

The Hongkong Electric Co Ltd
香港電燈有限公司



ENVIRONMENTAL IMPACT ASSESSMENT (EIA) ORDINANCE, CAP. 499

ENVIRONMENTAL PERMIT NO. EP-083/2000

**LAMMA POWER STATION
CONVERSION OF TWO EXISTING GAS TURBINES (GT5 & GT7) INTO A
COMBINED CYCLE UNIT
ENVIRONMENTAL MONITORING & AUDIT PROGRAMME
AT OPERATIONAL PHASE**


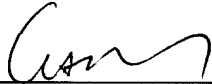
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| Report Title | <u>Monthly EM&A Report (January 2007)</u> |
| Date | <u>12 February 2007</u> |
| Certified by | <u></u> (Mr. Chan Kwok-Fai, Environmental Team Leader) |
| Verified by | <u></u> (Nature & Technologies (HK) Ltd, Independent Environmental Checker) |

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EXECUTIVE SUMMARY

This is the January 2007 monthly Environmental Monitoring and Audit (EM&A) report for the Project “Operation of GT57 Combined Cycle Unit” prepared by the Environmental Team (ET). This report presents the results of impact monitoring on air quality and marine water quality for the said project in January 2007.

Air and water quality monitoring were performed. The results were checked against the established Action/Limit (AL) levels. The implementation status of the environmental mitigation measures, Event/Action Plan and environmental complaint handling procedures were also checked.

Environmental Monitoring Works

Environmental monitoring works, as mentioned in the EM&A manual (Operational phase), were performed during the operation of GT57 in the reporting period.

Air Quality

No exceedance of hourly average water injection rate was recorded in the month.

Water Quality

No exceedance of Action and Limit levels for water quality was recorded in the month.

Environmental Licensing and Permitting

| Description | Permit/Licence No. | Valid Period | | Issued To | Date of Issuance |
|---|----------------------|--------------|------------|-----------|------------------|
| | | From | To | | |
| Environmental Permit | EP-083/2000 | 04/12/2000 | - | HEC | 04/12/2000 |
| Specified Processes Licence issued under APCO | L-7-002(6) | 14/09/2006 | 31/12/2008 | HEC | 13/09/2006 |
| WPCO discharge licence for L1-L9 and GT57 | EP890/W2/XD008 (V.2) | 18/12/2006 | 30/11/2009 | HEC | 19/12/2006 |

Implementation Status of Environmental Mitigation Measures

Environmental mitigation measures were implemented in the reporting month.

Environmental Complaints

No complaint against the Project was received in the reporting month.

Future key issues

Key issues to be considered in the coming month include:

Air Impact

- To monitor the water injection rate continuously.
- To monitor the fuel sulphur content of the LGO to be burnt in the combined cycle unit.

Water Impact

- To continuously carry out the water quality monitoring for GT57 as required by the EM&A manual (Operational phase).

Concluding Remarks

The environmental performance of the project was generally satisfactory.

1. INTRODUCTION

1.1 Background

The Environmental Team (hereinafter called the “ET”) was formed within the Hongkong Electric Co. Ltd (HEC) to undertake Environmental Monitoring and Audit for “Operation of GT57 Combined Cycle Unit” (hereinafter called the “Project”). Under the requirements of Section 5 of Environmental Permit EP-083/2000, an EM&A programme for impact environmental monitoring, as set out in the EM&A Manual (Operational Phase), is required to be implemented. In accordance with the EM&A Manual, environmental monitoring of air quality and water quality are required for the Project.

Figure 1.1 shows the location of the GT57 combined cycle unit. Making use of the open area between the existing gas turbines at the south western corner of Lamma Power Station, a steam-cycle bottoming system was installed to recover the waste heat from the exhaust gas of GT5 and GT7 so as to produce an extra output of 115MW and form a combined cycle unit of a gross output of 365MW. The exhaust gas after passing through the heat recovery steam generator (HRSG) is discharged to the atmosphere through the existing stacks of 80m height. Cooling water required for the steam-cycle bottoming system is supplied from additional C.W. pumps and returned to the existing No.1 C.W. outfall for discharge to the sea. As a result of the additional power output generated by the steam cycle, there is a substantial gain in the overall thermal efficiency from about 30% (in a simple cycle GT) to 46% (in a combined cycle GT).

The additional equipment installed for the project include:

- 2 numbers of heat recovery steam generators;
- 1 steam turbine building to house the steam turbine and auxiliaries;
- Generator and unit transformer; and
- 2 numbers of additional C.W. pumps.

This report summarizes the environmental monitoring and audit work for the Project for the month of January 2007.

1.2 Project Organisation

The management structure to oversee the Project, includes the following:

- Environmental Protection Department (The Authority);
- General Manager (Projects) (The official contact person between HEC and EPD);
- Environmental Team Leader (ET);
- Independent Environmental Checker (IEC);
- Environmental Team (ET).

The organization chart for the Operation EM&A programme is shown in Figure 1.2.

1.3 Summary of EM&A Requirements

The EM&A program requires environmental monitoring for air and water quality. The EM&A monitoring work for air quality and water quality are described in Sections 2 and 3 respectively.

The following environmental audits are summarized in Section 4 of the report:

- Environmental monitoring results;
- The status of environmental licensing and permits for the Project;
- The implementation status of environmental protection and pollution control / mitigation measures.

The future key issues for the Project will be reported in Section 5 of this report.

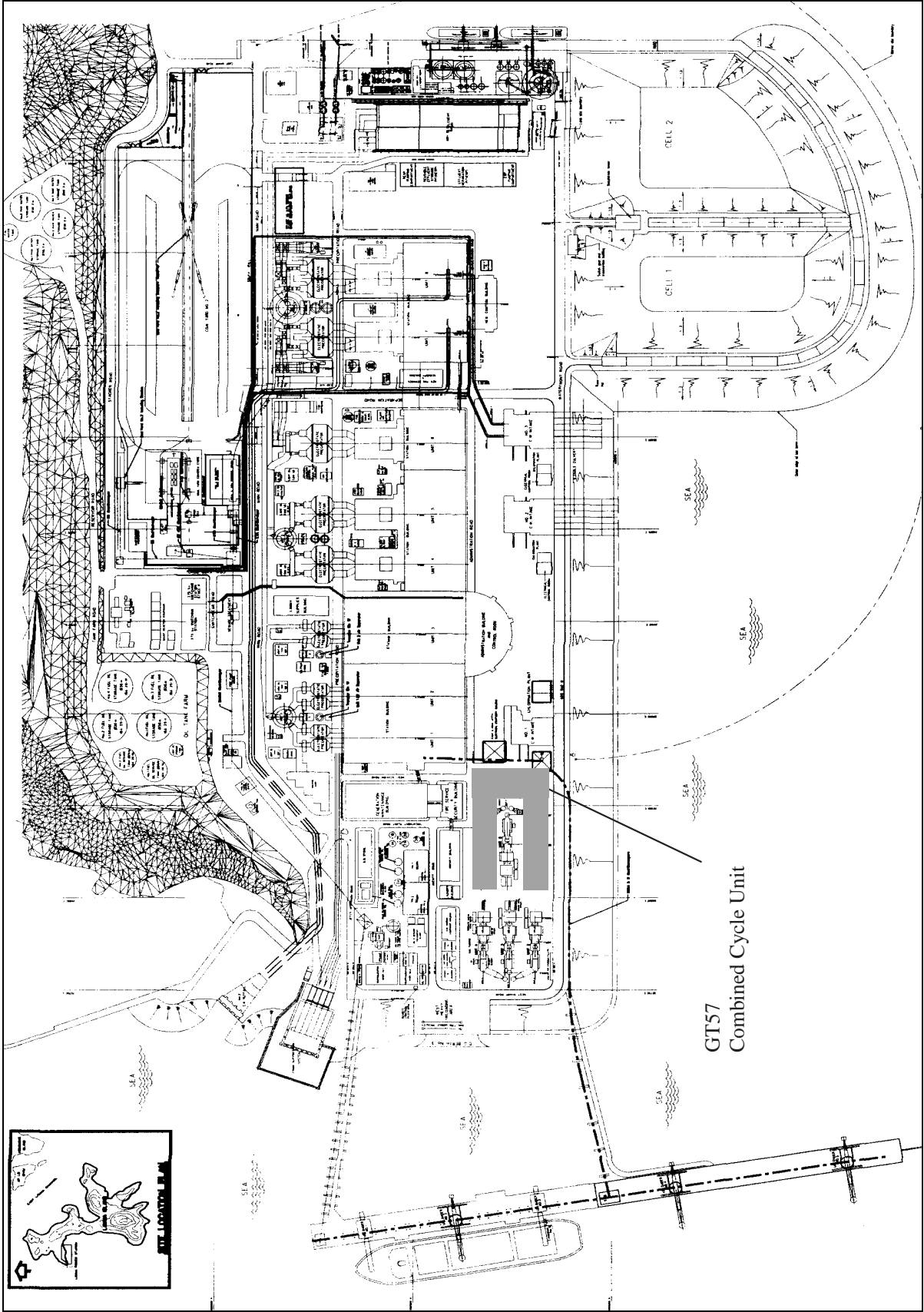


Figure 1.1 Location of GT57 Combined Cycle Unit

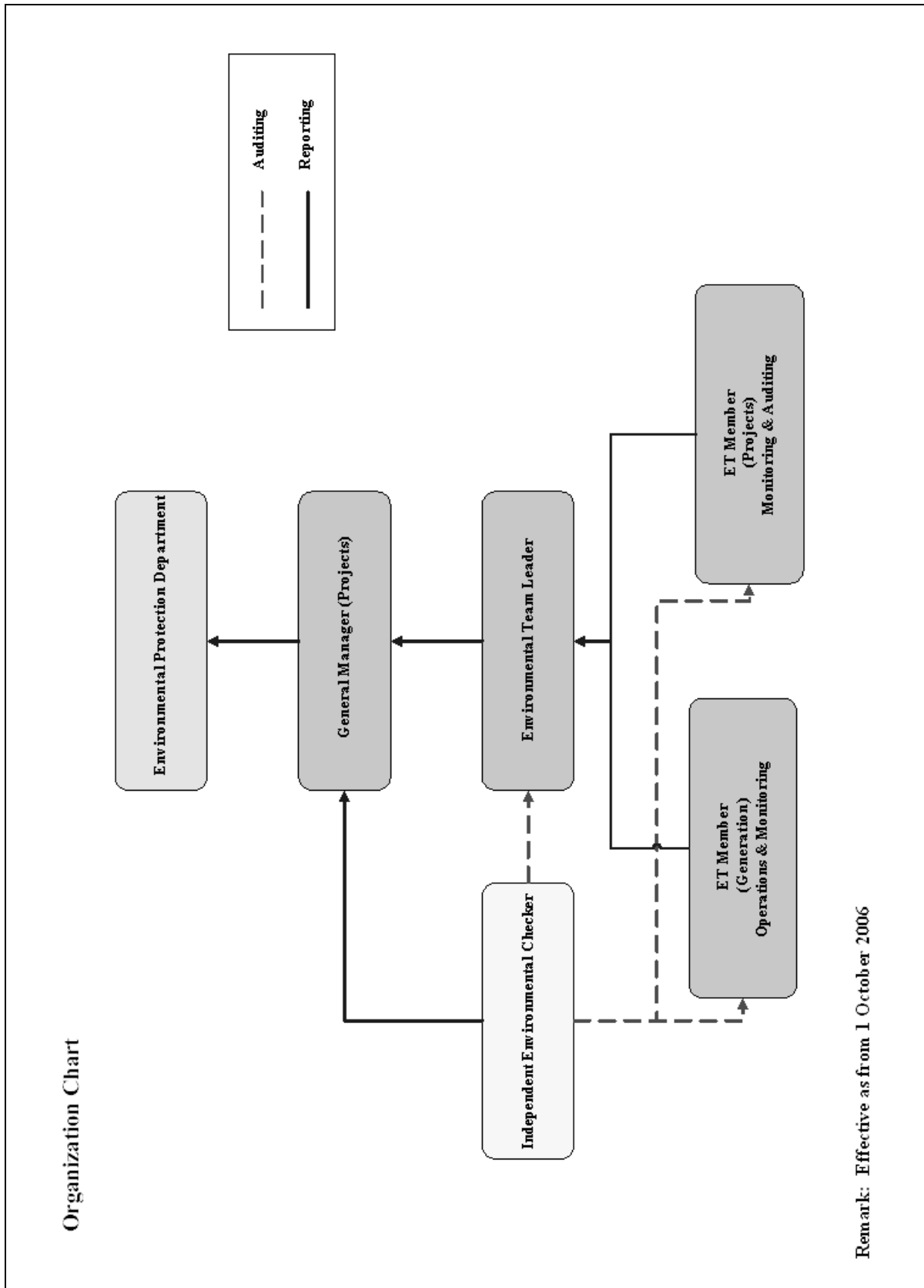


Figure 1.2 Organization Structure at Operational Phase of GT57 combined cycle unit

2. AIR QUALITY

2.1 Monitoring Requirements

In accordance with the EM&A manual (Operational Phase) for GT57 and the requirements stipulated in the Specified Processes Licence issued under Air Pollution Control Ordinance, water injection rates, sulphur content of fuel burnt and stack NOx emission are monitored. Various operation parameters (viz generation output and fuel consumption) are reported. Water injection rates and stack NOx sampling data were checked against the Action/Limit Levels as determined in the Baseline Monitoring Report shown in Appendix B. The monitoring frequency of various parameters are shown in table 2.1 below:

Table 2.1 Air Quality Monitoring Parameters and Frequency

| Parameter | Frequency |
|-------------------------------------|------------------------------------|
| Stack NOx | Once a year |
| Hourly Average Water Injection Rate | Continuous, when GT57 is operating |
| Sulphur content of fuel | Monthly |

2.2 Summary of Results And Observations

Monitoring of various parameters as mentioned in section 2.1 above was conducted during the operation of GT57 in the reporting month. A monthly summary of fuel data and Generation Output, as per the requirement stipulated in the SP licence, is shown below:

Table 2.2 Monthly Fuel Data and Generation Output

| | GT5 | GT7 | Steam Turbine | Total |
|-----------------------------------|-------|------|---------------|-------|
| Generation Output (MWH) | 278.1 | - | 56.0 | 334.1 |
| Fuel Consumption (MT) | 107.1 | - | - | 107.1 |
| Sulphur content of Fuel Burnt (%) | 0.19 | 0.19 | - | - |

| | GT6 |
|-----------------------------------|------|
| Sulphur content of Fuel Burnt (%) | 0.19 |

Table 2.3 Stack NO_x sampling for GT5

| | Date | Loading (MW) | Measured Concentration (mg/Nm ³) ⁽ⁱ⁾ |
|-----|------------|-----------------|---|
| GT5 | 12/01/2007 | 87 | 160 |

Note: (i) Expressed at dry, 0°C, 101.325 kPa and 15% O₂ concentration conditions.

Summary of Action/Limit Level Alarm in January 2007

No exceedance of both hourly average water injection rate and stack NO_x Action/Limit Level was recorded in the month.

2.3 Progress of Existing Ambient Air Quality Network Review

Commissioning test of the air quality monitoring station (AQMS) at Cheung Chau has been completed in January 2007. The AQMS has been put into service since then.

3. WATER QUALITY MONITORING

3.1 Monitoring Requirements

In accordance with the EM&A manual (Operational Phase) for GT57, the monitoring requirements for the EM&A work should strictly follow the discharge licence for L1-L9 & GT57 issued under the Water Pollution Control Ordinance (WPCO). The parameters as stated in table 3.1 were monitored and checked against the Action/Limit Levels as given in Appendix B.

Table 3.1 Water Quality Monitoring Parameters and Frequencies for GT57

| Item | Parameters | Frequency* |
|------|--|-------------------------|
| 1 | Cooling Water Temperature | Daily |
| 2 | Cooling Water Temperature Rise | Daily |
| 3 | Total Residual Chlorine | Bi-weekly |
| 4 | Grease & Oil from Oil Free Drain | Monthly |
| 5 | Temperature of Blowdown Effluent (HRSG) | At least twice per year |
| 6 | Suspended Solids from Blowdown Effluent (HRSG) | At least twice per year |
| 7 | Grease & Oil from Blowdown Effluent (HRSG) | At least twice per year |
| 8 | Scum of foam in ambient water | Daily |

Remark: * monitoring will only be carried out when there is operation of the GT57.

3.2 Summary of Results And Observations

Monitoring of various parameters as listed in table 3.1 above were carried out during the operation of GT57 in the reporting month. A monthly summary of the data is shown in Appendix C.

The data recorded for the monitoring parameters were all below their corresponding Action/Limit Levels. No AL level exceedance was recorded in the reporting month. There was no foam present within 500 meters of Hung Sing Ye Beach in the reporting month. Details of the foam observation report are also given in Appendix C. The effluent quality was generally satisfactory.

3.3 Implementation Status on Thermal Plume Surveys

No thermal plume survey was carried out in the reporting month. The thermal plume survey would only be conducted under the conditions stipulated in the proposal on the programme and methodologies of thermal plume attached in the EM&A manual (Operational Phase).

4. ENVIRONMENTAL AUDIT

4.1 Review of Environmental Monitoring Procedures

The environmental monitoring procedures were regularly reviewed by the Environmental Team. No modification to the existing monitoring procedures was recommended.

4.2 Assessment of Environmental Monitoring Results

Monitoring results for Air Quality and Water Quality

The environmental monitoring results for Air Quality and Water Quality in January 2007 presented in sections 2 and 3 respectively are summarized in Table 4.1.

Table 4.1 Summary of AL Level Exceedances on Monitoring Parameters

| Item | Parameter Monitored | Monitoring Period | No. of Exceedances In | | Event/Action Plan Implementation Status and Results |
|-------|-------------------------------------|-------------------|-----------------------|-------------|---|
| | | | Action Level | Limit Level | |
| Air | | | | | |
| 1 | Hourly Average Water Injection Rate | 01/01/07-31/01/07 | 0 | 0 | |
| 2 | Stack NOx | 01/01/07-31/01/07 | 0 | 0 | |
| Water | | | | | |
| 1 | Cooling Water Temperature | 01/01/07-31/01/07 | 0 | 0 | |
| 2 | Cooling Water Temperature Rise | 01/01/07-31/01/07 | 0 | 0 | |
| 3 | Total Residual Chlorine | 01/01/07-31/01/07 | 0 | 0 | |
| 4 | Grease & Oil from Oil Free Drain | 01/01/07-31/01/07 | 0 | 0 | |

| Item | Parameter Monitored | Monitoring Period | No. of Exceedances In | | Event/Action Plan Implementation Status and Results |
|------|--|-------------------|-----------------------|-------------|---|
| | | | Action Level | Limit Level | |
| 5 | Temperature of Blowdown Effluent | 01/01/07-31/01/07 | 0 | 0 | |
| 6 | Suspended Solids from Blowdown Effluent | 01/01/07-31/01/07 | 0 | 0 | |
| 7 | Grease & Oil from Blowdown Effluent | 01/01/07-31/01/07 | 0 | 0 | |
| 8 | Inspection of Scum/Foam in ambient water | 01/01/07-31/01/07 | 0 | 0 | |

4.3 Status of Environmental Licensing and Permitting

All permits/licenses obtained as of January 2007 are summarised in Table 4.2.

Table 4.2 Summary of Environmental Licensing and Permit Status

| Description | Permit / Licence No. | Valid Period | | Status |
|---|----------------------|--------------|------------|--------|
| | | From | To | |
| Environmental Permit | EP-083/2000 | 04/12/2000 | - | Valid |
| Specified Processes Licence issued under APCO | L-7-002(6) | 14/09/2006 | 31/12/2008 | Valid |
| WPCO discharge licence for L1-L9 and GT57 | EP890/W2/XD008 (V.2) | 18/12/2006 | 30/11/2009 | Valid |

4.4 Implementation Status of Environmental Mitigation Measures

Mitigation measures detailed in the permits and the EM&A Manual (Operational Phase) are required to be implemented. An updated summary of the Environmental Mitigation Implementation Schedule (EMIS) is presented below:

Table 4.3 Implementation Schedule

| Project Profile Ref. | Mitigation Measures | Implementation Status |
|----------------------|--|-----------------------|
| 19 | Use of 0.2% sulphur content for oil-firing of the conversion unit. | Complied |
| 19 | Use of acoustic enclosures around major noise sources | Complied |

4.5 Implementation Status of Event/Action Plans

The Event/Action Plans for air quality and water quality extracted from the EM&A Manual (Operational Phase) are presented in Appendix A.

As no action/limit level exceedance was recorded, no action has been devised.

4.6 Implementation Status of Environmental Complaint Handling Procedures

In January 2007, no complaint against the Project was received.

Table 4.4 Environmental Complaints / Enquiries Received in January 2007

| Case Reference / Date, Time Received / Date, Time Concerned | Descriptions / Actions Taken | Conclusion / Status |
|---|---------------------------------|------------------------|
| Nil | N/A | N/A |

Table 4.5 Outstanding Environmental Complaints / Enquiries Carried Over

| Case Reference / Date, Time Received / Date, Time Concerned | Descriptions / Actions Taken | Conclusion / Status |
|---|---------------------------------|------------------------|
| Nil | N/A | N/A |

5. FUTURE KEY ISSUES

5.1 Outage Plan for the coming 3 months

No major outage plan for the next 3 months.

5.2 Key issues for the coming month

Key issues to be considered in the coming month include:

Air Impact

- To monitor the water injection rate continuously.
- To monitor the fuel sulphur content of the LGO to be burnt in the combined cycle unit.

Water Impact

- To continuously carry out the water quality monitoring for GT57 as required by the EM&A manual (Operational phase).

6. CONCLUSION

Environmental monitoring was performed as required in the reporting month. All monitoring results were checked and reviewed.

No Action/Limit level exceedance on water injection rate or stack NO_x was recorded in the reporting month.

No Action/Limit level exceedance on water quality parameters were recorded in the reporting month.

Environmental mitigation measures recommended in the Project Profile were implemented in the reporting month. No complaint against the Project was received in the reporting month. No prosecution was received for this Project in the reporting period.

The environmental performance of the Project was generally satisfactory.

Appendix A Event / Action Plans

Table A.1 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 and advise ET 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 and advises ET for any finding; Verify the implementation of the remedial measures; | Discuss with ET 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 advise IEC, and inform the 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 and advises ET of any finding; Verify the implementation of the remedial measures. | Take immediate action to avoid further exceedances; Discuss with ET 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 advise IEC, and inform 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/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 on remedial actions required; Implement the agreed remedial actions; Stop the unit and check the suspected defective parts if the problem still does not come under control. |

Table A.2 Event/Action Plan for Water Quality

| Exceedance | ET Leader | IEC | Operations Engineer |
|---|--|---|--|
| Action Level | | | |
| Exceedance on one sampling day | Verbally inform IEC; Repeat in-situ measurement to confirm findings; Identify source(s) of impact. | Check monitoring data submitted by ET and advises ET 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; Increase monitoring frequency; Discuss with Operations Engineers on remedial actions required; If exceedance stops, discontinue additional monitoring | Check monitoring data submitted by ET and advises ET for any finding; Verify the implementation of the remedial measures. | Discuss with ET on remedial actions required; Implement the agreed remedial actions. |
| Limit Level | | | |
| Exceedance on one sampling day | Repeat measurement to confirm finding; Identify the source(s) of impact. Verbally advise IEC and inform the EPD of the exceedance, as soon as practicable; Discuss with Operations Engineers on remedial actions require; 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 and advises ET for any finding; Verify the implementation of the remedial measures. | Take immediate action to avoid further exceedance; Discuss with ET on remedial actions required; Implement the agreed remedial actions. |
| Exceedances on more than one consecutive sampling day | Identify the source(s) of impact. Verbally advise IEC, and inform 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/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 on remedial actions required; Implement the agreed remedial actions; Stop the unit and check the suspected defective parts if the problem still does not come under control. |

Appendix B Action and Limit Levels for Air Quality, Water Quality Monitoring

B.1 Air

| Parameter | Action | Limit |
|-------------------------------------|---|--|
| Stack NOx | 185 mg/Nm ³ | 185 mg/Nm ³ |
| Hourly Average Water Injection Rate | Measured Hourly Average Water Injection Rate lower than corresponding Specified Hourly Average water Injection Rate | Measured Hourly Average Water Injection Rate lower than corresponding Specified Hourly Average water Injection Rate. |

B.2 Water

| 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 and temperature at outfall should not exceed 40°C | 9.5°C | +10°C above intake | Please refer to the event & action plans in Table A.2. |
| | Total Residual Chlorine | Bi-weekly, when the combined cycle unit is operating | 0.5mg/L | 0.47 | 0.5 | |
| Trade Effluent oil free drain discharge | Grease and Oil | Monthly, when the combined cycle unit is operating | 20 mg/L | 15 | 20 | Please refer to the event & action plans in Table A.2. |
| Trade Effluent Boiler Blowdown (HRSG) | Temperature | At least twice per year, when the combined cycle unit is operating | 40°C | - | 40°C | Please refer to the event & action plans in Table A.2. |
| | Suspended Solids | At least twice per year, when the combined cycle unit is operating | 30 mg/L | - | 30 | |
| | Grease & Oil | At least twice per year, when the combined cycle unit is operating | 20 mg/L | - | 20 | |
| 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 event & action plans in Table A.2. |

Appendix C Summary Results and Observations on Water Quality Monitoring

Maximum Outlet Temperature and Temperature Rise (Deg. Celsius) of Cooling Water at C.W. Outfall Serving L1-L6 & GT57 Condensers Weighted by Flowrates of Individual Streams (January 2007)

| Date | Maximum Outlet Temperature (Deg. Celsius) | Maximum Outlet Temperature Rise (Deg. Celsius) |
|-------|---|--|
| 12/01 | 26.3 | 7.9 |
| 13/01 | 25.5 | 7.0 |

Total Residual Chlorine Level at First C.W. Outfall (January 2007)

| | |
|-------------------------------|-------|
| Date of sampling | 12/01 |
| Total Residual Chlorine, mg/L | 0.40 |

Grease & Oil at Oil Free Drain From Oil Interceptor for GT57 (January 2007)

| | |
|--------------------|-------|
| Date of sampling | 12/01 |
| Grease & Oil, mg/L | <10 |

Boiler Blowdown from GT5 HRSG to First C.W. Outfall (January 2007)

| | |
|---------------------------|-------|
| Date of sampling | 12/01 |
| Source of discharge | GT5 |
| Suspended Solid, mg/L | 15 |
| Grease & Oil, mg/L | <10 |
| Temperature, Deg. Celsius | 36 |

Remark:

1. Monitoring will only be carried out when there is operation of the GT57.

**OBSERVATION OF SCUM FORMATION IN MARINE WATERS MIXING ZONE
AT LAMMA POWER STATION (January 2007)**

| Date | Observation |
|-------------|--|
| 12/01 | No scum within 500m of HSY Beach & NW/SW corner of the Station; Some foam outside CW Outfall and defoamer added to Outfall No.1 & No.2 |
| 13/01 | No scum within 500m of HSY Beach, NW/SW corner of the Station & CW Outfall |