THE INSTALLATION STATUS OF THE SNS ACCUMULATOR RING

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Abstract

The Spallation Neutron Source (SNS*) accumulator Ring, when completed in 2006, will be capable of delivering a 1.0 GeV, 1.4 MW proton beam to a liquid mercury target for neutron production. This paper presents an overview of the issues and logistics associated with the preparation and installation of the accelerator Ring System. The preparatory activities which occurred at BNL, vendors and at the SNS will be discussed as well as the installation sequence and status.

INTRODUCTION

The installation of the SNS accelerator Ring System involved a collaborative effort between the two partner laboratories, BNL and ORNL. BNL had overall responsibility for the design, procurement, fabrication, testing and delivery of the beamline lattice components. And the ORNL/SNS Accelerator Systems Division (ASD) was responsible for the facilities preparation, equipment receiving inspection and testing, assembly, installation, and integrated testing and checkout of that equipment. The progress to date reflects the successful division of roles and responsibilities.

RING CONFIGURATION

The Ring configuration is shown in Figure 1 and consists of; the High-Energy Beam Transport (HEBT) beamline, the Accumulator Ring (Ring), the Ring to Target Beam Transport (RTBT) beamline, and the three associated Service Buildings which contain the power supplies, support systems, communications, controls and utilities.

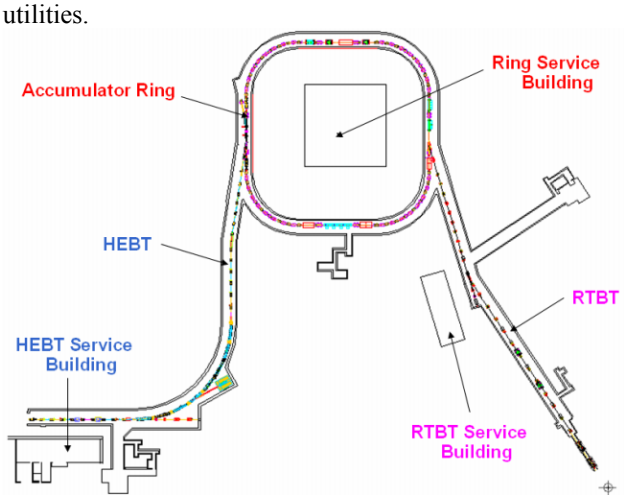

Figure 1: Overall Ring System.

THE RING INSTALLATION

Installation Scope

The installation of the Ring System encompasses not only the beamline lattice elements located in the tunnels, but also the technical equipment and support systems located in the service buildings.

Beamline Elements:

The accelerated beam is transported through 600 meters of lattice beamline in the tunnels before it reaches the Target. The beamline is composed of the following major components [1]:

- 312 magnet assemblies
- 267 vacuum chambers
- 45 diagnostic structures
- 7 collimators
- 4 RF cavities
- 272 support stands

Service Buildings

The operation of the lattice elements is supported by the technical equipment and systems located in the 15,000 sq. ft. of associated service buildings. These items include, but are not limited to, the following:

- 251 power supplies
- 200 equipment racks
- 550 rack chassis
- 8 cooling systems

Infrastructure

The tunnels and service buildings contained minimal accelerator infrastructure when turned over to ASD at beneficial occupancy. The following infrastructure had to be installed before the technical equipment could be set into position and operated:

- 4 km of cable tray
- 100 km of cables
- 1200 meters of cooling lines

Installation Plan

An overall project plan was prepared consistent with the Department of Energy (DoE) milestones. From this overall plan, an Integrated Project Schedule (IPS) addressing the installation and commissioning of the various systems was derived.

A detailed examination of the level of effort required to perform the Ring installation was conducted and some 31,000 individual activities were identified. The resources to perform these activities were then estimated resulting

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in a requirement of some 50 Man Years of craft and technician labor.

A joint BNL/SNS cost/capability evaluation for the design, procurement and testing of the Ring components was conducted in support of the IPS. This evaluation established the configuration of the equipment as it would be delivered to the SNS. As a result, some magnet assemblies, such as the Ring arc Half-Cells, would be delivered from BNL as complete assembled and tested units. Others, such as magnets, vacuum chambers and supports would have their first article units from industrial vendors tested and evaluated at BNL and the subsequent units delivered directly to the SNS as individual components which would require measurement, assembly, and testing capability at the SNS. From this determination, the level of equipment and resources necessary for on-site component preparation was defined.

The resulting detailed Ring installation plan thus integrated the identified installation activities, the resources and materials required to perform them and the component delivery status and schedule.

Installation Sequence

The installation sequence in both the tunnels and service buildings was initiated with the installation of the required infrastructure as these facilities contained minimal services when turned over for beneficial occupancy, Figures 2 and 3. The heavy and bulky items such as overhead cable trays, heavy DC cables, and cooling headers were installed first to minimize the potential for damaging technical components, Figures 4 and 5.

The facilities also required the establishment of a survey network to both monitor the movement of the tunnel structures and establish the positioning of the technical components. Some 700 floor and wall monuments were installed in the tunnels and 1.5 Man Years of effort required to establish and monitor it.

The mounting locations of the components were surveyed first, followed by the installation and alignment of the components' support stands. The technical components would then be set in position on the stands, aligned and finally interconnected to the adjacent units. With the technical component in its final orientation the infrastructure connections, i.e. cabling and cooling, would then be installed, Figure 3. The final element to be installed in the beamlines would be the diagnostics to protect their sensitivity as much as possible.

Upon completion of the physical equipment installation, a series of individual and integrated systems' tests would occur. These tests are used to validate the power supply, cooling, control systems' performance prior to operation with beam.

Figure 2: HEBT Tunnel at Beneficial Occupancy – Apr '03

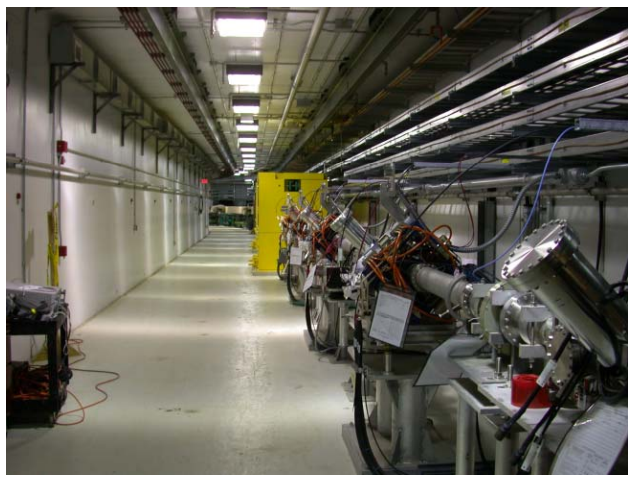

Figure 3: HEBT Beamline Installation – Apr '05.

Figure 4: HEBT Service Building at Beneficial Occupancy – Apr '03.

Figure 5: HEBT Service Building Installation – Apr '05.

INSTALLATION STATUS

The Ring system installation started in April 2003 with the occupancy of the HEBT tunnel. The Ring tunnel installation started one month later in May 2003 followed by the RTBT tunnel in September 2003.

At this time, all of the beamline technical components have been delivered from BNL and/or its vendors. The component installation to date in the tunnels is shown in Figure 6.

The HEBT beamline is 95% complete to the ground break. All that remains to be installed is a small open section immediately in front of the primary tunnel access door which has been kept open to enable the transport of large items into and out of the tunnels.

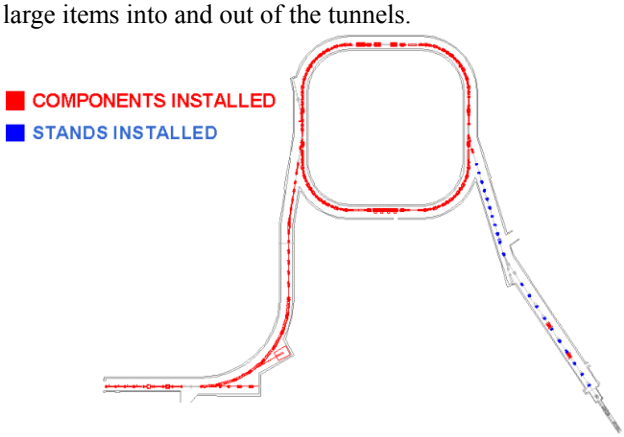

Figure 6: Ring Installation Status – Apr '05.

The HEBT beamline will be completed in early-June '05 followed by a full beamline integrated test and checkout. Radiation shielding will be installed at the exterior to the tunnel entrance and at the Ring system electrical ground break. The transmission of the full 1 GeV accelerated beam to the Linac Dump in the HEBT will occur in August 2005.

All the major Ring beamline components have been set in position. The beamline vacuum interconnections, cabling and cooling terminations, and diagnostic installations are in process at this time. The Ring beamline completion is scheduled for early July 2005 with integrated subsystem testing to occur from July to November 2005.

The RTBT beamline major component installation is in process at this time. Two magnets, two collimators and 21 magnet stands have been installed to date in the tunnel. The 21Q40 magnets are in the process of being measured, fiducialized and inserted into assemblies in the Magnet Measurement Lab at the SNS. The last four large (36Q85) magnets located in the beamline immediately upstream of the Target are currently staged in the Target building and will be assembled onto a test fixture in the Target building in June 2005 for remote coupling testing and alignment fiducialization.

The overall Ring installation will conclude with the installation of these last four large magnets in November 2005

CONCLUSION

The Ring installation to date has proceeded according to plan largely in part to the close coordination between ASD and BNL over the last 2 years. Continual dialogue has enabled adjustments in activities both at BNL and at the SNS to occur without major cost/schedule impact.

REFERENCES

[1] W McGahern et al, "Managing System Parameters for SNS Magnet and Power Supplies," EPAC'04.

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