Emissions Control Project at Castle Peak Power Station "B" Units

Project Profile

September 2005

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Contents

Project Profile for Application under *Section 5 (1)(a)* of the *Environmental Impact Assessment Ordinance* for an Environmental Impact Assessment Study Brief

The Castle Peak Power Station (CPPS) is an exempted Designated Project under *Section 9(2)* of the *Environmental Impact Assessment Ordinance* (EIAO). The installation of additional emissions control facilities and the demolition of certain existing facilities at the CPPS (the Emissions Control Project), however, will qualify as a Material Change (as defined in Schedule 1 to the EIAO) to the existing exempted Designated Project and an Environmental Permit (EP) will be required under *Section 9(4)* of the EIAO for the construction and operation of the Emissions Control Project.

In connection with the above, this Project Profile is prepared for an application under *Section 5(1)(a)* of the EIAO for an Environmental Impact Assessment (EIA) Study Brief to conduct an EIA Study for the Emissions Control Project at the Castle Peak Power Station "B" Units (CPB).

1 BASIC INFORMATION

1.1 PROJECT TITLE

Emissions Control Project at the Castle Peak Power Station "B" Units (the Project)

1.2 NAME OF PROJECT PROPONENT

Castle Peak Power Company Limited (CAPCO), a joint venture between CLP Power Hong Kong Limited (CLP Power) and ExxonMobil Energy Limited (EMEL).

1.3 NAME AND TELEPHONE NUMBERS OF CONTACT PERSONS

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Tel: 2678 4017

1.4 PURPOSE AND NATURE OF THE PROJECT

It is CAPCO's objective to responsibly manage the environmental impact of our operations. Indeed, over the last decades, CAPCO has made significant efforts to reduce emissions, as demonstrated by the material reduction in sulphur dioxide (SO_2), nitrogen oxides (NO_x) and particulates emissions.

CAPCO supports Government's objective to promote better air quality in the region. In support of the regional air quality improvement initiative, CAPCO has assessed various options to reduce air emissions. Our assessment indicated that retrofitting emissions reduction facilities at CPB is the best practical means to improve emissions performance. CAPCO and CLP Power have proposed in their 2005 Financial Plan an emissions control retrofit project at CPB. At the end of June 2005, the Executive

Council advised and the Chief Executive ordered that the proposal should be accepted.

The location of the Castle Peak Power Station (CPPS) and a pictorial view of its current layout are shown in *Figures 1.4a* and *1.4b* respectively.

Four power-generating units using pulverised coal as the primary fuel are installed at the CPB. These units were commissioned during 1986 to 1990 and are each sized at a nominal generating capacity of 677 MW (gross).

Since its full commissioning, CPB has been retrofitted with low NO_x burners for the boilers, which helps reduce the formation and subsequent emissions of NO_x. Flue gas conditioning systems, using sulphur trioxide (SO_3), were also added to these units to increase collection of particulates by their electrostatic precipitators (ESPs). CPB has also carried out upgrades of the electrostatic precipitators and boiler optimisation improvements in recent years for increased particulates and NO_x control. As a result, emissions of NOx, SO_2 and particulates from all CAPCO facilities have already been reduced by 76%, 37% and 65% respectively during the period of 1990 to 2004 when electricity demand has grown by about 70%.

In order to further reduce emissions, a range of currently available emissions control technologies has been assessed thoroughly. The final selection was based on considerations taking into account the technology maturity, the existing site's physical constraints, and the standards adopted in many developed countries. The technologies selected for the Project are as follows:

- Selective Catalytic Reduction (SCR) for NO_x emissions control; and
- Limestone Flue Gas Desulphurisation (LS FGD) for SO_2 emissions control.

A typical SCR and FGD retrofit for a coal-fired power station is schematically depicted in *Figure 1.4c*.

FGD and SCR technology can achieve about 90% SO_2 and 80% NOx emissions reductions respectively on retrofitted units similar to CPB. FGD may also help reduce particulates emissions to some extent.

1.5 LOCATION OF PROJECT

The Project will be located within the existing site of the CPPS and will only occupy a small portion of the total area of 62 hectares of CPPS (see *Figures 1.4a* and *1.4b*).

Figure 1.4a

Location of Castle Peak Power Station

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Figure 1.4b

Current layout of Castle Peak Power Station.
“B” Units seen in the foreground with “A” Units seen in the background

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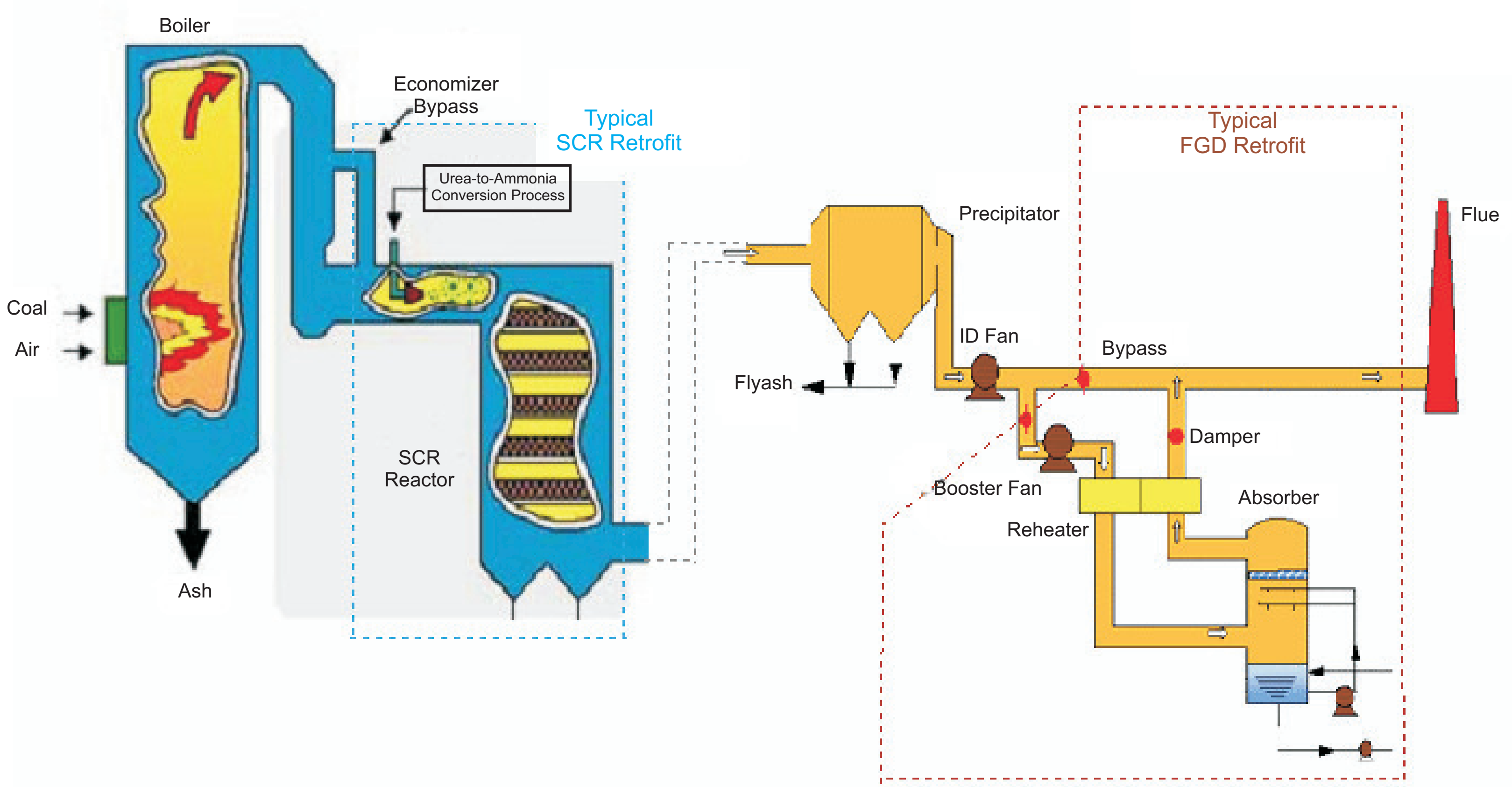

Figure 1.4c

Typical SCR and FGD Retrofit for a Coal-fired Power Station

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1.6 PROJECT DESCRIPTION

This section provides a generic description of the currently envisaged construction and operational activities associated with the Project. It should be noted that the Project is still being designed and the details are subject to final engineering design.

1.6.1 Construction Phase

The construction of the Project will involve installation of new facilities and relocation or demolition of existing facilities in a highly congested site of an operating power station, which provides a significant portion of the overall electricity demand in Hong Kong.

Demolition and Relocation of Certain Existing Facilities

While the existing generating units will remain in their current locations, some of their auxiliary and common facilities to the south of the generating units at CPB may be demolished or relocated to provide space for the FGD, SCR and related facilities. *Figure 1.6a* shows the area where these existing facilities are currently located. It must be emphasized that the extent of demolition / relocation works depends primarily on the layout and design of the new emissions control facilities which will be finalised during the design engineering phase. The following paragraphs aim to provide a description of the preliminary scheme of these demolition / relocation works.

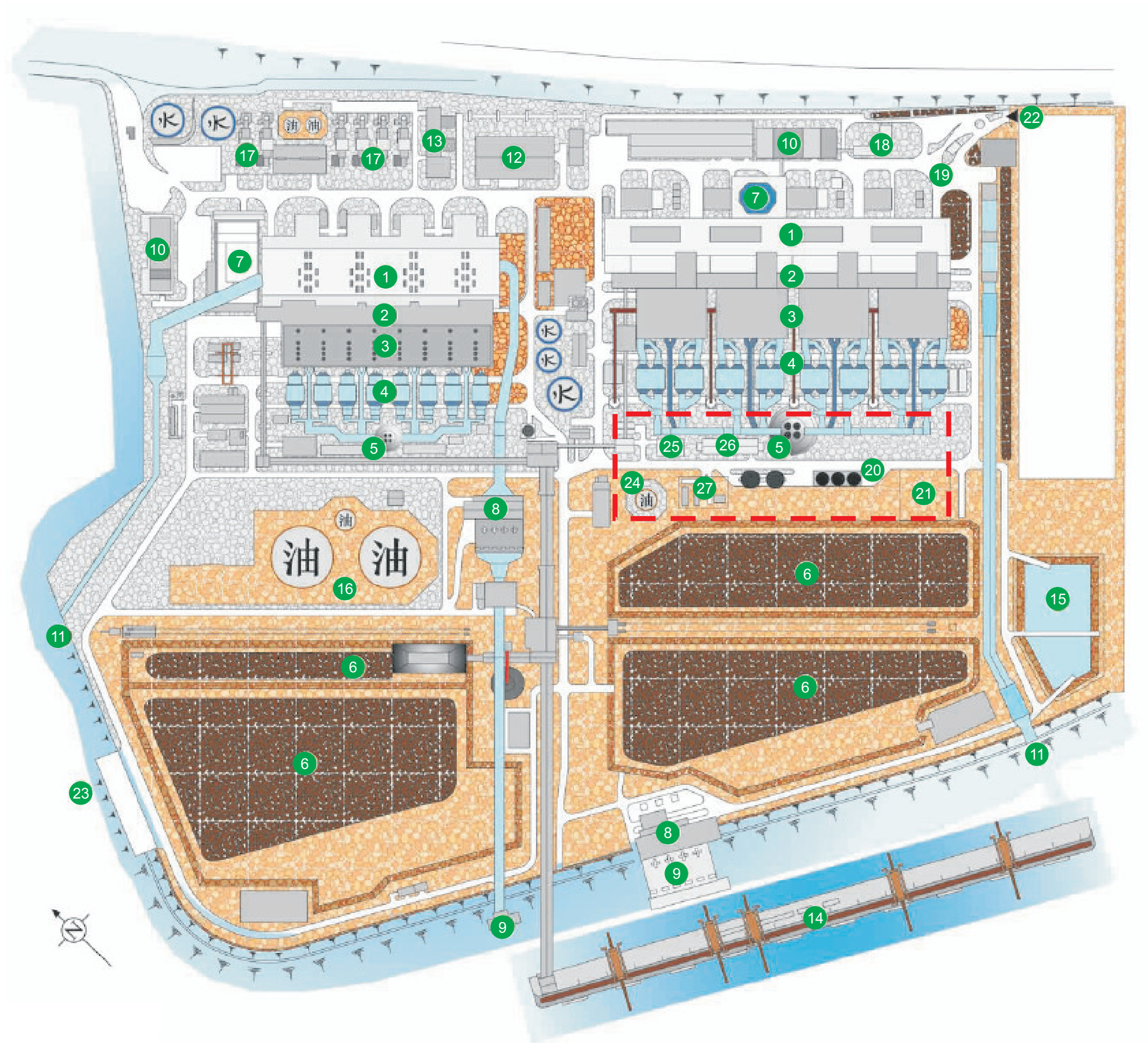
Demolition of CPB Fuel Oil Day Tank

The Fuel Oil Day Tank (FODT) (see Item 24 in *Figure 1.6a*), which has a capacity of 4,680 t, with the associated stairs, piping, instrumentation, junction boxes, heat tracing, cables, etc, located southwest of the CPB generating units will be demolished. The works will involve cutting the fuel oil piping, moving the fuel oil equipment, and demolishing the fuel oil tank and retaining wall.

The existing 1 m thick reinforced concrete foundation under the tank will be left in place. The eight existing 2 m diameter caissons drilled into the bedrock will also remain in place. The portion of the concrete slab between the tank support foundation and the retaining wall will be filled in with concrete.

Demolition of Fuel Oil Pump House

The Fuel Oil Pump House (FOPH) (see Item 25 in *Figure 1.6a*) located to the east of the FODT will be demolished after all equipment within the building is removed. The concrete ground floor, associated pump pads and trenches will remain in place. The trenches and sumps will however be backfilled to create a flush surface for the future emissions control equipment construction work laydown area. All cables will be removed from the trenches before the trenches are backfilled.



Legend :

1. Turbine Hall
渦輪機大堂
2. Coal Bunker Bay
煤倉
3. Boilers
鍋爐
4. Precipitators
除塵器
5. Chimney
煙囪
6. Ready Use Coal Store
備用煤倉
7. Control Block
控制大樓
8. Cooling Water Pump House
冷水泵房
9. Cooling Water Pump Intake
冷水進口
10. Administration Building
行政大樓
11. Cooling Water Outfall
冷水排水口
12. 400kV Substation
400 千伏電力支站
13. 132kV Substation
132 千伏電力支站
14. Coal Jetty
卸煤碼頭
15. Water Collection & Conservation System, On-site Lagoon
集水循環系統, 工地內人工湖
16. Fuel Oil Tank
燃油庫
17. Gas Turbine Area
燃氣輪機機組
18. ElectriCity
電力世界
19. Security Gate House
保安閘樓
20. Ash Classification Plant
煤灰分類廠
21. Intermediate Pressure Reduction Station
中壓減壓站
22. Site Entrance
發電廠入口
23. Heavy Load Berth/Oil Jetty
重負載碼頭 / 燃油碼頭
24. Fuel Oil Day Tank
日用燃油庫
25. Fuel Oil Pump House
燃油泵房
26. Ash Plant Substation / Ash and Dust Control Room
煤灰處理支站 / 煤灰及塵埃控制室
27. Area of DG Store, LPG Storage Tanks and CO_2 Storage Tank
危險品倉庫、液化石油氣缸及二氧化碳缸區

Figure 1.6a

Area (enclosed by red dotted line) where some of the existing auxiliary facilities may be required to be demolished or relocated

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Demolition of Ash Plant Substation, and Ash and Dust Control Room

The existing two-storey building housing both the Ash Plant Substation (APS) in the ground floor and the Ash and Dust Control Room (ADCR) in the upper floor (see Item 26 in *Figure 1.6a*) will be demolished after all equipment within the building is removed. The floor mat and caissons will be retained to support future new emissions control equipment in this area.

Demolition of Dangerous Goods Store

The Dangerous Goods (DG) Store (see Item 27 in *Figure 1.6a*) to the south of the FOPH will be demolished. The ground floor slab and the existing concrete pavement will remain in place. If caissons or concrete piers are required in the area to support the future emissions control equipment, portions of the pavement will be demolished.

Re-routing of Underground Pipeworks

Certain sections of the underground pipeworks of the following systems will be re-routed aboveground:

- Sea Water Flushing;
- Town Water Domestic;
- Town Water Maintenance; and
- Sea Water Fire Main.

The underground trench will be backfilled with soil after re-routing of the pipeworks.

Relocation of CO_2 Storage Tank

The existing 2,626-litre CO_2 storage tank (see Item 27 in *Figure 1.6a*), fill connection and vaporisers will be relocated from their existing locations to the area north of the chemical waste building in an area presently occupied as a scaffolding laydown area. The concrete slab supporting the existing CO_2 Tank will remain in place.

Relocation of the LPG Storage Tanks

The existing two LPG tanks (see Item 27 in *Figure 1.6a*) of capacity 4,600 litres each and the associated equipment will be removed and relocated to the existing foundation and piers east of Eastern Road. The adjacent vapour room and switch room will be demolished but the concrete slab on grade will remain in place.

Relocation of the Intermediate Pressure Reduction Station

The Intermediate Pressure Reduction Station (IPRS) (see Item 21 in *Figure 1.6a*) of the gas transmission system will be relocated to provide space for the installation of the emissions control equipment.

Removal of Oil Interceptors

The oil interceptors, oil receivers and attached pipeworks listed below will be removed to avoid the possibility of oil leakage in future after relocation of all associated equipment:

- Oil Interceptor for FODT bund area;
- Oil Interceptor No. 1 for the APS transformer compound (west end);
- Oil Interceptor No. 2 for the APS transformer compound (east end);
- APS oil sump (which collects oil from both APS transformers);
- Oil Sewer Manhole No. 4034, 4036 & 4038; and
- Foul Water Pumping Station No. 9.

<u>Installation of the New Emissions Control Equipment and Facilities</u>

New facilities to be installed for the Project will include the SCR and FGD equipment, reagent and by-product handling and storage facilities associated with the SCR and FGD operations and additional berthing facilities for the loading and unloading of reagents and by-products. These are described in the following sections.

Installation of SCR and FGD Facilities

The SCR and FGD facilities will be retrofitted to the CPB generating units. The exact footprint of these facilities will be finalized upon design optimisation.

Provision of Reagent and By-product Handling and Storage Facilities

The major reagent and by-product handling facilities for FGD operations will include limestone silos, limestone slurry tanks, gypsum dewatering and storage facilities, and handling and storage facilities for off-specification gypsum. SCR systems will require urea as the ammonia supply reagent, urea storage silos, dissolvers, urea solution storage tanks and urea-to-ammonia reactors will be required.

Provision of Additional Berthing Facilities

The SCR systems could require about 40,000 tonnes per annum (tpa) of urea, while the FGD systems could consume about 150,000 tpa of limestone and generate about 257,000 tpa of gypsum as by-product. The quantities of reagents required and by-product produced will be finalized during the design engineering phase. It is anticipated that a new berthing facility will be needed to cater for the loading and unloading requirements of the additional reagents and by-product.

One of the options for providing additional berthing is to extend the existing Heavy Load Berth to form a multi-purpose wharf, providing a long, straight quay with the potential to accept ships with a wide range of loaded draft requirements.

Alternatively, the existing coal jetty could be extended at its western end to provide the required berthing space.

It is anticipated that the heavy load berth extension will require dredging for the foundations of the jetty and catwalk. The extension of the coal jetty, if this option is selected, would involve piling and related activities.

Table 1.6a summarises the proposed modification works and new installations required for the Project.

Table 1.6a A Summary of the Proposed New Installations, Modifications and Demolition Works Associated with the Emissions Control Project at CPB+

Item	Relevance of EIAO Provisions
Demolition/Decommissioning of Existing CPPS Facilities	
• Demolition of Fuel Oil Day Tank (FODT)	• The demolition of the FODT (4,680 tonnes capacity) will qualify as a Designated Project under Item 16, Part II, Schedule 2 to the *EIAO*.
• Demolition of the Fuel Oil Pump House (FOPH)	
• Demolition of the two-storey building for the Ash Plant Substation (APS) and the Ash and Dust Control Room (ADCR)	
• Demolition of Dangerous Goods (DG) Store to the south of the FOPH.	
• Removal of the oil interceptor for FODT	
• Removal of Oil Interceptor No. 1 for the APS Transformer Compound (west end)	
• Removal of Oil Interceptor No. 2 for the APS Transformer Compound (east end)	
• Removal of APS Oil Sump	
• Removal of Oil Sewer Manhole Nos. 4034, 4036 and 4038	
• Demolition of Foul Water Pumping Station No. 9	
Modification of Existing CPPS Facilities	
• Extension of the existing Heavy Load Berth to form a long dedicated multi-purpose wharf or extension of the existing Coal Jetty at its western end	• The extension of the existing berthing facilities may involve dredging operations at a distance of less than 100m from a seawater intake, which would qualify as a Designated Project under Item C.12 of Section C, Part I, Schedule 2 to the *EIAO*.
• Re-routing of certain sections of the existing underground water pipework system to aboveground	
• Relocation of the existing CO_2 Storage Tank with fill connection and vaporisers to an area north of the Chemical Waste Building	
• Relocation of the existing Liquefied Petroleum Gas (LPG) Storage Tanks and Intermediate Pressure Reduction Station (IPRS)	
New Installations	
• FGD and SCR equipment for the generating units at CPB	• The operation of the new installations will introduce changes in the types and quantities of waste and effluents, which may constitute a Material Change under the *EIAO*.

Item	Relevance of EIAO Provisions
• Limestone silos, limestone slurry tanks, gypsum dewatering and storage facilities for FGD operations	• The facilities required to handle the off-specification gypsum, gypsum from FGD commissioning and any surplus gypsum requiring temporary storage or disposal may likely qualify as a Designated Project under Item G.6 of Section G, Part I, Schedule 2 to the *EIAO*.
• Urea storage silos, dissolvers, urea solution storage tanks and urea-to-ammonia reactors for SCR operations	• The facilities required for the storage of urea for the SCR operations would likely qualify as a Designated Project under Item K.6 of Section K, Part I, Schedule 2 to the *EIAO*.

+ The Project is still being designed and the details are subject to final engineering design.

1.6.2 *Operational Phase*

The schematics of the emissions control systems have been presented in *Figure 1.4c*. The operations involved in the control of emissions from CPB are summarised in the following sections:

Selective Catalytic Reduction Process

The selective catalytic reduction (SCR) process reduces NO_x emissions by injecting a nitrogen-based chemical reagent in the form of ammonia (NH_3) spray into the flue gas upstream of the SCR catalyst. An urea-to-ammonia conversion process will be used to avoid the hazards of bulk ammonia storage or handling on-site. In such a conversion process, urea is converted to ammonia vapour by either thermal decomposition or hydrolysis.

The ammonia selectively reacts with nitrogen oxides (NO_x) in the presence of an SCR solid catalyst to form nitrogen (N_2) and water vapour (H_2O). The presence of a catalyst accelerates and improves the efficiency of the above chemical reactions. On the catalyst surface, the ammonia reacts with NO_x primarily as follows:

$4\ NO + 4\ NH_3 + O_2 \rightarrow 4\ N_2 + 6\ H_2O$
$NO + NO_2 + 2\ NH_3 \rightarrow 2\ N_2 + 3\ H_2O$
$6\ NO_2 + 8\ NH_3 \rightarrow 7\ N_2 + 12\ H_2O$
$2\ NO_2 + 4\ NH_3 + O_2 \rightarrow 3\ N_2 + 6\ H_2O$

As indicated above, the reactions are essentially the reduction (or the removal of the oxygen from a chemical compound) of various nitrogen oxides in the flue gas to nitrogen gas (N_2). The oxygen removed from the nitrogen oxides combines with hydrogen to form water (H_2O). The products of the reactions, nitrogen gas (N_2) and water (H_2O), are innocuous and exist naturally in the atmosphere in large quantities. In other words, ammonia is added to remove nitrogen oxides in the flue gas, as a result producing nitrogen gas and water that are harmless and natural substances. There are no other reaction products except spent catalysts requiring disposal. A minute amount of un-reacted ammonia may be present in the flue gas, but reaction conditions will be optimised to result in negligible ammonia left (usually in the order of a couple of part-per-million (ppm) of gas volume).

Limestone Flue Gas Desulphurisation (LS FGD) Process

In a LS FGD system, the flue gas enters a large vessel (usually known as the 'absorber'), where it is sprayed with or bubbles through limestone slurry in the absorber. The calcium carbonate ($CaCO_3$) from limestone in the slurry reacts with the sulphur dioxide (SO_2) in the flue gas to form calcium sulphite ($CaSO_3$). The calcium sulphite initially formed in the absorber is nearly 100% oxidised to form gypsum ($CaSO_4$, calcium sulphate) by the provision of oxidation air into the sulphite slurry in a separate vessel, or in-situ, depending on the technology design.

The overall LS FGD chemical reactions, involving SO_2 removal, are as follows:

$SO_2 + H_2O \rightarrow H_2SO_3$ (absorption)
$CaCO_3 + H_2SO_3 \rightarrow CaSO_3 + CO_2 + H_2O$ (neutralisation)
$CaSO_3 + H_2SO_3 \rightarrow Ca(HSO_3)_2$ (bisulphite formation, pH control)

$CaSO_3 + ½ O_2$ →	$CaSO_4$	(forced/natural oxidisation)
$CaSO_3 + ½ H_2O$ →	$CaSO_3. ½ H_2O$	(crystallisation of solids)
$CaSO_4 + 2 H_2O$ →	$CaSO_4. 2H_2O$	(crystallisation of solids)

In other words, limestone slurry is added to remove sulphur dioxide, resulting in the production of gypsum.

1.7 *PROPOSED PROJECT PROGRAMME*

The preliminary engineering design for the Project has commenced. Indicative project milestones include the following:

Key Stage of the Project	**Indicative Date**(1)
Commencement of front-end engineering design	2005
Submission of Project Profile for EIA	Q3 2005
Issue of Environmental Permit	Q3 2006
Finalization of other permitting requirements	2006
Commence relocation of existing facilities	2006
Award of major contracts	2007
Commencement of retrofit site work	End 2007
Start-up of 1st Unit	End 2009
Start-up of 2nd Unit	End 2010
Start-up of 3rd Unit	Early 2011
Start-up of 4th Unit	End 2011

(1) A key objective of the front-end engineering design is to review and optimise the current schedule which may result in changes to the timing of key milestones. Efforts are underway to reduce the overall duration of this project but feasibility at this point is uncertain.

2 *MAJOR ELEMENTS OF THE SURROUNDING ENVIRONMENT*

The Project will be implemented within the boundaries of the existing CPPS, which is zoned "Other Specified Uses" annotated "Power Station" on the approved Tuen Mun Outline Zoning Plan (OZP) No. S/TM/20. The land-uses immediately adjacent to the CPPS are mainly industrial in nature. The restored Siu Lang Shui (SLS) Landfill lies to the north-east of the CPPS. The restored SLS Landfill is currently zoned "Green Belt" on the approved OZP.

The locations of adjacent Air Sensitive Receivers are shown in *Figure 2.1a*.

The closest residential uses are the villages north of the CPPS approximately 750 m away. These villages are unlikely to be affected by construction noise due to the separation distance.

The CPPS is also located with the North Western Water Control Zone (NWWCZ) and fronts the marine waters of the Urmston Road on its south-western and western boundaries. Water quality sensitive receivers in the vicinity of the CPPS are identified as follows:

- *Gazetted Bathing Beaches*: Butterfly Beach and the Tuen Mun Beaches (Castle Peak, Kadoorie, Cafeteria Old, Cafeteria New and Golden);
- *Non-Gazetted Bathing Beaches*: Lung Kwu Upper and Lung Kwu Lower;
- *Water Intakes*: Tuen Mun Flushing Water Intake, Area 38 Industries Intake, CPPS Intake and Black Point Power Station Intake; and
- *Area of Ecological Value*: Sha Chau and Lung Kwu Chau Marine Park and the Sha Chau and Lung Kwu Chau Artificial Reef, which is within the boundaries of the Marine Park.

The locations of the above water quality sensitive receivers are shown in *Figure 2.1b*.

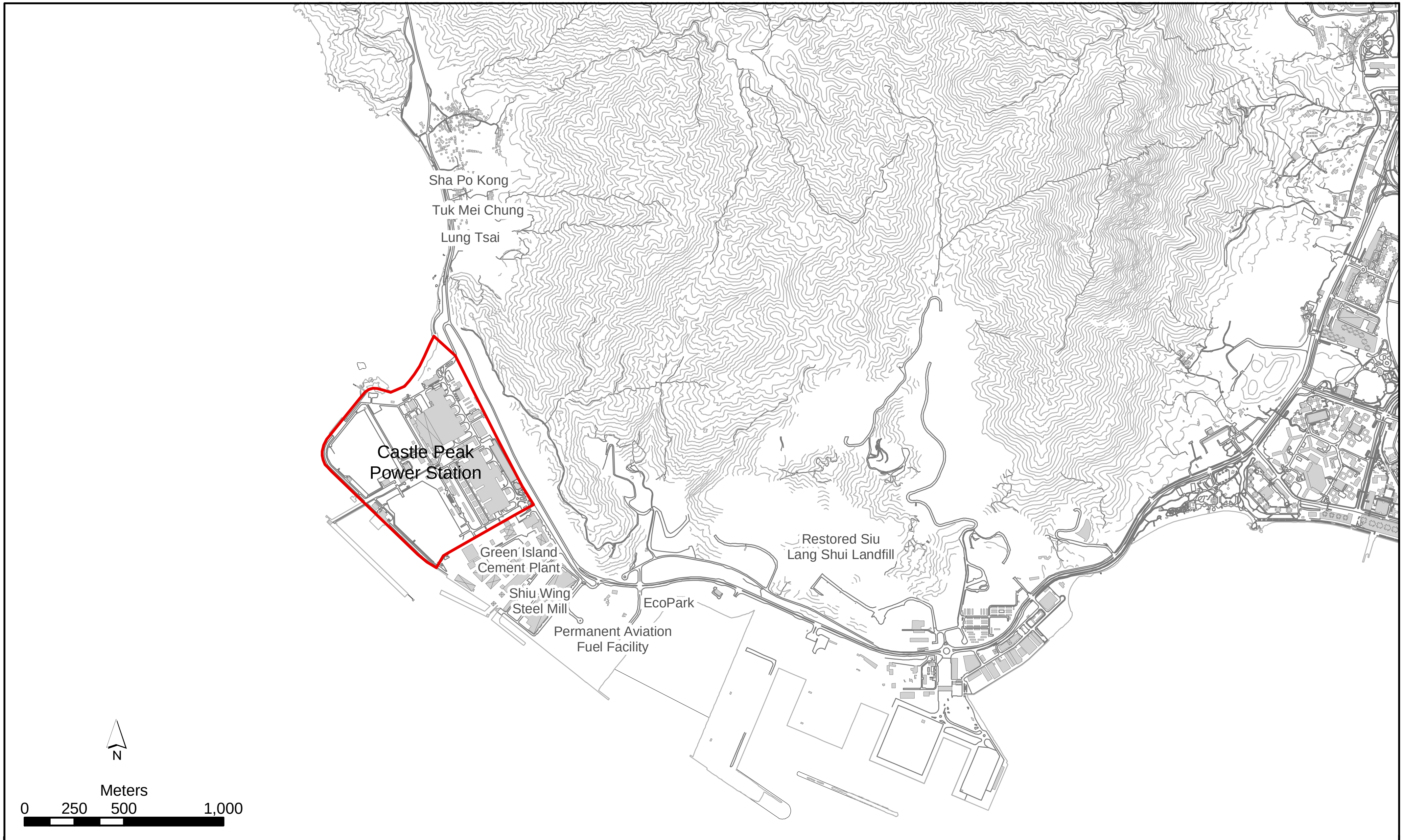

Figure 2.1a

Location of Air and Noise Sensitive Receivers

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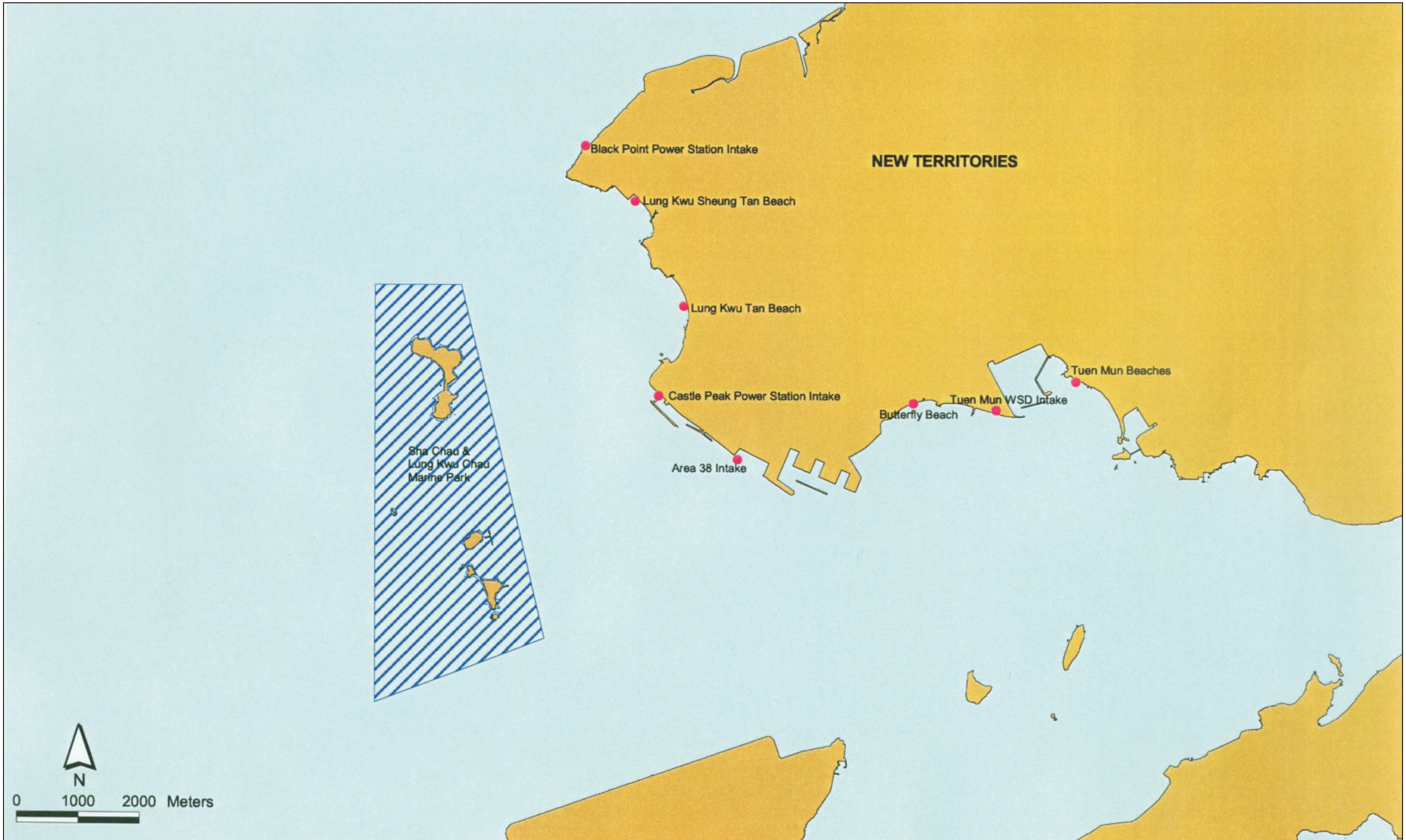

Figure 2.1b

Location of Water Quality Sensitive Receivers

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3 POSSIBLE IMPACT ON THE ENVIRONMENT

The construction and operation of the Project may give rise to potential environmental impacts. These potential impacts are identified in *Table 3.1a* and addressed in the following sections.

Table 3.1a Potential Environmental Impacts Arising from the Emissions Control Project at Castle Peak Power Station "B" Units

Potential Impact	Construction	Operation
• Gaseous Emissions	✓	✓
• Dust	✓	--
• Odour	--	--
• Noise	✓	✓
• Night-time Operations	✓	✓
• Traffic (Land & Marine)	✓ **(marine only)**	✓ **(marine only)**
• Liquid Effluents, Discharges or Contaminated Runoff	✓	✓
• Generation of Waste or By-products	✓	✓
• Manufacturing, Storage, Use, Handling, Transport, or Disposal of Dangerous Goods	--	--
• Hazard to Life in case of Spillage	--	--
• Landfill Gas Hazard	--	--
• Disposal of Spoil Material, including potentially Contaminated Materials	--	--
• Disruption of Water Movement or Bottom Sediment	--	--
• Unsightly Visual Appearance	--	--
• Cultural & Heritage	--	--
• Terrestrial Ecology	--	--
• Marine Ecology	--	--
• Cumulative Impacts	--	--

Legend:
✓ = Possible **'–'** = Not Expected

3.1 CONSTRUCTION PHASE

3.1.1 *Air Quality*

The construction of the new facilities will not require major site formation and the structures to be demolished or built are mostly of metal construction, with the only concrete structures being floor slabs and culverts, and therefore no adverse air quality impacts are expected, provided that the general dust suppression measures stipulated under the *Air Pollution Control (Construction Dust) Regulation* are adhered to where applicable.

3.1.2 *Noise*

The demolition and construction works for the Project will involve the use of Powered Mechanical Equipment (PME), which have the potential to cause elevated noise levels. The works are also not expected to require extensive concrete breaking activities. As indicated in *Section 2*, the closest Noise Sensitive Receivers (NSRs), Lung Tsai, Tuk Mei Chung and Sha Po Kong Villages, are at a relatively long distance of approximately 750 m away. Adverse construction noise impacts are therefore not envisaged.

3.1.3 *Water Quality*

Adjacent water quality sensitive receivers are indicated in *Section 2*. No major site formation is expected and pre-fabricated metal structures will be encouraged. With the implementation of good site practice, no water quality impacts from the land-based construction works of the Project are expected.

The construction of additional berthing facilities will require dredging of the seabed and placing of rubble foundations, which may have the potential to increase turbidity in the immediately surrounding marine water body. However, the effects on water quality are expected to be minimal because of the small scale of the works involved and the transient nature of the activities.

It is expected that the marine sediments to be removed for the construction of the berthing facilities are uncontaminated. With appropriate mitigation measures, including the use of silt curtain to contain the sediment losses and proper disposal of the dredged materials, no adverse impacts on water quality arising from the dredging works and from the construction of the berthing facilities are expected.

3.1.4 *Waste Management*

The construction and demolition activities associated with the Project will result in the following broad categories of waste:

- construction and demolition (C&D) materials, mainly from the demolition of existing facilities and comprising concrete and steel;
- chemical waste, such as batteries and lubricating oils from the maintenance of construction vehicles and equipment; and
- general refuse, including food waste from the on-site work force and the packaging from the construction materials.

It is expected that C&D materials generated from the construction works will be properly segregated and scrap metals will be recovered for recycling. The amount of C&D waste requiring disposal at landfills and the associated potential impacts will be minimised.

The construction activities of the Project are not expected to generate significant quantities of chemical waste and therefore minimal or no impact is expected in this respect. With proper housekeeping measures and refuse collection in place, minimal or no impact is expected to result from refuse generated during the construction phase of the Project.

Although the existing Fuel Oil Day Tank, Fuel Oil Pump House and the associated piping may be demolished and/or relocated, their concrete foundations are expected to remain in place and the area will continue to be used by CAPCO. In addition, we are not aware of any spillage in the history of the operation of these facilities. No land contamination issues are therefore envisaged to arise from the demolition of these facilities.

3.2 *OPERATIONAL PHASE*

The main objective of the Project is to reduce atmospheric emissions of key pollutants (principally NO_x and SO_2), i.e. achieve improvement in the emissions performance of CPB. However, certain aspects of the operations of the Project may impact water quality and waste management. In addition, lower stack plume rise height may affect air quality in some areas under certain meteorological conditions. Reduced NO_x emissions may also have a potential to give rise to increased levels of ozone in some areas. These potential operational phase impacts are further discussed in the following sections.

3.2.1 *Air Quality*

Effects of Lower Plume Rise

The FGD process will reduce the flue gas temperature and exit velocity. This would lower the final plume rise, causing the plume to touch ground closer to the source and in a potentially less dispersed state. However, according to our preliminary modelling assessment, the magnitude of any concentration increases due to the lower plume rise is expected to be low.

Effect on Ozone Concentrations

Nitrogen oxides are important ozone precursors and any reductions in NO_x emissions are in general considered beneficial to regional ozone pollution. The nitrogen oxides - volatile organic compounds - ozone (NO_x – VOC – O_3) photochemistry is complex. However, according to our preliminary modelling assessment, exceedance of the Air Quality Objective (AQO) for ozone is not expected as a result of this effect. In the remote areas, where ozone concentrations are normally higher, the NO_x emissions reduction by the SCR systems of the Project would result in a decrease of ozone levels.

Ammonia Slip

The operation of the SCR systems may result in a phenomenon known as "ammonia slip", i.e. a minute amount of unreacted ammonia making its way to the flue gas.

For typical SCR systems in a coal-fired power station, the ammonia slip is kept in a range of a couple of ppm. At these concentrations, the potential ammonia emissions from the Project would be negligible in comparison with the total HKSAR ammonia emissions, which have been estimated at over 12,000 t yr^{-1} (1). As a result, the ammonia slip from the SCR systems of the Project is not expected to cause any deterioration in air quality. With a commonly accepted odour threshold of ammonia at 46.8 ppm(2), potential odour impacts from ammonia gas are not expected.

3.2.2 *Water Quality*

Under normal circumstances, the SCR process will not generate any effluent and no water quality impact is expected from the process.

In the FGD process, the flue gas is passed through absorbers that contain a slurry of ground limestone in fresh water. The SO_2 is removed by reacting with the limestone (calcium carbonate) to form calcium sulphite. The slurry is then aerated to oxidise the calcium sulphite to form gypsum (calcium sulphate). The resulting gypsum slurry is then treated, resulting in dewatered gypsum and a small quantity of liquid effluent.

The treated effluent from the FGD process may have a small chemical oxygen demand (COD) and/or reduced dissolved oxygen (DO) concentrations. A minute residual portion of the ash in the flue gas will likely be entrained within the limestone slurry and retained in the treated effluent.

The treated effluent will be added to the cooling water flows and discharged via the cooling water outfall of CPB, resulting in a small increase in the total flows from the outfall. The treated effluent is not expected to increase the temperature or the residual chlorine levels of the cooling water discharge.

3.2.3 *Waste Management*

SCR Process

For the SCR process, solid or liquid reaction products are not expected.

Spent catalyst is the only SCR waste category requiring special consideration. Different types of SCR catalyst are available in the market. The catalyst active surface is typically metal, ceramic or fibre reinforced. The most common catalyst body configurations are the honeycomb, plate and corrugated types. For a 3-year lifecycle for the catalyst management, the estimated average annual quantity of catalyst to be replaced ranges from 35 to 100 m^3 per SCR reactor per year as suggested by potential suppliers. The actual amount in a given year may be lower or

(1) CH2M HILL (China) Ltd (2002) **Final Report, Agreement No CE 106/94, Study of Air Quality in the Pearl River Delta Region**, *Appendix 3*

(2) Leonardos, G, Kendall, D and Barnard, N (1969) **Odor Threshold Determinations of 53 Odorant Chemicals** J. Air Poll. Control Ass., 19(2), 91-5

higher than this range, depending on the actual catalyst, conditions and operation regime.

Based on current technological development and regulatory requirements, there are potentially 3 possible approaches to the management of spent catalysts: disposal within Hong Kong, on-site catalyst rejuvenation and off-site recycling/regeneration. Since the technology of rejuvenation and recycling of spent catalyst is being developed, the disposal of the spent catalyst in Hong Kong will be the base case. These schemes are described in more detail in the following paragraphs.

Disposal in Hong Kong

The spent catalyst can be disposed of at the Chemical Wastes Treatment Centre (CWTC) or at the South East New Territories (SENT) Landfill after stabilisation. In general, the potential environmental impacts associated with the handling and disposal of solid wastes to be generated from the SCR process on the existing and future waste management facilities in Hong Kong will be minimal.

On-site Catalyst Rejuvenation

Some catalyst suppliers are now undertaking trial and pilot tests of on-site rejuvenation to recover the activity level of the catalyst after prolonged use in the SCR reactor. The technical viability of such a scheme, including the potential secondary environmental impacts associated with the scheme (if any,) needs to be assessed in the detailed design stage of the SCR system.

Off-site Recycling/Regeneration

It is possible that the spent catalyst could be sent back to the supplier for recycling. In such a case, it will be temporarily stored at the CPB prior to shipment to the supplier. As the spent catalyst will be classified as chemical waste under the *Waste Disposal (Chemical Waste) (General) Regulation* (refers to Schedule 1 ("Substances and Chemicals") to the *Regulation*), it will be labelled and stored in accordance with the requirements of the *Code of Practice on Packaging, Labelling and Storage of Chemical Wastes* published by the EPD.

The transportation of the spent catalyst within the HKSAR will be carried out by a collector licensed to collect chemical waste. It is anticipated that the suppliers of the catalyst are located outside Hong Kong. The spent catalyst would therefore be exported from Hong Kong to the overseas suppliers. This operation may require a permit to export under the *Waste Disposal Ordinance*. This ties in with the requirements of the *Basel Convention on Control of Transboundary Movements of Hazardous Waste and their Disposal*. Based on typical chemical composition of the SCR catalyst, the spent catalyst will be classified either as GC052 (Spent catalysts: precious metal bearing catalyst) or GC053 (Spent catalysts: transition metal catalysts) in the Schedule 6 to the *Waste Disposal Ordinance* (waste import into or export from Hong Kong for which permit is required). However, as the spent catalyst will be exported for the purpose of reprocessing/ recycling, such export should not require an export permit from the EPD since metal oxides attached to the catalyst are non friable and have low risk to workers who handle the catalyst.

LS FGD Process

Two principal types of by-product or waste will be generated from this system. They are the gypsum and the sludge from the treatment of the FGD wastewater. Gypsum is a non-hazardous and non-toxic substance. It is produced in the form of fine, white, crystalline powder consisting predominantly of calcium sulphate. The quantity of gypsum generated will depend on a number of factors including the sulphur content of the fuel used and the operational profile of CPB.

Gypsum slurry is produced from the FGD scrubber; it needs to be dewatered to produce a cake-like product so that it can easily be handled and transported. The limestone FGD system being considered for CPB will produce commercial grade gypsum as a by-product. We expect to generate about 240,000 tonnes per annum (tpa) of gypsum. As mentioned earlier in Section 1.6, the quantity of gypsum production will be finalized in the design engineering phase. Due to operational reasons (ie during start-up and shut-down of plant), a small amount (about 17,000 tpa or 6.6% of the total) of off-specification gypsum may be generated. CAPCO plans to enter into a commercial agreement(s) with major plasterboard/cement producers for the reuse of both the high quality and off-spec gypsum. However, provision for temporary buffer storage within CAPCO facilities will be required to allow for operational contingencies.

Gypsum is included in Schedule 6 to the *Waste Disposal Ordinance*. As the gypsum is uncontaminated and will be exported for reuse, the export operation will not require an export permit under the *Waste Disposal Ordinance*.

FGD operation involves a stream of process discharge known as chloride purge stream (CPS). The purpose of the CPS is to reduce the concentration of total dissolved solids and fine-sized suspended solids in the absorber vessels. The process involves soluble chlorides and no chlorine gas would be generated. The CPS will be treated in a chloride purge effluent treatment system to remove the suspended solids and trace elements, reduce the residual COD and adjust the pH before it is discharged with the cooling water of the CPB to Urmston Road. About 60 tonnes per day (tpd) of sludge dry solids will be generated from the chloride purge treatment system. Typical composition of the sludge is presented in *Table 3.2a*.

Table 3.2a ***Typical Chemical Composition of Sludge from Chloride Purge Effluent Treatment System***

Component	**Content**
Calcium sulphate	40%
Calcium sulphite	1%
Calcium carbonate	4%
Inerts	20%
Fly ash	5%
Others	30%

The stabilised sludge (e.g., stabilised with cement or other media), fulfilling the acceptance criteria for disposal at landfills, could be disposed of at the strategic landfills. With respect to the chemical composition of the sludge, it will not cause adverse environmental impacts if it is disposed of at designated landfills. From a technical perspective, the chemical composition of the sludge may also allow it, with the agreement of Lands Department, to be disposed of at the CAPCO Ash Lagoons. However, disposal of the sludge would have to be at a designated area of the Ash Lagoons so that it will not affect the reuse potential of the lagooned PFA.

3.2.4 Storage and Handling of Dangerous Goods

For the SCR and FGD processes, it is not anticipated that dangerous goods would be used in substantial quantities. The ammonia vapour converted from urea under the current Project design is only an intermediate reagent for the SCR process and no bulk storage or handling is required. Therefore, there should not be concern with regard to the *Dangerous Goods Ordinance* (DGO). The storage and handling of dangerous goods will have to comply with the requirements of the DGO and its subsidiary legislation.

3.2.5 Marine Traffic

The SCR systems could use about 40,000 tpa of urea, while the FGD systems could consume 150,000 tpa of limestone and generate about 257,000 tpa of gypsum. As mentioned earlier in Section 1.6, the quantities of reagents required and by-product produced will be finalized during the design engineering phase. These materials would likely be transported by sea and result in additional marine vessel movements. The potential marine traffic impact is currently envisaged to amount to only a few additional marine vessels per week. This will be reviewed with reference to the actual sizes of vessels to be used for the transportation of each type of materials.

With the adoption of marine transportation for emissions control process reagents and by-products, no significant increase in vehicular traffic on the adjacent road network is expected as a result of the SCR and FGD operations.

4 DESCRIPTIONS OF MITIGATION MEASURES

4.1 CONSTRUCTION PHASE

4.1.1 Air Quality

The following mitigation measures stipulated in *the Air Pollution Control (Construction Dust) Regulation* are proposed to be incorporated in the Contract Specifications for the construction activities and implemented to minimise dust nuisance:

Measures for General Construction Activities

- where a site boundary adjoins a road, street, service lane or other area accessible to the public, hoarding of not less than 2.4 m high from ground level shall be provided along the entire length of that portion of the site boundary except for a site entrance or exit;
- every main haul road shall be sprayed with water or a dust suppression chemical so as to maintain the entire road surface wet;
- the portion of any road leading only to a construction site that is within 30 m of a discernible or designated vehicle entrance or exit shall be kept clear of dusty materials;
- exposed earth shall be properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with latex, vinyl, bitumen or other suitable surface stabilizer within 6 months after the last construction activity on the construction site;
- any stockpile of dusty material shall be covered entirely by impervious sheeting or sprayed with water or a dust suppression chemical so as to maintain the entire surface wet;
- all dusty materials shall be sprayed with water or a dust suppression chemical immediately prior to any loading, unloading or transfer operation so as to maintain the dusty materials wet;
- where a vehicle leaving the works site is carrying a load of dusty materials, the load shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle; and
- the working area of any excavation or earth moving operation shall be sprayed with water or a dust suppression chemical immediately after the operation so as to maintain the entire surface wet.

Measures for Demolition of Buildings

- the area at which demolition work takes place should be sprayed with water immediately prior to, during and immediately after the demolition activities so as to keep the entire surface wet;
- for any wall of the building to be demolished that abuts or fronts upon a street, service lane or other open area accessible to the public, impervious dust screens or sheeting should be used to enclose the whole wall to a height of at least 1m higher than the highest level of the structure being demolished;
- any dusty materials remaining after a stockpile is removed should be wetted with water and cleared from the surface of roads or streets; and
- all demolished items that may dislodge dust particles should be covered entirely by impervious sheeting or placed in an area sheltered on the top and the 3 sides within a day of demolition.

4.1.2 Noise

The following construction noise management measures are proposed for the construction and demolition works:

- only well-maintained equipment should be operated on-site and equipment should be serviced regularly during the demolition works;
- machines and equipment that are in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- silencers or mufflers on demolition equipment should be utilised and should be properly maintained during the demolition; and
- where necessary, mobile noise barriers should be positioned within a few metres of noisy plant items.

4.1.3 Water Quality

It is important that appropriate measures are implemented in the construction and demolition works to control run-off and drainage and, thereby, minimise suspended solids (SS) from entering the North Western Water Control Zone (NWWCZ) and causing impacts on the identified sensitive receivers. Proper site management is proposed to minimise surface water run-off, soil erosion and the impacts of sewage effluents.

Site run-off and drainage impacts will be prevented in accordance with the guidelines stipulated in the EPD's Professional Persons Environmental Consultative Committee Practice Note for Professional Persons, *Construction Site Drainage* (ProPECC PN 1/94). The implementation of good housekeeping and stormwater best management practices will ensure that Water Pollution Control Ordinance

(WPCO) standards are met and that no unacceptable impacts on the Water Sensitive Receivers (WSRs) arise due to the demolition works.

Silt curtains will be installed to limit the dispersion of SS during dredging and underwater filling works. The release of SS to the water column will be controlled by the maximum production rate to be specified in the Contract for dredging work.

A detailed programme for sampling and testing the dredged mud will be prepared and implemented to determine whether the mud is contaminated in accordance with *Environment, Transport and Works Bureau Technical Circular* (ETWB TC) *No. 34/2002* on *Management of Dredged/Excavated Sediment*.

4.1.4 Waste Management

The Contractors of the Project will be required to incorporate recommendations on waste recycling, storage, transportation and disposal measures into a comprehensive on-site waste management plan. Such a waste management plan should incorporate site-specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials.

In the waste management plan to be prepared, the hierarchy presented below will be used to evaluate waste management options, thus allowing maximum waste reduction and often reducing costs:

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

Only limited quantities of construction and demolition waste are expected to arise from the construction of the Project, of which only a small portion would require disposal at landfills. To further minimise waste arising and keep environmental impacts within acceptable levels, careful design, planning and good site management practice will be adopted to minimise waste generated and waste on-site will be properly segregated to increase the feasibility of recycling certain components of the waste streams, such as steel.

Chemical waste generated during the construction of the Project will be properly stored in accordance with EPD's *Code of Practice on the Packaging, Labelling and Storage of Chemical Waste* before collection for disposal by a licensed Chemical Waste Collector. General refuse generated on-site will be stored in enclosed bins and collected by the existing CPPS waste collector on a daily basis.

4.2 *OPERATIONAL PHASE*

4.2.1 *Air Quality*

Ammonia slip in the flue gas is a feature of all SCR systems. However, the level of the slip can be controlled below a couple of ppm by properly setting the operating conditions of the SCR process, with reference to the actual properties of the coal and the SCR reagents used. Relevant specifications to ensure the above system performance with respect to ammonia slip will be included in the tender conditions during the tendering of the Project.

According to results of our preliminary modelling assessment, effects of lower plume rise and possible increases of ozone concentrations in certain areas will be small, if any, and therefore specific mitigation measures are not considered necessary.

4.2.2 *Water Quality*

Water quality impacts of the different vendor-specific FGD designs will be carefully reviewed and assessed during procurement of the FGD equipment. Apart from the water quality management measures inherent to the specific FGD system selected for the Project, no special measures are expected to be required for the protection of water quality during the operational phase.

4.2.3 *Waste Management*

It is expected that no additional measures for waste and by-product management, other than the considerations discussed in *Section 3.2.3*, will be required.

4.2.4 *Storage and Handling of Dangerous Goods*

With the compliance of all DGO requirements, no additional measures are expected to be required for the storage and handling of any dangerous goods, if used.

4.2.5 *Traffic*

The additional marine traffic generated from the transportation of reagents and by-product is considered to be negligible and therefore no mitigation measure required.

4.3 *SUMMARY OF IMPACTS AND MITIGATION MEASURES*

The proposed emissions control project at the Castle Peak Power Station "B" Units will provide important net environmental benefits through large reductions in SO_2 and NOx emissions. In addition, FGD may also help reduce particulates emissions to some extent.

During the construction phase of the Project, as discussed in *Sections 3.1* and *4.1*, no adverse environmental impact with respect to air quality, noise, water quality and waste management is envisaged. The implementation of sound construction practice(s) and mitigation measure(s) as described earlier are envisaged to be sufficient to manage these issues.

During the operational phase of the Project, no adverse environmental impact is expected. The ammonia slip associated with SCR process will be addressed by appropriate and proven methods to control the level of the slip to below a couple of ppm which is significantly below odour level. The water quality management measures required for the FGD process will also be further assessed for appropriate treatment and further mitigation if required. The spent catalyst from the SCR process can be disposed of in Hong Kong with minimal environmental impacts while the technical viability of alternative on-site rejuvenation or off-site recycling/regeneration will also be investigated. The main outlets for commercial grade and off-specification gypsum by-products will be plasterboard and cement works through commercial agreement(s) with major off-takers in the region . Finally, stabilised CPS sludge could be disposed of at one of strategic landfills or the CAPCO ash lagoons without causing adverse environmental impacts.

5 USE OF PREVIOUSLY APPROVED EIA REPORTS

The CPPS is an exempted Designated Project and there are no previously approved EIA reports for the existing CPPS. However a reference can be made to the approved study (ref EIA-012/BC) entitled "Environmental Impact Assessment of Units L7 and L8 Lamma Power Station" which assessed the impacts of a similar LS FGD system to be operated by HEC (at the time of the study).