



Leibniz Supercomputing Centre

Liquid Cooling Commissioning Lessons Learned @LRZ

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Leibniz Supercomputing Centre



Munich

Bavaria

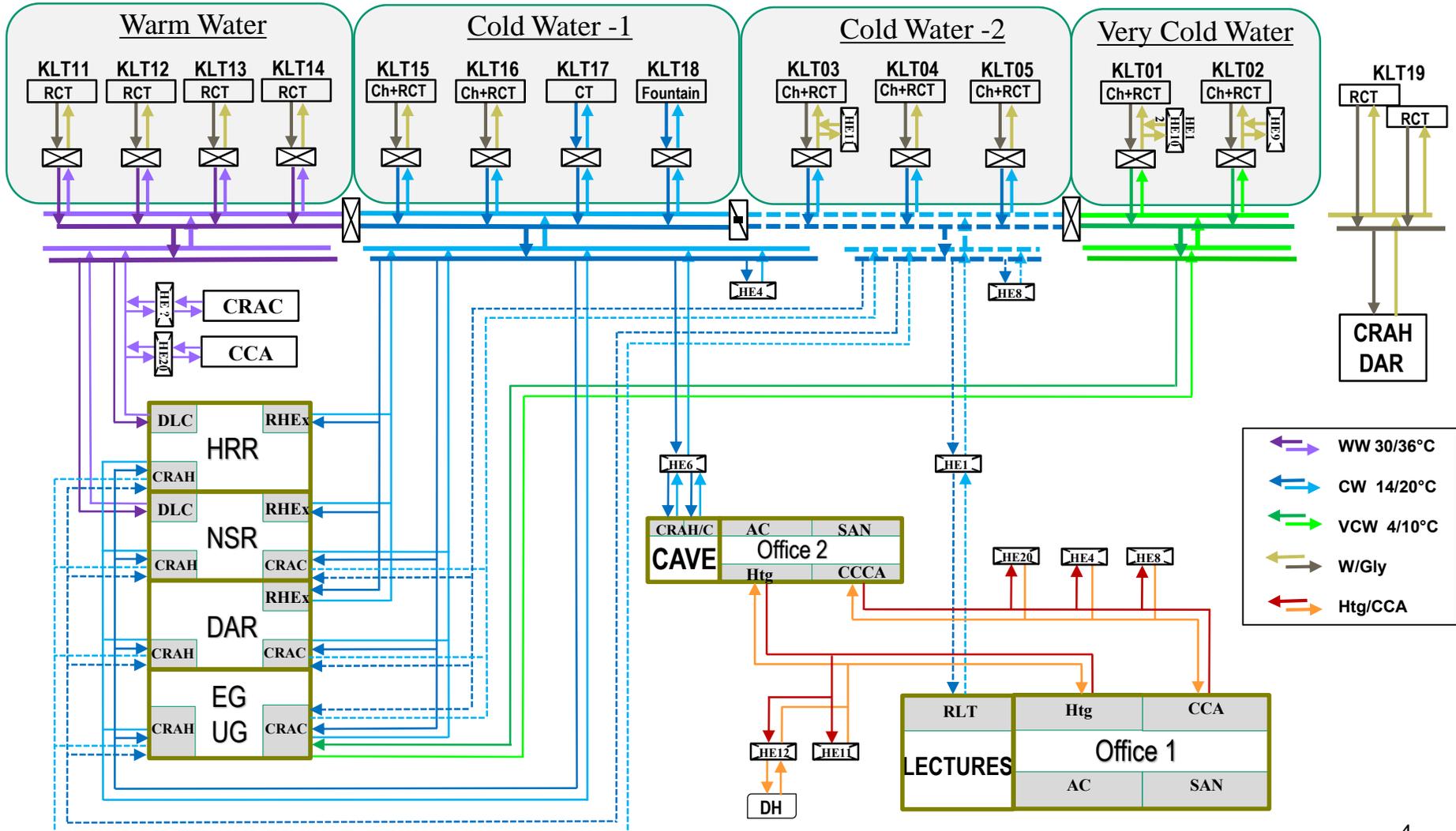
Germany & Europe

- **We provide generic IT services to all Munich universities**
- **We provide special IT services to all universities in Bavaria**
 - Network, High Performance and Grid Computing
 - Backup and Archive Services
 - IT Management
- **We provide supercomputing resources to scientists in Europe**
 - Member of the German Gauss Supercomputing Centre
 - Third party of the European HPC Infrastructure PRACE
 - PRACE Tier-0 Supercomputing Center (SuperMUC system)
 - Investigations on Future HPC Systems:
 - Hardware Architectures
 - Programming Models & System Software
 - Zero Emission Data Center Infrastructures
 - Re-Use of Waste Heat

Some more Facts

- **3160.5 m² (34 019 ft²)** IT Equipment Floor Space (6 rooms on 3 floors)
- **6393.5 m² (68 819 ft²)** Infrastructure Floor Space
- **2 x 10 MW 20kV** Power Supply
- **Powered Entirely by Renewable Energy**
- **> 300 000€ (~ 400 200 US\$)** Electricity Costs per Month

Layout of Cooling Infrastructure



SuperMUC: IBM System x iDataPlex With Direct Water Cooling

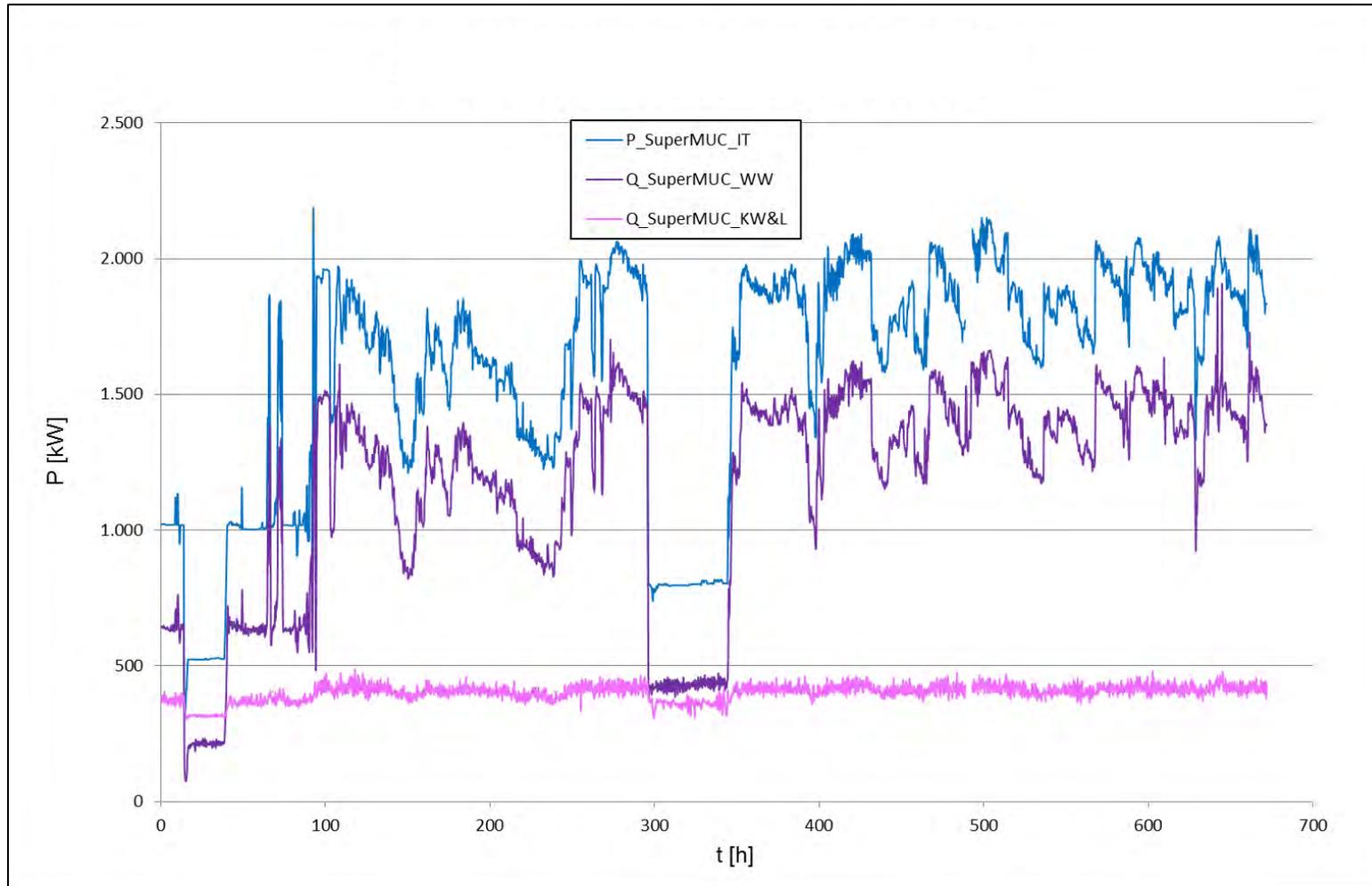


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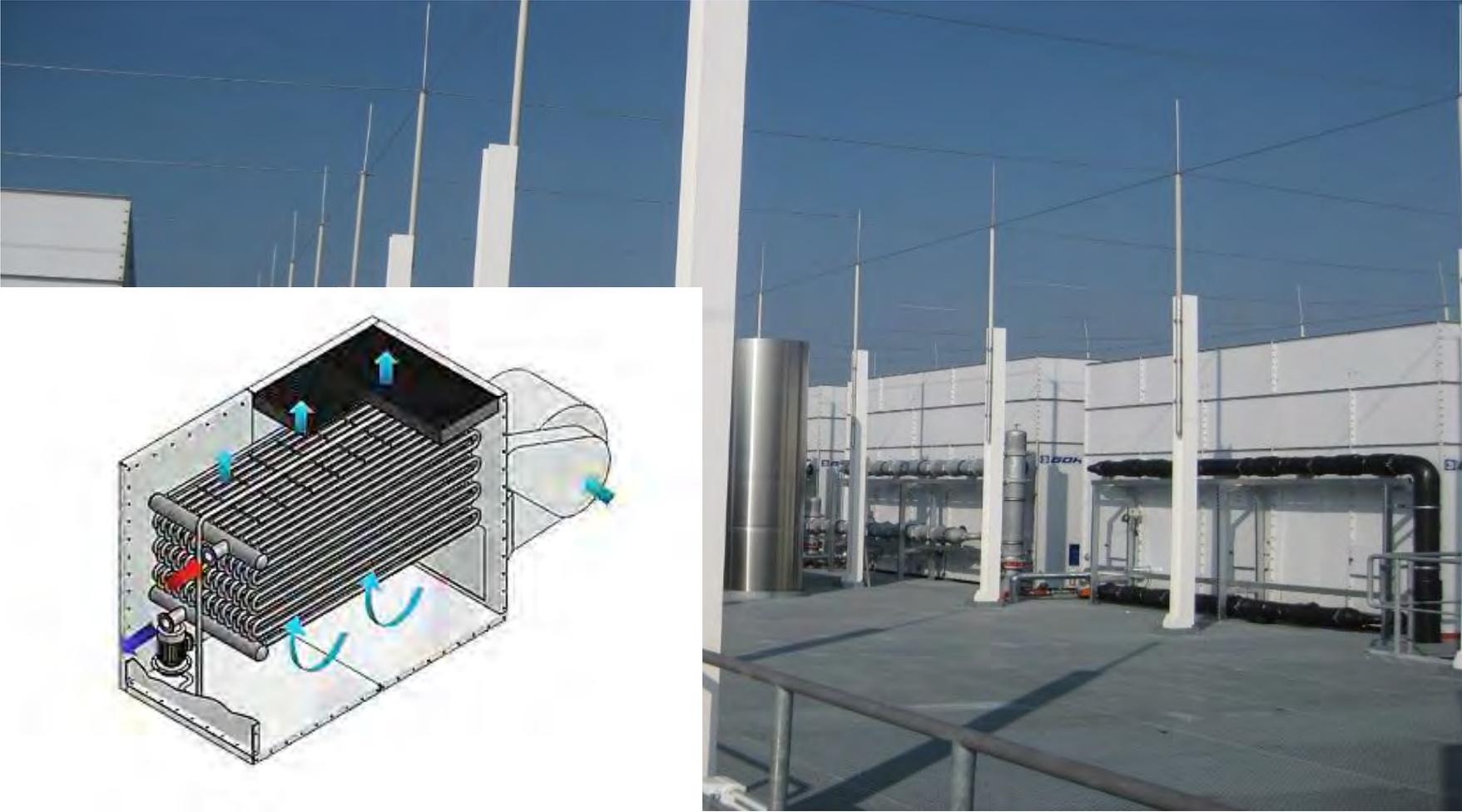
2897 TFlop/s HPL Performance
Rank 4 (June 2012)
Rank 6 (November 2012)
Rank 9 (June 2013)

iDataPlex DWC Rack w/ water cooled
nodes
(rear view of water manifolds)

Heat Profile of SuperMUC (2/2013)



CASE #1: Cooling Towers

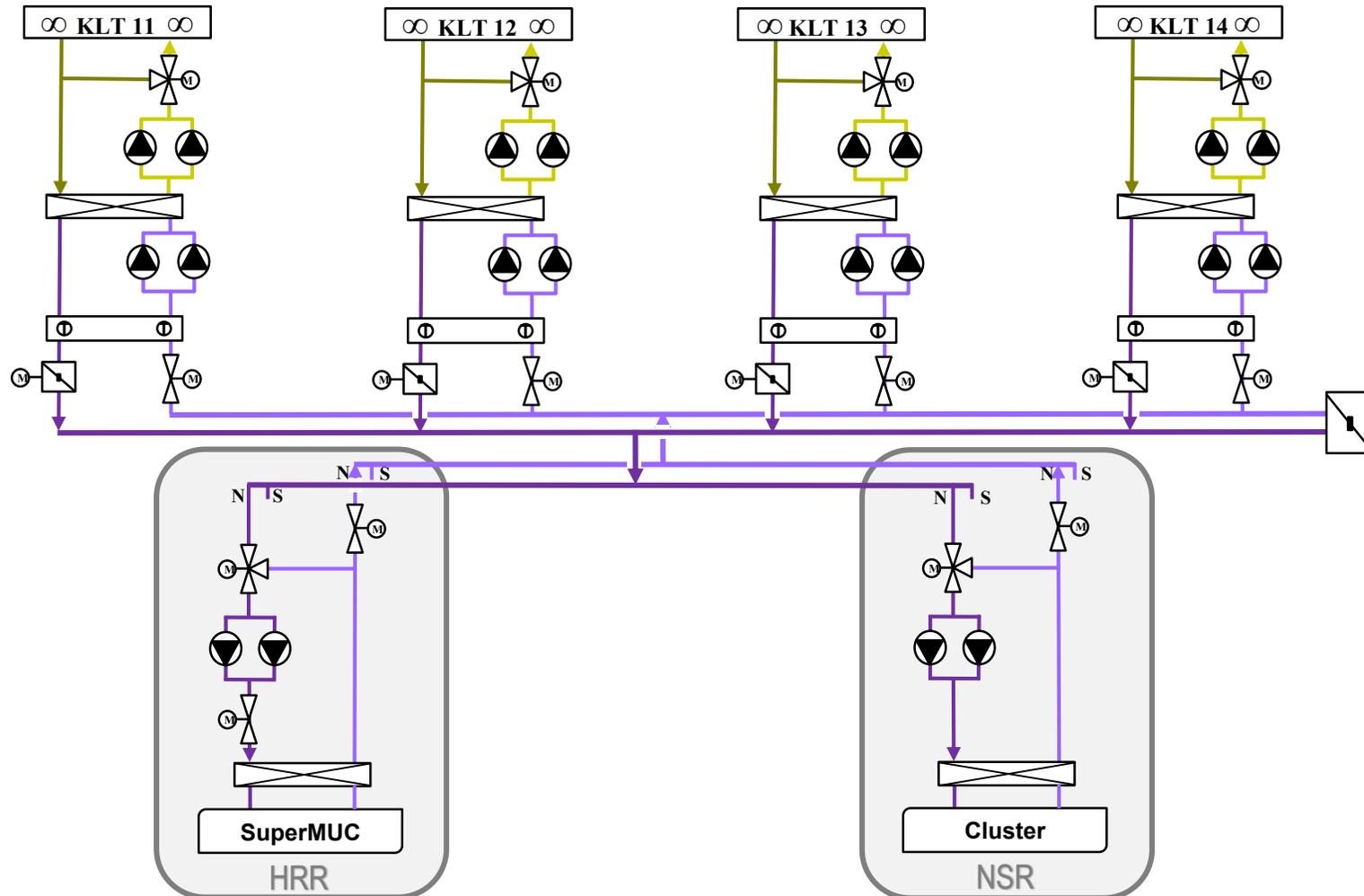


Malfunction of Water Level Sensors

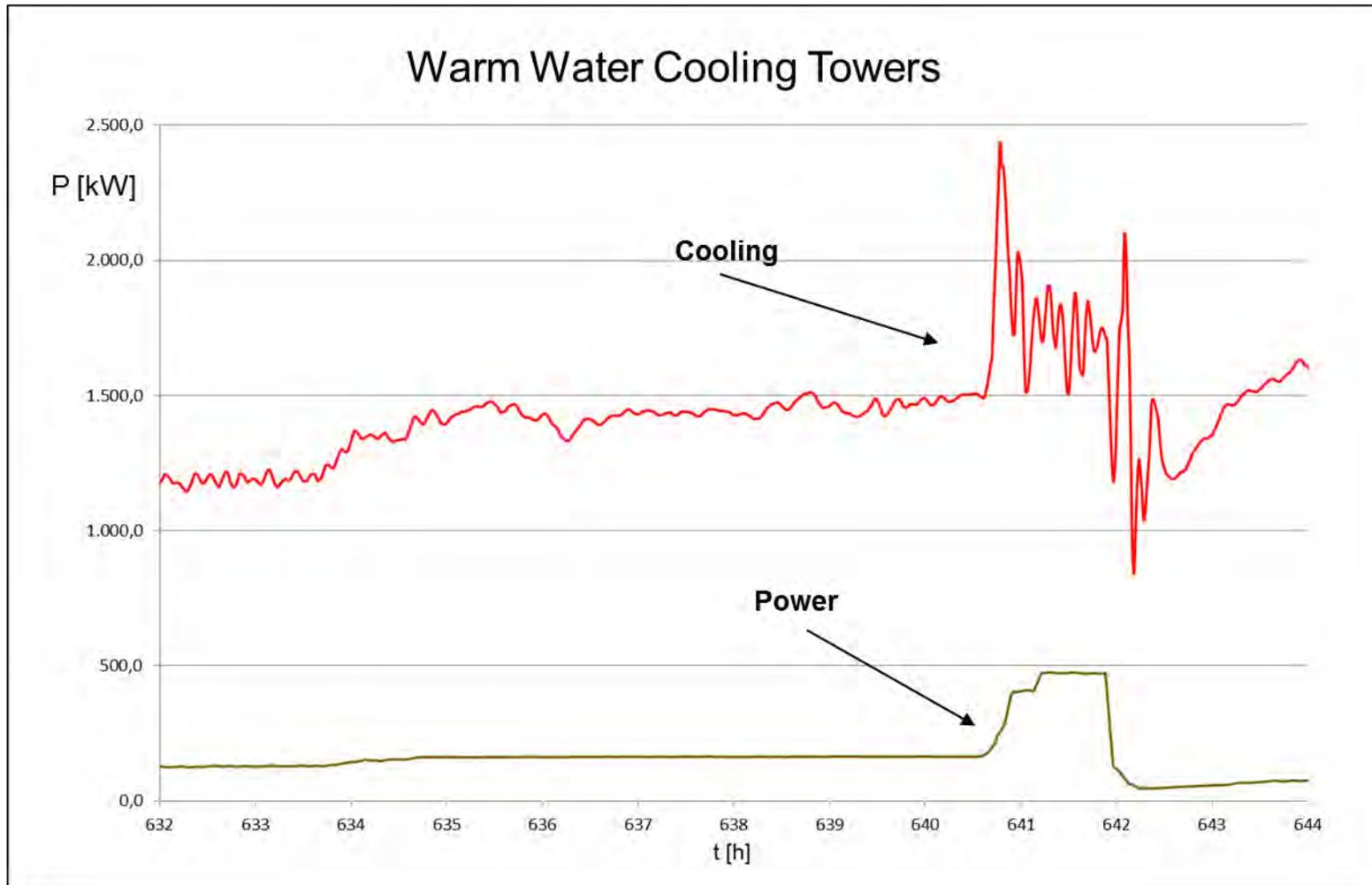
- **Issue:**
 - **Water demand cooling loop increased**
 - Filling volume: 7 m³
 - Typical feed: 1+ m³/h
 - Observed losses: 1 – 2 m³ in hours or days
- **Investigations:**
 - Load tests of the cooling towers
 - Inspection of the control system
 - Examination of the measuring devices
- **Reason:**
 - Wrong dimensions of the filling level sensor installed
- **Root cause:**
 - Main contractor did not use the sensor recommended by the manufacturer of the cooling tower



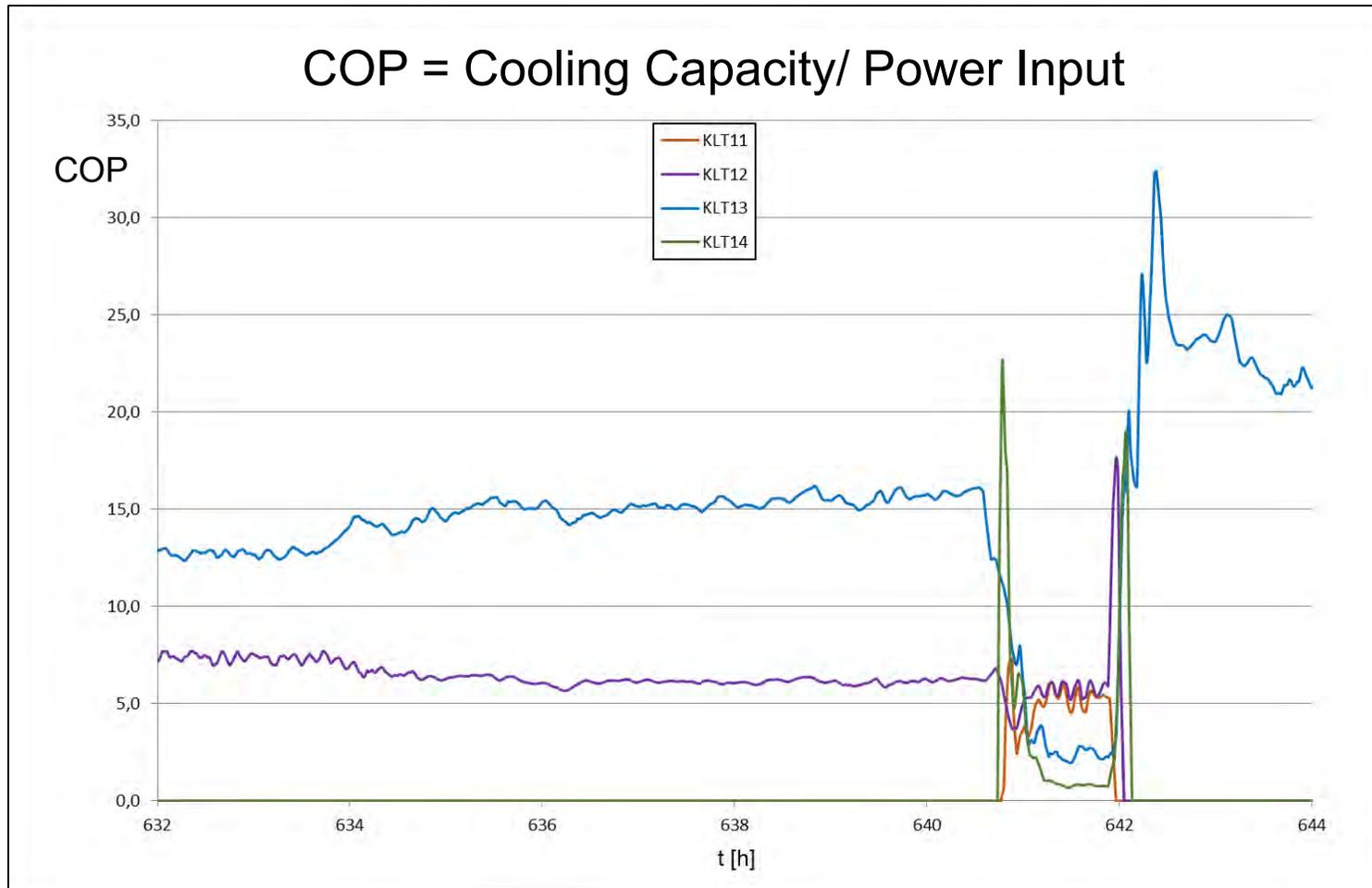
CASE #2: Operating Control Warm Water Cooling Infrastructure

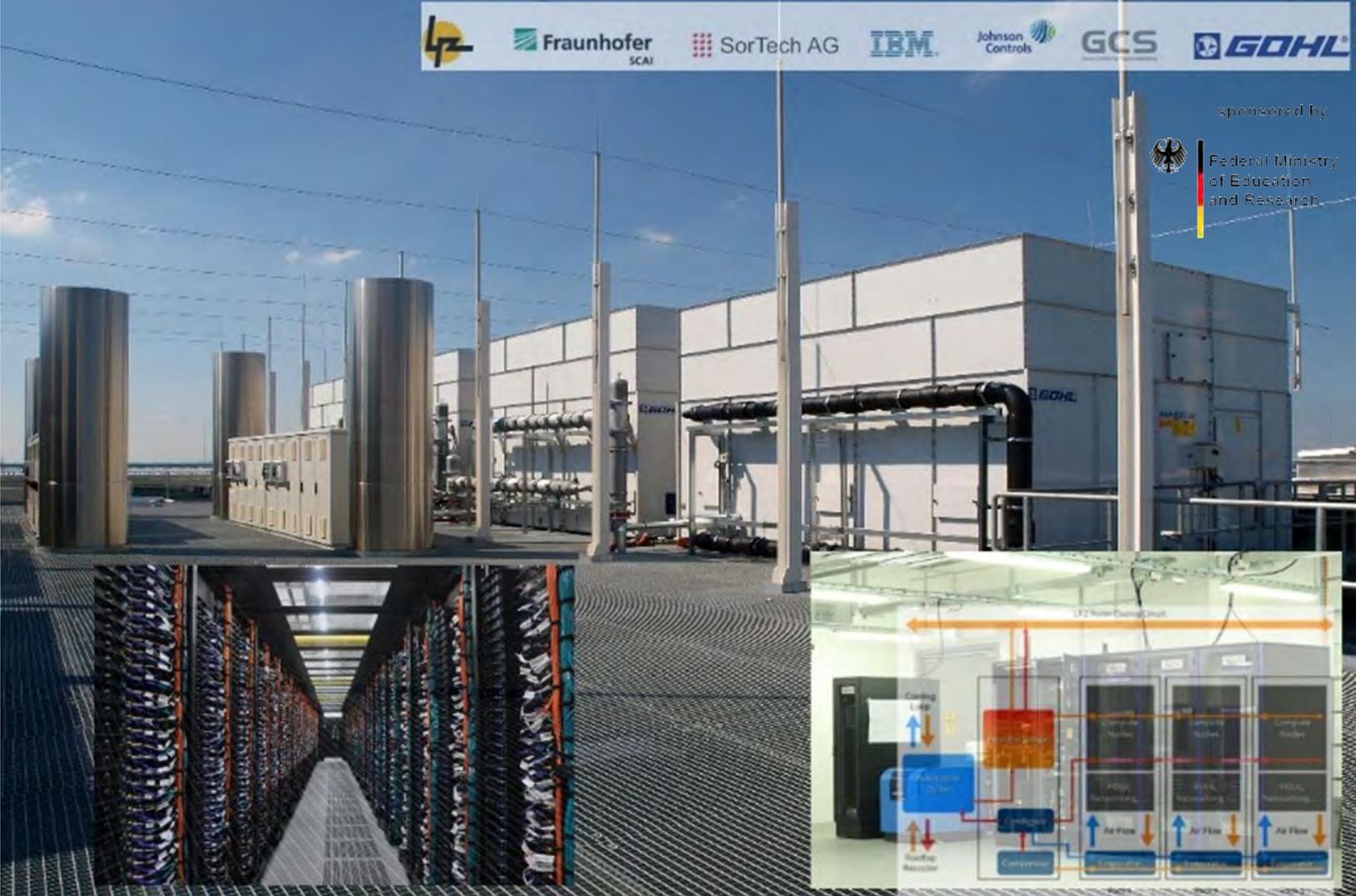


Operating Control: Test of $\Delta T_{inlet}(NSR) = -20\text{ K}$ Response of Warm Water Cooling Infrastructure



Operating Control: Test of $\Delta T_{inlet}(NSR) = -20\text{ K}$ Response of Warm Water Cooling Infrastructure







Thank You!



Zero Emission Supercomputing Centre

Energy Efficient HPC: The Four Pillar Model

