

Accelerator Systems Division Highlights Ending December 19, 2003

ASD/LANL: Warm Linac

HIGH-POWER RF (WBS 1.4.1.1)

Accomplishments This Week: (1) J. Bradley and D. Rees were at the SNS site to successfully complete commissioning of first two transmitters for the superconducting linac (SCL). They also installed retrofits and worked with the transmitter manufacturer to diagnose and repair infant mortality failures. (2) Bradley and Rees operated and conditioned the first 12-pack of SCL klystrons up to 69.5 kV, 10.8 A, 1.35 ms pulsewidth at 20 Hz. (3) Rees also supported ORNL staff in diagnosing rf leaks in the MCI waveguide bellows. After these units were replaced with the MEGA units the first six klystrons were operated at full output saturated RF power (350 kW) at 1.25 ms RF pulsewidth and 20 Hz. (4) A LANL representative was at E2V to witness the acceptance tests for the tenth (of eleven) DTL klystron (S/N 11). All tests to date went well. (5) Factory acceptance tests at Thales for the 5-MW CCL klystron S/N 5 are now complete. This tube was shipped to LANL; upon arrival, we will have four 5-MW tubes, enough for the entire CCL. (6) We are in the process of conditioning CCL klystron S/N 1 at LANL. We are up to 123 kW, 1.35 msec hv pulsewidth and 1.25 msec rf pulsewidth, at 60 Hz. (5) LANL approved test data for CPI SCL klystrons S/N 45-46. Three klystrons (S/N 42, 45-46) will ship to ORNL this week. (6) Two more Thales SCL klystrons (S/N 3 and 9) were factory accepted and shipped to LANL.

Concerns & Actions: We are (finally) accumulating a significant inventory of Thales klystrons (5 MW CCL units and 550-kW SCL units). To meet IPS installation dates, site acceptance tests need to be efficient, vendor support responsive, and hv converter modulator availabilities need to be high. Ensuring these criteria will be a primary focus at LANL over the next three months.

HIGH-VOLTAGE POWER CONDITIONING (WBS 1.4.1.2)

Accomplishments: (1) W. Reass was at the SNS site to initiate first operation of the SCL hv converter modulator (HVCM) with a 12-pack SCL klystron load. Testing and operations went very well. We operated the 12 klystrons to system full peak power (69 kV and 120 amps) and pulse width (1.35 ms). The rep-rate was limited to 20 Hz so we could further analyze core flux offsets that were different than our modeling predictions. The DSP control increments we have for core flux adjustments were too fine, 250 ns, to make any significant changes. We will reprogram the DSP to provide greater steps (500 ns) and re-calculate the achieved performance to iterate our model. A few crowbars occurred at full voltage and the resulting waveforms indicate about 12 joules into the klystron. The 12 joules may be a pessimistic number, as the observed gas load changes in the tubes were minimal. In addition, the HVCM efficiency seems better than anticipated. For operations at the full 60 Hz, it would appear that efficiency will be ~ 93%. (2) We completed installation of the improved IGBT bypass capacitors in the prototype HVCM.

Concerns & Actions: We brought the production HVCM at LANL on line to operate the 5-MW Thales klystron. Above 125 kV at 1.35 ms pulsewidth and 60 Hz repetition rate, the unit was showing signs of internal arcing, which is indicated by a reduction of output voltage during the pulse. We operated the unit until the risk of catastrophic failure became unacceptable. We have initiated a repair cycle. We are bringing the prototype HVCM back on-line to complete the 5-MW klystron tests.

DRIFT-TUBE LINAC (WBS 1.4.2)

Accomplishments: (1) By COB today, we anticipate that 208 of the 210 drift tubes will have been shipped to ORNL. The final two are tank-2 drift tubes (2-27 and 2-30) under repair for cracked weld joints. The plating vendor will finish units 2-27 and 2-30 on 12/24. They will ship ~ 12/30. (2) ORNL returned drift tube 6-17 to LANL this week for a leak repair. Unit was baked out over night and leak checked. No excessive leak was found; under 100 psi He pressure the leak rate was 6.61×10^{-10} Torr-liter/s. The unit was taken to LANSCE-1 for a second leak check which proved negative. We were puzzled by leak locations marked with tape, as the locations were not over known joints. The unit will be shipped back to ORNL today. (3) We resolved the short-circuit problem on the BPM drift tube (6-3) ORNL returned to LANL and shipped it back to ORNL. J. Power verified problem, but our data from before we shipped and it did not show a short. During the fabrication of the BPM instruments we had seen similar problems after cleaning the BPMs. We had been able to "fix" it in the past by baking out the instrument. We suspect that cleaning fluid gets into the feed through and shorts it out. Baking seems to get fluid or residue on the feed through out. To prevent this from happening to our finished drift tubes we installed a plug in the bore of the BPM while they undergo final cleaning. We think some fluid must have gotten past the seal in the plug causing the problem with 6-3. J. Power re-tested the BPM and all four electrodes are working properly. (4) DTL beam box 2-3 has been

vacuum leak checked and proven tight; it will be shipped to ORNL today. This is the last of the intertank beam boxes.

Concerns & Actions: BPM drift tube 3-8 stem is out of tolerance 0.040" fore aft resulting in a 0.040" tilt. We made an urgent request to ORNL today to ship this unit to LANL as soon as possible. CMI will do the work; we will see if we can have the tooling brought up to LANL on 12/19. We are predicting the earliest we may be able to ship the drift tube back to ORNL is Saturday, 12/27 but we'll try to do better.

COUPLED CAVITY LINAC (WBS 1.4.4)

Accomplishments: (1) The LANL-ORNL team completed installation and tuning of CCL Module-1 (Fig. 1). Vacuum pumpdown should occur by early next week. (2) ACCEL has the complete Module-2 on the support stand. □/2 mode tuning is underway. Module level tuning will begin 1/6/04. LANL physics team personnel will be present to oversee this work. (3) ACCEL completed the vacuum furnace braze of the fourth (of twelve) segment for Module 3.



Fig. 1: CCL Module-1 in the SNS tunnel after module-level tuning.

Concerns & Actions: (1) While at ORNL, we encountered a problem with two of the eleven bridge coupler tuning screws. Copper material transfer was observed on the fine thread silver-coated stainless screws. A retrofit using helicoil inserts was implemented. We are now determining the appropriate actions to be taken with the Module-2, 3, 4 tuning screws. (2) We continue to monitor the ACCEL schedule, and have weekly management weekly. Schedule remains tight, but trends appear stable. (3) The dollar-euro exchange rate is an all time high. The SNS project office has been supportive and the projected cost variance has been included in their EAC. A PCR will need to be submitted in January to supplement the outstanding commitment in the ACCEL contract to accommodate the unfavorable changes in the exchange rate.

WBS 1.4.5 PHYSICS & DIAGNOSTICS

BPM Pickups: As mentioned above, the short circuit in BPM drift tube 6-3 has been cleared. Unit was shipped back to ORNL.

BPM Electronics: (1) Eleven systems for the DTL were shipped out this week to ORNL. The 12th unit seems to have a computer problem. We are holding on to it for now for both debugging and also for some further LabVIEW code development. (2) We are still working on getting the test programs to work in concert with the BPM application. As soon as the issues are resolved we will ship a CD with all of the correct code to ORNL. This will probably happen during the week of 1/5. (3) We shipped more components for the CCL DFE assembly, (LT1962EMS8-3.3 and VPLD54TE-080.00MHz) to Suntron in Phoenix. Work is proceeding on the gate array programming. That should be completed next week and shipped as well which would complete the parts list for the DFE.

RTBT Harp: (1) Work continues on reviewing the final set of harp drawings. Some areas required minor but necessary changes. (2) We have continued to contact different companies that may be able to manufacture the harp cards. We will select a vendor next week.

Wire Scanner Electronics: We asked for bids for mounting the parts on the bare PC boards and received reasonable quotes from experienced suppliers. We have kitted the parts and will ship them this week. The goal is to get the parts to the vendor 12/20 so that they can work on the order during the holiday break. We anticipate a delivery date of on or before the 1/16/04.

Wire Scanner Pickups: Four actuators were shipped to ORNL this week. The shipment also included the forks, DTL mounting flanges, connectors, certification of cleaning from the machine shop and certifications from Huntington. The remaining hardware (nuts, bolts and vacuum seals, *etc.*) will be ordered this week with anticipated shipment to ORNL the week of 1/12. The SOW for the remainder of manufacturing by Huntington was completed this week. We also developed a revised and complete wiring diagram for Huntington to follow for wiring the remaining actuators. The last 6" stroke actuator will be ready to ship shortly, following the receipt of the updated wiring diagram.

Energy Degradator / Faraday Cup Hardware: We delivered five Faraday Cup/Degradator Actuator Assemblies (1 CCL, 4 DTL) to the LANL shipping office. The expected arrival date at ORNL is ~ 1/5/04.

Energy Degradator / Faraday Cup Electronics: The two controllers have passed all the tests with one minor exception. They are expected to be shipped to ORNL next week.

ASD/JLAB: Cold Linac

Two more medium- β cavities were qualified this week. The third cavity for the M-11 string (and the last cavity needed for the medium- β program) is processed and evacuated, ready for cold testing when we return in January.

The M-4 cryomodule was successfully cooled to 2 K (no sign of the feedthrough leaks that have plagued M-5 through M7). The first cavity processed up to full gradient very quickly, achieving 17 MV/m.

Shipment of cryomodule M-5 to ORNL is scheduled for the first week in January.

The insulation vacuum leak in the M-6 cryomodule has been repaired.

The M-7 cryomodule insulation vacuum leak has been identified and is being repaired.

The M-8 cryomodule cold mass has been inserted into the vacuum vessel and aligned.

Transfer of the M-9 cavity string to cryomodule assembly will take place as soon as an assembly rail is available.

ASD/BNL: Ring

Controls

The first SCL vacuum I/O crate was shipped to ORNL this week.

The status of some software development activities follows:

- The QMCS and CCL1 RCCS PLC, database, sequences, and screens are ready for test. CCL1 vacuum and magnet control system design continues.
- SCL HPRF control software was used as part of this week's SCL RF testing.
- The LLRF task force made significant headway in tracking and fixing the problems with the HPM, Utility module, and FCM working together in the VXI crate.
- Development of a new SNMP driver (to support monitoring of network parameters via EPICS) has been started. The plan is to provide a preliminary version by Feb. 1st.
- A channel access change (to not fully disconnect channels until a timer expires) has passed regression testing and should be ready for release soon. This should ease the load put on the control system when there are hiccups.

- The archiver modification effort now has a working data collection engine (not rewritten - but reorganized), with the server providing raw and averaged data into time buckets (for doubles only), XML-RPC over the network, and a client that is ready to give the data to a plot routine. This works in under 1.5 seconds for 4 channels with 1K samples each. The configuration tool for viewing and plotting is not yet ready. Plotting should be tested next week.

The BNL EPICS development environment has been upgraded to EPICS R3.14.4. All BNL developers are earnestly converting BNL software. This includes BNL software already delivered to ORNL for the BLM system and for the PSC, and all future software delivered to ORNL.

Draft requirements and a set of 86 operating screens for vacuum systems was generated and reviewed by Operations. It has been sent on to the vacuum team for their review. It includes the new way of using the Alarm Handler and Summary PVs that operations has requested, and includes a "one button in one place" reset for MPS trips.

Installation

Craft Snapshot 12/16/03

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	8.0
Less absent	0.0
TOTAL BD BY ASD/ORNL DB WPs	45.0

Operations Group

Held a "Lessons Learned from DTL Tank 1 Commissioning" meeting last Thursday, Document being put together.

Working to clear the remaining ARR "To Do" items in the Action Tracking System

Beginning the Certification Procedure work for PPS 1.0

Since there has been a lot of discussion and e-mail recently about the DTL3 commissioning beamstop, there will be a meeting Friday morning after the Installation Meeting to discuss it.

Automating, in checklist form some Standard Operating Procedures

Discussing with MIS, an ORACLE based Fault Reporting System, similar to the Action Tracking and Interlock

Bypass Systems. This will evolve into a User GUI into DataStream, the same way the Equipment Tracking System will be.

To Date as a Project we have about 4000 items bar-coded. We are concerned that the Bar-coding rules are not being followed by all groups. We are discussing a Barcode Audit conducted by QA

CLO Labs; An issue came up last week on the BI Power supply labs. CF changed the orientation of the labs, not the

ACTION ITEM Operations takes over ownership of Beam Stops.

Accelerator Physics

Preliminary analysis of MEBT beam profile data shows that the RFQ output Twiss parameters in one plane after the RFQ detuning event are different from the output Twiss parameters measured before the detuning event. As

previously reported, no impact on beam emittances has been observed, so the beam quality appears unaffected by this change. Analysis continues as this observation may shed some light on the source of the detuning.

Magnet polarities and wiring lists are being generated for all SNS electromagnets. This data is being checked, will be entered into the global database, and a report will be generated.

Planning for DTL1-3 commissioning is underway; with discuss centering on beamstop issues. S. Kim is evaluating the DTL3 ED/FC from the standpoint of beamstop requirements.

Good progress continues to be made in the physics applications. Code has been written to automatically generate MAD input files from the on-line database. This allows us to run MAD off line using an input file based on actual magnet currents. The on-line model for the HEBT is almost ready, lacking only the transport matrix for a thick bender. The ring database is also almost fully populated.

On the modeling front, the ORBIT calculation that showed that the 402.5 MHz component of the beam will disappear after 6 to 10 turns around the ring has been verified by an analytic calculation. One conclusion from this work is that it will be important for the baseband BPM system function well for single-turn injection.

Ion Source Group

The effort to computer control the hot spare stand continues in high gear. This week we learned how important is to located the control electronics in boxes for proper shielding. Without this protective measure, the RF noise occasionally upsets the control electronics, resulting in frequent RF amplifier faults.

The new LEBT has been successfully tested with 8 mA, the highest current that could be achieved in the short time span available to run the new uncesiated source.

Martin Stockli visited Lloyd Gordon and Tom Hardek at LANL to look at access control measures used at LANSCE. It appears that some of their implemented safety measures can be used on the ion source hot spare stand and the front end. Currently protection from the source and LEBT high voltages is achieved with 4 procedural measures and a single engineering control. The engineering control failed to ground the high voltage platform in a single incident end of October, which drives our desire to implement a second, independent engineering control.

Survey and Alignment Group

First, we are continuing with drift tube fiducialization.

Second, we started aligning the drift tubes in DTL4.

Third, Survey and Alignment verified alignment of the first nine plates of the momentum collimator located in the HEBT. Our findings show an approximate 1.5mm shift longitudinally and laterally, along with being 5mm high in the "Y" direction. This was intentionally set 5mm high to allow for settlement from the incredible amount of localized weight in that area.

Fourth, we aligned the HEBT dipoles and as-built the dipole chambers.

Fifth, Survey and Alignment as-built the chopper cavities for instrument beam line 2. We also set out the tank location for the same beam line. We also verified position of the first "target cart rail support plates".

Mechanical Group

We have now received the first 12 DTL2 permanent magnet drift tubes and are processing them at ORNL.

The "dummy" drift tubes have been removed from DTLs 1 and 3 in preparation for the installation of the 4 new EMDs in DTL1 and DTL3 as well as the 2 new BPMs in DTL3.

We have begun the alignment of DTL4 drift tubes in preparation for tuning the tank over the holidays.

CCL-1 tuning is complete and the module is being prepared for vacuum pumping and leak testing, which will begin in early January.



CCL-1 Assembly in the Tunnel

Water Systems Installation

- Installation of DI water piping from TRCC-04 cart to the second ½ of SCL ME-02 continues.
- Installation of DI water piping from the CF headers to the SCL ME-03 TRCC-05 skid was started.
- Installation of piping to the CCL-01 klystron, circulators and water loads continues.
- Fabrication of the QMCS piping manifold in the Linac continued.

Ring Systems Installation

- The installation of the HEBT momentum collimator steel shield plates was completed.
- The RING Half-Cell No.15 (Unit C9) was received and staged for installation.
- Installation of the magnet cables from the Ring Service building to arcs A&D continued.
- Installation of the cable tray in the RTBT tunnel was started.

Magnet Task

Today we finished mapping DTL EMD's, 24 in all.

This week we also loaned out the ATLC Research Mechanic to the Cryo Group.

We are now starting mapping efforts on DTL PMQ's.

We are making plans to map fields in the SCL beam tunnel.

Electrical Group

Tested 1 SCL Quadrupole power supply and installed (5 of 41)

Tested 6 corrector supplies (227 of 356)

LINAC KL-SS2 (Klystron substation) 65 to 70% of KL-SS2 installation completed, installation inspected and AC power available in the equipment racks.

SCL cable distribution mock-up partially dismantled and reworked

Ring SB and tunnel - ALL 535 MCM DC cables pulled except RING SB to TROT

TROT (to the ground break) cable tray 60% done

One DC bus for extraction septum shipped back to shop for repair

HPRF

LLRF

H. Ma and C. Swanson from ORNL were at LANL working with our staff on the remaining LLRF system integration issues. We are now able to successfully operate the entire system consisting of the HPM, FCM, and the timing utility modules in one crate. All the bus contention issues have been successfully resolved. Although not affecting the system operation or performance, there is still some detectable bus noise on the HPM and FCM boards. ORNL engineers will be investigating this further back at home. This was a very successful and productive visit by ORNL engineers. (2) Following the completion of HPM production documents last week, we have completed all the necessary documents for producing the FCM (module diagrams, bill of materials, *etc.*) and have placed them on the ORNL FTP site. We continue providing technical support for the procurement of the entire LLRF system. (3) We are conducting an inventory of all the electronics parts purchased for the production of the LLRF boards, including the original design (FRCM). Following the inventory, we will ship all the parts back to ORNL.

The first boxes of parts from LANL (see above) were already received at ORNL on Friday.

The Analog Front End (AFE) procurement is awaiting DOE approval because it is a foreign purchase.

The request for proposals for the HPM, VXI motherboard, DFE and RFO was submitted to procurement. We expect it will be released to vendors prior to Christmas with bids due in early January.

The FCM intramodule coaxial cables and the VXI module enclosures were ordered this week.

The production parts inventory was updated this week; only ~40 items remain to be received, and about 50% of these are on a single PO, that was delayed in procurement. We will be tracking all missing items over the next weeks to make sure we are ready for production in January.

The prototype downconversion/distribution chassis was delivered to a vendor for inspection. We anticipate receiving one or two bids in the next week or two on the production of the chassis required for the SCL.

We supported testing of the first HVCM and pair of transmitters in the SCL. The provisional LLRF control system supported RF testing of six klystrons at one time. After testing of the first six klystrons was completed, we relocated the LLRF control system to support testing of the second six klystrons. This changeover was completed with minimal interruption.

Berkeley is sending a digital board for the spare MEFT LLRF control chassis (1st generation) that is in the LLRF laboratory at ORNL. They are building another spare board using existing parts.

Larry sent out a preliminary report to Hengjie Ma and John Power on his noise measurements of the FCM.

Berkeley reviewed the statement of work for the HPM, VXI, DFE and RFO procurement package and provided information on vendors in the San Francisco bay area.

Cryosystem Group

The top hat assembly for the helium Dewar is being fabricated; delivery is scheduled for 2/9/03. This is a key component in the 4.5K cold box test and we have requested an earlier ship date.

The cold box room "U" tube design package has been received at SNS. The materials should arrive next week.

The 80K "B" bed and the 20K bed are under nitrogen purge and the heaters are activated. We have encountered some wiring problems with the heaters on the "A" 80K absorber bed. The cold box is presently under nitrogen purge for dehydration.

Mr. Bruno Renzetti of Air Liquid will be here the week of January 26th to mount and shim the cold compressors.

The oil relief valves of the second stage compressor skids have been re-set at the vendors and are currently in shipment back to SNS. They will be installed as soon as they arrive.

The following action items are being cleaned up by the vendor (PHPK):

- Purchasing and processing 4 additional barrels of compressor oil.
- Repair of the oil coolers (tentative target date is mid January).
- Evaluation of the instrument 3 way valves that leak.

The leaking bellows at transfer line module #4 has been replaced and the outer vacuum shell has been repaired.

Work continues on the assembly of the Cryomodule "U" tubes. This work effort will be transferred

Beam Diagnostics