

Accelerator Systems Division Highlights for the Two Weeks Ending June 13, 2003

ASD/LANL: Warm Linac

HIGH-POWER RF (WBS 1.4.1.1)

Accomplishments This Week: (1) 402.5-MHz klystron: An E2V representative is still scheduled to come to LANL for the tuning of SN 10 the week of June 16-20. (2) 805-MHz, 5-MW Thales klystrons: Thales is still on schedule for the factory acceptance tests of SN 1 on June 23-24 and SN 3 on June 26-27. SN 4 has been delayed to the week of July 7. (3) 805-MHz, 550-kW Thales klystrons: Two Thales representatives were scheduled to come to LANL this week to tune, but their trip was postponed until the week of June 23 because the test stand is not operational (see below). The factory tests for SN 005 and 006 are scheduled for next week. Discussions on the calibration of their voltage probe are still in progress. (4) 805-MHz, 550-kW CPI klystrons: Dan Reese visited CPI and observed the new test set. He also observed part of the tests for SN 25. LANL has not approved this data yet but is expecting to do so soon.

Concerns & Actions: (1) The RF test stand is has been down for two weeks pending repair of the SCR controller for the HVCM (see below). This is impacting our ability to complete the test program as scheduled.

HIGH-VOLTAGE POWER CONDITIONING (WBS 1.4.1.2)

Accomplishments This Week: (1) We completed factory acceptance testing of 140-kV modulator baskets SN 7 and 8, at Dynapower. (2) We worked with Dynapower to add a test of individual phases to the test plan. (3) We began factory acceptance tests of three IGBT assemblies for shipping to ORNL next week. (4) We received the voltage divider calibrated for operation in our oil tank back from Ross and installed it on the prototype modulator output.

Concerns & Actions: (1) Bill Reass and others are working with Dynapower to determine the cause of oscillations in the SCR controller that failed last week. Moreover, the substation switchgear feeding LANL's SCR controller system also failed. We ordered parts and have a line crew working to repair and restart this switchgear, which should occur today (Friday) or Monday. In the meantime, we re-routed the HVDC cables and control cables from the SCR controllers to allow the prototype modulator to be connected to the second SCR controller (the one shipped to LANL with the production HVCM system). Assuming this SCR controller is operational, we should get the RF test stand back into operation early next week.

LOW-LEVEL RF CONTROLS (WBS 1.4.1.3)

Accomplishments This Week: (1) Following a very promising integration of all the components at LANL, we shipped a complete LANL-developed LLRF system to Berkeley to continue validations tests. The system consisted of the VXI motherboard, the DFE, RFO and AFE boards, as well as a VME IOC. Kay Kasemir traveled to Berkeley to help with the installation of the EPICS control system at the test stand and to help with system tests at LBNL. Following a few modifications to the VHDL firmware, the Berkeley team was able to demonstrate the critical functionality of phase and amplitude control on a test cavity. This indicates, as commented by Larry Doolittle, "the core analog and digital signal processing path through the AFE, DFE, and RFO is fully checked out and functional. The project looks like it is on a sound footing and is ready to move to the next stage of revisions and feature enhancements." This is a major milestone in the development of the LLRF system for SNS. (2) Following further tests next week at LBNL and LANL, we plan to ship a complete LLRF unit to ORNL the week of June 23 -- we will be ready to perform high-power RF tests with this new unit the week of July 7. (3) The other major activity for this week was to produce sufficient hardware to allow parallel testing at the three partner laboratories, plus two spare LLRF units. We fabricated and assembled two more VXI motherboards that have passed tests and are waiting for integrating testing. We also received three AFE units from Bergoz and two RFO units from the production facility in Albuquerque. We placed an order for two more units of the DFE with Suntron and expect to receive complete units in a week. With these we will have all the modules necessary to produce five complete LLRF systems. (4) In preparation for analyzing tests data from the DTL, we have developed a program to reconcile cavity test data with our MATLAB models. We published a report titled "Analysis of the Superconducting Cavity Experiment Data," which includes an analysis of JLab test data from last April. The program not only gets the Lorentz-force detuning, but also proposes the open-loop feedforward signals against the klystron droop and Lorentz-force detuning that will result in a flat cavity field amplitude and phase. This is a form of gain scheduling control that we intend to implant in the future. (5) We received the first unit of the final REV of the HPM board. We completed the work to interface the new board to EPICS and also to reduce the calibration sensitivity for the HPM. The paddleboard for the HPM test stand was also released and will be tested shortly.

DRIFT-TUBE LINAC (WBS 1.4.2)Accomplishments This Week:

Tank-1: (1) The final five slug tuners were shipped to ORNL on Monday. (2) Following the weld failure of 3 of the 19 post couplers reported last week, all were inspected and 16 were re-welded. The shrinkage was minor; so no re-plating was required -- just machining of the mounting flanges. Nine of the 19 post couplers were shipped to ORNL on Thursday, arriving Friday. The remaining 10 are being packaged for shipment today (Friday) and should arrive at ORNL on Saturday, two days earlier than last week's estimate.

Tanks 4,5,6,2: (1) All Tank-4 and 20 Tank-5 drift tubes are going through a water-channel weld repair procedure and internal machining. (2) The remaining seven Tank-5 drift tubes and all of the Tank-6 drift tubes are being brazed prior to the water-channel welds. (3) The Tank-2 body and sleeves are being shrink fit.

COUPLED CAVITY LINAC (WBS 1.4.4)

Accomplishments This Week: (1) Nathan Bultman was at ACCEL this week to assist in mounting the cavities on the Module-1 support stand.

PHYSICS & DIAGNOSTICS (WBS 1.4.5)

Accomplishments This Week: (1) Two members of the diagnostics team (John Power and Matt Stettler) were at ORNL this week to install the new MEBT BPM systems and to work on the PCI timing card. We have calculated the low-beta corrections needed for the D-plate BPM systems; a tech note is in progress. (2) Work began to detail the HEBT wire-scanner layout. (3) We got approval from ORNL on the aperture for our target-harp design; we are finalizing details of how the wire planes will be stacked and secured.

ASD/JLAB: Cold Linac

Cryomodule M-1 was received at SNS in good condition. Beamline vacuum was excellent and did not change when the insulating vacuum was vented to begin incoming inspection. Low-power testing of M-2 is complete. Cavity #1 ran for an hour at 16 MV/m. Assembly of M-3 is complete and the cryomodule has been moved into the receiving area for final touches (see photo). The M-4 cold mass has been inserted into the space frame. The cavity string for M-5 has been rolled out of the string assembly clean room and into the cryomodule assembly area. Three cavities have been qualified for the M-6 string and assembly is scheduled for next week.

CW high-gradient (17 MV/m) testing of a cavity in the VTA was observed to lead to slight melting of the copper probe tip of the HOM coupler external feedthrough. Although these conditions represent roughly 50 times the fundamental power load expected in normal operation, the absolute power levels are believed to be of the same order as anticipated HOM power deposited in the cavity by the beam. The mechanism that achieves this much heating is not understood and investigations are underway.





ASD/BNL: Ring

Integral harmonics of the first article high field large aperture ring sextupole (26S26) have been measured at 1.0 and 1.3 GeV field levels. The data are being reviewed by our AP Group for baseline acceptance as a production magnet. Measurements appear to be in good agreement with the theoretical calculations as presented in the parameter sheet.

HEBT assembly drawings are being prepared for submittal to ASD. These include HEBT Q5 thru Q8 and Q9 thru Q11. The dipole assemblies with the different vacuum chambers are also being finalized and will be inserted into the HEBT installation drawings.

Arrangements have been made for a weekly teleconference between the engineering teams at BNL and ASD to review salient issues, schedules and priorities.

Richard Anderson traveled to SNS/OR this week to make mechanical corrections to the half-cell corrector magnets that have been delivered to ASD. All affected jumper connections have been changed-out.

21Q40: Shimming for the family of twelve Ring magnets is complete. All twelve magnets have been identified, measured and shimmed.

New England Technicoil (NETC) has four 27CD30 production magnets crated for shipment to SNS/OR.

Stangenes - the last three 26Q40 (8) production quadrupoles have been uncrated at BNL and visually inspected. Water flow testing and high pot testing will commence before the start of magnetic measurements.

Arrangements are being made with Debra Graves for the near term (June) delivery of Tesla quads (8) and frames, NETC corrector magnets (4), and HEBT collimators (2) from SDMS, France.

Controls

The Controls Team at SNS/ORNL hosted several colleagues from our partner laboratories this week.

Martin Pieck was here from LANL. Substantial progress was on getting the power supply controls checked out for the DTL1/Dplate magnets before he left.

Discussions were to identify requirements for an EPICS system to control power supplies and magnet data acquisition in the magnet test lab. A phased approach to upgrading the MEBT magnet controls screens and power supplies was also discussed.

Jeff Hill visited from LANL to help with the diagnosis of persistent high error rates on the SNS controls network. Some erroneous configurations were found and corrected, with dramatic effect, but an unresolved error rate remains, possibly due to noise although not correlated with RF operation.

Charles Pinney, David Warren and Steve Armejo visited from LANL to assist with the execution of the vacuum and RCCS test plans in preparation for the upcoming ARR and DTL1/D-Plate beam run. Test and operating procedures have been updated, the D-Plate Fast Valve and MPS connectivity tested and RGA software set up in the control room. Also – operator training was conducted on the DTL vacuum control system.

Yury Eidelman visited from BNL to implement more alarm handler files in preparation for the upcoming DTL1 beam run. In so doing, potential improvements to the alarm handler configuration tool were noted, and Yury agreed to stay an additional week to implement them.

At LANL, support was provided for changes, test, and integration of the Dplate vacuum system. Significant progress was also made on the RGA driver. LANL participated in a video discussion of the SCL vacuum system. A system description was drafted, reviewed, updated and reissued; a system block diagram started; and the P&ID screens for the SCL vacuum were completed. The modulator database was updated to support the latest version of PLC code.

Much effort was expended in preparing the Personnel Protection System for Phase 0.4 – DTL1 beam operation (with continued DTL3 RF operation.) Field wiring, PLC programming modifications, EPICS screen modification, installation and certification of five Chipmunks and system integration testing have all been completed. Dry Run and final System Certification are planned for Monday, June 16. One stand alone oxygen monitor has been installed and certified for use in the cold room at the CHL.

Channel Access security was configured for the FE&DTL vacuum control IOCs and is ready to be tested

An "Inspection Discrepancy Report" for the recent rack mis-wire discovery (in the CUB communications rack) was completed and forwarded to ES&H for use in preparing their occurrence report.

CCL communications cable installation is in progress (and has been for the last few weeks). CCL MPS input cable installation documentation was handed over to the installation team.

The draft calibration procedure for checkout of the cryogenic control system instruments was used to check the operation of an instrument. Minor revisions will be made to the procedure to incorporate issues that surfaced during the calibration. Once the steps of the procedure are verified, it will be issued for approval. The purifier recovery compressor screen was updated to use the new alarm sensitive text widget.

The IOC for CF control of the CUB was placed into operation.

Installation

Craft Snapshot 6/11/03

ASD craft workers	79.0
Foremen, ES&H, etc	12.0
Less WBS 1.9 etc	6.0
Less absent	7.0
TOTAL	78.0

Accelerator Physics

Operations Group

Ion Source Group

Following the Front End re-re-commissioning, the LEBT was vented and removed for a visual inspection. No problems or deficiencies were found. Using the LBNL alignment jig, the glued insulator assemblies of lens 2 were replaced with new brazed assemblies. After the LEBT was reinstalled, the Survey and Alignment group laser-tracked the extraction aperture as well as all ion source and LEBT fiducials.

The second ion source, previously commissioned on the Hot Spare Stand at RATS, was re-commissioned on the Hot Spare Stand in the Front End Building. It delivered 14 mA without a re-cesiation.

Efforts continue to complete source # 3 and a spare LEBT.

Survey and Alignment Group

Mechanical Group

After moving DTL-1 back on the beam line, DT alignment checks were performed, the data assessed, and no adjustments are required.

Slug tuners have been installed on DTL-1 and interim leak testing is in progress. Final integrated leak testing will be done next week after the post couplers have been installed.

Electrical cables and cooling headers have been reconnected to DTL-1 at its position on the beam line. Component testing will begin on Friday and extend through the weekend.

All ports on DTL-4 have been blanked off and leak testing has begun.

Magnet Task

Electrical Group

The RFTF HVCM has now successfully been tested by the ES Group for full operation up to 125 kV, 30 Hz, into the beamstick load for 4 hours. The documentation has been completed, and the unit is now ready to be turned over to the RF Group to support HPRF testing.

After careful inspection of the SCR controller on DTL-ME1, it was determined that last week's fault resulted from faulty insulation in the bridge assembly. ORNL has made several recommendations to Dynapower and is in the process of implementing these upgrades on DTL-ME1. Dynapower is considering the proposal and is expected to comment next week. We will also be adding some additional safety features to all modulator installations, including emergency off functionality to the switchgear operator and water shutdown capability to the SCR cabinet.

DTL-ME2 has been disassembled and is being carefully examined for evidence of the cause of the 2.5% ripple observed. We expect to have it operational for testing by the middle of next week.

All DTL magnet corrector power supplies have been installed in racks in the Klystron gallery.

Electrical Installation:

HEBT heavy cable pulls from the HEBT service building are complete.

Ring tunnel tray installation is progressing and is 45% complete.

Ring DC Bus installation has started.

HPRF

LLRF

Integration and testing of the 3rd generation LLRF control hardware continued this week at LBNL. Larry and Craig reported on Thursday evening that they had successfully demonstrated closed loop feedback control on a bench top resonator. Larry's report follows:

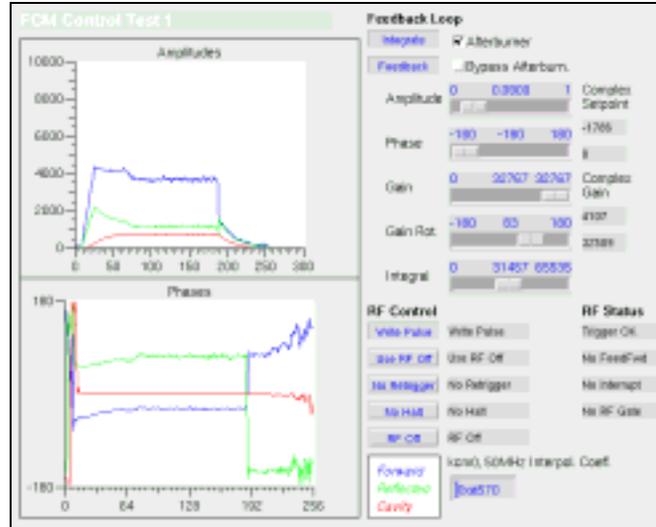
“At about 3pm today, Craig and I removed the last critical bug in the VHDL code for the FCM/DFE FPGA, and operated our test cavity in closed loop mode. The system behaves just like I am used to with the LBNL hardware. A screen shot is attached.

Some (but presumably not all) of the issues that remain, in no particular priority or time order, are:

- RFO level saturates at about 50% of the digital control range. A resistor probably needs to be changed on the RFO board, but for now we just cut the digital level in half.
- FPGA code to run the coarse RF output level control is untested, and our hardware has that control bypassed (to use a bench power supply instead).
- The FPGA code to permit writing to the feedforward table was hacked into a workaround mode at the last minute, a few lines of correct code needs to be written, simulated, and tested.
- The DFE card we have here had its remote JTAG programming interface disabled, so we have to use an external cable and computer to configure the FPGA. We have done that both with official Xilinx Windows software, and with C Linux code that Larry and Kay adapted from the LBNL chassis code base. The latter code should adapt fine to VXWorks and the Stettler VXI bus; Kay is ready to test that.

So, the core analog and digital signal-processing path through the AFE, DFE, and RFO is fully checked out and functional. The project looks like it is on a sound footing, and is ready to move to the next stage of revisions and feature enhancements.”

Craig will remain at LBNL through early next week. Within about 1 week we plan to have five complete prototypes of the 3rd generation controller. The LANL team will be working next week to confirm the LBNL results on the 2nd set of hardware. A third set will be shipped to ORNL the week of June 23. This system will be tested with the DTL at ORNL and with a cryomodule at JLab.



First demonstration of closed loop feedback control with the 3rd generation LLRF control system.

Reference System

The insulation was installed on the 402.5 MHz reference line. Two of four zones are already under temperature regulation; the final two zones will be energized June 16. The pressure regulation unit has been moved to the klystron gallery; tubing will be installed early next week. The AC power circuit for the frequency reference UPS power supply has been upgraded; the UPS will be powered up next week after the circuit had been turned over to the LLRF group.

MEBT Rebuncher

The spare MEBT chassis was returned to Oak Ridge. This unit still needs improvements, which will be performed as time permits.

DTL LLRF Control Chassis Production

All filters (long lead items) for the final run of 2nd generation controllers for the DTL are in house. Production of chassis for DTL2 and DTL4-6 is in progress.

Cryo Systems Group

CHL: The LN2 transfer line is complete and ready for commissioning. The 2 first stage warm compressor oil pumps have been replaced and are ready for alignment. Work continues on installing the warm compressor couplings. Electricians and pipe fitters are working on the purifier. The absorber is still being heated and remains under nitrogen purge. Helium storage tank #1 has been evacuated and is ready for helium gas.

Tunnel: All the 12" clamshells are installed in the down stream return modules and final welding has started. The first set of isolation valves have been installed in position #1 of the upstream modules.

RATS: We are preparing the shop to start construction of the transfer line "U" tubes. The first medium beta Cryomodule (MB1) has arrived from JLAB and is currently installed in the mock up area. Also we have installed the warm section stand between MB1 and the prototype.

Beam Diagnostics