Status Report: 22
Status as of: 30 November 2002

Contract Title:

BOOSTER APPLICATIONS FACILITY

Performing Organization: Brookhaven Science Associates
Location: Brookhaven National Laboratory
Upton, New York 11973-5000

Reporting Period: October1, 2002 – November 30, 2002

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:

	Last Month	This Month
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 Beam Line Instrumentation, Controls, Dosimetry and Experimental area outfitting. Commissioning continues and beam was successfully extracted from the Booster into the beam line.

W.B.S 1.1 Conventional Construction: Complete

W.B.S. 1.2Booster Modifications: Complete

W.B.S. 1.3 Beam Transport System

1.3.1 Magnets: Complete.

1.3.2 Power Supplies**:** Complete

1.3.3 Vacuum System: Complete

1.3.4. Instrumentation: 98% complete.

1.3.4.1 Flags & Cameras

All flags in vacuum are complete. Fabrication of components for the flag and flag motion system for the Experimental Area is complete and assembly is in progress. All mirror and cameras along the vacuum line are complete. Fabrication of components for the camera system for the Experimental Area is complete and assembly is in progress.

1.3.4.2 Collimators. Beam Plug Complete.

WBS 1.3.4.3 & 1.3.4.4 Ion Chamber, Scintillator & SWIC's

All instruments in vacuum are complete. Fabrication of all components for the instruments and motion system for the Experimental Area is nearly complete. Assembly with currently finished components is in progress.

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

Controls: 93 % complete.

1.4.1.1 Distributed Systems:

The first article V128 module that will be used for the dosimetry interface logic was received.

1.4.1.2 Central Services:

Wave Form Generator (WFG) control of MM spill servo, septa, bumps, sextupoles, tune trims

Status: Software was successfully commissioned. Some follow-up work is planned : start WFGs automatically, revise status reporting, and provide special behavior during state transitions.

Optics Control application Status: Software commissioned.

Delay Module (V202) Accelerator Device Object (ADO) Status: Commissioned. Two modules have been used for spill servo tests and for extraction septum timing.

Beam line Instrumentation control and data acquisition Status: SWIC and scaler software commissioned. Upstream systems were used during BAF extraction tests. Flag driver and server software was ready for final configuration and test with existing display software.

Pulse-to-Pulse-Modulation support for ADOs Status: Software has been commissioned.

Status: Software commissioned and in use. Some minor additions to PLC software are planned.

1.4.1.3 Process controls:

All power supplies in the BAF system were run via the control system and interface operation has been verified. The D3 and D6 septa WFG interfaces have been replaced by PSC units used for dc power supplies. Ramped waveforms were judged unnecessary on the basis of commissioning experience. The PSCs will also provide access to digital read-backs that were not available.

1.4.1.4 Personnel Safety System: Complete

W.B.S. 1.5 Experimental Area Outfittng:

1.5.1 Dosimetry Control:

Hardware:
Ion Chambers: Complete, being prepared for shipping to BNL
Cables for IC's: Complete, being labeled and readied for shipping to BNL
Binary Filter: Complete. Staying in Berkeley for the full test in January.
VME Crates: Set up for the January End-To-End test at Berkeley
Recycling Integrator Boards: In manufacturer's hands
Irradiation Control Module Boards: Not yet handed to manufacturing.

Software:
Software is complete. That is, the control routines are written, the user-interface is in place and working. A copy of all these is now in the hands of the BNL dosimetry team. What is being worked on now is the software-hardware interface, in the end-to-end test setup at Berkeley. Full control of the binary-filter through this interface as well as the one-channel recycling integrator prototype board has been achieved.

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

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

Commissioning: The highlight of this reporting period was the successful extraction of gold ions into the beam line on the evening of October 23. This demonstrated that the Booster modifications were

successful and the basic slow extraction system design worked. Beam was observed on the first and second “flags” in the beam line.

Several technical issues were uncovered during the commissioning efforts, as well as one significant equipment failure.

The failure being resolved is the D6 foil stripper /flag assembly, which seized while in service. Since the failed assembly is still in the ring, failure modes were identified during an 18 hour endurance test of the spare. The test included 'in service' conditions of vacuum, bake-out, and control system cycling. The spare assembly is now being modified to eliminate the suspected cause
In addition, for the D6 the magnet assembly, a redesign of the back leg conductors is in process. While this conductor design has been used in other magnets, the higher bake-out temperatures needed for the Booster caused higher stresses and weld joint failure. The revised design will eliminate the welded joints in each of the four conductors.

Booster Main Magnet Power Supply commissioning for Slow Extraction continued. The latest version of the controls program has been released and tested. The spill servo function has been tested and now works correctly. This system was not working during the beam commissioning, and so is a significant milestone. The back emf in the active filter has been measured, and the worst case peak to peak voltage observed is about 18 volts . Tuning of the firing modules on 1AB section of the Power Supply (at 3000 amp) reduced the harmonics at 240, 300, 360, and 420 Hz.

Commissioning of the beam line power supply for the 20 degree bend has not been successful. The supply cannot operate above 1600 amp (or roughly 1/2 current rating) with the magnets as a load. At higher currents the power supply goes into oscillations. The vendor is current working with BNL on this problem.

W.B.S. 1.8 <u>Project Services</u>

1.8.1 Project Management: In consultation with the DOE Project Manager $305,000 was assigned from contingency. This leaves a balance of $250,000 on $1,895,929 remaining to be expensed and committed. The details of these actions are outlined in section 3(f) and Table IV.
The Project was reviewed by NASA and DOE on October 24.

1.8.2 Fiscal: The Project has received $1,600,000 in incremental funding during this reporting period.

1.8.3 Environment, Safety and Health: The Accelerator Readiness Review process is well underway and approval was completed for the first stage of Project commissioning with extracted beam.

Quality Assurance: No issues.

3) Summary Status Assessment and Forecast

a) Financial Status

A total of $31,759,836 was expensed or obligated of the $32,305,000 available. Costs represented $31,361,769 and open commitments stood at $398,067. The Project Total

Estimated Cost (TEC) is $31,767,000. The Total Project Cost (TPC) is at $33,905,765.

b) Table II shows detailed expenses and commitments.

c) Table III shows the projected project spending profile.

d) Schedule Status

Milestones completed	Baseline	Actual
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

Milestones Upcoming	Baseline	Forecast
Beam Line Installation Complete	12/31/02	12/31/02

e) The critical path for the Project is indicated in Figure 1. With the completion of the Booster Modifications and successful extraction of beam, the critical path has moved from WBS 1.2 to the beam line installation effort in WBS1.3..

f) Baseline Change Proposals – During this reporting period, the budgets for the following WBS.'s were augmented/decreased with transfer of funds to and from contingency. The justifications for the modifications are given in Table IV. There is no change in scope or total project cost.

WBS	Description	New Budget
1.2.1	New Extraction Equipment	$1,790,000
1.2.2	Power Supplies	$2,892,000
1.3.1	Magnets	$1,124,000
1.3.4	Instrumentation	$2,002,000
1.4.2	Personnel Safety System	$711,000
1.5.1	Dosimetry Control	$3,262,000
1.7.1	Electric Power Distribution	$735,000
1.8.1	Project Management	$1,054,000
1.8.2	Fiscal	$362,000
1.8.4	ES&H	$462,000
1.8.5	Burdens & Space Charge	$1,670,000
1.9.1	Commissioning	$1,295,000

g) Cost Performance: Figure 2 provides a measure of project performance relating the planned budget profile versus expenses and commitments. Obligations and expenses were $240,000 less than planned, and expenses were $147,000 less than forecast. These differences are not significant at this stage of the Project.

Table I
BAF Project Milestones

	Projected
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

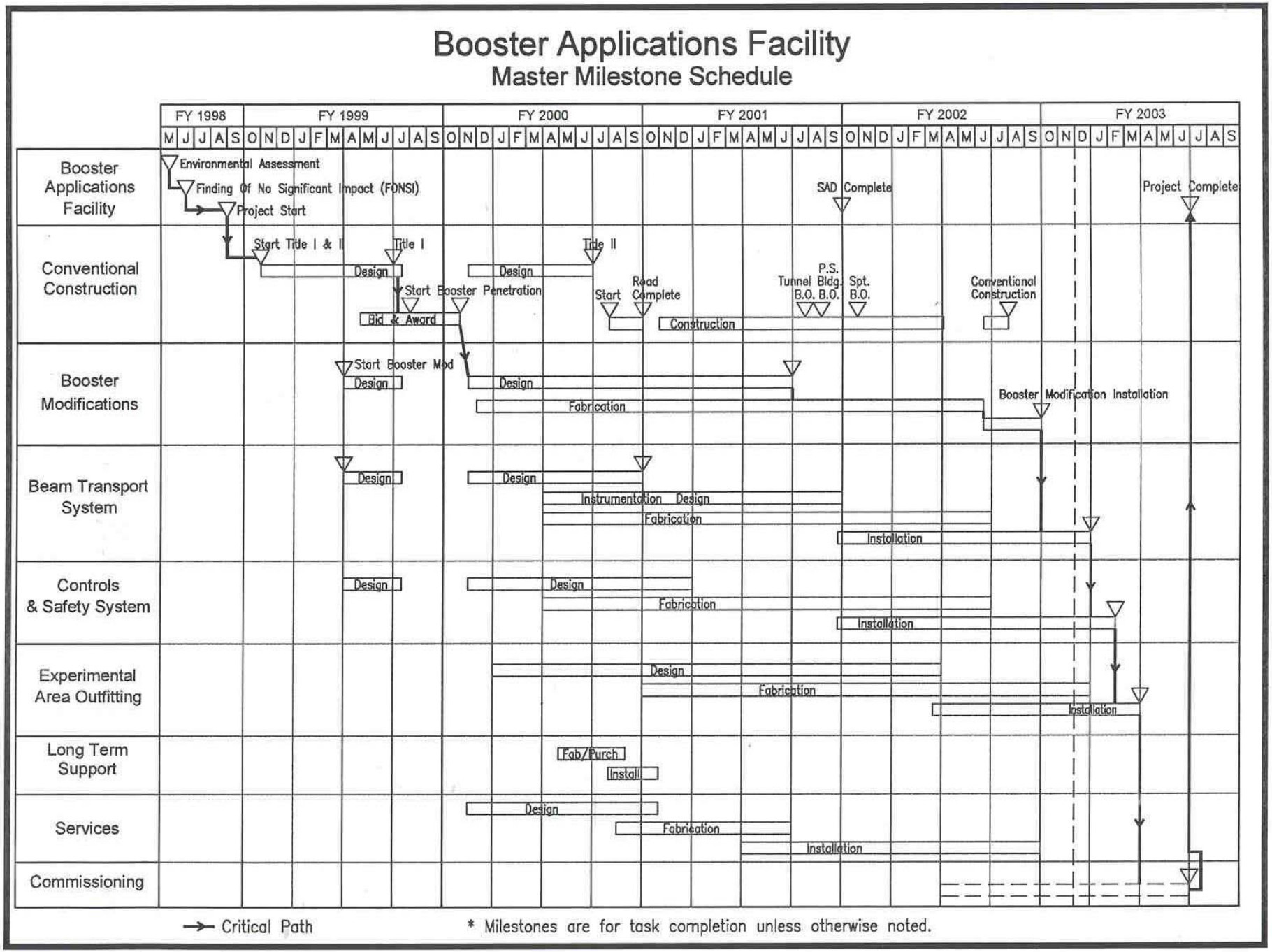
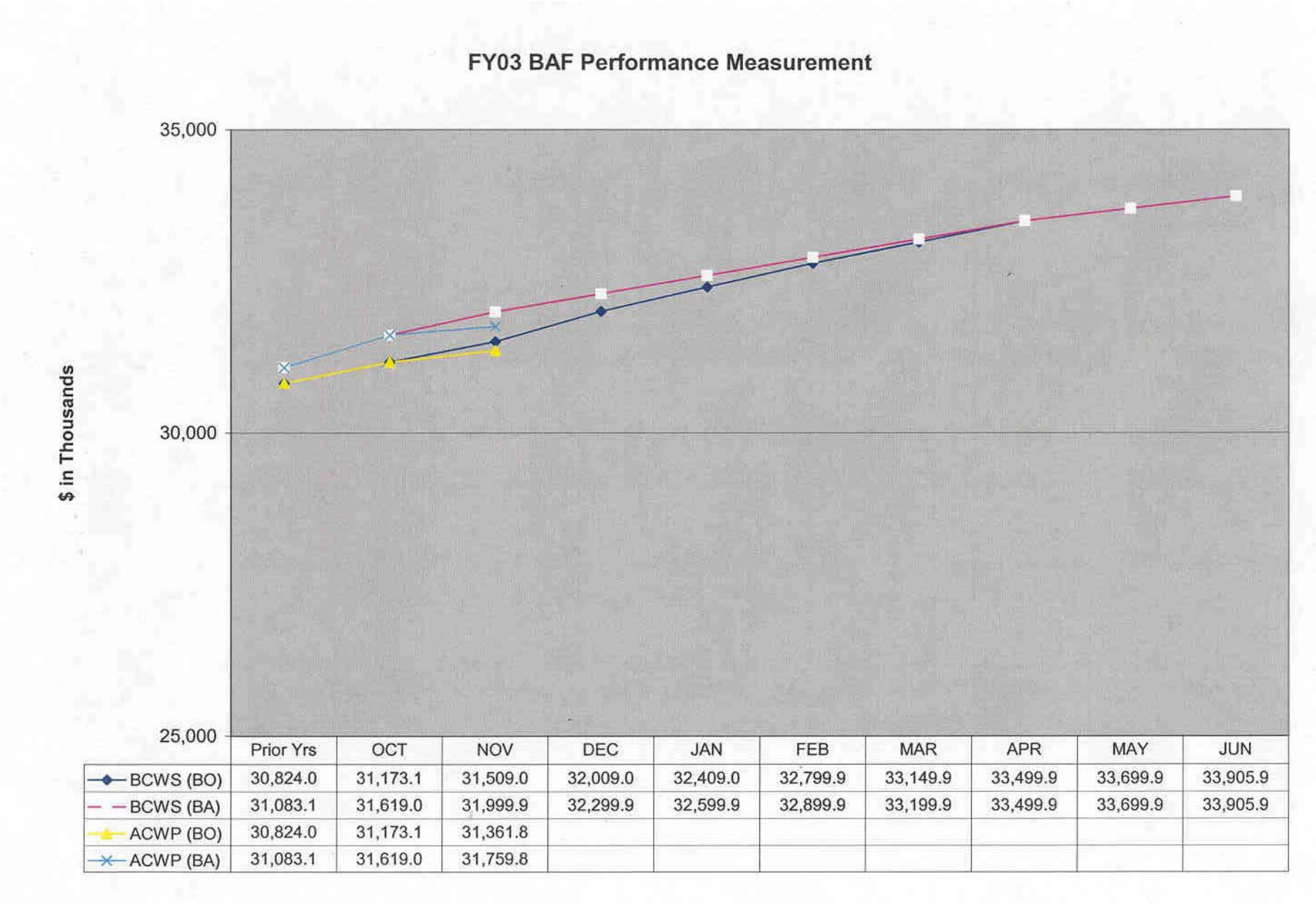

Booster Applications Facility
Master Milestone Schedule
FY 1998
FY 1999
FY 2000
FY 2001
FY 2002
FY 2003
M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
Booster Applications Facility
Environmental Assessment
Finding Of No Significant Impact (FONSI)
Project Start
SAD Complete
Project Complete
Conventional Construction
Start Title I & II
Title I
Design
Start Booster Penetration
Bid & Award
Title II
Design
Start
Road Complete
Tunnel B.O.
P.S. Bldg. B.O.
Spt. B.O.
Construction
Conventional Construction
Booster Modifications
Start Booster Mod
Design
Design
Fabrication
Booster Modification Installation
Beam Transport System
Design
Design
Instrumentation Design
Fabrication
Installation
Controls & Safety System
Design
Design
Fabrication
Installation
Experimental Area Outfitting
Design
Fabrication
Installation
Long Term Support
Fab/Purch
Install
Services
Design
Fabrication
Installation
Commissioning
Critical Path
* Milestones are for task completion unless otherwise noted.

Figure 2



	Prior Yrs	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BCWS (BO)	30,824.0	31,173.1	31,509.0	32,009.0	32,409.0	32,799.9	33,149.9	33,499.9	33,699.9	33,905.9
BCWS (BA)	31,083.1	31,619.0	31,999.9	32,299.9	32,599.9	32,899.9	33,199.9	33,499.9	33,699.9	33,905.9
ACWP (BO)	30,824.0	31,173.1	31,361.8							
ACWP (BA)	31,083.1	31,619.0	31,759.8							

TABLE II

BOOSTER APPLICATIONS FACILITY (BAF)
EXPENSE and COMMITMENTS
As of November 30, 2002

	Budget	EXPENSES Salary & Wage	Other Labor	Material & Contracts	Overhead	TOTAL EXPENSES	COMMIT.	TOTAL EXP. & COMMIT	BALANCE AVAILABLE
1.1 Conventional Construction	6,635,000	133,094	981,782	4,923,058	601,564	6,639,498	5,000	6,644,498	(9,498)
1.2 Booster Modifications	6,089,000	2,178,583	722,317	2,159,215	996,168	6,056,283	48,091	6,104,374	(15,374)
1.3 Beam Transport System	5,671,000	2,164,416	382,438	2,040,947	878,006	5,465,807	163,798	5,629,605	41,395
1.4 Controls & Personnel Safety System	1,757,000	708,357	145,866	585,709	294,357	1,734,289	9,618	1,743,907	13,093
1.5 Exp. Area Outfitting	3,624,000	99,322	43,414	2,913,691	272,819	3,329,246	115,993	3,445,239	178,761
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	3,686,000	1,015,993	288,701	1,867,581	477,378	3,649,653	2,045	3,651,698	34,302
1.8 Project Services	3,204,000	1,061,801	98,875	297,220	1,701,903	3,159,799	5,701	3,165,500	38,500
CONTINGECY	250,000					0		0	250,000
SPARES	683,000	42,167	74,185	438,459	106,001	660,812	44,676	705,488	(22,488)
Commissioning	250,000	148,144	2,475	12,002	58,602	221,223	1,448	222,671	27,329
1 BAF Construction	32,305,000	7,551,877	2,742,148	15,611,959	5,455,785	31,361,769	398,067	31,759,836	545,164

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	1,295					175	1,120
1 (TPC)	Total Project Cost (BA AY $)	33,906	300	600	11,648	8,713	9,844	2,801
1 (TPC)	BAF Construction (BO AY $)	33,906	300	600	5,348	11,932	12,644	3,082

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		3,803	870	4,673			Modified WBS elements to include overhead, escalation and FCR.
		1.2		3,742	1,109	4,851			
		1.3		4,478	1,160	5,638			
		1.4		1,236	321	1,557			
		1.5		2,710	358	3,068			
		1.6		851	104	455			
		1.7		1,708	463	2,171			
		1.8		1,129	2,129	3,258			
			Contingency	3,796	1,037	4,833	4,833	4,833	
			Overhead	4,649	0	0			
			Escalation	1,912	0	0			
			FCR	993	0	0			
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
BAF CHANGE CONTROL
$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.