

Case study | VLT® Solutions

A cost-effective solution: **district cooling** in central **Copenhagen**

Energy efficiency was a major consideration in the design of Copenhagen's new district cooling project. Large numbers of Danfoss VLT® drives are employed to control the pumps and compressors in the new district cooling plant and are contributing to reducing CO₂ emissions by more than 3000 t per year.

A former power plant near the Kongens Nytorv square in central Copenhagen has been given a new lease on life. From here, Denmark's first large scale district cooling plant supplies large commercial buildings such as banks, hotels, office buildings and many other companies, including Denmark's biggest media company, with cost-effective, environmentally friendly cooling.

According to Jan Don Høgh, District cooling manager at Copenhagen Energy Ltd., "Our new district cooling

resource is produced by free cooling from the sea, surplus steam and waste heat from incineration plants (in the summer time) as sources. The idea behind this is to utilize resources that otherwise would be wasted".

Electricity costs cut by 80%

Copenhagen Energy Ltd has been delivering district heating to almost the whole of Copenhagen since the 1970's so the move to start delivering district cooling to existing customers is a logical extension. Over the last few years, the company has constructed a pipeline network for

cooling around the Kongens Nytorv square and in the spring of 2009, the first companies were supplied with cooling.

Since then, the network has constantly connected-up new customers, as word has spread that district cooling is a very stable and cost-effective cooling method with low CO₂ emissions, and also eliminates noisy and ugly rooftop chillers on every building. "According to our calculations the CO₂ emissions are reduced by approx. 67% compared to traditional cooling. A centralised



> 3000 t CO₂
emissions
reduced per year

Large number of Danfoss VLT® High Power Drives

An important contributor to the high efficiency of the district cooling system is the choice of Danfoss VLT® High Power Drives to adjust the flow of all the main pumps to meet the changing cooling need. The refrigeration compressor capacity is speed controlled with VLT® High Power Drives and the HVAC system in the building uses some smaller Danfoss drives. "We are very satisfied with the cooperation with Danfoss. The 98% energy efficiency of the VLT® High Power Drives was a key decision-making factor for us - and all the drives were installed and commissioned on schedule", Jan Don Høgh, District cooling manager at Copenhagen Energy Ltd. said.

cooling facility like ours increases efficiency 5-10 times compared to localized electrically driven cooling solutions. This means that electricity costs are cut by up to 80%", Jan Don Høgh explains.

Cold seawater is taken directly from the harbor

In the winter period, the district cooling system extracts cold seawater directly from Copenhagen harbor, pumped to the district cooling plant through the old pipeline formerly used for cooling water for the old power plant.

From November to April, the cooling water from a 1200 kW heat exchanger is used directly for free natural cooling, resulting in a coefficient of performance (COP) of 20. This means that the cooling power achieved is 20 times higher than the electrical power used in the system. During the summer period when the cooling need and the sea temperature both increase, it is necessary to actively cool the water.

From May to October, a 3400 kW steam powered absorption chiller provides additional refrigeration capacity. The active chiller is supplied



Jan Dong Høgh, District Cooling Manager at Copenhagen Energy in front of VLT® High Power Drives.



The refrigeration system comprises two 3.5MW screw compressors and one 1.3MW reciprocating compressor.

with surplus heat from the combined heat & power plant at Amagerværket. A large proportion of the steam is generated using bio-fuel and incinerated waste.

An electrically powered refrigeration system provides additional refrigeration capacity during peak load periods. The refrigeration system comprises of two 3.5 MW screw compressors and one 1.3 MW reciprocating compressor, controlled by an AC drive.

The actual cooling capacity is 12 MW and the system can be enlarged with a further 8 MW to a total capacity of 20 MW.

The cooling water is sent out in the network to the customers at a temperature of 5.5°C and returned to the plant 10°C higher. In the summertime it is possible to achieve a COP of 6-7 under normal conditions. This is much higher than traditional localized cooling of individual buildings.

IT takes up to 50% of the cooling demand

Obviously, the need for cooling is highest during the summer season. However, more and more cooling is needed to cool server rooms, data centres and offices full of computers, which have the same cooling needs year round. According to Jan Don Høgh, up to 50% of the cooling demand around Kongens Nytorv is for server rooms and the demand for cooling in Copenhagen has been constantly increasing over the last 10 years. The main reason is that increasing use of IT and a growing need for information storage increases the electricity use in offices and server rooms.

One of the customers is Berlingske Karré. The original home of the oldest Danish newspaper Berlingske Tidende has gone through a major modernization from 2006-2009, during which they installed the district cooling system, which now supplies the employees with comfort cooling and moreover provides server rooms with cooling.

The building has now been bought by the real estate company Jeudan A/S. The company owns not only Berlingske Karré, but also several other buildings in the area. "We have installed a district cooling network not just in Berlingske Karré, but in a whole range of shops and buildings, so that we can distribute cooling to all of them", Ole Frederiksen, works manager at Jeudan, says. We find him in the garage under Berlingske Karré, where he has come to show us the district cooling system.

The heat exchanger for cooling has a capacity of 1380 kW. "We have installed the network in every shop, no matter if they take the cooling service or not. In that way it is very easy to connect the shops if they later decide to join the system. Almost everybody who gets the opportunity is actually joining the system now", Ole Frederiksen explained.

Due to customers' huge interest in receiving district cooling around Kongens Nytorv, another similar district cooling plant is now to be established in the city hall area of Copenhagen.



Ole Frederiksen, works manager at Jeudan A/S, on top of the Berlingske Karré building which has installed the district cooling system.



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