

## **Accelerator Systems Division Highlights Ending February `13, 2004**

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

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

Accomplishments This Week: Two fully conditioned CCL windows were taken off the LANL high-power test stand. They are ready to be packaged and shipped to ORNL.

Concerns & Actions: (1) LANL has a backlog inventory consisting of three Thales 5-MW CCL klystrons and four Thales 550-kW SCL klystrons that need site acceptance tests at LANL. Work should resume next week as we bring both HV converter modulators back online. To recover lost schedule, we have started converting the 402.5-MHz transmitter into an 805-MHz system; this will enable simultaneous testing of two Thales klystrons. Two-shift and weekend operation is also planned. (2) We have an agreement with MCI (an SCL waveguide supplier) to honor warranty claims for the leaky flex waveguide sections. MCI will supply replacement straight sections, and will reimburse the project for the purchase of fully compliant flex sections. The ORNL installation schedule will be met and there will be a no additional cost to the project.

#### HIGH-VOLTAGE CONVETER MODULATOR (HVCM) (WBS 1.4.1.2)

Accomplishments: (1) The LANL HVCM was overhauled and reinstalled onto the LANL test stand. Modifications include new boost transformers with production HVCM mechanical supports. (2) IGBT driver cards on the LANL production HVCM were retrofitted to enable quicker IGBT turn off. We believe this will prevent potential shoot-through failures.

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

Accomplishments: (1) 20 (of 23) Tank-2 post couplers were completed and shipped to ORNL. The remaining 3 should be dispatched on 2/14 or 2/16 as soon as shipping containers come back from ORNL. (2) Drift tube 2-02 was electroformed, finish machined, straightened, and sent to LANL on 2/13. It will be baked for 8 hours at 110-deg C tonight. LANL will perform vacuum leak checking, cleaning, and packaging on Saturday 2/14. Drift tube will be shipped on 2/14 with delivery to ORNL on Monday 2/16. (3) Drift tube 6-17 was electroformed and is now at CMI for finish machining. It should be completed next week. (4) 17 (of 27) Tank-4 post couplers can be assembled and are ready for shipment to ESCO for final e-beam welding.

#### COUPLED CAVITY LINAC (WBS 1.4.4)

Accomplishments: CCL Module 2 was crated and was scheduled to be shipped from Germany today. Arrival at ORNL is scheduled for Monday 2/16/04.

Concerns & Actions: ACCEL has fallen behind schedule on Modules-3 and 4 by approximately one week each. (1) Resource conflicts during the crating of Module-2 have slipped the Module 3 shipment from 3/12 to 3/19/04. Some recovery might be gained by reversing the vacuum tests and the tuning. LANL will be at ACCEL to oversee tuning on 3/3/04. (2) A handling accident this week by ACCEL has resulted in the loss of the first Module-4 segment. Four half cells will need to be rebuilt from scratch. To minimize impact, ACCEL immediately arranged with their suppliers to rebuild the half cells. Current forecasts show a slip in the shipment date from 4/8 to 4/12/04. ORNL installation schedule can probably accommodate the delay, but it will cause a cost variance from the LANL standing army (of 2 FTEs).

#### PROJECT MANAGEMENT (WBS 1.4.5)

Los Alamos SNS Division will disband in 49 days. We are working with SNS-ORNL on closeout issues. Considerable progress in contract novation and transfer was made. Approximately one half of the 24 contracts that require transfer of the files to ORNL were completed.

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

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

As part of a C-AD/SNS reorganization, it was announced this week that Tom Russo will assume responsibility for SNS Diagnostics Group, reporting directly to C-AD's Chief Electrical Engineer, Jon Sandberg.

Tom Owens is at BNL to assist with HLRF testing.

Half-cell #21 was shipped to SNS/OR this week. Work continues on the assembly of HC units #22 and 23.

Conducted a design and layout review of the injection dump line to resolve the 3/4" interference between the dump septum chamber and the chicane #4 chamber.

The vacuum pipes for the two RF doublet magnets have been TiN coated.

Leak checking of the chicane vacuum chambers is underway.

We conducted an internal review of beam line / vacuum chamber equipment for the various Diagnostics' systems.

Lifting fixtures for the quarter cells and RF cavities are being checked against actual crane dimensions.

IE Power (PS vendor) has three (3) 185A power supplies, two (2) 390A power supplies, and one injection bump power supply ready for shipment to SNS/OR next week.

BNL and Oak Ridge engineers will visit Alpha Magnets next week for a pre-award meeting and design review of the extraction Lambertson magnet.

The first article production PFN is ready for tuning. ASD's Ken Rust will witness and assist the BNL team. One of the terminating resistor rings in the 1<sup>st</sup> extraction PFN found to be cracked. Thus, we plan to request that the second unit to be shipped to BNL instead of ORNL for further tests and inspections.

Measurements of the 30Q44 (12) have resumed. One magnet is complete and a second is being set-up for testing.

Alpha Magnetics delivered the seventh of nine 26S26 magnets for Ring assembly. The remaining two are due in late February.

## **Controls**

Work proceeded on the three step conversion process for all IOCs required for the upcoming DTL 1-3 run: 1) implement EPICS v 3.13.9 in the easiest way possible; 2) implement a standard EPICS "make" mechanism; and 3) implement EPICS v3.14.4. The first step is complete for all but eight IOCs. All three steps are complete for eight IOCs. There remains much to be done.

Test plans for most controls subsystems were updated and submitted this week. There is more work to be done on the MPS, Timing and IOC test plans – they will be submitted early next week.

Testing of DTL power supply control began this week. Some fiber communication issues remain to be addressed. Cooling water is connected and flowing. A first DTL power supply screen became operational.

Testing of CCL ICS communications infrastructure continues. Preparations were made for preliminary testing of the EPICS communications with vacuum system remote I/O and with vacuum controllers.

Tests on a fiber-to-fiber fanout prototype printed circuit board revealed a few problems and it will have to be rebuilt. Testing can continue with cut traces and wire jumpers added. An Integrated Circuit that was ordered overnight Thursday was apparently lost in shipment and the vendor will be sending another 10 for delivery Monday morning. This work is critical to an early decision on whether or not to build fiber or copper timing inputs for the Diagnostic NADS.

As requested by ORNL Diagnostics, the Analog Front End (AFE) Labview software for testing and calibration was enhanced at BNL to use XML for storing test results. The Diagnostics team at ORNL is confident that this will facilitate importing data into Oracle. Additional changes were required for this software to accommodate interface changes to the AFE chassis.

The Front End Test Stand continued a long-term high-intensity run under computer control this week. Remaining control system interface work was addressed at the bi-weekly status meeting. The LEBT controls remain to be interfaced, and there continue to be EMI noise in the timing system.

The Vacuum Controls FSD was updated to include all new requirements and decisions from our video conference series. An FSD and drawings defining design data for the Collimator Cooling Water System was issued and cable could now be pulled.

A work package defining configuration changes to MPS input cabling (required for DTL1/2/3 operations) was issued to Controls Group technicians. This work addresses several issues, including differences between D-Plate and DTL1/2/3; changes in strategy for diagnostics inputs and MPS equipment that wasn't there earlier but is now.

A naming scheme for "summary PVs" was proposed and is under discussion.

An initial test of the SCL vacuum control system was made. The IOC software with Utility module, VxStatus, Vacuum device serial driver, and Beckhoff Interface has been built and is on-line.

### Installation

Craft Snapshot 2/10/04

ASD productive craft workers	<b>57.0</b>
Foremen (Pd by 15% OH)	7.0
AMSI management (Pd directly)	3.0
TOTAL AMSI WORKERS	67.0
Less WBS 1.9, 1.2 etc	<b>6.0</b>
Less absent	<b>2.0</b>
TOTAL PD BY ASD/ORNL DB WPs	<b>49.0</b>

### Accelerator Physics

We have completed a set of simulations of magnet alignment errors, based on realistic alignment tolerances including roll, pitch, yaw, transverse misalignments, and also including simulated beam position monitor errors. In some cases the uncorrected beam loss is as high as 50%. But even in this case after correction using the as-planned correction magnets, the beam loss drops to less than 0.02%, which is five times better than specifications.

We had another target interface meeting this week, where we discussed proton beam window failure scenarios. In the worst-case scenario up to 110 gallons of water can be deposited into the RTBT beam line. Both ASD and the target systems group are working together to mitigate this scenario (the target systems group is working to minimize the water volume, and ASD personnel are working on methods to clean up after a window failure). We also discussed similar failure scenarios for the ring injection dump vacuum window.

Work is underway to prepare for the ASAC review in March.

### Operations

#### Ion Source Group

The current extracted from the hot spare ion source is now being monitored by a "black box" PC from diagnostics. In addition, the diagnostics PC monitors the extractor current, because its 2 MHz sample rate allows for capturing the fast transients induced by sparks. Capturing and time stamping undesirable discharges will eventually allow for categorizing sparks and for prioritizing counter measures accordingly.

An exhausted hydrogen bottle prematurely terminated an otherwise successful ion source lifetime test. The eighty hours of ion source operations at ~40 mA with full duty cycle were preceded by a ~200 hour ramp-up of the duty cycle. All in all, the ion source was operated for the equivalent of 7 days with a 6% duty cycle.

The exhausted hydrogen bottle caused the mass flow controller to malfunction. A replacement has been ordered. The original controller has been returned for repair. When repaired, it will be used to integrate standard size Hydrogen bottles on earth ground. About six month ago we adapted upgrade plans that include standard size hydrogen bottles located outside the big blue box because it simplifies operations and eliminates several safety concerns.

The high voltage gradient inside the de-ionized water system induced a spark that produced a pinhole leak in the plastic tube of the hot spare stand. Installing metal unions in the plastic hose eliminated the problem, which was successfully tested on the front end. The unions relocate the internal water high voltage terminal closer to the outside high voltage terminal.

An AC contactor in the @MHz amplifier failed. A replacement has been ordered and will be installed as soon as received.

It was decided to integrate the fiber receiver in the 2MHz pulse generator. This should eliminate the problems encountered with the timing on the ion source hot spare stand.

### **Survey and Alignment Group**

Set the elevation on the half cell plates in super period "C". We are now waiting on Ray S. to grout and mount the jacks so they can next be set in elevation.

Re-verified the elevation of the momentum collimator. Based upon our settlement calculations, the assembly was originally set nearly 10 millimeters high with respect to beam to counter settlement. This week's measurements indicate that the momentum collimator is now within 2 millimeters of ideal height.

Laid out nearly 100 bolt holes in the south straight section.

Based upon information received from BNL last week we are completing calculating the ideal positions for all half cell assemblies now received.

Fiducialized the following in magnets this week:

- Two CCL quads (total now fiducialized approximately 32)

- One 8Q35 quad

- Pre-positioned for fiducialization one additional 21Q40 magnet (total fiducialized 10).

Re-validated the alignment of DTL-3 Tank Assembly

Laid out the floor bolt holes for CCL Module 2

Finished the chopper cavity for BL 1 and laid out the three points that were requested by the people in instruments.

Measured the angular variation on the bulk shield liner flange for BL 2.

Completed "as built" measurements on of the chopper cavity for Beam Line 4. The chopper cavity profile was significant data for the engineer of this beam line due to the limitation of space that is available for his components. Since this is a multi-channel beam line, space is limited. Knowing now where the chopper cavity is with respect to his beam, redesigns can be made in their components to fit the allowable space. Beam line 2, we will begin to lay out the new tank location based on his revised drawings. The site surveyor will be given the same task so this will be a good verification. We also checked orientation of the bulk shield liner flange for this beam line.

Completed pre-analysis to design the Target-Linac ties, taking into account the new line-of-sight restrictions. We began performing observations for this campaign. The purpose of this campaign is to verify that the re-observed Linac network is still properly oriented relative to the as-built target center. We worked with other groups to ensure that several line-of-sight obstructions were moved or removed, including transformer cables, shielding above the DTL hut, and DTL2 itself.

Most of the S&A group also performed LOTO safety training this week

### **Mechanical Group**

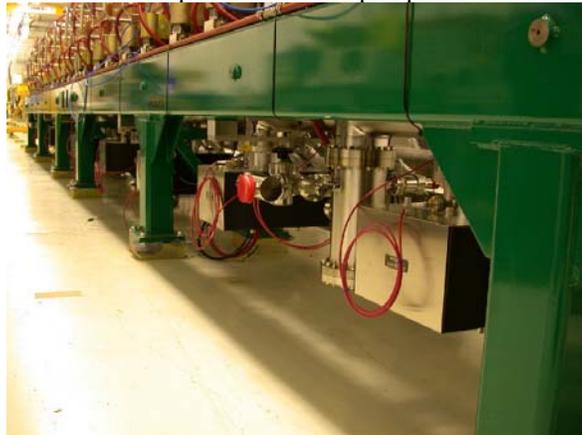
DTL-1 has been declared as acceptable by our tuning contingent. We have re-installed the valve between it and the MEBT and will resume leak checking in the near future.

Slug Tuners have been installed in DTL-2. The 3 removed drift tubes have been re-installed and we are awaiting the one under repair. The tank is now in the Linac tunnel. We put it on line, set the floor anchors, and then moved it back to the isle for further work.



The DTL-3 EMD's have been tested and worked properly. The tank tuning tests showed some unusual results and we are attempting to understand these by putting a few adjustable post-couplers back in the tank. The field flatness will be re-tested.

CCL-1 vacuum system installation is 90% complete. The NEG pumps are all that remain to be installed.



CCL-1 Vacuum Pumps

CCL-1 module cooling manifolds have been installed. Connection to the facility pipes will be done next week.



CCL-1 Cooling Manifolds

#### Water Systems Installation

- Installation of DI water piping on SCL ME-03 continued.
- Installation of DI water piping from the facility to the SCL ME-04 TRCC8 cart was completed.
- Installation of DI water manifolds on CCL1 module were completed.
- Installation of DI water piping to the CCL2 RF loads and circulators continued.
- Fabrication and installation of the QMCS manifold in the Linac tunnel continued.

#### Ring Systems Installation

- The RING Half-Cell #21 was received and staged in the tunnel.
- The HEBT Momentum Collimator was received and staged in the tunnel.
- Three RTBT magnet support stand assemblies were received and staged in the tunnel.
- Installation of the Arc C Half-Cell support stands continued.
- Installation of PPS system conduit was started in the HEBT,

Final flushing of the RING Systems' DI cooling loops by the installation contractor continued.

#### Magnet Task

This week we were shut down for 2 ½ days due to the DI water outage. We have mapped two more CCL Quads and one more 21Q40. We now have strings of 3, 2, 3 matched and we need 4 and 4.

We are also working on CCL intersegment assembly planning.

#### Electrical Group

The majority of the week was spent preparing DTL-ME1 and -ME2 for operation late next week. In addition to rebuilding the switch plate assemblies, we also have to modify the modulator tank plumbing to ensure adequate flow to the boost transformer region. This has been completed on DTL-ME1 and is in process on DTL-ME2.

We continued to take switching time measurements on DTL-ME3 for comparison and modeling purposes. Also, we started checkout of CCL-ME3 this week, and expect to apply high power next week.

#### HPRF

Four 3-hole SCL klystron HV tanks were prepared in the RFTF and moved to the Gallery. Twelve klystron/magnet assemblies were fork-lifted into the tanks. The tank/klystrons assemblies have been made available to the Installation Division in preparation for the pipe-fitter work.

The 5MW klystron in the CCL-1 RF Station was brought up to 3700 MW at 20Hz with a 1.5 ms pulse width (1ms rf) running into a shorted waveguide that reflected power back through the circulator and into a water load. This peak power level is 20% above that required for the CCL-1 structure. One arc was encountered at 2700 kW within the circulator, but the system ran steadily after that. The LLRF High Power Protect Module (HPM) was set to shut down the system on the first arc and it performed well. The timing and pulse width were controlled from EPICS. We will complete cleaning the flanges for the remainder of the waveguide system through the phase shifter and hybrid splitter down to the tunnel and repeat the power test. CCL-1 HPRF testing resumed Friday morning, the intent is to power the entire waveguide runs, shorts are on final waveguide pieces located in the tunnel.

All of the HPRF bar-coding labels have been installed through DTL6 as well as the SCL MB1-4 systems and the corresponding equipment descriptions have been entered into the BC data base.

Thales reports our prototype 402 klystron (a back-up for the E2V unit) had an internal oscillation in preliminary tests. They are reviewing their design codes while awaiting use of the test stand that is presently in use by our 5MW tube.

A phone conference between Thales and ORNL was held on the 13th concerning the TH-2177 klystron. Their simulations revealed the presence of a Monotron oscillation in the 4th cavity. They will send us the results of their simulations and their plans. The TH-2177 tube will be returned to the test stand and experimental measurements will resume on 1-March-2004. Mike McCarthy and Paul Tallerico will be present at Thales when testing resumes on the 1st.

MCI was given a list of replacements waveguide pieces needed for completion of the remaining 18 HB runs. On March 8, 2004 we will have enough replacement pieces to finish 4 more waveguide runs and every week thereafter we will receive enough pieces to complete 4 more runs, until the order is filled.

A list of replacement waveguide pieces for HB-24 to HB-63 waveguide runs was provided to LANL for presentation to MCI, we expect these parts to arrive after the 1st order is complete.

## **LLRF**

### **Cryosystem Group**

Compressor #5 has been operating this week in conjunction with the purifier to heat up the oil and drive off the H<sub>2</sub>O that was absorbed when the oil cooler seals were replaced. Conditioning is going very well and we expect the compressor oil to be dry some time next week.

The motor on compressor #4 was unable to start this week. The problem was traced to a faulty CT in the switch gear. The replacement parts are on order.

Work continues in the tunnel on orbital welding the instrument tubing for the warm gas header.

We have started to assemble the cold box "U" tubes, and are awaiting the final designs for the dummy Cryomodule.

### **Beam Diagnostics**