

## Efficient refrigeration and control system for the super computer in the High Performance Computing Centre at Stuttgart University

H L R I S

Modern building management by Johnson Controls permits reliable, optimum cooling of Stuttgart University's new High Performance Computing Centre (HLRS), while saving energy at the same time.

113,664 processor cores, 126 terabyte main memory and 2.7 petabyte hard-disk memory with a performance rate of more than 1 petaFLOPS, i.e. 1 quadrillion computing operations per second: these superlatives make "Hermit" one of the fastest industrially used computers in the world. Hermit belongs to Stuttgart University's High Performance Computing Centre (HLRS), which was founded in 1995 and has been the Federal High Performance Computing Centre since 1996.

The HLRS uses supercomputer technology to assist scientists from Germany and Europe. Leading global players in the Research & Development sector, involved in the automotive industry for example, are given access to the high-end infrastructure systems of the HLRS in the interests of swifter product development, while saving costs at the same time.



### Flexible controls with short reaction times

To accommodate the supercomputer, the customer wanted to construct an infrastructure building with low energy consumption, high redundancy and operating reliability together with the smallest possible carbon footprint, for fast regulation of refrigerating capacity.

The result of these flexible control possibilities with extremely short reaction times is impressive to say the least: efficient refrigeration in four cooling towers permits great energy savings in Stuttgart's High Performance Computing Centre.

Furthermore, the installed cooling concept and the low energy consumption have also reduced the carbon footprint.

Johnson Controls has been working for Stuttgart University for more than 30 years and is one of the customer's most experienced and reliable technology partners for building management and refrigeration technology.

## Connection to the campus system

On the grounds of Stuttgart University's High Performance Computing Centre, a new infrastructure building has been constructed specially for the installation of extra-large systems such as Hermit. Johnson Controls has assumed responsibility for setting up the building management systems for the new building. Eight switchboards have been supplied, together with automation components and the field equipment such as sensors, valves (DN125/DN200) and frequency converters, including the wiring and all necessary services. The entire university campus is equipped with a building management system by Johnson Controls. This is the Metasys M5i control system, based on the advanced global BACnet standard for vendor-neutral data transfer to the building management system.

## Efficient, free cooling with four cooling towers

The HRLS devised its concept for the new infrastructure building early on in order to meet the growing cooling demands of new supercomputers. This featured four cooling towers with 1.2 MW refrigeration capacity each in order to safeguard reliable cooling, while meeting the highest efficiency requirements at the same time. As a result, the new infrastructure building offers adequate redundancy to cope with incidents or maintenance work and is also already ideally prepared for the next generation of computers. Water treatment plays a key role for the wet cooling towers, with controlled biocide dosing to prevent nucleation. Troublefree operation of the dosing unit is monitored by the building management system. The innovative free cooling of the system means that Hermit can operate essentially without tapping into the university's district cooling network.

The computer is only cooled by district cooling under extreme temperatures at the height of the summer or during maintenance work to the cooling towers. Two redundant heat exchangers exchangers, with a capacity of 4 MW each, were installed in the infrastructure building for connecting to the district cooling network. The innovative building management by Johnson Controls organises reliable changeover of the cooling possibilities between free cooling and district cooling.

## Erratic dynamic forces under control thanks to Metasys

Controlling the refrigeration capacity for this computer is extremely challenging. The cooling demand can change drastically in a matter of seconds. Peaks of several hundred kilowatt waste heat have to be managed to safeguard the computing performance. This problem was solved by implementing a Modbus data interface to the computer power supply. The interface allows the Johnson Controls building management to permanently monitor the supercomputer's power consumption in order to take the right preemptive decisions for the anticipated cooling demand. A heat flowmeter has also been fitted to ascertain the actual amount of waste heat involved in the procedure.

"The building management system by Johnson Controls gives us refrigeration at our fingertips whenever we need it. It can also be turned off again straightaway when it's no longer needed. This gives us the greatest possible energy efficiency together with maximum computing performance at all times. As a result, the HRLS is one of the most efficient high performance computing centers in the world."

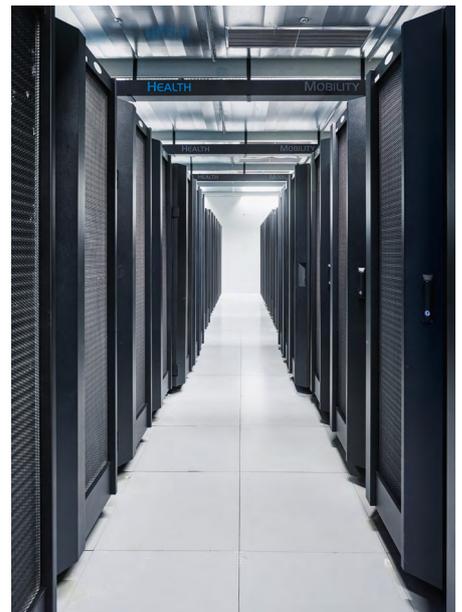
**Professor Michael Resch,**  
Director of the HRLS



New technical building with transformer station, four cooling towers and building automation facility.



Control surface, wiring and control panels of the new High Performance Computing Centre.



Serverroom; Source: HRLS (Simon Sommer)

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