

Tailor-made Procurement Features to Facilitate Operation of the Tseung Kwan O Desalination Plant in Hong Kong

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Introduction

Hong Kong is one of the most densely populated cities in the world with more than 7.5 million people inhabiting 110,000 hectares. Its potable water demand is about 1,000 million m³/year (725 million gallons per day). Hong Kong's water source is facing various challenges, including increasing local water demand arising from population and economic growth, impact of climate change, as well as competition for water resource due to the rapid economic development in the Pearl River Delta Area of the mainland China. Consistent with its forward planning vision, Water Supplies Department ("WSD") of the Government of the Hong Kong Special Administrative Region has been implementing the Total Water Management ("TWM") Strategy since 2008 to better prepare Hong Kong for meeting the challenges to its water resources. One of the key supply management initiatives is to diversify the water resources by developing new water resources. In this connection, WSD is implementing a new seawater desalination plant which is not susceptible to climate change and provides a new water resources in Hong Kong.

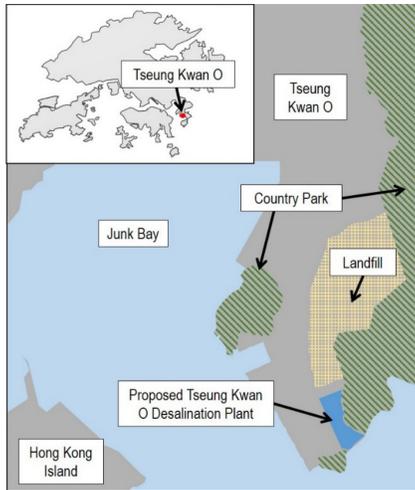


Figure 1: Location of proposed Tseung Kwan O Desalination Plant

Project Development

After the promulgation of the TWM Strategy in 2008, along with pilot plant studies (2007-2012) conducted on reverse osmosis ("RO") technology in Hong Kong, it was recommended as part of a WSD planning and investigation study (2012-2015) that it was technically and environmentally viable to construct a desalination plant in Tseung Kwan O ("TKO"). The seawater quality was stable and characterised by relatively low concentrations of turbidity, suspended solids, chlorophyll-a and total organic carbon (TOC). The TKO site was also strategically located to connect to the water supply network of other parts of the territory. The first stage of the TKO desalination plant will have a water production capacity of 135 million liters per day ("MLD") using two-pass RO technology with the provision for future expansion to the ultimate stage of 270 MLD within the 8-hectare site.



Figure 2: Reverse Osmosis technology selected for the TKO Desalination Plant

Design Development

One of the most critical element was the establishment of the intake seawater quality envelope and the treated water quality standards to be adopted for the desalination plant.

Intake Seawater Quality Parameters Treated Water Quality Standards

- | | |
|--|--|
| <ul style="list-style-type: none"> ▪ Temperature ▪ Total dissolved solid (TDS) ▪ Suspended solids ▪ Boron ▪ Bromide | <ul style="list-style-type: none"> • The Hong Kong Drinking Water Standards based on the "Guidelines for Drinking-water Quality" of the World Health Organisation • TDS • Alkalinity • Boron • Bromide • Hardness • Langlier Saturation Index (LSI) |
|--|--|

Bromide has been included in the treated water quality standards due to the potential for formation of brominated disinfection by-products ("DBPs") in desalinated water, when it is blended with other water sources.

The reference design has been prepared to set out the essential requirements of the desalination plant for the Contractor to carry out the detailed design.

Design objectives:

- ✓ Compact footprint
- ✓ Optimal energy consumption
- ✓ Provision for future expansion
- ✓ Operation flexibility

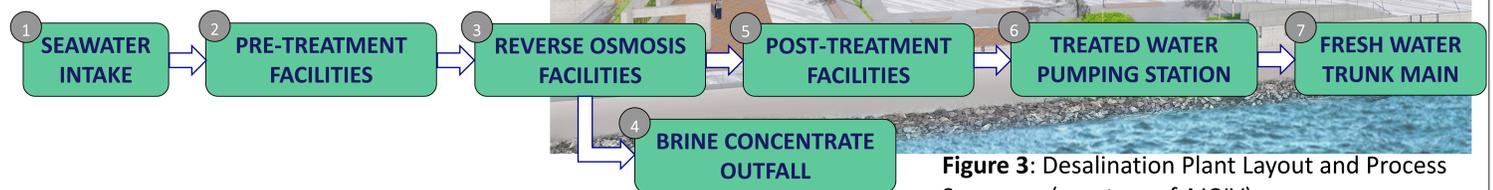


Figure 3: Desalination Plant Layout and Process Summary (courtesy of AJCJV)

PROCUREMENT STRATEGY AND SPECIAL CONTRACT FEATURES

Among various procurement methods, WSD has opted to implement the project using a design-build-operate ("DBO") model which includes an operation period of 10 years certain and extendable to 15 years. The plant will be handed over to WSD afterwards. Tenderers will have the incentive to utilize their experience and expertise in formulating the design to optimize energy efficiency and enhance cost effectiveness not only for construction but also from operation perspective. Procuring the plant using DBO method also gives WSD an opportunity to co-locate WSD colleagues with the DBO contractor during the operation stage for acquiring the experience in operating a seawater desalination plant which is new to Hong Kong. In preparing the contract document, tailor-made features for the operation phase are incorporated into this DBO contract to ensure reliability in operation, quality assurance of the operator and flexibility in the contract to cope with the changing circumstances. These features include:

Maintenance and Asset Replacement Programme for Major Plant and Equipment

The DBO contractor's asset replacement programme will list all the major plant and equipment which are envisaged to be replaced throughout the operation period, detailing the time of replacement along with the associated replacement costs. As the major plant and equipment are replaced according to the asset replacement programme, payment for the replacement will be made to the DBO contractor accordingly. Full condition surveys on the whole desalination plant will be carried out every 5 years during the operation period to ensure that all facilities are properly operated and maintained before the handover of the desalination plant to WSD.

Provision for Facility Enhancement

Over the 10 to 15 years operation period, new technologies may emerge over time and facilities in the plant may be upgraded to adopt new technologies and new requirements. Proposals for facility enhancement will be allowed during the operation period and the actual cost for the improvement works will be reimbursed to the DBO contractor.

Structured Governance

To promote operational excellence, a leadership group will be set up upon commencement of the plant operation. The leadership group consist of senior management of WSD and the DBO contractor, allowing them to review and monitor the plant operation performance, and to agree on the management plan of the plant annually. The operation plan will also be updated annually to set out the arrangement for any plant overhaul, proposed enhancement works, staffing plan etc.

Knowledge Transfer by Secondment

To pave the way for the eventual plant operation by WSD in the future, during operation stage by the DBO contractor, WSD will second a number of professional and technical staff to form an integrated operation and maintenance team with the DBO contractor. This will enable WSD staff to acquire hands-on operation and maintenance experience at various levels ranging from frontline to plant management. To build up a sizable workforce with hands-on experience, regular rotation of the WSD seconded staff will be arranged.

Performance Guarantee by Key Performance Indicators

To ensure that the DBO contractor operate and maintains the desalination plant effectively, the guaranteed performance parameters will be monitored throughout the operation period under a comprehensive set of Key Performance Indicators covering production level, water quality, safety, environmental performance, etc. Annual capacity tests will be carried out to verify the Guaranteed Production Capacity of the desalination plant.

Conclusions

The TKO desalination plant will be the first seawater reverse osmosis desalination plant in Hong Kong. With the in-depth studies conducted to conclude the technical feasibility in local context and the procurement features tailor-made to ensure smooth operation of the desalination plant, the TKO desalination plant will serve its purpose to provide a strategic new water resource to better Hong Kong in combating the challenges in water supply.