

Accelerator Safety Envelope

Title of Facility: AGS, Booster and Linac

Date of Initial ASE: May 30, 2003

Subsequent Revision Dates: August 13, 2004, July 5, 2007

Version of the SAD that the ASE applies to: C-AD SAD, August 2004

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Section 1: Introduction

The ASE Requirements define the conditions, safe boundaries, and the administrative controls necessary to ensure safe AGS, Linac and Booster operations and to reduce the potential risk to the public, workers and environment.

- 1.1 The reference to the method used by the Collider-Accelerator Department for change control of the ASE is the BNL Subject Area on [Accelerator Safety](#).
- 1.2 A variation beyond the boundaries described in Sections 1, 2, 3, and 4 of this ASE shall be treated as a violation of the ASE and shall be a reportable occurrence, as defined by the BNL [SBMS](#) Subject Area on Occurrence Reporting. A violation is defined as not satisfying a Requirement or its specific Authorized Alternative. C-A Department staff shall make notifications of occurrences according to the requirements in the [C-A Operations Procedure Manual](#).
 - 1.2.1 If a Requirement is not satisfied and it has a specific Authorized Alternative, implement the Authorized Alternate or stop the activity that uses the affected equipment within one hour.
- 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 and environmental safety. 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.

Section 2: BNL Safety Envelope Limits

This section contains the absolute limits that BNL places on its operations to ensure that we meet the regulatory limits established to protect our environment, public and staff/visitors and that those operations are conducted within the assumptions of the AGS, Linac and Booster safety analyses documented in the [C-AD SAD, August 2004](#). BNL Safety Envelope Limits for AGS, Linac and Booster operations are:

- 2.1. Less than 25 mrem in one year to individuals in other BNL Departments or Divisions adjacent to a Collider-Accelerator Department accelerator facility.
- 2.2. Less than 5 mrem in one year to a person located at the site boundary.
- 2.3. 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.
- 2.4. Less than 1250 mrem in one year to a Collider-Accelerator Department staff member.

- 2.5. Maximum tritium concentration of 10,000 pCi/L in the BNL sanitary sewer effluent, caused by liquid discharges from AGS, Linac and Booster facilities averaged over a 30-day interval.
- 2.6 In order to protect groundwater, if the annual activity concentration of sodium-22 or tritium in leachate is calculated to exceed 5% of the Drinking Water Standard, then a cap shall be used unless BNL Management is convinced otherwise¹.
- 2.7 All emissions from AGS, Linac and Booster facilities are managed in accordance with the Air Emissions subject area². 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.

Section 3: Corresponding AGS, Linac and Booster Safety Envelope Parameters

This section identifies the measurable limitations on critical operating parameters that, in conjunction with the specifically identified hazard control considerations established by the facility design and construction, ensure that AGS, Linac and Booster operations will not exceed the corresponding Safety Envelope Limits discussed in Section 2. These parameters are derived from the safety analyses described in the [C-AD SAD, August 2004](#). AGS, Linac and Booster Safety Envelope Parameters are:

AGS, Linac and Booster Particle Limit and Limits on Particle Loss

- 3.1. The maximum product of the number of high energy unpolarized protons or polarized protons and particle energy in the Linac shall not exceed 9×10^{17} GeV in one hour.
- 3.2 The maximum product of the number of high energy unpolarized protons, polarized protons or heavy ions and particle energy in the AGS ring shall not exceed 1.1×10^{19} GeV in one hour.
- 3.3 The maximum product of the number of high energy unpolarized protons, polarized protons or heavy ions and particle energy in the Booster ring shall not exceed 5.4×10^{17} GeV in one hour.

Control of Beam Loss

- 3.4 Loss monitoring results and radiation survey results shall be used in order to maintain beam loss “As Low As Reasonably Achievable” as defined in the [BNL Radiological Control Manual](#). The following requirements keep the skyshine dose to levels below the limits in 2.1 and 2.2:

¹ BNL SBMS Accelerator Safety Subject Area, [Design Practice for Known Beam Loss Locations](#).

² BNL SBMS Subject Area, [Radioactive Airborne Emissions](#).

- 3.4.1 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.
- 3.4.2 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, which belongs to the Medical Department.
- 3.4.3 The measured dose rate on the beam stop surfaces shall average less than 1300 mrem/h averaged over 20 weeks of operation for a beam stop surface area of 2000 ft². The limiting location is the site boundary.
- 3.4.4 Beam loss induced radiation within uncontrolled areas is less than 0.5 mrem in an hour and for repeated losses less than 25 mrem in a year.
- 3.4.5 Beam loss induced radiation in a Controlled Area is less than 5 mrem in an hour and for repeated losses less than 100 mrem in a year.

Classification of Radiological Areas

- 3.5 Radiological area classifications shall be in accord with requirements in the [BNL Radiation Control Manual](#).

Access Controls System (ACS)

- 3.6 The Access Controls System shall be functional during operations with beam.
- 3.7 During the running period, area radiation monitors that are interfaced with the Access Controls System shall be within their calibration date.
- 3.8 During the running period, the locations of area radiation monitors interfaced with ACS are to be configuration controlled.

Oxygen Deficiency Hazard (ODH) Control

- 3.9 ODH area classification and controls shall in accord with the requirements in the BNL SBMS Subject Area, [ODH Classification / Controls](#).

Fire Protection

- 3.10 During periods of beam operation, when access to the primary beam areas is prohibited the installed fire detection and suppression systems shall be 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 shall specify the compensatory actions to be taken during inoperability.

- 3.11 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 stations in the occupied areas shall be operable.

Authorized Alternative: The Operations 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.

- 3.12 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 empty the affected area and prevent occupancy until operability is restored.

Section 4: Engineered Safety Systems Requiring Calibration, Testing, Maintenance, and Inspection

The systems and requirements for calibration, testing, maintenance, accuracy or inspection necessary to ensure the operational integrity of the Safety Envelope Parameters during operations are given in this section:

- 4.2 Access Controls System (ACS) shall be functionally tested in accordance with requirements in the [BNL Radiological Control Manual](#). AGS, Linac and Booster fire protection systems shall undergo annual testing (not to exceed 15 months).
- 4.3. Area radiation monitors shall undergo annual testing (not to exceed 15 months).
- 4.4. Radiological barriers shall undergo annual visual inspection (not to exceed 15 months).
- 4.5. Rainwater barriers for activated soil shall undergo annual visual inspection (not to exceed 15 months).

4.5.1 The rainwater barriers for the g-2 and the BLIP spur activated soil areas shall be visually inspected semiannually (not to exceed 8 months)^{3,4}

Section 5: Administrative Controls

Administrative controls necessary to ensure the operational integrity of the Safety Envelope Parameters during operations are:

5.1. Minimum Main Control Room Staffing

5.1.1. C-A Main Control Room: Two Operators shall be on duty for Linac only beam operation and one Operations Coordinator and one Operator shall be on duty for all other beam operations. During normal operations, one of the two must remain in the Main Control Room at all times.

Authorized Alternative: If one operator is incapacitated, the remaining operator may continue operations as long as manning requirements are restored within two hours.

5.2. Liquid Hydrogen Target Experiment Staffing

Cryogenic Target Watch: one Cryogenic Section Technician shall be on watch when liquid hydrogen is in use in the experimental area.

5.3. On-shift operations and technician staff shall be trained and qualified on their safety, operational and emergency responsibilities. Records of training and qualification shall be maintained on the Brookhaven Training Management System ([BTMS](#)).

5.4. Work planning and control systems shall comply with the requirements in the [C-A Operations Procedure Manual](#).

5.5. Environmental management shall comply with the requirements in the [C-A Operations Procedure Manual](#).

5.6. Experiment modification and review shall comply with the requirements in the [C-A Operations Procedure Manual](#).

5.6.1. Each experiment in the Linac, Booster, AGS, AGS Experimental Halls, U-line, V-line and Building 919 shall be reviewed before running with beam.

³ Medical Department and Collider-Accelerator Department, Memorandum of Understanding BLIP and g-2 Cap Inspection Process dated June 25, 2007.

⁴ Record of Decision for Area of Concern 16T g-2 Tritium Source Area and Groundwater Plume, Area of Concern 16K Brookhaven Linac Isotope Producer and Area of Concern 12 Former Underground Storage Tanks dated April 6, 2007.

- 5.7. Modifications of the AGS, Linac and Booster that are known to increase the oxygen deficiency hazards shall be reviewed and approved by the C-A Accelerator Systems Safety Review Committee.
- 5.8. Industrial hazards shall be controlled in accordance with the applicable portions of the BNL SBMS Subject Area.