

## **Accelerator Systems Division Highlights for the Week Ending July 12, 2002**

### **ASD/LBNL: Front End Systems**

By now, five shipments with Front-End equipment have safely arrived at Oak Ridge. The sixth and last shipment has left Berkeley Lab on July 10 and is expected to arrive at Oak Ridge on Monday, July 15; it includes the Diagnostic Beamline, miscellaneous cabling, spares, and tools.

80% of the electrical systems documentation have been completed and uploaded into the SNS iMAN system. Completion of the remaining documentation is proceeding steadily.

The experimental results obtained with the LEBT chopper system have been compiled and will be issued as an FES Tech Note.

Don Syversrud of the FES team has been at the SNS site for a week to help with FES installation oversight.

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

One 402.5-MHz klystron, four 805-MHz 550-kW RF loads, two 805-MHz, 5-MW windows, six arc detector chassis, a crate of cables, and one klystron lifting fixture were shipped to ORNL. Delivery is expected by noon July 12. (WBS 1.4.1.1)

With help from a Marconi engineer on-site, we retuned SN-3 402.5 MHz Marconi klystron and achieved full power (2.5 MW), and full efficiency (58%). (WBS 1.4.1.1)

The fourth Marconi 402.5 MHz klystron was pumped down at the factory. (WBS 1.4.1.1)

We completed the factory acceptance test of the next 402.5 MHz transmitter. (WBS 1.4.1.1)

Modeling of the TVA utility grid for the HVCM shows problems (the generation of high frequency harmonics) with a capacitive distribution network. We have located a potentially more suitable distribution cable, a cable with reduced per-foot capacitance. Bill Reass had planned to visit ORNL this week to discuss these concerns about the AC distribution network, but the right people to interact with at ORNL were not there. ORNL will reschedule as a videoconference next week. (WBS 1.4.1.2)

Modeling of the Dynapower cast resin transformers for the HVCM shows problems with the use of high-epsilon epoxy (~5). Field stresses go to 270 kV/cm. We are working epoxy bobbin design issues with Dynapower to change the epoxy formulation and reduce the field stress. (WBS 1.4.1.2)

We received the first silver-plated copper IGBT switchplate for the HVCM, and we began to build up the assembly. (WBS 1.4.1.2)

We are installing four Eupec IGBT's in one switch plate to determine their operability in the converter-modulator. (WBS 1.4.1.2)

The first batch of production SCR controllers for the HVCM is scheduled to ship to ORNL this weekend. (WBS 1.4.1.2)

The LLRF near term schedule was developed submitted to ASD last week. It stashed this week. Those results were submitted to ASD. (WBS 1.4.1.3)

The flash memory problem with the LLRF HPM is now understood. It will ultimately require both hardware and software modifications which we will incorporate in Rev C. In the mean time we have developed a workaround that will allow us to use the Rev-B boards. (WBS 1.4.1.3)

The EPICS interface for the LLRF HPM is finished. (WBS 1.4.1.3)

The VXI interface for the LLRF FRCM is finished (WBS 1.4.1.3)

The LLRF RF daughterboard, Rev-C went out for fabrication last week. (WBS 1.4.1.3)

A modified Rev-B version of the FRCM was defined last week. The modified version is a reduced set of corrections that will allow us to meet the JLAB tests in September. This new Rev-B of the FRCM went out for fab on July 3. (WBS 1.4.1.3)

We started the process of handing off the Reference Line tasks to ORNL. (WBS 1.4.1.3)

We are pursuing two different secondary structures designed to stiffen the drift tube mount. The two LANL concepts for drift tube stabilization are nearing completion and should ship today. (WBS 1.4.2.3)

The vacuum leak on DTL Tank 3 EMD drift tube has been successfully repaired. It is now at the platers and expected to be back at Coronado later this week. The anticipated delivery date is July 18. (WBS 1.4.2.3)

The vacuum leak in DTL Tank 3 BPM drift tube was found to be between the drift tube body and diverter stem. The quickest repair involves CUSIL wire and an EB weld type repair. ISIS is currently working with weld samples to validate the process and we should know their results by early next week. If this repair is unsuccessful, we will explore other possibilities such as a weld at the stainless-copper interface. Assuming success, the anticipated delivery date is July 18. (WBS 1.4.2.3)

The vacuum leak in DTL Tank 3 empty drift tube was found to be a pinhole leak on the face of the drift tube body. This repair is straightforward and involves a plug of material with an EB weld. The anticipated delivery date for this drift tube is July 18. (WBS 1.4.2.3)

The drive iris for DTL Tank 3 is expected to ship on or before July 22. Coronado is working around the clock to meet this delivery schedule. (WBS 1.4.2.2)

The final post couplers for Tank 3 are expected to ship on or before July 22. (1.4.2.2)

Thirteen DTL Tank 1 drift tubes were shipped to ORNL last week. (WBS 1.4.2.3)

Two of the EMD drift tubes for DTL Tank 1 failed the hi-pot after the initial e-beam weld on the drift tube body. This appears to be caused from a shrinkage problem associated with the small geometry, which caused the material at the base of the diverter stem to cut into the Kapton insulation above the coil. There should be adequate schedule float. We are still working to deliver all of the Tank 1 drift tubes on or before July 31. (WBS 1.4.2.3)

The physics team evaluated the consequences of relaxed alignment DTL drift tube tolerance on potential beam loss. Optimistic results, corresponding to a beam halo extending out to 3 sigma, infer that the probability of beam loss is increased by 20%. If the halo extends to 5 sigma, we would expect the beam to intercept the bore in only the very worst-case scenario for misalignments. Since it is the halo that will be lost, this situation increases the priority of measuring and tailoring the emittance of the injected beam. It likewise increases the importance of measuring (and possibly improving) the transverse acceptance of DTL Tank 1 to make sure we don't have a particularly unfortunate set of misalignments. As noted above, there is presently an initiative underway to improve the stability of the drift tubes. The expected magnitude of any improvement awaits evaluation of the candidate designs. (WBS 1.4.5.3)

LANL visitors at ORNL this week included Chris Allen and Nick Pattengale (EPICS support during commissioning).

LANL visitors at ORNL next week include Rick Martineau (DTL stiffening prototype tests) and Scotty Jones (safety plan implementation).

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

The performance of the prototype cryomodule in all tests to date has been excellent. Peak gradients achieved and demonstrated  $Q_0$  at the operating gradient have significantly exceeded requirements on all cavities. Power handling,

conditioning and cryogenic performance of all fundamental power couplers has met requirements. Both mechanical and piezo-electric tuners have demonstrated required range and resolution with acceptably small backlash. Static and dynamic Lorentz detuning has been consistent with initial modeling and within specified levels at the nominal gradient. Microphonic levels are acceptably low.

High-power testing of the prototype cryomodule has been interrupted by the failure of the shield door on the test cave. A repair plan has been developed and it is expected that tests will be able to resume by the end of next week and be completed by the end of July, given the excellent performance documented to date.

The vendor has shipped the remaining two cold compressors.

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

A call for a "best and final" offer was requested of the two responsive bidders for our Ring dipole power supply. At a vendor's request, the bid close date has been extended to July 18<sup>th</sup>. Full power testing at the vendor's facility will be an option rather than a requirement.

Bob Lambiase has been working with ASD's Stuart Henderson to review and confirm magnet parameters for the medium range power supplies. Their efforts have been focused on the June 28 Magnet Parameter List with a look towards magnet fields, head room margins and model groupings.

Our engineers are working on a position paper on the design and status of BNL's Low Level RF System. This package will be sent to ASD next week.

21Q40 (60) – Tesla reported that they shipped six more units to BNL.

12Q45 (32) – Danfysik shipped eleven magnets to ORNL last week.

30Q44/58 (17) - The first article from BINP (30Q58) arrived at BNL last week. Initial visual inspections look good. The magnet is being uncrated for a more detailed QA.

27CDM30 (28) – Nine magnets arrived from Danfysik last week.

41CDM30 (9) – Alpha Magnetics reported that they are near finished winding the 1<sup>st</sup> article magnet. They plan to ship to BNL by mid July.

Drawings, specification and statement of work for the 27CD30 corrector magnets were sent to Contracts this week for vendor RFQ. A copy of the work package was also sent to Ted Hunter. BINP is included on the bidder's list.

The dipole test stand is operational for the Type-II magnets. The first "left hand" magnet was measured at 1.0 GeV and was found to need 14 mil shims under the pole. Complete field measurements will be made after the shims are added.

BNL/Contracts issued a job order to fabricate a vacuum chamber for the Injection Dump Septum magnet.

Our Diagnostics Group is working on the agenda and presentations for the Diagnostics Design Reviews to be held via videoconference on July 23, 24 and 25.

HEBT Vacuum – Purchase orders were placed for the standard 12cm pump tees and foil stripper instrument tees.

Ring Vacuum – Four more type B chambers have been coated with TiN bringing the total number of coated chambers to sixteen. The first production RF cavity pipes have been received and are being inspected before being set-up for TiN coating.

RTBT Vacuum – We continue with the design details of the magnet chambers and the drift space pipes.

## **Controls**

Johnny Tang and Coles Sibley visited LANL from ORNL for discussions on documentation, vacuum, and resonance control system, shielding and grounding, RF systems and power supply cycling.

The controls team was visited this week by the KGB, a small controls software company from Slovenia, and by Andy Foster of Observatory Sciences in the UK for discussions of Physics Applications and EPICS enhancements.

The factory test for FELK CF controls software was completed and software for the CF Controls CHL was completed and is ready for factory testing. Cabinets for the CHL and Site Utilities were completed and sensors for CHL, Site Utilities, and CUB were placed on order.

Implementation of PCR for replanning controls was completed, and will be presented to management next week.

Design of the heater control system for the JLab cryomodule testing was completed. Components were ordered and most have been received. Assembly of the system was started. PLC and EPICS programming is underway.

Preliminary wiring diagrams for the 4.5 K Cold Box PLC cabinet have been completed. Final drawings will be completed when we receive final wiring details from the vendor. Typical wiring interconnection diagrams for all cryomodule devices have been completed. PLC and IOC module wiring diagrams for the individual devices were started.

Swing heater control was incorporated into the cryomodule cavity heater sequence control. These swing heaters react rapidly to maintain a constant helium pressure in the primary return transfer line at the 'T' in the LINAC tunnel. The overall cavity heater sequence control continually monitors the amount of swing heat power. It slowly adjusts the heater power sent to the other cryomodules to equalize the amount of heater power supplied to each superconducting cavity.

A new LINUX-based development environment was installed at BNL (remotely – from ORNL). IOCs and applications are being migrated to this new environment. This will solve several immediate problems with the present development environment, and make it easier in the future for BNL to be regular contributors to CVS.

New Power Supply Interface (PSI) test software was sent to Apogee labs so that they can produce another batch of PSIs. Previously, they had used test software based on an old Power Supply Controller design.

At LANL, preliminary stepper motor support for cavity tuning was developed and tested. Work continued on supporting the low-level RF boards required for the upcoming Jlab tests. In particular, the register map of the troublesome Field and Resonance Control Module (FRCM) is now complete, and communication with EPICS established.

## **Installation**

The balance of all the IS/LEBT, RFQ and MEBT vacuum system components were installed.

A helium leak check was performed on the entire FES assembly and everything was found to be leak tight.

The balances of all the RFQ RF system components were installed.

The MEBT FER10-13, FER14-17 and FER08-09 and FER18-19 rack assemblies were placed in their final locations.

The inter-rack and rack to accelerator cable trays and troughs were installed.

The diagnostic timing cable spools and support was installed.

The large HV copper ground plate was installed.

The IS/LEBT safety cage was moved into position.

The HV Matching Network installation was started.

The Big Blue Box was moved into position.

The last shipment of FES components will arrive next Monday 7-15-02.

### **Accelerator Physics**

Visitors from COSYlab in Slovenia and LANL (C. Allen, N. Pattengale) have been at ORNL this week discussing with the Applications Programming and Controls groups the possibility of further collaboration on applications software. Under discussion is the possibility of utilizing some accelerator software infrastructure developed at COSYlab and used at several machines in Europe.

S. Kim and M. Doleans have been at Jlab this week participating in low-power tests of the prototype cryomodule.

S. Henderson has been working with B. Lambiase at BNL to finalize the ring and transport line magnet parameters and power supply specifications.

S. Alexandrov continues analysis of MEBT emittance data.

J. Holmes and A. Shishlo continue building simulation software on the ORNL supercomputer.

### **Operations Group**

The SNS Readiness Assessment Plan of Action was submitted accepted and signed by DOE.

The SNS Commissioning Program Plan is being signed for submission.

The Video Conference closeout for the FSAD for the FE-LINAC will be held next week.

Computerized Maintenance Management Software systems evaluations were held Thursday and Friday.

The database Electronic Logbook demo is out on the web. A requirements meeting for the upgrade path was held this week.

Continuing work on PC-3 Seismic calculation for the accelerator related to the XFD-Target Protection System Operator Training requirements continue to be developed.

Front End Operations Training and Certification procedures continue to be developed.

### **Ion Source Group**

On Friday, July 12, Sonali Shukla and Robert Welton operated the start-up ion source with the capacitive matcher at 25 kW RF power with a full 6% duty cycle for 8.5 hours with one single trip.

This accomplishment became possible after the resistive voltage divider at the output of the QEI RF amplifier was found to be underrated, indicated by a burning odor and smoke. The heavily carbonized divider was removed on Thursday as we normally measure the RF power with a directional coupler.

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

Don Syversrud of the Berkeley FES team visited us for a week to help with oversight of the front-end installation. He visited several times the RATS to answer a long list of questions that came up during the assembly and checkout of the hot spare stand.

Lucia Spears from the ORNL transportation department has filed a claim to recover the repair costs for the QEI RF amplifier that was initially received damaged.

### **RF Group**

PDR for the Thales 402.5 klystrons is the week of the 14th. Ray, Yoon, Lisa and Paul will attend. We will also go over a testing plan.

Installation of 2 klystrons 402.5, is scheduled for the 21st. We are busy finalizing the lifting and moving into place procedure.

We are interviewing for a HPRF technician, hope to get an experienced person.

Mark is at Jlab for 2 weeks and Hengjie goes to LANL on the 17th, for a week.

Another Marconi tube arrived today along with a lifting fixture.

LLRF is a hot topic and update schedule arrived today.

### **Mechanical Group**

#### **Magnet Systems**

We are mapping a prototype DTL dipole in preparation for DTL Dipole and DTL Quadrupole measurements. Both use the same system.

We have placed #1 HEBT Dipole back on the stand and repeated measurements. It looks the same as before and not like #4 Dipole or the 8D406. So, no measurement-induced errors are present #4 Dipole or the 8D406.

The first Buss assembly was taken to the site and installed in the 6 O'clock position.

#### **Vacuum Task**

#### **Cryogenics Group**

The siding post installation has been completed and the siding sheeting is being installed on the north and east sides of the RF section of the CHL.

The CHL crane bridge installation is complete and the trolley section has been delivered and is awaiting installation.

The roofer has started installation of the CHL roof.

The stairs are installed to the control room and the cold box room.

The return "T" section has been positioned and is being fitted for welding in the tunnel.

The contract has been released for the installation of the tunnel warm gas piping, and the contractor will start on 7/15/02.

We have hired the 3rd technician for the JLAB Cryomodule assembly project.

#### **Electrical Systems Group**

DC magnet cabling for DTL1, 2 and 3 has been pulled.

RFQ rack base with HF Cu sheet grounding has been completed.

Main Dipole power supply DC bus in the 6 o'clock duct bank has been installed.

## **Survey and Alignment Group**

### **Beam Diagnostics**

LANL Beam Diagnostics Progress Report:

**BPM pickups:** The batch of DTL BPMs in fabrication is now at ISYS. Welding operations should take place next week. The prototype CCL and SCL BPMs will hopefully be welded there next week also. Fabrication continues on the mapper fixture modifications for the new SCL BPM design.

**BPM electronics:** The ECAD modifications to the PCI card are almost done. The ECAD modifications to the digital front-end card started this week (10/Jul). John Power will spend next week working with Bergoz to improve the analog front-end design. The FPGA chip file has been sent to BNL.

**WS actuators:** Fabrication continues at Huntington on the prototype and D-plate actuators. They were originally scheduled to arrive this week, but there will be a delay of a couple weeks or so. Assembly designs are almost complete on all the Huntington actuators. This includes the wire scanner mounting collar modifications, the slit design, and the harp design.

**WS electronics:** We are working on the PCR to transfer funding for the HEBT, ring, and RTBT actuators and electronics.

**D-plate:** The steering magnet iron blocks have been delivered to the magnet winding shop. Fabrication continues on the D-plate mechanical systems. We are collecting parts to assemble prototype electronics for the halo scraper. One slit assembly arrived this week (11/Jul).

**ED/FC:** Design work is underway to finish detailing the Bimba air cylinders. We are collecting parts to assemble prototype electronics for the ED/FC control, bias, and current read-back. The prototype ED/FC unit destined for DTL-1 arrived this week (11/Jul).

**CMs:** Two DTL CM transformers have been delivered to the vacuum shop for testing. The CM mounting design for the CCL is being modified to use the same electrical break and housing as the CCL to SCL TR unit.

**Cabling:** Final signatures were received this week on the DTL-3 diagnostics cabling drawing and spreadsheet. We are working to resolve details on the best way to route the diagnostics cables to minimize electromagnetic interference.

BNL Beam Diagnostics Progress Report:

General - work continues on preparations for design review for all systems.

1.5.7.1 BPM: Continue to explore details of PCI interface. It appears that the recent rev B boards received from LANL have an older rev of the PGA. They respond only to falling edge triggers and do not support multiple channel data acquisition. Received the chip file for the Quicklogic PGA from LANL, but there is now concern about which rev we actually received. Continued assembling the balance 21cm hebt/rtbt BPMs. Running total of delivery to Vacuum Group is now 32 ea of 21 cm ring and 10 ea of 21 cm hebt/rtbt. Continued work on wire scanner for PUE transfer function measurements.

S11 and TDR measurements of SNS and RHIC (for reference) PUEs are in progress.

1.5.7.2 IPM: Investigating possible rad hard in-tunnel preamp solutions to provide the bandwidth needed for turn-by-turn profiles (this is an AP requirement for this system)

1.5.7.3 BLM: We continue working with the three vendors who are generating manufacturing proposals for the improved ion chamber detectors. We have tested a LND, Inc. prototype based on a modification of one of their designs, but its response was not as good as the BNL prototype. LND will make modifications, we plan to retest next week. Thermal gain and offset drift tests continue on the prototype analog front-end electronics.

1.5.7.4 BCM: The rev 2 board stuffing continues. Continued fabricating the housing and the beam pipe of the prototype HEBT BCM (with 6"ID) in the shops. Work is now 90% complete. Sent information about our signal needs for the timing module to ORNL. We received the Current Source to be used for BCM testing. This is being set up for testing with the new multimeter. Set up the BCM returned from Berkeley to verify the test setup for the new PCI boards from LANL.

1.5.7.5 Tune: UAL modeling and preparations for design review continue.

1.5.7.6a Carbon Wire Scanner: Preparations continue for refurbishment of the MEBT wire scanners. Critical path remains Huntington actuator refurbishment. Continuing efforts to improve the wire attachment method.

1.5.7.6b Laser Wire Scanner: Preparations continue for installation of a SCL diagnostics beam-box upstream of the AGS LTB line.

1.5.7.7 Beam in Gap: UAL simulations and vendor discussion regarding pulsers continue.

#### SNS Beam Diagnostics Progress Report:

We interviewed a number of candidates for the diagnostic technician positions. Wim is working with the students on the BPM test stand and runtime Labview on the scopes. At present both EPICS and Labview VI's are running on the Tektronix scope. Dave Thompson from the controls is helping Nick to setup the shared memory software connection to EPICS rather than the Active\_x. They are very close to finishing the project before students leave (end of July). Craig completed the electron detector design for the Laser systems. Danny Mangra and designers are progressing very well on detailing the laser wire beam box and the magnet. Dave Purcell is bench testing the EPICS performance apps on different NADs. The two MEBT current transformers are taken off for repair. Per Norbert's suggestion, we are buying one BCM spare. The PCMCIA card-bus timing module design is also coming along well.