

## Accelerator Systems Division Highlights Ending April 16, 2004

### ASD/LANL: Warm Linac

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

Accomplishments This Week: (1) *805-MHz, 5-MW Thales klystrons:* We completed testing the 3rd 5-MW klystron. Klystron was tested to full 5 MW of peak power at full duty factor. The next 5-MW klystron, number 4, was dropped in the socket and the assembly of the shielding was started on Tuesday. (2) *805-MHz, 550-kW Thales klystrons:* We completed testing of 2 Thales 550-kW klystrons. They tested with efficiencies of 61% and 64% respectively. The testing of another Thales 550 kW klystron was started on Tuesday April 13. The last 550-kW klystron has completed factory tests. (3) *ORNL Installation support:* The first LANL 3- person installation team at ORNL from March 29 to April 9 accomplished their activities quite successfully and to the satisfaction of the ORNL personnel. There was a switch over of the LANL teams over the weekend. Currently we have 1 technical staff member and 2 Techs out at ORNL supporting the start up of CCL - 2 and SCL 13 - 24.

Concerns & Actions: Currently we have one broken and one functional converter modulator at LANL. We are hoping to have the broken unit repaired by next week.

#### COUPLED CAVITY LINAC (WBS 1.4.4)

Accomplishments: (1) Module 3 was delivered to the SNS site Tuesday afternoon from Atlanta. During the evening we opened all the crates and staged the equipment (segments and bridge couplers) in the end of the tunnel. Wednesday morning, April 14, the support stands were set into position and the crew began the leveling and alignment process



Figure 1 Unloading CCL unit 3 at ORNL

Module-4 is on schedule for an April 23 ship date from ACCEL and arrival at SNS on Monday the 26th.

### ASD/JLAB: Cold Linac

Assembly of the H-1 cryomodule continues. The cold mass has been transferred to the space frame (see photo).

Testing of the M-8 cryomodule is complete. All cavities substantially exceeded their performance specifications. Final LLRF tests and a trial of 4.5 K operation were also successfully concluded. The module is being warmed in preparation for shipment to ORNL.

Assembly of the H-3 cavity string is complete. The fundamental power coupler processing team is at ORNL to process couplers for the H-4 string, which is scheduled to begin assembly April 26.



### ASD/BNL: Ring

While ASD was busy with DTL beam commissioning, we at BNL/SNS were watching the live pulses recorded on the BNL BPM electronics via IP link. Jie Wei sent a snapshot from one of our local PC's to ASD. Congratulations to all!

Tom Russo and Craig Dawson (Diagnostics Group) traveled to SNS/OR this week to support the beam commissioning effort.

Lorelei Smart (Vac Group) was at OR this week to assist with rack wiring for vacuum controls.

We measured the first of two chamfered 30Q44 magnets. The harmonics after machining are about the same as before, well within variations expected from a disassembly and reassembly operation. The ITF at low fields is also reasonably the same but the saturation at higher fields is increased. AP is investigating with A. Jain.

Bend angles, radii, trajectory center points, mechanical geometry, and beam line trajectory are being finalized for each of the four Chicane magnets to finalize the lattice drawing and provide accurate placement for the mock-up installation layout that is underway in B905.

In support of ASD's Installation Schedule, design effort on the installation drawings for the Injection straight section elements has been given top priority in our design room.

The first injection kicker magnet assembly is being prepared for shipment to ORNL. This assembly is the upstream short magnet and consists of a ferrite core and ceramic vacuum chamber. We have taken several extra measures to secure safe shipping. For this first unit delivery, we will send a technician to help off-load, inspect, remove the safety measures and help set the magnet in its final configuration. Included in the shipping container are: the upstream kicker magnet assembly, support stand, lifting fixture and power supply; also included are vacuum chambers for the Ring system and assorted magnet hardware from our Shops.

The two injection dump septum dipoles finally arrived from our vendor, NETC. Arrangements are being made for electro-mechanic inspections and acceptance testing.

IE Power is shipping six (6) of the 390 amp power supply units and four (4) of the 700 amp units to SNS/OR this week.

Preparations are underway to ship the first of two RF systems to SNS/OR; the second complete RF system will be shipped shortly afterwards.

Half-cell #25 was shipped this week to SNS/OR. Work on HC #26 is progressing well.

IE Power is working on the acceptance punch list for the Ring dipole high field power supply. The next acceptance test is scheduled for May 25<sup>th</sup>.

Our vendor, SDMS, shipped Ring #2 and #3 collimators to SNS/OR this week. In addition, they shipped the vacuum chamber for the Ring Primary Collimator to BNL for NiT coating. We will coat the chamber and return it to SDMS within six weeks for final assembly.

Two more PFNs for the extraction kicker magnets will be acceptance tested at APS next week. These units will then be direct shipped to SNS/OR.

We are working with Danfysik to resolve the output stability issues seen on the dynamic tuning PS for RF#3. Unit #1, now at SNS/OR is also suspect and will be returned to BNL for vendor repairs.

Chicane #4 is being magnetic measured in the B902 magnet factory.

The lifting fixture for our quad doublet assemblies is complete and ready for Safety testing, scheduled for later this week.

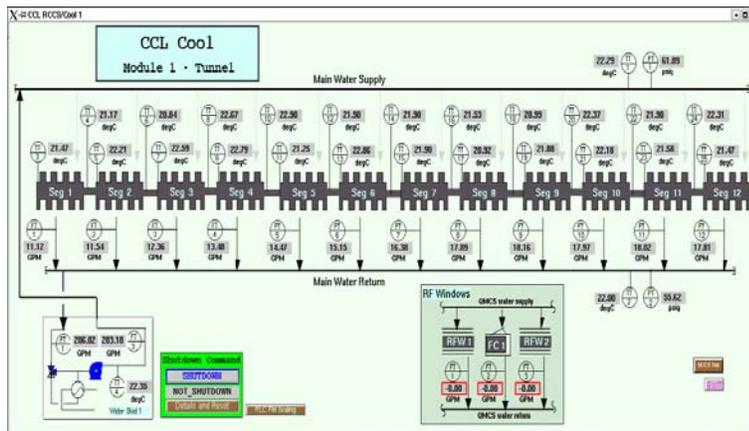
## Controls

The Control System was ready for the start of the DTL1-3 run this week, and has run well during the first week of the run. Vacuum and RCCS functional tests had been completed the previous week with help from visiting LANL control system engineers. The RCCS system continues to be a problem – not surprising as no changes have been made since the last run. Noise issues continue to effect beam instrumentation; these are addressed case-by-case. There has been no recurrence of “IOC Disease,” although configuration control of archive request files (which was a contributing factor) is a continuing issue. The new archiver, which will be deployed for the next run, is running in parallel and performing well.

The Front End Control Room was modified to increase the work space and add more operator interfaces (OPIs). Two OPIs were added to support Operations and Control System personnel.

The Cryogenic Control System was also ready for start-up of the 4K cold box in the CHL. The system worked as expected, although one IOC had to be replaced after a second failure (at the canonically expected time of 3:00am.)

The Phase 1 Lite PPS was certified for operation. This phase provides access control for the portion on the Linac east of the DTL hut gate to the Linac/HEBT gate and will provide PPS control of the RF to CCL1. The Control System was also ready and all tests completed and signed off in time for processing of the first CCL cavity, which began this week. Sample screens are shown below.



## Installation

Craft Snapshot 4/13/04

ASD productive craft workers	<b>63.0</b>
Foremen (Pd by 15% OH)	6.0
AMSI management (Pd directly)	3.0
TOTAL AMSI WORKERS	72.0
Less WBS 1.9, 1.2 etc	<b>4.0</b>
Less absent	<b>2.0</b>
TOTAL PD BY ASD/ORNL DB WPs	<b>57.0</b>

## Accelerator Physics

The accelerator physics staff is playing a significant role in the DTL1-3 beam commissioning, in the roles of organizing shift activities, manning shifts and testing software. The commissioning to date is going well, with generally stable beam. Beam was transmitted through DTL3 on the first shift that attempted it.

Application software has been tested and is in use. This includes a new wire scan application to facilitate the running of profile scans and logging data, a new client-server based MPS post mortem service, the new orbit display and scanning software for setting cavity phase and amplitudes.

Sang ho Kim won a national award for outstanding young Korean physicist.

Tested cryomodule M8 with cavities exceeding specifications considerably (16, 18, 20 MV/m).

Mark Champion concluded the LLRF production unit tests at 2 K successfully.

The test at 4.2-4.5 K was performed successfully at JLAB: reached 13.5 MV/m over 300 microseconds incident power pulse and controlled at 10.3 MV/m. No limitation was observed. The test was contained to those field levels to avoid any possible question of quench. This proves that tests at 4.2 K in tunnel would at least yield information about meeting minimum field requirements

Coupler conditioning at ORNL will resume late Sunday or Monday morning. One set of two high beta couplers is being baked now and one more set will arrive Monday morning. The two sets, necessary for the next HB cryomodule string assembly, will be shipped back to JLab early the week of April 26.

A radiation issues video conference was held Apr. 5. The issues discussed were radiation levels, both prompt and residual, at the end of the RTBT and in the ring injection area. Model results were presented by both BNL and ORNL for the RTBT area. More work is needed to make an accurate prediction of the radiation levels. Updated model calculations are now underway. Preliminary results for the ring injection area were presented by ORNL. The radiation levels in this area are higher than were initially believed because up until this time there had been no detailed model calculations. Detailed calculations are now underway in this area.

An XFD/ASD interface meeting was held on 13/Apr/04 to discuss the injection dump thermal performance. Previous model calculations only considered an on-axis beam, but the Parameters List calls for a beam up to 5 cm off center. After modifications to the vacuum window and the beam dump front plate the system can now accommodate 5-cm offset beams with the nominal power density (0.028 A/m<sup>2</sup>), but not with the full power density of 0.048 A/m<sup>2</sup> called for in the Parameters List. Work is now underway to determine the maximum reasonable power density.

Planning is underway to move the wire scanner in the HEBT arc from a point of low-dispersion to a point of high dispersion. This will allow the wire scanner to fulfill its intended mission in life -- a measurement of the energy spread in the beam. The new location is near QH16 in the HEBT arc. The old location is near QH12.

## **Operations**

Turned on Front End and DTL Tanks 1-3 on Monday and prepared systems for commissioning studies.

On Tuesday, early in the afternoon we achieved 100% beam transmission to the DTL3 Beam Stop.

We are proceeding with the DTL 1-3 Beam Commissioning Plan.

We expect to finish DTL 1-3 Commissioning on or about April 26.

## **Ion Source Group**

The problem of the tripping RF amplifier has been solved by reconnecting the extra ground cable of the QEI pulse generator to the rack as it is too short to connect it to the ground bus. This was accomplished before DTL1-3 started. The event demonstrates that conditioning the RF and HV not simultaneously does not test full readiness. Full readiness testing requires a full-power beam stop in the LEBT.

At the end of the MEBT checkout, the ion source was cesiated, but failed to show an increase at the end of the cesiation cycle. However, tuning during the early part of DTL1-3 commissioning brought the BCM2 current up from ~10 mA to ~ 25 mA. Most of the time we need only ~20 mA, which requires only ~ 22 kW RF power. This makes us believe that the source is capable of delivering 38 mA when needed.

Around 2 AM on April 14, the 65 kV supply lost its ability to maintain 65 kV due to an excessive current draw. Through elimination, the problem was found to be the water-hoses that cool the ion source. Over less than year they accumulated an internal conductive coating. Replacing both hoses reduced the current draw to a fraction of a mA, consistent with ~2 Mohm cooling water. This caused a downtime of 2.5 hours.

## **Survey and Alignment Group**

Completed measurements of crane hook's elevation and trajectory as the crane traverses through the bending magnet areas. This information was requested by BNL.

Phase II of our global network measuring campaign in no in the HEBT. Over the next few days we will redundantly measure all HEBT survey floor and wall monuments. Upon completion of the HEBT, technicians will continue through the Ring and RTBT performing the same measurements. Our objective is to provide a new updated global survey network for the areas by mid to late May. This update is a precursor for the alignment of all HEBT and Ring Components.

The following measurements were requested by the ASD Design Group in support of the Diagnostic's Laser Project. These tasks include:

- The first job was the measurement of a penetration point in the front end required for the design and installation of laser equipment.
- The second task is the providing "as built" measurements of the laser boxes at the end of the LINAC.
- The third task is the alignment of the laser pick off boxes along the LINAC. There are approximately 12 of these units. We have been provided with necessary drawings and alignment tolerances.

All three tasks will be completed by early next week.

This week, S&A performed a series of tasks for the beam line 2 instrument engineer. In preparation for this job, Survey & Alignment set out set out the necessary references in January. This greatly simplified the task.

In completion of this assignment we first, marked the locations of the entrance and exit port flanges on the 2TU tank located at the downstream end of beam line 2.

Second, we verified the location of these ports once the port flanges were welded in place.

Finally, we set the sample center tooling fixture to its proper location. This sample center tooling fixture represents the experiment sample center when the beam line is operating.

Added last of the assigned CCL Quads to our database and drawings and placed all BPMs from CCL1 to 4. Generated Ideal elevation numbers for the CCL3 and CCL4 stands and segment supports, provided documents and instruction to our technicians.

Survey and Alignment completed field work for the annual elevation monitoring of all exterior global network monuments. Processing was also completed (rod temperature corrections), and a preliminary adjustment was performed using the inner-constraint datum. The adjustment passed the chi-squared test; in fact, only one residual exceeded 150 microns. Work has begun on determining a best-fit datum, to identify which monuments have been subject to deformation, and to best match previous years' elevations for the remaining subset of undisturbed monuments

#### FINAL WORD ON SETTLEMENT

The monthly RTBT floor monitoring survey was performed. An additional 2.0 mm of settlement occurred at the RTBT-Target interface (March 16 – April 12). The lowest point in the RTBT floor is now 5.2 inches below design elevation.

Processing was completed on the elevation monitoring survey for the HEBT and Ring floor monuments. A quick inspection still shows no obvious pattern of unusual settlement in the vicinity of the remediated construction-induced dropouts. A more thorough analysis will be performed next week.

#### **Mechanical Group**

##### Water Systems Status

- Installation of the piping for all of the RF equipment on SCL-ME3 and SCL-ME4 has been completed and leak tested. The SCR cabinets, HVCN modules, and the magnet power supply racks will be tied in once these pieces of equipment have been installed.
- TRCC-9/SCL-ME5 and TRCC-11/SCL-ME6 are staged and will be installed once space is made available in these areas.
- Assembly and installation work has begun on the DTL-6 tank manifold.
- Installation of the piping on CCL-2 has been completed and the system has been pressure/leak checked.
- The number of pipe fitters in the SCL area has been reduced from 8 to 6 while awaiting equipment placement and space availability.
- QMCS system has been running and adjustments made to assure proper cooling of the magnets on CCL1.

##### Ring and CF Interface Systems

- Piping has been received for the HEBT-SB piping for the power supplies. Installation can begin next week.
- The Collimator cooling manifold with remote connectors has been modified and pressure tested and is being mounted on the collimator.
- Have been working with DI resin vendors on the DI system for the SRF clean room to be installed in the RF facility.
- The collimator cooling system procurement process is on going, technical questions have been responded to, and the proposal closing has been moved to 4/29/04.
- Had the transition meeting with CF on the DI and glycol cooling water systems. A follow up meeting is next week and if approved the transition will start next week. This means money and manpower needs to be provided.

Modification to the bus bar flow diagram is being done to correlate with the electrical diagram.

##### Design Progress

RTBT/Target interface conceptual design continues – conceptual design presentation next week.

Ant-chopper vacuum vessel design & diagnostics conceptual design complete, detailing underway.

Laser reverse box & transfer line almost complete design.

Collimator bellows extraction mechanism conceptual design complete detail design underway.

21Q40 magnet measurements coil design complete, detailing underway.

Low energy differential pumping station design on-going.

After a very short time we were able to accelerate our first beam through DTL 1, 2, and 3 and put it on the beam stop on Tuesday afternoon. This took roughly two days of attempted operation and overall went extremely well. Beam operation and analysis continues on a 24 hour basis.

DTL-4 tank has been vacuum tested, RF tuned, and is essentially ready to be moved to the tunnel.

DTL-5 Slug tuners have been flow tested, measured, and installed. Post couplers were received today and are already being flow tested. These tuners will go to QA afterward and then be ready for installation next week.

In DTL-6 about half of the water manifold system was installed this past week. Slug tuners have arrived and will follow the DTL5 post couplers through flow testing and QA.

The Front End was brought into operation to support DTL commissioning over the past couple of weeks. This involved a checkout of all systems and operational tests to help "shake-out" any potential problems. The system came on-line and into operation very reasonably.

### **Magnet Task**

#### **Electrical Group**

Ten additional Ring Medium power supplies were delivered, bringing the total on this order to 28 delivered (of 77).

Integration tests on the first 3 CCL1 magnets and power supplies are complete, and integration tests on 8 additional CCL1 magnets and power supplies are in progress. All CCL1 magnets have their leads covered by plastic shields.

DTL-ME3 was taken out of service to support RFTF cryo coupler testing. CCL-ME1 was turned over to operations for RF conditioning. CCL-ME2 was checked out and configured to support RF testing scheduled to begin next week. SCL-ME1 was brought back online, and measurements were taken under different phased-back operational conditions. It was discovered that phasing back the devices results in voltage oscillations of the device, which can result in excessive switching losses. This needs to be better understood and mitigated before and modulation scheme can be applied. SCL-ME2 had its IGBT switch plate assemblies rebuilt this week.

All CCL1 magnet power supply in row CCL01 were terminated, inspected and made available for magnet test

HEBT AC prepared for main feeder pulls and terminations

Two sets of ring injection kicker cables pulls were completed

Part of the ring mezzanine racks were delivered to ring service building to liberate space in RATS2.

### **HPRF**

DTL - RFQ through DTL3 RF Stations are operating in support of beam commissioning.

CCL - CCL-1 RF Station Operating 5MW klystron in support of CCL-1 structure conditioning.

CCL-2 RF Station has water cooling connections completed, transmitter power and preliminary functionality has been verified.

Three person LANL crews have been leading the effort to bring CCL-2 & 3 RF Stations on line. LANL participation is helping us maintain the HPRF installation schedule.

SCL - SCL-1 RF Stations for MB1-4 are operating in the diode mode in support of HVCM testing.  
SCL-2 RF Stations: waveguide adjustments have been completed for MB 5&6, electrician work continues.  
SCL-3 & 4 RF Stations: Pipefitter work complete.  
SCL-5 RF Station: Adapter plates for Thales klystrons modified and in shop. Seven of eleven tubes are on site.

48 of 81 SCL klystrons installed.

RF technicians have started replacement of the leaky waveguide bellows in the HB Section.

MEBT- The new MEBT output circulator has been successfully tested to 15 kW into a short. We are arranging for a higher power source to test to 20kW before authorizing fabrication of four additional circulators.

RFTF – The 805 RF station is operating in support of cryo-coupler processing.

## **LLRF**

### **Cryosystem Group**

The Linde technical staff has arrived and is preparing the 4.5K cold box for the acceptance run. Before starting the plant all the cryogenic valves on the 4.5K cold box must be inspected, we are in the process of inspecting these valves.

Preliminary tests by the manufacturer of the sample feedthroughs for the cold compressor of the 2.1K cold box, indicate that the new batch of connectors will pass the cold shock and leak testing procedure. Full production of the 24 feedthroughs is scheduled to begin after all the samples have been tested.

All the open ports to the vacuum header and the cool down header have been sealed and the headers have been back filled with gas helium at 1 atmosphere.

Assembly has started on the cold box “U” tubes necessary to operate the transfer line to the tunnel.

Parts’ ordering for the dummy cryomodule has started.

### **Beam Diagnostics**

#### Willem Blokland

Work consists of assisting ORNL/SNS staff on the design, implementation, RF noise environment, and testing of the diagnostic instruments such as Beam Position Monitors and Wire Scanners. Experience with motion control, data acquisition, and Lab VIEW is required.

- 1) Work on commissioning wire scanners, bpm, and bcms.
- 2) Noise measurements on BCM with Craig and Coles.
- 3) Phase measurements on BPMs (rebunchers off and on).
- 4) Bump measurements for LANL/BNL electronics (Craig Deibele and Craig Dawson).

#### Dave Purcell

This week I have worked supporting operations, Saeed, Wim, and Craig in the commissioning efforts. I have also worked with Darryl on the BIW/EPICS paper. I have also met with Jeff Patton, Judy, and Brad and they are starting to move on various web/database issues.

#### Jim Pogge

The new biphas decoder logic appears to be running, on both the EL and RTDL channels. A digital pattern generator has been ordered and this will be used to thoroughly test the functionality of the system.

Andy Webster

I began the week working with Bill on wire scanner problems. I also worked with Craig to start terminations of BPM Helix in the tunnel. I finished updates to SCL cable pull sheets and went over them with Chris. I made a BLM signal interconnect drawing for the SCL BLMs to help with cable routing and termination. I created a conduit layout to be used for shielding BLM and ND cables. I worked on orders and that is about it.