Datacenter concept design Wasa Zero Emission Data Centre WSTAR

14.6.2024

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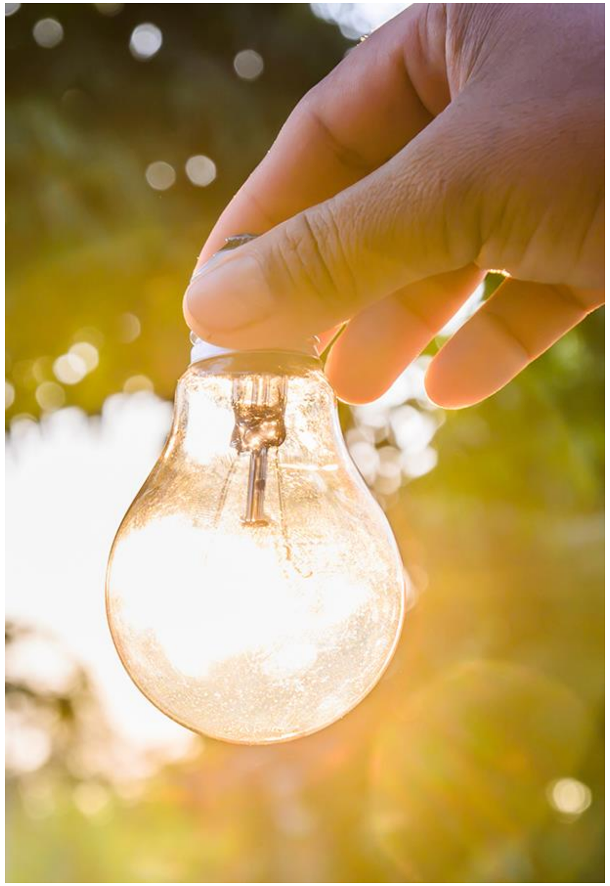
Contents

Building on Innovation

Project summary

- Wasa Zero Emission Data Center (WSTAR) is a new local infrastructure located in the research and development laboratory Technobotnia Vaasa, Puuvillakuja 3, 65200 Vaasa.
- This concept plan serves as the basis for the overall contract offer for the design and built contract
- Detailed design needs to be included in the turn key delivery project (design & build) or alternatively completed separately

Project summary, building efficiency



Design targets

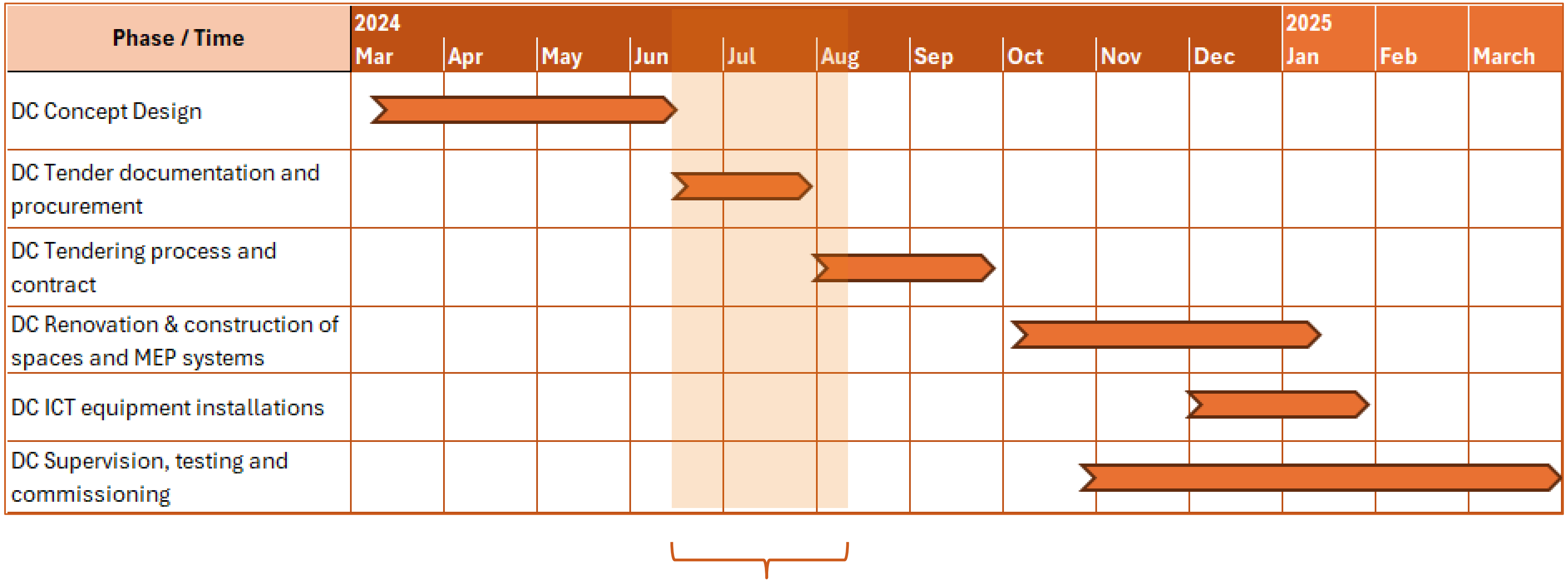
- 50 kW IT laboratory facilities
- Direct liquid cooling + perimeter cooling
- Full heat recovery by a heat pump system
- 400 VAC/DC distribution to the potential DC supplied servers, along with UPS-distribution
- Independent heat rejection to ambient
- UPS systems with flexible battery chemistry options
- Net Zero Data center for various research purposes

Construction cost estimation (full built)

Cost item category	Eur
Services: Design, project management and supervision	80 000
Construction: Structure, equipment and installation work	234 000
• Data center room structural construction works	20 000
• Mechanical	99 000
• Fire suppression[1]	4 000
• Electrical panels and cabling	45 000
• Electrical 400 VDC distribution and rectifier	62 000
• Building automation	20 000
UPS and Batteries[2]	45 000
IT hardware and servers (14 servers)	365 000
TOTAL BUDGET	**622 000**

All the fees are exluding VAT (VAT 0%)
The cost estimate is on high level with ±25 % accuracy
1)Excluding UPS/battery room gas extinquishing system (90 000 Eur)
2)Cost estimate for integrated ”on the shelf” 15 kWh UPS and battery solution

High level project schedule



Critical time ”summer” vacation.
Risk of project being delayed 1-2 mths.

Possible procurement models

Considerations in construction and procurement strategy

- Detailed design execution options
  a) Included in the overall turn key procurement solution (IT Hardware delivery & constrcuction)
  b) Carried out in separate packages
- Building permit
  - As protected building all outdoor installation for Dry Cooler might need building permit
- Construction management and supervision services
  a) WSTAR Consortium internal task and reposibility
  b) Assignment to construction management consultant

Site plan

Connections to existing utilities

Electricity

- Datacenter will be connected to the existing main distribution panel. There is available 250 A spare feeder for the connection.

Telecommunication connections

- Client will arrange the needed fiber connections

Water and sewage

- Cooling water piping fill connection
- Condensate drainage for CRAC unit

Heating

- Waste heat is intended to be fully recovered and output to heating system

1st floor

Site plan

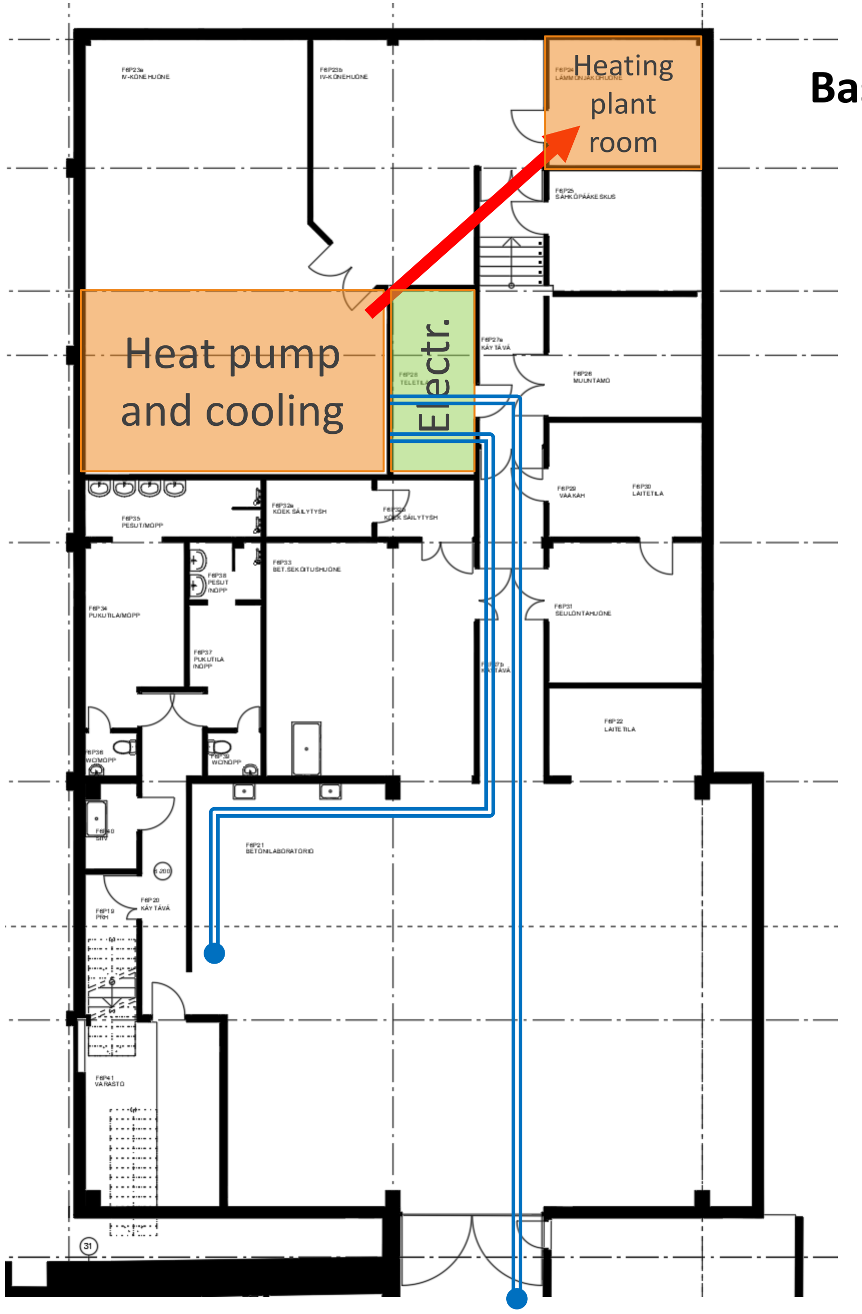
New space allocations

Cooling plant and heat pump

- A location cleared in a ventilation plant room
- Compressed air systems need to be relocated
- Heat supplied from heat pump plant to heating system, connection point in heating plant room
- Cooling water lines from cooling plant to IT laboratory via corridors and penetration to 1st floor in concrete lab area
- Dry air cooler location TBD, preliminary location on a yard deck top of the driving ramp to concrete lab
- DAC piping from plant room to the DAC via concrete lab

Electrical systems

- A location cleared in telecommunications room



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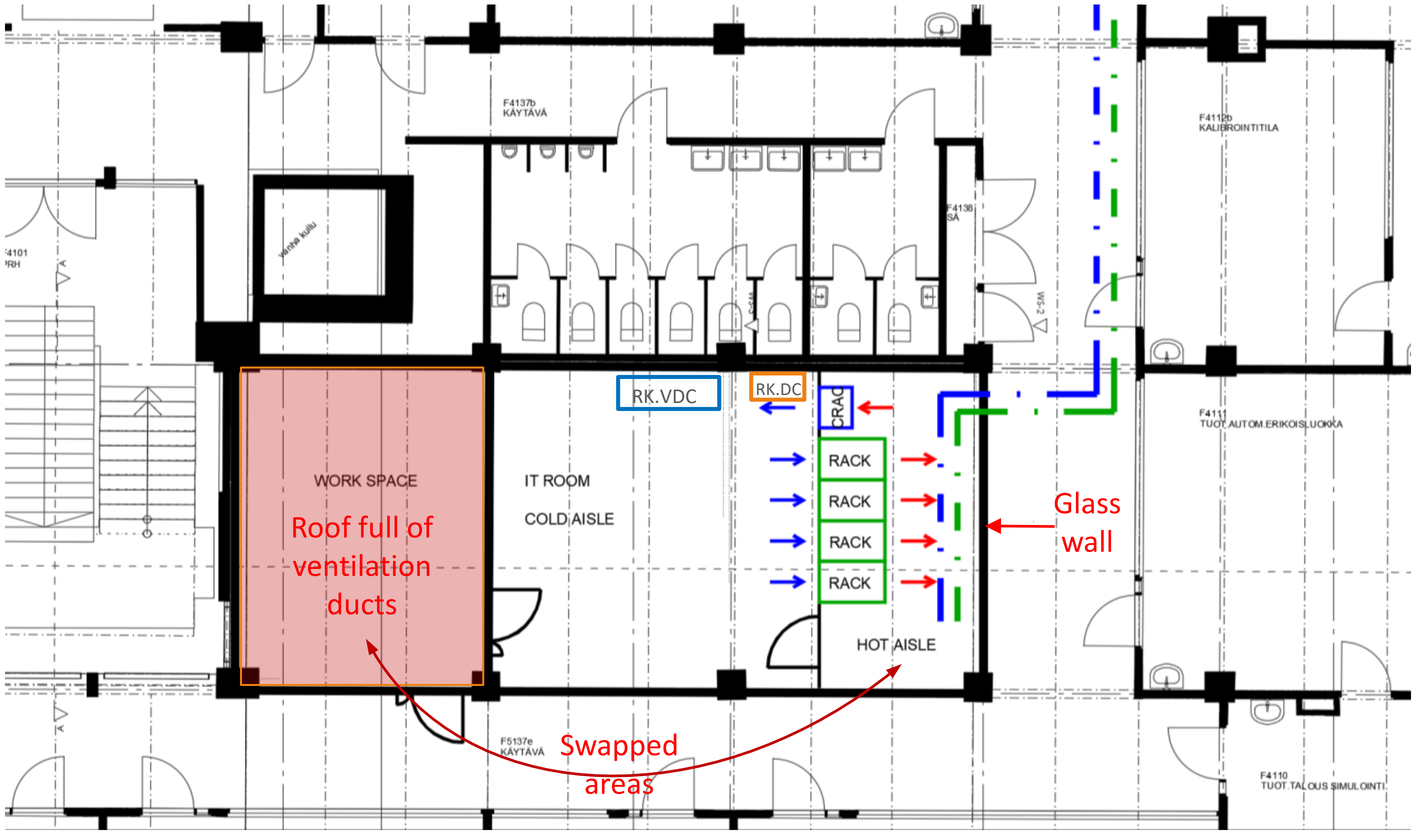
Datacenter layout proposal

- The space allocation of work space and IT laboratory are proposed to be swapped
- The IT laboratory should implement a hot aisle containment for improved cooling efficiency
- Electrical distribution board RK.DC for 230 V and 400 V connection
- Walls are recommended to built for EI60 fire rating, for e.g., acoustic performance, no fire dampers in ventilation ducts



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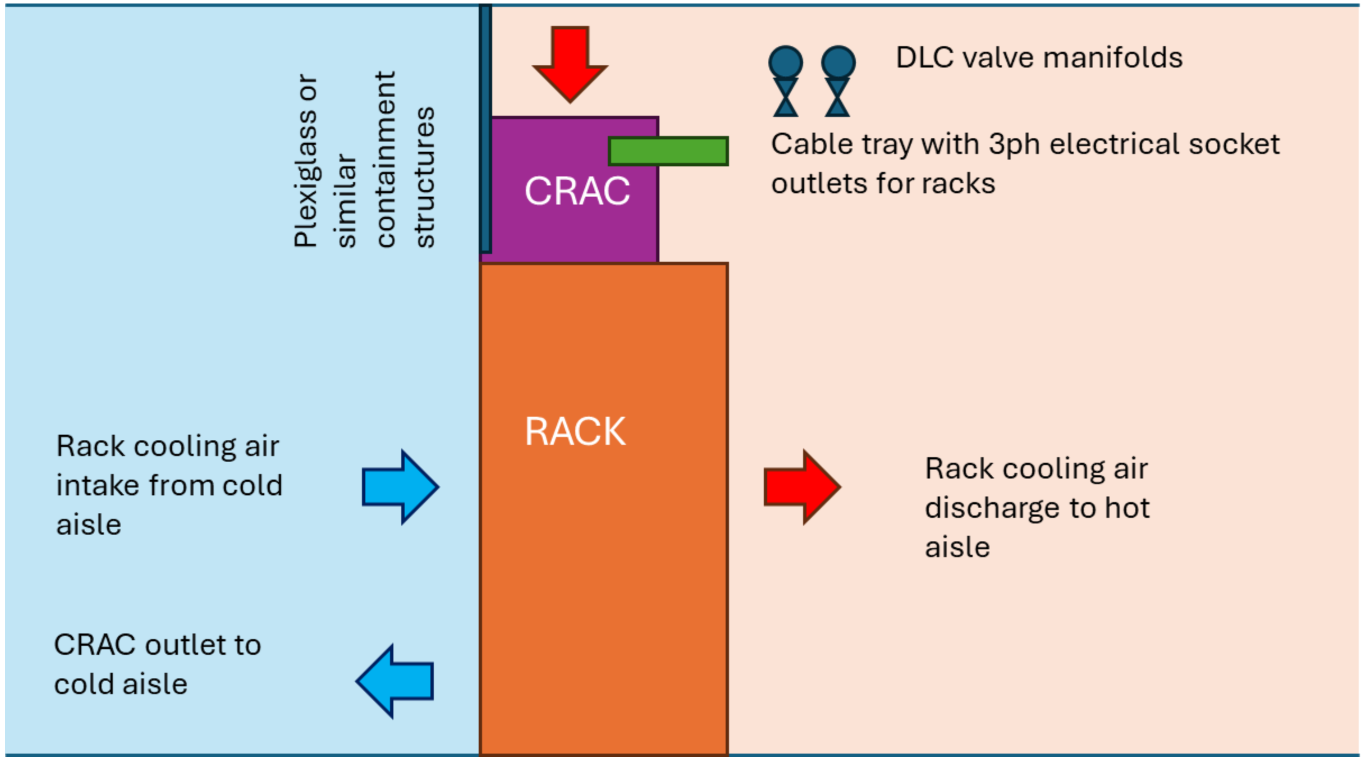
Datacenter containment section

- The IT lab should be divided into two air conditioning areas (hot and cold containments) which will improve cooling efficiency and provide more comfortable working enviroment
- CRAC will take air from the hot containment and blow it into the cold aisle
- DLC cooling system pipe headers with valved zero leak connections for liquid-cooled racks overhead, coordinated with electrical supply cable trays



Electricity supply system

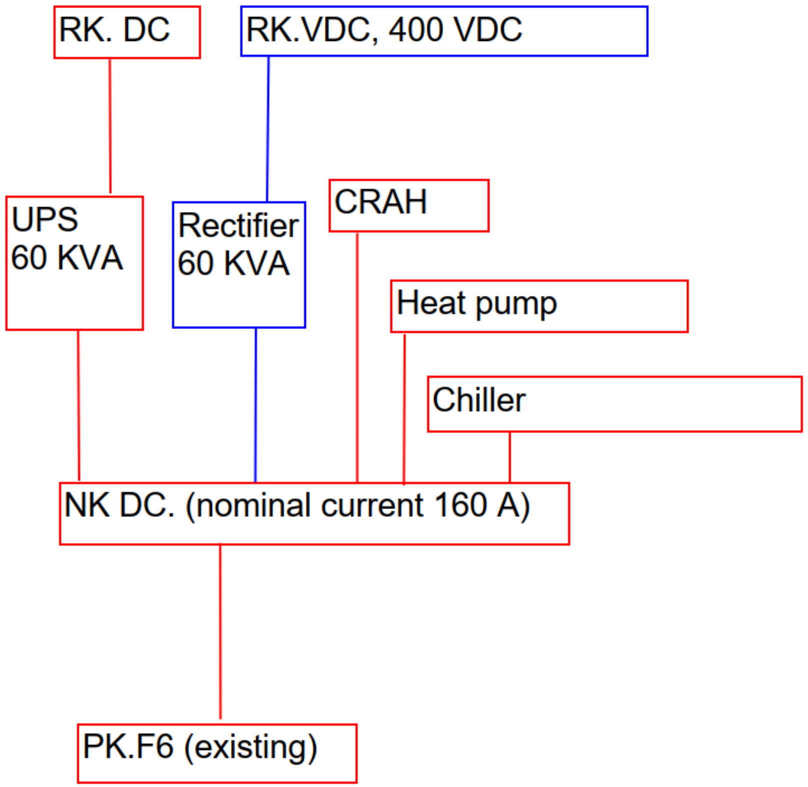
Electricity connection:

- Site is supplied from the Vaasa energy 400 V network
- Electrical connection to the datacenter main panel (PK.F6)

Technical data:

- NK.DC Nominal current is 160 A
- Following feeders (rates to be confirmed when products are defined):
  - 3*25 A Heat pumps
  - 3*25 A for chiller
  - 3*25 A for CRAH
  - 3*125 A for DC panel
  - 3 * 125 A for UPS device
  - 3 * 125 A for DC rectifier.
- Entire panel and all feeders to be equipped with kWH meters and power monitoring
- In the DC room there will be two electrical panels one for 400 VAC and one for the 400 VDC. Included into the delivery.

Below is the single line diagram.



Electricity supply system

RK.DC

- Nominal current 125 A
- Six 3*16 A (400 VAC) feeders for the datacabinets + same amout of available circuit brakers for extensions as a spare. All feeders to be connected to power monitoring with kWH and power readings
- One 3*16 A feeder to the main cooling pumps (also cabling from DC room to cooling pump).

RK.VDC, technical data:

- Nominal current 125 A
- Six 2*32 A (400 VAC) feeders for the datacabinets + same amout of available circuit brakers for extensions as a spare. All feeders to be connected to power monitoring with kWH and power readings

Installations:

- Cable routes from NK.DC is the same as where the cooling pipes are located.
- Room lighting will be connected to the existing lighting supply systems
- One 300 mm cable route for the lan and fiber connections to be installed above the cabinets
- One 300 cable route for the 400 V cabling to be installed above the cabinets
- Four 3*16 A (AC) socket to be installed to the cable route for the rack cabinets.
- Four 32 A (DC) socket to be installed to the cable route for the rack cabinets
- Physical security: Existing doors, accesscontrol and security systems to be used
- Separate grounding bar to be installed to DC room. To be wired directly from the main grounding bar. (all datacabinets to be connected to this)

PDU’s inside data racks with power monitoring are included to the rack and hardware delivery.

Electricity supply system

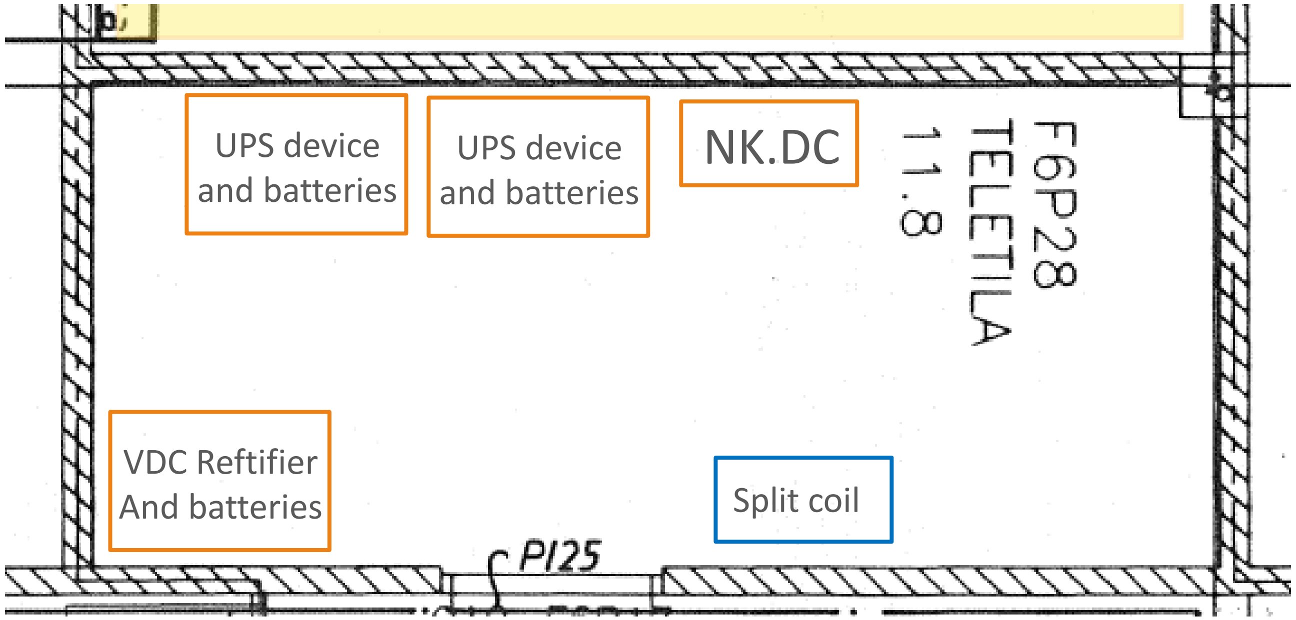
NK.DC and UPS-device:

- Location ”Teletila” in the basement
- Electrical distribution panel NK.DC
- UPS devices and batteries
- Separate from the racks due to demand respond requirement

Electrical room cooling

- Split coil air conditioner (3 kW)
- Refrigerant piping to outdoor unit via concrete lab to yard deck or transformer ventilation ducts to east facade

Lay-out for the NK.DC and UPS-device



Electricity supply system

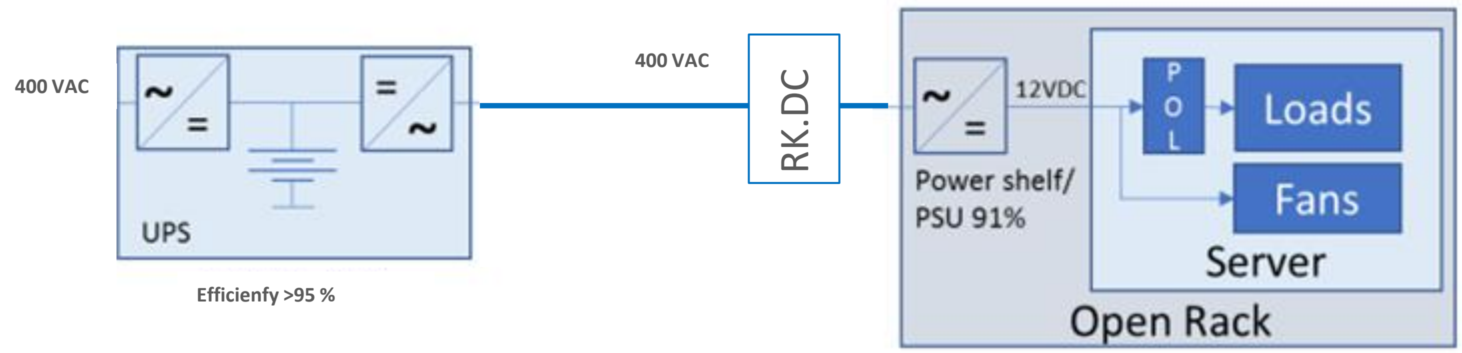
UPS device:
- 60 kVA (Continues discharge capability: 50kW)
- Battery running time approx. 10 min
- Recommended size W 600 D 1000 H 1900
- Batteries can be located on a different frame if needed.
- Battery type Li-ion
- UPS device must be connectable to the electricity demand respond market
- BMS with open communication protocol (CAN or RS385/ModBus)

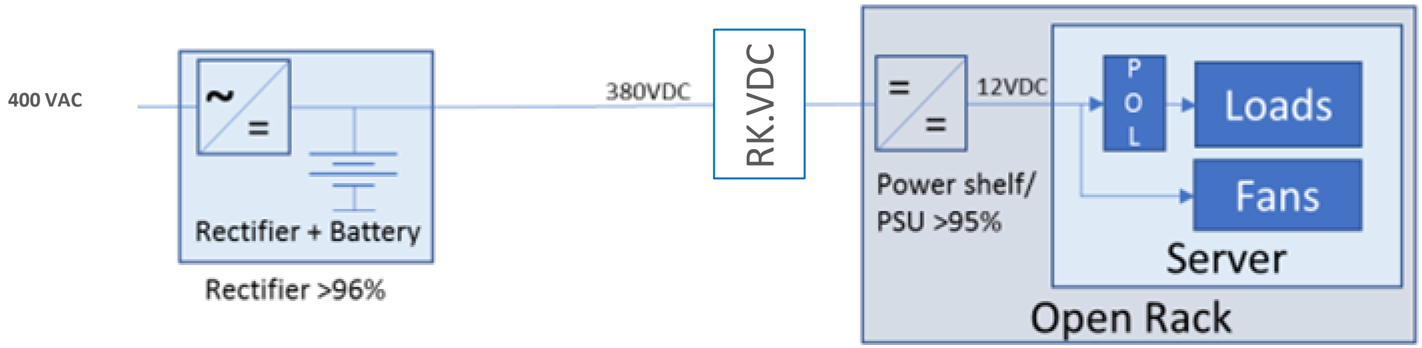
DC Rectifier :
- Continues discharge capability: 50kW
- Battery running time approx. 10 min
- Recommended size W 600 D 1000 H 1900
- Batteries can be located on a different frame if needed.
- Battery type Li-ion
- BMS with open communication protocol (CAN or RS385/ModBus)
- The device must be connectable to the electricity demand respond market

Options*
- Bi-Directional UPS to support provision of grid services
- Chemistry: LiFePO4
- Capacity (100kWh)
- Voltage: 400V (128s for example, or be done with 48V 16s modules in series)
- DC/DC and AC/DC conversion/mppt options for grid connectivity (but this can be separate).

*possible changes to the cooling, fire suppression, and room improvements have to be considered

Electrical back-up system principle diagrams





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Automation

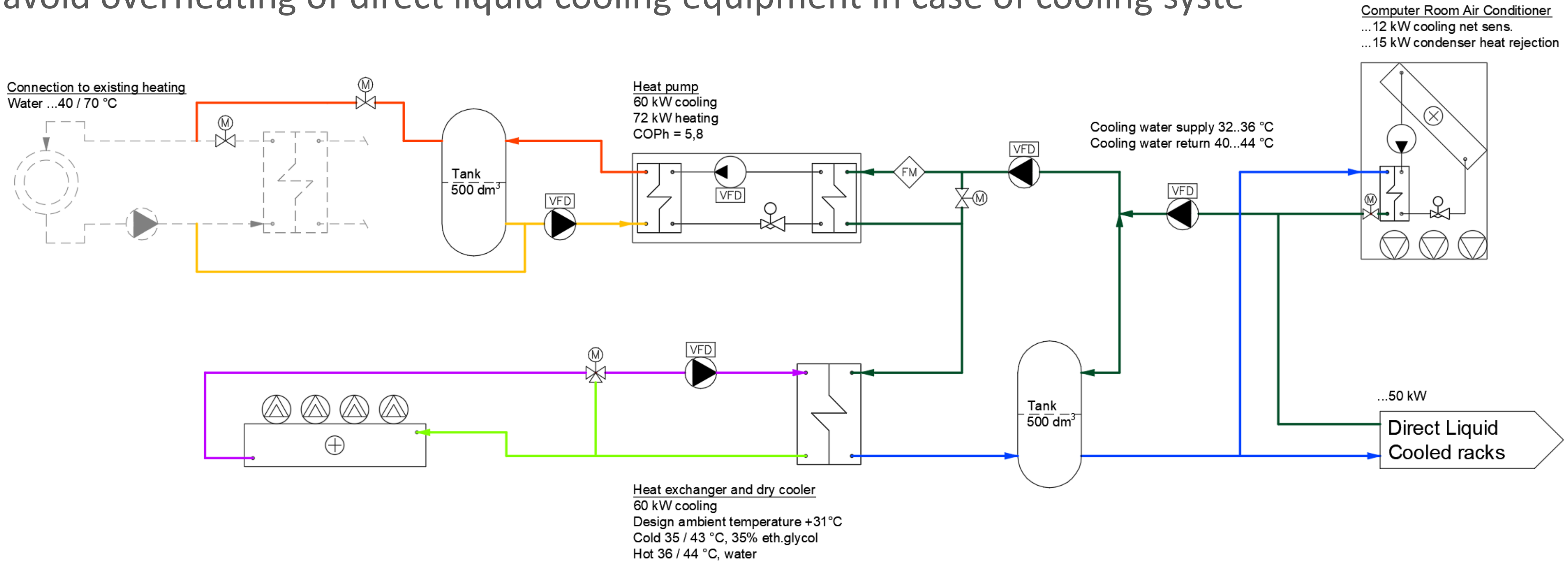
- Dedicated BMS substation for cooling and IT laboratory building systems controls and monitoring
  - Energy and heat recovery monitoring and logging
- Building management automation systems can be used for optimal customizability
- Advanced process data monitoring and data logging capabilities
- Temperature, moisture and failure alarms to users, safe shutdown integration
- Sensors for temperature and flow monitoring
- Open protocol for connectivity and data transfer

Cooling supply system

- Cooling system shall:
    - Facilitate different direct-to-chip cooling solutions (indirect, direct, direct expansion etc.)
    - Facilitate energy efficient and flexible heat recovery and ambient air heat rejection
    - Provide comfortable and safe working conditions and equipment operating envelope
    - Provide cooling (residual heat removal) in case of power outage for the UPS system run time of 10 minutes

Cooling supply system

- One integrated system for cooling and heat recovery
- Heat rejection to the ambient by a dry air cooler
- 100% heat recovery possibility
- 60 kW cooling plant load divided between direct liquid cooled IT hardware and water-cooled CRAC unit used for IT laboratory perimeter cooling
- Cooling system main circulation pump must be supplied by UPS for safe shutdown conditions and avoid overheating of direct liquid cooling equipment in case of cooling syste power loss



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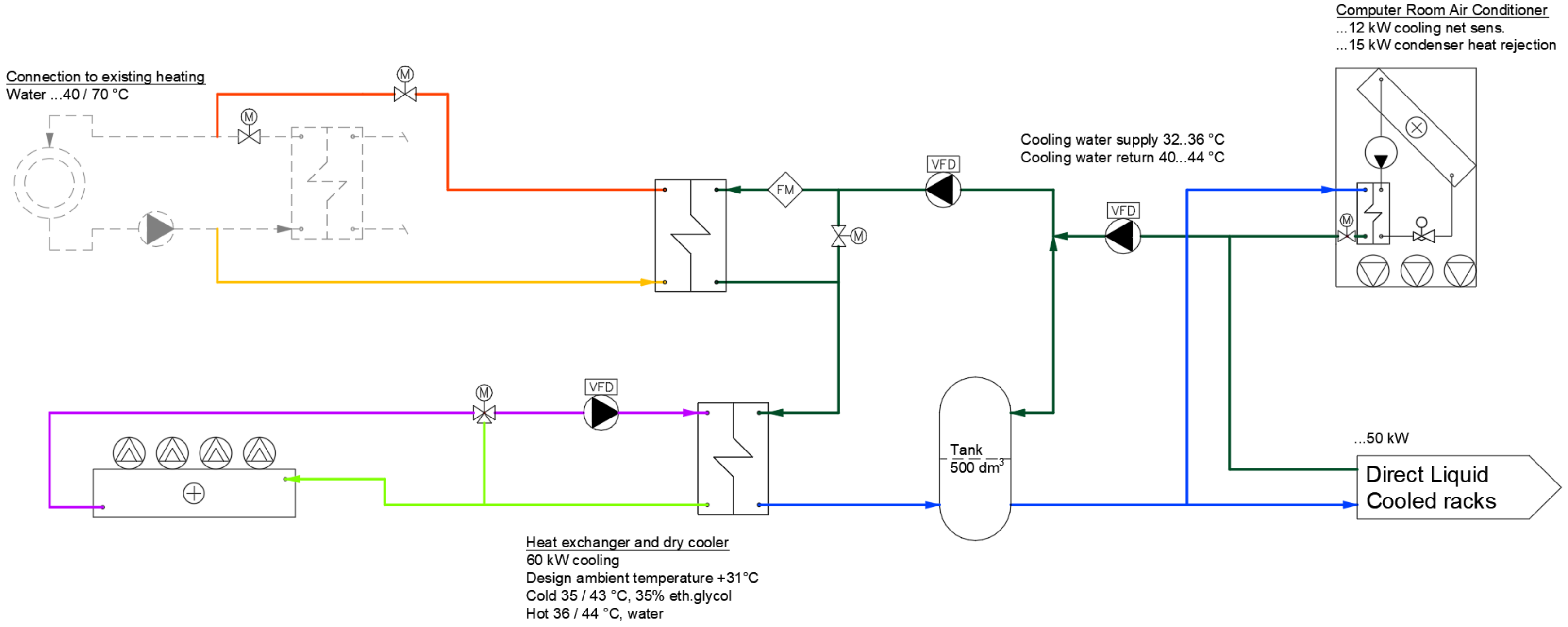
Cooling supply system

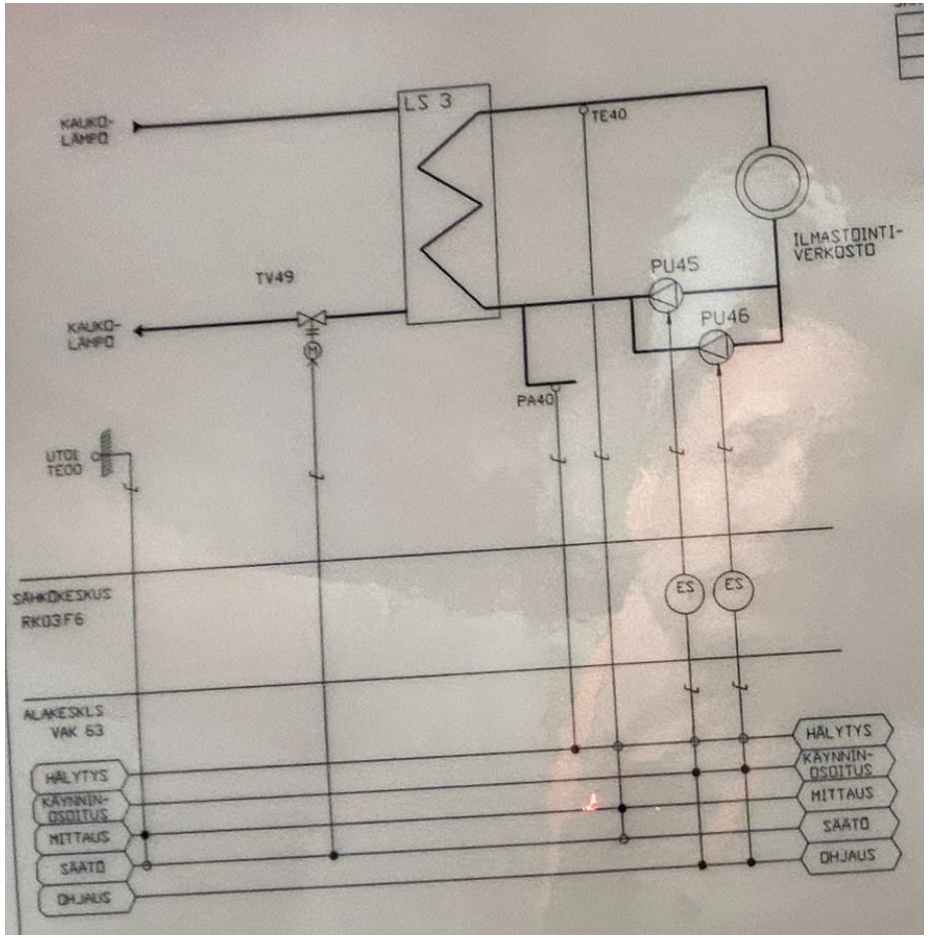
- Direct heat recovery option
- Partial heat recovery to heating system, the rest of the heat rejected to the ambient
- Most suitable for high temperature direct liquid cooling solutions
- Increase of cooling water temperature may decrease CRAC capacity
- Metering of heat recovery energy



Heat recovery

Heat pump feasibility

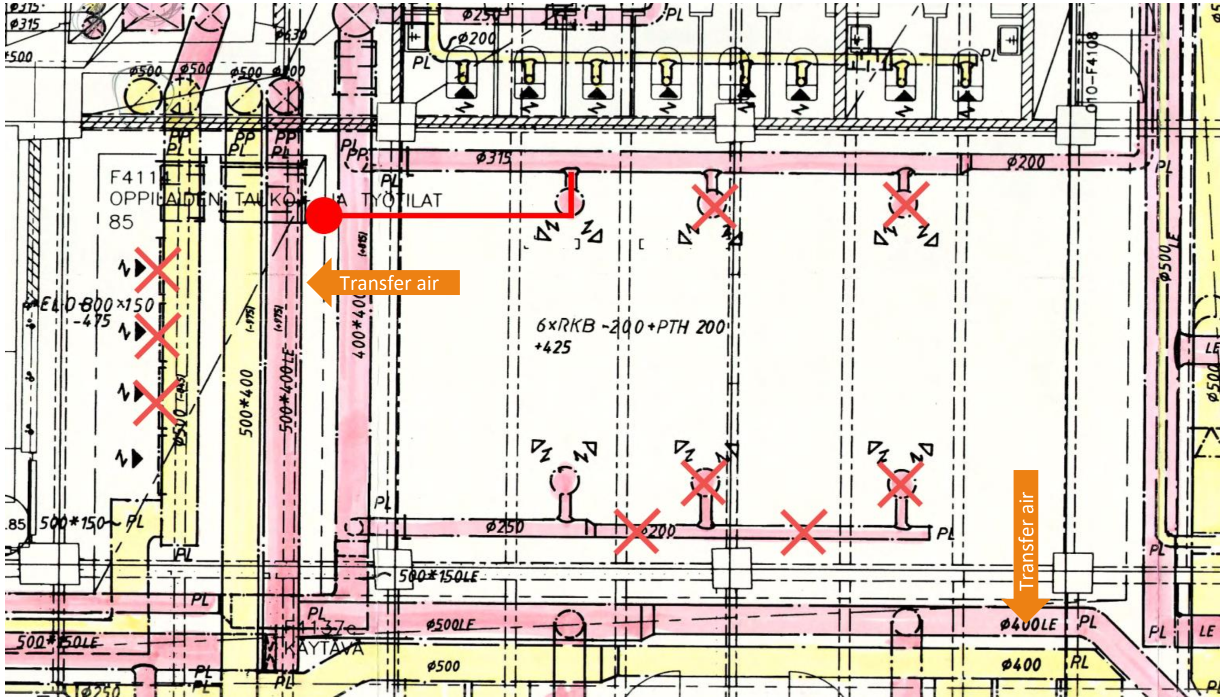
- Expected peak run time 1460 h/a
- Rated capacity for the heat pump 65 kW heating, 95 MWh/a produced heat
- With 63 €/MWh district heating energy charge, annual savings approx. 6 k€



Ventilation and air conditioning system

IT lab and work space

- Demolition of ventilation and allocation of ventilation capacity to work space
- IT lab is overpressurized
  - Only supply air required, transfer air to corridor or workspace



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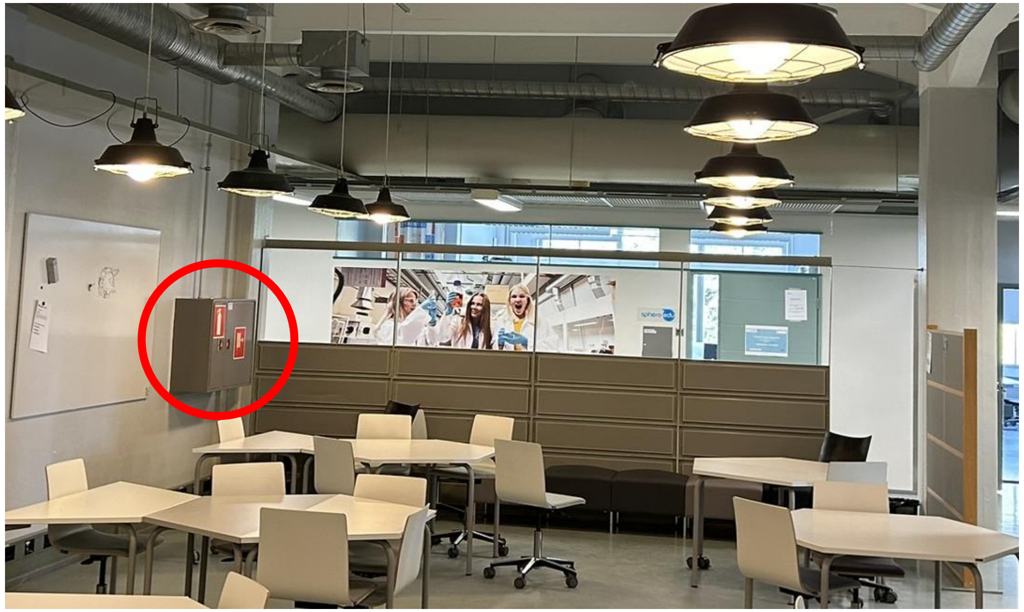
Fire suppression

- No sprinklers in the area
- A fire hydrant in the data center area must be relocated
- Relocate and add smoke detectors, so both rooms are covered
- First aid fire extinguishers to be installed in the IT laboratory



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IT Hardware solution (Examplary[1])

Components

- LCP Row Cooler (Water)
- UPS in its own space (Teletila)
- Rack
  - Size: 42U, 1200 mm deep, 800 mm wide, 2000 mm high
  - Closed air circulation (cover plates, etc.)
  - 2x “plug” measuring PDU, 3-phase (manageable/monitored)
  - Installation (Granlund brings the connection close – one PDU connected to the national grid, the other behind the UPS)
- Network
  - TOR Switch, 1U + 1U Spare (network, L3)
  - Switch, 1U (management, L2)
  - Firewall, 1U
- Networking Equipment Rack and Cabling

Servers

- ADM
  - ThinkSystem SR665 V3, 2U – 7 Units
  - AMD EPYC 9254 24C 200W 2.9GHz
  - 64GB RAM
  - 2x 960GB SAS SSD
  - 1x NVIDIA L40S (max 3 kpl)
  - Dual 25GB
  - Power requirement max 900W
- Network
  - ThinkSystem SR650 V3, 2U – 7 Units
  - Intel Xeon Gold 6418H 24C 185W 2.1GHz
  - 64GB RAM
  - 2x 960TB NVMe
  - 1x NVIDIA L4 (max 3 kpl)
  - Dual 25GB
  - Power requirement max 665W

[1)]IT Hardware and Servers cost estimate (Page 5) is based on this examplary configuration.
The costs are peovided by IT hardware and solution povider.

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