SIS100 status report 2014

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Introduction

SIS100 is the main accelerator of the FAIR project. It is a worldwide unique heavy ion synchrotron dedicated to accelerate highest intensities of intermediate charge state heavy ion and proton beams up to 100 Tm. From the technical point of view, most challenging issues are the fast ramped superconducting magnets and the acceleration of intense, intermediate charge state heavy ions beams. The latter required a unique lattice design (charge separator lattice) in combination with an ultra-high vacuum system based on distributed cryopumping with actively cooled magnet chambers, adsorption pumps and dedicated cryocatchers for local suppression of gas desorption.

Procurement status

The year 2014 was very much loaded with completing, reviewing and finishing specifications and drawings for all kind of components. Finally, shortly after end of 2014, all contracts for the major SIS100 components and the large series have been closed (i.e. Milestone ”M4” has been reached), which is a major step ahead. This corresponds to a bound value of 50% of the SIS100 costbook value. The last large in-kind contract regarding the quadrupole unit production has been successfully negotiated and closed with the Joint Institute for Nuclear Research (JINR, Dubna, Russia) and signed by JINR, GSI and FAIR management at an official ceremony at JINR at 2015/02/20, see fig. 1.

Besides the major series with long production times, many other components have been tendered or contracted, e.g. the injection kicker system, the resonance sextupole magnets (awarded to DANFYSIK, Denmark) and the cryocatcher system. The local cryogenics system will be delivered by the Wroclaw University of Technology (WrUT, Poland) and the manufacturing design review took place for the first bypass line segment. The contract for the production of the bypass line as been awarded to the company KRIOSYSTEM, Poland.

Building planning

Detailed planning for the accelerator tunnel and the supply area (K0923A/T110) complex, including 3D DMU models of the accelerator and its technical infrastructure, has matured and is transitioning to execution planning, which will take place in 2015, see fig. 2. This will allow the creation of the necessary building tendering documents in late 2015.

Figure 1: Signature of quadrupole unit production contract at JINR (l.t.r with the contract in their hands: B. Sharkov / FAIR and V. Matveev / JINR.

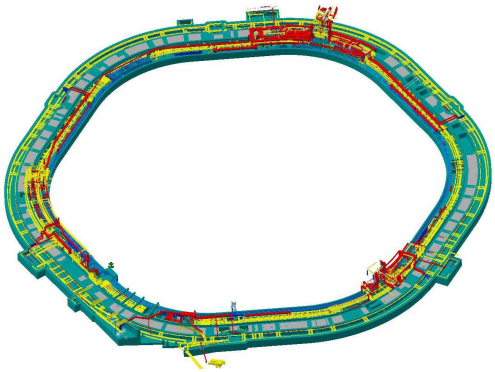

Figure 2: T110 design with cable trays (yellow), cooling water supply lines (blue) and venting (red).

Progress on component tendering and delivery

The first of the 109 s.c. 1.9 T dipole series magnets (FoS) has already been delivered in June 2013 and thoroughly tested under warm and cryogenic conditions. Although, the FOS dipole has a completely new coil design and is being operated at twice the electrical current as the prototype, the quench training showed excellent behavior. Nevertheless, the planned high current operation allows only minimum mechanical errors in the yoke production. Therefore, together with the manufacturer and external experts, the production and welding process has been review and optimized. A mechanically further improved FoS yoke will be produced and delivered until Q3/2015. After a short test period the series production will be released. The FoS thin wall, actively cooled dipole vacuum chamber has been

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delivered by the company PINK and tested at warm and cold conditions. The manufacturing has been done with excellent results and the specified UHV properties were achieved. However, the cryogenic pumping properties of the He cooling circuit has to be improved.

The s.c. quadrupole modules (83 pcs, see fig. 3) are very demanding due to their technical complexity and the international structure of the project. The quadrupole units (quadrupole magnet + corrector magnets) will be built at JINR, Dubna, whereas other components (vacuum chambers, cryocatcher, BPM's, local current leads, cryostats, ...) will be tendered by GSI. Currently, 80% of the specification work of the units and all manufacturing drawings for the quadrupole module type 2.5 FoS units are finished and are finally reviewed at JINR; the remaining 20% will be done when the external (industrialized) design work has been completed. The yoke steel (323 t in total) has been ordered at C.D. Wälzholz, Germany and the first lot will be delivered to JINR 04/2015. The cryocatcher tendering is nearly completed, bids do exist. Finally, smaller standardized components like voltage breakers and temperature sensors for the full quadrupole module series has been ordered by GSI in 2014, too.

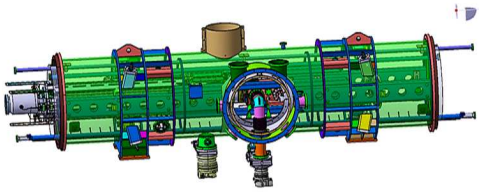

Figure 3: Design of the type 2.5 quadrupole module.

The RF acceleration system (14 pcs, 1.1...3.2 MHz, 20 kV_p, 30 kW beam power, see fig. 4) has been tendered by FAIR GmbH and awarded to a consortium of RI/AMPEGON in 11/2014. Preparation of the manufacturing concept is currently done by the consortium, the conceptual design review (CDR) will take place Q1/2015. Driver amplifier and LLRF procurement has been started, too.

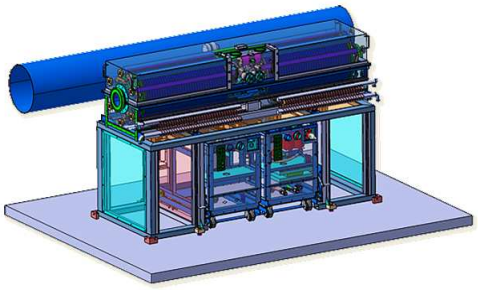

Figure 4: Design of the acceleration cavitiy.

The RF Bunch compression system (9 pcs) has been tendered by GSI and awarded to the company AURION (Germany) in 04/2014. The conceptual design review has been successfully concluded. As last step before the start of production a final design review (FDR) is foreseen, which will take place in 03/2015 - the 1st device will be delivered in 07/2015.

The design of the SIS100 injection straight section (sector 6) has been detailed; as a result, the injection kicker system (6 modules, 130 ns rise time, 7.5 mrad deflection angle) procurement has been started.

S.c. test facilities

The prototype test facility (PTF) has been equipped in 2014 with all missing infrastructure, 13 kA HTS current leads, power supplies, etc. to upgrade it for the testing of the dipole FoS tests. Fig. 5 shows the team after the first dipole cold test.

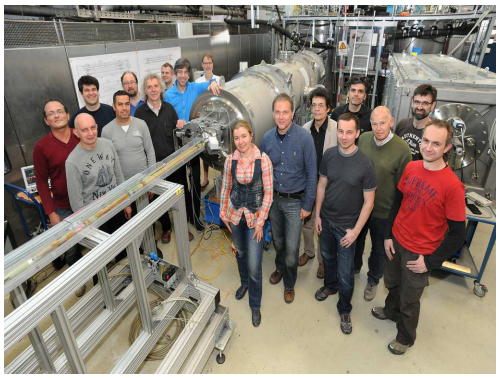

Figure 5: The test team at the PTF with the FoS dipole.

For the series dipole magnet test facility (STF), a dedicated building has been constructed at GSI (Bldg. SH5). The cryogenic system, including feed boxes and test benches is currently commissioned. The power converter for ramping the s.c. dipole magnets with 29 kA/s will be delivered in 04/2015. High precision magnetic field measurement equipment is currently built in a collaboration with CERN. This subproject runs smooth and is profiting a lot from the experience gained during the FoS dipole testing, where high precision mechanical measurement devices has been developed.

The quadrupole unit testing will be done at JINR, Dubna. Here, an R&D contract between GSI and JINR has been closed in 12/2013. The cryoplant at JINR has already been commissioned; measurement equipment will be designed by JINR in parallel to the construction of the first quadrupole units.

Finally, the SIS100 stringtest will comprise two dipoles, one quadrupole module, the cryogenic bypass line, feedbox and current lead box. The space is preserved at the STF and the layout has been completed. The contract for the bypass line has been closed (WrUT) and the FDR will take place in 02/2015. Specifications for the remaining items are 50% finished.

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