Date: August 8, 2017

To: RSC, A. Fedotov, D. Kayran, L. Hammons, J. Tuozzolo, and J. Citro

From: D. Beavis

Subject: Increasing the LEReC gun Current to 10 mA

The LEReC operated 0.3 MeV beam from the gun to the gun beam dump with a current of 1 mA. This was a holding point pending review of the radiation levels. There are several chipmunks in the IR to measure the radiation from CeCPoP and LEReC. This note will document the chipmunk readings that were used to allow operation to 10 mA where another simple review will be conducted. At some point there may be fault studies conducted although the CeCPoP beam losses have already verified aspects of the shielding.

A. Fedotov has provided data for the beam current and the response of chipmunks, which is shown in Figure 1. The correlation between the chipmunks and the beam current is clearly evident. Most of the beam is delivered into the beam dump and is demonstrated in Figure 2 with the measured charge of the two transformers being nearly equal. The small difference is due to beam losses in the transport and possible calibration differences.
Figure 1: Top figure is the beam current. The bottom figure shows the readout of several chipmunks. The chipmunks are readout in 1 minute bins.

Figure 2: The integrated charge measured by the two transformers one after the gun and the other just before the beam dump.

Based on Fig. E.1 of NCRP Report 51 a dose rate of 6-60 rads/hr at a meter would be expected for a loss of 1 mA of 0.3 MeV beam. Chipmunk NM0324 is about 7 meters from the LEReC transport line. The distance would provide a reduction of 50 in the radiation resulting in a dose rate of 120 to 1200 mrad/hr for full beam loss in the transport. The beam has a current of about 0.2 mA and the chipmunk detects 4 mrad/hr. This simple estimate suggests a beam loss in the transport of order 5%. The radiation detected by the chipmunks is consistent with the running conditions with most of the beam delivered to the beam dump.
The conclusion that the source for the radiation detected by the chipmunks is beam loss in transport and not the beam dump is deduced by the ratio of the chipmunk responses. NM320 and NM324 have almost the same response. This implies that the source not close to the gun but in the transport past the location of NM320. NM321 is near the CeC high power beam dump. It has line-of-sight to the beam dump and the transport before the beam dump. NM321 is about 50% lower than NM320 and NM324 which suggests the dump is not the source but the beam transport. Finally, NM323 is closest to the beam dump and has the highest response but not as high as would be expected if the beam dump is the source. The radiation distribution suggests that the radiation being detected is the beam loss in transport.

The results are consistent with the beam dump being well shielded and a small fraction of the beam being lost in transport to the beam dump. The absolute magnitude of the radiation in the IR is consistent with expectations. Radiation measurements\(^1\) during beam losses of the CeCPoP 15 MeV beam challenged the shielding and penetrations with higher radiation than the present LEREc beam could generate with 100% beam loss in the transport. Based on Footnote 1 increasing the LEREc beam to 10 mA will not create a hazard outside the shielding.

\(^{1}\) D. Beavis, June 30, 2017; [http://www.c-ad.bnl.gov/esfd/RSC/Memos/06_30_17_CeC.pdf](http://www.c-ad.bnl.gov/esfd/RSC/Memos/06_30_17_CeC.pdf)
MREM/Hr
4.09

NM323 -- 1002 LIEC DUMP
Aug-1-17

DATA ENTRIES ARE IN 5-MINUTE INTERVALS
LAST HOUR AVERAGE: 0.09