Collider-Accelerator Department

BROOKHAVEN NATIONAL LABORATORY

Building 911B – P.O. Box 5000
Upton, NY 11973-5000
Phone 631 344 7124
Fax 631 344 5568
beavis@bnl.gov
www.bnl.gov

managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

Date: *September 29, 2016*

To: *RSC, A. Drees, D. Phillips, J. Tuozzolo, and A. Fedotov*

From: *D. Beavis*

Subject: *LEReC Utility Penetration without Conduits*

The potential radiation leakage out four utility penetrations were analyzed in a memorandum[1] that was provided to the committee. One penetration, the one closest to the IR, had an interference with the head wall for the transition from the 26 foot-diameter tunnel to the 20 foot diameter tunnel. The 16 inch diameter penetration was stopped before the tunnel and a 8 inch-diameter pipe was added from the tunnel to meet the larger penetration. This makes this penetration different from the others. In addition, the intent is not to place conduits inside this penetration. The attenuation of this penetration as planned[2] to be constructed was calculated and is presented in this memorandum.

The eight inch-diameter pipe is 330 cm long. However, there may be lower density soil on one side of the penetration for a few feet due to the larger diameter pipe boring. The penetration was treated a 210 cm long eight inch diameter pipe with a transition to a 16 inch-diameter penetration[3]. The center of the penetration is 89 cm above the beam height. MCNPX was used to analyze the attenuation of radiation along the penetration for RHIC and LEReC beam losses. Figure 1 displays the attenuation as a function of distance along the penetration, with the penetration starting at z=490 cm. The statistics at the larger distances become increasingly poor**. The dose rate at the fence was estimated to be 0.04 mrem for a RHIC beam loss[4] and 30 mrads/hr for an LEReC beam loss[5]**. The potential dose for a maximum beam fault satisfies the C-AD shielding policy for both RHIC and LEReC beam losses. Routine losses in the area will be orders of magnitude lower.

---

[1] D. Beavis, August 26, 2016 ; http://www.c-ad.bnl.gov/esfd/RSC/Memos/8_26_16_LEReC.pdf

[2] Originally it was thought by me that this penetration was going to have conduits so it would have less radiation leakage than the others. In discussion with the engineer it was determined that since there is less area for cables that there would be no conduits.

[3] There is an angle between the two different pipe sizes that is not accouinted for in the calculations. This will further reduce the dose at the end og the penetration.

[4] $2.5*10^{13}$ protons at 250 GeV.

[5] 130 kW of 2.5 MeV electrons.

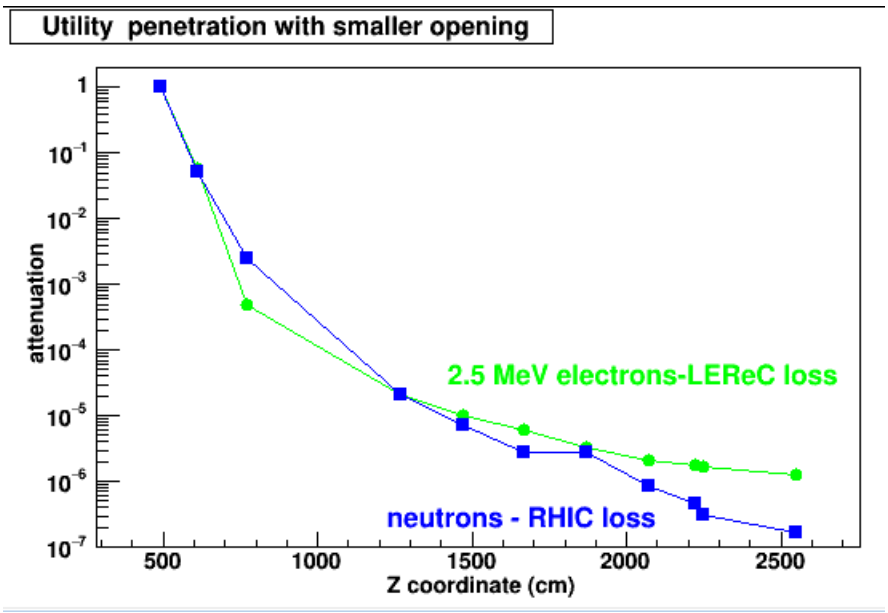

Figure 1: Attenuation for neutrons from RHIC beam losses and X-rays from LEReC beam losses along the penetration. The green points are for x-rays form LEReC beam and the Blue points for neutrons from RHIC beam losses.