VELO CO2 cooling reuse proposal

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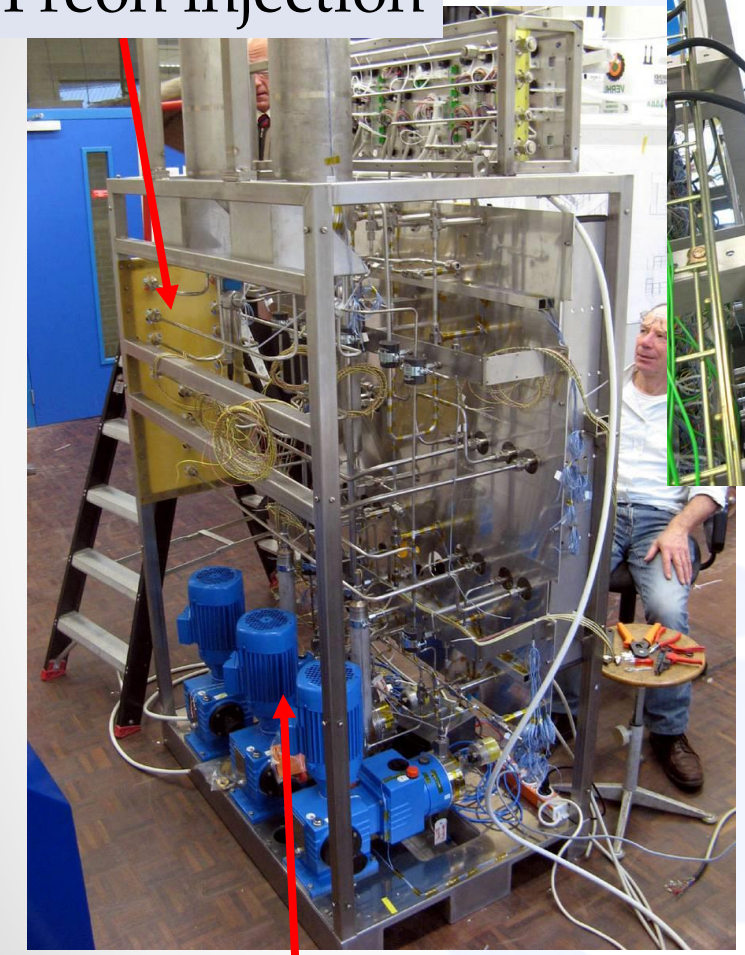
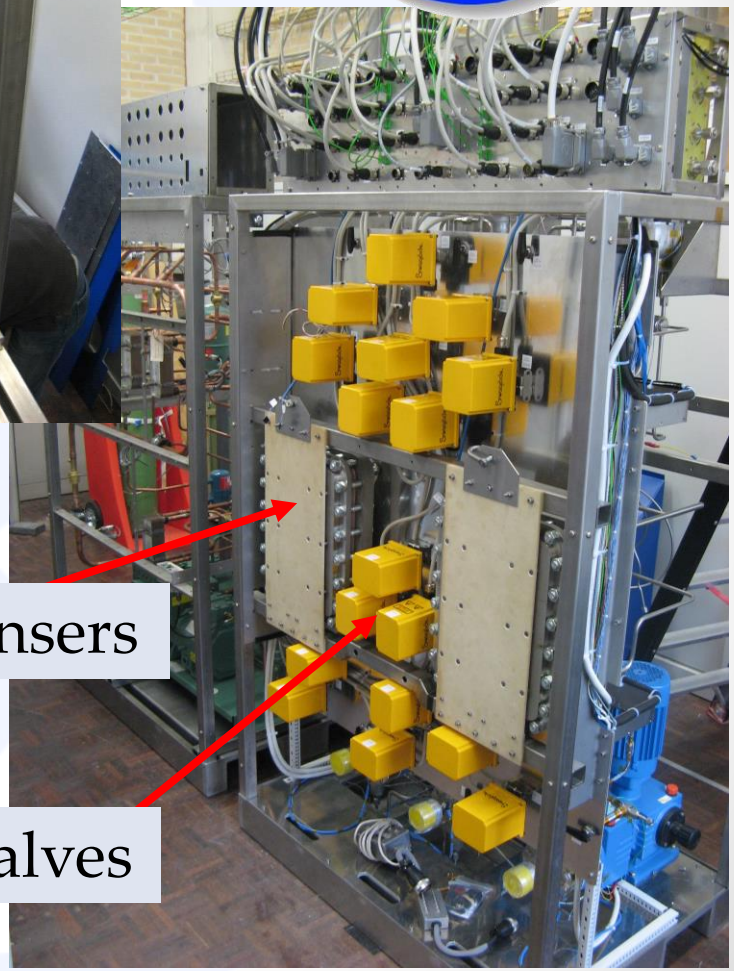
VELO CO_2 cooling plant in LHCb

CO_2 unit

Freon injection



Accumulator

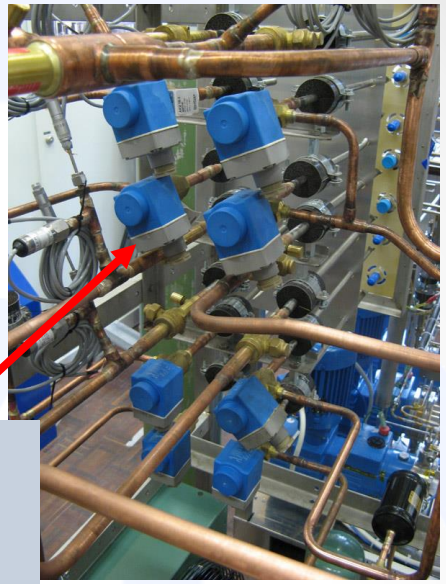


Condensers

Valves

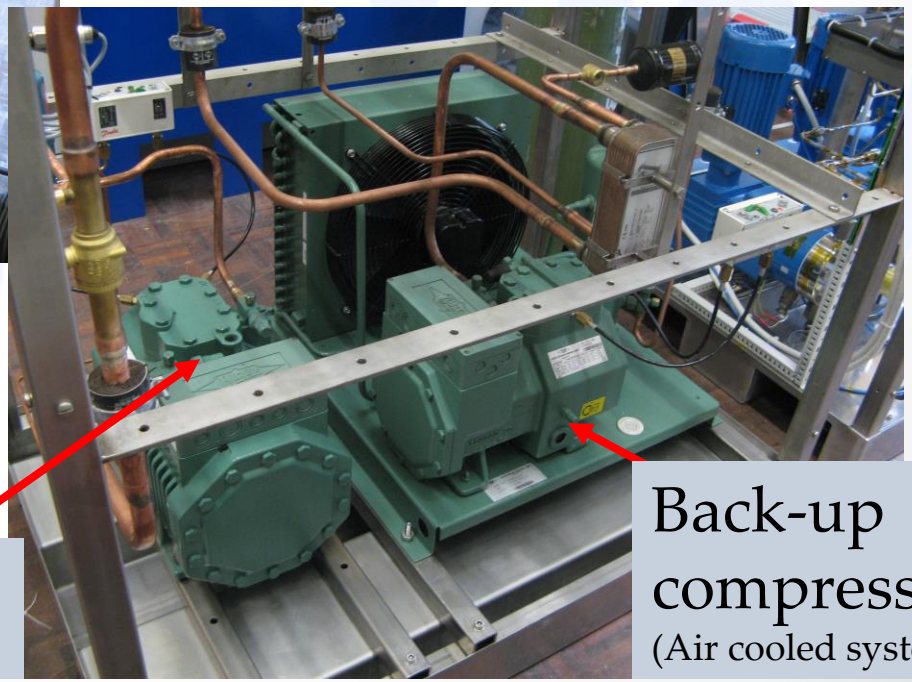
CO_2 pumps

Freon unit



Expansion valves

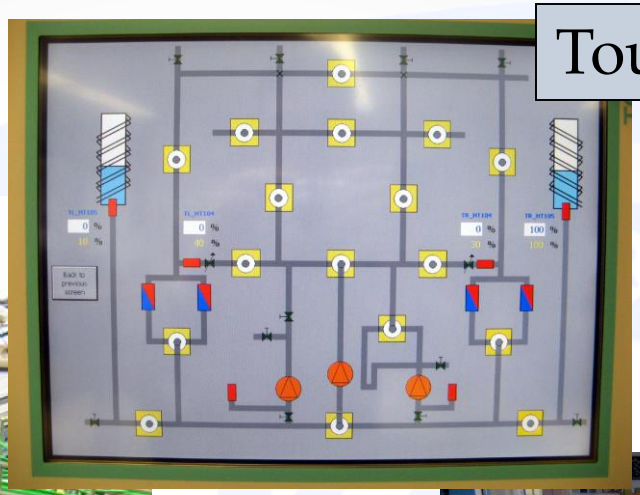
Freon buffer



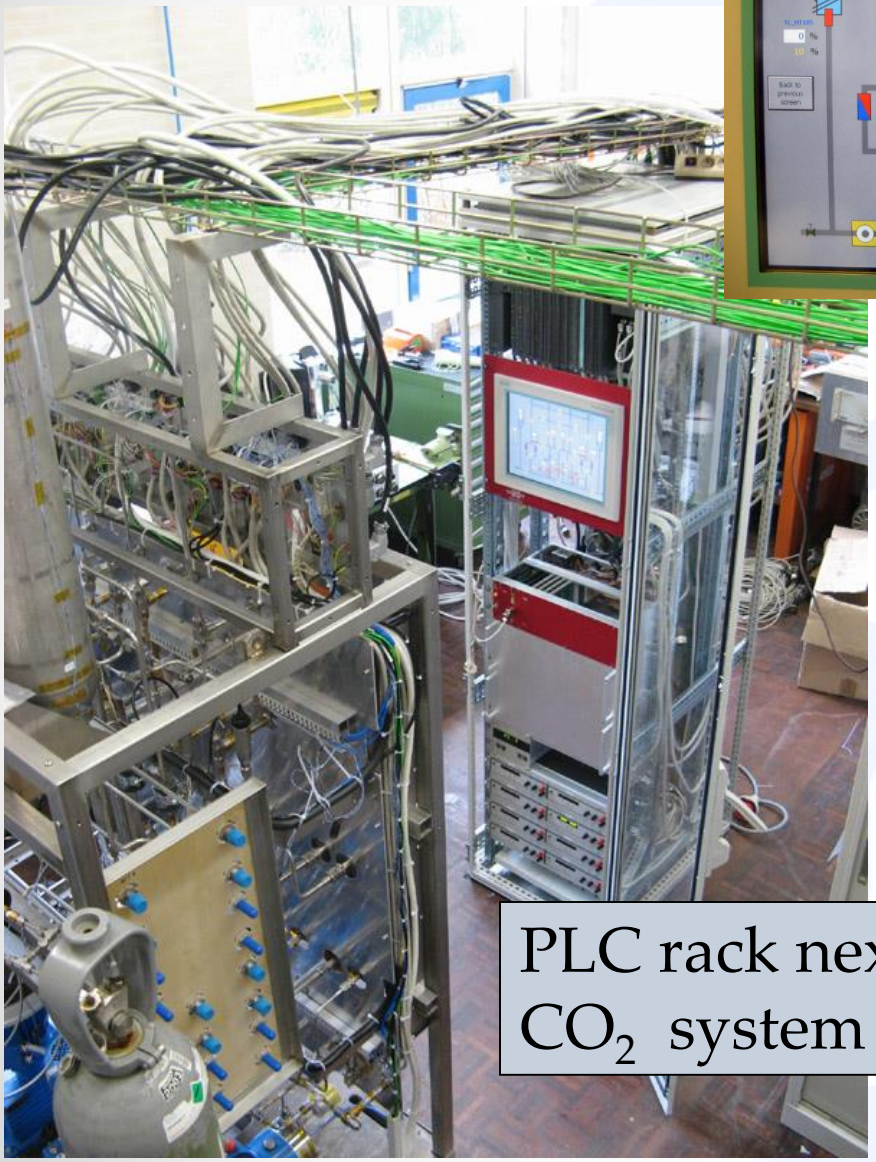
Main compressor
(Water cooled system)

Back-up compressor
(Air cooled system)

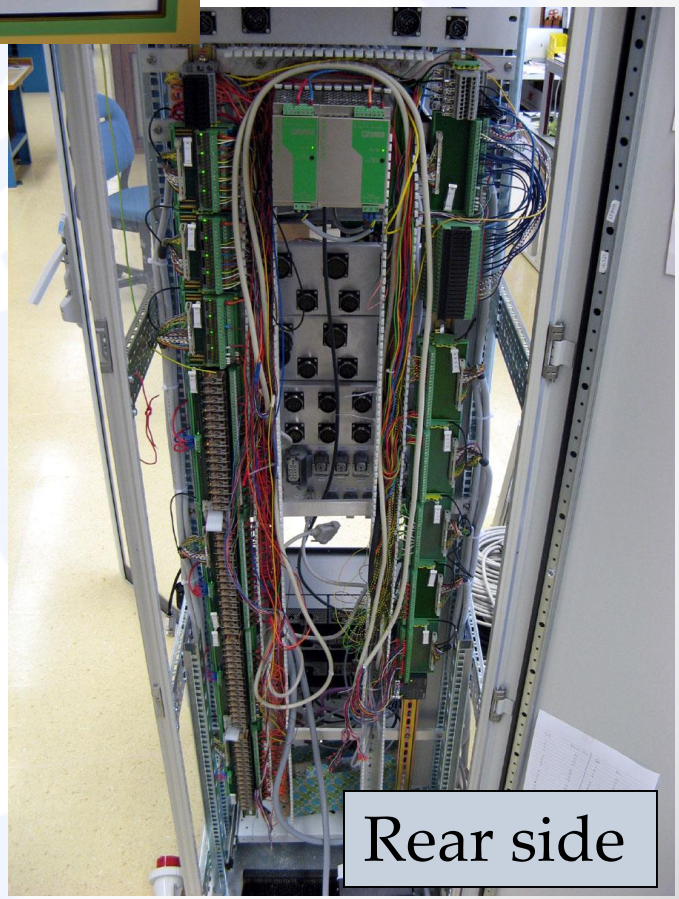
PLC-rack



Touch screen



PLC rack next to CO_2 system

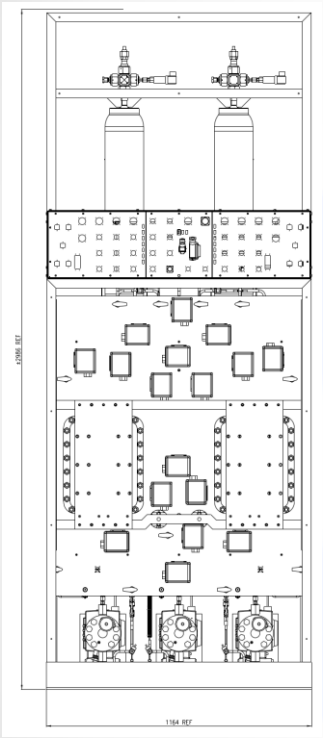


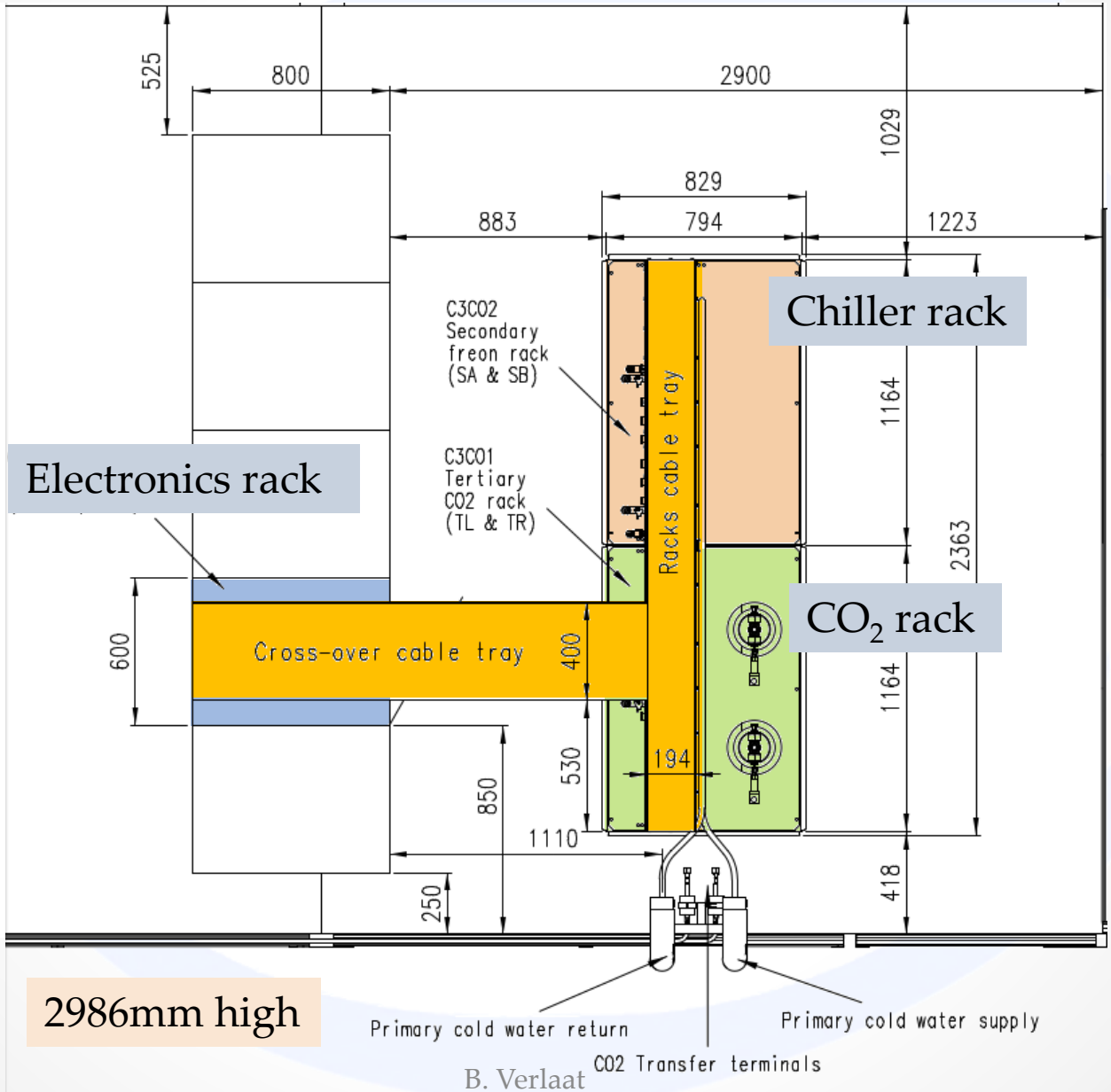
Rear side

Documentation

- All cooling EDMS documents (not complete)
  - https://edms.cern.ch/ui/#!master/navigator/project?P:1405012445:1405012445:subDocs
- VTCS technical design Report:
  - https://edms.cern.ch/document/1056946/3.0
- Gathered electrical information
  - https://cernbox.cern.ch/index.php/s/mTbJ8niDSARwtQ9
- Drawings of the system:
  - https://www.nikhef.nl/pub/departments/mt/projects/lhcb-vertex/pdf/TVC-COOLING/
  - Assembly drawings:
    - TVC60: CO2 rack
    - TVC66: Chiller rack
    - TVC70: Integration situation
- Photo Archive:
  - https://www.nikhef.nl/pub/departments/mt/projects/lhcb-vertex/production/Coolingparts/
  - https://www.nikhef.nl/pub/departments/mt/projects/lhcb-vertex/production/Freonparts/

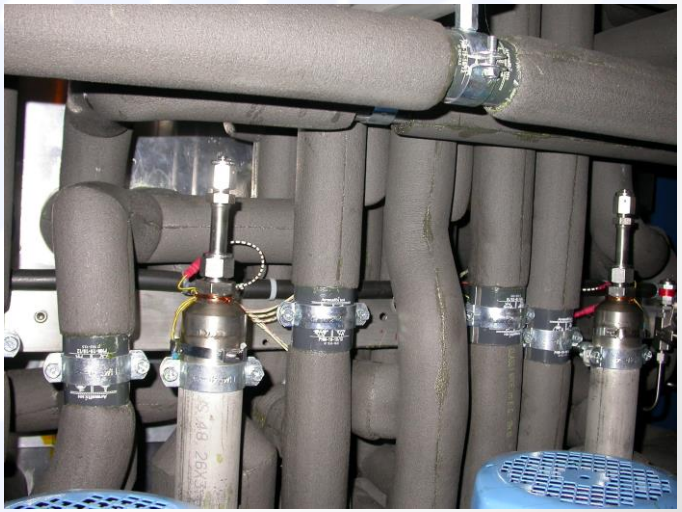
Overall size of the set-up





Reuse of the VELO CO2 cooling

- The VELO cooling has been functioning well till December 2018
- All components are in a good shape and can be used to continue running.
- A few things need to be changed for future use:
  - The control software must be re-written to UNICOS standards to guarantee safe operation by new users to streamline the use of the unit according the EP-DT standards for cooling systems. Only like this we can guarantee a safe use for new users.
  - New insulation: The current insulation is warn out and need to be re-applied.
- The VELO has back-up hardware to have guaranteed a 24/7 operation in LHCb
  - This hardware is not needed and can be taken out
  - This will help a lot in simplify the new control and hence commissioning.
  - The application of the new insulation is much simpler, less to insulate, better access.
- All cabling between the cooling and racks and plants are by connectors
  - The same set-up is needed, this takes space
- The system is designed for long distance transfer lines
  - The new lab can be remote from the plant (~50m)
  - There are 2 individual plants, 2 locations can be served with the transfer lines

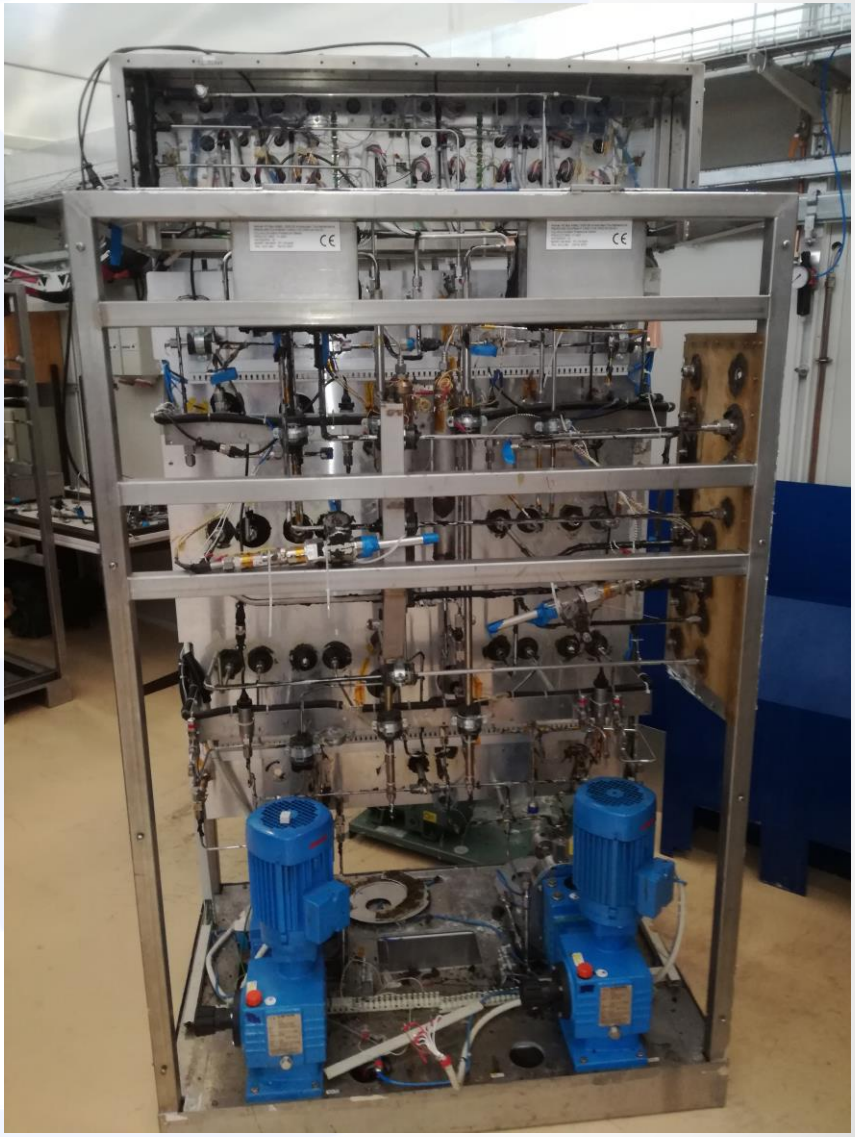


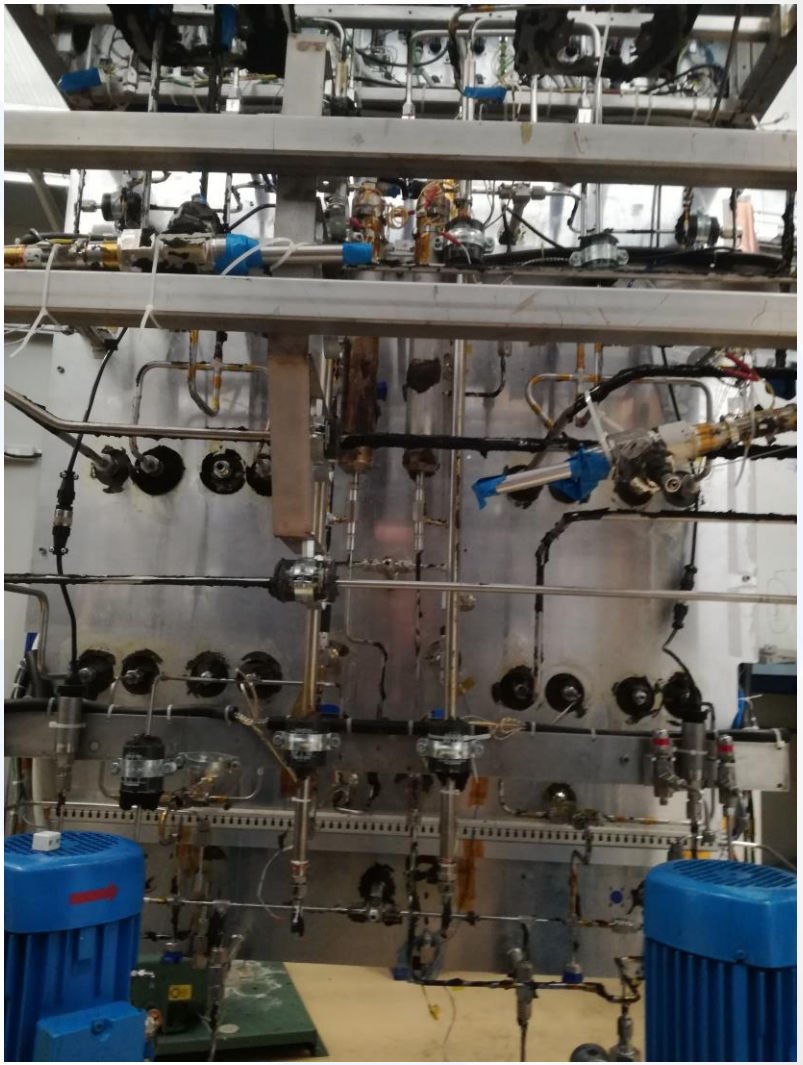
Proposal for reuse:

- In order to see the effect the unnecessary back-up hardware is removed.
- In order to make it the most simple set-up the injection lines of the back-up system will be reused and will be connected to the main condensing unit.
  - The injection of the main chiller was too complex and was tricky to tune.
- The removal of all back-up hardware gives now a reasonable access to apply the insulation
- Further optimization of space can be made by cutting some more pipes.
  - Only sections with connectors are removed
  - This cutting requires some welding
  - A few valves can also be taken out to simply the use and insulation, might also require some welding
- The reuse of the electronics must be reviewed by control experts
  - Documentation has been retrieved
  - Is this sufficient to understand the cabling spaghetti?
- The unit needs thorough cleaning
  - Remove of insulation remains
  - Remove of calcified deposit due to condense water

The elements..

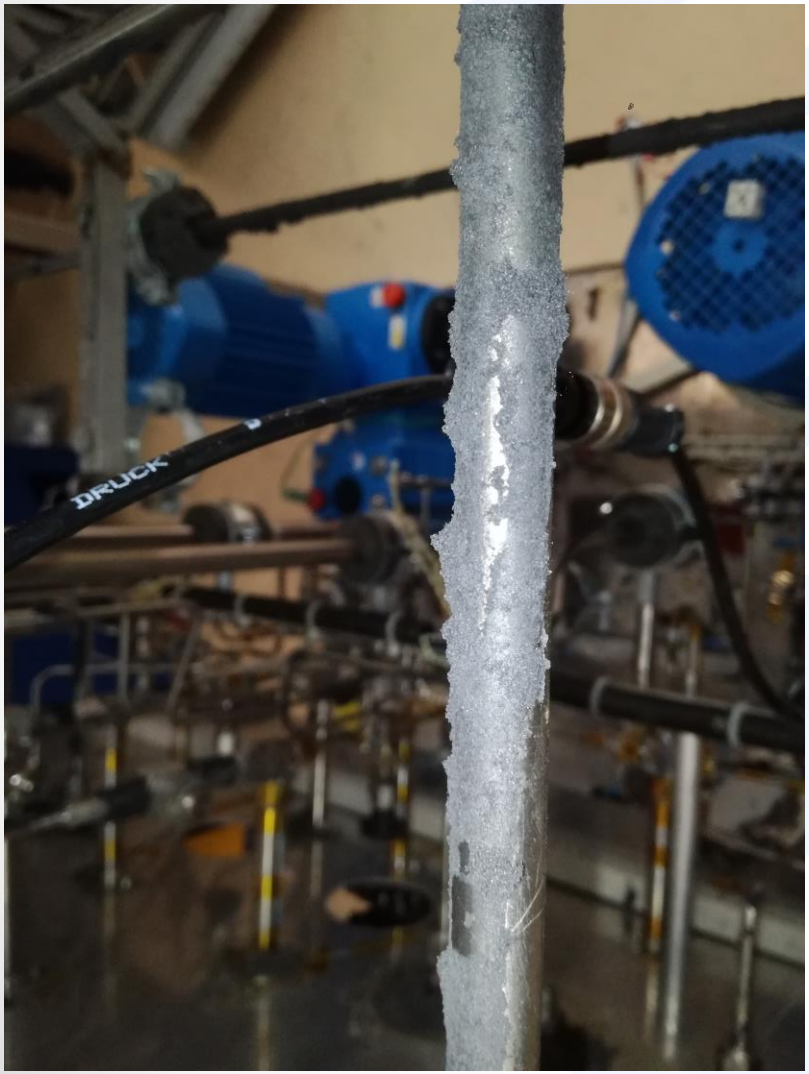
The units after stripping back-up HW





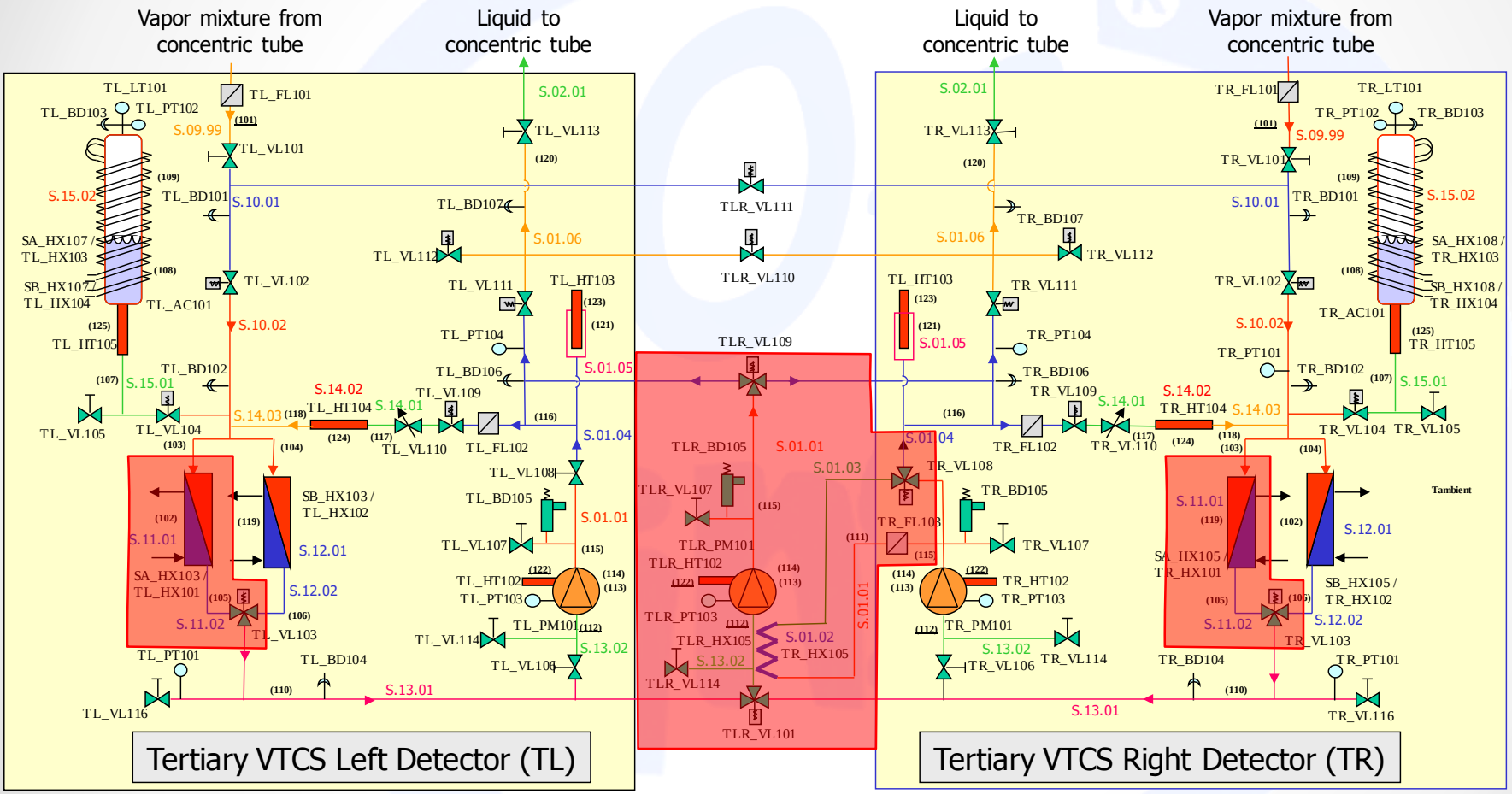
For the trash can……

The unit needs thorough cleaning

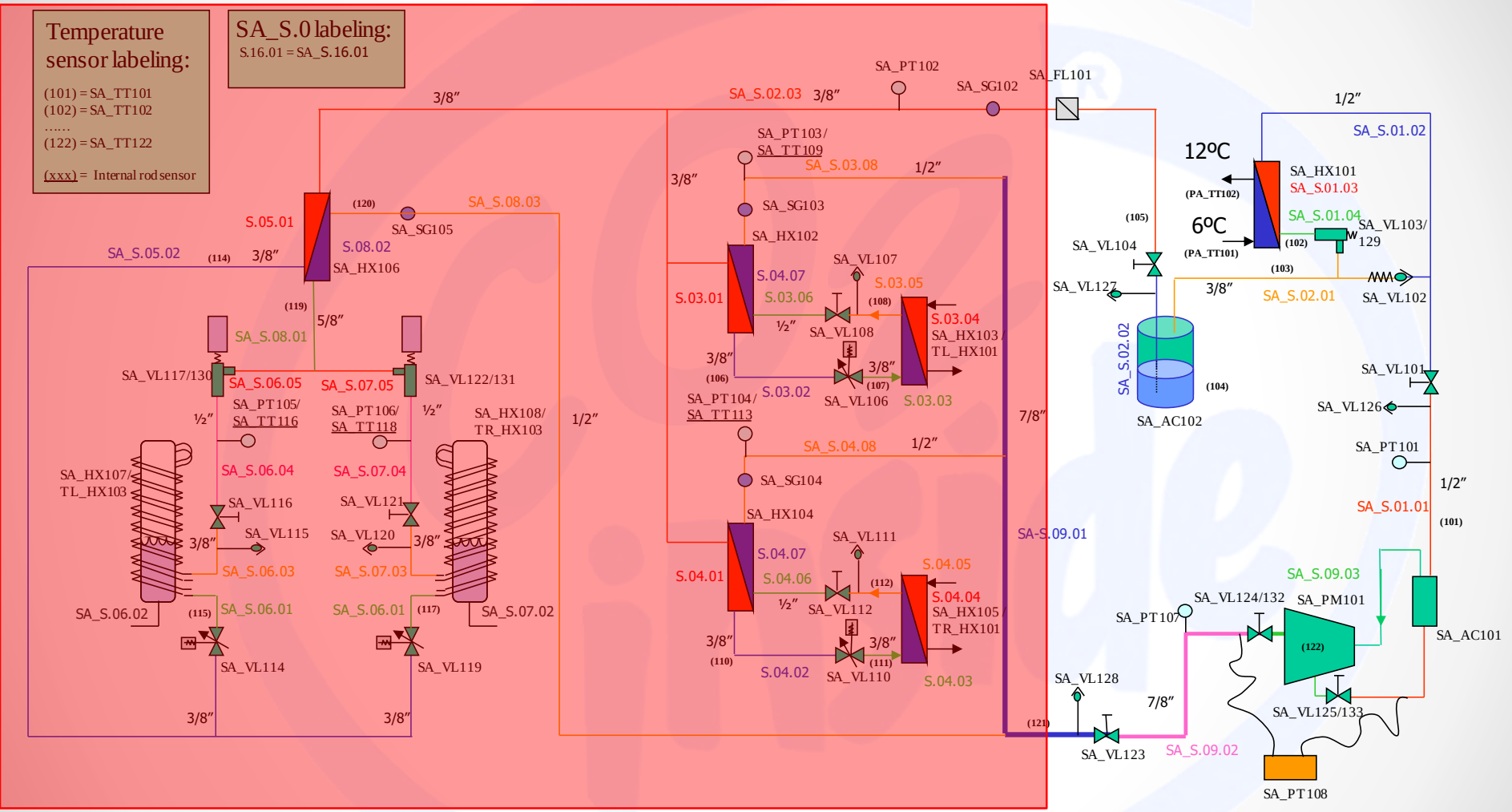


CO2 plant and hardware which has been removed

Red zones are removed to simplify and create insulation access

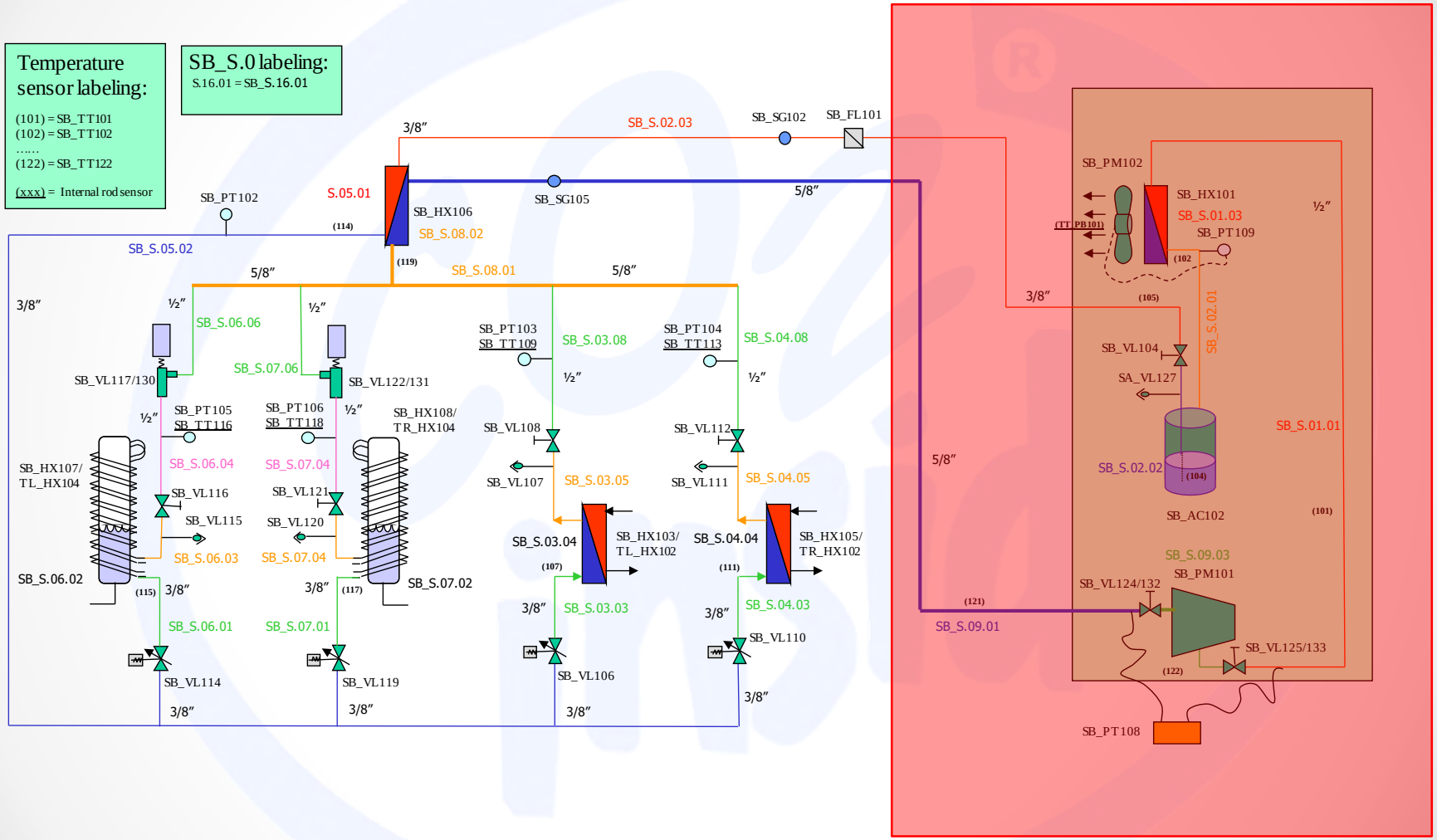


Main chiller and hardware which has been removed



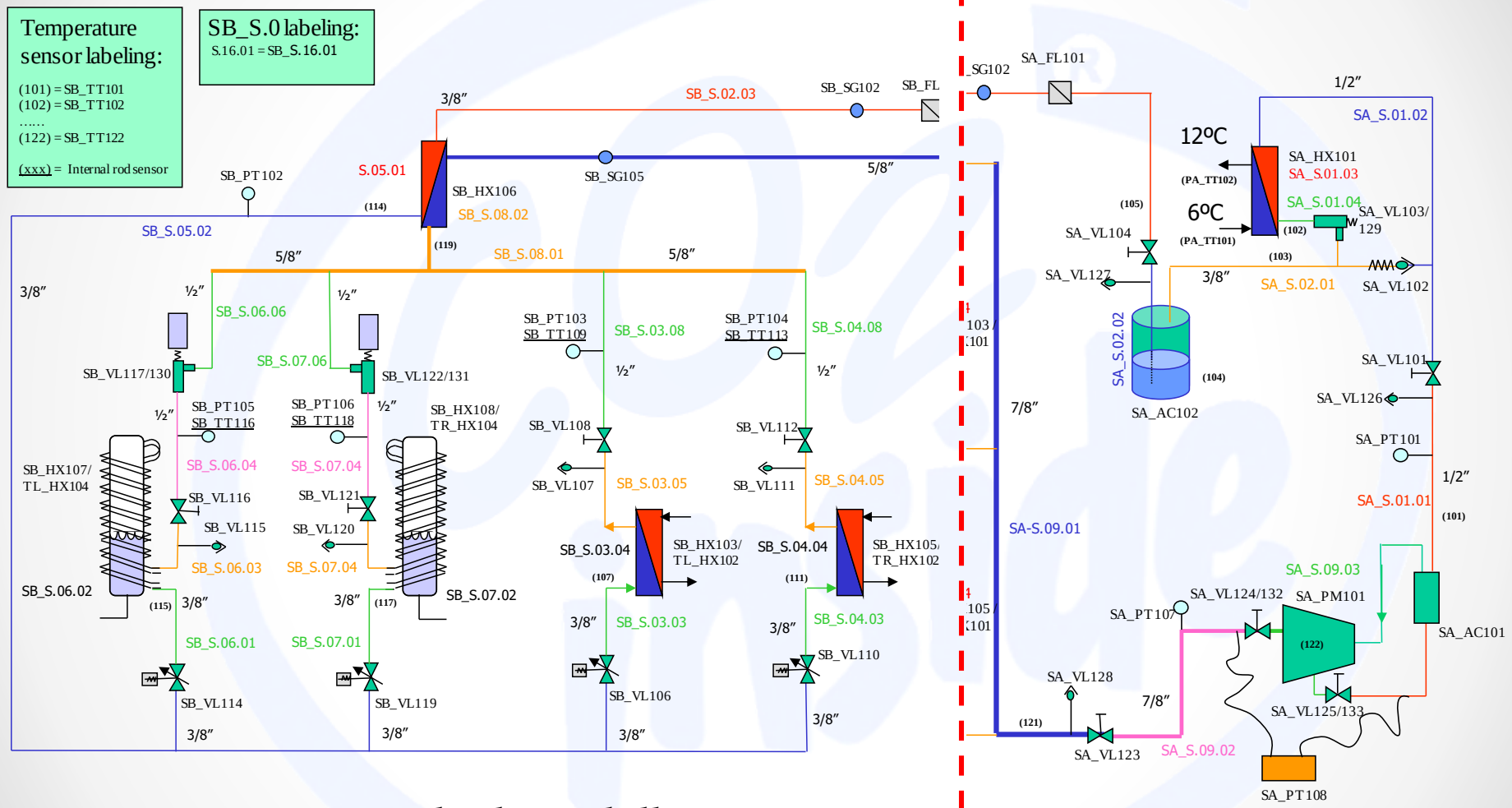
Red zones are removed to simplify and create insulation access

Back-up chiller and hardware which has been removed



Red zones are removed to simplify and create insulation access

Combined new chiller



Former back-up chiller (simplicity)

Former main chiller (high capacity)