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C-A OPERATIONS PROCEDURES MANUAL

2.5.1 Accelerator Safety Envelope Parameters for C-A Tandem Van de Graaff

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Collider-Accelerator Department Chairman Date

E. Lessard, R. Karol

2.5.1 Accelerator Safety Envelope Parameters for Tandem Van de Graaff

1. Purpose

- 1.1. This procedure assigns responsibility for maintaining the Accelerator Safety Envelope Parameters for the TVDG and TTB Facilities. These Parameters are based on the [Accelerator Safety Envelope](#) and any relevant USIs documented using [C-A OPM 1.10.1](#), Unreviewed Safety Issues.
 - 1.1.1 Additionally, the TVDG and TTB 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 TVDG and TTB.
- 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, then implement the Authorized Alternative or safely stop the activity associated with the Requirement.
 - 1.2.2 If a Requirement is not satisfied and it does not have a specific Authorized Alternative, then 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 C-A Department Chairman 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:
 - 2.1.1 Associate Chair for ESSHQ
 - 2.1.2 Chair of ESRC
 - 2.1.3 Chair of RSC and RSC
 - 2.1.4 Operations Supervisor for TVDG/TTB
 - 2.1.5 Head of MCR
 - 2.1.6 MCR Operations Coordinator and Operator
 - 2.1.7 TVDG/TTB Liaison Physicist
 - 2.1.8 TVDG/TTB Liaison Engineer
 - 2.1.9 TVDG Mechanical Engineer
 - 2.1.10 On-duty Operations Coordinator
 - 2.1.11 On-duty TVDG Operator in Charge
 - 2.1.12 Facility Support Representative (RCD)
 - 2.1.13 Access Controls Group Leader
 - 2.1.14 ESH Coordinator
 - 2.1.15 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:

- TVDG and TTB Beam Limits
- Control of Beam Loss
- Classification of Radiological Areas
- Access Controls During Operations With Beam (Class III and IV)
- Fire Protection
- Handling and Alerting System for Insulating Gas
- Column Truss Structures
- Staffing
- Calibration, Testing, Maintenance, and Inspection
- Shutdown Periods
- Groundwater Protection, Radiological Barriers and Dose Limits

5.1 TVDG and TTB Beam Limits

5.1.1 The on-duty TVDG Operator-in-charge shall maintain the limit on the beam extracted from the TVDG or injected into the TTB shall be such that exposure to individuals in uncontrolled areas is likely to be less than 25 mrem in one year. For example, in the case of deuteron losses with 3 feet of earth shielding over the TTB tunnel, an uncontrolled area is maintained for 12 MeV deuterons with a pulsed-beam average-current less than 200 nA.

5.1.2 Beam limits for specific ions shall be proscribed in terms of beam energy and intensity, before operations with the specific ion, by the C-A Department Radiation Safety Committee in order to meet the requirement in 5.1.1.

5.2 Control of Beam Loss

5.2.1 The on-duty TVDG Operator-in-charge shall routinely interpret loss monitoring results and RCT radiation survey results in order to maintain beam loss “As Low As Reasonably Achievable” as defined in the [BNL Radiological Control Manual](#).

5.2.2 When applicable, the Operations Supervisor for the TVDG/TTB shall provide the TVDG Operator-in-charge with procedures that will control beam loss as follows:

5.2.2.1 In no case shall beam-loss induced radiation within TVDG/TTB uncontrolled areas be greater than 0.5 mrem in an hour and for repeated losses greater than 25 mrem in a year.

5.2.2.2 In no case shall beam-loss induced radiation within TVDG/TTB Controlled Areas be greater than 5 mrem in an hour and for repeated losses greater than 100 mrem in a year.

5.3 Classification of Radiological Areas

5.3.1 The Liaison Physicist for the TVDG/TTB shall not allow changes to radiological area classifications 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](#).

5.4 Completion of RSC, ASSRC and ESRC Checkoff Lists

5.4.1 The Head of the Main Control Room or designee and the TVDG/TTB Operations Supervisor or designee shall ensure all relevant RSC, ASSRC and ESRC Checkoff Lists are completed and signed by appropriate personnel before allowing beam into the TVDG/TTB or beam for TVDG experimental programs.

5.5 Access Controls During Operations With Beam

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

5.5.2 The TVDG Operations Supervisor shall ensure that the Class IV safety-system configuration control and maintenance shall be in accordance with [C-A OPM 4.91](#).

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

5.5.4 The TVDG Operations Supervisor shall ensure that the area radiation monitors that are interfaced with the Class IV Access Controls System are within their calibration date.

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

5.5.6 The TVDG Operations Supervisor shall ensure that the locations of area radiation monitors for Class IV areas are maintained as defined by the C-A Radiation Safety Committee.

5.6 Fire Protection

- 5.6.1 During periods of beam operation, when access to the primary beam areas is prohibited the on-duty Operator-in-charge shall insure that 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 TVDG/TTB 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 In occupied areas, TVDG/TTB equipment may be energized if the smoke detection system for the energized area can transmit an alarm to summon the BNL Fire/Rescue Group.

Authorized Alternative: The Operator-in-charge, 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.

5.7 Handling and Alerting System for Insulating Gas

- 5.7.1 The TVDG Mechanical Engineer shall ensure the following:

5.7.1.1 TVDG accelerator tanks - The absolute maximum allowable working pressure for these vessels is 300 psig, as per ASME Code Stamp on the vessel.

5.7.1.2 The maximum working pressure for the insulating-gas storage-tanks is 575 psig.

5.7.1.3 The minimum allowable ambient temperature for the insulating-gas storage-tanks location is 32 °F.

5.7.1.4 The maximum working pressures for these vessels are:

5.7.1.4.1 Heat Exchangers: 250 psig @ 300 °F

5.7.1.4.2 Dryer Towers: 250 psig @ 450 °F, 450 psig @ 250 °F

5.7.1.4.3 Filter Towers: 250 psig @ 100 °F

5.7.1.5 Installed oxygen monitors that are used to alert against displacement of oxygen by insulating gas leaking into occupied areas shall alarm for oxygen levels below 19.5%.

Authorized Alternative: The TVDG Operations Supervisor, TVDG Operator-in-charge or the C-AD ESH Coordinator may allow personnel oxygen monitors to be used for up to 80 hours while the installed monitors are out of service.

5.8 Column Truss Structures

5.8.1 The TVDG Mechanical Engineer shall ensure the following:

5.8.1.1 For MP6, the maximum additional column load that may be added to the original configuration is 5000 pounds or less concentrated at the high voltage terminal.

5.8.1.2 For MP7, the maximum additional column load that may be added to the original configuration is 3000 pounds concentrated or less at the high voltage terminal.

5.9 Staffing

5.9.1 The TVDG Operations Supervisor shall ensure an adequate number of qualified personnel in the TVDG Control Room. Two qualified individuals are required for operation of the MP6 and/or MP7 Tandem accelerators. The Operator-in-charge must be fully qualified and must be on-duty at the TVDG facility. The second operator is a person who is judged by the Pre-Injector Group Leader and TVDG Operations Supervisor, or in their absence the TVDG Operations Shift Supervisor, to have sufficient knowledge to assist the Operator-in-charge. The second operator must be on-duty at the C-A Complex and must have radio communication with the on-duty Operator-in-charge at the TVDG.

Authorized Alternative: If the second operator is incapacitated, the operator-in-charge may continue TVDG/TTB operations as long as manning requirements are restored within two hours.

5.9.2 C-A Main Control Room: one Operations Coordinator and one Operator shall be on duty when TTB beam is injecting into Booster. During normal operations, one of the two must 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 TTB beam injection into the Booster as long as manning requirements are restored within two hours.

5.10 Calibration, Testing, Maintenance, and Inspection

5.10.1 The Access Controls Group Leader shall ensure the interlocks for Class III radiation safety are functionally tested according to the requirements in [BNL RadCon Manual, Chapter 3, Appendix 3A](#).

5.10.2 The Access Controls Group Leader shall ensure the area radiation monitors for Class III areas undergo annual testing (not to exceed 15 months).

5.10.3 The TVDG Operations Supervisor shall ensure the interlocks for Class IV radiation safety are functionally tested according to the requirements in [BNL RadCon Manual, Chapter 3, Appendix 3A](#).

5.10.4 The TVDG Operations Supervisor shall ensure the area radiation monitors for Class IV areas undergo annual testing (not to exceed 15 months).

5.10.5 The Operations Supervisor for the TVDG/TTB shall ensure the accelerator building ventilation exhaust fans undergo annual testing (not to exceed 15 months).

5.10.6 The Operations Supervisor for the TVDG/TTB shall ensure fire protection systems undergo annual testing (not to exceed 15 months).

5.10.7 The Liaison Engineer for the TVDG/TTB shall ensure radiological barriers undergo annual visual inspection (not to exceed 15 months).

5.10.8 The Liaison Engineer for the TVDG/TTB shall ensure rainwater barriers (if installed) for activated soil undergo annual visual inspection (not to exceed 15 months).

5.10.9 The Operations Supervisor for the TVDG/TTB shall ensure the insulating gas handling system undergoes annual inspection and testing (not to exceed 15 months).

5.10.10 The Operations Supervisor for the TVDG/TTB shall ensure the oxygen monitoring system undergoes annual inspection and testing (not to exceed 15 months).

5.11 Shutdown Periods

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

5.12 Groundwater Protection, Radiological Barriers and Dose Limits

5.12.1 The C-A Associate Chair for ESSHQ shall ensure that:

5.12.1.1 No individuals in other BNL Departments or Divisions, located adjacent to C-AD facilities receives more than 25 mrem in a year.

5.12.1.2 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.

5.12.1.3 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.

5.12.1.4 No C-A staff member receives more than 1250 mrem in a calendar year.

5.12.1.5 C-A operations do not cause tritium concentrations in the BNL sanitary system effluent to exceed 10,000 pCi/liter averaged over a 30-day interval.

5.12.1.6 All emissions from the TVDG/TTB 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.

5.12.1.7 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-AD SAD](#)
- 7.2 [Accelerator Safety Envelope for TVDG/TTB](#)
- 7.4 [BNL RadCon Manual, Chapter 3, Appendix 3A](#)
- 7.5 [C-A-OPM 10.1, "Occurrence Reporting and Processing of Operations Information"](#)
- 7.6 [C-A-OPM 1.10.1, "Procedure for Documenting Unreviewed Safety Issues"](#)
- 7.6 [C-A-OPM 4.91, "Configuration Management Plan for the C-A Access Controls System"](#)
- 7.8 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