



Memo

date: *October 20, 2008*

to: *RSC*

from: *D. Beavis and R. Karol*

subject: *Radiation from the 200 MeV Water Cooled Beam Stops*

One of the HEBT beam stops has been moved upstream of the HEBT dipole, ND-249. The radiation from the water cooled stops was reviewed based on this move. The water cooled stops can create radiation to other areas through the neutrons and also from the activated cooling water. The fault studies and previous memoranda were examined to tabulate the potential radiation to these other areas based on the present configuration.

The dose rates were scaled in the past to a maximum Linac operating intensity of 4×10^{14} protons per second at 200 MeV. The Linac ASE particle limit corresponds to 1.25×10^{15} p/s and this number will be used as the maximum possible Linac intensity for scaling the potential dose rates.

Two interlocking chipmunks located in the BLIP pump room (BPR) limit the amount of beam that can strike the Linac water cooled beam stops. Both chipmunks have an interlock level of 50 mrem/hr and alarm level of 10 mrem per hour. Chipmunks NMON61 and NMON65 redundantly interlock the LEBT beam stops. This was done to provide redundant protection for access to the BPR. These chipmunks also limit the neutron dose to the AGS tunnel and the gamma dose from the water pipes in the Booster. Both chipmunks have a quality factor of 1 since they are measuring the gamma dose from the water pipes.

The high intensity operation of the Linac is conducted for the BLIP program. There is no high intensity operations presently planned for the Booster or Linac HEBT tunnel. The Fast Beam Interrupt (FBI) system inhibits the Linac beam if the pulsed bending magnet, BM-1, is not pulsed to deliver the beam to BLIP. The potential dose rates with the Linac operating at the ASE particle limit with the beam on a water cooled stop are:

Location	Dose Rate at ASE Limit
Chipmunks in BLIP pump room	6.25 rem/hr
BPR heat exchanger	87 rem/hr
AGS/HEBT door	8.75 rem/hr
B6 Dump water pipes in Booster	11.6 rem/hr
Berm over Linac water stop	89 mrem/hr

The dose rate to the AGS ring at the AGS/HEBT door assumes that the beam is striking the last beam stop in the HEBT line. In the future most of the Linac beam that goes to HEBT will be delivered to the beam stop that was recently relocated to 225 feet downstream of tank 9, and is before the HEBT bend. This beam stop is under a newly installed soil cap. Only limited beam for energy measurements will be delivered to the downstream HEBT beam stop, which is located 307 feet from tank 9 and 45 feet from the AGS tunnel.

It is useful to examine the potential dose rates at these locations when the chipmunk reading is at the interlock level and alarm level. These dose rates are given in the table below. Again, the dose rates for the AGS/HEBT door conservatively assume that the beam is striking the last HEBT beam stop. Access to the booster originally required that the water flow to the dump be turned off. When the configuration of the pump room chipmunks was changed in the early 1990s, this requirement was removed. C-A-OPM 4.47 currently requires that a chipmunk be placed in the AGS ring near the AGS/HEBT door for access to the AGS if the Linac is operating with beam to HEBT. With most of the beam being delivered to the new, upstream HEBT beam stop location this requirement can be removed. The MCR should review C-A-OPM 4.47 and revise it to address the condition when Linac beam is sent to the downstream HEBT water stop. Any needed precautions should also be tied to the new operating procedure for delivering beam to the downstream beam stop (part of checkoff list item 539).

Location	At Interlock Level	At Alarm level
Chipmunks in BLIP pump room	50 mrem/hr	10 mrem/hr
BPR Heat exchanger	700 mrem/hr	140 mrem/hr
AGS/HEBT door	70 mrem/hr	14 mrem/hr
D6 Water pipes in Booster	90 mrem/hr	20 mrem/hr
Berm over Linac water stop	0.7 mrem/hr	0.1 mrem/hr

The present interlock level allows a continuous proton beam on a water cooled beam stop of 10^{13} p/s. The alarm level allows 2×10^{12} p/s on the water cooled stops. These threshold levels have not been a problem for routine polarized proton operations.

The access procedure used by the water group for the BLIP pump room has been reviewed and updated.

References

1. [Memorandum from D. Beavis, "Review of the Interlocks for the BLIP PUMP Room", Jan. 21, 1992](#)
2. Linac Fault Studies No. 1 and 8.
3. [Memorandum from K. Reece and Jim Alessi to J.W. Glenn, "BLIP Pump House Chipmunk", Feb. 2, 1993](#)
4. [Memorandum from D. Beavis, "Summary of Linac Fault Studies 1-3", Jan. 1, 1991.](#)

CC: Linac RSC File
 Booster RSC File
 AGS RSC File
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