

Status Report: 23
Status as of: 31 January 2003

Contract Title:

BOOSTER
APPLICATIONS
FACILITY



Performing Organization:
Location:

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

Reporting Period:

December 1, 2002 – January 31, 2003

1) Project Objective:

The purpose of this project is to provide a new experimental facility and beam line and undertake accelerator modifications required to take advantage of heavy-ion beams from the Brookhaven AGS Booster accelerator for radiation effects studies of importance for the NASA Space Program.

Heavy ions will originate in the Brookhaven MP-6 tandem accelerator and be transported to the Booster synchrotron for acceleration to the required energies.

Concurrent operation of the Booster for space radiation research and other kinds of research applications will be achieved by utilizing independent tandem injectors. The beam species and energy for both applications will be independent. Beams from either Tandem will be switched into the common injection line. At the Booster a new slow extraction system will be implemented which will require extensive accelerator modifications and rearrangements. A new beam line and tunnel enclosure will be built to transport the extracted beam to the experimental facility. Uniform beam intensities will be provided over rectangular areas ranging in size from about 1 cm to about 20 cm.

Other existing on-site facilities, such as the medical Department's extensive animal handling installations will also be utilized. Dosimetry and local access control will be provided through a local facility control room.

The conventional facilities to be constructed for the Booster Applications Facility will provide experimental space and support facilities. A labyrinth connects the experimental area with the laboratory support building. The target room is provided with a concrete beam stop imbedded in the back wall. The entire facility is shielded by 15 feet of earth equivalent shielding over the top of the target rooms and transport lines. The laboratory building contains support laboratories, including temporary biological specimen holding and preparation areas, as well as radiological laboratories for work with cell cultures and tissues. Also included are a dosimetry control room, a mechanical service equipment area and rooms for radioactive storage and miscellaneous items.

Power supplies for the beam transport magnets and various other equipment will be located in a power supply building, a pre-engineered steel frame construction.

The funds requested will also provide for spares and facility commissioning.

2) Technical Approach Changes:

No change.

Project Head's Summary Assessment:

	<u>Last Month</u>	<u>This Month</u>
Cost:	satisfactory	satisfactory
Schedule	satisfactory	satisfactory
Technical	satisfactory	satisfactory
Overall	satisfactory	satisfactory

W.B.S. 1.0 BAF Construction Summary: All systems are complete except for Controls , Dosimetry and Experimental area outfitting. The Commissioning effort focused on fault studies for the verification of radiation shielding integrity of the relevant Booster modifications.

W.B.S 1.1 Conventional Construction: Complete

W.B.S. 1.2Booster Modifications: Complete

W.B.S. 1.3 Beam Transport System : Complete

The last instrumentation items were installed during this reporting period, completing this WBS.

W.B.S. 1.4 Controls and Personnel Safety System

Controls: 97 % complete.

1.4.1.1 Distributed Systems: Complete

1.4.1.2 Central Services:

Pre-commissioning coding of software was completed with the exception of the addition of timing parameters for operation with the dosimetry system. Those will be added during integration of that system. Final integration testing of several systems with beam will require further software support.

1.4.1.3 Process controls: VME installation in building 958: All required equipment was installed except for the V128 module, which was in test. Fiber-optic connections remain to be completed. Final checkout awaits dosimetry system installation.

Permit hook up in buildings 914, 930A, & 930UEB – Installation of permit monitors was complete and cabling to power supplies was being finished.

1.4.2 Personnel Safety System: Complete

W.B.S. 1.5 Experimental Area Outfitting:

1.5.1 Dosimetry Control: 88% complete

The first official release of the software has been tested and shipped to BNL for further testing. Documentation will be sent by the end of this week. The current version of the hardware-software interface document (V23) has been shipped to BNL as part of the software release.

The remaining ion chambers and associated cables and collection chassis have been shipped to BNL.

Four broken foils on the binary filter are being repaired. When that's done (by mid-February) a box and protective end plates will be constructed and the device will be shipped to BNL.

Thermally unstable resistors in the HV interface box have been replaced and tested. The ADC module needs to be calibrated by Peter Oddo (BNL).

Two shorts in the large VME crate have been fixed. All crates will be shipped to BNL after testing by LBNL and BNL personnel in Berkeley at the end of February.

The recycling integrator front panel blanks have been shipped to BNL, but the silkscreen pattern has to be updated before they are silk-screened.

The first production recycling integrator board will arrive next week. The prototype accelerator interface control module board is being stuffed.

The C-AD staff responsible for the dosimetry system are going to LBNL the last two weeks in February for training and an end-to-end test of the system.

Optical table nearly complete (needs grouting and some finishing touches to the removable parts)

Ion chambers complete and delivered.

Cables thereof are complete, delivered and installed.

1.5.2 Support Rooms: 90 % complete

The following were purchased for general use, including the User Ready Room: mobile file cart and file holders for instruction manuals, warrantee cards, etc., aluminum ladder, Kik step stools, white Magnalux board (white erasable-marker and magnetic board) and Melamine Shoe Cube for storage of street/inside shoes. For Support Room C, stainless shelves for Belco dry incubators were purchased and set into place. Chairs were purchased for use at the Biological Safety Cabinet, computer station and laboratory benches. Wall-mount brackets for carbon dioxide cylinders (for Biological Safety Cabinets) were purchased and delivered to D. Phillips for installation. Three stainless steel tables were purchased and placed in service holding the CO₂ incubators.

W.B.S. 1.6 Long Term Support Lab: Outfitting 98% complete.

W.B.S. 1.7 Installation and Services: Complete.

Commissioning: Several fault studies were completed. These will allow for future work with deuterons in the BAF transport line. The 20 degree bend power supply works well enough to allow beam commissioning but it still does not meet design specifications. The vendor has been supplying technical support to resolve the remaining issues.

W.B.S. 1.8 Project Services

1.8.1.1.1 Project Management: With the completion of the beam line instrumentation in late January, the Project milestone Beam Transport Installation was completed one month behind schedule. This delay has no impact on the Project overall schedule.

1.8.2 Fiscal: The Project has received \$1,200,000 in incremental funding during this reporting period. The project is now fully funded.

1.8.3 Environment, Safety and Health: The Accelerator Readiness Review process has moved to the second phase: Experimental Equipment Ready for Commissioning.

Quality Assurance: No issues.

3) Summary Status Assessment and Forecast

a) Financial Status

A total of \$32,092,558 was expensed or obligated of the \$33,904,765 available. Costs represented \$31,870,615 and open commitments stood at \$221,943. The Project Total Estimated Cost (TEC) is \$31,767,000. The Total Project Cost (TPC) is at \$33,904,765.

b) Table II shows detailed expenses and commitments.

c) Table III shows the projected project spending profile.

d) Schedule Status

<u>Milestones completed</u>	<u>Baseline</u>	<u>Actual</u>
Title I Start	11/01/98	11/01/98
Booster Modification Start	04/01/99	04/01/99
Title II Start	04/01/99	04/01/99
Title I Complete	06/31/99	06/31/99
Conventional Construction-Start	08/15/99	08/15/99
Booster Penetration Complete	10/15/99	10/29/99
Title II Complete	06/30/00	06/30/00
Beam Transport Design-Complete	09/30/00	09/30/00
Booster Mod. Design-Complete	06/30/01	06/30/01
Safety Analysis Document (SAD) Complete	09/30/01	06/15/01
Conventional Construction Complete	06/30/02	07/31/02
Booster Modification Installation Complete	09/30/02	09/30/02
Beam Line Installation Complete	12/31/02	01/24/03

<u>Milestones Upcoming</u>	<u>Baseline</u>	<u>Forecast</u>
Experimental Equipment Installation Complete	12/31/02	03/31/03

e) The critical path for the Project is indicated in Figure 1. With the completion of the Beam Transport System Milestone, the critical path has moved from WBS 1.3 to Experimental Equipment Installation effort in WBS 1.5.

f) Baseline change proposals: none

g) Cost Performance: Figure 2 provides a measure of project performance relating the planned budget profile versus expenses and commitments. Obligations were \$507,000 less than

planned, and expenses were \$538,000 less than forecast. These differences are not significant at this stage of the Project.

Table I
BAF Project Milestones

	<u>Projected</u>
Project Start	10/01/98
Title I Start (Preliminary Design)	11/01/98
Booster Modification Design Start	04/01/99
Title II Start (Final Design)	04/01/99
Title I Complete	06/31/99
Conventional Construction Start	08/15/99
Booster Penetration Complete	10/15/99
Title II Complete	06/30/00
Booster Modifications Design Complete	06/30/01
Beam Transport System Design Complete	09/30/00
Safety Analysis document (SAD) Complete	09/30/01
Conventional Construction Complete	07/31/02
Booster Modifications Installation Complete	09/30/02
Beam Transport System Installation Complete	12/30/02
Experimental Equipment Installation Complete	03/31/03
Project Complete	06/30/03

Figure 1

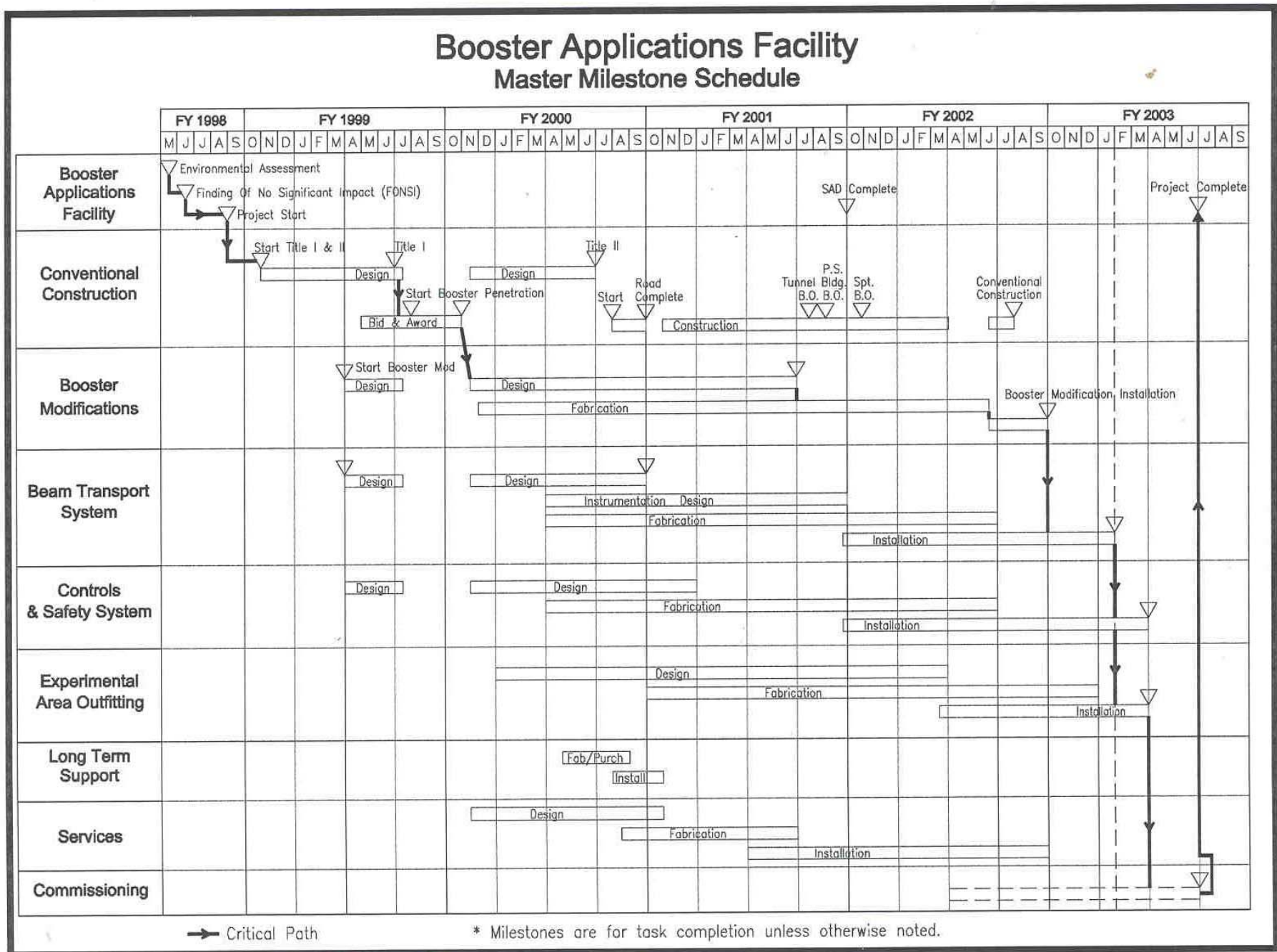


Figure 2

FY03 BAF Performance Measurement

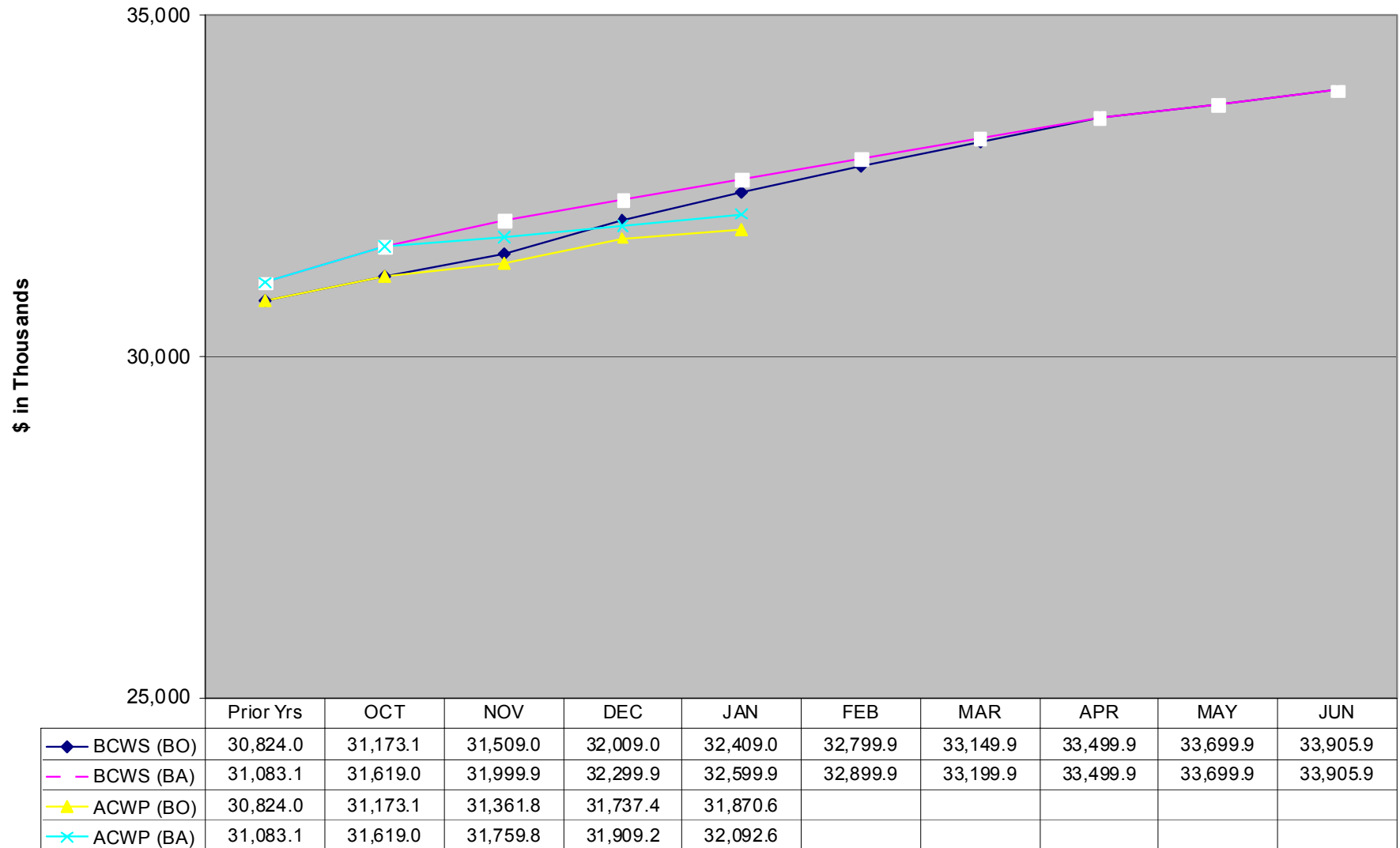


TABLE II
BOOSTER APPLICATIONS FACILITY (BAF)
EXPENSE and COMMITMENTS
As of January 31, 2003

	Budget	Salary & Wage	EXPENSES Other Labor	Material & Contracts	Overhead	TOTAL EXPENSES	COMMIT.	TOTAL EXP. & COMMIT	BALANCE AVAILABLE
1.1 Conventional Construction	6,635,000	133,094	984,081	4,923,058	602,725	6,647,958	0	6,647,958	(12,958)
1.2 Booster Modifications	6,089,000	2,181,196	722,524	2,161,598	997,411	6,062,729	44,477	6,077,206	11,794
1.3 Beam Transport System	5,671,000	2,181,256	400,051	2,165,550	896,540	5,643,397	42,562	5,685,959	(14,959)
1.4 Controls & Personnel Safety System	1,782,000	713,361	145,893	589,665	296,241	1,745,160	5,927	1,751,087	30,913
1.5 Exp. Area Outfitting	3,624,000	106,733	43,675	2,982,271	285,731	3,418,410	48,748	3,467,158	156,842
1.6 Long Term Support Lab	456,000		2,095	374,077	68,987	445,159	1,697	446,856	9,144
1.7 Installation & Services	3,671,000	1,017,152	288,703	1,867,581	477,616	3,651,052	0	3,651,052	19,948
1.8 Project Services	3,589,000	1,078,297	99,006	303,166	1,730,669	3,211,138	688	3,211,826	377,174
CONTINGECY	250,000					0		0	250,000
SPARES	844,000	75,128	74,887	481,745	123,910	755,670	19,264	774,934	69,066
Commissioning	1,293,765	183,956	8,783	17,776	79,427	289,942	88,580	378,522	915,243
1 BAF Construction	33,904,765	7,670,173	2,769,698	15,871,487	5,559,257	31,870,615	221,943	32,092,558	1,812,207

TABLE III
BOOSTER APPLICATIONS FACILITY (BAF)
COST ESTIMATE
Spending Profile
(\$ in Thousands)

WBS	ELEMENT	TOTAL	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
1.1	Conventional Construction	6,635	290	80	4,628	989	648	0
1.2	Booster Modifications	6,089		282	1,747	1,886	2,074	100
1.3	Beam Transport System	5,671		56	961	2,547	1,927	180
1.4	Controls & Personnel Safety System	1,782		8	497	579	563	135
1.5	Exp. Area Outfitting	3,624		0	1,200	679	1,385	360
1.6	Long Term Support Lab	456		0	343	0	113	0
1.7	Installation & Services	3,671		9	1,237	1,117	1,293	15
1.8	Project Services	3,589	10	165	985	650	1,329	450
		31,517	300	600	11,598	8,447	9,332	1240
	Contingency	250	0	0	0	0	0	250
1 (TEC)	BAF Construction (BA AY \$)	31,767	300	600	11,598	8,447	9,332	1,490
	Spares	844			50	266	337	191
	Commissioning	1,294					175	1,119
1 (TPC)	Total Project Cost (BA AY \$)	33,905	300	600	11,648	8,713	9,844	2,800
1 (TPC)	BAF Construction (BO AY \$)	33,905	300	600	5,348	11,932	12,644	3,081

TABLE IV
BAF CHANGE CONTROL
\$1000's

Date	Change No.	W.B.S.		Base Line	Change	Adjusted Base Line	Contingency Increase (Decrease)	Contingency Balance	Description
06/30/00	1	1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8	Contingency Overhead Escalation FCR	3,803 3,742 4,478 1,236 2,710 851 1,708 1,129 3,796 4,649 1,912 993	870 1,109 1,160 321 358 104 463 2,129 1,037 0 0 0	4,673 4,851 5,638 1,557 3,068 455 2,171 3,258 4,833 0 0 0	4,833	4,833	Modified WBS elements to include overhead, escalation and FCR.
08/31/00	2	1.1		4,673	425	5,098	(425)	4,408	Vendor bid exceeded estimate
08/31/00	3	1.7		2,171	68	2,239	(68)	4,340	Vendor bid exceeded estimate
11/30/00	4	1.0		31,100	800	31,900	200	4,540	Modified spending profile to coincide with NASA operating plan
11/30/00	5	1.0		Changed Project Completion Date from 09/30/02 to 06/30/03					Modified schedule to match spending profile
11/30/00	6	1.3		Changed Completion Date from 04/31/02 to 09/30/02					Modified schedule to match spending profile
11/30/00	7	1.4		Changed Completion Date from 05/30/02 to 03/31/03					Modified schedule to match spending profile
11/30/00	8	1.5		Changed Completion Date from 06/30/02 to 03/31/03					Modified schedule to match spending profile
11/30/00	9	Commissioning		Changed Completion Date from 09/30/02 to 06/30/03					Modified schedule to match spending profile
11/30/00	10	1.1		5,098	600	5,698	(600)	3,940	Vendor Change orders to cover soil conditions, upgrading water line under beam tunnel & Plant Engineering oversight
11/30/00	11	1.2.1		1,122	200	1,322	(200)	3,740	Design effort exceeded estimate
11/30/00	12	1.2.2		2,182	200	2,382	(200)	3,540	Vendor bid exceeded estimate
11/30/00	13	1.7.1		353	200	553	(200)	3,340	Substation reconditioning more extensive than estimated

TABLE IV
BAF CHANGE CONTROL
\$1000's
(continued)

Date	Change No.	W.B.S.		Base Line	Change	Adjusted Base Line	Contingency Increase (Decrease)	Contingency Balance	Description
11/30/00	14	1.7.2		641	300	941	(300)	3,040	Detailed design increased cost
12/30/00	15	1.3.2		1,513	(250)	1,263	250	3,290	Vendor bids lower than estimate
12/30/00	16	1.3.4		2,007	(150)	1,857	150	3,440	Detailed design resulted in lower device costs
12/30/00	17	1.3.1		599	400	999	(400)	3,040	Vendor bids exceeded estimate, design effort exceeded estimate
12/30/00	18	1.2		Booster Modification Completion Date changed from 10/31/01 to 08/31/02					RHIC operating schedule modified, eliminating FY01 summer shutdown
01/20/01	19	1.2		Design complete extended from 12/31/00 to 06/30/01					Design effort extended due to loss of personnel
09/30/01	20	1.8		3,659	160	3,499	160	3,200	Reduced budget due to projected lower project burden and fiscal and FS&H expenses.
09/30/01	21	1.2.1		1,322	100	1,422	(100)	3,100	Design effort increased.
09/30/01	22	1.2.2		2,382	100	2,482	(100)	3,000	Buss work design effort increased.
09/30/01	23	1.7		2,739	160	2,899	(160)	2,840	Higher than expected Vendor bids
11/30/01	24	1.1		5,689	602	6,300	(602)		Increase required for HVAC controls, doors and canopy at alcove, HVAC duct work, structural steel work, berm liner, engineering and inspection and overhead cost increases
11/30/01	25	1.2.1		1,422	50	1,472	(50)	2,188	Increase required for D3 septum development.
11/30/01	26	1.2.2		2,482	50	2,532	(50)	2,138	Buss work fabrication for D3 and D6 power supply installation.
11/30/01	27	1.3.1		999	25	1,024	(25)	2,113	Increase required for magnet monitoring system and octupoles.
11/30/01	28	1.7		2,899	197	3,096	(197)	1,916	Increase required for electrical distribution system transformer rework and cooling system changes for power supplies.
01/31/02	29	1.1		6,300	300	6,600	(300)	1,616	Increased cost for engineering oversight.

TABLE IV
BAF CHANGE CONTROL
\$1000's
(continued)

Date	Change No.	W.B.S.		Base Line	Change	Adjusted Base Line	Contingency Increase (Decrease)	Contingency Balance	Description
01/31/02	30	1.2.1		1,472	100	1,572	(100)	1,516	Development and manufacturing costs exceeded estimates.
01/31/02	31	1.2.3		1,547	200	1,347	200	1,716	Design and manufacturing costs lower than estimate.
01/31/02	32	1.3.1		1,024	200	1,224	(200)	1,516	Fabrication and procurement exceeded estimate.
01/31/02	33	1.3.2		1,263	300	963	300	1,816	Procurement costs lower than estimate.
01/31/02	34	1.3.3		1,620	100	1,720	(100)	1,716	Fabrication costs exceeded estimate.
01/31/02	35	1.4.2		486	100	586	(100)	1,616	Design change added costs to building access system.
3/31/02	36	1.2.1		1,572	50	1,622	(50)	1,566	Cover increased manufacturing costs for thin septum magnet
3/31/02	37	1.2.2		2,532	150	2,682	(150)	1,416	Cover installation effort and materials for power supplies
3/31/02	38	1.5.1		2,706	296	3,002	(296)	1,120	Additional software and hardware effort required to complete Dosimetry system
3/31/02	39	1.7.3		1,245	50	1,295	(50)	1,070	Increased effort in survey and installation coordination
3/31/02	40	1.8.4		122	165	287	(165)	905	Funding to re-rout storm line located under Booster B 6 Dump
3/31/02	41	Spares		1,294	450	844	450	1,355	Spares estimate more than as built shops and manufacturer's costs
5/31/02	42	1.1		6,600	60	6,660	(60)	1,295	Cost increase for retaining wall
5/31/02	43	1.2.1		1,622	50	1,672	(50)	1,245	Magnet measurement cost increase
5/31/02	44	1.3.1		1,224	(135)	1,089	135	1,380	Magnet system came in under budget
5/31/02	45	1.7.1		685	25	710	(25)	1,355	Re-installation of repaired transformer
5/31/02	46	1.7.2		1,151	100	1,251	(100)	1,255	Control system cost increases
5/31/02	47	1.7.3		1,295	250	1,545	(250)	1,005	Rigging and survey costs exceeded estimates
5/31/02	48	1.8.4		287	75	362	(75)	930	Beam dump cap under estimated
7/31/02	49	1.1		6,660	(25)	6,635	25	955	Credits from Vendor
7/31/02	50	1.2.1		1,672	93	1,765	(93)	862	Installation underestimated
7/31/02	51	1.2.2		2,682	110	2,792	(110)	752	Buss work had to be reworked

TABLE IV
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\$1000's
(continued)

Date	Change No.	W.B.S.		Base Line	Change	Adjusted Base Line	Contingency Increase (Decrease)	Contingency Balance	Description
7/31/02	52	1.2.3		1,347	(16)	1,331	16	768	Work over estimated
7/31/02	53	1.4.2		586	65	651	(65)	703	Installation costs underestimated
7/31/02	54	1.7.1		710	10	720	(10)	693	Added installation effort
7/31/02	55	1.7.2		1,251	10	1,261	(10)	683	Increased costs
7/31/02	56	1.7.3		1,545	115	1,660	(115)	568	Survey and rigging cost underestimated
7/31/02	57	1.8.4		362	50	412	(50)	518	Requirements underestimated for Dump Cap
7/31/02	58	1.3.3		1,720	(138)	1,582	138	656	Job overestimated
9/31/02	59	1.2.2		2,792	25	2,817	(25)	631	Water cooled bus system required extensive rework
9/31/02	60	1.2.3		1,331	76	1,407	(76)	555	D6 half cell required modification
11/30/02	61	1.2.1		1,765	25	1,790	(25)	530	Installation redone because of component rework
11/30/02	62	1.2.2		2,817	75	2,892	(75)	455	Rework of water cooled buss
11/30/02	63	1.3.1		1,089	35	1,124	(35)	420	Low field magnet measurements and installation hardware
11/30/02	64	1.3.4		1,857	145	2,002	(145)	275	Instrumentation production cost increase
11/30/02	65	1.4.2		651	60	711	(60)	215	System documentation costs underestimated.
11/30/02	66	1.7.1		720	15	735	(15)	200	Labor costs underestimated
11/30/02	67	1.8.1		1,089	(35)	1,054	35	235	Management oversight costs reduced
11/30/02	68	1.8.2		412	(50)	362	50	285	Fiscal oversight costs reduced
11/30/02	69	1.8.4		412	50	462	(50)	235	ES&H oversight costs reduced
11/30/02	70	1.9.2		1,405	(110)	1295	110	345	Commissioning costs re-estimated
11/30/02	71	1.8.5		1,835	(165)	1670	165	510	Burdens and space charges re-estimated
11/30/02	72	1.5.1		3,002	260	3,262	260	250	Beam line target area support systems funded.