

Accelerator Systems Division Highlights Ending April 23, 2004

ASD/LANL: Warm Linac

HIGH-POWER RF (WBS 1.4.1.1)

Accomplishments This Week: (1) *805-MHz, 5-MW Thales klystrons:* A 5-MW klystron failed the site acceptance test. The alumina RF vacuum window on the tube failed as we moved to full duty-factor operation. The klystron will be sent back to Thales for warranty repair. Another klystron is being inserted, and testing will resume next week. We also received another 5-MW klystron from the factory this week. (2) *805-MHz, 550-kW Thales klystrons:* We finished the site testing of a 550-kW Thales klystron. The final 550-kW Thales klystron has been factory tested and shipped. (3) *ORNL Installation support:* A team was at ORNL this week to help with installation. Concerns & Actions: The window breakage is not an unusual failure mode for a high-average-power klystron. This type of failure is one of the reasons it is important to do site acceptance tests of the 5-MW klystrons, since Thales can only test to one-third the required average RF power at the factory.

HIGH-VOLTAGE POWER CONDITIONING (WBS 1.4.1.2)

Accomplishments: Both LANL HVCMs are now operational, one for the 5-MW klystron tests and one for the 550-kW klystron tests.

DRIFT-TUBE LINAC (WBS 1.4.2)

Accomplishments: Final machining of the Tank-6 post couplers is underway at CMI, and they expect to ship to ORNL next week.

COUPLED CAVITY LINAC (WBS 1.4.4)

Accomplishments: ACCEL completed the final adjustment of the coupling slots on Module 4, to get the required 62.4% coupling, and they began disassembly for packaging to ship. Pi/2 mode, tilt sensitivity and coupling are all well within specification.



Fig. 1. The happy crew at ACCEL with the final CCL module in the background

PHYSICS & DIAGNOSTICS (WBS 1.4.5)

Accomplishments: (1) *Wire-scanner pickups:* S. Armijo remained at ORNL this week to complete wire-scanner installation. (2) *RTBT harp pickup:* We had a successful test of the platinum traces on sample ceramic boards and were able to solder the small capacitors to the sample board. Our ceramic board order is on schedule for delivery around the beginning of June. We have completed four of the high-voltage planes, with four more to go. We are finalizing the details of the wire runs from the ceramic boards to the vacuum feedthroughs, coordinating with ORNL on these details. (3) *RTBT harp electronics:* We held a design review this week with Tom Shea present and other collaborators via video. The design was basically approved with some concern expressed on the complexity of the circuitry. However, participants realized the need to achieve very high sensitivity and low noise for this application. Following a review suggestion, we are taking noise measurements on a similar harp in use at LANSCE.

ASD/JLAB: Cold Linac

Assembly of the H-1 cryomodule continues. The cold mass/space frame assembly has been inserted into the vacuum vessel. Alignment and end can assembly is underway (see photo).

The M-11 cryomodule has been installed in the cryomodule test facility and is being prepared for cooldown.

The H-3 cavity string has been removed from the clean room and cryomodule assembly has begun, with installation of process helium piping complete.

The latest batch of feedthroughs for the cold compressors has performed well in early tests. If this performance is sustained through the end of the current series of tests, first operation of the cold compressors by the end of May may be possible.



ASD/BNL: Ring

An air ride truck carrying the injection kicker, power supply and other equipment was shipped from BNL on Tuesday, April 20th, and arrived at SNS/OR on Wednesday. Upon arrival, on site inspections were made by BNL technician Don Von Lintig to confirm shipping methods and protection for future deliveries.

Preparations are underway for the upcoming DOE Review. Dry runs are scheduled for next week. The breakout talks will be divided into three parallel sessions: mechanical, electrical, and diagnostics.

Craig Dawson (Diagnostics Group) returned to SNS/OR this week to assist with final testing of the BCM electronics during the waning days of DTL3 commissioning.

Half-cell #26 was shipped to SNS/OR this week. Work on #27 is underway.

Two of the extractions PFNs are being acceptance tested this week at APS. A 60 hour heat run at 35kV will commence next week.

At their request, an overview report on BNL/SNS work flow, staffing and critical path areas was submitted to ASD.

Revision D of the draft report on the SNS Ring Diagnostics Production Plan was submitted to ASD along with production and delivery schedules.

A video conference was held with ASD to review BNL progress and issues related to Diagnostics' production, delivery and installation status and plans.

We had a video conference with ASD this week to review Diagnostics' ETC, status and production options. Another meeting is planned for next week.

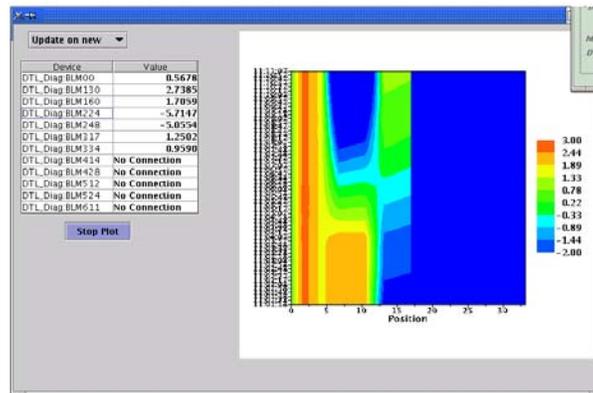
Visitors from ASD will be at BNL next week to review the RTBT rad hard quad design and equipment delivery schedules for the Ring straight sections.

Work has started on the mock-up installation of the injection line.

An RFQ for the 17D224 (RTBT) dipole core has been released to Contracts.

Controls

The controls team continued to support the DTL 1-3 run this week. The control system ran well. Two LANL team members were at SNS to support commissioning, and in particular XAL applications and use of the model. During this run, the BNL-provided Beam Loss Monitor system and "waterfall" display made a debut in the SNS e-log.



The PCR and new BA plan to match actual available BA was completed this week.

Installation and testing of all signals required for start-up of the CHL Main 4.5 K cold box was successfully completed, and start-up was supported at the end of the week.

LANL continues to keep pace with upcoming installation. An action item list was generated for the vacuum and RCCS controls for DTL 4-6. Databases and PLC code are already installed for all of the QMCS, DTLs, and CCLs. SCL vacuum controls for the second rack is ready to install.

A meeting was held with Operations to define the next PPS phases. The next PPS phase, named 1.1, will provide access control for the entire Linac and operation as a Radiation Generating Device. RF processing for the CCL will be possible. Following phase 1.1 will be phase 1.2 which will separate the warm and cold sections of the Linac with a shield wall (no gate). Each section will be controlled independently, allowing RF processing in the cold section, and beam commissioning in the warm section.

PPS cabling in the HEBT began this week. These cable runs are for HEBT equipment in the tunnel including BSSs, gates, doors, and chipmunks.

A plot of residual and prompt radiation dose rates for the Injection area of the Ring was obtained. This will be the basis for defining the boundaries of sub segments within the Ring and for locating BSSs.

At BNL, the ControlLogix/PLC-5 "bridge" configuration has been moved out of the controls development lab and into the RF cavity-testing lab. EPICS is now being used to control and monitor the BNL HPRF equipment. This is the first step in the planned migration of Ring RF controls from a PLC 5 – based system to an SNS standard ControlLogix (CLX) PLC – based system.

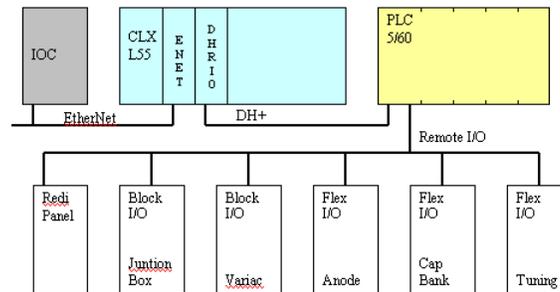


Fig. 1 The system layout with CLX as an interface

Installation

Craft Snapshot 4/20/04

ASD productive craft workers	61.0
Foremen (Pd by 15% OH)	6.0
AMSI management (Pd directly)	3.0
TOTAL AMSI WORKERS	70.0
Less WBS 1.9, 1.2 etc	5.0
Less absent	2.0
TOTAL PD BY ASD/ORNL DB WPs	54.0

The second phase of Research Mechanic hiring started. The first interview was conducted April 23, 04. There are six more candidates to interview. Interviews will be completed on April 29, 04.

It is anticipated that the new Research Mechanic – Electrical Trainee will report for work on Monday, May 24, 04

Accelerator Physics

Commissioning goals for DTL1-3 were achieved, and beam commissioning was terminated Friday 4/23. The ion source peak current was increased to 38 mA and was brought to the beam dump with 100% transmission. Much data on beam trajectories, beam sizes, time-of-flight measurements, etc was obtained for offline analysis.

The online model has been updated to include the longitudinal dynamics necessary for modeling beam/RF phase errors. The online model has been compared against measurements of downstream BPM phases and phase differences vs. DTL cavity phase. Fits to BPM phase differences show promise in determining input beam energy and cavity phase and amplitude errors.

Two staff members attended the ECLLOUD04 workshop last week to present results of particle-in-cell electron cloud simulation in ORBIT. Good agreement is obtained between a simple analytic two-stream model and the ORBIT results for growth rates and mode frequencies

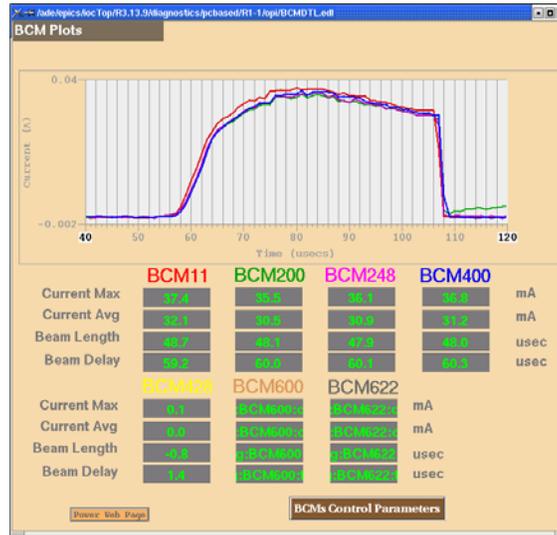
Work continues to evaluate the limits on operations imposed by the injection dump. Linac emittance, stripper foil thickness, chicane magnet errors, and injection dump gradient magnet errors all play a role. We are working to identify the combinations which lead to unacceptable beam distributions at the injection dump.

Work continues to change the planned wire scanner location in the HEBT arc from near QH12 to near QH16. The mechanical group is reviewing installation drawings to identify any potential problems.

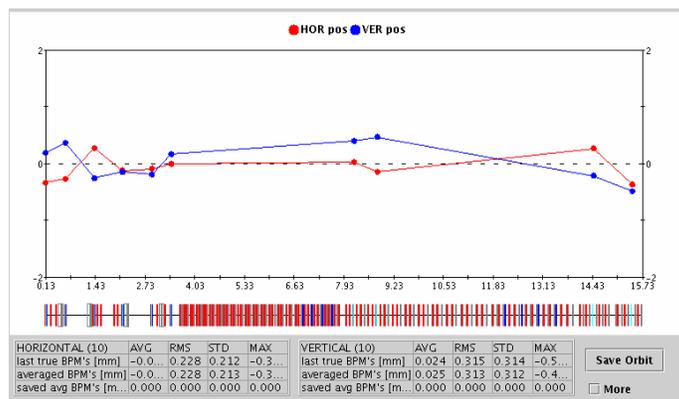
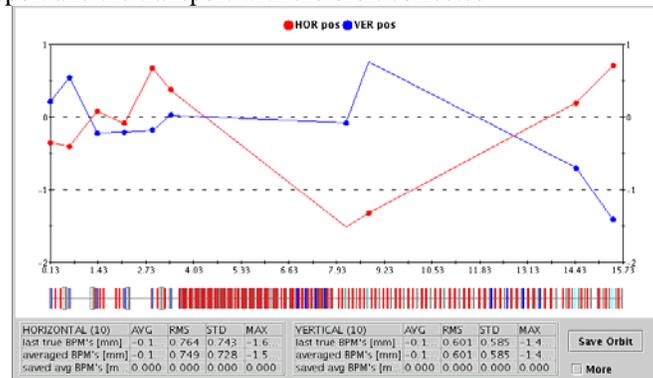
Work continues to model the radiation environment in the ring injection area.

Operations

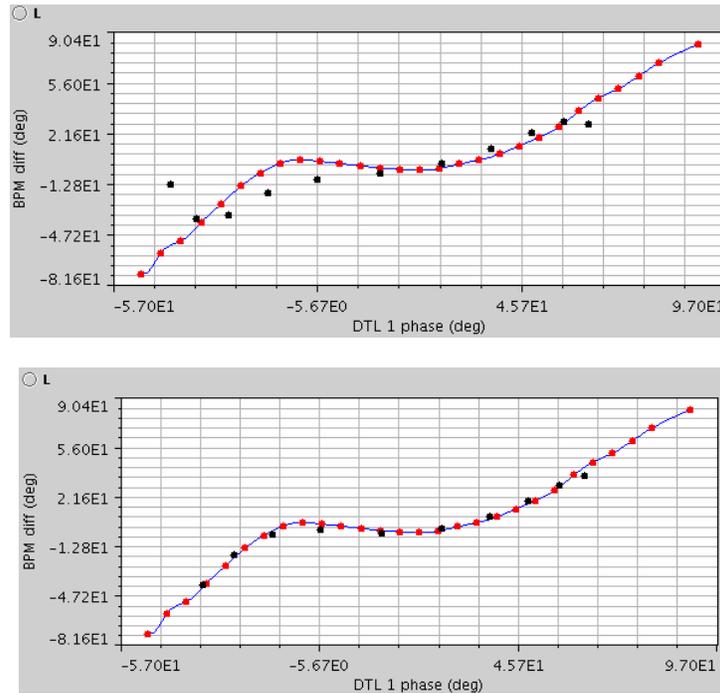
ASD Operations has conducted and supported Commissioning of DTL Tanks 1-2-3 for the past week. Although the commissioning period was scheduled through May 12, we have completed all the commissioning goals and plan to terminate commissioning today April 23. Beam commissioning began April 12. The beam was successfully transported to the beam stop downstream of DTL-3 shortly after noon on April 13. The Ion Source and DTL RF have been remarkably trouble free during the run. The following picture is of the 38 mA beam transported with essentially 100% transmission



The beam was initially transported to the DTL-3 beam stop with essentially no use of steering. The pictures below show the initial beam transport and the transport with the orbit corrected



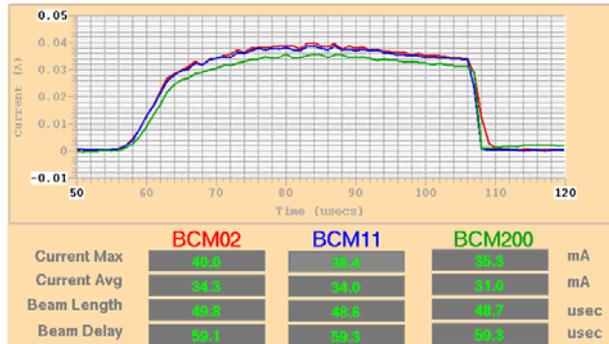
We were able to employ all the Accelerator Physics application codes from the previous commissioning run as well as the new ones developed for DTL Tanks 1-3 commissioning. These new codes will be essential to the timely completion of the upcoming commissioning run for DTL Tanks 4-6 and CCL Modules 1-3. One of these codes is the Delta Phi scan. This enables us to make a much more precise measurement of the tank set points, incoming energy etc. The following pictures show the Delta Phi results for DTL Tank 2 using the assumed values and a second plot showing the fit values from the code.



The Beam Loss Monitor system was further developed as well with many significant measurements and calibrations taken. We expect that in the next commissioning period, with the beam dump sufficiently far away, the Beam Loss System will become an essential element in the tuning and monitoring of the Linac beam transport system.

Ion Source Group

The ion source held up to its promise: When the RF power was increased to 45 kW, the antenna current increased to 600 A pk-pk. And after all ion source and LEPT parameters were fine tuned, the first beam current monitor at the exit of the RFQ indicated a peak current of 40 mA, or about 38 mA when averaged over the “flat top”. The source maintained this output for the two final days of DTL1-3 commissioning, although the RF power and the lenses were sometimes reduced to protect diagnostic equipment and to reduce activation.



The ion source hot spare stand has been restarted with the newly installed current transformer at the exit of the LEBT. This will allow us to confirm the Faraday cup measurements after the calibration planned for next week.

Survey and Alignment Group

This week, S&A aligned eleven of the twelve installed diagnostic laser boxes located in the SCL. The twelfth box could not be aligned due to the deformed I-beam which bolts to the ceiling and supports the laser box. This deformation along with a step in the ceiling caused the box location to change erratically with small movement. As a result, this last box could not presently be aligned and is being modified.

We are also returning to the chopper cavity as-built measurement campaign. We are now measuring the bulk shield liner flanges that we were not able to complete because of tape and other residue on the flange surface. This includes instrument lines twelve thru eighteen.

We also performed a complete "as-built" of beam line nine chopper cavity.

S&A repositioned the upstream pipe end of the LINAC dump. On the following Monday we will assist the ME Group in installation and fit up of the end flange.

Set the cross members on the CCL 3 stand. This was needed so that the segments for CCL 3 could be set in place. Today we will begin setting the segments on CCL 3. This task is required to allow for the full assembly of CCL 3.

Phase II (laser tracker monument measurements) of our global network measuring campaign in the HEFT/Ring/RTBT is about 80% complete. Our original target date for the completion and adjustment of the global network was 15 May. Unfortunately, due to our increasing work load, we have found it necessary to set a new completion date of June 10th.

Both laser trackers on site were taken out of service for ½ day each while required field calibrations were performed.

Mechanical Group

CCL-1 conditioning began this week.

CCL-1 magnet power supply testing was put on hold until the performance of the magnet cooling system can be better understood.

CCL-2 cooling manifolds have been installed. Vacuum and cooling system terminations are in progress.

CCL-3 segments have been installed on the support frame.



CCL-3 Segments on the Support Frame

Water Systems Installation

- The assembly and installation of the manifold for DTL-6 is nearly completed.
- The assembly and installation of the manifold for CCL-2 was temporarily put on hold awaiting a fitting delivery.
- Installation of the piping from the waveguide chase to the CCL-2 manifold has begun.
- The relocation of the 'temporary' CPVC manifold for testing magnet power supplies continued and will be completed next week and the system turned back over for testing.
- The feed piping from the CF headers to the SCL TRCC skids 9 and 11 is approximately 75% complete.
- Installation of the piping for all of the RF equipment on SCL-ME3 and SCL-ME4 has been completed and leak tested. The SCR cabinets, HVCN modules, and the magnet power supply racks will be tied in once these pieces of equipment have been installed.

Ring Systems Installation activities occurring the week ending Apr 23.

- The RING Half-Cell #25 (Unit A4) was installed.
- The RING Half-Cell #26 (Unit B4) was received and staged in the tunnel.
- The RING Injection Short Kicker Magnet Assembly, its support stand and prototype PS were received and staged in the tunnel.
- The shipment of 7 - 21Q40 magnet chambers was received.
- Two shipments consisting of assorted spare magnets, beam pipe chambers, girders and frames were received.
- The base plates for the RING primary, #2 & #3 as well as the 2 - RTBT collimators have been measured and staged.
- Pulling of the kicker magnet cables in the RING Injection straight section continued.
- Installation of grounding for the HEBT lattice components was completed.

Magnet Task

This week we have measured more CCL Quads and now have a total of 8 CCL Module 2 intersegments ready to install.

We also removed and repaired CCL Module 1 intersegment 9 Quad which had a ground fault appear.

We have also measured another 8Q35.

Design/Drafting is busy with modifications to the 21Q40 measurement system. This will be completed in a couple of weeks.

Electrical Group

We completed integrated testing of CCL 1 corrector power supplies and magnets. Started testing CCL1 quadrupoles and power supplies 4-11, but water system problems have delayed the completion of these tests.

CCL-ME2 was operated to support klystron testing to 30 Hz, 1.3 ms pulsewidth, 132 kV. We experienced an SCR failure shortly after initiating the checkout, and were able to get the unit back online in about 4 hours. SCL-ME2 is near completion of the installation phase, with checkout expected to begin sometime next week.

We have started troubleshooting and fixing the DEI GRX LEPT chopper pulsers to allow for testing next week in situ. The one unit sent back to the vendor finally arrived this week.

We will begin testing of a modified gate drive circuit for the SCR units. Analysis by the device manufacturer of failed devices seems to indicate that this may be a source of problems with the unit

HPRF

RFQ through DTL3 RF Stations continue to support beam operation.

CCL3 Waveguide prep continues – awaiting magnet for 5MW tube. Modifications made to CCL waveguide phase shifter to allow position sensing and control.

JLAB team continues processing of couplers.

Put 3.4 MW into shorted waveguide for CCL 2 at 1ms and 30 Hz. No waveguide arcing. We will go to 4 MW and stop.

SCL-ME2 being readied for testing 12 more SCL tubes. Progress has been fine and testing may start the week of May 2nd. SCL ME-2 nearing completion of cable terminations. Transmitter checkout next week. Replacement of leaky waveguide bellows continues on Fridays.

CCL 1 structure conditioning going well obtained 1.6 MW into structure with low reflection. Problem arose with CCL 1 klystrons arcing at the circulator. SF6 circulator gas pressure is being checked and fresh gas being installed. Short place on CCL1 waveguide in the gallery and tube will be powered to 4 MW, 1ms RF at 30 Hz for checkout. Will be ready to resume CCL 1 conditioning this afternoon

Coupler testing in the RFTF going well, another pair should be conditioned and another pair are in bake out.

LANL help with RF installation has been invaluable.

LLRF

The LLRF group provided support for DTL1-3 beam commissioning, CCL1 RF conditioning, and CCL2 klystron testing. CCL1-2 are both equipped with production Field Control Modules (FCMs) and High-Power Protection Modules (HPMs).

The group is working on CCL3-4, SCL ME1 and SCL ME2. The highest priority is SCL ME2 since the testing of those klystrons is scheduled to commence the week of May 10.

The 805 MHz reference line was turned on and can be used to support RF testing in CCL and SCL. Installation of the temperature and pressure regulation systems is in progress.

Mark Crofford attended a week-long course on digital design with VHDL.

We have received 63 of 125 HPMs. Another 30 units are expected next week. The AFEs are under production and we expect to take delivery of the first ~20 units near the end of April. The production of the FCM motherboard, DFE and RFO is still on hold pending the outcome of measurements on the first 20 units. The only outstanding performance issue is the quality of the ADC clock signal, which is generated on the RFO. We expect to release production next week on the balance of these boards.

Hengjie Ma and Mark Champion visited JLab the week of April 12th to test a production FCM with a medium-beta cryomodule. The FCM performed as expected after some computer/software issues were resolved and signal levels adjusted. The cavity was operated under closed-loop feedback control at gradients well above the specification of 10 MV/m. Upon completion of testing with the cavity at 2.1 K, the cryomodule was warmed to 4.2 K and we conducted a proof-of-principle test whereby we demonstrated the FCM may be used to regulate cavity fields in excess of 10 MV/m, albeit at reduced duty factor. Thanks to the Controls group for setting up the software and to JLab staff for supporting the testing.

Cryosystem Group

The warm helium compressors have been running since Friday purging the 4.5K cold box of impurities. As of this morning purities are within acceptable limits. Plans are to clean the turbine filters, install the expanders and continue on with the commissioning of the 4.5K cold box.

The vendor for the 2.1K cold compressor connectors has reported being able to produce a connector that will meet the requirements of the cold compressors. We are waiting for a schedule of production and installation for the connectors.

We have started the fabrication of the remaining "U" tubes for the CHL cold box room.

Beam Diagnostics

Wire scanner work continued with 2 visitors from LANL. Several bug fixes were implemented. The 8 and 12 inch wire scanner first articles have been received from LANL.

BLM test stand equipment has been moved into the mezzanine cage. A separate rack has been set up for ND testing.

A second BCM was installed and configured for the Source test stand. Two BNL ring BCM chassis were also installed and tested with beam under remote control.

The BNL ring BPM electronics continues to run under remote control. TDR used to cut off BPM heliax for termination at CCL modules.

The flipper and controller for the laser system passed a 10k cycle test. The first article of the laser wire chassis has been received and assembled. Found 2 mods to be made one of the mods required the return of 14 panels to the machine shop and the other will be done at assembly. Laser wire motor driver rear panels have been assembled.

The new biphas decoder logic appears to be running, on both the EL and RTDL channels. This has been tested using the SNS timing master VME crate. For more complete testing, a digital pattern generator has arrived and will be integrated into a test system capable of providing all RTDL frames and event patterns with frequency modulation, jitter, amplitude changes, and simulated errors.

Beam studies continued and data analysis programs are being written for the BPM, BCM, and BLM data.

For noise mitigation, an SRO estimate is in preparation for adding BLM and Laser wire conduit runs in SCL.

Two technician interviews were performed and phone interviews for engineers and technicians continue. The second contractor requisition was recast into the ORNL leased personnel form. Meetings were held at LANL regarding harp design and status, remaining diagnostics budget and deliverables, support for Labview and EPICS, test signal availability at LANSCE, and digital architectures for data acquisition. The harp electronics review was held during the Monday VC. The Ring straight section delivery schedule was also discussed. BNL presented their diagnostics ETC during a special VC on Friday. Preparations for BIW04 continue. A local organizing committee meeting was held and a meeting at the Marriott was scheduled for the following week. 200 devices requiring calibration have been identified and data sheets are being collected. Work continues on preparation of DOE presentations and BIW presentations. Labor estimates are being reviewed system by system in support of the ORNL diagnostics ETC.