Report of the Accelerator Systems Advisory Committee Of the Spallation Neutron Source September 2004 Meeting

Introduction

The eleventh meeting of the Accelerator Systems Advisory Committee (ASAC) for the Spallation Neutron Source was held on September 27 - 29, 2004 at the SNS Central Lab Building in Oak Ridge, Tennessee. The committee membership is: D. Finley (Fermilab), R. Jameson (LANL), R. Kustom (ANL), W. McDowell (ANL), G. McMichael (ANL), D. Proch (DESY), G. Rees (RAL), P. Schmor (TRIUMF), R. Siemann (SLAC, Chair), Y. Yamazaki (JAERI), and F. Zimmermann (CERN). T. Peterson (Fermilab) joined ASAC for this meeting, and there was a meeting of the SNS Cryogenic Advisory Committee concurrent with the ASAC meeting.

Charge to Committee

1) Provide an overall assessment of the physics and technical progress on the project. Does the committee see any serious problem areas?
2) Provide a detailed assessment on hardware installation and recommendations for improvements and increased efficiencies within the constraints of funding and schedules.
3) Provide a detailed assessment on beam commissioning and recommendations for improvements and increased efficiency within the constraints of funding and schedules.
4) Comment on installation and commissioning scope, costs and schedule risks and resource allocation to mitigate these risks.

General Assessment

We are impressed with the progress each time we visit. This time there were major milestones with the commissioning and operation of the Drift Tube Linac and three of the four Coupled Cavity Linac modules, completion of roughly 75% of the superconducting linac cryomodules, a successful test of a medium beta cryomodule at 4.3K, completed installation of the four arcs of the accumulator ring, installation of a full complement of klystrons in the klystron gallery, and movement of the SNS activities to the CLO Building at the SNS site.

The activities of the Accelerator Systems Division (ASD) are focused on the important CD-4 goals of installing the equipment needed for 1 MW operation and the delivery of 10^{13} protons to the target in a single extracted turn. The focus on CD-4 is entirely appropriate. The delivery of 10^{13} protons is a modest goal, and there should be multiple ways to meet it. Concrete plans for doing so will develop as more systems are commissioned and their performance becomes better understood. One aspect of those plans is likely to be delaying of the accumulator ring commissioning to early 2006. We do not see this as a substantial risk provided systems are checked out ahead of time and critical spares are available. The superconducting linac is more of a concern. Successful operation requires the cavities themselves, the RF systems, and the cryogenics systems. All of these are making good progress, but there is a ways to go.

The future of the SNS is summarized in SNS 102000000-TR0004-R00 ("The Spallation Neutron Source: Operational aspects and reliability in the transition from Commissioning to fully committed User Operation"), which has 95% reliability, 5000 hours of operation annually, and 1.4 MW beam power in FY2011. ASD is approaching the time for transition from construction to operations. The plans seem reasonable, but there was not enough information provided to judge whether the post 2007 staff and budgets will be adequate to achieve the goals.

We would like to hear more about the plans for the evolution of the accelerator towards the 2011 goal at the next meeting.

With the present short term focus on CD-4 and the longer term objective in mind we felt it important to advise the project about issues that could either impact long term operations and/or be exceptionally costly to repair or replace in the future. Aspects of the superconducting linac have that character. The most important issue in our opinion is the behavior of the higher order mode couplers and the plans to replace broken higher order mode feedthroughs in the field rather than in a clean room. Procedures should be devised and careful tests performed before this is undertaken. There are more details in the section on the superconducting linac.

Front End Systems

Significant improvements were reported in beam reliability, beam availability, ion source lifetime, beam diagnostics, pulse shape and current stability. Operational experience and the availability of the hot spare and ion source test facility have been important elements in these achievements. The ion source test facility is now capable of running unattended safely at full duty cycle. The Faraday cup was found to have design flaws that were leading to an overestimate of the actual H- current. An improved design is now providing values that are consistent with a beam current transformer. The recalibrated current values are still adequate for initial operation. Modifications to the emittance scanner have demonstrated that the actual beam emittance is smaller than previously measured. A better understanding of the cesium chemistry in the ion source has led to a significant improvement in the beam current following repeated cesium injection cycles. The current variation during a beam pulse has been reduced. The group has also made a concerted effort to address the problem of RF leakage from the ion source.

There are still some operational concerns. The reduction in RF noise has been modest and continues to be a problem for obtaining accurate values on the current monitors. The LEBT chopper power supply has not yet operated with a full current at full duty cycle beam. The LEBT chopper must work reliably in order to achieve the low spill accelerator requirements and for the MEBT chopper to operate. It is not clear that the existing design is adequate. There is still no demonstration of the MEBT chopper operation, and this continues to be a concern. The emittance and MEBT lattice parameters seem to depend on the beam current level. This needs to be better understood, and it is likely that pulse flattening and current stabilization during the pulse will be needed to maintain the Front End emittance and Twiss parameters. A 2 MHz feed forward system is under consideration for this. We would like to hear more about this at the next ASAC meeting.

There are several peculiar aspects of the RFQ performance that could be indicative of changes to the RFQ that are difficult to understand. The vertical Twiss parameters differ from design by a factor of two, and the output energy is wrong by 50 keV. (These are in addition to an unexplained shift in the resonant frequency reported in the past.) The former can be accommodated by retuning the MEBT, but the origin is a concern. The latter is outside the allowed range for the Drift Tube Linac, and it could increase the longitudinal emittance. Simulations are needed to estimate this effect. The energy and Twiss parameter measurements should be checked to ensure that there are no systematic errors. If convinced that that is the case, it will be necessary to investigate and model the type of changes, e.g., in the geometry of the RFQ or at the source, that could explain these errors. In addition, the output parameters of the RFQ be checked at the start of each run at least until this problem is better understood.

Two of the eight RFQ windows have failed due to copper being sputtered on them. Such sputtering cannot be avoided if the ceramic windows directly see the inner surface of the accelerating cavities. If this is the case for the RFQ (we did not look at the RFQ drawings in detail), the location and the geometry of the windows with respect to the RFQ should be changed so as to eliminate the area that has a direct line of sight from the inner surface of the RFQ. It is likely this window failure will re-occur unless changes are made to the coupler/window assembly. Copper plating of the ceramic tends to be a runaway situation; with breakdown or plating happening at lower and lower power levels once a certain minimum amount of plating has occurred. Several things may solve or mitigate the problem, including

- Reducing the area with a direct line of sight from the inner surface. This will be effective, even if this area is not totally eliminated
- Improving the vacuum pumping at the window
- Geometry changes to reduce peak electric fields
- Installing arc detectors to shut down the RF at the first initiation of an arc.

Warm Linac Installation and Commissioning

The Drift Tube Linac (DTL) and Coupled Cavity Linac (CCL) installations went well and had impressive learning curves. DTL installation was completed in June 2004. The six tanks processed quickly to 120% of the required RF power and vacuum performance is better than the specification. CCL installation was completed in July 2004, and three of the four sections have been RF processed. Vacuum performance exceeds specification.

Beam commissioning through the RFQ, DTL 1 - 6 and CCL 1-3 has progressed extremely well. The whole complex of equipment including the ion source, high and low level RF systems, diagnostics, controls and ancillary systems functioned well together. For these early runs, very low duty factor 'pulse-on-demand' mode and short pulse length were used. Full peak current of 38 mA was demonstrated with full transmission within the measurement resolution.

The performance of the RF reference system was particularly of interest to the committee; we were pleased to learn that the system has been simplified, with careful attention to both short- and long-term stability, and that there is no evidence so far of drifts that affect operation.

One exception to the generally good system performance was the resonance control of the warm accelerator structures. Performance is not satisfactory for low duty factors where the valves operate nearly closed. This appears to be essentially unchanged from six months ago although some progress has been made with water quality and the monitoring devices, particularly the flow metering. Manual operation is presently being used for commissioning runs. While this should be sufficient for CD-4, this problem needs to be solved for future operational efficiency. This is an unfortunate unlearned lesson, as LAMPF/LANSCE had exactly the same problem and later linacs copied it. Adequate work-arounds were implemented at LAMPF, involving hardware such as the heaters and also careful shaping of the open-loop gain of the resonance control loop. Although the exact details (valves, etc.) may differ, it is recommended that the LAMPF/LANSCE system be studied for ideas that may be useful for the SNS. In addition, there is now a simulation program that is giving good agreement with the DTL resonant cooling control system performance although a team of 7 people to understand and define the requirements for improvements seems excessive.

The control and tuning procedures implemented through the central control system were impressively demonstrated. These included beam current measurements, and setting of the DTL RF set-points by making acceptance scans using energy-degraders and Faraday cups between tanks. Real time fitting of the accelerator model to measured data to predict the rf amplitude and phase set points in the DTL was done with the PASTA (Phase/Amplitude Scan and Tuning Application) program. Time-of-flight information gave measurements of the RFQ and DTL 2 output energies and energy variation within the pulse and jitter from pulse-to-pulse. The jitter at the end of CCL 3 is within specification. Beam position and profile information were obtained. The profiles show that beam halo is present; this will be a subject of continuing investigation as commissioning proceeds. The Delta-T procedure was used for setting the CCL RF amplitude and phase set points, with a fully functional and convenient user interface application program.* Initial limited information from beam loss monitors was obtained. This initial commissioning experience is very impressive, demonstrating performance that appears to fully support the CD-4 goals.

Plans for future commissioning activities were presented, concentrating on longitudinal emittance measurements with Beam Shape Monitors in the CCL, longitudinal beam profile measurements with a mode-locked laser in the MEBT, MEBT collimation and emittance measurements, transverse beam profile and halo measurements, stability tests, and extensive work with the LEBT chopper. This outline and priority are appropriate for the next commissioning steps.

Linac RF Systems

There has been impressive progress on the installation of klystrons and power supplies. There is a complete complement of klystrons in the klystron gallery, and ten High Voltage Converter Modulators (HVCM's) are installed. Reliable and stable operation of the RF system has been an important contribution to the DTL and CCL commissioning.

The RF system with the highest power is the CCL, where the number of the accelerating cells exceeds two hundred. This system including the CCL's themselves were power-tested beyond its design value at one third the design repetition rate. This rate was limited by the SCR's in the HVCM. The reliability and performance of the HVCM's are adequate for CD-4 but still need improvement for the longer term. Reliability has improved almost a factor of ten in last year, but still needs to improve by another factor of five to reach a goal of less than one failure per month. The performance limitations have been analyzed and improvements are planned. These include the use of the non-inductive resistors, the upgrade in the bridge insulator, and the redesign of the gate circuit. This analysis and associated plans are reasonable and should be supported.

One of the issues for a pulsed proton superconducting linac is the compensation of the dynamic Lorentz detuning, vibrations, and beam loading. For this purpose each superconducting cavity is powered by one klystron. The low-level RF (LLRF) system compensates for these effects. The SNS superconducting linac has one klystron per cavity, which requires a large number of the RF systems. The phase reference system is an important subsystem, and it has a phase stability of one degree without the temperature control. It is reasonable to expect that the phase between the systems can be controlled within 0.1° to 0.2°, which would not consume the overall tolerance of the phase stability of one degree.

The installation, testing and operation of the large number of RF systems will require a large number of the people, and the RF group has been augmented for this. This level of manpower will continue to be required in the near-term future.

Superconducting Linac

A 4.3K test of a complete cryomodule has been conducted in the SNS tunnel. The purpose of this experiment was to get early experience with the cool down and operation of a superconducting RF accelerator module and not wait until commissioning of the 2K refrigerator

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* R. Jameson, an ASAC member, is aware of powerful extensions of the Delta-T procedure that can be very useful for working around problems that might exist in as-built accelerators. These should be made available to SNS at some point.

plant. It was expected, of course, that the operation at this elevated temperature will not allow exploring the full capability of the module. The cool-down went easily, coupler conditioning was not needed (this module was tested at Jefferson Lab previously), and the three cavities were operated simultaneously at different gradients and pulse conditions. Maximum values for the accelerating gradient of 14 MV/m with an open RF control loop and 12 MV/m with a closed loop were established. No evidence was found of RF, mechanical, thermal, or ponderomotive crosstalk between the cavities. In general the experiment went smoothly, faster than planned and gave no hint of unexpected difficulties. The committee applauds the achievements of this milestone experiment.

The production of the cryomodules is well progressing: 11 out of 11 medium beta and 6 out of 11 high beta modules have been fabricated. Six medium beta and two high beta cryomodules have been tested and exceed the accelerating gradient specification. It should be noted, however, that most tests were done with open loop RF control conditions, and in this case thermal effects might be masked by the only short duration of the high gradient operation. Recently active compensation of Lorentz force detuning was demonstrated during a module test. Cavity qualification tests (VT) for high beta modules result in average performance of 19% above gradient and 35% above quality factor specification. The rejection rate of VT cavity testing was high during the first half of 2004. No explanation was given in the presentation but obviously quality control actions are not adequate. The presented production rate of cryomodules is optimistic but seems doable.

The installation of cryomodules and warm section is progressing. Installation of clean infrastructure and assembly procedures for the warm sections will follow the recommendation of external experts group to insure that cleaning and installation of the warm connection beam line is done properly.

Several problems were encountered during module production. Contamination from O-rings in the gate valves were detected after bake out. The vendor has reworked all valves and six existing modules need change of the valves. The cavities will be sealed during this action by in-cryostat valves, but the possibility of migration of contamination to the cavities cannot be excluded. Piezo tuners failed in the high beta modules after cool down. The reason is not understood, this failure did not occur at medium beta modules, which have the same piezo tuner design. Mechanical modifications of the tuner are under test, and all tuners of the high beta modules will be exchanged. This action can be carried out through the tuner repair excess flanges and will not affect the performance.

Feedthroughs at the higher order mode coupler failed due to vacuum leaks caused by excessive heating by fundamental mode RF power. There is evidence that the fundamental mode rejection filter detunes when raising the cavity gradient. The feedthroughs of two finished modules (M11, H1) will be exchanged. The feedthroughs are accessible through the tuner repair flange. But in this case the cavity vacuum must be opened inside the cryostat environment. This is a critical action because clean-room conditions with the standard quality cannot be established inside the cryostat. Procedures should be devised, thoroughly thought through, and tested before the repair is undertaken.

Considering the nature of these repairs, particularly the feedthrough replacement, we recommend testing the modules at SNS as soon as possible in order to have time for unforeseen and unplanned actions. (No further module tests are foreseen at Jefferson Lab)

We consider it important to create a core group with expertise in all aspects of superconducting RF including superconducting RF physics, and RF, coupler, vacuum, cryogenics, and clean room technology, and we recommend creation of such a core group.

Upcoming repairs and module commissioning would offer the first opportunities and challenges for this group.

Cryogenics

A Cryogenic Advisory Committee (CAC) was appointed this past spring to help with technical and management issues following the loss of Don Richied. The CAC met at Oak Ridge in July and again concurrently with this ASAC meeting. The following comments reflect some of the recent CAC discussions.

The 4.5 K module test was a great success. The next major hurdle for the cryogenic system is the 2 K cold box commissioning and 2 K module operations.

As Jefferson Lab found when first commissioning their 2 K cold box, control of the four cold turbo-compressors operating in series is difficult. Jefferson Lab has provided the PLC logic for cool down and operation of the cold compressors, and their experts will be here for the commissioning run.

The 2 K cold box commissioning will be done without a connection to the tunnel. This mode of operation looks a bit difficult and is different from what Jefferson Lab has ever done. The plan is to pump on a pipe back to a nearby throttling valve with the gas source to the valve coming from a positive pressure dewar. The helium gas also goes through a heater before the first cold compressor. The new issue relative to Jefferson Lab cold compressor runs, and potential difficulty, is the relatively small volume of helium upstream of the first stage of cold compressor. Despite this difference the Jefferson Lab experience with operating cold compressors arranged in series will provide invaluable help in completing the 2 K commissioning.

There are some lingering issues for the 4 K cold box, which are under discussion with Linde. These include rebuilding one or possibly two turbo-expanders, understanding and reducing liquid nitrogen consumption, and improving control of the level control for the liquid nitrogen vessel within the cold box. Although Linde has offered to take on some of these upgrades at their expense, these involve 4 K cold box downtime and at least one additional 4 K cold box test run. It is important to understand the 4 K cold box problems now; however, we recommend that the SNS cryogenics group retain enabling 2 K operations as their top priority. They should continue the commissioning of the remaining parts of the system and do what is necessary to most efficiently match the refrigeration to the load. SNS has a cryogenic plant that works quite well right now, and they should focus on the necessary tasks for 2 K operation. Later, one could upgrade for overall efficiency or capacity as required.

Accumulator Ring

The lattice elements for all four arcs are installed and under vacuum. This is another significant accomplishment for the SNS project. The sorting of the Ring lattice quads has resulted in a predicted beta wave of about 0.5% and a tune shift of about 0.001. This should be acceptable.

The status of the HEBT/Ring/RTBT power supplies was presented. Nearly all of the magnet power supplies needed for the HEBT service building have been installed. The Ring dipole magnet power supply is installed, 5 of the 8 injection kicker power supplies are installed, and 11 of the 14 extraction supplies are delivered. Thirty-five of the 77 medium power supplies are installed, and 93 of the 195 corrector supplies are installed. The 6 Ring quadrupole power supplies are among the medium power supplies that have not yet been delivered to ORNL, but delivery is expected to begin within a month. There has been no installation in the RTBT service building as yet, and this is intentional since this building is presently being used to fabricate cryogenic components for the superconducting linac.

All the Ring magnet cables have been pulled from the service building to the beam enclosure, and cables in the HEBT and RTBT have been pulled and hooked up as appropriate. Installation of electronics for diagnostics has begun in the HEBT service building, but the Ring and RTBT installation has not begun. HEBT communications cables are all pulled and are being terminated now, and the process control cable installation is also in progress. The beam line component installation in the HEBT is as complete as possible at the moment. Most of the line is under vacuum, and although all of the magnets are on hand for the remainder of the line, two sections are deliberately left uninstalled in order to provide paths for equipment access. All components for the linac dump line are installed and under vacuum. The RTBT beam line element installation has not yet begun in earnest, and the enclosure is presently used to stage various equipment destined for elsewhere. Although all lattice components are in place in large sections of the HEBT and the Ring, some diagnostics are not yet installed, but these can be installed before they are needed as they become available. These accomplishments demonstrate the capabilities of the various ORNL teams required to carry out this work, and give confidence that the remainder of the work should continue smoothly according to priority.

A trial assembly at BNL of the devices needed for the injection straight section identified many mechanical mismatches that required changes. Some of these mechanical changes also required adjustments to preserve the quality of the magnetic field as well. The injection chicane field angle measurement shows the behavior needed to transport the stripped electrons to their catcher, and the overall understanding of the behavior of the stripped electrons is quite impressive. The ORNL installation team intends to go to BNL once the injection straight is put together, take it apart, and after it is shipped to ORNL, re-assemble it in the Ring.

The other three Ring straight sections are at various stages of installation. The work is proceeding according to priority, with the first priority being the RF straight section since it contains not only the RF but also many diagnostics. Three of four RF cavities are installed (but not aligned and the power sources still disconnected), but the diagnostics are not. The fourth RF cavity is being deliberately held at BNL for testing and training purposes. The straight sections have 2 of 3 collimators installed, 1 of 8 injection bump magnets installed, and none of the 14 extraction kickers are as yet installed.

Few problems continue to be discovered in components delivered from BNL, and those that are found are corrected. For example, a crack was found during standard QA in one of the bellows connected to a vacuum pipe of a Ring arc cell upon delivery to ORNL. The problem was due to an insufficient restraint that allowed the bellows to bang around during trip from New York to Tennessee. The spare was used to allow for installation in the arc, the damaged part will be sent back to BNL and upon repair will join the spares inventory.

All of the components that BNL is responsible for are scheduled to be delivered in March 2005. The schedule is tight, but possible. The delivery of components is keeping up with the needs for efficient installation. The plans for installing shield walls is well considered and will allow flexibility in beam commissioning of the HEBT, Ring or RTBT. We would like to see the plan for the work needed in the HEBT, Ring and RTBT to deliver beam to the target with emphasis on how much time is allocated for beam commissioning at the next meeting.

We commend the design work undertaken on the components for the downstream end of the RTBT and the interface with the neutron target. We strongly endorse the design philosophy adopted for this area, with vertical access, the use of radiation resistant, mineral insulated coils for the final four magnets, and the active handling techniques adopted for remote clamps, quick release water fittings, and for the compression of bellows. The design of the HARP vacuum vessel assembly for the region just upstream of the target appears well advanced. It appears a low risk to the committee to proceed to CD-4 without a spare radiation hard magnet for the end of the RTBT. It is advisable to have the ring collimators at their protection positions, even for CD-4.

Accelerator Physics and Application Programming

The ORBIT code has by now been benchmarked not only at the LANL PSR, but also against experiments at the CERN PS, e.g., emittance exchange near the Montague resonance. The ORBIT simulations, which include the real accelerator lattice, seem to be in closer agreement with the experimental observations than simulations by the IMPACT code. The benchmarking of these two codes against each other is a positive by-product of the PS investigation. The origin of the difference, possibly related to the correct modeling of the lattice in ORBIT, remains to be understood.

The question whether resistive-wall wake fields propagating at less than the speed of light may drive the beam unstable has been addressed. Earlier results from 1996 by M. Karliner *et al* were shown to be inconsistent with more recent theories and, after discussions, have been put into question by some of the original authors.

A first analytical stability diagram for the SNS ring has been calculated for a coasting beam without space charge. It suggests that the extraction kicker impedance is insufficient to drive the beam unstable. However, with space charge included a coasting beam would always be unstable. We encourage the SNS accelerator-physics team to continue these investigations, which address at a fundamental level the question of beam stability in the SNS ring, and at the same time provide a helpful analytical reference for numerical simulations with the ORBIT code.[*]

The electron-cloud studies have progressed well. The electron-cloud module of the ORBIT code has been fully implemented. A benchmarking study for an analytically solvable example demonstrated good agreement with the ORBIT instability simulation. Simulations of the electron build up are being benchmarked against observations at the PSR. In parallel, first 3D electron-cloud simulations for the stripping foil region, recommended at the last ASAC review, have been performed with the BNL CLOUDLAND code. They revealed differences in the motion of back-scattered and secondary electrons, and underlined the importance of a grooved surface and position control. Similar 3D electron-cloud studies for a biased BPM and a collimator are in preparation. Additional studies are being conducted for several partially coated surfaces. The committee was glad to see a firm plan to transfer the CLOUDLAND code and its algorithms from BNL to ORNL, within the next few months. ASAC welcomes the collaboration between ORNL/SNS, LANL, Indiana U., and LBNL for an experimental test of active damping of the e-p instability at the LANL PSR.

The exploratory study of model-independent analysis for the linac is a worthwhile initiative, which will likely prove beneficial for future operation.

The analytical impedance model for the injection kicker was updated, and the impedance of the completely assembled extraction kicker with coating was measured. The updated impedance numbers do not significantly differ from earlier estimates. For the expected impedance, ORBIT simulations predict beam stability at twice the nominal intensity.

The commissioning has shown that substantial halo can be generated in the front part of the linac by small optical mismatches, and the halo extent might vary along the pulse. Linac halo has been a central, key consideration in the SNS design because low beam loss is required to keep the residual radiation of equipment at a level that would allow hands-on maintenance. It

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* Some historical references for pertinent treatments of space charge are the Ph.D. thesis of F.J. Sacherer, (UCLR-18454, 1968) and a 1979 paper by G. Besnier (Nucl.Instrum.Meth.164:235-245, 1979, in French).

is important for the design of all future high intensity proton linacs for the same reason. This is the first unambiguous measurement of halo at the SNS. We recommend performing linac simulations with a mismatched optics, in order to explore the origin of the halo, and to compare its shape and magnitude with experimental observations. We would like to hear about the progress with the measurements, simulations, and what has been learned from them about operational techniques that will be required at high beam power.

As in the previous review, application programming is in impressive shape, and is greatly facilitating the commissioning. Available tools were used for the linac RF phase and amplitude tuning, beta function and emittance measurements, etc. Applications for the ring commissioning are being prepared. In some cases this is being done by accelerator physicists outside of the application programming group.

Diagnostics

The linac diagnostics were installed and available right from the start for the DTL and CCL commissioning. This was important for the successful commissioning. The diagnostic performance has been compared with accelerator physics requirements. Beam position monitors are performing better than required for both position and phase measurements. Aspects of the beam current monitors and beam loss monitors that do not require wide bandwidth are performing at required levels, but wide bandwidth applications of these diagnostics are still limited by electromagnetic noise.

The diagnostics group has also been able to respond to requests for additional instrumentation as the value is seen during commissioning. A diagnostic plate in the MEBT with Faraday cups, viewing screens and apertures and slits is the latest example.

A plan has been developed for the Ring diagnostics. This plan calls for the high priority diagnostics to be completely instrumented and for the vacuum hardware of the other diagnostics to be completed and installed in the ring. They will be outfitted with signal processing electronics in the future when the budget permits. There have been tests of beam position monitor and beam loss monitor electronics. The performance of the former is encouraging, and noise reduction is still required for the latter to meet specifications.

Controls

The controls installation is proceeding well. The timing system, Machine Protection System (MPS) and Personnel Protection System (PPS) installations are on time. Subsystem status including Global Systems, Timing, MPS, the Network, the Accelerator Systems, the PPS and the Cryogenic Controls is good. More than one-hundred IOC's are installed, that that number is rapidly increasing. The Cryogenic Controls has been a particular success as the system runs entirely on EPICS.

There are a number of concerns:

1) The fiber optic plant and the number of available spares have been reduced. We recommend that there be careful allocation of the installed fibers.
2) Considerable effort will be required to install and configure the roughly 95 remaining systems in the linac. We support using some resources to automate the procedures and eliminate duplication of testing between other groups, (Power Supplies for example) and Controls by moving the testing process to EPICS based systems. We also support moving the Main Control Room to its CLO location as soon as possible to support superconducting linac commissioning.
3) A complete configuration control system still needs to be implemented. Many of the hardware devices being delivered to the SNS by the collaborating Laboratories are run by embedded software. These devices include Programmable Logic Controllers (PLC), Field

Programmable Gate Arrays (FPGA), Digital Signal Processors (DSP), etc. The SNS will have to be able to program and modify these devices. The code for these devices will have to be placed under or continued to be under configuration control. This will take resources and commitment.

4) Configuration control for all application software and screens must also be instituted.
5) The SNS control room looks very nice, but experience at APS and other facilities is that frequent access to the under floor is needed, we were surprised to see a carpet in place and assume that frequent access will not be too difficult.

Methods for protecting the Controls Network have been developed and successfully deployed with the cooperation of ORNL IT. They include a method of registering hardware Ethernet (MAC) addresses for all devices being attached to the network and the blocking of unregistered devices. An ORNL wide Linux patch server has been implemented and the SNS Linux systems are patched commensurate with the operating schedule.

Commissioning Readiness and Operations Report

The Accelerator Readiness planning, data logging, and maintenance planning are developing well. The interlock bypass system that is in place for e-log entry is a good idea. The Operations Group should take an active role in having the technical groups remove bypasses as quickly as possible (if they are not already), and a system that minimizes the length of time bypasses can be kept in place would be wise.

The Operations Group should work with technical groups to develop EPICS based equipment startup and shutdown as a means to minimize the demand on staff time during these periods.

Topics for the Next Meeting

The next ASAC meeting has been tentatively scheduled for March 14 - 16, 2005. We would like to hear presentations on the following at that meeting.

1) Plans for meeting the CD-4 performance goal including the time allocated for commissioning including the plans for work in the Superconducting Linac, HEBT, Ring, and RTBT.
2) Plans for the evolution of the accelerator beyond CD-4 to the 2011 performance goals including considerations of the required staff and budget.
3) Progress with the linac halo measurements and simulations including what has been learned from them about operational techniques that will be required at high beam power.
4) An update on the achieved diagnostics performance as compared to accelerator physics requirements.
5) The 2 MHz feed forward system for pulse flattening and current stabilization.

Spallation Neutron Source ASAC Review
September 27 - 29, 2004

	Monday, September 27	
8:30	Welcome, Charge and Project Status	T. Mason
9:00	SNS Accelerator Systems Overview	N. Holtkamp
9:45	ASD Resources and Transition to Operations Plan	D. Olsen
10:30	Accelerator Physics Overview	S. Henderson
11:10	Commissioning Readiness and Operations Report	G. Dodson
11:30	H- Ion Source Progress and Results	M. Stockli
12:50	Warm Linac Commissioning Progress and Results	A. Aleksandrov
1:30	Linac Beam Diagnostics Performance and Progress	S. Assadi

2:00	Application Programming	J. Galambos
2:20	Control System and Safety Systems Progress	D. Gurd
	Tuesday, September 28	
8:30	ASD Electrical Installation and Power Supply Progress	R. Cutler
8:50	Warm Linac Installation Final Report	G. Johnson
9:10	Final DTL-CCL Tuning Results	C. Deibele
9:30	Resonance Control Cooling System Performance	P. Gibson
10:05	Cold Linac Overview	C. Rode
10:35	Cryomodule Production, Testing and Performance	J. Preble
10:55	Cryo Systems Progress and Commissioning	F. Casagrande
11:25	Cryomodule Testing Progress at ORNL	I. Campisi
11:45	Cold Linac Installation & Testing and Warm Sections	D. Stout
1:05	HPRF Installation, Testing, and Commissioning	R. Fuja
1:25	HVCM Progress	D. Anderson
1:45	LLRF Status Report	M. Champion
2:05	HEBT-Ring-RTBT Overview and Component Delivery	J. Wei
2:35	HEBT-Ring-RTBT Installation Progress	M. Hechler
2:55	HEBT-Ring-RTBT Diagnostics Production Plan and Progress	T. Russo
3:15	HEBT-Ring-RTBT Diagnostics Installation Plan	T. Shea
	Wednesday, September 29	
8:30	Magnet and Engineering Support	D. Raparia
8:50	RTBT Rad Hard Magnet Design	C. Pearson
9:10	RTBT-Target Interface and Remote Handling	G. Murdoch
9:30	Ring Impedance and Instability Update	V. Danilov