Committee(s):	Date:
Markets	24 January 2018
Subject: Smithfield Market – Condenser Water Cooling System - Update	**Public**
Report of: The City Surveyor (Report no. CS010/18)	**For Information**
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Summary

This update report informs Members about recent developments on Smithfield Market's refrigeration condenser water cooling system, and answers two questions raised at the last Committee meeting.

The system has been operating normally since the end of November 2017. The system operating temperature has been set at 24^0 C since 22 November. This will be increased to 25^0 C again when agreed with the Market Tenants' Association.

Recommendation(s)

Members are recommended to note the contents of this report.

Main Report

Background

1. The Market's condenser water cooling system removes waste heat from 120 tenants' refrigeration units in East, West and Poultry Markets and dissipates it to the atmosphere via five cooling towers located in the Poultry Market. The system is operated and maintained by the City Corporation as Landlord.
2. In 2014, the City Corporation completed a programme of works to improve the water circulation in the three Market buildings served and remove dirt contamination in the system. As a result, performance greatly improved.
3. The cooling system was originally specified to provide water to tenants' fridges at 30ºC. Over the years, this was gradually reduced and for approximately five years was set at 20ºC. This was done to assist fridges at a time when there were issues with water flow, dirt contamination, system balancing, and tenants' condenser under-sizing.
4. Over the last 18 months, the City has gradually raised the system operating temperature a degree at a time to alleviate airborne dirt ingestion at cooling

towers, allow more economical operation in the future, and reduce risk of breakdown. The eventual aim is to operate the system at 25ºC year round. However, a higher temperature results in fridges working harder and in some cases experiencing problems.

Current position

5. Immediately prior to the last Committee report in November 2017, there had been reports of further fridge operating problems, which were traced to faults with the City's water softening plant which supplies softened make-up water to the cooling system. Since these were rectified, the system has been operating normally.
6. The system operating temperature had been raised a degree to 25ºC on 14 November 2017, however, at the request of the Market Tenants' Association, it was reset back to 24ºC on 22 November, and has remained at that setting to date.

Incidents since last report

7. Since the end of November there have been no further operating incidents reported on the cooling system.

Response to matters raised at last Committee Meeting

(a) re-use of waste heat

8. The waste heat returned from the fridges to be dissipated to atmosphere by the five cooling towers is 'low grade' heat at about 25-28^0 C. Whilst the system operates continuously, the quantity of heat from the three markets varies from about 500 kilowatts at quiet, cold times to about 1,200 kilowatts at peak summer times.
9. Heat could be recovered from the system return water to the cooling towers by means of technology known as a water source heat pump. This could be used to supply useful heat to a heating circuit, although an electrical power supply is needed.
10. A couple of issues arise. Firstly, most commercial heating systems, including that serving the Meat Market, are designed to work at about 80^0 C. A heat pump would generate hot water at a significantly lower temperature than this, meaning a re-design of the heating system would be required to make use of the heat, or a more complex heat pump design.
11. Secondly, the Market is committed to take all its bulk heat supplies from the Citigen Combined Heat and Power (CHP) system, based close by in Charterhouse Street. The City has long term agreements with Citigen to develop, support and expand the system. Replacing the Citigen supplies (which are considered low-carbon) with an alternative source would breach legal agreements and be seen as a withdrawal of the City's support for the scheme.

(b) cooling system operating costs

12. With refrigeration systems there is always the need to remove and dissipate the waste heat produced in the fridge condenser. This can either be air cooled or water cooled. Air cooled condensers can be adjacent to the fridge, but are less energy-efficient, require a good air supply, and can create noise problems. Most larger systems are water cooled for energy efficiency, and allow cooling towers to be sited remotely from the fridges, which assists with planning and noise problems, although more costly and with the disadvantage of the need for strict water hygiene controls.

13. At Smithfield Market, the use of air cooled fridge condensers would have been difficult and probably non-feasible due to the amount of heat to be dissipated, up to 600 kW in each half of the Market. Without major ventilation works, temperatures above Buyer's Walk would have become excessive in summer, adversely affecting fridge performance. As listed building restrictions limit the options to provide high levels of ventilation, it is possible significant office space would have had to be sacrificed for plant.

14. Figures given below are estimates of the average annual system operating costs for the cooling system met by the City, compiled with the assistance of Skanska.

Water	£6,000
Power – cooling tower fans	£12,000
Power - pumps	£100,000
Salt and chemicals	£16,500
Water treatment servicing	£15,500
Cooling tower maintenance	£9,000
Repairs and call-outs	£18,000
Strainer/condenser cleaning	£15,000
TOTAL	**£192,000**

Apart from power to pumps and water treatment servicing, all costs would tend to reduce as the system operating temperature is increased.

15. Operating costs for equivalent air-cooled fridges including additional ventilation plant in each quadrant, assuming this could be provided, may well be of the same order, taking into account loss of income from commercial office space needed to house the plant. As noted above, the likelihood is that this would not be feasible for technical reasons.

Proposals

16. The temperature of the system will be increased back to 25ºC when agreed with the Tenants' Association. Performance of fridges will continue to be monitored and any reports of fridges experiencing problems investigated.

Corporate & strategic implications

17. The system supports the meat trade at Smithfield Market and the following Strategic Aims:

    - To provide modern, efficient and high quality local services and policing within the Square Mile for workers, residents and visitors with a view to delivering sustainable outcomes.

    - To provide valued services to London and the nation.

Implications

18. The cooling system operated by the City provides a critical service for tenants' refrigeration equipment. A failure of the system could potentially expose the City to claims from tenants for loss of product. The City therefore needs to ensure it provides a reliable service that meets the needs of the tenants, whilst at the same time keeping its operating and maintenance costs and risk of breakdown to the minimum.

Conclusion

19. Provided that the water quality and flow is maintained, fridges appear to be able to cope with water supplied by the cooling system at 25^0 C in winter conditions. However, if flow is reduced, or scale build-up occurs within condensers due to water hardness, heat transfer is impaired, and unless these problems are corrected, it is necessary to reduce the water temperature to compensate.

20. Added to this, the City considers there are still some condensers which are undersized for the duty required and hence more sensitive to reduced flow and scale accumulation.

Background Papers

Report of the City Surveyor 'Smithfield Market – Condenser Water Cooling System – update' to Markets Committee, November 2017 (Report ref. CS561/17).

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