Ref: PD/900/00/00

PROJECT PROFILE

DEVELOPMENT OF A 100MW OFFSHORE WIND FARM IN HONG KONG

July 2006

Revision 0

香港電燈有限公司

The Hongkong Electric Co., Ltd.

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1. BASIC INFORMATION

1.1 PROJECT TITLE

Development of a 100MW Class Offshore Wind Farm in Hong Kong.

1.2 PURPOSE AND NATURE OF THE PROJECT

Following the official opening of Hong Kong's first grid-connected 800kW "Lamma Winds" Power Station by the Secretary for Environment, Transport and Works on 23 February 2006 and the extent of encouraging responses shown by the community, the Hongkong Electric Company Limited (HEC) is now in active pursuit of developing large-scale wind power generation system in Hong Kong. Given the scarcity of land resources within the territory, development of offshore wind farm is viewed as the way forward. Having reviewed the wind potentials of the proposed sites, the capacity of wind turbines available on the markets and the overall sea area requirement, an installed capacity of 100MW for the proposed offshore wind farm is considered appropriate.

The purpose of the proposed project is to utilize wind as source of renewable energy for power generation to supplement fossil fuels, and to make contributions to the improvement of the air quality in Hong Kong. The operation of the proposed 100MW offshore wind farm with an estimated annual generation of 175GWh electricity would offset approximately:-

- Annual use of 62,000T of coal
- Annual emission of 150,000T of carbon dioxide
- Annual emission of 520T of sulphur dioxide
- Annual emission of 240T of nitrogen oxide

The electricity generation from the proposed wind farm would be adequate to meet the consumption for 50,000 families in Hong Kong and is roughly around 1.6% of HEC's total electricity sent out in 2005. This is in support of HKSAR Government policy of generating 1% of electricity output using renewable energy by 2012.

This Project Profile serves to outline the environmental information of the proposed offshore wind farm and associated equipment for application for an environmental impact assessment study brief under Section 5.1 (a) of the Environmental Impact Assessment Ordinance (EIAO).

1.3 NAME OF PROJECT PROPONENT

The Hongkong Electric Company Limited (HEC).

1.4 SCALE AND LOCATIONS OF PROJECT

1.4.1 Scale of Project

The proposed offshore wind farm with an installed capacity of 100MW consists of tentatively 40 sets of 2.5MW class wind turbine units. The actual capacity of each wind turbine unit and the total number of units to be installed will be subject to the results of detailed study on the choice of equipment manufacturer, the model of wind turbine to be adopted and the measured wind data of the selected site at the implementation stage of the proposed project.

The proposed project involves the construction of the following items:

- One Offshore Wind Monitoring Mast
- 40 sets of 2.5MW Class Offshore Wind Turbine
- One Offshore Substation
- Submarine Transmission Cables connecting all wind turbines to Offshore Substation and thereof to HEC Grid

Subject to the proprietary design of the 2.5MW class offshore wind turbine adopted for the proposed project, the turbine hub height is about 75m and the rotor diameter is about 80m, giving a total tip height in the order of 115m. Separation distance between individual wind turbine units is in the order of 550m.

1.4.2 Preliminary Site Search

The following screening criteria have been considered in the initial study on site selection for the proposed off shore wind farm:-

Wind Potential

Areas where wind power density above 200W/m^2 can be considered as feasible sites for development of wind power generation facilities. Figure 1.4a[1] shows the wind power density over the region of Hong Kong and indicates that most of the Hong Kong waters except areas close to shorelines have adequate wind resources for power generation.

[1] EMSD 2002 Report, 'Study on the Potential Application of Renewable Energy in Hong Kong'.

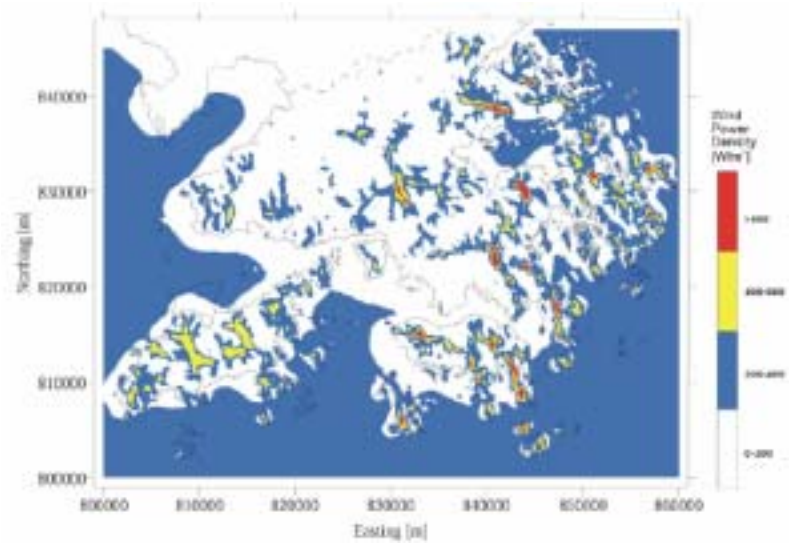

Fig. 1.4a – Wind Power Density Over the Region of Hong Kong

Navigation Channel

The offshore wind farm has to avoid navigation channels, fairways and other shipping lanes to prevent obstruction to marine traffic. Figure 1.4b indicates the major marine channels in Hong Kong waters[2] where the proposed wind farm site has to avoid.

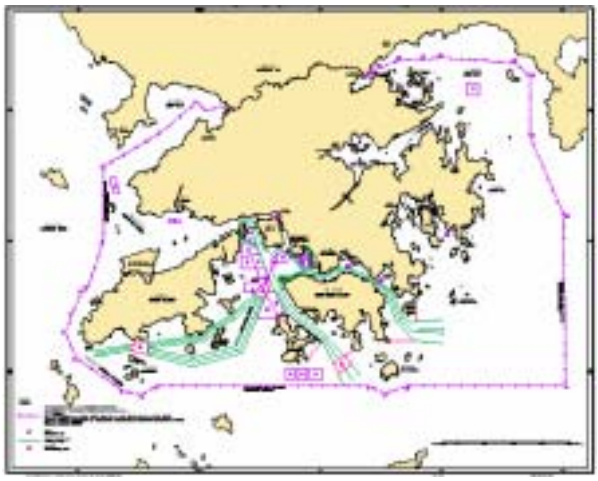

Fig. 1.4b – Navigation Channels in Hong Kong

Seabed Utilities & Other Designated Uses

Extensive areas of the seabed within Hong Kong waters are currently occupied by third party utilities. Examples of these utilities include telecommunication cables, mud disposal areas, sand bodies, explosive dumping ground, anchorage zones, subsea gas pipelines, sewage outfalls, etc. Figure 1.4c indicates all seabed utilities

[2] Source: http://www.hydro.gov.hk/product/misc.htm

currently exist in Hong Kong waters. The wind farm site and the associated transmission cable corridor has to avoid those areas that are occupied by these third party utilities.

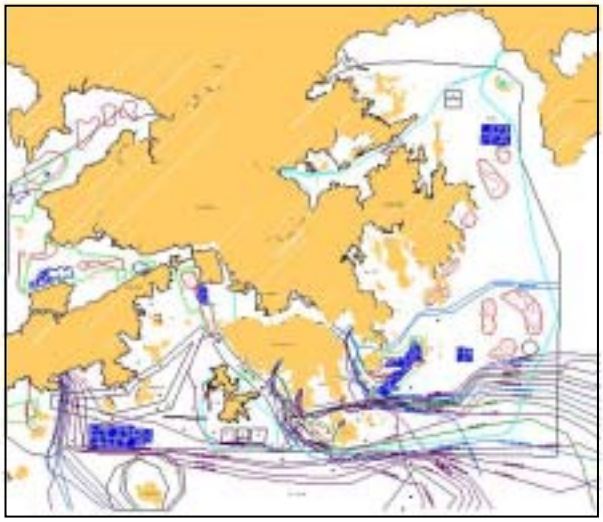

Fig. 1.4c– Existing Seabed Utilities in Hong Kong Waters

Marine Conservation Areas

Marine conservation areas refer to marine parks, marine reserves, fish culture zones and artificial reef deployment sites. There are currently 4 marine parks, 1 marine reserve and 26 designated fish culture zones in Hong Kong waters. Figure 1.4d indicates the marine conservation areas including all potential future marine parks in Hong Kong. All these marine conservation areas have been excluded in the site selection.

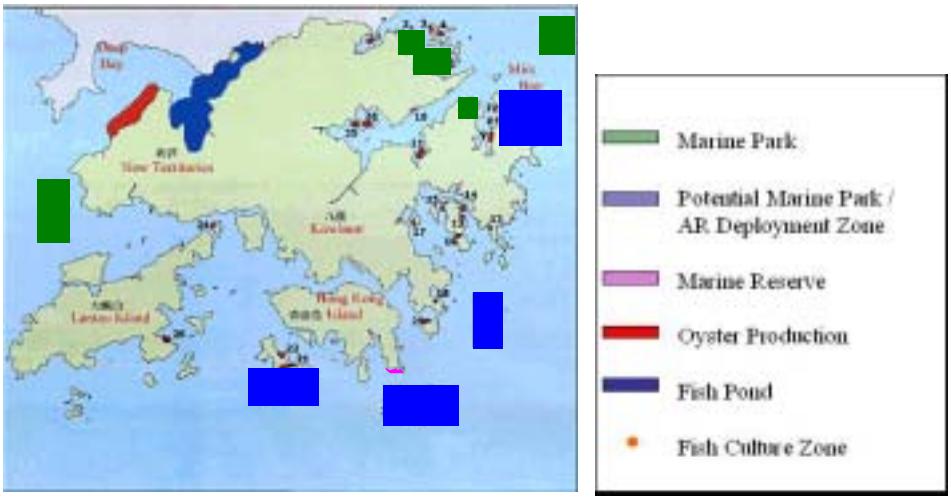

Fig. 1.4d – Marine Conservation Areas in Hong Kong

Water Depths

A maximum water depth of around 30m is considered as being the current limit from technical and economic viewpoints for a potential offshore wind farm. Sites with shallower water depths are obviously more preferred wherever practicable since the cost of turbine foundation increases with water depths almost proportionately. However, within the Hong Kong territorial waters, areas with shallow water depths usually locate near shore and have relatively weak wind potentials. Besides, visual impact of wind turbines to the local community along shore areas is much higher. When all these factors are taken into account, sites farther away from shore are chosen for assessment in order to harness more wind energy and to minimize visual impact, provided the water depths do not exceed 30m.

Height Restriction

Under the Hong Kong Airport (Control of Obstruction) Ordinances, there are height restrictions imposed onto all high rising structures that may cause potential obstructions to aircrafts traveling in Hong Kong. The current civil aviation height restriction varies from around 25mPD in areas near to Chek Lap Kok Airport up to a maximum level of 989mPD in areas off east Sai Kung.

As the maximum height of the wind turbine is in the order of 115m above sea water level, areas with a civil aviation height limitation of 115m or less have been excluded. Most of the Hong Kong waters except areas near to north of Lantau Island can satisfy the height restriction requirement.

Proximity to HEC Power Grid

As the electricity generated from the proposed wind farm will be routed to shore via submarine cables for connection to HEC's existing power grid, remote areas far away from HEC's power grid would result in substantial power loss. From technical and economical considerations, the potential sites shall be located reasonably close to HEC's power grid.

1.4.3 Potential Sites

A site constraint map as shown in Figure 1.4e is generated by superimposing all technical constraints identified in Section 1.4.2.

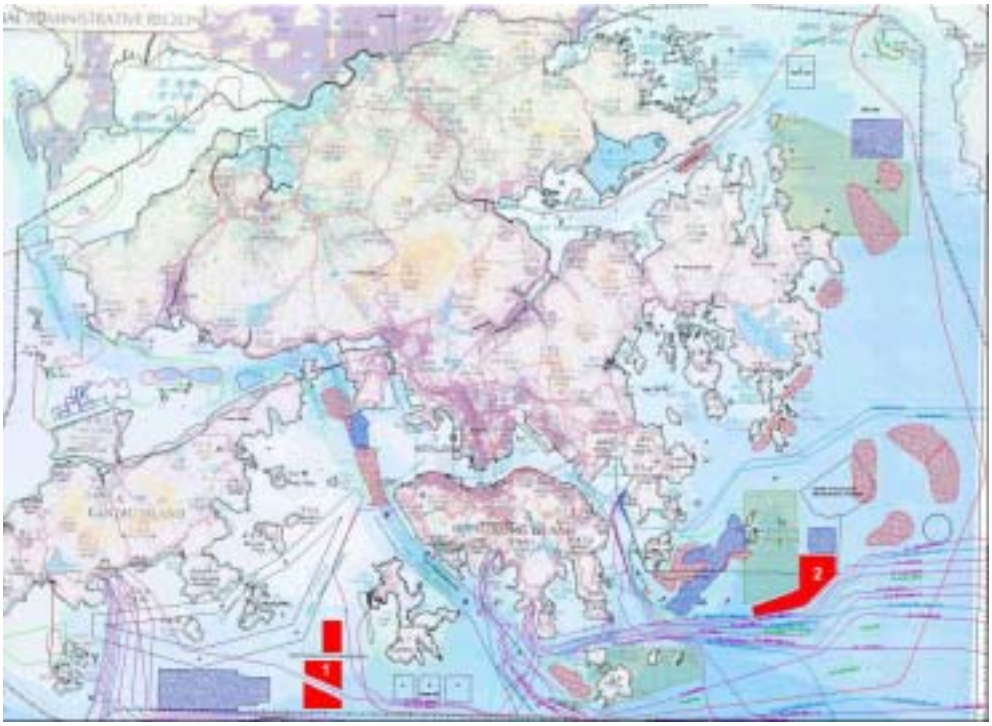

Fig. 1.4e – Potential Sites of Offshore Wind Farm

Based on the above constraint map, the following 2 offshore potential sites are identified:

1. Southwest Lamma
2. Southeast Ninepin; and

The two potential sites as highlighted in Figure 1.4e above in red will be subject to detailed technical evaluation and environmental assessment under the EIA Ordinance to identify the most preferred site(s) for development of the proposed offshore wind farm.

1.5 NUMBER AND TYPES OF DESIGNATED PROJECTS COVERED BY THE PROJECT PROFILE

This Project Profile covers the following designated project:

- Construction and operation of an offshore wind farm
  (Ref. item D.1, Part 1, Schedule 2 of the EIA Ordinance).

1.6 NAMES AND TELEPHONE NUMBERS OF CONTACT PERSON

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2. OUTLINE OF PLANNING AND IMPLEMENTAION PROGRAMME

The whole project will be undertaken by HEC's in-house project team with supports from consultants and contractors. Based on the lead time required for design, engineering, procurement, delivery and construction, the tentative programme for the proposed wind farm project are as follows:

EIA Study	mid 2006 – end 2007
Wind Monitoring	2008
Construction of Wind Turbines	2009
Completion	early 2011

It shall be noted that the above schedule is indicative and the project commencement date will be subject to the program of EIA study and subsequent Government approval of relevant statutory applications.

3. MAJOR ELEMENTS OF THE SURROUNDING ENVIORNMENT FOR THE TWO POTENTIAL SITES

3.1 POTENTIAL SITE AT SOUTHWEST LAMMA

The Southwest Lamma potential site is located in the waters between Lamma Island and Cheung Chau lying adjacent to the West Lamma Channel. The closest distance of this potential site is around 3.5km west of Lamma Island. The average water depth at this site is around 15m. This site encompasses the proposed Lamma breakwater and one submarine telecommunication cable. Adequate separation distance between these two seabed utilities and the nearby wind turbines has been provided to avoid direct encroachment. Figure 3.1a shows the proposed layout of the Southwest Lamma potential site.

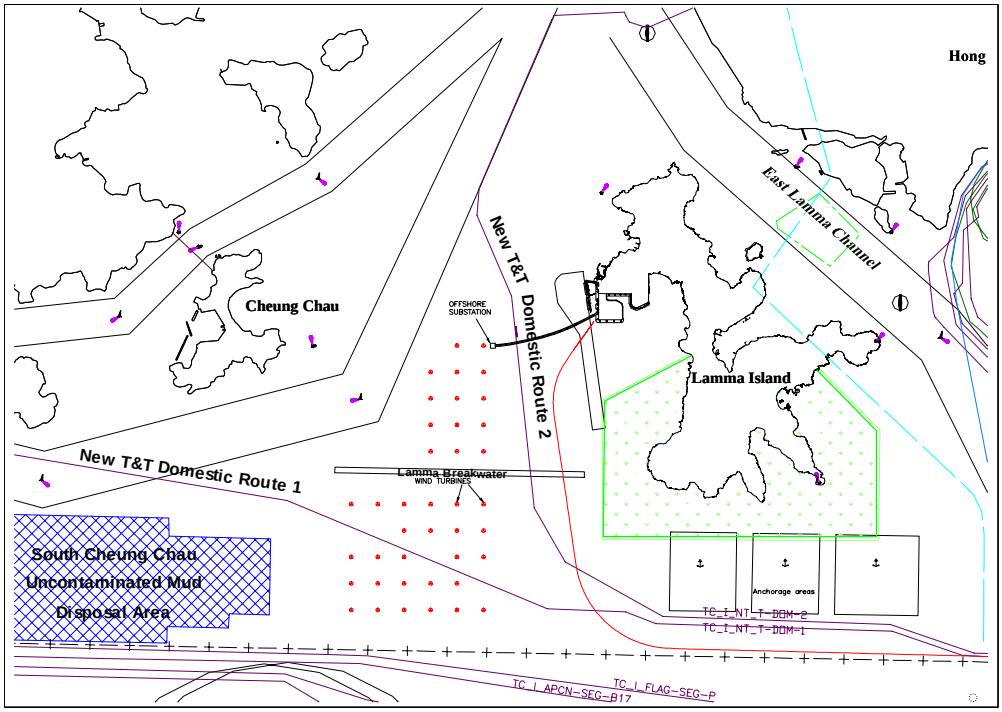

Fig. 3.1a – Layout of Southwest Lamma Potential Site

One or more 275kV transmission cables will be installed between the offshore wind farm and HEC's power grid at Lamma Power Station. The length of the submarine section of the transmission cable(s) is around 2.5km, which will be buried underneath the seabed. The aforesaid transmission cable(s) and the interconnection cables between individual wind turbines will have to cross one (1) existing telecommunication cable. Suitable measures will be implemented for cable crossing and protection.

The proposed offshore wind farm site, cable landing point and transmission cable corridor will be located adequately away from any major navigation channels, gazetted marine facilities and third party seabed utilities. The sites are not expected to encroach upon any gazetted bathing beaches, marine parks, marine reserves, sites of special scientific interest, fish culture zones, recorded cultural heritage and other conservation areas. Residential dwellings are far away from the proposed site and the nearest populations are more than 4km away at Yung Shue Wan.

3.2 POTENTAIL SITE AT SOUTHEAST NINEPIN

The Southeast Ninepin potential site is located about 3.2km southeast from the Ninepin Group. The average water depth at this site is around 29m. This site is closely surrounded by a submarine telecommunication cable, a potential artificial reef deployment site and a mud disposal area. Figure 3.2a shows the proposed layout of the Southeast Ninepin potential site.

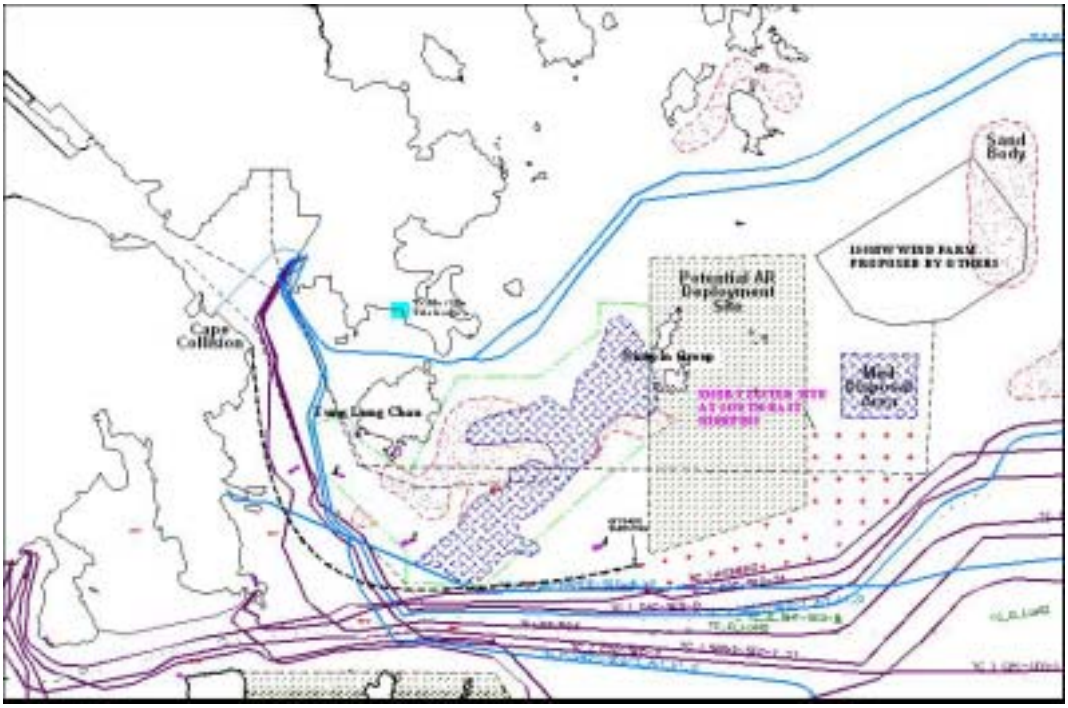

Fig. 3.2a – Layout of Southeast Ninepin Potential Site

The irregular shape of the wind farm is mainly due to avoidance of the nearby designated areas. Discussion with relevant government departments will be made during EIA study to review the feasibility to make use part of the potential artificial reef deployment site for the proposed wind farm development.

One or more 132kV transmission cables will be installed between the offshore wind farm and HEC's power grid at Hang Fa Zone Substation in Hong Kong Island via a cable landing point at Cape Collision. Length of the submarine section of the aforesaid transmission cable(s) is estimated to be around 13km which will be buried underneath the seabed. The transmission cable(s) will have to cross three (3) in-service telecommunication cables. Land cable(s) will be laid to connect Hang Fa Zone Substation and the Cape Collision cable landing point.

The proposed offshore wind farm site, cable landing point and transmission cable corridor are not expected to encroach upon any existing navigation channels, gazetted marine facilities, gazetted bathing beaches, marine parks, marine reserves, sites of special scientific interest, fish culture zones, recorded cultural heritage and other conservation areas. Residential dwellings are far away from the proposed site and the nearest populations are about 8km away at Po Toi O at Clearwater bay Peninsula**.**

4. POSSIBLE IMPACT ON THE ENVIRONMENT

4.1 OUTLINE OF PROCESSES INVOLVED

The proposed offshore wind farm is of 100MW capacity comprising tentatively 40 sets of 2.5MW class wind turbines. The actual numbers and capacity of each wind turbine will be subject to review depending on detailed engineering design, availability of marine landtake and the proprietary models of the final choice on wind turbine manufacturers. Should the final wind turbine capacity is larger than 2.5MW, the number of wind turbines may be reduced to maintain the total wind farm output of around 100MW.

Configuration of the proposed wind turbine is of horizontal axis type machine consists of three rotor blades, a nacelle and a tubular steel tower. The nacelle mounted on top of the tower houses a rotor blade shaft, braking device, gearbox, generator, and electrical, instrument and control components. Individual wind turbine is supported by a foundation piled onto seabed. On top of the pile is a transition piece comprising a working platform and access ladder usually stands several meters above sea level depending on the tidal level at the selected site. The wind turbine tower is connected to top of the transition piece.

Depending on the final proprietary model of the offshore wind turbines, rotor diameter of the 2.5MW class wind turbine is about 80m. The hub height is usually site dependant and is about 75m for 2.5MW class wind turbine to capture adequate wind resources at high levels. The highest point of the wind turbine blade tip is estimated about 115m above sea level. The layout of wind turbines will be arranged in array forms with a separation distance between each wind turbine of about 550m. Figure 4.1a shows the layout of the configuration of the proposed offshore wind turbine.

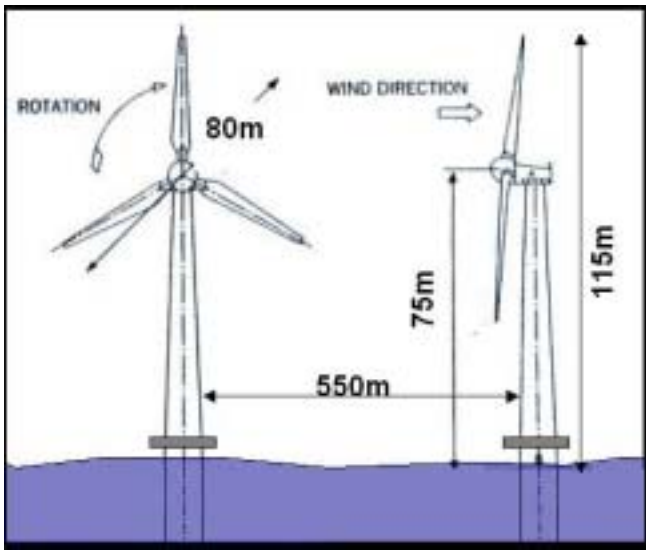

Fig. 4.1a –Offshore Wind Turbine Configuration

Interconnection cables between individual wind turbines will be laid and connected to a 22kV switchgear and a step up transformer located inside the offshore substation. To tie in with HEC's onshore power grid, a 22kV/275kV step up transformer will be adopted for the Southwest Lamma potential site whereas a 22kV/132kV step up transformer will be adopted for Southeast Ninepin potential site. The 275kV or 132kV transmission cable(s) from the offshore substation to HEC's power grid includes a submarine section, cable landing point and a land portion. Figure 4.1b illustrates the electrical schematic diagram of the proposed 100MW offshore wind farm.

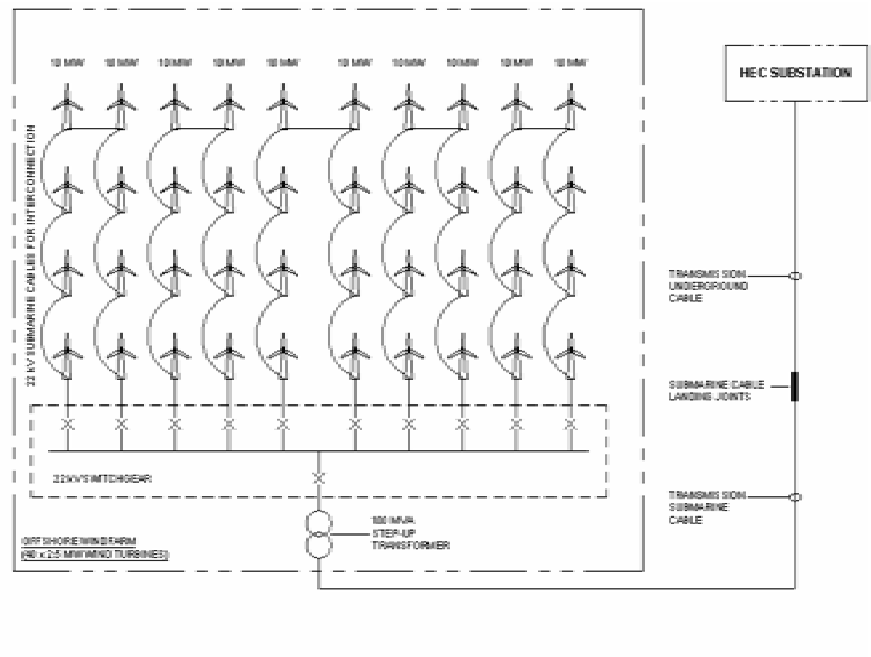

Fig. 4.1b – Electrical Schematic Diagram of Offshore Wind Farm

The wind turbines, wind monitoring mast and the offshore substation will stand firm onto the seabed through their respective foundations. Selection of suitable type of offshore wind farm foundations, such as mono pile and tripod, will be decided at project detailed design stage.

Wind turbines and associated infrastructures have a typical lifespan of 20 -25 years. At the end of their service life they will be decommissioned. The wind turbines, monitoring mast and offshore substation can be removed from site while the buried cable can either be removed or disconnected and left buried under the seabed.

4.2 POTENTIAL ENVIRONMENTAL IMPACT

The major activities involved in the construction of the proposed offshore wind farm include the following:-

a. Construction of wind monitoring mast foundation
b. Construction of wind turbine foundations
c. Construction of offshore substation foundations

d. Installation of wind turbines and associated equipment
e. Laying of submarine interconnection and transmission cables
f. Construction of cable landing point

Major equipment and plants required for the construction works would include a jack up vessel for construction of foundation and wind turbine installation. A cable-laying vessel and cable-ploughing machine for cable burial would be required for installation of submarine cables. Other mobile plants include tugs, barges and other support crafts would be deployed during the construction phase.

Site assembly works are considered of minimal scale as the wind turbine equipment will be delivered to site mostly in form of pre-assembled equipment. Based on overseas offshore wind farm experience, the construction work is expected to last not more than one year. Environmental impacts during construction works are considered of short-term nature.

The operation of wind turbines will not consume fuel nor generating waste or side products. Major impacts during operational phase are associated with rotating blades which may cause potential impacts on noise, visual and interference to radar system. The potential environmental impacts arising from construction and operation of wind turbine are highlighted below:-

4.2.1 Construction Phase

Air Quality

Air quality impact arising from construction of the offshore wind farm is considered negligible as gaseous emission arising from construction vessels will only cause insignificant and short-term impact to the surrounding environment. Dust emission from the civil construction works is not anticipated as most of the construction works will be carried out underwater except for construction of the cable landing point which involves small-scale excavation works. All debris and waste materials will be covered or stored in a designated area to minimize fugitive emission. Fugitive and gaseous emissions during construction phase are expected to be of localized nature and no adverse impact of air quality during construction phase will be envisaged.

Noise Impact

The major above sea noise source during construction phase is expected to come from crane operation and vessel movement. All two potential sites are significantly distant from their respective nearest sensitive receivers (NSR), with the nearest NSR at Yung Shue Wan being about 4km from the Southwest Lamma potential site and shielded by the topography. Construction works during restricted hours will be under the governance of a statutory permitting system. Noise impact to nearby sensitive receivers is not expected to be of concern.

Noise resulted from construction of the cable landing point will mainly be generated from minor excavation work. As the proposed landing points are either located at Lamma Power Station or Cape Collision which are reasonably distant and shielded from populated areas, it is not expected that the construction of cable landing point will cause adverse impact to the environment.

Water Quality

Impacts on water quality due to construction of the proposed wind farm covers the following:-

- Change in hydrodynamic due to addition of pile arrays in the wind farm site
- Sediment plume dispersion due to piling
- Sediment plume dispersion due to cable burying
- Sediment plume dispersion due to excavation work near the cable landing point.

The Southwest Lamma potential site is located within the Southern Water Control Zone. According to statistical data obtained from EPD's water quality monitoring stations, water quality at south Lamma (viz Monitoring Station SM18) is generally good with full compliance in Dissolved Oxygen (DO) and unionized ammonia levels throughout 2004. Suspended solid level in SM18 is good with an average level of 4.1mg/L which is one of the lowest value among all other monitoring stations in the Southern Water Control Zone.

The Southeast Ninepins potential site is located within the Mirs Bay Water Control Zone. The nearest EPD's water quality monitoring stations are MM8 and MM13. Monitoring station results show that water quality in the region is generally good with full compliance in DO, Total Inorganic Nitrogen (TIN) and unionized ammonia throughout 2004. Suspended solid level in the region ranges from 2.9mg/L to 8.6mg/L indicating water quality in the region is generally good.

Construction of the proposed project is expected to cause water quality impact to the surrounding water but the extent of impact is considered localized and of short-term nature. Given the small footprint of the wind turbine foundations, the potential impact on water quality arising from the construction works is expected to be small.

Waste Management

Construction of the wind farm including piling of foundation is not expected to generate any waste material. The only waste material generated from the construction works is expected to come from laying of submarine cables and excavation at cable landing point. All excavated mud will be properly disposed of at designated areas and therefore impact of waste generation resulted from the construction work is not expected to be of concern.

Marine Ecology

Direct impact on marine ecological resource due to construction of the wind farm includes to the permanent occupation of seabed areas where the wind turbine foundations are to be constructed. This occupied area in total due to piling onto seabed is estimated to be around 550m^2. Nevertheless the wind turbine foundations will provide a new habitat for the benthic organisms. It is therefore not anticipated the seabed occupied by the foundation piling has significant impact to the surrounding environment.

Indirect impact due to construction of the wind farm relates to the impact onto epifaunal and infaunal communities in vicinity of the proposed sites due to sediment release associated with the construction works. However, in view of the short-term construction period, such impact is expected to be insignificant.

Direct impact due to installation of transmission cable includes the removal of near shore subtidal and intertidal assemblages at the cable landing sites. In view of the small scale of excavation work required for the construction of cable landing point, the associated impacts are considered short-term and insignificant.

Indirect impact to marine ecology related to cable installation is mainly associated with the change in water quality during cable laying. Actual impact to the marine ecology due to cable installation works will be reviewed in the EIA.

Chinese White Dolphin and Finless Porpoise are reported to be the only species of marine mammal regularly sighted in Hong Kong water. Sighting of the Finless Porpoise have mainly been in the coastal waters of southwest Lamma Island. Impact associated with construction mostly related to the underwater noise generated from piling, cable installation and mobile construction vessel traffic. Suitable mitigation measures, if found required, will be proposed in the EIA study to minimize the marine ecological impacts.

Terrestrial Ecology

Direct impact on terrestrial ecological resource due to construction of the project mainly relates to the occupation of small area of terrestrial habitat at the cable landing point. By selection of suitable location for the cable landing point and the construction methodology, impact to the terrestrial ecology resulted from the project is expected to be minimum.

Impact to Fisheries

Direct impacts on fisheries due to construction of the proposed project mainly associate with the fishing grounds occupied by the wind turbines/substation support foundations. Short-term impacts are predicted to occur within the excavated area during the cable laying works. Indirect impacts of the construction works are mostly related to the change in water quality during underwater works. Nevertheless, the impact is expected to be localized and of short-term nature.

Cultural and Heritage

It is not expected to identify any high archaeological resources with significant value within the concerned areas.

4.2.2 Operation Phase

Air Quality

Wind turbine produces electricity without gaseous emissions and this will reduce emissions from power generating plant using fossil fuels. No impact on air quality is anticipated for operation of the proposed offshore wind farm.

Noise Impact

Modern wind turbines are of low rotating speed with aerodynamic airfoils and well-insulated nacelle to minimize noise impact. Based on operating experience of HEC's 800kW wind turbine at Lamma, the noise level in the vicinity of the wind turbine is considered insignificant. Given the far distance between the potential sites and residential areas, the noise level during operational phase of the project is expected to be well below the statutory control limits.

Water Quality

Impact on water quality due to operation of the proposed wind farm is considered negligible as the wind farm operation will not produce any effluent discharge or surface run off to the surrounding environment.

Ecology

Major ecological impacts during operational phase will be confined to birds strike. Overseas experiences of wild birds collision with wind turbines are both site and species specific. As the potential sites are not expected to lie within flight path of migrant birds, the impact to birds is expected to be low.

Impact to Fisheries

Direct impacts on fisheries due to operation of the proposed project mainly associate with the fishing grounds occupied by the wind turbines/substation support foundations. Overseas experience however indicated that the section of underwater structures as part of the support foundation would enhance fisheries resources. Consultation with relevant parties will be made during EIA study to address the impact to fishing activities.

Visual and Landscape

The layout of the proposed offshore wind farm in array form at the proposed locations will inevitably be noticed and may cause visual impact to others. Nevertheless, the visual intrusion of the wind turbines on landscape is highly subjective. Many people see them as a welcome symbol of clean energy whereas

some find them rather unpleasant additions to the landscape. Understanding of the broader environmental benefits of wind energy tends to improve the public perception of the offshore wind turbine project.

Hazard and Risk

Operation of offshore wind farm is sometimes reported to cause interference to radar system leading to twinkling of radar image. The impact to the existing air surveillance radars and marine radars operated by the Civil Aviation Department and Marine Department will be reviewed whenever necessary in the EIA.

Hazards with respect to marine traffic and navigation resulting from operation of the offshore wind farm will be addressed whenever necessary in the marine impact assessment and navigation hazard assessment.

5. DESCRIPTION OF MITIGATION MEASURES

Based on the findings of assessment presented in Section 4, the construction and operation of the proposed wind farm are not expected to result in any adverse environmental impacts with the implementation of the following mitigation measures:

5.1.1 Construction Phase

- Implementation of standard noise control measure such as selection of quiet powered mechanical equipment and rescheduling of deployment of noisy equipment to less sensitive periods to minimize impact of noise during construction phase.

- Adoption of proven piling methodology and utilizing suitable construction plants to minimize water quality impact during construction. Impact due to excavation work near the cable landing point can be mitigated by adopting suitable measures to contain dispersion of the disturbed sediment.

- Implementation of good site management practice to minimize waste arising from the construction. All debris and construction waste will be covered or stored properly before removed from the site. Windblown litter and dust will be minimized by use of impervious sheets or sheltered storage. Excavated material will be segregated from other wastes to avoid contamination and reused, as far as practicable, for backfilling at site.

5.1.2 Operation Phase

- Careful architectural consideration and colour selection would be made to enable the development to blend well with natural surroundings and minimize the visual intrusion.

- Proper selection of colour scheme (e.g. non-reflective surfacing) will be applied on rotor blades and tower to make the wind turbine visually obvious to birds.

6. USE OF PREVIOUSLY APPROVED EIA REPORT

a. EIA Report for Renewable Energy by a Wind Turbine System on Lamma Island [AEIAR-080/2004]
http://www.epd.gov.hk/eia/register/report/eiareport/eia_0992004/EIA/html%20version/Table%20of%20Content_fn.htm

b. EIA Report for 1,800 MW Gas-fired Power Station at Lamma Extension [AEIAR-010/1999]
http://www.epd.gov.hk/eia/register/report/eiareport/eia_00998/index.htm