For discussion on
2 June 2015

LEGISLATIVE COUNCIL
PANEL ON ENVIRONMENTAL AFFAIRS

Provision of on-shore power supply at Kai Tak Cruise Terminal

PURPOSE

This paper reports on the key findings of a technical feasibility study on the provision of on-shore power supply (OPS) at the Kai Tak Cruise Terminal (KTCT) and recommends the way forward.

BACKGROUND

2. Ocean going vessels (OGVs) such as container vessels, cruises, etc. will operate their auxiliary engines while berthing in order to provide electricity for lighting, ventilation, loading and unloading, and other operations. Their auxiliary engines use residual fuel oil, whose sulphur content could be up to 3.5% as capped by the International Maritime Organization. Their sulphur dioxide (SO_2) emissions during berthing account for about 40% of their total SO_2 emissions in Hong Kong waters.

3. To improve air quality for protecting public health, we enacted the Air Pollution Control (Ocean Going Vessels)(Fuel at Berth) Regulation on 15 April 2015, which will require all OGVs to switch to marine fuel of sulphur content not exceeding 0.5% when berthing, starting from 1 July 2015. Hong Kong is the first port in Asia to mandate fuel switching for OGVs.

4. To reduce the emissions of OGVs at berth, the use of OPS could be an alternative such that their auxiliary engines can be turned off. To do so, the dockside should have OPS and the OGV should be equipped to use the electricity supplied at dedicated voltage and frequency. In 2007, the

International Electrotechnical Commission (IEC) started working on an international technical standard to help OGVs to use OPS. In July 2012, the IEC released the first part of its standard for OPS and aimed to release the remaining part in January 2016. The first part of the standard is on the hardware of OPS while the second part is on the software, which does not affect the physical design and interface of an OPS.

5. To enable the development of OPS in Hong Kong, the design of KTCT has allowed for the future installation of OPS facilities. The Environmental Protection Department (EPD) entrusted the Electrical and Mechanical Services Department in November 2013 to engage a consultant to study the technical feasibility of installing OPS at KTCT. The consultancy study was completed in July 2014. Subsequently, EPD has conducted further analysis to collate information from cruise liners and cruise terminals on their plans to adopt OPS or other alternative emission abatement measures.

FINDINGS OF THE STUDY

Technical Feasibility

6. KTCT has two berths, which could accommodate a maximum of three mid-sized ("Panamax Class") cruise vessels, e.g. Sun Princess from Princess Cruises, or two large-sized ("Genesis Class") cruise vessels, e.g. Oasis of the Seas and Allure of the Seas from Royal Caribbean International, to berth simultaneously. Sufficient space at KTCT can be made available for accommodating two bare plant rooms for installing OPS.

7. The consultancy study has confirmed the technical feasibility to install OPS at KTCT. To meet the electricity demand of the cruises berthed there, each plant room could be installed one OPS unit with a maximum power at 25MVA at dual frequency (50Hz/60Hz) and dual high voltage system (6.6KV/11KV). The latter is the international standard set by IEC for the hardware of an OPS installation. Each unit can serve one large-sized cruise vessel or two mid-sized cruise vessels simultaneously. The dual frequency arrangement is needed at KTCT because the vast majority of international

cruises are equipped to use electricity at a frequency of 60 Hz [1] but the frequency of local electricity is 50 Hz.

8. The estimated capital cost at April 2014 price level for the whole OPS system is about $315 million, including the engineering consultancy for detailed design, equipment and system procurement, structural and civil works and allowances for contingencies. The annual recurrent cost including maintenance and operation is estimated to be around $14 million at April 2014 price level, assuming full operation over the year. A breakdown of the key cost items is at **Annex**. It is worth noting that an OPS providing dual frequencies is more costly than one operating on single frequency. The dual frequency arrangement in KTCT could account for about 26% of the total capital cost of the OPS.

9. Installing an OPS at KTCT will be a capital work item. The key steps include preparing Technical Feasibility Statement and detailed design, seeking funding approval, tendering and construction. The programme for the installation works is likely to be quite lengthy (possibly several years) due to the need to avoid clashing with berthing of the visiting cruises. The whole process may take up to about 60 months.

Market Demand Assessment

10. In order to use electricity provided by OPS, cruises must be equipped with the necessary equipment and shore power connection point on board. Based on the findings of the consultancy study and EPD's follow-up survey, globally only 32 international cruises were OPS-capable in 2014. Three cruises are expected to be retrofitted with OPS in 2015, raising the total number of OPS-capable cruises to 35, accounting for about 16% of the international cruises [2] in 2015. Most of these OPS-capable cruises operate in routes in North America.

11. According to the cruise schedule of KTCT in Year 2015 (as at 6 May

1 According to a study [Chalmbers University of Technology, 2008, "A feasibility study and a technical solution for an on-shore electrical infrastructure to supply vessels with electric power while in port"], 83% of the cruises surveyed (39 out of 47 cruises surveyed) operate at a frequency of 60 Hz. Besides, according to the 2015 cruise schedule of KCTC, 56 calls will be made by 17 cruises at KCTC in 2015. All these 17 cruises operate at a frequency of 60 Hz.

2 As of March 2015, there are 214 international cruise ships owned by 25 Global Cruise Line Members of the Cruise Lines International Association.

2015), there would be 56 cruise-calls. Only six calls would be made by OPS-capable cruises, or about 10% of the total calls scheduled for 2015. There is however no indication that the share of OPS-capable cruises in local cruise-calls would increase substantially in the foreseeable future.

12. Currently, seven cruise terminals in North America are providing OPS for international cruises, which operate at 60Hz only. In Europe, the first OPS for international cruises with dual frequencies is being built in the Port of Hamburg and the installation is expected to be completed in 2015 [3]. No cruise terminal in Asia has OPS in operation.

13. There are some 60 cruise terminals in the Asia Pacific region. We understand that only five ports are considering the provision of OPS in the coming five to ten years. The survey findings suggest that setting up OPS is not a priority task among cruise ports in the Asia Pacific region and this will likely remain so in the foreseeable future. It would thus be difficult to attract the global cruise liners to deploy their OPS-capable cruises to the region. In other words, cruise companies are likely to continue to deploy the majority of their OPS-capable cruise ships in North America for the foreseeable future.

14. There is a new trend that is affecting the development of the OPS-technology which we need to take into account. Over the last two years, scrubber (a mature abatement technology for land-based emission sources) is gaining popularity as a measure to reduce the SO_2 and particulate matters (PM) emissions of OGVs, including cruises. Scrubbers of advanced design could cover all the operation modes of OGVs (i.e. normal operation at sea, maneuvering and berthing). Most importantly, with a scrubber, OGVs can run on heavy fuel oil without breaching the latest sulphur limit requirement (0.1% sulphur content) of the Emission Control Areas in North America and Europe while saving fuel cost. As a result, an increasing number of cruises are being fitted with scrubbers. The world's largest cruise liner announced in 2014 a plan to retrofit more than 70% of its fleet [4] with scrubbers. The second largest cruise liner will retrofit at least 50% of its fleet and provide scrubbers in

---

[3] In Europe, there are a few ports providing OPS for inland vessels such as RORO (roll-on/roll-off) ferries but not for international cruises. The first OPS for international cruise terminal is being built in Port of Hamburg.

[4] http://phx.corporate-ir.net/phoenix.zhtml?c=200767&p=irol-newsArticle&ID=1933369
http://www.rivieramm.com/article/carnival-builds-on-its-scrubber-strategy-18267

its new built ships [5]. Another cruise liner plans to expand its fleet with scrubbers up to 60% [6]. Eventually, at least 60% of the world's international cruise vessels will be equipped with scrubbers to reduce emissions. This development will further reduce the interest of cruise liners to retrofit their cruises with OPS capable system and also the eagerness of cruise ports to set up OPS.

WAY FORWARD

15. On environmental considerations, the use of OPS would eliminate emissions from cruises while the vessels are at berth. However, current findings indicate that, the proposed OPS system at KTCT, if installed, will be significantly underutilized in the foreseeable future because:

(a) Globally, only a small number of cruise vessels can use OPS. Most of them are operating in North America. Major cruise liners now prefer to add scrubbers for reducing their emissions, particularly to fulfill the requirements of Emission Control Areas. It is unlikely that OPS will become the technology of choice among cruise vessels for reducing their emissions;

(b) OPS systems are costly to install. The capital investment in KTCT could be up to $315 million (2014 price level). The annual recurrent cost could be up to $14 million (2014 price level). The high cost outlay coupled with low interest of cruise liners in equipping their vessels with OPS are not conducive to the installation of OPS systems; and

(c) OPS could be more costly to use than low sulphur fuel in Hong Kong. As such, OPS-capable cruises visiting Hong Kong would likely prefer to continue with the mandatory requirement of switching to low sulphur fuel (which will take effect on 1 July 2015) while they are at berth in Hong Kong, instead of opting to use OPS.

16. Having regard to the above considerations, we recommend to keep a

5 http://www.rclinvestor.com/phoenix.zhtml?c=103045&p=irol-newsArticle&ID=2001601

6 http://www.ncl.com/nclweb/pressroom/pressRelease.html?storyCode=PR_021314

close monitoring on developments internationally on installation of OPS-capable systems in cruises for the time being. As and when there is a rising trend of installation of OPS capable systems in cruises, we would review whether it is appropriate to take forward the installation of OPS in KTCT and seek Members' views.

Environmental Protection Department
May 2015

Annex

Breakdown of the capital cost and operating cost of an OPS at the KTCT

Capital Cost

Description	Estimated Cost ($ million)
Detailed Design Work	12
Base OPS system	
1. OPS Equipment in Plant Rooms	133.2
2. OPS Berth Systems	65.7
3. Structural and Civil Works	4.9
4. Risk Allowance [7]	40.8
5. Provision Sum for Price Fluctuations and MPF [8]	57.5
Total	**314.1** **315 (rounded)**

[7] Allowances for contingencies are estimated in accordance with "Estimating using Risk Analysis" approach as promulgated by Works Branch Technical Circular No 22/93.

[8] Annual increment for price fluctuations is assumed to be 5.5% from Year 2014 to Year 2017 and Mandatory Provident Fund (MPF) is assumed to be 3% of the sum of base OPS system.

Operating Cost

Description	Maintenance Cost [9] ($ million)	Operation Cost [10] ($ million)
1. OPS Equipment in Plant Rooms	5.6	1.9
2. OPS Berth Systems	4.1	2.0
3. Structural and Civil Works	0.035	---
Sub-total	**9.7** **10 (rounded)**	**3.9** **4 (rounded)**
In total ***(Maintenance + operation)***	**13.6** **14 (rounded)**	

[9] The annual maintenance includes inspections, repair testing, parts replacement for transformers, switchgear, cooling system, automation system and mobile cable units etc. The maintenance cost is estimated to be the sum of 5-7% of its capital cost for OPS equipment in plant rooms and berth systems. For structural and civil work, the maintenance cost is estimated to be 0.5-0.7% of its capital works.

[10] The annual operation cost includes trained labour and plants cost to operate the mobile cable units and to connect/disconnect cables from ships, assuming full operation over the year.