Accelerator Systems Division Highlights for the Week Ending November 16, 2001

ASD/LBNL: Front End Systems

The 24x7 test of ion source and LEBT with continuous beam production was very successful overall; in essence a 100-hour operational capability of the entire system, using a 0.3-mm coated RF antenna in the ion source, was confirmed. After the initial burn-in phase, sparks occurred in 1-hour intervals on the average. The beam current faded only very slightly at the rate of 1 mA in 12 hours without readjusting the RF power level. We also learned important technical lessons such as the need for very good cesium coverage to essentially eliminate a parasitic electron beam. Three of the four major interruptions of beam production during 8 days of testing were caused by circumstances unrelated to the Ion-Source/LEBT system itself. The substantial assistance by SNS-ORNL staff in conducting this test was greatly appreciated.

Six members of the FES team attended the semi-annual DOE Review and gave three formal presentations, in addition to participating in a dedicated Front-End breakout session. The recent improvements in beam emittance and antenna lifetime were recognized by the reviewers.

In discussions between M. Hechler, SNS-ORNL, and R. DiGennaro, FES, an agreement on the shipment-schedule of FES-components was reached: Four "kits" will arrive on four separate dates at ORNL between June 7 and July 15, 2002, and we plan on keeping FES personnel involved in this hand-off process until July 31.

We repeated LEBT-chopper tests with a Faraday cup attached to the LEBT tank and again found 25 ns rise/fall times, even in absence of the RFQ.

We are collaborating with R. Welton of SNS-ORNL on modifications to the cesium-collar design to obtain an improved outlet-aperture contour and at the same time allow operation of all cesium-coated surfaces at the ideal temperature and to apply a bias voltage with respect to the chamber potential.

A full set of 8 RFQ coupler windows is ready for RF conditioning; some of the ceramic disks were re-coated with TiN by the IBT Plasma Applications group at LBNL. A. Aleksandrov of SNS-ORNL visited us for three days and participated in the balancing of the RFQ power-couplers. This process has been completed in air, and only very minor adjustments might be necessary once the cavity is pumped down again to operational vacuum pressure.

We received the second MEBT rebuncher cavity and started its RF conditioning; the remaining two cavities have been copper plated.

All MEBT rafts are fully loaded with quadrupoles, beam pipes, and beam boxes; all quadrupoles are very well within alignment tolerances.

R. Keller will attend the ESS Symposium in Saclay, France, Nov. 28-30, and give a formal presentation.

ASD/LANL: Warm Linac

The 2.5-MW, 805-MHz prototype klystron from Litton has been delivered to LANL. Site acceptance test are pending. (WBS 1.1.2.7)

Marconi tests of the first 402.5-MHz klystron continue and are encouraging. Initial steady-state operation without any tuning resulted in production of 2.1 MW RF power over 1.1-ms pulses at 40 Hz. (WBS 1.4.1.1)

LANL and ASD personnel conducted a preliminary design review with Thales (formerly Thomson) personnel for the 550-kW SRF klystron. Results were satisfactory. (WBS 1.4.1.1)

LANL and ASD personnel conducted a final design review with Titan-Beta (formerly Maxwell) personnel for the SRF transmitters. Results were satisfactory. (WBS 1.4.1.1)

After consultation with the SNS Project Office and ASD, we exercised the option to purchase 13 production SRF transmitters. Total quantity of the contract is 14, all for the accelerator, and none for test stands or spares. (WBS 1.4.1.1)

High-power acceptance testing of the production 402-MHz circulators occurred last week. Vendor (AFT) representatives were present to participate in these tests. Results were encouraging. Calibrations are being validated at LANL and AFT is performing minor adjustments to the tuning circuit. (WBS 1.4.1.1)

We successfully conducted high-average-power tests of the SNS high-voltage converter modulator (HVCM) system. We ran for more than five hours one day into the 2.5-MW 805-MHz CPI klystron at approximately 115 kV and over 500 kW average HVCM power. The pulse length was about 1.55 ms at 60 Hz with the RF drive about 1.1 ms. Performance was satisfactory, but we continue to experience oscillation problems with the prototype NWL SCR controller. (Another supplier will provide the SNS production controllers.) All converter modulator electrical components and the oil tank maintained appropriate temperatures. The only components that got warm were the IGBT bypass capacitors, which heated to about 55-deg C. They will soon be replaced with new capacitors with improved performance. We are now moving on to evaluate IGBTs from an alternate supplier. After that, we plan to push higher in power and voltage, after ensuring that the klystron mod-anode capacitor by-pass networks are resistively snubbed. (WBS 1.4.1.2)

DTL Tank 3 was copper plated in Darmstadt by the LANL-GSI team (Fig 1). (WBS 1.4.2.2)
Metrology on the first completed DTL Tank 3 drift tubes is encouraging (Fig. 2). The vendor is beating the dimension specs by almost one order of magnitude; unprecedented in drift tubes we have built for other projects. (WBS 1.4.2.2).

Fabrication of the numerous DTL ancillary hardware continues. DTIL Tank #3 support stand is completed and ready to be painted (Fig.3). (WBS 1.4.2.2)

Fig. 1: Copper-plated DTL Tank 3 Sections.

Fig. 2: Dimension measurements on completed DTL Tank 3 drift tubes.

Fig. 3: DTL Tank 3 support stand prior to painting.

The SRF quadrupole magnet RFP has been issued. (WBS 1.4.9.2)

Preliminary studies with beam starting at the ion-source shows that transmission through the RFQ and the 'Twiss parameters' of the output beam are far more sensitive to the 'matching' at the input to the RFQ than expected. (WBS 1.4.5.3)

The physics team reconciled and completed consistency checks of the linac 'engineering layout' with 'physics' design. They also re-evaluated and finalized quad and dipole steering requirements, reconciling requirements with engineering specs. (WBS 1.4.5.3)

Ray Valicenti has returned to LANL ESA Division after successful assignments with the SNS Mechanical Engineering Group. During his tenure, Ray was responsible for a number of mechanical design and manufacturing activities such as the DTL drift tubes and magnets. We thank Ray for a job well done and wish him continued success on her new assignments in support of ESA Division. (WBS 1.4.6.7)

ASD/JLAB: Cold Linac

ASD/BNL: Ring

A thermal test was initiated on the extraction kicker magnet assembly. The test was performed by applying 2.7 ka at 60hz. After a full day of running, the temperature rise in the magnet ferrite was measured (TC) to be less than 1F. Calibrations and confirmations are now underway.

Another milestone was reached this week. Alex Zaltsman reported that power tests of the first article RF cavity and power amplifier exceeded design requirements by achieving 11kv in the gap on first try (design specs require 10kv).

Peter Cameron and his Group presented a technical review of the Diagnostic Systems. The review covered Carbon Wire mounting, IP module, BCM/AFE, BCM software, Laser Wire, Laser Wire / Controls interface, and BLM. Tom Shea was at BNL for this review.

Dick Hseuh and Mike Hechler conducted a Project review of the HEBT vacuum systems via a videoconference link with partner labs. This review included HEBT vacuum, Injection vacuum, ceramic chambers, chamber coating, doublet vacuum chambers, and pressure modeling. Mike Hechler was at BNL for this review.

Hans Ludewig traveled to SNS/OR this week to attend a Target workshop.

Received parts from the BNL Shops for the four 21cm Ring BPMs. They are being assembled for brazing.

Work continues towards testing the Laser Wire in the 200MeV AGS Linac. All wiring connections have been made inside the tunnel; some outside rack wiring still needs to be done.

Vacuum beam pipe drawings for the HEBT 12cm quads and the relocated collimators are in checking.

Two-ring half-cell vacuum chamber assemblies have been welded, leak checked and vacuum baked at 400C. The first half-cell chamber is being setup for coating. Two more dipole chambers are in route to BNL via airfreight from France. The balance of the dipole chamber order should be completed by mid December.

Magnet documentation – a “pack and ship” zip file of the HEBT dipole magnet drawings was transmitted by BNL’s Kathy Brown to SNS/OR’s Karen Cox this week.

Mike Hemmer and Frank Karl conducted an all hands meeting with BNL/SNS tech and physics personnel to address SNS Lattice Drawing baseline, data confirmation, equipment layout, and control. Mike Hemmer sent notes from this meeting to John Galambos and Joe Error.

After working with designers from Danfysik, it has been agreed that the input AC voltage will be changed from 120vac to 208vac/3phase for all the low field power supplies. Danfysik will modify the existing prototype supply for acceptance testing by Jan. 02. We do not expect this to result in any added cost to the existing contract. Danfysik has a BNL power supply interface module (PSI) for their factory tests.

All technical issues have been settled on the medium range power supply specification package. The bid evaluation panel completed their work this week. We expect to award this contract within days.

Arrangements are being finalized with Dan Stout to conduct a hand-off workshop at BNL on Thursday, Nov. 29th. The purpose is to resolve miscellaneous open issues for all WBS 1.5 Ring systems.

Figure #1: Wiring of RF Cavity and PA Assembly
(First article at BNL)

Controls:

Ten papers on various aspects of the SNS Control System were submitted to the ICALEPCS Conference at the submission deadline. Only the Group Leader's paper wasn't ready on time. He was vacationing.

The 90% review of the CF Controls FELK package was completed. Nearly all comments have been resolved and CFC is expected on Friday Nov 16.

PLC hardware configuration and programming for extracting chipmunk signals for the Personnel Safety System has been accomplished. A demonstration is currently functioning in the PLC lab.

Machine Protection System cards have been successfully installed in the PMC SPAN PCI bus expander and operationally verified. The verification consists of writing and reading MPS configuration registers, setting software masks, enabling/disabling individual channels, and verifying the operation of the fault counters (allowing the counters to count continuously with a slowed down clock). This verifies operation of up to five MPS systems per IOC. PMC/PCI bus interrupts have also been tested and verified to operate normally.

A VME-based waveform digitizer from LBNL has been successfully integrated here at SNS/ORNL. The digitizer will be used for the RFQ emittance application.

"Bumpless reboot" on the Power PC has been successfully tested at LBNL, removing the last hurdle preventing transition to PPC IOCs for the Front End.

A pre-shipment meeting and inspection of the warm compressor system was held at the PHPK facility in Columbus, Ohio. A number of controls related issues were discussed and clarified. The warm compressor skids were inspected to verify conformance to the P&IDs. A few minor discrepancies were found. The P&IDs will be updated to reflect

the as-built configuration of the warm compressor skids. The vendor provided informal copies of the PLC logic and PanelView configuration file. These will be used to better define the SNS interface to the PHPK warm compressor PLCs.

Testing of the Power Supply Interface (PSI) under power dropout conditions was completed at BNL. The PSI FPGA code was modified to zero a counter on start-up and the reset code to the ADC was changed. After these changes, the PSIs were cycled over 1000 times without seeing any ADC errors.

Testing of the Power Supply Controller (PSC) continues at BNL. In the normal configuration for SNS operations, external hardware triggers are used. In this mode the system ran 125 millions messages without an error. Using software initiated triggers we noticed an error about once per million messages. We are working on trying to identify and resolve this problem. The error consists of a bad ADC reading.

Software for the CDM - a Low-Level RF Control Module – was registered with the configuration management system (CVS) at ORNL so that LBNL can access it.

ASD/ORNL: Integration and Installation Support

Accelerator Physics

Simulations by Dong-o suggest that, in order to commission the CCL in terms of transverse matching with the existing equipment, the best option would be to observe the signals of 4 wire scanners in the first CCL module (as well as those from the wire scanners in the remaining modules) whilst changing the first 4 CCL quads such to minimize the beating of the beam envelope. AP and Diagnostics sat together with LANL in videoconferences this week to discuss different possible scenarios to achieve this goal (at present only 2 wire scanners are foreseen in CCL module 1) and their impact on schedule and budget.

ORNL ASD completed a check of the 1.3 GeV HEBT/Ring/RTBT power supply order, comparing the operating currents for all magnets with the power-supply specifications. About six of the supplies were re-categorized in response to the comparison. The 1.3 GeV order has been placed by BNL.

Work is progressing on compiling the holy-lattice. For the linac, a list of beam-line devices including proper names is gathered. The locations of the diagnostics are being finalized. Progress can be seen at http://www.sns.gov/APGroup/refTables/lattices/linac.htm

The new transverse impedance model in ORBIT was exercised in conjunction with space charge for the SNS, using recently measured extraction kicker impedances. Significant halo was observed for the 2-MW operation intensity. Chromaticity effects are now being included, which are expected to significantly improve the situation.

Beam heating of the dump windows is being investigated. Presently, the beam size at the linac dump window is quite small, and is a heating issue.

Operations

ASD was well represented at the American Nuclear Society (ANS) meeting held in Reno, Nevada this week. Several posters presenting shielding/penetration configuration and calculation results were presented by both SNS personnel and SNS Partner lab staff. K. Reece was asked to be a member of a presentation panel to present safety considerations and mitigation factors in the design of high intensity proton accelerators as part of a morning long discussion. The panel and audience participation was lively as both technical and regulatory issues were discussed. The ANS is quite interested in using high intensity accelerators as the initiators for sub-critical reactors and the community was very i8nterested in the merging of these two technologically different facilities. It is very likely that these discussion groups will continue (and grow more detailed) as the interaction between the accelerator community and the sub-critical reactor community continue to pursue this technological merge."

Ion Source Group

We finished our shifts for the 7x24 test run on Sunday, November 4, respective Monday, November 5, to return to ORNL for the DOE review. Many of our findings have been discussed in the highlights of last week. In summary the 7x24 test was extremely successful showing that the SNS ion source and the ORNL ion source group are capable of providing an H- beam with the intensities required for commissioning and for time spans adequate for commissioning.

The most impressive fact of the 7x24 test run is the 0.3 mm Cherokee antennas, which performed very well at the 33 kW level. The only antenna failure was caused by a catastrophic vacuum failure, which now became impossible as a vacuum interlock was implemented the day after. This puts some concerns to rest which arose from the DESY data of P&G antennas operated at 45 kW which failed after an average of 3.3 hours when scaled with the respective duty cycles.

On the other hand, the 7x24 test run revealed another few shortcomings, but being able to provide beam for commissioning will buy us time to implement the desired improvement for which LBNL may not have time.

After attending the DOE review we refocused our efforts to implementing the Hot Spare Stand in the RATS building. As part of this effort, which includes a duplicate LEBT, we are in the process of reevaluating the LEBT ceramic standoffs, especially the choice of material and fastening method.

The delivery of the big blue box encountered a small delay. It is now expected to arrive end of November.

RF Group

Mechanical Group

Magnet Measurement Group

We have received the first HEBT 8D533 dipole from Tesla by way of BNL. The magnet is shown, in the RATS magnet measurement area, installed on the support structure that was delivered from BNL. After the magnet was lowered onto the support stand, Survey and Alignment surveyed the gap of the magnet. Results of this survey show that the magnet meets mechanical tolerances called out in the drawings. We then performed hookup of the water cooling, installed thermal switches, and did pressure and flow checks on the magnet coils. All is well here. Next we connected the power supply and powered the magnet. All is well here too. We have installed our measurement coil into the gap of the magnet and have begun magnet mapping efforts. Initial data suggest that the field will perform well, but a detailed mapping effort is underway.

Cryogenics Group

We have successfully completed the pre-shipping inspection of the 6 helium compressors at the vendors. Shipping of the compressors to the RATS facility will commence the week of 11/19.

We have completed the assembly of the last 80-foot section of return transfer line that will run from the CHL to the tunnel. This completes both the supply and return transfer lines from the CHL to the tunnel.

The machine shop fabrication portion of the expansion sections of the supply and return "T" components of the transfer line, are out for bid.

We are currently reviewing the "SNS CHL helium gas storage system piping specification" and drawing package from JLAB.

Electrical Systems Group

Survey and Alignment Group

We have just completed the first epoch of FE/Linac floor surface measurements. Results will be available shortly.

We have now completed three sets of measurements on the DTL Cold Model. Our goal is to familiarize engineers and technicians with the model and gain "hands on" experience and perfect measuring techniques.

The first HEBT Dipole received at the RATS Bldg last week has been measured with the laser tracker for the purpose of determining magnet specifications (QC).

Completed final dimensional inspection of the base plate in Support of Target Group.

Visited PCC in York, PA where the DVTS (Design Validation Test Stand) is being manufactured. As a result of that trip we are now in the process of designing fixturing for quality assurance of the manufacturing.

Also designing fixturing for quality assurance of the bulk shield liner.

Fieldwork has been completed for the network observations between the existing permanent monuments and connections to key construction points. The initial analyses show standard deviations of the estimated coordinates at the sub-mm level. Office work still remains to transform all coordinates and corresponding variances from a geodetic system to the SNS global coordinate system. Additional network observations will be made when the penetration points are installed and the stockpile is removed.

Beam Diagnostics Group

LANL beam diagnostics progress report:

BPM electronics: The gain/calibrate/timing FPGA has been burned and preliminary testing is complete. We are now extending the DLL to control the FPGA and allow further testing. The next step will be to write the Labview VI for it, then test it in a realistic environment. Testing continues on the AFE/DFE/motherboard assembly, together with Labview software development. Everything looks good. We have received two leak-tight DTL BPMs. Earlier in the week we placed the order for the prototype CCL and SCL pickups. Initial tests of the gain/calibrate/timing FPGA are complete, and one unit is being installed on a DFE card so it can be tested fully in a real-life environment. The DLL to control this FPGA is complete, and the rudimentary Labview code needed to support it is complete.

BPM pickups: One new insert has been welded into a DTL BPM body. It was leak checked at every step of the way, and it was successful. The new process of machining a uniform thickness body joint prior to welding is working well. Now that the CCL and SCL bids have been received, we expect to place the orders for prototype CCL and SCL BPMs next week.

D-plate: Water cooling calculations are complete for the emittance slits and the quad magnet. Water cooling calculations continue for the beam stop. Work continues on a simple IR detector for the beam stop. Final design work continues.

Wire scanner electronics: All the necessary National Instruments parts necessary for the MEBT WS systems have arrived, with the exception of 3 ea. motor drives. The order for the revised signal processor PC boards went out this week, and they should arrive next week. BNL has agreed to ship a MEBT actuator to us to ensure good integration at LBL.

Wire scanner pickups: We are working out the details of the graphite wire mounting fixtures. The prototype Huntington actuator is now cycling with a 9 lb. load, and the LVDT position read-back is up and running.

Energy degraders / Faraday Cups: Work continues to determine the maximum power of the ED/FCs, and to optimize the degrader thickness. The 87 MeV ED/FC will have a Glidcop degrader, a graphite insert in the Faraday Cup, and will take a maximum pulse length of 50 us at 26 mA. It may be possible to exceed 1 Hz.

WS pickups: During tests of the prototype actuator the bellows failed catastrophically somewhere between 4,000 and 6,000 cycles. The bellows are rated for 100,00 cycles. Huntington has had some problems with a new bellows manufacturer, and this may be the source of our problem. We will ship the failed unit back to Huntington for bellows replacement.

WS electronics: The new signal processor PC boards have not arrived yet. We expect them any day. Labview software development continues.

ED/FC: We plan to use a graphite insert with cylindrical grooves to improve the thermal performance of the three lowest-energy Faraday Cups.

ORNL_SNS beam diagnostics progress report:

Dave Purcell is back from LBNL. He worked with Larry Doolittle on diagnostic rack spacing and cabling. He has placed a number of pictures under the diagnostic folder in the SNSFTP site. Craig has made a number of TDR measurements of the first fast Faraday Cup. The results are promising. Saeed discussed the emittance measurements with John staples and Alex Ratti during the DOE review. Tom discussed the inline emittance beam box with several people and concluded that ORNL should take responsibility for this component. Tom and Saeed attended the DOE review. We have started to address the diagnostic concerns identified by the reviewers.

1.5.7.1 BPM: Two more 21cm Ring BPMs were received from the brazing vendor. Because Wall-Colmony had moved their Pennsylvania operation to Ohio, there was some concern about braze quality. This concern now seems relieved, as the parts were brazed beautifully. If anything, the quality of the hydrogen-furnace copper braze is even better than what we received in the past. Final assembly is underway for delivery to the Vacuum Group. Delivered two HEBT 21cm BPMs to the Vacuum Group. Ring BPM strip-lines are undergoing modification to allow movement during vacuum firing. Tools are being designed and built to hold the strip-lines during firing the HEBT type BPMs. The Ring BPM analog front-end electronics dealing with resolution requirements and large saturating signals is under investigation.

1.5.7.3 BLM: Work continues on the interface of the BLM with the MPS. We are examining the possibility to utilize modified versions of the RIC BLM system. Work on a faster ion chamber continues

1.5.7.4 BCM: Visited by Tom Shea. Demonstrated the present data acquisition system. Discussed calibration concepts. DC restoration was added to droop compensation in Matt Stettler's software. It appears to work well. Labview software development continues. A parts package has been prepared for assembly of another prototype BCM board for testing after shipping the existing board to Berkeley. Schematics have been revised and are ready for review.

1.5.7.5 Tune: Beginning detailed design of incoherent tune measurement system.

1.5.7.6a Carbon Wire Scanner: Worked on quote for brake and encoder for all actuators. Finalizing MEBT actuator design. We expect to ship the first scanner to LANL this week.

1.5.7.6b Laser Wire Scanner: Shop making parts for the MEBT laser wire. Expect completion at end of month. 200MeV test is ready for beam, pending all committee approvals.

Craig is in Italy working on the fast Faraday Cup. Dave has added thousands of PV names to the diagnostic database. He is working on web-based intelligent diagnostic search engine. In this database, user can follow the Network-Attached-Device (NAD) connectivity from pickup, electronics, cables, and rack location to the bar codes and the device history reports. Dave, Earnest and Saeed are working on the LBNL off line emittance scanner device. Tom visited BNL. He discussed the calibration and testing criteria for the Beam Current Monitor and recommended that BNL and ORNL study the effect of beam intensity, beam shape, noise, and pulse length using an arbitrary waveform generator. Other topics of discussion included: loss monitor design (electronics, MPS interface, parallel plate option), Labview architecture, and timing interface. We met with a laser research group at ORNL. Unfortunately, we discovered that the new CCL beam box design does not include ports for laser diagnostics.