

EIA/004-5/92

The Hongkong Electric Company Limited



ENVIRONMENTAL IMPACT ASSESSMENT (EIA) STUDY

FOR

UNITS L7 AND L8 AT LAMMA POWER STATION

Key Issue Report on Environmental Monitoring & Auditing

Consultants

Kennedy & Donkin International

In Association with

- **Kennedy & Donkin Generation & Industrial**
- **Ashdown Environmental Ltd**
- **Binnie Consultants Ltd**
- **BMT Fluid Mechanics Ltd**
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**THE HONGKONG ELECTRIC
COMPANY LIMITED**

**ENVIRONMENTAL IMPACT
ASSESSMENT: UNITS L7/L8 LAMMA
POWER STATION**

**KEY ISSUE REPORT:
ENVIRONMENTAL MONITORING
AND AUDITING**

NOVEMBER 1992

EXECUTIVE SUMMARY

This Key Issue Report considers the environmental monitoring and auditing requirements which would follow from the addition of Units L7 and L8 at Lamma Power Station.

Monitoring of the air environment of Hong Kong Island for SO₂, NO_x and TSP is already comprehensive. HEC have, however, agreed to undertake additional monitoring on Lamma Island where air quality impact studies indicated relatively high air pollution concentrations may arise occasionally at some uninhabited hill top locations.

Monitoring of the environmental impacts of construction site activities will be needed to ensure adequate control and compliance with conditions of contract.

Additional monitoring of new effluent streams arising from Units L7 and L8 will be required and this monitoring will need to reflect new requirements for effluent loading contained in the Technical Memorandum for Effluent Standards. The exact nature of this monitoring of effluent streams will require to be discussed and agreed with EPD as part of future licensing conditions applied to Units L7 and L8.

Monitoring of the heat load in the coastal waters off Lamma and also of metals are recommended to check on the actual environmental impact of the station.

A system of compliance auditing, similar to that currently operating at the power station, whereby monitoring data is passed to EPD at regular intervals, should also be adopted for the new units. Appropriate lines of communication, management and review of environmental data should also be implemented within HEC to ensure performance evaluation of the various controls applying to the station.

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1.0 **INTRODUCTION**

1.01 The draft Initial Assessment Report (IAR) on the environmental impact of Units L7 and L8 at Lamma Power Station was submitted to Government in December, 1990. The IAR was subsequently reviewed by Government and at the Study Management Group (SMG) meeting held on 6th March, 1991.

1.02 Following the Government review process, various key issues were identified for further study. This report is one of a series of key issue reports designed to address these key issues and is concerned with the environmental monitoring and auditing requirements for L7 and L8.

2.0 **MONITORING**

- 2.01 The Initial Assessment Report (IAR) contained a detailed review of the current environmental monitoring programme for Lamma Power Station [1]. For completeness, a summary of that review is presented below.
- 2.02 A programme of environmental monitoring of Lamma Power Station has been in operation since 1980 and a comprehensive database exists for many key parameters in the air and water environment. In addition, a long term noise monitoring study has been carried out at two sites in the vicinity of the power station (Ching Lam since 1984 and Hung Shing Ye since 1980). The data gathered in these monitoring programmes is reviewed in Chapters 5, 6, 9 and 11 of the IAR.
- 2.03 In addition to the long term monitoring conducted by HEC, various shorter term monitoring studies have also been undertaken. These include measurements of dust concentration and deposition carried out within or close to the external boundary of the Lamma site; noise measurements at facades of properties where there have been noise complaints; sea water temperature/water quality studies and biological monitoring of trace metals.
- 2.04 The environmental monitoring programme operated by HEC was set up as a condition of the site licence for the development of the Lamma Power Station. It has proved to be useful in assessing any changes in pollution level in the external environment that have arisen following the development.
- 2.05 In broad terms, the monitoring data reflects the changes that have occurred in generating pattern on the HEC system, with a gradual decline in load at the Ap Lei Chau Station, followed by an increase in capacity of the Lamma site. These changes have been reflected in a general improvement in air quality conditions at various monitoring sites on Hong Kong Island.
- 2.06 Liquid effluents generated at the power station are regularly monitored by HEC in accordance with a formal discharge consent, initially issued in January 1986 and revised in July 1989 by EPD. The data from this self monitoring programme are submitted to EPD at regular intervals for auditing purposes.

Air Pollution Control (Specified Processes) Regulations, 1989

- 2.07 Air emissions from the Lamma Power Station are regulated under the terms of a licence (L-7-002) issued by EPD under the Air Pollution Control (Specified Processes) Regulations, 1987. This licence, issued on 6th March 1990 and renewed on 29 May 1992, provides for control of some 53 separate emission points on the Lamma site. For each of the separate

emission points, the licence specifies regulated limits on discharges in terms of emission rates and concentration. The licence applies to steam boiler Units L1 to L6 and specifies a requirement for a flue gas desulphurisation system on Unit L6. It also covers emissions from the gas turbine GT1, whilst another licence, L-7-001, covers the six 125MW gas turbines, GT2-GT7, and one black start gas turbine.

2.08 A comprehensive system of sampling and monitoring is specified in the licence. In summary, the requirements are as follows:

1. To provide sampling points on chimneys serving Units L1 to L6, for the purposes of stack gas testing in accordance with USEPA Reference methods 5, 6 and 7 (or equivalent);
2. To fit each of the chimneys serving Units L1 to L6 with a double pass transmissometer and data recorder for in stack opacity monitoring;
3. To fit the chimney serving Unit L6 with a sulphur dioxide analyzer and Units L1-L6 with a nitrogen oxides analyzer, all with recorders;
4. To conduct at least once a year, an analysis of emission rates of particulates and nitrogen oxides (prior to the installation of the oxides of nitrogen analysers) in exhaust gases from Units L1 to L5;
5. To monitor the 24 hourly ambient particulate concentration at selected locations by high volume sampler, at a frequency of once every 6 days;
6. To monitor the hourly average SO₂ concentration at Queen Mary Hospital; Victoria Road; Ap Lei Chau; Chung Hom Kok and the Peak.
7. To monitor the hourly average ambient nitrogen dioxide concentration at Queen Mary Hospital; Victoria Road and the Peak within one year after licence renewal (May 1992).

There are also requirements to sample stack gases from the 125MW gas turbines, to monitor fuel usage of the power station and to maintain various operating and maintenance records of the plant and associated pollution control equipment. The results of the various monitoring studies are to be submitted at regular intervals to the Authority (i.e. EPD).

2.09 The majority of the licence requirements have already been implemented by HEC, with outstanding items awaiting the completion of Unit L6 FGD system.

Liquid Effluents - Consent to Discharge

- 2.10 The liquid effluent discharge consent issued to HEC in 1989 specifies all effluent streams and permitted discharge limits. The consent requires that HEC carry out a self monitoring programme in accordance with an agreed frequency schedule.
- 2.11 The self monitoring programme is already in operation and covers effluents from the cooling water; effluent treatment plant; ash settling basin overflow and sewage treatment plant.
- 2.12 Although not specifically required under the terms of the consent, HEC has also conducted biological monitoring in the past which has included:
1. Plankton population and chlorophyll concentration at the c.w. intake and outfall;
 2. Species diversity of fishes caught on intake screens, and;
 3. Heavy metal concentrations in barnacles.

The results of these various biological monitoring studies are reviewed in Chapter 9 of the IAR.

Air Quality Monitoring

- 2.13 The analysis of air quality impacts reported in the IAR, identified Hong Kong Island as being an area where maximum ground level concentrations of air pollutants probably arise. In addition, short term maxima were predicted for North Lamma under adverse but infrequent meteorological conditions. The addition of Units L7 and L8 would make only a small addition to the total pollution load.
- 2.14 With the addition of the Peak monitoring station in August 1990 (monitoring SO₂ and NO_x) it is considered that the air quality monitoring network will be sufficient for assessing any impact of the extension on the air environment of Hong Kong Island, as well as for assessing cumulative impacts. However, because of the predicted occasional high pollution levels on North Lamma, HEC have agreed to install an additional continuous monitoring station on Lamma.

- 2.15 Monitoring of stack gas emissions is already a requirement for existing units and will be required for Units L7 and L8. The requirement will be for continuous monitoring of stack gas pollutants and a summary specification for the air quality monitoring for L7 and L8 required by EPD is given in Appendix A. Detailed implementation of the requirements will be discussed between EPD and HEC in due course. This will provide a continual check on the performance of pollution control devices incorporated in L7 and L8. A requirement to provide continuous records of concentration for inspection by the Authority, together with suitable alarm facilities to warn operations staff of mechanical failure of pollution control plant, would provide an adequate basis for monitoring emissions at source.

Construction Activities - Dust Control

- 2.16 As with any large construction project, there are a variety of potential sources of dust emission which require to be adequately controlled, if nuisance is to be avoided. This matter was reviewed in Chapter 4.0 of the IAR and various dust control measures recommended.
- 2.17 The key elements of construction site dust control are good site management, adequate mitigation measures for potentially dusty activities, specific contractual conditions in Contractors Contracts and appropriate site management control. Monitoring of conditions is also required to provide a quantitative check on the efficacy of control systems.
- 2.18 Fugitive dust from construction activities tends to be predominantly of large size ($> 10\mu\text{m}$) and hence will fall out relatively close to the source of emission. In the context of monitoring of such dust, attention needs to be focused on potential impacts in the immediate environs of the power station site, specifically the village of Hung Shing Ye and the productive agricultural land to the east of the power station.
- 2.19 HEC has established two high volume air sampling stations at the perimeter of the Lamma site - one at the reservoir and the other at the East Gate. These two stations were commissioned in August, 1990 and provide 24-hour measurements of TSP on a 6 day cycle. It is considered that these two stations should provide an adequate monitoring system for construction dust resulting from the development of L7 and L8.

Operational Factors - Dust Control

- 2.20 Provision of FGD to Unit L6 will require the necessary infrastructure for handling and storage of limestone and gypsum. There is no experience of bulk handling of these materials on power station sites in Hong Kong and so the need for any additional monitoring to assess environmental impacts cannot be readily ascertained at this stage. However, any air impacts associated with the handling of FGD process materials should be adequately monitored by the high volume air sampling programme.

Crop Contamination

- 2.21 During the course of the public consultation programme, Lamma residents expressed concern over possible dust emissions from the Lamma site and deposition onto agricultural produce. To date, there has been no substantive evidence to indicate that the activities of the power station are responsible, although the investigations have so far only been carried out on an ad-hoc basis.
- 2.22 Whilst high volume air sampling will assist in identifying if unacceptable dust emissions do arise from the site, it is also considered useful to carry out some additional monitoring of vegetable crops grown near the power station. It is, therefore, recommended that HEC arrange to conduct regular sampling of vegetation in collaboration with local farmers, and to subject this vegetation to appropriate microscopic and chemical analysis. A sampling interval of once per quarter is recommended in the first instance, with a review after twelve months. HEC have also agreed to install an additional high volume air sampler to measure TSP on a once/6 day basis in the crop growing area. This monitoring will provide a systematic basis of assessing the impact of dust on crop growing areas.

Water Quality Monitoring

- 2.23 The provision of the additional units will result in additional quantities of effluents. These additional effluents will require to be monitored prior to discharge. HEC have decided to adopt a new effluent managing system for Units L7 and L8, based upon the concept of zero discharge. The basic operating principle of the system is to separate those effluents which comply with the limits specified in the Technical Memorandum on Standards for Effluents [2], from those that do not. Compliant effluents will be discharged through the cooling water system to sea, whilst non-compliant effluents will be recycled in a 'closed loop' system and will not be discharged. Full details of the system are given in a separate Key Issue report [3].

2.24 The power station extension will require provision of an additional cooling water outfall, which will be constructed adjacent to the current outfall. There will therefore be an additional discharge point, which will need to be considered in any additional monitoring work.

2.25 A programme of effluent monitoring will need to be developed in accordance with EPD requirements and licence conditions.

Heat Dispersal

2.26 The additional thermal discharge from the new cooling water outfall will add to the heat load in adjacent waters. The biological impact of this additional heat load has been addressed in Chapter 9 of the IAR.

2.27 The temperature Water Quality Objective (WQO) for the Southern Water Control Zone requires that the waste water discharge does not cause the ambient temperature to increase by more than 2°C. In addition, the Discharge Consent for the power station currently permits exceedence of the +2°C criterion within a defined mixing zone. Testing for compliance with this objective requires firstly that the ambient temperature is defined and secondly that the area where temperature rises exceed +2°C is delineated. There are difficulties in defining both parameters that the monitoring programme must overcome.

2.28 The basis for the proposed monitoring programme is for occasional intensive surveys. These surveys would not need to be repeated each year, but only at intervals as the peak daily output of the coal fired units at Lamma increased. For the first year, it is suggested that monitoring is undertaken more frequently at an interval of once every three months. The results of the monitoring can then be reviewed and any modifications to the frequency considered in the light of actual data.

2.29 The intensive surveys should be arranged to measure conditions at times when the area affected by the power station heat field is largest. The modelling reported in the IAR suggested that spring tide conditions in the wet season caused the +2°C envelope to enclose the largest sea area. There are also indications that a tide such as that on 24 September 1990 with a prolonged period of near constant sea level might also provide critical conditions. Apart from tidal effects, the size of the mixing zone is sensitive to the amount of electricity generated which varies on a weekly cycle as well as seasonally. Maximum electricity generation normally takes place on week days in the summer months. This is therefore the most appropriate time for these intensive surveys to take place. A summer survey would be associated with wet season conditions in Hong Kong waters.

2.30 The proposed programme of measurement recommended is broadly similar to that carried out in September 1990 and reported in Appendix 6F of the IAR. Traverses of water temperature and salinity should be made in the area that is likely to be affected by the power station discharge over a complete 24 hour period. There is also a need to take additional fixed point measurements to help define ambient temperature. The suggested location of the measurements are shown on Figure 1.

2.31 A key factor in determining the thermal rise is the definition of ambient water temperature. This is naturally a highly variable parameter depending *inter alia* on the time of year, time of day, season, state of tide and heat loss coefficient. In order to assist in defining the ambient during thermal surveys, at least two sites located at a distance more than 4 km from the outfall should be selected. The exact points are best defined at the time of the surveys.

Metal dispersal

2.32 With the adoption of the proposed closed cycle effluent management system, there will be no metal releases from the operation of Units L7 and L8. However, in order to provide a check on metal releases from the power station prior to the new effluent management system becoming operational, it is recommended that monitoring of metals in seawater is carried out. Samples could be taken for analysis north and south of the power station at sites such as T1 and T5 shown in Figure 2. It is proposed that monitoring is carried out initially once per year for the first three years, but the frequency of sampling should be reviewed in the light of results obtained. The exact metal parameters to be monitored will need to be agreed with EPD when the equipment required to comply with the TM for Units L1-L6 has been finalised.

2.33 If high concentrations are detected, repeat sampling should be undertaken as sample contamination is a likely source of error. If high concentrations persist, the monitoring of power station effluents should confirm whether this is due to increased releases from the power station or due to other factors beyond HEC control.

2.34 Monitoring of bioaccumulation by shrimp trawling in Ha Mei Wan has been recommended as part of the environmental monitoring associated with the ash lagoon. This programme is probably adequate to monitor heavy metals discharged from the power station, possibly extended to include shrimps trawled north of the power station as indicated on Figure 2. The use of this monitoring method should be reviewed in the light of experience with the ash lagoon.

- 2.35 A review of the results of the biological monitoring of trace elements in barnacles does not enable any firm conclusions to be drawn on the possible impacts of trace metal discharges from the station. It is clear that considerable variation exists in the biological monitoring data both between sites and over time. No significant increase in barnacle metal content was found over time. The study has now been terminated and there would seem little benefit in reinstating it.

Construction Impacts - Water Quality

- 2.36 Potential sources of water pollution associated with construction activities include:
- washout from concrete mixing/batching;
 - runoff from soil/spoil;
 - fuel oil spillage; and
 - runoff from silt and dust suppression activities.

If uncontrolled, the discharge of contaminants from construction activities into marine waters has potential to cause localised increases in turbidity, discolouration, increases in biological oxygen demand (BOD), possible nutrient enrichment and, in extreme cases, smothering of benthic fauna.

- 2.37 The above potential impacts apply to most major construction activities and are not specific to the construction of Units L7 and L8 at Lamma. As detailed in the IAR, construction of the second marine outfall will result in some localised water quality impacts due to the nature of the proposed work. The area where impacts are expected is the formation of the cofferdam to allow access to the intertidal region so that the new cooling water discharge weir can be formed. This work will cause some short term damage to the intertidal biota and HEC plans to carry out additional monitoring during the construction of the outfall. The details of such monitoring will be agreed with EPD prior to construction. No significant long term environmental consequences are anticipated.
- 2.38 With regard to general construction activity, wastewater and runoff should be routed to a properly designed effluent treatment system and disposal facility. As specified in the Water Pollution Control Ordinance any effluent discharged from the site into waters of Hong Kong, including ground water, will require to be licensed. The proposed effluent treatment and disposal facilities should be designed to comply with government standards. A monitoring programme for the effluents should be formulated according to the license requirements. Similarly, adequate sewage treatment and

disposal facilities must be provided for the enlarged workforce on Lamma Island during construction and licensed as currently practised at the Lamma site.

Noise

- 2.39 HEC operate two long term noise monitoring sites on Lamma, one at Ching Lam and the other at Hung Shing Ye. In addition, individual noise surveys are carried out in response to specific noise related problems. It is considered that the existing noise monitoring activities are adequate for the purposes of assessing the operational impacts of Units L7 and L8 and no additional monitoring should be necessary. Periodic checks on construction noise should be carried out by HEC staff to ensure compliance with agreed standards.

Sewage Treatment Plant

- 2.40 The monitoring effort should also include effluent from the sewage treatment plant. Parameters to be monitored should be agreed with EPD.

3.0 AUDITING

- 3.01** Environmental auditing (EA) is an integrated assessment process involving examination of all aspects of an organisation's environmental performance. The procedure can be used to both check compliance with environmental objectives and standards, and also as a planning and management tool to minimise environmental impacts. An environmental audit can be carried out either in house (normally with external guidance); by an external contractor engaged by the particular organisation or by the relevant regulatory body. It can be carried out at plant level, site level or corporate wide.
- 3.02** Environmental auditing as an environmental management tool has only recently been formally introduced into Hong Kong, although a system of auditing for compliance purposes has operated successfully for a number of years, through an environmental monitoring review process operated by EPD. In this process, air quality data from HEC's air quality monitoring network is passed to EPD at regular intervals and reviewed. In the early years of monitoring, this review included the formation of a Joint Working Party comprising representatives of both Power Companies, EPD (then EPA), the Royal Observatory and Labour Department. The purposes of the Joint Working Party were to disseminate information; pool expertise; solve common problems relating to the operation and use of monitoring equipment and to provide a forum for continuing technical discussions on the data derived.
- 3.03** The auditing/review process also extends to on-site emission testing whereby stack emissions are periodically tested by EPD using USEPA Reference methods to check compliance with agreed emission standards.
- 3.04** Liquid effluents generated at the power station are regularly monitored by HEC in accordance with a formal discharge consent, initially issued in January 1986 and revised in July 1989 by EPD. The data from this self monitoring programme are submitted to EPD at regular intervals for auditing purposes.
- 3.05** A major component of the EA process should be self monitoring and reporting, as currently carried out by HEC. It will be necessary to integrate the monitoring/reporting strategy currently being practised by HEC with the additional monitoring/reporting requirements for Units L7 and L8.

- 3.06 It is proposed that compliance auditing of the monitoring activities is carried out through submission of monitoring data to EPD at regular intervals, as is currently practised. In addition, performance evaluation checks to ensure the continued efficiency of pollution control equipment should be carried out on a regular basis by HEC staff. In order to ensure that corrective action is taken in the event of malfunction of control equipment, or monitoring equipment, appropriate lines of authority and managerial control should be in place. In order to ensure effective performance evaluation/compliance, data from all parts of the monitoring system should be processed as rapidly as possible and scrutinized by HEC environmental staff so that any non compliance can be identified. Where non compliance is identified for any reason this should be suitably reported, together with the remedial action taken.
- 3.07 The primary responsibility for routine plant monitoring should rest with operational personnel at the power station site. However, for auditing purposes, it is important that for all monitoring undertaken, performance evaluation targets are available and made known to operational staff. This will enable those responsible for monitoring source emissions to be immediately aware of non-compliance. Those charged with routine monitoring activities should have clearly defined lines of reporting for the monitoring data, such that prompt and effective remedial action can be taken in the event of non-compliance. Ultimate responsibility for ensuring such action is taken should rest with the Station Manager.
- 3.08 HEC environmental staff should have an internal auditing function and undertake regular reviews of monitoring data and performance targets to check overall compliance with agreed targets. Any breaches of the agreed performance targets/emission limits should be immediately brought to the attention of the Station Manager who should certify that any requisite remedial action has/will be taken.
- 3.09 Particular auditing requirements will apply with regard to the construction phase when it will be necessary for HEC to ensure compliance with both construction noise limits and particular dust control measures incorporated into Contractors Contracts. It is not possible at this stage to specify the nature of these auditing activities as the precise details of the construction activities and any associated environmental controls are not available. It is clear, however, that regular site "policing" by HEC staff, together with evaluation of environmental monitoring data will be essential to the effective auditing of the construction work. After award of the contract, the contractor should also be responsible for demonstrating that the works and equipment comply with EPD requirements, and provide documentary evidence to this effect to HEC.

- 3.10 Although details of the construction activities are not yet available, it is possible to indicate certain standard methods of dust control that may be suitable for inclusion in Contractors Contracts. A list of specimen conditions is given in Appendix B. These specimen conditions should be regarded as for general guidance only and specific conditions would need to be applied by HEC to individual contracts. Inclusion of such conditions in Contractors Contracts, together with regular monitoring should prove effective in minimising dust problems from the construction activities.
- 3.11 Specific conditions with regard to noise control will also be necessary during construction activities. The detailed requirements of relevant Technical Memoranda and the Construction Noise Permit will need to be applied to all contractors. Other general controls typically applicable to large scale construction work are given in Appendix C.
- 3.12 With regard to water pollution during construction, a number of specific measures will have to be taken to avoid environmental impacts. These include:
- avoiding release of sediments or other polluted matter to the sea;
 - avoidance of visible foam, oil, grease, scum, litter or other objectionable matter to storm drains or the sea;
 - provision of an appropriate treatment system for wastewater and run-off;
 - provision of wheel washing facilities for construction traffic.
- 3.13 Appendix D gives a summary of the monitoring/auditing proposals arising from this key issue study, and from discussion with EPD. Also included in the Appendix are proposed trigger, action and target levels for each parameter, together with an action plan in cases of exceedence.
- 3.14 Monitoring data should be submitted as part of a Monitoring and Auditing Report at a frequency to be agreed with EPD. The report should include:
- monitoring data according to an agreed format;
 - audit/review of the data to identify compliance with regulatory requirements, policies and standards; and
 - remedial works taken/required to redress adverse impacts.

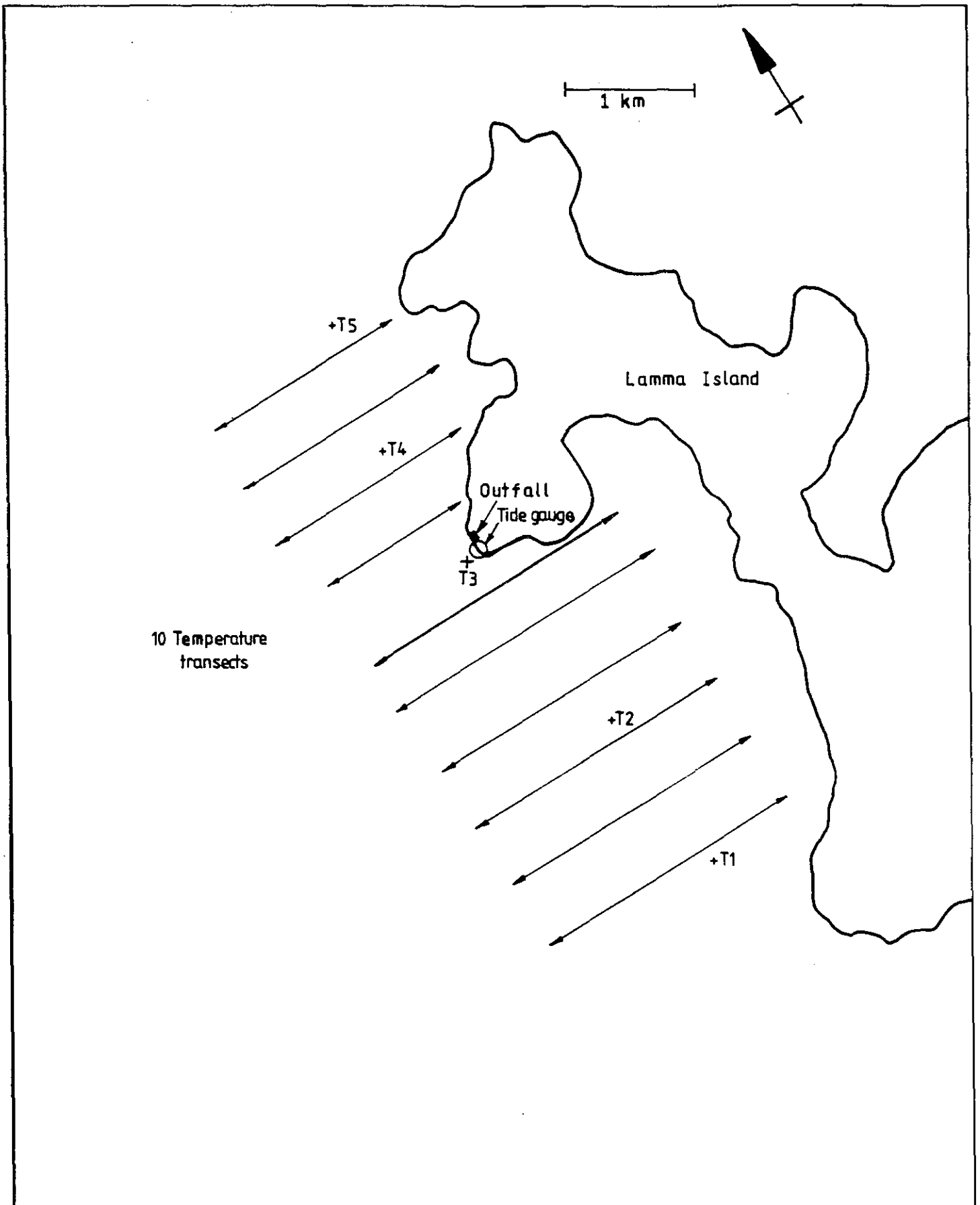
In order to provide a systematic basis for long term monitoring and auditing of the power station, it is recommended that the monitoring and auditing protocols described in this report are incorporated into a fully documented Environmental Monitoring and Auditing Manual. This document will provide a sound basis for the proper implementation of the EM&A programme, as well as guidance to staff undertaking the audit requirements.

4.0 CONCLUSIONS

- 4.01 The proposed extension to Lamma Power Station will require additional source and environmental monitoring in order to provide an on-going check on the performance of pollution control measures incorporated into the design, and also to provide a check on the environmental impacts.
- 4.02 It is envisaged that the various emissions and effluent streams associated with Units L7 and L8 will be monitored prior to discharge on a routine basis according to a regime required under licence conditions. Records from such source monitoring should be maintained and supplied to the Authority at regular intervals.
- 4.03 Specific monitoring will need to be carried out during construction activities to ensure that noise and dust controls are being properly adhered to by Contractors. As well as physical measurements of noise and dust, frequent inspections by HEC site staff during construction activities should form part of the overall environmental management activities. Monitoring and Control of water quality will also be required.
- 4.04 With the establishment of an air quality monitoring station on the Peak in August 1990, it is considered that the air quality monitoring system on Hong Kong Island is sufficiently comprehensive to monitor the air quality impact arising from Units L7 and L8. Additional monitoring of SO₂, NO_x and TSP is required on Lamma Island and periodic checks on dust fallout onto vegetable growing areas is recommended.
- 4.05 Additional water quality monitoring in relation to the increased thermal discharge, and metals, is recommended so that the actual impact of these releases can be adequately quantified.
- 4.06 Compliance auditing should form a key component of the monitoring activities with regular review of data collected by both HEC staff and Government. Appropriate lines of communication, responsibility and management should be in place to ensure that prompt remedial action is taken in the event of non compliance with environmental objectives. Overall responsibility for ensuring compliance should rest with the Station Manager who should be kept regularly informed of the results of emission monitoring. Regular site audits should be carried out by HEC site staff to serve as an overall check on the environmental performance of the station.

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1. Hong Kong Electric Company, Environmental Impact Assessment of Units L7 and L8 at Lamma power station: Final Initial Assessment Report, May 1992.
2. Environmental Protection Department. Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters, 1991.
3. Ashdown Environmental Ltd: Environmental Impact Assessment (EIA) Study for Units L7 and L8 at Lamma Power Station: Compliance with Effluent Technical Memorandum and Related Water Quality Aspects, October 1992.



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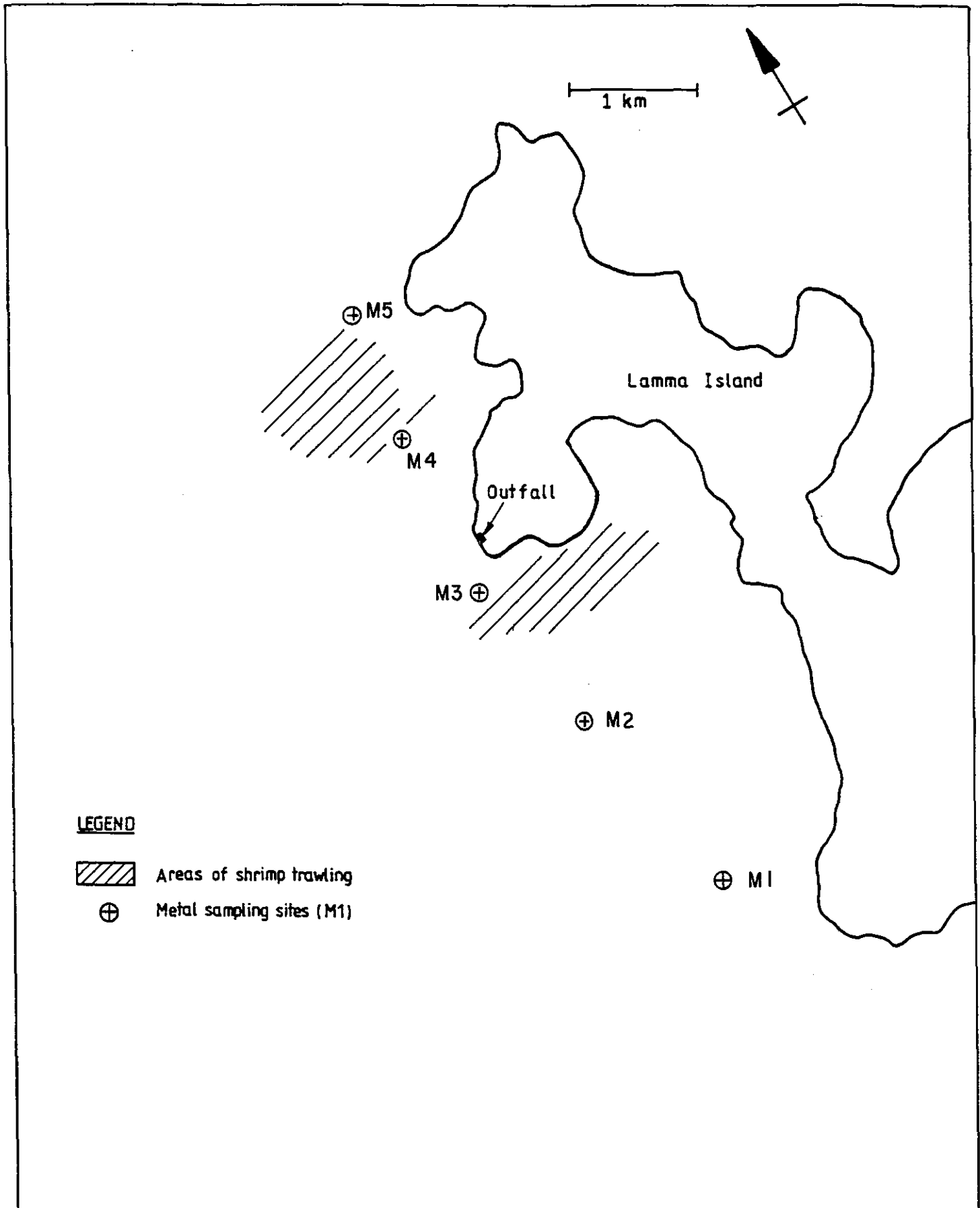


PROJECT



EIA LAMMA POWER STATION

TITLE THERMAL MONITORING SURVEY PLAN

FIGURE 1



LEGEND

-  Areas of shrimp trawling
-  Metal sampling sites (M1)

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PROJECT

EIA LAMMA POWER STATION

TITLE METAL SURVEY PLAN

FIGURE 2

APPENDIX A

Air Quality Monitoring Requirements for Units L7 and L8 at Lamma Power Station

A.1 General Requirement

In general, the parameters to be monitored and the sampling frequency will be determined by the Authority aiming at achieving a proper environmental monitoring and auditing. However, as a minimum requirement, the parameters specified in the following paragraphs shall be monitored continuously. The in-stack monitoring data should also be transmitted to the Authority instantaneously by telemetry.

A.2 In-Stack Monitoring

A.2.1 Oxygen, carbon monoxide, particulates (opacity), sulphur dioxide, nitrogen oxides, carbon dioxide, stack temperature shall be monitored continuously. The data should also be transmitted to the Authority instantaneously by telemetry.

A.2.2 The dust burden of the stacks shall be analysed at least once for every year. The analysis shall be done by means of the standard methods approved by the Authority.

A.3 Process Monitoring

Generation output, essential operating parameter(s) which may significantly affect the emissions of air pollutants of air pollution control equipment (including the flue gas desulphurisation plant) shall be monitored continuously.

A.4 Ambient Monitoring

A.4.1 Total suspended particulates (at least one 24-hour sample per 6 calendar day) shall be monitored at the site boundary and the possible receptors. In addition to the two existing TSP monitoring sites at the plant boundary, a third monitoring site will be required at the possible receptors to be determined by the Authority.

A.4.2 Ambient concentration of sulphur dioxide, nitrogen dioxide shall be measured at the areas of Queen Mary Hospital, Victoria Road, Ap Lei Chau, Chung Hom Kok, Peak Area and North Lamma Island. The locations of the monitoring sites is to be determined by the Authority.

A.5 Equipment Maintenance

The air pollution control equipment such as electrostatic precipitator, flue gas desulphurisation plant, bag filter etc shall be routinely inspected and maintained in good order at all times. The frequency of the inspection is to be determined by the Authority.

A.6 Wind Data

The wind direction, wind speed and ambient temperature shall be monitored at the Lamma Power Station and all the monitoring sites mentioned in A.4:2.

APPENDIX B

EXAMPLE CONTRACTORS CONDITIONS FOR DUST CONTROL

- B.1 The Contractor shall agree with the Site Engineer and shall implement appropriate working methods to minimise dust generation and to ensure adequate dust control.
- B.2 The Contractor shall implement control measures to contain at source the quantity of airborne particles produced. Such measures will typically include those in clause A.3 to A.9.
- B.3 The Contractor shall give a high priority to the implementation of measures to minimise dust from unmade roads.
- B.4 The Contractor shall ensure that all unsurfaced roads receive regular dousing or surface treatment during dry weather when located close to sensitive sites. The Contractor shall ensure that all roads and verges are cleaned and dampened to ensure effective dust suppression.
- B.5 The Contractor shall establish and enforce a maximum speed limit over all unmade surfaces, in consultation with the Site Engineer. The latter shall exercise discretion in enforcing the further reduction of such speed limits where dust problems so dictate.
- B.6 The Contractor shall ensure that all engine exhausts are directly vertically upwards where possible, and are directed away from the ground as a minimum standard.
- B.7 The Contractor shall ensure that all vehicles are clean prior to departure off site.
- B.8 Control of dust generation from stockpiles shall aim to minimise the effects of attrition and wind action. Stockpiles shall be sited and shaped to minimise the potential for dust generation where this can be done. The Contractor shall ensure that the number of handling operations is kept to a minimum, and that material deposited onto stockpiles is from the minimum practicable height. The surface of long term stockpiles shall be stabilised by methods to be agreed with the Site Engineer.
- B.9 Mixing of large quantities of concrete or bentonite slurries shall only be carried out in an enclosed plant or enclosed/shielded area, to be agreed with the Site Engineer.

APPENDIX C

**EXAMPLE CONTRACTORS CONDITIONS FOR NOISE CONTROL
(ADDITIONAL TO ALL RELEVANT REQUIREMENTS IN TECHNICAL
MEMORANDA AND CONSTRUCTION NOISE PERMITS)**

- C.1 To protect all persons living and working in the vicinity of the construction activity, the underlying principle must be to avoid creating any noise not necessary to the operation in hand. In achieving this objective, general recommendations made in BS 5228 must be complied with as a minimum standard.
- C.2 In accordance with the desire to reduce impact to as low as reasonably achievable, the Contractor should endeavour to institute further improved practices wherever a noise reduction is achievable, even where this exceeds the requirements of BS 5228 or any Construction Noise Permit.
- C.3 The Contractor must maintain all construction equipment in good and efficient working order, to the satisfaction of EPD. This requirement extends beyond operative parts of equipment to the condition of covers, bodywork, etc.
- C.4 The contractor must ensure that all vehicles and machinery are fitted with effective noise reduction equipment.
- C.5 Where activity is expected to last for a period of greater than two months, the Contractor should consider the use of temporary bunds or acoustic fencing. In addition, should consistent justified complaints be received regarding noise emissions, further mitigation must be considered in the short term.
- C.6 Audible reversing warnings must normally be switched to as low a setting as is compatible with safety and in any case should switch automatically to visual warnings during the hours of darkness. The Contractor must consider the use of the alternative systems in all locations where disturbance may result.

APPENDIX D

**PROPOSED MONITORING FREQUENCY SCHEDULE FOR
L7 AND L8, AND TARGET, TRIGGER AND ACTION LEVELS**

1. **ENVIRONMENTAL MONITORING AND AUDITING: FUNCTIONAL REQUIREMENTS (L7 AND L8)**

Air Emissions

Sources of Emissions	Parameter(s) to be monitored	Frequency	Concentration not to be exceeded (mg/m ³)	Proposed Levels for:			Proposed Action
				Trigger	Action	Target	
Steam boilers L7 and L8	Particulate Particulate (opacity) SO ₂ NO ₂	once/year continuous continuous continuous	50 - 191 200 (ppm)	- To be agreed 150 180	45 - 175 190	50 - 190 200	Station Manager informed at action level Maintenance initiated. Temporary load shift until pollution control equipment repaired and reinstated. Report to EPD.
Fugitive Dust (Coal, PFA, limestone, gypsum construction dust)	Particulate Ambient	Once every six days by HiVol.	260 (µg/m ³)	-	-	260	Investigation of sources and additional dust suppression to be employed at Target level. Frequency of monitoring to be increased as necessary.
Coal/ash storage/handling, construction, etc	Dust contamination on vegetables	Once/quarter by microscopical and chemical analysis of leaves	-	-	-	-	If microscopical/chemical analysis identifies significant contamination from power station source, additional dust suppression to be initiated.
	TSP	Once/6 days	260 (µg/m ³)	-	-	260	
Chimney emissions	Ambient air SO ₂ NO ₂	Continuous at existing monitoring stations plus N Lamma.	 800 (µg/m ³) (1h) 300 (µg/m ³) (1h)	 - -	 - -	 800 (1h) 300 (1h)	HEC staff to review data on post-hoc basis and check for possible power station contribution.

2.

LIQUID EFFLUENTS

Source of Discharge	Parameters to be monitored	Frequency	Concentration not be exceeded	Proposed Level for:			Proposed Action
				Trigger	Action	Target	
Cooling water	Temperature	Daily	Temperature at outfall should not exceed intake by >10°C	-	9.5	+ 10°C above intake	Investigation to be carried out on steam turbines and condensers at Action Level. Maintenance procedures to be implemented. Report to EPD if level exceeds Target.
Cooling water	Mixing zone	To be agreed	Seawater temperature should not be more than +2°C above ambient outside defined mixing zone	-	-	+ 2°C above ambient	
Cooling water	Chlorine	Biweekly	0.5 mg/l free available chlorine	0.3	0.4	0.5	If Cl residuals exceed action level, level of chlorine dosing should be adjusted downwards.
Cooling water	Scum	-	-	-	-	-	Work is being carried out by HEC to minimise scum formation from existing discharges. This will be developed for Units L7/L8 outfall, success of remedial work to be reviewed once/6 months in collaboration with EPD.
Oil interceptor discharge	Grease and oil	Weekly	20 mg/l	12	15	20	Investigations to be carried out of oil interceptors at Action Level. Maintenance procedures to be implemented. Exception report to EPD if level exceeds Target.

2. **LIQUID EFFLUENTS (CONT'D)**

Source of Discharge	Parameters to be monitored	Frequency	Concentration not be exceeded	Proposed Level for:			Proposed Action
				Trigger	Action	Target	
Boiler blowdown	Temperature	Monthly	40°C	-	-	40°C	If temperature exceeds 40°C consideration to be given to increasing flow volume to decrease temperature.
	Iron	Monthly, frequency of monitoring to be reviewed after 12 months following commissioning of Unit L7	3 mg/l	2	2.5	3	If levels exceed trigger level, monitoring frequency to be increased. Station Manager to be informed if temperature, iron, copper or SS concentration approach action level and investigations initiated to identify and remedy cause.
	Copper SS		0.3 mg/l 30 mg/l	0.2 20	0.25 25	0.3 30	
Sewage Treatment Plant	SS	Monthly	30 mg/l	20	25	30	Frequency of monitoring to be increased at trigger level. Station Manager to be advised if concentrations approach action level. Remedial work initiated at action level to improve effluent quality.
	BOD	"	20 mg/l	10	15	20	
	E.Coli	"	1000/100ml	750	800	1000	
	Chlorine	"	1mg/l total residual	0.6	0.8	1	
Grease and Oil	"	20 mg/l	12	15	20		

3. **NOISE**

Parameters to be monitored	Frequency	Proposed Level for:			Proposed Action
		Trigger	Action	Target	
Operational Noise L_{90} , L_{10} , L_{eq} , L_{max}	30 minute intervals, continuously			60 dB(A) (L_{eq} 30 min) daytime 50 dB(A) (L_{eq} 30 min) nighttime	When noise levels reach Target level, investigation of sources and need for additional mitigation to be initiated by HEC. Noise levels recorded in excess of Target Level may require additional mitigation. Exceedence of target noise levels to be reported to EPD with proposed remedial action.
Construction Noise	Periodic checks during construction work.	-	-	60 dB(A) (L_{eq} 30 min) daytime 50 dB(A) (L_{eq} 30 min) nighttime	Monitoring at Hung Shing Ye will provide primary data source to check compliance with CNP. If exceedences are noted, additional monitoring to be instituted at NSR's and remedial work initiated. HEC staff to routinely check compliance with Contractor's Contract.

Notes:

1. Target levels taken from relevant statutory limits/licence conditions. Trigger and action levels, where stated, are initial proposals.
2. All monitoring data to be audited for compliance with TM and licence limits. Where non compliance identified, a list of actions taken to achieve compliance to be given.
3. Audit reports to be submitted to EPD at a frequency to be determined.
4. A detailed monitoring, operation and maintenance manual would be developed after the exact equipment to be installed at Lamma Power Station is confirmed.



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