Leibniz Supercomputing Centre

Liquid Cooling Commissioning Lessons Learned @LRZ

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Leibniz Supercomputing Centre

- 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

Torsten Bloth, IBM Lab Services - © IBM Corporation
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 $\Delta T_{\text{inlet}}(\text{NSR}) = -20$ K
Response of Warm Water Cooling Infrastructure
Operating Control: Test of $\Delta T_{\text{inlet}}(\text{NSR}) = -20$ K

Response of Warm Water Cooling Infrastructure

\[
\text{COP} = \frac{\text{Cooling Capacity}}{\text{Power Input}}
\]
Thank You!

Zero Emission Supercomputing Centre
Energy Efficient HPC: The Four Pillar Model

**Data Center** (Goal: Reduce Total Cost of Operation)

- **Utility Providers**
  - Building Infrastructures
  - HPC System Hardware
  - HPC System Software
  - HPC Applications

- **Neighboring Buildings**
  - Goal: Improve PUE (Power Usage Effectiveness)
  - Goal: Reduce Hardware Power Consumption
  - Goal: Optimize Resource Usage, Tune System
  - Goal: Optimize Application Performance

**Global Optimization Strategy**