



**Brookhaven National Laboratory**

**SNS**

**Ring and Transfer Lines Systems**

**JANUARY**

**MONTHLY REPORT**

01 January – 31 January 2002

Performing Organization:  
Location:

Brookhaven Science Associates  
Brookhaven National Laboratory  
Upton, New York 11973-5000

Contract Period:

October 1998 – June 2006

Brookhaven National Laboratory  
SNS MONTHLY PROGRESS REPORT  
January 2002  
Ring and Transfer Lines Systems

**I. Senior Team Leader Assessment**

**1. TECHNICAL PROGRESS AND ACCOMPLISHMENTS**

- The first article RF station for the ring system showed good performance on resonance frequency, accelerating voltage which exceeding design goal. A dynamic tuning loop is installed to keep gap voltage constant during injection period. Without tuning, the gap voltage suffers more than 30% droop to the end of the cycle. Production for another three units will begin after full power, full operates and life time test.
- The first article extraction kicker reached design rise time of about 200 nsec after tuning and will be subjected to full power test when the oil cooling tank is complete.
- The ring dipole magnets showed one thousandth of variation after 10 magnets. This is due to the design change from original laminated core to solid core recommended by the project office during 1999 cost cutting exercise. The orbit correction magnets provided to reduce orbit error to less than 0.3 mm. BNL can compensate this deviation and ORNL physicists and engineers are working on methods to reduce such variation.
- The high field power supply system design is near completion. The project office will review it before RFP is distributed to industrial vendors. The schedule calls for complete delivery of the system to ORNL in the fall of 2003.
- T. Shea of SNS visited BNL to assist on the beam testing of the laser profile monitor at the 200 MeV linac of the AGS. The test was performed with both proton and polarized proton beams. Test was interrupted by the power supply failure of the laser system. Tom also assisted on the electronic design of the BCM system for the front end.
- D. Gurd of the SNS visited BNL to review the software interface of the timing system. He was very happy about the progress. Further review on the high level system application is scheduled to be in April.
- BNL produced the BA requirement for FY 2003 to 2006, which will be integrated into the SNS plan for the remaining period of the SNS project. BNL also produced the quarterly milestone plan for the second quarter of FY 2002, which will be used to monitor the progress of ring construction.

- BNL staff worked on the presentation material for the ASAC review. Dry run is scheduled for Feb. 4th and the submission of the presentation to SNS is due on Feb. 6th.
- BNL STL, W. T. Weng will step down on March 1st and J. Wei will assume the new STL position for BNL. Both SNS and BNL management have approved this arrangement. The transition is smooth due to the two-month overlap of the STL function between them.

## **2. ISSUES AND ACTIONS**

- None.

### 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)

<u>BCWS</u>	<u>BCWP</u>	<u>ACWP</u>	<u>SV</u>	<u>%</u>	<u>CV</u>	<u>%</u>
5053.5	5053.5	5039.5	0.00	0.0%	13.9	0.3%

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

Current period CV of \$7.4K (95.6%) is driven by WBS 1.1.3.3, RF & Diagnostics whereas actual costs were less than performed.

**Project Impact:** None.

**Corrective Action:** None.

##### WBS 1.5 Ring and Transfer Lines

<u>BCWS</u>	<u>BCWP</u>	<u>ACWP</u>	<u>SV</u>	<u>%</u>	<u>CV</u>	<u>%</u>
42563.2	43552.9	42721.8	989.7	2.3%	831.1	1.9%

**Variance Statement:** Variances are within thresholds. No analysis required.

**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	129
FY02	0	0	0	0	27
Due in Next 30 days	0	0	0	0	1
Total Due at present	0	0	3	12	94
Made	0	0	3	11	86
Missed	0	0	0	1	8
Ahead of Schedule	0	0	0	0	0

### 3.3 PROJECT CRITICAL PATH ANALYSIS

The critical path items for the Ring are the Ring Sextupole magnet, followed by the BCM.

## II. Detail R&D Subproject Status

### WBS 1.1.3 – Ring System Development

All work covered by R&D funds is essentially complete except for some material commitments.

#### 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>
5053.5	5053.5	5039.5	0.00	0.0%	13.9	0.3%

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

Current period CV of \$7.4K (95.6%) is driven by WBS 1.1.3.3, RF & Diagnostics whereas actual costs were less than performed.

**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 dipole magnet. Tesla has started fabrication of the second magnet. They expect to ship it on or before 3/8/02. The position of the magnet in the lattice has been shifted slightly by the Physics group. This will require a redesign of the vacuum chamber-mounting bracket. The vacuum group is doing the redesign.

Phone conferences continued with Danfysik during the month. Danfysik is machining the 12Q45 quadrupole magnet core and has wound the coils. The 16CD20 corrector coils have been wound and potted and are ready for testing. They are holding to their 2/15/02 shipping date to ORNL for both magnets.

Six standard dipole chambers have been packaged and shipped to SNS with the expected arrival in early February. All 12 cm inconel bellows drawings have been released, the RFQ package generated and sent to vendors for bid. The detailed layouts of 12cm HEBT vacuum chambers/pipes were reviewed and will be revised when designer is available. Central Shops has completed the final machining of the 21 cm pseudo bpm flanges and 21 cm quadrupole beam pipe spool pieces. Delivery and inspection of various size CeFiX flanges and seals continue. Problems continue to exist with the aluminum and copper seals.

Drawings for the truncated HEBT line collimators are being prepared. Conceptual drawings of the HEBT momentum dump are also being prepared.

#### **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>
3722.5	3702.6	3608.1	(19.9)	-0.5%	94.5	2.6%

**Variance Statement:** Variances are within thresholds. No analysis required.

**Project Impact:** None.

**Corrective Action:** None.

#### WBS 1.5.2 – Injection Systems

The drawings for the two C magnets for the foil mechanism area have been completed and submitted to checking. A design review was held with Project Office representatives and the design team. There were no major issues on the magnet. A second meeting was held with Project Office representatives on the injection foil vacuum chamber. The beam spot parameters have been revised after a review by ORNL Physics. They indicate a much tighter (smaller) electron beam spot that would melt the water-cooled copper heat sink used in the present design.

Carbon/Carbon absorbers are now being considered. An engineer will start a time step analysis to determine the heating of the carbon/carbon over the injection time period and repetition rate.

The fabrication of the injection septum magnet components continues. Most of the parts except the vacuum chamber and bus bars have been fabricated. The assembly should begin next month.

The redesign of the dump septum magnet continues. The drawings will be ready for checking next month.

A PCR for the spare injection septum magnet and spare coils for the last chicane magnet awaits approval by the project office.

The injection foil mechanism still awaits the delivery of the rotary feedthroughs. The base support plate fabrication has been approved. The design of the dump stripping foil mechanism has been completed and will be turned over to the design room next month.

The fabrication of components for the two first article long injection kicker magnets (horizontal and vertical) is complete. All of the Ferrites have now been delivered and have passed inspection. Assembly of the first core assembly has begun. Everson Electric has delivered the first article coils and jumpers. The coils were successfully, high potted, rung, and hydraulically tested. Some minor dimensions were out of tolerances but the coils were successfully fit into the core and the bus jumpers were installed. Ceramaseal still has a delivery date of 2/26/02 for the ceramic chambers. The revised short injection kicker design work is nearly complete. The drawings should be released to checking next month.

#### **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>
3055.3	3229.0	3276.7	173.7	5.7%	(47.7)	-1.48%

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

Current period cost variance (CV) -\$77.1K (-48.7%) is driven by the material cost of Pulsed Magnets, WBS 1.5.2.1 whereas actual costs have been expensed against performance.

**Project Impact:** None.

**Corrective Action:** None.

#### **WBS 1.5.3 – Magnet Systems**

The twelfth ring dipole (17D120) is on the measuring stand. As is now well known two of the magnets have integrated fields that vary beyond the original design parameters. The accuracy of the measurements was checked in two ways. Previous measurements of one dipole were checked by measuring it a second time. One magnet was measured with reversed polarity. Also,

NMR measurements at the center of the magnet have been added to the production measurement plan.

Many solutions have been suggested but the goal is to measure all of the magnets ASAP to get a complete picture of the problem and possible solutions. The re-measurements and re-checks have delayed the magnetic measurements schedule further. The plan is now to complete the measurements by the end of April and determine a solution after a review of the results. Five new ring dipoles were measured.

The measurement schedule was slowed by other factors during the month:

- Scheduled maintenance of the cooling tower (at the start of the month) and a search for a ground fault in the cooling system.
- Recalibration of the field angle of the rotating coil. (The sequence of measurements across the magnet gap was changed to reduce the frequency of this in the future.)
- Replacement of an SCR in the power supply. (Efforts are underway to increase the MTBF of the power supply.)

Phone conferences continued with Tesla during the month on the 21Q40 quadrupole magnet. Fabrication of the next four magnets continues with shipment scheduled now for the middle of February.

Design of the fixtures that will hold the remaining ring magnets in the magnetic measurement facility continued. BNL Central Shops continued work on the two measuring coil forms needed for the larger aperture magnets.

Detailed design of the 1/2 cell assembly continues. Four of the cell assembly types have been submitted for checking. The 1/2 cell-lifting fixture for the ring is being fabricated.

Danfysik shipped the first production group of seven 27CDM30 correctors on 1/31/02. They continue to work on the production of the rest of the magnets.

The first article 21CO26 octopole corrector magnets acceptance testing was completed. The poles and the measuring coil were carefully aligned by the survey group and it was found that the magnetic center and the mechanical center match. New England Technicoil has been given permission to proceed with production. New England Technicoil has begun reworking the first article 21CS26 sextupole corrector magnet that was returned to them because it was out of tolerance.

Shipping of first article 26Q40 quadrupole has slipped to February 15, 2002. A visit was made to Stangenes and their subcontractor Quest during the month (ORNL personnel opted not to attend). The magnet core has been assembled, dowelled, and painted. Stangenes is currently installing the coils and fabricating the interconnect buss work / power leads.

Two phone conferences were held with Budker Institute of Nuclear Physics (BINP). At the end of the month they provided a production schedule but it was for the first article only. It did not

include the production magnets. We have requested that information. A 1 inch thick sample pole piece was provided that looked very good but it was out of tolerance – BINP is reviewing the results. A large effort was expended in paying SGS Vostok, Ltd. for their inspection and surveillance services that were discussed in last month’s report. This effort is ongoing as they are having difficulty understanding our system of invoice and payment. We also await documentation on the annealing of the steel used for the quadrupoles.

The bids for the 41CDM30 were received. Alpha Magnetics was the low bidder. A pre-award survey was made as part of the visit to Stangenes and Quest (ORNL personnel opted not to attend). The purchase was placed with Alpha.

A design review was held on the 36CDM30 corrector magnet with ORNL Project Office Representatives. There were no open issues. The drawings have been submitted for checking and the requisition is being prepared.

The detailed design of the 21S26 high field sextupole has been completed and the drawings have been submitted for checking. Preliminary design has started on the 26S26 high field sextupole.

PCR’s for spare magnets and to update costs as a result of actual contract prices await approval by the Project Office.

The BNL/SNS magnet parameter list being updated to include the latest design and physics information. All four levels of magnet development (designer, engineer, magnetic field analysis, and physics parameters) are being reviewed and compared for correct information. The lattice drawing is being updated again to incorporate the latest information from ORNL physics and survey and the revised dipole magnet offsets. There are some errors that are being worked on with 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>
8102.5	8018.1	8045.1	(84.4)	-1.0%	(27.0)	-0.3%

**Variance Statement:** Variances are within thresholds. No analysis required.

Current period cost variance (CV) -\$44.2K (-26.8%) is driven by the material cost of High Field Magnets, WBS 1.5.3.1 whereas actual costs have been expensed against performance.

**Project Impact:** None.

**Corrective Action:** None.

**WBS 1.5.4 – Power Supply Systems**

A lot was accomplished during January in the area of power supply controls. The last of the known bugs were gotten out of the hardware, and a software design review was held. Part of the documentation distributed at that meeting was the final ICD for power supply controls.

PSIs and PSCs are being shipped to ORNL. Requests for units by our power supply vendors are being fulfilled by ORNL. Vendor use of the PSIs and PSCs is going very well. Danfysik is setting up a second test station.

A design report on the medium range power supplies was received in preparation for the design review at the vendor's facility to take place on February 12.

An additional circuit, named the regeneration circuit, is being added to the injection bump power supply. This will improve the low current performance by raising the duty cycle lower limit of the pulse width modulation circuit. Tests of this circuit will also be viewed during the vendor visit for medium range supplies.

The vendor of the low field corrector power supplies has reported successful testing of the power supplies in a parallel configuration. First article inspection is on schedule for February 27.

The extraction kicker went through successful testing in air during January. Testing in it's insulating fluid will be done through February. In addition, selection of a production vendor will start in February.

The process of determining spares and writing PCRs for their purchase has begun, and will continue for several months.

**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>
853.3	853.4	852.7	0.1	0.0%	0.7	0.1%

**Variance Statement:** Variances are within thresholds. No analysis required.

**Project Impact:** None.

**Corrective Action:** None.

**WBS 1.5.5 – Ring Vacuum System**

Nine type-A halfcell (HC) chambers have been welded, leak checked and vacuum baked. The welding fixture will be set up for type-B HC chambers. The bellows for all the remaining chambers have flanges welded. Twenty-four dipole chambers were received and the remaining 9 have been shipped. The injection straight section (SS) doublet vacuum chambers have been detailed and the drawings submitted for checking. The available beam envelopes were forwarded to AP for final verification. The RF SS vacuum chambers are in the design stage. The beam pipe aperture and loss issues for Collimator SS were discussed in AP meetings.

Five HC chambers have been successfully coated with TiN. Pump down and outgassing measurements of the uncoated and coated HC chambers continue. Gauge controller order was placed early this month; with 1<sup>st</sup> articles due by end early Feb. Bids for turbopump carts were received and reviewed; and an order issued to Varian, the low bidder, for a first article, due at BNL in mid March. Vacuum and control interface issues and work planning were reviewed and PLC interface hardware was ordered to set up the HEBT control test bed. Two abstracts, one on the ring pressure simulation and the other on the coating of ceramic chambers, were submitted to EPAC2002.

**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>
3207.6	3329.4	3220.0	121.8	3.8%	109.4	3.3%

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

Current period cost variance (CV) -\$46.1K (-28.0%) is driven by the material cost of Ring Vacuum Pumps, WBS 1.5.5.2 whereas actual costs have been expensed against performance.

**Project Impact:** None.

**Corrective Action:** None.

**WBS 1.5.6 – RF System**

- For low level RF, the DSP evaluation hardware is on order.
- Evaluation of the LLRF DDS (synthesizer) hardware and high speed, high dynamic range ADC hardware is in process. Code simulation and development continues for the cavity I&Q feedback loop.
- Specification of the LLRF GUI is under development. Initial LLRF ICD to be completed by mid February.
- For high level RF, tests of dynamic tuning continued.
- Accelerator physics: Studies of the electron-proton instability continued.

**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>
4684.0	5500.4	4853.4	816.4	17.4%	647.0	11.8%

**Variance Statement:** Cum schedule variance (SV) of \$816.4K (17.4%) is driven by 1.5.6.1 High level RF Sys. and early delivery of material for RF Cavities, Amplifiers and High Voltage Power Supply. Cum cost variance (CV) of \$647K (11.8%) is driven by 1.5.6.1 High level RF Systems material deliveries whereas actual costs have not been expensed. Current period SV of \$190.1K (104.5%) is driven by 1.5.6.1 material deliveries, as in cum SV. Current period CV of \$230.4K (61.9%) is driven by 1.5.6.1 material deliveries whereas actual costs have not been expensed, as in cum CV.

**Project Impact:** None.

**Corrective Action:** None.

### **WBS 1.5.7 – Ring Diagnostics**

- Abstracts were submitted to EPAC for the BLM, BCM, Tune, and Laser Wire systems.
- Delivery of Ring 21cm BPM PUEs to the Vacuum Group continues, with a total of 20 so far complete. Work continues on the Ring AFE design.
- Parts for the ‘Optical IPM’ prototype were received, and assembly is in progress. The prototype will be installed in the AGS Linac, downstream from the 200MeV Laser Wire experiment.
- The BLM prototype fast ion chamber drawings were completed. The shops fabricated parts, and mechanical assembly is nearly complete. The second generation AFE layout was completed, board fab is in progress, and assembly of the parts kit for stuffing is underway.
- Vertical integration of the BCM system from data acquisition thru LabVIEW processing to display in EPICS was completed. This is the first diagnostics system to complete vertical integration. BCM IFE is ready for shipping to LBNL. Problems with implementing multi-channel acquisition on the PCI card have been resolved. A second generation AFE PC board is in review.
- Efforts to model Beam Transfer Function measurements during the Ring accumulation cycle are underway. Possibility of sharing Tune hardware with Beam-in-Gap system to facilitate the ‘banana bunch’ and reduce the effect of extraction kicker impedance is being investigated.
- Five carbon wire scanners were delivered to LBNL. MEBT carbon wire scanners are now complete. The prototype scanner was shipped from LBNL to LANL for electrical testing.
- Laser wire profile measurements at 200MeV were accomplished with the 100uA polarized beam, confirming that the method is easily sensitive enough for the 15ma beams expected during SNS commissioning. Measurements with the 10ma beam from the unpolarized magnetron source were hampered by large amplitude variations with a

bandwidth of tens of MHz. Efforts to improve amplitude and phase matching are underway. The 50mJ laser installed in the BLIP line for radiation resistance measurements failed during the first weekend. The failure was not radiation-related, but rather due to cheap power supplies. A Big Sky rep flew in to repair the unit and promptly broke our spare. We are now trying to get a system running for the MEBT commissioning.

- The possibility of removing the laser and power supply/controller from the tunnel and piping in the photons via optical fiber is being investigated. This approach opens many doors, including the possibility of using a mode-locked laser.

**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>
4727.6	4693.7	4930.5	(33.9)	-0.7%	(236.8)	-5.0%

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

Current period SV of -\$52.9K (-37.5%) is driven by a belated 1.5.7.6 Wire Scanner Design. Current period CV of -\$185.6K (-210.5%) is driven by material costs for WBS 1.5.7.3, Beam Loss Monitors; and labor costs for 1.5.7.6 Wire Scanner Design.

**Project Impact:** None.

**Corrective Action:** None.

**WBS 1.5.8 – Collimation and Shielding**

- The final scraper drawings are complete. A work order for the BNL shop is being prepared.
- Drawings of the modified shield are being prepared. A modified bearing system for the moveable arms is being investigated.

**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>
1303.3	1305.9	1296.7	2.6	0.2%	9.2	0.7%

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

Current period schedule variance (SV) \$31.9K (92.3%) and CV \$34.3K (48.6%) are labor performance driven by 1.5.8.1, Collimation and Shielding; whereas design and assy out performed BCWS.

**Project Impact:** None.

**Corrective Action:** None.

### **WBS 1.5.9 – Extraction System**

Ceramic Magnetics has provided a delivery date for the low mu ferrite of 4-5-02. The PFN Assembly work was completed and real power testing at full voltage and repetition rate is in progress. Based on assembly and tests the design of PFN tank and top flange were revised to cut down the cost of fabrication. Modifications made on PFN assembly were documented and detailed revisions to the drawings will start soon.

#### **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>
1184.8	1188.9	1170.7	4.1	0.3%	18.2	1.5%

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

Current period CV of \$29.9K (40.6%) is driven by WBS 1.5.9.3, Lambertson Septum Magnets; whereas actual costs were less than performed.

**Project Impact:** None

**Corrective Action:** None.

### **WBS 1.5.10 – RTBT System**

RTBT vacuum layouts, including details of the various magnet vacuum chambers/drift spools and locations of diagnostics equipments were reviewed. A designer is available, on part-time basis, at the end of month to detail the changes. The Linac and Extraction dump window design was reviewed during a PO visit.

The layout and detailed drawings for the 36Q80 magnet core are 90% complete. A design review was held with ORNL Project Office Representatives. There were no open issues on the design. There are still concerns about the interface with conventional facilities and the target group for installation of these magnets. A trip to SNS 2/18 to 2/20 to review integration issues in RTBT-Target Bldg area is being planned by S. Henderson. C. Pearson will attend. The PCR for the radiation resistant mineral insulated coil material was approved. Coil material was ordered for the 1<sup>st</sup> article quadrupole. The insulators were also ordered. Contact was made with a Russian laboratory that has similar material in a smaller size. It would require some redesign and a cost for the material has not been provided yet.

The magnet cores for the radiation resistant dipole corrector magnets have been completed. The coil tooling for the 36CD30 has been fabricated as well. Assembly of the tooling and possible winding of a sample coil will begin next month.

Update of the transfer line equipment list is underway. The size and number of vacuum chambers for the various magnets is being defined.

The manufacture process for the first article is on schedule. The collimator tube is currently being backed out. The final drawings of the inner collimator box are complete. The final drawings of the second RTBT collimator are being carried out.

#### **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>
1953.5	1962.6	1812.4	9.1	0.5%	150.3	7.7%

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

Current period CV \$44.1K (43.5%) is driven by WBDS 1.5.10.1 RTBT Magnet & Support; and 1.5.10.3 RTBT Vacuum Sys. whereas actual costs were less than performed.

**Project Impact:** None.

**Corrective Action:** None.

#### **WBS 1.5.12 – Technical Support**

- Transverse coupling impedance measurements for the full-size prototype of the SNS extraction kicker connected to the PFN circuit: effect of the saturating inductor.
- Study of the ceramic transverse coupling impedance of a displaced beam.
- Calculation of the RF section beam pipe aperture.
- Two group members were lecturers at the USPAS course in Los Angeles.
- Ring Web Page for lattice is published on web.
- Group mainly concentrated on ASAC review talks.
- Measurements for the Transverse coupling impedance of full-size prototype of the SNS Extraction kicker connected to the PFN circuit (effect of the saturating inductor) are completed.
- Beam Dynamics study of closed orbit offset in the Extraction Kicker is underway.
- Study on the ceramic transverse coupling impedance of a displaced beam is started.

- Simulations started for effect of kicker rise time on halo growth.
- Started studies of collective instabilities driven by Transverse Impedance: effect of space charge, etc.
- Improvement in Beam Loss Model with a more detailed study of fringe-field effect and correction of closed orbit due to magnet misalignments.
- Reviewed beam pipe aperture of the RF section.
- End to end simulation for ring part is being performed.
- Linac dump window thermal and stress analysis is completed.
- HEBT optics setup procedures are completed.

**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>
9768.2	9768.2	9654.8	0.0	0.0%	113.4	1.2%

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

Current period CV of \$94.7K (30.3%) is driven by WBS 1.5.12.1, Project Mgmt; and 1.5.12.3, Application Software whereas actual costs were less than performed.

**Project Impact:** None.

**Corrective Action:** None.

**WBS 1.9.1 – R&D**

**WBS 1.9.2.2 – Global Timing**

V124s

The pre-production run of 10 V124s modules arrived yesterday, almost one month ahead of schedule. A test procedure has been written. Incoming inspection and testing will begin before the end of the week.

V123s

No activity.

Eventlink Monitor

No Activity.

A True Time GPS receiver with the network time server option and IRIG B VME module has been set up in the SNS controls lab for software development.

The prints for the SNS 16 channel eventlink fanout have been marked up and are ready for submission to drafting.

Prototype eventlink and RTDL master systems remain set up in the SNS controls lab for system testing.

### **WBS 1.9.2.2 –Timing Software**

Event Timing System:

A software design review was held at BNL in January. It covered the functional design of each timing board, the design of the driver software for each board and workstation software to demonstrate some of the needed functions. There were a total of five boards reviewed, three boards for the event system and two boards for the RTDL system. We have received some recommendations for improvement. These are being reviewed and it's expected that they will result in some additional functions being added to the software.

An antenna for the GPS system was installed and it is working properly. The software for the associated VME board is being designed. There is more work to do on integrating and testing the various parts of the systems that includes the utility module, GPS VME board and the timing boards.

### **WBS 1.9.5.1 -Ring Controls Integration**

We are in the process of updating our test facility to allow us to automate the testing of VME boards needed for diagnostics. The 24-bit ADC board shows considerable temperature drift. Instrumentation is needed to measure temperature accurately to determine accuracy and drift as a function of temperature. Also measuring 24-bit systems require accurate reference sources and measuring instruments.

### **WBS 1.9.5.2 - Power Supply Controls**

PSI:

We have shipped 21 PSIs to ORNL. We have shipped two VME PSC boards and two standalone PSCs. ORNL will use these units to setup a test stand at ORNL and at the power supply vendor to check out the power supplies before delivery to ORNL. Danfysik also has a PSC/PSI pair with Labview software to test power supplies.

PSC:

This month the design of the PSC was finalized. All the changes in the board are reflected in the latest driver code and in the VME boards delivered to ORNL.

We have 48 PSIs and 8 PSCs running continuously for over a month in two test systems and have not had any problems or failures. We will continue to run these systems for several weeks or months to get a good indication of their reliability. The tests stress the system by running with clock rates much higher (3000Hz) than the rate needed for SNS( 60 Hz).

#### Power Supply Review:

At BNL there was a software design review of the PSC driver and power supply application. Three people from ORNL, two from LANL and one from RHIC reviewed the system. We were able to demonstrate two systems with 24 PSI's connected to 4 PSCs. The review covered the PSC/PSI hardware, the PSC driver software, the IOC application development code, the workstation display programs and other items. A MEDM application that reads the power supplies was shown. All the development for the power supply application was done on the Linux cluster. There were several suggestions made at the review. From these we expect there will be some improvements (increased functionality) added to the software.

LANL has asked for loaner modules so they could start software development. BNL has started delivering extra units to ORNL. As BNL has more than needed in the next year some of these can be loaned to LANL.

A CD was distributed at the review that contains all the driver software, application software, PSC/PSI documentation and MEDM examples. It also included the final Power Supply CD documentation. This will be forwarded to ORNL and satisfies a couple of milestone items.

### **WBS 1.9.5.3 – Diagnostics**

#### BLM:

Testing of the VME 24-bit ADC board started. A preliminary report is being written and will be placed on the WEB next month. The tests show a considerable drift with temperature. Other tests show the code distribution with fixed input, drift, linearity etc. Additional testing to determine if the effect of temperature changes can be mitigated by doing a calibration versus temperature or some other means. If necessary it would mean the IOC temperature would have to be measured when taking data. Tests are being performed the possible improvement in accuracy by averaging data

Testing of the 16-bit ADC board is almost complete. Accuracy as a function of temperature variation remains to be tested.

The test results will be presented to the diagnostic group for evaluation next month.

#### Laser Wire:

A data log function and additional software was written for the Laser Wire test facility at the request of the diagnostic group. The units should be shipped to LBNL shortly. Software was added and tested so that either stepping or servo motors will work with the system.

#### BCM:

To support the diagnostic group we are investigating the Active X Channel Access Server that is needed for the BCM prototype. We received the shared memory DLL code for review. An ActiveX CAS is running at BNL. The next step is to build EPICS 3.14 on a PC and run IOCCore for Win32.

#### **WBS 1.9.5.4 - Vacuum**

Controls are working with the Vacuum group to produce the final version of the Vacuum System ICD. It will be placed on the Web next month. Now that the final version of the gauge and pump hardware has been chosen, serial port driver software can start. Presently BNL is in the process of acquiring information on the protocols used and the interface hardware needed.

#### **WBS 1.9.5.5 - Application Software**

SNS Ring Simulation Environment:

N. Malitsky visited Prof. Ingo Hofmann's group in the GSI, Darmstadt. Ingo Hofmann is a expert in the area of space charge dynamics that is critical for the SNS ring project. His group is interested in the UAL-based studies and applications. Collaboration would be beneficial to both teams. During this visit Nikolay installed the UAL software on their Linux cluster, reported on the status of UAL applications and development, participated in discussions and prepared UAL based examples GSI applications..

The TEAPOT library was ported to the gcc 3.0 compiler.

#### **WBS 1.9.5.6 – RF**

We expected to have the HLRF ICD available this month. Because of design reviews this month some work on the ICD was postponed. The high level RF is sufficiently defined that a preliminary ICD can be written quickly and it should be completed in February.

Work is proceeding on writing the LLRF ICD. This should be completed in February or March.

## **IV. Earned Value Reports and Charts**

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

PROJECT TITLE: SPALLATION NEUTRON SOURCE			REPORTING PERIOD: 1-Jan-02 thru 31-Jan-02				PROJECT NUMBER: 99-E-334						
PARTICIPANT NAME AND ADDRESS: Brookhaven National Laboratory Brookhaven, NY			BCWS PLAN DATE: October 1999				START DATE: October 1998						
			COMPLETION DATE: 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	7.7	7.7	0.3	0.0	7.4	5,053.5	5,053.5	5,039.5	0.0	13.9	5,115	5,101	13.92
1.5 Ring & Transfer Line System	1,502.5	1,639.0	1,540.9	136.6	98.1	42,563.2	43,552.9	42,721.8	989.7	831.1	113,037	112,654	382.34
1.5.1 HEBT (High Energy Beam Transport) Systems	153.5	120.3	110.6	(33.2)	9.6	3,722.5	3,702.6	3,608.1	(19.9)	94.5	10,174	10,028	146.07
1.5.2 Injection Systems	150.2	158.2	235.4	8.0	(77.1)	3,055.3	3,229.0	3,276.7	173.7	(47.7)	8,994	9,215	-221.39
1.5.3 Magnet Systems	203.9	164.78	209.0	(39.1)	(44.2)	8,102.5	8,018.1	8,045.1	(84.4)	(27.0)	16,712	16,612	100.09
1.5.4 Power Supply System	13.9	13.1	5.0	(0.8)	8.0	853.3	853.4	852.7	0.1	0.7	3,434	3,433	0.55
1.5.5 Vacuum System	152.7	164.4	210.4	11.7	(46.1)	3,207.6	3,329.4	3,220.0	121.8	109.4	9,759	9,771	-12.41
1.5.6 RF System	181.9	372.0	141.6	190.1	230.4	4,684.0	5,500.4	4,853.4	816.4	647.0	12,132	12,279	-147.25
1.5.7 Ring Systems Diagnostic Instrumentation	141.1	88.2	273.8	(52.9)	(185.6)	4,727.6	4,693.7	4,930.5	(33.9)	(236.8)	14,410	14,503	-92.87
1.5.8 Collimation and Shielding	38.7	70.6	36.3	31.9	34.3	1,303.3	1,305.9	1,296.7	2.6	9.2	3,429	3,422	6.58
1.5.9 Extraction System	62.1	73.6	43.7	11.5	29.9	1,184.8	1,188.9	1,170.7	4.1	18.2	6,169	6,155	14.08
1.5.10 RTBT (Ring to Target Beam Transport) System	92.1	101.5	57.4	9.4	44.1	1,953.5	1,962.6	1,812.4	9.1	150.3	7,487	7,012	475.52
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	1	0.00
1.5.12 Technical Support	312.4	312.4	217.8	0.0	94.7	9,768.2	9,768.2	9,654.8	0.0	113.4	20,337	20,223	113.38
WBS SUBTOTAL	1,510.2	1,646.8	1,541.3	136.6	105.5	47,616.6	48,606.4	47,761.4	989.7	845.0	118,152		
UNDISTRIBUTED BUDGET													
SUBTOTAL	1,510.2		1,541.3			47,616.6		47,761.4			118,152		
MANAGEMENT RESERVE													
TOTAL	1,510.2		1,541.3			47,616.6		47,761.4			118,152		
RECONCILIATION TO CONTRACT BUDGET BASE													
DOLLARS EXPRESSED IN:  THOUSANDS			SIGNATURE OF PARTICIPANT'S PROJECT DIRECTOR:  Bill Weng									DATE:  February 12, 2002	

# 1.5 Performance Measurement Chart

