine closure (Figure 5-2) Frequency : Every 3 months, 5 consecutive days each time - Conduct employee annual check-up as follows: * General physical and lung check-up for all employees * Hearing ability inspection for the employees working in the area of noise level above 85 dB(A). * Visual ability and lung condition inspections for the employees working as welders or associated with heat. - Collect accident and damage statistics related to the project operation. - Collect statistics on illness and annual	

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	- Prepare a safety manual for the employees to better understand about safety regulations. - Provide medical check-up for the new employees prior to starting work, and for all the employees annually. - Provide first-aid facility, including the referral system, within the project. **Management of working environment** - Design the work environment within the project in accordance with the ministerial rules on Management and Administration of Safety, Occupation Health and Working Environment related to heat, brightness, and noise B.E. 2549 (2006), as follows: <u>Noise</u> * Create noise contour to determine the area where noise level is higher than 85 dB(A) and personal protective equipment is to be used. * Provide a control room with air-conditioned system for the employees to prevent	physical check-up. - Report the emergency drill results	

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	a direct noise exposure. Brightness * Ensure sufficient brightness in the workplace and traffic routes. Heat * Ensure the workplace is at appropriate temperature. * Designate the employees who work in high temperature areas to wear personal protective suits. **Safety systems/ equipment** - Provide a sufficient amount of personal protective equipment such as helmets, safety shoes, earmuffs or earplugs, etc. - Provide sufficient and proper fire extinguishing systems, consisting of sprinkle system, deluge water system, CO_2 system, fire hydrants, mobile foam unit, fire extinguishers and fire detector, to be in accordance with the National Fire Protection Association (NFPA)		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	standard. - Install various measuring devices to inspect the boiler performance such as pressure, temperature, flow rate, water level, etc. These devices must be linked to control room to report the results and warnings. - Install the safety or protective equipment at the boiler, including the installation of 2 safety valves at minimum in order to safely release the steam when the pressure level is higher than the limit. **Working with chemicals** - Prepare a safety document of each chemical substance, and post it at the working area. - Educate the employees about the chemical hazard in case it leaks and spills, and solution guidelines. - Provide emergency showers in the process area and chemical storage building sufficiently and appropriately.		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	Natural gas pipeline and MRS - Prepare a report on risk analysis from potentially risky activities, such as HAZOP study of natural gas pipeline during detailed design stage. - Provide safety systems of natural gas pipeline including pressure and temperature control systems to prevent over pressure or temperature in the pipeline by using such devices as safety valves, pressure control disc, flow meters, vent valves, check valves, control valves and shut-off valves. These devices can either automatically shut off or manually shut off from the central control room the natural gas distribution (if leakage of the pipeline is found). - Inspect and test welding points as part of the maintenance plan following the international standard. - Install pressure measuring devices in natural gas pipelines. - Install gas detector devices in MRS station.		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	- Establish emergency control system as a backup system to control the pipeline in case of failure other control systems. - Assign well trained staffs to be responsible for command and control in case of leakage of natural gas pipelines. - Organize training to and raise awareness of the staffs on hazard protection of natural gas pipelines. - Establish an emergency response team prepared for any major hazard occurrences on the pipeline system, and collaborate with PTT Public Company Limited on the response practice. - Monitor unsafe operations and conditions by providing safety inspectors and operators to inspect along the piping structure. - Install firewall at the transformer and MRS area (referring to Figures 5-5 and 5-6). **Steam generation unit** - The boiler used shall be in compliance with		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	international standards such as ASME (The American Society of Mechanical Engineering), BS (British Standard), DIN (Deutsches Institute Fur Normung), JIS (Japanese Industrial Standard). - Provide boiler control operators in compliance with related laws and regulations e.g. Ministerial Regulation No. 2 B.E. 2535 (1992) issued under the Factory Act B.E. 2535 (1992). - Test boiler's safety equipment/systems at least once a year or as indicated in the related Ministry of Industry notifications, for example the notification No. 26 B.E. 2534 (1991). - Install various measuring devices to inspect the boiler performance such as pressure, temperature, flow rate, water level, etc. These devices must be linked to control room to report the results and warnings. - Install safety protective equipment of the boiler, including the installation of 2 safety valves at minimum in order to safely release the steam when the pressure level is higher than the limit.		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	- Provide a preventive maintenance plan for the equipment/ systems related to the boiler. **Emergency response plan/preventive maintenance and inspection plan** - Provide emergency response plans as follows: * 1st level emergency plan (shown in Figure 5-7) * 2nd level emergency plan (shown in Figure 5-8) * 3rd level emergency plan (shown in Figure 5-9) - Arrange an emergency drill for the 1st level emergency plan, together with those from the existing power plant and the 401 MW power plant project, at least once a year, and cooperate with the industrial estate for the 2nd and 3rd level emergency plan drills. - Daily inspect and seek for unsafe conditions by security officers. If found, they shall correct and improve such conditions immediately.		

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
	- Set up a plan for inspection of the fire control systems/equipment. - Set up a preventive maintenance plan for the boiler equipment/system. - Provide a preventive maintenance plan for the equipment/ systems related to the boiler.		
8. Action Plan on Occupational Health and Safety During construction period, public health impact may be caused by unsanitary practices of the workers, resulting in infectious diseases, and dusts from construction activities which potentially cause respiratory disorders. Hence, the project will have the contractors strictly follow the action plan on public health during the construction period. During the project operation, the impact on public health is potentially caused by the emissions of air pollutants from natural gas burning in the CTG	**1) Procedure/ operation area** - Follow the following measures to prevent the spread of diseases: * Provide clean drinking water for the construction workers. * Manage the waste in accordance with the sanitary principals. * Provide a sufficient number of toilets for the construction workers. - Strictly comply with the measures on air quality, water quality, noise level, waste management, and occupational health and safety. - Provide enough first-aid kits and pharmacies, along with the arrangement of ambulance stand-by in case of emergency.	**1) Construction phase** -	Glow Energy Public Co., Ltd.

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
which comprises mainly NO_x and small amounts of SO_2 and TSP. These air emissions may irritate the respiratory system. For example, NO_x at the density of 0.1 ppm or 190 micrograms/m^3 increases the resistance of respiratory system immunity and increases the constriction of the airways in the respiratory system of asthma patients, SO_2 at the density of 0.11-0.19 ppm or 300-500 micrograms/m^3 increases the hospitalization rate due to respiratory disorders, and TSP emission density in the atmosphere is related to asthma and reduction of lung efficiency. According to the results of air quality assessment from the project operation (including the 700 MW power plant project), it is found that the maximum concentrations of NO_2, SO_2, and TSP from the project's emissions do not exceed the national standards, and the areas impacted by	**2) Operation phase** - Set up a plan for regular health impact assessment for the nearby communities. - Coordinate with the local public health agencies in obtaining the statistics on health quality of the communities, and information on disease prevention and treatments of illnesses resulting from the effects of power plant operation. - Arrange annual physical check-up for the nearby communities, especially those of a high potential to be affected by the power plant operation (risky group), and keep those records.	**2) Operation phase** Parameters : Frequency and seriousness of illnesses that may be affected by the power plant operation, such as respiratory disorders, skin diseases, etc. Sampling stations : With in communities potentially affected by the power plant operation Frequency : Once a year, repeat sampling at the same community except when the location impacted tends to change.	

ENVIRONMENTAL IMPACTS	MITIGATION MEASURES	MONITORING MEASURES	RESPONSIBLE PARTY
the maximum concentrations are not the sensitive areas, such as communities. Therefore, the health impact from the project operation is acceptable. However, the project has created action plan on public health in order to mitigate the impacts on public health, and monitor the public health quality of the nearby communities during both the construction and operation periods.			