

Status Report: 18
Status as of: 31 March 2002

Contract Title:

BOOSTER
APPLICATIONS
FACILITY



Performing Organization:
Location:

Brookhaven Science Associates
Brookhaven National Laboratory
Upton, New York 11973-5000

Reporting Period:

February 1, 2002 – March 31, 2002

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: The conventional construction effort is limited to those punch list items that can be accomplished before the Booster is shut down at the end of the FY 2002 operating cycle. However some work was done in the upstream stub tunnel and in a restricted area in Building 930A during an unscheduled 2 week Booster shutdown due to an a failure of a Beam Separator in the AGS Beam line. This effort reduced the conventional work remaining to less than 5%. Power supply testing is on going and vacuum system installation in the Beam line is proceeding on schedule. All Booster Modification components are complete with the exception of the D4 modifications and the D3 septum magnet. The project is estimated to be 72 % complete.

W.B.S 1.1 Conventional Construction: Power Supply Building, Experimental Support Building and Tunnel substantially complete and installation of scientific equipment is in progress. Punch list work is in progress. Site work 95%, Utilities 100% complete. Balance of site work and tunnel work to be completed upon shutdown of Booster estimated to begin no later than June 15, 2002. Conventional construction is estimated to be 98% complete.

W.B.S. 1.2 Booster Modifications: (Critical Path)

1.2.1 New Extraction Equipment: 96 % complete.

1.2.1.1 Thin Septum: Fabrication of the thin septum is approximately 90% complete at central shops. The magnet core and retainer clips are being porcelain coated in the vacuum lab. The drive assemblies have been tested and are now having the rotary tables assembled. The furnace at bldg 902 has been retrofitted to perform vacuum brazing. This eliminates the use of outside vendors for septum brazing. Two septa are scheduled for brazing next week. The vacuum vessels have been received and leak checked. The chambers are being vacuum fired. The heating blankets have been fitted to the chambers and tested. This WBS is 75% complete.

1.2.1.2 Thick Septum Magnet: Field measurements on the magnets have been delayed due to problems with power supply used for testing. The revised plan is to test the magnet with the power supply to be used in the BAF facility, which has just been shipped to BNL. The spare magnet will be tested first.

1.2.1.3 The stripper/collimator/flag assembly has been installed in the first article magnet. The wiring of the controls is now in process. The spare assembly is about 50% complete.

1.2.2 Power Supplies: 85 % complete.

1.2.2.1 Thin Septum Supply: D3 Power Supply is undergoing final testing at the vendor

1.2.2.2 Ejection Septum Supply: Power Supply is in transit to BNL.

1.2.2.3 Tune Quads Supplies: Both power supplies moved to their final location. Procurement of spare parts is underway.

1.2.2.4 Sextupoles: The power supplies have been received.

1.2.2.5 Bumps: Three of the five units ordered have been received. Power supply testing of two units is in progress.

1.2.3 Equipment Modifications: 60 % complete

1.2.3.1 D4 and D6: Parts complete.

1.2.3.2 D6 Beam Dump and Wall Current Monitor: Complete

1.2.3.3 D3 IPM and Beam Dump Kicker: There are no changes in these areas. The design is complete.

1.2.3.4 Vacuum System Modifications: All heating blankets have been tested. The security valve blanket and the fast valve have been ordered.

W.B.S. 1.3 Beam Transport System

1.3.1 Magnets: Complete

1.3.2 Power Supplies: Installation of the beam-line power supplies is going well. Final testing of the power supplies will commence as soon as the magnets and utilities are connected. One of the 2500 ampere - 70 volt units has been tested with no problems found. 85 % complete.

1.3.3 **Vacuum System:** 68 % complete

1.3.3.1 Beam Tubes, Bellow and Valves: The stands and the pump tees have been surveyed into place. The beam pipe stands are in the process of being surveyed and anchored to the floor. The Neg strips were received. Eighty per cent of the support stands and brackets have been fabricated by central shops. The vacuum boxes for D1 and D2 were received and are being leak checked. Supports for the all metal gate valve at extraction and the fast valve are in checking.

1.3.3.2 Pumps, Power Supplies and Gauges: The turbo roughing pumps stations are now being tested after small modifications to the control systems have been wired.

1.3.3.3 Instrumentation and Controls: Vacuum pumps, gauges and valves were named. Vacuum system cables were pulled. PLC ladder programming is in progress. Work on the Vacuum system to Controls system interfaces continued. Additional ion pump and gauge controllers were provided to Controls for driver development.

1.3.3.4 Transport Line Bake-out System: All blankets on order have been received and have been tested. The bake-out cart assembly is in progress.

1.3.4 Instrumentation: 78 % complete

- 1.3.4.1 Flags and Cameras: The Personal Computer, which will be dedicated as a video frame grabber has been configured, testing and data transfer effort to the high-level controls continues. A prototype flag control chassis has been built and tested on the bench; it uses interval relays to power the DC plunge/retract motor. Soon we will be testing it with a mechanical flag drive assembly. Mechanical assembly of the flags and motion development has begun

Progress has been made to solve our long-haul 1394 Fire wire data transport configuration between the BAF transport CCD cameras and the Fire wire hubs and PC. We have transported the high-speed digital video over 75 feet without repeaters, we anticipate even longer lengths are possible.

- 1.3.4.2 Collimators: Beam Plug and Beam Plug Chamber is near completion in the Central Machine Shops. Delivery to 919B for thermal testing (for bake-out) and motion development should begin by mid-April.

- 1.3.4.3 and 1.3.4.4 Ion Chamber, Scintillators and SWICS: Continuing effort on SWIC's, Ion Chambers and Scintillators systems.

- Effort continues on the assembly of SWIC electronics. The SWIC electronics scanner euro-card (with remote control gain) is back from the design room, again. Upon completion of the assembly and testing of one unit from the previous attempt, serious problems were found (errors on the +5V and ground busses). We have made the necessary changes, and are reviewing drawings before more boards are fabricated.
- Continue development of signal transfer interface between C-AD and NASA. The C-AD Controls group has accepted responsibility for providing the necessary logic and timing requirements using existing boards (V102 & V128). The controls group is in the process of writing the necessary firmware to download into the VME boards.
- Discussions about the high level Controls application requirements for data analysis and display continue.
- We now have the entire Bira High Voltage VME system in house and powered up. We have had minor improvements made to the Controls interface application. We are testing the system performance in the tech-shop. One of the HV pods were returned to the manufacturer after it was found to have ripple > 100mV.
- The racks for the Equipment Building have been installed; we await line power before installing instrumentation electronics.
- The scintillator NIM electronics have been installed and will be tested during the NASA run in the A3 line on the AGS Experiments floor.
- Progress on the BAF transport Argon gas distribution system has been made. The mixing panel has been completed and installed.

SWIC-Ion-Scintillator vacuum chambers have been vacuum fired and leak checked. Assembly and testing of the stand and motion system is in progress. New, larger "foil stretcher" for HV planes has been completed and successful prototype HV planes have been produced. 1.5mm horizontal and vertical SWIC boards have been fabricated and strung with wires for testing.

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

1.4.1 Controls: 73 % complete

1.4.1.1 Distributed systems: The permit monitor boards came in and two boards were built.

1.4.1.2 Central Services: Software development and testing is continuing for power supply and vacuum system interfaces. Test platforms are being provided for engineering level testing of instrumentation systems. Some application level software library development has begun.

1.4.1.3 Process Controls: A VME Test chassis for testing Beam line power supplies was installed in the Power supply test area on the experimental floor. The test chassis is being used by the power supply group to test their supplies and by the controls group to develop software. The 930UEB BAF power supply control chassis was installed. The power supply group will use this chassis to test the new Booster power supplies.

1.4.2 Personnel Safety System: Installation Continues. 90% complete

W.B.S. 1.5. Experimental Area Outfittng: 80 % complete.

Dosimetry Control: The Target Room design is complete and component selection has begun.

Software: Work continues on the channels for the new ring/quad ion chambers and for the 16 by 16 ion element chamber; channels to support the bias and gain hardware in the recycling integrator VME cards; refinement of various displays; the design document.

The conversion of the range program--which calculates the dE/dx and residual range at isocenter and various other points along the beamline (the location of the three quad ion chambers, etc.)--is complete.

The initial version of the document defining the procedure to calibrate the gain and bias in the 16-channel recycling integrator VME cards--for the new ring/quad ion chambers and for the 16 by 16 ion chamber--is complete.

Based on this document, work has been completed on a set of three programs to handle the fast bias sub-system of the 16-channel recycling integrator VME cards. Testing of these three programs awaits the availability of the hardware.

Also based on this document, work has been started on programs to handle the gain sub-system of the 16-channel recycling integrator VME cards.

Hardware: The Binary Filter Driver chassis is nearly complete. Testing of the high voltage system has started. Half of the cables are complete. The custom VME crates have been wire checked and two errors have been fixed. The Recycling Integrator module layout is nearing completion.

1.5.2.to 4. Support Rooms: We are ordering selected items for Rooms A and C.

For the A rooms, we ordered 6 stainless steel 5-shelf racks, and 3 stainless steel carts with shelves.

For the C rooms, we ordered 4 single CO2 incubators.

We also received early delivery of the two Baker HEPA-filtered hoods, due to a shipping mistake by the Baker Company. They were transported from Receiving to the BAF. At our request, they sent a letter saying that the warrantee period would not begin until the hoods are unpacked and placed in service. The sales representative will come to BNL to unpack the hoods and place them in service.

For the use by all BAF investigators, we ordered 1 Scotsman Ice (flaker) machine.

We visited BAF several times and pointed out several small problems, which are being remedied by the contractor: mismatched corner guards; mis-constructed seams in the poured epoxy floor, badly scratched laminate on counter tops, leaking faucet in Users' Room, poorly operating room locks on several C Rooms.

Delivery of several other large pieces of equipment (e.g., roll-in incubators) is expected shortly.

W.B.S. 1.6 Long Term Support Lab: No change: 90 % complete.

W.B.S. 1.7 Installation and Services:

1.7.1 Electric Power Distribution: No Change-95 % complete.

1.7.2 Equipment Cooling Water:

1. Pump alignment in process estimated @ 90% complete, only the tower pump alignment remains to be completed.
2. Full electrical power is available to turn on all pumps and check system operations for the tower system, power supply system and the magnet system.
3. Installation and check out of PLC system. The unit has been 100% fabricated off location. The PLC electrical power and the installation cables between transducers to the PLC are currently being installed. The PLC and system check out will commence after that. The system check out is scheduled for mid to late April.
4. The piping in the tunnel is 90% complete. Only the BAF/Booster tunnel connection to the Booster Ring remains to be completed and tested. This second Phase is also nearly complete. Final work is expected to start mid June.
5. Completion of Power Supply Piping in Bldg #930 has started and is about 50% complete. This now is also on hold until June 02. Only the underground connect to Bldg #930 is installed and tested. The piping contractor is almost complete with the other PS piping within Bldg #957.
6. The piping contractor is complete or near complete with the following work in Bldg #957:
 - a. sump drains to holding tank
 - b. installation of holding tank
 - c. air lines from compressor to tunnel and within tunnel
 - d. compressor installation
 - e. air filter and oil separator installation to air compressor
 - f. connection of c, d, and e above

Overall Progress: 93% complete.

- 1.7.3 Installation: AC, DC and Magnet Interlock cables installation 95% complete. Termination of these cables is 10% complete.

Booster down time allowed the installation of the remaining four magnets in the upstream "stub" tunnel. Final positioning and survey are still required during the summer shutdown.

W.B.S. 1.8 Project Services

- 1.8.1 Project Management: In consultation with the DOE Project Manager \$361,000 was assigned from contingency. This leaves a balance of \$1,355,000 on \$5,365,870 remaining to be expensed and committed. The details of these actions are outlined in section 3(f) and Table IV. It is planned to begin commissioning of the Tandem Accelerator and beam line for the extraction and acceleration of Fe+20 ions. This high charge state is required for the Booster if the full energy range required for BAF is to be achieved. To accomplish this the distribution of funding between FY 2002 and 2003 was changed to permit funding for Commissioning in FY 2002. Small amounts of funding for Controls and Laboratory Outfitting was moved to FY 2003. The total required funding for each WBS and fiscal year remains unchanged.

The operating schedule for the Booster accelerator has been extended and now the start of Booster modifications installation and completion of conventional construction have been rescheduled to June 1 and July 31 respectively.

- 1.8.2 Fiscal: No change.

- 1.8.3 Quality Assurance: No issues.

- 1.8.4 Environment, Safety and Health: Preparations for Accelerator Readiness Review for BAF Commissioning began during this reporting period.

3) Summary Status Assessment and Forecast

a) Financial Status

A total of \$27,179,130 was expensed or obligated of the \$31,105,000 available. Costs represented \$24,457,382 and open commitments stood at \$2,721,748. The Project Total Estimated Cost (TEC) is \$31,657,000. 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	07/31/02

- e) The critical path for the Project is indicated in Figure 1. WBS 1.2 is now on the critical path. The majority of the items in this WBS can only be installed when the Booster is in a scheduled shutdown. The estimate for installation is 4 months, including time to allow “cool-down” of radioactive components. The FY 2002 Booster shutdown is now scheduled to begin between June 1 and June 15 and beam operations in the Booster are scheduled to resume October 15, 2002 if the shutdown begins June 1 or earlier but will be delayed until November 1 if the shutdown begins after June 1.

All items will be ready for installation before June 1 and detailed installation plans are being “fine tuned” to meet ALARA guide lines. Financial contingency will be maintained to assure this critical effort is completed during the scheduled shutdown.

- f) Baseline Change Proposals – During this reporting period, the budgets for the following WBS’s were augmented/ decreased with transfer of funds to and from contingency. The justification for the modifications are given in Table IV. There is no change in scope or total project cost.

WBS	Description	New Budget
1.2.1	New Extraction Equipment	\$1,622,000
1.2.2	Power Supplies	\$2,682,000
1.5.1	Dosimetry Control	\$3,002,000
1.7.3	Installation	\$1,295,000
1.8.4	ES&H	\$272,000
NA	Spares	\$844,000

- g) Cost Performance: Figure 2 provides a measure of project performance relating the planned budget profile versus expenses and commitments. Obligations and expenses were \$676,000 more than planned, and expenses were \$748,000 lower than forecast. The lower than expected expenses result from rescheduling of Booster shutdown. The increased commitment rate is the result of the early commitment of the total value of the dosimetry contract with LBL.

Table I
BAF Project Milestones

	<u>Projected</u>
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	07/31/02
Booster Modifications Installation Complete	09/31/02
Beam Transport System Installation Complete	12/30/02
Experimental Equipment Installation Complete	03/31/03
Project Complete	06/30/03

Booster Applications Facility

Master Milestone Schedule

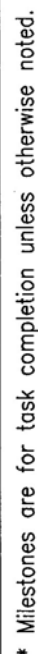


Figure 2

BAF Performance Measurement

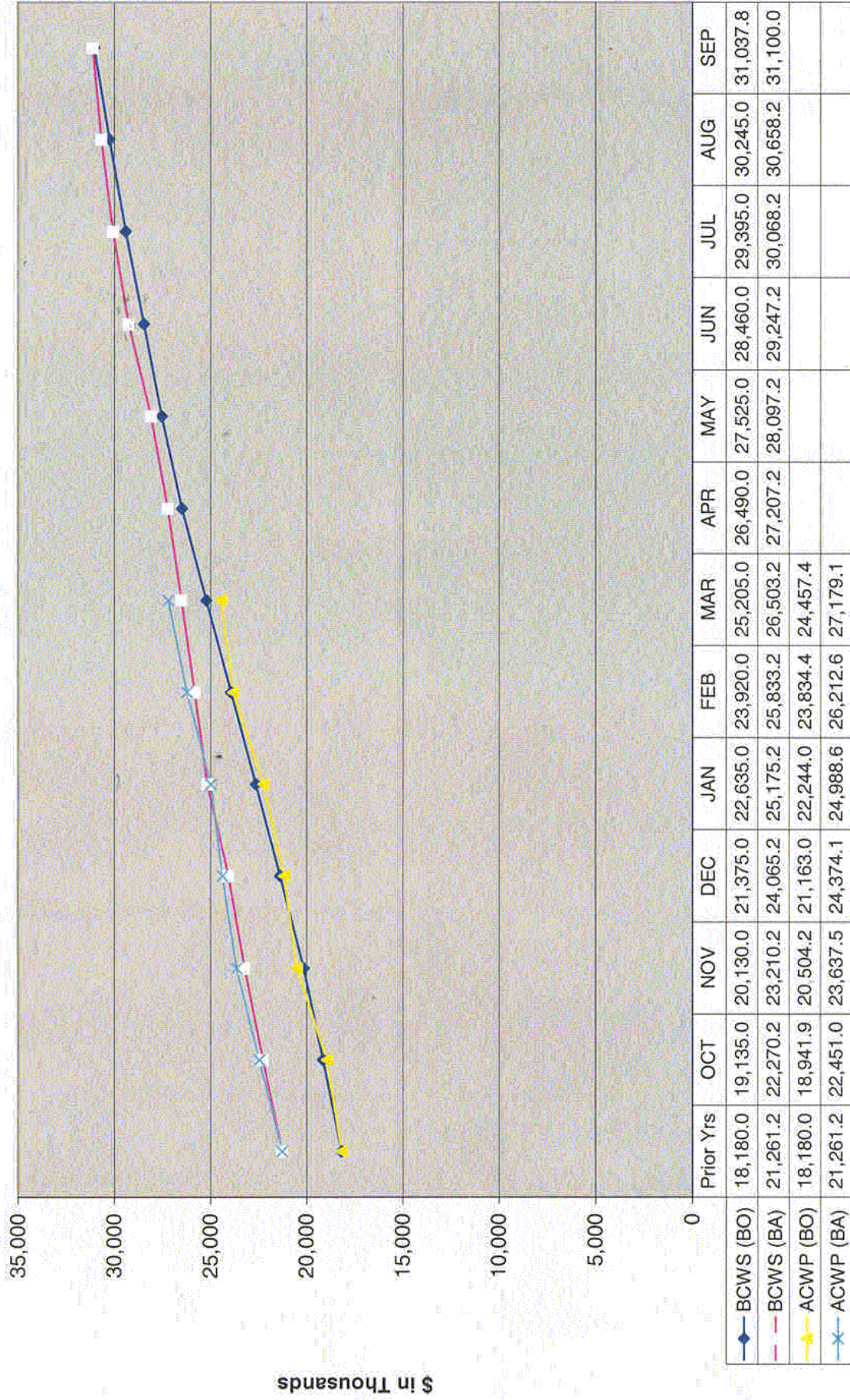


TABLE II
BOOSTER APPLICATIONS FACILITY (BAF)
EXPENSE and COMMITMENTS
As of March 31, 2002

	Budget	Salary & Wage	EXPENSES Other Labor	Material & Contracts	Overhead	TOTAL EXPENSES	COMMIT.	TOTAL EXP. & COMMIT	BALANCE AVAILABLE
1.1 Conventional Construction	6,600,000	132,937	964,226	4,663,399	556,875	6,317,437	274,719	6,592,156	7,844
1.2 Booster Modifications	5,651,000	1,735,368	523,969	1,684,695	786,938	4,730,970	433,875	5,164,845	486,155
1.3 Beam Transport System	5,764,000	1,689,329	312,439	1,403,956	662,897	4,068,621	751,144	4,819,765	944,235
1.4 Controls & Personnel Safety System	1,582,000	490,111	75,700	517,817	225,753	1,309,381	22,645	1,332,026	249,974
1.5 Exp. Area Outfitting	3,264,00	19,874	635	2,001,787	159,156	2,181,452	548,224	2,729,676	534,324
1.6 Long Term Support Lab	456,000	0	2,095	325,013	55,388	382,496	12,324	394,820	61,180
1.7 Installation & Services	3,146,000	806,931	124,640	1,531,631	353,332	2,816,534	298,786	3,115,320	30,680
1.8 Project Services	3,014,000	899,722	339	67,082	1,305,353	2,272,496	192,745	2,465,241	548,759
CONTINGENCY	800,000					0		0	800,000
SPARES	653,000	28,521	68,360	219,695	61,419	377,995	187,286	565,281	87,719
Commissioning	175,000	0	0	0	0	0	0	0	175,000
1 BAF Construction	31,105,000	5,802,793	2,072,403	12,415,075	4,167,111	24,457,382	2,721,748	27,179,130	3,925,870

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

		FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
	TOTAL						
1.1	Conventional Construction	290	80	4,628	989	613	0
1.2	Booster Modifications		282	1,747	1,886	1,736	0
1.3	Beam Transport System		56	961	2,547	2,200	0
1.4	Controls & Personnel Safety System		8	497	579	498	75
1.5	Exp. Area Outfitting		0	1,200	679	1,385	100
1.6	Long Term Support Lab		0	343	0	113	0
1.7	Installation & Services		9	1,237	1,117	783	0
1.8	Project Services	10	165	985	650	1,204	650
		300	600	11,598	8,447	8,707	650
	Contingency	0	0	0	0	800	555
1 (TEC)	BAF Construction (BA AY \$)	300	600	11,598	8,447	9,057	1,205
	Spares			50	266	337	191
	Commissioning					175	1,224
1 (TPC)	Total Project Cost (BA AY \$)	300	600	11,648	8,713	9,844	2,795
1 (TPC)	BAF Construction (BO AY \$)	300	600	5,348	11,932	12,858	2,862

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
06/30/00	1	1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8		3,803 3,742 4,478 1,236 2,710 851 1,708 1,129 3,796 4,649 1,912 993	870 1,109 1,160 321 358 104 463 2,129 1,037 0 0 0	4,673 4,851 5,638 1,557 3,068 455 2,171 3,258 4,833 0 0 0			Modified WBS elements to include overhead, escalation and FCR.
08/31/00	2	1.1		4,673	425	5,098	(425)	4,408	Vendor bid exceeded estimate
08/31/00	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 09/30/02 to 06/30/03					Modified schedule to match spending profile
11/30/00	6	1.3		Changed Completion Date from 04/31/02 to 09/30/02					Modified schedule to match spending profile
11/30/00	7	1.4		Changed Completion Date from 05/30/02 to 03/31/03					Modified schedule to match spending profile
11/30/00	8	1.5		Changed Completion Date from 06/30/02 to 03/31/03					Modified schedule to match spending profile
11/30/00	9	Commissioning		Changed Completion Date from 09/30/02 to 06/30/03					Modified schedule to match spending profile
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 & 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

TABLE IV
BAF CHANGE CONTROL
\$1000's
(continued)

Date	Change No.	W.B.S.		Base Line	Change	Adjusted Base Line	Contingency Increase (Decrease)	Contingency Balance	Description
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 08/31/02					RHIC operating schedule modified, eliminating FY01 summer shutdown
01/20/01	19	1.2		Design complete extended from 12/31/00 to 06/30/01					Design effort extended due to loss of personnel
09/30/01	20	1.8		3,659	160	3,499	160	3,200	Reduced budget due to projected lower project burden and fiscal and FS&H expenses.
09/30/01	21	1.1		5,698	(200)	5,898	(200)	3,000	Increase engineering design effort for electrical distribution & building modifications
09/30/01	22	1.7		2,739	(160)	2,899	(160)	2,840	Increased budget required for higher than expected vendor bids
11/30/01	23	1.1		5,698	602	6,300	(602)	2,238	Increase required for HVAC controls, doors and canopy at alcove, HVAC duct work, structural steel work, berm liner, engineering and inspection and overhead costs increases.
11/30/01	24	1.2		5,251	100	5,351	(100)	2,138	Increase required for D3 septum development and buss work fabrication for D3 and D6 power supply installation.
11/30/01	25	1.3.1		999	25	1,024	(25)	2,113	Increase required for magnet monitoring system and octupoles.
11/30/01	26	1.7		2,899	197	3,096	(197)	1,916	Increase required for electrical distribution system transformer rework and cooling system changes for power supplies.
01/31/02	27	1.1		6,300	300	6,600	(300)	1,616	Increased cost for engineering oversight.

