

HONG KONG OFFSHORE WINDFARM IN SOUTHEASTERN WATERS

Marine Navigational Safety Risk Assessment

Executive Summary

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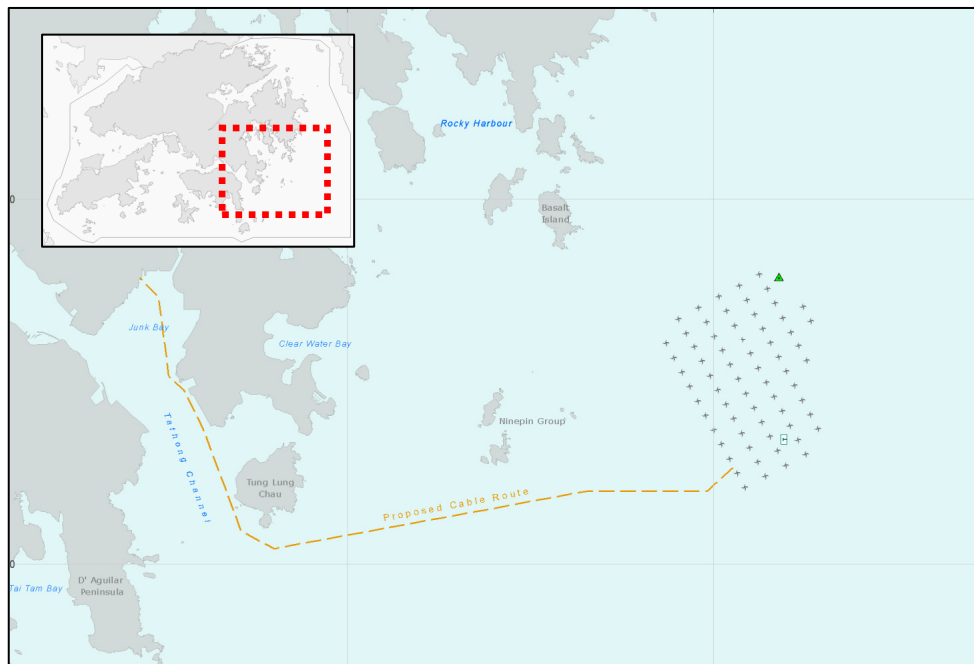
Executive Summary

Background

HK Offshore Wind Limited, a 100% subsidiary of Wind Prospect (HK) Limited, is proposing to install a windfarm in offshore south-eastern waters of Hong Kong, in response to the HKSAR Government's target of 1-2% of Hong Kong's electricity to come from renewable energy by 2012.

Figure 1.1 illustrates the proposed location of the Project that is expected to comprise up to 67 turbines, linked by cables that collect electricity from the various turbines, and transmit via an offshore transformer to shore at Tseung Kwan O.

Figure 1.1 Proposed Windfarm Site & Proposed Cable Route



BMT Asia Pacific Limited, acting for Wind Prospect have been tasked with the examination of the marine safety aspects associated with the Project.

The objective of the assessment is to show that sufficient actions have been taken to ensure the risks are acceptable, with appropriate mitigation, and can be used by Marine Department as the basis for a positive consent decision.

Marine Navigational Safety Risk Assessment (MNSRA)

The key questions associated with development of an offshore wind farm are:

- Where to site it?
- How to mark it?
- How to manage it?

The purpose of the Marine Navigational Safety Risk Assessment (MNSRA) has been to produce an assessment that is proportionate to the scale of the development and the magnitude of the risk.

Given that Hong Kong has no prior experience with such developments it was agreed with Marine Department that a quantitative marine risk assessment based on Formal Safety Assessment methods would be conducted in accordance with the most comprehensive guidance available for the assessment of such projects currently being used in Europe. This guidance is the Department of Transport & Industry, UK (2005) *“Guidance on the Assessment of the Impact of Offshore Windfarms: Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms.”*

The key tasks undertaken during the study are identified below

MNSRA Submission Activities

Stage 1: Project Inception

- Preliminary Hazard Analysis
- Definition of an appropriate Programme of Work
- Specification of tools and techniques to be used

Stage 2: Traffic Review

- Understanding the Base Case densities and types of traffic
- Understanding the future densities and types of traffic

Stage 3: Area Traffic Assessment

Stage 4: Formal Safety Assessment comprising

- Hazard identification
- Risk assessment
 - Hazard log
- Risk control log

Stage 5: Final Assessments and Submission Preparation.

Traffic Assessment

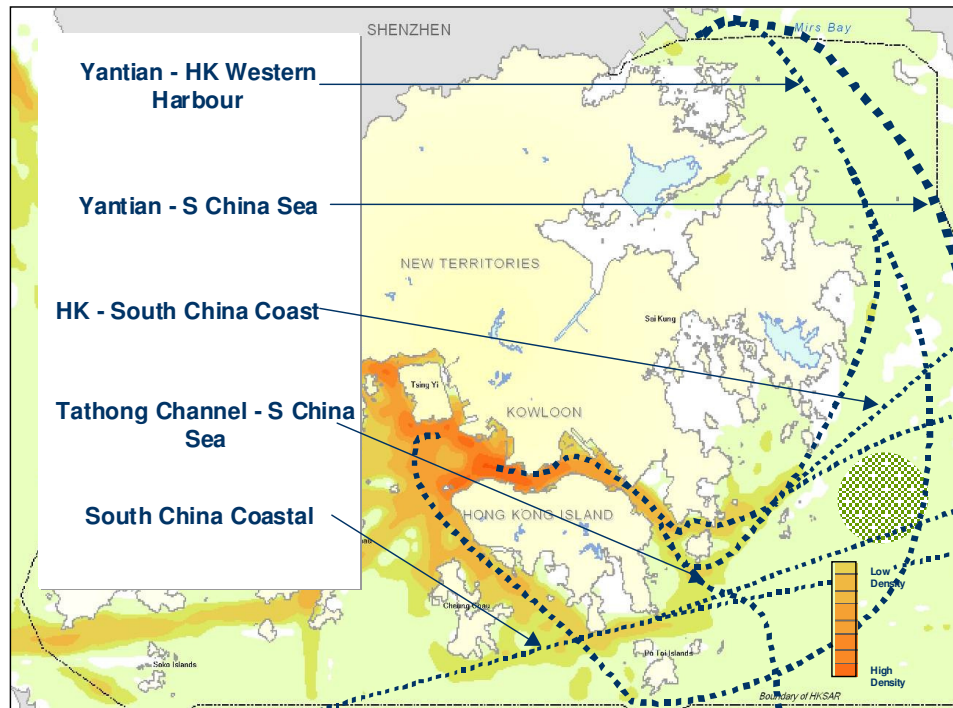
Baseline Activity

Historically marine traffic risks have been a major issue for developments in Hong Kong waters, given the busy nature of local waters. While the proposed windfarm was specifically sited in an area of little traffic activity its size (approximately 15km²) creates the potential for marine navigation issues.

An extensive survey campaign (June – September 2006) has been undertaken to develop a comprehensive understanding of current traffic patterns, as it may impact the proposed windfarm. This was achieved by collation of short-term and long-term records including timetabled data, Marine Department arrival/departure records, visual boat-based surveys and capture of digital radar records.

The key traffic streams within the south-eastern waters are illustrated below:

Principal Shipping Activity near Site.



The survey identified that:

- The initial site selection has successfully located the Windfarm in an area away from key traffic routes - particularly those traversed by larger ocean-going vessels, and hence any site impacts are restricted to effects on smaller local vessels.
- Peak traffic activity across a 5km north-south transect is approximately 20 movements per day across the proposed Windfarm.
- While the proposed Windfarm site is large (aprox. 5km N-S and 3km E-W) the development does not impose significant diversions of the traffic or extensions of transit routes
- The proposed Windfarm site area itself is not a specific focus of fishing, with the greatest activity concentrated closer inshore, particularly near the Ninepins island group.
- The development is sited in an exposed deep water area of Hong Kong waters. Recreational power boating and sailing activity is focussed further inshore to the north-west of the site, within and around the islands and beaches of the Sai Kung Country Park area.

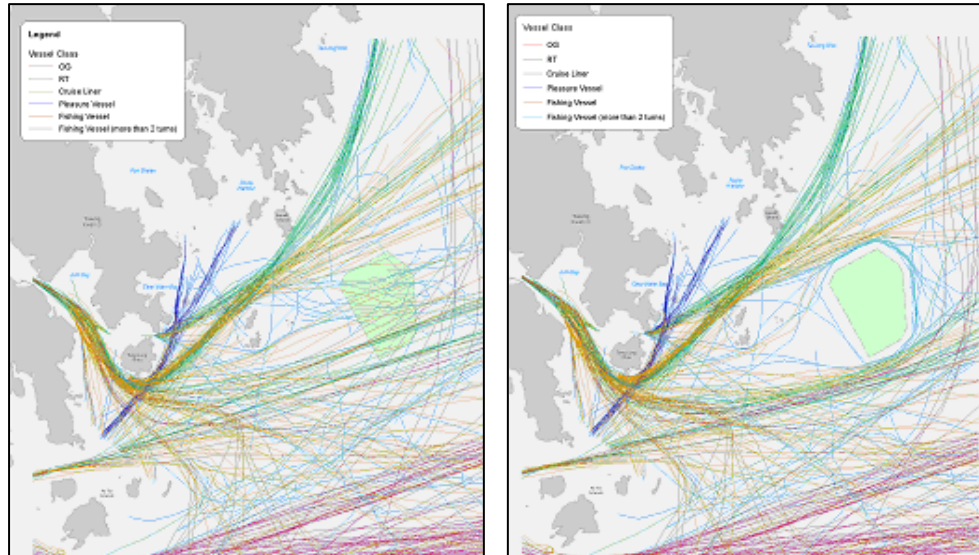
Future Traffic

A comprehensive assessment of future drivers to marine traffic was performed to examine the growth in commercial cargo, passenger, recreational and fishing activity that may impact the traffic within the Study Area. This provided the foundation for the assessment of the marine traffic risk. It was identified that

- traffic growth forecast for the area is anticipated to grow in the order of 1.5% per year
- Construction, operation and decommissioning activities are not widespread and are focussed within the site boundaries, in particular at the turbine locations
- While increased larger scale development of Yantian port (north of the site) is expected, and coastal routes will increase traffic south of the site, no developments are planned that will directly inject new traffic into the area that will be adversely constrained by the proposed Windfarm's location.

The following figures illustrate the distribution of vessel tracks across south-eastern waters sampled from a peak four day traffic period. Within these plots each line represents a single movement, or many transits along the same route. The displaced traffic structure was created by routing all vessels that currently pass across the windfarm site around the perimeter to create a conservative “worst case” representation of traffic impact on vessel routing.

Original & Displaced Traffic Routes around proposed Windfarm (shaded green)



Formal Safety Assessment

The Formal Safety Assessment (FSA) was progressed via the following stages, to ensure a wide range of potential hazards were captured:

- Hazard Identification
- Risk Assessment
- Hazard & Risk Control Log

The key hazards posed by the proposed Windfarm may be broadly described as:

- **Internal** – the potential for collision with the new marine structures (if unrestricted access was permitted), and a variety of issues associated with maintenance operations and the conduct of Search & Rescue operations within the proposed Windfarm area. Key issues are also developed with respect to the presence of the Windfarm drawing people into an exposed offshore area.
- **External** - what may happen to traffic that may divert around the proposed Windfarm and how will the vessel collision potential be changed? A key issue is also the impact of the windfarm on Marine Department and local vessel radar.

Internal to Windfarm

Internal – A review of operational risks has been conducted. It is identified that:

- The potential for collision with the new marine structures as a result of vessels transiting through the proposed Windfarm for normal navigation is extremely low, and acceptable as the spacing of the turbines (at widths of 450m+) allows safe navigation of small craft.
- Risks associated with operational maintenance activities and Search & Rescue operations within the proposed Windfarm area mirror those being faced by many facilities operational or under permitting in European waters and can be effectively managed.
- The frequency of hazards associated with public access to the Proposed Windfarm is difficult to quantify. It is apparent that the safety-security aspects of unrestricted public access to the Windfarm area pose the most significant risk issue for the project.

External to Windfarm

External - The key risks of vessel-vessel collision external to the proposed Windfarm were assessed using marine traffic simulation. In agreement with Marine Department, Base Case and Future Case (2011 - 2021) marine traffic simulations have been conducted to examine the change in the future risk profile of the Study Area, with and without the proposed Windfarm. It is identified that:

- In the most conservative case of all, vessels skirting the Windfarm, the collision risk for local craft is forecast to increase by a maximum of 0.3 incidents per year. Review of historic incident records have identified that only 1% of collisions are likely to result in a fatality; presenting a risk of fatality of 1 in 300 years.
- As such there is a small chance of a marine collision hazarding life during the 25 year life of the wind farm and the “Societal Risk”, (a measure of exposure of the local marine population) is predicted to be within the acceptable limits of local guidelines. In consequence, the “knock-on” effects of the proposed Windfarm to 3rd party marine traffic are considered acceptable.
- External risks such as stranding, capsizing and fires would not be impacted by the development.

Risk Control – Marking & Management





A series of risk control measures have been developed to assist in the safe operation of the proposed Windfarm development. Experience to date of operational offshore wind farms in European waters identifies that these structures can be readily identified and avoided. Other hazards may be addressed by operational management initiatives. These include:

- The provision of additional radars and CCTV to supplement Marine Department/HK Police surveillance of south-eastern waters,
- Turbine marking (lights, painting and sound signals) to international standards.
- Regular deployment of at least one offshore support/patrol vessel to act in a maintenance support and first response role to assist in the management of safety of the site.
- Search & Rescue trials to be undertaken to co-ordinate operational measures
- Restricted Access, (see below)

Review of the hazards and the key risks have identified a series of hazards that cannot be readily mitigated by engineering/operational measures. These hazards are associated with a variety of behaviours that may be undertaken by members of the public due to the presence of the proposed Windfarm, which may draw people into an offshore area for which the passengers and vessels are unprepared. These include:

- Members of public scaling turbines for fishing, with the potential for falls, or stranding on towers due to boats unable to return and pick-up
- Capsizing hazards due to un-seaworthy vessels accessing the windfarm area for sight-seeing activities
- Trawlers taking advantage of the anticipated aggregation of fish around turbine bases to trawl very close to foundations developing the risk of snagging of nets/collision.

In order to manage these risks it is proposed that the Windfarm area is designated as a controlled waterspace through the development of byelaws or similar legal instruments. Waterborne access would be restricted to vessels that have received approval from a joint Operator/Marine Department review body. The following vessel restrictions are proposed at this stage:

Class	Type	Existing Operations in Wind Farm Site Area	Initial Proposed Restriction
Fishing Vessels		Occasional fishing operations across Site, however most activity concentrated closer to Nine Pins Islands	Trawling & transit Restricted.
Rivertrade coastal vessels		Transits of extreme southern tip of Site, on east-west alignment across Mirs Bay, and occasional feeder trips Yantia-Hong Kong north-south	Transit Restricted
Small Craft, Fast Launches & Powered Recreational Craft		Very sparse activity during daylight hours. Radar records of early morning, potentially elicit transits. Development of project expected to increase activity.	Licensed tourist vessels only, all others Restricted
Sailing Vessels		Very sparse activity, however development of project expected to increase activity	Licensed vessels only, all others Restricted

Approved vessels would include all Government craft, Windfarm maintenance vessels, and may be extended to include dive boats, specific tourist launches, etc. It is anticipated that these vessels would be required to carry AIS transmitters to monitor and safeguard their operations, and be surveyed to ensure they are adequately seaworthy for offshore conditions.

Conclusion

A comprehensive assessment of the marine navigation safety risk implications arising from the establishment of an offshore wind farm in south-eastern Hong Kong waters has been conducted in accordance with a methodology agreed by Marine Department. This Study, conducted within the framework of a Formal Safety Assessment and following specific UK guidelines for offshore wind farm assessment, has included the identification of key hazards and the quantification of key risks arising.

It is identified that the impact of the proposed Windfarm on marine users is minor, and acceptable, given the design features and management measures proposed to accompany the development. These include the provision of navigation aids, CCTV, additional radars, regular deployment of a support/patrol vessel and the designation of the windfarm waterspace area as restricted, with managed access.