

## Accelerator Systems Division Highlights for the Week Ending September 20, 2002

### ASD/LANL: Warm Linac

The second CPI 550 kW tube passed all acceptance tests this week. This includes meeting the full efficiency spec of 65%. (WBS 1.4.1.1)

We received the low power test data for 12 each, 550 kW circulators this week. 11 of these will ship to ORNL, and 1 will come to Los Alamos for further testing. (WBS 1.4.1.1)

We started tests of two 402.5 MHz windows this week. We ran the windows for 4 1/2 hours and got up to 108 kW peak power at a pulse width of 500  $\mu$ sec and a rep rate of 60 Hz. The windows were very gassy, but we did not have any arcs. We found an RF leak on one unit on the upper edge of the ceramic joint. At 60 kW peak power and 1.8 kW average power, the leak was 2.3 mW/cm<sup>2</sup> a distance of 2 cm from window surface. The specification states the RF leakage shall not exceed 1 mW/cm<sup>2</sup> at a distance of 10 cm at 2.5 MW. Our plan is to measure the leakage at a distance of 10 cm at a low power from which we can linearly extrapolate the RF leakage at 2.5 MW. With this information we will contact Thales to inform them that this window fails the acceptance criteria. (WBS 1.4.1.1)

Most of this week at Los Alamos was spent on continuing struggles to repair the Dynapower production SCR controller (Fig. 1) for the SNS high-voltage converter modulator (HVCM). We finally achieved success in mid-week, such that we were even able to run the Marconi klystron for window tests on Wednesday afternoon and evening. The SCR unit required multiple fixes, from relocating parts, to replacing parts with higher power equivalents, to modifying the bandwidths of various parts of the circuit. Dynapower will make the appropriate corrections to both the units already shipped as well as those still to be completed. (WBS 1.4.1.2)



Fig. 1: Production SCR controller for the SNS HVCM.

LANL and ASD again had personnel at Dynapower to help them with their assembly of the production converter modulator in order to speed up the delivery of the first units. (WBS 1.4.1.2)

Two more HVCM control racks were completed by ZTEC and delivered to the ORNL RATS facility. Low-Level RF work at JLAB continued. We continue to have history buffer problems. At the end of the week we temporarily ended the test at JLAB, giving up on the rev A FRCM. We decided to bring the system back to Los Alamos and work on getting a system ready with a Rev C FRCM. (WBS 1.4.1.3)

LLRF Rev C FRCM testing continued. The power supply issues have been cleaned up. We had problems both with sequencing and noise. Changing out components alleviated these. Upcoming actions include: (1) reverify the PLD interface is fine; (2) develop a boot loader which provides for programming upon power up without all of the peripherals; and (3) develop a pass-through test which simply dumps data from the ADC's directly onto the VXIbus. (WBS 1.4.1.3)

LLRF Rev D HPM boards were ordered. These will fix the flash issue. Emphasis has been on the flash problem for so long that we deemed it useful to go out and make this rev now. Now no laptop programming will be required. We also put made modifications in the analog front end to minimize channel-to-channel crosstalk noise. (WBS 1.4.1.3)

We communicated with Larry Doolittle at LBNL a number of times to ensure he has all of the information he requires for the LBNL backup LLRF system for the RFQ. (WBS 1.4.1.3)

Four of the leaking DTL Tank1 drift tubes were shipped back to ISYS for repair welding. Three were welded with the multiple stitch and smooth technique. The fourth that had the worst eruptions was sent to Coronado Machine and had the weld area machined to prepare a groove that would accept a repair ring. All four were repaired successfully and will be at LANL on Monday. After inspection they will be sent to ORNL for magnet mapping. (WBS 1.4.2)

Work continued on preparing documentation that will be required before resumption of the production drift tubes for Tanks 2,4,5,6. A preliminary set of "state point" process drawings has been produced and will be discussed with Coronado Machine. (WBS 1.4.2)

Testing of the magnets in the Tank 1 drift tubes at ORNL has shown indications of degraded quadrupole strength and some increased harmonic content in the  $n = 4$  component. The problem is being actively investigated with corroborating measurements being planned for next week at Aster. (WBS 1.4.2)

Accel has begun final accelerating cavity machining on the first septum brazed cells. This is being done on their large lathe after roughing the cavities on vertical milling machining. This machining is supporting stack tuning the second week of October. (WBS 1.4.4)

The first article SRF EMQ was delivered to the RATS facility. (WBS 1.4.9)

The LANL ETC was reviewed by the SNS ORNL Project Office and accepted. (WBS 1.4.6)

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

The internal piping leak check of the 4.5K Cold Box (see photo below) was completed. The previous week's 2-3 day slip in the shipping date has been made up, and the date remains October 7.

The vacuum skid was shipped from JLAB to SNS on Monday, Sept 16 along with south wall valve rack and miscellaneous parts.

The Cold Box Room Installation Design Package was sent to SNS for comments on Friday, Sept 13. Comments are due back by Sept 27 next week.



### ASD/BNL: Ring

Dan Ciarletti and John Galambos were at BNL this week to meet with Larry Hoff (SNS/BNL Controls) and others.

Henning Bach of Danfysik will be visiting BNL next Friday, Sept. 27. He may also travel to SNS/OR for a short visit on Thursday, Sept. 26, to meet with Ted Hunter and the SNS/OR Team.

Talks for the ASAC Review were submitted to ASD. Dry runs were conducted at BNL; Physics talks were reviewed with ASD by videoconference.

Bids for extraction PFNs are still being reviewed. A list of open issues and/or specific questions was sent to all vendors this week as part of the final phase of the evaluation process.

A contract has been signed for the Ring dipole power supply.

The order has been placed for the medium field power supply (w/ IE Power).

Design of the 26S26 chromaticity sextupole magnet is complete and the drawings are in checking. The statement of work is being prepared.

#### Leaky magnet fittings:

- Danfysik has received the HH-630 material for brazing their ten remaining HEBT quads. A qualifying sample section and a repaired bus bar will be sent to Ted Hunter next week for process approval. Travel plans are IP for BNL engineers to visit Danfysik.
- BNL has shipped via FedEx the HH-630 to Tesla Engineering. They will use this material for Ph II qualification and to estimate the rework required on the remaining six (Ph I) quads. Magnets that are currently at BNL will be re-brazed at BNL. Travel plans are IP for BNL engineers to visit the Tesla facility.
- We are working with all of our vendors on notification, qualification and procurement of HH-630 brazing material.

#### Magnet assembly and measurements:

- Ring dipole measurements – nine type B magnets have been shimmed, fully measured and matched with nine type A magnets (26/32 are complete). Additionally, three more type B magnets have been shimmed and are ready for testing; three are un-shimmed awaiting initial measurements.
- 21Q40 – field quality measurement of quad #8 was completed this week. To date, seven of these magnets have integral fields within the desired range for Ring grouping. Measurements are on hold until magnet fittings are repaired.
- 41CDM30 – the 1<sup>st</sup> article magnet is being tested. The skew-quad is complete.

- 21CS26 – measurements of production #1 are IP.
- Continuing with first half-cell assembly. Pictures have been sent to ASD for next week's ASAC Review.
- 36CDM30 – 1<sup>st</sup> article awaits testing.
- Chicane #4 has been uncrated and awaits hydro testing and field quality measurements.

## **Controls**

Congratulations to Bruce Hanan and Rob Taylor, both of whom graduated last week. Congratulations also to Derrick Williams, whose baby daughter Skylar was born on the 12<sup>th</sup>. (The proposed name of "Spallatia" was apparently vetoed.)

Twenty members of the controls team participated in a full day of Electrical Safety Training this week.

Two more Conventional Facilities Controls cabinets have been delivered to the site.

The FE communication cable installation is essentially complete. Most (all?) Ethernet cables have been tested, and twinax testing will be conducted next week.

There have been some QA problems in terminating the timing and MPS cables. Installers have been trained, and provided with proper equipment. Electrical testing, TDR, Cable length, and polarity checks have started, and a procedure documented.

The CCL Control Racks and 10 utility modules have been shipped by LANL to ORNL. An engineer to be responsible for the SCL vacuum system controls has been hired by LANL, and the project kicked off with a visit to Jlab. Progress on RCCS, Vacuum and power supply applications continues.

The hot spare ion source was run for radiation surveys using EPICS, and more devices are being interfaced daily. The goal is to run the test stand entirely from EPICS screens.

Work began calibrating the MEBT Kepco steering supplies, using EPICS to set the power supplies and Labview to read them back.

The first draft of a revised design manual for ring controls is complete. This is expected to facilitate communication with other groups (RF, vacuum, magnet power supply, diagnostics). It includes sections on the global timing system, but not yet on the Machine Protection System.

The first two production Machine Protection System boards arrived and were tested. No problems were found. The boards are now in production mode.



## Installation

This week we had the magnet group install the 5 quads that had been off for maintenance of the MEBT. These were also electrically connected.

Electrical power is available to approximately 70% of the Front End Systems now. Most of it is still locked out for safety but can be used when needed.

Testing began on the MEBT steerer power supplies. This is a joint effort between the Power Supply Group and Controls to both check the power supplies and to verify their EPICS calibrations.

We very much look forward to the arrival of and tour for the ASAC conference attendees.

This week we also received and installed Diagnostics electronics modules for the MEBT BCMS and BPMs. These modules were at BNL and LANL, respectively, being upgraded.

## Accelerator Physics

J. Galambos has been at the Global Accelerator Network Meeting this week.

S. Aleksandrov has been working with S. Assadi on plans for a laser-based beam-in-gap measurement during front-end commissioning. Sensitivity better than  $10^{-3}$  should be possible

D. Jeon has simulated the beamloss in the linac with the modified MEBT optics and halo scraper. He finds a very large reduction in integrated linac beamloss, of about an order of magnitude.

Five AP group members have been preparing presentations for ASAC.

### **Operations Group**

ARR Process underway –

- Committee visit scheduled for on-site meeting the week of October 14
- The agenda is being written
- Les Price agreed for his closeout to be the visit closeout on Oct. 17
- A website has now been set up for the review at: <http://www-internal.sns.gov/asd/arr/arr.htm>
- Finalizing review documentation for the ARR
- On schedule with Training Courses for Operator Certification and Subject Matter lecture in the Operations Training Program
- Underway with Review and Sign Off process for - Operations Procedures Manual for ARR.

One interview was held this week for a Chief Operator

### **Ion Source Group**

All group members continue to participate in the operator training.

Paul Gibson and Robert Morton continue to participate in the installation of the front end.

John Munro keeps making progress on the control of the hot spare stand demonstrating the complete control of the 2MHz RF supply.

Most of the 2MHz power, however, was reflected because modifications brought the matching network way out of tune. Tuning should be completed today.

Most of the redesign glue-less LEBT insulator disintegrated when the LEBT was installed. The design and material specifications are being revised. In the meantime the extractor was installed without the two lenses.

An ASAC presentation, a work package and a trip report were submitted on time.

### **Mechanical Group**

The two tank sections for DTL tank 1 were assembled for the first time this week. The three tank sections for tank 3 have been reassembled. Leak testing will begin next week.



DTL Tank 1

The brush plating of the bare o-ring grooves on the end flanges of tanks 1, 2, and 3 was completed this week in the RATS facility.

A long-term stability test of the Stabilizer Shroud “Can” concept was completed this week. A drift tube was installed, aligned, and locked in place on Wednesday (Sept 11) and the alignment rechecked on Monday (Sept. 23). No motion was indicated when checked with the laser tracker. The o-rings for this test were lubricated with alcohol when it was initially installed. The mount was then moved to a new position (without lubrication) and allowed to set for one more day. The alignment was rechecked and no motion was indicated.

### **Magnet Systems**

### **Vacuum Systems**

### **RF Group**

Most members of the RF Group attended an excellent all-day safety presentation by Lloyd Gordon of LANL. Training included Electrical Injury Mechanisms, Pulsed Power Safety, RF and Microwave Safety and Basics of R&D Shielding.

The first section of the linac field control 402.5 MHz reference line was assembled in RATS2 (see photo attached). Preparation work was performed on the reference line routing in and out of chase #8. Developed CAD drawing for Reference Line Temperature controller chassis. Resolved Reference line temperature controller AC routing for 402 MHz section. Prepared CAD drawings for reference system pipe attachments and directional coupler housings, visited machine shop. Received quotes for reference system directional couplers, reference line hangars, and transmission line components.

Dave Anderson went to DynaPower (Vermont) to work with LANL on the Converter Modulator (HVCM). He has arranged for the shipment of the Converter Modulator shell on 9/23/02. This will allow progress on cable and plumbing routing to continue while the issues regarding internal components are resolved. Shipment of the core components is expected by 10/14/02.

Lloyd Gordon, from LANL, was at ORNL on Monday and Tuesday. He presented Electrical Injury Mechanisms, Pulsed Power Safety, RF and Microwave Safety, and Ground and Shielding training, which was very well received and attended by many ASD, CF, and target staff members and technicians. On Thursday, Dynapower shipped 2 safety enclosures, 2 modulator tanks, 2 water panels, several grounding plates, and a set of HVCM cables to ORNL. They will arrive Monday morning.



### **Electrical Systems Group**

Reviewing Ring extraction kicker power supply bids.

Submitted work package for group.

Presented practice talk to division for upcoming ASAC review.

Resolved transformer pad flatness issue at Linac Klystron Building – Outside Modulator Transformers and switchgear will be shimmed level and then grouted to provide flat, sealed base.

Members of the group are providing expertise on CCL structure QA analysis our QA office.

### **Survey and Alignment Group**

Epoch 5 of our Linac floor settlement survey was begun Thursday, 19 September. The measuring process will require about three days with an additional day or two for analysis.

On Thursday of this week we began a mapping/measuring campaign in the Klystron area. Our plan is to (1) map existing equipment, (2) as built Klystron Walls, (3) Mark column lines. Completion will require about three weeks.

Engineers from our group have met with the Target Group at their request to discuss the establishment of the new target center. Also attended second meeting with Target Group to discuss the alignment of the target cart rails

Provided a mini workshop for the millwrights working on the DVTS (Design Validation Test Stand) regarding optical alignment.

Continued magnet fiducialization.

Performed alignment tests on the DTL top hand design. Although the alignment tests have been performed on one drift tube only, the results were encouraging.

### **Cryogenics Group**

The warm helium compressors and Kinney vacuum pumps have been placed in their final locations. Grouting of the compressors has started.

The cold box room is being prepared for delivery of the cold box the week of the 7th of October 02. The vendor is working 2-shift operation 7 days a week to meet the delivery schedule.

We are reviewing the "cold box room piping package" delivered from JLAB this week.

The instrument air storage vessel is on order and shipping is expected in 7-8 weeks.

We have received the main vacuum skid from JLab and have stored it in the RATS-2 storage facility.

Leak checking of the 3.5" clamshells in the tunnel on the upstream supply modules is completed and superinsulating of that line is in progress.

Welding of the 6" outer vacuum jacket of the upstream supply modules has also started.

All the supply support stands for the down stream transfer line have been set and 5 supply modules have been placed on the stands.

The warm gas piping for the upstream section is complete. Work will begin on adding the piping taps and installing the downstream piping.

Two supply and two return modules were shipped to the tunnel. The last Supply module is 25% completed. We expect completion of that last supply module some time next week. Work has started on the west end box.

The last 3 Cryomodule technicians will start at JLAB on the 30th of September 02.

### **Beam Diagnostics**

BNL SNS Beam Diagnostics Progress Report:

Group members submitted material to ORNL for the ASAC Review.

1.5.7.1 BPM: Work continues on PCI interface card design and baseband AFE. Draft of Beam Based Alignment AP note is circulating.

1.5.7.3 BLM: Prototype circuit evaluation and testing for interface with the MPS continues.

1.5.7.4 BCM: Software upgrades continue. Assembly of prototype HEBT BCM is in progress.

1.5.7.6a Carbon Wire Scanner: Work continues on MEBT scanners. Completed reworking the flanges on the spool pieces. One scanner is complete, technicians are working over the weekend to complete the other four. There remains some concern about the reliability of the wire attachment method, namely the quality of the solder/carbon interface. It may be necessary to resort to conductive epoxy to resolve this, the disadvantage being that wire replacement is then much more difficult. Efforts will continue to perfect the replaceable carbon option.

1.5.7.6b Laser Wire Scanner: Received preliminary dwgs of the SCL beam box from ORNL. Initiated the design of the optics box to be used in BNL 200 MeV line. Continuing to push for dedicated beam time for electron detector testing at 200MeV in November, but this still appears unlikely. Evaluating the possibility of accomplishing electron detector testing at 750KeV.

LANL SNS Beam Diagnostics Progress Report:

BPM pickups: The 3 ea. DTL BPM's that were ready for testing have now been tested. The results are good, and the BPMs will now be returned to Albuquerque to have the extension tubes welded on to complete the fabrication process. Testing continues on the CCL BPMs. Fabrication continues on the SCL BPMs.

BPM electronics: We are working on a precision 2.5 MHz oscillator needed to drive the Roscoe RF box that generates the LO and CAL signals. We have been able to duplicate the 4-degree peak-to-peak jitter in the phase measurement, and we are now in a position to track down the various contributions to the jitter. Work continues on the FPGAs needed for the new DFE board.

WS actuators: Huntington announced yet another delay on their delivery of the prototype and D-plate actuators. The prototypes are now expected the week of 23/Sep, and the D-plate actuators are expected to ship by 30/Sep.

D-plate: Fabrication continues at local machine shops. The steering magnet winding by LANSCE-2 is now complete. We have begun mounting beam boxes, magnets, and spool pieces to the D-plate stand.

ORNL SNS Beam Diagnostics Progress Report:

We spent the week preparing backup information for the FY03 budget and ASAC presentations.

Warren is working with the ME designers on the optical boxes. Dan Stout is leading the mechanical design of the optics box that is embedded in the HEBT ceiling. We have one design at hand, which incorporates off the shelf components. We also had another Laser-wire meeting to discuss the design progress. Saeed presented the group with a draft cost structure. The designers are looking into the detailed cost estimates. The vacuum beam box is in the shop. We expect to ship the laser-wire vacuum box to BNL on time before October-1-2002. Parts will be arriving in RATS starting Monday September-23-02.

The laser room in RATS is ready. This is due to the hard work of Paul Holik, Jim Schubert and John Kristy. We appreciate their effort. We expect to receive the Nd-YAG laser from continuum this coming week. Peter Ladd and Johnny Tang will help us with vacuum and controls necessary to start the laser-wire test at RATS around the end of October.

We have invited the diagnostic experts to come to ORNL for pre-beam integration on October-15-2002. Craig Dawson from BNL has already indicated that he will be available. The MEBT electronics are installed in the racks. Paul Gibson has been helping us.

Wim is working on LabView Template: programming, some db files, and further design of shared memory interface (more types, more functionality to handle interrupts). He also circulated a preliminary list of requirements for the PC hardware platform. We received very useful feedback from LANL and will incorporate their suggestions.

Craig reviewed the final design of the electron detector. He sent it for manufacturing on Monday. He continues working on DTL tuning at 50% level. Wim modified the LabView code that Craig is using for the RF group's cavity tuning.

Craig Swanson worked on the bill of materials for the embedded timing circuit by working with IES Gray to be able to put together a kit to assemble the board once it is manufactured by Halmark. He and Coles Sibley visited Lumagraphics and reviewed the board layout. Some slight changes were made and the layout now looks like it is ready for fabrication.