SKELLY & COUCH

REPORT TITLE:

Harlington Fleet Refurbishment

Initial Heat Provision Options

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Contents

1 Executive Summary

As described within this report, the best solution to deliver heating to the library would be an air source heat pump connected to a hybrid VRF system and the best solution for delivering heat to the Harlington would be a heat pump generating hot water in a more traditional, but more intrusive solution. A ground source heat pumps would be an enhancement to this at a higher capital cost and with higher efficiency.

As fundamentally different solutions, the two systems would ideally not be linked.

The proposals are expected to require a new substation, which must be installed prior to the upgrades of the Harlington and presumably before the upgrade to the library. This would be located somewhere on site, accessible by a lorry.

2 Introduction

Following a site visit on 24 Feb 2023, Skelly and Couch have been asked to advise on outline options for the provision of a replacement heating system for the Harlington Fleet and the associated library, including initial commentary on low carbon heating solutions. Options should be considered for maintaining the heating system connection between the two buildings.

3 Existing situation

3.1 Building Fabric

The Harlington Fleet and associated library date from the early 1970's and were originally two separate buildings that have since been connected. A fire in the Harlington in 1991 led to significant alterations and extensions, and the building re-opened in 1994.

The two buildings are generally constructed from building fabric of the expected thermal quality for the age of the buildings. Of particular note are the roofs. There is believed to be almost no insulation to the roof of the Harlington auditorium, and the library is substantially made up of single glazed rooflights. The 1990's refurbishments to the Harlington will have marginally improved thermal values, but not to anywhere near current insulation levels.

Windows in the Harlington are generally single glazed in the foyers and peripheral spaces have double glazed units of varying ages and styles. The windows in the library have recently been replaced by triple glazed units. As noted above, the library rooflights appear to remain single glazed polycarbonate units.

As the windows have been replaced without full consideration of the wall upgrades, the window sills and potentially the external reveals would need to be replaced again if the external walls to the library were to be externally insulated.

3.2 Heating system

The two buildings are both served from an array of five cast iron sectional boilers. These are ageing and need replacement. Sourcing spares has become increasingly difficult and now some of the boilers are no longer working. The boiler room is at the extreme east end of the building.

The boilers are comparatively inefficient compared to new boilers. The ideal situation would be to replace them with heat pumps. However, a slight increase in efficiency could be gained by changing them to modern, condensing boilers. This would require a new flue to be installed through the existing chimney stack, which is showing signs of concrete deterioration and should be checked structurally.

Figure 1: existing boiler flue showing concrete damage

The Harlington is generally served via radiators, perimeter plinth convectors and heater batteries to air handling units. The library is heated via perimeter plinth convectors and these are connected to steel pipes, cast into the concrete first floor and expected to be distributed at high level in the ground floor ceiling void.

The library heating system is connected back to the plant room via steel pipework which is cast into the ground floor of the Harlington, rising near to the foyers and then running above ceiling level in the foyers to connect to the library. This cast-in heating system is badly rusted where it can be inspected and should not be considered to be suitable for re-use without an intrusive survey. Replacement pipework would require very disruptive work in running the new pipes through or below the WC's to the Harlington.

3.3 Existing electrical intake

The existing electrical intake to the Harlington has been inspected and is understood to be a 200A TPN supply. Whilst adequate for the existing situation, proposals for the upgrades that were associated with the 2018 scheme identified that a substation and larger, 400A TPN supply would be preferred.

The existing electrical intake for the library was not inspected. Details of this would be useful to see. It is understood not to be served from the Harlington.

4 Alternative heating system options

4.1 Gas Boilers

The simplest solution for the heating of the refurbished building would be new gas boilers. These would be more efficient than the existing boilers. However, this needs to be considered in the light of the proposed phase out of gas boilers in domestic circumstances by 2025 and the tightening up of the minimum standards for EPC's for rented properties to band C by 2025 and Band B by 2030 in England and Wales. It may be that this will be achieved by converting the gas grid to a hydrogen grid, but the direction here is far from clear. BEIS are currently consulting on phasing out new natural gas boilers from 2035 for commercial buildings.

The advantages of using gas at this location are:

- The existing heat emitters are sized for the heat outputs that a gas boiler can provide and a heat pump will struggle to provide. Heaters will get much bigger with heat pump flow temperatures if they are to meet the required heat loss of the existing building.
- The existing pipework is sized for the flow and return temperatures that gas boilers can deliver. Heat pumps need larger pipes to achieve the required heat output. A substantial proportion of the existing pipes serving the library are cast into the building structure.
- They place no additional burden on the electricity supply, the primary input energy is the fossil fuel.

The disadvantages are that the technology is more polluting, is more likely to become redundant sooner, and that it allows the thermal upgrade of the building to be deferred for longer, thus leading to continued emissions.

A new boiler flue would be needed, the boiler plant room equipment would all need to be changed, and the concrete "chimney" may need refurbishment.

A gas boiler replacement would be the lowest cost option but is not recommended if a major refurbishment is proposed.

4.2 Air Source Heat Pump

An air source heat pump (or heat pumps) could be suited to the development and should be installed as part of a major refurbishment. In this way, the system and the heat emitters would all be replaced with systems suited to the improved building fabric, and the building fabric would all be replaced or upgraded to meet modern expectations for thermal efficiency.

When considering the introduction of an air source heat pump installation at the Harlington Fleet and the associated library, allowance should be made for a new pipework installation, a new radiator installation and a new plantroom location. Air source heat pumps require more air circulation than boilers and should be located outdoors.

The heat pumps place greater load on the electrical power supply. This is known to be in need of upgrade to serve the Theatre in any case, to meet the additional theatrical demands of the space. The details of this upgrade will depend on the theatrical demands as well as the additional load from an air source heat pump.

Based on a rough estimate of the heat loss from the Harlington, this might demand an array of 6 units like the following:

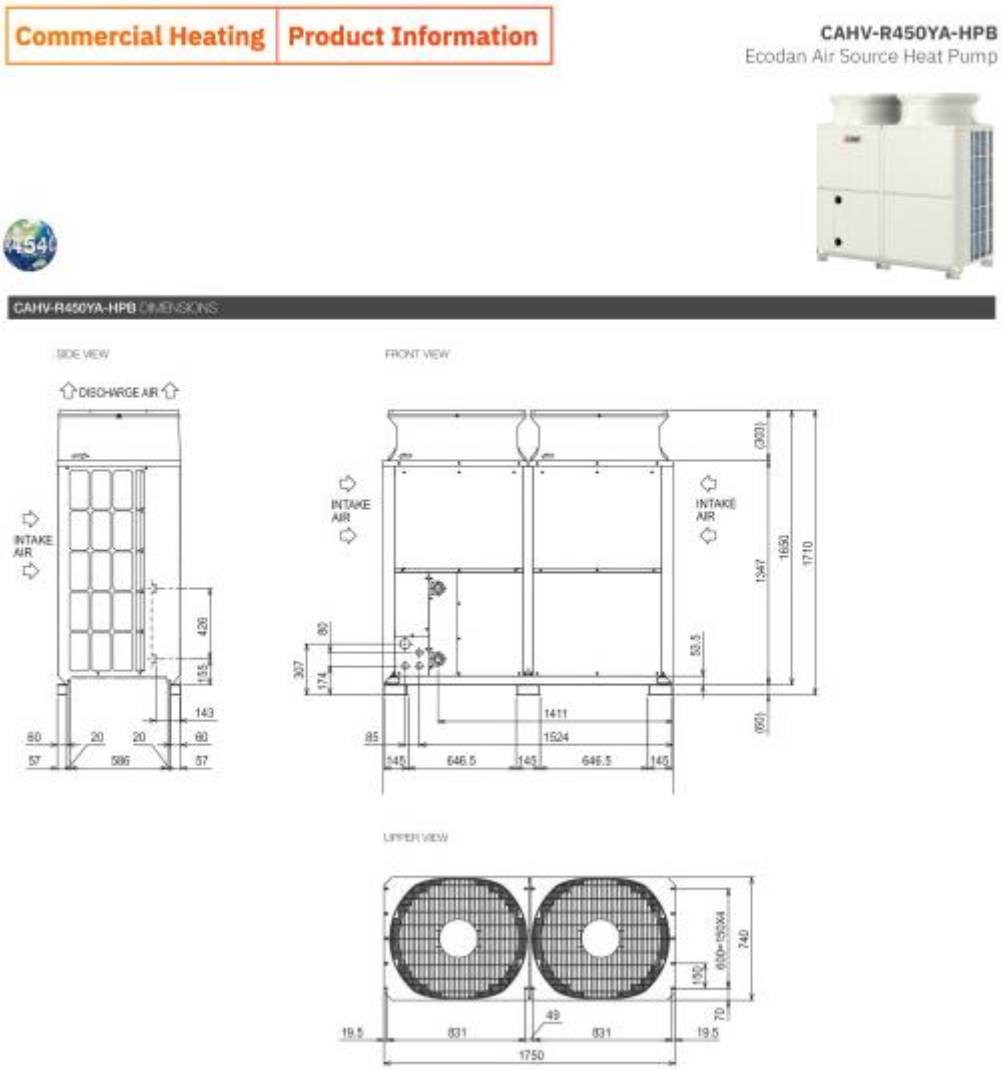

Figure 2: Air source heat pump option 1

Alternatively it could be delivered through a single larger unit such as the following, approx. 4.4 m long, 2,3m wide and 2.3 m high:

Figure 3: Air source heat pump option 2

The optimum for the Harlington would be two units as option 2 above, split so that each gave some degree or redundancy.

This would be very significantly reduced in the event that the building was properly thermally upgraded.

Library Alone

Based on a rough estimate of the expected heat loss from the library, this would be of the order of 60 kW heat load. This could be very substantially reduced through a carefully considered programme of thermal upgrades. The air source heating plant required to support that might be two such units like the image in option 1 above, possibly this could be reduced to a single unit if measures were taken to prepare the library for a zero carbon future (all subject to a full design).

However, it is worth noting that the existing plinth heaters will be inadequate to support the heating load required. A new installation will need to be provided, and the optimum solution would be likely to be a Variable Refrigerant Flow (VRF) fan coil unit installation. This is different from the Harlington, which will be best served from a traditional installation distributing heat via hot water in pipes. The two are fundamentally different solutions.

A VRF system might use units such as the image below.

Figure 4: Ceiling mounted fan coil to suit the library.

Electrical implications

The above would require a substantial additional electrical load, to the extent that a new substation should be provided to support heat pumps irrespective of the thermal upgrade of the Theatre and the Library.

Depending on the building fabric thermal upgrade works this might need to be between 100 kW and 50 kW. Three phase power should be provided.

Installing a standalone cooling system to the library (assuming no thermal upgrades would require a power supply of around 25 kW. This would be 60A three phase, in addition to the existing electrical demand of the library. This could be halved if the building was thermally upgraded.

4.3 Ground Source Heat Pump

A Ground source heat pump solution would be more efficient than an air source heat pump. It would cost more, because of the piling work required which might require around 25 boreholes at 10m centres. It would be more disruptive, as this would be located below the car park in Gurkha square, potentially. This land is separately owned and a legal agreement would need to be in place.

Many other options are available but would need further design work.

Aside from the increased efficiency, the advantage of a ground source heat pump solution is that there would be no external plant and much less fan and compressor noise. It is proposed that the options around air source are looked at initially, a potential upgrade to ground source could be looked at.

Figure 5: example ground source heat pump. An array of these would be located in a plant room.

5 Phasing and Master planning

It is worth considering that the library is expected to remain open throughout. In the event that the Harlington was to be refurbished, this would need to replace the boiler room plant in one form or another. Unless a separate energy centre were to be provided prior to the boilers being decommissioned (occupying additional land around the buildings) it will complicate matters to continue to serve the library from the Harlington.

Alternatively, it might be worth considering the wider “civil service/public buildings” campus taking in the future heating for the larger Hart offices. This might introduce a large, ground source heat pump to serve all the buildings, which could be built separate from all the existing buildings and could serve the Hart offices, the library and the Harlington, at increased efficiency and decreased carbon emissions.

6 Conclusion

The existing heat emitters and pipework in the library are not suitable for connection to a heat pump solution. The existing pipework running through the Harlington is cast in and is likely to be undersized and in a bad state.

Without significant thermal upgrades to the library such as external insulation to the walls and roof, the replacement of the rooflights and measures to make the building more airtight, the provision of carbon-efficient heating from the Harlington does not make sense.

Unless these thermal upgrades are carried out, we would recommend the provision of a hybrid VRF heating system for the library, and a LTHW heating system for the Harlington. As fundamentally different systems there would be no advantage in combining these. Providing separate systems would also simplify the phasing of the upgrade work.

We suggest that the external condensers for the library would be located in the recessed first floor area, hidden behind a new acoustic screen. Two adjacent windows would need to be knocked together to provide a door out to this area.

Alternatively, there may be space for the heat pumps around the rooftop plantroom at the western end of the library.

A check that there is a suitable existing incoming electrical supply will need to be carried out. If not currently suitable, an upgrade to this power supply should be allowed for.

Figure 6: Potential location for the library air source heat pump

Figure 7: existing library rooftop plantroom that might be adapted to house heat pump plant

A new air source heat pump or ground source heat pump that can deliver low temperature hot water to air handling units, underfloor heating and fan coil units should be provided as part of a more major refurbishment to the Harlington, which must include good levels of thermal upgrades to the external façade. There shall be space allocated in the newly constructed building form to integrate these heat pumps into the final design. The assumption is that there would be no heating system provided to the Harlington for the duration of the refurbishment project.

These two systems would be separate.

A combined heat pump solution to serve both buildings could be provided. This would complicate the phasing and would be significantly more intrusive within the library, meaning that the library would need to be closed for longer.

A new substation should be provided to enable these works, whether the systems have a combined heating system, or separate systems.

7 Next Steps

- The condition of the cast-in pipework needs to be verified through a specialist survey
- The structural integrity of the chimney needs to be verified by a structural engineer.
- The details of the electrical supply to the library would be important to review (number of phases, agreed maximum availability, fuse rating, MPAN number)
- The designs for the Harlington should be developed, to better understand the needs of the building following completion
- Thermal upgrade works should be developed and installed to serve the library, irrespective of the eventual source of heat.