For discussion
on 20 December 2002

Legislative Council Panel on Environmental Affairs

Implementation of District Cooling System at South East Kowloon Development

PURPOSE

This paper aims to brief Members on the findings and recommendations of the consultancy study on the implementation of a district cooling system (DCS) at South East Kowloon Development (SEKD) and seek Members' views on them.

BACKGROUND

2. Air conditioning accounts for 32%[1] of Hong Kong's electricity consumption. The use of more efficient air conditioning systems would be an effective measure to conserve energy. A consultancy study commissioned by the Electrical and Mechanical Services Department (EMSD) concluded in 1999 that a water-cooled air conditioning system (WACS) generally consumes less energy than a conventional air-cooled air conditioning system (AACS) and should therefore be more economically and environmentally attractive. Among the various forms of WACS[2], DCS is the most energy efficient one and can save up to 35% of energy when compared with AACS.

3. DCS is a very large-scale centralised air conditioning system. It consists of one or more chiller plants to produce chilled water (usually at 6^{o}C or below), and a closed loop network of underground pipes for distributing it to buildings within its service area for air conditioning purpose. The chilled water

[1] Year 1998 data from the Energy End Use Database of the Electrical and Mechanical Services Department.

[2] There are three basic forms of WACS in general, namely Centralised Piped Supply System for Condenser Cooling (CPSSCC), Centralised Piped Supply System for Cooling Towers (CPSSCT), and DCS. CPSSCC is a system to supply sea water to the buildings' air conditioning systems which employ once through condensers that require a large water consumption capacity. This system is most suitable for buildings near the sea front. CPSSCT is a system to supply fresh water to the buildings' air conditioning systems which employ evaporative cooling towers. The water consumption is much less than CPSSCC but fresh water is used.

is pumped to individual buildings for use in their air conditioning systems and is then returned to the central chiller plant for re-chilling. Heat rejected from the chilled water network is carried away either by sea water pumped into the chiller plant through a pump house near the sea front, or through cooling towers using fresh water. DCS is being widely used in countries like the US and Japan which have over 6,000 and 140 systems respectively (which are also used for providing district heating). There are also four DCS in Malaysia and two in Singapore.

4. Besides being energy efficient, DCS also has other benefits, e.g. reducing emission of greenhouse gases and air pollutants, saving plant room space in individual buildings, and eliminating noise pollution and water dripping arising from the use of conventional air conditioning systems.

5. At the Public Accounts Committee (PAC) hearing in December 1999 on the use of energy efficient air conditioning systems in Hong Kong, PAC Members opined that air conditioning in commercial premises was no longer simply for comfort but has become a basic requirement for business operations. They urged the Administration to expedite its efforts in promoting and facilitating the wider use of WACS in Hong Kong. We subsequently briefed Members of this Panel on 10 February 2000 and 2 March 2000 on our proposal to conduct various consultancy studies on WACS and the future directions on wider adoption of WACS in Hong Kong. One of the studies proposed was on the implementation of DCS at SEKD.

6. SEKD, with a total site area of over 461 hectares including mainly the former Kai Tak Airport, will be one of the largest urban redevelopment programmes in Hong Kong in the coming years and will be developed in phases. As SEKD will be a new district under planning, it offers an excellent opportunity for implementing the more energy-efficient DCS to meet the demand for air conditioning in the area. Upon full development, the peak cooling demand from non-domestic buildings[3] for the whole SEKD is estimated to reach 200 MW.

7. With the approval of funding by the Finance Committee on 26 May 2000, EMSD commissioned the "Implementation Study for a District Cooling Scheme at South East Kowloon Development" in January 2001 to examine the

[3] In line with the Outline Master Development Plan prepared for South East Kowloon Development, planned non-domestic buildings at SEKD include commercial buildings; stadium; cruise terminal; tourism node; Government, Institution or Community (G/IC) buildings such as schools, hospital, Government complexes; shopping centres, railway stations, etc.

detailed technical, environmental, regulatory, financial, institutional, contractual, infrastructural, and land use requirements for its implementation, and to draw up an implementation plan. The study has recently been completed.

KEY FINDINGS AND RECOMMENDATIONS OF CONSULTANCY STUDY ON IMPLEMENTATION OF DCS AT SEKD

8. The consultant's key findings and recommendations are summarized below:

a) The estimated total capital investment for the DCS project is $655 million at 2001 price level. The system will comprise two central chiller plant buildings, one sea water pump house, and a distribution pipe network (for chilled water and sea water) to serve the whole SEKD area. To tie in with the planned population intake at the time of the study, the first chiller plant and the pump house should commence operation in 2005 and the second chiller plant in 2014.

b) The DCS project is technically viable. However, its financial viability is sensitive to the overall service subscription rate, the pace of development of SEKD, as well as the land costs for the system. More details are given in paragraphs 11 – 13 below.

c) The project can bring about significant environmental benefits. Energy saved at SEKD as a result of the use of DCS is estimated to be 90,000 MWh per year, equivalent to roughly 0.24% of the total electricity demand in Hong Kong in 2001. The estimated energy saved will also result in an annual reduction of about 53,000 tonnes of carbon dioxide (a major type of greenhouse gases), about 0.15% of the total carbon dioxide emission in Hong Kong in 2000. Noise level generated from the plants will also be much lower than that of the traditional AACS. As a whole, DCS will not have any unacceptable impact on the environment during both the construction and its subsequent operation stages.

d) The Government could involve the private sector in taking forward the DCS project, possibly by means of a "build-operate-transfer" (BOT)

contract. It is suggested that the DCS operator should be allowed to operate the facilities for 30 years. After the expiry of the contract, ownership of the whole system would be returned to the Government subject to the latter paying the residual value of the assets to the operator.

e) No new legislation is required to implement DCS at SEKD.

f) Non-residential buildings will be the main users of DCS. It is likely that extending the DCS service to residential buildings, even the high-density ones, may not be able to yield any marginal return for the DCS operator and would therefore reduce the commercial viability of the project.

9. The study also identifies a number of risks and uncertainties that the DCS operator and DCS users might encounter. From the DCS operator's perspective, its major risks are the uncertainty in the subscription rate, the intensive upfront capital outlays, and the long payback period. For DCS users, the main concerns are about their limited bargaining power and control over the services provided by the DCS operator once they opt to subscribe to the DCS service.

10. To gauge the interest of the private sector in the DCS, the consultant wrote to a number of stakeholders (e.g. overseas DCS service providers, local utility companies, property developers, contractors in construction and air conditioning industries, consulting engineers, professional engineering institutions and financial institutions) in June 2002, inviting their views on the implementation of a DCS at SEKD on a no-commitment basis. 12 companies subsequently indicated their interest in tendering for the project by setting up consortiums or joint ventures. Most of them opined that the project should be commercially viable if there was certainty on the uptake rate and incentives could be given. However, in line with the projection of the consultant, most respondents are not in favour of extending the DCS service to domestic buildings as it would undermine the commercial viability of the project.

THE PROJECT'S FINANCIAL VIABILITY

11. Based on the consultant's cost model and the development programme of

SEKD at the time of the study, it is estimated that the net present value (NPV) of the project is $64 million for a contract period of 30 years under the following assumptions:

a) The DCS service will be provided to non-domestic buildings only, with the following estimated subscription rates:

Type of building	**% of total non-domestic cooling demand (in 2018)**	**Estimated service subscription rate**
Government, Institution or Community (G/IC) facilities under Government control (e.g. Government complexes, police station, post office, etc)	20%	100%
G/IC facilities not under direct control of Government (e.g. hospitals, commercial premises under the Housing Authority, etc.)	33%	70%
Private commercial developments	47%	50%

b) There is no major variation in the development programme and development mix of SEKD after the study.
c) The DCS operator charges its customers at a tariff comparable to the expenditure incurred by the customers in obtaining air-conditioning from their own WACS.
d) After the contract expires, Government will resume the ownership of the whole system by paying the DCS operator the residual value of the assets.
e) The DCS operator does not have to pay any land cost to the Government, including premium for the land associated with the DCS or fees for

laying distribution pipes on Government land[4].

12. The study reveals that the financial viability of the project is very sensitive to the following factors:

a) **ultimate service subscription rate** (especially from G/IC facilities, which will ultimately account for over 50% of the forecast maximum total non-domestic demand) – assuming G/IC facilities under Government's direct control do not subscribe to the service, the NPV of the project will decrease to -$160 million (i.e. there will be a net loss);

b) **changes in the development programme of SEKD** – a slippage of one year for planned developments in SEKD after 2010 will cause the NPV of the project to decrease by $33 million (from $64 million to $31 million);

c) **premium** for land associated with DCS and the **fees for laying pipes** under Government land – if the DCS operator has to pay these costs, the NPV of the project will decrease by $191 million to -$127 million.

13. In order to ensure that the project can remain reasonably attractive to the private sector, the consultant has suggested that the Government should consider providing some support, for example, by reducing the project risk through requiring all G/IC facilities under Government's direct control to subscribe to the district cooling service and by waiving the land costs for the DCS facilities and for laying distribution pipes.

GOVERNMENT'S POSITION

14. From the environmental perspective, the Government is supportive of the use of a more energy-efficient cooling system in principle. The consultant's recommendation to involve the private sector in taking forward the project is also generally in line with the prevailing Government policy to foster public-private partnerships. However, as the study has just been completed, the Government will need more time to examine the findings and recommendations of the consultant, including their financial implications to the Government. We

[4] These fees may be waived if DCS is considered as a public utility.

welcome views from Members on the way forward.

ADVICE SOUGHT

15. Members are requested to note the findings of the consultancy study and offer views.

Environment, Transport and Works Bureau
Electrical and Mechanical Services Department
December 2002