



**Brookhaven National Laboratory**

**SNS**

**Ring and Transfer Lines Systems**

**F E B R U A R Y**

**MONTHLY REPORT**

01 February – 28 February 2003

Performing Organization:	Brookhaven Science Associates
Location:	Brookhaven National Laboratory Upton, New York 11973-5000
Contract Period:	October 1998 – June 2006

Brookhaven National Laboratory  
SNS MONTHLY PROGRESS REPORT  
February 2003  
Ring and Transfer Lines Systems

**I. Senior Team Leader Assessment**

**1. TECHNICAL PROGRESS AND ACCOMPLISHMENTS**

- 2<sup>nd</sup> ring half-cell magnet assembly was shipped to ORNL. The 1<sup>st</sup> assembly, shipped in November 2002, was successfully re-surveyed at ORNL and obviously survived the shipping.
- An Estimate-To-Complete was performed. An additional fund of about \$0.93M was needed mainly to cover added scope of magnet measurements and vendor cost increases. An early return to contingency of \$1.1M, due to reduction of laboratory overhead rates on large procurements, helped to minimize the impact.
- Efforts were made during machine study at RHIC to better understand the performance of ionization profile monitors. A close correlation was made between IPM malfunction and beam loss/expected electron cloud.
- Solution was implemented to mitigate out-of-tolerance pole length and width of the ring quadrupole magnet (26 cm ID) from our vendor (Stangenes).
- 1<sup>st</sup> article medium range power supply was successfully tested. Earlier problems with noise and ripple were resolved after close interaction of BNL power-supply group and our vendor (IE Power).
- Leaks were found in BPM welding in ring vacuum chambers. The cause was found and repairs were made in a week.
- 2<sup>nd</sup> RF power amplifier was successfully tested.
- The first article ring sextupole (21 cm ID) arrived from Alpha Magnetics and passed acceptance tests.
- Ring quadrupole magnets (21 cm ID) were continually measured. 16 out of 27 measured quadrupoles were sorted into two families according to their integral transfer functions for the ring.
- A single-ellipse geometry, instead of double-ellipse geometry, was chosen for the ring secondary collimator to ease maintenance and to reduce construction cost. Calculations were made to assess reduced collimation efficiency (negligible) and increased radiation dose at downstream corrector (about 25%).

- Prof. H. Okamoto from Hiroshima University, Prof. R. Gluckstern from University of Maryland, and Dr. J. Xia from Institute of Modern Physics, China, visited us for collaboration.
- The SNS project office at ORNL performed a cost/schedule/performance review on BNL/SNS.

## 2. ISSUES AND ACTIONS

- Project change requests agreed upon by ORNL Project Office needs to be formally signed off before actions can be taken, PCR RI 03 001 for ASAC recommendations and Moveable Shield, PCR RI 02 014 for spare vacuum chambers and BPMs, PCR RI 03 006 for magnet vendor costs plus spares, and PCR RI 03 007 for Incorporation of FY 03 ETC.

## 3. COST AND SCHEDULE STATUS

### 3.1 VARIANCE ANALYSIS AND PROJECT COST PERFORMANCE REPORTS

#### WBS 1.1.3 R&D

##### Variance Analysis (Cumulative to date) (\$K)

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
5115.0	5115.0	5112.9	0.00	0.0%	2.1	0.0%

**Variance Statement:** Cum variances are within thresholds. No analysis required.  
No current period activity.

**Project Impact:** None.

**Corrective Action:** None.

#### WBS 1.5 Ring and Transfer Lines

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
66033.2	68307.3	69481.8	2274.08	3.4%	(1174.5)	-1.7%

**Variance Statement:** Cum variances are within thresholds. No analysis required.

The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and reliable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None

### 3.2 MILESTONE STATUS

WBS 1.5 and 1.1.3 have no level 0 milestones. Milestone status is listed below.

Milestones	Level 1	Level 2	Level 3	Level 4	Level 5
Project	0	1	3	13	125
FY03	0	0	0	0	7
Due in Next 30 days	0	0	0	0	1
Total Due at present	0	0	3	12	111
Made	0	0	3	12	100
Missed	0	0	0	0	11
Ahead of Schedule	0	0	0	0	0

### 3.3 PROJECT CRITICAL PATH ANALYSIS

The critical path item is Ring Diagnostics. The Ring Diagnostics schedule is presently being reworked, and a design review will be held at the end of March.

## II. Detail R&D Subproject Status

### WBS 1.1.3 – Ring System Development

All work covered by R&D funds is essentially complete.

#### Variance Analysis (Cumulative to date) (\$K)

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
5115.0	5115.0	5112.9	0.00	0.0%	2.1	0.0%

**Variance Statement:** Cum variances are within thresholds. No analysis required.  
No current period activity.

**Project Impact:** None.

**Corrective Action:** None.

### III. Detail Line Item Subproject Status

#### WBS 1.5.1 – HEBT Systems

Phone conferences continued with Tesla during the month on the HEBT/RTBT 21Q40 magnets. They are machining parts for the first six HEBT/RTBT 21Q40 magnets (Phase II), and provided a shipping date of “early April”. Actual BNL delivery would then be ~May 1 - we are waiting for a more detailed response. Tesla still believes they can build and deliver six magnets a month after that.

The stands for the 21Q40 and 27CD30 are being fabricated. ECN’s were implemented to reduce some of the manufacturing cost – they will be ready for shipping by the end of April. New England Technicoil will ship the first article 27CD30 corrector magnet in March.

The welding fixture for the 12cm chambers has been assembled and aligned by the survey group. The welding of the 12cm quadrupole chambers has begun with 8 standard chambers completed, leak checked and vacuum degassed. They are being prepared for shipment to SNS for integration into the magnets. Most 5” tubes for the fabrication of the drift pipes have been machined. Additional 5” bellows for diagnostic boxes were ordered and received. They are vacuum degassed and leak checked. Quotes for base and head castings for 12 cm drift pipe supports have been received and the order for the base has been placed.

Drawings of the HEBT momentum dump and shielding are being reviewed. Fabrication of the HEBT collimators is continuing. Outer shield arrangements have also been designed, and the drawings are complete. A pedestal to which the support jacks, and the lateral movement jacks will be attached has been designed and the drawings are complete.

#### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
6770.9	7398.9	6225.7	627.94	9.3%	1173.2	15.9%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None.

#### WBS 1.5.2 – Injection Systems

The production injection kicker assembly work is moving along in the bldg. 911B by the beam components group. The ECN to implement the vibration reducing wedge clamps was completed. A RFQ will be sent to shop for fabrication. A long duration full power test will be

performed on the first article magnet to check if there is any eddy current heating induced in the ceramic pipe. The TiN coating in the inside surface of the ceramic chamber is moving along in the vacuum lab. Some screening schemes were being tested with a Mylar film, which was placed in the ID of the pipe. The real coating will take place next month. Ceramic Magnetic Inc. has delivered most of the core ferrites for all of the magnets. The final delivery will be around 3/9/03. According to Ceramaseal, the delivery date for the long kicker ceramic chambers is two chambers on 3/25/03, and the rest (three) on 5/11/03. According to Macro-Metallics, the delivery date for the 4 short kicker ceramic chambers will be in the early April/03.

Long coil magnetic measurements of the chicane outfitted with an initial set of iron “z-bumps” have been completed. The results indicate that the required field uniformity has not been achieved. A second set of Z bumps was defined, fabricated, and installed. The magnet is ready for another set of measurements. New England Technicoil has machined the steel cores for the chicane #2 and #3 magnets. They are doing assembly and alignment work to achieve the required tolerances for the assembled magnet. The core for the extraction dump septum has been machined but one piece had to be returned to the sub-contract (Ranor) for machining because it was out of tolerance and could not meet the assembly tolerance. The bid package for chicane #1 was completed with approved drawings and specifications and sent to the purchasing department – it will be released the beginning of March.

**Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
4967.0	5728.6	5733.6	761.65	15.3%	(5.0)	-0.1%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None.

**WBS 1.5.3 – Magnet Systems**

The second half-cell was shipped and the third half-cell was being prepared for shipping at the end of the month. Fabrication of the rest of the dipole interconnect bus work was completed.

The last Phase I batch of 21Q40 magnets is being magnetically measured (total 28 of the 29 received have been measured). The measurement rate is now slightly higher than the rate planned for production measurements of these magnets. Performance of the system was hampered at the start of the month by occasional lockups of the data acquisition system. The faulty component has been replaced. Of those 28 magnets a total of 16 (2 strings with 8 magnets each) has been matched for the ring. As noted in the HEBT section we are awaiting shipment and delivery of the phase II quadrupoles to measure and identify the last string of 12 magnets.

The water fittings repairs have been completed.

Quite a bit of communication went back and forth with Stangenes Inc. over the out of tolerance components for the 26Q40. After reviewing their inspection data it was determined that they have enough steel for only 7 matched quadrupoles from the same steel batch + the 1<sup>st</sup> article magnet. We came to an agreement that they will not provide a spare magnet since it would be made from different steel. They will still provide spare coils. With this agreement, Stangenes will still have to re-machine the overall lengths of most of the pole pieces to bring them within specification. They have agreed to this.

The BINP held one phone conference during the month. Also a physicist from ORNL visited their facility. They have redefined their production schedule: shipment of 4 – 30Q58's and 1 – 30Q44's from their facility. Their photos and the visit confirmed that they are making progress but they have not provided a shipping date and they are still working on the ground transportation issue.

The 1<sup>st</sup> article 21S26 was received from Alpha, passed acceptance testing, and has been set up in the magnet measurement facility. So far the measurements look good. Alpha was given the go ahead to wind the production coils and to machine the outer rings for the cores. Fabrication of the 26S26 first article is under way. Machining of the magnet core steel is in process and the first coils have been wound. Delivery is expected in April.

NETC has reworked the 36CDM30 corrector magnet and will ship it again in March. As a check of the integrity of the measurement system, the previously measured 41CDM30 prototype was re-measured. The repeat measurements agreed with the original to  $1 \times 10^{-4}$ .

Alpha Magnetics has started winding the 41CDM30 poles. They expect to deliver the first two units in early March.

#### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
11636.4	11653.2	12824.2	16.84	0.1%	(1171.0)	-10.0%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None.

#### **WBS 1.5.4 – Power Supply Systems**

- The first RF Tuning PS was delivered to BNL, where it will undergo system testing.

- First article testing of the 5000A, 18V medium range power supply was completed at the vendor's facility, and the unit was shipped directly to ORNL. At ORNL, the unit is being set up both for further performance evaluation and as a power source for magnet testing.

**Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
1272.3	1024.5	1461.1	(247.83)	-19.5%	(436.6)	-42.6%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None.

**WBS 1.5.5 – Ring Vacuum System**

Modified pump tees for rf section doublet chambers have been ordered. The doublet chamber welding fixture is being fabricated at Central Shop. The layout of the collimation and extraction sections has been reviewed to identify design effort. Two more type-C halfcell chambers have been coated with TiN. Coating of the injection kicker ceramic chambers has started with several test runs to reduce the shadowing effect from 150% to ~ 10%.

The vacuum instrument block diagram, the rack layout, the PLC I/O assignment and the cable run list have been forwarded to the Project Office. Communication and data sharing between Ring PLC and the HEBT PLC via ControlNet have been successfully tested. The Hytec 485 serial driver has been wired to gauge controllers and ion pump controllers and is ready for testing.

The ETC effort for vacuum system has been completed and submitted. An abstract on the TiN coating and outgassing of the ring vacuum chambers was submitted to, and accepted by the 8<sup>th</sup> European Vacuum Conference.

**Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
5422.1	5712.9	5745.3	290.82	5.4%	(32.4)	-0.6%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None.

## **WBS 1.5.6 – RF System**

### SNS Ring High Level RF

- Tests of the second PA are complete;
- The final version of the anode PS came in and is being tested.
- Production of the cavities is on schedule.

### SNS Ring LLRF

- IQ demodulator daughter board was successfully tested.
- Preparations for the test of the cavity IQ control loop are underway with completion expected in March.
- An EPICS development system was setup in the LLRF development lab. Testing of the EPICS interface to the ring LLRF will begin in March.
- Preparations for March ASAC review underway.
- DSP code development continued.

### SNS accelerator physics

- Simulations of transverse instabilities with space charge tune spread indicate that the effect of this tune spread is quite small for smooth transverse beam profiles. More than 50 simulations, with varying numerical and physical parameters, were done in an attempt to numerically verify Figure 18 in Blaskiewicz, Furman Pivi and Macek PRSTAB, 6, 014203.
- For small resistive impedance and the largest space charge shown in the figure, the range of stable reactive impedance, from simulations, is only 1.3 times larger than with no space charge. The analytic curves in the Figure show an increase by a factor of 3.2.
- The implication is that a semi-quantitative understanding of the damping mechanism for the electron cloud instability in PSR is still lacking. On the bright side, if one naively scales from PSR to SNS the new results imply SNS will be more stable than the paper suggests.

### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
7946.2	8084.2	8404.8	137.96	1.7%	(320.5)	-4.0%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None.

## **WBS 1.5.7 – Ring Diagnostics**

### General:

- Preparations are underway for the ASAC Review the week of March 10th, and the upcoming design review the week of March 24th. BNL hosted a visit from ORNL Diagnostics on the 24th thru 26th of February. This visit was extremely productive. Many thanks to Tom Shea and our counterparts at ORNL. A high point of the visit was presentation of LabVIEW and EPICS templates by Wim Blokland. These provide a guide to program development that will help ensure that code written for Diagnostics applications will be more uniform in style and make maintenance and modifications easier after handoff. This material appears to be of great value to the BNL team.

### BPM:

- Recent welding problem with the recently delivered 12cm HEBT BPM PUEs has been resolved by removing the ceramic blanket on which the PUEs sit in the brazing furnace, and making a skin cut on the contaminated areas of brazed PUEs before welding. Continue to check the baseband prototype board. Investigating the possibility of relaxing first turn AP requirements to permit baseband system to meet the spec. Continue work on RF (400MHz) daughter card. Made S21 BPM measurements to study calibration techniques

### IPM:

- The performance of the IPM amplifiers has been specified and the requirements have been discussed with Instrumentation Division. We will require amplifiers with a transimpedance of 1V/300nA and a 5MHz bandwidth. They will have to survive for over a year in the 100kR/yr expected SNS environment. Detailed design of the transducer head is in progress, which will lead to a firm number for the magnet gap and permit the shop drawings for the magnet to be finalized. An experiment was performed at RHIC to test the radiation immunity of the new IPM design. A large transverse bump was placed in the beam upstream of the IPMs causing beam loss and downstream radiation spray of the IPMs. The old design with the MCP in the beampipe registered large backgrounds which made the detector unusable for profile measurement. However the new design, with the MCP in a radiation-shielded alcove, registered no radiation-induced background and continued to measure beam profiles during the entire test. In fact it accurately registered the beam size decreasing during the test caused by beam scraping against the beampipe. Additional testing with a vertical bump to bring the beam tail in proximity with the horizontal MCP will hopefully confirm the claim that the new design is extremely robust in the presence of beam loss. An analysis has started of the higher multipole components of the magnetic field of the IPM magnets. These results will be given to the beam optics people to evaluate the effect the magnets will have on beam aberrations.

### Electron Detectors:

- Work on electron detector continues. Preliminary drawings & sketches were submitted to the mechanical design room to generate final drawings of the modified (ANL) electron detector now being tested in RHIC. These drawings will be passed on to C. Deibele so he can simulate electro-magnetic response characteristics. Discussions continue with Controls on the details of the PC components to be used for this system. During a RHIC

study, (110 bunches, total intensity of  $82e9$  Au+79) we believe the first glimpse of electron cloud was seen, further studies are planned.

#### BLM:

- The initial tests of the 10 BLM ion chamber detectors from LND look good. We are in process of writing a sole source justification, required QA documents, and device specification to prepare for the purchase of all the detectors. A prototype blm detector endcap assembly has built & tested, successful holdoff to 5kV. Next we will optimize the design for cost and manufacturing convenience. Further tests on the first two channels of the AFE pcb were successful, we are now populating the remaining 6 channels. We submitted the requisition for all the remaining parts to populate all the required AFE modules. We have received the BLM AFE chassis parts from Rittal, and will begin building the first prototype chassis soon. The MPS comparator pcb, as well as the AFE backplane design continues. Construction of the AFE test stand, and AFE chassis also continues. Analog interface cables to feed the ICS110BL 24 bit digitizer were ordered. Controls continues to test the ISEG HV bias supply with EPIC's in the SNS VME environment.

#### BCM:

- Calibrator design efforts continue. Four AFE/digitizer circuit boards were received back from stuffing. Received all the raw material and the transformer spacer design for the HEBT BCM, which can prevent the connector on the transformer from touching the housing. Continued working on shop drawings.

#### Incoherent Tune:

- Detailed design of resonant dipole and quadrupole circuits continues. Beampipe/striplines assemblies have been fabricated and delivered to the diagnostics lab for application of this design work. Power amplifiers have been specified.

#### WS:

- Fabricating HEBT WS/BCM beam box and bellows assemblies. Working on integrating Ring WS beam boxes with the IPM vacuum chambers.

#### BIG/Coherent Tune:

- Investigation continues into gated photomultiplier solutions for the gap cleaner detector. Two phone conferences with Dr. Marcel Gaudreau & Dr. Floyd Arntz of Diversified Technologies resulted in clarification of the pulser specs. Received a quote from Tera Technologies (local rep for Lambda) on power supplies. Waiting for quote from Universal Voltronics. Received comments on pulser from an ORNL pulsed power specialist. Preliminary draft of system Acceptance Criteria generated.

#### Video Foil Monitor:

- A video synch board was ordered from Dage-MTI for testing in our system mock-up stand. A National Instruments image processing board NI-PCI-1409 and a development Dell PC were ordered for simulations and tests for framegrabbing and image analysis.

### Variance Analysis (Cumulative to date) (\$K)

<u>BCWS</u>	<u>BCWP</u>	<u>ACWP</u>	<u>SV</u>	<u>%</u>	<u>CV</u>	<u>%</u>
7716.1	7645.2	7596.0	(70.92)	-0.9%	49.2	0.6%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None.

### WBS 1.5.8 – Collimation and Shielding

- Work is continuing on the scrapers for the ring. The ring secondary and tertiary absorber drawings have been completed, with the exception of the flanges. In addition; configurations integrating the primary collimator with its outer shielding are being prepared and discussed.
- Drawings of the modified shield are complete. A review with project office staff was carried out, and the drawings are now in checking.

### Variance Analysis (Cumulative to date) (\$K)

<u>BCWS</u>	<u>BCWP</u>	<u>ACWP</u>	<u>SV</u>	<u>%</u>	<u>CV</u>	<u>%</u>
1911.8	1937.4	1812.0	25.6	1.3%	125.4	6.5%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None.

### WBS 1.5.9 – Extraction System

The checking of the down stream end kicker assembly is almost complete. The upper stream kicker drawings are being done in parallel and will be finished soon too. The prototype kicker magnet has been reassembled with CMD5005 ferrites and will be moved to Bld.930 for full power test. The ECN to implement the PFN modifications is almost complete. ORNL engineers requested these modifications during the 1/17/03 design review that was held at APS. This ECN

includes adding casters to the PFN tank. A lifting fixture to lift the upper PFN subassembly for maintenance is being designed. Ken Rust of ORNL requests this fixture. This fixture will have a minimum height and adjustable lifting point for lifting from true gravity center of the upper subassembly.

Fabrication of the first jumper bus for the ELS coils is underway. This piece is used both to test fabrication procedures and, with success, will act as first article. ORNL has changed the lambertson magnet bus connection method from water-cooled bus to multiple cables. A design of the cable flags for jumper terminations was sent to ORNL for review and approved by them. A PCR still needs to be generated by ORNL to identify which special magnets will now be fed by cables instead of water-cooled bus. This change could involve putting cable terminations on eight different high current injection/extraction magnets. The number of cables to be terminated on each magnet type needs to be identified as well by ORNL.

**Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
1929.6	2186.7	2558.4	257.13	13.3%	(371.6)	-17.0%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None

**Corrective Action:** None.

**WBS 1.5.10 – RTBT System**

The first 36Q85 radiation resistant quadrupole coil has been successfully wound and fit-tested into the magnet core. After winding, the coil fixture was sent back to the shops for some modifications that will quicken the winding process. The 36Q85 cores from Ranor are being dimensionally inspected by survey on a low priority. So far so good.

Two shipments of 8” bellows were received and are being leak checked. The 1<sup>st</sup> article pipe stand base casting was also received. The extraction region including the Lambertson magnet chamber and the kicker-to-Lambertson drift pipe was reviewed, and resulted with additional bellows upstream of the Lambertson and a 14” diameter drift pipe. Chambers for RTBT QV13 and the 16.8° dipole magnet are being revised due to the 3mm shift of the target window location.

The as built drawings for the RTBT collimator are complete. The drawings for the remaining RTBT collimator have been completed, and the fabrication of the unit has started.

## Variance Analysis (Cumulative to date) (\$K)

<u>BCWS</u>	<u>BCWP</u>	<u>ACWP</u>	<u>SV</u>	<u>%</u>	<u>CV</u>	<u>%</u>
3341.8	3816.6	4047.1	474.87	14.2%	(230.5)	-6.0%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None.

### WBS 1.5.12 – Technical Support

- ETC was completed and presented to ORNL via videoconference. At the same video conference, agreement was reached on several pending PCRs, the incorporation of which would allow BNL to have a blank Risk Contingency Summary at the DOE Review in May.
- Prof. H. Okamoto from Hiroshima University, Prof. R. Gluckstern from University of Maryland, and Dr. J. Xia from Institute of Modern Physics, China, visited. Worked with Gluckstern and Okamoto on space-charge induced resonances of collective beam modes.
- A single-ellipse geometry, instead of double-ellipse geometry, was chosen for the ring secondary collimator to ease maintenance and to reduce construction cost. Calculations were made to assess reduced collimation efficiency (negligible) and increased radiation dose at downstream corrector (about 25%).
- Ring quadrupole magnets (21Q40) were sorted into two families according to their integral transfer functions for the ring.
- Completed studies on Landau damping of coherent instability with octupoles.
- Nonlinear resonance correction study with the space charge continues.
- Implemented the mechanism for integrating JFreeChart-based graphics for visualization of simulation results (such as mountain range plot, scattering plots, and various diagnostics displays) completed for UAL.
- Added to the UAL the Doxygen-based specification of the Standard Exchange Format (SXF) parser to facilitate its upgrade developed by Ray Filler from the BNL/CAD department.

### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
13118.3	13118.3	13072.9	0.00	0.0%	45.3	0.3%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None.

### **WBS 1.9.5.1 – Ring Controls Integration**

A new estimate to complete (ETC) was performed for the BNL contribution to the SNS controls effort (WBS 1.9.5) and submitted to ORNL project controls.

### **WBS 1.9.5.2 – Power Supply Controls**

Work continues on improving the EPICS support for the ethernet based LeCroy oscilloscopes used to measure extraction “kicker” magnet waveforms. Waveform records are now processed asynchronously to avoid “blocking” other EPICS record processing, and the driver has been enhanced to address various network failure modes. More fault testing is planned, and non-waveform oscilloscope records will be made asynchronous as well.

The PSC/PSI EPICS databases have been imported in VDCT (the standard visual database configuration tool for SNS). The PSC/PSI databases had previously been developed using the schematic capture program CAPFAST. With this migration to VDCT, BNL no longer has any dependency on CAPFAST.

Configuration and installation documentation is under development in anticipation of installation of PS racks and IOCs in HEBT, Ring, and RTBT service buildings.

### **WBS 1.9.5.3 – Diagnostics**

Much attention is being paid to the BLM system, in light the first use of the system for DTL commissioning currently scheduled for May. The remaining software development is expected to be completed this month, and integration and documentation efforts are expected to be completed by May 1 in time to ship the first prototype system to ORNL.

EPICS sequencer software is under development to poll each channel of each BLM “AFE module” for configuration and identification information, and make that information available via EPICS PVs.

To reduce CPU loading, and increase data throughput on the VMEbus, the software for the ICS-110B digitizer is being redesigned to use direct memory transfer (DMA). The new design will be benchmarked against the previous design, and against system requirements.

The BLM system will use high voltage power supplies, provided by ISEG, to bias the detectors. The same units will also be used for the neutron detectors. Two spare RHIC units were tested using EPICS software and control screens from SLAC. Initially the ISEG modules failed to work correctly. The fault was traced to an incompatibility with the VMEbus auto-configuration scheme used in the Dawn VMEbus crates we use for development and test. When the ISEG modules were tested in the Wiener crates that will be used for operational BLM systems, the ISEG modules worked perfectly. The SLAC control screens are being converted from the display manager used at SLAC (MEDM) to the SNS standard (EDM).

#### **WBS 1.9.5.4 – Vacuum**

The Gauge Controller and Ion Pump Controller serial interfaces are being ported to Hytec RS-485 hardware (the SNS standard for RS-485 communications). Efforts to produce EPICS databases and control screens for these devices are being shared between BNL, LANL, and ORNL.

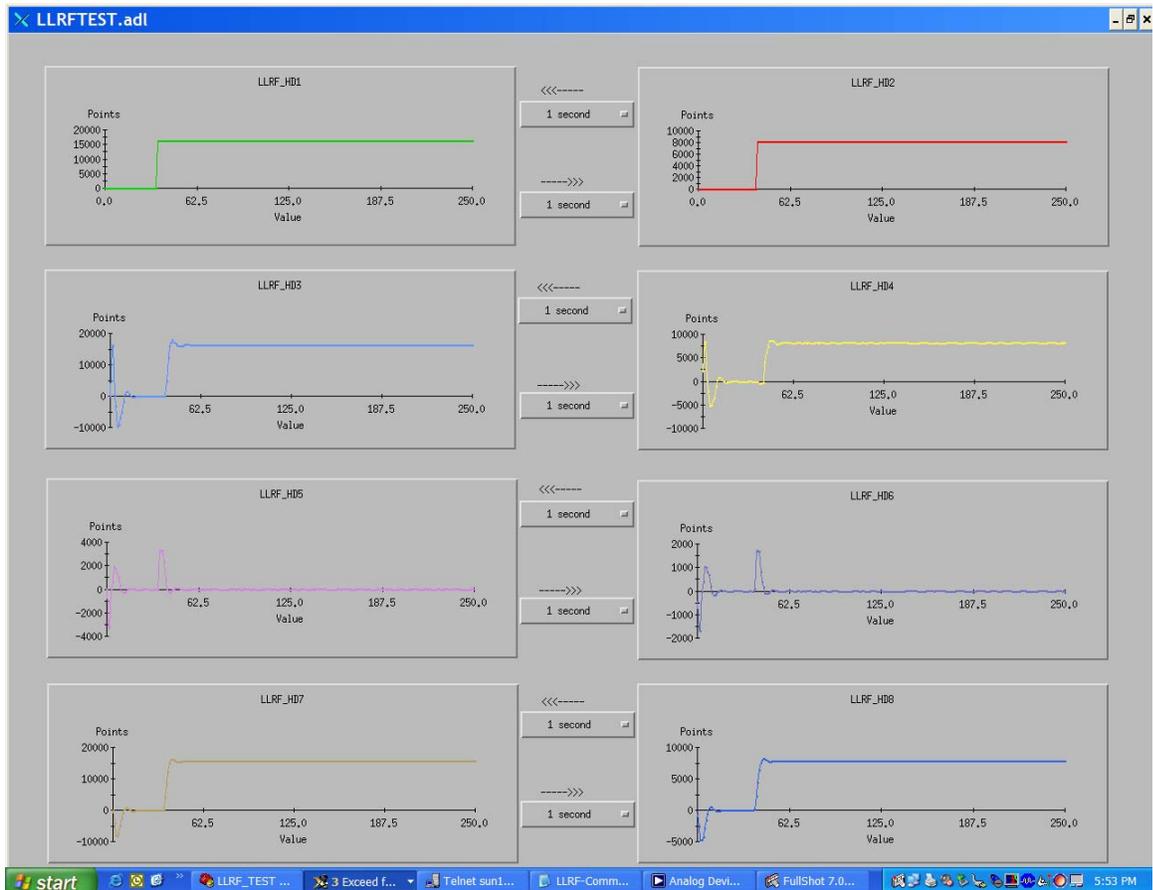
The ControlNet interface between the HEBT PLC and Ring PLC has been configured and demonstrated to share data between the valve control logic in those PLCs.

#### **WBS 1.9.5.5 – Applications Software**

First version of user documentation for the Alarm Handler Configuration Tool was completed and sent to ORNL. The Alarm Handler Configuration Tool has undergone some revision at BNL since it was installed at ORNL. The source code is being checked into ORNL CVS so that these revisions can be shared with ORNL.

#### **WBS 1.9.5.6 – RF**

The Ring low-level RF DSP system has been interfaced with EPICS. Waveforms that have been configured using the “llrfConfig” application can now be downloaded through the IOC to the LLRF system, as can the DSP application itself. The real-time response of the DSP system can be displayed on MEDM screens. Attached is one such screen.



**Variance Analysis (Cumulative to date) (\$K)**

BCWS	BCWP	ACWP	SV	%	CV	%
5250.0	7668.1	4712.6	2418.09	46.1%	2955.5	38.5%

**Variance Statement:** The February cumulative and current period variances reflect changes made to implement the PCR RI03007, Estimate to Complete. Changes to percent complete and activity closure have biased BCWS and BCWP for this period only. PCR RI03007 will be fully implemented for the March CPR and relatable performance variances will be reported.

**Project Impact:** None.

**Corrective Action:** None.

**IV. Earned Value Reports and Charts**

**U.S. DEPARTMENT OF ENERGY  
COST PERFORMANCE REPORT - WORK BREAKDOWN STRUCTURE (FORMAT 1)**

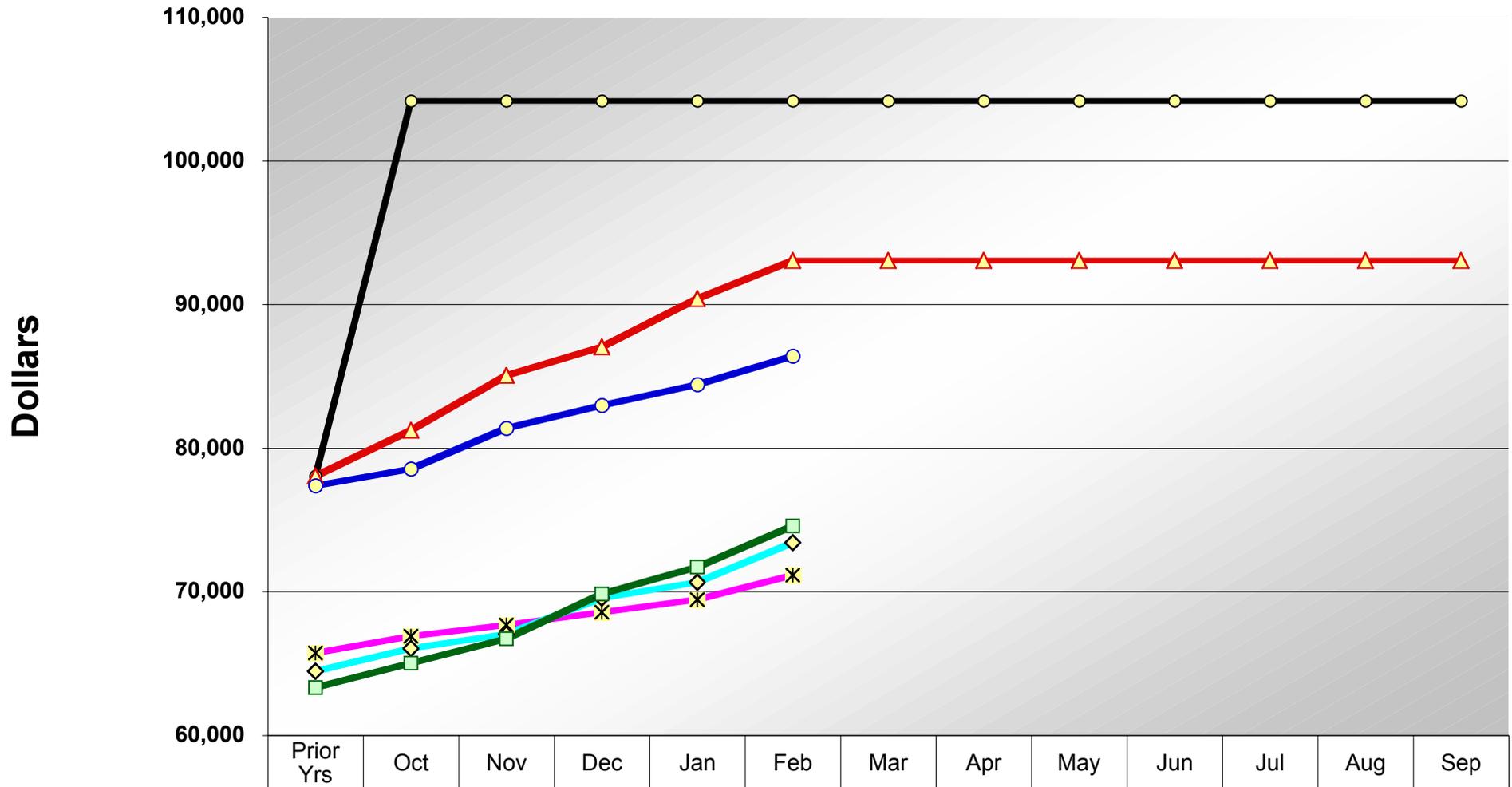
<b>PROJECT TITLE:</b> SPALLATION NEUTRON SOURCE	<b>REPORTING PERIOD:</b> 1-Feb-03 thru 28-Feb-03	<b>PROJECT NUMBER:</b> 99-E-334
		<b>START DATE:</b> October 1998
<b>PARTICIPANT NAME AND ADDRESS:</b> Brookhaven National Laboratory Brookhaven, NY	<b>BCWS PLAN DATE:</b> October 1999	<b>COMPLETION DATE:</b> November 2006

WORK BREAKDOWN STRUCTURE	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
	Budgeted Cost		Actual Cost of Work Performed	Variance		Budgeted Cost		Actual Cost of Work Performed	Variance		Budgeted	Revised Estimate	Variance
	Work Scheduled	Work Performed		Schedule	Cost	Work Scheduled	Work Performed		Schedule	Cost			
1.1.3 Rings System Development	0.0	0.0	0.0	0.0	0.0	5,115.0	5,115.0	5,112.9	0.0	2.1	5,115	5,115	0.0
1.5 Ring & Transfer Line System	1,684.1	2,771.1	2,864.5	1,087.1	(93.4)	66,033.2	68,307.3	69,481.8	2,274.1	(1,174.5)	112,153	112,153	0.0
1.5.1 HEBT (High Energy Beam Transport) Systems	913.9	79.9	146.2	(834.0)	(66.3)	6,770.9	7,398.9	6,225.7	627.9	1,173.2	9,862	9,862	0.0
1.5.2 Injection Systems	51.3	354.8	239.4	303.5	115.4	4,967.0	5,728.6	5,733.6	761.7	(5.0)	9,316	9,316	0.0
1.5.3 Magnet Systems	122.0	331.2	700.5	209.2	(369.3)	11,636.4	11,653.2	12,824.2	16.8	(1,171.0)	16,899	16,899	0.0
1.5.4 Power Supply System	10.6	(63.6)	129.0	(74.1)	(192.6)	1,272.3	1,024.5	1,461.1	(247.8)	(436.6)	3,741	3,741	0.0
1.5.5 Vacuum System	60.8	358.2	137.2	297.4	221.0	5,422.1	5,712.9	5,745.3	290.8	(32.4)	9,708	9,708	0.0
1.5.6 RF System	124.8	446.0	455.4	321.2	(9.4)	7,946.2	8,084.2	8,404.8	138.0	(320.5)	11,902	11,902	0.0
1.5.7 Ring Systems Diagnostic Instrumentation	113.2	377.6	272.7	264.4	104.9	7,716.1	7,645.2	7,596.0	(70.9)	49.2	13,527	13,527	0.0
1.5.8 Collimation and Shielding	23.2	153.9	38.3	130.7	115.5	1,911.8	1,937.4	1,812.0	25.6	125.4	3,441	3,441	0.0
1.5.9 Extraction System	44.4	160.2	406.1	115.8	(245.9)	1,929.6	2,186.7	2,558.4	257.1	(371.6)	6,139	6,139	0.0
1.5.10 RTBT (Ring to Target Beam Transport) System	55.6	408.7	119.8	353.1	288.9	3,341.8	3,816.6	4,047.1	474.9	(230.5)	7,258	7,258	0.0
1.5.11 Cable	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.0	0.0	0.7	0.7	0.0
1.5.12 Technical Support	164.2	164.2	219.8	0.0	(55.6)	13,118.3	13,118.3	13,072.9	0.0	45.3	20,360	20,360	0.0
<b>WBS SUBTOTAL</b>	<b>1,684.1</b>	<b>2,771.1</b>	<b>2,864.5</b>	<b>1,087.1</b>	<b>(93.4)</b>	<b>71,148.2</b>	<b>73,422.3</b>	<b>74,594.7</b>	<b>2,274.1</b>	<b>(1,172.5)</b>	<b>117,268</b>		
<b>UNDISTRIBUTED BUDGET</b>													
<b>SUBTOTAL</b>	<b>1,684.1</b>		<b>2,864.5</b>			<b>71,148.2</b>		<b>74,594.7</b>			<b>117,268</b>		
<b>MANAGEMENT RESERVE</b>													
<b>TOTAL</b>	<b>1,684.1</b>		<b>2,864.5</b>			<b>71,148.2</b>		<b>74,594.7</b>			<b>117,268</b>		

RECONCILIATION TO CONTRACT BUDGET BASE

<b>DOLLARS EXPRESSED IN:</b> THOUSANDS	<b>SIGNATURE OF PARTICIPANT'S PROJECT DIRECTOR:</b> Jie Wei	<b>DATE:</b> March 19, 2003
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## 1.5 & 1.1.3 Performance Measurement Chart



**Months**