

Status Report: 14
Status as of: 31 July 2001

Contract Title:

BOOSTER
APPPLICATIONS
FACILITY



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

Reporting Period: June 1, 2001 – July 31, 2001

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

W.B.S. 1.0 BAF Construction Summary

Rapid progress continues on conventional construction . It is expected that all conventional facilities ,with the exception of work on the Booster berm and minor work at the upstream end of the beam tunnel, will be completed by the November 30,2001.Beneficial occupancy of the beam tunnel is available for component installation and we expect to begin installation of water cooled buss in early September Two project milestones, Design of Booster Modifications and The Safety analysis were completed during this reporting period . Beam line magnet construction and the Access control systems are ahead of schedule and the remaining areas of the project remain on schedule.

W.B.S. 1.1 Conventional Construction

Structural steel, metal siding and roofing for Power Supply Building is complete. Structural steel for Experimental Support Buildings is complete ; metal siding and roofing are 75% complete. Tunnel backfill, liner installation and earth retaining wall are complete. Site, tunnel and building electrical are 50% complete. HVAC and process water piping is in progress. Site utilities are 75% complete and switch-gear and transformers are in place. The conventional construction is 68% complete.

W.B.S. 1.2 Booster Modifications:

1.2.1.1 Thin Septum: The detailed design for the thin septum is complete. The drawing package is in checking. The drive mechanism, vacuum “feed-throughs”, position indicators and position controls have been received. The fabrication of the assembled magnet core, including the copper septum, is 75% complete.

1.2.1.2 Thick Septum Magnet: All drawings are completed and approved. Manufacturer of magnet parts is in process and delivery is scheduled for early September. All parts of the vacuum chamber are completed and welding of the chamber will be done by late September. Fabrication of the conductors is in process. Welding and brazing of conductor assemblies will also be done during September.

Assembly of magnet will be started in later September and be completed in late October. It is expected that magnet testing will then start in November.

1.2.1.3 D6 Foil Stripper/Collimator: The manufacturer of the foil stripper, collimator and flag located upstream of the Thick Septum Magnet is completed. Testing of the collimator stepper drive for the collimator is completed. The foil stripper drive will be tested at a later date.

1.2.2 Power Supplies

1.2.2.2 Ejection Septum:

1.2.2.3 Tune Quads: Power supply manufacturing in progress. IE Power Inc. has put four people wiring and assembling the two power supplies. Target for first unit testing will be early August.

1.2.2.4 Sextupoles: IE Power has received more than 90% of the parts. Target for first unit testing will be early September.

1.2.2.5 Bumps: The problem with the size of the power supply has been resolved. Updated delivery schedule will be determined early August.

1.2.2.6 Spill Servo: no change

1.2.3 Equipment Modifications

1.2.3.1 D4 and D6: No Change.

1.2.3.2 D6 Beam Dump and Wall Current Monitor: A vacuum break has been successfully coated with fired resistors and conductors and welded to a beam pipe and a “conflat” flange. This sub-assembly had gone through a 300°C bake-out for 24 hrs with no leaks. Assembly of a new WCM has started.

1.2.3.3 D3 IPM and Beam Dump Kicker: No change.

1.2.3.4 Vacuum System Modifications: Approximately 80% of the heating blankets have been ordered for the Booster Modifications and design of the The remaining blankets are complete. A vacuum valve, which will be used for remnant beam removal, was received and prepared for installation. Detailed design of the modifications to the existing bake-out system is complete.

W.B.S. 1.3 Beam Transport System

1.3.1 Magnets: Quadrupole assembly is 100% complete. Dipole assembly is 100% complete. Octupole assembly is 90% complete.

1.3.2 Power Supplies :No change

1.3.3 Vacuum System

1.3.3.1 Beam Tubes, Bellow and Valves: Approximately 85% of the detailed design is complete. Drawings for special vacuum chambers, heating blankets the collimator, and NEG pipes are being released Vacuum hardware such as bolts and seals have been received. Pump tee support stand are being fabricated in Central Shops.

1.3.3.2 Pumps, Power Supplies and Gauges: The ion pumps and power supplies orders are complete and the ion pumps are in QC. The Residual gas analyzers as well as the vacuum gauges are due at BNL on 8-14-01.

1.3.3.3 Instrumentation and Controls: Approximately 60% of the heating blankets are out for RFQ. The remaining blankets are in the final stages of detailed design.

1.3.3.4 Transport Line Bake-out System: The vacuum gauges and controllers were received, the coax cable was received, the ion pump HV connectors, and the vacuum control system PLC components were ordered and received. Orders for the vacuum control system PC and gauge controller mounting kits were placed.

1.3.4 Instrumentation

1.3.4.1 Flags and Cameras: Received radiation exposure results for Sony DFW-300 CCD camera. We see about 1% pixel loss, otherwise camera performs well. The camera was installed in the A line transport cave during the last NASA run with low energy iron beams.

Completed drawing packages for the Flag Actuators. Drawings have been submitted for checking and release.

Continuing detailed design of cameras and cubby slide system.

1.3.4.2 Collimators: The collimator assembly (upstream of D6) was cycled several hundred times, and so far, no signs of any mechanical problems have been seen.

Initial phase of motion/control tests for the stripping foil/flag assembly is complete, we will begin endurance test soon.

1.3.4.3 and 1.3.4.4 Ion Chamber, Scintillator and SWICS: Completed drawing packages for the Instrumentation Chambers and Actuators. Drawings have been submitted for checking and release.

Continuing detailed design of SWIC's, Ion Chambers and Scintillators.

- Prototype SWIC Eurocard modified for remote/local gain control.
- Received partial shipment of the VME based high voltage power supply system.
- Received partial shipment of Scintillator signal conditioning electronics.
- Progress on Bldg 957 and 930A detailed instrumentation rack layout.
- Further development of instrumentation interface with controls.
- Continue development of signal transfer interface between C-AD and NASA.
- Began preparing racks for electronics in building 957.
- Finalized Instrumentation motion techniques and control method.
- Submitted Purchase Order for Instrument Bi-Metallic Vacuum Chamber with machined .012 inch thick aluminum windows. Submitted P.O.'s for Flag Chamber and all mechanical actuators. Began receiving and storing hardware for Instrumentation and Flag Systems.

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

1.4.1 Controls

1.4.1.1 Distributed systems: No change.

1.4.1.2 Central Services: No change.

1.4.1.3 Process Controls: Ten VME peripheral boards have arrived and documentation has been further developed.

1.4.2 Personnel Safety System: The field PLC cabinets are ready for installation in Building 957. Preliminary assembly work has started on the gate and crash boxes for the tunnel installation.

W.B.S. 1.5. Experimental Area Outfitting

1.5.1 Dosimetry Control

Software: The integration of the trace logger into most of the components of the control system has been completed.

The integration of the display sub-system into the control system has been mostly completed.

We are in the process of adding channels for the new ring / quad ion chambers and for the 16 by 16 ion chambers.

We are in the process of implementing the tune procedure.

Hardware: A prototype of the front-end for the recycling integrator VME card is currently being fabricated.

The VME crates for the recycling integrators are currently being modified.

The preliminary design for the range absorber is in progress.

A prototype for the ring /quad ionization chambers is being assembled.

1.5.2. Support Rooms – General: We are getting information from vendors, updated pricing, delivery times, etc. on the items for outfitting the BAF. We will continue this to be able to begin ordering in October, 2001.

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: The unit substations installation is now 90% complete. The 15 kV feeder to the sectionalizing switch is ready to energize. The 480V switchboard for the 930 UEB distribution is on order and should be received soon.

1.7.2 Equipment Cooling Water: The cooling Tower was installed in position. Ancillary supporting items are being installed. There is no active pump room work in progress. Pump room activity is dependent on the progress of building construction. Construction activity is currently in progress at this time. We are waiting for instructions to move the pumps, heat exchangers, control valves, etc. to the pump room area. The change orders for the tunnel piping and in Bldg 930 have been processed and activity has commenced on the tunnel piping.

1.7.3 Installation: The Beneficial Occupancy review was held for the Tunnel and Target Area.

W.B.S. 1.8 Project Services

1.8.1.1.1 Project Management: A DOE/NASA Project Review was held on June 21,2001 at BNL. Key areas reviewed were cost, schedule, dosimetry and the Safety Analysis Document and Base line changes.

Two Project Milestones, **Booster Modifications Design Complete** and **Safety Analysis Document Complete** were completed during this reporting period

1.8.1.2 Fiscal: An additional \$1,356,000 was received from NASA on June 29,2001 at BNL. This completes the expected funding for this fiscal year

1.8.3 Quality Assurance: No Change

1.8.4 Environment, Safety and Health: The Safety Analysis Document(SAD) has been completed.

3) Open Items: None

4) Summary Status Assessment and Forecast

a) Financial Status

A total of \$20,276,966 was expensed or obligated of the \$21,281,000 available. Costs represented \$14,576,232 and open commitments stood at \$5,700,736. 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

<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
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
<u>Milestones Upcoming</u>	<u>Baseline</u>	<u>Forecast</u>
Conventional Construction Complete	06/30/02	06/30/02

- e) The critical path for the Project is indicated in Figure 1. The crucial parts of the critical path are items in WBS 1.2. The items in this WBS can only be installed when the Booster is in a scheduled shutdown. If the appropriate window of opportunity is missed the Project completion will be delayed. The projected schedule now provides a schedule contingency of 3 months between being ready for installation of Booster modification and start of the shutdown.
- f) Baseline Change proposals – During this reporting period, there have been no baseline change proposals.
- g) Cost Performance: Figure 2 provides a measure of project performance relating the planned budget profile versus expenses and commitments. Obligations and expenses exceeded the predicted profile, while expenses lagged. We will only place orders essential purchase orders to meet planned commitments and to maintain project momentum and forward progress for this year. It is expected the expense rate will increase to meet the planned target by years end. We are keeping reserves to a minimum, and expect to receive FY02 funding in early October.

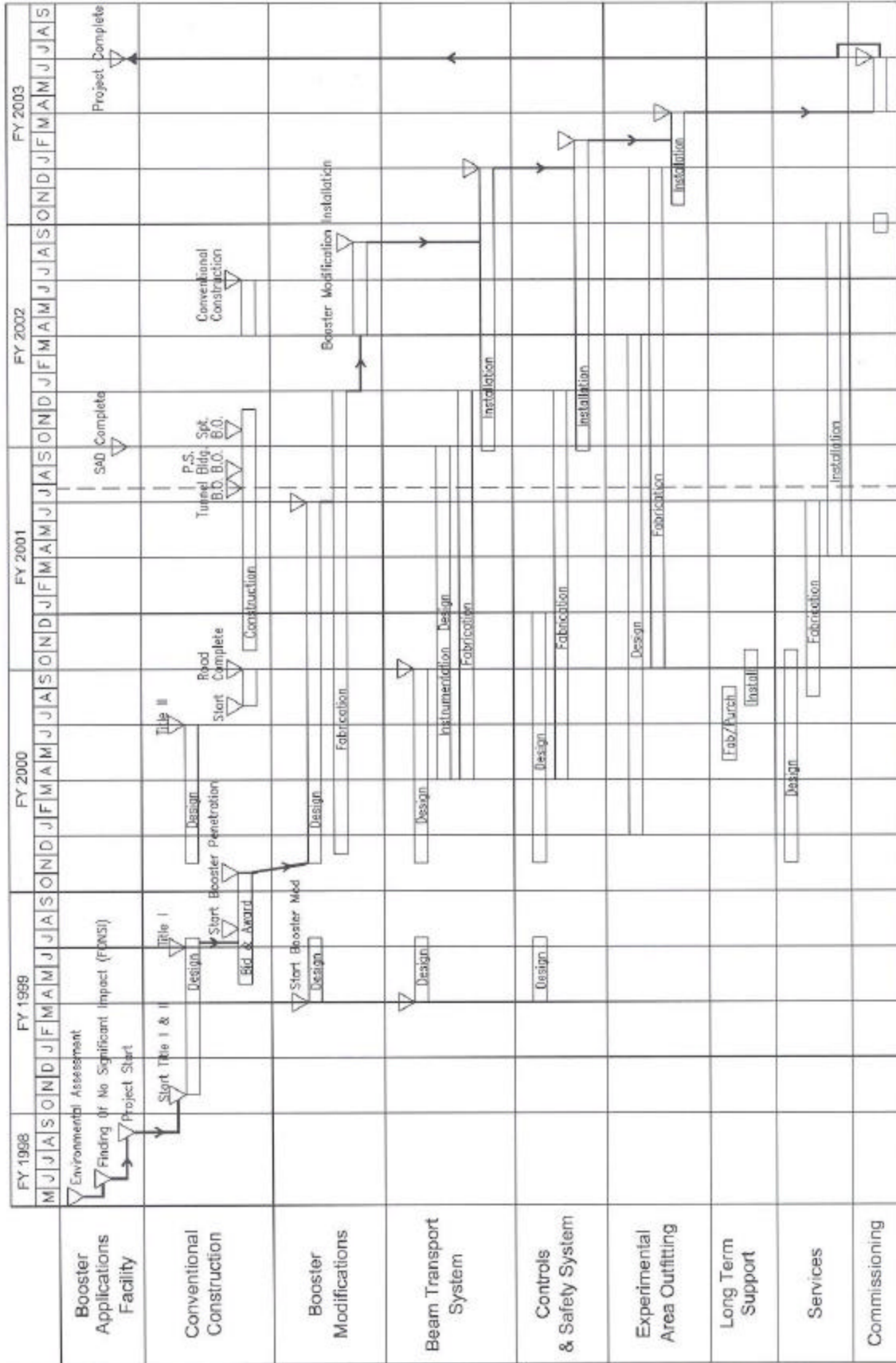
Table I
BAF Project Milestones

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	06/30/01
Beam Transport System Design Complete	09/30/00
Safety Analysis document (SAD) Complete	09/30/01
Conventional Construction Complete	06/30/02
Booster Modifications Installation Complete	08/31/02
Beam Transportation 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



* Milestones are for task completion unless otherwise noted.

→ Critical Path

Figure 2

BAF Performance Measurement

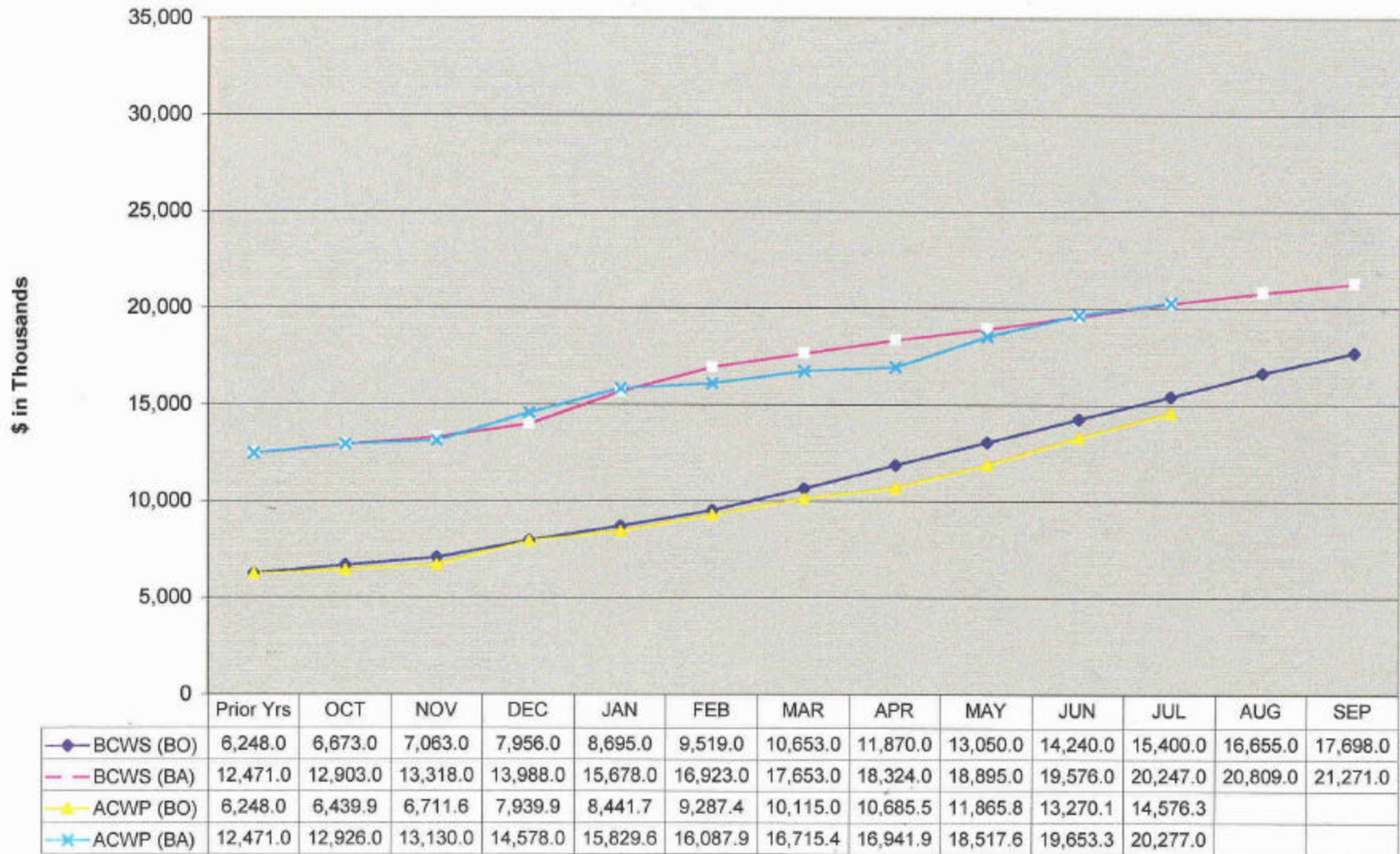


TABLE II
BOOSTER APPLICATIONS FACILITY (BAF)
EXPENSE and COMMITMENTS
As of July 31, 2001

	Budget	Salary & Wage	EXPENSES Other Labor	Material & Contracts	Overhead	TOTAL EXPENSES	COMMIT.	TOTAL EXP. & COMMIT	BALANCE AVAILABLE
1.1 Conventional Construction	5,698,000	89,736	656,503	3,113,855	461,394	4,321,488	1,567,158	5,888,646	(190,646)
1.2 Booster Modifications	4,157,000	1,211,906	233,958	566,199	424,579	2,436,642	1,300,111	3,736,753	420,247
1.3 Beam Transport System	3,635,000	1,033,327	152,736	732,484	345,429	2,263,976	1,208,866	3,472,842	162,158
1.4 Controls & Personnel Safety System	824,000	362,517	49,193	255,570	138,203	805,583	95,340	900,923	(76,923)
1.5 Exp. Area Outfitting	1,842,000	7,450	0	1,222,776	83,517	1,313,743	537,482	1,851,225	(9,225)
1.6 Long Term Support Lab	456,000	0	2,095	291,225	46,068	339,388	2,279	341,667	114,333
1.7 Installation & Services	2,073,000	492,710	46,170	615,311	192,432	1,346,623	851,309	2,197,932	(124,932)
1.8 Project Services	1,969,000	712,454	339	60,052	893,390	1,666,235	5,745	1,671,980	297,020
CONTINGECY	200,000					0		0	200,000
SPARES	427,000		23,632	44,495	14,427	82,554	132,446	215,000	212,000
1 BAF Constructio n	21,281,000	3,910,100	1,164,626	6,901,967	2,599,539	14,576,232	5,700,736	20,276,968	1,004,032

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**

<u>Date</u>	<u>Change No.</u>	<u>W.B.S.</u>	<u>Base Line</u>	<u>Change</u>	<u>Adjusted Base Line</u>	<u>Contingency Increase (Decrease)</u>	<u>Contingency Balance</u>	<u>Description</u>
6/30/00	1	1.1	3,603	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 Overhead	3,796	1,037	4,833	4,833	4,833	
		Escalation	4,649	0	0			
		FCR	1,912	0	0			
		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 coincide with NASA operating plan
11/30/00	5	1.0	Changed Project Completion Date from 9/30/02 to 8/30/03					Modified schedule to match spending profile
11/30/00	6	1.3	Changed Completion Date from 4/31/02 to 9/30/02					Modified schedule to match spending profile
11/30/00	7	1.4	Changed Completion Date from 8/30/02 to 3/31/03					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
11/30/00	9	Commissioning	Changed Completion Date from 9/30/02 to 6/30/03					Modified schedule to match spending profile

TABLE IV continued
BAF CHANGE CONTROL
\$1000's

<u>Date</u>	<u>Change No.</u>	<u>W.B.S.</u>	<u>Base Line</u>	<u>Change</u>	<u>Adjusted Base Line</u>	<u>Contingency Increase (Decrease)</u>	<u>Contingency Balance</u>	<u>Description</u>	
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	1,322	200	1,522	-200	3,740	Design effort exceeded estimate	
11/30/00	12	1.2.2	1,982	200	2,182	-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	
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 8/31/02						RHIC operating schedule modified, eliminating
01/20/01	19	1.2	Design complete extended from 12/31/00 to 6/30/01						fy'01 summer shutdown Design effort extended due to loss of personnel.