Status Report: 06
Status as of: 31 May 2000

Contract Title:

BOOSTER APPLICATIONS FACILITY

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

Reporting Period: May 1, 2000 – May 31, 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.

3) Project Head's Summary Assessment:

	Last Month	This Month
Cost:	satisfactory	satisfactory
Schedule	satisfactory	satisfactory
Technical	satisfactory	satisfactory
Overall	satisfactory	satisfactory

Commissioning of the Negative Ion Injector (NII) and the by-pass beam line continued this reporting period.

W.B.S. 1.0 BAF Construction Summary

Progress continues on the conventional construction design package, Booster Modifications and Beam Line design.

W.B.S. 1.1 Conventional Construction

The status of conventional construction is as follows:

Task	Design Status	Expected Design Completion Date
1. Experimental Support Building 958	95%	6/9/00
2. Target Building & Labyrinth Bldg. 956	75%	6/30/00
3. Beam Tunnel Bldg. 956	50%	6/30/00
4. Access Alcove	80%	6/16/00
5. Power Supply Building 957	50%	6/30/00
6. Site Work-Road, Fencing, Ret. Walls	80%	6/23/00
7. Site Utilities	60%	6/30/00
8. Earth Shielding & Liner	95%	6/12/00
9. Design Package out for Comment		7/15/00
10.Design Package to DCP		7/15/00

W.B.S. 1.2 Booster Modifications:

1.2.1 New Extraction Equipment

	% Complete	To Shops
1.2.1.1 Thin Septum		
Engineering	10	
Design	0	
Fabrication	-	09/30/00
1.2.1.2 Thick Septum		
Engineering	100	
Design	100	
Fabrication		
Long lead items	0	03/30/00
Balance	-	07/31/00
1.2.1.3 Foil Stripper Assembly		
Engineering	100	
Design	100	
Fabrication		
Vacuum box	50	01/10/00
Balance	-	05/30/00

1.2.2 Power Supplies

Design work continued on the power supplies for the septa magnets and the buss work for the D6 septum. Design of the active filter system for the "spill servo" was started.

1.2.3 Equipment Modification

	% Complete	To Shops
1.2.3.2.1 Move D6 Beam Dump & WCM		
Engineering	100	
Design	100	
Fabrication	100	11/10/99
1.2.3.2.2 New WCM		
Engineering	100	
Design	100	
Fabrication	10	04/07/00
1.2.3.3 D3 IPM & Beam Dump Kicker		
Engineering	90	
Design	50	
Fabrication	-	08/31/00

W.B.S. 1.3 Beam Transport System

1.3.1 Magnets

We had separate design reviews for the trim magnets (8) and the octupole magnets (2) in the beam line. The trim magnets, labeled 9x14D18, provide an integral field of 37.2 kG-inch at a current of 460A. The magnet can be operated up to a current of 750A. The field integral of the octupoles is 162.733 kG-inch at a radius of 4", close to the pole tips, at a current of 2000A. The maximum operating current is 2300A. Both magnet designs were approved by the review committees.

The design of a pair of trims with air-cooled coils to be installed in the Booster tunnel has started. These magnets have been added to aid the steering of the beam into the center of the first quadrupole magnet in the beam line which is about 18m downstream of the extraction point.

1.3.2 Power Supplies

Development of the power supply specifications continued this month.

1.3.3 Vacuum System

The front end of the transport line was rearranged in order to fit two trim magnets in the line. The trim magnets need to be as far upstream as possible to optimize beam parameters and keep the isle in the Booster ring clear of any support stands bolted to the

floor. The chambers just before the penetration wall are also being rearranged to keep the isle clear. Keeping the isle clear of any beam components will allow the vacuum pipe across the isle to be removed very quickly by using two quick disconnect clamps should a large piece of equipment need to be moved in the Booster ring. Quotations were received for other vacuum valves required in the transport line and a purchase order is being generated.

1.3.4 Instrumentation

The following have been accomplished for this reporting period:

- Further development of the mechanical vacuum enclosure for the plunging devices.
- Investigation and design of a new I/F converter.
- Progress on the spill servo detector approach.
- Preparation for the Preliminary Design Review.
- Progress in the actual device location with respect to magnets and vacuum systems.
- Communication with LBL concerning data transfer and dosimetry performance issues.

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

1.4.1 Controls

Commissioning of the MP6 Bypass beamline began this month. Beam harp data acquisition was debugged and software was completed for Faraday cups and beam transformers and testing with beam was begun. Trim magnet power supply software was also completed.

Prototypes of the redesigned V197 and V198 timing boards were on order. The Event Link input modules (V1010) were being built. Proposals were solicited for "build to print" Waveform Generator (V115) modules for magnet power supply and rf control.

A preliminary design review of the spill servo system led to several decisions on controls components needed, but further evolution of the system design may lead to additional controls requirements.

1.4.2 Personnel Safety System

The cabinets for the supervisory electronics were received this month. Electricians have started to install AC power and cable trays to these cabinets in building 911B. The design of the gate status box has started

W.B.S. 1.5. Experimental Area Outfittng

1.5.1 Dosimetry Control

In the past month, the final system configuration has settled down and was defined with consultation from the users and BNL personnel.

The baseline system now has 80% more dosimetry channels than originally planned. We believe this is within reach by dropping some other unneeded items that were in the original budget. We also hope to save some money on the range shifter by building a Binary Filter rather than a Water Column. As it turns out, a Binary Filter is more appropriate for this project.

The dosimetry configuration now has:

2 calibration chambers

3 chambers with 2 collection foils each

> 1 foil has 8 rings cut into quadrants 32 channels
> 1 foil has 1 small 1cm diameter element in the center
> and 1 element covering everything else out to 32cm

1 "256" chamber with 2 collection foils

> 1 foil has 16x16 elements 256 channels
> 1.5 x 1.5 cm elements 24 x 24 cm total
> 1 foil has a square the same size as all 256 on the
> other foil and a square perimeter out to 32cm.

This gives a check against the sum of the 256. And an additional dose for the remainder of the field.

In addition we will build a set of foils with 256 channels (16x16) but with 0.5 x 0.5 cm elements 8 x 8 cm total. Unfortunately the small size means that the beam simulation aspect of the small chamber must be done at the connectors rather than at the detection elements.

Building the extra foils now is cost effective. In the future the small 256 chamber can be built into a complete system.

General design has begun on several items to validate the overall system design. Detailed design is beginning on the Recycling Integrator system and ion chambers.

The programs to load the channel table load are over 90% complete. Meanwhile, a start has been made on the demand scaling system described in Chapter 6 of the detailed design document, and on the display system.

1.5.2 Support Rooms General

No change.

1.5.3 Support Room A

No change.

1.5.4 Support Room B

No change.

W.B.S. 1.6 Long Term Support Lab

By the end of May we have received 60% of the equipment ordered. We have started the refurbishment of the tissue culture room (painting). By the end of June we estimate that the two new upgraded rooms will be ready for users.

W.B.S. 1.7 Installation and Services

1.7.1 Electric Power Distribution

No change.

1.7.2 Equipment Cooling Water

The pumping room drawings are nearing completion and consist of :

a. All pump room equipment in the Bldg #957 .
b. Power Supply piping under ground to Bldg #931. (Existing equipment building.)
c. Power Supply piping to power supply area in #957.
d. Magnet cooling piping out of pump room.

The Power Supply pump selection is being reviewed.

The preliminary Piping Specification is being prepared

1.7.2 Installation

No change.

W.B.S. 1.8 Project Services

1.8.1 Project Management

Design work on W.B.S. 1.2.1.1, Thin Septum Magnet, has been delayed because of resource availability. The design is now expected to be completed on 9/30/00. This will cause a shift in the Booster modification design complete milestone from 6/30/00 to 9/30/00. This will still allow installation of the thin septum magnet in the FY2001 shutdown with no impact on the project completion date.

In order to proceed with the start of construction on the conventional facilities this fall, it has been decided to re-route the existing road in the BAF area during this summer.

1.8.2 Fiscal

No change.

1.8.3 Quality Assurance

No change.

1.8.4 Environment, Safety and Health

No change.

4) Open Items:

The beam line modeling including field errors in the magnets has been completed. It has also been determined that the planned beam line instrumentation is sufficient to commission the beam line. These two actions bring to 9 out of 26 action items closed.

5) Summary Status Assessment and Forecast

a) Financial Status

A total of $5,366,303 was costed or obligated of the $11,450,000 available. Costs represented $3,826,982 and open commitments stood at $1,539,321. The Project Total Estimated Cost (TEC) is $30,507,000. The Total Project Cost (TPC) is at $33,100,000.

b) Table II shows detailed expenses and commitments.

c) Table III shows 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

Milestones Upcoming	Baseline	Forecast
Title II Complete	06/30/00	06/30/00
Booster Mod. Design-Complete	06/30/00	09/30/00

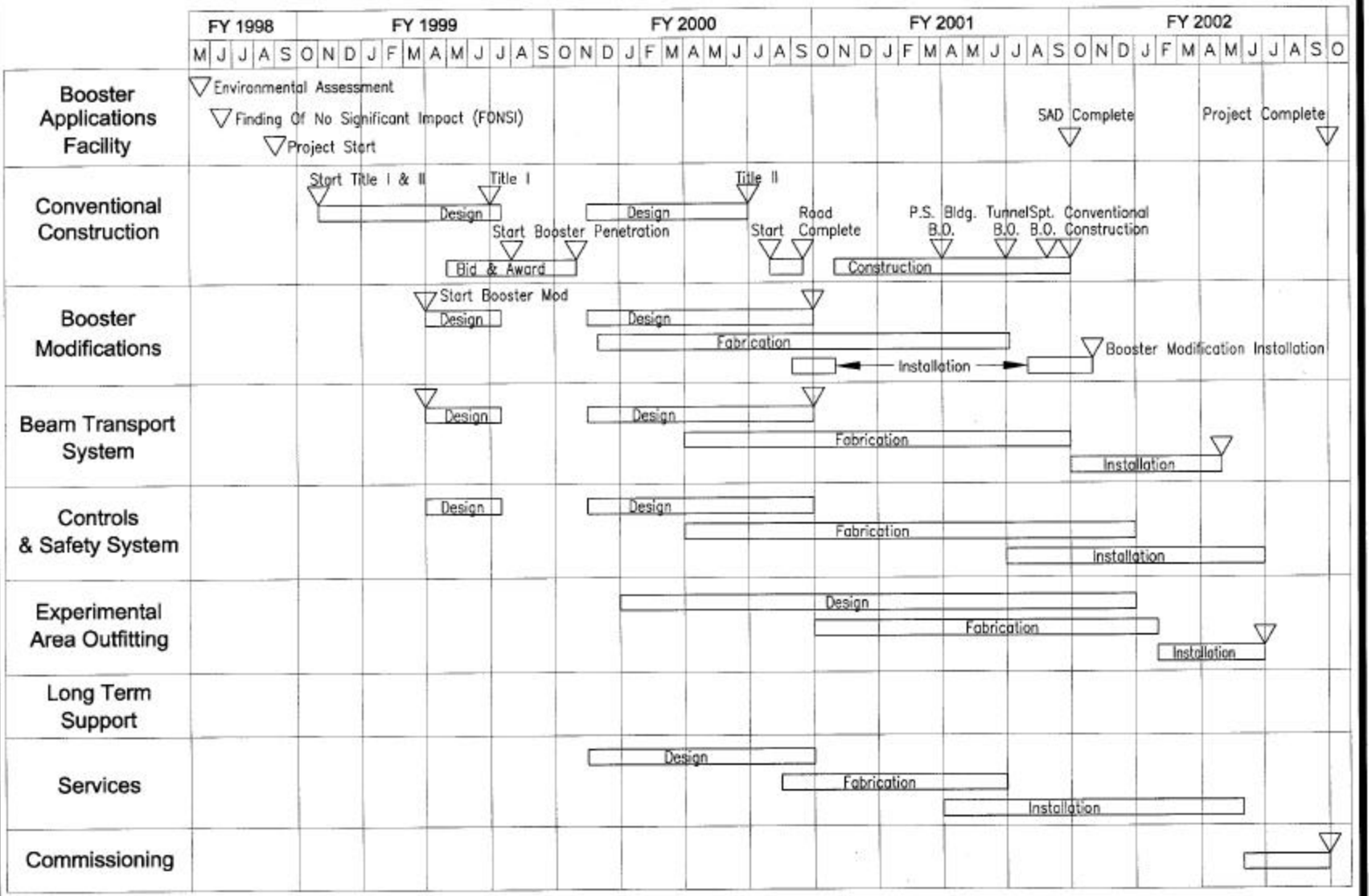
e) Baseline Change proposals – None.

6**)** **Performance Analysis:** – method to be determined.

Table I
BAF Project Milestones

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

Booster Applications Facility
Master Milestone Schedule



* Milestones are for task completion unless otherwise noted.

TABLE II

BOOSTER APPLICATIONS FACILITY (BAF)
EXPENSE and COMMITMENTS
As of May 31, 2000

		EXPENSES							
	Budget	Salary & Wage	Other Labor	Material & Contracts	Overhead	TOTAL EXPENSES	COMMIT.	TOTAL EXP. & COMMIT	BALANCE AVAILABLE
1.1 Conventional Construction	3,876,000	70,610	262,080	321,673	146,845	801,208	92,393	893,601	2,982,399
1.2 Booster Modifications	2,200,000	526,396	128,505	80,813	154,179	889,893	114,105	1,003,998	1,196,002
1.3 Beam Transport System	1,720,000	338,830	357	67,128	76,666	482,981	71,098	554,079	1,165,921
1.4 Controls & Personnel Safety System	454,000	170,229	0	52,962	44,962	268,153	11,578	279,731	174,269
1.5 Exp. Area Outfitting	1,220,000	0	0	182,885	10,000	192,885	1,007,115	1,200,000	20,000
1.6 Long Term Support Lab	350,000			74,571	17,770	92,341	175,053	267,394	82,606
1.7 Installation & Services	383,000	218,637	0	19,107	44,223	281,967	45,870	327,837	55,163
1.8 Project Services	1,097,000	371,979	0	20,016	425,559	817,554	4,500	822,054	274,946
Spares	150,000					0	17,609	17,609	132,391
1 BAF Construction	11,450,000	1,696,681	390,942	819,155	920,204	3,826,982	1,539,321	5,366,303	6,083,697

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

		TOTAL	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
1.1	Conventional Construction	4,092	202	83	2,882	925	0
1.2	Booster Modifications	3,810		219	1,765	1,435	391
1.3	Beam Transport System	4,478		44	1,391	2,086	957
1.4	Controls & Personnel Safety System	1,236		33	401	539	263
1.5	Exp. Area Outfitting	2,710		0	1,042	1,169	499
1.6	Long Term Support Lab	351			295	56	0
1.7	Installation & Services	1,708		7	379	585	737
1.8	Project Services	1,182		96	486	347	253
		19,567	202	482	8,641	7,142	3,100
	Contingency	3,799	37	0	823	1,978	961
		23,366	239	482	9,464	9,120	4,061
	Overhead	4,779	52	100	1,934	1,863	829
1	BAF Construction (FY98 $)	28,145	291	582	11,397	10,985	4,889
	Escalation	1,368		0	0	854	515
	Full Cost Recovery @ 3%	994	9	18	353	367	247
1 (TEC)	BAF Construction (BA AY $)	30,507	300	600	11,750	12,204	5,653
	Spares	1,294			150	296	848
	Commissioning	1,299					1,299
1 (TPC)	Total Project Cost (BA AY $)	33,100	300	600	11,900	12,500	7,800
1 (TPC)	BAF Construction (BO AY $)	33,100	300	600	6,000	16,000	10,200