



## 2.5 Accelerator Safety Envelope Parameters for AGS, Booster, Linac and Associated Experimental Areas

### 1. Purpose

- 1.1 This procedure defines the responsibilities for maintaining the Accelerator Safety Envelope Parameters for the AGS, Booster and Linac portions of the C-A complex including associated experimental areas. These Parameters are based on the [Accelerator Safety Envelope](#) and any relevant USIs documented using [C-A OPM 1.10.1](#), Unreviewed Safety Issues.

**Note:**

Separate ASE parameters are provided for the Tandem Van De Graaff and TTB Line in [OPM 2.5.1](#), for the Collider (RHIC) in [OPM 2.5.2](#) and for the NASA Space Radiation Laboratory (NSRL) in [OPM 2.5.3](#).

- 1.1.1 Additionally, the AGS, Booster and Linac experiments are limited by ESH requirements established by the C-A Radiation Safety Committee (RSC), the C-A Accelerator Systems Safety Review Committee (ASSRC), and the C-A Experimental Safety Review Committee (ESRC). C-A safety-committee requirements are documented in RSC, ASSRC, and ESRC Checkoff Lists in the Main Control Room (MCR). These Checkoff Lists must be completed before allowing reviewed systems to become operational, or allowing beam in the AGS, Booster, Linac or experimental beam lines.
- 1.2 Implicit in the notion of an Accelerator Safety Envelope Parameter is that variations in operating conditions are permitted if and only if they do not exceed the defined boundaries. A variation beyond the boundaries described in this procedure shall be evaluated as a reportable occurrence by C-AD management as defined by [SBMS](#) Subject Area on Occurrence Reporting. Notifications of occurrences shall be made according to [C-A OPM 10.1](#).
- 1.2.1 If a Requirement is not satisfied and it has a specific Authorized Alternative associated with it, implement the Authorized Alternative or safely stop the activity associated with the Requirement.
- 1.2.2 If a Requirement is not satisfied and does not have a specific Authorized Alternative, stop that activity that uses the affected equipment within one hour.

- 1.2.3 If an Authorized Alternative is implemented, then this is not a reportable occurrence; however, a C-AD Critique shall be conducted (as required by the BNL ESH Committee) to document the reasons and any recommendations made to reduce the need for implementing the Authorized Alternative in the future to the C-AD Chair.
- 1.3 Emergency actions may be taken that depart from these approved ASE Requirements when no actions consistent with the Requirements are immediately apparent and when these actions are needed to protect the public, worker or environment.
  - 1.3.1 These actions shall be approved by the person in charge of facility safety, as defined in the operating procedures, when the emergency occurs and shall be reported to C-AD management within 2-hours.

## **2. Responsibilities**

- 2.1 The Department Chair shall approve all changes to the Accelerator Safety Envelope Parameters (ASEPs).
- 2.2 The following individuals have responsibilities for each of the ASEPs as specified in the beginning of the ASEP:
  - 2.2.1 Associate Chair for ESHQ
  - 2.2.2 Chair of ESRC
  - 2.2.3 Chair of RSC
  - 2.2.4 Head of MCR
  - 2.2.5 Liaison Physicists
  - 2.2.6 Liaison Engineers
  - 2.2.7 On-duty Operations Coordinator
  - 2.2.8 Facility Support Representative (RCD)
  - 2.2.9 Access Controls Group Leader
  - 2.2.10 Maintenance Coordinator
  - 2.2.11 ESH Coordinator
  - 2.2.12 CAS Group Leader
- 2.3 The person in charge that approves Emergency Actions that depart from the requirements of this procedure (see step 1.3.1) shall inform the Department Chair within 2-hours of this decision.

## **3. Prerequisites**

None

#### 4. **Precautions**

None

#### 5. **Procedure**

Accelerator Safety Envelope Parameters are established for:

- AGS, Linac and Booster Beam Limits in Terms of the Product of Nucleon Energy and Flux and Limiting Particle Loss
- Classification of Radiological Areas
- Completion of RSC, ASSRC and ESRC Checkoff Lists
- Access Controls During Operations with Beam
- Oxygen Deficiency Hazard Control
- Fire Protection
- Staffing
- Calibration, Testing, Maintenance, and Inspection
- Shutdown Periods
- Groundwater, Radiological Barriers and Dose Limits

##### 5.1 AGS, Linac and Booster Particle Beam Limits in Terms of the Product of Nucleon Energy and Flux and Limiting Particle Loss

5.1.1 The on-duty Operations Coordinator shall ensure that the maximum product of the number of high energy unpolarized protons or polarized protons and particle energy in the Linac does not exceed  $9 \times 10^{17}$  GeV in one hour.

5.1.2 The on-duty Operations Coordinator shall ensure that the maximum product of the number of high energy unpolarized protons, polarized protons or heavy ions and particle energy in the AGS ring does not exceed  $1.1 \times 10^{19}$  GeV in one hour.

5.1.3 The on-duty Operations Coordinator shall ensure that the maximum product of the number of high energy unpolarized protons, polarized protons or heavy ions and particle energy in the Booster ring does not exceed  $5.4 \times 10^{17}$  GeV in one hour.

5.1.4 The appropriate Liaison Physicist shall determine the limits for protons on targets under their responsibility.

5.1.4.1 The Head of the MCR or designee shall write a procedure with the limits for protons on targets as a C-A OPM Temporary Procedure, "Procedure to Limit Flux of Protons on Targets". This procedure shall be reviewed and approved prior to each running period by the RSC Chair and the C-A Associate Chair for ESHQ.

- 5.1.5 The on-duty Operations Coordinator shall routinely interpret loss monitoring results and RCT survey results shall be used in order to maintain beam loss “As Low As Reasonably Achievable” as defined in the [BNL Radiological Control Manual](#).
- 5.1.6 During high intensity proton operations, the appropriate Liaison Physicist shall ensure the following limits are satisfied (the C-AD RCD FS Representative makes the following measurements):
  - 5.1.6.1 The measured dose rate on the surface of the AGS Ring shielding above the A, F, H and J superperiods shall average less than 1100 mrem/h averaged over 36 weeks of operation. The limiting location is the site boundary.
  - 5.1.6.2 The measured dose rate on the roof over Building 914 or the shield above the Booster scraper shall average less than 15 mrem/h averaged over 200 days of operation. The limiting location is Building 931 (BLIP).
  - 5.1.6.3 The measured dose rate on target cave beam stop surfaces shall average less than 1300 mrem/h averaged over 20 weeks of operation for a beam stop surface area of 2000 ft<sup>2</sup>. The limiting location is the site boundary.
- 5.1.7 The appropriate Liaison Physicist shall provide the on-duty Operations Coordinator with OPM procedures that will allow the Operations Coordinator to control radiation levels.
  - 5.1.7.1 In no case shall beam loss induced radiation within uncontrolled areas be greater than 0.5 mrem in an hour and for repeated losses greater than 25 mrem in a year.
  - 5.1.7.2 In no case shall beam loss induced radiation in a Controlled Area be greater than 5 mrem in an hour and for repeated losses greater than 100 mrem in a year.

## 5.2 Classification of Radiological Areas

- 5.2.1 The appropriate Liaison Physicist shall not allow changes to radiological area classifications at the AGS, Booster, Linac, transfer lines, or beam caves before consultation with the Facility Support Representative, the RSC Chair, and the Associate Chair for ESHQ, or their designates. Changes shall be in accord with the requirements in the [BNL Radiological Control Manual](#).

## 5.3 Completion of RSC, ASSRC and ESRC Checkoff Lists

5.3.1 The Head of the Main Control Room or designee shall ensure all relevant RSC, ASSRC and ESRC Checkoff Lists are completed and signed by appropriate personnel before allowing beam into the AGS, Booster, Linac, transfer lines, or beam caves.

#### 5.4 Access Controls System During Operations with Beam

5.4.1 The Access Controls Group Leader shall ensure that safety-system configuration control and maintenance is in accordance with C-A [OPM 4.91](#).

5.4.2 The Access Controls Group Leader shall ensure that area radiation monitors that are interfaced with the Access Controls System are within their calibration date.

5.4.3 The Access Controls Group Leader shall ensure that locations of area radiation monitors are maintained as defined by the C-A Radiation Safety Committee.

#### 5.5 Oxygen Deficiency Hazard Control

5.5.1 If any systems are installed in the AGS, Booster, Linac, transfer lines or beam caves, that could cause oxygen concentrations to fall below 19.5% during pressure boundary failure, the ODH classification and controls shall be in accord with the requirements of the BNL [ODH SBMS subject area](#).

#### 5.6 Fire Protection

5.6.1 During periods of beam operation, when access to the primary beam areas is prohibited, the on-duty Operations Coordinator shall ensure that the installed fire detection and suppression systems are operable.

Authorized Alternative: Within 2 hours of discovery, the Department Chair or designee may allow partial or full inoperability of any fire detection and/or suppression system for up to 80 hours with beam operations if the benefit of continuing AGS, Linac or Booster operations is judged to outweigh the potential risk of fire damage. Operating procedures (OPM 3.24) specify the compensatory actions to be taken during inoperability.

5.6.2 During periods of shutdown, and if the facility is to be occupied, either the installed fire detection and suppression systems or the manual fire alarm

Authorized Alternative: The Maintenance Coordinator, ESH Coordinator or designee may allow partial or full inoperability of any fire detection system, suppression system or manual alarm station in occupied areas as long as a Fire Watch is posted who can verbally communicate with the BNL Fire/Rescue Group by radio or phone.

- 5.6.3 Personnel may occupy the AGS, Linac or Booster tunnel if the exhaust fans, required for personnel protection during an emergency, can be activated manually or automatically.

Authorized Alternative: If exhaust fan operability in the affected area cannot be restored within one hour, then the on-duty Operations Coordinator, ESH Coordinator or Maintenance Coordinator shall empty the affected area and prevent occupancy until operability is restored.

## 5.7 Staffing

- 5.7.1 The Head of the Main Control Room shall ensure an adequate number of qualified people in the C-A Main Control Room. As a minimum:

- (a) For running Linac only, at least one Operator and one CAS Technician shall be on duty when beam is in operation. During normal operations, one of the two shall remain in the Main Control Room at all times.
- (b) For AGS and/or Booster, at least one Operations Coordinator and one Operator shall be on duty when beam is in operation. During normal operations, one of the two shall remain in the Main Control Room at all times.

Authorized Alternative: If one of the two on-duty operators is incapacitated, the remaining operator may continue AGS, Booster or Linac operations as long as manning requirements are restored within two hours.

- 5.7.2 The Collider-Accelerator Support Group Leader shall ensure shall ensure a qualified Collider Accelerator Support (CAS) watch person is on duty for experimental operations with beam.

- 5.7.3 To ensure an adequate number of trained target watch personnel are present when liquid hydrogen is in use in an experimental area, the on-duty Operations Coordinator shall ensure that at least one Target Watch is on duty to maintain the safety of the liquid hydrogen target and to respond to emergencies related to liquid hydrogen targets.

## 5.8 Calibration, Testing, Maintenance, and Inspection

- 5.8.1 The Access Controls Group Leader shall ensure that the interlocks for radiation safety are functionally tested in accordance with requirements in the [BNL Radiological Control Manual, Chapter 3, Appendix 3A](#).
- 5.8.2 The Access Controls Group Leader shall ensure that the area radiation monitors undergo annual testing (not to exceed 15 months).
- 5.8.3 The appropriate Liaison Engineer shall ensure that radiological barriers undergo annual visual inspection (not to exceed 15 months).
- 5.8.4 The Liaison Engineers for the AGS, Linac and Booster shall ensure fire protection systems undergo annual testing (not to exceed 15 months).
- 5.8.5 The appropriate Liaison Engineers for the AGS, Linac and Booster shall ensure that rainwater barriers for activated soil undergo annual visual inspection (not to exceed 15 months).

## 5.9 Shutdown Periods

- 5.9.1 During shutdown periods, specific safety requirements for the experiments shall be reviewed on a case-by-case basis by the ESRC and approved by the Chair of the ESRC.

## 5.10 Groundwater, Radiological Barriers and Dose Limits

### 5.10.1 The C-A Associate Chair for ESHQ shall ensure that:

- 5.10.1.1 No individuals in other BNL Departments or Divisions, located adjacent to C-AD facilities receive more than 25 mrem in a year.
- 5.10.1.2 The maximum dose equivalent to a member of the public at the BNL site boundary is less than 5 mrem in a year from C-A operations.
- 5.10.1.3 Offsite drinking water concentration and on-site potable well water concentration must not result in 4 mrem or greater to an individual in one year from C-AD operations.
- 5.10.1.4 No C-A staff member receives more than 1250 mrem in a calendar year.

- 5.10.1.5 C-AD operations do not cause tritium concentrations in the BNL sanitary system effluent to exceed 10,000 pCi/liter averaged over a 30-day interval.
- 5.10.1.6 All radioactive airborne emissions from the AGS, Booster, Linac, transfer lines and beam caves are managed in accordance with the Radioactive Air Emissions subject area. If emissions are anticipated to exceed 0.1 mrem per year to the Maximally Exposed Individual, actions will be taken to ensure operations comply with NESHAP requirements including continuous emissions monitoring and permitting.
- 5.10.1.7 In order to protect groundwater, if the annual activity concentration of sodium-22 or tritium in leachate is calculated to exceed the limits given in the Accelerator Safety Subject Area, then a cap shall be used unless BNL Management is convinced otherwise.

**6. Documentation**

None

**7. References**

- 7.1 [C-A SAD](#)
- 7.2 [Accelerator Safety Envelope for AGS, Booster and Linac](#)
- 7.3 [BNL RadCon Manual, Chapter 3, Appendix 3A](#)
- 7.4 [C-A-OPM 1.10.1, "Procedure for Documenting Unreviewed Safety Issues"](#)
- 7.5 [C-A-OPM 4.91, "Configuration Management Plan for the C-A Access Controls System"](#)
- 7.6 [C-A-OPM 10.1, "Occurrence Reporting and Processing of Operations Information"](#)
- 7.7 Letter from M. Holland (DOE-BSO) to M. Bebon dated August 6, 2004, Approval of the Proposed Collider-Accelerator Department Accelerator Safety Envelope (ASE) Modifications.

**8. Attachments**

None