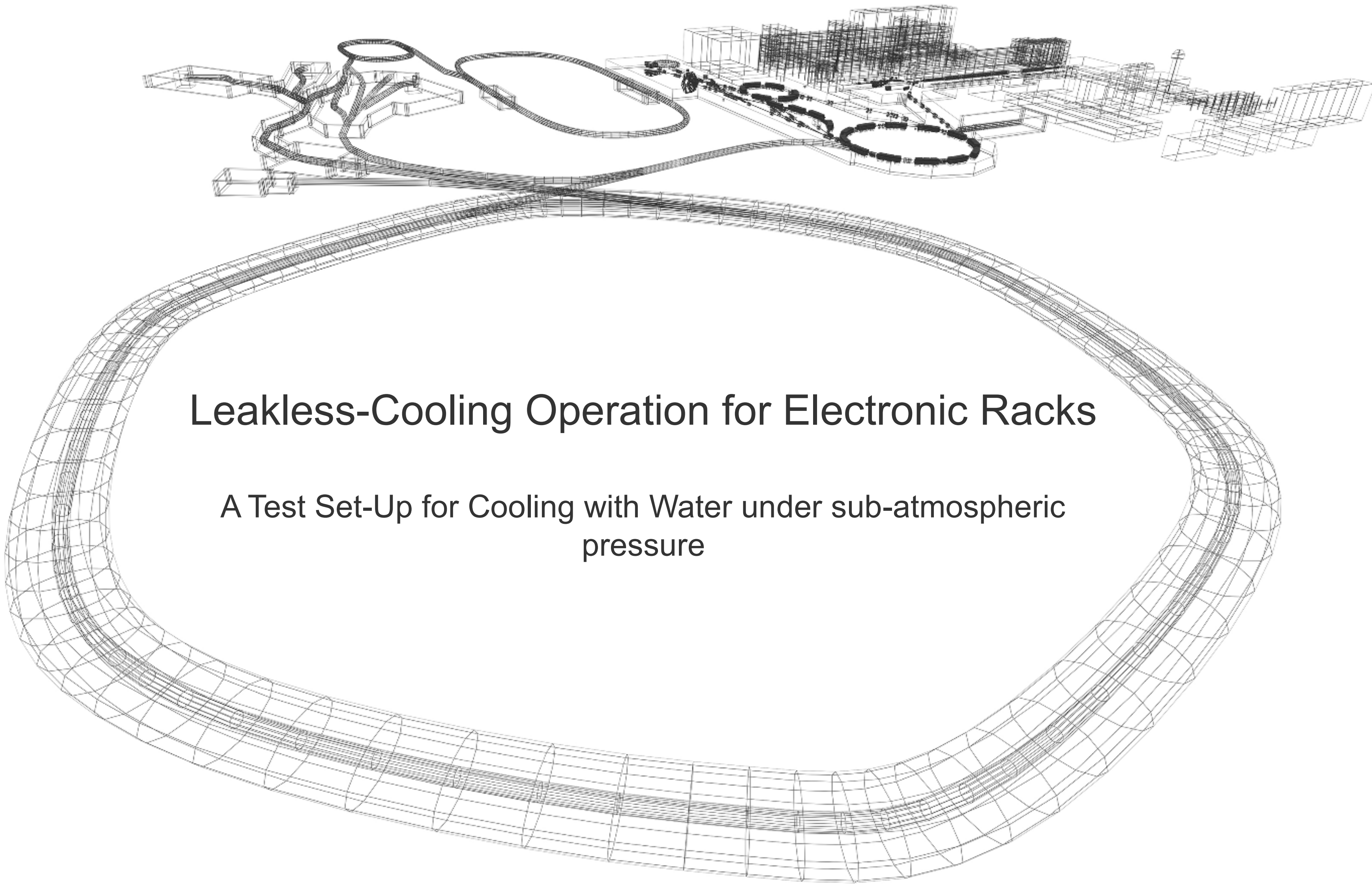
Leakless-Cooling Operation for Electronic Racks

A Test Set-Up for Cooling with Water under sub-atmospheric pressure



Overview

- Motivation & aim for a Cooling Test Set-Up
- Considerations & Constraints
- 1st Design of Cooling Test Set Up
  (Geometrical Properties, Components, Air ventilation)
- Open points

Leakless-Cooling operation for Electronic Racks
Cooling with Water under sub-atmospheric pressure

- Motivation for building a Test Set Up -

CERN has developed a vacuum cooling system
→ Aim: keeping water from leaking through sensitive equipment

Vacuum cooling systems established at CERN
(i.e. ATLAS Tile Calorimeter, COMPASS)
Both cool away up to 120 KW emitted heat

PANDA scopes regarding use of leakless cooling mode:

- 66 racks located in experimental area (placed on different height levels)
- expensive equipment must not get in contact with cooling water
- 90% of heat to be cooled (10 % are allowed to be released into environment)
- up to 620 KW heat emission → 5 x COMPASS output !

4. Considerations & constraints for a PANDA - Test Set Up -

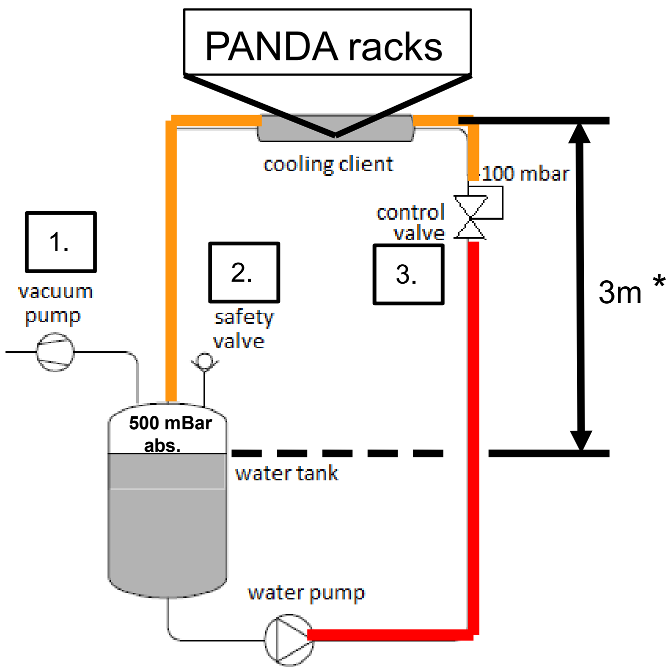
Vacuum-cooling system established at GSI (HADES) was dismantled and thrown away

Starting from scratch to set up vacuum cooling cycle for PANDA

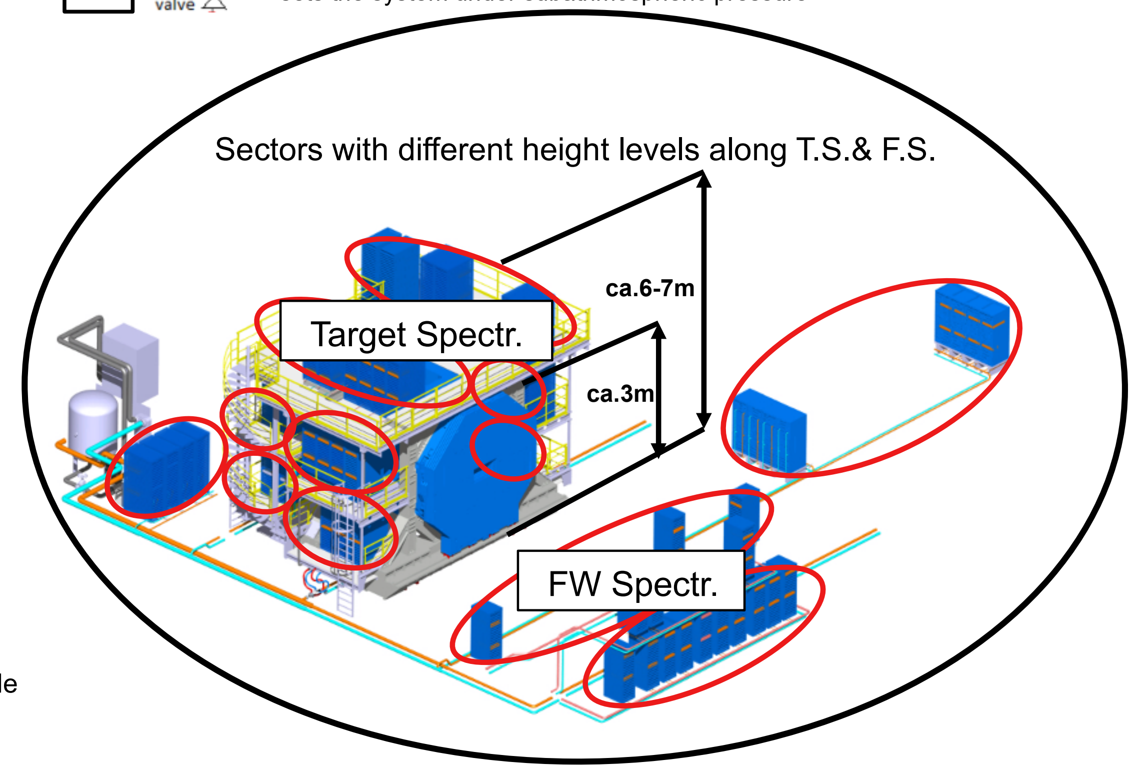
Points to check:

- Air ventilation in racks, (implementation of fan-trays & turbines).
- Circulation of air flow (taken from the top, guided through side ducts to the bottom).
- Implementation of heat exchanger type (are 11 mm water tube diameter sufficient ?)
- Water pressure in the return pipes. (Behaviour of lines filled with steam vs. water filled lines)
- Employing a programmable control circuit for connection of actuators and sensors (PLC)

5. Considerations & constraints for a PANDA - Test Set Up -



1. vacuum pump — keeps comfortable vacuum inside water tank (500mBar abs.)
2. safety valve — Releases excess air into environment to keep vaccum steady (mainly caused by leakage events)
3. control valve — sets the system under subathmospheric pressure



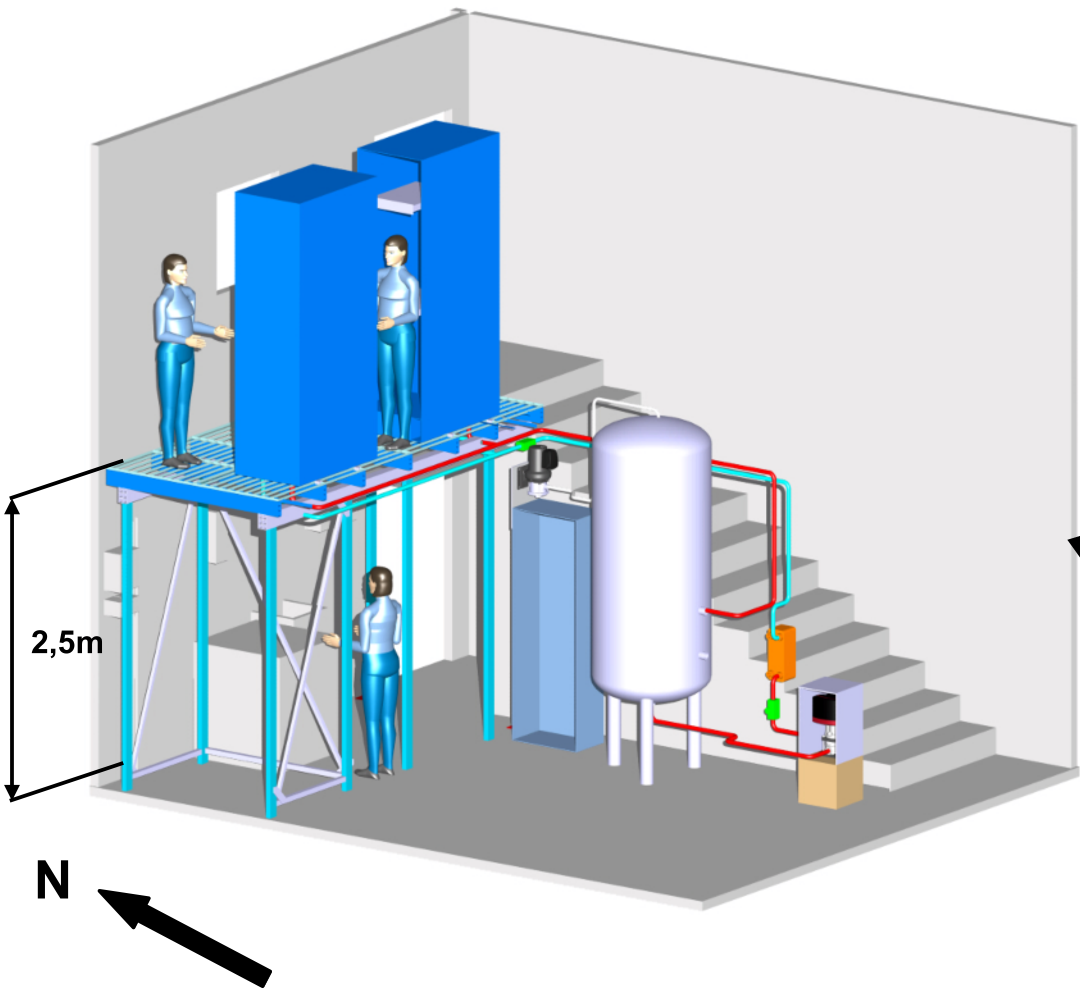
2 Entities

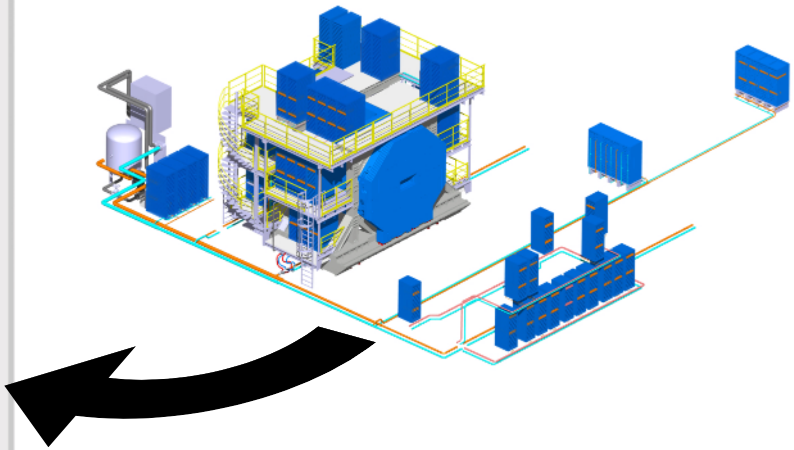
Subathmospheric part (orange)
Overpressure part (red)

* 3m suction height reported to work best in leakless mode

-> Vaccum cooling in all sectors on different height levels to be assured

6. Design of PANDA Test Setup – small scale potion of later experiment





<u>Design Set-Up for PANDA Testing Platform:</u>

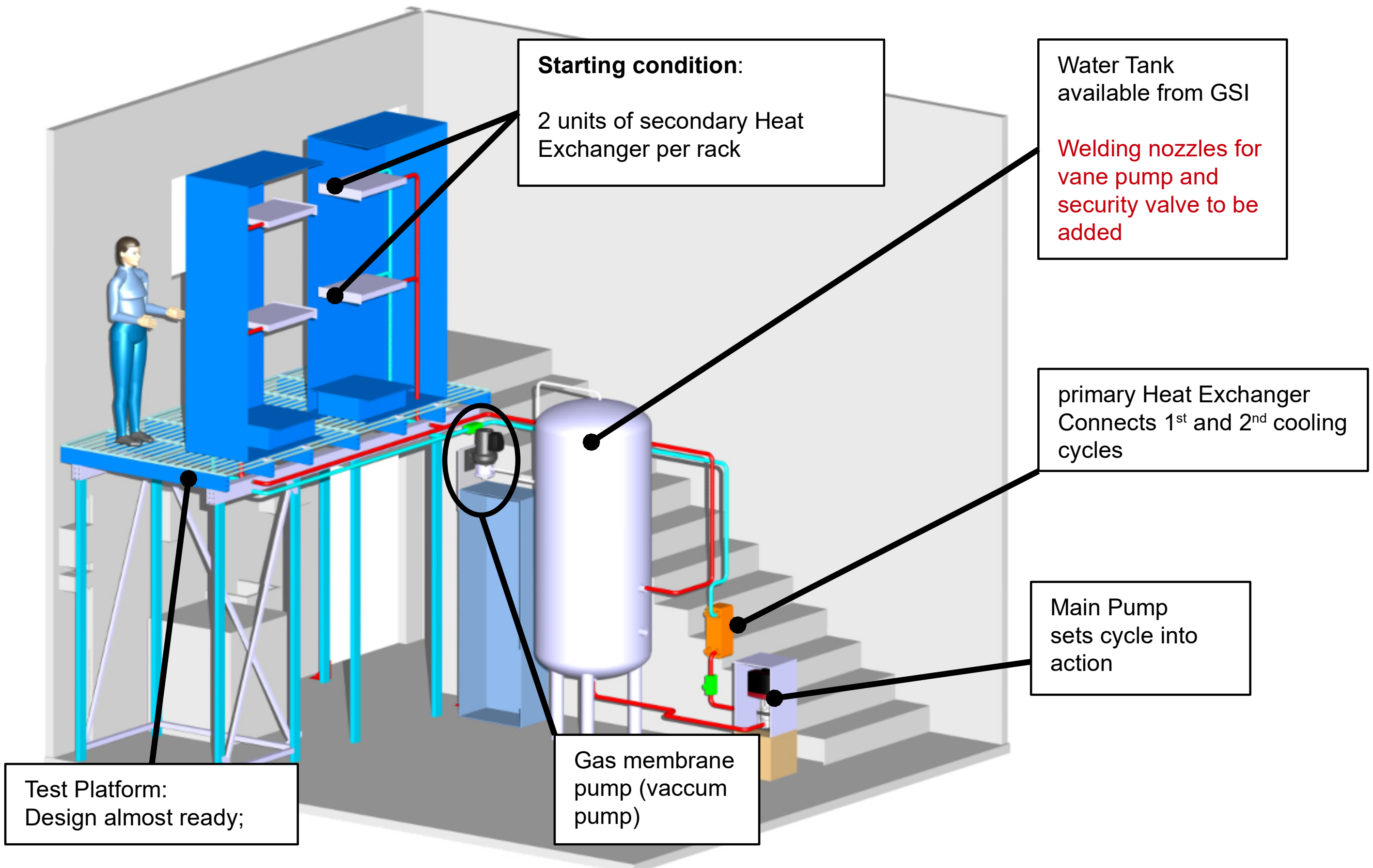
Access to platform through stairs

Design height of Platform: 2,5 m

Design load approx. 1000 kg

Accessibility to washing rooms in the north

7. Design of PANDA Test Setup – Basic Components



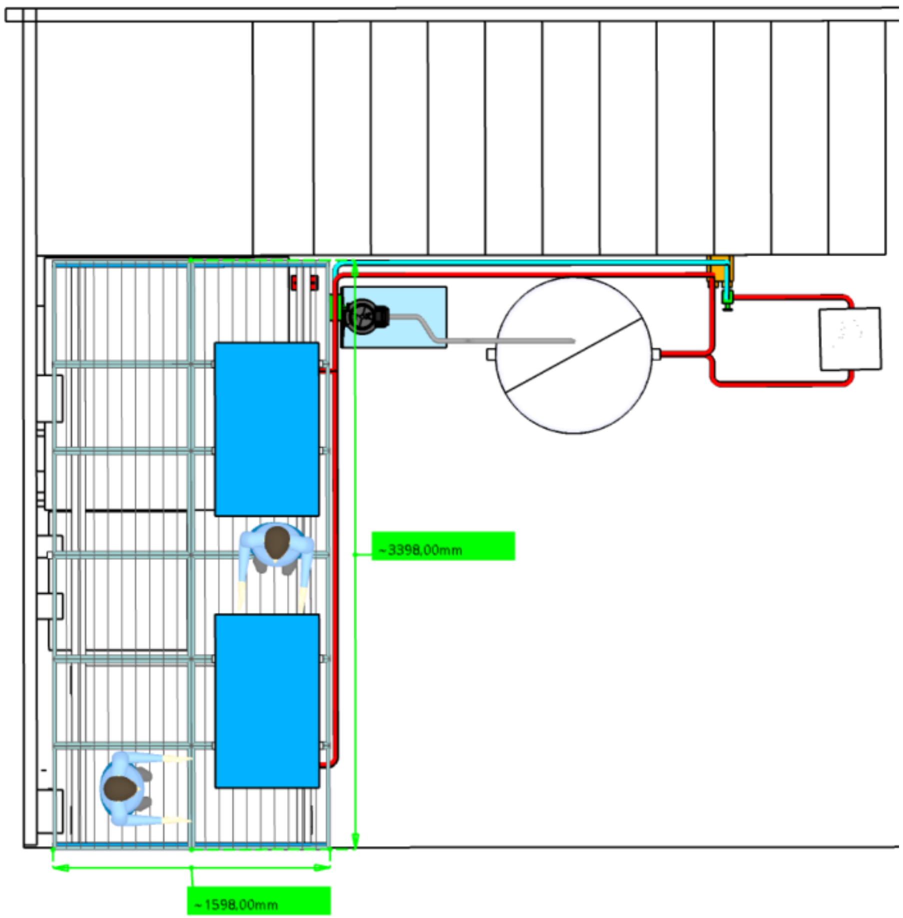
Done:

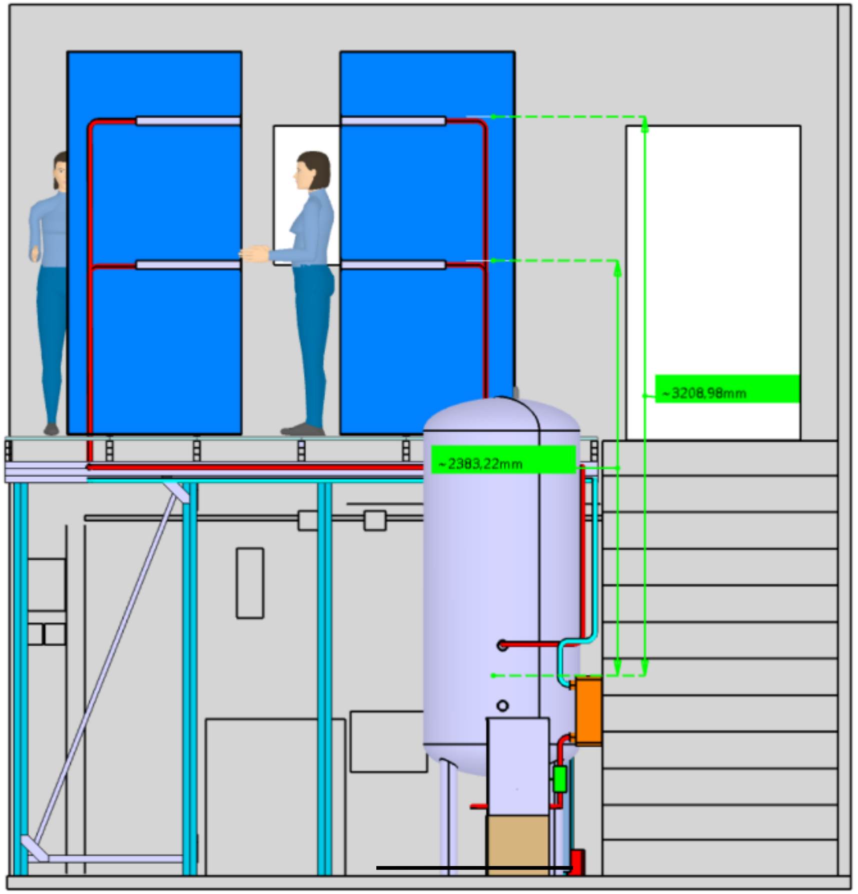
→ Test platform (90 % ready)
→ secondary Heat Exchangers (can be acquired from CERN; LHCb type)

Need further specification:

→ Primary Heat Exchanger
→ Main Pump
→ Gas Membrane Pump

8. Design of PANDA Test Setup - Geometrical Properties



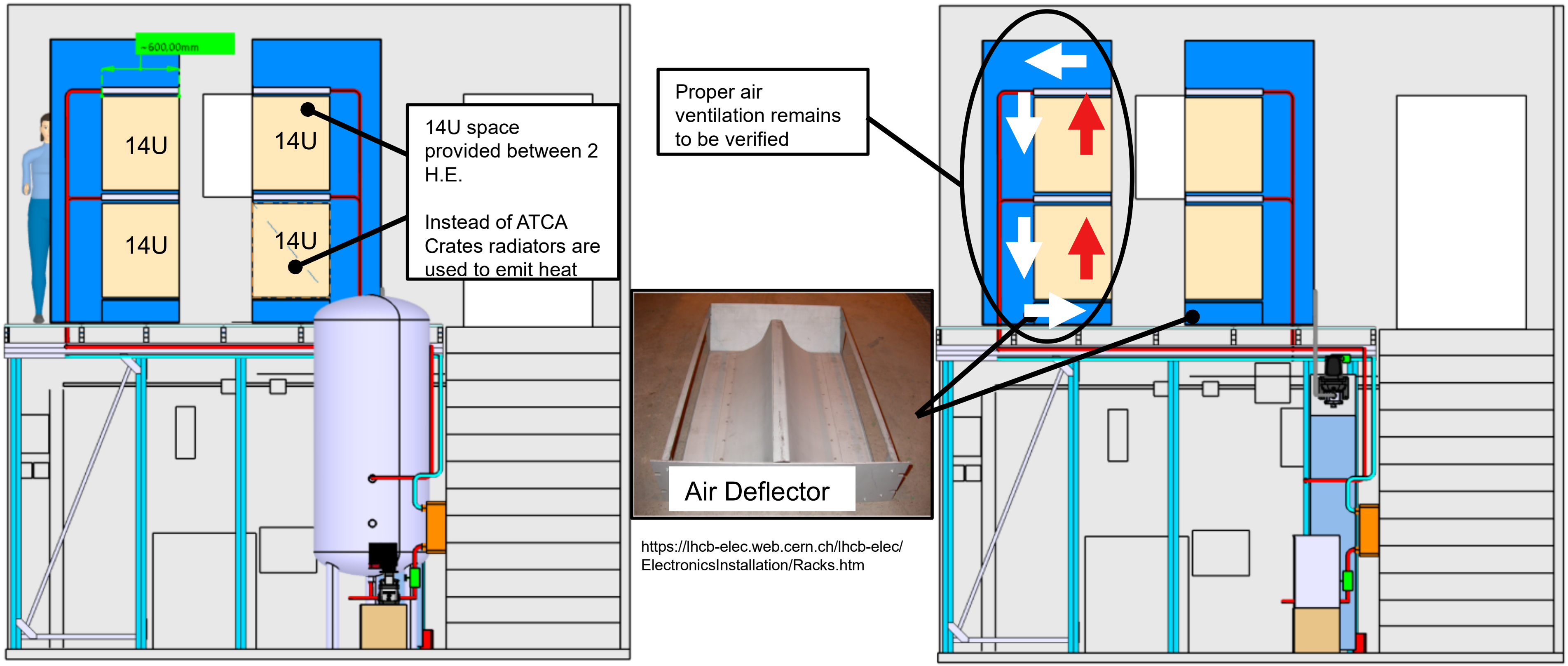


Choice of platform width: 1,6m
Choice of platform length: 3,4m;

Space fit for operation with 2 personnel

ΔH of water level between water tank and consumers approx 3m.
→ Good agreement following CERN reasoning
If operation works out height adaption to higher values possible

9. Design of PANDA Test Setup – Checking for decent air ventilation



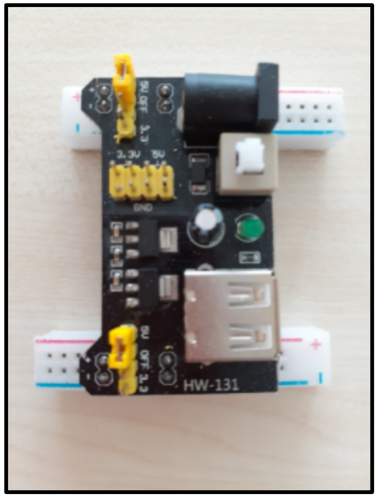
<u>Note:</u> No dummy cards at disposition → starting with Radiators instead of ATCA Crates

<u>Points to Clarify</u>:

How to get „*Vertical Air flow*“ working properly ?

Implementation of Deflectors needed. Always having to rely on CERN to get information on that

10. To do: Building temperature monitoring circuit with Arduino ESP 32 Module



Arduino Type *ESP 32*

https://new.siemens.com/global/en/products/automation/systems/industrial/plc/logo.html

Connection of actuators and sensors at COMPASS cooling cycle done with PLC
-> Type (Siemens Logo)

To do: Starting off with bulding a temperature monitoring cycle using ESP 32

To check: Options for Integration of ESP 32 monitoring into given Siemens Logo PLC

Open points:

- Test platform design almost ready

- „*Bauen bei der GSI Antrag*“ (BiG)
  Application to be filed before starting

- Preparing of electrical infrastructure
  (Heat dissipation of up to 20 KW
  requires additional sockets, fuses etc).
  (Power Supplies of radiators, Cooling fans i.e.)

Thank you for your attention