

## Accelerator Systems Division Highlights for the Week Ending September 28, 2001

### ASD/LBNL: Front End Systems

The antenna endurance test continued through 9/24 on the second test stand without any change in performance and was intentionally stopped after exceeding 100 hrs, in order to prepare the test stand for beam extraction with the ion source in its present condition. 18 mA of extracted beam have been repeatedly measured at the rf power level where the endurance test was conducted, and by raising the rf power to about 30 kW, 23 mA could be achieved. This result indicates that after a total of 107 hours accumulated 6% operation, the interior source surfaces are not 'poisoned' to a degree that H- beam production would suffer, even though a thin layer of deposited material was found on the source back flange.

Upon inspection, the tested antenna exhibited a somewhat stronger gray discoloration than found after 8 hrs., but not a single failure spot could be detected. Obviously, the 107 hours have not approached its lifetime limit under the chosen operating conditions. A new antenna designed by the SNS-Ion-Source group, with transversely oriented windings, has been installed in the same ion source and will be tested next week.

Production ion sources # 3 and 4 were completed but showed several vacuum leaks that are presently being repaired. Checkout activities of the Integrated Testing facility after completion of the Blue Box overhaul are proceeding with Ion Source #1 (the 'startup source'), and on 9/27 the first plasma was generated.

In compliance with a directive by the ASD division director, planning for an integrated 24 hours-a-day ion-source and LEBT beam-test has begun. We intend to demonstrate 7 days of uninterrupted operation. Because the general state of the second test stand and its infrastructure in Building 16 does not give any reasonable expectation of successfully concluding this test, the integrated testing program of the Front End itself (for now Ion Source and LEBT) has been modified to allow for up to three weeks of dedicated lifetime testing, including preparation. Staffing support from SNS-ASD is expected as a contribution. It is clear and was explicitly acknowledged by the ASD division director that this additional scope may well cut an equivalent time of planned MEBT integrated testing out of the Front-End schedule.

RFQ Modules #3 and 4 have been attached to Modules #1 and 2 on the RFQ support frame.

Conditioning of the needed 6 new power-coupler windows for the full RFQ has been slow, and we are now preparing operations software that will allow automated, round-the-clock conditioning.

Upon ASAC and the ASD Division Director's advise, the work plan for the Diagnostic Beamline has been significantly cut, eliminating all scope to measure longitudinal parameters. Discussion has started how to combine LBNL, LANL, and ORNL-ASD efforts to obtain transverse emittance measurements during the RFQ and MEBT commissioning activities in Berkeley. It was made clear that the LANL plans for an on-line emittance device do not accommodate the FES commissioning schedule at Berkeley.

We have received preliminary layout plans of concrete shielding for the DTL, inside the Front End building, and have voiced concerns that the proposed relocation of front-end racks and wire ways will result in significant, added installation scope at the SNS site. A newly proposed, schematic layout appears to somewhat reduce these concerns without totally eliminating them.

FES staff attended last week's Accelerator Systems Advisory Committee meeting, either in person at Oak Ridge or via videoconference. A total of four presentations were given. Since then, we have been addressing some issues that arose in the closeout session. Two major points are: (1) During this week's Accelerator Physics video conference it became clear that the LANL RFQ-to-CCL simulations, that showed significant beam halo, were performed for a 52 mA case, not the canonical 38 mA.. (2) The JAERI H- ion source presented at the recent Ion Source Conference in Oakland was recommended by one reviewer as a suitable solution for SNS. We have obtained a preprint of the published characteristics of this source and find the following facts: (A) While the reviewer quoted the value of 0.10 pi mm mrad for this emittance, the authors of the paper state the values of 0.13 (hor.) and 0.15 (vert.) at a current of 60 mA. Moreover, this emittance were measured for a diverging beam close to the source outlet plane, without any focusing element which could have deteriorated this beam and significantly increased the rms emittance size. (B)

This source uses a high amount of cesium, and the authors themselves are concerned about RFQ sparking, whereas we had not encountered any cesium-related problems in our RFQ-Module-1 beam-test. (3) The JAERI source uses filaments, and the authors anticipate a 100-hr lifetime limit in this configuration, based on their experience with proton beams.

#### **ASD/LANL: Warm Linac**

The 402-MHz klystron manufacturing and testing are attracting management attention. This week we held a videoconference with senior management of the supplier and another videoconference with their technical team responsible for production. A delivery schedule for the first three klystrons was developed. Delivery is set for Dec. 01, Jan 02, and Feb 02, respectively. (WBS 1.4.1.1)

Thanks to additional FY01 BA from the SNS Project Office, we have fully funded the SRF circulator contract. (WBS 1.4.1.1)

We received two 402-MHz RF circulators. Although the shipping crate was damaged, test results indicate that the equipment was acceptable. We received a 402-MHz Glycol Load. This package was also damaged during shipping. The load sustained minor damage. Fortunately, the damage did not penetrate into the RF region of the waveguide or affect the seal and it appears that it can be corrected with a sander. LANL Procurement Specialists will be contacting the vendors to address deficiencies in their packaging and transportation. (WBS 1.4.1.1)

The LANL RF test stand building and infrastructure improvements are on schedule and drawing to a close. (WBS 1.4.1)

Contracts were awarded for the production high-voltage converter modulator (HVCM) SCR controllers, and for the HVCM control racks. Three of the four Reass' Pieces are now under contract. We also awarded the HVCM capacitor contract. A QA review was conducted on the revised converter modulator RFP. Further clarifications are required resulting in a one-week schedule slip. (WBS 1.4.1.2)

The diverter stems were brazed onto the drift tube bodies for the PMQ drift tubes in Tank 3 (Fig. 1). All of the drift tubes for Tank 3 successfully passed the leak check at the braze facility. The diverter stems for the EMD and BPM drift tubes associated with Tank 3 are nearly complete. Two types of thermal diagnostics have been incorporated into the design for the BPM drift tubes. The first involves an RTD, which will be bonded to the inner surface of the drift tube body. Both the RTD and BPM wires will extend up through the drift tube stem and will exit at the top of the drift tube water manifold. There will also be a connection for an RTD on the water manifold at the top of the BPM drift tube. (WBS 1.4.2.3)



Fig. 1: Drift tube with diverter stem following braze

JLab personnel have returned to LANL along with the third pair of prototype SRF couplers. Vacuum bakeout is scheduled to occur into the weekend followed by RF testing next week. (WBS 1.4.1.1)

The contract for the struts associated with the DTL tank support stands was placed. We also received the bearings for the support struts. This hardware was immediately shipped to the integrating vendor. We recently visited the vendor responsible for manufacturing the DTL tanks. The tanks themselves look satisfactory and it appears that the vendor has successfully overcome most of their fabrication concerns; however, they are still behind schedule. To mitigate this, they are running 3 machines, with two shifts for 20 hours a day. Currently, the completion dates for tanks 3B, 3A, and 3C are 10/9, 10/11, and 10/29 respectively. We have scheduled the plating trip to GSI for 10/19-11/16. (WBS 1.4.2.2)



Fig. 2: DTL Tank 3B following the machining of the slug tuner and vacuum ports.

We awarded the contract for the CCL RF structures fabrication. (Project Milestone and WBS 1.4.4.2)

We awarded the contract for the DTL and CCL ion pumps. We were able to expedite this award because of a previously negotiated contract completed by the Brookhaven team. (WBS 1.4.2.4 and 1.4.4.4)

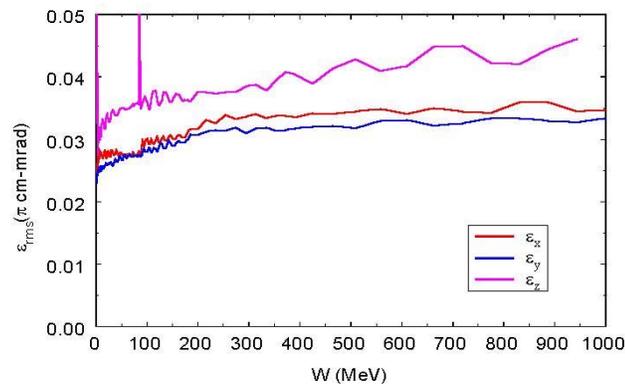


Fig. 2: 37% RMS emittance growth meets design spec (from 10 end-to-end simulations with errors).

LANL made five presentations at ASAC last week, including the final linac physics design. End-to-end simulations, with errors, for the reference beam indicate that SNS requirements are met for rms emittance (Fig. 3), spatial stability, energy stability, and energy spread. ASAC unanimously agreed that the physics design is essentially complete. (WBS 1.4.5)

\$650K of R&D funding was exchanged with ORNL for \$700K of line item as a result of the CCL Hot Model Capitalization. More than \$100K of additional R&D funding is anticipated being transferred back to ORNL in October. (WBS 1.4.6)

The SNS project Office reviewed our ETC estimates. (WBS 1.4.6)

To date, the FY01 closing is going smoothly. LANL's strategy is to carry over 2% of our FY01 BA.

### **ASD/JLAB: Cold Linac**

Detailing of the gas storage tank area and the He trailer off-load valve panel is complete. The warm helium piping design package is essentially complete and under internal review.

Oil coolers and after coolers for the warm compressors have been received by the compressor vendor and are being installed on the compressor skids.

Fabrication of remaining transfer line components continues.

Buffered chemical polishing of prototype medium- $\beta$  cavities 3 and 4 is complete. Cavity 4 is in the dewar and being prepared for rf testing. The single-cell high- $\beta$  cavity has also had BCP treatment and is installed in a dewar in preparation for rf testing.

Another pair of FPCs has been delivered to LANL, installed on the bakeout stand and bakeout has been started in preparation for a two-week test period.

The electropolish cabinet procurement has been awarded, using a phased contract.

The second titanium fixture for cavity production is complete. A trip to the vendor confirmed good progress on the thermal shield, the space frame and the vacuum vessel.

### **ASD/BNL: Ring**

Bill Weng, Jie Wei and Danielle Davino traveled to SNS/OR for the ASAC review talks. Peter Cameron, A. Fedotov and Mike Blaskiewicz presented their talks by a videoconference link from BNL.

Medium Field Power Supplies: at the request of the Project Office, a contract award for the 1.0 GeV medium range power supplies will be put on hold for a short period of time. Instead of awarding a contract this week, BNL will further explore vendor capability and evaluation for the 1.3 GeV bid options for this family of sixty-nine power supplies.

Issues related to vendor qualification verification for the Budker Institute of Nuclear Physics (BINP) have been resolved between BNL and SNS/OR for the procurement of twenty-one quadrupole magnets (30Q44/30Q58). BNL plans to award a contract with BINP for a first article assembly. A production contract will follow upon mutual acceptance of the first article.

"Handoff Plans and Acceptance Criteria" for the Ring Systems were received from Dan Stout. These documents have been distributed to group leaders for their review. These plans will quickly evolve with upcoming first article deliverables that include: the PS Reference Magnet (17D120), Tesla's first article HEBT Dipole (8D533), Apogee's PSI/PSC interface modules (production units), IE Power's first article Injection Kicker PS, and Danfysik Low Field Power Supplies.

An internal meeting was conducted by Joe Tuozzolo to review magnet parameters for all medium field magnets/power supplies. The Project Office was advised.

M. Nekulak submitted ETC cost spreadsheets and preliminary P3 schedule that supports the ETC to the PO.

Work continues on completing cost justification comments for ETC and finalizing P3 schedule activities.

FY01 year-end closing activities intensified this week, with the goal of efficiently using all of our allotted budget authority.

Work continues on preparing FY02 SOW and Funding Packages.

A videoconference was held between BNL and SNS/OR to review our procurement strategy for the medium field power supplies and the 30Q Ring quadrupoles. BNL will proceed with contract awards on both fronts.

D. Raparia is reviewing S. Henderson's Commissioning Plan.

Work continued on the laser wire test set-up in the AGS. The laser assembly has been integrated with Controls and is ready to go.

Field quality testing of the 27CDM30 prototype is underway. Measurements indicate that 2 turns must be added to the skew sextupole. Modifications are in-progress to confirm corrections by next week. Other windings look good.

NiT coating development continues on glass tubes.

The production run for Apogee's PSI/PSC power supply interface modules is now complete. We recommend a PCR to cover an add-on order for operational spares at ~10% level.

All thirty-two Ring arc dipole magnets have been assembled, here at BNL. We plan to start magnetic measurements next week.

Tesla reports that the #1 HEBT dipole magnet coils have been epoxy potted. Coils are now being fitted to the core. Our aim is to deliver to SNS/OR prior to the DOE review in November.

Tesla has also wound the coils for the first article production 21Q40 quadrupole. The magnet core is ready and awaiting the coils.

BNL Shops have finished the fabrications for the HEBT dipole magnets. These components are being prepped for painting and delivery to SNS/OR.

### **Controls**

A significant amount of network hardware for the ICS communications network arrived this week. This hardware will be used for prototyping of the network at 701 Scarboro Rd. and will later be moved to the site to become the production network.

A "first article" of the SNS standard 21-slot VME crate arrived this week. Most of the planned testing has been completed and a list of issues has been provided to the supplier.

Eric Bjorklund, on a one-year sabbatical from LANSCE, has arrived at ORNL and begun work on the Run Permit System.

FE Control system rework (to match Source/LEBT electrical rework) was successful: plasma is now in production again.

LBNL is in the process of switching to the standard SNS VME processor(PowerPC) board. Last week all FE device drivers were confirmed as working on this processor.

An initial design was prepared for a sequencer to use a klystron for conditioning of RF windows or the RFQ at LBL.

Reconfiguration of the current EPICS system for full RFQ operation was begun at LBL.

### **ASD/ORNL: Integration and Installation Support**

A two-day Installation Planning Review was completed on 9/26 - 27/01. A seven-person external review committee chaired by Pierre Grand conducted the review. The high level assessments of the committee were summarized as follows:

A. "The schedule and labor estimates as presented are a good first level effort, but will need refinement as information partner labs becomes available."

B. "In general, group leader discussion indicate acceptance of the approach and the plan to estimating cost and schedule constraints."

C. "Planning and estimates for installation of individual components appears to be well understood. Manpower estimates from the system owners will need to be refined."

Monday, five (5) additional 8-inch metal seal valves were received from VAT. This now brings the total received at RATS to ten (10). This is the quantity required for the full Ring Vacuum System. Friday, four (4) 402.5 MHz rf loads were received from Atlantic Microwave. One (1) prototype and eleven (11) Production Loads were ordered by LANL.

### **Accelerator Physics**

J. Galambos attended EPICS training at LANL.

Alternatives are being evaluated for the beam transport through the MEBT to alleviate halo. These alternatives include adding scrapers in the MEBT and also shortening the MEBT by eliminating the anti chopper.

Magnet and power supply requirements for procurement packages are being reviewed for the linac and ring.

### **Operations**

#### **Ion Source Group**

The fabrication of the diagnostic spool, vacuum chamber, plasma chamber and most of the other ion source parts was awarded to TTI in Cookville, TN.

DCS reports to have an assembled a box which will become our Big Blue Box.

Following Division advice, the ordering of the RF amplifier was delayed for one week.

Sachin Babu tested 5 Cherokee sample antennas. Two failed the standard conductivity test, while another two failed at a very low voltage. One, however, withstood repeatedly the full 3 kV test limit.

Cherokee Porcelain coated three antennas with 10-layers resulting in a 1 mm thick porcelain layer. Another antenna was coated with a 0.7 mm thick coat. Two of those antennas were shipped to LBNL for testing. These thick layers are expected to dramatically reduce the failure rate of the insulation and accordingly extend the antenna lifetime.

Two revised manuscripts describing our simulation- and antenna-developments have been submitted for publication in the proceedings of the International Conference on ion Sources.

Our simulation- and antenna-work, as well as our plans were presented at ASAC and can be viewed from the SNS user folder M:\Stockli\presentations\asac01.ppt;

### **RF Group**

Concerns about the cavity tuner resolution and backlash have been alleviated, it is believed the results will be much better than the specifications.

Mark Champion is organizing, this week, a conference to address the cavity stiffness issue.

Marion and Ray have been charged with investigating other Klystron manufactures.

David Anderson is looking into the HVCM, inverter, changes.

Yoon Kang will develop a plan for using the cold model DLT and hot model CCL structures when they arrive here.

Hengjie Ma spent this week at LANL assisting in the LLRF development.

### **Cryo Transfer Line Group**

### **Mechanical Group**

### **Magnet Measurement Group**

We continue to work on the 8D533 system and are also modifying the SSC-Danfysik system in order to measure 12Q45's.

### **Power Supply Group**

### **Survey and Alignment Group**

The S & A Group is in the process of calibrating instrumentation and updating calibration records on all survey & alignment equipment. This is a regular on-going process that is performed on regular intervals.

The latest iteration of our drawing compilation and accompanying spreadsheet is now available to those who utilize it. This version (09-24-01) is comprised of the latest coordinate information available and now includes beam line locations. This drawing is available in both the CF coordinate system (feet) and also the SNS coordinate (meters).

Today, (Friday) we will have completed the installation of interface hardware on all site survey monuments. During the month of October, the Survey & Alignment Group will be involved in a full-fledged campaign of measuring the global survey network with a target date for completion of four - six weeks. Earlier completion is contingent upon good weather.

### **Beam Diagnostics Group**

BNL-SNS Beam Diagnostics Weekly Report:

1.5.7.1 BPM: Beam-pipes are vacuum fired at 400C for cleaning. Details are being worked out with the vacuum group to avoid damage to susceptible areas of BPMs.

1.5.7.2 IPM: Preliminary design continues. Layout now includes magnets and supporting stands. Calculations indicate the uniformity of the electric field is not an issue. Magnet analysis continues. Structural analysis of the vacuum chamber indicates a maximum deflection of 0.01 inch under vacuum, which is small. Investigation of alternate IPM design continues.

1.5.7.3 BLM: We are investigating an alternate source for the ion chamber assembly.

1.5.7.4 BCM: A board is being stuffed for delivery to Berkeley. Schematic updates are in progress. LabVIEW software for signal processing algorithms, and algorithm testing is underway. The digital interface board has been received from LANL along with some test and driver software. Installation and initial testing on a BNL computer is underway. A sample current output DAC (TI - DAC 902, 12 bit 165MSPS) has been received for use in a calibrator.

1.5.7.6b Laser Wire Scanner: Data acquisition algorithm has been specified for the first Linac tests at BNL. Experiments with the apparatus are in progress. A dummy signal is generated from a photodiode. Work to obtain a low-jitter timing pulse is in progress to act as an integration gate.

#### LBNL-SNS Beam Diagnostics Weekly Report:

The RTDL receiver IP card was tested successfully and the PLL locked across the required range. The problem was identified with the slew rate of the ADCs, which was too slow to keep up with our clock rate. After replacing the ADC with faster ones, the PLL locked immediately. The efforts are now concentrated in programming the Altera FPGA. Likewise we are seeking ORNL and other collaborator's support to commission the RTDL system received from BNL so that we can test the receiver IP card functionality.

All hardware for the transverse emittance measurement system is on order, including the actuators (one is in house), with motors and controllers, the wire harp. The design of the pre-amp board is ready to be sent out for fabrication, and the 32 channel digitizer has been received.

The beam box housing this hardware is being finished, with two separate lids to accommodate the various measurements configurations.

#### LANL Beam Diagnostics Weekly Report:

A second data acquisition motherboard has been stuffed, tested, and shipped to BNL. Matt is currently upgrading the software (the initial version is already in the hands of BNL and ORNL staff).

Mike Plum clarified that LANL does not plan to build any emittance scanner electronics. Therefore, the one system built for use at Berkeley will be re-deployed for use with LANL's MEBT inline scanner and DTL D-plate.

An outline for the response to the wire scanner and D-Plate review reports has been distributed. Input is requested in time for Mike's return from travel (Oct. 10).

#### ORNL Beam Diagnostics Weekly Report:

Dave went to LANL to get EPICS training. Craig finished the design of the BPM test stand for ORNL. Craig and Saeed looked at modeling non-relativistic beam response for their BPM time-domain testing. Craig received the first Faraday Cup connector brazed to a flange from Italy. Saeed is gathering the ORNL-SNS response to the diagnostic committee regarding the wire scanners. Mike Plum will prepare two separate documents responding to the diagnostic committee's questions on WS and LANL D-plate by mid-October. Tom is working on MEBT timing integration, diagnostics handoff and responsibilities, and Berkeley diagnostics beamline changes.