

Eco-planning of Integrated Waste Management Facilities

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Abstract

A modern 'Integrated Waste Treatment Facilities' (IWMF) has been proposed for municipal solid waste management in Hong Kong. The first phase has an incineration capacity of 3,000 tonnes per day, with renewable energy generated sufficient for electricity supply to over 100,000 households. There have been key concerns from the public, eg. NIMBY; impacts of air emissions from incineration on human health; and impacts on water and ecological resources. This paper highlights the ecological and environmental planning and design of the facilities based on impact assessment, providing objective and scientific inputs to the public engagement process and implementation of the IWMF project.

Introduction

A comprehensive Engineering Investigation and Environmental Impact Assessment (EIA) Studies for Integrated Waste Treatment Facilities (IWMF) Phase 1 – Feasibility Study was commissioned by the Environmental Protection Department of Hong Kong (HK) in 2008. The Development of the IWMF Phase 1 - EIA Report was approved in January 2012 under the EIA Ordinance.

Taking into account the EIA Report results, other factors relating to site selection and HK's overall waste management strategy as a whole, the HK Government has identified an artificial island near the Shek Kwu Chau (SKC) island as the preferred site for developing the first modern IWMF in Hong Kong, with incineration capacity of 3,000 tonnes per day and renewable energy generation. This paper presents the ecological and environmental planning and design of the facilities through the EIA process, focusing on the SKC artificial island site.

IWMF EIA

IWMF is one of the comprehensive waste management measures set out in the "Policy Framework for the Management of Municipal Solid Waste (2005-2014)". The Government plans to develop the IWMF with incineration as the core technology to achieve substantial bulk reduction of unavoidable waste and to recover energy in the treatment process for gainful uses. Following a comprehensive site search and EIA studies, the first modern IWMF in HK is planned to be constructed at a preferred artificial island site, SKC.

The project is to construct and operate a modern IWMF for managing municipal solid waste (MSW) under a design-build-operate (DBO) contract arrangement. The IWMF comprises: (a) an advanced thermal incineration plant with design capacity of 3,000 tonnes per day (tpd), and (b) a mechanical sorting and recycling plant with design capacity of 200 tpd. The non-recyclables sorted from the mechanical plant will be sent to the thermal incineration plant for further treatment.

Potential cumulative impacts from the IWMF Project and other developments, covering noise, air, human health, water, waste, ecology, landscape and cultural heritage were assessed in the EIA studies, in accordance with the EIA Ordinance and the Technical Memorandum on EIA Process. The EIA has proposed appropriate mitigation measures to ensure that the impact on the environment can be alleviated to an acceptable level, and recommended environmental monitoring and audit programmes to ensure the effectiveness of various mitigation measures.

The IWMF EIA Report has concluded that with the adoption of the recommended environmental and

ecological planning and design measures, the project would be environmentally acceptable. Some of these key measures are highlighted below.

Eco-Planning Measures

Project Planning and Site Selection

A comprehensive site search exercise was conducted to identify potential sites for the development of the IWMF. Exclusion areas were identified, such as conservation, coastal protection, residential and major tourism development areas. An initial list of 21 sites was generated and shortlisted to 8 sites for further evaluation, based on a number of criteria under 5 main categories: environmental, engineering/technical, social, economics, consumer & user. Two potential sites were identified, namely a site at Tsang Tsui Ash Lagoons and the SKC island site (to be reclaimed). More detailed EIA studies of these two potential sites concluded no unacceptable environmental impacts.

Developing the first modern IWMF at the SKC site on an artificial island has been selected, despite the relatively longer construction period and a higher capital cost, given the following considerations:

- Central location and significantly shorter distances of MSW transportation - more environmental and cost effective.
- SKC's location is even more remote and farther from major population clusters, and there are no other air emissions sources within 10 km of the SKC site
- Selection of the IWMF site at SKC will achieve a well-balanced spatial distribution for waste management facilities for HK as a whole.
- This would further minimize potential impact on air quality, and reduce greenhouse gas emissions. The reclamation works will absorb about 4.6 million tonnes of construction waste, which would otherwise use up space at public fill banks.

The electricity generated from waste in the incineration process is a form of renewable energy. Since fossil fuel is not used in the generation of electricity, this will reduce greenhouse gas emissions from power plants. It is estimated that the first IWMF will reduce carbon dioxide emissions by 440,000 tonnes a year.

Air Emissions

The main public concern about the operation of the IWMF is potential air quality impacts from incinerator stack emissions. The HK Government carried out a world-wide search for the right technology for the IWMF steered by an independent Advisory Group. It was concluded that in light of the heterogeneous nature of the MSW in HK, the IWMF should adopt a multi-technology approach with incineration as the core waste treatment technology.

Modern incineration technology brings together an effective process control mechanism and an air cleansing system to minimize the emission of pollutants. The process of incineration is designed so that wastes would undergo treatment in a high-temperature environment, with adequate flue gas combustion residence time and in highly turbulent conditions. This would result in the optimal combustion of wastes, ensuring the complete destruction of organic pollutants (e.g. dioxin) and eliminating any factor for the generation of new pollutants in the process. Fitted with state-of-the-art flue gas cleaning and pollution control facilities (e.g. selective catalytic reduction (SCR), scrubber and powdered activated carbon injection system), the technology can effectively control pollutant emissions and meet the most stringent international emission standards. For example, with the adoption of the SCR process, the daily average emission of NO_x is reduced to 100 mg/m³, which is only 50% of the EU standard.

In determination of the height of the incinerator stack which is the highest, most prominent structure of the IWMF, it is important to strike a balance between sufficient height for air pollutants dispersion, whilst not to result in significant visual intrusions. To determine the optimal height of the stack, wind tunnel tests that consisted of plume visualization were conducted for the stacks at various heights. The stack height of 150m is a result of a balanced solution, considering potential air quality and visual impacts.

Cumulative air quality impact assessment was conducted for the project based on the

regional PATH (The Pollutants in the Atmosphere and their Transport over HK) computer model, taking into account the emissions from both regional and local sources, including the emissions within the Pearl River Delta Economic Zone and major local air pollution sources in HK. The predicted maximum cumulative concentrations of air quality parameters at sensitive receivers that might be impacted by the IWMF emissions all complied with regulatory standards.

Human Health

The public is concerned about human health risks related to the IWMF operation. The cancer risk arising from exposure to compounds of potential concern (COPCs) associated with the emissions of the IWMF has been evaluated in the EIA. The highest incremental (excess) cancer risk arising from the IWMF is predicted to be 2.76×10^{-6} , well below the screening level of 1×10^{-5} adopted by the USEPA. The highest predicted total Hazard Index (HI) at all receptors is also well below 0.25, which is an initial screening exposure benchmark derived from a conservative approach by the USEPA. Cumulative acute non-carcinogenic health impact of the IWMF imposed to the worst impacted receptors were assessed and compared with local and overseas guideline levels. The levels of non-carcinogenic chemicals were found to be insignificant when compared to the adopted 17 derived reference levels.

The IWMF will be designed and operated to the latest standards and good practices. With the implementation of preventive measures such as the use of best available techniques, continuous and regular stack emission monitoring, regular safety monitoring and auditing, as well as an effective emergency response plan for the IWMF, the health impact associated with any potential accidental events could be minimized if not avoided.

Water Quality

In order to minimize dredging and filling works of the Project and its environmental impacts, the EIA recommended to use cellular cofferdam and breakwater to replace sloping seawall. Therefore large scale sediment dredging work during reclamation and breakwater construction works would be avoided. Further measures such as silt curtain, and control over dredging rate and filling rate will be implemented for the marine works to ensure no adverse water quality impacts.

An on-site wastewater treatment plant will be provided and all wastewater will be discharged to the plant for treatment. The treated effluent will be reused in the incineration plant and mechanical treatment plant, or for washing and landscape irrigation within the IWMF site.

Ecology & Fisheries

The waters to the south of Lantau and Lamma Island, including the area near SKC is an important habitat for Finless Porpoise, a marine mammal of conservation interest in HK. The main ecological concern relates to direct loss of significant habitat for Finless Porpoise. The local marine mammal expert has been engaged to provide technical input to the EIA, including 6-month site-specific surveys to supplement existing Government data. With the adoption of design measures such as efficient site layout and use of cellular cofferdam for the construction of breakwater and artificial island, the area occupied by the proposed works is reduced to a practical minimum. To compensate for the habitat loss of about 30 ha, mitigation has been proposed in the form of designating a marine park of approximately 700 ha in the nearby waters, with habitat enhancement measures such as deploying artificial reefs and releasing fish fry.

A fisheries enhancement programme will be implemented to enhance fisheries resources in the vicinity of the project area, to mitigate the loss of fishing area and fisheries spawning and nursery grounds.

Continuous Public Involvement

The public has been engaged in the IWMF project since 2002. The IWMF Advisory Group with five sub-groups comprised 24 non-official members from professional bodies, green groups, academic and business sectors. Wider consultations have been conducted since 2008 following identification of the potential sites, with over 110 consultation and engagement activities ranging from meeting individual stakeholder or groups, District Councils, to the Advisory Council on

the Environment and the Legislative Council, to:

- explain need for the project, EIA findings, site preference and responses to their concerns;
- explain to local communities Government's rationale for the preference for the artificial island near SKC as the site for the first IWMF, and measures to safeguard public health and minimise impacts.

Public comments on the EIA and responses by the project proponent are documented in the EIA Report, available in the EIA Ordinance web site.

A community liaison group(s) comprising representatives of concerned and affected parties such as the fishery sector, will be set up for the IWMF project to facilitate communications, enquiries and complaint handling on all environmental issues.

Conclusion

This paper shares the experience of the significant role of an EIA to facilitate the environmental planning and design of the first modern 'Integrated Waste Treatment Facilities' in Hong Kong, which is not without public concerns. The main good practices to share include:

- Key concerns identified early and addressed through transparent continuous public engagement process, with an Advisory Group formed to provide credible, independent input to project planning, site and technology selection.
- Robust, objective and scientific basis important, providing substantiation of findings and decisions to address public queries.
- Partnership with project team to consider environmental issues up-front and develop eco-friendly design for the project.
- Clear responsibilities of who to do what by when in the form of implementation schedule and plan for the EIA follow-up stage.

References

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<http://www.epd.gov.hk/eia/>

IWMF project web site

http://www.epd.gov.hk/epd/english/environmentinhk/waste/prob_solutions/WFdev_IWMF.html

Note

The findings, interpretations, and conclusions expressed in this paper are entirely of the authors' and should not be attributed in any manner to any organizations.