Report No. 55 of the Director of Audit — Chapter 4

INSTALLING BUILDING SERVICES SYSTEMS IN GOVERNMENT BUILDINGS

Summary

1. Building services systems are the electrical and mechanical installations inside a building that provide the internal infrastructure for its proper functioning. Major building services systems include electricity supply systems, air-conditioning systems, lighting systems, lifts and escalators, and fire services systems. The Architectural Services Department (ArchSD) is responsible for installing building services systems in government buildings. The Audit Commission (Audit) has recently conducted a review of the design and installation of building services systems in government buildings.

Post occupancy evaluation of completed building projects

2. In July 2005, the ArchSD introduced a requirement to conduct a post occupancy evaluation (POE) of the building services systems of a completed building project. The POE aims to oversee the performance of these systems to ensure that they function satisfactorily, meet the clients' operational requirements, and achieve optimum energy efficiency during the post occupancy period. Between July 2005 and June 2010, the ArchSD selected 12 building projects for conducting POE. As of June 2010, the POE exercises on 8 building projects had been completed.

3. ***Need to expedite action to implement improvement measures.*** In December 2008, the ArchSD commissioned a consultancy study to review the POE framework. The study was originally scheduled for completion in October 2009. As of mid-October 2010, the ArchSD was examining the consultant's recommendations on various aspects of the POE, and conducting the trial run of a proposed POE framework. *Audit has recommended that the Director of Architectural Services should closely monitor the progress of the consultancy study and promptly implement the consultant's recommendations where appropriate.*

4. ***Need to set objective selection criteria and target.*** According to the ArchSD's instructions, POE exercises should be conducted on complicated projects. However, the instructions did not provide guidelines on the selection of such projects. The ArchSD also did not set a target number of building projects for conducting POE. Of the 175 building projects completed between July 2005 and June 2010, the ArchSD selected 12 building

projects (7%) for conducting POE. On average, fewer than 3 completed projects were selected for POE each year. *Audit has recommended that the Director of Architectural Services should formulate guidelines and objective criteria for selecting building projects for POE, and, subject to availability of resources, consider selecting more building projects for evaluation.*

5. ***Need to cover different types of building projects.*** ArchSD building projects comprised in-house projects and outsourced projects of different building types. Between July 2005 and June 2010, 83% of the 175 completed building projects were outsourced. However, only 4% of outsourced projects were selected for POE while 21% of in-house projects were selected. Moreover, no POE had been conducted for projects in respect of five building types. *Audit has recommended that the Director of Architectural Services should take into account different project and building types in selecting building projects for POE in future.*

Design and installation of electricity supply systems

6. In a building, the electricity supply system distributes electrical energy through a network to individual building services equipment and other electrical appliances. The main components of an electricity supply system include distribution transformers, main cubicle switchboards, and a distribution network. The power capacity of an electricity supply system is set at a level to meet the peak electrical load on the system from all the building services systems and other electrical appliances.

7. ***Need to review capacity variances.*** Audit reviewed the electricity supply systems of the eight government buildings with POE completed. Audit found that, during the POE period, the installed capacity of the electricity supply system for these buildings was greater than the projected peak electrical load by 27% to 61%. *Audit has recommended that the Director of Architectural Services should review the capacity variances in electricity supply systems of government buildings with a view to identifying measures for improvement.*

8. ***Need to revise guidelines for provision of spare capacity.*** Audit found that the spare capacities provided for two buildings (68% and 36%) exceeded the norm of 30% as stipulated in the ArchSD guidelines. In July 2010, the ArchSD informed Audit that various design considerations were taken into account in determining the installed capacity of an electricity supply system. Audit noted that these design considerations were not explicitly promulgated in the ArchSD's design guidelines and were not fully documented in the design reports of the eight buildings. *Audit has recommended that the Director of Architectural Services should: (a) incorporate in the design guidelines relevant design considerations that would affect the determination of the capacity of an electricity supply system; and (b) document in the design report the calculations and justifications for providing spare capacity in an electricity supply system.*

9. ***Room for improvement in estimating electrical load.*** The ArchSD has laid down guidelines for estimating the capacity of an electricity supply system. For three buildings, Audit found that the estimated electrical load was greater than the actual load by 19% to 35%. *Audit has recommended that the Director of Architectural Services should review the methodology for estimating the electrical load of an electricity supply system with a view to identifying measures for improving the accuracy in estimation.*

Design and installation of air-conditioning systems

10. The air-conditioning systems in government buildings are usually in the form of a centralised system comprising a chiller plant, a water distribution system, an air distribution system and air-handling equipment. The cooling capacity of air-conditioning systems is set at a level to meet the estimated peak cooling load of the air-conditioned floor area in the building.

11. ***Need to review cooling capacities.*** Audit reviewed the air-conditioning systems of the eight government buildings with POE completed. Audit found that, during the POE period, the installed cooling capacity was greater than the actual peak cooling load, with a capacity variance ranging from 0.2% to 65%. For three buildings, the capacity variances were 45% to 65%. Excluding the standby plant which would not be in operation during normal conditions, the capacity variances of the eight buildings ranged from 0.2% to 47%. *Audit has recommended that the Director of Architectural Services should, in conjunction with the Director of Electrical and Mechanical Services, keep in view the cooling loads of government buildings and consider revising the capacities to be provided, where necessary, when the air-conditioning systems are due for replacement.*

12. ***Need to review provision of spare capacity.*** For three buildings, Audit found that the spare capacities provided for them ranged from 43% to 137%, which were in excess of 30% as stipulated in the ArchSD guidelines. Excluding the standby plant, the spare capacities ranged from -3% to 66%. In July 2010, the ArchSD informed Audit that various design considerations were taken into account in determining the cooling capacity of an air-conditioning system. Audit noted that these design considerations were not explicitly promulgated in the ArchSD's design guidelines and were not fully documented in the design reports of the eight buildings. *Audit has recommended that the Director of Architectural Services should: (a) incorporate in the design guidelines relevant design considerations that would affect the determination of the cooling capacity; and (b) document in the design reports the workings showing how the installed capacity in an air-conditioning system is determined.*

13. ***Room for improvement in estimating cooling loads.*** The ArchSD has laid down guidelines for estimating the cooling capacity of an air-conditioning system. Audit found that, for two buildings, the estimated cooling load was greater than the actual load by 20% to 30%. *Audit has recommended that the Director of Architectural Services should review the methodology for estimating the cooling loads of government buildings.*

Provision of space heating facilities

14. Space heating is one of the functions of an air-conditioning system. The ArchSD guidelines do not specifically mention whether and when space heating facilities should be provided in an air-conditioning system. According to the ArchSD, all building projects with central air-conditioning systems were provided with space heating facilities to achieve an indoor temperature of 20°C in winter. An audit examination of seven joint-user government office buildings revealed that, from January 2005 to June 2010, the heating facilities had not been in operation for any one day. *Audit has recommended that the Secretary for the Environment and the Director of Architectural Services should review the need for providing space heating facilities in government office buildings, taking into account the views of bureaux and departments.*

Design and installation of lighting systems

15. The lighting system of a building provides artificial lighting for the occupants to carry out tasks and activities. The main components of a lighting system include lamps, lighting fittings and associated electrical circuits. According to the ArchSD design standard, the recommended lighting level (measured in lux) for general office areas is 500 lux on desk level. For common areas, the recommended lighting levels are: (a) 200 to 500 lux for circulation areas; and (b) 100 to 300 lux for foyers and entrance lobbies.

16. ***Need to determine appropriate lighting levels for common areas.*** In six out of the eight buildings with POE completed, the POE exercises found that there was room for reducing the lighting levels in common areas to reduce electricity consumption. Modification works were carried out by de-lamping, i.e. detaching some of the lamps from the lighting fittings. Some of the lighting equipment became redundant after de-lamping. In one building, Audit found that the lighting levels in some locations of the common areas were below the recommended level. *Audit has recommended that the Director of Architectural Services should: (a) review the design lighting levels for common areas; and (b) discuss with the client departments during the design stage of new building projects to determine the appropriate lighting levels for common areas.*

17. ***Lighting design for office buildings.*** Government offices in Hong Kong usually adopt the general lighting design under which the office space is illuminated uniformly at a lighting level of 500 lux. Alternatively, office lighting can adopt the task lighting design under which a lower ambient lighting level (e.g. 300 lux) is provided, with a task light (e.g. a table lamp) to achieve a lighting level of 500 lux over the task area. In 2008, the ArchSD completed two pilot projects and found that there were savings in electricity consumption and capital costs by using task lighting design. In December 2009, the ArchSD issued a circular to promulgate the adoption of task lighting design in new government building and refurbishment projects. *Audit has recommended that the Director of Electrical and Mechanical Services should promote to the public the task lighting design as an energy management measure.*

Rectification of defects in building services systems

18. Upon completion of a new building, there are usually a number of defects identified for rectification. During the one-year defect liability period, the project contractor is responsible for making good the defects at his own cost. The ArchSD has laid down guidelines and procedures for handling defect rectifications. Audit selected three defect rectification cases from government building projects with POE conducted for examination.

19. ***Need to step up verification of building services equipment.*** In a government building completed in April 2004, there were a number of incidents of false fire alarm after occupation. In July 2005, the ArchSD found that some of the installed smoke detectors were suspected counterfeit products with possible latent defects. All the smoke detectors were subsequently replaced. After the incident, the ArchSD issued instructions for conducting sample checks on the make and origin of building services materials and equipment used in new government building projects. However, the scope and intended coverage of the sample check are not clearly defined. *Audit has recommended that the Director of Architectural Services should: (a) state clearly the scope and intended coverage of the sample checks; and (b) consider extending the sample checks to refurbishment projects and minor building works.*

20. ***Need to ensure compliance with contract specifications.*** In December 2005, one of the four compressor motors of the air-conditioning system of a government building completed in November 2004 suffered a serious breakdown and was replaced. In February 2006, a similar breakdown occurred in another compressor motor. The ArchSD investigation found that the motor enclosures did not meet the contract specifications and all the motors were replaced. *Audit has recommended that the Director of Architectural Services should consider taking measures to provide additional assurance that building services equipment installed in government buildings comply with contract specifications.*

21. ***Need to step up inspection of works.*** In a government building completed in November 2004, a centralised hot water system was installed for generating hot water and distributing it through a network of thermally-insulated pipes to meet operational needs. Upon occupation of the building in April 2005, the temperature of hot water supply was found not high enough. After checking, the ArchSD found that many parts of thermal insulation materials on the water pipes were not properly installed and some of the pipes were without adequate insulation materials. The defects were subsequently rectified by the contractor. *Audit has recommended that the Director of Architectural Services should step up the inspection of works before acceptance of completed building services systems.*

Response from the Administration

22. The Administration agrees with the audit recommendations.

November 2010