Accelerator Systems Division Highlights for the Week Ending April 26, 2002

ASD/LBNL: Front End Systems

MEBT commissioning efforts continued, including Saturday, April 20, with the assistance of A. Aleksandrov and S. Assadi.

The RF systems are working reliably. Some adjustments in the high power cables are still needed, but these are not limiting the current operations plan. The EPICS screens have full control of operational parameters and give relevant feedback information.

The noise in rebuncher cavity #1 was cured by replacement of the DACs in the LLRF controller. This action significantly improved the quality of BPM and BCM signals. The BCM readings now agree to a fraction of a mA to the Faraday cup value. All BPMs are working, but there is a systematic intensity error in BPM5 and BPM10, because their bore size of 36 mm differs from the standard 30-mm size, and the gains are set the same way for all BPMs.

A number of phase scans were taken to optimize the buncher parameters. The proposed values were set, but the measured Twiss parameters disagreed with Trace3d predictions, with progressive deterioration down the beam line. Resetting the quadrupole magnets to nominal values somewhat improved this situation, but some discrepancies remained.

In the process of performing these tests, a defect occurred on April 23 in the (commercial) 2-MHz amplifier for the ion source, abruptly terminating all beam operations. Aided by advice from the amplifier vendor, we have identified and repaired a major defect, and by the end of April 26 we were able to produce ion-source plasma again. Some minor technical issues with the amplifier still have to be resolved before the commissioning efforts can be resumed.

The down time was used to implement some upgrades in the FES control system.

R. Keller and R. Yourd attended the Dry Runs for the upcoming DOE Review and spent one more day at Oak Ridge on discussions with SNS staff.

ASD/LANL: Warm Linac

The second 402.5-MHz klystron was shipped by Marconi on April 25 and will arrive in Los Angeles on April 27. LANL Customs is tracking the shipment. (WBS 1.4.1.1)

The first Marconi klystron continues to be tested at LANL. This week it operated well above 1 MW output with the prototype high-voltage converter modulator (HVCM) running at 125-kV and 60 Hz. (WBS 1.4.1.1)

The first article 5-MW 805-MHz transmitter has not completed acceptance tests, primarily due to failure of the test load at Titan-Beta. Delivery was delayed another week. (WBS 1.4.1.1)

LANL personnel were at Dynapower all week to review progress and to provide technical and project support to the manufacturing of the production HVCM SCR controllers and converter modulators. All 17 SCR controller cabinets have been completed and component installation is nearly completed. The converter modulator staging are has been established on the plant floor. Dynapower made significant progress in placing orders for nearly all long lead item parts and most other parts required. The LANL lead designer was present to provide 3-D drawings for the boost transformer mold drawing for the bobbin. LANL project controls staff was present to provide logic diagrams that interface and track Dynapower's manufacturing schedule. (WBS 1.4.1.2)

The prototype HVCM passed the crowbar-wire tests at 144 kV. We used a 30 AWG, .010"-dia test wire through-out the test program (over 100 events). At the instant after crowbar, (high-frequency) ringing is evident (few hundred amps) in the current waveform, but then quickly subsides to about a 100 amp follow on current of millisecond

duration. Regardless of the waveform, the energy is insufficient to break our test wire. In addition, the HV cable is about 3X the SNS installation length. (WBS 1.4.1.2)

During the 125-kV 60-Hz Marconi tests, an HVCM IGBT failed. The problem seems to manifest itself as a heating issue. We are examining the modulator drive waveforms and have made some observations. We intend to recheck our diagnostics to be sure what we are seeing is correct. The diagnostics are telling us the IGBTs are not acting as saturated switches. The thermal dots on the blown IGBT show a hot device. Also, both Mitsubishi and Eupec say switching during the "tail-current" is not a problem. Eupec also adds that they have systems in operation with a 1.5 microsecond dead time. We intend to change back to the 20 kHz switching. In addition, both the Eupec and Mitsubishi IGBT application engineers are coming within two weeks to view the operations to provide additional guidance on our use. (WBS 1.4.1.2)

We performed modeling for our system using IGBT device models, and found that at high current and dI/dt, the devices were pulled out of saturation. The solution from the modeling is to increase the gate drive. This seems to agree with our result of increasing gate drive from 11V to ~15 volts to successfully move us from the 105 kV region to 125 kV. We have parts on hand to change out the supply transformer on our gate driver board to give us +20 Volts gate drive. This should give us plenty of drive for the Marconi klystron operations at full voltage and duty. We are modifying the IGBT driver boards (for production) to enable an asymmetric drive (+25 Vand –15 V) and also accommodate two or more IGBT modules. (WBS 1.4.1.2).

The water design team returned from a successful trip to AVANTech in Aiken, SC where they performed the successful inspection and acceptance testing of the DTL Tank 3 Water Cooling Skid (Fig. 1). We were impressed with the quality and timeliness (right on schedule) of the water skid construction, as well as its performance. The skid easily met all of the functionality requirements that could be tested at the Vendor's facilities. The unit was shipped and arrived at the RATS building. (WBS 1.4.2.5)

Fig. 1: DTL Tank 3 resonant frequency control system water skid.

LANL and ASD personnel continued to tune DTL Tank #3. They explored new methods for measuring post coupler lengths and decided that a depth micrometer mounted on the end of the post showed the most promise. We are now modifying the post couplers to allow attaching the micrometer. (WBS 1.4.2.7 & 1.4.5.2).

When we completed the final alignment of DTL Tank 3 on April 16, we believed the magnetic center of each drift tube was positioned within 0.005" relative to the beam channel. This week, we checked the alignment of several drift tubes using the laser tracker and found the drift tubes to be out of alignment by as much as 0.016". The reason for the change is unclear at this time, but our confidence in the laser tracker and/or the accuracy of the alignment is uncomfortably low. This week, we also used an optical technique to check the relative geometric position of each drift tube. This was performed by establishing a line between the drift tubes on each end. The maximum geometric offset was 0.018". Part of this offset, up to 0.005", could be due to an offset between the magnetic and geometric center. Taking this into account, the positional offset is still 0.013". This implies an unacceptable misalignment in Tank 3. We are now looking at several options to correct the alignment: (1) Perform the alignment with two laser trackers. The error in the laser tracker is a function of the distance measured. This distance can be reduced by using two laser trackers, where one is positioned at each end of the DTL tank. The two trackers would then interface with the same computer and we believe the accuracy would improve. (2) Hire an external organization with the latest, calibrated, and updated hardware and software to independently perform the taut wire measurements. (3) Use both optical and laser tracker methods to align the drift tubes. The optical method could be used to align the x and y position of each drift tube and the laser tracker could be used to align the z position of each drift tube. The laser tracker should be the most accurate in the z-direction, based on laser interferometry verses decoding techniques. (4) Initiate a research effort to analyze, identify, and resolve the alignment issues required to obtain repeatable measurements with the laser tracker. (WBS 1.4.2.7)

ACCEL Instruments satisfied another intermediate milestone by formally placing a contract with Mechanic Center Erlangen for machining the copper cells of a portion of the CCL structure. (WBS 1.4.4.2)

The physics team continues to examine the impact of partially chopped beams. Beam simulations through the front end and into the entrance of DTL were performed and the results look encouraging. LEBT and MEBT chopper sequencing optimization is underway. (WBS 1.4.5.3)

ASD/JLAB: Cold Linac

Assembly of the prototype cryomodule was completed, and the unit has been rolled into the cryomodule test facility to begin integration with RF, cryogenic, instrumentation and control systems. A leak in the insulation vacuum was discovered, and repairs are underway. The stands have been received.

The first production helium vessels and vacuum vessel have been received.

The remaining transfer line end can design package was submitted to SNS for review.

The thermal shock and leak checks of the 2 K Cold Box were successfully completed.

Cold compressor #2 was successfully tested at Air Liquide.

ASD/BNL: Ring

J. Wei, M. Nekulak and W. McGahern traveled to SNS/OR to participate in the dry run of the DOE Review.

BNL exercised the option to release the production coil order for the remaining six (6) injection kicker magnets (2 long and 4 short).

An RFQ was released to Contracts for procurement of the 21S26 high field chromaticity sextupoles.

A bid package for the Ring RF Cavity Tuning Power Supply was sent to ASD for final review. BNL Contracts are preparing the RFQ.

IPM – Completed installation of the prototype luminescence monitor in the AGS Ring. The first data shows a lot of beam coupling. Floating the PMT box from the beam line and adding a screen over the optical input to the PMT box will address this. Next ring access is scheduled for Wednesday, May 1.

Laser Wire Scanner - Beam tests with the 200Mev LPM again produced nice differential current measurements from the striplines. We were able to get a scaled-back version of the software working just as we lost beam. Next beam test is scheduled for Wednesday, May 1.

21Q40 – ASD approved BNL testing of 1st article Ring quadrupole. Tesla has been authorized to start the production run.

21Q40 Disassembly Test - J. Jackson reported, "…the maximum difference (before and after disassembly) occurs for the octupole harmonic and is about 1 part in 10,000."

A bid has been accepted for the 36Q85 magnet yoke production order. Formal approval by BNL Contracts is underway.

Bill Birkholz made a pre-delivery visit to our vendor, Stangenes, to inspect a first article 26Q40 quadrupole. This unit is now in route to BNL for magnetic testing and final acceptance.

While in California, Bill Birkholz visited another vendor, Alpha Magnetics. Bill noted that their coil winding effort on the 41CDM30 is underway.

SDMS (France) reported that they have finished fabrication of the RTBT #2 round absorber. Assembly with the inner box is underway. A visit to the vendor's plant is scheduled for 5/12/02. We expect shipment to ORNL on 6/03/02.

Ring dipole power supply (high field) bid package is at SNS/OR for review. RFQ to be released by BNL Contracts on 5/08/02.

W. Eng is at IE Power this week to conduct acceptance tests on the 1st article injection kicker power supply. Major tests will include:

1) Pulse tests at 250A, 500A, 1000A, and 1400A
2) 2) Voltage ripple measurements at 100ADC, 200ADC, 300ADC, and 400ADC.
3) Current frequency response for sinusoidal and triangular waveforms at 500Hz, 1KHz, and 2KHz at 100A, 200A and 300A.

Controls

FE commissioning activities at LBNL included: Four 402.5MHz 20kW rebuncher rf power amplifiers integrated with EPICS. Additional vacuum and cooling sensors were added.

Work continued on the ion source test stand. A stand for testing the hot spare high voltage power supplies was set up and the first power supply was tested in manual mode.

Oak Ridge received a TrueTime VME-SG2 GPS interface board this week, installed software written for it, and is currently using it (in stand-alone mode) to fetch the time we transmit on the RTDL. (Most of the development work for this was done at BNL).

Verification of the status and control signals from one of the six CHL main warm compressor skids to the SNS PLC to the SNS IOC to the EPICS screen is 80% complete. A few problems have surfaced. Most problems have been corrected. There are several problems in the PLC software provided by the vendor. All vendor problems are being documented and a list of issues will be transmitted to the vendor once checkout of the first compressor skid is complete.

Installation

Accelerator Physics

A general purpose application program for monitoring beamline device parameters was tested, using the live LBNL MEBT data. This application provides a means to find quantities through an intuitive accelerator hierarchy, without having to know signal names. It will also work for future accelerator sequences, as they are filled into the global database.

Initial Ring and RTBT fault studies were completed this week. Jeff Holmes studied various injection painting faults to understand if it is possible to unintentionally produce a high current-density beam at the target. In the worst-case scenario in which the beam is accumulated on the closed orbit (no painting) and scattering in the stripping foil is neglected, the current density on the target is a factor of two above the maximum current density allowed. This is unrealistic in that the stripping foil would be quickly destroyed. All other painting faults resulted in current densities that were slightly worse, or no worse than the nominal conditions. In any case, all painting errors considered were accompanied by rather large losses in the ring, and as a result, will be detected through the machine-protection system via beam loss monitors.

Stuart looked at RTBT quadrupole faults in an attempt to see if it was possible to focus the beam on the target and violate target requirements. In almost all cases of individual quadrupole errors, target current-density violation was accompanied by huge losses in the RTBT. That is, it does not seem possible to violate target requirements without first detecting losses in the RTBT beam loss monitors. As a result, the MPS system is adequate for detecting events that violate target parameters.

Dong-O did a study on transverse matching of DTL to CCL in which it is proposed to minimize envelope oscillations using four wire scanners in series. This method appears to provide more robust matching and is less sensitive to pulse-to-pulse jitter than the method that fits RMS beam sizes with the use of a machine model. A note was written and posted at http://it.sns.ornl.gov/asd/public/pdf/sns0057/sns0057.pdf)

The global database is being populated for the different DTL subsystems. Jeff Patton is setting up the proper repositories for this. The DTL tank 3 water skid has arrived. Cable and rack orders are in full swing in view of installation for DTL3. Drafts for the PPS search procedures for DTL3, written by Shane Passmore are now being reviewed.

Shunts for the CCL quad power supplies have been discussed; it has been recommended to keep the electronic shunts in order to guarantee operational and physics flexibility.

Operations Group

Worked on the ASD Spares list and Hot Region Spares List

Worked on the ASD RAMI Analysis

Worked on the Equipment Tracking System

Developed a proposal for the Electronic Traveler System

Continued development of the Readiness Plan of Action

Continued development of the Commissioning Program Plan

Continued development of the Operations Procedures Manual

Continued with development of the Operations Training Manual

Ion Source Group

The previously reported turbo pump problem was solved after it was traced to a warped flange. Reducing the bolt torque let the O-ring make up some of the unevenness, and lets the turbo pump spin happily ever after.

The first ion source plasma was generated on Tuesday, April 23, using the LBNL startup source and the LBNL capacitive matcher. Power did not exceed 200-Watts continuous 13.56-MHz RF, limited by overheating of an uncooled connection in the matching network. The filament heater cable was shielded after it acted as an antenna. Pedro Gonzalez from Radiological Services surveyed the area but could not detect any elevated radiation, as predicted because voltages are much below 1 kV and there are no electron cyclotron resonances.

Most of the parts for the matching network were received.

After completing the repairs, the 80 kW 2MHz amplifier was successfully tested at full power. It will be shipped next week.

RF Group

Visited LANL and ZTEC this week. Reviewed recent IGBT failures, failure causes, and possible solutions with Bill Reass. Concurred with LANL on rejection of 1st article SCR Controller unit due to unacceptably high audible noise levels (~80 dB / unit) and suggested baffling of cabinet to reduce levels below required 70 dB. Attended ZTEC and discussed delivery schedule for cables for first 3 units (May 20), first 3 racks (June 1), and DSP / FPGA object codes (May 15).

Stephen Smee performed the first 4 K test of the piezoelectric actuators that will be used to compensate for Lorentz force detuning in the superconducting RF cavities. The static stroke is 20 microns at 1 kV with 1800 N tensile preload. The dynamic stroke requirement of 17 microns was achieved with a bipolar drive signal from -250 V to +550 V. The dynamic response was measured with a trapezoidal drive signal featuring 160-microsecond rise, 1000 microsecond flattop, and 160-microsecond fall. The repetition rate was 60 Hz.

Mechanical Group

Forty seven ion pumps were vacuum tested, bar coded and prepped for long term storage, fifteen 240 L/S pumps and thirty-five 300 L/S pumps. Twelve crates of ion pumps sent to storage.

The computer control system similar to the one that will be used with the cryogenics group leak detection stations was setup on a laptop and is now being used on the beam dumps.

Cleaning and leak checking has started on the two remaining beam dumps. An RGA will be taken of the pre-fabricated parts prior to welding.

Support was provided to the ASD ion source group and equipment furnished for leak testing the ion source.

Support was also provided to the magnet group. The first two bus bars were leak tested with vacuum group equipment and personnel.

Vacuum equipment received this week, included: hardware for leak detection control systems, 2 ion pump installation carts and assorted tools.

Accelerator equipment received this week included twelve vacuum gauge controllers, twenty-three cold cathode vacuum gauges and twenty-three thermo couple vacuum gauges.

Cryogenics Group

CHL: The steel is set on column lines 1-4, and the forms are in place for the concrete of the RF test cave.

Transfer lines: WE have finished building 4 medium beta supply transfer line modules. WE have stopped production to set the assembly tables for production of the high beta supply modules. Also, we are placing the tooling for the medium beta return modules.

Beam dump flight tubes: We continue cutting and facing pipes for the 2nd and 3rd flight tubes.

Personnel: We continue interviewing for the open Cryomodule technician positions.

Electrical Systems Group

A meeting was held with SNS/ORNL operations and ORNL+LANL physicists to discuss possible changes in CCL power supply shunt chassis specifications to produce cost savings as the bids for these items came in over budget. No changes were made, the baseline design was retained as it was felt that maximum flexibility was needed for commissioning and beam based alignment. A PCR for $109K will cover the overage.

Ken Rust visited LANL to observe operation of the High Voltage Converter Modulator.

Tom Owens visited LANL to study the ring RF system at the LANSCE PSR.

Survey and Alignment Group

Beam Diagnostics

LANL Beam Diagnostics Progress Report:

BPM pickups: The modified drawings for the CCL and SCL BPMs have been turned over to purchasing. Fabrication continues on 8 ea. DTL BPMs.

BPM electronics: We are working with LBL to resolve electronic noise issues on one of the BPMs (see below).

WS actuators: We are working with BNL to specify the HEBT/ring/RTBT actuators. We placed an order with Huntington for six actuators needed for the D-plate. Work continues at JLab to test and qualify the SCL actuator and beam box.

D-plate: Final detailing continues. We are working with local vendors to fabricate various components.

Current monitors: Work is underway at Bergoz to swap out the coax cables with more vacuum compatible twisted pair cables.

Cabling: Work continues on the cable specifications, rack layouts, wiring lists, and block diagrams.

Misc: Preparations are underway on two papers for the Beam Instrumentation Workshop.

ORNL Beam Diagnostics Progress Report:

Craig is at LANL. He is working on DTL tuning. Activities are going smoothly. New tooling is being developed to assist in post tuner positioning.

John Power and Craig measured the DTL Tank 3 BPM's. Discussions have been made regarding the performance of these BPM's and the cable assemblies. DTL BPM 3-8 looks fine. DTL BPM 3-2 has one electrode that is different from presumably some machining operation. The performance of DTL bpm 3-2 is off by 1% and performs similarly to FEM calculations. The cables have changed the performance of TDR measurements in both BPM's. Discussions continue about whether the BPM's should be removed and new parts installed. We will have a videoconference with LANL on Monday April-29th.

We are working on Laser wire cost and installation issues as compared to the baseline carbon wires. Warren Grice completed budget schedule for the laser transport line. He also carried out calculations and posted a tech note regarding the effect of ghost reflections. These effects have been discussed with Joe Frisch (at SLAC) and Bob Shafer. In order to accommodate the laser wire in the SCL, we need to investigate changes to the warm section beam box design. Danny has sketched a conceptual beam box design that can accommodate angled windows and/or carbon wires. We have asked LANL to revise the existing SCL beam box drawings such that the new warm section requirements are met and two normal-incidence windows are added.

We are participating in the commissioning of the MEBT diagnostics. We traced the MEBT BPM noise to beam induced rf rather than electronics. Beam was excited by the debuncher cavity-one high frequency rf module. We converted all diagnostic triggers to the ORNL-Control's group trigger system. All MEBT prototype diagnostics are functioning and providing useful information to the commissioners. Wim wrote a high-level application program to analyze the Laser wire data. In collaboration with the controls group, he is looking at integrating EPICS IOC core into the network-attached devices. Wim is also writing and compiling notes on the MEBT wire scanner performance and the needed improvements to make them operational.

Tom attended the dry runs for the DOE review. On Friday, Tom and Saeed presented the installation and integration estimates for the diagnostics. The estimate basis and comparisons with other facilities was also discussed. We are all involved in providing or gathering information to order the cables. Racks for the FE and DTL are ordered. Database work continues with the linking of cable information to accelerator device information. We are developing the capability to automatically produce and update our system block diagrams.

BNL Beam Diagnostics Progress Report:

Work continues on BIW papers and materials for DOE Review

1.5.7.1 BPM: Welding is now possible in the PUE production facility. We are waiting for parts from shops to resume production.
 BPM electronics conceptual design continues.

1.5.7.2 IPM: Installation of the prototype luminescence monitor in the AGS Ring was completed. The first data shows a lot of beam coupling. Floating the PMT box from the beam line and adding a screen over the optical input to the PM box will address this. Ring access is scheduled for next Wednesday.

1.5.7.4 BCM: Fabrication of Rev 2 Circuit boards continues. LANL is working on shroud resonance calculations. Keithley 2002 DMM demo was received for evaluation

1.5.7.5 Tune: UAL modeling of beam transfer function measurement continues to show good progress.

1.5.7.6b Laser Wire Scanner: Beam tests with the 200Mev LPM again produced nice differential current measurements from the striplines. We were able to get a scaled-back version of the software working just as we lost beam. Next beam test is scheduled for next Wednesday and we will have the earlier and simpler software running for that test.