CONTROLS AND INTERLOCKS FOR THE NEW ELETTRA SUPER CONDUCTING WIGGLER*

MOPGF113

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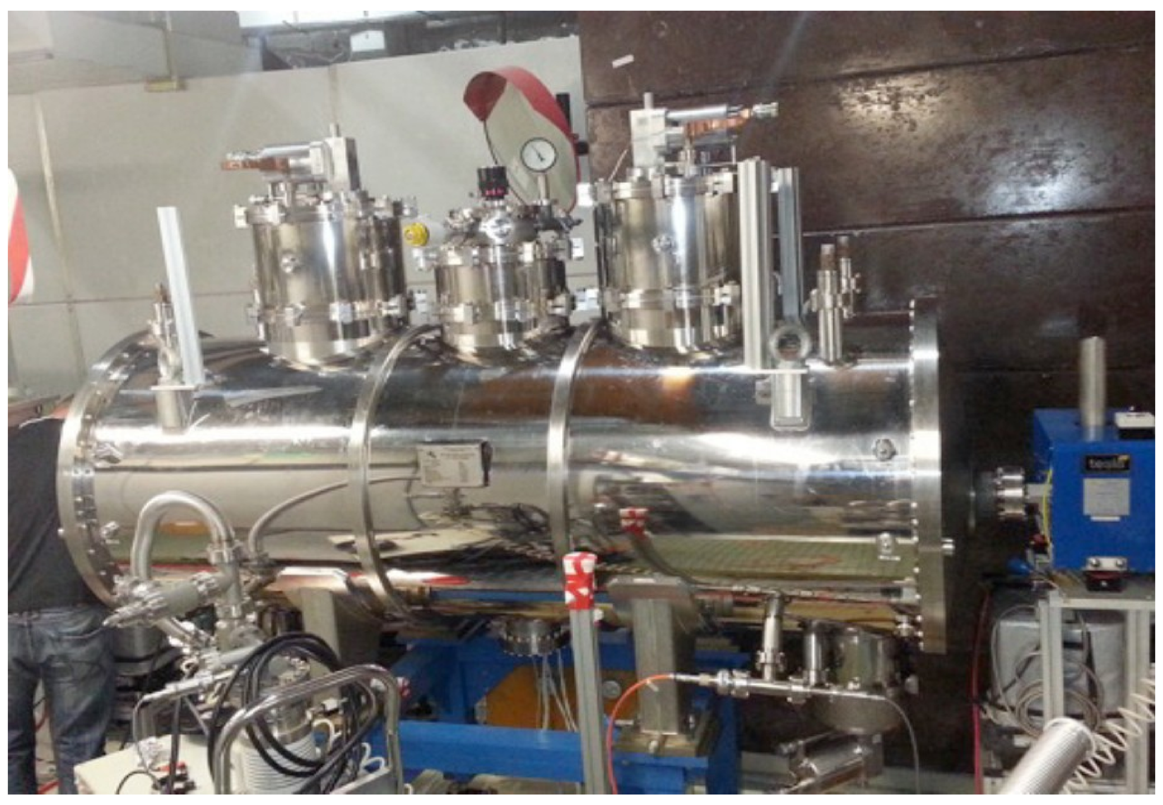
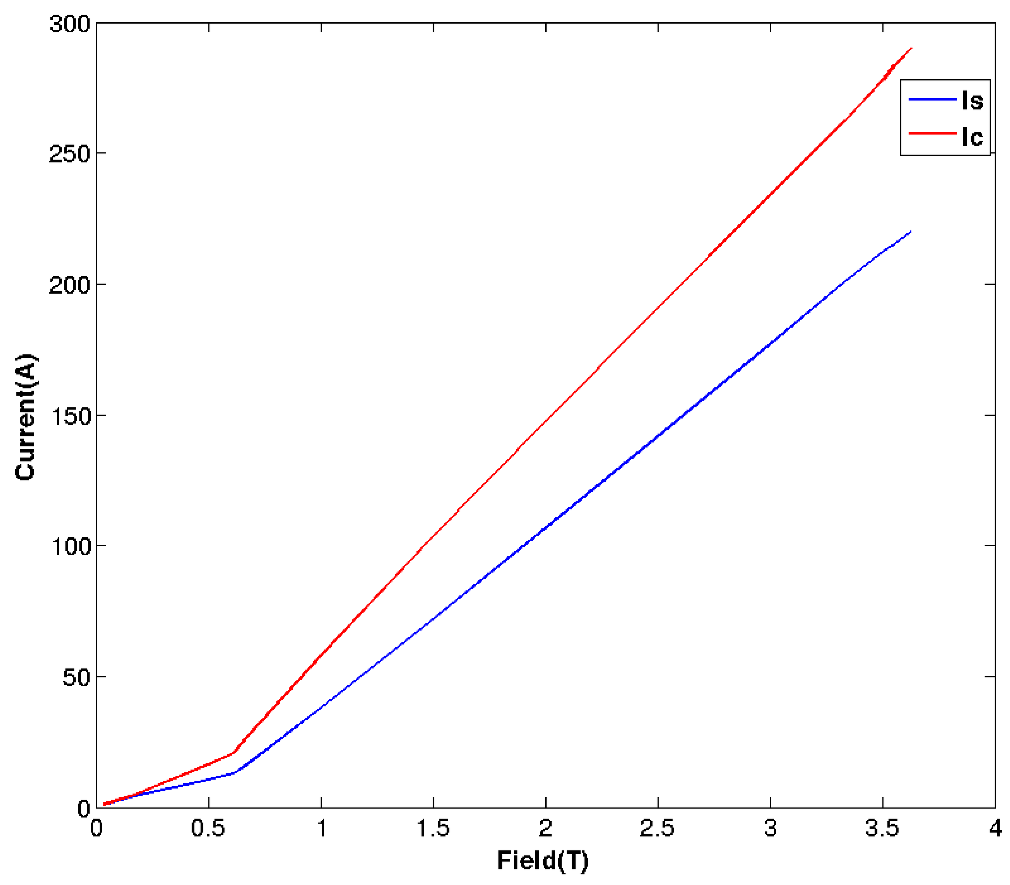
During the last two years, triggered by the construction of the XRD2 beamline, and to comply with the top-up operations, a complete refurbishment of the Elettra Super Conducting Wiggler (SCW) has been carried out. Alongside with the mechanical, cryogenic and electrical components, also the electronics, the control and interlock systems have been upgraded. The MVME5110 PowerPC single board computer, which is a standard in the Elettra control system, has been adopted, as well as RS23 communication modules, analog to digital converters and digital I/O lines. To cope with the high output power of the SCW, up to 18 KW, the interlock system, protecting both the wiggler and the beamline front-end, has been completely redesigned. The control system software has been re-written from scratch using the TANGO software framework. The complete system has been tested during the second half of 2014 and is now fully operational.

A 3.5 T superconducting wiggler, designed and built by the Budker Institute of Nuclear Physics (BINP), has been installed in the Elettra storage ring as a photon source for the X-ray diffraction beamline XRD2. During 2012 and 2013 the SCW has been provided of a new cryostat aimed at decreasing the helium consumption and increasing the reliability.

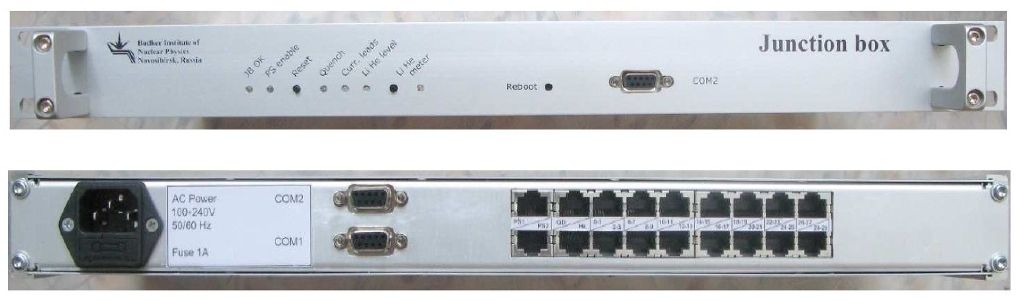


All the control software has been moved to the TANGO Controls Framework. TANGO device servers have been developed for the MPS883 power supplies, the Coolpack 6000 compressors, the junction box, whilst existing device servers have been reused for the DUAL and TPG300 high voltage power supplies. One additional TANGO device serve is in charge of the overall SCW supervision monitoring all the devices and implementing the magnetic field ramps using a look-up table to compute the power supplies currents to feed the superconducting coils.

A new dedicated front-end computer, based on the Artesyn MVME5110 VME single board computer, which is a standard for the Elettra control system, has been installed in a VME64x crate. A number of RS232 serial lines are requested to interface the two Danfysik MPS883 power supplies, the four compressors, the junction box and the vacuum power supplies. Two TIP866 industry pack mezzanine cards, each providing 8 RS232 serial lines, are installed on a TVME220 VME carrier board. An in-house developed signal conditioning board, compliant to the VME64x rear I/O board specifications, provides the opto-insulation on the serial lines.

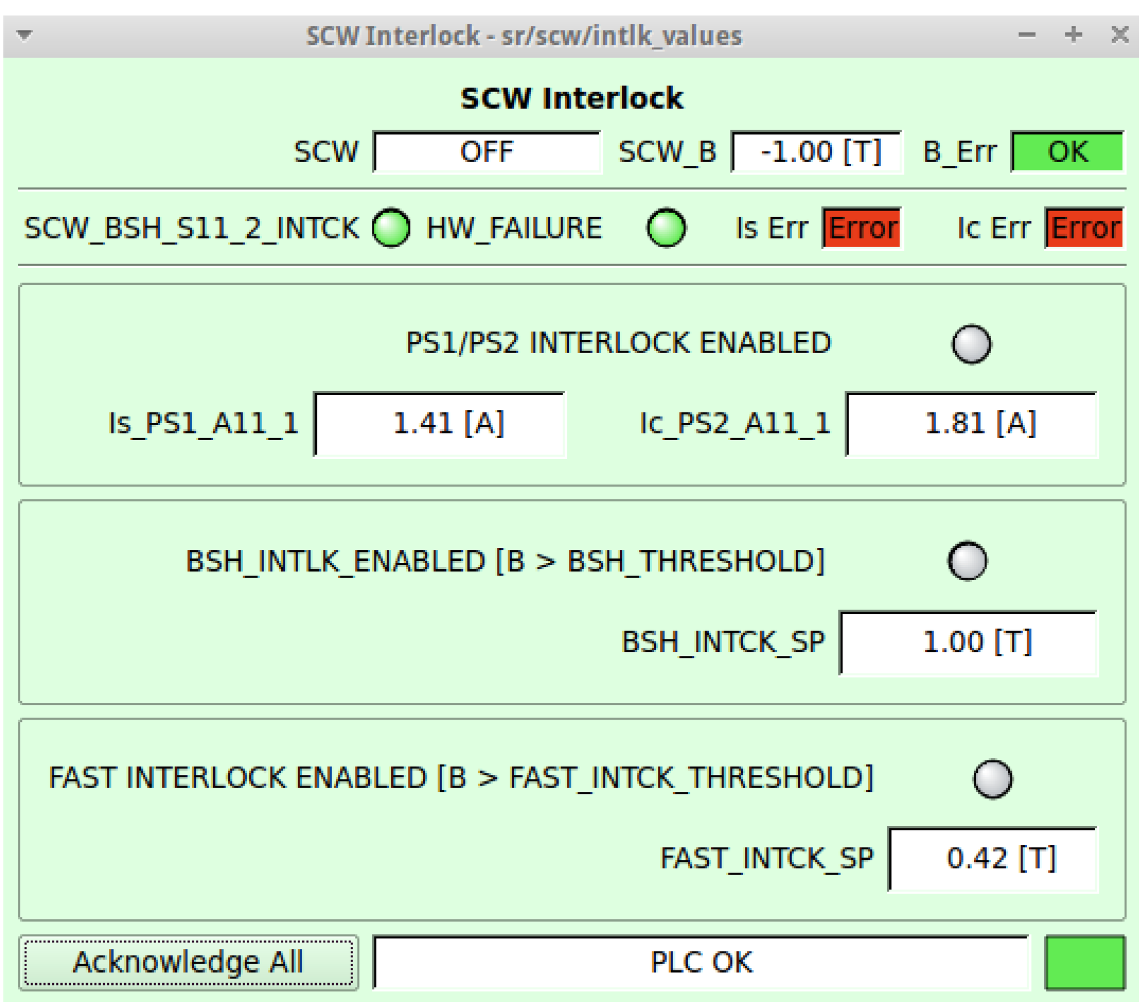


The original Danfysik MPS883 power supplies, feeding the central and the side superconducting coils, after being revised have been kept in operation, as well as the four existing Leybold Coolpack 6000 compressors, provided with new Coolpower cooling heads. A new junction box has been designed by BINP to replace both the old cabled box and the VME-based signal conditioning and acquisition board. The new junction box, based on an Atmel ATmega128 microprocessor, acquires the signals coming from the temperature and pressure sensors installed into the cryostat and implements the quench interlock logics.



Ion pumps, powered by the DUAL high voltage power supplies manufactured by Varian, are also installed to provide the requested vacuum levels. A pirani vacuum gauge allows to monitor the pressure in the vessel insulation, whilst some penning gauges are used in the front-end vacuum chamber; they are all powered with two TPG300 power supplies.

The large output power of the SCW required e redesign of the front-end. A new photon shutter, capable of holding 18 KW photon beam power has been designed and a mechanism to protect the existing exit valve/shutter has been implemented. Thermocouples, flow meters and vacuum gauges, installed on the front-end are also monitored and the appropriate interlock logics implemented. Currently, in case of low flow the electron beam is immediately dumped.



Alarms have been set up in the TANGO alarm system to alert the operator of possible problems with the temperatures or the vacuum. In case of increasing front-end temperatures, for instance, the operator can ramp down the SCW magnetic field decreasing the output power. Should the operator miss the action, the interlock PLC dumps the electron beam.

A graphical user interface, to be used by the control room operators and the insertion devices specialists, has been developed with Qtango and the Qt graphics library. All the parameters and the readings, such as temperatures, power supplies status and current, helium level, junction box and compressors status and, last but not least, wiggler magnetic field and status are shown over a synoptic image of the SCW.