Status Report: 10
Status as of: 30 November 2000

Contract Title:

BOOSTER APPLICATIONS FACILITY

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

Reporting Period: October 1 – November 30, 2000

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

Excellent progress has been made in conventional construction and it appears all foundation work will be completed before the on- set of severe cold weather. Power supply orders for the project are on schedule and are either placed or in the bid process. Good progress has been made in instrumentation design and magnet production. Design and development of the dosimetry system continues.

W.B.S. 1.1 Conventional Construction

The Contractor mobilized for construction at the beginning of October and by the end of November the foundations for Power Supply and Experimental Support Buildings and the Alcove structure concrete were completed. Preparations for installation of corrugated metal tunnel are underway and Site and Power Supply Building electrical work has begun. The job is estimated to be 18% complete.

W.B.S. 1.2 Booster Modifications:

1.2.1 – New Extraction Equipment

1.2.1.1 Thin septum magnet: The bellows and the vacuum chamber have been designed. Detailing of the magnet core is in progress.

1.2.1.2 Thick septum magnet: Fabrication in process

1.2.1.3 Foil stripper assembly: Complete

1.2.2 – Power Supplies

1.2.2.1 Thin septum: Bid solicitation in process.

1.2.2.2 Thick septum: Order placed with Alpha Scientific for $116,950 and delivery is scheduled for mid June,2001.

1.2.2.2 Tune Quads: Order placed with I E Power for $290,900 and delivery is scheduled for late June, 2001.

1.2.2.3 Sextupoles: Order placed with I E Power for $119,760 and delivery is scheduled for late July, 2001.

1.2.2.4 Bumps: Bid solicitation in process.

1.2.2.5 Spill servo: System electronics are complete and further progress requires a Booster long -term shutdown.

1.2.3. – Equipment Modifications

1.2.3.1 D4&D6: Extensive modifications to the D4 half cell are necessary which include relocating pumps and gauges. The D4 half cell will need to have a new correction magnet installed since the horizontal aperture will be increased.

1.2.3.2 D6 Beam dump & Wall Current Monitor :Design and fabrication is complete and further progress requires a Booster long term shutdown.

1.2.3.3 Vacuum System modifications: No change

W.B.S. 1.3 Beam Transport System

1.3.1 Magnets

1.3.1.1 Dipoles: no change

1.3.1.2 Quadrupoles: no change

1.3.1.3 Octupoles: first article coil accepted and remaining coils in production. All steel fabrication complete.

1.3.1.4 Low field magnets: Standard corrector magnet first article coil accepted and remaining coils in production. Prototype core complete and back leg steel in production. Small angle corrector magnet parts are fabricated

1.3.2 Power Supplies :All supplies are in the bid cycle.

1.3.3 Vacuum System

Instrumentation was rearranged on the beam line and a new layout was drawn again. The vacuum spool pipes were changed to reflect the new instrumentation box locations. The bellows and pump tee were detailed and drawing will go to checking. The front end of the line in the Booster tunnel has been redefined with a new type of fast valve incorporated in the design. The fast valve takes up much less space and solves interference problems with the existing Booster half cell.

1.3.4 Instrumentation

Mechanical design continued on the plunging instrumentation vacuum enclosures and internal instrumentation assemblies. A mechanical design review is scheduled for December, soon after we begin building a prototype. We have become more confident in our approach utilizing a large bellows (9.5" ID) to enable the detector heads to be easily removed during bake-out and for service/modification. Various SWIC wire spacing layouts have been drawn to resolve any logistical constraint problems. We are considering limiting the SWIC wire coverage on the aperture to monitor only the area of interest with increased resolution.

We have strength and reliability tested several prototype plunging instrumentation vacuum window assemblies. A 0.015" thick aluminum window was able to withstand 100 psi. The rate of transition (slow is better) from the window to the 0.25" vessel wall is a critical characteristic. The deflection was 0.5" at 100psi. Next, we will test two 0.012" windows, one machined, one electron beam welded.

Effort on the producing the digitized SWIC electronics continues. We have received an order from Rittal for the euro-card crate hardware. We have placed an order for the 8 channel integrator modules with Advanced Technologies Laboratories, Inc., expect delivery in June.

We have assembled a prototype scintillator /PMT device. We are building a flag material test assembly to see the relative luminescence response of Radlin, Ruby, AlOx, and a Gadolinium Terbium phosphor. Both will be performance tested with iron beams during the January NASA run in the A3 beam line.

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

1.4.1 Controls

Panels for the event-link VME modules were received and mounted. PLDs were being programmed for the VME modules. Installation of the modules awaits an assignment by drafting of identification for the various configurations of the boards. The racks were installed and the electrical power hookup finished. The event-decode PLD files for the booster controllers have been modified. One half of the waveform generator order was received.

1.4.2 Personnel Safety System

The final design of the of the PLC logic state table was completed. Work continues on the assembling of the PLC cabinets.

A proto-type design of the BAF target cave access scheme will be tested during the January 2001 NASA run in the A1 SEB line.

W.B.S. 1.5. Experimental Area Outfittng

1.5.1 Dosimetry Control

Software

A major milestone was crossed during this reporting period - the entire channel table load ran through to completion. This required a fully functioning demand scaling sub-system. While some clean-up and documentation remains to be done, the channel table load is essentially done.

An initial version of the operator interface to the memory-resident database (DAT) is done. Several of the features of the original DAT remain to be added.

Work has just started on the trace logger.

Work continues on the display system.

Work has started on the fast scaling system.

Work on the trace logger continues.

Work continues on the conversion of the numerous VMS command files to the SUN OS.

Work continues on the display system.

Hardware

The Recycling Integrator analog front end prototype has been designed. Parts have arrived for a prototype. The first 9U VME Crate arrived and we are designing the modifications necessary to accommodate the custom modules and custom dosimetry bus. A second 9U VME Crate has been ordered. Two 6U crates have also been ordered for supporting the standard VME modules.

We are negotiating the final specifications for the beam line bench. We will then provide a conceptual design drawing for the instrumentation bench from which the bench can be built. We have obtained surplus bench rails and mounting brackets which will be sent to BNL.

The ion chamber bodies are mostly fabricated. We are continuing to have difficulty with the gold adhering to the kapton without a copper underlayer. Our fix did not work and we are looking for outside vendors who may be able to do this. The problem is finding a vendor with a large enough coating vessel to hold our foils.

1.5.2 Support Rooms – General

No change.

1.5.3 Support Room A

No change.

1.5.4 Support Room C

No change.

W.B.S. 1.6 Long Term Support Lab

No change.

W.B.S. 1.7 Installation and Services

1.7.1 Electric Power Distribution:

Prices have been received for reconditioning the sub-station circuit breakers.

1.7.2 Equipment Cooling Water

All Pump Room and associated drawings have been completed for the following:

All pump room equipment in the Bldg #957.
PS piping from Bldg #957 underground to Bldg #931.
PS piping and connection to the existing system in Bldg #930.
PS piping to power supply area within #957.
Magnet piping through Bldg #957 through double containment piping to the tunnel.
Magnet piping and distribution in the tunnel.

All major equipment pieces have been selected. Specifications are currently being prepared (approximately 50% are complete) and procurements have been initiated.

The double containment piping has been ordered and has arrived and ready for installation.

All primary pumps and heat exchangers have been ordered. The remaining items are expected to be on order before the end of January, 2001.

The underground piping between Bldg #957 and Bldg #931 has been installed and pressure tested.

1.7.3 Installation

No change

W.B.S. 1.8 **Project Services**

1.8.1 Project Management

This period marks several changes in reporting. Included are change control logs for cost and schedule changes at level 3 and above and, as mentioned in the last report, an additional performance measure comparing budgeted cost of work scheduled with actual cost of work performed.

We have modified the Project spending profile to match the NASA operating plan. This has resulted in a delay of 9 months in the project completion date to June 30,2003 and an increased total project cost of $800,000.The master milestone list has been updated (see Table I) and the master schedule has been changed to reflect the milestone changes. (See Figure 1.)

The RHIC operating schedule has been modified to combine the FY '01 and FY'02 runs. This has eliminated the FY'01 Summer shutdown of the Booster. The installation of the equipment in WBS 1.2, Booster Modifications, has been rescheduled to start April 1, 2002 instead of August 1, 2001. This delayed shutdown is six months long instead of three, and should relieve the pressure on the critical path since it allows more time to complete the installation. The later completion date does not impact the project completion date

1.8.2 Fiscal

Due to a change in the BAF funding profile, reducing FY01 funding by $4 million and extending the project funding into FY03, we have been forced to increase the Total Project Cost by $800,000 as follows:

W.B.S. 1.3 Beam Transport System - Instrumentation	$100,000
W.B.S. 1.8 Project Services	400,000
Contingency	200,000
Commissioning	100,000
	$800,000

1.8.3 Quality Assurance

No change.

1.8.4 Environment, Safety and Health

Work commenced on the Safety Analysis Document (SAD).

3) Open Items:

4) Summary Status Assessment and Forecast

a) Financial Status

A total of $12,984,115 was expensed or obligated of the $14,200,000 available. Costs represented $6,439,370 and open commitments stood at $6,544,745. The Project Total Estimated Cost (TEC) is $31,207,000. The Total Project Cost (TPC) is at $33,900,000.

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

Milestones Upcoming	Baseline	Forecast
Booster Mod. Design-Complete	06/30/00	12/30/00

e) Critical Path: Booster Modifications Installation Complete.

f) Baseline Change proposals – see Table IV.

g) Cost Performance: Figure 2 provides a measure of project performance relating the planned budget profile versus expenses and commitments.

Table I
BAF Project Milestones

		Modified
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	12/31/00	
Beam Transport System Design Complete	09/30/00	
Safety Analysis document (SAD) Complete	09/30/01	
Conventional Construction Complete	11/30/01	06/30/02
Booster Modifications Installation Complete	10/30/01	08/31/02
Beam Transportation System Installation Complete	04/30/02	12/30/02
Experimental Equipment Installation Complete	06/30/02	03/31/03
Project Complete	09/30/02	06/30/03

Figure 1

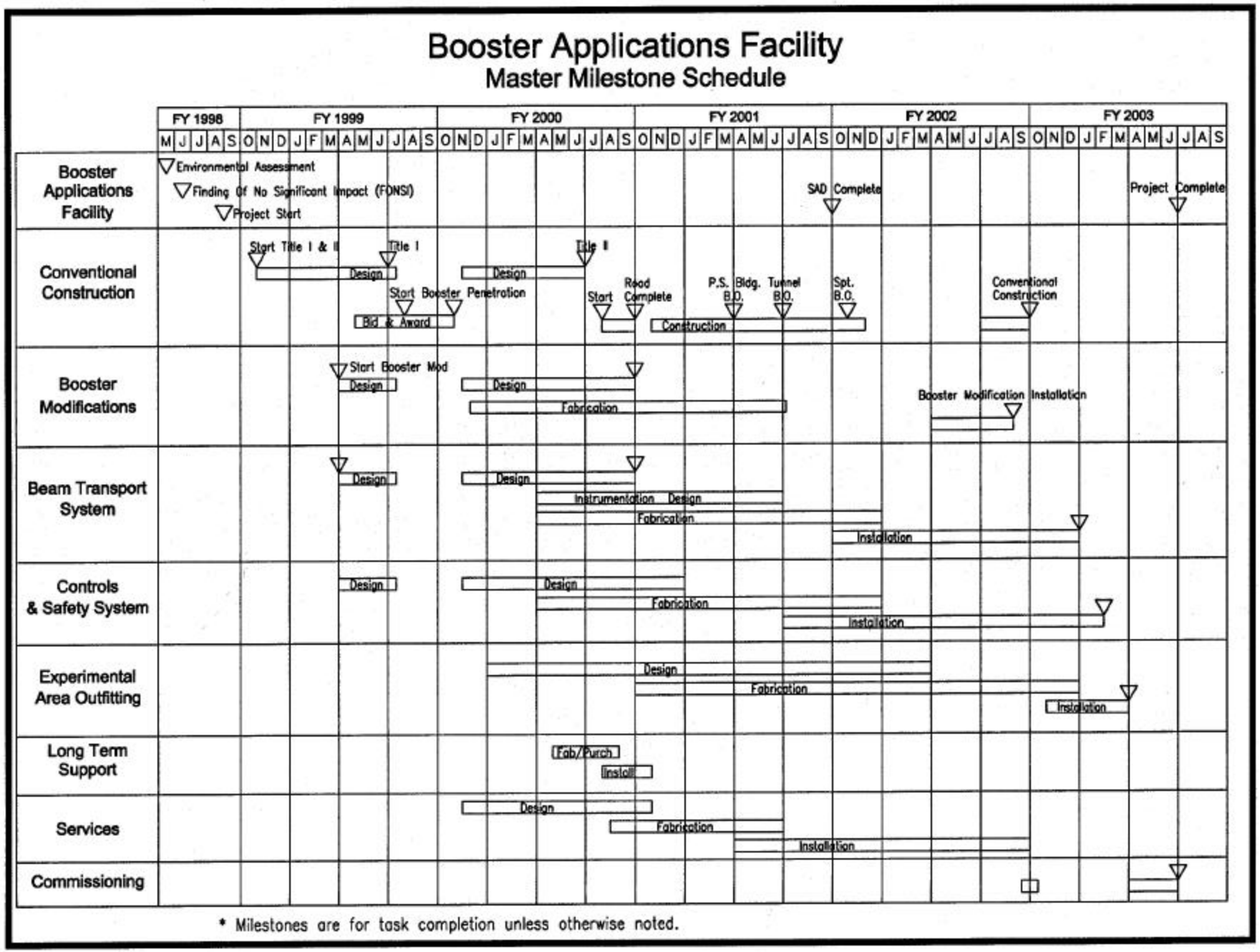
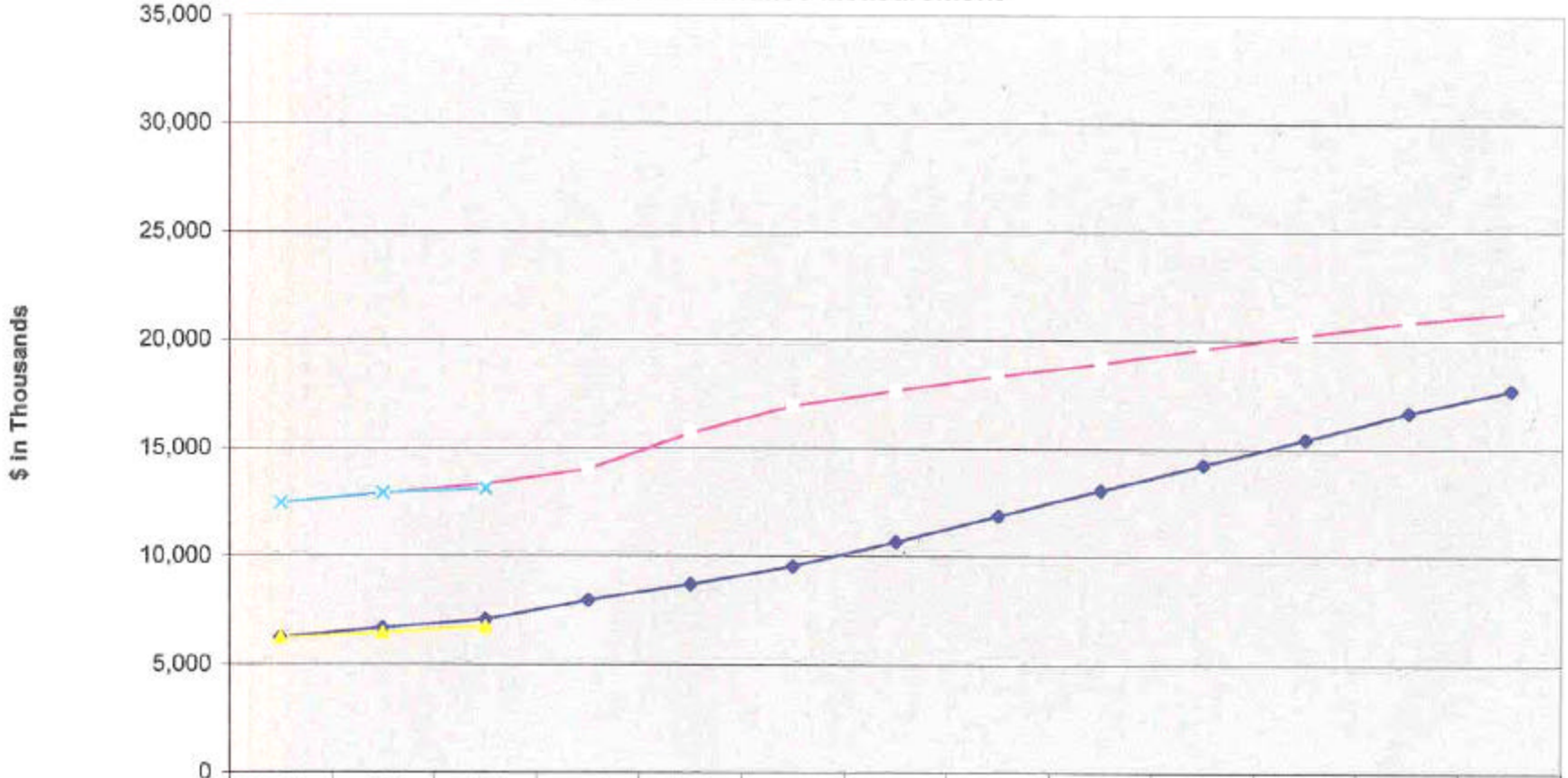

Booster Applications Facility
Master Milestone Schedule
FY 1998
FY 1999
FY 2000
FY 2001
FY 2002
FY 2003
M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
Booster Applications Facility
Environmental Assessment
Finding Of No Significant Impact (FONSI)
Project Start
SAD Complete
Project Complete
Conventional Construction
Start Title I & II
Title I
Design
Start Booster Penetration
Bid & Award
Design
Title II
Start
Road Complete
P.S. Bldg. B.O.
Tunnel 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
* Milestones are for task completion unless otherwise noted.

Figure 2
BAF Performance Measurement



	Prior Yrs	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
BCWS (BO)	6,248.0	6,673.0	7,063.0	7,956.0	8,695.0	9,519.0	10,653.0	11,870.0	13,050.0	14,240.0	15,400.0	16,655.0	17,698.0
BCWS (BA)	12,471.0	12,903.0	13,318.0	13,988.0	15,678.0	16,923.0	17,653.0	18,324.0	18,895.0	19,576.0	20,247.0	20,809.0	21,271.0
ACWP (BO)	6,248.0	6,439.9	6,711.6										
ACWP (BA)	12,471.0	12,926.0	13,130.0										

TABLE II
BOOSTER APPLICATIONS FACILITY (BAF)
EXPENSE and COMMITMENTS
As of November 30, 2000

	Budget	EXPENSES Salary & Wage	Other Labor	Material & Contracts	Overhead	TOTAL EXPENSES	COMMIT.	TOTAL EXP. & COMMIT	BALANCE AVAILABLE
.1 Conventional Construction	5,098,000	84,129	432,483	635,736	220,096	1,372,444	3,879,574	5,252,018	(154,018)
.2 Booster Modifications	2,429,000	755,772	171,699	175,323	251,400	1,354,194	771,827	2,126,021	302,979
.3 Beam Transport System	1,519,000	588,480	95,799	124,992	141,229	949,600	306,003	1,255,603	263,397
.4 Controls & Personnel Safety System	615,000	252,050	296	101,399	72,810	426,555	102,775	529,330	85,670
.5 Exp. Area Outfitting	1,200,000	0	0	630,727	89,341	720,068	571,899	1,291,967	(91,967)
.6 Long Term Support Lab	383,000	0	2,095	282,256	43,553	327,904	3,784	331,688	51,312
.7 Installation & Services	1,173,000	338,052	2,546	22,557	66,991	430,146	766,901	1,197,047	(24,047)
.8 Project Services	1,160,000	515,355	0	43,654	557,944	1,116,953	5,745	1,122,698	537,302
CONTINGECY	73,000					0		0	73,000
SPARES	50,000		11,235		2,003	13,238	9,805	23,043	26,957
BAF Construction	14,200,000	2,533,838	716,153	2,015,744	1,445,367	6,711,102	6,418,313	13,129,415	1,070,585

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

		TOTAL	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
1.1	Conventional Construction	5,698	290	80	4,728	600	0	0
1.2	Booster Modifications	5,251		282	1,747	2,128	1,094	0
1.3	Beam Transport System	5,739		56	963	2,616	2,104	0
1.4	Controls & Personnel Safety System	1,557		8	507	309	733	0
1.5	Exp. Area Outfitting	3,068		0	1,200	502	1,242	124
1.6	Long Term Support Lab	456		0	383	73	0	0
1.7	Installation & Services	2,739		9	1,237	827	666	0
1.8	Project Services	3,659	10	165	985	949	915	635
		28,168	300	600	11,750	8,004	6,754	759
	Contingency	3,040	0	0	0	200	2,390	450
1 (TEC)	BAF Construction (BA AY $)	31,207	300	600	11,750	8,204	9,144	1,209
	Spares	1,294			50	396	656	192
	Commissioning	1,399					0	1,399
1 (TPC)	Total Project Cost (BA AY $)	33,900	300	600	11,800	8,600	9,800	2,800
1 (TPC)	BAF Construction (BO AY $)	33,900	300	600	5,348	11,452	12,500	3,700

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
6/30/00	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		351	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			
8/31/00	2	1.1		4,673	425	5,098	-425	4,408	Vendor Bid exceeded estimate
8/31/00	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 coinside with NASA operating plan
11/30/00	5	1.0		Changed Project Completion Date from 9/30/02 to 6/30/03					Modified schedule to match spending profile
11/30/00	6	1.3		Changed Completion Date from 4/31/02 to 12/30/02					Modified schedule to match spending profile
11/30/00	7	1.4		Changed Completion Date from 6/30/02 to 2/15/03					Modified schedule to match spending profile
11/30/00	8	1.5		Changed Completion Date from 6/30/02 to 3/31/03					Modified schedule to match spending profile

TABLE IV continued
BAF CHANGE CONTROL
$1000's

Date	Change No.	W.B.S.	Base Line	Change	Adjusted Base Line	Contingency Increase (Decrease)	Contingency Balance	Description
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 and 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**
11/30/00	**14**	1.7.2	641	300	941	-300	3,040	**Detailed Design increased cost**
11/30/00	**15**	1.2	Booster Modification Completion Date changed from 10/31/01 to 8/31/02					**RHIC operating schedule modified,eliminating fy'01 summer shutdown**
11/30/00	**16**		Conventional construction completion change from 11/30/01 to 06/30/02					**Same as above**