

Accelerator Systems Division Highlights for the Week Ending June 7, 2002

ASD/LBNL: Front End Systems

- Rod Keller and Alex Ratti are in Paris this week attending EPAC.
- Following the completion of the beam tests on Friday of last week, ongoing efforts are focused on disassembly, crating, shipping and documentation. Work is progressing well, and is on or ahead of schedule in most areas. The LBNL and visiting Oak Ridge staff are working extremely well together permitting the disassembly and crating activities to proceed very efficiently.
- Truck number 2 left Berkeley on schedule Tuesday evening (June 4) containing over a dozen major items, and is expected to arrive in Oak Ridge by Friday, June 7. The items include the 18 and 25 MW chillers, Front End Racks (8, 9 and 18 through 25) together with associated controls and miscellaneous items. These racks house vacuum controls, MEBT steering power supplies, and MEBT rebuncher power supplies. After a 2-week visit, Mike Hechler left Thursday evening to be in Oak Ridge for unloading of the truck.
- Disassembly is continuing, with efforts now focused on preparing the RFQ and MEBT for shipment next week. By Friday afternoon, the Ion Source(s) LEBT, RFQ and MEBT have all been separated and stripped down to their shipping configuration, and ready for weighing. Truck number 3 is scheduled to leave Berkeley with the RFQ and MEBT Thursday evening of next week.

ASD/LANL: Warm Linac

- We submitted our test report for the first 402.5-MHz klystron to ASD. This klystron is suitable for operation in either the RFQ or DTL #1. The report included factory test data, site acceptance test data from LANL, a strip chart of the 96-hour heat run, an operational summary of the 96-hour heat run, and calibration data. (WBS 1.4.1.1)
- The second Marconi klystron and the recently upgraded prototype HVCM continued operations toward completion of the 96-hour heat run of the klystron. Engineers and technicians stayed until 3 AM one night to complete a 20-hour operating segment, the longest to date. The system continues to run fine, and the 96-hour heat run is expected to be completed this week. (WBS 1.4.1.1)
- The third Marconi klystron completed its acceptance test at Marconi on May 31. It is scheduled to leave Marconi on June 19. This tube passed the full power (2.5 MW) and full efficiency (58%) specifications. After it arrives at LANL, we will be able to complete full power testing of the 402.5 MHz loads, windows, and circulators. (WBS 1.4.1.1)
- One 402-MHz RF Transmitter (S/N #2) was delivered to ORNL. LANL personnel completed factory acceptance tests on the third 402.5-MHz transmitter. We also anticipate completion on the fourth unit this week. They will then be shipped together to ORNL directly from Titan Pulsed Power Systems. (WBS 1.4.1.1)
- Thales started testing the first 805-MHz CCL klystron. It delivered 5 MW peak power saturated - 25 kW average at 140 kV and 68.5 A, over a 100- μ s pulse with 50Hz frequency repetition. The drive power is lower than 50W. The body losses are unacceptably high, about 11% of the average output power. The manufacturer is attempting to locate and reduce the beam interception. (WBS 1.4.1.1)
- The modified prototype HVCM operated all week at 130-kV, 60-Hz, and 1.2-ms in support of the second 402.5-MHz klystron 96-hour heat run. There were no faults or trips in the converter modulator. (WBS 1.4.1.2)

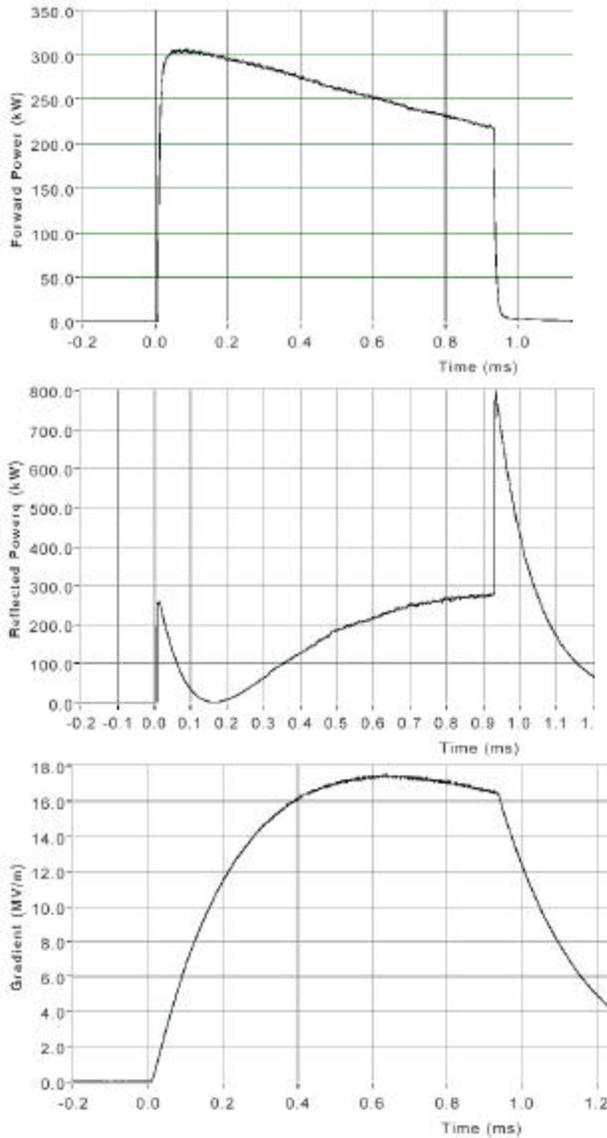
- The LANL design engineer for the HVCM (Bill Reass) visited Dynapower this week. Careful analysis of the tasks and schedules revealed some ways to make improvements, and about a week was recovered in the schedule. (WBS 1.4.1.2)
- On his return from Dynapower Bill Reass stopped for a visit at Oak Ridge on June 6. Walkarounds of the site and discussions with ORNL personnel revealed that the 13.8 kV distribution at the site was underground in conduits. This was not the originally planned configuration, and there is some concern about the additional cable and distribution capacitance creating problems with harmonics. Additional modeling of the system is now needed to assess the impact. (WBS 1.4.1.2)
- The integration of the LLRF system is moving along. Most of the recent focus has been on the Field and Resonance Control Module (FRCM) and its 3 daughter boards (1 RF board and 2 DSP boards). A problem earlier in the week with the VXI interface on the FRCM board has been solved. The RF daughter board has completed the initial integration. All channels are operational and the RF daughter board communicates properly with the motherboard. The current focus is on the integration of the DSP daughter boards. Internal operations on the DSP boards are working, and debugging of the on-board bus is taking place. (WBS 1.4.1.3)
- The stems on the first 27 drift tubes for DTL Tank 1 should be welded by the end of this week. By June 14, Coronado should have 34, Tank 1 drift tubes, ready for shipping. The remaining drift tubes should ship by June 28. The four EMDs for Tank 1 should also ship by the end of June. (WBS 1.4.2.3)
- The downstream end wall for Tank 1 should arrive at LANL by the end of this week. We are planning to perform a vacuum and pressure drop test on this end wall before sending it to ORNL. Major Tool and Machine has four other end walls ready for acceptance, which should occur before the end of this month. (WBS 1.4.2.2)
- The weld repair on the EMD for Tank 3 has turned out to be a bigger challenge than originally anticipated. ISIS has tried twice to weld a plug into the drift tube body and both attempts have resulted in problems. We are aggressively working this issue with ISIS and are planning to have this drift tube repaired before the end of June. (WBS 1.4.2.3)
- The DTL 3 vacuum and water cooling system (RCCS) electronics racks were shipped to ORNL, along with five of the global control system racks. (WBS 1.4.2.4)
- The bridge coupler-tuning fixture (Fig. 1) was successfully tested and the end cells were tuned. It is was shipped to Accel. (WBS 1.4.4.7)
- The following procurements were awarded: (1) DTL Water Manifolds for remainder of tanks- \$361,075; (2) CCL Magnet Power Supplies- \$245,000; (3) CCL Shunt Chassis - \$79,700; (4) CCL Module Support Structure- \$121,238.
- LANL visitors conducting work at ORNL this week included: Jim Billen and Lloyd Young (tuning DTL Tank 3); John Bernardin and Steve Hopkins (DTL-3 Tank 3 vacuum and water); and Bill Reass (HVCM installation preparation).
- LANL visitors conducting work at ORNL next week include: Jim Billen (tuning DTL Tank 3); John Bernardin and Steve Hopkins (DTL-3 Tank 3 vacuum and water).
- LANL visitors conducting work at ORNL week of June 17 include: Mike Lynch (RF installation schedule and integration).
- LANL visitors conducting work at ORNL week of June 24 include: Amy Regan (Low-Level RF installation and integration).

ASD/JLAB: Cold Linac

- A visit to the 4.5 K cold box vendor confirmed that they are still on schedule to meet the August 12 shipping date. The work is well organized and is judged to be of very high quality. The valve panel assembly is shown in the photo.



- Testing of the prototype cryomodule continues. The piezoelectric tuner has demonstrated 2700 Hz range at a position of the slow tuner which makes the cavity somewhat easier to tune, but there will be no difficulty in meeting the 2000 Hz requirement at all slow tuner positions. Preliminary measurements of pressure detuning, microphonics, cavity mechanical resonances and dynamic Lorentz detuning effects have taken place. The pressure detuning coefficient is -95 Hz/Torr, which is acceptable. Mechanical resonances were detected (using the piezoelectric tuner to excite them) at frequencies which are reasonably close to those predicted by the finite element analyses done last year. We have demonstrated the ability to observe dynamic Lorentz detuning, but some instrumental calibrations remain to be done. Although we cannot yet report on the absolute magnitude of the frequency excursions, results to date are encouraging.
- The attached figures show input and reflected power, as well as the cavity gradient as a function of time through the RF pulse. The droop in the input power is the result of limited high voltage DC power available to the klystron. We hope to overcome this limitation in the near future by regulating the input rf power to the klystron. The large spike of reflected power at the end of the RF pulse is expected, and can be mitigated by slowing down the rate at which the RF drive drops from its maximum, but still may be a concern for the circulators and loads protecting the klystrons. The gradient curve shows the maximum values achieved (corresponding to peak fields of 45 MV/m, compared to the design specification of 27.5 MV/m). At lower gradients it should be possible to flattop the gradient curve by manipulating the klystron input pulse.



ASD/BNL: Ring

- Members of the SNS/BNL Physics Group participated in the EPAC review.
- Acceptance testing and magnetic measurements of the 1st article 26Q40 quadrupole magnet (Stangenes) are underway.
- Bids for the Ring dipole high field power supply were opened on June 6th. A technical evaluation of the three responsive bidders is in progress.
- Another iteration of the SNS magnet parameters was circulated this week for staff review. Others, from our AP Group, will look it over when they return from EPAC. The next iteration will include magnet polarity information.

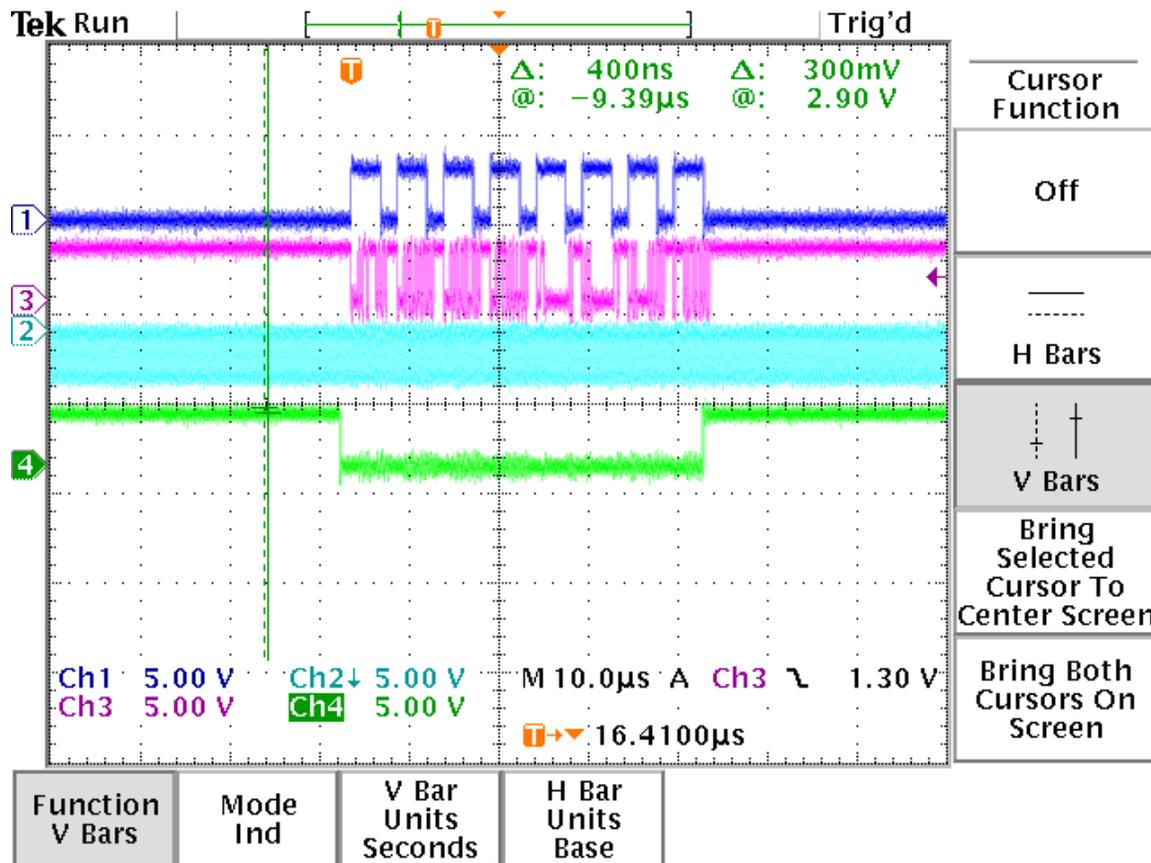
- A PCR is being generated for ASD's approval to build six (6) spare vacuum chambers for the Ring doublet magnet assemblies.
- Equipment arrivals this week included:
 - Three (3) more 21CS26 correctors from NE Techni-Coil
 - Six (6) more 21Q40 quadrupoles and frames from Tesla
- Chicane #4 has been shipped to BNL by Techni-Coil.
- The RFQ for chicanes #2, #3 and the dump septum magnet is being finalized.
- Laser Monitor – some beam time was available this week to measure beam profiles. A wire scan profile was obtained for comparisons. To date, we have not been able to see a notch. Efforts continue.
- Enclosed is an SNS group photo taken on May 15 during ASD's visit to BNL.



Controls

- The Controls Team at ORNL welcomed Carl Lionberger this week. Carl helped develop the Front End Control System at Berkeley, and will be with us for two years (at least??) to help with Front End commissioning on the ridge.

- The five DTL control system racks from LANL Racks arrived this week, as well as the vacuum and RCCS PLC control racks. Thanks to LANL for this on-time delivery. The vacuum and RCCS racks are being set up for testing in the RATS Building.
- A meeting was held to decide whether or not the “Machine MODE” could be removed from the event link and sent only on the RTDL. This has a number of benefits that are described in tech note # 71 <http://it.sns.ornl.gov/asd/public/pdf/sns0071/sns0071.pdf>
- The result of the meeting was to add the CRC check frame to the RTDL and remove the mode event from the event link. The frame number and data are included in the CRC. The additional FPGA logic for verifying the CRC is complete and tested. The scope traces below show the RTDL data(2), RTDL-CRC shift register(1) and the CRC status(4).



- A problem in the Timing System Event Link Receiver circuit was discovered after the addition of this CRC logic. The receiver is too sensitive to the duty factor of the input serial data stream. Although the receiver driver chip is rated at 20 MHz, the 50% duty cycle becomes 60-40 or worse driving the signal to the Altera part. This makes the Event link reception intermittent. A faster receiver should solve the problem.
- The MPS chassis layout is being redesigned at RIS Corp. in Knoxville. The unit will fix a few errors in the prototype board and will fit in a smaller chassis than the first design. The board should be back in two weeks, with a production run after verification of the new board.
- EPICS training of Controls and Diagnostics Team summer students has begun. These students are initially converting all of the Front End Control Screens to the standard SNS Display Tool – EDM.

- The PLC for the protection functions for the ion source hot spare has been mounted and is ready to use to check out the protection systems in the RATS Building. Wiring of the protection systems is now complete.
- The PLC for the hot spare vacuum systems is now in operation in the RATS Building with two vacuum gauges currently mounted on the ion source chamber. The PLC-5 ladder logic program conversion effort is now underway. The converted programs will be loaded into the ControlLogix PLCs for the hot spare and will be used to operate the hot spare with the front end EPICS support from Berkeley. This will be the first stage of a phased conversion of the Berkeley front end from use of the PLC-5 to use of SNS-standard ControlLogix PLCs.

Operations Group

Ion Source Group

- Paul Gibson and Syd Murray traveled to LBNL to participate in the disassembly and crating of the front-end.
- John Munro from the controls group succeeded with the first remote control for the hot spare stand by controlling the gas valve. This is a very essential step to complete the hot-spare stand.
- Robert Welton and Rob Morton succeeded with generating a 2 MHz plasma in the ion source using the LBNL capacitive matcher.
- The LBNL horizontal normalized rms -emittance of the ion beam injected into the RFQ was determined to be 0.25 +/- 0.01.
- Over 30 participants attended the "9th International Symposium on the Production and Neutralization of Negative Ion and Beams" on May 30 and 31, featuring 23 presentations. Martin Stockli presented the "Self-Consistent, Unbiased RMS-Emittance Estimates for Data Measured with a Single Current Amplifier" which was received with high interest. The same level of interest became evident after Robert Welton's et al's presentation on "Emittance Characteristics of High Brightness H- Ion Sources", which was presented by Martin Stockli.
- A significant number of people showed interest in Robert Welton's poster "Enhancing Surface Ionization and Beam Formation in Volume-type H- Ion Sources", presented by Martin Stockli at EPAC2002.

RF Group

- We have one 402.5 Klystron, one complete transmitter and water carts for 2 transmitters and cables for 3 transmitters.
- LANL accepted 2 more transmitters this week and they will be shipped directly to us on Monday.
- Mike McCarthy relocated from LANL this week and will be at ORNL full time starting next week.
- All RFQ wave guide installed, DTL 1 & 2 wave guide runs should be complete early next week. Starting on DTL 3 wave guide runs next week.
- Fork truck ran into wave guide bellows, bellows will be replaced.
- Mark returning to Jlab next week for 2 weeks, Yoon and crew measuring DTL3tune, measurements looking good.
- Transmitter racks will be test fitted to rack mounting base to work out any issues.
- Klystron support base looked terrible when tube arrived, water attacked the steel plate, it's being cleaned and we will try to come up with a fix, maybe a coating of the insulating oil on the steel is all that's needed, maybe something else.

DTL Warm Linac

- The drift tubes for DTL-3 were disassembled and vacuum grease applied to the three o-rings that must move during alignment. This is expected to reduce unwanted motion of the DT's resulting from stresses in dry o-rings. The stresses result from o-ring rolling during the alignment process. The DT's were reassembled, realigned and their position will be monitored during the coming week. Tuning was performed by a joint LANL - ORNL team and was completed on Friday afternoon (see photo). The final dimensions of the slug tuners and post couplers will be measured and faxed to the fabrication vendors this weekend.
- John Bernardin and Steve Hopkins from LANL began assembling the cooling manifold system for DTL-3. Assembly on the DTL-3 support frame will continue next week.



DTL-3 Tuning Team in RATS

Magnet Task**Vacuum Task****Cryogenics Group****Electrical Systems Group**

- Installation effort in the klystron building resumed Tuesday with cable tray installation

- Pictures of DC bus work in progress and Klystron modulators as well KL-SS1 are shown below



Survey and Alignment Group

Beam Diagnostics

LANL Beam Diagnostics Progress Report:

- **BPM pickups:** Some problems have been discovered in the first two DTL BPMs from the batch of 8 now being fabricated. One BPM has two electrodes that are slightly twisted at the feedthrough end, and both BPMs have intermittent connections at the feedthrough/electrode junction. The extension tubes have been cut off to examine the connection, and poor e-beam weld joints were found. The BPMs have been sent back to ISYS for repairs. The order for the CCL and SCL BPMs is still not finalized. It's been well over a month since the paperwork was given to the buyer. This delay will likely impact our CCL BPM delivery schedule.
- **BPM electronics:** Testing and characterization of the 402.5 MHz electronics continues. We are preparing a list of items to correct during the analog front end design modification.
- **WS actuators:** Work continues at JLab to test the SCL wire scanner actuator. JLab plans to ship it back to us the week of June 18. Fabrication continues at Huntington on the prototype and D-plate actuators. The prototype 3-inch and 6-inch actuators are due the end of June. The remainder of the actuators are due two weeks later. We are waiting for vendor fabrication quotes for the new SCL beam box design. An estimate for LANL to deliver the HEBT, ring, and RTBT actuators was sent to ORNL and BNL.
- **WS electronics:** We have determined that it is advantageous to change to a linear stepper motor drive (from a chopper drive) for the wire scanners. One benefit is an SNS facility-wide standard, since we will use the same driver as the SCL rf resonance control (but packaged slightly differently).
- **D-plate:** Minor detailing work is now finishing up. The major detailing work is complete. Drawing checking is in progress. Vendor fabrication continues.
- The water manifold drawings should be done by next week. The beam stop fabrication drawing package is now being signed off. The harp profile monitors from Princeton Scientific arrived 5/Jun.
- **Current monitors:** The modified DTL transformers should arrive next week. Specifications for the CCL and TR transformers are now complete, and a request for quote was issued.
- **ED/FC:** Fabrication continues on the first prototype unit. The head is expected to arrive next week.
- **Cabling:** Work continues on cable specifications, rack layouts, wiring lists, and block diagrams.

BNL Beam Diagnostics Progress Report:

- **1.5.7.1 BPM:** Work continues on tech-note and preparations for design review. Exploring details of PCI interface. PCR is in progress for additional 30cm BPMs for Ring vacuum chamber spares.
- **1.5.7.2 IPM:** IPM efforts have taken a back seat to Laser Profile Monitor work.
- **1.5.7.3 BLM:** Consulting with vendors regarding price and manufacturing engineering of the new detector design continues.
- **1.5.7.4 BCM:** Missing parts have been ordered, and parts are coming in, to stuff the new board. Work has started on testing the current transformers that were received last month.
- **Preparation for FDR has started**
- **1.5.7.5 Tune:** A paper and poster were presented at EPAC.

- **1.5.7.6a Carbon Wire Scanner:** Preparations continue for refurbishment of the MEBT wire scanners.
- **1.5.7.6b Laser Wire Scanner:** We have had beam time due to an AGS vacuum failure. A wire scan profile was successfully attained for comparison purposes. So far we have been unsuccessful in seeing a notch. An access was made to try to see if the mirrors were stuck, and we were unable to see well enough into the chamber to confirm. A limit switch wiring error was found for the vertical scanner explaining the problems we had with vertical scan software runs. The switch mirror was moved into position to permit vertical scans, and subsequent runs made using vertical scans also yielded no evidence of a notch. We continue to work this problem using various processing approaches with similar results.

ORNL Beam Diagnostics Progress Report:

- Wim and students are working to setup an automatic BPM field-mapping stand. Danny Mangra is assisting us in the mechanical component design. Additional analysis was performed on the laser wire data. Development of software standards continues. Nick and Dave have embedded XP running on a 1U rackmount server in the Lab. EPICS IOC-Core installation continues. Craig is working on the DTL tank-3 tuning. We are working on the MEBT laser wire data analysis. Warren is researching the radiation effect on the fused silica windows. Tom prepared the procurement package for design of the timing module.