

Accelerator Systems Division Highlights Ending July 9, 2004

ASD/LANL: Warm Linac

An air-ride van left on Tuesday for ORNL containing klystrons, magnets, shielding, and CCL windows.

We successfully completed the high power acceptance tests of an 805 MHz, 5 MW load.

We have the high power acceptance tests of an 805 MHz, 5 MW circulator and another 5 MW load in progress. We are about 70% complete on these tests and everything looks good.

We shipped the windows for CCL-4 on Wednesday. This completed high power testing and conditioning last week.

We continue to support installation out at SNS with a 3 person team.

ASD/JLAB: Cold Linac

Three cavities are qualified for the H-7 string.

Assembly of the H-6 string is going well.

The H-5 cryomodule assembly is nearly complete. Attachment of the warm beam pipes and end cans is underway.

Assembly of the H-4 cryomodule is complete.

ASD/BNL: Ring

Half-cell #30 was shipped on Tuesday.

Work continues on half cells #31 and 32.

We have been notified by IE Power that they have shipped four power supplies to SNS/OR. Included in the shipment are: the rectifier for the Ring dipole magnets; two (2) 700 amp medium range power supply units; one (1) injection kicker PS.

A contract is being prepared for production of twenty-one (21) rigidized carbon foils needed for the HEBT (charge exchange), Injection (thick) and RF scrapers.

Installation drawings for the two (2) RTBT collimators, and their associated shielding, are underway in the design room.

BNL's AP Group completed their modeling work of beam trajectories for the injection dump septum magnet. The upstream bellows on the downstream drift tube will be enlarged to provide additional clearance between the beam and inside wall of the chamber. The last remaining issue is the vendor's non-conformance (bend geometry) of the vacuum chamber for the dump septum magnet.

Preparations are underway for the next container shipment to SNS/OR. The shipment will include: one of the injection kicker magnet assembly, one extraction PFN, various chambers & stands, etc.

Magnetic Measurements: magnetic measurements of the first rad-hard corrector magnet (36CDR30) were completed this week and sent to AP for review and approval. The measurements were taken using an existing AGS 15.24 cm radius harmonic coil. Data included excitation curves for the magnet powered as a vertical dipole and horizontal (skew) dipole at 1.0 and 1.3 GeV. Included were the sextupole terms as a function of excitation current along with measured harmonics. Measurements of chicane #1 are expected to begin next week.



A design review of the RTBT/Target area has been rescheduled for Thursday, July 1st. BNL will participate by videoconference.

Ray Savino will visit BNL next week to meet with BNL technicians and inspect the injection straight section installation mock-up.

Charlie Pearson will travel to Oak Ridge over the BNL holiday (Monday and Tuesday) to visit with ASD personnel on Tuesday to discuss various interface and design issues related to the radiation hardened 36Q85 magnet assemblies.

SNS posters and papers were prepared for EPAC-2004.

High voltage modulators (extraction kicker PFNs) #6 and 7 are being tested by our vendor, APS, this week. Production units #4 and #5 were received at SNS/OR.

As Ring systems are close to spending and/or obligating all anticipated (but not yet received) FY04 BA, all new change orders and requisitions are on hold. Approval will be done on a case-by-case basis for the remainder of FY04, as funding permits.

Two CCL VME crates were fully assembled, configured, tested, packaged and shipped to SNS/OR, attention Saeed Assadi. The equipment should arrive next week.

R. Connolly shipped a Big Sky CFR200 laser to SNS/OR. This is the laser that was bought by Bob Shafer at LANL for laser wire work. It was loaned to BNL in spring of 2002 to complete our proof-of-principle experiment. Roger returned all four laser components: 1) the laser head, 2) the laser controller, 3) water cooling module, 4) electrical and water lines.

Work continues on half cells #31 and 32. Final survey and manifold work remains to be done. We expect to ship these last two units later this month (July).

Magnetic Measurements: data from the first radiation-hardened corrector magnet (36CDR30) has been reviewed and accepted by AP; the second magnet is now being tested. Measurements of chicane #1 are in progress. S/U of the first dump septum magnet is underway.

A design review of the RTBT / Target area has again been rescheduled. The new date is Tuesday, July 27th. BNL will participate by videoconference.

At the request of ASD, our engineering team is developing a cost estimate for turn-key measurements of the 17D224 magnet at BNL.

The doublet lifting fixture is being reviewed by BNL Safety.

A trip report by Mark Champion and Chip Pillar on their recent visit to BNL (Ring RF) was received this week. Engineers at BNL stated that these meetings were fruitful and they fully support the proposed "Plans" outlined in the report.

Bob Lambiase has been communicating with our vendor, Apogee Labs, on specific problems encountered at BNL with the power supply interface module (PSI). The Apogee schematic (the one included in the manual) correctly shows the values of the gain resistors on the input amplifiers. But, the boards were built to an assembly drawing that was not updated by Apogee. Bob will work with Apogee to come up with a resolution and will keep ASD informed.





Controls

Support was provided to Larry Doolittle in his tests of the latest firmware and EPICS code for the LBNL LLRF system. In comparing Larry's "hardware abstraction layer" (HAL) to the current FCM support, we find that the key thing missing is support for the FCM-to-HPM interlock chain. Also missing are some details like DMA support. Meanwhile we have to set up FCMs for the SCL and work on new "power limiting" code. Therefore our current view is that HAL isn't ready to fully support the FCM, and even if it was, we don't have the resources to adapt it to EPICS for another month or so.

A point-to-point check of the hot-spare ion source vacuum system wiring was conducted. Field cables are locked out so that testing of control software on the IOC and the PLC will not impact on the Ion Source operation. An informal review of the wiring design and interlock scheme will be held before the integration test. (The review date is still TBD).

WBS 1.9.4 Linac Controls activities by LANL included the following:

- Vacuum control software was converted to EPICS 3.14.6. The "hot swap" feature for our serial communications VME board was incorporated into our vacuum control software. Charles Pinney will be at Oak Ridge next week to support CCL vacuum system checkout.

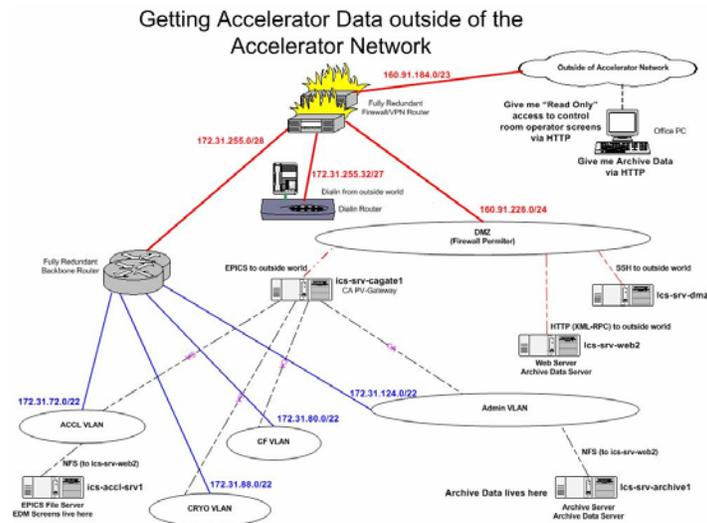
- Martin Pieck was at Oak Ridge this week for power supply testing. Martin Pieck and John Munro worked on setting up the power supply controls for DTL 4, 5, and 6 and for CCL 1. A number of problems slowed the checkout. PPS jumpers had been removed and had to be put back into place. Also, cooling water was not available.
- Re our archiver software: The export function of ArchiveGUI was completed. The capability to change major plot attributes on-the-fly was added. Work on waveform plots and user interactivity is in progress.
- Re RCCS control software: PLC heartbeat functionality was integrated into RCCS IOCs. PLC heartbeat status was incorporated into outbound interlocks. Interlock screens were improved. These new features will have to be tested at site.

A LabVIEW program was developed to automate the acceptance testing of BLM-to-MPS interface modules designed by the Diagnostic group. This program characterizes the response time of the MPS interface module to simulated beam loss signals under various configurations. The full report has been sent to Coles Sibley (responsible for MPS), and the ORNL Diagnostic group.

The contractor responsible for developing SCL vacuum control software visited the site. Checkout was begun for the first cryomodule to be implemented (the one in cryomodule slot #3). A number of problems were found with most being fixed. The most nagging problem remains the slow response of our serial interface with the vacuum controllers.

The week was spent preparing for the DTL 1-6 RF processing run which began at 4:00pm Friday afternoon. Work involved completion and execution of test plans for all subsystems required for this run.

In parallel with run preparation, effort continued on settling into new office and laboratory space. By the end of the week, the PPS and Controls Laboratories were both largely functional. The servers having been moved the previous week, one major activity involved changing the server architecture to improve remote access to archive data from the main archive server and synchronization between controls EDM screens and the outside world. The new architecture is illustrated below.



A new web server (ics-srv-web2.sns.ornl.gov) was installed in the Control Systems Server Room to provide real-time access to archive data via XML-RPC over the network. One can now access archived accelerator data from the CLO via Windows or Linux by using a java-based retrieval tool. Likewise, data can be accessed from outside ORNL such as from home.

The same web server now also “serves” the same EDM screens that are used in the “Control Room” for operations. The EDM screens are delivered to the remote client via HTTP and the Channel Access PV gateway then serves the EPICS data. This technique provides screens “on demand,” an improvement over the mirror technique used in the past.

In making these architectural changes, security issues were first worked out with the ORNL Network group and then the appropriate firewall rules were put in place to allow limited remote access.

It is now possible to monitor and control the coupler testing currently taking place in the RF Test Facility. The Labview acquisition system was remoted, and a network video camera was implemented. The complete set up was tested this week from the Front End Control Room and found to function properly.

Although not required for RF processing, magnet power supply control applications for DTL4, DTL5, and DTL6 were tested this week. Everything appears to work as it should. Likewise for the software interlocks. DTL magnet power supply controls applications will be upgraded to EPICS R3.14.6 before doing the systematic testing. Cabling of the CCL power supply controls is also in progress, and testing is scheduled over the next few weeks.

PPS Phase 1.1 having been successfully certified for the upcoming RF processing run, planning is underway for the next phase of the PPS (phase 1.2). This phase will support beam operation in the warm section of the LINAC and RF processing in the cold section. Activities include adding PPS control of the magnet power supplies, additional Chipmunk installations, revised logic to support a divided tunnel, relocating a beam shutdown station located at the new shield wall and adding a temporary control panel from phase 0 to support a separate sweep of the cold section.

A final "punch list" has been developed to complete the LINAC ODH system. All of the field devices are installed. The control rack in the control room will be completed next week. An ODH certification procedure is being developed. Plans for next week include initial system testing (the individual field devices have already been tested).

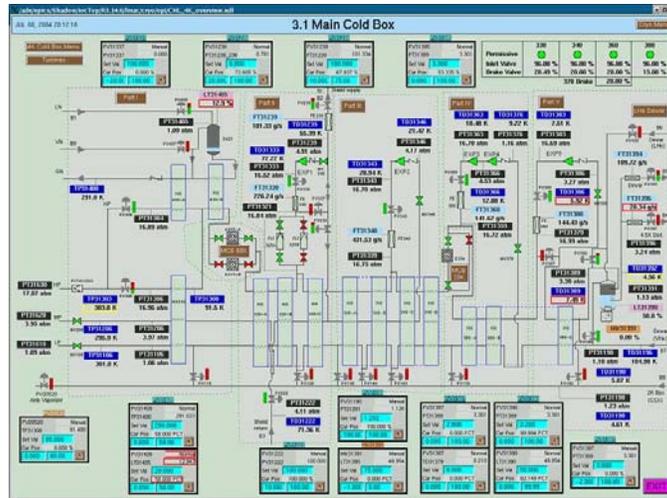
The controls team is taking over some responsibility for power monitoring. The configuration file for the OPC server was corrected, and all the power use reported to the power monitoring workstation is now available in the control room. Channel Access security rules will be adapted to allow appropriate permissions from the control room.

Last week LANL engineers worked on the CCLL vacuum system control software at ORNL. Multiple delays were encountered from I/O wiring not complete to lock-outs found on the systems being tested. PLC heartbeats were added and testing begun on CCL 2 vacuum. The sector gate valve control scheme requires urgent attention. Requirements must be finalized, and code written and tested. Target date for implementation is after RF conditioning but prior to the August ARR. Work continued on moving the RGA (residual gas analyzer) to EPICS 3.14.6.

Work continued at LANL on Archiver retrieval tools. Progress threads were added to the Archiver user interface and some GUI features were added or improved.

All instrumentation and control system checks required for running the CHL main 4.5 K cold box were completed. Changes made to the warm compressor slide valve control loop function properly enabling more precise control of the warm compressors. All temperature, pressure, and flow sensors appear to read correctly. At request of Linde, changes were made to the 4.5 K cold box PLC logic to improve operation and protection of the turbines.

Checkout of the cryomodule in slot MB04 was started.



Installation

Craft Snapshot 7/6/04

| | |
|------------------------------------|-------------|
| ASD productive craft workers | 63.0 |
| Foremen (Pd by 15% OH) | 5.0 |
| AMSI management (Pd directly) | 3.0 |
| TOTAL AMSI WORKERS | 71.0 |
| Less WBS 1.9, 1.2 etc | 6.0 |
| Less absent | 7.0 |
| TOTAL PD BY ASD/ORNL DB WPs | 50.0 |

Accelerator Physics

Operations

Ion Source Group

Source # 2 is in its second week of 7/24 operation. On Monday noon the rep rate was increased to 60 Hz and the RF to 60 kW. The current has slowly decreased during week from 28 mA to about 24 mA. Several cesiations failed to bring more sustainable current. Considering the 7.4% duty cycle, this is the highest power we have operated for extended periods of time.

Source #3, which delivered 30 Hz, 1.23ms long pulses with an average of more than 40 mA for one day, but failed to sustain that current, did not show any significant sign of wear. It was cleaned and prepared for the next run.

Survey and Alignment

We are continuing to work on the CCLs. Completed Alignment of CCL2 Quads including mapping of Segments, data compiled and added to comprehensive DTL/CCL exterior position list. Have completed eight of twelve quad alignments on CCL3. As of Friday morning, we have a six magnets remaining that require alignment on CCL3. That will complete alignment of all magnets (CCL1.....CCL3) CCL #4 magnet alignment is still in the future. No magnets are presently installed.

High precision leveling was performed to monitor deformation in the floors of the Front End Building and the upstream Linac. Differential recompression settlement continues; the floor along the walls of the tunnel is still settling more than the floor in the center of the tunnel. The difference between side and center floor settlement over the last 4-5 months has been about 250 microns.

The exterior datum tie has been repeatedly delayed by poor weather conditions, so we can not yet state the magnitude of the deformation in an absolute sense. However, if we assume that the westernmost points on the Front End slab are stable (questionable), the absolute settlement along the centerline of the tunnel floor appears to be about 750 microns during the last 4-5 months.

Programming continued for the simultaneous collimation error determination procedure, which is used in the monthly deformation monitoring of the RTBT floor. Two blunder detection methods were added.

Tentative equipment layout plans for the CLO Survey and Alignment shop were created.

The quarter cell stands were set to proper elevations. The procedure consisted of a two part process. First, the lower section of the stand was set to the correct elevation. This insures the proper amount of travel of the upper section of the stand. The upper section of the stand (which accommodates the quarter cell) was also set to the correct elevation. This required upwards movements in excess of one half inch. Performing these operations at this time allows the ring crew to proceed with quarter cell installation before grouting, and yet, not make it an inconvenience for us when it comes to performing the alignment where space around the quarter cell becomes limited.

We are assisting the magnet measurement group in the re-design and alignment of the 21Q40 stand. The work is progressing slowly but the end is in sight. This stand should be operational within the next few working days.

S&A surveyed the elevations of the first two adapter plates located in the target cart liner of the hot cell. When finished, there will be a total of six adapter plates requiring surveying. The plates are required to be level within +/- 0.010" over the total length (approximately sixty feet). These adapter plates accept the target cart rails on which the target cart rides.

Measurements recorded the week of June 10th indicate continued settlement. Changes recorded over the thirty day placed total RTBT settlement at 6.28 inches. However, resumption of the backfilling procedure after our last measurements has definitely resulted in additional settlement. Although we have not recorded any "hard" data since our June 10th monthly update, measuring elementary settling benchmarks established at the RTBT Tunnel / Target Interface indicate that at least another 6 millimeters of settlement has occurred as of today (25 June). The next scheduled measuring epoch is tentatively scheduled for the 12 July.

Mechanical Group

Work has begun on the Front End system to install a new diagnostics box in the space formerly occupied by the MEBT anti-chopper. This system,

The waveguides are assembled on DTLs 4-6 and certified.

The RCCS water systems control and mechanical sign-offs are being done.

All six DTL tanks are under vacuum with all pumping systems active. Pressures are in the mid to low 10⁻⁷ Torr which is well below what is needed for the start of conditioning.

PPS certification was completed on all systems to allow the start of conditioning.

A poster presentation was made to represent the installation of the SNS Warm Linac system at the EPAC conference.

Ring Systems Installation

- The RING Qtr-Cell Assy Stands (A5, B5, C5, and D5) supports were installed.
- Termination of magnet cables to the HEBT tunnel magnets continued.
- The RING Qtr-Cell Assy #1 (A5) was installed completing arc A.
- The RING Half-Cell Assy #30 (B6) was installed.
- The RING Qtr-Cell Assy #2 (B5) was installed completing arc B.

- Termination of magnet cables to the HEBT tunnel magnets continued.
- The RING arc A was completely assembled and vacuum leak tested. A vacuum leak was found at one Half-Cell chamber weld and preparations for its repair are under way.
- The RING arc B was completely assembled and vacuum leak tested. A vacuum leak was found in one BPM flange gasket. The gasket was replaced and overall pump down continues.
- Pulling of vacuum and diagnostic cables into the HEBT tunnel continued.

Water Systems Installation

- Installation of the cooling manifold on CCL4 module was completed and the system is being filtered.
- Installation of the SCL QMCS header piping resumed.
- Installation of the piping to the CCL4 klystron RF equipment continued.
- Installation of the SCL QMCS header piping continued.
- Installation of the piping to the RF equipment on SCL-ME5 continued with the pressure and leak testing completed on the first half.
- Installation of the piping to the RF equipment on SCL-ME6 continued with the pressure and leak testing completed on the first half.

Magnet Task

Electrical Group

Testing of the SCL-ME1 modulator at high average power was attempted this week. Operation to 60 Hz, 64 kV, 1.35 ms into 12 klystrons was successful, but when we attempted to increase the voltage to the desired 69 kV, we experienced a shoot-thru fault on the C phase IGBTs. It is suspected that increases in minority carrier lifetimes due to high transient operating temperatures in the junction are responsible for this failure. We have decided to pursue a dual IGBT configuration to reduce the peak currents and di/dt experienced by individual IGBTs. We will work closely with LANL (they have done the majority of the design work for this topology) to develop this configuration for 1 modulator. The modulator has been repaired, and is once again operational.

We have been building a pulser unit for LBNL to allow for next generation ion source R&D. That unit is nearly complete.

All repaired LEBT chopper pulsers were installed, and proper operation was demonstrated. We now have in-house repair capability for these devices.

CCL3 cabling and termination finished this week.

SCL rack row bases 13,14,15,16 and 17 set and anchored

HEBT magnet cable termination completed except the LINAC dump area

Ring SB AC feeder terminations to ASD panels completed

HPRF

CCL3: Waveguide to CCL structure was phase matched using compensating pucks. William Roybal (LANL) is leading the test and calibration effort for the 5 MW klystron. Arcing occurred at 3.6 MW. Remedial work was undertaken and testing is continuing.

CCL4: Water loads and circulator installation continuing along with waveguide flange cleaning.

SCL: Lead shielded waveguide elbows were lifted onto the klystron outputs of the six Thales tubes on SCL5. Four more Thales tubes arrived this week. They will be moved to tanks in the gallery as soon as possible to ease demands on storage space.

Klystron 4 of SCL ME 3 was observed to have a small internal water leak. This klystron is in the middle of a "six pack" already installed. The klystron will be replaced early next week. This will give us the opportunity to test the modifications we made to replace a klystron without removing the entire HV 3-hole tank.

LLRF: The reference line in the tunnel is physically complete. All phase matched coax for systems in the upcoming conditioning run are installed. Work continues on the reference line temperature control and pressure control systems.

RF Test Stand: Yoon Kang is leading effort to test/condition the remaining pairs of cryo-couplers as this task has just been transferred to ORNL from JLAB. The first pair of couplers was assembled and tested to 110 kW with 0.5 ms pulse width at 10 Hz. Conditioning continues. Increased automation and remote control is planned to maintain an aggressive coupler production schedule.

LLRF

Cryo-Group

The Linde technical representative visited from 6/9 to 6/18 to repair warranty items. Significant items included adjusting the length of temperature diodes which were providing incorrect readings, and modifying internal coldbox liquid level tubing. Following this, the coldbox was sealed and pumped down. Installation of the modified shield heater was completed this week, as was installation of the 2K coldbox LN2 vessel.

Beam Diagnostics

BPM: Electronics are installed. Phase matching of the CCL cabling continues. John Power will return in one week to assist electronics modifications and integration.

BLM: The VME crate was received from BNL. We are still waiting for a few modules. The plan is to integrate the system and be ready for noise tests by the 12th.

Timing: The first article cost-reduced boards were received and 2 are assembled. The FPGA is programmed and the PCI interface has passed all initial tests. Simulated events successfully trigger the delay counters and provide trigger pulses at the outputs. The remaining significant task is to debug the decoder section. This involves an isolated code module within the FPGA and should be complete within a week.

Faraday Cups: We are still working with the Mechanical group to fix the seal design. The first try was unsuccessful, but other options are being pursued.

Misc: A purchase requisition was prepared for a software contractor. Two group members are presenting papers at EPAC. Two staff members attended the Windows Embedded conference and hope to learn about more efficient deployment solutions for OS updates.