# GreenITCube

## The new data center for FAIR & GSI

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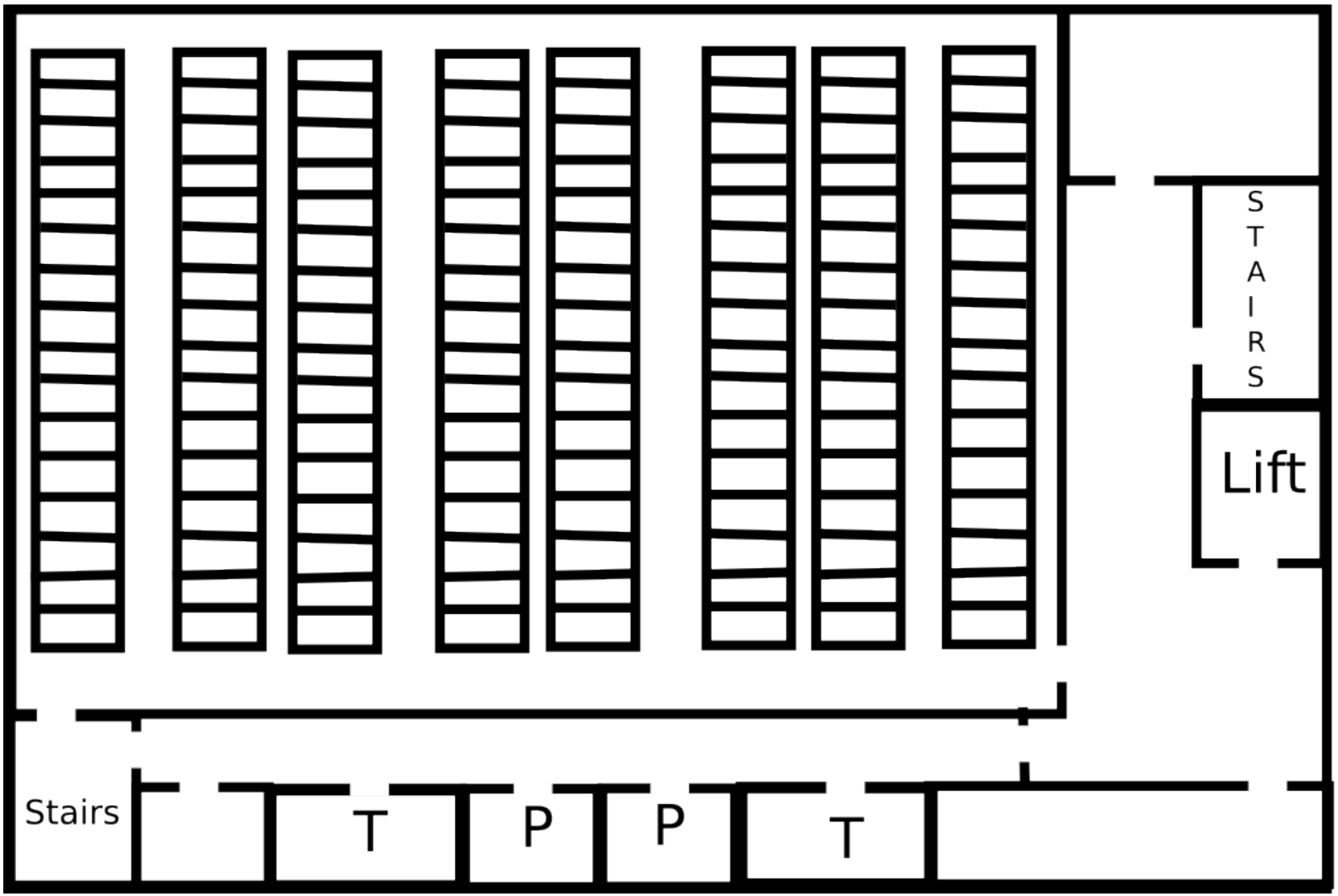
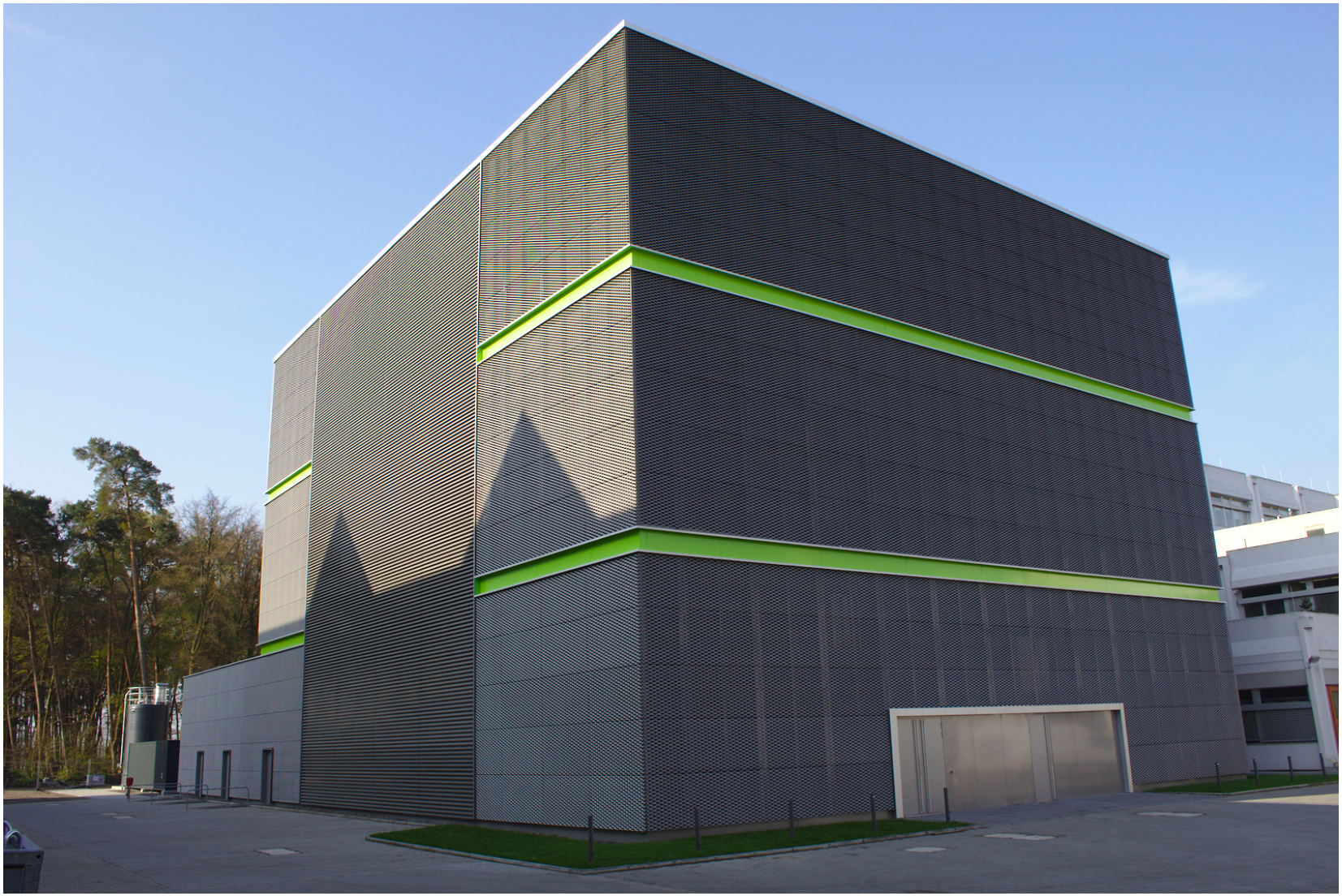
# Starting

# Going on

# floor plan



# Finally



# Finally

# Inside

# Inside

# Building

- 27*30 meters, height 22 meters - nearly a cube :-)
- 6 floors with 128 racks each
- only level 5+6 in use now
- 2225m$^3$ concrete
- 480t steel
- building for cooling infrastructure attached in the south
- Costs including technical infrastructure:
  11.5 million euro / 16 million euro for all floors
- Construction started December 2014, opening ceremony was January 2016
- First clusters running March 2016

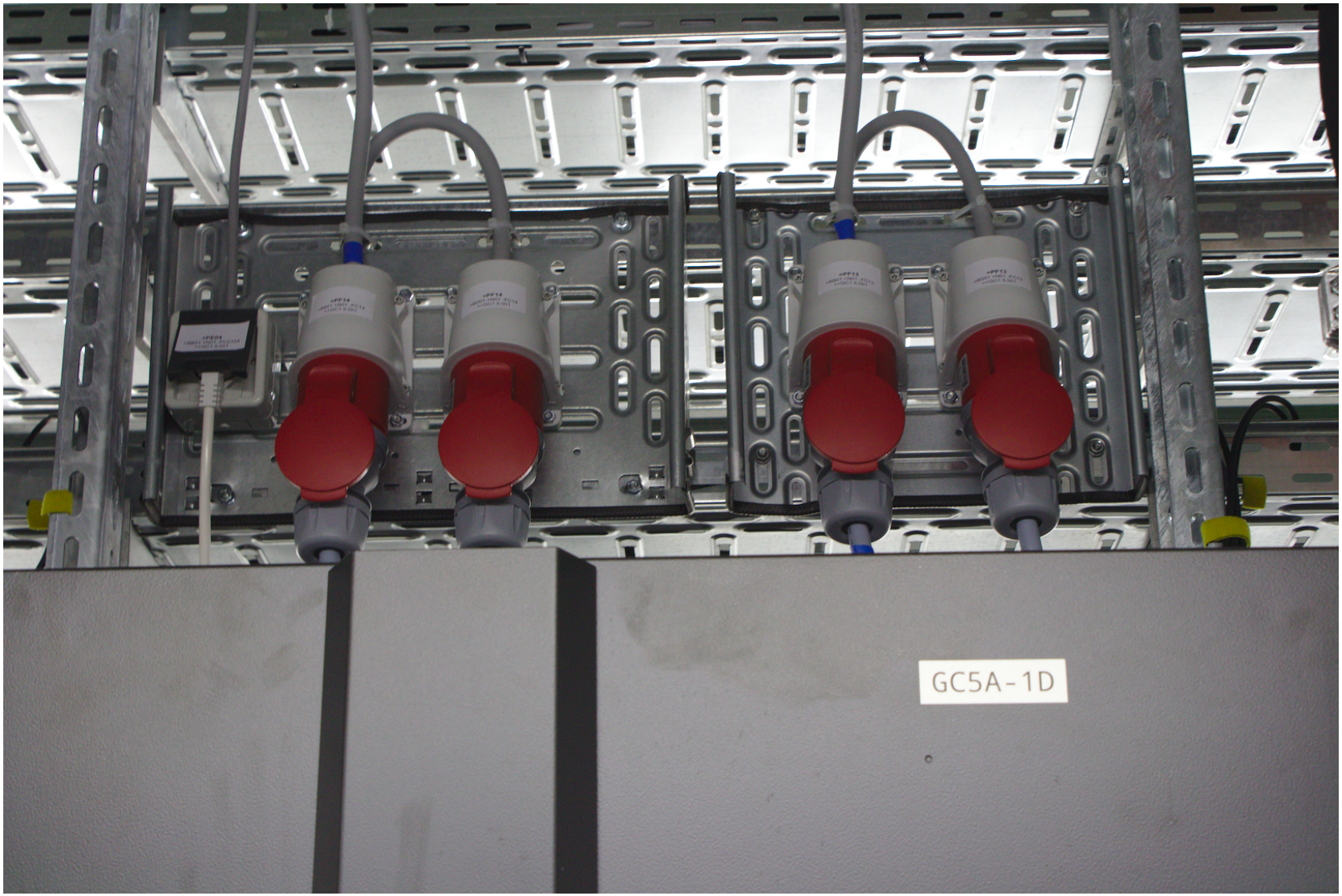
# Energy

- Two independent power supplies
  - 8 rows equipped redundant
  - 4 rows only Power A
  - 4 rows only Power B
- possible to switch to only one supply manually
- In the data center: power cables on top of the racks

# Transformators

# Energy

# Energy



# Cooling

- cooling is placed in separate building (GT1)
- 2 circuits
  - closed circuit: racks <=> heat exchangers in GT1
  - open circuit: heat exchangers in GT1 <=> free fall water towers
- 1300$m^3$/h water moved in closed circuit
- pumps, heat-exchangers, cooling tower: n+1 redundancy
- heat is used for heating the new office&cantine building
- In the data center: tubes located in the corridors

# Cooling

# Cooling

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# Cooling

# Heating new office building

# bringing water to the rack

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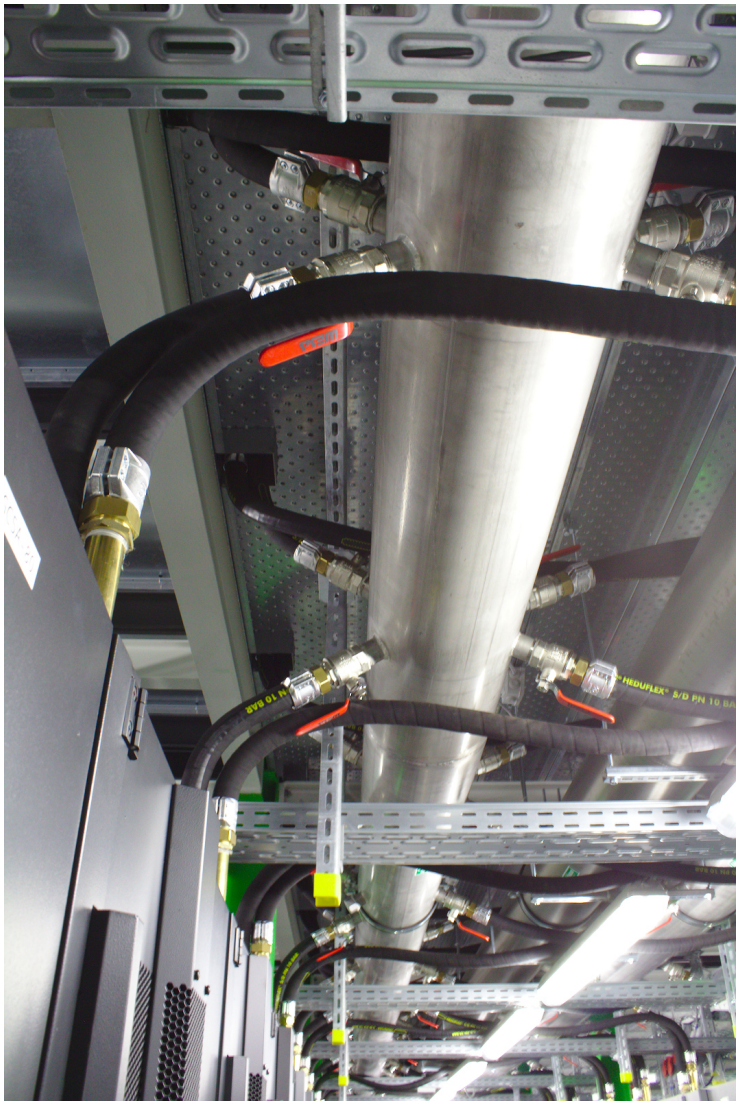


# Racks

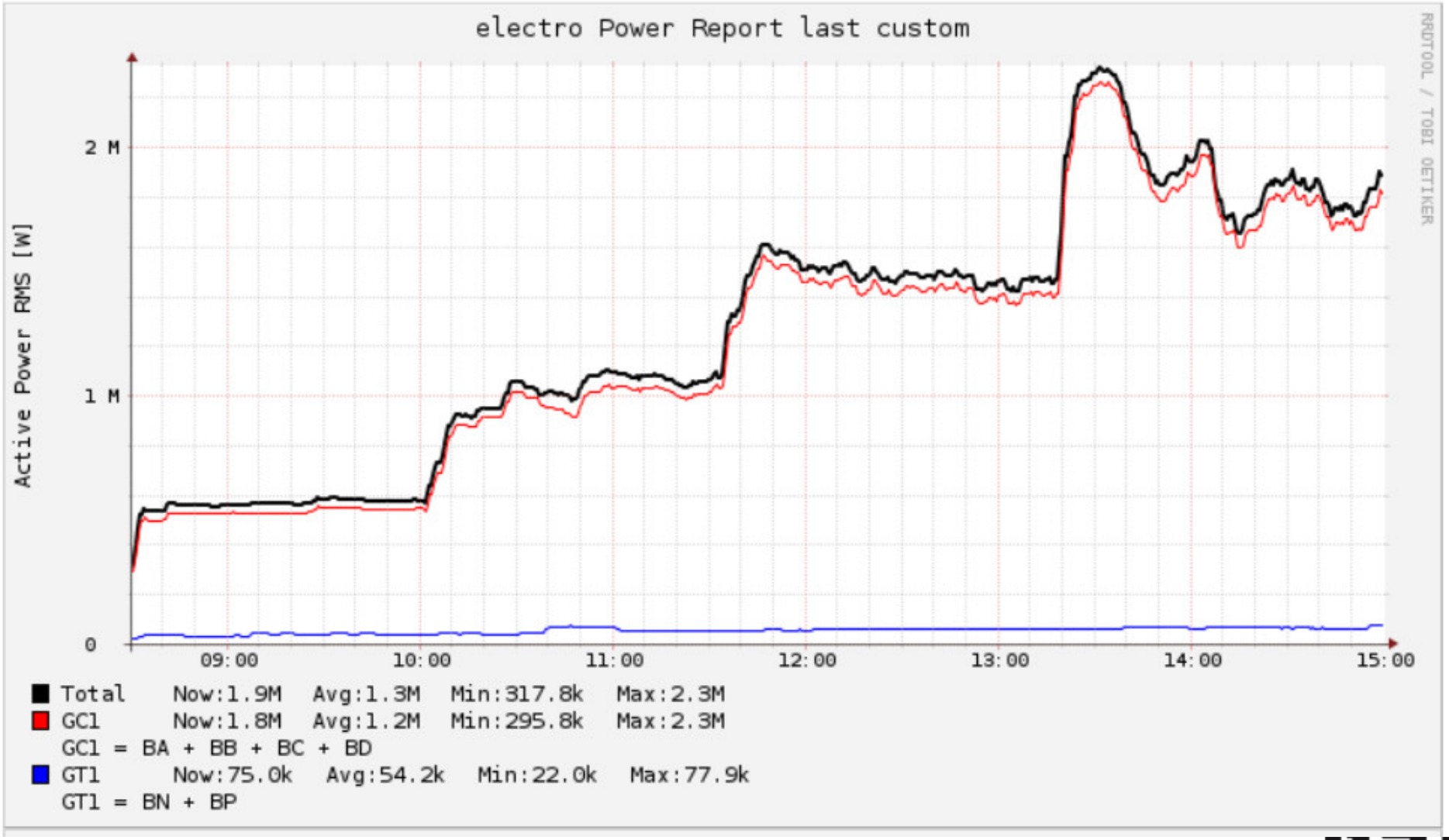
- Emerson Knürr DCD racks
- Passive rear-door heat-exchanger up to 35kW
- no additional fans - only fans inside the servers
- 220*80*120cm (H*W*D), 47 U
- Bought completely equipped with PDUs, cable reels, ...
- PDU:
  - Sensors for humidity and temperature
  - independent network for PDUs
  - Used for: Monitoring, Alarming, Emergency shut off
  - 2 PDUs in racks with redundant power -> PDU Array
    - SNMP problems -> investigating together with Emerson

# Racks

# Testing the Cube

- Installed fan heater in each rack
- fan heaters used stable with 10kW -> 2.5MW reached
- PUE measured during test < 1.1
- Fan heaters used for intensive PDU testing, too

# bringing water to the rack



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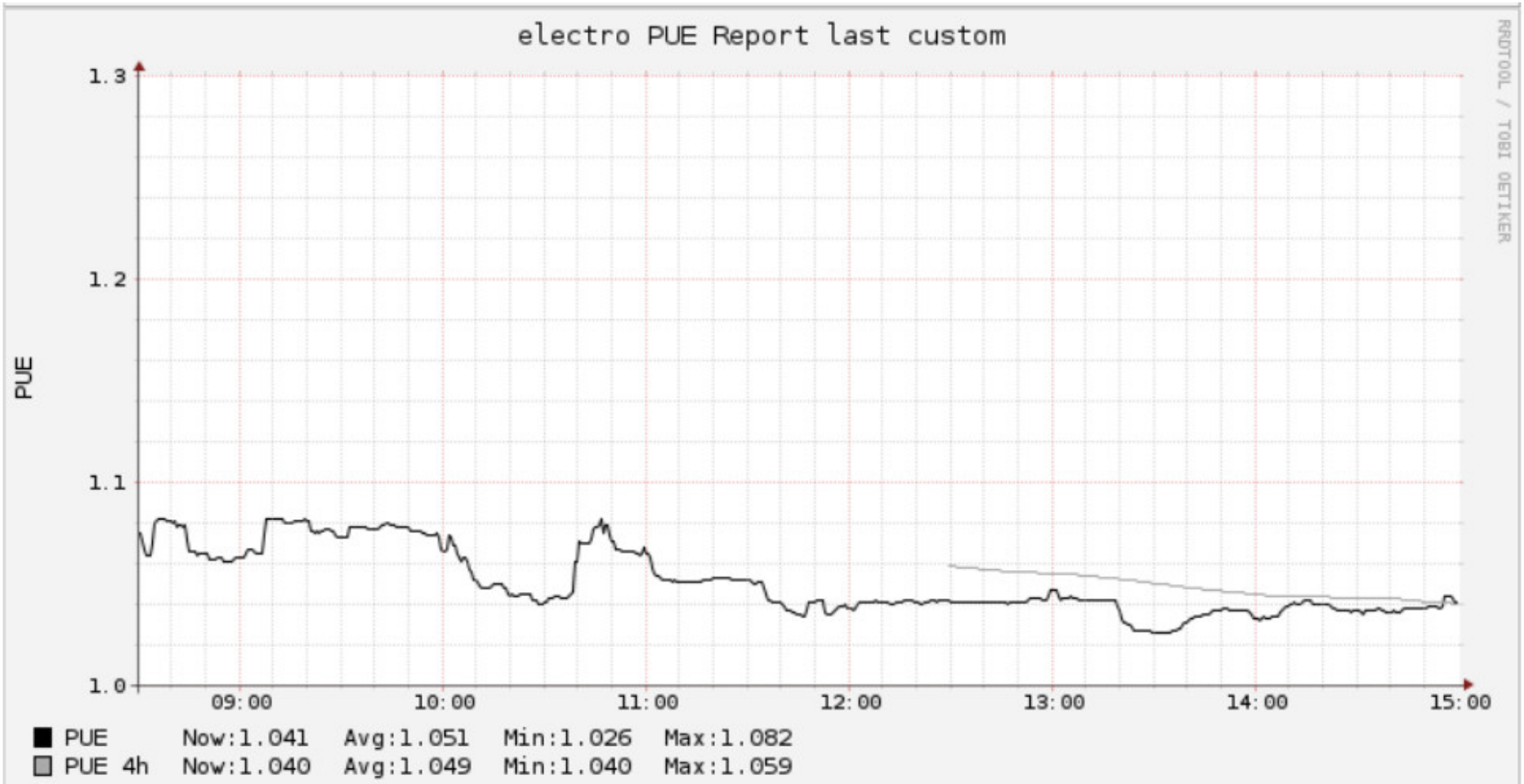


# Migration

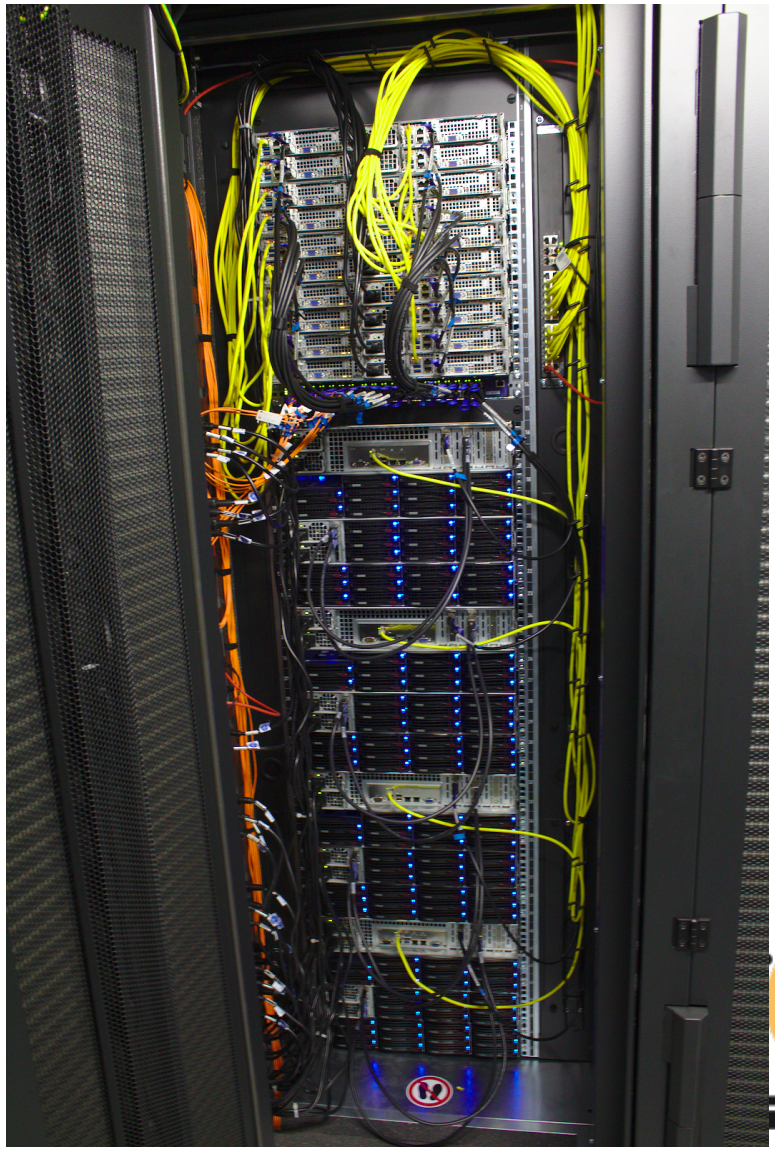
- What was moved?
  - Nyx - 7.1 PB Lustre FS (11 racks)
  - Kronos - 4000 Cores CPU cluster (3 racks)
  - L-CSC - GPU cluster (8 racks)
  - in addition service machines, gateways, ...
- Will add new machines during this year
- AND of course more services will move to the Cube

# Steps

- planing everything in detail (long time)
- preparing network before (3 weeks)
- moving itself & in-rack cabeling (1 week)
- checking the systems (2 days)
- bring everything online (1 day)
- moving itself was done by external company
- everything else by GSI employes beside normal work, mostly HPC people
- only 3 of 460 servers damaged/didn't start

# Combining FS & Compute

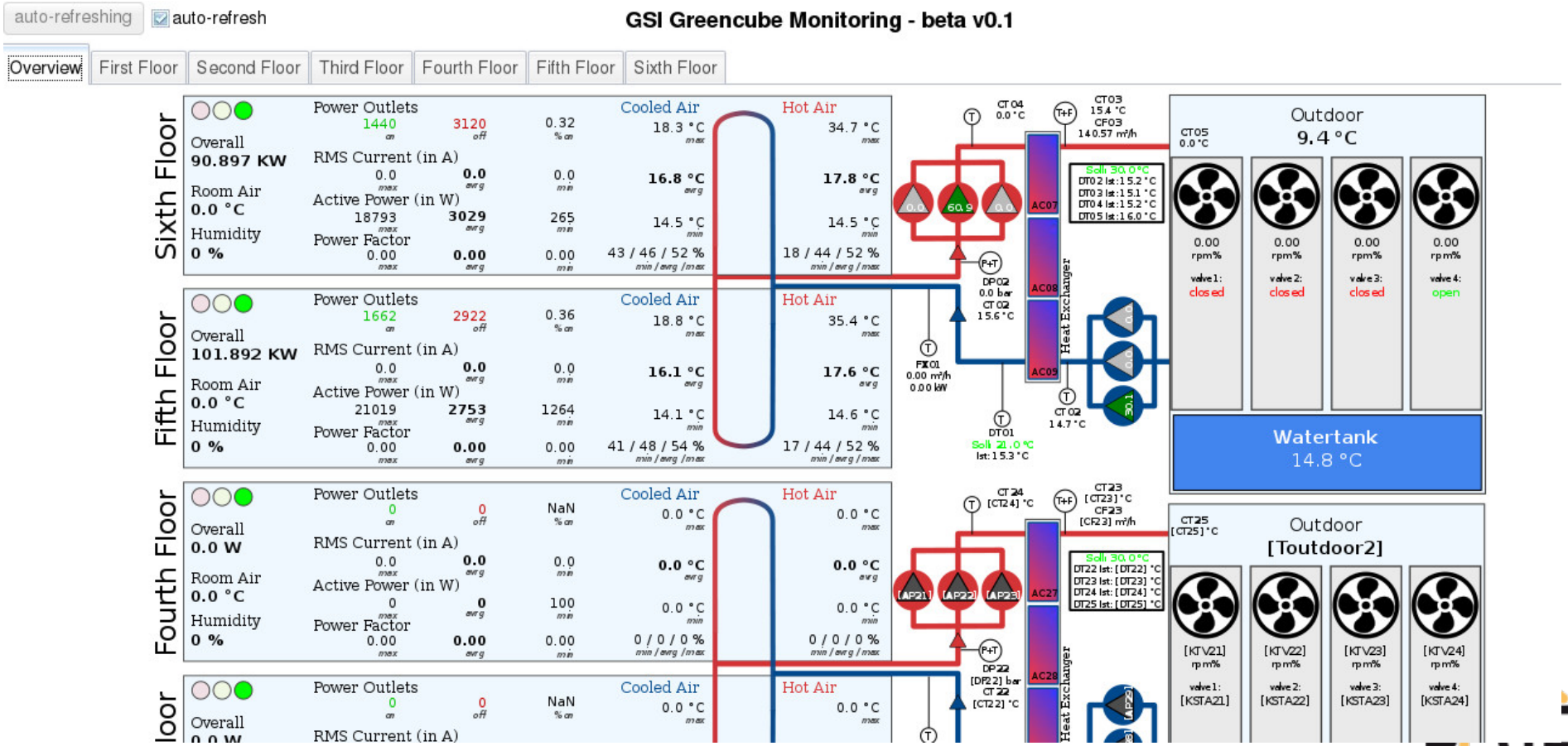
- Advantages
  - perfectly filling up IB switch
  - optimissed usage of power capacity



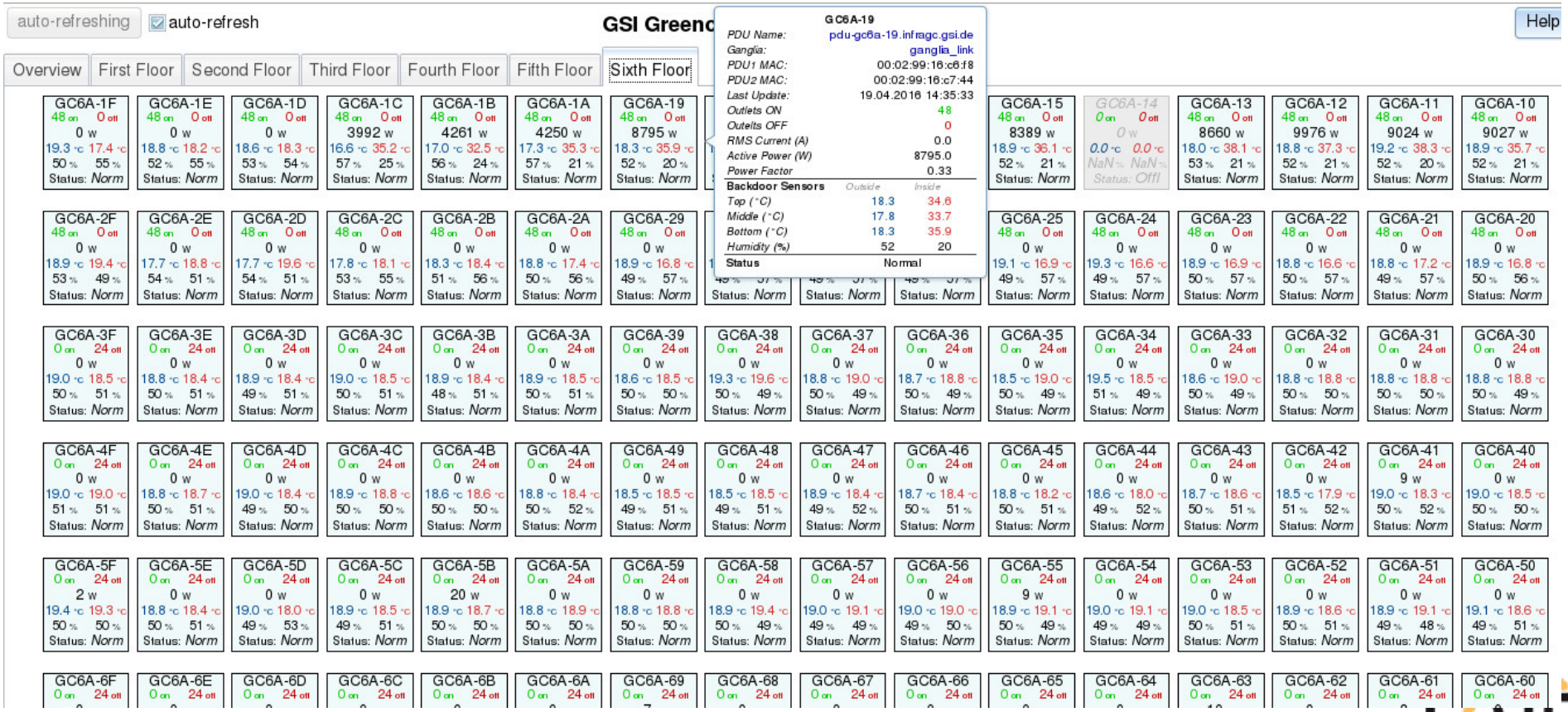
# What is monitored?

- racks (temperature and humidity)
- infrastructure (cooling and energy)
- data of infrastructure directly collected from different system controls
- At the moment collecting as much as possible
- ToDo: Learn, which parameters are relevant and create reports

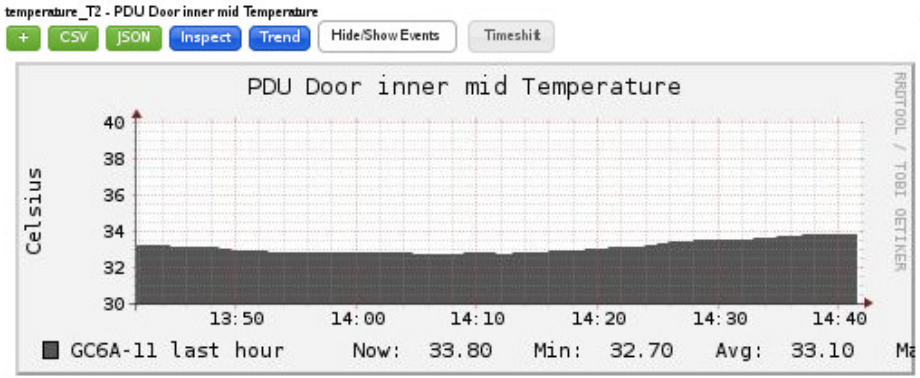
# Live-Monitoring

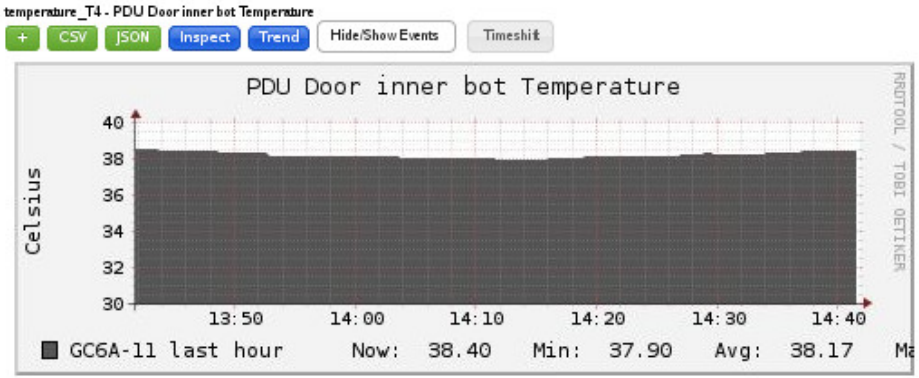


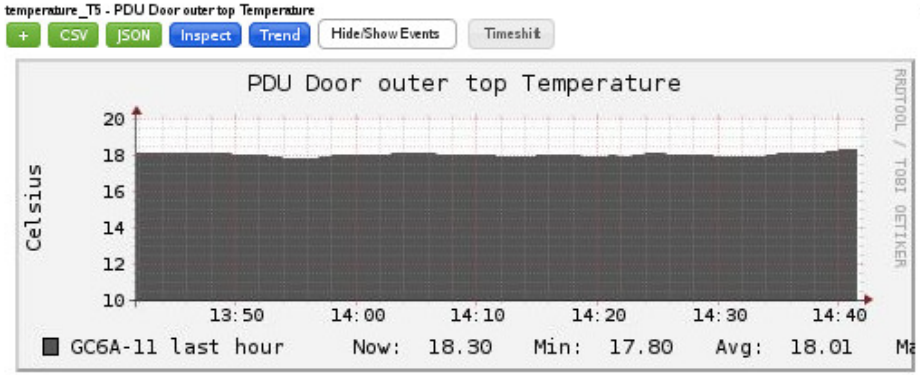
# Live-Monitoring

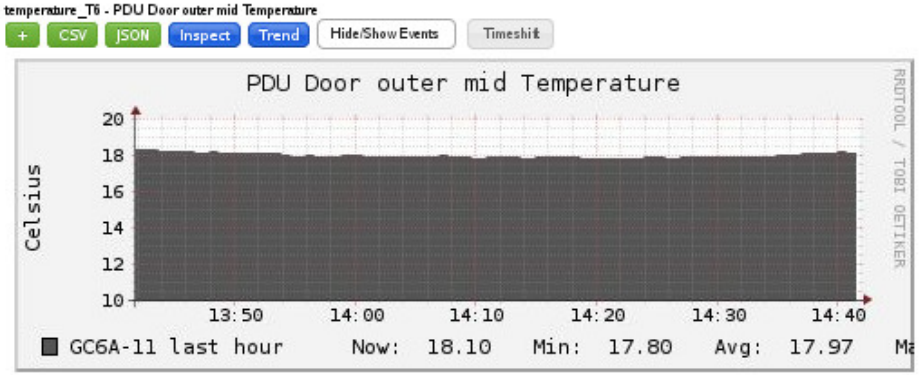


# Ganglia - racks



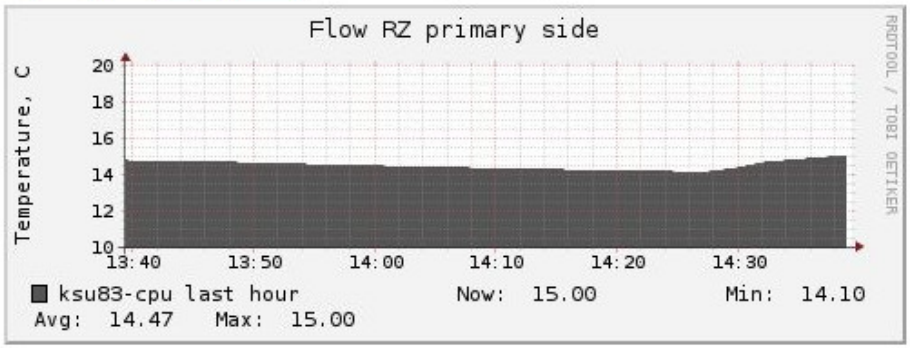



# Ganglia - cooling

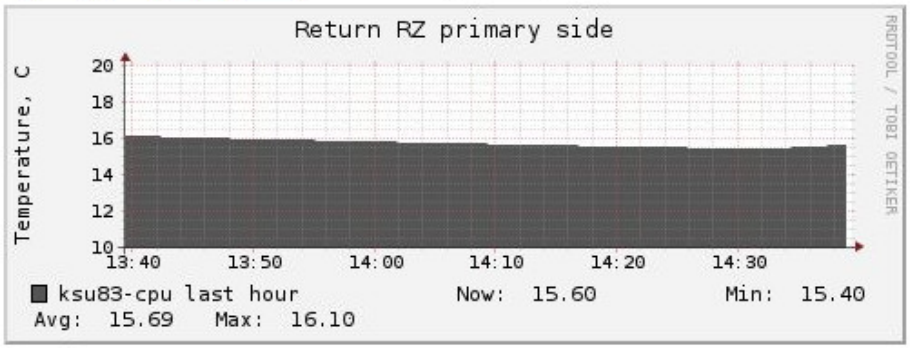
temperature_lp06ct02_flow_rz_primary_side - Flow RZ primary side

+ | CSV | JSON | Inspect | Trend | Hide/Show Events | Timeshift




temperature_lp06ct03_return_rz_primary_side - Return RZ primary side

+ | CSV | JSON | Inspect | Trend | Hide/Show Events | Timeshift




temperature_lp06dt01_cooling_water_tank - Cooling water tank

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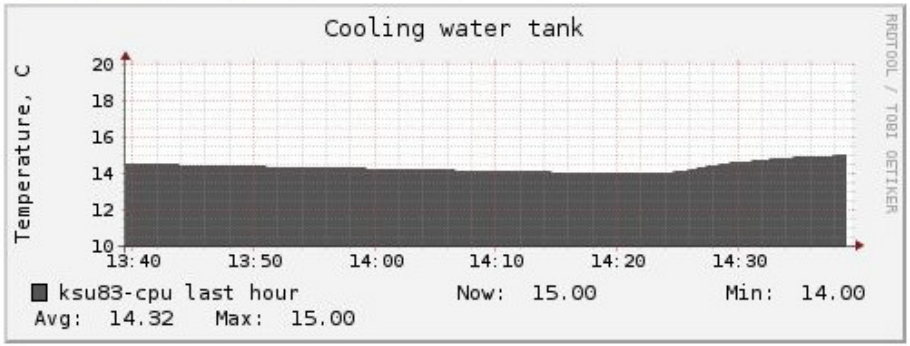
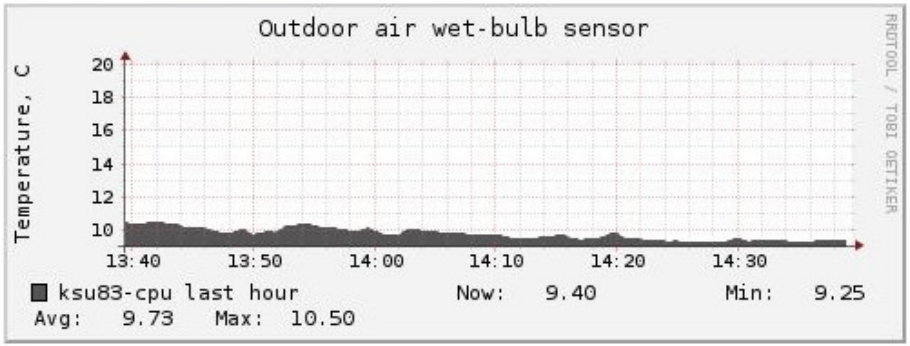



temperature_lp06dt05_outdoor_air_wet_bulb_sensor - Outdoor air wet-bulb sensor

+ | CSV | JSON | Inspect | Trend | Hide/Show Events | Timeshift



# The End

- Thanks to
  - many many people at GSI for supporting this project
  - external partners

Questions?