

ITEM FOR PUBLIC WORKS SUBCOMMITTEE OF FINANCE COMMITTEE

HEAD 705 – CIVIL ENGINEERING

Civil Engineering – Multi-purpose

45CG - District Cooling System at the Kai Tak Development

Members are invited to recommend to Finance Committee the upgrading of **45CG** to Category A at an estimated cost of \$1,671 million in money-of-the-day prices for providing a district cooling system at the Kai Tak Development.

PROBLEM

The Kai Tak Development (KTD) will generate substantial new demand for air-conditioning. The Government should grasp the opportunity to promote energy efficiency in the provision of air-conditioning in this area.

PROPOSAL

2. The Director of Electrical and Mechanical Services, with the support of the Secretary for the Environment, proposes to upgrade **45CG** to Category A at an estimated cost of \$1,671 million in money-of-the-day (MOD) prices for the provision of a District Cooling System (DCS) at KTD.

PROJECT SCOPE AND NATURE

3. The scope of works under **45CG** comprises –

/(a)

- (a) construction of a northern chiller plant;
- (b) construction of a southern underground chiller plant cum underground seawater pumphouse and above-ground operational facilities;
- (c) laying of seawater intake and discharge pipelines;
- (d) laying of chilled water distribution pipe networks; and
- (e) provision of connection facilities (including heat exchangers) at user buildings at KTD.

———— A conceptual layout plan¹ of the proposed DCS at KTD is at Enclosure 1.

4. The project will be developed and commissioned for operation in phases. We plan to commence the design and construction works in April 2010 for commissioning of the first phase from 2013 onward to match the developments at KTD in the period from 2013 to 2015. The second phase and the third phase for the proposed works are targeted to be commissioned by mid 2016 and mid 2021 respectively for operation to match the schedule of respective packages of developments at KTD. For optimal use of capital cost, the construction and installation schedule of the component equipment and distribution networks will be suitably adjusted to suit the actual development schedules of respective developments of KTD.

JUSTIFICATION

5. KTD, with a planned total of about 1.7 million square metres (m²) in public and private non-domestic air-conditioned floor areas requiring about 284 megawatt (MW) cooling capacity, presents a unique opportunity for implementation of a DCS in Hong Kong. As announced in the 2008-09 Policy Address, the Government plans to implement a DCS at KTD to promote energy efficiency and conservation. The project is to construct a large scale centralized air-conditioning system which produces chilled water at its central chiller plants and distributes the chilled water to user buildings in KTD through an underground water piping network. A line schematic diagram explaining the distribution of chilled water is at Enclosure 2.

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¹ As the project will be implemented under a Design-Build-Operate contract, the conceptual layout plan of the proposed works is for illustrative purpose only and subject to the contractor's design.

6. The DCS is an energy-efficient air-conditioning system as it consumes 35% and 20% less electricity as compared with traditional air-cooled air-conditioning systems and individual water-cooled air-conditioning systems using cooling towers respectively. The technology has been widely adopted around the world. Examples of DCSes in overseas countries are at Enclosure 3.

7. **45CG** can bring about significant environmental benefits. By implementing the proposed project, the maximum annual saving in electricity consumption will be up to 85 million kilowatt-hour, equivalent to a maximum annual saving of \$76.5 million in electricity bill, and a reduction of 59 500 tonnes of carbon dioxide emission per annum for the planned total public and private non-domestic air-conditioned floor area of about 1.7 million m². Furthermore, by connecting to the DCS, user buildings do not need to install their own chillers and the associated electrical equipment. The noise and heat arising from operation of these equipment to adjacent buildings can be eliminated.

8. The implementation of DCS at KTD is also in line with the environment-friendly planning theme for KTD under the Kai Tak Planning Review conducted by the Planning Department in 2004. The planning theme, as highlighted in the Kai Tak Planning Review completed in November 2007, is “Heritage, Green, Sports and Tourism Hub of Hong Kong”. The implementation of DCS is one of the initiatives to promote environment-friendly and sustainable development in Kai Tak.

9. The proposed DCS is for public and private non-domestic developments at KTD. As a demonstration of Government’s determination to reduce energy consumption, all public developments² at KTD will connect to the DCS provided that their implementation programme can match the development schedule of DCS.

10. The connection to the proposed DCS for private non-domestic developments would be on a voluntary basis. We will approach the relevant private developers at an early stage to promote the service. While we do not propose to mandate the use of DCS by private developments, we believe the DCS would enjoy a high subscription given the following benefits –

/(a)

² By “public developments”, our targets are all Government premises and developments funded or commissioned by the Government which are not for domestic use.

- (a) reduction of upfront capital cost for installing chiller plants at their buildings;
- (b) user buildings do not need to install their own chillers and the associated electrical equipment thus allowing more flexible building designs;
- (c) the DCS is more adaptable than individual air-conditioning system to the varying demand for air-conditioning; and
- (d) the service quality and reliability will be overseen by the Electrical and Mechanical Services Department (EMSD).

FINANCIAL IMPLICATIONS

11. We estimate the capital cost of the proposed works to be \$1,671 million in MOD prices (see paragraph 12 below), made up as follows –

	\$ million	
(a) DCS plants		
(i) civil works	422.0	
(ii) electrical and mechanical works	464.0	
(b) Mains laying	279.0	
(c) Connection facilities at user buildings	54.0	
(d) Environmental mitigation measures	10.0	
(e) Consultants' fee for contract administration	9.0	
(f) Resident site staff costs	41.0	
(g) Contingencies	123.0	
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Sub-total	1,402.0	(in September 2008 prices)
(h) Provision for price adjustment	269.0	
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Total	1,671.0	(in MOD prices)
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A detailed breakdown of the estimates for the consultant's fees and resident site staff costs by man-months is at Enclosure 4.

12. Subject to approval, we will phase the expenditure as follows –

Year	\$ million (Sept 2008)	Price adjustment factor	\$ million (MOD)
2010-2011	75.0	1.05570	79.2
2011-2012	119.0	1.07681	128.1
2012-2013	194.0	1.09835	213.1
2013-2014	234.0	1.12032	262.2
2014-2015	168.0	1.15113	193.4
2015-2016	113.0	1.18566	134.0
2016-2017	99.0	1.22123	120.9
2017-2018	83.0	1.25787	104.4
2018-2019	76.0	1.29560	98.5
2019-2020	75.0	1.33447	100.1
2020-2021	65.0	1.37450	89.3
2021-2022	47.0	1.41574	66.5
2022-2023	27.0	1.45821	39.4
2023-2024	12.0	1.50196	18.0
2024-2025	6.0	1.54702	9.3
2025-2026	5.0	1.59343	8.0
2026-2027	4.0	1.64123	6.6
	1,402.0		1,671.0

13. We have derived the MOD estimates on the basis of the Government's latest forecast of trend rate of change in the prices of public sector building and construction output for the period 2010 to 2027. The contract will provide adjustments for price fluctuation as appropriate.

14. We estimate that the annual recurrent expenditure arising from this project will increase from about \$2.487 million in the initial operation year of 2012-13 to about \$75.460 million upon full development by 2025-26 assuming a 50% subscription rate. The estimated annual recurrent costs based on the assumed subscription rate of 50% are at Enclosure 5. Subject to the approval of the Legislative Council of the relevant legislation, the recurrent costs arising from the proposal, including the service fee payment to the contractor and other operating costs, will be offset by the DCS tariff charges to users.

15. The provision of DCS service to users will be subject to payment of a tariff. We will introduce a new legislation into the Legislative Council for the Government to charge tariff for the provision of DCS services and to provide for the necessary powers and duties in relation to the operation and accounting arrangements of DCS services. We envisage that the Government should be provided with sufficient flexibility to determine the charging structure, tariff levels and adjustment mechanism to ensure that the capital and operating costs can be recovered from users over the project life, while the tariff can be set at a competitive level comparable to the charge of individual water-cooled air-conditioning systems using cooling towers (one of the most cost-effective air-conditioning systems available in the market) so as to attract a critical mass of private users to connect to DCS. The Government is currently conducting a consultancy study on the development of a tariff scheme and charging schedule.

PUBLIC CONSULTATION

16. We have consulted the following parties which either supported or had no objection to the proposal -

- (a) the Energy Efficiency and Conservation Sub-committee of the Energy Advisory Committee (24 October 2008);
- (b) Wong Tai Sin District Council (18 November 2008);
- (c) the Environment and Hygiene Committee of the Kwun Tong District Council (2 December 2008);
- (d) the Housing and Infrastructure Committee of the Kowloon City District Council (11 December 2008); and
- (e) the Harbour-front Enhancement Committee (15 December 2008).

17. We consulted the Legislative Council Panel on Environmental Affairs on the proposed works on 15 December 2008. Members did not object to the submission of the proposal to the Public Works Subcommittee for consideration.

18. We gazetted the proposed works for the seawater intake and outfalls for the DCS plants under the Foreshore and Seabed (Reclamations) Ordinance on 19 December 2008. We received one objection which was subsequently withdrawn on 27 February 2009. The proposed works was authorised on 20 March 2009.

19. On 24 December 2008, we submitted a planning permission application to the Town Planning Board under section 16 of the Town Planning Ordinance for the underground DCS including chiller plant cum seawater pump house and above-ground operational facilities as proposed public utility installation in “Open Space”, “Commercial (4)”; and “Residential (Group C)” zones lying at the middle section of the ex-Kai Tak Airport runway, Kai Tak shown in the approved Kai Tak Outline Zoning Plan No. S/K22/2. Having considered the public comments, the Town Planning Board approved the application with conditions on 13 February 2009.

ENVIRONMENTAL IMPLICATIONS

20. **45CG** is not a Schedule 2 designated project requiring environmental permit under the Environmental Impact Assessment (EIA) Ordinance. However, the DCS forms part of the overall KTD which is a Schedule 3 designated project under the EIA Ordinance. The KTD EIA report approved by the Director of Environmental Protection (DEP) on 4 March 2009 concluded that the DCS would not cause adverse long term environmental impact.

21. The cooling water discharge of the DCS would be subject to license control imposed by DEP under the Water Pollution Control Ordinance. The cooling water discharge of the DCS will be designed at a standard higher than that of the prevailing licensing requirements.

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22. For short term construction impacts, we will control noise, dust and site run-off to levels within established standards and guidelines, through the implementation of mitigation measures recommended in the KTD EIA report, such as the use of quiet construction plant, water-spraying and proper pre-treatment of site run-off. We will also carry out site inspections to ensure that these recommended mitigation measures and good site practices are properly implemented.

23. We have considered the alignment, design level and construction method of the proposed works in the planning and design stages to reduce the generation of construction waste where possible. In addition, we will require the contractor to reuse inert construction waste (e.g. excavated soil) on site or in other suitable construction sites as far as possible, in order to minimize the disposal of inert construction waste to public fill reception facilities³. We will encourage the contractor to maximize the use of recycled or recyclable inert construction waste, as well as the use of non-timber formwork to further minimize the generation of construction waste.

24. We will also require the contractor to submit for approval a plan setting out the waste management measures, which will include appropriate mitigation means to avoid, reduce, reuse and recycle inert construction waste. We will ensure that the day-to-day operations on site comply with the approved plan. We will require the contractor to separate the inert portion from non-inert construction waste on site for disposal at appropriate facilities. We will control the disposal of inert construction waste and non-inert construction waste to public fill reception facilities and landfills respectively through a trip-ticket system.

25. We estimate that the project will generate in total about 923 161 tonnes of construction waste. Of these, we will reuse about 346 619 tonnes (37.5%) of inert construction waste on site and deliver 473 362 tonnes (51.3%) of inert construction waste to public fill reception facilities for subsequent reuse. In addition, we will dispose of 103 180 tonnes (11.2%) of non-inert construction waste at landfills. The total cost of accommodating construction waste at public fill reception facilities and landfill sites is estimated to be \$25.7 million for this

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³ Public fill reception facilities are specified in Schedule 4 of the Waste Disposal (Charges for Disposal of Construction Waste) Regulation. Disposal of inert construction waste in public fill reception facilities requires a licence issued by the Director of Civil Engineering and Development.

project (based on a unit cost of \$27/tonne for disposal at public fill reception facilities and \$125/tonne⁴ at landfills).

ENERGY CONSERVATION MEASURES

26. Apart from the environmental benefits brought by this project as detailed in paragraph 7 above, this project has also adopted various forms of energy efficient features in the buildings/plantrooms design including –

- (a) T-5 fluorescent tubes with electronic ballast for general lighting and occupancy sensors for lighting control; and
- (b) light-emitting diode (LED) type exit signs.

27. For renewable energy technologies, this project will use solar energy for exterior lighting.

28. For greening features, the above-ground operational facilities such as ventilation shafts, ground accesses, etc. of the southern underground chiller plant cum underground seawater pump house are proposed to be covered with greening features; and the open space of the northern chiller plant is proposed to be landscaped.

29. The total estimated additional cost for adoption of the above features is around \$1.4 million (including \$0.4 million for energy efficient features), which has been included in the cost estimate of the project. The energy efficient features will achieve 3.6% energy savings in the annual energy consumption of building services in the buildings/plantrooms with a payback period of about 7.4 years.

HERITAGE IMPLICATIONS

30. The project will not affect any heritage site, i.e. all declared monuments, proposed monuments, graded historic sites/buildings, sites of archaeological interest and Government historic sites identified by the Antiquities and Monuments Office.

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⁴ This estimate has taken into account the cost for developing, operating and restoring the landfills after they are filled and the aftercare required. It does not include the land opportunity cost for existing landfill sites (which is estimated at \$90/m³), nor the cost to provide new landfills (which is likely to be more expensive) when the existing ones are filled.

LAND ACQUISITION

31. The proposed works do not require any land acquisition.

BACKGROUND INFORMATION

32. At the Public Account Committee hearing in December 1999, Members urged the Administration to expedite its effort in promoting and facilitating the wider use of water-cooled air-conditioning systems in Hong Kong. The EMSD commissioned a study on the implementation of a DCS at South East Kowloon Development (SEKD) (i.e. the Kai Tak Development) in 2001. The study was to examine the detailed technical, environmental, regulatory, financial, institutional, contractual, infrastructural, and land use requirements for the implementation of DCS, and to draw up an implementation plan for the DCS at the then SEKD. The findings and recommendations of which were supported by the Legislative Council Panel on Environmental Affairs in end 2002. Further to the SEKD study, an updated study on DCS based on the KTD plan was completed in late 2007. The study in 2007 is to update the reference scheme, potential services providers, land issues, financial analysis, project risks and measures and alternative approaches of DCS. The sums of the two studies are about \$7.3 million funded under **Head 42 Subhead 700** Item 703 C2 "Implementation Study to a District Cooling System at South East Kowloon Development".

33. Further to the announcement of implementation of DCS in the 2008-09 Policy Address, we included **45CG** in Category B in October 2008.

34. The project works will be carried out by Design, Build and Operate (DBO) contract arrangement given the following considerations -

- (a) the proposed DCS is the first of its kind in Hong Kong and is essentially a pilot project. As the cost and disruptions for buildings that have chosen the proposed DCS service to switch to other cooling systems are prohibitive, there are merits for the Government to assume a higher level of involvement in the design and operation of the proposed DCS so as to ensure system reliability as well as reasonable service quality and price. Experience gained will serve as a reference for possible development of DCSes in other districts; and

/(b)

- (b) without the proposed DCS at an early stage of KTD, each private development coming on stream will build its own individual cooling system. The DBO approach will facilitate early delivery of the proposed DCS to achieve sufficient subscription for sustaining the DCS project.

35. There are three trees within the project boundary. The proposed construction of the project will affect them and require tree removal including one tree to be felled and two trees to be replanted within the project site. None of the trees to be removed are important trees⁵. To compensate one tree to be felled, we will incorporate planting proposal (of an estimated quantity of three new trees and 1 000 shrubs) as part of the project.

36. We estimate that the proposed works will create about 460 jobs (377 labourers and 83 professional/technical staff) providing a total employment of 20 800 man-months.

Environment Bureau
April 2009

⁵ "Important trees" refers to trees in the Register of Old and Valuable Trees, or any other trees that meet one or more of the following criteria -

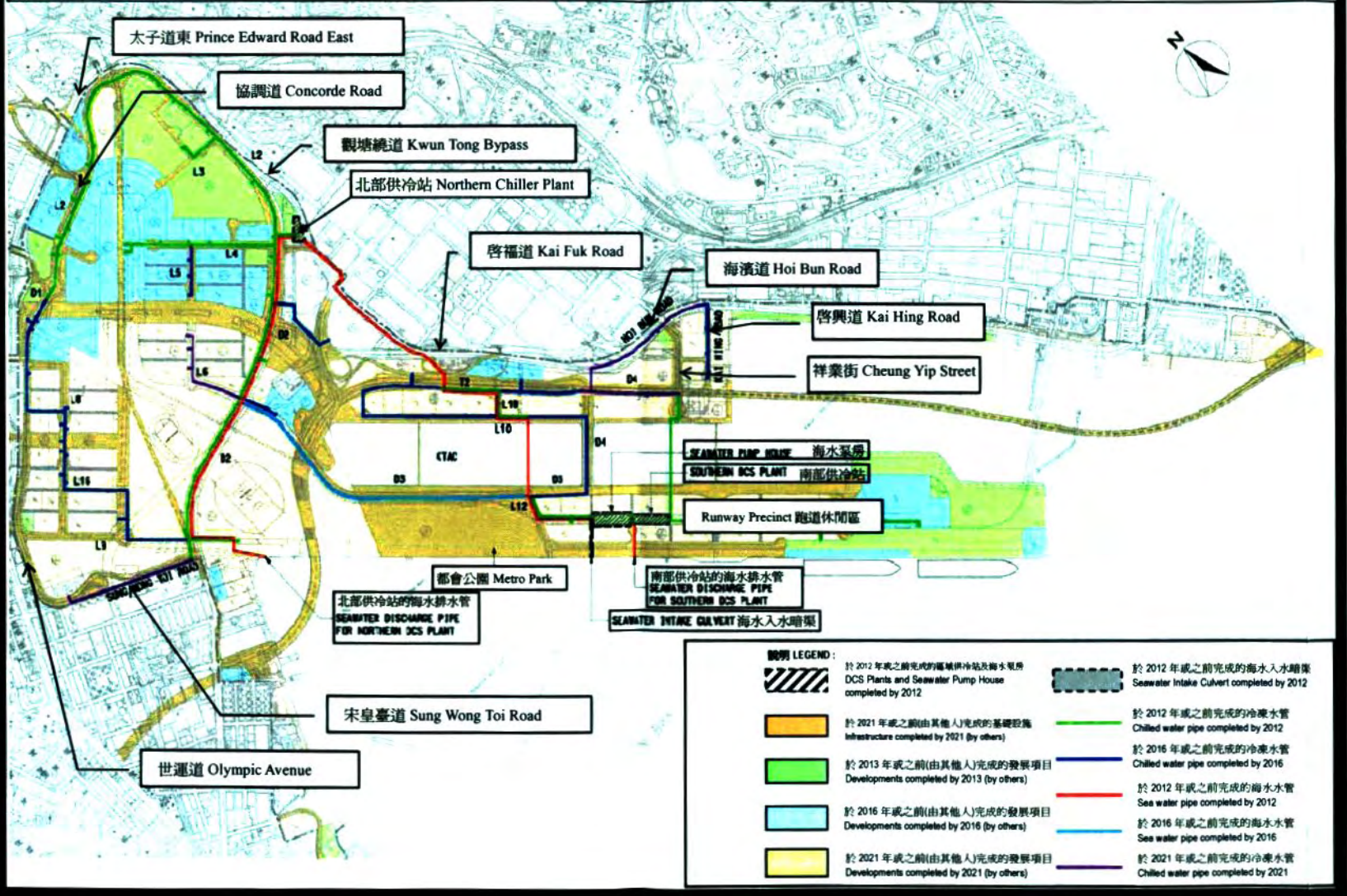
- (a) trees of 100 years old or above;
- (b) trees of cultural, historical or memorable significance e.g. Fung Shui tree, trees as landmark of monastery or heritage monument, and trees in memory of an important person or event;
- (c) trees of precious or rare species;
- (d) trees of outstanding form (taking account of overall tree sizes, shape and any special features) e.g. trees with curtain like aerial roots, trees growing in unusual habitat; or
- (e) trees with trunk diameter equal or exceeding 1.0 metres (measured at 1.3 metre above ground level), or with height/canopy spread equal or exceeding 25 metres.

5045CG 啓德發展計劃區域供冷系統

5045CG DISTRICT COOLING SYSTEM AT THE KAI TAK DEVELOPMENT

啓德發展計劃區域供冷系統概念設計圖

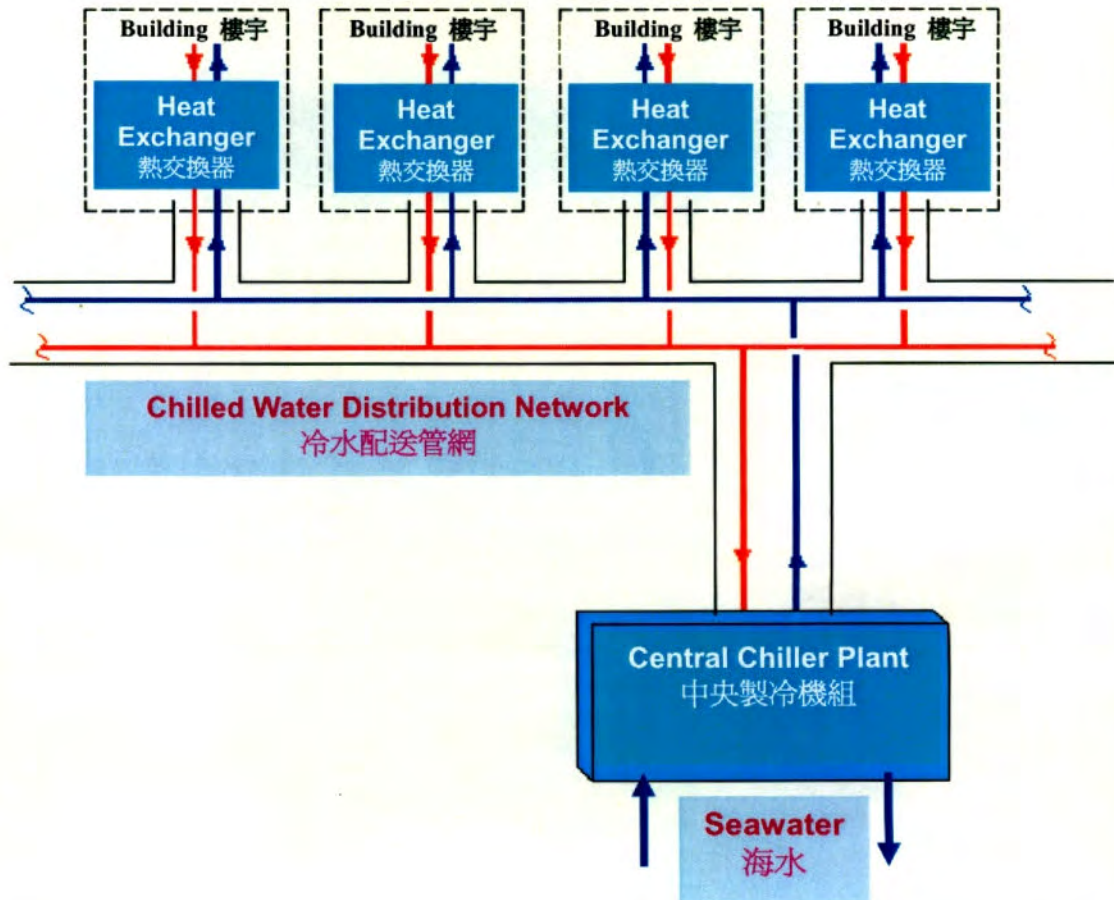
District Cooling System at the Kai Tak Development Conceptual Layout Plan



5045CG 啓德發展計劃區域供冷系統

5045CG DISTRICT COOLING SYSTEM AT THE KAI TAK DEVELOPMENT

區域供冷系統線式示意圖 District Cooling System Line Schematic Diagram



District cooling systems in overseas countries

DCS is a popular air-conditioning system which has been widely adopted in overseas countries. Some prominent examples are set out below for reference (figures in brackets refer to their cooling capacities) -

- (a) United States of America
 - Boston (366MW);
 - Chicago Downtown (349MW);
 - New York International Business Centre (172MW);
 - the Pentagon (132 MW);
 - Denver Airport (42MW);
 - Cleveland, Ohio (35 MW); and
 - New York Kennedy Airport (35MW)

- (b) Canada
 - City of Toronto Downtown (263 MW); and
 - City of Windsor (18 MW);

- (c) Japan
 - Yokohama MM21 (301 MW)
 - Tokyo Marounouchi (232 MW);
 - Tokyo Shinjuku Kabukicho Area (207 MW);
 - Osaka Airport (90 MW);
 - Tokyo Arfino (89 MW);
 - Tokyo Nishi-Shinjuku 1-chome Area (44 MW); and
 - Osaka Senri New Town (69.6 MW);

- (d) United Kingdom
 - Heathrow Airport (28 MW);
 - Channel Tunnel of Shakespeare Cliff Lower (28 MW); and
 - City of London (12 MW);

- (e) France
 - La Defense Business District (243 MW);
 - City Centre of Paris (92 MW);
 - Monaco (36 MW); and
 - Bordeaux Airport (24 MW).

Enclosure 4 to PWSC(2009-10)24

45CG - District Cooling System at the Kai Tak Development

**Breakdown of the estimates for consultants' fees and resident site staff costs
(in September 2008 prices)**

		Estimated man- months	Average MPS* salary point	Multiplier (Note 1)	Estimated fee (\$million)
(i) Consultants' fees for					
(a)	Construction	55	38	2.0	6.6
	supervision and contract administration	55	14	2.0	2.2
(b)	EM&A	1	38	2.0	0.1
	programme	3	14	2.0	0.1
(ii)	Resident site staff	153	38	1.6	14.8
	costs ^(Note 2)	824	14	1.6	26.2
Total					50.0

*** MPS = Master Pay Scale**

Notes

1. A multiplier of 2.0 is applied to the average MPS point to arrive at the full staff costs including the consultant's overheads and profit as the staff will be employed in the consultants' offices. A multiplier of 1.6 is applied to the average MPS point to arrive at the cost of resident site staff supplied by the consultants. (As at 1 April 2009, MPS pt.38 = \$60,335 per month, and MPS pt.14 = \$19,835 per month)
2. We will only know the actual man-months and actual costs after the completion of the construction works.

Enclosure 5 to PWSC(2009-10)24

45CG - District Cooling System at the Kai Tak Development

Estimated recurrent costs on the assumed subscription rate of 50%
(in September 2008 prices)

Year	Estimated recurrent costs* \$ million
2012-2013	2.487
2013-2014	10.309
2014-2015	11.771
2015-2016	19.328
2016-2017	39.563
2017-2018	42.601
2018-2019	42.747
2019-2020	43.584
2020-2021	52.419
2021-2022	72.813
2022-2023	74.450
2023-2024	73.130
2024-2025	73.458
2025-2026	75.460
2026-2027	74.694

* The estimated recurrent costs cover the service fee for the repairs, maintenance and management of the DCS plants operated by the DCS operator, and the operating costs for the electricity and other utility charges such as water for the operation of the DCS plants.