

Report No. 53 of the Director of Audit — Chapter 11

WIDER USE OF WATER-COOLED AIR-CONDITIONING SYSTEMS

Summary

1. Central air-conditioning systems can be broadly categorised as air-cooled air-conditioning systems (AACS) or water-cooled air-conditioning systems (WACS). WACS are much more energy-efficient than AACS. WACS may operate in the form of an evaporative cooling tower system using fresh water, or a direct cooling system using sea water. The use of WACS in Hong Kong is limited because the Water Supplies Department (WSD) used to disallow the use of mains water for air-conditioning purposes. In February 2000, the Public Accounts Committee (PAC), after considering Chapter 2 of the Director of Audit's Report No. 33 of October 1999, recommended that the Administration should relax the ban on the use of mains water for air-conditioning, and facilitate the wider use of WACS in Hong Kong. The Audit Commission (Audit) has recently conducted a review to examine the Government's efforts and progress in promoting the wider use of WACS.

Measures to promote wider use of water-cooled air-conditioning systems

2. In June 2000, the Administration launched a "Scheme for Wider Use of Fresh Water in Evaporative Cooling Towers for Energy-efficient Air-conditioning Systems" (the FWCT Scheme). The Scheme was implemented on a district basis. Owners of non-domestic buildings within the designated areas could apply for approval to use fresh water for WACS.

3. *Need for sustained efforts to promote the wider use of WACS.* Up to April 2009, 396 applications were received under the FWCT Scheme and 162 WACS installations were completed, with an estimated electricity saving of 129 million kilowatt-hours a year. While the FWCT Scheme covered 75% of the total non-domestic gross floor area (GFA) in Hong Kong, only 11% of the total non-domestic GFA had joined the Scheme. *Audit has recommended that the Secretary for the Environment should, in collaboration with the Secretary for Development and the Director of Electrical and Mechanical Services, step up efforts in promoting the wider use of WACS in Hong Kong.*

4. ***Need to extend coverage of FWCT Scheme.*** As at April 2009, about 25% of the non-domestic GFA in the territory was not yet covered under the Scheme. Audit noted that the Electrical and Mechanical Services Department (EMSD) would only start to consider including a new area as a designated area upon receiving requests and enquiries. In determining whether a new area should be included under the Scheme, the EMSD would estimate the peak daily water demand on the basis of a full conversion of all the non-domestic buildings in the area to WACS. However, Audit noted that in all existing designated areas, up to April 2009, only 14% of the non-domestic GFA in the designated areas had joined the Scheme. *Audit has recommended that the Director of Electrical and Mechanical Services should, in consultation with the Director of Water Supplies: (a) consider adopting a more proactive approach in extending the FWCT Scheme to new areas; and (b) review the basis for estimating the peak daily water demand of WACS in determining whether an area should be designated under the FWCT Scheme.*

5. ***Need to encourage conversion of AACS to WACS.*** As at April 2009, 97% of the new non-domestic buildings (in terms of GFA) in designated areas joined the FWCT Scheme to install WACS. However, only 5% of the existing buildings (in terms of GFA) joined the Scheme to replace their AACS with WACS. *Audit has recommended that the Director of Electrical and Mechanical Services should continue to provide the necessary assistance and incentives to facilitate conversion of AACS in existing buildings to WACS.*

6. ***Need to ensure compliance with scheme requirements.*** Participants of the FWCT Scheme are required to submit monthly returns and annual independent examination reports to the EMSD as evidence of compliance with scheme requirements. Audit examination of 30 WACS installations under the FWCT Scheme revealed that most of the scheme participants did not fully comply with the reporting requirements. *Audit has recommended that the Director of Electrical and Mechanical Services should strengthen controls over the participants' compliance with the requirements under the FWCT Scheme.*

Use of water-cooled air-conditioning systems in hospitals

7. ***Need to review the use of cooling towers.*** The Architectural Services Department (ArchSD) is the works agent for the design and installation of air-conditioning systems in government buildings and public facilities. In 2004 and 2006, the ArchSD conducted reviews and concluded that WACS with cooling towers should not be used in acute or infectious disease hospitals to prevent the spreading of infectious diseases. The ArchSD's practice was determined in-house on a case-by-case basis. Audit noted that there were cases where WACS with cooling towers were installed in a number of public and private hospitals. *Audit has recommended that the Director of Architectural Services and the Director of Electrical and Mechanical Services should, in consultation with the Director of Health and the Chief Executive, Hospital Authority, conduct a review on the use of*

cooling towers in hospitals and healthcare premises with a view to formulating guidelines for the adoption of WACS in such premises.

Development of district cooling systems

8. A district cooling system (DCS) is a centralised WACS on a mega scale, comprising one or more chiller plants to produce chilled water, and a network of underground pipes for distributing the chilled water to buildings within its service area for air-conditioning purposes. In June 2009, the Finance Committee of the Legislative Council (LegCo) approved funding of \$1,671 million for implementing a DCS at Kai Tak Development (KTD).

9. ***Room for improvement in estimating energy saving.*** It was estimated that the development of DCS at KTD could achieve a maximum electricity saving of up to 85 million kilowatt-hours a year. Audit considers that the estimated electricity saving may not be attainable because: (a) the saving was estimated by comparing DCS with AACS, but not the more energy-efficient WACS; and (b) the assumed 100% subscription rate to the DCS service might not be achieved. *Audit has recommended that the Director of Electrical and Mechanical Services should state clearly the basis of estimates and estimate electricity saving arising from DCS development based on realistic assumptions in future submissions to LegCo.*

10. ***Need to take proactive action to increase the subscription rate.*** Of the total planned non-domestic air-conditioned floor area in KTD, 35% would be in public developments and 65% in private developments. All public developments in KTD would be connected to the DCS as far as practicable. For private developments, the connection to the proposed DCS would be on a voluntary basis. *Audit has recommended that the Director of Electrical and Mechanical Services should: (a) continue to liaise with the ArchSD and other relevant departments at the early stage of development of public facilities at KTD to facilitate connection of such facilities to the DCS; and (b) liaise with private developers at an early stage to promote the DCS service with a view to increasing the DCS subscription rate.*

Health concerns over cooling towers and water-using apparatus

11. ***Need to closely monitor the increasing trend in LD cases.*** The installation and maintenance of cooling towers require special care because they have been found to be associated with the spread of Legionnaires' Disease (LD). LD is an acute pneumonic illness caused by human inhalation of aerosols contaminated with the Legionella bacteria dispersed from cooling towers or other water-using apparatus. In Hong Kong, sporadic cases of LD have been reported without any outbreak. However, there has been an

increasing trend of LD cases in recent years since 2005, notably in 2009. *Audit has recommended that the Director of Health and the Director of Electrical and Mechanical Services should: (a) make sustained efforts in the prevention and control of LD in Hong Kong; and (b) closely monitor the increasing number of LD cases and examine the underlying reasons with a view to formulating appropriate measures to minimise the spread of LD.*

12. ***Impact of contaminated aerosols on public health.*** In addition to LD, the Legionella bacteria may induce Pontiac fever, a self-healing illness with flu-like symptoms. Audit notes that Pontiac fever has a high infection rate but it is not adequately mentioned in published guidelines for prevention of LD. *Audit has recommended that the Director of Health and the Director of Electrical and Mechanical Services should examine the need to provide more information about Pontiac fever to the public.*

13. ***Guidelines on using water-using apparatus other than cooling towers.*** Many types of water-using apparatus, besides cooling towers, could be a potential source of infection of LD. The two published codes of practice for prevention of LD provide general guidelines on a wide range of water-using apparatus and detailed guidelines on cooling towers. However, there is little information about the risk of LD of certain types of water-using apparatus which are found to be a potential source of infection. *Audit has recommended that the Director of Health and the Director of Electrical and Mechanical Services should keep in view the LD risks of water-using apparatus, with a view to providing more comprehensive guidelines for the prevention of LD.*

Inspection of cooling towers

14. The EMSD's surveys in 1996 and 1999 found that there were about 12,000 cooling towers scattered in the territory. Many of them were also not properly installed or maintained. In its report of February 2000, the PAC recommended that the Administration should closely monitor the operation and maintenance of the 12,000 cooling towers in order to minimise the risk of LD. Since then, the EMSD had launched two cooling tower inspection programmes, one from 2001 to 2005 and another from 2006 to 2008.

15. ***Need to prioritise and conduct more inspections of cooling towers.*** In 2005, the EMSD completed the first round of inspections covering 8,387 cooling towers, but was unable to inspect all the known cooling towers. The inspection programme from 2006 to 2008 was also substantially reduced in scale. *Audit has recommended that the Director of Electrical and Mechanical Services should: (a) consider conducting inspections of cooling towers on a regular basis as far as practicable; and (b) consider adopting a risk-based approach in the inspections of cooling towers by giving priority to those which may pose a higher risk to public health.*

16. ***Need to strengthen controls over cooling towers.*** For cooling towers detected with Legionella bacteria in the water samples collected, the EMSD would request the owners to take necessary remedial actions. Audit noted that in many cases the owners did not respond to the EMSD's instructions. *Audit has recommended that the Secretary for Development and the Director of Electrical and Mechanical Services should, in consultation with the Director of Health and the Director of Water Supplies, consider ways to deal with cooling towers found not properly installed or maintained, and those found contaminated.*

17. ***Contamination of cooling towers under FWCT Scheme.*** Cooling towers under the FWCT Scheme are expected to be properly maintained without contamination. The EMSD's inspections from 2001 to 2008 found that some cooling towers under the Scheme, including some installed in 10 government premises, were contaminated. *Audit has recommended that the Director of Electrical and Mechanical Services should: (a) conduct a review and take measures to ensure that cooling towers approved under the FWCT Scheme are properly maintained and not contaminated; and (b) review the programme for the operation and maintenance of cooling towers in government premises with a view to identifying effective measures for improvement.*

18. ***Presentation of cooling tower water quality test results.*** In May 2007, the Administration informed LegCo that inspections carried out by the EMSD, covering 10,057 water samples, found that 892 (9%) of them were detected with Legionella bacteria concentration exceeding the acceptable level of 1,000 colony forming units per millilitre (cfu/ml). However, Audit noted that the cooling water quality criterion for Legionella bacteria adopted by the EMSD was 10 cfu/ml. A Legionella bacteria count of over 1,000 cfu/ml was considered as a high contamination level calling for emergency decontamination. *Audit has recommended that the Secretary for Development and the Director of Electrical and Mechanical Services should, in reporting test results for Legionella bacteria in water samples in future, consider providing information on contamination cases with a Legionella bacteria count of 10 cfu/ml or more, apart from those over 1,000 cfu/ml.*

Control measures on unauthorised cooling towers

19. In order to minimise the risk of LD, in February 2000, the PAC recommended that the Administration should consider ways of requiring operators and owners of unauthorised cooling towers to properly operate and maintain their cooling towers.

20. *Need to review effectiveness of voluntary compliance measures.* In September 2000, the EMSD launched the Voluntary Registration Scheme for Cooling Towers (VRS) and sent invitation letters to owners of unauthorised cooling towers. In November 2006, the EMSD issued letters to owners of unauthorised cooling towers inviting them to join the FWCT Scheme. Despite the EMSD's invitations, very few owners of unauthorised cooling towers responded to join the VRS or the FWCT Scheme. *Audit has recommended that the Secretary for Development and the Director of Electrical and Mechanical Services should, in consultation with the Director of Water Supplies, keep in view the need for introducing alternative strategies and additional measures for controlling unauthorised cooling towers in the long term.*

21. *Need to ensure no unauthorised cooling towers in government buildings.* Two fresh water cooling towers were installed in the Civil Engineering and Development Building in Ho Man Tin for air-conditioning purposes. According to the WSD, it had no records of approving the use of mains water for air-conditioning purposes in this government building. *Audit has recommended that the Director of Electrical and Mechanical Services should introduce control measures to ensure that unauthorised cooling towers are not installed in government premises in future.*

22. *Need to identify target groups of cooling towers for further action.* Audit noted that some unauthorised cooling towers were located in: (a) shopping centres of housing estates; (b) premises owned by major property developers; (c) premises managed by major property management agents; and (d) premises operated by reputable chain stores and restaurant groups. *Audit has recommended that the Director of Electrical and Mechanical Services should consider identifying target groups of owners of unauthorised cooling towers with a view to encouraging them to join either the FWCT Scheme or the VRS.*

Response from the Administration

23. The Administration agrees with the audit recommendations.

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