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Memo

date: *January 17, 2014*

to: *RSC*

from: *D. Beavis*

subject: *Blue Kicker Pre-fire Scraping Target near Q4 at 12 O'clock*

It has been proposed to place a small scrapper a few meters from Q4 on the outgoing blue beam at 12 O'clock. The purpose would be to induce energy loss in Au ions that have only been partially kicked due to a blue abort pre-fire. The energy loss would prevent them from being transported to the 6 O'clock IR. A foil thickness of 1mm has been suggested for this purpose[1]. Several radiation issues were quickly considered.

First a few general remark about Au ions. For a 1 mm thick target only about 5-10% of the ions will interact in the foil that is used to shadow the beam. For these interactions most of the collisions will result in collisions with most of the Au beam fragmenting down the beam pipe. Therefore, assuming that the Au behaves like 200 nucleons interacting is very conservative. Most of the Au will have an energy loss of about 0.1% and aperture in the magnet systems. It should be noted that most of the beam losses occur away from the scrapper and only with beam optics would the correct location be known. It was assumed that using the dose through the berm for a magnet string was appropriate. The cold mass and cryostat provide some shielding.

Blue kicker pre-fires are expected to have less than 20 bunches at $2*10^9$ Au ions with 20 pre-fires in blue per year. This is a conservative estimate of the beam that does not receive sufficient kick to be transported into the beam dump. A total of $8*10^{11}$ Au ions or $1.6*10^{14}$ nucleons lost per year. Assuming all is lost at the scrapper is very conservative.

Issues:

Residual activity→ not expected to be an issue and can be examined by radiation surveys. **Post local (small) area pending radiation surveys after a blue kicker pre-fire.**

Air activation→ not considered to be an issue. (no explicit calculation done)

Soil activation(ground water)→ A local loss of 1.6*10**14 nucleons per year would be close[2] to the BNL action limit.

[1] C. Montag to D. Beavis private communication; e-mail Jan 16, 2014
[2] http://www.c-ad.bnl.gov/esfd/RSC/Memos/scrub_rhic_012512.pdf

Dose on berm→ Using the analysis for MCIs[3] the dose would be less than 12 mrem per blue kicker pre-fire. **Suggest placing a few monitor TLDs on the berm to register any dose.**

Penetrations→ Both the area and drawing were examined and there are no penetrations close enough to be a concern.

Muons→ No explicit calculation was conducted since 100 GeV muons do not penetrate the muon lobes. For 250 GeV protons it is expected that the muon lobes are more than sufficient.

Skyshine→ The following was done to provide a rough estimate for skyshine at the site boundary. The skyshine calculations for the beam dumps[4] were examined and the formula used. The formula requires an estimate for the total number of neutrons emerging from the berm with energy graeter than 20 MeV. The z-distribution of neutrons emerging through a typical berm section was presented in the calculations[5] for increasing the proton intensity. It will be assumed that an average of $4.5*10^{-8}$ n/cm^2 per lost proton emerge over an area of 8 meters long by 4 meters wide. Scaling for energy, using 366 meters to the site boundary, and assuming all the nucleons interact at a single location near the scrapper than a dose of 0.008 mrem/yr is estimated at the site boundary for the kicker pre-fires and the scrapper.

It is concluded that placing a thin scrapper in front of Q4 will not create any radiation exposure of environmental issues.

The monitoring suggested in this note will be tracked to either completion or a review decides they are unnecessary. (ATS-RHIC-Beavis-Drees-2014).

The actual design of this thin scrapper has not been examined but is assumed to be substantially outside the beam aperture for normal operations.

CC:

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[3] http://www.c-ad.bnl.gov/esfd/RSC/Memos/RHIC_berm_052312.pdf

[4] http://www.c-ad.bnl.gov/esfd/RSC/Memos/RHIC_dump_082310.pdf
[5] http://www.c-ad.bnl.gov/esfd/RSC/Memos/RHIC_berm_052312.pdf