

## Accelerator Systems Division Highlights Ending January 9, 2004

### ASD/LANL: Warm Linac

#### HIGH-POWER RF (WBS 1.4.1.1)

Accomplishments This Week: (1) *402.5-MHz, 2.5-MW E2V klystrons:* The next 402.5-MHz tube, SN 7, is scheduled for factory tests March 8-12. SN 11 has passed all the factory acceptance tests and LANL has authorized shipment to ORNL. SN 5 passed the high pot test on Jan 7. (2) *805-MHz, 5-MW Thales klystrons:* We received SN 5 at LANL. We are still in the process of conditioning SN 1 at LANL, but progress has been limited due to problems with the HVCM (see below). (3) *805-MHz, 550-kW Thales klystrons:* The next 550-kW klystron, SN 6, is scheduled for factory acceptance tests on Feb 3- 6. (4) *805-MHz, 550-kW CPI klystrons:* SN 10 passed the vacuum hold test. (5) *805-MHz, 2.5-MW Thales windows:* We are preparing to start the bake out of two 805-MHz windows. (6) *Transmitters:* We worked with Titan to document failure scenarios, troubleshooting methods used, and solutions for the magnet power supply failures at ORNL in December. We worked with Titan to co-ordinate retrofit of ion pump power supplies in SC transmitters at ORNL.

Concerns & Actions: Testing is delayed pending repairs to the HVCMs. We are experiencing quite a backlog of HPRF equipment to test.

#### HIGH-VOLTAGE POWER CONDITIONING (WBS 1.4.1.2)

Accomplishments: (1) We reviewed and approved Dynapower test data for IGBT assemblies 046, 047, 048, 049, and 050.

Concerns & Actions: We experienced various failures of both the prototype and production HVCMs that supply LANL's RF test stands and have spent much of the week on repairs.

#### DRIFT-TUBE LINAC (WBS 1.4.2)

Accomplishments: (1) Drift tubes 2-27 and 2-30 were vacuum leak checked, flow tested, cleaned; and packed for shipment. These final two drift tubes for Tank 2 are expected to arrive in Oak Ridge on Monday, Jan. 12. (2) Drift tube 6-17 has been dispatched to CMI for leak repair machining preparation (see below). Following the repair, it may be shipped directly to Oak Ridge for final processing (leak checking, flow testing, cleaning, etc.), as there is discussion of dismantling the Los Alamos final processing equipment next week and shipping it to Oak Ridge. 6-17 will be the last DTL drift tube provided everything "in the pipeline" is okay. (3) Surplus material and tooling used in fabrication and testing of the EMD/BPM drift tubes and RLWGs were shipped to ORNL this week.

Concerns & Actions: The leak in drift tube 6-17 has been confirmed, along with the physical location; repair planning is underway. We plan to mill out a band that includes the leak, electroform copper into the band, and then re-profile to final form.

#### COUPLED CAVITY LINAC (WBS 1.4.4)

Accomplishments: (1) Jim Billen and Jim Stovall are at ACCEL this week to help with final tuning on CCL Module 2. The tuning is going smoothly, and we hope to start cutting irises on Monday. ACCEL plans to ship this module by the end of January. (3) Brazing of CCL Module 3 is proceeding on schedule. (4) ACCEL has decided to install the complete support stand for Module 3 alongside that for Module 2. The vacuum manifolds were installed this week. For disassembly of Module 2, segments will be packed in crates between the support stands – it will be crowded but doable. Module 4 will, in fact, just fit in the hall as planned.

Concerns & Actions: (1) A no-cost solution was developed by ACCEL for the tuning-screw problem reported earlier, essentially relieving the threads near the vacuum slot. We concurred with the solution, although another solution is available if necessary at some additional cost. (2) The management conference calls with ACCEL are now held on Thursday of each week. ACCEL reported they lost the use of a lathe, which was not yet reflected in the schedule they provided. They expected that this problem would have a minor impact on the completion of Module 3. The estimated ship date for Module 3 is now the week of March 3 or 10. Once the schedule has been updated a firm date will be determined.

#### PHYSICS & DIAGNOSTICS (WBS 1.4.5)

Accomplishments: (1) *BPM electronics:* Eleven systems for the DTL were sent to ORNL in December, and 10 computer chassis for CCL systems are at LANL, ready for installation of the BPM electronics and software. The vendor Suntron has all of the parts for production of the remaining 85 DFE and Clock Multiplier circuit boards. We still need to send them the FPGAs for the PCI cards. We have about 30 of these parts programmed and the

remainder should be ready by the end of next week. (2) *Wire-scanner electronics*: The vendor SMT is assembling components on the boards for the short-pulse version. The anticipated delivery date to LANL is Jan. 16. We modified the software so that both versions of the electronics can now be run by one software package. (3) *Wire-scanner pickups*: The remaining hardware parts for the four wire-scanner actuators that were shipped to ORNL in December were sent to ORNL this week. We received comments from Huntington in response to the wiring diagram that we sent out in December. Following our approval of the changes they will ship the last 6-inch stroke actuator. Subsequently they then will ship the 3-inch stroke actuators one a day. (4) *ED/FC electronics*: The two controllers passed all tests with one minor exception (see below). (5) RTBT harp: The SNS harp drawing package has gone through final checks and has received all the necessary signatures. We have begun the procurement of parts and next week will start fabrication of the support plates and strong back. We have started the SPICE simulations on the harp test system and have seen no unexpected results to date. We need another couple of days to do this in more detail and document the results. (6) *Harp electronics*: We are currently testing a prototype analog front end (single channel) for the harp electronics.

Concerns & Actions: (1) We discovered a problem with the ED/FC electronics in that the positive-bias power supply is damaged if the output polarity is switched while the voltage is programmed to its maximum output. This should normally never be done. As we have no spare power supply units on hand, and the estimated delivery date for more is March 6, we will ship the units without the positive-bias supply installed, and have that added later at ORNL. (2) In response to the request for quotes on the harp card that was issued in December we have received two more "no bids." There is still one other company, Coorstek, that intends to provide a quote early next week. We have also sent a finished set of drawings to Macro-Metallic for an updated quote. This is the only company that has provided a quote to date, but that was back in September, and it no longer valid.

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

The final medium- $\beta$  cavity was qualified.

Assembly of the M-10 string will begin on Monday.

Testing of the M-4 cryomodule was successfully completed. It is being prepared for shipment to ORNL next week.

The M-5 cryomodule was shipped to ORNL.

The M-7 cryomodule has been repaired and installed in the cryomodule test facility in preparation for cooldown next week.

End cans are being installed on the M-8 cryomodule.

The M-9 cavity string has been transferred to storage, awaiting the availability of an assembly rail.

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

Extraction Kicker PFNs: The first extraction kicker power supply, built by Applied Power Supplies, which includes one PFN tank, one pumping station and one power supply rack has been received at BNL. Initial measurements show an increase of impedance in the output that is believed due to a change in the pulse grounding scheme; studies are underway.

Injection Bump Power Supplies: A detailed test procedure has been generated. The only remaining testing is the "third corner stability" which is to be done this week.

DC Power Supplies: Testing of the main dipole PS is scheduled for the week of March 15<sup>th</sup>.

BNL techs shipped half-cell #16 this week. Assembly work continues on HC #17 and 18.

Load testing of the half-cell lifting fixture was successfully completed last week. A Magnaflux inspection of all critical welds is in progress to be followed by identification of lift points for the various half-cell configurations.

Fabrication drawings for the Diagnostic's vacuum chambers are complete. Drafting efforts will now shift back to installation drawings for the Ring straight sections (RF first) and the RTBT line.

Chicane magnets #1 (Alpha) and #4 (NETC) have both been received at BNL.

26S26 (8) sextupole units #4 and 5 were shipped from Alpha to BNL in late December along with the spare coils for Chicane #1.

Spare coils (NETC) for Chicane #2 and 3 are complete and will be shipped to BNL later this week.

Ranor, Inc. has started fabrication work on the permanent outer shielding for the Ring #2 and 3 collimators.

Bid package for the Extraction Septum Lambertson magnet (including the spec, SOW, and design drawings) was delivered to our Contracts Department last week. Ted Hunter will get a duplicate set of documents. The vendor bid date has been extended to January 23.

Fabrication of the 21cm quad vacuum chambers for the RTBT line is underway and QA travelers have been written for them.

BNL assembly of the first set of short injection kicker magnets is nearing completion. Expect shipment to SNS/OR in February.

The assembly of two extraction kicker magnet modules has been completed and work on the third (of fourteen) is underway.

#### Magnetic Measurements:

- 30Q58 (12) - transfer function measurements on all twelve magnets are complete. Results show that sorting will be acceptable and that shimming is not necessary.
- 30Q44 (12) – the first of twelve is ready to be tested. Testing will be delayed, however, until February due to RHIC test priorities.
- Chicane #2 & 3 are set-up on a common base for magnet measurements. Plans are being considered to measure the foil region on #2.
- Injection septum magnets – field quality and fringe measurements are finished on both magnets.

#### Controls

LANL has tested EPICS archiver updates for 4 channels, 1000 samples each and plotted them in under 4 seconds. The new RTree index is being used to create master indices for multiarchives. We can build a master index for 90 files in under 20 minutes (down from multiple hours).

Development of a "Simple Network Management Protocol" (SNMP) IOC driver continues. This driver will be used to obtain real-time status of the ICS network. The SNMP driver will be based on a socket driver that we are developing to make non-EPICS systems easy to integrate into EPICS. The first half is nearly complete. The connection to SNMP remains.

Conversion of the BNL development environment continues. All BNL software development efforts have been converted to R3.14.4, and most have been checked in CVS as well, the remainder will be checked into CVS within a week.

The latest shipment of V108S utility modules has arrived at BNL. 10 modules have been successfully tested, and will be shipped to ORNL early next week. The remaining modules will be acceptance tested over the next few weeks.

We have now installed all the communications cables that we can in the Klystron Building. We will continue this installation effort after more racks get installed. Testing of communications cables in the CCL is in progress. Testing of SCL communications cables should begin next week.

## Installation

Craft Snapshot 1/6/04

ASD productive craft workers	53.0
Foremen (Pd by 15% OH)	6.0
AMSI management (Pd directly)	3.0
TOTAL AMSI WORKERS	62.0
Less WBS 1.9, 1.2 etc	6.0
Less absent	2.0
TOTAL PD BY ASD/ORNL DB WPs	45.0

## Operations Group

### Accelerator Physics

S. Kim has performed thermal analyses of energy degrader/faraday cups for DTL commissioning. He finds for DTL3 ED/FC a maximum allowed rep-rate of 0.5 Hz, and 30 microsecond pulse length. For DTL4-6 the maximum rep-rate is 0.3 Hz. Discussions continue regarding potential improvements to increase average power-handling capabilities.

S. Cousineau has been benchmarking ORBIT's longitudinal impedance routines against measurements and other simulations performed at the PSR. This work is in response to an ASAC recommendation. Good agreement in mode spectra is obtained. Work continues.

Electron-cloud simulation efforts have obtained better agreement between the ORBIT e-cloud implementation of secondary electron emission and that obtained by Furman and Pivi.

Polarity and Magnet hookup tables have been generated for the Linac, HEBT and Ring. These are undergoing internal quality control and will be disseminated shortly.

Magnet mapping information for the 21Q40's in the ring has been received from BNL and added to the database. After adding the magnet equipment table to the database we will be able to use this information to realistically model the effect of the quadrupole errors on the ring performance. As information becomes available for the other magnets we will add them to our model. The goal is to have a model that uses as-built magnet parameters for each magnet.

The code to generate MAD input files from the database is now up and working. We are testing it using the HEBT as an example.

Work has started to realistically model the radiation generated by the ring injection dump. We are now gathering data on the beam line components.

We received Cryomodule MB05 from Jefferson Lab. Being inspected.

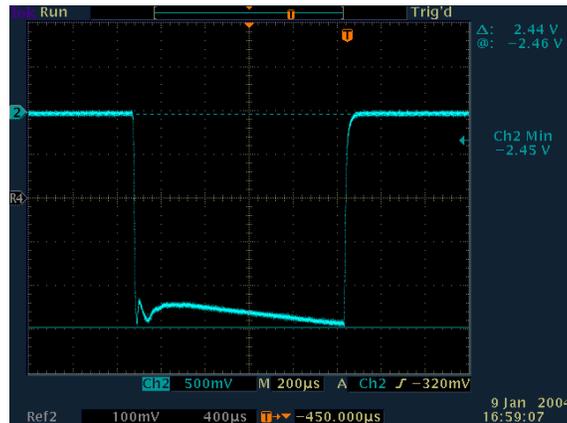
We performed measurements of ambient magnetic field in the linac tunnel at the location of existing and future Cryomodules. The data are being evaluated.

### Ion Source Group

Thanks to a monumental effort by the controls group, the computer control for the hot spare stand is about 50% complete. This is a very difficult task, as we keep discovering, because RF fields inside the Big Blue Box tend to upset some of the control units. In addition, LEBT sparks resulted in very frequent trips of the RF amplifier. Improved grounding and shielding apparently solved the problems as the system is now running stable without a single trip for more than 30 hours.

The controls group made it possible to observe the H- current extracted from the hot spare stand online within the Oak Ridge reservation by connecting to <http://192.168.240.22/>

As the picture shows, this Friday at 16:59, the website indicated 1 ms long pulses with a pulse current of approximately 46 mA. This is the highest current so far transmitted through the new hot spare LEBT that was installed in November. Over the last three days, the source operated for about 35 hours, being switched off during Wednesday night, and then tripping off Friday morning due to an interruption of the cooling water supply. As designed and tested, the drop in cooling water flow switched off the RF amplifier, thus preventing any consequential problems.



### Survey and Alignment Group

In preparation of the final placement and alignment of DTL Tanks 1, 2, & 3, we will begin a network re-observation campaign in this area. This campaign is expected to last for 7 – 10 days. At the conclusion we will have the necessary data to position DT components to their “ideal location”.

All drift tubes with the exception of two (in LANL for rework) have now been fiducialized.

This week, the S & A Group met with the Instrument Group to present our findings on why the site surveyor’s tank location for beamline 2 was different from ours by approximately three inches. The conclusion; drawings used by the site surveyor did not reflect the 0.024 degree rotational and 0.125 inch translational change of the core vessel. Since the poured in place stands have already been set, our findings are being discussed with the beamline scientist to determine a resolution.

S & A measured the momentum collimator for location in the “Y” plane. The momentum collimator was initially set five millimeters high to allow for deformation brought about by the immense amount of weight. Upon the completion of the stack-up of the collimator plates and shielding, we find the upstream end of the collimator approximately three millimeters above design value and the downstream end of the collimator approximately two millimeters above design value.

We laid out all magnet centers in RTBT to facilitate wire pulling.

Continued mapping 21Q40 magnets.

### Mechanical Group

208 out of 210 drift tubes are in-house from LANL. The final 2 are on their way.

Installation of Drift tubes in DTL2 has begun. There are now 27 out of the 47 drift tubes installed in DTL2.

DTL1 has been surveyed and consensus is that it is ready to be closed up for a tuning check.

DTL3 is ready to be surveyed. It has new EMD and BPM drift tubes installed.

DTL4 has been surveyed and had its preliminary tuning done. Post Couplers and Slug Tuners are being manufactured.

CCL-1 initial vacuum leak testing has found several leaks in the o-ring joints between the bridge couplers and the segments. Repairs are in progress and will continue through next week.



CCL-1 Vacuum Leak Testing

#### Ring Systems Installation

- The HEBT momentum collimator shield block installation was completed.
- The RING Half-Cell assembly #16 was received.
- Installation of the magnet cables from the Ring Service building to RTBT was started.

#### Water Systems Installation

- Installation of DI water piping on the second half of SCL ME-02 (SCL-TRCC4) continued.
- Installation of DI water piping from the facility headers to the SCL ME-03 (TRCC-05 & TRCC-06) skids was completed.
- Installation of DI water piping on the CCL-01 klystron continued.
- Installation of DI water piping on the CCL-03 HVCM was started.
- Fabrication of the QMCS piping manifold was completed up to CCL4 module

#### Magnet Task

We have now completed all but six DTL PMQ measurements. The remaining units are for DTL Tank 6.

We completed mapping another HEBT 21Q40 for a total of six so far. We need two sets of four. The data indicates two sets of two that are matched close enough to be on common power supplies.

We are also pressure and flow testing CCL Quads as they arrive.

#### Electrical Group

We continued to operate DTL-ME3 without incident over the holidays. The system will not be operating next week due to the water outage. Completed checkout of CCL-ME2, and plan to begin checkout of CCL-ME3 after tower water becomes available again. Performed modifications to DSP code to modify start pulse durations for SCL-ME1, and we believe we now have a sequence which will allow us to operate the SCL HVCMs to full average power. Received most of the parts for a pulser we are building for LBNL to develop a future ion source and expect to deliver it in February.

## **HPRF**

Six more pipes to install and the CCL1 klystron system will be piped, electrician's work on this system is complete, waveguide modifications and connections will continue into next week. RF is expected the last week in January. Group is catching up on tasks delayed during the SCL RF checkout last month. No resolution on the MCI bellows issue.

Pipefitters have finished piping another 6 SCL klystrons and waveguide systems; they are starting on the next 6 pack Around the 8th of March checkout of another 12 klystron should begin.

### SCL RF Systems

The hand-off from LANL of first two SCL transmitters (twelve 550 kW klystrons) was completed by Dec 19<sup>th</sup>, 2003. Two components failed during first high power testing (a klystron magnet power supply and an interface PCB) and are being shipped back to the transmitter vendor for warranty repair.

Interference was noted on HVCM power supply diagnostics that was traced to a measurable leakage of rf power along the seams of flexible waveguide (bellows) near the klystron output. The bellows were replaced with units from another manufacturer. This eliminated the rf leak and the interference. LANL is investigating the problem with the first vendor.

Six coax cables have been ordered to connect the solid state amplifiers front panel "Klystron Reflected Power" output to the single rf detector on each of the 14 transmitters. This is necessary to provide protection to the klystrons from excessive reflected power.

### CCL RF Systems

The electrical cable pulls are complete for all CCLs.

CCL-1: Water piping from the klystron connections out of and around the lead shielding of Thales 5MW klystron (#3) was completed. Drawings of the waveguide air-cooling system were completed. The pipes from the water loads and collector to the cooling cart are made up. Pressure testing will be performed the week of 1/20/04 because of water system upgrades.

Electrical power has been turned on at the CCL-1 transmitter control rack. The transmitter checkout procedure will begin next week.

Measurements of the phase difference between the two waveguide legs that power CCL-1 were performed. Tuning posts were fabricated to bring the phase into rough agreement. The remotely controlled waveguide phase shifter will adjust the phase finely during operation.

## **LLRF**

### **Cryosystem Group**

The cooling tower water has been turned off at the building isolation valves. All the CHL water piping has been drained. All the water piping to the warm compressor oil coolers has been removed under the direction of Ken Kreinbrink from PHPK. Monday morning the rebuilding crew arrives to remove the oil coolers and modify the cooler seals.

The shield leak has been repaired and the circuit has passed the pressure/leak test. Work continues on installing the 1/4" orbital welding for the warm gas piping.

Work has started on the fabrication of the cold box room "U" tubes

Cryomodule M-05 was received last week from JLab and installed in the tunnel.



**Beam Diagnostics**