香港電燈有限公司
The Hongkong Electric Co., Ltd.

Lamma Power Station Extension
Environmental Monitoring & Audit Manual
(Operational Phase)

August 2006

TABLE OF CONTENT

ANNEX A IMPLEMENTATION SCHEDULE

ANNEX B BASELINE MONITORING REPORT

1 INTRODUCTION

1.1 PURPOSE OF THE MANUAL

The purpose of this Environmental Monitoring and Audit (EM&A) Manual (Operational Phase) is to provide information, guidance and instruction to personnel charged with environmental responsibilities and undertaking environmental monitoring and auditing work during the Operational Phase of the Lamma Power Station Extension (the Project). It provides systematic procedures for the monitoring and auditing of potential environmental impacts that may arise from the works.

According to Section 4.2 of the Environmental Permit (EP-071/2000/C), HEC shall submit this EM&A Manual for the operational phase of the Project at least three months before the commissioning of the first 300MW unit to the Director of EPD for approval.

1.2 BACKGROUND

1.2.1 *Background to the Study*

The Environmental Impact Assessment (EIA) Report for the Project, which was prepared in response to the *EIA Study Brief No. ESB-001/1998* issued to Hongkong Electric Company Limited (HEC) by the Environmental Protection Department (EPD), was completed in February 1999. The EIA Report was submitted to the Director of Environmental Protection (DEP) in accordance with the *Environmental Impact Assessment Ordinance (EIAO)* on 23 December 1998 and was approved by DEP on 5 May 1999.

The EIA Study concluded that unacceptable or insurmountable impacts were not expected from the proposed development, provided the recommended mitigation measures in the EIA Report are adopted and implemented.

The application for Environmental Permit (EP) was submitted to EPD on 10 July 2000. The Environmental Permit (EP-071/2000) was granted on 8 August 2000. The subsequent applications and approvals of the variation of Environmental Permit are summarised in the following table:

Environmental Permit	Application	Purpose of Variation	Approved by EPD
Environmental Permit (EP-071/2000/A)	25 November 2000	Shortening of various notification periods.	22 December 2000
Environmental Permit (EP-071/2000/B)	20 June 2001	Addition of dredging scenarios for reclamation work.	13 July 2001
Environmental Permit (EP-071/2000/C)	23 April 2005	Change of dredging and jetting rates for gas pipeline construction work, and change of the time period for which the pipeline jetting work is not allowed.	18 May 2005

1.2.2 *Project Description*

The Project involves the construction and operation of a gas-fired power station employing combined cycled gas turbine technology, forming an extension to the existing Lamma Power station. The following outlines the key elements of the Project including the new power station and its associated transmission system and submarine gas pipeline.

(a) The New Power Station

Combined Cycle Plant

Six 300 MW class gas-fired combined cycle units will be constructed on the Lamma Extension. Each unit will consist of a gas turbine, a heat recovery steam generator (HRSG), a steam turbine, a generator and a flue gas stack of about 110 m.

Gas Receiving Station

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

The Project area for the operation of new power station is shown in *Figure 1.2a.* The details of the cooling water intake and outfall designs are shown in *Figure 1.2b, 1.2c and 1.2d.*

(b) Transmission System

The electricity generated from the Lamma Extension Project will be transmitted via a new transmission system linking the Lamma Extension to load centres on Hong Kong Island as shown in *Figure 1.2e.*

(c) Gas Pipeline

Natural gas for the new power station will be supplied via a submarine pipeline from a regional LNG terminal located at Cheng Tou Jiao in Shenzhen as shown in *Figure 1.2f.*

1.3 *OBJECTIVES OF THE ENVIRONMENTAL MONITORING AND AUDIT PROGRAMME*

The environmental impacts resulting from the operation of the Lamma Extension are discussed in the EIA Report. The report also proposed mitigation measures that need to be implemented to ensure compliance with the required environmental criteria; these mitigation measures and their implementation requirements are presented in the Implementation Schedule contained in *Annex A* of this Manual. In order to ensure that these mitigation measures are properly implemented, environmental monitoring and audit for noise, air, water and waste management issues are also required.

This Manual provides specific details of the EM&A requirements that have been recommended to ensure compliance with the mitigation measures specified in the EIA Report.

The main objectives of this EM&A programme are to:

- provide a database against which any short or long term environmental impacts of the Project can be determined;
- provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards;
- monitor the performance of the Project and the effectiveness of mitigation measures;
- verify the environmental impacts predicted in the EIA Study;
- determine the Project's compliance with regulatory requirements, standards and government policies;
- take remedial action if unexpected problems or unacceptable impacts arise; and
- provide data against which environmental audits may be undertaken.

1.4 THE SCOPE OF THE ENVIRONMENTAL MONITORING AND AUDIT PROGRAMME

The scope of this EM&A programme is to:

- establish baseline noise, air and water quality levels at specified locations and review these baseline levels at specified period acceptable to the Authority as and when required;
- implement operational noise, air and water quality monitoring programmes;
- implement audit requirements to address noise, air and water quality issues;
- liaise with and provide environmental advice (as requested or when otherwise necessary) to Operations Engineers on the comprehension and consequences of the EM&A programme;
- identify and resolve environmental issues and other functions as they may arise from the works;
- check and quantify the overall environmental performance, implement Event and Action Plans (EAPs), and recommend and implement remedial actions to mitigate adverse environmental effects as they may arise from the works;
- conduct regular reviews of monitored impact data as the basis for assessing compliance with defined criteria and to ensure that necessary mitigation measures are identified, designed and implemented, and to undertake additional *ad hoc* monitoring and auditing as required by special circumstances;

- evaluate and interpret all environmental monitoring data to provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards, and to verify the environmental impacts predicted in the EIA;

- manage and liaise with other individuals or parties concerning any other environmental issues deemed to be relevant to the operational process;

- submit regular EM&A reports which summarise the environmental monitoring and auditing data and the implementation status of the required environmental monitoring works, with full interpretation illustrating the acceptability or otherwise of any environmental impacts and identification or assessment of the implementation status of agreed mitigation measures.

1.5 STRUCTURE OF THE EM&A MANUAL (OPERATIONAL PHASE)

Following this introductory Section, the remainder of the Manual is set out as follows:

- *Section 2* presents the organisation and structure for the management of the EM&A programme, outlines the various parties involved in the EM&A process, the notes and responsibilities of key individuals;

- *Section 3* presents the EM&A general requirements;

- *Section 4* details the requirements for baseline and impact monitoring for noise, and lists relevant monitoring equipment, locations, compliance and EAPs;

- *Section 5* details the requirements for baseline and impact monitoring for air quality, and lists relevant monitoring equipment, locations, compliance and EAPs;

- *Section 6* details the requirements for baseline and impact monitoring for water quality, and lists relevant monitoring equipment, locations, compliance and EAPs;

- *Section 7* details the requirements with regard to waste management issues;

- *Section 8* describes the auditing requirements; and

- *Section 9* details the EM&A reporting requirements.

In addition, *Annex A* presents the summary of mitigation measures recommended in the EIA Report in the form of an Implementation Schedule, and *Annex B* provides the baseline monitoring report.

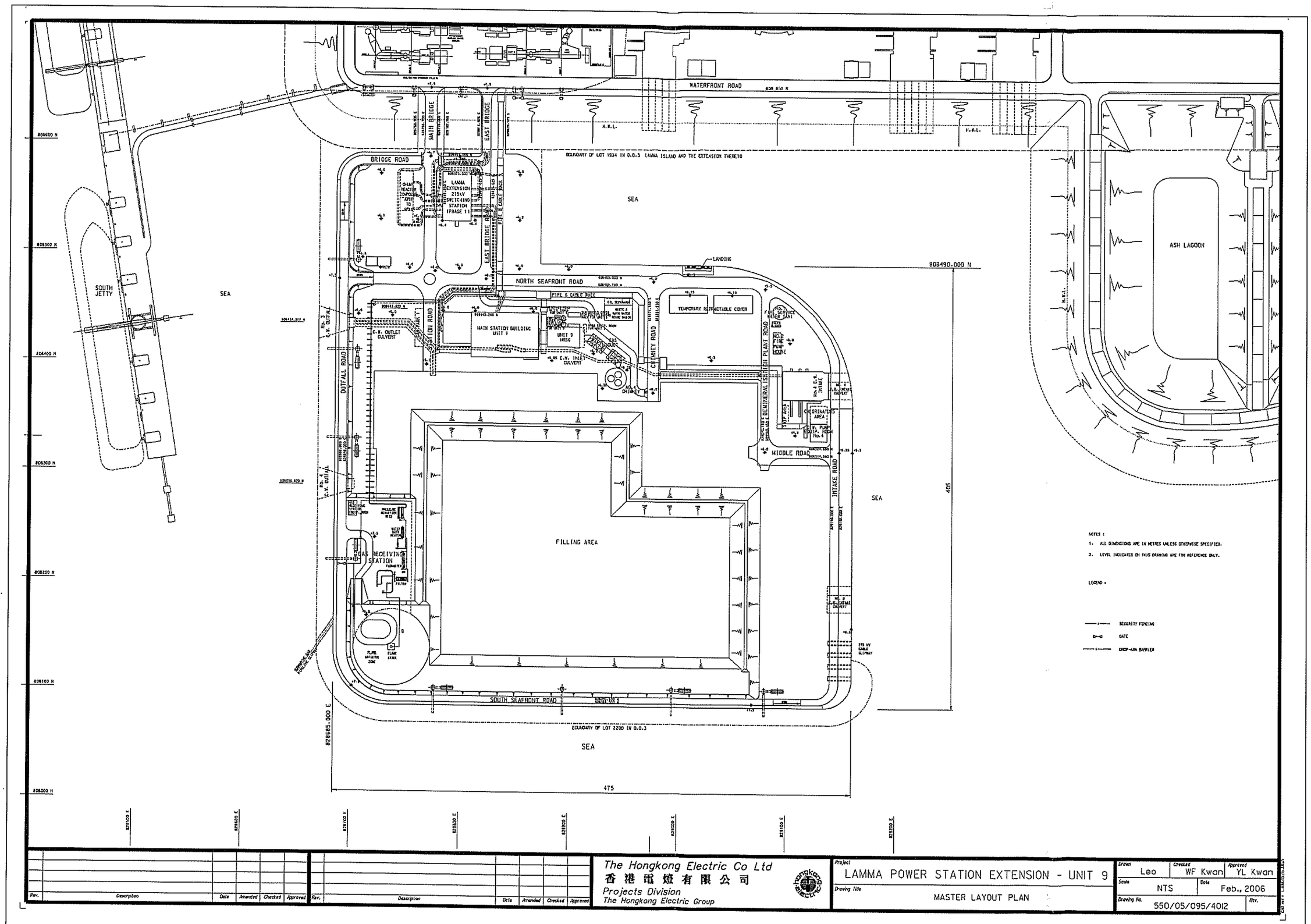
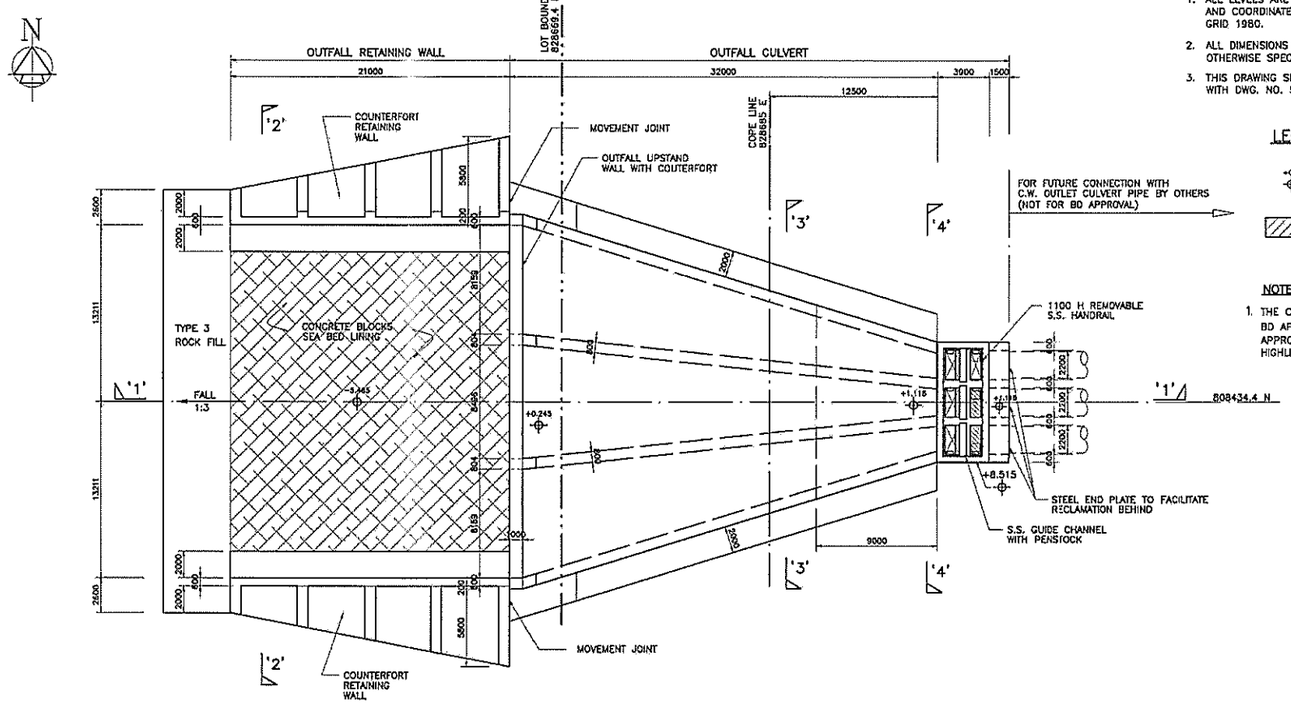


Figure 1.2a Layout of Lamma Power Station Extension

B.D. REF. NO. 3/9200/00(3)(P)



TOP PLAN OF NO. 3 C.W. OUTFALL

NOTES–

1. ALL LEVELS ARE IN METERS RELATIVE TO PRINCIPAL DATUM AND COORDINATES ARE RELATED TO HONG KONG METRIC GRID 1980.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 550/03/025/1082 & 1083.

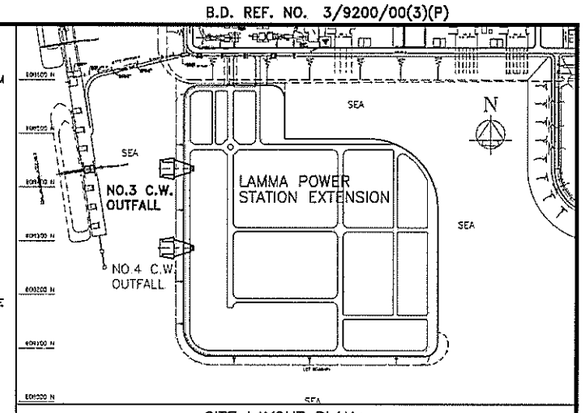
LEGEND–

+0.6 FINISHED LEVEL

REMOVABLE PRECAST CONCRETE COVERS WITH EDGES SEALED WITH JOINT SEALANT

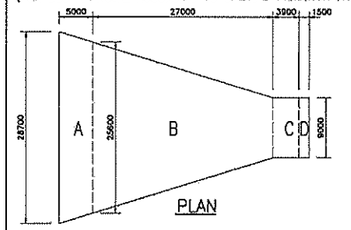
NOTES FOR RECORD PLAN:–

1. THE CONTENT OF RECORD PLAN IS SAME AS BD APPROVAL DRAWING 550/03/025/1081J APPROVED ON 10/6/2004 EXCEPT THOSE HIGHLIGHTED WITH RED COLOUR.



SITE LAYOUT PLAN (1:5000)

CALCULATION OF PLAN AREA AND VOLUME
(FOR DLO APPROVAL ACCORDING TO SPECIAL CONDITION NO. 8(a) OF PTG)

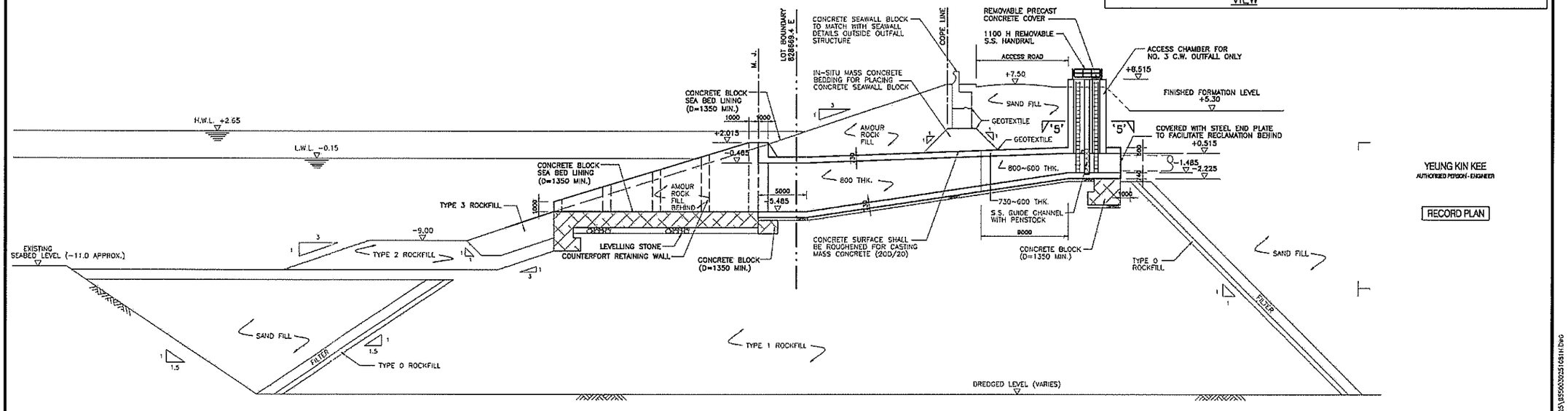


PLAN AREA (COVERAGE) :
A = 1/2(25.6 + 28.7) x 5 = 135.75m²
B = 1/2(9 + 25.6) x 27 = 467.1m²
C = 9 x 3.9 = 35.1m²
D = 9 x 1.5 = 13.5m²
TOTAL = A + B + C + D = 651.45m²

VOLUME :
A = 135.75 x 6.46 = 876.95m³
B = 1/3(3.34/4) [(3.34 x 9) + (6.46 x 25.6) + 4 x (3.34 + 6.46) /2 x (9 + 25.6) /2] = 2405.32m³
C = 35.1 x 10.74 = 376.98
D = 13.5 x 3.34 = 45.09m³
TOTAL = A + B + C + D = 3704.34m³

PLAN AREA & VOLUME :

PLAN AREA	VOLUME
651.45 m²	3704.34 m³



SECTION '1' – '1'

YEUNG KIN KEE
AUTHORISED PERSON-ENGINEER

RECORD PLAN

Issue	Description	Date	By	Checked	Approved
J	CONCRETE BLOCK UNDER THE OUTFALL ADDED & LEVEL REVISED	APR.,04	CWHUNG	K.T.HUNG	P. LAU
K	RECORD PLAN	APR.,04	CWHUNG	K.T.HUNG	P. LAU
C	SECTION '1' – '1' REVISED.	MAR.,01	W.Y.W.	K.T.HUNG	P. LAU
D	SECTION '1' – '1' LEVEL REVISED.	8-01	S. IP	K.T.HUNG	P. LAU
E	REVISED ACCORDING TO STRUCTURAL PLANS FOR BD SUBMISSION	11/01	LPC	K.T.HUNG	P. LAU
F	REMOVABLE PRECAST CONCRETE COVERS ADDED	10/03	CHL	K.T.HUNG	P. LAU
G	DELETION OF GANTRY WITH HANDRAIL	12/03	CHL	K.T.HUNG	P. LAU
H	BD AMENDMENT NO. 3	01/04	CHL	K.T.HUNG	P. LAU

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

Project: LAMMA POWER STATION EXTENSION
SITE FORMATION

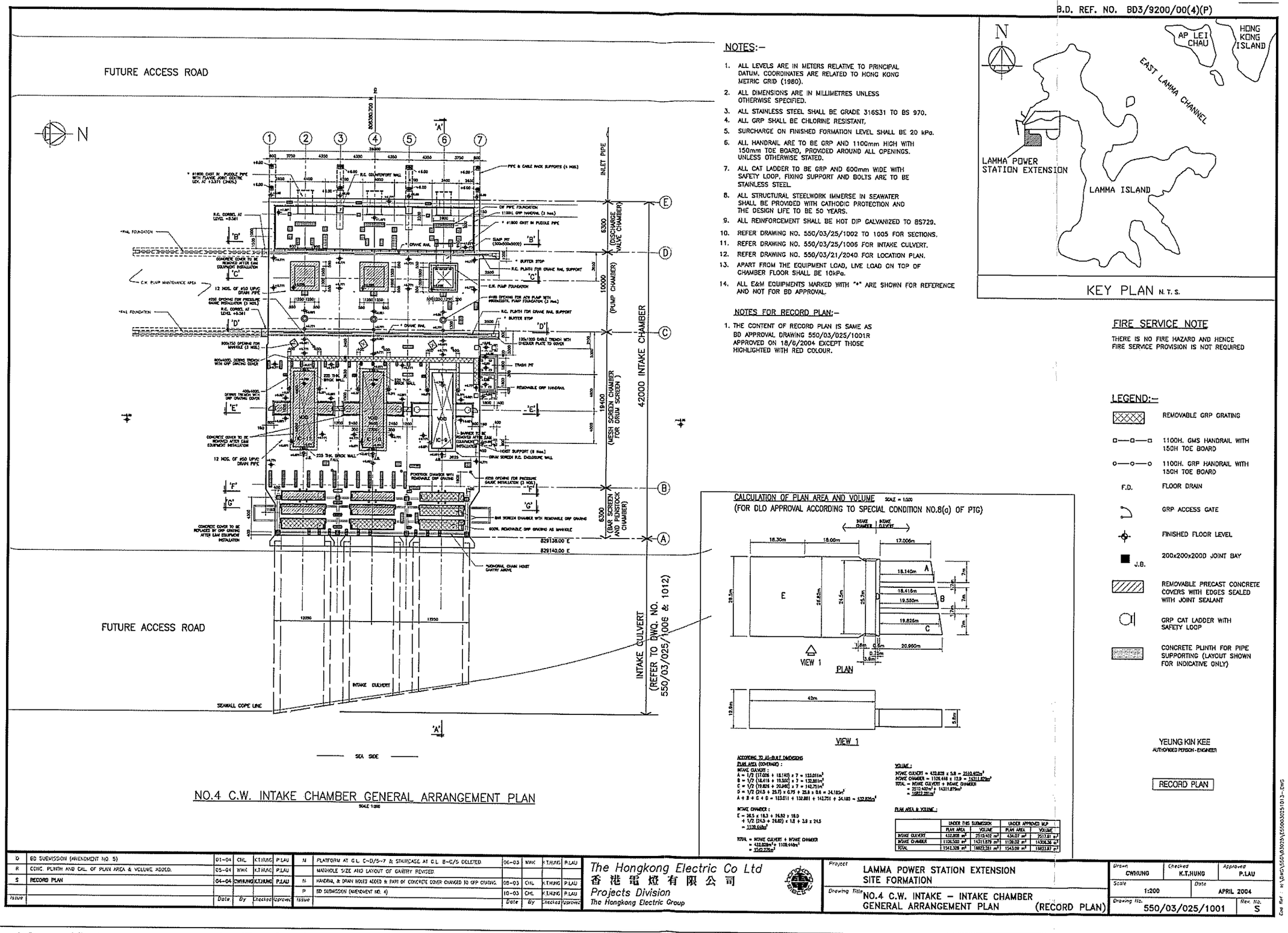
Drawing Title: NO. 3 C. W. OUTFALL
GENERAL ARRANGEMENT PLAN AND SECTIONS (RECORD PLAN)

Drawn	Checked	Approved
Y. W. WONG	K. T. HUNG	P. LAU
Scale: 1 : 200	Date: SEPT., 2000	
Drawing No. 550/03/025/1081 FORMERLY DWG. NO. 550/03/028/10010	Rev. No. K	

Cad Ref : H:\DWG\550\03\025\1081\550030250251081K.DWG

Figure 1.2b No.3 C.W. Outfall – General Arrangement Plan and Sections

B.D. REF. NO. BD3/9200/00(4)(P)



NO.4 C.W. INTAKE CHAMBER GENERAL ARRANGEMENT PLAN
SCALE 1:200

NOTES:–

1. ALL LEVELS ARE IN METERS RELATIVE TO PRINCIPAL DATUM. COORDINATES ARE RELATED TO HONG KONG METRIC GRID (1980).
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.
3. ALL STAINLESS STEEL SHALL BE GRADE 316S31 TO BS 970.
4. ALL GRP SHALL BE CHLORINE RESISTANT.
5. SURCHARGE ON FINISHED FORMATION LEVEL SHALL BE 20 kPa.
6. ALL HANDRAIL ARE TO BE GRP AND 1100mm HIGH WITH 150mm TOE BOARD, PROVIDED AROUND ALL OPENINGS. UNLESS OTHERWISE STATED.
7. ALL CAT LADDER TO BE GRP AND 600mm WIDE WITH SAFETY LOOP, FIXING SUPPORT AND BOLTS ARE TO BE STAINLESS STEEL.
8. ALL STRUCTURAL STEELWORK IMMERSE IN SEAWATER SHALL BE PROVIDED WITH CATHODIC PROTECTION AND THE DESIGN LIFE TO BE 50 YEARS.
9. ALL REINFORCEMENT SHALL BE HOT DIP GALVANIZED TO BS729.
10. REFER DRAWING NO. 550/03/25/1002 TO 1005 FOR SECTIONS.
11. REFER DRAWING NO. 550/03/25/1006 FOR INTAKE CULVERT.
12. REFER DRAWING NO. 550/03/21/2040 FOR LOCATION PLAN.
13. APART FROM THE EQUIPMENT LOAD, LIVE LOAD ON TOP OF CHAMBER FLOOR SHALL BE 10kPa.
14. ALL E&M EQUIPMENTS MARKED WITH "*" ARE SHOWN FOR REFERENCE AND NOT FOR BD APPROVAL.

NOTES FOR RECORD PLAN:–

1. THE CONTENT OF RECORD PLAN IS SAME AS BD APPROVAL DRAWING 550/03/025/1001R APPROVED ON 18/6/2004 EXCEPT THOSE HIGHLIGHTED WITH RED COLOUR.

KEY PLAN N. T. S.

FIRE SERVICE NOTE

THERE IS NO FIRE HAZARD AND HENCE FIRE SERVICE PROVISION IS NOT REQUIRED

LEGEND:–

- REMOVABLE GRP GRATING
- 1100H. GMS HANDRAIL WITH 150H TOE BOARD
- 1100H. GRP HANDRAIL WITH 150H TOE BOARD
- F.D. FLOOR DRAIN
- GRP ACCESS GATE
- FINISHED FLOOR LEVEL
- J.B. 200x200x200D JOINT BAY
- REMOVABLE PRECAST CONCRETE COVERS WITH EDGES SEALED WITH JOINT SEALANT
- GRP CAT LADDER WITH SAFETY LOOP
- CONCRETE PLINTH FOR PIPE SUPPORTING (LAYOUT SHOWN FOR INDICATIVE ONLY)

CALCULATION OF PLAN AREA AND VOLUME SCALE = 1:500
(FOR DLO APPROVAL ACCORDING TO SPECIAL CONDITION NO.8(a) OF PTG)

ACCORDING TO AS-BUILT DIMENSIONS

PLAN AREA (COVERED) :
INTAKE CULVERT :
A = 1/2 (17.006 + 18.140) x 7 = 123.011m²
B = 1/2 (18.416 + 19.550) x 7 = 132.881 m²
C = 1/2 (19.826 + 20.960) x 7 = 142.751 m²
D = 1/2 (24.5 + 25.7) x 0.75 + 25.8 x 0.6 = 34.185m²
A + B + C + D = 123.011 + 132.881 + 142.751 + 34.185 = 432.828m²

INTAKE CHAMBER :
E = 28.5 x 18.3 + 24.82 x 18.0
+ 1/2 (24.5 + 28.82) x 1.8 + 3.8 x 24.5
= 1109.448m²

TOTAL = INTAKE CULVERT + INTAKE CHAMBER
= 432.828m² + 1109.448m²
= 1542.276m²

VOLUME :
INTAKE CULVERT = 432.828 x 5.8 = 2510.402m³
INTAKE CHAMBER = 1109.448 x 12.9 = 14311.879m³
TOTAL = INTAKE CULVERT + INTAKE CHAMBER
= 2510.402m³ + 14311.879m³
= 16822.281m³

PLAN AREA & VOLUME :

	UNDER THIS SUBMISSION		UNDER APPROVED M/P	
	PLAN AREA	VOLUME	PLAN AREA	VOLUME
INTAKE CULVERT	432.828 m²	2510.402 m³	434.07 m²	2517.61 m³
INTAKE CHAMBER	1109.503 m²	14311.879 m³	1109.02 m²	14306.36 m³
TOTAL	1542.328 m²	16822.281 m³	1543.09 m²	16823.97 m³

YEUNG KIN KEE
AUTHORISED PERSON - ENGINEER

RECORD PLAN

D	BD SUBMISSION (AMENDMENT NO. 5)	01-04	CHL	K.T.HUNG	P.LAU	N	PLATFORM AT G.L. C-D/5-7 & STAIRCASE AT G.L. B-C/5 DELETED	06-03	WWK	K.T.HUNG	P.LAU
R	CONC. PLINTH AND CAL. OF PLAN AREA & VOLUME ADDED.	05-04	WWK	K.T.HUNG	P.LAU		MANHOLE SIZE AND LAYOUT OF GANTRY REVISED.				
S	RECORD PLAN	04-04	CWHUNG	K.T.HUNG	P.LAU	N	HANDRAIL & DRAIN HOLES ADDED & PART OF CONCRETE COVER CHANGED TO GRP GRATING.	03-03	CHL	K.T.HUNG	P.LAU
Issue		Date	By	Checked	Approved	P	BD SUBMISSION (AMENDMENT NO. 4)	10-03	CHL	K.T.HUNG	P.LAU
						Issue		Date	By	Checked	Approved

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

Project: LAMMA POWER STATION EXTENSION SITE FORMATION

Drawing Title: NO.4 C.W. INTAKE – INTAKE CHAMBER GENERAL ARRANGEMENT PLAN (RECORD PLAN)

Drawn	Checked	Approved
CWHUNG	K.T.HUNG	P.LAU
Scale: 1:200	Date: APRIL 2004	
Drawing No.: 550/03/025/1001	Rev. No.: S	

Cad Ref: H:\DWG\550\03025\550030251001-DWG

Figure 1.2c No.4 C.W. Intake – Intake Chamber General Arrangement Plan

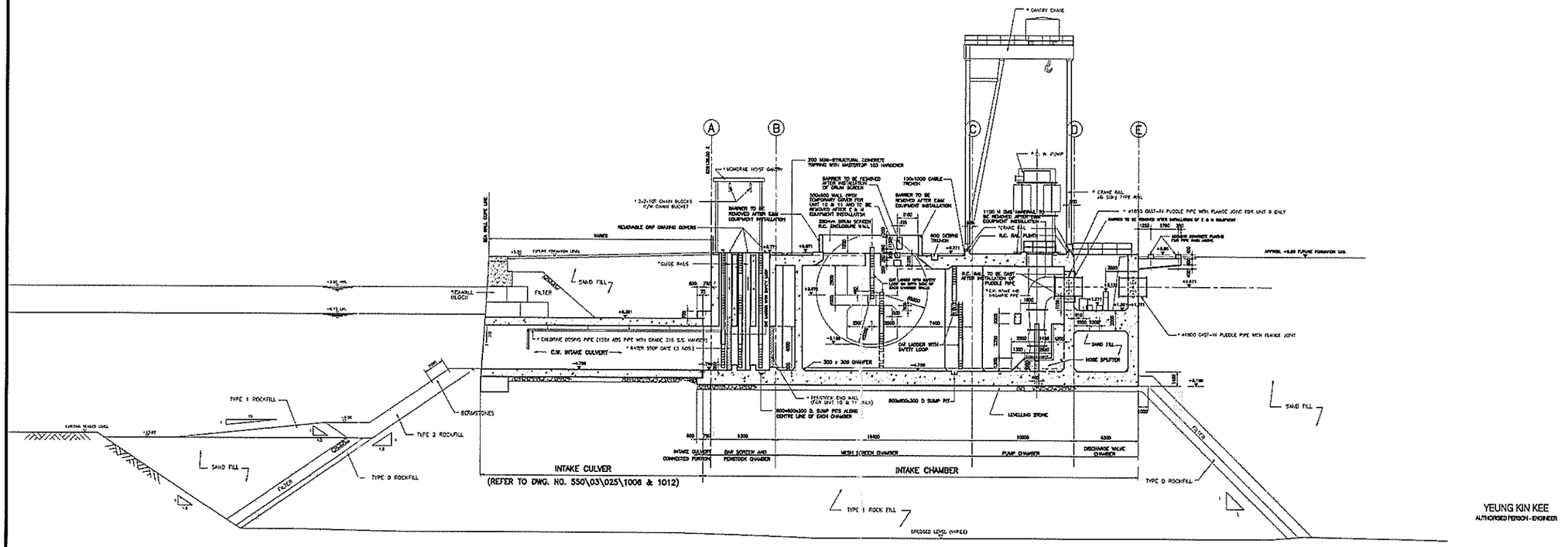
B.D. REF. NO. BD2/9200/00(4)(P)

NOTES

1. ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
2. ALL LEVELS ARE SHOWN IN METERS ABOVE PRINCIPAL DATUM.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO.550/03/25/1001 TO 1003 AND 1005.

NOTES FOR RECORD PLAN

1. THE CONTENT OF RECORD PLAN IS SAME AS DD APPROVAL DRAWING 550/03/025/1004Q APPROVED ON 18/6/2004 EXPECT THOSE HIGHTGHTED WITH RED COLOUR



SECTION 'A' – 'A'

TYPICAL LONGITUDINAL SECTION FOR No.4 C.W. INTAKE CHAMBER

R	RECORD PLAN	04/04	CWHUNG	K.T.HUNG	P.LAU
Issue		Date	By	Checked	Approved

M	HANDRAIL ADDED	08/03	CHL	K.T.HUNG	P.LAU
N	BD SUBMISSION (AMENDMENT NO. 4)	10/03	CHL	K.T.HUNG	P.LAU
P	BD SUBMISSION (AMENDMENT NO. 5)	01/04	CHL	K.T.HUNG	P.LAU
Q	DESCRIPTION FOR 500sq mm WALL OPENING AT LEVEL 671 BET. G.L. B & C REVISED.	03/04	CHL	K.T.HUNG	P.LAU
Issue		Date	By	Checked	Approved

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

Project: LAMMA POWER STATION EXTENSION SITE FORMATION

Drawing Title: NO.4 C.W. INTAKE – INTAKE CHAMBER LONGTUDINAL SECTION (RECORD PLAN)

Drawn	Checked	Approved
CWHUNG	K.T.HUNG	P.LAU
Scale: 1:200	Date: APRIL 2004	
Drawing No.: 550/03/025/1004		Rev No: R

Cad Ref : H:\DWG\550\03\025\1550030251004P.DWG

Figure 1.2d No.4 C.W. Intake – Intake Chamber Longitudinal Section

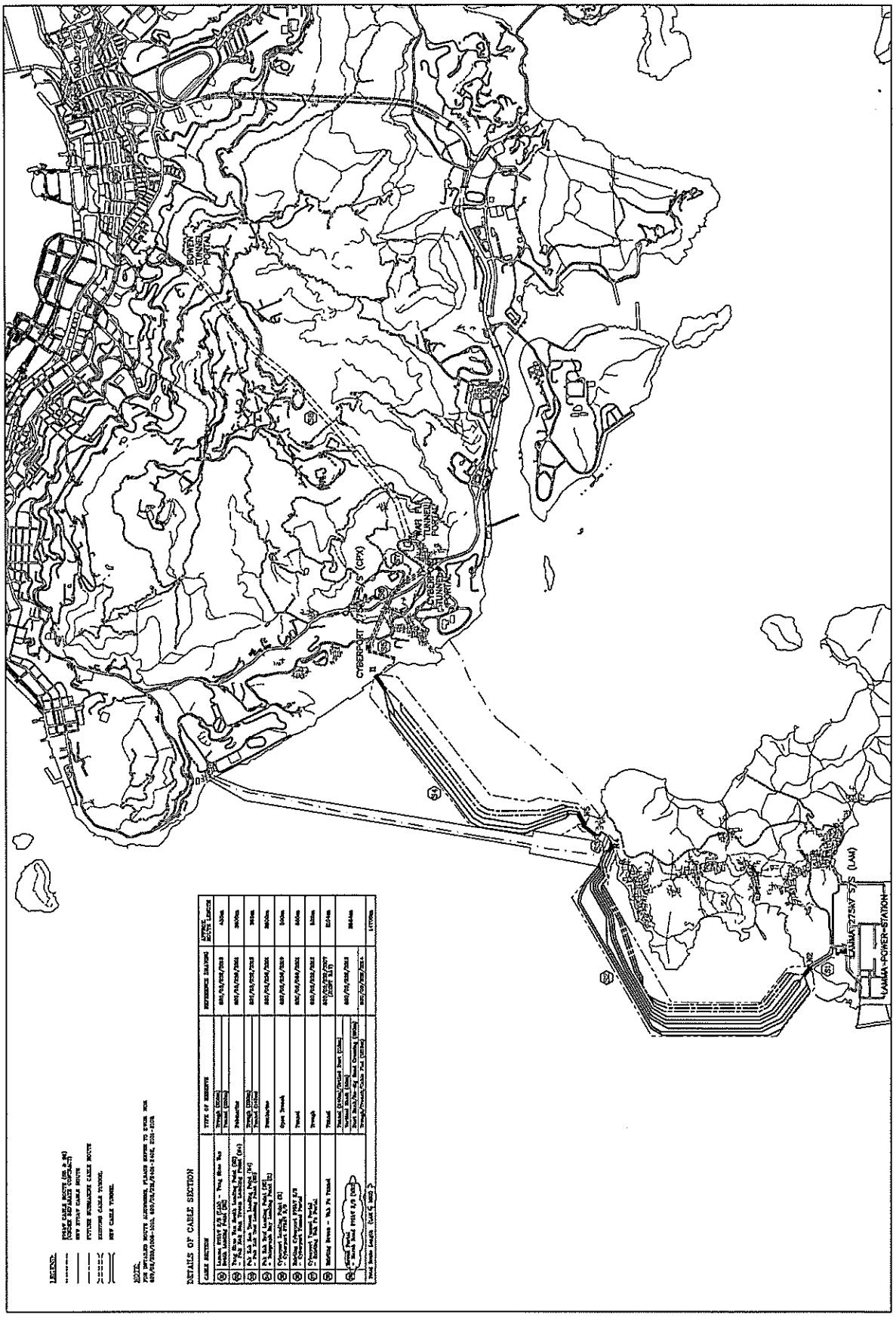


Figure 1.2e Layout of Transmission System

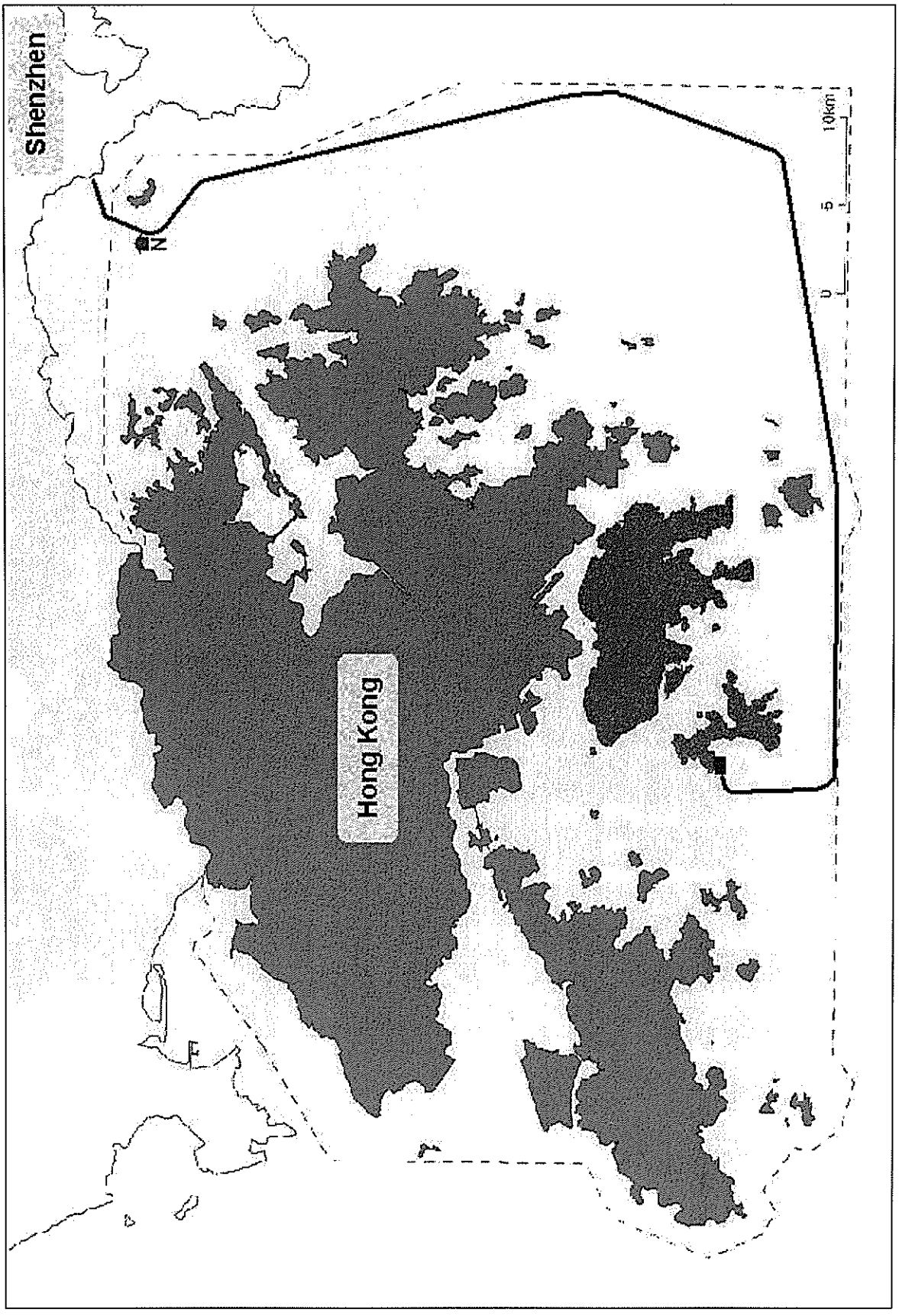


Figure 1.2f Layout of Gas Pipeline

2 ORGANISATION AND STRUCTURE OF THE EM&A PROGRAMME

2.1 GENERAL

The Environmental Permit of the Project requires appointing an Environmental Team (ET) for the operation of the Project. The roles of the ET are to conduct the EM&A works and to provide specialist advice to the ET Leader on the undertaking and implementation of his environmental responsibilities.

The ET shall have previous relevant experience of managing similarly sized EM&A programmes and the ET Leader shall be a recognised environmental professional, who has at least seven years relevant experience in environmental monitoring and auditing or environmental management.

To maintain strict control of the EM&A process, an independent environmental consultants shall be appointed to act as an "Independent Environmental Checker" (IEC) before the commissioning of the Project. The IEC is to verify and validate the environmental performance of the ET. The IEC shall have at least seven years' experience in EM&A or environmental management.

2.2 PROJECT ORGANISATION

The Chief Engineer (Projects) (thereafter called CE(PD)) is the official contact person between EPD and HEC. CE(PD) shall sign all submissions to EPD in accordance with the requirements of the EM&A Manual (Operational Phase).

An ET consisting of Operations Engineers, Chemists and Environmental Engineers from various Divisions of HEC will be established in house to implement the environmental monitoring work as required by this EM&A Manual (Operational Phase). The Operations Engineers and Chemists are from the Generation Division of HEC whereas the Environmental Engineers are from the Projects Division (PD) of HEC. The organisation and management structure for the EM&A programme are illustrated in *Figure 2.2a*.

The Operations Engineers are mainly responsible for operation of the combined cycle units and ensure proper operation of their pollution control and monitoring equipment. The main duty of the Chemists is to carry out routine sampling and analysis of effluent discharges. The Environmental Engineers are mainly responsible for stack source monitoring and noise monitoring, conducting stack samplings and acquiring stack emission data & effluent thermal discharge data for compliance checking.

The IEC is appointed to audit and verify the overall environmental performance of the Project and assess the effectiveness of the ET.

The specific roles and responsibilities of the various parties involved in the EM&A process outlined above are further expanded upon in the following sections.

2.2.1 *Environmental Team Leader*

The duties of ET Leader are to:

- be responsible for the implementation of the EM&A programmes in accordance with the EM&A requirements as contained in this EM&A Manual;
- verify EM&A reports for submission to the Authority as required by the EP; and
- liaise with the IEC on all environmental issues, and the timely submission of relevant reports.

2.2.2 *Environmental Team - Operations Engineers*

The duties of the Operations Engineers are to:

- operate the plants according to the terms and conditions stipulated in the environmental licences;
- provide assistance to the ET Leader in conducting the required environmental monitoring;
- provide information/advice to the ET Leader or IEC regarding works activities which may contribute, or be contributing to the creation of adverse environmental conditions;
- implement measures or undertake corrective actions to reduce impact when Action and Limit levels are exceeded; and
- take responsibility and strictly adhere to the guidelines of the EM&A programme

2.2.3 *Environmental Team - Chemists and Environmental Engineers*

The duties of the Chemists and Environmental Engineers of the ET are to:

- implement the EM&A programmes in accordance with the EM&A requirements as contained in this EM&A Manual;
- monitor the environmental parameters as required by this EM&A Manual;
- report the implementation status of various environmental monitoring works as required by the related pollution control licences and/or this EM&A Manual;
- prepare EM&A reports for submission to the Authority as required by the EP;
- report the status of the general environmental conditions and the implementation of mitigation measures;
- report on the EM&A results and the wider environmental issues (such as with compliance with environmental and pollution prevention and control regulations) and conditions to CE(PD) or his/her representative;

- adhere to the agreed protocols (contained in this EM&A Manual) in the event of exceedances or complaints. For complaints, this will comprise investigation and identification of suitable corrective measures;

- advise CE(PD) or his representative on environmental improvements, awareness, enhancement matters etc.

- monitor if any necessary additional mitigation measures or alternative measures are required to be undertaken to prevent adverse environmental impact arising from the operational activities.

2.2.4 *Independent Environmental Checker*

The IEC shall be appointed to independently audit and verify the overall environmental performance of the works and to assess the effectiveness of the ET in their duties. The IEC, who shall be independent from the management of the Project, shall advise CE(PD) on the environmental issues related to the Project. The main objectives will be to:

- review and audit the overall EM&A programme including the implementation of all environmental mitigation measures, submissions relating to EM&A, and other submissions required under the Environmental Permit (EP);

- review the effectiveness of environmental mitigation measures and environmental performance;

- review and verify the EM&A Reports prepared by the ET;

- verify, if necessary, any additional mitigation measures or alternative measures to be undertaken by the ET as corrective actions to prevent adverse environmental impacts arising from the operational activities; and

- check complaint handled and the effectiveness of corrective measures implemented by HEC under the EAP.

2.3 *PROGRAMME*

The 1st new gas-fired combined cycle unit (viz. Unit L9) would be in operation by October 2006. The remaining five units will be constructed and put into service in accordance with system demand growth and subject to Government approval.

A review on the EM&A requirements will be conducted, if necessary, before work commencement of subsequent units, taking into account the latest development programme stipulated in the Commissioning Schedule as submitted under Condition 4.3 of the Environmental Permit No. EP-071/2000/C issued under the EIA Ordinance.

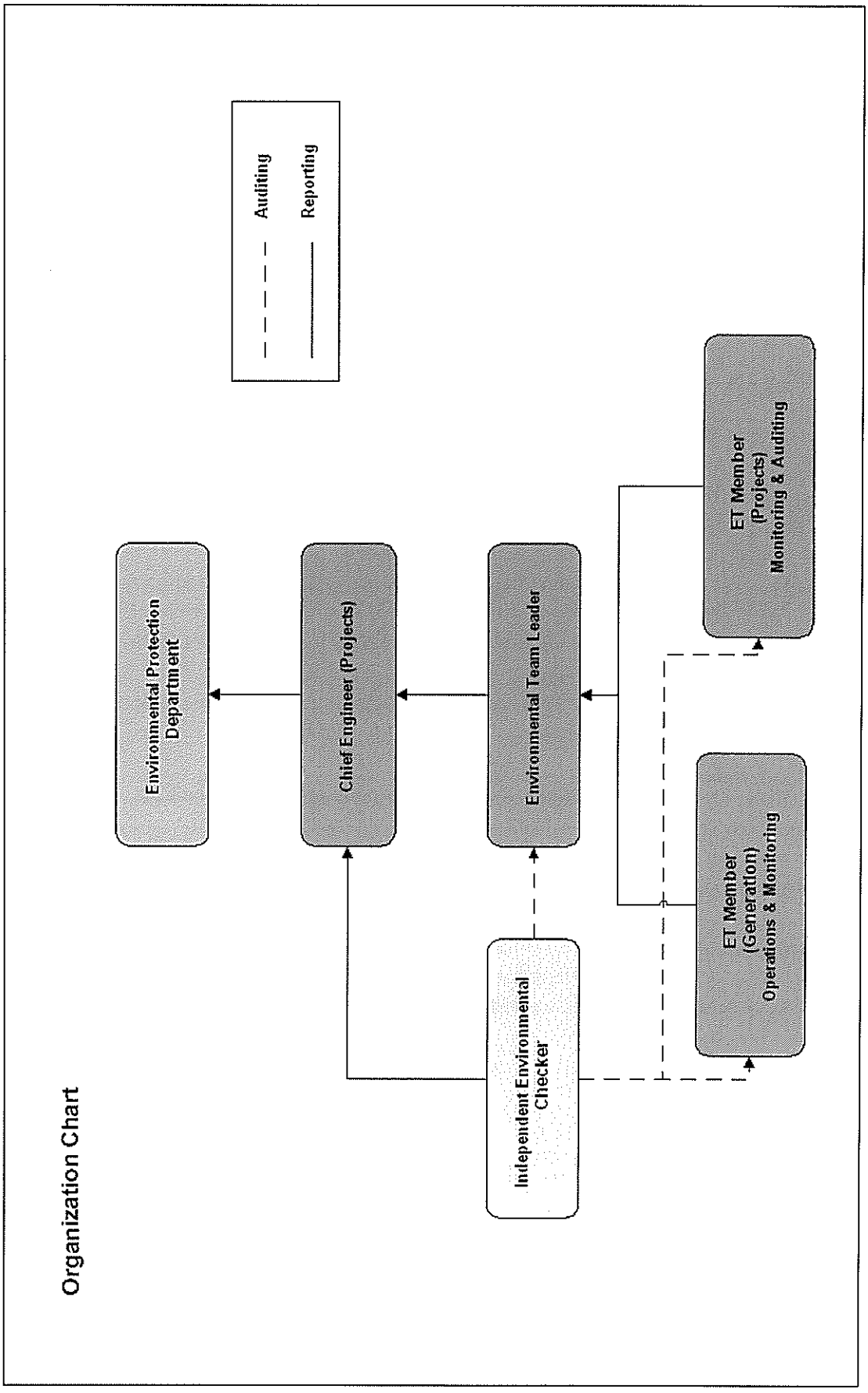


Figure 2.2a Organization Structure at Operational Phase

3 EM&A GENERAL REQUIREMENTS

3.1 INTRODUCTION

In this Section, the general requirements of the EM&A programme for the operational phase of the Project are presented.

The environmental issues associated with the operational phase of the Project identified in the EIA report will be addressed through the monitoring and controls specified in the EM&A Manual (Operational Phase).

3.2 EM&A REQUIREMENTS

The following sub-sections summarise the EM&A requirements during the operational phase.

3.2.1 Noise Impact

With reference to the EIA report, the critical NSR is Hung Shing Ye, which will be used for monitoring the noise impact from the Lamma Extension operation. The noise monitoring system will comprise the existing noise alarm station at Ash Lagoon (roof top of decantrate pump house). Based on standard acoustical principles and practices, the noise levels at the critical NSR will be calculated from the measured noise levels at the existing noise alarm station.

3.2.2 Air Quality Impact

The EIA study for Lamma Power Station Extension (simply named as "Lamma Extension") concluded that the operation of the new 1800 MW gas-fired combined cycle power station will not cause any potential exceedance of the AQOs for SO2 and NO2.

The environmental monitoring requirement of air pollutants emissions from new gas-fired units will be stipulated in a Specified Processes (SP) Licence issued under Air Pollution Control Ordinance (APCO). The licence will specify the emission limits in terms of concentrations and emission rates. To avoid duplication of effort, all the monitoring and reporting requirements under the SP Licence will not be included in this EM&A programme. The EM&A programme will only check the implementation status of the monitoring and reporting requirements as required by the SP Licence.

A summary of the environmental monitoring data and the implementation status will be reported in the monthly EM&A reports.

3.2.3 *Water Quality Impact*

Monitoring of the effluent discharges will be covered in a Water Pollution Control Ordinance (WPCO) Licence. Similarly, to avoid duplication of effort, all those monitoring and reporting requirements under the WPCO Licence will not be included in this EM&A work. The EM&A programme will check the implementation status of the monitoring and reporting requirements as required by the WPCO Licence.

The EIA study for Lamma Power Station Extension predicted that the new gas-fired power station would not cause adverse environmental impacts as a result of the thermal discharges from the Project. The study also predicted that the elevations in chlorine concentrations would be of localized nature and the discharge would not cause unacceptable environmental impacts as no sensitive areas would be impacted. As such, no mitigation measures during the operational phase were specified. To verify the above predictions, surveys for thermal plume and residual chlorine concentration shall be carried out.

A summary of environmental monitoring data as required by the WPCO discharge licence and the implementation status of the above surveys shall be reported in the monthly EM&A reports.

3.2.4 *Ecological Resources*

Impact of operational activities will be monitored through on-site monitoring of water quality parameters (including residual chlorine and temperature) of the discharged cooling waters. Monitoring and audit activities designed to detect and mitigate any unacceptable impacts to water quality will serve to protect against unacceptable impacts to marine ecological resources.

The discharge monitoring programme will provide supplemental mitigation measures to be employed should impacts arise, thereby ensuring the environmental acceptable impacts to water quality will serve to protect against unacceptability of the Project. As the EIA study concluded that there is no unacceptable impact to marine ecological resources, the development and implementation of a monitoring and audit programme specifically designed to assess the effects of operational activities on marine ecological resources is deemed not necessary.

3.2.5 *Land Contamination*

A Land Contamination Avoidance Plan shall be submitted to EPD no later than three months prior to the commissioning of the first 300MW unit.

The monthly EM&A reports shall contain the incidents of land contamination happened, if any, and the results of the practices being implemented. The detailed procedures, if any, as outlined in the Land Contamination Avoidance Plan shall be followed.

3.2.6 *Waste Management*

A Waste Management Plan shall be submitted to EPD no later than three months prior to the commissioning of the first 300MW unit.

The monthly EM&A reports shall contain the results of the waste management practices being implemented. The detailed waste management procedures as outlined in the Waste Management Plan shall be followed.

3.3 *ENVIRONMENTAL MONITORING*

The monitoring of environmental impacts shall be carried out by the Chemists and Environmental Engineers of the ET. The monitoring work will comprise samplings of stack source & stack continuous emission monitoring (CEM), and effluent discharges as required by the APCO (SP) Licence and WPCO Discharge Licence respectively. The purpose of the monitoring work is to ensure compliance with these pollution control ordinances. Other additional monitoring works not covered by the ordinances but proposed in this EM&A Manual are the noise monitoring, and thermal plume and chlorine concentration surveys. The EM&A program as part of the established environmental monitoring system is to ensure that these monitoring works have been implemented. To avoid duplication, detailed monitoring data already reported to EPD under the relevant licences will not be repeated in this EM&A program. Nevertheless, a summary of monitoring data will be reported in the monthly EM&A reports.

3.4 *ACTION AND LIMIT LEVELS*

Action and Limit (A/L) Levels are defined levels of impact recorded by the environmental monitoring activities which represent levels at which a prescribed response is required. These levels are quantitatively defined later in the relevant sections of this manual and described in principle below:

- *Action Levels*: beyond which there is a clear indication of a deteriorating ambient environment for which appropriate remedial actions are likely to be necessary to prevent environmental quality from falling outside the Limit Levels, which would be unacceptable; and

- *Limit Levels*: statutory limits stipulated in the relevant pollution control ordinances, the Hong Kong Planning Standards and Guidelines (HKPSG) or *Environmental Quality Objectives* established by the EPD. If these are exceeded, operation of the unit should not proceed without appropriate remedial action, including a critical review of plant and working methods.

3.5 *EVENT AND ACTION PLANS*

The purpose of the EAPs is to provide, in association with the monitoring and audit activities, procedures for ensuring that if any significant environmental incident does occur, the cause will be quickly identified and remedied, and the risk of a similar event recurring is reduced. They also apply to the exceedances of A/L criteria identified in the EM&A programme.

3.6 *ENQUIRIES, COMPLAINTS AND REQUESTS FOR INFORMATION*

Enquiries, complaints and requests for information can be expected from a wide range of individuals and organizations including members of the public, Government departments, the press and television media and community groups. The detailed complaints handling procedure is presented in Section 8.2.

3.7 *REPORTING*

EM&A reports shall be prepared by the ET, and certified by the ET Leader and verified by the IEC. The monthly EM&A reports shall be prepared and submitted within two weeks after the end of each reporting month. Additional details on reporting protocols are presented in Section 9.

3.8 *REVIEW OF EM&A*

The EM&A work will be reviewed taking into account the experience gained and the actual environmental conditions as and when required.

4 NOISE MONITORING

4.1 INTRODUCTION

In this section, the methodology, equipment and location for the monitoring and audit of the noise impact associated with the operation of the Lamma Extension Project are described.

4.2 MONITORING METHODOLOGY

The noise level at the critical NSR will be used as the indicator for the noise impact of the Lamma Extension operation. According to the EIA report, the critical NSR is the village at Hung Shing Ye.

Continuous noise alarm monitoring would be carried out to calculate the noise levels at the critical NSR for checking of any exceedance of limit levels as shown in *Table 4.7a.*

The noise monitoring system will comprise the existing noise alarm station at Ash Lagoon (the roof top of decantrate pump house) as shown in *Figure 4.4a.* The noise alarm station at Ash Lagoon is the existing monitoring station as required by the EM&A programme for Lamma Extension construction.

Noise levels will be measured at the noise alarm station at Ash Lagoon. The notional background noise levels (viz. baseline noise data at Ash Lagoon) shall be applied to the corresponding measured noise levels (MNLs) in 30-min L_{Aeq}. The noise levels after notional background correction at Ash Lagoon would be used to calculate the noise level at the critical NSR at Hung Shing Ye. The calculated noise levels would then be checked against the limiting noise levels for any exceedance.

The features of continuous noise alarm monitoring are as follows:-

a. During the Lamma Extension operation, 30-min L_{Aeq} shall be measured at 07:00-23:00 hrs and 23:00-07:00 hrs on next day.

b. Adverse meteorological conditions would affect the noise measurements, e.g. strong wind, heavy rain and thunder. A wind speed sensor has been installed at the existing Lamma Power Station Building rooftop. The wind speed signal shall be used to determine whether the data from the Ash Lagoon noise alarm station are affected. The computer shall be programmed to discard the instantaneous data in case the instantaneous wind speed exceeds 10 m/s.

   The 30-min LAeq shall be considered valid only if the amount of valid data is equal to or above 70%.

c. A single notional noise source centre for Lamma Extension operation is assumed in calculating the noise levels at the critical NSR according to the following equation:

$$CNL_{NSR} = SPL_{ALM} + 10x\log(\frac{d_{ALM}}{d_{NSR}})^2 + BC + AtmC \quad [dBA]$$

where,

CNL_{NSR} denotes the calculated noise level at the critical NSR;

SPL_{ALM} denotes the measured noise level at the alarm station after background correction;

d_{ALM} denotes the separation distance between the notional source centre and the alarm station;

d_{NSR} denotes the separation distance between the notional source centre and the critical NSR;

BC denotes the correction for accounting the difference between the barrier attenuations for the alarm station and NSR;

AtmC denotes the correction for accounting the difference between the atmospheric absorption attenuations for the alarm station and NSR.

Noise alarm shall be raised in the central control room if the calculated noise level at Hung Shing Ye exceeds the corresponding limit level.

The automatic noise monitoring is on 24-hour basis and can fully replace the conventional manual regular measurements. This approach has been adopted in the current EM&A programmes for Lamma Extension construction and Units L7 & L8 operation as endorsed by EPD.

4.3 MONITORING EQUIPMENT

The sound level meter/analyzer used shall comply with International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1).

The sound level meter/analyzer and calibrator shall be verified biennially and annually respectively by the manufacturer or accredited laboratory.

Monthly calibration of the noise measuring equipment shall be carried out.

4.4 MONITORING LOCATION

The location of the noise alarm station, i.e. the existing noise alarm station at Ash Lagoon for the current EM&A programme for Lamma Extension construction, is shown in *Figure 4.4a.*

4.5 BASELINE MONITORING

The baseline noise levels at the monitoring location are shown in Annex B.

4.6 *IMPACT COMPLIANCE MONITORING*

The continuous noise alarm monitoring would be carried out according to *Table 4.7a.*

4.7 *COMPLIANCE ASSESSMENT*

Action and Limit (A/L) Levels provide an appropriate framework for the interpretation of the monitoring results. The monitoring data shall be checked against the A/L levels as listed in *Table 4.7a.*

4.8 *EVENT AND ACTION PLAN*

All the impact monitoring results should be checked against the Action and Limit levels set out in *Table 4.7a.* Actions required in the event of exceedance of any of the levels are summarised in *Table 4.8a.*

Table 4.7a *Monitoring Frequency and Action & Limit Levels of Operational Noise*

Parameters	Frequency	Action	Limit	Proposed Action
Noise Levels at the critical NSR at Hung Shing Ye calculated by the noise alarm monitoring system	Continuous	When more than one complaint is received within two weeks, which are concerning the same event or location	a. 60 dB(A) in $L_{Aeq,30\ min}$ (07:00-23:00 hrs) b. 50 dB(A) in $L_{Aeq,30\ min}$ (23:00-07:00 hrs on next day)	In case of exceedances of respective AL levels, action as outlined in *Section 4.8 (Table 4.8a)* should be taken.

Table 4.8a Event and Action Plans - Operational Noise

Exceedance	ET Leader	IEC	Operations Engineer
Action Level	If the complaint against Lamma Extension operation is valid, identify the source(s) of the noise and propose remedial measures if necessary;	Verify the implementation of the remedial measures.	Discuss with ET Leader on remedial actions required; Implement the agreed remedial actions.
Limit Level	Check monitoring data to confirm findings; Identify the source(s) of the impact. If the exceedance is found to be valid and due to the Lamma Extension operation, verbally inform IEC and EPD of the exceedance as soon as practicable; Discuss with Operations Engineers on remedial actions required.	Check monitoring data submitted by ET Leader and advise ET Leader of any finding; Verify the implementation of the remedial measures.	Take action to avoid further exceedance; Discuss with ET Leader on the remedial actions required; Implement the agreed remedial actions.

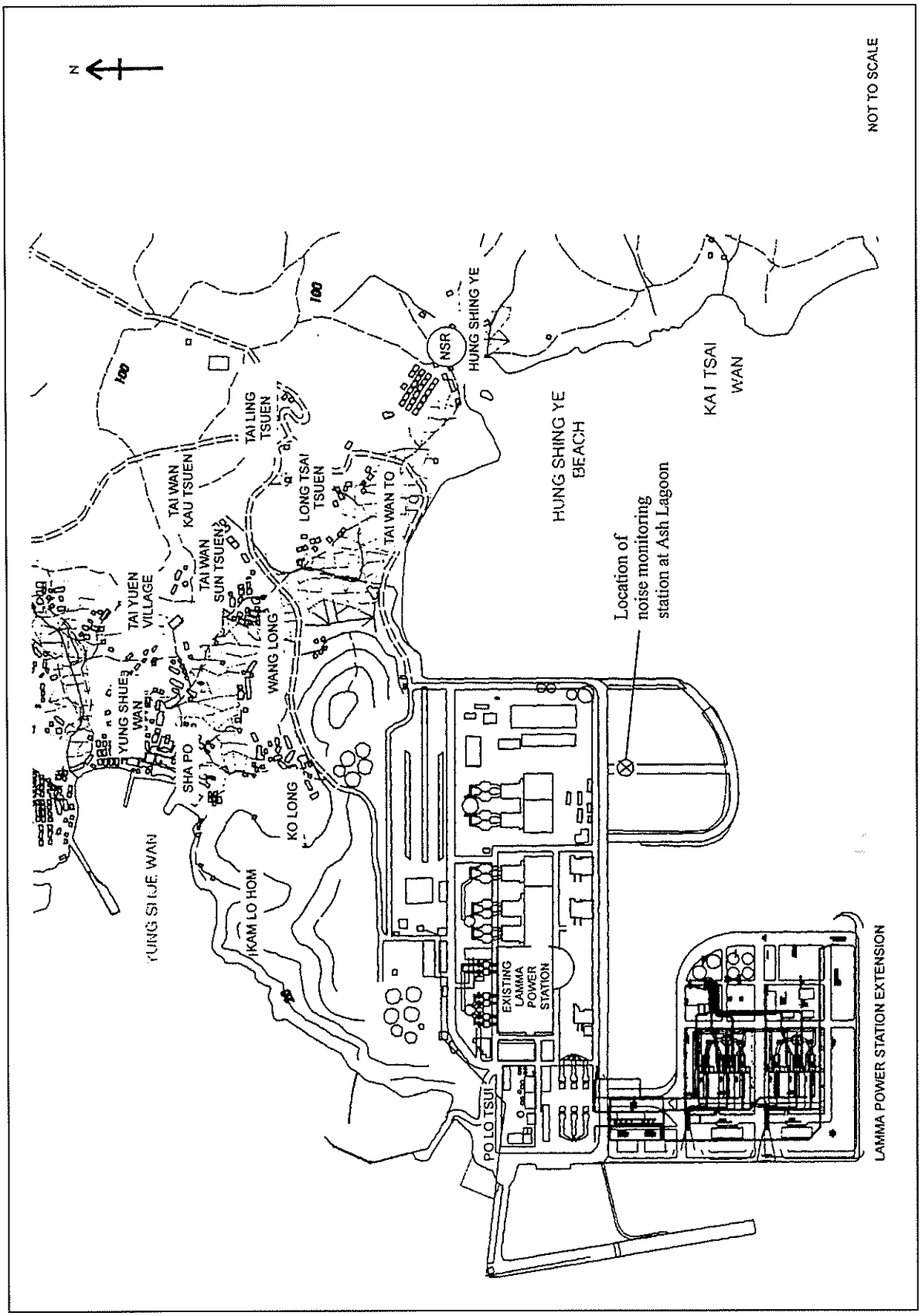


Figure 4.4a Location of Noise Monitoring Station

5 AIR QUALITY MONITORING

5.1 INTRODUCTION

According to EIA study report for Lamma Extension, it has been concluded that the new gas-fired power station would not result in any insurmountable environmental constraints to Hong Kong SAR and Pearl River Delta region. Hence, the monitoring requirements as stated in section 4.10.1 of Volume 2 of the EIA report for Lamma Extension and in the EPD's publication "A Guidance Note on the Best Practicable Means for Electricity Works" are considered adequate.

5.2 MONITORING REQUIREMENT

Details of the monitoring requirements are presented below:

Continuous In-stack Monitoring

- Nitrogen oxides (NOx);
- Oxygen (O_2);
- Carbon monoxide (CO);

5.3 MONITORING LOCATION AND EQUIPMENT

In-stack monitoring

Stack NOx, O_2 and CO will be monitored continuously. NOx, O_2 and CO analyzer will be installed at a level of about +81.3m PD. The specifications of instrument or its equivalence to be used in the continuous emission monitoring (CEM) system are presented below:

NOx, O_2, CO:

ENDA-600 stack flue gas analyser or equivalent

Measuring method

NOx:	NDIR cross flow modulation method
O_2:	Magnetopneumatic detection
CO:	NDIR cross flow modulation method

Measuring range

NOx:	0 – 200 mg/Nm^3
O_2:	0 – 25%
CO:	0 – 500ppm

Repeatability

NOx: ±0.5% full scale
O_2: ±1% full scale
CO: ±0.5% full scale

Linearity

NOx: ±0.5% full scale
O_2: ±1% full scale
CO: ±0.5% full scale

The emission data of the new gas-fired combined cycle unit will be made available to EPD office via a telemetry system.

Routine maintenance: weekly

Routine calibration: weekly

5.4 *BASELINE MONITORING*

Unlike the EM&A programme for the construction phase, baseline monitoring to measure monitoring parameters of air quality at the sensitive receivers during a representative pre-project period for the Project during the operational phase is not required. Similar environmental monitoring work would be conducted to meet the requirements set out in the licence issued under the APCO.

5.5 *COMPLIANCE ASSESSMENT*

Action/Limit level for stack NOx are summarized in Table 5.5a below. They are established from the limit levels/criteria stipulated in the Specified Processes Licence issued under APCO and are subject to change according to the Specified Processes Licence.

Derivation of Action/Limit levels are shown as follows:

NOx:

Limit level: The NOx emission limit stated in section 3(b) of EPD's guideline "A Guidance Note on the Best Practicable Means for Electricity Works" is adopted. It is anticipated that this value would be imposed in the APCO SP Licence as the NOx emission concentration limit for the new gas-fired combined cycle unit.

Action level: The experience gained from L7/8 Operation EM&A suggests that setting the action level at 90% of limit level can adequately prevent the concerned pollutants from exceeding the limit level. In this regard, the action level of NOx is set at 90% of limit level.

Table 5.5a *Specific Action in Response of Exceedance of AL Level (Air Emission)*

Source of Emission	Parameters to be monitored	Frequency	Concentration not to be exceeded	Action	Limit	Proposed Action
Stack flue gas	NOx (as NO_2)	Continuous	90 mg/Nm^3 *	81	90	In case of exceedance of respective AL levels, actions as outlined in section 5.7 should be taken.

* - Hourly average value. Expressed as at 0°C, 101.325kPa, dry and corrected to 15% O_2 condition.

5.6 *AUDITING OF THE IMPLEMENTATION OF THE ENVIRONMENTAL MONITORING WORK*

The environmental monitoring data as required should be checked against the requirement to be stipulated in the new SP Licence for the gas-fired combined cycle unit to ensure compliance in each reporting period. A summary of the monitoring data and the implementation status of each of the monitoring requirements shall be reported in the monthly EM&A reports.

However, in view of the time required for the verification of measured monitoring data, the monitoring data might not necessarily be recorded in the immediate reporting month, depending on whether they become available for release.

5.7 *EVENT AND ACTION PLANS*

All the impact monitoring results should be checked against the Action and Limit levels set out in *Table 5.5a.* Actions required in the event of exceedance of any of the levels are summarized in *Table 5.7a.*

Table 5.7a *Event and Action Plans for Air Quality*

Exceedance	ET Leader	IEC	Operations Engineer
Action Level			
Exceedance of one sample	Identify source; Inform IEC verbally; Repeat measurement to confirm finding.	Check monitoring data submitted by ET Leader and advise ET Leader for any finding.	Rectify any unacceptable practice; Amend any working methods if appropriate.
Exceedance of two or more consecutive samples	Identify source; Inform IEC verbally; Repeat measurement to confirm finding; Increase monitoring frequency; Discuss with Operations Engineers on remedial actions required; If exceedance stops, discontinue additional monitoring.	Check monitoring data submitted by ET Leader and advise ET Leader for any finding; Verify the implementation of the remedial measures;	Discuss with ET Leader on remedial actions required; Implement the agreed remedial actions.
Limit level			
Exceedance of one sample	Repeat measurement to confirm finding; Identify the source(s) of the impact. Verbally inform IEC and EPD of the exceedance as soon as practicable; Discuss with Operations Engineers on remedial actions required; Increase monitoring frequency; Assess the effectiveness of the remedial actions and keep IEC and EPD informed of the results.	Check monitoring data submitted by ET Leader and advise ET Leader of any finding; Verify the implementation of the remedial measures.	Take immediate action to avoid further exceedances; Discuss with ET Leader on remedial actions required; Implement the agreed remedial actions.
Exceedance of two or more consecutive samples	Identify source; Identify the source(s) of the impact. Verbally inform IEC and EPD of the exceedance as soon as practicable; Repeat measurement to confirm finding; Increase monitoring frequency; Carry out analysis on existing control procedures to determine possible mitigation to be implemented; Discuss with Operations Engineers on the remedial actions to be taken; If exceedance stops, discontinue additional monitoring.	Provide feedback and advise ET Leader/Operations Engineers on the effectiveness of the remedial actions proposed by them; Verify the implementation of the remedial measures.	Take immediate action to avoid further exceedance; Discuss with ET Leader on remedial actions required; Implement the agreed remedial actions; Check the suspected defective parts if the problem still does not come under control.

5.8 *MITIGATION MEASURES*

The EIA has recommended air quality control and mitigation measures during the operational phase of the Project. These are outlined in the Implementation Schedule *(Annex A)*. The progress and the implementation status of the mitigation measures will be reported in the monthly EM&A reports.

In the event of exceedances or complaints, the ET leader, Operations Engineers and concerned Departments shall be responsible for the investigation of the causes of exceedance and propose remedial measures.

6 WATER QUALITY MONITORING

6.1 INTRODUCTION

This section provides details of the environmental monitoring programme and presents technical requirements for monitoring water quality during the operation of the Lamma Extension.

According to the EIA study for Lamma Extension, the impacts to water quality from the Project during the operational phase are considered to be acceptable. No further mitigation measures during the operational phase were specified. The Implementation Schedule *(Annex A)* has recommended that all discharge of effluent/ wastewater shall be controlled through licensing under the Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters, issued under Section 21 of the WPCO.

Monitoring of the effluent discharges is covered in the WPCO Licence. Details of some monitoring requirements are proposed below. Details of monitoring requirements are subject to change according to the WPCO Licence.

The EIA study predicted that the new gas-fired power station would not cause adverse environmental impacts as a result of the thermal discharges from the Project. The study also predicted that the elevations in chlorine concentrations would be of localized nature and the discharge would not cause unacceptable environmental impacts as no sensitive areas would be impacted. As such, no mitigation measures during the operational phase were specified. To verify the above predictions, surveys for thermal plume and residual chlorine concentration shall be carried out.

6.2 EFFLUENT DISCHARGE MONITORING REQUIREMENTS

Monitoring of effluent discharge arising from the Project will be stipulated in the WPCO Licence as terms and conditions. These monitoring requirements are subject to change according to the licence. These monitoring requirements are summarised as follows:-

a. The discharge does not cause the ambient temperature to increase by more than 2°C outside a defined mixing zone.

   The current practice of monitoring condenser cooling water flows and temperature for the existing coal-fired units will also be adopted for the combined cycle unit. Cooling water flows will be monitored using differential pressure transmitter and cooling water temperatures by temperature transmitter across the condenser inlet and outlet. Weighted temperature rise across the condensers at the outfall will be reported if the unit is operated.

b. Total residual chlorine should be monitored bi-weekly at cooling water discharge.

c. Oil free drain Oil & Grease should be monitored monthly at its discharge point.

d. Boiler blowdown temperature should be monitored twice a year.

e. Foams due to discharge at the cooling water outfall should be monitored daily by visual inspection.

A summary of environmental monitoring data as required by the WPCO discharge licence shall be reported in the monthly EM&A reports. However, in view of the existing practice of 3 weeks time required for result analysis, the monitoring data might not necessarily be recorded in the immediate reporting month, depending on whether they become available for release.

6.3 *MONITORING EQUIPMENT*

For water quality monitoring, the following equipment / methods shall be used to carry out the monitoring:

(a) Temperature/Flow Measuring Sensor

The sensors located at the inlet and outlet of the condensers shall be capable of measuring the temperature and differential pressure from which flow rate can be calculated. The measured temperatures/differential pressure will be logged and stored in the plant computer for determination of weighted temperature rise.

Measuring range of temperature sensor:	0 – 100 °C
Accuracy of temperature sensor:	± 0.35 °C
Measuring range of flow sensor:	0 – 2 kg/cm^2
Accuracy of flow sensor:	± 0.2 %

(b) Total Residue Chlorine (TRC) Measuring Equipment

A portable TRC test kit shall be provided for measuring TRC of the water at the sampling points.

Measuring Range:	0 – 0.7 mg/L
Accuracy:	± 0.05 mg/L

(c) Boiler Blowdown Temperature Measuring Equipment

A portable mercury-in-glass/digital thermometer shall be provided for measuring Boiler Blowdown Temperature at the sampling point.

Measuring Range:	0 – 100 °C
Accuracy:	± 0.5 °C

(d) Oil Free Drain Oil & Grease (O&G)

Oil Free Drain Oil & Grease (O&G) should be measured by means of Partition-Gravimetric Method or equivalent.

6.4 *TESTING PROTOCOLS*

(a) All measuring equipment shall be checked, calibrated and maintained at intervals as recommended by the equipment manufacturers throughout all stages of the monitoring program.

(b) Sufficient stocks of spare parts shall be maintained for replacements when necessary. Backup monitoring equipment shall also be made available so that monitoring can proceed uninterrupted even when equipment is under maintenance or calibration.

6.5 *LABORATORY ANALYSIS FOR O&G*

For O&G measurement of grab sample, the analysis work shall start within 24 hours after collection of the samples or else the samples should be suitably preserved until analysis commences. The analyses shall follow the standard method APHA 5520B as described in APHA *Standard Methods* for the Examination of Water and Wastewater, 17th or later Edition, unless otherwise specified.

6.6 *QUALITY ASSURANCE AND QUALITY CONTROL*

Sampling

All samples will be assigned with a unique code, which shall be attached to the sample container or written directly on the container.

Measurement Procedures

All in-situ monitoring equipment shall be checked and calibrated throughout all stages of the monitoring, or as required per the manufacturers specification. Certificate(s) of Calibration specifying the instrument being functional shall be available for inspection when required.

Laboratory Testing

Quality assurance is provided during the processing of sampling and the subsequent analytical procedures. The laboratory operates its own in-house Quality Assurance and Quality Control Procedures in which all methods used are referenced or fully documented. Laboratory blanks, batch duplicates, matrix spikes, laboratory standards and certified reference materials, where available for the last two items, should be performed in accordance with the requirements of good laboratory practices.

All water testing parameters should be analyzed using method based on the "Standard Methods for the Examination of Water and Wastewater" APHA or other international methods accepted by EPD.

6.7 *BASELINE MONITORING*

Unlike the EM&A programme for the construction phase, baseline monitoring to measure monitoring parameters of water quality at the sensitive receivers during a representative pre-project period for the Project during the operational phase is not required. Similar environmental monitoring work would be conducted to meet the requirements set out in the licence issued under the WPCO.

6.8 *COMPLIANCE ASSESSMENT*

A/L levels for effluent discharge monitoring as shown in *Table 6.8a* below are established from the limit levels/criteria stipulated in the WPCO Licence. They are subject to change according to the WPCO Licence.

Effluent discharge monitoring results will be evaluated against A/L levels. The implementation of EAPs such as increasing monitoring frequency may be carried out if exceedance on the A/ L Level is found in the monitoring results.

Compliance assessment against the WPCO Licence requirements shall be made with respect to the EAP *in Table 6.8b* below as well as the mitigation measures taken to rectify problems. The results of compliance assessment shall be reported in the monthly EM&A report.

6.9 *EVENT AND ACTION PLANS*

All the impact monitoring results should be checked against the A/L levels set out in *Table 6.8a*. Actions required in the event of exceedance of any of the levels are summarised in *Table 6.8b*.

6.10 *MITIGATION MEASURES*

The EIA Report recommended that no further mitigation measures for water quality were found to be necessary during the operational phase of the Project. Details are provided in the Implementation Schedule *(Annex A)*.

In the event of exceedances or complaints, the ET, Operations Engineers and concerned Departments shall be responsible for the investigation of the causes of exceedance and propose remedial measures.

6.11 *THERMAL PLUME AND RESIDUAL CHLORINE CONCENTRATION SURVEYS*

One survey for thermal plume and residual chlorine concentration at the seawater around the discharges from the Lamma Power Station and Lamma Power Station Extension shall be carried out after the commissioning of each of the generating units for the Project. The first survey would be tentatively conducted in the summer of 2007 for the first gas-fired combined cycle unit.

The objective of the thermal plume survey is to determine the size of the 2°C mixing zone. The survey shall be conducted by suitable techniques including survey boat measurement, infrared thermography or other potential methodologies.

The objective of the residual chlorine concentration (TRC) survey is to determine the dispersion and dissipation of TRC around the cooling water discharges with a view to map out the mixing zone if practicable. The survey shall be conducted with suitable techniques including measurement from a boat, chemical analysis or other suitable methods.

Detailed technical requirements of the above surveys will be derived and submitted to EPD for agreement at least 6 months before commencements of the surveys. The monitoring results of the surveys would be submitted to EPD through a separate report. The implementation status of the surveys shall be reported in the monthly EM&A reports.

Table 6.8a Action and Limit levels for Effluent Discharge

Monitoring Area / Location	Parameters to be Monitored	Frequency	Concentration Not to Be Exceeded	Action	Limit	Proposed Action
Trade Effluent Cooling Water	Temperature	Daily, when the combined cycle unit is operating	Temperature at outfall should not exceed that at intake by > 10°C	9.5°C	+10°C above intake	Please refer to the EAPs in Table 6.8b.
	Total Residual Chlorine	Biweekly, when the combined cycle unit is operating	0.5mg/L	0.47	0.5	
Trade Effluent oil free drain discharge	Oil and Grease	Monthly, when the combined cycle unit is operating	20 mg/L	15	20	Please refer to the EAPs in Table 6.8b.
Trade Effluent Boiler blowdown	Temperature	Twice/year, when the combined cycle unit is operating	40°C	-	40°C	Please refer to the EAPs in Table 6.8b.
Marine waters cooling water outfall	Scum of foam in ambient water	Daily, when the combined cycle unit is operating	No scum within 500 m of Hung Shing Ye Beach	When scum passes the station south-west corner and north-west corner	No scum within 500 m of Hung Shing Ye Beach	Please refer to the EAPs in Table 6.8b.

Table 6.8b Event and Action Plans for Water Quality

Exceedance	ET Leader	IEC	Operations Engineer
Action Level			
Exceedance on one sampling day	Identify source(s) of impact; Verbally inform IEC.	Check monitoring data submitted by ET Leader and advise ET Leader for any findings.	Rectify unacceptable practice; Amend any working methods if appropriate.
Exceedances on more than one consecutive sampling day	Identify source(s) of impact; Verbally inform IEC; Repeat in-situ measurements to confirm findings; Discuss with Operations Engineers on remedial actions required; Increase monitoring frequency; If exceedance stops, discontinue additional monitoring.	Check monitoring data submitted by ET Leader and advise ET Leader for any finding; Verify the implementation of the remedial measures.	Discuss with ET Leader on remedial actions required; Implement the agreed remedial actions.
Limit Level			
Exceedance on one sampling day	Identify the source(s) of impact; Verbally inform IEC and EPD of the exceedance, as soon as practicable; Repeat measurement to confirm finding; Discuss with Operations Engineers on remedial actions required; Increase monitoring frequency; Assess the effectiveness of the remedial actions and keep IEC and EPD informed of the results.	Check monitoring data submitted by ET Leader and advise ET Leader for any finding; Verify the implementation of the remedial measures.	Take immediate action to avoid further exceedance; Discuss with ET Leader on remedial actions required; Implement the agreed remedial actions.
Exceedances on more than one consecutive sampling day	Identify the source(s) of impact; Verbally inform IEC and EPD of the exceedance as soon as practicable; Repeat measurement to confirm finding; Discuss with Operations Engineers on remedial actions required; Increase monitoring frequency; Carry out analysis on existing control procedures to determine possible mitigation to be implemented; If exceedance stops, discontinue additional monitoring.	Provide feedback and advise ET Leader/Operations Engineers on the effectiveness of the remedial actions proposed; Verify the implementation of the remedial measures.	Take immediate action to avoid further exceedance; Discuss with ET Leader on remedial actions required; Implement the agreed remedial actions; Check the suspected defective parts if the problem still does not come under control.

7 WASTE MANAGEMENT

7.1 INTRODUCTION

This section sets out recycling, storage, transportation and disposal measures which are recommended to avoid or minimize potential adverse impacts associated with waste arising from the operation of the new gas-fired power station.

HEC shall develop a waste management plan for the operation of the Lamma Extension which should incorporate the recommended mitigation measures of the EIA report. Upon commissioning of the first unit of the gas-fired power station, HEC shall implement the waste management plan for the proper management of the waste arising from the Lamma Extension.

7.2 WASTE MITIGATION MEASURES

When handling the waste material, the following procedures and measures shall be implemented.

7.2.1 *Waste Management Hierarchy*

The various waste management options can be categorised in terms of preference from an environmental viewpoint. The options considered to be more preferable have the least impacts and are more sustainable in a long term context. Hence, the hierarchy is as follows:

- avoidance and minimisation, that is, not generating waste through changing or improving practices and design;
- reuse of materials, thus avoiding disposal (generally with only limited reprocessing);
- recovery and recycling, thus avoiding disposal (although reprocessing may be required); and
- treatment and disposal, according to relevant law, guidelines and good practice.

This hierarchy should be used to evaluate waste management options, thus allowing maximum waste reduction and often reducing costs. For example, by reducing or eliminating over-ordering of construction materials, waste is avoided and costs are reduced both in terms of purchasing of raw materials and in disposing of wastes.

7.2.2 *Chemical Waste*

For those processes which generate chemical waste, it may be possible to find alternatives which generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste.

Chemical waste that is produced, as defined by *Schedule 1* of the *Waste Disposal (Chemical Waste) (General) Regulation,* should be handled in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* as follows. Containers used for storage of chemical wastes should:

- be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;
- have a capacity of less than 450 L unless the specifications have been approved by the EPD; and
- display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.

The storage area for chemical wastes should:

- be clearly labelled and used solely for the storage of chemical waste;
- be enclosed on at least 3 sides;
- have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest;
- have adequate ventilation;
- be covered to prevent rainfall entering (water collected within the bund must be tested and disposed as chemical waste if necessary); and
- be arranged so that incompatible materials are adequately separated.

Disposal of chemical waste should be:

- via a licenced waste collector; and
- to a facility licenced to receive chemical waste, such as the Chemical Waste Treatment Centre which also offers a chemical waste collection service and can supply the necessary storage containers; or
- to a reuser of the waste, under approval from the EPD.

7.2.3 *General Refuse*

The Lamma Extension is normally unmanned, hence general refuse production is minimal, and will be handled together with general refuse stream of the existing Lamma Power Station, i.e. transferred to Lamma Power Station for further handling.

7.3 *REPORTING*

The monthly EM&A reports shall contain the results of the waste management practices being implemented on site. The detailed waste management procedures as outlined in the Waste Management Plan shall be followed.

8 ENVIRONMENTAL AUDITING

8.1 COMPLIANCE WITH LEGAL AND CONTRACTUAL REQUIREMENTS

HEC shall comply with environmental protection and pollution control requirements stipulated in this EM&A Manual (Operational Phase) as well as Hong Kong environmental protection and pollution control laws.

8.2 ENVIRONMENTAL COMPLAINTS

Complaints on environmental issues may be received through various channels and are generally classified as verbal complaints and written complaints. These complaints may be lodged by the public or via the Authority. The formal procedure for handling these complaints is briefly described below.

Acknowledgement

When a verbal complaint is received, the receiving party shall carefully note down the concerns of the complainant and advise him/her that an investigation will be carried out immediately and that he/she will be informed of the results as soon as possible. In case of a written complaint, an acknowledgement shall be made within one week unless a reply can be made within this specified period.

Immediate Alleviating Measure

Where there is any immediate concern (such as noise nuisance), the receiving party shall at once refer the complaint to the relevant action party for immediate investigation. Where appropriate, immediate action shall be taken to alleviate the problem or prevent it from getting worse.

Detailed Investigation

The ET Leader shall be informed of the complaint as soon as possible who shall then, if necessary, coordinate a detailed investigation to determine the legitimacy of the complaint and identify the source of the problem. In this regard, the ET Leader may:

- arrange monitoring to verify the existence and severity of the situation leading to the complaint;
- propose mitigation measures;
- arrange additional monitoring and audits to verify the status and effectiveness of the mitigation measures.

Reply

The complainant shall be informed of the investigation results and subsequent remedial action taken unless such a reply is no longer necessary. In case the investigation takes time, interim replies shall also be made if necessary.

Review

A review system (such as regular evaluation in routine working committee meetings) shall be in place to ensure timely follow-up of outstanding complaints and to avoid similar problems.

HEC's Contacts

The contact telephone numbers at HEC for complaints are:-

Party	Attention	Telephone
Generation Division	Chief Operations Engineer	2982 6205
Projects Division	Senior Environmental Engineer	2843 3459
Public Affairs Department	Public Affairs Manager (Corporate Communication)	2843 3205
System Control Department	Customer Emergency Services Centre Hotlines (English)	2555 4000
System Control Department	Customer Emergency Services Centre Hotlines (Chinese)	2555 4999

9 REPORTING

9.1 INTRODUCTION

The primary reporting function, undertaken within the EM&A programme, will be the issuance of formal exceedance notifications, corrective actions and ongoing feedback between the ET Leader and the relevant parties.

For those routine environmental monitoring works that are required under the APCO and WPCO, the issuance of formal exceedance notifications and other follow-up should be made in accordance with the APCO and WPCO requirements. Such kind of reporting system is in place to ensure compliance of the licence requirements. The EM&A program is to audit the implementation of such a system, report on any non-compliance with the APCO and WPCO requirements, and summarise any follow-up or mitigation measures taken.

9.2 BASELINE MONITORING REPORT

The primary purpose of the baseline monitoring prior to the commencement of the Project is to form the basis for establishing the criteria (viz. A/L Levels) for the impact monitoring.

However, unlike the EM&A programme for the construction phase, baseline monitoring to measure monitoring parameters of air and water quality at the sensitive receivers during a representative pre-project period for the Project during the operational phase is not required. Similar environmental monitoring work would be conducted to meet the requirements set out in the licences issued under the APCO and WPCO. Hence, the purpose of the baseline monitoring report is to provide background information of the Project and the baseline noise data. The Baseline Monitoring Report is provided in Annex B.

9.3 *MONTHLY EM&A REPORTS*

EM&A Reports shall be submitted to the Authority on a monthly basis. The reports shall be prepared and certified by the ET Leader. The reports shall be verified by the IEC and submitted to EPD, one hard copy and one soft copy, via CE(PD) within 2 weeks of the end of each reporting period after commencement works. The ET Leader shall liaise with the relevant parties to confirm the format of monthly reports in both hard copy and electronic format. The monthly EM&A report shall include the following elements:

- Executive Summary highlighting breaches of agreed criteria, complaints log, summons, reporting changes and future key issues;
- Implementation status of the environmental monitoring and reporting exercises performed in accordance with the APCO and WPCO Licence requirements, together with a summary of the EM&A monitoring results and findings;
- Implementation status of the thermal plume and chlorine concentration surveys to be arranged;
- Description of recommendations and / or actions taken, or outstanding, in the event of non-compliances, complaints, notifications of Summons, prosecutions, and audits;
- Review of the implementation status and effectiveness of environmental protection works in relation to non-compliances and deficiencies and the mitigation measures recommended in the Project Profile;
- Summary of complaints, results of investigations and follow-up actions;
- Future key issues, if any, and steps taken to combat them.

Should there be any incidents of land contamination happened, the record of incident as mentioned in Section 6 of the Land Contamination Avoidance Plan shall also be reported in the monthly EM&A report.

In addition to the above, the First Monthly EM&A Report shall also include:

- Brief background to the Project and figure showing its location;
- Basic project information (e.g. project organisation, programme, management structure, current permits and licences);

9.4 *ELECTRONIC REPORTING OF EM&A INFORMATION*

To facilitate public inspection of the Baseline Monitoring Report and monthly EM&A Reports via the EIAO Internet Website and at the EIAO Register Office, electronic copies of these Reports shall be prepared in Hyper Text Markup Language (HTML) (version 4.0 or later) and in Portable Document Format (PDF version 4.0 or later), unless otherwise agreed by EPD and shall be submitted at the same time as the hard copies to EPD. For the HTML version, a content page capable of providing hyperlink to each section and sub-section of these Reports shall be included at the beginning of the document. Hyperlinks to all figures, drawings and tables in these Reports shall be provided in the main text from where the respective references are made. All graphics in these Reports, if any, shall be in interlaced GIF format unless otherwise agreed by EPD. The content of the electronic copies of these Reports must be the same as the hard copies.

All environmental monitoring data in the Baseline monitoring and the monthly EM&A shall be made available to the public via internet access in the form of a website, in the shortest possible time and in no event later than two weeks after the relevant environmental monitoring data are collected or become available, unless otherwise agreed with EPD.

The internet website shall enable user friendly public access to the monitoring data and with features capable of:

i) providing access to environmental monitoring data collected since the commencement of works;
ii) searching by date;
iii) searching by types of monitoring data; and
iv) hyperlinks to relevant monitoring data after searching.

9.5 DATA KEEPING

All documents and records, in both paper and electronic format, pertaining to this EM&A programme will be retained by the ET Leader. All documents and data shall be kept for at least 3 years from the date of recording.

9.6 INTERIM NOTIFICATION OF ENVIRONMENTAL QUALITY LIMIT EXCEEDANCES

Interim notifications of exceedances of Limit levels will be reported to responsible EPD officials as soon as practicable, normally in two working days. Investigations will be conducted to confirm whether the exceedance is genuine.

The details will also be provided in the Monthly Reports.

ANNEX A: IMPLEMENTATION SCHEDULE

Operational Phase Mitigation Measures and their Implementation

EIA Ref.	EM&A Log Ref.	Mitigation Measures	Implementation	Implementation Agent	Relevant Legislation & Guidelines
		AIR QUALITY			
4.9.1	A1	Implement the gas-fired units as base-load units. For the existing power station, the more efficient units incorporating FGD and low NOx systems shall be operated first under normal situation to meet system demand. In case of any deviations from this, EPD shall be notified of the details and circumstances for the deviation.	Operational phase	HEC	
4.9.1	A2	HEC shall undertake annual revisions and update of its GHG emissions inventory, which covers all HEC existing facilities and new extension, for at least the six GHGs specified under the Kyoto Protocol (CO2, CH4, N2O, HFCs, PFCs and SF6). The inventory shall be established and maintained in accordance with the latest IPCC Guidelines or any other guidelines issued by Government, with details documented for regular reviews and updates. The inventory shall be reported on an annual basis, including actual figures and targets for the previous and current years, as well as the next year's forecast. Discrepancies for actual versus target figures and actions for improvement or enhancement shall be discussed. HEC shall update the inventory according to the figures of the electricity load forecast, upon every subsequent review by the Government. This shall also be reported in the annual report.	An annual update of the HEC's GHG inventory shall be submitted to EPD within three months of the end of the reporting period.	HEC	
		WATER QUALITY			
	B1	No further mitigation measures were found to be necessary provided the discharge of cooling water and residual chlorine are kept below the rates assumed in the water quality assessment*. *All discharges of effluent/wastewater shall be controlled through licensing under the *Technical Memoradum for Effluents Discharged into Drainage and Sewerage Systems. Inland and Coastal Waters*, issued under Section 21 of the *Water Pollution Control Ordinance*.	Operational Phase	HEC	*Water Pollution Control Ordinance*
		NOISE			
6.6.1	C1	HEC shall implement the gas-fired units for based-load operation to minimize the noise generated from the existing units.	Throughout the operational phase	HEC	*Noise Control Ordinance*
		LANDSCAPE & VISUAL IMPACTS			
	D1	No mitigation measures were considered necessary.	-	-	-

EIA Ref.	EM&A Log Ref.	Mitigation Measures	Implementation	Implementation Agent	Relevant Legislation & Guidelines
		LAND CONTAMINATION			
	E1	HEC shall maintain records of the following items: - integrity testing of light oil tanks; - daily inspection of the light oil tanks and bunded areas; - quantities of oily waste and sludge generated from oil interceptors and chemical waste generated from operation of the power station; - deposal oil oily waste/sludge and chemical waste to licenced site; - quantities of chemical and chemical waste; - incident of spillage and remediation actions; and - emergency response training and drills.	Operational Phase	HEC	Self regulatory
		MARINE ECOLOGY			
	F1	No mitigation measures were considered necessary.	-	-	-
		FISHERIES			
	G1	No mitigation measures were considered necessary.	-	-	-
		RISK ASSESSMENT			
	H1	No mitigation measures were considered necessary.	-	-	-

香港電燈有限公司
The Hongkong Electric Co., Ltd.

Annex B

Lamma Power Station Extension (Operational Phase)

Baseline Monitoring Report

January 2006

TABLE OF CONTENTS

The Project area for the operation of new power station is shown in Figure 1.1.

(b) Transmission System

The electricity generated from the Lamma Extension Project will be transmitted via a new transmission system linking the Lamma Extension to load centres on Hong Kong Island as shown in Figure 1.2.

(c) Gas Pipeline

Natural gas for the new power station will be supplied via a submarine pipeline from a regional LNG receiving terminal located at Cheng Tou Jiao in Shenzhen as shown in Figure 1.3.

The Environmental Impact Assessment (EIA) Report for the Project, which was prepared in response to the EIA Study Brief No. ESB-001/1998 issued to Hongkong Electric Company Limited (HEC) by the Environmental Protection Department (EPD), was completed in February 1999. The EIA Report was submitted to the Director of Environmental Protection (DEP) in accordance with the Environmental Impact Assessment Ordinance (EIAO) on 23 December 1998 and was approved by DEP on 5 May 1999.

The application for Environmental Permit (EP) was submitted to EPD on 10 July 2000. The Environmental Permit (EP-071/2000) was granted on 8 August 2000. The subsequent applications and approvals of the variation of Environmental Permit are summarised in the following table:

Environmental Permit	Application	Purpose of Variation	Approved by EPD
Environmental Permit (EP-071/2000/A)	25 November 2000	Shortening of various notification periods.	22 December 2000
Environmental Permit (EP-071/2000/B)	20 June 2001	Addition of dredging scenarios for reclamation work.	13 July 2001
Environmental Permit (EP-071/2000/C)	23 April 2005	Change of dredging and jetting rates for gas pipeline construction work, and change of the time period for which the pipeline jetting work is not allowed.	18 May 2005

1.3 Structure of the Baseline Monitoring Report

The structure of the report is as follows:

Section 1: Introduction – detailing the purpose and structure of the report.

Section 2: Air Quality – presenting the zero baseline emission result.

Section 3: Noise – presenting the baseline noise data.

Section 4: Water Quality – presenting the zero baseline emission result.

Section 5: Conclusion

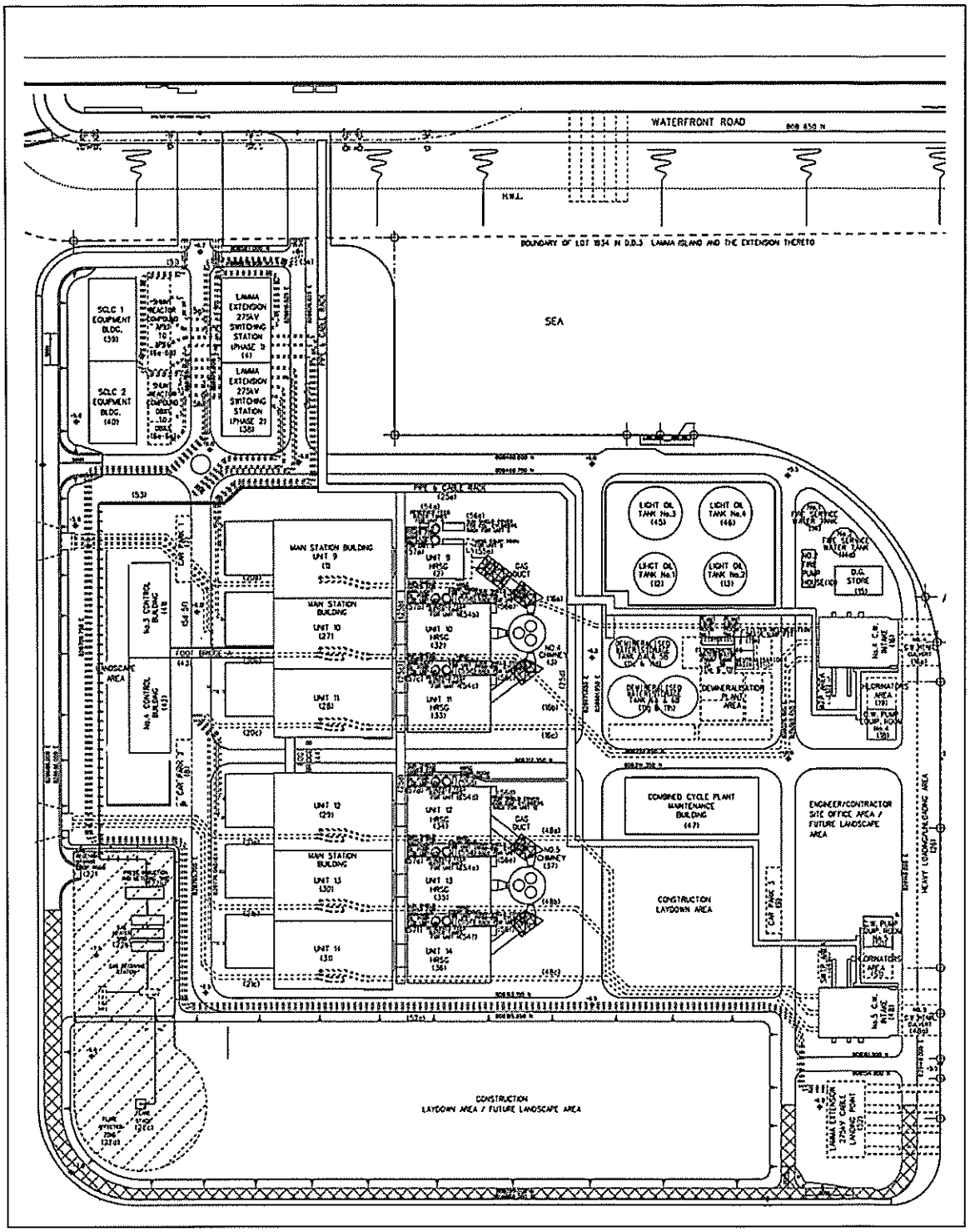


Figure 1.1 Layout of Lamma Power Station Extension

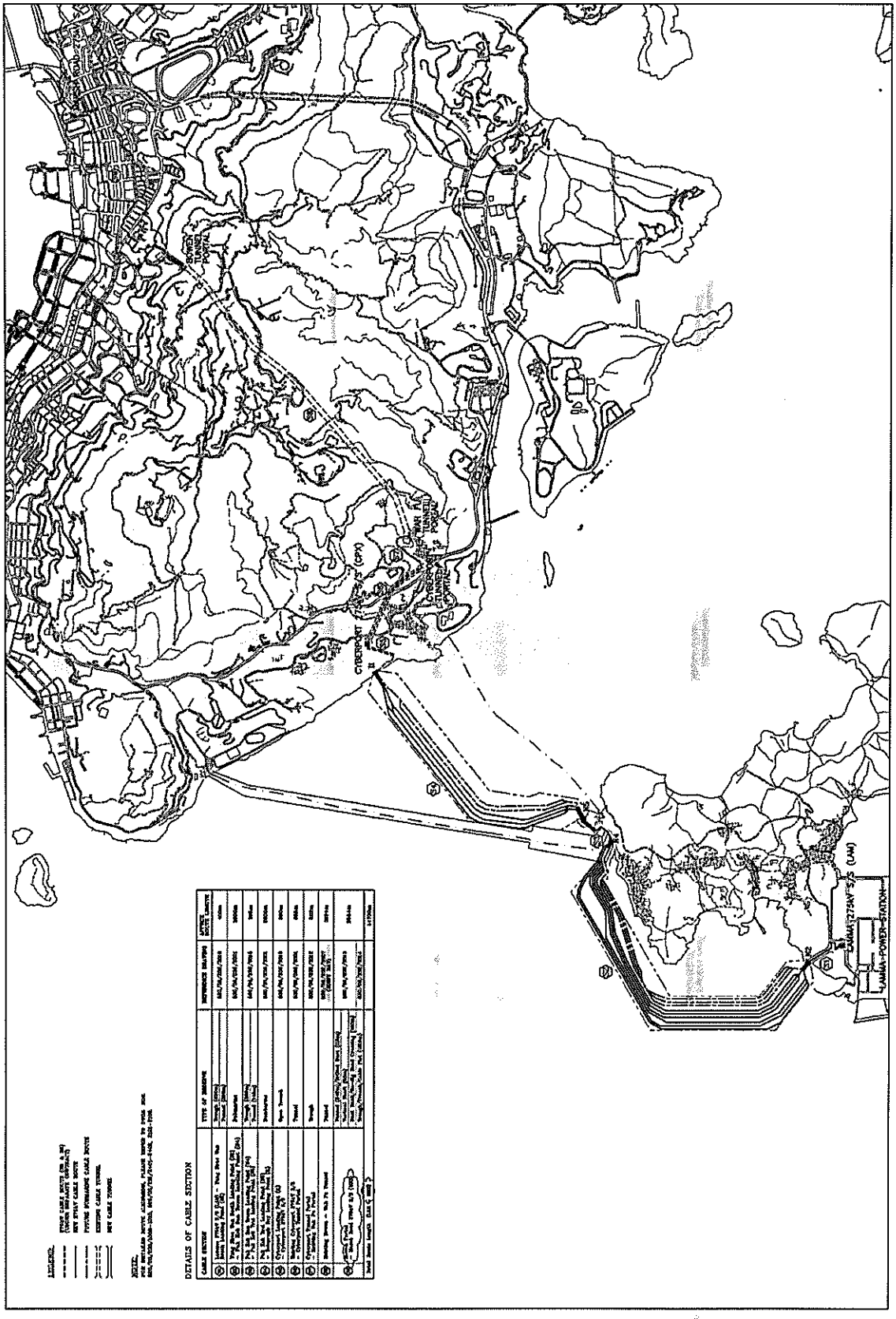


Figure 1.2 Layout of Transmission System

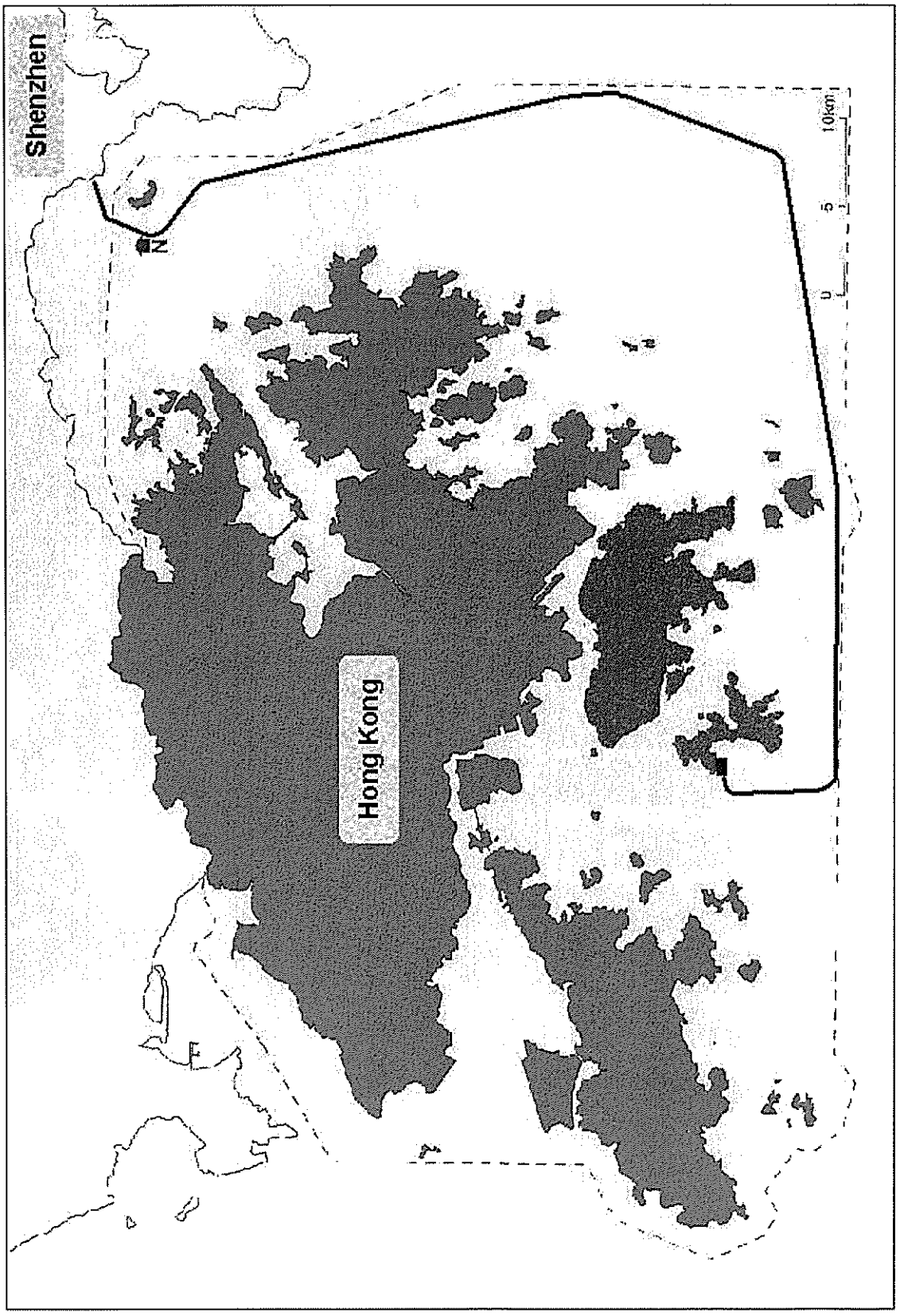


Figure 1.3 Layout of Gas Pipeline

2. Air Quality

The environmental monitoring requirement of air pollutants emissions from new gas-fired units will be stipulated in a Specified Processes Licence issued under APCO. The Licence will specify the emission limits in terms of concentrations and emission rates.

At the time of writing this baseline monitoring report, the plant is still under construction and no environmental monitoring data related to air pollutant emission is available. Hence, a "zero" emission baseline can be assumed for air quality monitoring. Furthermore, no information regarding the licence emission limit is available, the action/limit levels would be established from the NOx emission limit stated in section 3(b) of EPD's guideline "A Guidance Note on the Best Practicable Means for Electricity Works".

3. Noise

Continuous noise monitoring at a strategic location (viz. the monitoring station at Ash Lagoon) for the critical noise sensitive receiver (NSR) at Hung Shing Ye would be carried out for the EM&A (Operational Phase) of the Project. Baseline noise levels are required for applying correction to the impact noise monitoring data at the monitoring station. The location of the existing Ash Lagoon noise monitoring station is shown in Figure 3.1.

As the major noisy dredging and site formation works had been completed before 2004, the monthly average Leq's measured at the existing Ash Lagoon noise monitoring station from January 2004 to December 2004 can be taken as the baseline noise levels for the EM&A (Operational Phase) of the Project.

The noise measurements at Ash Lagoon were made in accordance with standard acoustical principles and practices in relation to weather conditions. The sound level meters used shall comply with International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1).

Baseline Data in Monthly Average Noise Level at the Ash Lagoon Noise Monitoring Station are as follows:

Month	Monthly Average Leq Noise Level (dB(A))	
	07:00-23:00	23:00-07:00 of next day
January 2004	62.7	56.8
February 2004	63.2	55.9
March 2004	62.5	55.6
April 2004	63.4	55.7
May 2004	62.1	55.4
June 2004	60.8	55.3
July 2004	60.7	55.1
August 2004	60.1	55.8
September 2004	60.8	56.2
October 2004	61.0	56.1
November 2004	61.1	56.1
December 2004	61.4	56.2

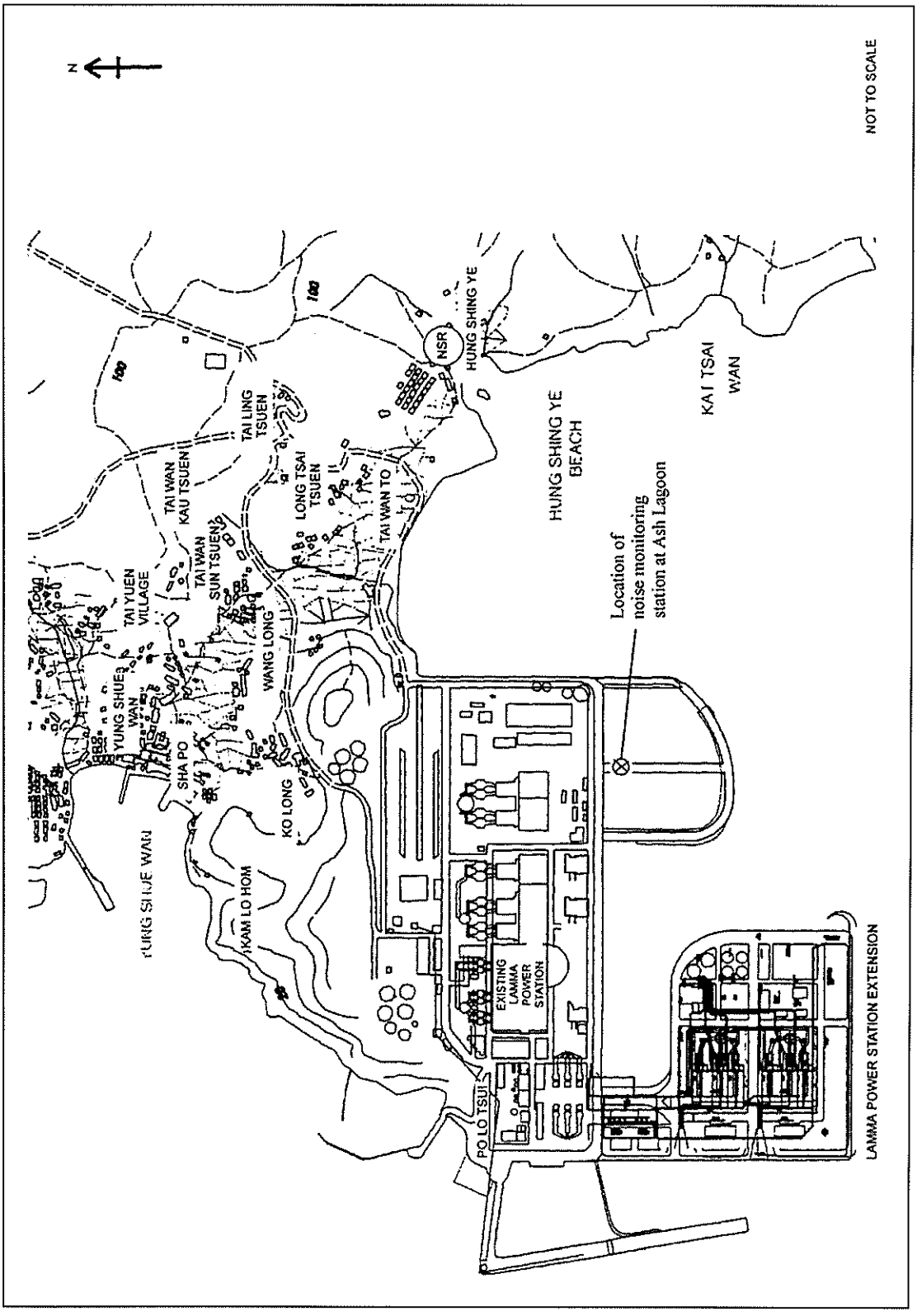


Figure 3.1 Location of the Existing Ash Lagoon Noise Monitoring Station

4. Water Quality

Effluent discharges from the Project would be covered in the WPCO. At the time of writing the baseline monitoring report, the plant is still under construction and no environmental monitoring data related to effluent is available. Hence, a "zero" emission baseline can be assumed for water quality monitoring. The action/limit levels would be established from the limit levels/criteria to be stipulated in the WPCO Licence.

5. Conclusion

Similar environmental monitoring work would be implemented in the future to meet the requirements set out in the Licences issued under the APCO or the WPCO.

The Action and Limit Levels for stack NOx would be established from the NOx emission limit stated in section 3(b) of EPD's guideline "A Guidance Note on the Best Practicable Means for Electricity Works".

Continuous noise monitoring would be carried out for the EM&A (Operational Phase) of the Project. The monthly average Leq's measured from January 2004 to December 2004 at the existing Ash Lagoon noise monitoring station (which will be the monitoring station for the operational phase) were regarded as the baseline noise levels for the EM&A (Operational Phase).

Effluent discharges from the Project would be covered in the WPCO. The action/limit levels would be established from the limit levels/criteria to be stipulated in the WPCO Licence.