

Accelerator Systems Division Highlights Ending October 3, 2003

ASD/LANL: Warm Linac

HIGH-POWER RF (WBS 1.4.1.1)

Accomplishments This Week: (1) The Thales 5-MW klystron for the CCL successfully passed its 24-h heat run (see below)! (2) CPI shipped SCL klystrons S/Ns 32, 33, and 34. (3) We witnessed factory acceptance testing of SCL transmitter S/N 10 (of 14).

Concerns & Actions: (1) The Thales 5-MW klystrons for the CCL remain our most important issue. Recent results continue to be encouraging. The first tube successfully passed its 24-hour heat run at full 5-MW RF output, 1.2-ms pulsewidth, and 60-HZ repetition rate. We are working on the efficiency and performing the remaining acceptance tests. Another Thales representative is at LANL working with us. (2) With the 5-MW klystron now operating, we have resumed testing of the 5-MW loads from Titan SureBeam, and found that the previously reported arcing problem is occurring on the flange near the o-rings. We also have an RF leak on the water pipe. We are working with the vendor to resolve these issues (3) Progress with the Thales 550-kW SCL klystrons is being made. Thales improved the efficiency to 63.5% but the klystron does not meet the linearity specification. We are still expecting to receive an updated delivery schedule for the remainder of the tubes. The four klystrons, S/N 1, 2, 3, and 6 are still in transit back to France. Also we have amended the Thales contract reducing their order from 23 to 15, and amended the CPI contract for SCL 550-kW increasing the order from 73 to 81. As part of their modified contract, CPI will increase their production rate from 3 to 4 tubes per month by January. CPI is expected to ship klystrons directly to ORNL beginning with their October shipment.

HIGH-VOLTAGE POWER CONDITIONING (WBS 1.4.1.2)

Accomplishments: (1) The prototype high-voltage converter modulator (HVCM) continues to operate without failure, 17 hours per day to support full power testing of the 5-MW CCL klystron. (2) We coordinated and reviewed the required IGBT switching parameters for DSP controls with ORNL and Z-tec. (3) We reviewed procedures for closing breakers safely for prototype and production HVCMs, and we obtained LANL Electrical Safety Officer approval of all electrical equipment related to testing of transmitters and HVCMs. (4) We worked with Dynapower to insure correct delivery of remaining spare parts to ORNL and return of equipment and supplies loaned to them from ORNL and LANL. (5) We worked with Dynapower to bring as-built documentation of safety enclosure wiring up to date.

Concerns & Actions: New modeling suggests ripple inherent with design caused by differences in IGBT switch timing. The ripple can be mitigated through the addition of 20-kHz and 40-kHz harmonic traps. The traps do not impact pulse rise and fall times or klystron fault energy. We completed electrical design of the trap chokes. The design is compact and will fit under HV socket assemblies. We ordered FT-3 nanocrystalline cores for the trap assemblies.

DRIFT-TUBE LINAC (WBS 1.4.2)

Accomplishments - Tank-2: All groups (with the exception of the five units being rebuilt) are machined within 0.020" of final profile; seven drift tubes have one side machined to final profile with this operation ongoing. Most of the J-group and some units from the other three groups (for a total of about 22 units) will require some weld repair in the form of a cosmetic pass weld. The two J units being rebuilt have had water channel welds completed and were shipped to Bodycote for annealing; subsequent machining on these units should resume on 10/6. The three empty units are being repaired with end caps welding; difficulties with the tooling water cooling are slowing the progress on these units. When these welds are complete the cosmetic pass repairs of the group J's and other drift tubes will commence; these weld repairs are expected to extend into next week. Work is being serviced with a day and swing shift at ESCO; Los Alamos personnel are monitoring both shifts. We also picked up the "lost" waveguide iris shipped by ORNL to LANL. It will be flow tested next week and returned to ORNL.

Tank-4: Fabrication and testing of all PMQ and empty drift tubes, and their associated hardware, is complete! Hardware was shipped to ORNL.

Tank-5: (1) PMQ and empty drift tubes were final profiled and leak checked. Unit 5-9 was slightly damaged (OD at bottom dented) due to a handling error during leak testing. Based on a verbal description, the physics experts predict this unit will be acceptable; unit was transported to LANL for further inspection. Some units were sent out for stem welding. It is likely we will be shipping completed drift tubes to ORNL next week.

Tank 6: All units are at CMI for final profiling; a machine programming error resulted in the scrapping of unit 6-17. The PMQ is being cut out of this unit and a spare dummy unit is being bored out to make a replacement. A contract

is in place for qualifying the tank six cap weld at ESCO (Hanford welding operations cease tomorrow); this will be done as soon as possible but will be of lesser priority than finishing the tank two drift tubes. RLWG/iris is at Los Alamos for final leak checking, flow testing and cleaning.

Tank 3: RLWG/iris is at Los Alamos for final leak checking, flow testing and cleaning.

EMD & BPM DT's: Four EMD DT's are at Kaehr Plating for stem plating. There are water channel to magnet cavity leaks in six of the EMD units; replacement in the case of 1-55 or weld repair of the other five is the next step to address this problem. Other solutions are being considered include: *in-situ* leak repair with a sealant, the quick manufacture of tank two dummy EMD units and also the remanufacture of tank one and two EMD drift tubes with revised weld joints and procedures. The ten BPM drift tubes are either in mapping or final machining.

Beam Boxes: The tank 4/5 and 5/6 beam boxes are at Los Alamos for cleaning and final leak checking. Machining continues at Integrated on the tank 2 and 4 pumping grills and port covers.

Issues and Concerns: Our biggest concern is with leaking drift tubes. LANL personnel are monitoring all operations including machining, welding, leak checking, and high pot testing operations at CMI, ESCO and Sciaky. The processing of drift tubes and other components at LANL continues to tax remaining DTL recovery team personnel resources.

COUPLED CAVITY LINAC (WBS 1.4.4)

Accomplishments: Accel made progress with Module-1 bridge coupler tuning. They have completed the first five and started the sixth. We anticipate module level tuning to begin next week.

Concerns & Actions: We remain concerned about manufacturing schedule and will request a weekly status meeting between the LANL contract specialist and ACCEL. N. Bultman and J. Billen will be at Accel starting 10/7 to monitor manufacturing and tuning.

ASD/JLAB: Cold Linac

ASD/BNL: Ring

An engineer visited Oak Ridge Tool & Engineering to track production progress on the outer shielding for the HEBT momentum collimator. All material is at the vendor's plant and fabrication is underway. We are awaiting receipt of a planned delivery schedule.

Installation drawings showing coordinates of the HEBT momentum collimator are complete and being checked by the survey, lattice and AP personnel.

Preparations are underway for shipment of a complete RF System to SNS/OR. Requested handling/shipping/delivery info and photos will be sent to M. Hechler in advance of the special shipment, expected around mid October.

Three transformers and associated switchgear for the Ring dipole power supply have been accepted and shipped to SNS/OR.

The final shipment of magnets from Budker (BINP) has been received at BNL. These magnets are being processed as part of incoming inspections. Our plan is to test all of these large aperture quads before making a decision on field quality corrections. The production measuring coil is being surveyed into position.

Chicane #3 is being surveyed in the test stand for magnetic measurements.

All thirteen of the 21S26 magnets are now at BNL. Eleven of the thirteen have been fully measured.

The first article 26S26 production magnet was shipped from Alpha Magnetics this week. We expect a production delivery rate of 1 every two weeks starting Nov. 1.

A wiring defect has been uncovered on one of the nine 41CDM30 magnets received at BNL. We plan to remove the interconnection jumpers to isolate and determine the cause of the observed field anomaly.

Injection septum magnet #1: measurements are underway. Transfer function measurements are complete; fringe field measurements are in progress.

At BNL, coil winding continues on the 36Q85 and the 36CDR30 magnets. To date, seven of the 36Q85 and eight of the 36CDR30 coils have been wound.

Controls

On Tuesday of this week the Controls Team hosted a long-scheduled meeting to discuss issues related to the Resonant Cooling Control System (RCCS). Members of the ORNL Controls, Mechanical (water) and RF Groups attended, as did several of the system's designers from LANL (via videoconference.) After several presentations and much discussion, the start of a plan was formulated. Some measurements are planned, and a steady-state model will be developed or acquired at ORNL. There will be follow-up meetings.

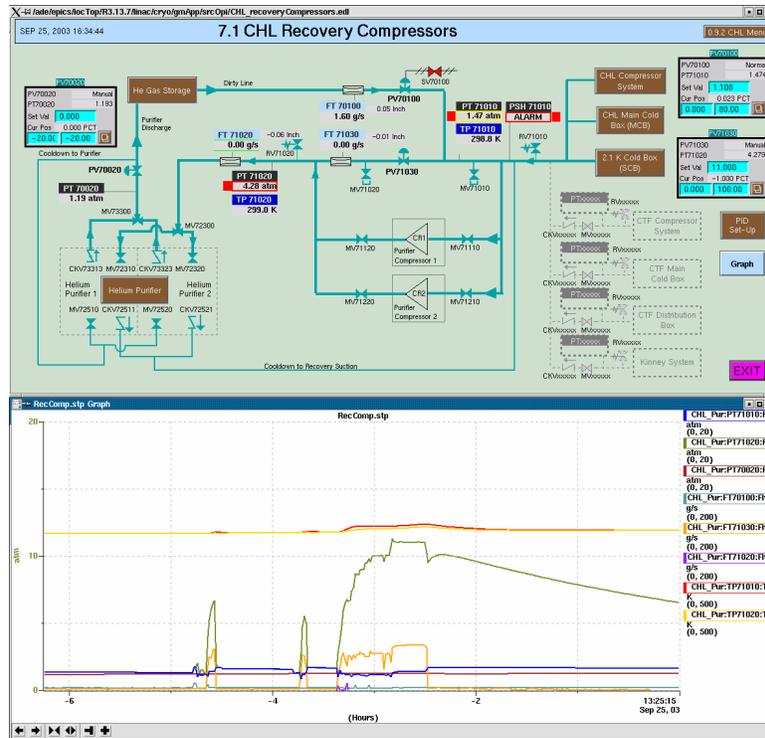
During Thursday's maintenance day, the control system suffered a serious outbreak of what has come to be called "IOC Disease." IOCs stop communicating with each other, and fall back into the same solipsistic behavior again shortly after rebooting. As the control system is largely dependent upon this interprocessor communication, it became quite inoperable. After several hours of systematically reverting back changes made during the day, the system was eventually returned to an operational state. The early diagnosis is a possible incompatibility between new versions of "VxWorks" (the commercially-supplied real-time kernel at the heart of the system) and "VxStats" (a locally-developed package used for monitoring the health of the IOCs.) Ironically, the latter was being used in an attempt to analyze indications of incipient IOC disease already noted. There remained some concern that either the control system down time or the repeated reboots of IOCs may have caused some damage to Ion Source equipment.

This week all of the remaining DTL high-power RF systems were successfully brought into the control system, with PLC to IOC communication established and live data visible on control room screens. The control system integration toll has started accumulating hours for DTL ME3.

Work continued on preparations for Ring control system installation. Fabrication of the MPS and Network racks was completed. Functional System Descriptions (FSDs) for the Ring High Power and Low-level RF systems were drafted, and design details for motion control cabling were worked out with BNL. Meetings were held to clarify requirements for Thermomolecular Pump operation in HEBT, ring and RTBT. One issue which surfaced is the need to pump down sections of HEBT before racks are available to house the PLC and IOC. This pumpdown will be performed manually, eliminating the need for the "roughdown" mode of PLC operation used in the LINAC.

An event-link monitor was set up at ORNL, monitoring the development event-link in 701 Scarboro. BNL-developed software was installed and executed. Despite its embryonic state, the software was able to correctly display the events occurring on the event-link, and record their relative time. More work is required at BNL before the software is useful for a non-expert. This is a timing system monitoring tool that was requested by the timing review committee. When fully operational it will help with diagnosing timing system operation and will assure proper functioning of the Machine Protection System.

The Central Helium Liquefier Recovery Compressor has been successfully tested and run. The EPICS based PID loops were tuned and stable system operation was achieved. All hardware interlocks functioned properly. All parameters were monitored and displayed correctly. This is the first process system to be operated in the CHL. Stable operation was achieved less than 2 hours after the first attempt to start the system. (See chart below.) The recovery compressor discharge pressure was then slowly increased to approach normal operating conditions.



LANL Status Report 9/25/200

The cable design for SCL MB communications cables was revised to account for changes in the LLRF IOC layout. The new documentation has been handed off to the Davis-Bacon electricians and installation should begin next week.

Optical fiber has been installed in the hot spare so that timing signals are now available to the 2 MHz RF pulse generator on the hot deck.

Fabrication of the Injection Dump PLC cabinet and development of the PLC and EPICS software began this week. The hardware and software are scheduled to be completed by December 15. The IOC for the Injection dump will be provided by the Ring.

At LANL, the Residual Gas Analyzer (RGA) software driver was completed, tested against an RGA mounted on a vacuum vessel at LANL, and checked into CVS. This is will be installed during the week of October 13. RGA control panel was completed in EDM.

Work continues at LANL on many fronts. Progress has been made on strategies to improve performance of the Archiver. Controls software for magnet mapping was modified and committed to CVS at ORNL. Signal lists are ready to deliver for the CCL: vacuum, RCCS, diagnostics and power supplies as well as the QMCS. Displays and the database for the SCL vacuum are nearing completion. The test box for the SCL Beckhoff I/O is near complete. The box for housing the Beckhoff I/O in the rack is complete and the design is confirmed. A design for the JLab vacuum equipment test is complete. Wire scanner parts are being ordered – LANL is building wire scanners and PC boxes for the diagnostic group. LANL continues to support XAL applications.

LANL continues to contribute to the SNS RF controls program. The LLRF IOC runs well on its own, but is sluggish if there are too many clients. Five SCL HPRF control racks have been tested at LANL – the first complete with Tuners. LANL will come to lead the HPRF controls installation in late October. Startup files for LLRF IOCs for DTL 4, 5 and 6 have been prepared.

The resonance error calculation has been ported from a buffer in the LBNL module to the Field Control Module (FCM). Work continues on FCM "Phase Zeroing." The FCM measures the phase of the RF reference line, and uses that information to add offsets to the displayed phases and phase setpoints for the feed-forward and closed-loop. At present this is done manually – the best strategy for automating it is under discussion.

Installation

Craft Snapshot 9/30/03

ASD craft workers	54.0
Foremen, ES&H, etc	9.0
Less WBS 1.9 etc	9.0
Less absent	2.0
TOTAL	52.0

Work continues on the first SCL HVCM/RF systems. It will be operations by the end of Oct 03.

The third Medium Beta Cryomodule is scheduled to ship from JLAB on Oct 14, 2003.

Three transformers for the main ring power supply were received and installed on the south side of the Ring Service Building.

Six EMD drift tubes for Tanks 1, 2 & 3 were delayed due to water leaks. This additional delay has impacted DTL 1, 2 and 3 completions in Jan 04.

In addition, DTL 2 drift tube deliveries were delayed from Oct 28, 03 Nov 7, 03. DTL 4 drift tubes will now be available before DTL 2. DTL 2 continues to have the highest priority.

DTL 4 klystron installation was completed.

Davis Bacon installation scope is 50.8% complete as of the end of Sept, 04.

Accelerator Physics

Operations Group

Ion Source Group

Not being able to increase the MEBT ion beam current through cesiation of the source, it was replaced with the source tested and conditioned on the Hot Spare Stand. After a shift of low power operation providing 10 mA MEBT beam, the source was cesiated for 30 minutes at 500 C, which immediately increased the beam current to 20 mA. The source continued to condition, reaching 37mA eight hours later. Fine-tuning brought the current up to 38 mA.

As reported 2 weeks ago, the 12 kV 15 μ F capacitor banks in the source RF amplifier was damaged most likely by an arc. The bank is shown in the left picture after being removed from the supply. It has been replaced with a single 15 kV 11 μ F capacitor shown installed in the right picture. The modification has been tested with the ion source on the hot spare stand for approximately 20 hours.



Survey and Alignment

This week, the Survey and Alignment group has been very busy during the day shift due to the fact that we only had one two man crew available. The remaining crews were performing a night global network campaign.

The majority of the day crews' time was spent performing target work.

First, we measured the location of Bulk Shield Support Rings 2 & 4. This leaves ring plates 1 & 5 to measure once they are set.

Second, we performed a complete as-found profile of the target cart liner which connects the bulk shield liner to the hot cell. This profile consisted of measurements of the sides with respect to "F" line along with floor and ceiling measurements with respect to the inner support cylinder "flat".

Third, the Survey and Alignment group set the elevations on the two HEBT collimator base plates. These plates are ready for grouting.

We are currently in the process of fiducializing drift tubes for DT Tank 4.

As stated earlier, this week was a night campaign to bring the target building network into the global network. This consisted of a crew of four. There are over 100 floor monuments that require a tie into the global network. In June, we had measured the horizontal control. This week consisted of the bringing in vertical control to the target building floor monuments. We also performed several ties from the inside the target monolith through the proton beam window to floor monuments located in the RTBT.

Mechanical Group

Ring Systems Installation

- The baseplates for HEBT collimators #1 and #2 were set in place, aligned and formed for grouting next week.
- The structural rebar for the HEBT momentum collimators support base was assembled and formed for pouring next week
- Installation of beamline diagnostic and drift pipe chambers continues.
- The entire ring magnet cooling DI water system was blown dry and charged with Nitrogen.

Water Systems Installation

- SCL-ME1 Piping from TRCC Cart #2 to MB3 and MB4 Klystrons is progressing.
- The water manifold installation on DTL-2 Tank was started.

- SCL DI water headers were relocated on the north Klystron gallery to eliminate cable tray interfere.
- The 2nd Klystron gallery DI water system, which serves the CCL systems, was charged and put into service.

The first 16 DT's for DTL-4 have been received at ORNL. We expect the remaining PMQ and empty DT's next week. We have begun fiducialization and will begin magnet mapping and leak testing next week. As we get groups of 10 or 15 ready, they will be installed in DTL-4.



DTL-4 Drift Tube in the FE Building

Magnet Task

Electrical Group

HPRF

LLRF

Cryosystem Group

Beam Diagnostics