CONTROL SYSTEM INTEGRATION OF MAX IV INSERTION DEVICES

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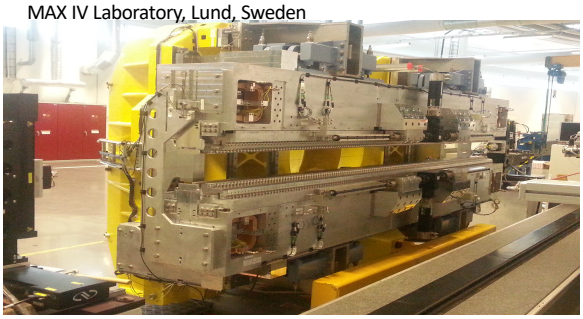


Introduction

During the last 3years, MAX IV have installed and commissioned in total 15 Insertion Devices out of which 6 are new in-vacuum undulators,1 in-vacuum wiggler, and 7 in-house developed and manufactured Apple II elliptically polarized undulators. From the old lab, MAXLAB, 1 Planar Undulator has been refurbished and installed. Looking forward, 3 additional insertion devices will be installed shortly. As MAX IV only has one Control and IT group, the same concept of machine and beamline installation have been applied also to the insertion devices, i.e. Sardana, Tango, PLC, and IcePAP integration. This has made a seamless integration possible to the rest of the facility in terms of user interfaces, alarm handling, archiving of status, and also future maintenance support

System description

All the Insertion Devices share the same mechanical principle of two girders. Besides that EPUs girders are divided in two subgirders that can be shifted longitudinally with respect to each other.

The girders can be up to 4 m long and weight up to 13.5 tons. Massive structures are needed as the maximum attractive and repellent forces between the top and bottom girder can reach 46 kN and 30 kN, and are not linear with gap distance. This causes the entire casted iron structure to bend dependent on gap and phase. Positionin requires sub-um control

Safety requirements: Avoid crushing vacuum tubes and personel during maintenance, avoid diverting beam in a dangerous way or let the beam hit and melt the equipment

The ID should be operated from both machine and beamline whose networks are separated.

Hardware

Brushless DC motors, absolute encoders, precision limit and overtravel switches, tiltmeters, temperature and vacuum sensors, corrector coils, override keys, safety switches

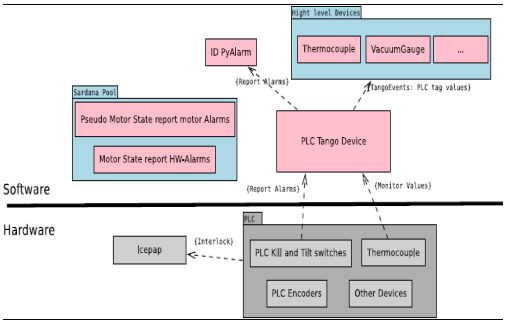
Nidec Digitax servo drives and IcePAP motion controller deal with the motion part

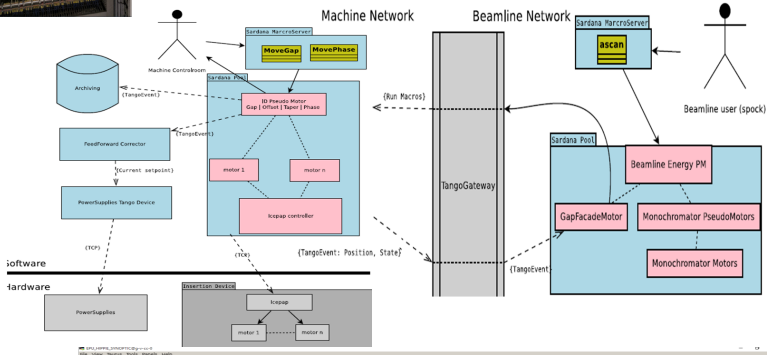
Allen-Bradley PLCs read switches and other safety hardware and disable power

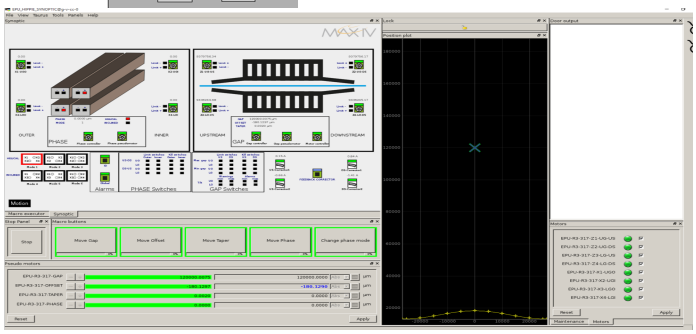
Itest power supplies are used for orbit correction

Software

- Control implemented based in Sardana SCADA on top of TANGO control system. Individual Sardana/MacroServer instances per ID
- Sardana motors allow access to all hardware driver parameters
- Sardana pseudomotors implement synchronized combined motions
- Sardana macros for gap/phase movements with correction
- PLC tango device to expose tiltmeters, temperature sensors, vacuum sensors, safety switches, water sensors,...
- Feedforward tango device for corrector coils based on gap acting on the Itest power supplies tango device
- PyAlarm used for alarm reporting and stored in Kibana/Elasticsearch
- Tango HDB++ event-based archiving system
- Tango Gateway to expose Machine network motors information to the Beamline network
- Beamline MacroServer to execute acquisition scan macros that move virtual motors in the beamline Sardana Pool talking through the Gateway to the machine network
- Control room GUIs for operators and maintenance







Conclusions

MAX IV has reached already a state where 10 beamlines are taking users, 4 more are in different phases of commissioning and 2 more are starting procurements. The use of a well in-house established set of technical solutions has allowed to install, test and commission a big number of insertion devices in parallel to the rest of the work for accelerators and beamlines in a relatively short period of time.

Acknowledgements

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MAX IV Laboratory

MAX IV Laboratory has operated successfully for more than 30 years and is currently operating the new MAX IV synchrotron facility in Lund. Fully developed it will receive more than 2 000 scientists annually, from Sweden and the rest of the world. They will do research in areas such as materials science, structural biology, chemistry, geology, physics and nanotechnology. MAX IV is the largest and most ambitious Swedish investment in national research infrastructure. It is the brightest source of x-rays worldwide, inaugurated June 2016. MAX IV Laboratory is hosted by Lund University.