9 LAND CONTAMINATION

9.1 INTRODUCTION

A number of industries, including power stations, have been identified under the *Environmental Impact Assessment Ordinance (EIAO) (Cap.499)* and EPD's *Practice Note for Professional Persons (ProPECC) PN 3/94: Contaminated Land Assessment and Remediation* as having potential for causing land contamination. To prevent land contamination problems the EIAO and the *ProPECC* note require the project proponents for the construction of major industrial installations which may give rise to land contamination to address the potential problems associated with their operations at the project planning stage.

The primary aim of the land contamination component of this Study is to meet these requirements and to formulate appropriate measures for the prevention of potential contamination problems due to the construction and operation of the power station.

The specific objectives of the *Land Contamination Study* were:

- to identify possible sources of land contamination in the operation of the new power station; and
- to formulate appropriate operational practices, waste management strategies and precautionary measures for prevention of contamination problems.

This *Section* presents the findings of the land contamination assessment and proposes operational and waste management practices for prevention of contamination problems due to the operation of the 1,800 MW gas-fired power station at Lamma Extension Site.

9.2 LEGISLATION AND STANDARDS

Assessments of land contamination sources and the potential impacts of particular development projects are investigated in accordance with EPD requirements as specified in the *EIAO*, its *Technical Memorandum on Environmental Impact Assessment Process (EIAOTM)*, and *ProPECC PN 3/94*.

Annex 19 of the *EIAOTM* identifies a number of land uses (eg power plants, petrol stations, storage and scrap yards, and dumping grounds) as having the potential for land contamination, and provides guidance on a framework for development of a Contamination Assessment Plan (CAP) and a Remedial Action Plan (RAP) for investigation of these developments or activities with high land contamination potential.

ProPECC PN 3/94 defines the objectives and procedures for a land contamination assessment study, and provides guidance on criteria used by EPD for evaluating different levels of contaminated land impacts. In particular, *ProPECC PN3/94* requires the following tasks to be undertaken as part of the study and before the commencement of new development:

- assessment of the present use of the land and the relevant past land history in relation to possible land contamination;

- identification of potential contamination and associated impacts, risks or hazards; and

- as required, submission of a plan to evaluate actual contamination of soil and groundwater, including details of the proposed site investigation programme to evaluate key contamination concerns identified; and

- where the site investigation programme indicates a contamination concern, development of remediation and mitigation measures to remediate the site to the satisfaction of the EPD before the commencement of construction.

There are currently no standards for the cleanup of contaminated soil and groundwater in Hong Kong. In the absence of any specific criteria defined by the Hong Kong SAR Government, the Dutch Guideline Values presented in the *ProPECC PN 3/94* guidance document will be used as a basis to evaluate the levels of contamination.

The following legislation, EPD guidelines codes of practice are related to the management of wastes in Hong Kong and provide good waste management practices for prevention of land contamination problems:

- *Waste Disposal Ordinance,* in particular the *Waste Disposal (Chemical Waste) (General Regulation;*

- *Water Pollution Control Ordinance,* in particular *Part III* on prohibited discharges and deposits;

- *A Guide to the Chemical Waste Control Scheme;*

- *A Guide to the Registration of Chemical Waste Producers;*

- *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes;*

- *Code of Practice on Handling, Transportation and Disposal of Polychlorinated Biphenyl (PCB) Waste;*

- *Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste;* and

- *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters.*

9.3 POTENTIAL SOURCES OF LAND CONTAMINATION

Operation of the gas-fired power station will require the use of a variety of chemicals and dangerous goods, and produce chemical wastes and sludge. If not properly managed, uncontrolled spillages and the handling and disposal of these materials have the potential to cause land contamination. The facilities which use, handle or store these materials may also be sources of land contamination. The chemicals to be used and the wastes to be generated at the power station are identified below.

9.3.1 *Potential Contamination Sources (from Chemical and Waste Inventories)*

The types and quantities of chemical to be used and wastes to be generated from the operation of the power station, as provided by HEC, are given in *Tables 9.3a* and *9.3b*, respectively. *Figure 9.3a* shows the locations of the facilities which use the chemicals.

Table 9.3a ***Chemicals to be Used At the Lamma Extension Site***

Facility	Chemical	Estimated Annual Consumption	Estimated Quantity to be Stored on-Site
Main Station Buildings	•Sodium hydroxide (98% solid)	30 kg	Negligible
	•Trisodium phosphate (98% solid)	30 kg	Negligible
	•Hydrazine, 99% as hydrazine hydrate	600 kg	Negligible
	•Ammonia, 25% solution	30 kg	Negligible
Boiler House[a]	•Hydrochloric acid, 33% solution	13,000 kg	Negligible
	•Acid inhibitor, 100% liquid	500 kg	Negligible
	•Surfactant MC 300B, 100% liquid	25 kg	Negligible
	•Citric acid, 99% solid	90 kg	Negligible
	•Sodium hydroxide, 98% solid	10,000 kg	Negligible
	•Hydrazine, 99% as hydrazine hydrate	120 kg	Negligible
	•Ammonia, 25% solution	400 kg	Negligible
Demineralisation Plant	•Sulphuric acid, 98% solution	160,000 kg	Negligible
	•Sodium hydroxide, 98% solid	82,000 kg	Negligible
	•Sodium chloride, 98% solid	7,000 kg	Negligible
	•Hydrochloric acid, 33% solution	10,000 kg	Negligible
	•Sodium Sulphite, 98% solid	200 kg	Negligible
	•PAC (Coagulant), 98% solid	150 kg	Negligible
	•Cationic resin	1,000 litres	Negligible
	•Anionic resin	1,500 litres	Negligible
Effluent Treatment Plant	•Sulphuric acid, 98% solution	2,500 kg	Negligible
	•Sodium hydroxide, 98% solid	8,000 kg	Negligible
Light Oil Storage Tanks (Four tanks, approximately 10,500 m^3 each)	•Light gas oil, sulphur content of less than 0.5% and viscosity of not greater than 6 centistokes at 40°C	Varies	40,000m^3
Dangerous Goods Store	•Sodium hydroxide (98% solid)	NA	10 tonnes
	•Sodium hydroxide (liquid)	NA	11.2m^3
	•Hydrochloric acid, 33% solution	NA	2m^3
	•Sulphuric acid, 98% solution	NA	13.44 tonnes
	•Citric acid, 99% solid	NA	-
	•Ammonia, 25% solution	NA	1.6 tonnes
	•Hydrazine, 99% as hydrazine hydrate		2m^3
Maintenance Workshop	•Lube oil	240,000 litres	-
	•Solvent (immiscible organic solvent)[c]	}1,000 litres	300 litres
	(miscible organic solvent)[d]	}	300 litres
	(cleaning solvent)	}	340 litres
	(water solvent)	}	6m^3
	•Batteries	Varies	-

Notes:
(a) Quantity for one steam generator set; only required at the commissioning of the plant and thereafter once every 10 years for each unit
(b) NA means data are not available
(c) Including hexane, heptane, petroleum ether and toluene
(d) Including acetone, isopropyl alcohol and glycerol

Table 9.3b ***Waste to be Generated From Operation of the Gas-fired Power Station***

Facility	Waste	Estimated Annual Quantity
Sewage Treatment Plant	Sewage sludge	Approximate 33 tonnes per month @ 1% solids
Maintenance Workshop	• Waste lube oil	240,000 litres
	• Spent Resin	2,000 litres
	• Spent Solvent	1,000 litres
	• Spent batteries	Varies

Note:
(a) For locations of the facilities, see *Figure 9.3a*

9.3.2 *Potential Contamination Sources (from Facilities)*

The following facilities will be the principal sources of land contamination during the operation of the gas-fired power station:

- light oil storage tanks;
- dangerous goods store;
- maintenance workshop; and
- oil pipelines.

Leakage from the oil pipelines has the potential to cause land contamination. A final, detailed piping layout has yet to be determined, however, oil pipes will probably be installed above ground. Should underground piping be required, it will be laid inside pipe trenches which will be lined concrete utility vaults/corridors to minimise the potential for land contamination. The trenches will have cover plates which will be easily removed to allow servicing or inspection. Any leakage of oil could therefore be detected during routine site inspections.

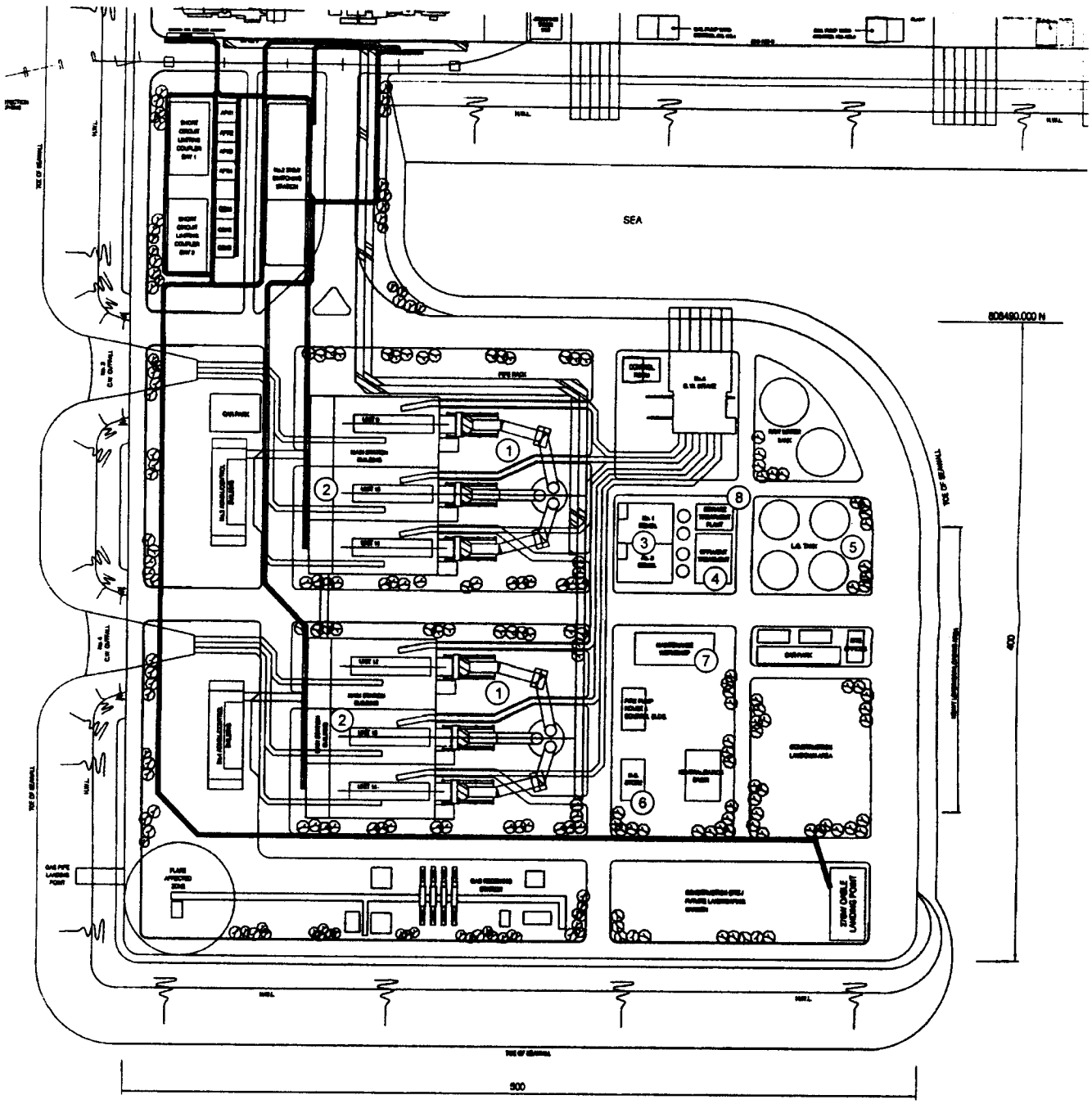
9.4 *CONTAMINATION AVOIDANCE APPROACH*

As a corporate environmental policy, HEC have indicated that its *Chemical Control Standards and Procedures* and *Standing Instructions for Handling and Disposal of Hazardous Substances and Dangerous* Goods, which are currently used for the Lamma Power Station, will also be used for the new power station, where appropriate. In order to formulate appropriate operational practices and precautionary measures for prevention of land contamination at the Lamma Extension site, the existing standard procedures and standing instructions have been reviewed with respect to their adequacy for prevention of land contamination.

The following sections present the measures to be adopted for the new power station for prevention of land contamination.

9.4.1 *Preventative Measures for Oil Spillage*

The procedures proposed below are based on HEC's existing standard procedures and standing instructions for handling light oil with respect to prevention of land contamination. Parallel measures will also be undertaken to protect the health and safety of plant personnel and to minimise water pollution in the event of oil spillage.



① MAIN STATION BUILDINGS
② BOILER HOUSE
③ DEMINERALISATION PLANT
④ EFFLUENT TREATMENT PLANT
⑤ LIGHT OIL STORAGE TANKS
⑥ DANGEROUS GOODS STORE
⑦ MAINTENANCE WORKSHOP
⑧ SEWAGE TREATMENT PLANT

FIGURE 9.3a

LOCATION OF CHEMICAL WASTE / WASTE GENERATION

FILE: C1830/C1830o3
DATE: 13/10/98

Environmental Resources Management

ERM

Tank Construction

The oil tanks will be founded on raft foundations, which will be formed by a thick reinforced concrete with thickness of around 1m. Cracks through the entire foundation depth are very unlikely in view of its thickness, and hence the chance for oil seepage to the underground soil is considered to be very remote.

In addition, in accordance with the Building Authority's *Standard Code of Practice for Oil Storage Installations (1992)*, a 50 mm thick layer of bitumen will be applied between the tank base and the foundation, in order to waterproof the foundation and to prevent direct seepage of leaked product from the tank to the concrete foundation. A sloping layer of compacted, crushed gravel drainage will also be provided at the base of the foundation and around the outer rim between the bitumen layer and the raft foundation, so that any possible oil leakage will be drained away to the surrounding U-channel. Thus any release will be directed to the nearby oil interceptor within the tank bund, in order to avoid any oil accumulation at the vicinity. *Figures 9.4a* and *9.4b* present typical details of these arrangements.

Operation Procedures

Light oil tanks will be constructed within a bunded concrete area which is capable of holding at least 110% of the total storage capacity of the tanks (i.e. minimum of 50,000 m^3). Drainage for the bunded area will be controlled by an isolating valve located outside the bund, to an oil interceptor. The valve will be kept close and locked and will only be opened during controlled conditions. The key will be kept under the control of the engineer-in-charge of the shift.

The tanks will be fitted with a filling line with an isolating valve and non-return valve. A tank drain will also be provided. The filling and drain valves will be kept closed and locked, and the keys will be kept under the control of the engineer-in-charge of the shift. The tanks will be equipped with high level alarms to prevent overflow. An oil leak detector will be installed at the sump pit within the bunded area, and alarms will be initiated if the oil leak detector senses the presence of oil. Upon receipt of the alarm, the technician will immediately conduct an oil leak check and, if a leak has occurred, the technician will follow the actions in the event of oil spillage.

The light oil tanks and bunded areas will be inspected on a shift basis. The inspection will cover:

- verification of valve positions and security;
- leak checks around the tank;
- tank level checks;
- bunded area inspection and clearance of any combustible materials; and
- fire protection equipment check.

Any leakage identified will be reported to the engineer-in-charge of the shift. The remaining oil in the leaking tank will immediately be transferred to other appropriate tanks. Daily inspection records of the tanks and bunded area will be kept in the site office.

Tank integrity testing will be carried out on an annual basis by an independent qualified surveyor or structural engineer to ensure that the oil tanks are in good order. Test results will be submitted to the Building Department for record.

Tank Filling Operation

Tank filling operations are expected to be infrequent. However, during filling of the oil tanks, technicians with portable fire extinguishers will be posted at the service tank and light oil storage tank. Communication between these two locations and the control room will be maintained using portable radios. The procedures will be as follows:

- The technician at the light oil storage tank will check that the bund drain and filling values are closed and locked, and then confirm this with the technician in charge of the tank filling operation.

- On receipt of confirmation from the technician at the light oil storage tank area, the technician at the service tank will open the transfer value on the light oil storage tank and confirm that the value is fully open. The fluid level of the storage tank will be monitored.

- The service tank filling valve will be opened to start filling.

- The level will be noted at reset level of service tank low level alarm.

- The level will also be noted when the storage tank high level alarm initiates.

- On receipt of the high level alarm, the filling valve on the service tank and the transfer valve on the storage tank will be closed and both tank levels recorded.

Handling Oily Waste and Sludge from Oil Interceptor

Oil interceptors will be inspected by technicians on a daily basis. If oily waste or sludge is found to accumulate inside the interceptor, the technician will report to the engineer-in-charge of the shift. The oily waste or sludge will be removed under the supervision of the technician. The sludge recovered will be put into drums and labelled as chemical waste, which will be collected and delivered by a licensed operator to the Chemical Waste Treatment Centre (CWTC) at Tsing Yi for disposal. A record of cleaning and disposal of sludge will be kept.

Emergency Procedures

Training and Exercises: To ensure that appropriate actions are taken promptly in the event of an oil spillage, and to prevent land contamination, training will be given to relevant staff so that they can respond effectively to the emergency situation. The training will cover:

- familiarisation with resources to combat oil spillage;
- general methods to deal with oil spillage; and
- procedures for emergency drills.

Regular drills will be carried out as follows:

- a full drill with a simulated oil spillage will be carried out regularly; and
- a familiarisation training exercise will carried out regularly.

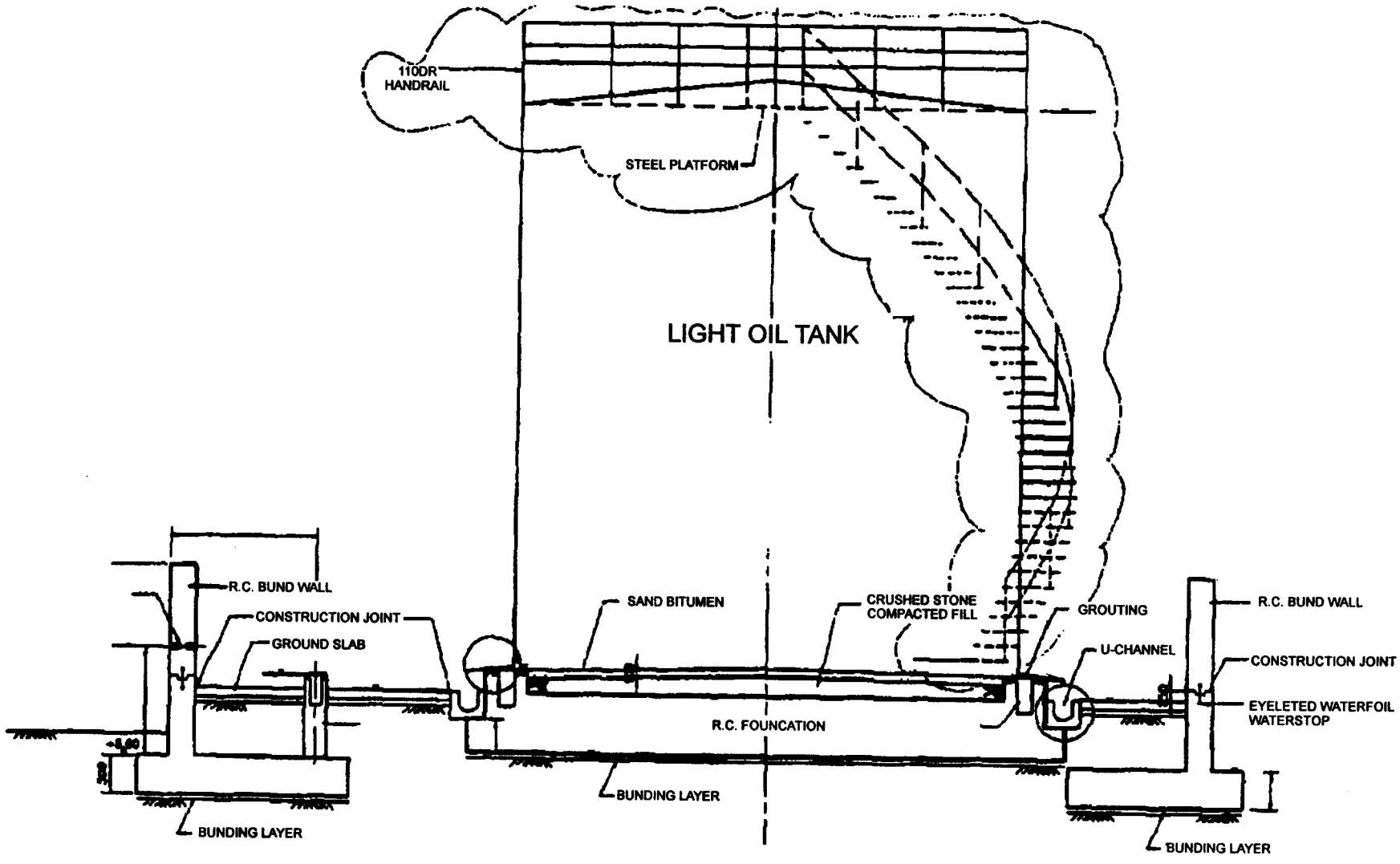


FIGURE 9.4a

TYPICAL DESIGN OF OIL TANK

FILE: C1830/C1830Z28
DATE: 20/11/98

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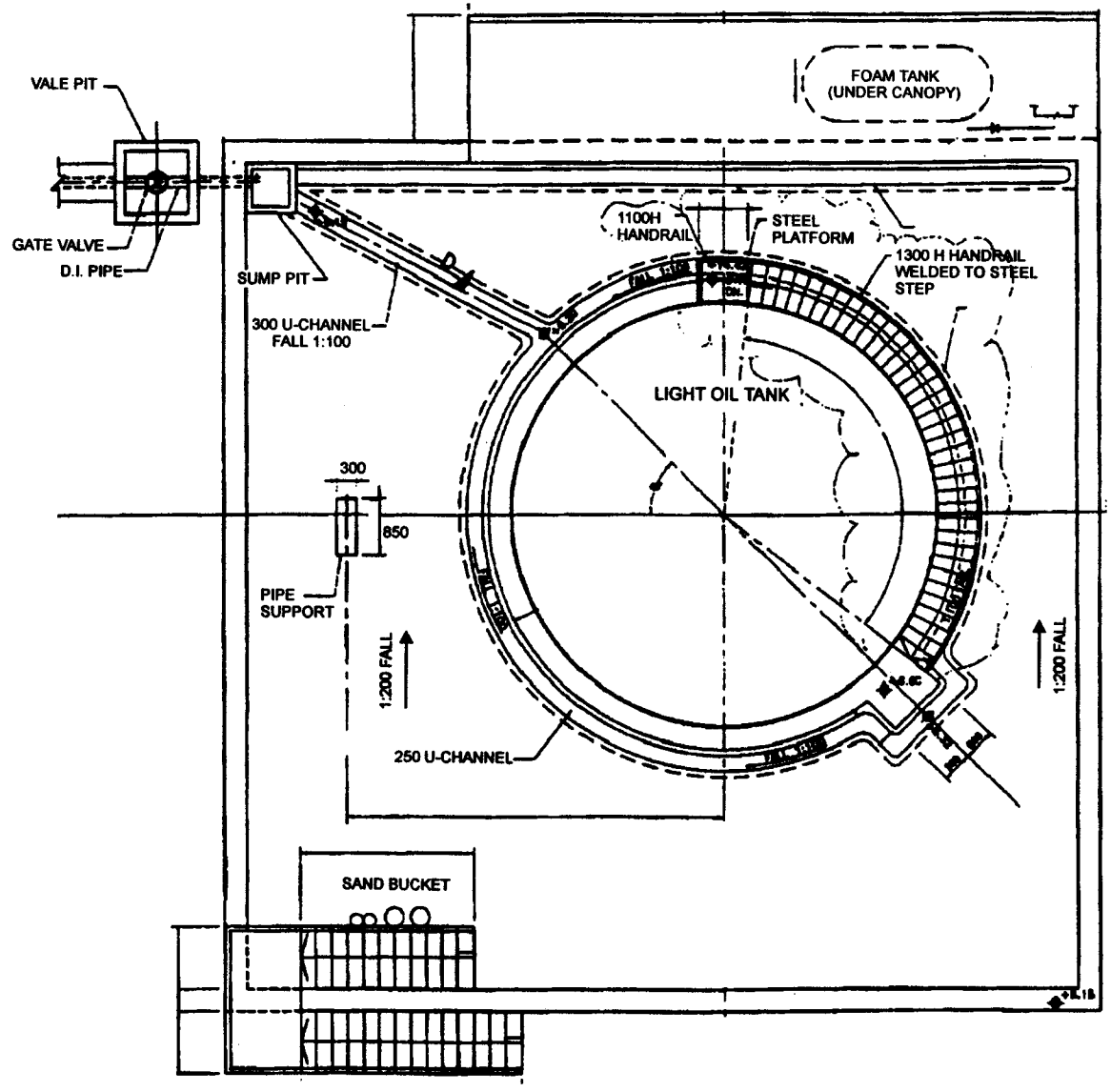

FIGURE 9.4b

TYPICAL DESIGN OF OIL TANK (PLAN VIEW)

FILE: C1830/C1830Z27
DATE: 20/11/96

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General Procedures: Any spillage within the Lamma Extension Site will be reported to the engineer-in-charge of the shift with the following details:

- location of spillage;
- source and possible cause of spillage; and
- extent of spillage.

The engineer-in-charge of the shift will immediately tend to the spillage and initiate any appropriate health and safety and environmental actions to confine and clean up the spillage. If required, advice from the Senior Generation Chemist will be sought. The prime objectives in combatting an oil spill are:

- to identify and isolate the source of the spillage as soon as possible;
- to contain the oil spillage and avoid infiltration into soil and discharge to sea;
- to remove oil using absorbent materials;
- to use dispersants to emulsify the oil, as required; and
- to clean up the contaminated area using appropriate detergent.

Spillage During Tank Filling Operations: Should spillage occur during filling of a storage tank, the filling procedures will immediately be stopped by closing the transfer and filling valves and the engineer-in-charge of the shift will be notified.

Following inspection of the spillage, the engineer-in-charge of the shift will decide upon the best way to remove the spillage, taking advice from the Senior Generation Chemist, if necessary. Uncontaminated oil will be recovered to another oil tank in a controlled manner using a portable pump. Contaminated oil not suitable for use as fuel will be removed using absorbent materials. The recovered material will then be put into drums, labelled as chemical waste and taken by a licensed collector to the CWTC.

If the spillage is to be removed via the oil interceptor, this will be done in a controlled manner and technicians will be posted at the tank bund and the oil interceptor throughout the process. The technicians will communicate via radio. The technicians will control the flow of oil from the bunded area and monitor the satisfactory operation of the oil interceptor. When removal of the spillage is complete the bund drain valve will be closed and locked. The contaminated surface of the bunded areas will be cleaned using suitable detergent.

Oil Spill Along the Oil Pipelines: In the event of a spillage along the oil pipelines, pumping should be stopped immediately and appropriate isolating valves closed. The oil product will then be removed using absorbent materials and put into appropriate drums, labelled as chemical waste, and then taken by a licensed collector to the CWTC at Tsing Yi for disposal.

Adequacy of The Existing Oil Spillage Control Procedures

As the light oil storage tanks and the associated pipelines within the plant will be constructed above ground, any leakage of oil will be detected through routine site inspection. In the unlikely event of an oil spillage, the existing oil spillage control procedures should effectively contain the spillage and ensure proper clean up of the contaminated area. This should effectively avoid pollution of soil, surface water and marine water. The preventative approach adopted by HEC has proven to be satisfactory as there are no oil spillages recorded at the Lamma Power Station since its commissioning in 1984.

9.4.2 *Preventative Measures for Chemical Spillage*

Storage of Chemicals and Chemical Wastes

The same preventative approach used for oil spillage will apply to the storage of raw solid and liquid chemicals and chemical wastes.

Chemicals or chemical wastes will only be stored in purpose-built storage areas. For chemicals which are classified as dangerous goods under the *Dangerous Goods Ordinance*, all segregation, storage and handling will comply with the requirements of the Ordinance. For the storage of chemical wastes, procedures will comply with the requirements of the *Code of Practice on the Packaging, Labelling and Storage of Chemical Waste.*

The storage areas will have an impermeable floor or surface made of suitable materials for the storage of containers of chemicals. An impermeable layer will prevent infiltration of solid or liquid chemicals into the floor in case of leakage or spillage and hence prevent land contamination. For example, epoxy resin could be applied to the floor surface prior to the laying of heavy duty floor tiles. Other materials may be used but they must not be liable to chemically react with the materials to be stored. The physical and mechanical properties of the impermeable layer must be able to withstand normal loading and physical damage caused by container handling. The integrity and condition of the impermeable layer or surface should be regularly inspected to ensure that it is satisfactorily maintained.

For the storage of liquid chemicals, the storage area will be bunded to contain at least 110% of the total storage capacity of the containers. Where containers of liquid chemical waste are stored, the area should be designed to contain the content of the largest container intended to be stored or 20% of the total quantity of the chemical wastes stored, whichever is the greater.

Storage containers will be checked regularly for their structural integrity and to ensure the caps or fill points are tightly closed.

Chemical filling will be carried out by properly trained workers under the supervision of the technician.

Emergency Procedures

Any spillage will be reported to the engineer-in-charge of the shift who will attend to the spillage and initiate any immediate actions required to protect workers and to confine and clean up the spillage. If required, advice from the Senior Generation Chemist will be sought.

Spillage/Leakage of Liquid Chemical/Waste at Storage Area

Where the spillage/leakage is contained in the enclosed storage area, the material will be transferred back into suitable containers by appropriate equipment, such as hand-operated pumps, scoops or shovels. If the spillage/leakage quantity is small, it will be covered and mixed with suitable absorbing materials such as tissue paper, dry soft sand or vermiculite. The resultant slurry will be treated as chemical waste and transferred to suitable containers for disposal.

Spillage/Leakage at Other Areas

For spillage/leakage in other areas, immediate action will be taken to contain the spillage/leakage. Suitable absorbing materials will be used, as appropriate, to cover the spill. The resultant slurry will be treated as chemical waste and transferred into containers for proper disposal.

Areas that have been contaminated by chemical waste spillage/leakage will be decontaminated. For aqueous chemicals or wastes and water soluble organic waste, water will be used to clean the contaminated area. For organic chemical wastes that are not soluble in water, kerosene or turpentine will be used. The waste from the cleanup operation will be treated and disposed of as chemical waste.

9.4.3 *Recording of Incidents*

A detailed report will be compiled by the engineer-in-charge of the shift as soon as possible after any incident. The report will contain details of the incident, including an estimate of any amounts spilled, and any actions taken. The incident report will be used to evaluate any environmental impacts due to the spillage and to assess the effectiveness of the measures taken, so that improvements can be made to the response procedures for future incidents.

In incidents where the spillage/leakage may result in significant contamination of an area or risk of pollution, the EPD will be informed immediately.

9.4.4 *Procedures for Disposal of Waste*

Used or expired chemicals, deteriorated synthetic lube oil, expired or non-usable paint and similar materials will be collected by a licensed collector and disposed of at the CWTC. To avoid prolonged storage of chemical waste on site which may increase the potential for land contamination, waste will be removed from the power station on a regular basis.

9.5 *Summary and Conclusions*

With proper implementation of the above practices and procedures, the potential for land contamination due to the operation of Lamma Extension is expected to be minimal. It is considered that the current *Chemical Control Standards and Procedures* and *Standing Instructions for Handling and Disposal of Hazardous Substances and Dangerous Goods* currently used by HEC to Lamma Power Station will be adequate for the prevention of land contamination when applied to Lamma Extension.