The European XFEL Photon Beam Transport System

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European XFEL, the fourth generation Free-Electron-Laser facility in Hamburg (Germany), is going to start user operation in early 2017. In full operation the novel facility will produce at MHz repetition rate coherent femtosecond pulses with unprecedented brilliance in the energy range from 250 eV to 25 keV. The facility comprises of a linear accelerator and three beamlines: SASE1 and SASE2 that operate in the hard X-ray regime and SASE3 that covers the soft X-ray range up to 3 keV.
The installation of the windowless 800-meter long ultra-high vacuum beam transport system of the SASE1 beamline is almost completed and the assembly of the SASE3 beamline is ongoing. Challenges of the installation are the implementation of a particle-free assembly of the vacuum system around x-ray mirrors and avoiding particle transport through the beam pipe.
The control and interlock system is a custom build Programmable Logic Controller (PLC) to detect a fault vacuum condition and to prevent damage to the beamline hardware.

Avoiding Particle Contamination on Optics

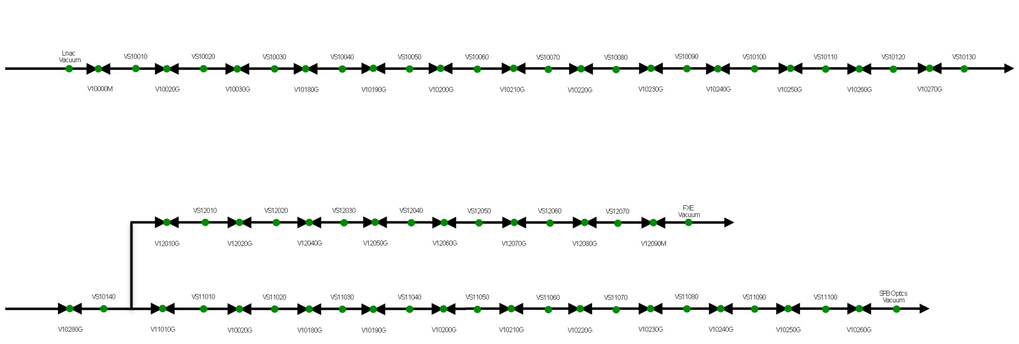
- Particle free areas ±30 m around mirrors and gratings
- Preassembly of components in cleanroom class ISO5
- Venting of the vacuum system only through particle filters with gas stream away from mirrors
- Small, mobile cleanroom tents for beam pipe installation in the tunnel
- Large, permanently installed cleanrooms at sensitive optics
- Installation of fast safety valves towards the electron beamline and upstream the distribution mirrors (closing time: 10 ms)
  - To avoid particle transport towards the mirror
  - To prevent venting the entire beamline
  - Only one instrument of a beamline will be affected in the case of an air inrush, the other remains operational

On-site welding of 18 m long vacuum pipes

- Assembly of three 3 m long pre-fabricated and cleaned DN100 vacuum pipes in SASE1 XTD9 tunnel
- The whole procedure was carried out under cleanroom conditions
- Advantages of orbital welding:
  - less installation work, less potential leaks, less expensive
  - consistent quality of welds
- 46 pipes (92 welds) were produced and put into place within two weeks
- Production of SASE2 vacuum pipes will start end of 2016 in tunnel XTD6

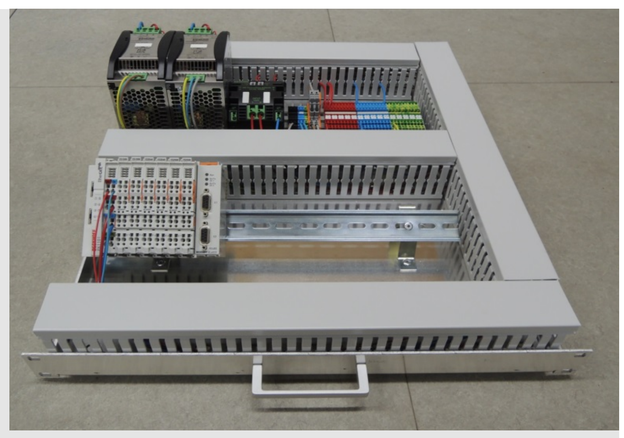
GUI developement

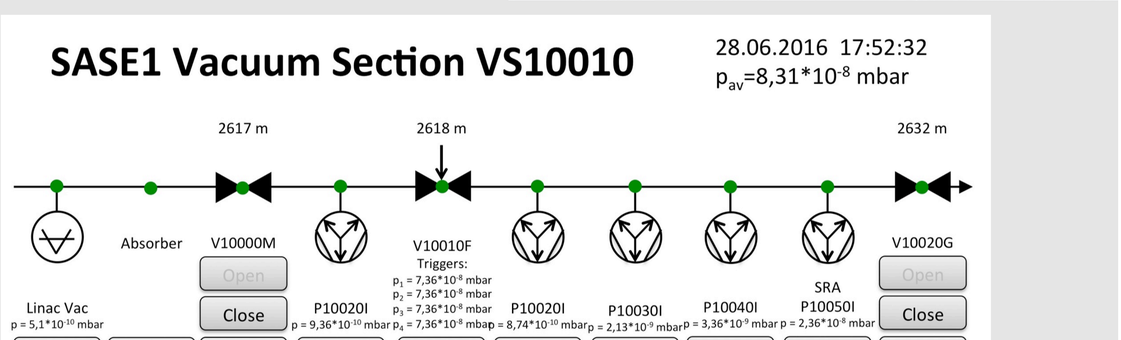
- Based on Karabo framework
- Alarms, remote access, archive …



Vacuum Control System

- Modular PLC system
  - Interlock running on PLC level
  - Based on Beckhoff hardware
  - Ethercat bus system
  - More than 60 units installed





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