

Booster Radiation Safety Check-Off List for operation with **Protons from Linac**

(For Booster operation with Linac protons
beginning in January 2009)

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Protons from Linac may be injected and accelerated in Booster **only upon completion of this check-off list**. Completion of this list **does not allow** for the injection of Ions from Tandem.

Before proceeding with the numbered check-off items, the **LTB** and **TTB** Beamstops must be **Inserted, Locked, and Tagged**. If necessary, equivalent devices and/or procedures may be substituted with appropriate LP and RSC approval. The Beamstop Locks and Tags are as follows:

1. _____ (LPB) LOTO **Linac-To-Booster (LTB) Beamstop**
Enable Key (in Building 914):
Tag Number 6506
Lock Number 10L240
Person/Date: Chris Gardner 30 June 2008
2. _____ (LPB) LOTO **Tandem-To-Booster (TTB) Beamstop**
Enable Key (in Building 914):
Tag Number 5040

Lock Number 10L222

Person/Date: Chris Gardner 9 December 2008

Note: The TTB lock and tag prohibiting injection from Tandem may not be removed until an appropriate Radiation Safety Checkoff list for operation of Booster with ions from Tandem is completed.

The following items are to be initialed as complete:

1 Linac

1. _____ (LPL) Linac Radiation Safety Check-Off List complete.

2 Security System

1. _____ (ACG) Functional Test of the Booster access control system complete.
2. _____ (ACG) Functional Test of Booster Extraction interlocks complete.
3. _____ (ACG) Functional Test of Booster-NSRL Penetration Stub interlocks complete. (These interlocks ensure that the stub region cannot be entered with beam in Booster.)
4. _____ (ACG) Functional Test of HEBT-TTB Cross-Over interlocks complete. (These interlocks ensure that this region cannot be entered with the TTB or the LEBT beamstops open.)
5. _____ (ACG) Booster Shutter to prevent long stored beam installed and operational. (The shutter is located in the B6 straight section downstream of the dump.)
6. _____ (ACG) B6 Dump cooling water flow-switch interlock operational. (This interlock closes the LTB and TTB beam stops if water flow ceases.)
7. _____ (ACG) D3 Septum Magnet cooling water flow-switch interlock operational. (This interlock closes the LTB and TTB beam stops if water flow ceases.)

8. _____ (ACG) Functional test of the High Intensity Source to ATR Interlock complete.
9. _____ (ACG) The B15 current transformer interlocks have been functionally tested.
10. _____ (B15SE) The B15 current transformer trip level has been set to 140 mA. This corresponds to 2.5×10^{12} protons in the AGS ring.
11. _____ (MCR) Procedure in place for the initial setup, calibration and periodic checking of the B15 current transformer.

3 Shielding

1. _____ (LE) Inspection of Booster berm shielding complete.
_____ (LPB)
2. _____ (LE) Booster F6 Septum shielding in place.
_____ (LPB)
3. _____ (LE) Walk-through inspection of shielding inside Booster tunnel complete.
_____ (LPB)
4. _____ (LPA) Shielding on AGS side of common boundary between Booster and AGS inspected.

4 Fencing and Posting

1. _____ (LE) Booster Perimeter Fence in place.
_____ (LPB)
2. _____ (RCD) Booster Perimeter Fence posted as a "Radiation Area".
3. _____ (LE) Building 914 roof security fence in place.
4. _____ (RCD) Building 914 roof security fence posted as a "High Radiation Area".

5. _____ (LE) Security fence enclosing the area over the BTA line in place.
6. _____ (RCD) Security fence enclosing the area over the BTA line posted as a "High Radiation Area".
7. _____ (LE) Structure covering the three pipes that come through the Booster berm over C1 is in place.
8. _____ (RCD) The structure over C1 is posted to prohibit entry.
9. _____ (RCD) Top of building 914 plug door posted as a "High Radiation Area".
10. _____ (RCD) Building 914 posted as a "Radiation Area".
11. _____ (LE) Vent pipe gratings in the Booster tunnel in Place.
12. _____ (RCD) In the AGS ring, the Booster/AGS labyrinth must be posted on top as follows, to prohibit personnel from working on top of the labyrinth:
"WARNING! Working at shield top height prohibited, contact MCR if access is necessary."
13. _____ (RCD) The gate at the downstream end of NSRL Zone 3 (also known as the Booster-NSRL penetration stub) posted as a "High Radiation Area with Beam in Booster" (with instructions to contact MCR for beam status).
14. _____ (RCD) NSRL Zone 2 posted.
15. _____ (LE) Fence in place to prevent entry onto the Booster berm from the stairs at the downstream end of the Linac Building.
_____ (LPB)
16. _____ (RCD) This fence (above) posted as a "Radiation Area".
17. _____ (RCD) In the Linac building the area around the Ebis-Booster feed-through pipes is posted as a "Radiation Area".
(RSC item CK-Booster-FY2009-544.)

5 Chipmunks

1. _____ (BCIG) Chipmunk NM060 on top of Building 914 plug door installed and checkout complete. This chipmunk is set to alarm at 40 and interlock at 50 mr/hour.
2. _____ (BCIG) Chipmunk NM058 in "High Radiation Area" on Booster berm over F6 Septum installed and checkout complete. This chipmunk is set to alarm at 40 and interlock at 50 mr/hour.
3. _____ (BCIG) Chipmunk NM059 in "High Radiation Area" on Booster berm over BTA DH2 & 3 installed and checkout complete. This chipmunk is set to alarm at 40 and interlock at 50 mr/hour.
4. _____ (BCIG) Chipmunks NM133 and NM134 in the Booster-NSRL Penetration Stub are installed and checkout complete. The chipmunk at the penetration headwall (NM134) is set to alarm at 16 and interlock at 20 mr/hour. The chipmunk at the stub gate (NM133) is set to alarm at 16 and interlock at 20 mr/hour. (Note that these chipmunks are disabled when extraction from Booster to NSRL is permitted.)
5. _____ (BCIG) Chipmunk NM112 on Linac side of EBIS-Booster Penetration installed and checkout complete. This Chipmunk is located at beam height at the penetration headwall close to the beam pipe. It is set to alarm at 2.0 and interlock at 2.5 mr/hour.
6. _____ (BCIG) Chipmunk NM114 on the Linac side of the EBIS-Booster feed-through pipes installed and checkout complete. This chipmunk is located close to the pipe openings in the Linac building wall. It has scalar readout so that radiation levels at the pipe openings can be monitored. It is set to alarm at 2.0 mr/hour but is not an interlocking chipmunk. (**RSC item CK-Booster-FY2009-545.**)
7. _____ (LPB) Location of above chipmunks checked.

6 Booster Extraction to AGS

1. _____ (LPB) Red Radiation Security Hold Tags have been applied to BTA QV5 power supply and magnet to ensure that the polarity of this quadrupole is not changed. (The quadrupole is wired to be vertically focussing for particles with positive charge).
2. _____ (RSC) Booster extraction critical device review complete or hazard considered acceptable pending further review.

Either Item 3 OR Item 4 must be completed:

3. _____ (LPA) The AGS Radiation Safety Check-Off List for operation with protons from Linac is completed
OR
4. _____ (LPA) The Booster Extraction Enable Key is LOTO:
Tag No. _____
Lock No. _____
Person/Date: _____

7 Booster Extraction to NSRL

Either Item 1 OR Item 2 must be completed:

1. _____ (LPN) NSRL (R-line) is ready to accept beam.
OR
2. _____ (LPN) Booster Extraction to NSRL is LOTO:
Tag No. _____
Lock No. _____
Person/Date: _____

8 Additional EBIS-Booster Feed-Through Items

1. _____ (LE) EBIS-Booster feed-through installation complete. "As-built" reviewed and approved by the RSC.

2. _____ (RSC) EBIS-Booster feed-through pipes inspected and approved for initial fault studies.
 _____ (LPB)
 _____ (LE)
3. _____ (LPB) Approved fault study plans are in place and ready to be executed. (RSC items **CK-Booster-FY2009-541** and **CK-Booster-FY2009-542.**)

9 Administrative Items

1. _____ (LPB) Procedure (OPM 2.5) which sets limits on losses at F6 Septum and B6 Dump reviewed.
2. _____ (LPB) Memo stating Booster Parameter Limits that are consistent with the Booster Operational Safety Limit in OPM 2.5 has been issued to MCR for required reading.
3. _____ (CME) Proton beam intensity limit established for B6 dump and given to MCR.
4. _____ (RSCC) Active temporary changes or bypasses for Booster have been reviewed. (RSC item **CK-FY2009-Booster-559.**)
 _____ (ACG)

10 Verification and Permission

All of the above check-off items have been initialed as complete.

_____ (OC)

_____ (Date/Time)

The RS LOTO(s) that prevent Linac proton beam from entering Booster may be removed. The **LTB** beamstop remote enable key (in Bldg. 914) may be inserted and turned (or equivalent devices enabled) to allow beam enable from the MCR.

_____ (LPB)

_____ (Date/Time)

Abbreviations

LPL = Liaison Physicist Linac (**James Alessi** or designee)

LPA = Liaison Physicist AGS (**Haixin Huang** or designee)

LPB = Liaison Physicist Booster (**Chris Gardner** or designee)

LPN = Liaison Physicist NSRL (**Adam Rusek** or designee)

LE = Liaison Engineer (**George Mahler** or designee)

CME = Chief Mechanical Engineer, ME (**Joe Tuozzolo** or designee)

RSC = Radiation Safety Committee (**Dana Beavis** or designee)

RSCC = Radiation Safety Committee Chair (**Dana Beavis** or designee)

ACG = Access Control Group (**Jonathan Reich** or designee)

RCD = Radiation Control Division (**Paul Bergh** or designee)

BCIG = Beam Components and Instrumentation Group
(**Ray Atkins** or designee)

MCR = Main Control Room

OC = Operations Coordinator