Ref: PD/665/00/00

ADDITIONAL GENERATING FACILITIES

Project Profile

1,800MW Gas-fired Power Station at Lamma Extension

April / 1998

Revision 0

The Hongkong Electric Co., Ltd.

香港電燈有限公司

CONTENTS

1. INTRODUCTION

HEC proposes to develop a new 1,800MW power station in Hong Kong to meet the forecast increase in electricity demand to cope with the social and economic growth of the Hong Kong SAR in the 21st century. In March 1997, the Planning, Environment and Lands Branch established a Steering Group to monitor the Site Search Study to search for a site for HEC's proposed new power station. In parallel, an EIA (known as Stage 1 EIA) was carried out as an integral part of the Site Search under the guidance of the Environmental Study Management Group chaired by EPD. The Stage 1 EIA provided to the Site Search Study environmental information such as environmental acceptability and preference of the power station; and the environmental implications of various site, fuel and power generation technology options.

Both the Stage 1 EIA and the Site Search Studies were completed in mid November 1997, and gas-fired combined cycle plant at the Lamma Extension Site was recommended as the overall preferred option from both environmental and engineering/economic viewpoints. The Stage 1 EIA also concluded that the local environmental issues were likely to be surmountable and the contribution from HEC's new power station to regional air pollution would be small. Should the Project be taken forward, a detailed EIA study (Stage 2 EIA) would be required to address the outstanding issues identified in the Stage 1 EIA Study.

The findings of the Stage 1 EIA and Site Search Studies have been agreed by:

- the Committee on Planning and Lands Development (CPLD) on 15 January 98,
- the Energy Advisory Committee on 22 January 98,
- the EIA Subcommittee of the Advisory Council on the Environment on 9 February 98,
- the Southern District Board on 12 February 98,
- the Islands District Board on 23 February 98,
- the Advisory Council on the Environment on 24 February 98,
- the Lamma Area Committee, Islands District Board on 25 March 98, and
- the Executive Council on 31 March 98.

On 1 April 98, the ESB advised that Government has given consent to HEC to conduct detailed EIA for a 1,800MW gas-fired power station at the Lamma Extension Site.

2. BASIC INFORMATION

2.1 Project Title

1,800MW Gas-fired Power Station at Lamma Extension.

2.2 Purpose & Nature of the Project

Generation of electricity using natural gas as fuel.

2.3 Name of Project Proponent

The Hongkong Electric Company Limited (HEC).

2.4 Location and Scale of Project

The proposed gas-fired power station will be located on an area of new reclamation to the south of the existing Lamma Power Station at the western edge of Lamma Island (Figure 2.4a). Taking advantage of the synergy in shared O&M staff and some of the facilities with the existing power station, the site will have an usable area of about 20 hectares. The planned capacity of the station is 1,800MW. According to the load forecast, the first 600MW unit will need to be commissioned in 2003 followed by the second unit in 2007 and the third unit in 2012.

Natural gas will be supplied from a regional LNG terminal in Shenzhen to the Lamma Extension Site via submarine pipeline.

2.5 Number and Types of Designated Projects

This Project Profile will cover the following designated projects:

(1) Construction and operation of 3x600MW combined cycle plant at Lamma Extension Site.

(2) Laying of submarine pipeline to supply natural gas from a regional LNG terminal in Shenzhen to the Lamma Extension Site.

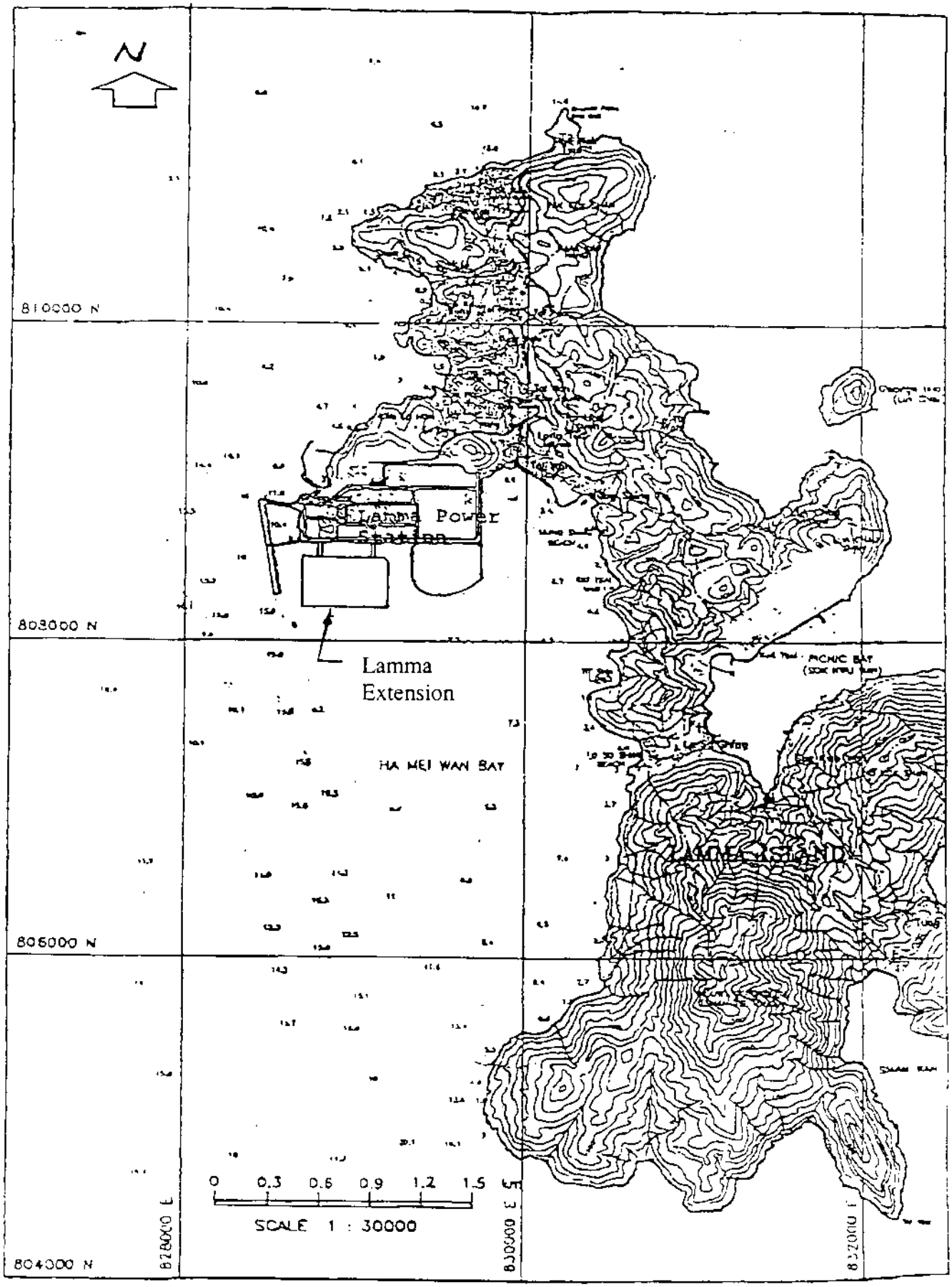

Figure 2.4a - Location of the Proposed Gas-fired Power Station (Lamma Extension)

3. PLANNING AND IMPLEMENTATION PROGRAMME

3.1 Planning & Implementation

The whole project will be planned and implemented by HEC's in-house Divisions together with consultants. Construction will be carried out by contractors.

3.2 Project Programme

To meet the target of first unit operational in mid 2003, the project programme of the new power station at Lamma Extension is as follows:

3.2.1 Power Station

a.	Site possession & Commencement of site formation	1 January 1999
b.	Commencement of civil work	1 July 2000
c.	Commencement of plant erection	1 July 2001
d.	Commercial operation of Unit 1	1 July 2003

3.2.2 Submarine Gas Pipeline

a.	Commencement of pipeline laying	1 March 2002
b.	Completion of pipeline laying	1 January 2003

4. POSSIBLE IMPACT ON THE ENVIRONMENT

4.1 Power Station

4.1.1 Outline of Processes Involved

(a) Layout

The Lamma Extension Site will be constructed entirely by reclamation in a depth of water of about 10m. The site platform having an usable area of about 20 ha will be connected to the existing power station by two link bridges. A water channel will be retained in the north of the site to avoid blockage of cooling water intakes for the existing power station. Dredging will be required to remove soft marine mud so that seawall and reclamation will rest on firm stratum.

Figure 4.1a shows the layout of the gas-fired power station which consists of:

- power block units including gas turbines, heat recovery steam generators (HRSGs), steam turbines, generators and chimneys;
- ancillary building including ancillary plant, administration building, waste water treatment system, cooling water facilities, oil tanks, site services/roads and switching station;
- gas receiving station; and
- construction works/storage area.

(b) Combined Cycle Plant

Each combined cycle unit will consist of gas turbines, HRSGs, steam turbine, generators and a flue gas stack of about 110m in height above the ground. Gas from the gas receiving station will be combusted in the gas turbine which in turn drives a generator to produce electricity. The waste heat energy from the hot gas exhaust discharging from the gas turbine is passed through a heat recovery steam generator to produce steam for driving a steam turbine for secondary electricity generation, and the exhaust gas is then discharged to the atmosphere through a stack. A once-through cooling water system will be adopted to condense steam exhaust from the steam turbine. Sea water will be extracted from the east side of the site and discharged to the west side after passing through a condenser. The cooling water flow required for a 600MW combined cycle unit is about 11m^3/sec. A schematic representation of a combined cycle gas-firing plant is illustrated in Figure 4.1b.

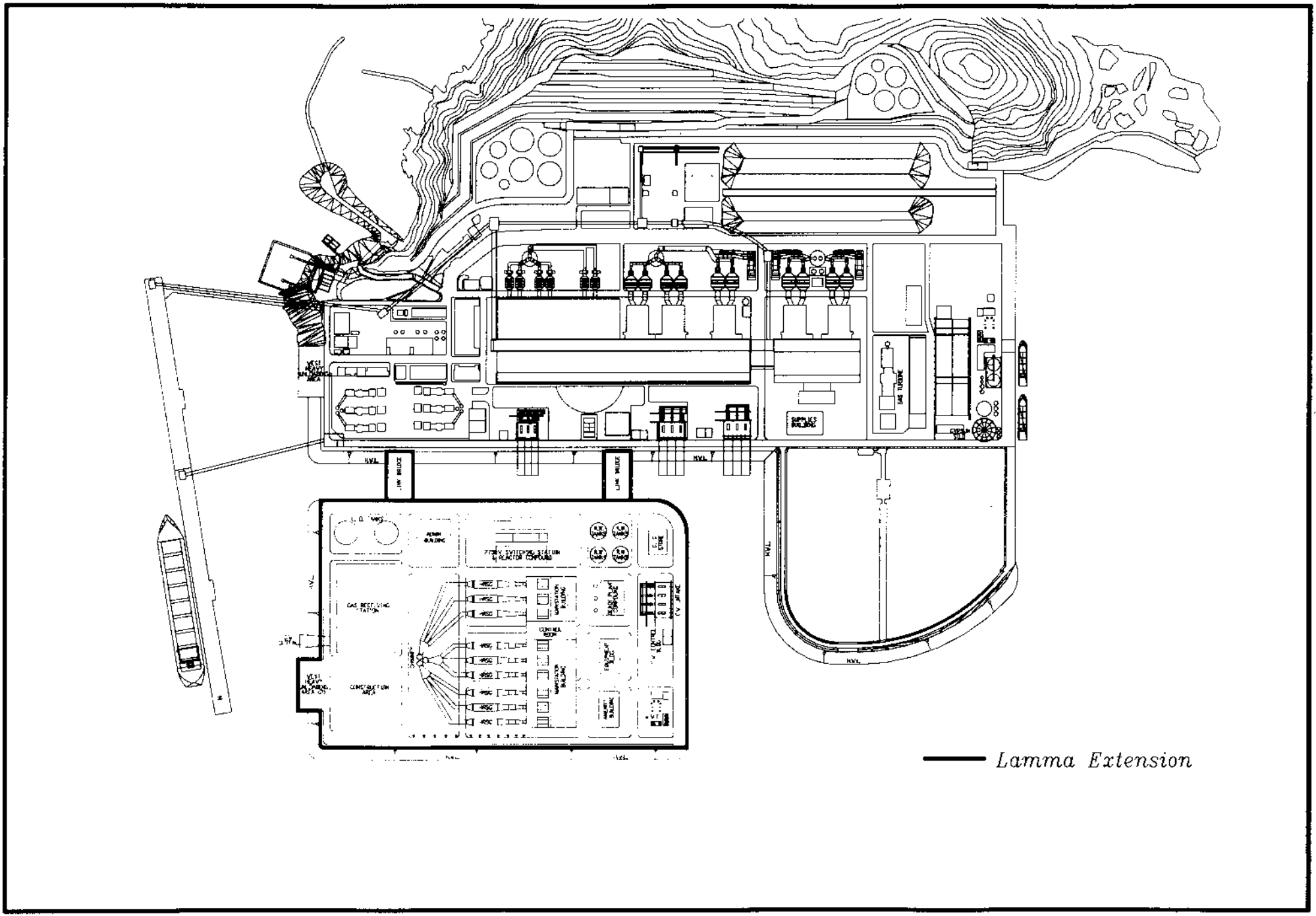

Figure 4.1a – Site Layout of the Lamma Extension Site

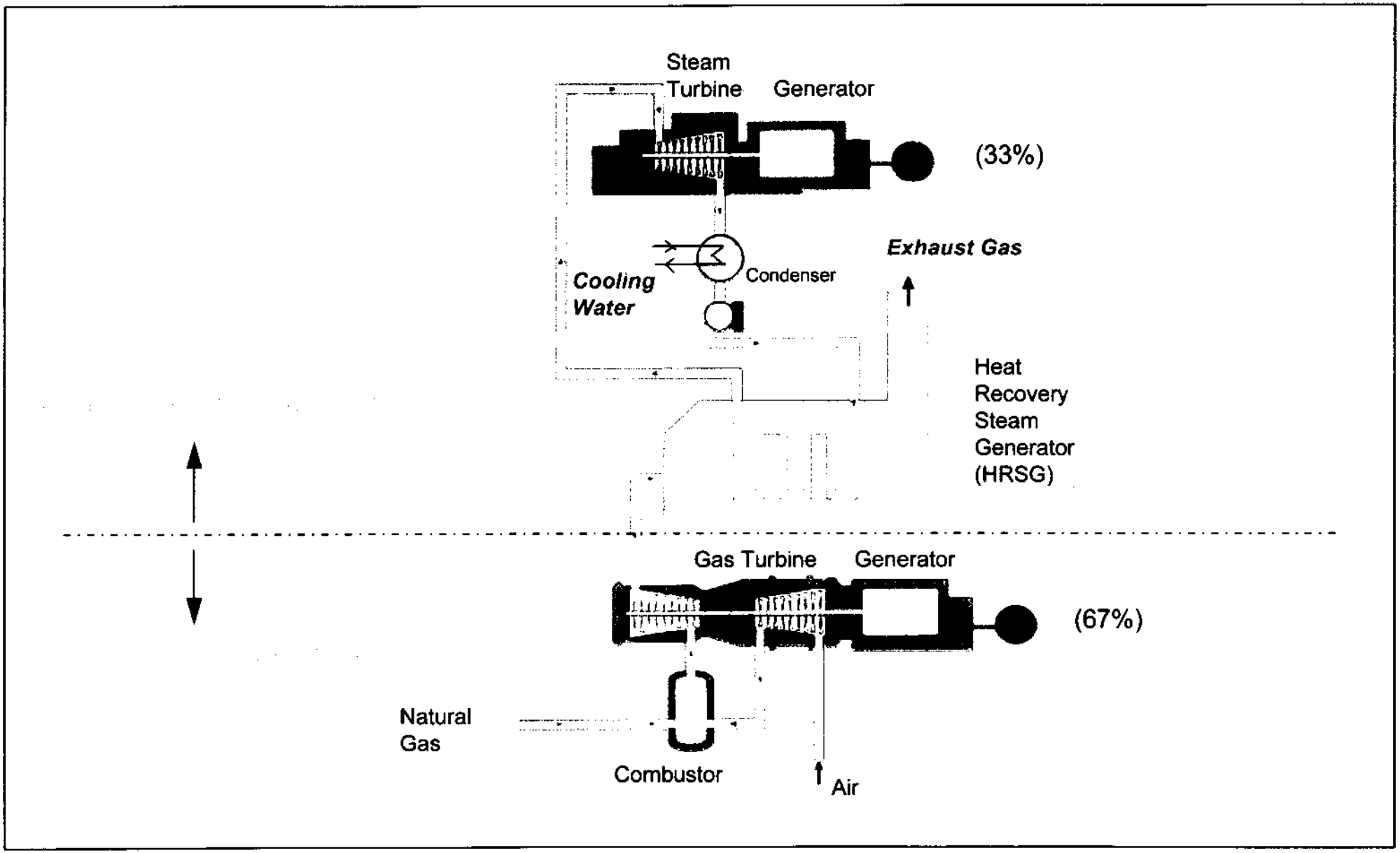

Figure 4.1b - A Schematic Diagram of Combined Cycle Gas-firing Plant

(c) Gas Receiving Station

To receive natural gas delivered from a regional LNG terminal through a pipeline, a gas receiving station is required. The received natural gas is processed in the receiving station and subsequently delivered to the plant for combustion. Major components of the station comprise shut-off valves, pig receiver, slug catcher, filter, gas heaters, pressure regulator, metering device, vent stack and protection system to ensure safe operation.

(d) Light Gas Oil System

In line with the restrictions imposed by the Environmental Protection Department on the existing generating units at the Lamma Power Station, light gas oil with sulphur content of less than 0.5% and viscosity of not greater than 6 centistokes at 40°C would be used as an alternative fuel in case of interruption of natural gas supply. A light gas oil supply and storage system having a storage capacity of about 50,000m^3 to cater for seven days of full oil firing will be adopted.

4.1.2 Possible Environmental Impacts

(a) Greenhouse Gas Emission

The issue of greenhouse gas emission from the additional generating facilities has been duly addressed in the Stage 1 EIA. The study concluded that there appears to be an ongoing correlation between the continued growth of Hong Kong and a consequent growth in emissions of greenhouse gases, particularly carbon dioxide (CO_2). At present, the Hong Kong Government has no firm policy on greenhouse gas emissions, but is aiming at improving Hong Kong's performance in line with the objectives of the United Nations Framework Convention on Climate Change. It was found that using coal instead of natural gas will increase the annual CO_2 emission by 5.8 million tonnes when the proposed additional generating facilities are fully developed in 2012. The Environmental Study Management Group considered that the additional CO_2 emission from the coal-fired power station option was significant and policy guidance on this issue was awaited. It was agreed that the use of natural gas as fuel and the adoption of high efficiency combined cycle technology will be the best practical measures to lower the CO_2 emission from the additional generating facilities. The use of gas instead of coal will reduce the CO_2 emission by 50%.

HEC has taken further initiative by participating in various local and regional Afforestation Schemes. These will help to offset the CO_2 emission from HEC's system.

(b) Regional Air Quality

The air quality impact to the Pearl River Delta area arising from the proposed gas-fired new power station at Lamma Island has been assessed in the Stage 1 EIA. A three-

dimensional prognostic mesoscale meterological model, the Lagrangian Atmospheric Dispersion Model (LADM) was used to model the air quality impact from the proposed new power station. LADM consists of two main components: a mesoscale windfield model which predicts the diurnal cycle of winds and turbulence at many levels and gridpoints in the atmosphere, and a Lagrangian particle dispersion model which uses the winds and turbulence to predict the pathways of pollutants released from the identified sources. This provides a more accurate prediction methodology than the Gaussian dispersion models as the model is able to simulate the effects of rugged terrain, sea breezes and the interaction of complex wind flows such as drainage winds.

The assessment first identified the worst meteorological conditions, for air quality modelling purposes, which are conducive to poor dispersion and photochemical production of smog in the Pearl River Delta. The Integrated Empirical Rate (IER) equations of smog formation were used to evaluate the impact of power station emissions on the regional air quality. Major sources in Hong Kong were included in the emission inventory to simulate hourly NO_2 and O_3 concentrations over the wider region during daylight hours, and concentrations of secondary particles were predicted for use in visibility calculations. Local Visual Distance (LVD) was calculated from the concentration of fine particles by means of an extinction coefficient.

The study concluded that the additional units would have insignificant effect to regional surface ozone and nitrogen dioxide concentrations even under the worst-case scenario. Concentrations and dispersion patterns of fine suspended particulates are not influenced by the addition of a gas-fired power station and no emission of sulphur dioxide is registered. The proposed additional units will help to reduce the overall acid deposition to the region by about 1%.

(c) Local Air Quality

Construction Phase

Construction of the gas-fired power station will be carried out in three main stages, comprising:

- Reclamation works;
- Foundation construction works; and
- Superstructure construction.

Construction dust impact to nearby Air Sensitive Receivers (ASRs) arising from these activities is the principal construction phase air quality impact. The Stage 1 EIA identified the nearest air sensitive receiver to the proposed gas-fired power station at Lamma Extension is Ko Long Village which is located approximately 750m to the north of the proposed site. As the village is screened from the power station by the

topography of Lamma Island, potential construction dust impacts are expected to be low due to the distance and topography. Such impacts are considered to be minor as they are transient, amenable to mitigation and relatively short term.

Operational Phase

The main pollutant emission from a gas-fired power station is nitrogen oxides (NO_x). Other pollutant emissions from a gas-fired power station, such as sulphur dioxide and suspended particulate, are negligible. The relevant Hong Kong's Air Quality Objective (AQO) for this assessment would be the hourly-averaged NO_2 concentration which is $300\mu g/m^3$ (160ppb).

In the Stage 1 EIA study, the ground level concentration of NO_2 and NO_x resulting from the emissions from the gas-fired power station at Lamma Extension was simulated using LADM. Under the worst meteorological conditions, the emissions from the main stacks are likely to impact on the sensitive receivers on the Victoria Peak, 7 km from the site. Throughout the day, 15 to 20% of the NO_x is predicted to be NO_2 with a maximum of 90ppb at 1100hrs which is below the HKAQO criteria of 160ppb.

Ozone (O_3) is a secondary pollutant formed via photochemical reaction in the presence of NO_x, hydrocarbons and sunlight. As majority of the NO_x emissions are NO close to the emission sources, there is generally a high rate of O_3 destruction as a result of conversion of NO to NO_2 near the power station. This reduce the potential for O_3 formation. Hence, the effect from the proposed gas-fired power station on the formation of O_3 within Hong Kong area is not significant.

(d) Water Quality

Due to the relatively small reclamation involved for Lamma Extension, hydrodynamic impact due to reclamation was anticipated to be minor in the Stage 1 EIA. Other impacts, such as those associated with construction works, can be kept to a minimum by adopting appropriate measures. Operational plant effluent would be reused as far as possible to minimize discharge to the Hong Kong Water. Those discharging effluent would prior be treated to meet TM limits.

In the Stage 1 EIA, impact to water quality associated with the gas-fired power station has been assessed by the generation of mathematical models to predict the impact of thermal plume with respect to sensitive receivers including finless porpoise, coral and gazetted beaches. Modelling simulations accounted for a worst case projected heat discharge for year 2012 from both the existing and the gas-fired power station. The model shows that temperature elevations are greatest at the surface and are largely restricted to 30% of the depth of the water column. The 2°C mixing zone is at its maximum extent on the spring tide when it is approximately 10.4 km^2. The zone extends to the north, around the northern end of Lamma, and to the south, parallel to the western coast of Lamma. On the neap tide the mixing zone is smaller

(approximately 7.5 km^2) but extends closer to the western coast of Lamma.

Impacts to the beaches, corals and water to the south of Lamma were considered by examining the spatial and temporal distribution of predicted temperature elevations. Time history plots were generated which show that exceedances of the WQO criterion of 2°C are not predicted at Hung Shing Ye and Lo So Shing beaches. Impacts at the beaches are therefore considered to be acceptable.

Temperature elevations above 2°C are predicted to occur to southwest of Lo So Shing beach, but heating in this area is not considered to be of concern because although corals are found to the east of this area, they are not expected to be subjected to elevated temperatures. This is a result of the plume being largely restricted to surface waters (approx. 0 - 4m) and the majority of corals, including those with higher conservation value, being found below -6m PD.

To the south of the island, temperature elevations only occur for short periods of time (2% and below). Although the mixing zone extends within the Study Area for the possible marine park/marine reserve, elevations above 2°C only occur transiently. Moreover, the exceedances are considered mitigatable by engineering design.

Thermal impacts to Finless Porpoises are not expected because porpoises are highly mobile and could avoid areas of elevated temperature.

(e) Solid Wastes

There is no solid waste generated from the combustion of natural gas. The potential environmental impacts associated with the handling and disposal of construction waste arising from the construction of the proposed gas-fired power station at Lamma Extension have been assessed in the Stage 1 EIA.

As the Lamma Extension site is an area of sea at present, waste generated from site clearance, excavation and demolition are not anticipated. Environmental impacts associated with general construction waste, chemical waste and general refuse are considered minimal provided that storage, transport and disposal of waste are properly handled.

It is estimated that the depth of the marine mud in the area ranges from 10m to 20m. Dredging will be required for construction of the seawall and site platform. For formation of the site, appropriate engineering measures will be adopted to reduce the amount of dredging required. With reference to EPD sediment monitoring data, it is likely that the level of contamination of the dredged mud will be classified as Class A sediment, i.e. uncontaminated, which could be disposed of at gazetted marine dumping grounds.

To minimise the loss of dredged mud to the water column, the following measures

would be taken:

- transport of marine mud should be by barge well maintained and capable of rapid opening and discharge at the disposal site;
- all barges and hopper dredgers should be fitted with tight fitting seals to their bottom openings to prevent leakage of material;
- mud should be placed in the disposal site by bottom dumping, at a location with the pit specified by the Fill Management Committee;
- discharge should be undertaken rapidly and the hoppers should then immediately be closed, material adhering to the sides of the hopper should not be washed out of the hopper and the hopper should remain closed until the barge next returns to the disposal site;
- barge loading should be monitored to ensure that loss of material does not take place during transportation; and
- transport barges or vessels should be equipped with automatic self monitoring devices as specified by the EPD.

Provided that the measures discussed above are properly implemented, it is anticipated that the environmental impacts associated with the handling and disposal of mud will be within acceptable standards. As there will be a large quantity of mud to be disposed of at gazetted marine dumping grounds, the Fill Management Committee (FMC) will be consulted for which dumping grounds to be used.

(f) Noise

The Stage 1 EIA identified the nearest noise sensitive receiver to Lamma Extension will be the village areas located on the north western part of the island, including Ko Long, Sha Po Old Village, Tai Wan San Tsuen, Long Tsai Tsuen and Hung Shing Ye. Noise would be generated during construction from site foundation works, piling and operation of mechanical and electrical equipment. The noise impacts at the NSRs have been calculated and assessed. The highest construction noise level predicted is 71 dB(A) which complies with the daytime noise limit of 75dB(A). The construction works to be carried out are not expected to cause any unacceptable noise impact.

Potential noise sources during operation include the combined cycle gas turbine, heat recovery steam generator, cooling water pumps, air compressors and gas receiving station. Majority of the NSRs, including Ko Long, Wang Long, Tai Wan San Tsuen, Sha Po Old Village and Yung Shue Wan are located to the north of the proposed site and are completely screened from the proposed site by natural topography. The predicted facade noise levels are 41 to 44 dB(A). Operational noise would therefore

comply with the Hong Kong Planning Standards and Guidelines criterion.

The noise contributions from the existing Lamma Power Station have also been considered. The cumulative noise levels at Ko Long, Wang Long, Tai Wan San Tsuen, Sha Po Old Village and Yung Shue Wan are all within the NCO criteria. The predicted cumulative noise levels at Long Tsai Tsuen and Hung Shing Ye will be 56 dB(A), which is 1 dB(A) above the night-time NCO criteria. It is confident that the noise exceedance could be mitigated by the use of practicable noise measures such as quiet equipment, acoustic enclosures, purpose built noise barriers and building design.

(g) Traffic

Construction of the gas-fired power station at the Lamma Extension site can be treated as a continuation of the construction works of the existing Lamma Power Station which has been on-going for the past 19 years. With proper management, the risk of marine hazards resulting from the increase in vessel movements in the vicinity of Lamma Extension during the construction stage is considered to be extremely remote.

Since natural gas will be transported to the power station via submarine pipeline, the increase in marine traffic during operational stage is limited to staff ferry service which could be common to both existing and gas-fired power stations.

(h) Landscape and Visual Impact

The Lamma Extension site is located to an immediate sea area to the south of and surrounded by the existing Lamma Power Station facilities with a low landscape quality. The loss of the water area at Lamma Extension is insignificant as it would have no effect on the coastal morphology.

Visual impact of the Lamma Extension site is considered to be low as the new structures could be well absorbed by the established industrial character of the existing power station. Significant impacts to visual amenity would be limited to the Hung Shing Ye Beach area which is just over 1 km from the site with close-to-foreground views.

(i) Potential Hazards

Natural Gas

Uncontrolled release of natural gas from the gas receiving station (GSR) and gas supply pipeline to the gas turbines are of concern. Such hazard can be prevented by installing a shutdown valve which can shutdown supply immediately in the event of any failure downstream. The design and construction of the GSR will be in full compliance with Government regulations and international standards. Various preventive measures and protection devices will be adopted to ensure safe operation of the GSR including a carbon dioxide snuffing system which can extinguish fires in case the vent stack is

ignited. The height of the stack will also be designed to limit the radiation intensity from an ignited release to ground level.

Hydrogen

Hydrogen gas is used for generator cooling. Hydrogen may be generated at the site through the electrolysis of water or alternatively may be imported in cylinders. The proposed option is to import hydrogen cylinders each of 0.05 m^3 at a pressure of 200 bar (this is equivalent to 10Nm^3 per cylinder). The total storage capacity for hydrogen is estimated as about 1500 Nm^3 which is equivalent to about 150 cylinders.

Hydrogen is a flammable and explosive gas. Hydrogen has wide flammable range of 4 to 75% and is therefore easily ignited. However, hydrogen gas has low density and therefore tends to rise quickly and disperse.

The storage of H_2 in cylinders do not pose any significant hazard except when the cylinders are exposed to flame impingement which can cause rupture of the cylinders. The storage area for the cylinders will be well ventilated, and occupational hazards can be minimised by proper design and management.

Chlorine

Chlorine is required for treatment in the cooling water system. Chlorine is proposed to be generated from electrolysis of sea water in the electrochlorination plant and hence no storage for chlorine is proposed.

Chlorine is a toxic gas. The main hazard of chlorine release may occur due to failure of piping downstream of the generating unit. Mitigation measures such as immediate isolation of the leak and tripping of the chlorine generation unit are expected to minimise the consequences of any release.

Fuel Oil

Light gas oil will serve as alternate fuel in the event of failure of gas supply. A fuel oil system consisting of a berth, fuel oil tanks, fuel oil pumps would be installed for unloading, storage and transfer of fuel oil. The quantity of gas oil proposed to be stored at the site is about 50,000m^3, equivalent to about seven days' requirement. Two atmospheric storage tanks are proposed to meet the storage requirement.

Light gas oil has a high flash point, about 66°C. The main hazard from light gas oil storage is tank fire. The effects of radiation from fire are however limited to a distance of about two to three times the tank diameter. Appropriate control measures will be designed to minimise the chances of tank fire.

(j) Decommissioning

The generating units of the gas-fired power station are anticipated to have an operational life of 30 years. The plant, equipment and materials involved are similar to all fossil fuel power stations and primarily comprise concrete structures, pipework, ductwork, pressure vessels, metallic equipment and insulation materials. HEC will comply with the legislation in force at that time to minimise the impacts arising from decommissioning of the gas-fired power station to acceptable levels.

4.2 Submarine Gas Pipeline

A general assessment of the environmental impact of the submarine gas pipeline from a regional LNG terminal to the Lamma Extension site has been made in the Stage 1 EIA. Environmental impacts from the gas pipeline are only anticipated during the construction period, as the pipeline will be completely sealed and thus any emission or discharge will be confined to the outlets of the pipeline. Figure 4.2a shows the indicative routing of the gas pipeline from the Shenzhen LNG terminal to the Lamma Extension site. It is anticipated that the majority of the pipeline would be laid on the seabed in deep water area without the need for dredging. In areas where the pipeline needs to cross busy marine channels, the pipeline may need to be laid under the seabed depending on site conditions. The impact on water quality is thus minimized. The installation of gas pipeline will have no impact on the air quality and the associated noise impact is expected to be minor.

In the case of pipe laying under seabed, typical operation will involve pre-trenching, pipelaying, post trenching and backfilling. A low capacity dredger will be adopted to reduce the disturbance to water column due to dredging. Appropriate mitigation measures will also be adopted which will focus on the following:

- improving dredging accuracy, achieving full load and therefore less sediment release;
- adopting slow hoist speeds to minimise sediment loss;
- planning of the dredging programme with due regard to sensitive receivers;
- accurate barge loading;
- supervision of the above by qualified professionals to ensure compliance.

Detailed selection of the pipeline routing will be carried out to avoid or minimise encroachment upon marine sensitive receivers and appropriate measures and techniques will be taken to prevent unacceptable impacts.

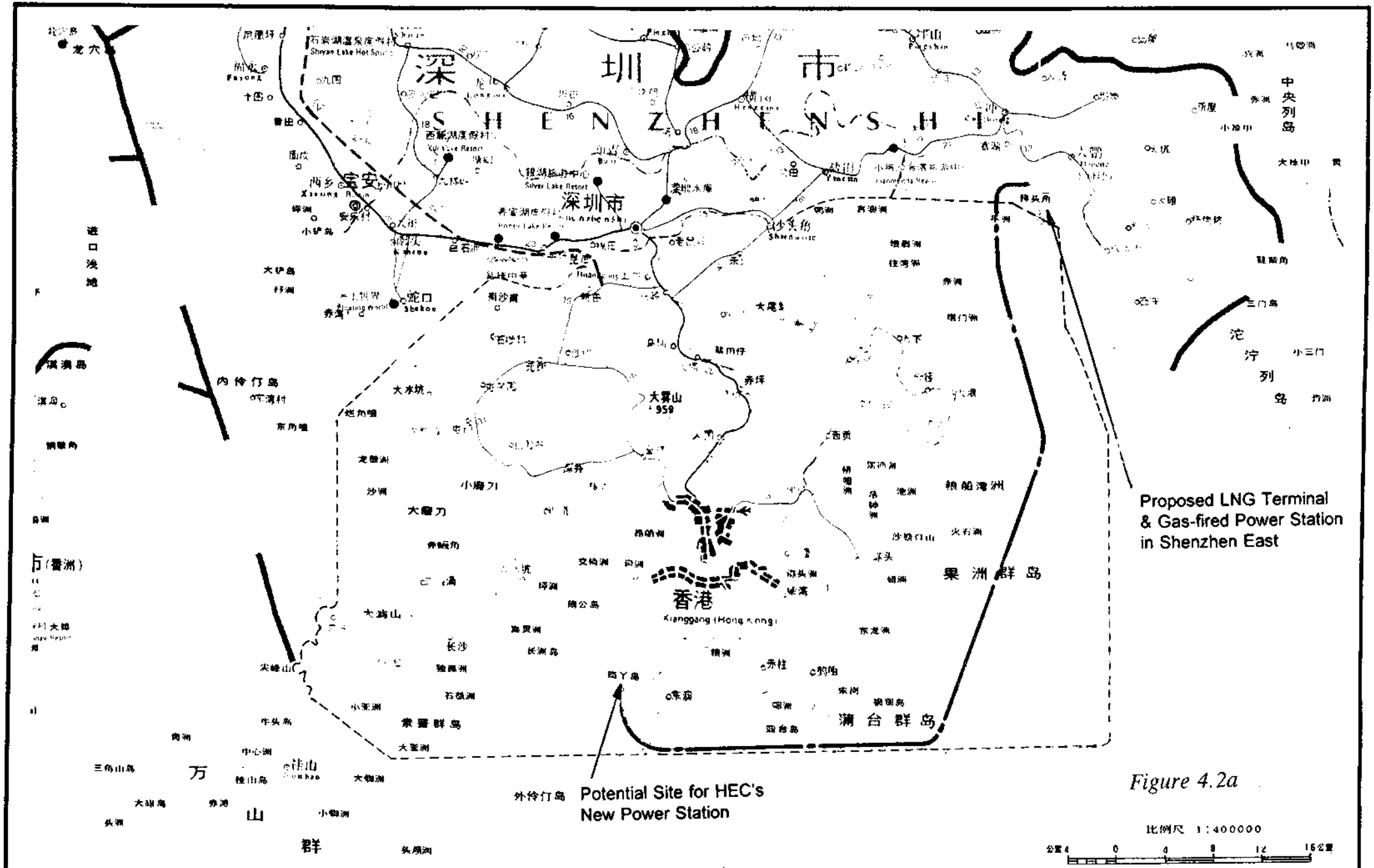

Figure 4.2a

Issue	Date	By

The Hongkong Electric Co Ltd
香港電燈有限公司
Projects Division
The Hongkong Electric Group

PRELIMINARY ROUTING OF SUBMARINE GAS PIPELINE FROM PROPOSED LNG TERMINAL IN SHENZHEN TO HEC PROPOSED NEW POWER STATION

Drawn	Checked	Approved
Scale	Date	
Drawing No.		Rev. No.

5. SURROUNDING ENVIRONMENT

5.1 Existing & Planned Sensitive Receivers

The site is located to the immediate south of the existing Lamma Power Station at the western edge of Lamma Island. The site area is designated as water in the Lamma Island Outline Development Plan. The surrounding land uses include Village Development Areas at Yung Shue Wan and Hung Shing Ye, and Agricultural Areas, Open Space Areas and Country side Conservation Areas. The adjacent Hung Shing Ye Beach is an officially gazetted beach. Since there are currently no statutorily designated or officially protected areas of environmental interest included nor within the vicinity of the proposed site, the proposed construction of a gas-fired power station would pose no direct conflict with the current land use.

A study of benthic communities (Shin and Thompson, 1982) suggested that although the area of the Lamma Extension site supports communities that are polychaete dominated, the mean numbers of individuals and biomass are still lower than the average for Hong Kong. The benthic and coral resources at the proposed Lamma Extension site are anticipated to rank low in comparison to other areas in Hong Kong.

Current research suggests that the water s around Lamma Island are used primarily by the Finless Porpoise (Neophocoena phocoenides). Sightings of Finless Porpoise occur more frequently at the southwestern tip of Lamma island than elsewhere in the Lamma area. However, impacts to Finless Porpoises are not expected because porpoises are highly mobile and could avoid areas of elevated temperature.

Although the southern water of Hong Kong are found to be important areas for commercial fish and crustacean spawning, Lamma Extension site does not lie within any of the candidate area for protection recommended by the Fisheries Resources and Fishing Operations in Hong Kong Waters study.

5.2 Major Element of Surrounding Environment

The existing Lamma Power Station is the only major element in the surrounding environment which might affect the area where the gas-fired power station is proposed to be located. With a total installed capacity of 3,305MW, the existing Lamma Power Station consists of eight coal-fired units (3x250MW and 5x350MW) designed to cater for Hong Kong's load demand pattern and seven gas turbine sets (1x55MW and 6x125MW) for peak lopping and emergency standby. The coal storage yard, oil tank farm and water tanks are all rested in the northern part of the Station whereas the chimneys, steam generators, steam turbines, gas turbines, electrostatic precipitators, flue gas desulphurization plants, station building and control rooms are located in the south. A coal unloading jetty located in the west together with a coal conveyor system, carries the coal either to the coal storage yard or directly to the boiler bunkers. Installations for

ash disposal, limestone and gypsum handling are situated on the east side of the Station. At the southeast corner is an ash storage lagoon used for contingency storage of ash. Sea water for condenser cooling is supplied via intakes located on the southern side and the outfall for cooling water discharge to the sea is located at the northwest corner to eliminate recirculation.

It is concluded in the Stage 1 EIA that the proposed gas-fired power station at the Lamma Extension Site will have no conflict with the operation of the existing Lamma Power Station. In fact, the two power stations would have the synergy of sharing the O&M staff and some of the facilities. Furthermore, it is not envisaged that the Lamma Extension will constrain future residential developments on Lamma Island.

6. ENVIRONMENTAL PROTECTION MEASURES & FURTHER ENVIRONMENTAL IMPLICATIONS

6.1 Measures to be Incorporated in Design to Minimize Environmental Impacts

6.1.1 Pollution Control Technology

NO_x emission is the only major pollutant emitted from a combined cycle plant resulting from the burning of natural gas in the combustion chamber of the gas turbine. The advances in gas turbine technology have not only improved the efficiency of combined cycle plants, but also resulted in the emergence of low NO_x combustion technology. The proposed gas-fired power station will adopt the advanced dry low NO_x combustion system to achieve a low NO_x emission level of less than 60mg/Nm^3 (based on 15% O_2).

6.1.2 Source Control

Natural gas has been identified in the Stage I EIA study as the environmentally preferred fuel which will be adopted for the proposed additional units and the at-source emissions can be kept to minimum levels.

6.1.3 Solid Waste Management

No solid waste will be produced from the combustion of natural gas.

6.1.4 Potential for Wastewater Minimization

Quantity of waste water generated from the gas-fired combined cycle plant will be small. Measures will be taken in the detail design stage to minimise the generation of waste water and to maximise the reuse of the waste water. Effluent to be discharged will be treated to meet TM limits.

6.1.5 Risk Mitigation Measures and Accident Emergency Response Plans

Natural gas will be piped from a regional LNG terminal through a submarine pipeline. To minimise the risk of uncontrolled release of gas, the natural gas pipeline will be designed and constructed for maximum reliability by employing accepted design and construction standards, identifying mitigation measures for failure modes, and proper inspection, testing, maintenance and cleaning. The design of the gas receiving station will be in full compliance with Government regulations and international standards. Various preventative measures and protection devices will be adopted to ensure safe operation of the gas receiving station including a carbon dioxide snuffing system which can extinguish fires in case the vent stack is ignited by lighting, static electricity or other causes. Shutoff valve will be installed to enable shutdown of supply immediately in the event of any failure downstream.

The Stage 1 EIA has concluded that the risk to off site population in the vicinity of Lamma Extension is insignificant. Moreover, detail risk assessment will be conducted to develop accident emergency response plans to the approval of the relevant authority.

6.1.6 Acoustic Barriers and Insulation

Comprehensive noise abatement measures in the form of acoustic enclosures, barriers and buildings would be provided for all the noise sources. The Stage 1 EIA has concluded that with appropriate measures, the noise impact from the gas-fired power station as well as the existing power station would comply with the Noise Control Ordinance and relevant Technical Memoranda.

6.1.7 Buffer Zones and Landscaping

As the proposed site is located to an immediate sea area to the south and surrounded by the existing Lamma Power Station facilities, the degree of potential impacts on landscape, visual and costal morphology are considered minimal.

Careful architectural consideration and colour selections would be made to enable the power station to blend well with the natural surroundings.

6.1.8 Different Siting of Activities

The Site Search and Stage 1 EIA Studies has identified Lamma Extension as the preferred site from environmental, planning, engineering and economic considerations. With the exception of the gas pipeline, all the facilities will be installed at the Lamma Extension site. For the gas pipeline, detailed route selection will be conducted to ensure minimum environmental impacts arising from the pipelaying operation.

6.1.9 Site Layout and Building Design

The site layout will be designed such that gas receiving station and the oil storage facilities will be located away from the main plant operational area. High standard of architectural design will be adopted for buildings to establish visual coherence with the existing power station.

6.1.10 Retention of Natural Environmental Features

The Lamma Extension site at present is a sea area with little natural environmental features. The Stage 1 EIA has also confirmed that the proposed site will have insignificant impacts to marine ecological resources.

6.1.11 Control of Construction Work Practices

The Stage 1 EIA has concluded that with appropriate measures, the environmental

impacts arising from the construction activities will be of acceptable level. HEC will adopt high standard of construction work practices to minimise the environmental impacts, such as:

- effective water spraying at potential dust emission sources
- watering of haul road at least twice a day
- restricted heights for dropping of excavated materials
- use of quiet equipment for construction
- provision of movable barriers
- remove waste in a timely manner
- dispose of waste at licensed sites
- use of appropriate equipment

6.1.12 Application of the Deep Bay Guidelines for Dredging, Reclamation & Drainage Works

Deep Bay Guideline for Dredging, Reclamation & Drainage Work, where applicable, would be observed during the construction of the Lamma Extension site.

6.1.13 Application of Chapter 9&10 of the Hong Kong Planning Standards & Guidelines

Chapters 9&10 of the Hong Kong Planning Standards & Guidelines have been duly observed during the Site Search and Stage 1 EIA Studies.

6.2 Possible Severity, Distribution and Duration of Environmental Effects

The Stage 1 EIA has concluded that with proper implementation and monitoring of the measures, no adverse environmental effect, either short term or long term, is expected as a result of the addition of new generating facilities. In fact, the environment of Hong Kong including air quality, water quality and solid waste will be improved with the addition of the new generating facilities due to shifting of base load operation from existing coal-fired units to more environmentally friendly and efficient new units which are of gas-firing.

6.3 Further Implication

Past experience during the various stages of development of Lamma Power Station since the early 80's showed that there had been no adverse social impact to the island. Compared with that when Lamma Power Station was first developed, the impact from Lamma Extension would be relatively small since the power station is already there and any impact the additional units would create is only marginal. In fact, the development of the Lamma Power Station has created job opportunities for the local residents and promoted business to the local business community, such as restaurants, shops, fish farm, hotels, accommodations, etc.

It should be noted that no adverse comments were received during the public consultations of the Stage 1 EIA and Site Search Studies and the proposed development is supported by members of the Southern and Islands District Boards.

To maintain Hong Kong's status as a leading financial centre with sustaining economic growth, a reliable and adequate electricity supply system is most important. Construction of the gas-fired power station will ensure that HEC continues to meet the needs of the consumers and to contribute to the prosperity of Hong Kong in the 21st Century.

7. USE OF PREVIOUSLY APPROVED EIA REPORTS

Environmental impacts of the Lamma Extension site for development of a 1,800MW gas-fired power station have been duly assessed in the Stage 1 EIA Study for HEC's proposed new power station. Findings and recommendations of the Stage 1 EIA Report, as highlighted below, are of direct relevance to this Project:

- *Title:* The Hongkong Electric Company, Limited - Stage 1 EIA for a New Power Station, Volumes I & II (November 1997)
  Reference Number : EIA-130/BC

- *Time of Approval:* 24 February 1998

- *Approved by:* Advisory Council on the Environment

- ***Environmental Aspects Addressed*:**

  - Air quality implications
  - Water quality implications
  - Noise implications
  - Construction spoil disposal
  - Terrestrial ecological resources
  - Marine ecological resources
  - Landscape and visual impact
  - Historic and cultural resources
  - Environmental assessment of gas pipeline routing

- ***Findings on Environmental Impacts*:**

  Local environmental impacts were likely to be surmountable and the contribution from HEC's new power station to the regional air pollution would be small.

- ***Recommendations:***

  The Stage 1 EIA identified the following issues to be further addressed in a detailed EIA study for the proposed gas-fired power station:

  - Optimisation of routes and assessment of impacts from the installation of gas pipeline.

  - Assessment of construction and operational noise.

  - Assessment of water quality impacts associated with construction of the gas-fired power station.

- Assessment of thermal discharge from operation of the gas-fired power station.

- Detailed assessment of local air quality impacts arising from operation of the gas-fired power station using wind tunnel modelling.

- Assessment of marine mud to be dredged during site formation.

- Risk assessment of onsite storage and use of dangerous goods.

- Assessment of landuse and visual impacts.

- Environmental Monitoring and Audit (EM&A) requirements during construction and operation.

- Assessment of cumulative impacts due to other existing and planned developments where appropriate information is available.