

Status Report: 08  
Status as of: 31 August 2000

Contract Title:

**BOOSTER  
APPLICATIONS  
FACILITY**



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

Reporting Period: July 1, 2000 – August 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.

**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

In related events the MP-6 upgrade and by-pass line was successfully commissioned and routine operations for Tandem users have begun.

**W.B.S. 1.0 BAF Construction Summary**

The highlight of this reporting period was the completion of the Conventional Construction design package and the bid and award of the construction job to Frendolph Construction Corporation, the low bidder.

The new road required for the BAF Facility was also bid and awarded this reporting period and road construction has started.

Design and fabrication of Booster modifications, beam line components and dosimetry system continued.

**W.B.S. 1.1 Conventional Construction**

The design of the BAF by-pass road was completed and the construction contract awarded on July 5, 2000. Road construction started August 29, 2000.

The construction package for the BAF facilities was let for bidding on July 15, 2000 and prospective bidder orientation was held on August 1, 2000.

The bid were received on August 17, 2000 and the construction contract was awarded on August 31, 2000 to Frendolph Construction Corporation, the low bidder, for \$4,602,000.

**W.B.S. 1.2 Booster Modifications:**

**WBS 1.2.1 – New Extraction Equipment**

<u>WBS</u>	% Complete	To Shops
1.2.1.1 Thin Septum		
Engineering	40	
Design	10	
Fabrication	-	12/31/00

1.2.1.2	Thick Septum		
	Engineering	100	
	Design	100	
	Fabrication		
	Long lead items	50	03/30/00
	Balance	-	10/31/00

1.2.1.3	Foil Stripper Assembly		
	Engineering	100	
	Design	100	
	Fabrication		
	Vacuum box	100	01/10/00
	Balance	100	01/28/00

1.2.2.1.1 Power Supplies

The specifications for all the power supplies have been completed and the purchase requisitions have been submitted for procurement.

1.2.3 Equipment Modification

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	90	04/07/00

1.2.3.3 D3 IPM & Beam Dump Kicker

	Engineering	90	
	Design	50	
	Fabrication	No fabrication required – reuse existing equipment	

**W.B.S. 1.3 Beam Transport System**

1.3.1 Magnets

Fabrication of the trim magnet continued and is on schedule for the 9x14D18 magnets and ahead of schedule for the air-cooled pair of trims. Fabrication of the stands for these magnets was completed on schedule.

### 1.3.2 Power Supplies

The power supply specifications were completed during this period and the requisitions were submitted for procurement.

### 1.3.3 Vacuum System

The detailed layout of the transport line in the Booster tunnel is complete. We are waiting for ring access to verify as built conditions in order to proceed with the design. Components in the beamline are being model with 3D software. A residual gas analyzer was received and tested. Specifications for a gauge controller needed to patch into the existing Booster vacuum control system are being generated.

### 1.3.4 Instrumentation

Design continued on the plunging instrumentation vacuum enclosures. We are focusing closely on the approach utilizing a large bellows (9.5" ID) to enable the detector heads to be easily removed during bakeout and for service/modification. Various wire spacing layouts have been drawn to resolve any logistical constraint problems. The design for the drive mechanism for the BAF beam plug may be interesting, since the forces needed are similar.

Effort on the producing the digitized SWIC electronics has begun. We have been in contact with Rittal and have samples and quotes for the euro-car crate hardware, we plan on placing an order for the SWIC's chassis soon. We have identified several BAF related modifications to these chassis, which include remote control of gain and polarity.

Evaluation of several competing solutions for measuring the (low level) signals from the ion chambers. We have a 20-bit charge detector ADC, investigating a recycling integrator approach, and evaluating a current to voltage conversion techniques.

A test assembly is being designed to evaluate various flag materials and scintillator performance with iron beams during the upcoming NASA run.

Investigation of an alternative to the existing video frame-grabber continues. The Sony 1394 "Firewire" data bus is now incorporated in high-end video cameras, and various software is available to process the data. This approach may simplify the technique now in use at the C-A facility. Investigation of different techniques to transfer digitized video images from the cameras to the framegrabber without repeaters is underway.

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

### 1.4.1 Controls

The Booster event link decoder (V297,V296) prototype boards were received and the V296 was assembled. PLD files for the V296 and V297 were being modified prior to testing. The production quantity of event link input modules (V101) was received from the fabricator. Quotes were obtained for various front panels.

Controls personnel participated in design reviews of beam line power supplies and instrumentation. No significant controls issues were identified in relation to the proposed power supply system. Many details remain to be elucidated concerning instrumentation and closure on controls interfaces will require further discussion.

#### 1.4.2 Personnel Safety System

The PLC cabinets for the field piers arrived at the end of July. The assembling of all the PLC cabinets with components has started. The initial design of the of the PLC logic state table was done.

#### **W.B.S. 1.5. Experimental Area Outfitng**

Software

The demand scaling system is about two-thirds done.

Work continues on the display system.

Hardware

Ion Chambers, Recycling Integrators the and VME System are being designed. We have ordered critical parts for the Recycling Integrators.

We are not planning to prototype any component except for the Recycling Integrator analog front ends. Some of the parts are not scheduled for delivery until December 20,2000. This means we will design the Recycling Integrators but hold off on Board layouts until we are sure the analog front ends will work.

We have also ordered a Sample VME crate and other modules including high voltage supplies and calibration sources

#### **W.B.S. 1.6 Long Term Support Lab**

No change.

#### **W.B.S. 1.7 Installation and Services (Phillips)**

##### 1.7.1 Electric Power Distribution

No change.

##### 1.7.2 Equipment Cooling Water

All design drawings are complete.

### 1.7.3 Installation

No change

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

### 1.8.1 Project Management

This reporting period was highlighted by the successful completion of the bid process for the conventional construction part of the project. Also included in the construction contract were items for the cooling water system, for the beam line system and Booster equipment. In addition, a portion of the electrical distribution system for the beam line power supplies and instrumentation were included. The purpose in doing this is to reduce the overhead costs since large value contracts are “taxed” at a lower rate.

This period also marked the first use of contingency for the project. This process was documented through the appropriate baseline change proposals as required by the Project Management Plan.

### 1.8.2 Fiscal

The funds for the conventional construction contract award were committed this reporting period. The commitments to the relevant WBS's are as follows:

WBS 1.1	(Conventional Construction)	\$3,857.00
WBS 1.7	(Installation & Services)	\$745,000

This required the following use of contingency:

WBS 1.1	\$425,000
WBS 1.7	\$68,000

The original contingency estimated for WBS 1.1 is \$934,600, which leaves a reasonable reserve for unexpected change orders as construction progresses.

### 1.8.3 Quality Assurance

No change.

### 1.8.4 Environment, Safety and Health

No change.

## **3) Open Items:**

It is planned to implement an additional reporting process that will track budgeted cost of work scheduled (BCWS) versus actual cost of work performed (ACWP). This will be put in

place starting with the October 2000 report. This action satisfies the last open item from the previous project review.

#### 4) Summary Status Assessment and Forecast

##### a) Financial Status

A total of \$12,143,297 was expensed or obligated of the \$12,700,000 available. Costs represented \$5,407,461 and open commitments stood at \$6,735,836. 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 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
<u>Milestones Upcoming</u>	<u>Baseline</u>	<u>Forecast</u>
Booster Mod. Design-Complete	06/30/00	09/30/00
Beam Transport Sys. Design-Complete	09/30/00	09/30/00

e) Baseline Change proposals – None.



**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	11/30/01
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

**TABLE II**  
**BOOSTER APPLICATIONS FACILITY (BAF)**  
**EXPENSE and COMMITMENTS**  
**As of August 31, 2000**

	Budget	Salary & Wage	EXPENSES			TOTAL EXPENSES	COMMIT.	TOTAL EXP. & COMMIT	BALANCE AVAILABLE
			Other Labor	Material & Contracts	Overhead				
.1 Conventional Construction	5,098,000	84,129	379,572	499,792	187,555	1,151,048	3,956,400	5,107,448	(9,448)
.2 Booster Modifications	2,029,000	659,966	160,569	147,532	211,296	1,189,363	643,153	1,832,516	196,484
.3 Beam Transport System	1,019,000	467,086	62,040	104,229	108,340	741,695	172,050	913,745	105,255
.4 Controls & Personnel Safety System	515,000	223,176	296	92,061	64,425	379,958	91,696	471,654	43,346
.5 Exp. Area Outfitting	1,200,000	0	0	182,885	6,053	188,938	1,017,115	1,206,053	(6,053)
.6 Long Term Support Lab	383,000	0	2,095	258,555	37,720	298,370	20,133	318,503	64,497
.7 Installation & Services	1,173,000	295,929	0	22,557	59,026	377,512	810,945	1,188,457	(15,457)
.8 Project Services	1,160,000	469,662	0	53,045	553,375	1,076,082	5,745	1,081,827	78,173
CONTINGECY	73,000					0		0	73,000
SPARES	50,000					0	4,495	23,094	26,906
BAF Construction	12,700,000	2,199,940	608,381	1,360,656	1,238,470	5,407,461	6,735,863	12,143,297	556,703

**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	4,673	248	80	3,308	1,037	0
1.2 Booster Modifications	4,851		282	2,248	1,825	494
1.3 Beam Transport System	5,638		56	1,754	2,624	1,204
1.4 Controls & Personnel Safety System	1,557		8	539	677	333
1.5 Exp. Area Outfitting	3,068		0	1,159	1,346	564
1.6 Long Term Support Lab	455		0	383	73	0
1.7 Installation & Services	2,171		9	479	736	947
1.8 Project Services	3,258	9	165	1,241	1,172	671
	25,668	257	600	11,106	9,490	4,213
Contingency	4,840	42	0	543	2,814	1,440
1 (TEC) BAF Construction (BA AY \$)	30,507	300	600	11,650	12,304	5,653
Spares	1,294			150	296	848
Commissioning	1,299					1,299
1 (TPC) Total Project Cost (BA AY \$)	33,100	300	600	11,800	12,600	7,800
1 (TPC) BAF Construction (BO AY \$)	33,100	300	600	6,000	16,000	10,200