Status Report: 04
Status as of: 31 March 2000

Contract Title:

# BOOSTER APPLICATIONS FACILITY


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

Reporting Period: March 1, 2000 – March 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 |

In related events the commissioning of MP-6 and the by-pass line has started. Several component failures have occurred in MP-6 and they are being addressed.

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

The design effort for the conventional construction is on track and is expected to be complete as scheduled (June 30, 2000).

Fabrication of the Booster modifications continues, but subsystem milestones have slipped due to a lack of designers. This has been corrected and we expect to meet our revised schedule. (See W.B.S. 1.2.)

We have purchased W.B.S. 1.7 (Long Term Support Lab) equipment earlier than planned. Work is on track for the dosimetry system, safety system, controls and installation and services.

**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 | 85% | 4/24/00 |
| 2. Target Building & Labyrinth | 85% | 4/15/00 |
| 3. Beam Tunnel | 50% | 4/30/00 |
| 4. Access Alcove | 25% | 5/30/00 |
| 5. Power Supply Building | 25% | 5/30/00 |
| 6. Site Work-Road, Fending,Ret. Walls | 35% | 5/30/00 |
| 7. Site Utilities | 20% | 5/30/00 |
| 8. Earth Shielding & Liner | 95% | 4/15/00 |
| 9. Design Package out for Comment | | 6/01/00 |
| 10.Design Package to DCP | | 6/30/00 |

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

1.2.1 New Extraction Equipment

| | % Complete | To Shops |
|---|---|---|
| 1.2.1.1 Thin Septum | | |
| Engineering | 40 | |
| Design | 0 | |
| Fabrication | - | 06/31/00 |
| 1.2.1.2 Thick Septum | | |
| Engineering | 100 | |
| Design | 100 | |
| Fabrication | | |
| Long lead items | 0 | 03/30/00 |
| Balance | - | 04/28/00 |
| 1.2.1.3 Foil Stripper Assembly | | |
| Engineering | 100 | |
| Design | 100 | |
| Fabrication | | |
| Vacuum box | 50 | 01/10/00 |
| Long lead items | 0 | 01/28/00 |
| Balance | - | 04/07/00 |

1.2.2 Power Supplies

Work has started on the specification for the ejection septum supply. Design has started on the water-cooled bus that transports power from the supply to the magnet. A conceptual design has been developed for the spill servo.

1.2.3 Equipment Modification

| | % Complete | To Shops |
|---|---|---|
| 1.2.3.2.1 Move D6 Beam Dump & WCM | | |
| Engineering | 100 | |
| Design | 100 | |
| Fabrication | 95 | 11/10/99 |
| 1.2.3.2.2 New WCM | | |
| Engineering | 100 | |
| Design | 100 | |
| Fabrication | - | 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

Field errors in the original design of the corrector magnets were obtained from a 3D TOSCA simulation and studied with the Decay Turtle beam transport program. The sextupole component was found to be unacceptable. Additional of steel shims on the pole edges were studied with a 2D model and satisfactory results were obtained. 3D calculations are in progress.

### 1.3.2 Power Supplies

The development of specifications for procurement of the beam line supplies has started.

### 1.3.3 Vacuum System

No change

### 1.3.4 Instrumentation

No change.

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

### 1.4.1 Controls

Development of software for instrumentation controller - harp data acquisition for the MP6 Bypass beamline continued. Front-end software for beamline power supply control was complete except for accommodation of additional dipole magnets not needed for early commissioning. Database configuration was completed for vacuum valves and gauges.

Engineering began on the V197 and V198 timing boards for replacement of the obsolete 50-ohm drivers. The Event Link input board (V101) PC boards and parts were ordered and chassis backplane boards were received. A preliminary discussion was held with power supply personnel about the Spill Servo system. The requirements for Controls fiber-optic infrastructure was reviewed and coordination was underway with the Network Group.

### 1.4.2 Personnel Safety System

The initial engineering review of the design for the Access Control System was done. Overall, the results were positive, with a few minor details to resolve. The design of the Programmable Logic Controller (PLC) communication links between the Power Supply Building (bldg. 957) and Main Control Room location (bldg. 911) was done. Procurement of components continued.

## W.B.S. 1.5. Experimental Area Outfittng

1.5.1 Dosimetry Control

**Software**

A first pass over the coding for the logical channels and channel tables for the segmented ion chambers has been completed. Another pass needs to be made to get rid of the remaining references to the VMS/Fortran/Camac based system.

The first five programs to load the channel tables are running on a SUN workstation running the latest version of the Solaris operating system. Work is ongoing on the remaining three programs.

**Hardware**

Work was completed for setting up LBNL BAF office including shared computer files for project tracking and facilitation.

Work has started on the Control System commercial component acquisition list, a draft was finished for the interface to the AGS Booster.

System design documentation and sub-system specification has begun.

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

During, March we initiated the purchasing of equipment to upgrade our current facilities in support of BAF and future runs at AGS.

In addition, we started to re-structure some of the cell biology laboratories and upgrade Brookhaven Laboratory Animal Facility (BLAF) for BAF operations.

The following items were ordered:

TBJ Bedding Dispenser, with Air Compressor
Garbel Auto-Feed Disposal with Accessories
300 Ancare Corp./High Temp.Rat Cages, plus shipping
Harrier 18/80R Refrig.Centrifuge with Accessories
Mol.Devices/Mic.Plate Reader/Spectramax 340 PC
Beckman/Coulter Z 2, with Extended Warranty
Misc.
Fisher-Thermolyne Locator Jr. Plus Cryo.Stor.System
Fisher-Nalgene Cryoboxes/System 100
Fisher-Denver Analytical Balance/Series M-220
Fisher-Ohaus "Portable Scout" Balance/ModelSC6010
Fisher-Eppendorf "Easypet" Pipet Filler/Dispenser
Fisher- 4 cu.ft. Undercounter Freezer/explosion proof
Fisher-5.5 cu.ft.Undercounter Refrig/Freezer/exp.proof
Fisher-Compac Micro 14 Microcentrifuge
Fisher-Accumet AB15 pH Meter Kit, Basic
Fisher-Napco Water Jacketed CO2 Incubator/ 5400
Fisher-Napco Water Jacketed CO2 Incubator/ 5400
Fisher-Napco Water Jacketed CO2 Incubator/ 6000

## W.B.S. 1.7 Installation and Services

1.7.1 Electric Power Distribution

Work continues on development of the one-line power distribution drawing.

1.7.2 Equipment Cooling Water

The pump room selection of all primary components including the cooling tower have been completed.

1.7.3 Installation

No change.

## W.B.S. 1.8 Project Services

1.8.1 Project Management

Development of a project schedule using MS Project is continuing. All tasks have been collected and will be scheduled to as low as level six, depending on job complexity. High level milestones are given in Table I and Figure I.

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:**

Complete action items from December 1999 review: Six of twenty-three completed.

**5) Summary Status Assessment and Forecast**

a) Financial Status

A total of $3,992,673 was costed or obligated of the $11,450,000 available. Costs represented $2,763,863 and open commitments stood at $1,228,810. 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 | 06/30/00 |

e) Baseline Change proposals – None.

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

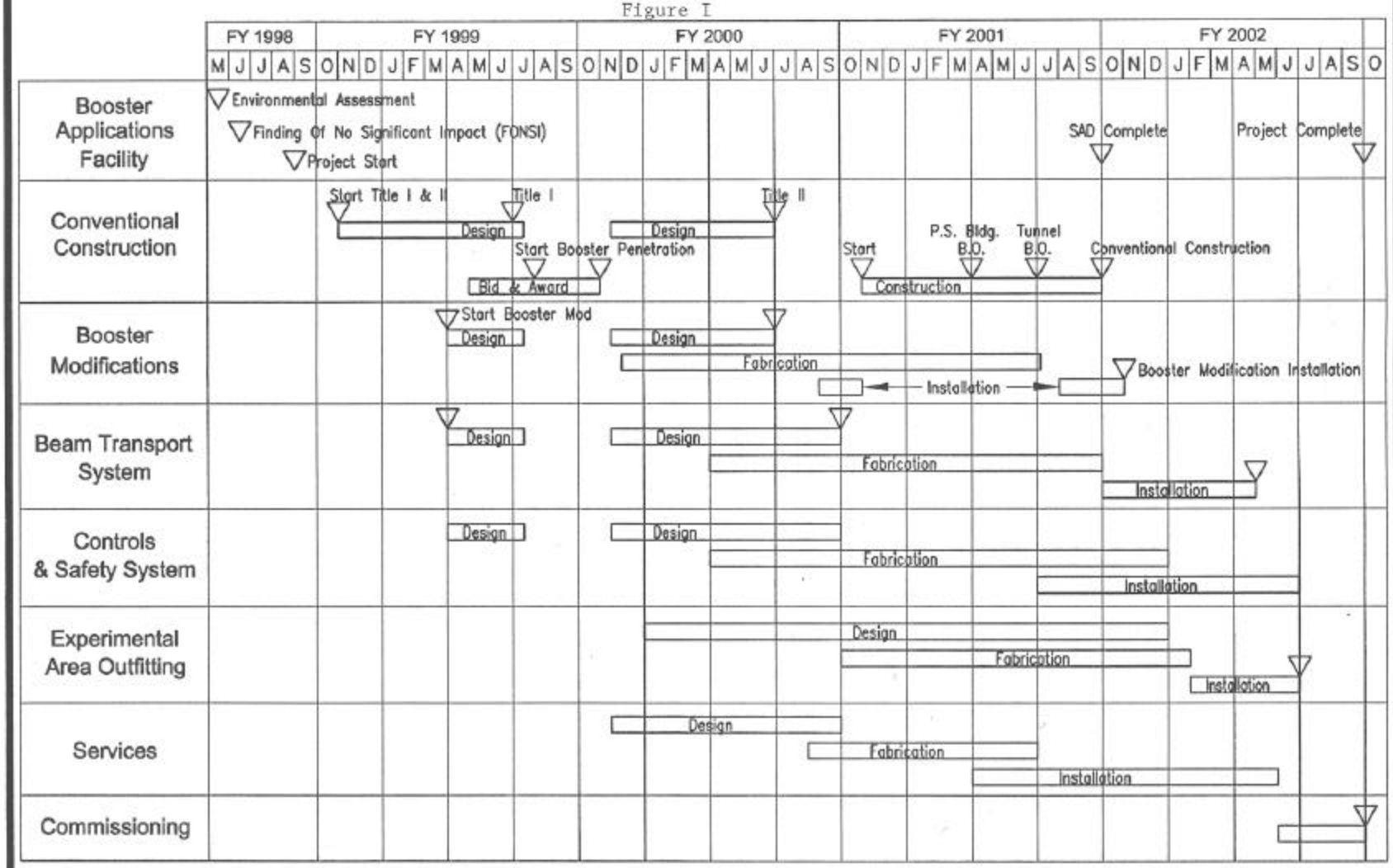
**Table I**

**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 | 06/30/00 |
| 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

Figure I




* Milestones are for task completion unless otherwise noted.

TABLE II

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

| | | EXPENSES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Budget | Salary & Wage | Other Labor | Material & Contracts | Overhead | TOTAL EXPENSES | COMMIT. | TOTAL EXP. & COMMIT | BALANCE AVAILABLE |
| 1.1 Conventional Construction | 3,098,000 | 53,670 | 212,792 | 306,673 | 109,344 | 682,479 | 7,640 | 690,119 | 2,407,881 |
| 1.2 Booster Modifications | 2,407,000 | 386,984 | 101,731 | 59,850 | 118,263 | 666,828 | 68,745 | 735,573 | 1,671,427 |
| 1.3 Beam Transport System | 1,829,000 | 248,724 | 357 | 28,878 | 53,850 | 331,809 | 45,015 | 376,824 | 1,452,176 |
| 1.4 Controls & Personnel Safety System | 547,000 | 99,805 | 0 | 37,894 | 28,607 | 166,306 | 2,422 | 168,728 | 378,772 |
| 1.5 Exp. Area Outfitting | 1,220,000 | 0 | 0 | 84,068 | 5,441 | 89,509 | 1,000,000 | 1,089,509 | 130,491 |
| 1.6 Long Term Support Lab | 110,000 | | | | | 0 | 100,488 | 110,488 | 9,512 |
| 1.7 Installation & Services | 419,000 | 120,267 | 0 | 3,016 | 22,582 | 145,865 | 0 | 145,865 | 273,135 |
| 1.8 Project Services | 1,669,500 | 262,286 | 4,387 | 131,152 | 283,242 | 681,067 | 4,500 | 685,567 | 983,933 |
| Spares | 150,000 | | | | | 0 | | 0 | 150,000 |
| 1 BAF Construction | 11,450,000 | 1,171,736 | 319,267 | 651,531 | 621,329 | 2,763,863 | 1,228,810 | 3,992,673 | 7,457,327 |

**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 | 3,803 | 202 | 83 | 2,400 | 1,118 | 0 |
| 1.2 | Booster Modifications | 3,742 | | 219 | 1,831 | 1,301 | 391 |
| 1.3 | Beam Transport System | 4,478 | | 44 | 1,441 | 2,336 | 657 |
| 1.4 | Controls & Personnel Safety System | 1,236 | | 33 | 431 | 509 | 263 |
| 1.5 | Exp. Area Outfitting | 2,710 | | 0 | 1,042 | 1,169 | 499 |
| 1.6 | Long Term Support Lab | 351 | | | 110 | 141 | 100 |
| 1.7 | Installation & Services | 1,708 | | 7 | 194 | 730 | 777 |
| 1.8 | Project Services | 1,129 | | 96 | 338 | 338 | 357 |
| | | 19,157 | 202 | 482 | 7,677 | 7,752 | 3,044 |
| | Contingency | 3,796 | 38 | 0 | 1,484 | 1,623 | 651 |
| | Overhead | 4,649 | 52 | 100 | 1,819 | 1,862 | 816 |
| 1 | BAF Construction (FY98 $) | 27,602 | 292 | 582 | 10,980 | 11,237 | 4,511 |
| | Escalation | 1,912 | | 0 | 560 | 876 | 476 |
| | Full Cost Recovery @ 3% | 993 | 9 | 18 | 357 | 375 | 234 |
| 1 (TEC) | BAF Construction (BA AY $) | 30,507 | 300 | 600 | 11,897 | 12,488 | 5,222 |
| | Spares | 1,294 | | | 3 | 12 | 1,279 |
| | 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 | 10,000 | 12,000 | 10,200 |