

Johnson Controls designs and develops largest -80°C coldstore in Europe

Odense
University Hospital
Denmark



Energy efficient storage of tissue samples in Odense University Hospital

Odense University Hospital (OUH) is one of the three university hospitals in Denmark. Today, OUH is one of the largest and most specialised education and training centres in the South Denmark Region. Annually, the hospital trains 2,500 people as part of either basic or continuing education. For these research purposes, Odense University Hospital stores a numerous amount of tissue samples and blood tests.

352m² for storage of tissue samples

Use of natural refrigerants
Ammonia R717 and R170 Ethane

Energy savings of approximately 4.5 million Danish Kroner (approx. 600,000 Euros per year) when the coldstore is fully operational and all 262 chest freezers replaced



Tissue sample storage

OUH used to store the samples in 262 different -80°C chest freezers across different departments of the hospital. This caused a relatively high energy consumption and made it more difficult for researchers to find the samples they needed. OUH turned to Johnson Controls for the design and development of a new and unique cold store installation. Here, all frozen tissue samples from OUH and other hospitals in the Southern Denmark region will be centrally stored and recorded in a database. The building will also function as a facility for long term storage of a large number of research projects. Johnson Controls designed and installed a -80°C coldstore, the first and largest of its kind in Europe. The new solution reduces energy consumption cost by approximately 4.5 million Danish Krone per year when the coldstore is fully operational.

352m² Large coldstore

Since the coldstore is the first of its kind in Europe, Johnson Controls had to come up with an innovative solution. The extreme cold conditions raised specific challenges and questions during the project phase. For example: is it safe to work in these kind of temperatures, what kind of protective clothing do workers in the coldstore need to wear, what kind of lighting will be used, how will the room be designed, etc. In close collaboration with the hospital all concerns were addressed and Johnson Controls could commence with the installation of -80°C temperature 352m² large coldstore cell. A second 5°C anti room was installed for the exchange of tissue samples.

The refrigeration installation consists of amongst others, a cooling system using SABROE Screw compressors, an electrical installation, a control system, an on-site built freezer compartment, lights, insulated doors, etc.

Innovative, environmental friendly solutions for extreme cold conditions

Meticulous attention to the design was paid to the coldstore cell as there can be a temperature difference of 110°C between the inside and outside panels. Johnson Controls custom-designed the steel panels of the coldstore to resist these differences and to make sure they didn't bend. The floor is also constructed out of special panels, so that the entire room, functions as a "box" and all sides work together when the room is cooled.

Johnson Controls built the refrigeration system of the coldstore as an indirect cascade system, using the natural and environmental friendly refrigerants Ethane R170 and R717 Ammonia. These natural refrigerants do not deplete the ozone layer and make negligible (or zero) contribution to global warming. Additionally, the use of natural refrigerants generally leads to lower operating costs due to less leakage, lower maintenance requirements and better energy efficiency.

The heat generated by the refrigeration system is used in the building's floor heating system, to prevent permafrost developing under the coldstore cell. As decade's worth of valuable research material is stored in the room, the -80°C temperature of the coldstore has been secured. The entire refrigeration system is equipped with high tech surveillance systems, which automatically monitor the operations of the entire installation and help identify and resolve any operational fluctuations. Additionally, an emergency generator was installed and battery back-up if the power supply fails and an emergency cooling system that uses nitrogen as a refrigerant. This way the samples are not destroyed by unintended shutdowns, which can cause the temperature to rise.

Energy and safety concerns

For internal lightning, Johnson Controls opted for LED lightning. This has a lower power consumption and does not generate as much heat as incandescent bulbs do. The LED's were built in a fixture that looks like a fluorescent lamp and mounted in such a way that it is easily removed with gloves on.

To address the safety concerns of working in -80°C , Johnson Controls worked with the Health & Safety crew of OUH, as well as, the sledge patrol. Anyone who works in the coldstore needs to wear two hats, four layers of clothing (wool, thermal and polar suit) and two pairs of socks in thermo boots in order to tolerate the extreme cold conditions. Additionally, no one is allowed to stay in the coldstore for more than ten minutes at a time.

Centralised, energy-efficient storage

Researchers have easier access to the samples, and can keep track of them as all tissue and research samples are now centrally stored in the coldstore. The use of one cooling system, with room for 328 cages, instead of 262 separate chest freezers will result in energy savings of around 4.5 million Danish Krone or approximately 600,000 Euros per year when the coldstore is fully operational and all 262 chest freezers replaced. The replacement of the chest freezers also meant that the departments in the hospital could now allocate that space to other activities.

"The storage of tissue samples is crucial for research and education purposes. Thanks to Johnson Controls we now have a 352m² coldstore with a unique and innovative design that can function as a facility for long term storage of a large number of research projects. Odense University Hospital is ready for a sustainable, secure and cold future"

Lars Kildelund
Operations Manager
Odense Hospital, Projects and Facilities Management