Brookhaven National Laboratory

SNS

Ring and Transfer Lines Systems

J U L Y

MONTHLY REPORT

01 July– 31 July 2002

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
July 2002
Ring and Transfer Lines Systems

I. Senior Team Leader Assessment

1. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

- We implemented three steps of procedure to better control design parameters and configuration: sign-off sheets under the engineering-change-request control for each type of magnets, web-based design-manual tables, and database tables shared between ORNL and BNL.

- Performance of extraction kickers was successfully optimized and tested. The 1-95% rise time was reduced by 20% to 200 ns, and the ripple reduced to 1%. The coupling impedances of these units are reduced by about 50% without changing existing power supplies. Full-power, full-repetition rate tests completely satisfy design requirements.

- An external panel consisting of experts from FNAL, SLAC, and other institutes reviewed the SNS Ring diagnostics system. A particular focus was on effects like electron clouds associated with next-generation high intensity rings.

- Parameters of medium-range power supplies were updated taking into account latest design modification in sextupoles, chicane magnets, and dump magnets. The latest re-grouping reduced the number power supply types from 12 to 8, reducing the needs for spare elements.

- Beam coupling-impedance budget was updated with latest optimization of extraction kickers, and latest measurements of the RF systems. Efforts continue on the study of collective instabilities and cures.

- CERN measurements of BNL,s coated vacuum-pipe samples indicate that excessive outgassing is associated with surfaces of lower secondary-emission-yield. As a measure to counter electron-cloud, physics group is evaluating the benefit of solenoid windings for the collimation section where large beam loss is expected.

- Writing of a design manual for the SNS ring has started.

- In July we proposed to sponsor the 29th ICFA Workshop on Beam Halo Dynamics, Diagnostics, and Collimation during May 2003. The ICFA committee approved the workshop. The Brookhaven Science Association gratefully provided support.

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)

BCWS	BCWP	ACWP	SV	%	CV	%
5099.5	5099.5	5112.9	0.00	0.0%	(13.4)	-0.3%

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

Project Impact: None.

Corrective Action: None.

WBS 1.5 Ring and Transfer Lines

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
53778.5	55619.6	54453.4	1841.06	3.4%	1166.2	2.1%

Variance Statement: Cum Variances are within thresholds. No analysis required.
Current period variance is driven by BCWP adjustments to WBS 1.5.1, 1.5.2, 1.5.3 & 1.5.7

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	127
FY02	0	0	0	0	17
Due in Next 30 days	0	0	0	0	4
Total Due at present	0	0	3	12	103
Made	0	0	3	11	94
Missed	0	0	0	1	9
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.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
5099.5	5099.5	5112.9	0.00	0.0%	(13.4)	-0.3%

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

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. They finished long magnet number 6 and it has been received at ORNL. Long magnet number 7 will be shipped soon also. Phone conferences continued with Danfysik during the month. The first production lot of nine 12Q45/16CD20 magnets was received by ORNL. The second production shipment is in the mail.

Detail design of 12cm drift chambers is complete. Detail drawings have been checked and modified. Welding fixtures for 21cm quadrupole chambers are complete and staged for set up, pending available welding and survey resources.

Drawings of the HEBT momentum dump are complete, and are being reviewed. A revised way of allowing for vacuum chamber settling interfering with the outer shield is being investigated.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
4913.0	5206.7	4386.9	293.71	6.0%	819.8	15.7%

Variance Statement: Cum CV of $819.8K (15.7%) is material driven by 1.5.1.1.1 HEBT 8D533 Magnet, whereas 6 of 9 magnets were received (580K). ACWP is understated and will be debited in subsequent current periods. Current period variances are also driven by the 8D533 Magnet deliveries.

Project Impact: None.

Corrective Action: None.

WBS 1.5.2 – Injection Systems

The bids for the #2 and #3 chicane magnets and the dump septum drawings were received. The order has been placed with New England Technicoil.

The long kicker magnet horizontal and vertical 1st article was moved to building 902 for magnetic measurement and testing with the power supply. The power supply is in house. The two are being connected at this time and will be tested in August. The requisition for the ferrite was approved, the specification, SOW, and drawings are complete, and the RFQ is being prepared. The P.O. will await the results of the testing. Ceramaseal shipped the ceramic chambers. They have passed acceptance testing and are being prepared for coating. There was a design review of the drawings for the magnet with ASD participation at BNL. There were no major issues and a few minor issues to be resolved.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
4032.2	4800.3	4242.7	768.17	19.15	557.6	11.6%

Variance Statement: Cum SV of $768.2K (19.1%) & CV of $557.6K (11.6%) are material driven by 1.5.2.1 Pulsed Magnet, Ferrite Blocks, ($460.8K) and 1.5.2.3.5 Ring/Injection Dipole, DC Magnets Spare deliveries ($82.2K). BCWS & ACWP are understated and will be adjusted and debited respectively in subsequent current periods. Current period variances are also driven by the same activities.

Project Impact: None.

Corrective Action: None.

WBS 1.5.3 – Magnet Systems

The SNS magnet parameters spreadsheet is being broken up into separate parameter sheets for each magnet type. These sheets will be distributed for review and approval separately by the cognizant physicists, engineers, and managers and tied to the magnets drawings. Any change to magnet design or parameters will require an ECN and an update to the sheet. The overall spreadsheet will be maintained and updated as a reference but the individual sheets will be the accurate reference for information.

At this time there are 20 17D120 ring dipole magnets (ITF that is $<1 \times 10^{-4}$ from the nominal value) that have been fully shimmed and magnetically measured. Another 4 magnets have been initially measured and shimmed.

Six 21Q40's were received and inspected at BNL during the month and Tesla is preparing another batch of six for shipping. Production measurements of the first 21Q40 have been completed. At the request of the instrumentation group, measurements were made to establish the settling time of the field following a change in current. In addition, the top half of this magnet has been removed, set on the floor, and reinstalled (as it will be when the magnet is assembled in a half cell) so that another check of the reproducibility of the assembly can be made. In addition, measurements to verify the accuracy of properly positioning the roll of the magnet (around the beam direction axis) were successfully completed.

The machining of the measuring coil form for the larger-aperture magnets (26Q, 30Q, etc.) has been completed.

Analysis of measurements of the first 26Q40 was completed. The measurements included integral field and separate measurements of the center and ends of the magnet. The measurements indicated that the field of the ends could be improved by chamfering the end pieces. Calculations to determine the size of the chamfer were completed. The magnet has been disassembled and the poles are being machined.

Phone conferences were held with Budker Institute of Nuclear Physics (BNIP). The first article 30Q58 magnet was received and inspected at BNL. The quality is very good with only minor discrepancies. The magnet has been set up on the measurement stand and first article measurement has begun.

The last batch of 27CDM30's was received from Danfysik during the month. Unfortunately one of the magnets broke during shipping. It was found that stainless steel bolts were used instead of the grade 2 steel bolts required by the drawings. All of the bolts will be replaced and the damaged magnet will be returned to Danfysik for repair.

Alpha Magnetics was visited during the month for inspection of the 41CDM30 1st article prior to shipment. The magnet looked very good and was shipped. It has been received at BNL and initial inspection has begun. 1st article magnet measurements will await completion of both the 26Q and 30Q measurements.

Alpha Magnetics is also responsible for the 21S26. Fabrication issues were reviewed during the visit. Alpha has the steel in house for the magnets but is still awaiting delivery of the copper. They are one month behind schedule.

A design review was held at BNL with ASD participation on the 26S26 sextupole. There were no major issues. The magnet should be ready for procurement by mid-September.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
10008.2	10348.2	10291.9	340.02	3.4%	56.3	0.5%

Variance Statement: Cum variances are within thresholds. No analysis required. Current period SV $476.3K (203.3%) & CV $447.9K (62.9%) are Material driven by WBS 1.5.3.1 High Field Magnets and 1.5.3.2 Low Field Magnets, whereas BCWP was adjusted for material received. BCWS & ACWP are understated and will be adjusted and debited respectively in subsequent current periods.

Project Impact: None.

Corrective Action: None.

WBS 1.5.4 – Power Supply Systems

- The BAFO for the Main Dipole Power Supply has been received; we are fine tuning the order to optimize testing and spares cost. The order should be placed in August.

- The medium range power supplies have been reconfigured into eight groups instead of the previous twelve. The ratings have been matched to a carefully reviewed magnet parameter list.

- Testing of the first two articles of the low field corrector power supply will be witnessed at the vendor's facility in August. This work will be combined with the design review of the RF Tuning power supply.

- The contract for the eight production injection power supplies has been awarded.

- The RFP for the extraction kicker has been released, and the bids are due August 19th. The first article kicker power supply has been running at full repetition rate at 40 kV for life testing.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
936.1	932.4	1042.5	(3.70)	-0.4%	(110.1)	-11.8%

Variance Statement: Cum CV of -$110.1K (-11.8%) is driven by WBS 1.5.4.1 & 1.5.4.2 for Material, is understated and will be adjusted in the next current period.

Project Impact: None.

Corrective Action: None.

WBS 1.5.5 – Ring Vacuum System

The last type-E QC chamber was welded and leak checked. One type-B and one type-C HC chambers were coated with TiN, bringing the total coated chambers to eighteen. SEY data of the coated HC chamber coupons were received from CERN. Chambers coated at lower pressure have higher SEY values, which tend to have lower outgassing and smoother surface based on SEM measurements. More coupons were sent to CERN and KEK for SEY measurements. The 1st production RF cavity pipes were assembled and ready for TiN coating after repairing several welding leaks.

The space conflict between the ion pumps and the arc sextupole magnet buss connection was resolved by rerouting the buss of 21cm sextupole and by custom elbows at 26cm sextupole. The layout of collimation straight section was detailed accommodating the needs of aperture requirement, shielding and diagnostics. Flanges are being machined for testing the sealing reliability of large flange assemblies near the collimators.

BNL technical and QA representatives traveled to the vendor to conduct inspections and tests of the first article TMP Cart. The unit passed inspections and was subsequently shipped to SNS. The vendor has been authorized to proceed with production. All the required TMP cart gauges

and gauge controllers were shipped to vendor for incorporating into production units. All the ring ion pumps were received at SNS. The order for TMP isolation valves was placed.

The HEBT, Ring and RTBT vacuum device lists and the valve interlock logic were updated to reflect the states of detail design. Work on the HEBT PLC ladder logic continues. Work on the EPICS database and the layout of the EDM screens for vacuum systems has been started.

A PCR for the cost of Ring spare straight section doublet chambers was submitted for approval. Work packages and statements for FY03 are generated.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
4494.9	4590.9	4590.0	96.07	2.1%	1.0	0.0%

Variance Statement: Cum Variances are within thresholds. No analysis required.
Current period SV -$305.4K (-66.8%) reflects BCWS recorded against Ring Ion Pump material previously received ($276.6K);
and current period CV $39.1K (25.8%) which is performance driven by labor & material.

Project Impact: None.

Corrective Action: None.

WBS 1.5.6 – RF System

- The RF overview for the design manual was finished.
- Benchmarking the electron cloud and instability codes was started.
- The ep simulation codes and dispersion diagram calculations were compared against each other. The agreement is good.

- Cavity fabrication continues.

- The design of the prototype IQ modulator board is complete. Board is going out for assembly.
- Design of the A/D converter board is underway.
- Design of the VME P2 read transition module is underway.
- DSP code development continues. Focus is on understanding “link port” communication issues and emulating A/D to DSP link.
- Work continues toward complete simulation of the cavity control loops. Development of the prototype high level RF application (GUI) is progressing well.
- Work on porting the DSP “Host Interface Libraries” to VxWorks continues.
- Presented engineering seminar “LLRF System for the SNS Accumulator Ring” for BNL SNS staff.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
5766.6	6331.4	6267.2	564.82	9.8%	64.2	1.0%

Variance Statement: Cum variances are within thresholds. No analysis required. Current period SV $73.8K (40.6%) reflects performance taken for RF Power Amplifier deliveries.

Project Impact: None.

Corrective Action: None.

WBS 1.5.7 – Ring Diagnostics

Group members devoted considerable effort to preparation of materials for the BNL Diagnostics Design Review, which was held the week of July 22nd.

Discussions and measurements of impedances of various modes of the BPM PUEs continue. SNS PUEs are designed with sum mode impedance of 50 ohms. It has been suggested that a better approach would have been to raise the impedance such that the 'circuit impedance' defined to be Z0=sqrt(zsum*zdiff) is set to 50 ohms. Preliminary conclusion of discussions with EM experts and AP is that (if this conjecture is correct) this difference has no consequence for narrowband measurements or accelerator physcis performance, and hence no implications for HEBT, Ring and RTBT PUEs. Investigation continues. BPM PUE wire scanner mapping facility was restored to operation, and preliminary transfer function measurements were completed. Working on calibration routine. Continued discussions with AP about matrix methods of beam-based offset determination, with an eye to removing the need for the relays and power supplies. Work continues on PCI interface.

A prototype IPM collector circuit board has been built. An optics experiment has been done to understand the depth of focus problem with the fluorescence profile monitor. The present concept is to use F/8 optics and average over about 20 turns to get a 3% measurement at the end of the store.

We have received a cost estimate from one vendor to produce 300 BLM detectors based on our prototype design of $627 each, compared with the unimproved detector cost of ~$450. We have also received a prototype detector based on our design from a second vendor which shows encouraging response curves from initial tests. We are still waiting for a prototype detector from the third vendor. Working on implementing and evaluating suggestions and comments brought up at the design review. These include minor changes to the analog front end, interfacing with the controls digital I/O, and addressing the request for redundancy of hardware to enable machine operation in the event of a module/chassis failure or service.

The rev2 BCM circuit board was stuffed and is being tested. Analog signals have been traced through the analog system. Detailed analog testing is now underway. Digital testing has also started. As per suggestions of the design review committee, BCM calibrator design is under review to include special features to assure safe operating conditions for the transformers during calibrator failures. Work continues on PCI interface.

Allocated space in the Ring lattice for the tune kickers. UAL modelling of beam transfer function measurement continues.

Contacted and pushed the vendor (Huntington) to come up with firm delivery date on the MEBT Carbon Wire Scanner actuator upgrade. Vendor promised mid to late August delivery, which will permit re-assembly and delivery to ORNL by mid-September. Actuators were removed from the previously assembled MEBT wire scanners and shipped. Completed redesign of carbon wire attachment method for MEBT wire scanners and parts are in fabrication. Second letter of intent was written for the transfer of responsibilities for carbon wire scanners from BNL to LANL. LANL will assume responsibility for all areas except vacuum envelop/beambox, which will remain with BNL. LANL is writing the PCR. Collecting wire scanner information (for hebt, ring and rtbt areas) from LANL for the beam box designs.

Contacted ORNL to obtain a SCL beam box for the proposed laser wire test in BNL. ORNL will send design dwgs to BNL by 8/10/02 and will fabricate a beam box for BNL by mid October for the beginning of beam tests around late November. Collected BNL Linac dwgs, which show the equipment around the test setup upstream of the AGS LTB line.

Sarah Cosineau completed Beam-in-Gap simulation of gap cleaning efficiency with 0.6mrad kick instead of 1.0mrad. Conclusion is that smaller kick is acceptable if number of kicks can be increased from 50 to 80. Contacted vendor to confirm that this is acceptable (our present understanding of the duty cycle spec is that this will be no problem).

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
5852.4	6065.1	6268.9	212.70	3.6%	(203.8)	-3.4%

Variance Statement: Cum variances are within thresholds. No analysis required. Current period SV $434.6K (163.4%) & CV $509.1K (72.7%) are material driven by WBS 1.5.7.1 BPM deliveries and 1.5.7.4 BCM deliveries whereas BCWP for material was acknowledged.

Project Impact: None.

Corrective Action: None.

WBS 1.5.8 – Collimation and Shielding

Work is continuing on the first scraper for the Ring. The ring secondary and tertiary absorber drawings are being prepared. Finally, the vacuum chambers before and after the primary collimator are being integrated with the collimator.

Drawings of the modified shield are complete. A review with project office staff was carried out, and the drawings are now ready for checking.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
1712.9	1523.4	1544.4	(189.49)	-11.1%	(21.0)	-1.4%

Variance Statement: Cum schedule variance (SV) of -$189.5K (-11.1%) is material driven by 1.5.8.1 Ring Collimator 1st delivery; whereas a PCR will be processed to show planned delivery in March '03 thus adjusting SV.
Current period variances are within thresholds. No analysis required.

Project Impact: None.

Corrective Action: None.

WBS 1.5.9 – Extraction System

The PFN drawings were sent with the bid package for the PFN. The complete package model has also been provided on CD. Detailed design of the extraction kicker magnets continues. The design of the support, vacuum chamber, and feedthroughs is being worked on. The impedance test set up used for extraction kicker was successfully used for RF cavity impedance test. It is now being modified for the injection kicker. A design review was held at BNL with ASD participation on the optics and layout of the extraction lambertson magnet. There were no major issues. A more detailed review of the extraction straight section will be held in the near future.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
1554.3	1474.8	1551.5	(79.50)	-5.1%	(76.8)	-5.2%

Variance Statement: Cum variances are within thresholds. No analysis required.
Current period SV -$28.1K (-45.3%) is labor driven by WBS 1.5.9.3 17DS244 Magnet Design

Project Impact: None

Corrective Action: None.

WBS 1.5.10 – RTBT System

The bids for the 27CD30 corrector dipole magnet that is used in both the RTBT and in the HEBT line have been received. We are awaiting the bid from one bidder that was lost and then they will be opened and the order placed. A design review was held at BNL with ASD participation on the RTBT line magnets and vacuum system. There were no major issues.

Detailing of RTBT magnet vacuum chambers and drift spaces pipes continues. Design Review was held for RTBT vacuum systems during project office visit.
The first unit has been shipped to ORNL. Methods of reducing the lifting requirements for the crane are being investigated. The final drawings of the second RTBT collimator are also complete.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
2879.4	2717.6	2771.6	(161.75)	-5.6%	(54.0)	-2.0%

Variance Statement: Cum variances are within thresholds. No analysis required. Current period CV -$180K (-121%) is material driven by WBS 1.5.10.5 RTBT Collimator & Shielding whereas ACWP was debited for material previously delivered.

Project Impact: None.

Corrective Action: None.

WBS 1.5.12 – Technical Support

- RF cavity coupling measurements finished.
- Magnet parameters were rechecked and finalized.
- Parameters of primary collimator and beam pipe were finalized. Scraper collimator design was optimized.
- A special electrode in the collimator area is analyzed to clean electrons for reducing the possibility electron-cloud effects.
- Studies continue for envelope instability and parametric resonances continued.
- Study of excitation of resonances with fringe field was continued.
- Group member finalized the diagnostic requirements and layout of diagnostics.
- Linac dump area optics was finalized.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
11627.9	11627.9	11495.0	0.00	0.0%	132.9	1.1%

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

Project Impact: None.

Corrective Action: None.

WBS 1.9.1 – R&D

WBS 1.9.2.2 – Global Timing

V124s
The first article module of the contract to manufacture 50 modules has been received at BNL and approval was given for the remaining 49 production boards. Delivery is scheduled for late August.

V123s
The V123 bug of not passing on the interrupt acknowledge has been fixed. New gate array files have been sent to ORNL.

The production version of this module will clean up the rework present on the six prototypes plus add three more i/o signals one each for a second $T_{cycle\ start}$ and T_{ext} plus a signal indication when the RF input signal is not present. Prepulse will be removed.

Eventlink fanout
A production contract of 80 pieces has been awarded.

V206
A production run of 16 modules has been awarded. The first article is due in late August.

Eventlink Monitor
The requirements for the SNS eventlink monitor are very similar to those of RHIC. The RHIC monitor module has been successfully tested at the SNS eventlink frequency of 17 MHz. An order of 3 built assemblies and seven blank PCB will be initiated.

WBS 1.9.5.1 -Ring Controls Integration

The BNL SNS web page (http://www.sns.bnl.gov) has undergone a major redesign to emphasize documentation, reports, reviews, and workshops.

WBS 1.9.5.2 - Power Supply Controls

The Yokogawa function generator and ADC hardware system has arrived, along with Windows based control software. This system will be used to test the prototype injection kicker power supply in the magnet test building. The related documentation is nearly completely translated from Japanese, allowing work to begin on EPICS device support for the system.

The last remaining issues with the Power Supply Interface module firmware have finally been resolved. Previous versions did not always power up in the correct state, and took a long time to complete the calibration sequence. New PSI firmware has been delivered, and has undergone significant testing without error. The process of refitting PSI modules with this final firmware (revision 3.3) is underway.

WBS 1.9.5.3 – Diagnostics

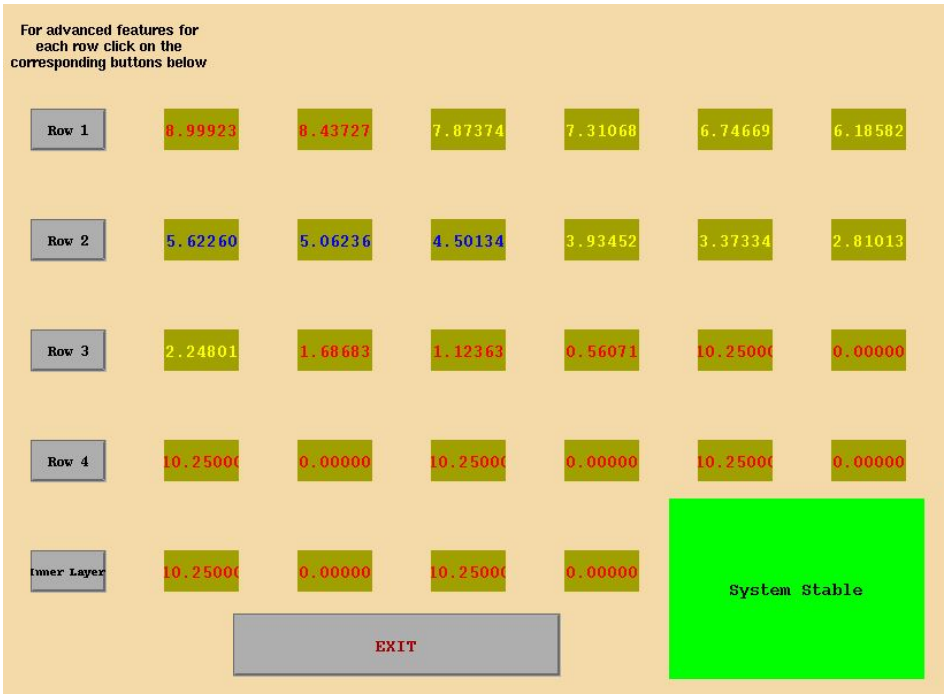
Two issues were raised at the Beam Diagnostic Review last week that are receiving close attention, both related to the beam loss monitor system:

1) The review committee suggested selecting a digitizer from among those tested, rather than continuing the search for a better option. Between the two digitizers that meet the minimum requirements, the more accurate digitizer is more sensitive to temperature variations. A test is underway to see if the temperature variations can be effectively compensated for in software.

2) ORNL diagnostic group suggested a higher level of redundancy than had previously been planned for (or budgeted for). The details of the impact of adding this level of redundancy are being worked out.

The review committee also suggested that the costs associated with using the standard PCI digitizer for IPM is evaluated. While that determination is still in progress, we are continuing to evaluate VMEbus based solutions, including offerings from Hytec and Struck for linearity, distribution, crosstalk and thermal drift. Reports will be posted on the web site when they are complete.

Preliminary EDM screens have been developed for the Beam Dump temperature monitoring system. The System is ControlLogix PLC based. Selected temperature channels above a threshold limit trigger an input to the MPS system. Using these EDM screens, the PLC ladder logic has been verified (using analog input modules while waiting for the thermocouple input modules to be shipped).


For advanced features for each row click on the corresponding buttons below
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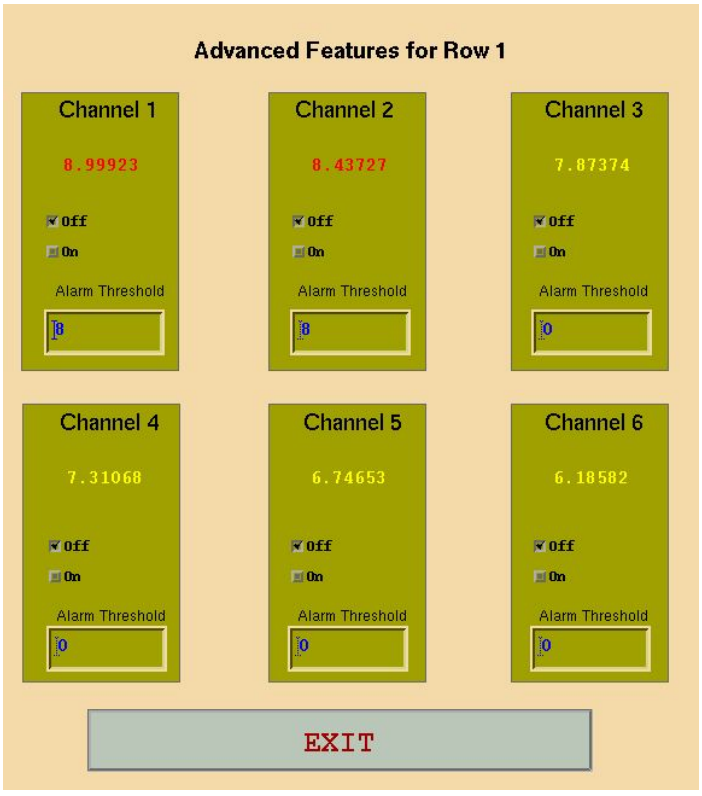
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WBS 1.9.5.5 - Application Software

The UAL module "ACCSIM" (accumulator simulator) was released including the following features:

- collimator algorithms (multiple scattering, beam loss, nuclear interactions)
- collection of bunch distributions (Gaussian, binomial, etc.)

The following ACCSIM API documentation was automatically generating using the newly installed Doxygen utility :

http://www.ual.bnl.gov/ref/v1/doc/doxygen/html/namespaceACCSIM.html

IV. Earned Value Reports and Charts

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

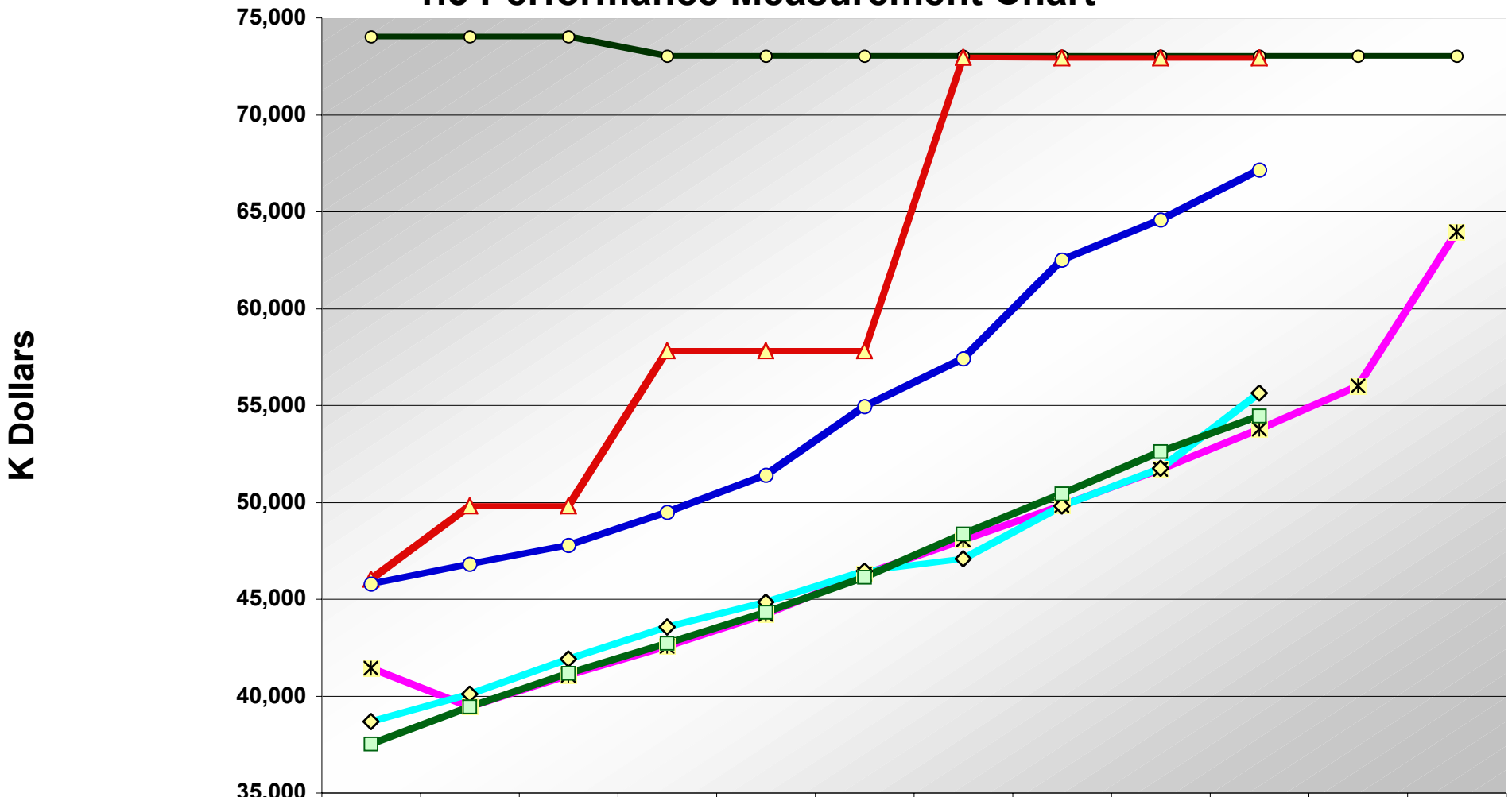
PROJECT TITLE: SPALLATION NEUTRON SOURCE	**REPORTING PERIOD:** 1-Jul-02 thru 31-Jul-02	**PROJECT NUMBER:** 99-E-334
		START DATE: October 1998
PARTICIPANT NAME AND ADDRESS: Brookhaven National Laboratory Brookhaven, NY	**BCWS PLAN DATE:** October 1999	**COMPLETION DATE:** November 2006

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				
	Work Scheduled	Work Performed		Schedule	Cost	Work Scheduled	Work Performed		Schedule	Cost	Budgeted	Revised Estimate	Variance
1.1.3 Rings System Development	7.7	7.7	0.00	0.0	7.7	5,099.5	5,099.5	5,112.9	0.0	(13.4)	5,115	5,115	0.0
1.5 Ring & Transfer Line System	2,093.444	3,882.917	1,854.712	1,789.5	2,028.2	53,778.5	55,619.6	54,453.4	1,841.1	1,166.2	113,174	113,174	0.0
1.5.1 HEBT (High Energy Beam Transport) Systems	214.8	840.2	108.5	625.3	731.7	4,913.0	5,206.7	4,386.9	293.7	819.8	10,081	10,081	0.0
1.5.2 Injection Systems	155.6	664.5	115.3	508.9	549.2	4,032.2	4,800.3	4,242.7	768.2	557.6	9,151	9,151	0.0
1.5.3 Magnet Systems	235.5	711.73	263.8	476.3	447.9	10,008.2	10,348.2	10,291.9	340.0	56.3	17,013	17,013	0.0
1.5.4 Power Supply System	13.9	15.8	39.6	1.9	(23.8)	936.1	932.4	1,042.5	(3.7)	(110.1)	3,524	3,524	0.0
1.5.5 Vacuum System	457.2	151.8	112.7	(305.4)	39.1	4,494.9	4,590.9	4,590.0	96.1	1.0	9,732	9,732	0.0
1.5.6 RF System	181.9	255.7	260.5	73.8	(4.8)	5,766.6	6,331.4	6,267.2	564.8	64.2	12,107	12,107	0.0
1.5.7 Ring Systems Diagnostic Instrumentation	266.0	700.6	191.5	434.6	509.1	5,852.4	6,065.1	6,268.9	212.7	(203.8)	14,374	14,374	0.0
1.5.8 Collimation and Shielding	38.7	47.4	67.1	8.7	(19.6)	1,712.9	1,523.4	1,544.4	(189.5)	(21.0)	3,418	3,418	0.0
1.5.9 Extraction System	62.1	34.0	57.8	(28.1)	(23.8)	1,554.3	1,474.8	1,551.5	(79.5)	(76.8)	6,144	6,144	0.0
1.5.10 RTBT (Ring to Target Beam Transport) System	155.4	148.8	328.8	(6.6)	(180.0)	2,879.4	2,717.6	2,771.6	(161.7)	(54.0)	7,342	7,342	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	312.4	312.4	309.2	0.0	3.2	11,627.9	11,627.9	11,495.0	0.0	132.9	20,287	20,287	0.0
WBS SUBTOTAL	2,101.2	3,890.7	1,854.7	1,789.5	2,035.9	58,878.0	60,719.1	59,566.3	1,841.1	1,152.7	118,289		
UNDISTRIBUTED BUDGET													
SUBTOTAL	2,101.2		1,854.7			58,878.0		59,566.3			118,289		
MANAGEMENT RESERVE													
TOTAL	2,101.2		1,854.7			58,878.0		59,566.3			118,289		

RECONCILIATION TO CONTRACT BUDGET BASE

DOLLARS EXPRESSED IN:	SIGNATURE OF PARTICIPANT'S PROJECT DIRECTOR:	DATE:
THOUSANDS	Jie Wei	August 15, 2002

1.5 Performance Measurement Chart



	Oct-01	Nov	Dec	Jan-02	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Cum Planned BA	74,034	74,034	74,034	73,034	73,034	73,034	73,034	73,034	73,034	73,034	73,034	73,034
Cum Authorized BA	46,034	49,806	49,806	57,806	57,806	57,806	72,947	72,931	72,931	72,931		
Cum Actual BA	45,796	46,801	47,788	49,500	51,402	54,943	57,427	62,496	64,584	67,150		
Cum BCWS	41,443	39,429	41,061	42,563	44,212	46,288	48,045	49,821	51,685	53,778	55,996	63,941
Cum BCWP	38,670	40,079	41,914	43,553	44,840	46,433	47,079	49,797	51,737	55,620		
Cum ACWP	37,521	39,429	41,181	42,722	44,326	46,140	48,353	50,439	52,599	54,453		

Months