Brookhaven National Laboratory

SNS

Ring and Transfer Lines Systems

A P R I L

MONTHLY REPORT

01 April – 30 April 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
April 2002
Ring and Transfer Lines Systems

I. Senior Team Leader Assessment

1. TECHNICAL PROGRESS AND ACCOMPLISHMENTS

- Larry Hoff becomes BNL control's group leader for SNS.
- In support of the Front-end commissioning at LBL, BNL diagnostics and controls group members traveled to LBL for MEBT diagnostics control.
- Anticipating future electron-cloud complications during high-intensity operation, the ring Beam-position-monitors are identified as clearing electrodes. A dedicated electrode is also implemented in the injection assembly.
- Extraction kicker's rise time is optimized by the adjustment of saturable inductors. The rise time is effectively reduced by 50 ns.
- A low-permeability ferrite was tested for possible impedance reduction. Although the benefit to SNS ring is negligible due to the existing PFN termination, the material can be useful to other machines (possibly CERN's and RHIC).
- The power-supply group re-evaluated the specifications. It was concluded that by grouping the ring power supplies into fewer types, we minimized engineering efforts, reduced costs, and raised machine reliability.
- Good progress is continually made in reducing the field variation of the ring dipole magnets. The completed 14 out of 32 magnets fully meet the 10^{-4} specification.
- In support of installation and commissioning at ORNL, the physics group developed software to automate global-coordinate generation, and participated in ring/RTBT fault studies.
- We are continually on time, within baseline budget, meeting all the milestones.

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	%
5076.3	5076.3	5106.9	0.00	0.0%	(30.6)	-0.6%

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

Project Impact: None.

Corrective Action: None.

WBS 1.5 Ring and Transfer Lines

BCWS	BCWP	ACWP	SV	%	CV	%
48044.9	47078.6	48352.6	(966.24)	-2.0%	(1274.0)	-2.7%

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

Current period variances reflect an adjustment to 1.5.6.1 High level Systems BCWP; as authorized by PCR RI02010.

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	28
Due in Next 30 days	0	0	0	0	2
Total Due at present	0	0	3	12	99
Made	0	0	3	12	88
Missed	0	0	0	0	11
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	%
5076.3	5076.3	5106.9	0.00	0.0%	(30.6%)	-0.6%

Variance Statement: 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. The third and forth magnet were received at ORNL. The second magnet was delayed because of a shipping error. ORNL is working to get the magnet shipped to the RATS building from Texas.

Phone conferences continued with Danfysik during the month. Both the 12Q45 quadrupole magnet and the 16CD20 corrector magnet have been measured by ORNL and accepted. Permission for production has been given to Danfysik. They have started to machine pole tips for the quadrupoles. They had already started winding the coils and machining the outer steel.

The design of the 27CD30 corrector for the HEBT arc is well underway – the drawings are in the checking que. The design of the stand for the 21Q40/27CD30 is being worked on.

Technical note for Linac Dump Vacuum Window Analysis and Design is being circulated at BNL in draft form for review and will be published shortly.

Some of the Standard Dipole chambers have been inspected for dimensional conformance at SNS. Dimensions for positioning the chamber were provided to SNS. The four special extraction and injection dipole chamber have been fully inspected. They have been received at SNS/RATS in good condition. Extraction chamber boundary coordinates were provided to determine the acceptance limitation of the momentum collimator dipole. The new analysis will be performed.

All 12 cm quadrupole beampipe drawings have been released. Detail design of 12cm drift chambers has resumed. Quotes for the pump tees were received and orders for pump tees will be processed soon. All the 5" inconel bellows were received and are being leak checked. Fixture fabrication for welding of 21 cm quadrupole chambers is underway in Central Shops.

Drawings for the truncated HEBT line collimators have being prepared, and have undergone internal review. Drawings of the HEBT momentum dump are complete, and are being reviewed.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
4358.1	4082.3	4010.4	(275.73)	-6.3%	72.0	1.8%

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

Current period (SV) -$104.7K (-82.4%) and CV -$165.7K (-743.3%) are driven by WBS 1.5.1.1 HEBT Magnets & Support; whereas BCWP was reversed from 100% to 0% complete for 12Q45 Magnet delivery which reduced HEBT Systems BCWP and triggered CV & SV beyond variance threshold.

Project Impact: None.

Corrective Action: None.

WBS 1.5.2 – Injection Systems

A final drawing review was held on the #2 and #3 chicane magnets to determine the gap tolerances and dimensioning. The drawings are in the final approval cycle. The specification and statement of work for those magnets and the dump septum are being prepared. They will be sent out as a single procurement. The pole shape for the #1 magnet is still being defined.

The second phase for the production run of the long and short kicker magnet coils has been issued to Everson Electric Co. Drawings of the revised short coil and jumpers were included in the production order. Drawings of short kicker magnet ferrite blocks have been completed and were sent to Ceramic Magnetics Co. for quote. The drawings are in the checking que. The ferrite purchase order will wait for test results from the field measurement and pulsing of the first magnet. The first article magnet will be moved to Bld.902 for magnetic measurement. A magnet lifting fixture was made by the shop. A load test is being prepared to certify it. Ceramaseal has received two ceramic pipes from their supplier. They are preparing the pipes for the final brazing and flange welding steps. If everything works well they will deliver these two chambers sometime in May. A revised power cable connection design for the magnets and support stand modifications are being implemented by designer.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
3524.5	3609.4	3612.3	84.89	2.4%	(2.9)	-0.1%

Variance Statement: Cum Variances are within thresholds. No analysis required.
Current period (SV) -$67.1K (-36.6%) is driven by WBS 1.5.2.3.2 Injection Dump Septum Dipole Magnet 6DS213 material and procure delivery and 1.5.2.3.4, 24D68 Magnet material and procure delivery whereas no performance was taken.

Project Impact: None.

Corrective Action: None.

WBS 1.5.3 – Magnet Systems

At this time there are eleven good 17D120 ring dipole magnets (ITF that is $<1 \times 10^{-4}$ from the nominal value) that have been fully measured and approved. The installation and testing of the automatic transverse drive mechanism for the dipole coil measuring station was completed. The system is being used to measure the magnets.

The "33rd" magnet (the first article 1.3 GeV magnet) is being prepared for final assembly and magnetic measurement. Once magnetic measurement and shimming (if necessary) is completed the magnet will be sent to ORNL to be kept as a spare.

The first 21Q40 from the production run was measured in the 1st article magnet measurement area. The magnet was found to be well within the design parameters. The magnet was split as it would be for vacuum chamber insertion and measured again. The magnet was again well within the design parameters.

Stanagenes, the vendor for the 26Q40 magnet, was visited during the month to determine the cause of their three month shipping delay. By the end of the month the magnet was shipped and received at BNL without incident. It is being set up for testing.

Production of the 21CO26 magnets continues. Four magnets were shipped to BNL during the month. The first one was magnetic measured and found to be well within specification. The third magnet was found to be slightly out of the dimensional specification. BNL technicians shimmed it. The sixth and seventh magnet were held and reinspected by NE Technicoil to determine if they had similar problem.

Phone conferences were held with Budker Institute of Nuclear Physics (BINP). Another set of coil brazed samples were sent by BINP and passed the pull testing. From pictures and discussions BINP is well into production of the magnet. The first four coils have been wound and one coil has been potted. The steel for the core is 60% complete. The magnet should be shipped in June.

Alpha Magnetics has begun winding the coils for the 41CDM30. They were visited during the month by W. Birkholz to determine progress and to inspect completed components.

The procurement package for the 21S26 high field sextupole was prepared and sent out for bid. The bids are due in the beginning of May.

A design of the 26S26 high field sextupole is well underway.

A proposal by ORNL to add eight additional survey holes to each quadrupole (for a total of 16 holes) has been sent to the vendors for review and a cost estimate.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
9065.7	8876.1	9043.3	(189.65)	-2.1%	(167.3)	-1.9%

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

Project Impact: None.

Corrective Action: None.

WBS 1.5.4 – Power Supply Systems

The procurement package for the Main Ring Dipole was completed and received physics approval. It will be released to vendors by mid-May. In addition to the actual construction, this contract will contain full power testing as well as installation and commissioning support.

A vendor conference was held a BNL to help vendors make a more informed bid on the production of the extraction kicker power supply. That request for proposal is scheduled to be released in May. Procurement of components that will be supplied to the vendor has started, and will continue into May.

Low field corrector power supply testing continued in April. This testing was also performed with engineers from ORNL, LANL, and JLab, who will be using these units. The vendor improved noise performance, and release for the first ten production units is expected in May.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
894.3	895.3	912.7	0.99	0.1%	(17.3)	-1.9%

Variance Statement: Cum Variances are within thresholds. No analysis required.
Current period (CV) -$15.7K (-117.7%) is labor driven by WBS 1.5.4.1 High Power PS System & 1.5.4.2 Main Ring Pwr Supply.

Project Impact: None.

Corrective Action: None.

WBS 1.5.5 – Ring Vacuum System

Six more Type C halfcell (HC) chambers have been welded and leak checked bringing the total 27 HC chambers completed. They are being vacuum degassed in furnace. All the remaining dipole chambers have also been leak checked. The set up and welding of type E quartercell chambers has started. The drawings for injection and RF straight section doublet chambers were sent to potential vendors for pricing. All type A HC are assembled with blank flanges for transferring to HC assembly building.

Three type B HC chambers have been coated with TiN at lower pressure and with various thicknesses. Outgassing tests revealed no benefit with thicker coating. Test coating of copper with TiN overlay on ceramic pipe was carried out with good adhesion but not good stoichiometry. More development work is needed before production coating starts. Adaptors for RF cavity pipe coatings were ordered. A paper on the coating of the injection kicker ceramic chambers was presented at Int. Conf. on Metallurgy Coating and Thin Films.

The first article SNS TMP Cart was received at BNL and undergone most of the first article tests. Many minor issues have been noted. Close coordination with the vendor to rectify these issues is underway. The partner labs have been contacted of the status and their input. Orders for the HEBT and RTBT sector gate valves and 1st article turbopump isolation valves were placed. Input and output modules for the HEBT PLC were received. PLC interface components were wired and installed in the prototype HEBT Vacuum Control rack and a sample valve control program was downloaded into the controller.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
3658.4	3781.0	4051.0	122.56	3.4%	(270.0)	-7.1%

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

Project Impact: None.

Corrective Action: None.

WBS 1.5.6 – RF System

- The electrical design of the wall current monitor was finished. The rudimentary interface between the Digital Signal Processor and the Input Output Controller was established.
- DSP code and IQ modulator development continued. Awaiting first prototype of the LLRF VME carrier card.
- Hooked up anode supply and did preliminary testing. Everything looks good so far.
- The RF Tuning power supply RFQ was released in April for a May award.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
5220.9	5069.8	5555.2	(151.16)	-2.9%	(485.5)	-9.6%

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

Cum CV is just below 10% threshold and close enough to require an explanation, whereas actual material costs are greater than BCWP, and BCWP will be adjusted in next reporting period. Current period SV & CV are above thresholds because BCWP was reduced to adjust for PCR RIO2010.

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 portion of the DOE Review, as well as to the preparation of papers for the Beam Instrumentation Workshop. Papers were presented for almost all systems.

- Setup of the BPM PUE production facility in the new lab is complete. The question of the use of BPMs as clearing electrodes is resolved for the moment, with the conclusion that the existing hardware can hold off the requested +/- 1KV if the decision to implement this is made at some time in the future. Work on the Bergoz Ring and RTBT AFE electronics continues.

- Hardware for the prototype luminescence monitor was installed in the AGS Ring and vacuum was restored. The first data showed a lot of beam coupling. This was addressed by floating the PMT box from the beam line, adding a copper screen over the optical input to the PMT box, and directly coupling the preamp box to the PMT box. Preliminary testing of the bleed gas system was completed. There are indications that we are seeing crude beam profiles without bleed gas.

- Development work continues on the new BLM ion chamber design.

- The question of calibration of the MEBT BCM system was resolved when damaged signal cables were replaced. Remaining problems center on operator error - if there is enough flexibility in the operator interface to permit someone to set the BCM up so it won't work, it seems inevitable that the system will be brought into that condition and left there. Fabrication of Rev 2 BCM circuit board is underway. LANL is working on shroud resonance calculations.

- UAL modeling of beam transfer function measurement continues to show good progress.

- Dimensions were provided to LANL for cost estimates for HEBT, Ring, and RTBT carbon wire scanners.

- A two-page operators manual for the MEBT laser wire was written and sent to Berkeley. Laser wire measurements at 200MeV at the AGS linac continue.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
5225.1	5076.6	5701.2	(148.56)	-2.8%	(624.6)	-12.3%

Variance Statement: Cum (CV) of -$624.6K (-12.3%) is material driven by 1.5.7.1 Ring Beam Position Monitor Sys and 1.5.7.4, Ring Beam Current Monitor, whereas BCWP for material is understated and will be adjusted in the next current period.

Current period cost variance (CV) -$188.5K (-120.7%) is material driven by 1.5.7.1 Beam Position Monitor Sys and 1.5.7.4 Ring Beam Current Monitor whereas material was received and no BCWP taken. BCWP will be adjusted in next reporting period.

Project Impact: None.

Corrective Action: None.

WBS 1.5.8 – Collimation and Shielding

- Work has started on the first scraper for the Ring. A meeting was held with instrument and controls staff to prepare an ICD covering all collimators and scrapers.

- Drawings of the modified shield are complete. A review is scheduled.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
1596.7	1415.2	1390.1	(181.53)	-11.4%	25.1	1.8%

Variance Statement: Cum schedule variance (SV) of -$181.5K (-11.4%) 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 completed and checked during the month. The pre-bid conference for the PFN assembly that was held on 4/10/02 was quite successful. Several companies have shown their interest and will bid this job. The low Mu ferrites have arrived. A series of comparison tests are being done in Bldg. 919B. A final full power and temperature tests will be done using the prototype PFN power supply. Since the extraction kicker parameters and locations are finalized, a new layout design is being worked on. This design will have 6 different types of magnet modules.

The detailed design of the Lambertson Magnet is now underway using the new extraction area parameters.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
1368.1	1333.9	1369.9	(34.18)	-2.5%	(36.0)	-2.7%

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

Current period cost variance (CV) -$37.4K (-70%) is material driven by 1.5.9.2 Extraction Kicker PS; whereas material was received and no BCWP taken. BCWP will be adjusted in next reporting period.

Project Impact: None

Corrective Action: None.

WBS 1.5.10 – RTBT System

The bids for the 36Q80 magnet core were received and the order has been placed in Raynor. Design work continues on the coil design and the coil winding fixtures.

The RTBT transfer line layout (magnets, instruments, collimators, etc.) is being finalized. A design review was held during the month and there were no major issues.

Design work continues on the 27CD30 corrector dipole magnet that is used in both the RTBT and in the HEBT line with the 21Q40 quadrupoles.

Design Review of the RTBT Vacuum System, including Extraction Dump, was held on 4/25/02 to finalize layout of magnet chambers and drift space spools. Draft technical note for Linac dump window analysis and design is being circulated for comments.

The first article has been manufactured, and an acceptance test will be carried out at SDMS in France during the week of May 13. Fabrication of the inner box for the first article has started. The final drawings of the second RTBT collimator are also complete.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
2441.6	2247.7	2161.6	(193.87)	-7.9%	86.1	3.8%

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

Current period cost variance (CV) -$79.2K (-82.7%) is material driven by 1.5.10.3 RTBT Vacuum Sys.; whereas material was received and no BCWP taken. BCWP will be adjusted in next reporting period.

Project Impact: None.

Corrective Action: None.

WBS 1.5.12 – Technical Support

- Study of the effect of the beam pipe joints in the collimation region on the collimation efficiency was completed..
- Analysis of the necessary modifications in the ring to use the BPMs as clearing electrodes was completed, BPM could work also as clearing electrode (+- 1kV) without any hardware modification.
- Measurement and analysis of the extraction kicker coupling impedance with respect to the bus-bar height were completed.
- Measurements and analysis of the extraction kicker coupling impedance with C2050 type ferrite blocks was completed and decided that will use CMD5005 ferrite.
- Group is preparing for the DOE Review.
- Magnet polarities were defined for the installation and commissioning.
- Automated of global coordinate from dipole measurement was completed.
- Field quality in the injection chicane magnets was reviewed.
- A collective instability study using 3D space-charge routine is continuing.
- The faults studies of the ring and RTBT for the target requirement were finished. The reduced apertures in the target region did not increase losses. The study also finds that it is hard to violet target requirements without significant losses in ring and RTBT.
- Attended the ECLOUD02 workshop at CERN and began preparations for a trip to LBNL in June to work with M. Furman on benchmarking our electron cloud codes.

Variance Analysis (Cumulative to date) ($K)

BCWS	BCWP	ACWP	SV	%	CV	%
10690.6	10690.6	10544.3	0.00	0.0%	146.3	1.4%

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
We are reviewing comments and attempting to reproduce observations from tests made at ORNL of the revised gate array logic. There are no issues with the module hardware design or performance.

Documentation of the V124s has been signed off and an order for a 50 module production order is out on the "street" for bids.

V123s
The V123 bug of not passing on the interrupt acknowledge has been duplicated at BNL. A fix has been engineered and an updated prom sent to ORNL for evaluation.

Eventlink fanout-
A prototype pcb was received, built and preliminary testing has just been completed. Performance is excellent. We will release the drawings and get ready for a production order of 80 pieces.

V206
The prototype V206, RTDL input module, is built and testing is underway. All functions are working. Testing of interrupts remains to be completed.

WBS 1.9.2.2 –Timing Software

A prototype (rev. A) V108S utility module was received from LANL and installed in a test IOC. The software drivers were downloaded from LANL, configured and installed. Testing of the V108S module has begun, using the downloaded software.

During the next month the V124S timing decoder module will be tested in a similar fashion. When that testing is complete, these modules will be integrated with the power supply IOC application.

WBS 1.9.5.1 -Ring Controls Integration

VxWorks driver for ethernet-based temperature control module is complete. EPICS device support is in progress.

WBS 1.9.5.2 - Power Supply Controls

BNL is working with ORNL and LANL on a method to implement new requirements for power supply and magnet control. These include cycling the magnets, allowing the operator to set the

magnet field and other functions. The new functions will require more IOC software that may have an impact on the number of power supplies per IOC or CPU memory size. For instance it will require for each power supply a field versus current table, ramp rate and response time data be maintained. Algorithms to implement the requirements are being worked on.

We continue to test the Epics power supply hardware and software with a Danfysk SNS type supply. The figures below show some of the test results. Previously we were able to demonstrate the standard control and monitoring functions with an MEDM screen. The purpose of this test is to demonstrate the system could help detect power supply ripple and noise. It is the first opportunity available to get real data from a typical power supply. Figure 1 shows the power supply current waveform viewed at 100Hz (the typical sampling rate). Figure 2 and 3 show the same waveform viewed at higher frequencies. At the higher sampling rates, it is easy to see there is 60Hz and higher frequency ripple. Figure 4 shows two graphs. The top is the raw data. The bottom is an FFT of the data showing noise at 60, 120, 720, 1440Hz. The FFT is done using Labview. In the next months we will work on high-level software to make the operator interface more useful and friendly.

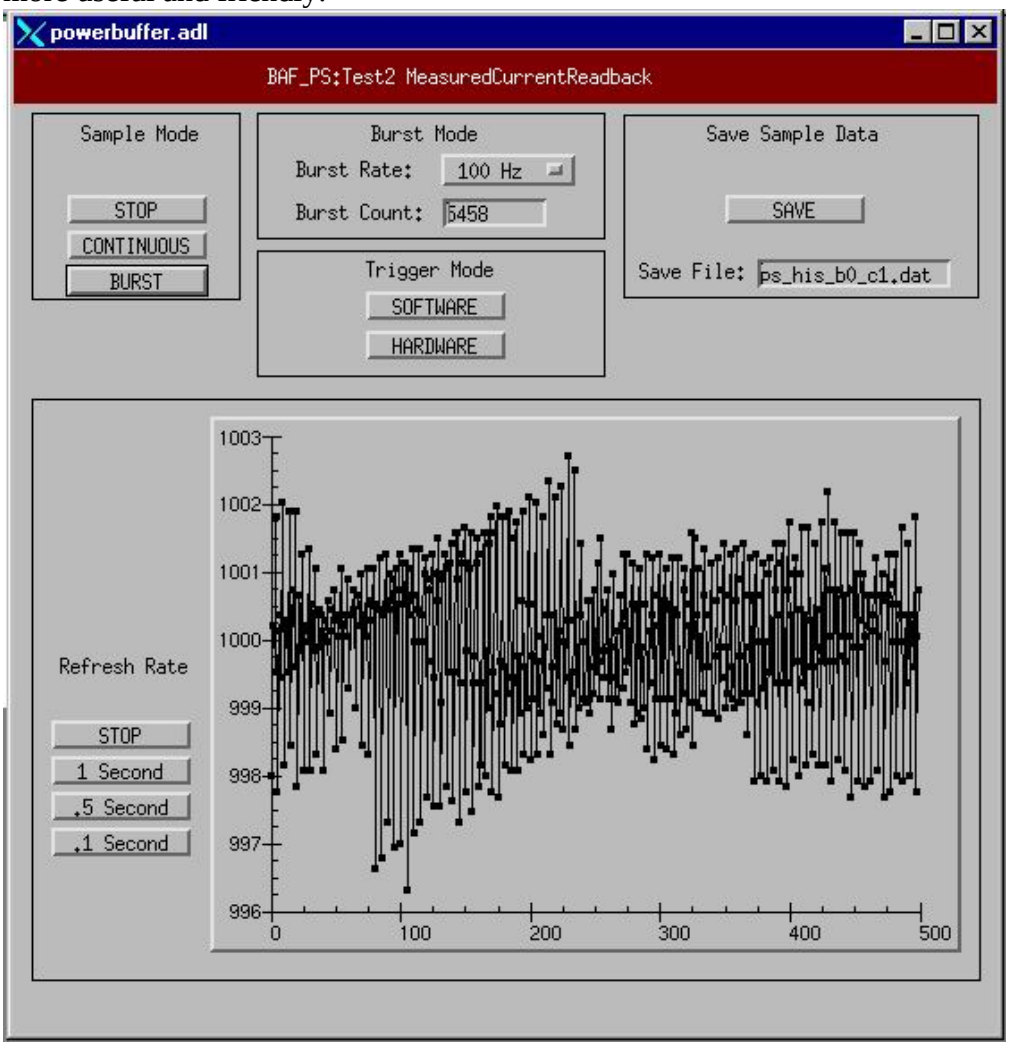


Figure 1 – Data taken at 100Hz

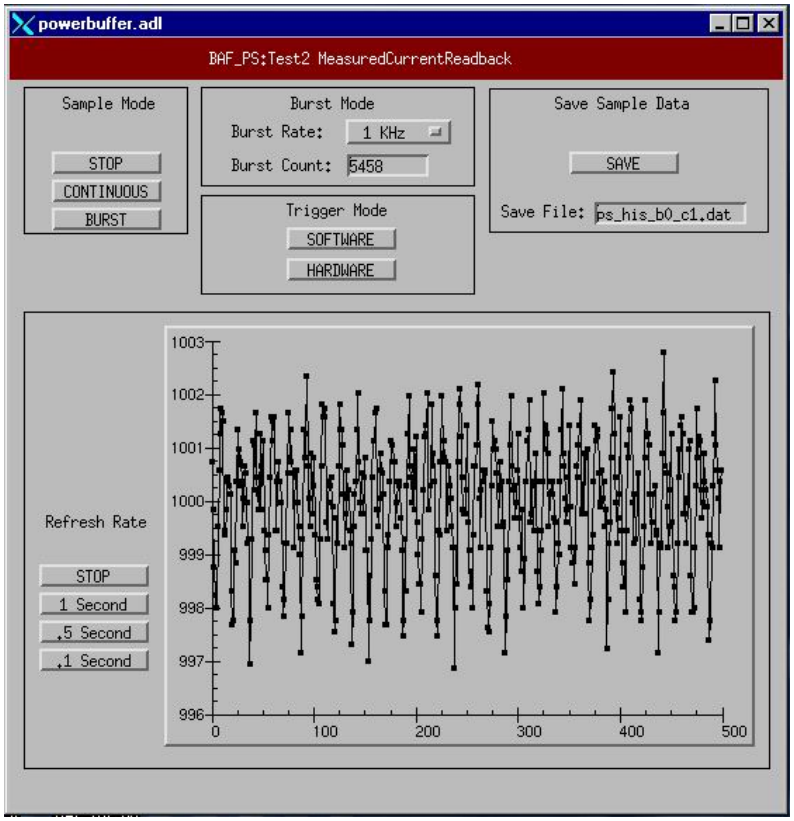


Figure 2 – Data Taken at 1,000Hz

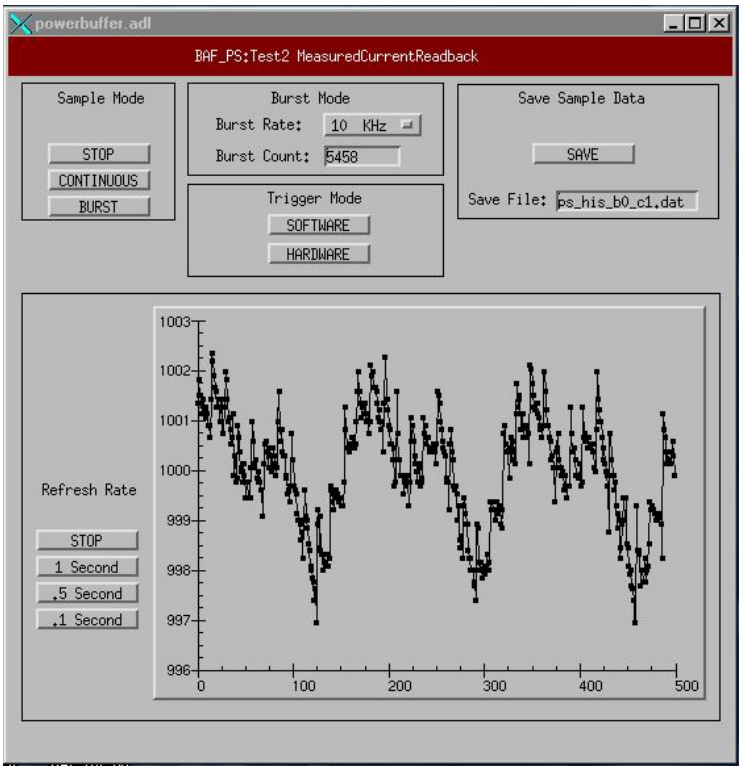


Figure 3 – Data Taken at 10,000Hz

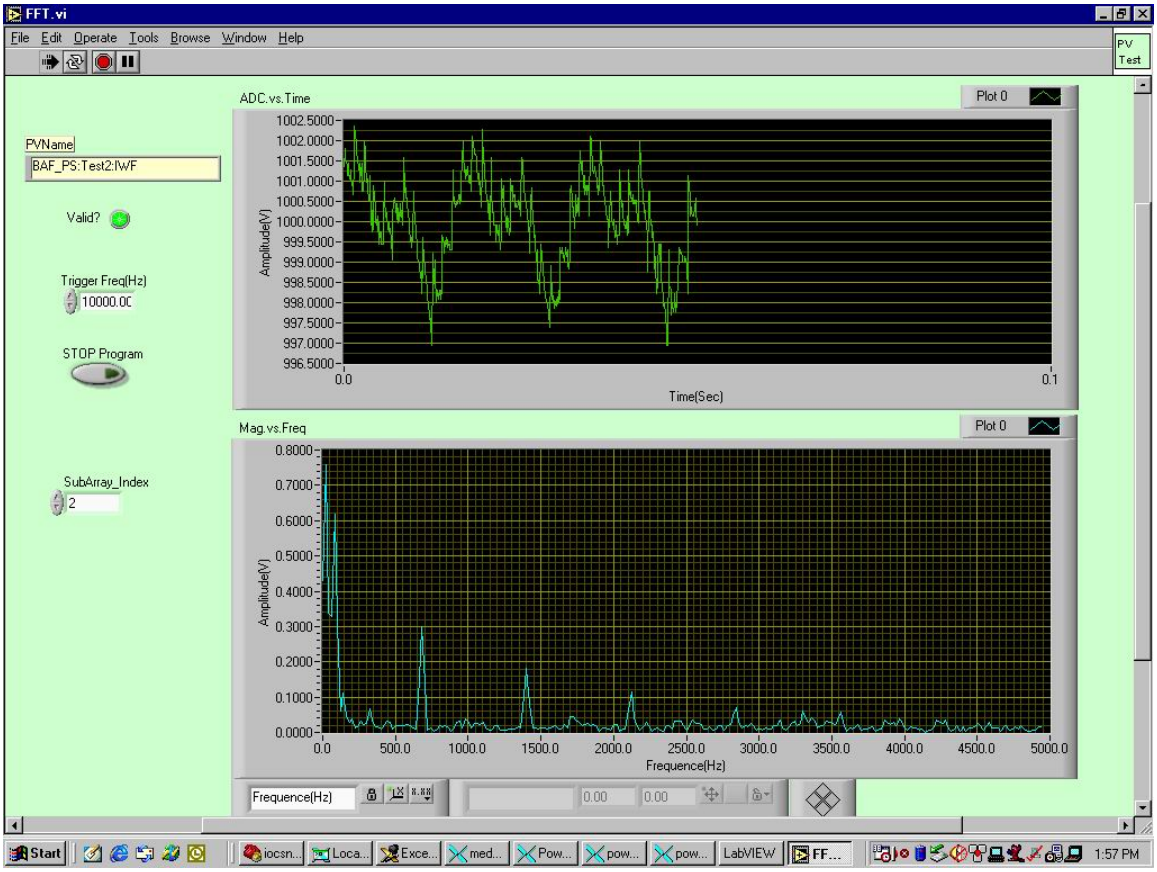


Figure 4 – Top is display of Raw Data Taken at 10,000Hz. Bottom is FFT of data.

WBS 1.9.5.3 – Diagnostics

Laser wire:

Laser wire Labview software is being used successfully in standalone mode but not yet integrated into EPICS.

IPM:

A high speed digitizer board was ordered. When received testing will be done to make sure it meets the requirements. The ADC board is similar to one used in the IPM system at RHIC.

WBS 1.9.5.4 - Vacuum

A vacuum test lab is being set up, which includes gauge controllers, ion pump controllers, and a PLC. The gauge and ion pump controllers interface to the IOC via serial lines, and the PLC via Ethernet. Drivers for the serial and Ethernet communication have been downloaded, but not tested yet.

WBS 1.9.5.5 - Application Software

Participated in the ICFA Advanced Beam Dynamic Workshop on High Intensity and High Brightness Hadron Beams (ICFA-HB2002), April 8-12, (http://www-bd.fnal.gov/icfa/workshops/20/) and presented the report an Application of the UAL to high-intensity beam dynamics studies in the SNS ring", (http://www-ap.fnal.gov/HB2002/viewgraphs/wed_wg1_malitsky.ppt).

Developed and studied the UAL-based applications for modeling the tune footprint measurement based on the kicker-BPM pair. The SNR Ring simulation model combines together several physical effects (such as errors, misalignments, space charge, etc.) and injection painting. To facilitate analysis and benchmarking of BPM data, the diagnostics simulation has been conducted into several consistent steps:

a. Injection painting in the design lattice without the beam energy spread. The simulation BPM turn-by-turn data successfully benchmarked with the analytical approach.
b. Injection painting in the design lattice with the beam energy spread. In this step, the tune footprint is not zero and determined by the lattice chromaticity multiplied by energy spread (~8*0.01). To find it, several applications with different kicker frequencies have been examined. The analysis of FFT signals is in progress.

WBS 1.9.5.6 – RF

The LLRF DSP module from Bittware is installed in a test IOC, along with the ORNL VxWorks kernel with PMC support. Work is underway to port the Bittware "Host Interface Library" to VxWorks.

IV. Earned Value Reports and Charts

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

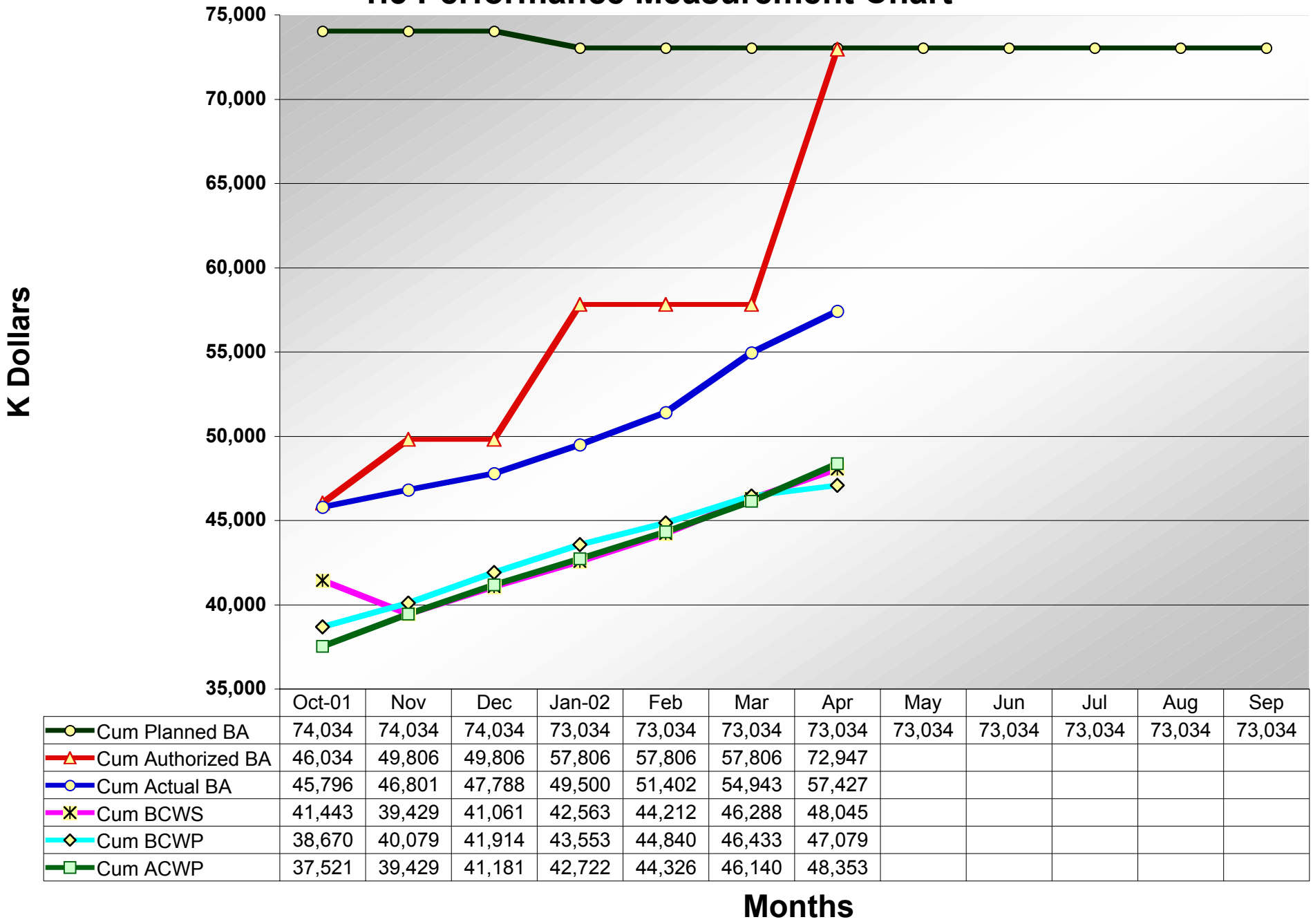
PROJECT TITLE: SPALLATION NEUTRON SOURCE	**REPORTING PERIOD:** 1-Apr-02 thru 30-Apr-02	**PROJECT NUMBER:** 99-E-334
		START DATE: October 1998
PARTICIPANT NAME AND ADDRESS: Brookhaven National Laboratory, Brookhaven, NY	**BCWS PLAN DATE:** October 1999	**COMPLETION DATE:** November 2006

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	8.1	8.1	23.60	0.0	(15.5)	5,076.3	5,076.3	5,106.9	0.0	(30.6)	5,115	5,115	0.0
1.5 Ring & Transfer Line System	1,757.3	645.5	2,212.2	(1,111.8)	(1,566.8)	48,044.9	47,078.6	48,352.6	(966.2)	(1,274.0)	113,367	113,367	0.0
1.5.1 HEBT (High Energy Beam Transport) Systems	127.0	22.3	188.0	(104.7)	(165.7)	4,358.1	4,082.3	4,010.4	(275.7)	72.0	10,149	10,149	0.0
1.5.2 Injection Systems	183.1	116.0	106.5	(67.1)	9.5	3,524.5	3,609.4	3,612.3	84.9	(2.9)	9,151	9,151	0.0
1.5.3 Magnet Systems	360.3	336.06	415.2	(24.2)	(79.1)	9,065.7	8,876.1	9,043.3	(189.7)	(167.3)	17,013	17,013	0.0
1.5.4 Power Supply System	14.6	13.3	29.0	(1.2)	(15.7)	894.3	895.3	912.7	1.0	(17.3)	3,524	3,524	0.0
1.5.5 Vacuum System	160.0	150.5	160.6	(9.5)	(10.1)	3,658.4	3,781.0	4,051.0	122.6	(270.0)	9,732	9,732	0.0
1.5.6 RF System	190.5	(668.9)	270.9	(859.4)	(939.8)	5,220.9	5,069.8	5,555.2	(151.2)	(485.5)	12,107	12,107	0.0
1.5.7 Ring Systems Diagnostic Instrumentation	189.3	156.2	344.7	(33.1)	(188.5)	5,225.1	5,076.6	5,701.2	(148.6)	(624.6)	14,374	14,374	0.0
1.5.8 Collimation and Shielding	40.6	43.4	36.9	2.8	6.5	1,596.7	1,415.2	1,390.1	(181.5)	25.1	3,418	3,418	0.0
1.5.9 Extraction System	65.0	53.5	90.9	(11.6)	(37.4)	1,368.1	1,333.9	1,369.9	(34.2)	(36.0)	6,144	6,144	0.0
1.5.10 RTBT (Ring to Target Beam Transport) System	99.6	95.8	175.0	(3.9)	(79.2)	2,441.6	2,247.7	2,161.6	(193.9)	86.1	7,466	7,466	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	327.3	327.3	394.5	0.0	(67.2)	10,690.6	10,690.6	10,544.3	0.0	146.3	20,287	20,287	0.0
WBS SUBTOTAL	1,765.4	653.6	2,235.8	(1,111.8)	(1,582.3)	53,121.2	52,154.9	53,459.5	(966.2)	(1,304.6)	118,482		
UNDISTRIBUTED BUDGET													
SUBTOTAL	1,765.4		2,235.8			53,121.2		53,459.5			118,482		
MANAGEMENT RESERVE													
TOTAL	1,765.4		2,235.8			53,121.2		53,459.5			118,482		

RECONCILIATION TO CONTRACT BUDGET BASE

DOLLARS EXPRESSED IN:	SIGNATURE OF PARTICIPANT'S PROJECT DIRECTOR:	DATE:
THOUSANDS	Jie Wei	May 20, 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					
Cum Actual BA	45,796	46,801	47,788	49,500	51,402	54,943	57,427					
Cum BCWS	41,443	39,429	41,061	42,563	44,212	46,288	48,045					
Cum BCWP	38,670	40,079	41,914	43,553	44,840	46,433	47,079					
Cum ACWP	37,521	39,429	41,181	42,722	44,326	46,140	48,353					