SOLARIS PROJECT PROGRESS *

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Abstract

Solaris is a 3rd generation light source facility being built in Krakow, Poland at the Jagiellonian University Campus. The project is being accomplished in a tight collaboration with the MAX IV Laboratory in Lund, Sweden. The Solaris 1.5 GeV storage ring is a replica of the MAX IV 1.5 GeV machine, whereas the injector and the transfer line although based on the same components, are unique for Solaris. One of the main differences is the 600 MeV injection energy requiring an energy ramp in the storage ring to the final operating energy of 1.5 GeV. The construction of the facility started in early 2010 and is planned to be finished in the autumn 2014. Up to now, 70% of the components have been procured and construction of the buildings in progress with expected handover in autumn 2013. This paper will give an update on infrastructure progress and design choices for shielding, service area placement of racks and routing of piping and cables. An update is also presented of machine layout that includes the injector, transfer line and storage ring.

INTRODUCTION

The Solaris National Radiation Centre being built at the Jagiellonian University in Krakow, Poland is a 3rd generation light source facility. The project is being accomplished in a tight collaboration with the MAX IV Laboratory in Lund, Sweden. The Solaris facility comprises a 1.5 GeV storage ring, which is a replica of the MAX IV 1.5 GeV machine, a 600 MeV normal conducting S –band injector with the transfer line and one bending magnet beamline. The injector and the beamline are unique for Solaris requiring their own design. Moreover, since the maximum injection energy is 600 MeV, an energy ramp in the storage ring to the final operating energy is required. The construction of the facility started in early 2010 and the goal is to finish by the last quarter of 2014.

BUILDING STATUS

Buildings

The contract for the design and construction of the Solaris building was awarded in the March 2011 to the consortium of companies Alpine Construction Polska Sp. z o.o./ Łęgprzem Sp. z o.o. Ground breaking of the green-field site was started in January 2012 and expected handover of the building is in autumn 2013. The facility building composed of the linac and klystron gallery tunnels located 7.7 m under the ground, the experimental hall with the storage ring tunnel and service area located 3.2 m below the surface, as well as an office area occupies a floor space of 7300 m^2. The detailed description of the building design was presented in [1, 2].

Construction work is progressing very quickly. Linac and klystron tunnels were constructed from heavy and normal concrete and covered in autumn 2012. At the same time access holes from linac tunnel to storage ring were defined as well as the service area configuration with trenches and floor level finalized. The experimental hall slab has been poured including storage ring floor and trenches. At the end of December 2012 the cold shell (external walls, windows, roof, thermal insulation without plaster, cladding, etc.) of the building was completed and construction of the shielding walls of the storage ring tunnel started with defined photon and alignment ports. Removable ring roofing slabs were cast in-situ at the end of April 2013 (Fig. 1).

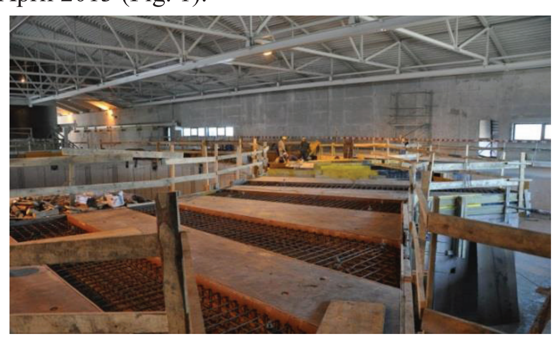

Figure 1: The roof of the storage ring tunnel.

At present thermal insulation and concrete screed are being placed on floors and work will soon finish the floors (epoxy resins, tiles, stone, coated concrete, linings, antielectrostatic linings, antielectrostatic epoxy resins). Both klystron and linac tunnels and the experimental hall area are equipped with 3.2 (Fig. 2), 1.6 and 8 tons cranes, respectively and are ready for commissioning. The 8 ton crane shares an overlap zone with the crane over the linac and klystron area for the handling and transport of materials. The roof of the building is finished and minor works on eaves of the roof are being performed (Fig. 3). The administration building area is very close to completion as are works on an access road around the building.

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Figure 2: The klystron gallery tunnel with a 3.2 t crane.

Figure 3: The building of Solaris facility.

Services and Installations

All building installation designs have been released for execution and are in the process of being accepted. The facility will have four transformers rated at 1600 kVA and will be able to handle 3 MW peak electrical power from a 15 kV line. Medium voltage electrical power will be distributed in the klystron gallery, linac tunnel, storage ring and on the outside of the experimental hall by bus-bars. Most of the electrical cables for the building are being laid.

The heating, ventilation and air conditioning system is capable of handling 25000 m3/h. Both the klystron gallery and the experimental hall will be stabilized at 22±2°C whereas the linac and storage ring will be based on a passive system with a temperature of 28±0.3°C. Work on external or internal installations of water, sewerage, HVAC, fire hydrant, storm water has already started. Nitrogen and compressed air installations are being accepted at the moment.

The primary demineralized water cooling circuit for accelerator components will have an inlet temperature of 25°C with a maximum conductivity of 2 μS/cm at 45°C and 6 bar maximum pressure.

The cooling system is still under design. The water circuit for the linac area has already been defined, however, the storage ring circuit still needs to be verified. The present concept is to have valves, filters, flow meters or flow switches in the service area. The expected handover of the cooling design is mid May 2013. In the service area of the storage ring a false floor will be situated, that will allow placement of most of the electrical cables and water pipes under the floor.

MACHINE STATUS

Pre-Injector

The pre-injector consists of a thermionic RF gun constructed by MAX-Lab, a chopper section to fit a time structure to the 100 MHz buckets of the storage ring, and a double bend achromatic energy filter composed of two 60 degree bending magnets and 5 quadrupoles that together with centrally located slit allow to filter out the low-energy electrons. Moreover, for early beam focusing, two solenoids between the e-gun and filter are installed. To have a control on beam parameters current transformers, YAG screens and a Faraday cup will be used. The gun body is being brazed and will be conditioned at MAX-IV Laboratory during the summer of 2013.

The gun will be powered by a separate RF plant that has been purchased from Scandinova Systems. The waveguide layout has been defined and additional waveguides are being purchased from Institute of High Energy Physics in China (IHEP). The delivery of all pre-injector components is expected until December 2013. The commissioning of the pre-injector is foreseen for early spring 2014. The pre-injector assembly is presented in Figure 4.

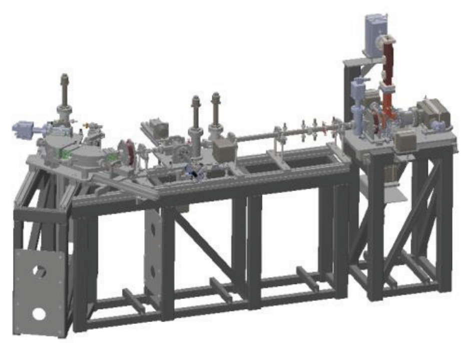

Figure 4: Solaris pre-injector assembly.

Linac and Transfer Line

The layout of Solaris S-band injector with transfer line was presented and described in [3,4]. Since then a few modifications to the optics design were made to improve the performance. Namely, the two last quadrupoles magnets were shifted to the last linac intersection to improve the optics matching and give a possibility to measure the emittance at the end of the linac with the quadrupole scan method. In addition the dedicated modulator for the gun allows to obtain a 9% higher injection energy. In the transfer line two beam stoppers were added to cover safety issues. The main linac modulators were fabricated at Scandinova and have passed the factory acceptance test. They are currently stored at the manufacturer site and will be delivered in September this year. Delivery of linac sections conditioned at 10 Hz repetition rate at Research Instruments is foreseen at the end of June 2013. All waveguides for the linac were fabricated (IHEP), and delivered to Solaris at the end of April 2013. Linac intersections (magnets, diagnostics, vacuum) and the stands are ordered. The cooling and the stabilization of the machine temperature will be done by secondary circuits using special cooling units that are developed at MAX IV. Summing up, 90% of the injector components has been ordered and will be delivered to Solaris before December 2013.

Storage Ring

Solaris storage ring is a replica of MAXIV 1.5 GeV machine [5], however there are a few differences in the operation scheme. The MAX IV machine will operate in top-up mode with the required full energy injection every few minutes. Solaris, on the other hand, will operate in a ramped-decay mode, with injection energy in the range from 550 to 600 MeV followed by energy ramping to 1.5 GeV. Triggering and ramping software will be implemented into the control system. The injection at low energy as well as a ramping of the magnet blocks is being investigated [3,6,7]. The storage ring consists of 12 Double Bend Achromats (DBA). The main parameters of the machine and the design details were described in [2,4,5]. The magnets were contracted to Danfysik in December 2012 and will be machined from 5 m long iron blocks, where all DBA magnets are integrated. The delivery of all DBA cells to the Solaris site is expected in May 2014. The power supplies for all magnets will be procured from three different companies, Danfysik, iTest and Delta Elektronika. For the largest power supplies the delivery time is scheduled for May 2014, whereas the rest are expected by the end of 2013. The vacuum system is designed by team from the CELLS-ALBA Synchrotron in collaboration with MAX IV as a conventional high quality stainless-steel system. Additionally, the vacuum chambers will have a Non Evaporable Getter (NEG) stripes, which reduced the number of ion pumps used in the system. The DBA vacuum system and magnet configuration assumes radiation to be extracted at 7.5 deg from the first bending magnet and from upstream insertion devices (at 0 deg). The contract for manufacture of the standard vacuum chambers was awarded to FMB-Berlin in March this year. The time schedule foresees delivery of final batch for Solaris in July 2014. The design of the non-standard vacuum chambers that includes tapers, diagnostics, vacuum chambers in RF section and absorbers is on-going, however delivery time is requested by May 2014. The RF system for the storage ring is composed of two 100 MHz main cavities (MC) and two 300 MHz Landau cavities (LC). Both types of cavities were ordered from Research Instruments and will be delivered late 2013 (MC) and early 2014 (LC) to MAX-lab where the conditioning of those cavities will be performed and then transported to Krakow. The procurement for two 60 kW RF transmitters is about to be concluded.

Beamline

The bending magnet front end is being designed by the ELETTRA-Sincrotrone Trieste ready for a call for tender. Moreover, the optics of the bending magnet beamline which includes the ray tracing of the Solaris' configuration and mirrors and gratings specification has been preparing by the ELETTRA-Sincrotrone Trieste too. Documents for call for tender will be delivered in mid-May this year and delivery is foreseen within the Solaris time schedule. The schematics of the beamline layout is presented in Figure 5.

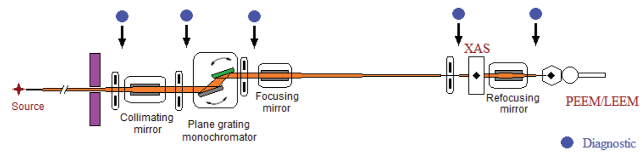

Figure 5: The conceptual layout of Solaris beamline.

SUMMARY

Most of the hardware has been procured. There are still remaining items such as racks, PLCs for machine protection, timing system and electronics (apart from BPM electronics that was contracted to Instrumentation Technologies) that need to be purchased. Additional on-going work is focusing on the personal protection system and the control system that has to be developed and/or tailored to the needs of Solaris. The focus of activities is now on installations and the system commissioning plans.

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