

## Accelerator Systems Division Highlights Ending August 22, 2003

### ASD/LANL: Warm Linac

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

Accomplishment This Week: Thales 5-MW klystron S/N 3 for the CCL is installed and operating in the LANL test stand. The tube cathode is conditioning rapidly, where we achieved 135-kV, 1.4-ms, and 60-Hz. The lead shielding is also better engineered on this tube. We started first RF operation on 8/22.

#### HIGH-VOLTAGE POWER CONDITIONING (WBS 1.4.1.2)

Accomplishments: (1) The prototype HV converter modulator (HVCM) operated well at 135-kV, and 800-kW average power in support of the Thales 5-MW klystron conditioning. (2) J. Bradley was at Dynapower to witness acceptance testing of the 14<sup>th</sup> and 15<sup>th</sup> (of 17) production HVCM units. Tests were satisfactory, although a faulty output rectifier string failed and had to be replaced during the 8-hour heat run. The final two units are expected to be ready for acceptance tests next month.

Concerns & Actions: The production SCR controller that feeds the production HVCM at LANL failed resulting in smoke coming out of the cabinet. The trigger of the event was from additional snubber RC circuitry we installed to address SCR triggering problems (and not the SCR unit itself). Snubber components were visibly damaged, while the SCR assembly appeared physically in tact. The engineer and ESO inspected the design, installation, and procedures this morning prior to the work, which was conducted through an SEWP and with constant contact with the SCR controller manufacturer. Personnel were wearing PPE and promptly called 911 when smoke continued after de-energizing. The engineered controls (primary and secondary switchgear) automatically tripped. A formal critique was held, and the event was found not to be a reportable occurrence; in the critique, SNS personnel were commended for having approved procedures in place and acting thoroughly and professionally.

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

Accomplishments - Tank-2: (1) Group J water internal machining has begun. All tank 2 end caps were machined and 26 water channel welds were completed. Waveguide final brazing is scheduled for next week. Projected date for arrival in ORNL of waveguide is 9/24.

Tank 4: Final profiling is underway; a second machine has been qualified for final profiling. Groups A & B are at CMI for final profiling; group C will ship from Hanford to New Mexico. The welding for group D is complete tomorrow and they should ship to NM on 8/26.

Tank 5: All drift tubes (magnets and caps installed, see Fig. 1) shipped to Hanford for water channel weld repairs and cap welds. Welding is expected to start 8/25.

Tank 6: Drift tubes are ready for magnet installation (Fig. 1). Waveguide final brazing is scheduled for next week. Projected date for arrival in ORNL of waveguide is 9/16.

EMD and BPM DT's: A very productive week of welding occurred at Sciaky. Some welding problems occurred but they were satisfactorily dealt with. Reworked drift tubes 2-39 and 5-19 are about caught up with the production stream. BPM drift tube parts underwent brazing at LANL. Approximate (schedules still be reworked) delivery dates to ORNL as currently calculated are tanks 2, 6 and 4 EMDs: 9/24, tanks 1, 3 and 5 EMDs: 10/21 and tanks 2-6 BPMs: 11/5.

Beam Boxes: Box 3/4 is complete (Fig. 1) and will be shipped out from Integrated on 8/22. Standing schedule of 10/17 for beam boxes 1/2 and 2/3 appears satisfactory, so the production order will not be disturbed.

Concerns & Actions: (1) Tank 2 schedule is showing delay due to an additional heat treat step that was added to the fabrication sequence. We are looking for ways to gain back time.



Fig.1: (a) DTL Tank-5 magnet installation; (b) Tank-6 drift tubes (c) beam box segment 3/4 ready for electro polishing.

#### COUPLED CAVITY LINAC (WBS 1.4.4)

Accomplishments: (1) All 12 segments of module 1 and 8 of 11 bridge couplers are installed and aligned on the support rails (Fig. 2). Competition with vacuum leak checking has precluded installation of the final 3 bridge couplers. We anticipate that the bridge couplers will be installed and doublet (two segments plus a bridge coupler) tuning can commence next week. (2) We are making progress with tuning. Previous frequency measurements of the 5 bridge-coupler modes were too irreproducible to be of any use. A loose shorting rod was identified as one of the culprits. The shorting rod was redesigned to reproducibly make positive RF contact on both ends. Field probes that were too thin and too flexible to be installed reproducibly also compromised measurements. New probes were fabricated from 0.085"-o.d. rigid coaxial cable terminated with SMA connectors and rigidly mounted on Conflat flanges. (3) Changes in local humidity required that each frequency measurements be converted to vacuum conditions leading to a significant source of error. The dry nitrogen purge system has been improved so that the effect of humidity is no longer an issue. All frequency measurements now appear to be quite reproducible. (4) Fabrication of the intersegment regions at ESCO is proceeding well (Fig. 3)

Concerns & Actions: (1) Primary concern continues to be the vendor's lack of technical skills, leadership, support, and commitment in the cavity tuning activities. The tuning equipment provided has been inadequate and has been replaced with instruments, software, probes, tooling *etc.* by SNS (LANL and ORNL). Daily phone conferences help sustain some momentum, but without someone from LANL on site, progress is too slow. J. Stovall and J. Billen will travel to ACCEL on 8/31. (2) Coupling cells in bridge couplers 7 and 11 are slightly low in frequency. A tuning fixture has been built to push out the nose of these cavities. In its initial trial it only caused local deformation without changing the frequency of the cavity. An improved version, designed to distribute the pushing force, only smoothed out the local deformation. A thicker transfer plate will be tested next week. (3) The bridge couplers are sealed to the segment coupling cells with copper spacers with o-ring grooves and RF seals on both sides. A poor fit of the o-rings in the spacer causes the dry o-rings to roll when the spacer ring is inserted. Two possible solutions, attempted by ACCEL, involved the use of glue and tape. Both attempts failed because the seals leaked. We tried better fitting o-rings that appear to solve this problem in preliminary tests.

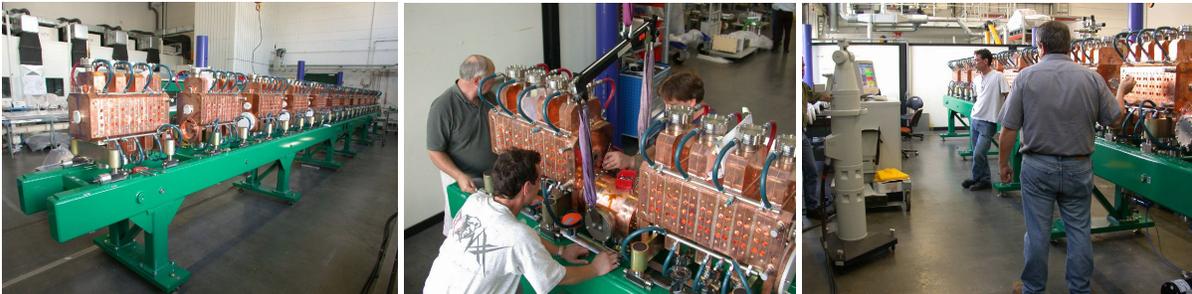


Fig. 2: CCL Module-1, bridge coupler installation, and alignment.



Fig. 3: CCL intertank components at ESCO

#### PHYSICS & DIAGNOSTICS (WBS 1.4.5)

Accomplishments: (1) J. Power was at ORNL troubleshooting BPM electronics. He traced the problem with the short lifetime of the AFE to a design error that burns up a resistor in the front-end amplifier when the calibration pulse is shut off. He has implemented a fix and contacted the vendor, Bergoz. The problem appeared only in the 805-MHz AFEs -- Bergoz appears to have corrected the error in the 402.5-MHz AFEs currently being used on the

D-Plate. Two of the BPM electronics also have digital problems and may have to be brought back to LANL for Matt Stettler to correct. John found no systematic error requiring a major change in the processors, so the order for additional units can proceed as planned. The first order for 15 units (enough for the DTL and CCL) is with the vendor and acquiring long-lead items to expedite the assembly. (2) SMA feedthroughs for the DTL current monitors arrived this week; the seven remaining DTL CMs will be shipped to ORNL along with the beam boxes. All CCL CMs have already been delivered (2 to CCL engineer for integration in intersegment regions, 1 spare to ORNL). This completes our CM deliverables.

Concerns & Actions: The first article DTL and CCL wire scanner actuators are scheduled to arrive within two weeks, but the vendor Huntington is having trouble procuring microswitches from Honeywell. We are exploring alternate suppliers with the vendor.

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

The problem with the 1 MW RF Test Stand continues. A leak has been identified and LANL technical support is expected Monday to carry out a repair. SNS has agreed to accept the M-3 cryomodule without a measured  $Q_0$  vs. gradient curve for the third cavity. Previous tests showed satisfactory gradient capability. The cryomodule has been warmed up and rolled out of the CMTF.

Cryomodule M-5 has been installed in the CMTF. Cooldown is scheduled for Tuesday.

End cans are being attached to the M-6 cryomodule.

Three cavities have been qualified for the M-7 string. String assembly is scheduled for next week.

One cavity is qualified for the M-8 string.

The HB02 cavity was electropolished. HB04 and HB06 are scheduled for electropolishing next week.

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

A report describing the recent BLM efforts at SNS/OR was submitted to ASD by Dave Gassner. The report includes an outline of the present system status, documentation, and items to be addressed.

Much effort is being spent to understand the BCM electronics problems at SNS/OR. Craig Dawson shipped a working BCM board to ORNL and will talk with Jim Pogue about possible improvements.

Layouts for the half-cell lifting fixture were sent to ASD for review, comment and confirmation of critical dimensions.

A follow-up to the Cost, Schedule, and Performance review of August 7<sup>th</sup> was held with ASD by way of a video-conference.

The "no-cost" PCR to increase the power supply voltage using dollars planned for the RTBT Collimator outer shielding was approved.

Roger Connelly presented a talk at this week's Accelerator Physics meeting on IPM measurements at 200 gauss vs. 2 kilogauss.

BNL designers are working on installation drawings for the HEBT collimators. Jim Alduino plans to release HEBT installation drawings up to injection region by Sept. 1.

AP Group is sorting through measurement differences between 30Q58 1<sup>st</sup> article and 1<sup>st</sup> production magnets. Plan is to measure all and re-evaluate.

Engineering review of the Lambertson extraction magnet has been rescheduled with ASD for Wednesday, Aug. 27.

Statement of Work, Specification, and an RFQ for the Ring collimator outer shielding (Ring #2 & 3) were released for vendor bids. Signed drawings are ready too.

Preparations are underway for delivery of half-cell #12 to SNS/OR. Other equipment (30Q58 stands, 21Q40 quads, etc.) will be added to our shipping list. ETA for the half-cell is Sept. 5.

Oak Ridge Tool and Engineering has started work on the Outer Shielding for the HEBT Momentum Collimator. They will be included in our weekly telecom meetings starting next Wednesday.

### Controls

Martin Pieck visited from LANL and helped with the power supply control application. Test results have been documented, and the new ramping algorithms should be ready for use at the start of the DTL run next week.

There were three "post-start" ARR recommendations for the MPS system, and these are being addressed:

1. The use of jumpers needs to be tracked and formally controlled. A tracking system using Oracle has been proposed and is being prototyped. It is a generic solution that can track other system interlock bypasses as well.
2. The tables that are used to control machine-status-masking of inputs need to be strictly controlled with a review, test and protection process. Oracle is used to generate these Mode Mask Files. The default Mode masks will be reviewed. Any deviations from the defaults will be posted in the e-log and reviewed individually. A second application reads the mode masks from Oracle and verifies the masks used by the IOC's. The test procedure is defined in SNS-ASD-MPS-0004 document.
3. All MPS equipment should be labeled with warning labels, including a contact phone number. All MPS chassis have been labeled with an MPS identifying sticker. Additional cable labels have been ordered to label MPS cables at the input equipment end.

The archiver configuration for 762 CF controls process variables in the FELK was completed, along with a document which presents a philosophy or basis for archiving each type of signal, identifies each signal, checks signals versus the FSD, generates a description for each, and determines the archive parameters for each signal.

All field wiring connections were completed in the Central Helium Liquefier Gas Management PLC racks. PLC modules were installed in the racks. Communication between the SNS Gas Management PLC and the 6 PHPK Warm Compressor PLCs was tested and verified to be functioning properly. Several pressures and temperatures appear to be reading correctly. Sensor calibration for these PLC systems will start soon. Calibration of all purifier signals was completed.

In the accelerator Personal Protection System (PPS), Beam Shutdown Stations are being installed in the LINAC tunnel, cable terminations are being made in the first PPS klystron PLC rack and signs are being developed for the DTL enclosure to enforce the use of the badge reader installed as a part of the PPS. There was progress as well on the Oxygen Deficiency Hazard (ODH) systems. The PLC and "PanelBuilder" programs were updated to alarm on high oxygen levels (indicates sensor fault), how the PLC monitors the three stand-alone units in the Cold Box Area was modified; and the installation of the temporary stand-alone system for the recovery compressor in the warm compressor area was started.

### Installation

Craft Snapshot 8/12/03

ASD craft workers	69.0
Foremen, ES&H, etc	12.0
Less WBS 1.9 etc	11.0
Less absent	4.0
TOTAL	66.0

### **Accelerator Physics**

E. Tanke, L. Kravchuk, I. Popova and F. Gallmaier completed a Fault Study Plan for DTL Tank 1 Commissioning. This work addressed several pre-start action items from the previous weeks' Accelerator Readiness Review. Four principal faults are presented in the plan, together with the required radiation dose rate measurements in and around the Front-End and DTL 1 Enclosure.

A. Shishlo and A. Aleksandrov are studying the MEBT beam dynamics with the PARMELA code in an attempt to reproduce the measured emittance results obtained during Front-end commissioning. Preliminary indications are that the PARMELA code better predicts the measured emittance than the PARMILA code. Investigations are still underway but preliminary agreement is encouraging.

S. Cousineau has been working with S. Tepikian of BNL on finalizing the next version of the official ring MAD lattice

### **Operations Group**

Worked with the ARR committee to clear the punch list of pre-start items so that we can obtain authorization to begin commissioning.

Worked on investigations of RER incidents.

Prepared for commissioning by running accelerator systems.

Started a formal Maintenance hand-over and hand-back with technical groups.

Met with XFD on proton current measurements as they relate to the Category 3 Nuclear threshold calculation.

Met with Controls on a new ORACLE based system for Interlock Bypass/Jumper management and installed a temporary system in the control room.

Prepared for the beam enclosure access control transition to prox-card entry.

### **Ion Source Group**

We are adding an emergency shutoff station at the entrance outside the hot spare stand cage to allow a fast and safe shut down of the hot spare stand.

We continue to participate in the conditioning of the DTL1 and RFQ.

We have continued to operate the ion source on the hot spare stand with the full six percent duty cycle yielding up to 38.6 mA. After a total of 30 hours of full duty cycle operations, when the yield dropped to 25 mA, the operation was suspended to inspect and clean the source.

### **Survey and Alignment**

Ring

S & A completed the layout of the half cell bolt holes in the ring. This makes way for the drilling of the bolt holes and hence, the installation of the half cell base plates. Once the base plates are installed and grouted, the half cells can be installed and we may continue aligning half cell magnets.

HEBT

We are continuing layout of the stands in the HEBT. We have completed the support stand layout for the straight section of the HEBT (before the dipoles) along with the stand layout for the LINAC beam dump line.

By performing this initial layout, we were able to detect a problem with interference between two stands. This preliminary layout allows the situation to be corrected before any holes are ever drilled. We are currently laying out the bolt holes for the stands downstream of the HEBT curve.

S & A completed the as-built measurements on two diagnostics wire scanners. An analysis of the data is processed at this time and results should be available soon.

We also completed elevation measurements linking a portion of the HEBT with our exterior concrete monuments. This is a continuation of our monitoring of the tunnels subsidence as the backfill is installed. As expected, there is a continuation of the subsidence in the HEBT with some areas as high as 1/4".

We marked the bolt hole pattern for the laser box, which will be installed at the beginning of the HEBT and run back towards the SCL. The bolt hole pattern was marked with respect to the pipe chase installed by CF. Through the process of the layout, we noticed a two inch plus discrepancy of the location of the center of the pipe with respect to design value. This discrepancy was presented to the appropriate personnel for their analysis of whether this will interfere with the existing equipment in the tunnel.

Finally, we are aligning one of the magnet measurement machines for the magnet measurement group.

### **Mechanical Group**

#### **DTL Installation Highlights**

DTL-1 is ready for commissioning to begin. Initial commissioning activities are expected to begin later this week.

DTL-2 tank segments are in the final stages of cleaning and seal preparation in the RATS facility. We plan to move them to the FE building late next week and begin tank assembly in early September. When DTL-2 DT's begin arriving in late September, they will have priority over other DT's arriving at the same time.

The DTL-4 tank is assembled in the FE building and is ready for DT installation.

DTL-5 tank segments are in the initial cleaning stage in the FE building. This involves removing masking used during plating and smoothing uneven sections of plating.

#### **CCL Assembly and Installation**

Julius Fazekas, Gary Johnson, and Peter Ladd from ORNL and Nathan Bultman and John Bernardin from LANL visited ACCEL in August to participate in CCL-1, assembly, alignment, leak testing, and tuning. All 12 segments have been assembled and aligned on the support frame. Seven bridge couplers, including the five for the first half module, have been installed, connected to the vacuum manifold, and leak testing has begun. Several o-ring leaks were discovered and the causes are being investigated. Tuning activities are continuing and include a daily call between ACCEL and ORNL/LANL tuning teams. CCL-1 module pictures are shown below.



CCL Assembly Area at ACCEL



CCL-1 Module



Bridge Coupler Installation



Segment Alignment

#### Water Systems Installation activities

Installation of SCL-ME1 Piping from TRCC Carts to the RF circulators and water loads was completed. Installation of SCL-ME1 Piping from TRCC Carts to the klystron collector and body circuit piping will begin next week.

Installation of SCL-ME2 Piping from TRCC Carts to the RF circulators and water loads was started.

Pipefitters continue to weld beamline support stands for the HEBT.

#### Systems Installation activities

Additional HEBT beamline components were received.

Assembly of the beamline diagnostic and drift pipe supports continued.

Drilling and mounting of floor inserts for beamline supports continued.

Cable pulling from the Ring Service Building to the HEBT continued.

Cable tray installation in the RING Service Building continued.

Buss bar interconnection installation in the RING was started.

#### **Magnet Task**

We have measured three CCL Quads this week.

We are preparing the 21Q40/27CD30 measurement stand for measurements.

There are eight-21Q40's which were shipped to BNL. They were supposed to come here. BNL will ship them here and we will proceed with measurements.

#### **Electrical Group**

Six additional SCL Quadrupole Power Supplies have been delivered, bring the total to 16 (out of 42). Testing has started on the first of these supplies.

The final 10 (of 370) corrector power supplies have been delivered, completing this contract.

DTL-ME1 was turned back over to operations this week with an upgraded Control Chassis. Operation to date is reliable. DTL-ME2 was also turned over to the RF group to allow for DTL3 klystron studies. DTL-ME3 has completed checkout, after a long delay characterizing voltage divider performance and calibrating voltage data, and will be operated into a klystron load when the RF group is ready. CCL-ME1 is near completion of the installation phase, only lacking some cable terminating and water connections. SCL-ME1 is awaiting crafts preparation work to complete installation. The IGBT switch plate assemblies on the RFTF HVCM were replaced with units with upgraded cooling, and we expect to start operating this unit next week. Faults associated with SCR manual reset may be related to incorrect relays installed; we continue to investigate. HVCM system retrofits continue. Maintenance and turnover procedures were developed to formalize operations on the HVCM.

### **HPRF**

HPRF: Installed newly fabricated adjustable socket contacts in DTL3 klystron HV tank to facilitate better seating of the klystron. Drained, filtered and re-filled the tank with FR3 high dielectric oil. The DTL3 klystron (E2V#3) had developed a vacuum leak as described last week. We coated the copper electroplating that Claude Conner previously deposited on the first cavity of this klystron with a copper paint to provide a robust mechanical backing to the plating. Brought the filament current to full operating value while observing vacuum ion current. Vacuum remained in normal range. Brought HV up from 55 kV to 125 kV as ion current remained in normal range. An x-ray survey verified that the restored shielding was still good. Brought the klystron output rf power up to 1500 kW in steps of 250 kW under EPICS LLRF control, vacuum remained normal. We measured perveance at 0.824 uP and Q loaded at 317, both close to the factory values. Declared klystron operational.

Dale Heidenreich designed and fabricated a mobile adjustable stand for the 402.5 MHz loads used in the RFTF. This allows these heavy water loads to be safely pushed into position and raised to match the waveguide. Wood was cut to allow safely stacking of the SC klystron tanks three high in the RFTF to make room for the loads.

### **LLRF**

Julius Fazekas, Gary Johnson, and Peter Ladd from ORNL and Nathan Bultman and John Bernardin from LANL visited ACCEL in August to participate in CCL-1, assembly, alignment, leak testing, and tuning. All 12 segments have been assembled and aligned on the support frame. Seven bridge couplers, including the five for the first half module, have been installed, connected to the vacuum manifold, and leak testing has begun. DTL-2 tank segments are in the final stages of cleaning and seal preparation in the RATS facility. We plan to move them to the FE building late next week and begin tank assembly in early September. When DTL-2 DT's begin arriving in late September, they will have priority over other DT's arriving at the same time.

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## Cryosystem Group

The first article warm beam pipe was assembled with all laser wire components and successfully leak-checked.



CHL: Piping of the 2.1K cold box continues.  
The supply and return end cans are 45% welded to their respective transfer lines.  
The supply and return helium gas lines have been installed on the recovery compressor.  
We continue purging the "B" charcoal bed in the purifier.  
The second 7000 gallons of LN2 was delivered and stored in the 20,000 gallon dewar. The boil off gas from the Dewar is used to purge the major refrigerator systems.  
The main tower water cooling valves have been opened in the CHL. All the bypasses are open and the system is flushing. All the supply and return water feed valves to the compressors are **locked closed**.

Linac Tunnel: Orbital welding of the helium gas purge system continues.  
Cryomodule #2 was installed in slot #3 of the transfer line.

Rats: Fabrication of "U" tube subassemblies continues.  
6 Supply "U" tubes have been assembled and evacuated

## Beam Diagnostics