

Accelerator Systems Division Highlights Ending November 14, 2003

ASD/LANL: Warm Linac

HIGH-POWER RF (WBS 1.4.1.1)

Accomplishments This Week: (1) *402.5-MHz E2V klystrons:* The factory acceptance test for SN 5 is scheduled for next week, the week of Nov 17, and the factory test for SN 11 is scheduled for Dec. 15-19. (2) *805-MHz, 5-MW Thales klystrons:* The factory acceptance test for SN 1 is complete, and we are waiting to receive the test data from Thales for approval. Assuming the test data are good, this tube is scheduled to be shipped on Nov. 20. The factory acceptance test for SN 4 is scheduled to start Nov 19, with a LANL representative present. LANL plans to send SN 3 to ORNL on Nov. 20. (3) *805-MHz, 550-kW Thales klystrons:* The factory acceptance test for the next 550-kW tube is scheduled for the week of Nov. 17, with a LANL representative present. (4) *805 MHz, 550 kW CPI klystrons:* We approved the test data for SN 39 and 40. (5) *805-MHz, 5-MW Sure-Beam loads:* The Sure Beam load that failed was re-machined and sent to Albuquerque at Kaehr Plating to be alodined. It was finished this week and is ready to pick up. We are in the processes of testing two other loads, #'s 4 and 6, while doing circulator testing. (6) *805-MHz, 5-MW AFT circulators:* So far, we have tested three circulators and two have failed (see concerns). We are in the process of installing the fourth circulator. (7) *SC Transmitter:* We gave final approval of SC transmitter SN 11 heat runs and acceptance tests, and we witnessed acceptance tests of SC transmitter SN 12. We worked with Titan to confirm that NC transmitter documentation of PIC and PLC software met the requirements of the specification and was completely up to date.

Concerns & Actions: (1) An AFT representative was at LANL this week working with us on the arcing problems that we have been having during the high power testing of the 5-MW circulators. (2) We worked with Titan and ORNL to determine how and when retrofits would be done on the early SC transmitters. Titan has offered to provide this labor themselves, but ORNL prefers to do the work, including de-soldering and re-soldering capacitors to the HV-enclosure circuit boards.

HIGH-VOLTAGE POWER CONDITIONING (WBS 1.4.1.2)

Accomplishments: (1) We supported klystron and RF component testing as required. (2) We analyzed ORNL SCL HVCM test data taken with a dummy load at low rep-rate – the waveforms look very good.

Concerns & Actions: (1) We have a growing concern that SCL HVCM operation with the present configuration may present problems at high average power. It will take an additional few months of analysis to be more confident with the SCL HVCM configuration. In the meantime, we suggested extreme caution when bringing the system on at ORNL. We also believe we should heavily diagnose the system to improve the existing models before operating the system at full average power.

DRIFT-TUBE LINAC (WBS 1.4.2)

Accomplishments – Tank 2: All Tank-2 PMQ drift-tube bodies are at GAR Electroforming for plating to restore the dimensions. They will attempt to work this weekend so that they can ship bodies Monday, Tuesday and Thursday of next week. Profiling on these units will commence at ESCO on Tuesday, Nov. 18.

Tank 4: Tank-4 post-coupler bodies are ready to go out for tube stub to body welding.

Tank 5: We have developed several possible solutions to the flow problems of units 5-20 and 5-21; all Tank-5 drift tubes should be shipped by Wednesday, Nov. 19.

Tank 6: All drift tubes are magnet mapped and most are flow tested; all Tank-6 drift tubes should be shipped by Friday, Nov. 21.

BPM drift tubes: 20 EMD drift tubes are at Los Alamos for final processing along with 3 BPM drift tubes. The four remaining EMD drift tubes require some slight machining rework, which is being done at Los Alamos in the LANSCE-1 shops. The remaining seven BPM drift tubes are at the plating vendor in Albuquerque.

EMD drift tubes: The Cerrobend alloy has been successfully flushed from two Tank-4 EMD drift-tube magnet coils to achieve a satisfactory water flow rate. We will begin shipping EMD drift tubes on Tuesday, Nov. 18 and should have the 20 units on hand, plus the three BPMs shipped by Friday, Nov. 21.

Beam boxes: The access port covers and pumping grills for the Tank-4 beam box are complete and are ready to be brought to Los Alamos for final processing (flow testing and leak checking). The shipping date is projected to be Nov. 21.

Concerns & Actions: (1) At this stage in the project we have a shortage of personnel, and parts are backing up. Several staff and technicians are working weekends to make up for this.

COUPLED CAVITY LINAC (WBS 1.4.4)

Accomplishments: (1) Disassembly and packaging (Fig. 1) began this week at ACCEL for Module-1 segments and bridge couplers. They continued to repair small leaks in the flange seals in parallel with disassembly and packaging. The source of these small ($\sim 5 \times 10^{-8}$ Torr-l/sec) leaks was traced to a rough surface on the thin copper RF-tuning shorting plate that was used for the end-cell frequency measurement. A higher quality copper-plated steel plate will be used in the future. (2) The present schedule calls for Module 1 to leave Frankfurt airport on Friday Nov. 21 and arrive about midnight in Atlanta. The equipment will be stored over the weekend in Atlanta and leave for Knoxville on Monday. (3) During the assembly process the location of the bridge coupler end cell tuning screws are checked with a dial micrometer to insure correct location later at reassembly (Fig. 2). (4) Eleven of the 12 segments for CCL Module 2 have been brazed, close to the latest (revised) schedule. (5) We are updating the CCLPLOT bead-pull analysis code to provide more useful information and allow comparisons between measurements that involve different numbers of segments. (6) We re-wrote a draft tuning plan to reflect methods developed at ACCEL while tuning CCL Module 1. (7) We developed a plan for final tuning of Module 1 in the SNS tunnel. This plan involves retuning the 36 coupling cells positioned along the bottom of the 12 segments and the 22 bridge coupling cavities. The 36 bottom cells are inaccessible after the segments are assembled on the stand. The procedure maintains constant average coupling cavity frequency, but will reduce steps in the tilt sensitivity curve relative to that obtained before shipment.



Figure 1. Shipping crates ready for bridge coupler packaging



Figure 2. Measurement of the tuning screw location

Concerns & Actions: We continue the daily technical calls and weekly management calls to ACCEL to consult and track progress. We are preparing a more detailed schedule for assembling and tuning CCL Module 2 to ensure its timely delivery in early January.

PHYSICS AND DIAGNOSTICS (WBS 1.4.5)

Accomplishments: (1) *BPMs:* A final report on the mapping of the DTL drift tubes was completed and distributed. (2) *Wire scanners:* We held a design review for the modifications to the wire-scanner electronics needed to accommodate the pulse structure in the RTBT. Both LANL and ORNL personnel participated, and the design was approved with requests for a few information items that are being addressed. (3) *Target harp:* Work continues on the integrated assembly model of the harp plane support and the seven planes. While there are not any components interference issues there are some clearance issues with providing clear access for connecting the conductors to the individual harp signal and high voltage planes. These clearance issues are being worked out. We scheduled a review of the target harp with LANL, BNL, and ORNL personnel for next Monday, Nov. 17.

ASD/JLAB: Cold Linac

All three cavities in cryomodule M-5 meet specification after extended periods of high-power processing. The module is being warmed up in preparation for removal from the test cave and preparation for shipment.

In the past 15 calendar days, a total of five medium- β cavities have been qualified under the new procedures. There have been no failures. Most had higher thresholds for the onset of field emission, accelerating gradients at $Q_0 = 5 \times 10^9$ of 15 MV/m or higher, and all had significantly lower radiation output. Enough cavities are now qualified to assemble cavity strings for M-8 and M-9.

Assembly of the cavity string for M-8 is complete and the string is under vacuum. (See photo)

Assembly of the M-7 cryomodule continues. Installation in the vacuum vessel is complete and end can attachment is underway.



ASD/BNL: Ring

Talks for the DOE Review were presented by J. Wei, J. Tuozzolo, J. Sandberg, P. Cameron, and D. Raparia.

Craig Dawson was at SNS/OR to assist with Diagnostics' tests and commissioning.

Half-cell #13 was shipped to SNS/OR.

Half-cell #14 is being prepared for shipment later this month.

Oak Ridge Tool and Engineering shipped the outer shielding for the HEBT momentum collimator to the SNS/OR job site. The QA documentation was given to ASD's Ray Savino during his inspection visit.

27CD30 (NETC): four more of the nineteen units were shipped to SNS/OR on Nov. 7. The last seven will be shipped by early December.

26S26 (Alpha): we are awaiting the arrival of the #3 production unit which was shipped to BNL on Nov 4.

A shipment from BNL to SNS/OR included stands for the HEBT collimators, castings for the vacuum support stands, and two SNS RF Junction Boxes.

A contract was awarded to Ranor, Inc. for the permanent outer shielding for the Ring #2 and #3 collimators.

Coating of the vacuum beam pipe for the Ring #2 collimator is underway at BNL. We will coat the R3 beam pipe next week and ship both back to SDMS for final assembly.

A digital copy of the Momentum Collimator Installation drawing was sent to Joe Error to help confirm lattice coordinates prior to the start of installation activities.

After being down for more than two weeks in order to accommodate scheduled facility repairs, power has been restored to the SNS production (mag measure) test station. Top priority is the resumption of measurements on the shimmed (coils to pole) 30Q magnets from BINP.

SDMS: Work on a modified top plate for RTBT #2 collimator is in-progress. They plan to ship it to SNS/OR by Jan 1 with the R2 and R3 collimator assemblies.

The Excel workbook "LATTICE_GLOBAL_COORDS.xls" has been reissued as Rev. B. Changes include naming, content and coordinates. The web published version of the workbook is available at http://www.cad.bnl.gov/SNS_Techinfo/

An electronic file of the recently held (BNL/ASD) meeting covering "The Next Six Months" was distributed to all attendees and a copy sent to ASD via DCC (Karen Cox). The file contains the meeting agenda, meeting minutes, and individual talks and presentations.

Controls

Dave Gurd attended the last SNS Division Review Committee meeting at LANL, where he presented the work and progress of the LANL Controls Team.

Ion source test stand control system development continued. EPICS control of the RF pulser was demonstrated.

The CHL control system has been used to operate the oil pumps and other components on the main warm compressor skids. Several changes, both hardware and software, were required in the vendor (PHPK) supplied controls before the equipment could be operated safely. Updated logic and information on all changes was provided to JLab for their review.

Checkout of local and remote control of the Central Helium Liquefier warm compressors was performed. All start, stop, and interlock functions were tested. Both the PLC and EPICS controls function as required. Checkout of the controls needed for starting the main compressors will be completed when proper operation of three of the control valves on the main gas management system is verified.

Checkout of the ICS equipment for the CHL Main 4.5 K cold box was started.

A design kickoff meeting was held for the Ring Collimator Cooling Water Skids.

The first set of Ring HPRF screens have been developed in conjunction with the Ring HPRF group. These screens will be available for use with the Ring HPRF test stand currently being assembled at ORNL, and expected to be operated in spring '04.

Installation

Craft Snapshot 11/4/03

ASD craft workers	52.0
Formen, ES&H, etc.	9.0
Less WBS 1.9 etc	7.0
Less absent	0.0
TOTAL	54.0

A review of the current Davis Bacon Staffing levels was completed and presented at the Division Director's Installation Meeting on Friday.

It was recommended that three additional pipe fitters be hired for seven months to hold the current linac HVCM/RF schedule. This recommendation is impacted by the return of pipe fitting work from JLAB to the ASD Cryo Group.

It was also recommended that the current electrician level of 31 be retained until March 04 when the Ring cabling will be completed.

Accelerator Physics

Operations Group

ASD Operations ran DTL Tank 1 commissioning all week.

Ion Source Group

Controls implemented a spark detector for the 65 kV and the 45 kV platforms. While very few sparks occurred from the 65 kV platform, the 45 kV platform shows a high rate of sparks.

When the front end was ramped to full duty cycle, a plastic centering piece carbonized in the matching network. Around the same time the antenna suffered extensive damage. Despite the extensive damage, the source could still be perfectly matched with 40 kW RF power, but delivered only 2 mA peak and 0.5 mA pulse current. The initial antenna replacement did not improve the situation. The spare ion source was needed to restore operations.

Survey and Alignment

All in house drift tubes have now been fiducialized. End walls have also been re-fiducialized as a result of the measuring stand rework.

Two CCL quads were mapped this week as well as the first 21Q40.

A new epoch has begun to measure the settling of the RTBT Tunnel. Further, our data indicated that the RTBT tunnel sank at a rate of approximately 1/8 inch per week during the month of October.

The laser stand bolt holes were laid out in the Linac tunnel. The verification of the position of the laser pipe has also been completed.

As a result of changes to the position of the momentum collimator, new bolt hole locations have been laid out. The layout of the ring quarter cells began this week.

Today information was received from LANL to facilitate the layout of the CCL Module One footprint. The actual layout will be once the LANL data is processed.

The Survey and Alignment group met with the Target/Instrument group to discuss their immediate needs. From the meeting, it looks as though one two man crew will be extremely busy for several months. The Target/Instrument group has requested a complete vertical and horizontal as-built survey of the chopper cavities, as-built survey of the bulk shield liner flange, and a layout of the experiment line for each of the eighteen lines. This work will commence the first part of December.

We also obtained the data for the layout of the Laser Box I-beam supports which are attached to the LINAC tunnel ceiling. These supports will secure the laser beam boxes at each of the warm sections in the SCL area. The current plan is the layout of twelve of such items, but eventually, the remaining thirty two will have to be marked.

The Survey and Alignment group is preparing the data for installation of MB 02 and MB03 Cryo Modules. We will align these once our trackers become available from either the magnet measurement or DTL areas

Mechanical Group

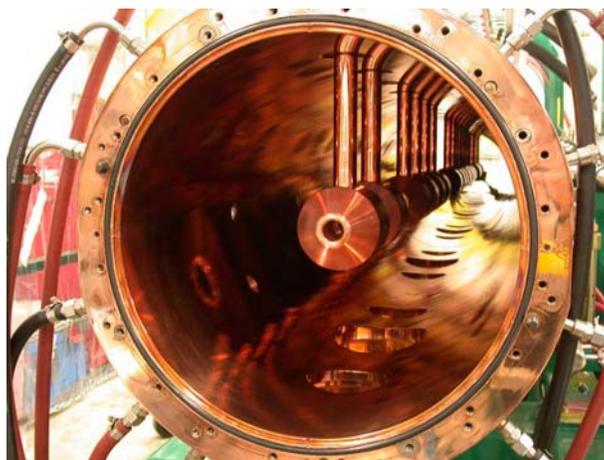
Ring Systems Installation

- The HEBT momentum collimator shielding was received.
- The HEBT collimators (2) lower external shielding assemblies were installed.
- The HEBT collimators (2) support assemblies were received.
- The RING half-cell #13 was received.
- Installation of the DC cable pulling from the Ring Service building to the tunnel continued.

Water Systems Installation

- Installation of piping from the facility to SCL ME-02, TRCC-03 and TRCC-04 carts was completed.
- Installation of piping from SCL ME-02, TRCC-03 cart to the circulators and loads was started.
- Installation of piping to the CCL1 magnet power supplies was started.
- Modification of the piping to the two air handling units in the Linac tunnel was completed. One unit has been returned to operation, and pressure/leak testing is being performed on the second.

Seventeen DT's (out of a total of 27) have been installed in DTL-4. This is all that can be installed without blocking the installation of BPM/EMD DT's which will be delivered later this month. After installation of the remaining DT's, they will be aligned and the tank tuned. We plan to complete this work in December.



Drift Tubes Installed in DTL-4

The DTL-5 tank has been leak tested and is leak tight. Cooling manifold installation will begin next later this week



DTL-5 Tank Leak Testing

The first 15 DT's for DTL-5 (of a total of 23) have been fiducialized, magnet mapped, and leak tested. We will begin DT installation in early December after the cooling manifold installation is complete.

Magnet Task

This week we completed measurements of the first HEBT 21Q40 Quadrupole.

We also continued measurements of CCL Quadrupoles. Milhous has delivered a total of 30 CCL magnets.

An issue has surface with CCL Quadrupoles in that leaks develop at the Stainless-to-copper braze. We are working with LANL and Milhous to solve this problem.

We took delivery of the #13 Ring Half Cell.

Two more 27CD correctors arrived from NETC.

Electrical Group

Installation of the CCL-ME3 modulator tank was completed. CCL-ME4 modulator tank is nearly ready for installation. We continue to rebuild IGBT switch plates from DTL-ME3, as well as checkout switch plates for other units. We await completion of crafts electrician work to checkout additional HVCM units. Operation of the RFTF HVCM was suspended this week awaiting parts for an RF amplifier. Operation of DTL modulators continues in support of commissioning activities.

5 kA PEM Rogowski probes were installed on SCL-ME1, and numerous switching waveforms on all IGBTs were acquired using a resistive load equivalent to 12 klystrons (see attached waveform, voltage in blue). The measurements were repeated with a 6 klystron equivalent resistive load. We will be analyzing these waveforms to determine a testing plan for the SCL modulator and klystrons in early December. It appears that, with the ability to adjust only the first 3 start pulses, the front end of the waveform exhibits over and undershoot, which will likely require fine tuning of additional start pulses to minimize.

The HVCM automated bypass circuitry has been designed, and will go out for fabrication soon.

Sent two 5 MW circulators to LANL for high power testing to replace the two failed units returned to the vendor.

Removed and shipped three 5 MW circulator port 2 windows to LANL to support testing.

Packaged and shipped 5MW klystron to Thales for repair.

Installed remote cables for CCL waveguide phase shifter control. Fabricated phase-shifter controller box.

Began CCL waveguide phase measurement.

Submitted design for CCL waveguide air-cooling adapter to drafting to generate fabrication drawings.

Sent SCL transmitter power-up procedure to LANL for final editing and review.

Continued cable terminations on SCL-1 RF Transmitter.

Started final alignment of SCL klystron to circulator waveguide runs.

Loaded IP address into RFTF 805 and 402 transmitter PLCs, established EPICS communication.

Installed a filter cleaning station for the RF equipment filters.

LINAC-SCL rack row 04 and 05 installed, base for rack row SCL06 set.

Terminations on CCL VAC

RING magnet pulls, about 20,000 feet of 535MCM pulled since DOE review started.

CHL termination and checkout continues to support CHL commissioning

CCL rack terminations, ring SB and tunnel tray are getting filled

HPRF

Work continued on installing the SCL-MB-ME1 transmitter.

Waveguide for the 1st 6-pack being reconnected. Final task before 6-pack complete.

Electricians continue work of the 2nd six pack.

Pipefitters, piping for SCL MB-ME2 transmitter.

RF shop transmitter and HVCM now operational from the MCR.

LLRF area expanding in the RFTF, preparing for production of LLRF control and feedback electronics.

Phase matching of CCL waveguide runs underway, after power splitter.

LLRF

The LANL team has installed a timing system in their lab and has duplicated the DMA data transfer problem that is currently under investigation. So far the only problem they have observed is marginal timing between setting up the data lines and sending the data acknowledgment (DTACK). The effect of this timing will be tested by holding off DTACK until the data lines have stabilized.

The LBNL team continues to work with the Rev B Field Control Module (FCM) to demonstrate the adequacy of the design and implementation.

Four new High Power Protection Modules, Rev F, were received and checked out at LANL. These HPMs are due next week at ORNL, where they will undergo complete acceptance testing and calibration. One of them will be tested with the FCM in the lab prior to being installed on DTL1.

The team will hold a production review on Nov. 17 via videoconference. The purpose is to review the production plan, seek out deficiencies, and propose improvements.

The purchase order for the 50, 402.5 and 805 MHz filters was issued this week. These filters are used on the RF Output board and are long lead items. We were able to reduce the filter cost by ~4 by going out for bids on a revised specification.

The requisition for the Analog Front Ends was submitted; the documentation required for the purchase order is being prepared.

Writing of acceptance test plans for the FCM production is in progress.

The primary effort this week has been on terminating and measuring transmission losses in the coaxial cables for the first SCL 12-pack.

The prototype downconversion chassis for the SCL was completed this week. This chassis will serve as a model for the vendor chosen to fabricate all of the chassis needed for the SCL.

Three benchtop resonators have been ordered from industry to augment the single resonator already in use in the laboratory at ORNL. These will allow for us to have multiple test stands for development and testing of LLRF control systems.

The ORNL LLRF laboratory is expanding into the area between the existing lab (the shielded bunker) and the RF Technician offices. The shortage of AC power distribution in the lab has been solved by using one of the portable distribution centers that is powered from a 480 V welding outlet.

Requisitions have been issued for the 805 MHz reference line, the amplifier that will drive the reference line, and one spare amplifier. The SRO for installation of the temperature regulation system wiring and junction boxes is under development.

We continue to support machine operations as necessary. Carl has worked this week to upgrade the 2nd generation control chassis to a newer version of EPICS in order to alleviate the problem of disconnected process variables. DTL1 continues to run with the Rev B Field Control Module that was installed several weeks ago.

Cryosystem Group

We have added oil to compressors 1-5 and modified the oil by-pass valve on the second stage compressors. The megger test on all the motors is scheduled for Tuesday 11/18/03. All the process piping is clean, purified and the charcoal bed is dehydrated and back filled with helium. Tower water cooling is available upon demand so we will be ready to run all the compressors for a brief period (30 Min) some time next week.

After pressure testing the return shield line last week we detected helium in the vacuum space. Upon further investigation we discovered a shield to vacuum leak in the west section of the return transfer line. We are presently testing to discover exactly where the leak is located

Beam Diagnostics