VITAL ENERGi

CASE STUDY

King's Cross Development

DISTRICT HEATING & COOLING ENERGY CENTRES & NETWORKS

OVERVIEW

The development of King's Cross is one of the most ambitious urban transformations in Europe. When finished the 67 acre site will deliver around 25 new office buildings, 20 new streets, 10 new major public buildings, the restoration and refurbishment of 20 historic buildings and structures and 2,000 new homes.

Our involvement has stretched over a decade and has seen us develop an energy solution which evolves alongside the build out, meeting the capacity demand at each phase whilst performing optimally. This was made more complicated as the King's Cross development is "Market led" meaning phases are constructed in accordance with demand, resulting in the energy solution needed to be flexible.

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THE SOLUTION

Creating an Evolving Energy Solution to meet Demand at every phase

It was clear that creating a large permanent energy centre in the initial stages of the development would be commercially unattractive and cause several technical challenges. The heating demand from the first phase would be very low which meant a large energy solution would not run efficiently and would also have relatively high operation and maintenance costs. By delaying construction of the main energy centre, it would also allow the developer to postpone the significant capital expenditure both in construction and future costs.

Working with the Energy Services Company (ESCo) we created a temporary, containerised solution which housed two 3MW boilers to serve the initial phase of the project, with the main T1 energy centre scheduled to go live as sufficient development demand increased. The temporary energy centre gave the developers flexibility in that it could be transported to another site to serve a similar purpose, or the plant could be integrated into the permanent energy centre at a later date.

When demand had increased sufficiently Vital Energi fitted out the permanent energy centre in the underground basement of a car park which had only had the first two storeys built at that stage. Our designers created a solution which would perform optimally, but leave enough space in the energy centre so that additional plant could be installed as demand increased.

Initially this saw the installation of two 10MW boilers, a 2MWe Combined Heat and Power (CHP) engine and two 74m3 thermal stores. As the energy centre was subterranean, it created some issues with access, especially with the larger pieces of equipment such as the thermal stores.

PROJECT SUMMARY:

CLIENT
Metropolitan King's Cross Limited

PROJECT
District Heating/Cooling

TIMESCALE:
2009– Present

CONTRACT VALUE
£34.5 million

THE BENEFITS:

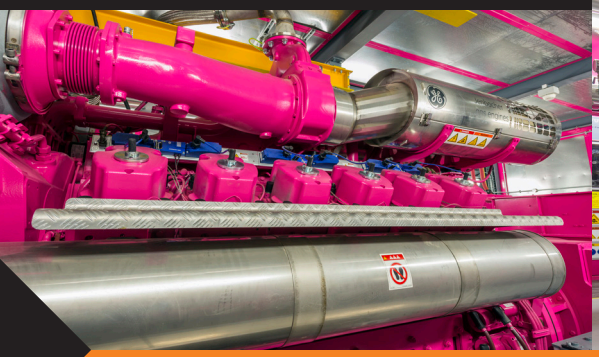
> Carbon savings

> Financial savings

> Delayed capital expenditure that also reduces operation and maintenance expenditure

> Utilising waste heat in summer months further enhancing the energy centres efficiency

Vital Energi supplied and installed 2 x 2MWe CHP engines at the Kings Cross Central Development



One of the challenges facing Vital Energi was designing an energy centre in a building which was largely uncompleted. Initially the energy centre and car park levels were completed, but another 14 stories were later added to the building. As these were not completed during the energy centre installation we needed to create free-standing chimneys which needed to be 55m high to adhere to the clean air act.

The project team were able to use the lift shaft to lower the plant into the energy centre and then carefully manoeuvre it into place. Because the energy centre was quite compact, our team also chose to specify a multitude of prefabricated items, which reduced on site storage requirements, on site works and gave the team more control over delivery times. A key concern when working with space and access restrictions.

In the second phase another 10MW boiler and a second 2MWe CHP engine was added and whilst this phased approach was ideal for the project, it created issues for the installation team, with the largest being the delivery and installation of the boilers. In designing the first phase our designers had been careful to create an access plan for the future boilers and CHP engines, but due to the constricted nature of the energy centre, tolerances were extremely tight. The boilers were therefore delivered through the opening created for the louvres before being placed and installed.

The third phase of expansion came when the decision was made to integrate the two 3MW boilers from the temporary energy centre into the scheme and whilst this was a relatively straight forward process, our engineers then needed to correctly and efficiently configure the surrounding infrastructure, such as flues and fan speeds to ensure they performed optimally.

Future-proofed district heating Network

Our initial involvement, which began in 2008 with the King's Cross development, started with the award of a contract to install 2km of district heating pipework. As the project expanded, it was important that our designers sized the pipework sufficiently to meet future capacity of the development. Based on the King's Cross anticipated build out accommodation schedules, it was a delicate assessment to ensure the network was not either over or under sized ad either of those carries issues over the life of the network. By designing the network with the future needs in mind it would be capable of serving the entire build out.

The development was, to an extent, market driven, which meant that the building connection dates could be brought forwards or delayed. To accommodate this we installed a series of valves throughout the network which enables ease of expansion without interruption to "live" customers.

Delivering the UK's first dedicated mixed use chilled water network

Planning permission had stipulated that the energy centre would produce low-carbon cooling, making it a "tri-generation scheme". We undertook the feasibility study which demonstrated this was possible and then designed a solution which created chilled water via a variety of methods which includes utilising summer CHP "Spare" heat from the T1 energy centre to produce chilled water via an absorption chiller. A significant benefit of this was that the excessive heat generated during the warmer summer months could now be utilised, making the overall energy system much more efficient.

The developer, Argent, had an unusual crescent-shaped piece of land with building potential which it wanted to use as the site of the "Cooling Pod" – the name given to the energy centre building which would house the chilled water plant and equipment. To utilise the footprint of the available land the architects, in conjunction with Vital Energi, created a 120m curved building which varies between 6-8m width with a height of approximately 11m and both the shape of the building and proximity to the HS1 train line would create significant challenges which our designers overcame.

When designing the mechanical layout of an energy centre it is important to not only place the plant and equipment in an optimal position, but also ensure there is space for safe operation and maintenance. Our designers created a two story solution within the cooling pod which comprises of a 1.4MW absorption chiller, three 3MW water-cooled electric chillers, two 1MW dry air-cooled chillers and two 30m^3 thermal stores. Crucially, the solution also has two 2.5MVA transformers which gives added resilience. This solution is capable of delivering 11MW of chilled water and meets the peak cooling demands of the connected buildings which will include office blocks, residential and the King's Cross Coal Drops facility.

Whilst the proximity to the HS1 train line meant there would be a high level of scrutiny on our works and we would need to gain approval for issues like crane usage, the largest hurdle was the possibility of pluming from the cooling towers which could drift across the tracks and obscure train drivers' view. Our designers created a technical solution which utilised three separate types of cooling; absorption, water-cooled and air-cooled, which each produce chilled water.

The comprehensive contract combines preventative and reactive services and will last for 25 years.

All cooling is controlled by a Supervisory Control & Data Acquisition (SCADA) system which ensures the optimal combination of cooling is in use at any time.

The purpose of the cooling pod was, in part, to utilise the excess heat generated by T1 during the warmer summer months when it wasn't needed for heating. If the external temperatures were too cold, however, using the absorption chillers could result in pluming from the cooling towers. To combat this our solution would see the absorption chillers initiate when external temperatures reach 17°C or above which eliminates the possibility of pluming. When heat from T1 is available and there is no danger of pluming the absorption chillers are utilised. When heat from T1 is not available and there is no danger of pluming, the water-cooled chillers are used and when pluming is a consideration, the system switches to the air-cooled chillers.

It is preferable to use the water-cooled chillers as they are more efficient than the air-cooled chillers, but both are low-carbon technology and will continue to become more environmentally friendly as the grid continues to further decarbonise.

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Creating the Cooling Network

Low Temperature Hot Water (LTHW) is pumped through an 80m long series 1 twin pipe district heating connection into the Cooling Pod from the T1 energy centre where it is utilised by the absorption chiller to produce chilled water. The chilled water is then pumped through a 680m series 1 pre-insulated network which connects to the buildings being served. This will eventually expand to 14 areas including Canal Reach and Handyside offices, Gas Holder Triplets residential blocks and the Coal drops.

Whilst the pipework used for district cooling is the same as that used for district heating, the aim is to minimise heat gain, rather than heat loss so it is often unnecessary to use pipework with higher insulation. This allowed our team to specify series 1 pipework, saving the client the additional capex investment.

The team ensured that the networks did not clash with existing services and needed to employ some innovative techniques to ensure this. One example of this saw our team create a 38m thrust bore tunnel beneath the foundations of T2 & T3 buildings to avoid the main utilities which feed the T1 energy centre. Whilst this took significant time and effort, it avoided the possibility of any clashes.

Connecting the Coal Drops

King's Cross Coal Drops is an exciting part of the development and was created to be a new shopping destination in London. The yard was originally built in the 1850's for receiving and sorting coal and as their dependency on coal waned, the yard fell into disuse. As part of the development, the viaduct arches were transformed into modern shops and eateries.

We provided the heating and cooling infrastructure for 39 units which were built under the viaducts and measure 100,000 sqft in total.

For the cooling we designed and built customised plate heat exchangers (between 12kW to 100kW) for each of the units. By building them in our pre-fabrication department we were able to significantly lower the cost, ensure quality and have complete control over the timescale of production and delivery. Not only is this method of cooling more environmentally friendly than traditional electric powered cooling units, it does not result in excess noise or emit waste heat locally.

Vital Energi also delivered the district heating network to the primary heating skid which serves all units at the Coal Drops.

Evolving the Infrastructure to Ensure Continuous Excellence

Due to the evolving nature of the energy scheme, our designers regularly have to make changes to the existing infrastructure to incorporate new works. Most recently our engineers have begun installing silencers on the large 10MW boilers. These sit between the boilers and the flue and are designed to remove low-level noise which could disturb residents.

Asset Management Delivering Consistent Performance & Legislative Compliance

We provide asset management services for the district heating and cooling networks, the T1 energy centre, the cooling pod and all associated plant and equipment.

At King's Cross we have a team of three engineers and one contract manager who provide a dedicated service. By using this approach of a dedicated team, they have developed an in-depth understanding of all areas of the project. We have an engineering presence on-site Monday to Friday and an on-call service 24/7, 365 days per year and have agreed response times with the client.

All assets are remotely monitored by our engineers to ensure that potential issues are detected at the earliest opportunity and our team also perform regular inspections and a comprehensive preventative maintenance programme.

Should an issue occur which requires reactive maintenance, we have 24 hour engineer callout cover 365 days per week.

Another core area of responsibility for us is to ensure legislative compliance for all assets. This can cover a broad range of areas including specialist areas such as Legionella inspections and applications for chemical water discharge licenses.