

**Commissioning and Acceptance Plan for Operation of the Booster
Applications Facility**

February 15, 2002

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Approval Date: 2/15/02

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I. Introduction

This acceptance plan describes necessary activities to be completed by the Collider Accelerator (C-A) Department prior to the ARR and commencement of commissioning and routine operation of the Booster Applications Facility (BAF). It is intended that this acceptance plan help the C-A Department prepare for an appropriate readiness review as required in DOE Order O 420.2, Section 5 b. An appropriate Accelerator Readiness Review (ARR) must be conducted following the declaration of readiness for commissioning or routine operations. The ARR report must support the decision by the DOE Field Office to approve the commencement of routine operations of the BAF and associated experiments.

This plan is intended to ensure the C-A Department avoids unsafe or environmentally unsound operations. It is noted that routine operation of the BAF may be concurrent with other operations; e.g., the fixed-target program in Building 912, or collider operations in the RHIC. From an operations standpoint, the BAF is viewed as a portion of a spectrum of operations in which machine physicists and shift-based operations personnel work out of a single Main Control Room (MCR) in Building 911. The role of the physicists and operators located throughout the complex is to achieve efficient, safe, and environmentally benign conveyance of protons or heavy ions in the machines and transfer lines during all operations.

C-A Department staff and Users are subject to the requirements of the Collider-Accelerator Conduct of Operations Agreement. The Conduct of Operations Agreement requires the on-duty Operations Coordinators be responsible for operation of the Collider-Accelerator complex. The operations staff consists of Operations Coordinators and Operators, as well as personnel from operations-support groups under their purview. Operations staff is trained, and only qualified personnel execute operation of the Collider-Accelerator complex. All authorizations, all permanent or temporary procedures, all Accelerator Safety Envelopes or Operational Safety Limits, and all responses to emergencies or occurrences must follow the formal processes identified in the Conduct of Operations Agreement. The BNL Directorate and the C-A Department management hold this understanding of the Conduct of Operations Agreement for the purposes of safe and environmentally sound operations.

Significant changes to Conduct of Operations, Training, Administrative or Technical Controls, Contingency Plans or the ARR process itself will be submitted as updates to this basic plan.

II. Scope

The scope of this plan covers both commissioning and acceptance for routine operations. The plan is intended to help prepare the following for verification by the ARR:

- Procedures, administrative controls, and personnel training and qualification for commissioning as well as routine operations
- Engineered safety systems for the baf beam line and associated experimental facilities
- Specific facilities, sub-systems, and operations modes

Beam particles for the BAF will originate from either the Tandem or Linac accelerators, depending upon the need for heavy ions or protons. Transport lines then deliver beam to the AGS Booster synchrotron accelerator, which further accelerates the beam to an energy prescribed by the needs of the particular experiment. In the case of heavy ions, particles from one of the Tandem Van de Graaff accelerators (MP-7) will typically be reserved for providing gold ions to the RHIC during collider operations; the MP-6 Van de Graaff will provide heavy ions of various species to the BAF, or to service commercial experimenters at the Tandem experimental rooms in Building 901. For protons, the Linac provides protons to the Booster, for BAF and as a pre-accelerator to the AGS, concurrent with operations for BLIP. With either protons or heavy ions, bunched beam will be debunched in the Booster prior to extraction down the BAF line. The debunched beam pulse, up to 1 second in length, travels down the 100 m beam line to the target building, where experimenters will utilize the beam.

Controls for the beam will be via the Main Control Room. Installed safety systems will be similar in design to those used for the RHIC; these will be verified as ready prior to commissioning or routine operations. Safety systems include beam crash, access control subsystems, radiation monitors and critical devices; additional items, such as remote cameras and iris-scanning identity-verification have been added to facilitate frequent experimenter accesses to the target area. These are items previously used with NASA experiments in Building 912.

The facilities created for the BAF project include three new buildings:

- An experimental support building (building 958) that contains laboratory space as well as dosimetry control and communication with the MCR
- A power supply building (building 957) that contains magnet power supplies and instrumentation electronics for the beam line and associated cooling water systems
- The beam line tunnel, including entry labyrinths, target area and beam stop (building 956)

The BAF mode of operation will primarily use heavy ions of various species, but a proton operation mode will also be possible. In order to extract debunched beam from the Booster, new systems will be commissioned, including:

- A scheme for “Slow Extracted Beam” (SEB) from the Booster accelerator
- The Booster dump and catcher at the Booster D Section
- The BAF beam line and its associated magnets, power supplies, vacuum system, instrumentation and associated cooling water systems
- The BAF experimental area and systems for inserting samples at the target station, monitoring dosimetry and precisely controlling exposure of samples

With regard to beam operation and ion species, a schedule of the plan can be found in Figure 1 of the [March 2001 BAF Status Report](#). As shown by the plan it is anticipated that BAF commissioning with beam will begin during September and October 2002 with an additional commissioning period in April-June 2003, following installation of experimental equipment. Routine operations, as shown in the [Fiscal Years 2002-2006 Draft Operating Schedule](#), are anticipated for July 2003.

For the purpose of allowing sufficient time for the ARR validation effort, two separate commissioning modules and one operations module are envisioned:

- The first module for which an ARR is planned starts August 1, 2002 and is for achieving readiness for BAF commissioning; it is planned that the ARR committee complete their report on or about September 1, 2002
- The second module starts January 1, 2003 and is for commissioning additional experimental equipment; it is planned that the ARR complete their report for this module on or about February 1, 2003
- The third module starts March 1, 2003 and is for achieving readiness for BAF routine operation; it is planned that the ARR complete their final report on or about April 1, 2003

A [Safety Assessment Document](#) (SAD) for the BAF routine operation was submitted to BNL’s ESH Committee on May 10, 2001, and they recommended approval. A draft Accelerator Safety Envelope (ASE) for routine operations was also developed and presented to the ESH Committee, who recommended it be sent to the DOE Area Office. The Commissioning/Acceptance Plan, the approved SAD, and the draft ASE are intended to support the request that DOE approve routine operations following completion of the ARR.

III. Relevant Documents Available On-line

- [BAF Safety Assessment Document](#)
- [Proposed BAF Accelerator Safety Envelope](#)
- [Collider-Accelerator Department Conduct of Operations](#)
- [Collider-Accelerator Department Operations Procedures](#)
- [Environmental Assessment for BAF](#)
- [Training and Qualification Plan](#)
- [Quality Assurance Procedures](#)
- [Configuration Management Plan for C-A Access Control System](#)
- [Procedure for Review of Shielding Design](#)
- [Procedure for Unreviewed Safety Issues](#)

IV. Conduct of Operations

The [Collider-Accelerator complex](#) is made up of a number of facilities. It includes the [Tandem Van de Graaff](#), the Tandem to Booster (TTB) tunnel, the [Linac](#), the Booster, the BAF line, the Booster to AGS (BTA) tunnel, the AGS Ring and its [fixed-target experimental areas](#) including the Muon Storage Ring, the AGS to RHIC (ATR) tunnel, the [Collider](#) and the experiments at the intersection regions. During operations, all problems encountered (e.g., operational, safety, scheduling, etc.) in any of these areas are reported to the Operations Coordinator in the MCR. All staff will be working under the procedures and authorizations prescribed by the Collider-Accelerator Conduct of Operations.

The Operations Coordinator makes the necessary notifications or arrangements for operations or authorizations. All operations would have to be preceded by the appropriate authorizations where required. Required authorizations are indicated in the Collider-Accelerator Operations Procedure Manual, and on the check-off lists authorized by the Radiation Safety Committee, the Accelerator Systems Safety Review Committee and the Experiment Safety Review Committee.

All operations personnel must satisfy requirements for authorization in the following areas:

- Delegating C-AD chairman, division head or supervisor authorization
- Operating collider-accelerator systems
- Starting-up or restarting collider-accelerator systems
- Performing maintenance on collider-accelerator systems
- Producing, classifying or removing existing procedures
- Approving temporary procedures
- Signing-off changes to procedures
- Reviewing procedures
- Appending training and qualification listings

- Declaring “critical” systems; that is, systems that must be worked on when energized

During maintenance and shutdown periods, all scheduled operational related maintenance is done following the notification of the appropriate Divisional Maintenance Coordinator. All maintenance is performed via requirements set down in [ES&H Standard 1.3.6](#), Work Planning and Control for Operations, and executed at the Department level via [OPM 2.10](#), Maintenance Management Policy, [OPM 2.28](#), Enhanced Work Planning, and [OPM 2.29](#), Enhanced Work Planning for Experimenters.

V. Training

It is the policy of the Collider-Accelerator Department to ensure general, facility-specific, and job-specific training of any C-A employee, visitor, contractor or experimenter who will require unescorted entry, into one or more of the buildings that form the Collider-Accelerator complex. Training is provided, to the level appropriate, to ensure conformance to the Collider-Accelerator Operations Procedures Manual in order to protect the environment, and to maintain the health and safety of personnel.

An examination system for training, which can be audited, is maintained by the Collider-Accelerator Department [Training Group](#).

Training courses are developed using performance-based training techniques, based on guidance from DOE's Training Accreditation Program (TAP) objectives. Training includes general BNL Rad Worker 1, C-A BAF facility-specific ESH training, and job-specific training for critical skills. Individuals, whether employees, guests or visitors complete specified training to maintain an acceptable level of performance required for safe, environmentally sound and efficient conduct of assigned duties.

Facility-specific ESH training is aimed at preparing individuals to enter either C-A accelerators and/or experimental areas, and is provided by the C-A Department. All individuals who may enter accelerators are required to take Collider-Accelerator Access Training. All Users who work in the experimental areas are required to take facility-specific Users Training. Study guides for facility-specific training programs are located at the [C-A ESHQ web site](#). The C-A Training Manager coordinates staff training. The [RHIC and AGS Users Center](#) provides training coordination and guest services for the experimenters.

Facility-specific training does not enable a person to work in a C-A facility. An additional determination regarding job-specific ESH training is required prior to authorizing work. Work Control Coordinators make this determination for each job they assign using the C-A Department work planning process (C-A OPM 2.28). For Users,

the Experimental Work Control Coordinator using a process described in C-A OPM 2.29 makes this determination.

In order for the Work Control Coordinators to verify personnel qualifications, the appropriate job-specific training for each C-A employee or User is assigned one or more Training Job Assessments. Each Job Training Assessment is linked to training course requirements that are listed in the [Brookhaven Training Management System \(BTMS\)](#). The BTMS can be searched by Work Control Coordinators to determine if an individual is qualified to perform the work. Additionally, the Access Control System will not allow Users to enter the BAF experimental area unescorted unless they have met training requirements.

BTMS job title relevant to routine operations of the BAF and experiments, and the minimum number of qualified personnel required to maintain operation of BAF, are:

- MCR Operations Coordinator, AD-510 (1 per shift)
- MCR Operator, AD-560 (1 per shift)
- Tandem Van de Graaff Operator if TVDVG is used, AD-012/AD-014 (1 per shift)
- C-A Radiological Control Technician, RP-01 and AD-520 (1 per shift)
- Collider-Accelerator Support, AD-570 (1 per shift)

VI. Contingency Procedures

It is not unreasonable to assume situations that employ equivalent safety or protection techniques may arise when operating facilities of this size.

Contingency procedures include a conventional but equivalent protection technique. One example is [C-A OPM 9.1.16](#), “Lock Out and Tag Out for Radiation Safety.” The C-A Department uses this formal procedure to maintain compliance with all applicable radiation standards in situations where a fully automatic access-control system is impractical. This C-A procedure provides instructions for liaison physicists, liaison engineers, members of the Access Controls Group, Operations Coordinators, and members of the C-A Radiation Safety Committee to follow in order to lock out and tag out equipment or beam lines for the purposes of radiation protection. C-A personnel who are members of our existing Conduct of Operations may employ this procedure whenever equipment or beam lines are to be locked out during barrier modifications or removals, or whenever the automatic access-control system alone does not provide the required protection.

Additional contingency procedures may be developed during the BAF commissioning period in order to ensure safe, environmentally sound and reliable execution of specific tasks.

VII. Commissioning and Routine Operation Modules

Module for Commissioning BAF SEB, Persons Responsible and Scheduled Readiness
Date

SCHEDULE: Commissioning of SEB to the BAF line on or about September 15, 2002.
DESCRIPTION: New Booster ring extraction equipment will be commissioned with beam ejected into the beginning of the BAF line. The Booster dump/catcher at Booster D Section and the beam dump at the end of the BAF line will be commissioned.
COMMISSIONING REQUIREMENTS (Persons Responsible): <ul style="list-style-type: none">• All ASSRC and RSC items relevant to this commissioning module are closed out (W. Glenn, D. Beavis)• Critical devices, beam current monitors and reach-backs for radiation protection have been established (D. Beavis)• The access control system is operational and tested (A. Etkin, N. Williams)• Emergency procedures are complete (R. Karol)• Operations procedures are complete (P. Ingrassia)• Fault Study Plan prepared (A. Rusek)• RSC Check-Off List prepared (A. Rusek)• ASSRC Check-Off List prepared (J. Hock)• Accelerator Safety Envelope is complete (E. Lessard)• Sweep procedures are complete (P. Ingrassia)• Training records for operations staff are complete (J. Maraviglia)

Module for Commissioning BAF Experimental Equipment, Persons Responsible and Scheduled Readiness Date

<p>SCHEDULE: Commissioning experimental equipment with heavy ions on or about April 1, 2003.</p>
<p>DESCRIPTION: Heavy ions will be transported to the BAF target station; experimental equipment and procedures will be tested.</p>
<p>COMMISSIONING REQUIREMENTS (Persons Responsible):</p> <ul style="list-style-type: none"> • Experimental Support Building is complete (D. Phillips) • ESRC, ASSRC and RSC items relevant to this commissioning module are closed out (A. Rusek, D. Phillips, Y. Makdisi, W. Glenn, D. Beavis) • The access control system is operational and tested for experimenter use (A. Etkin, N. Williams) • Emergency procedures for experiments are complete (R. Karol) • Experiment operations procedures are complete (A. Rusek) • Fault Study Plan prepared (A. Rusek) • RSC and ESRC Check-off Lists prepared (A. Rusek) • Accelerator Safety Envelope is complete (E. Lessard) • Sweep procedures are complete (P. Ingrassia) • Training records for relevant Users complete (J. Maraviglia)

Module for BAF Routine Operations, Persons Responsible and Scheduled Readiness Date

<p>SCHEDULE: BAF routine operations with beam on or about July 1, 2003.</p>
<p>DESCRIPTION: BAF will commence routine experimental running.</p>
<p>ROUTINE OPERATIONS REQUIREMENTS (Persons Responsible):</p> <ul style="list-style-type: none"> • All ESRC, ASSRC and RSC items relevant to routine operations are closed out (D. Phillips, A. Rusek, Y. Makdisi, W. Glenn, D. Beavis) • The BAF access-control system is operational and tested (A. Etkin, N. Williams) • Emergency procedures are complete (R. Karol) • Operations procedures are complete (P. Ingrassia) • RSC and ESRC Check-Off Lists prepared (A. Rusek) • ASSRC Check-Off List prepared (J. Hock) • Accelerator Safety Envelope is complete (E. Lessard) • Sweep procedures are complete (P. Ingrassia) • Facility specific training for users developed and implemented (P. Cernigliaro) • Training records for operations staff complete (J. Maraviglia) • Training records for Users complete (J. Maraviglia)

VIII. Technical and Administrative Controls

A *technical control* is an act, service, or document used to satisfy a specific requirement stated in a *DOE Order or Federal Law* to ensure safety or protect the environment. Examples include the following:

- Safety Assessment Document
- Accelerator Readiness Review
- Accelerator Safety Envelope
- Radiological training requirements
- ALARA program for dose reduction
- DOE approval prior to commissioning and routine operations
- Shielding Policy as per DOE Order 420.2A

Technical controls are found in [DOE Order 420.2A “Accelerator Safety”](#), [10 CFR 835 “Occupational Radiation Protection”](#) and [DOE 5480.19 “Conduct of Operations Requirements for DOE Facilities”](#).

An *administrative control* is an act, service, or document used to satisfy a specific requirement stated in a *BNL or Department/Division policy* to ensure safety or protect the environment. Examples include:

- Experiment and accelerator design reviews for safety and environmental protection
- Safely-off modes, critical devices, and reach backs for radiation protection
- Access control procedures for operators
- Operations procedures
- Fault studies
- Sweep procedures
- Records to ensure training is completed
- Roles, responsibilities, authorities, and accountabilities document (R2A2s)
- Facility Use Agreements
- Work planning

Administrative controls are found in Brookhaven's [Standards Based Management System](#), [C-A Department Conduct of Operations Matrix](#), and [C-A Department Procedures](#).

Specific Technical Controls for BAF Commissioning and Operations

- C-A Department Conduct of Operations Matrix
- BAF Commissioning/Acceptance Plan
- BAF Commissioning and Operations ARR Report
- DOE approvals for BAF Commissioning and Operations

- DOE approval of BAF Accelerator Safety Envelope
- BAF Environmental Assessment and FONSI
- BAF Safety Assessment Document
- ALARA procedures

Specific Administrative Controls for Collider Operations

- Configuration management plan
- Designation of critical devices by the Radiation Safety Committee
- ESH reviews by BNL and C-AD ESH committees
- Environmental management system requirements for the BAF
- Facility Use Agreements for BAF facilities
- Fault studies
- Functional tests of the BAF security system
- Laboratory management approval for BAF commissioning and operations
- Operational readiness reviews
- Operations procedures
- R2A2 documents
- Radiation Safety Committee check-off lists
- Experimental Safety Review Committee check-off lists
- Accelerator Systems Safety Review Committee check-off lists
- Radiation Work Permits
- Radiation monitor interlocks and main control room alarms
- Self-assessments, self-evaluations and C-AD management assessments
- Standards Based Management System requirements
- Sweep procedures
- Training documentation (BTMS)
- Work planning and work permits

IX. List of New/Updated C-A Operations Procedures Required for BAF Commissioning and Operational Readiness (Person Responsible)

(E. Lessard)

OPM 2.5.3, BAF Operational Safety Limits/Accelerator Safety Envelope

(P. Ingrassia)

OPM 4.56. Number to be determined, BAF Line Upstream (Z3) Sweep Checklist

OPM 4.56. Number to be determined, BAF Line Downstream (Z2) Sweep Checklist

OPM 4.56. Number to be determined, BAF Experimental Area (Z1) Sweep Checklist

(R. Karol)

OPM 3. Number to be determined, BAF Emergency Procedure

(N. Williams)

OPM 4. Number to be determined, BAF line (Peer 27) Security Gate Subsystem Check

OPM 4. Number to be determined, PASS Peer 27 Crash Subsystem Test

OPM 4. Number to be determined, Critical Response Subsystem Checklist for PASS – Peer 27

OPM 4. Number to be determined, Confirmation of Proper System Operation of PASS – Peer 27

Experiment Operating Procedures (A. Rusek)

OPM 11. Number to be determined, Operation of Experiment Sample Trolley

OPM 11. Number to be determined, Operation of Beam Degradation

OPM 11. Number to be determined, Operation of Overhead Crane

X. Responsibility Matrix

Acceptance Plan Element	Training - Records, Coordination	Fault Study Plan	Commissioning Fault Study Review	Sweep Procedures	Operations Procedures	Emergency Procedures	Access Control System Review	Experiment Operating Procedures	Work Planning for Experimenters	Facility-Specific Training	RSC Checklists	ESRC Checklists	ASSRC Issues/Checklists	Accelerator Safety Envelope	Prior Open Items (e.g., ORR items from construction project)	Facility Use Agreements	EMS Documents for BAF
Person(s) Responsible																	
A. Etkin		X	X				X									X	
A. Rusek		X	X					X			X	X					
B. Sutherland								X		X							
H. Kahnhauser		X	X														
D. Beavis							X				X						
D. Phillips													X				
E. Lessard					X									X			
J. Maraviglia	X									X							
P. Cirnigliaro								X	X								X
R. Karol						X									X		
J. Hock													X				
M. Vazquez								X		X							
N. Williams				X			X										
P. Ingrassia				X	X												
W. Glenn													X				
Y. Makdisi								X			X						