Collider-Accelerator Department

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Memo

Date: *November 1, 2016*

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

From: *D. Beavis*

Subject: *LEReC Gun HV Conditioning*

The LEReC gun conditioning with HV is being considered as part of the accelerator exemption request for the LEReC gun test. There have been some concerns raised about the configuration and potential dose rates exterior to the shielding. **The intent of this memorandum is to clarify a few points in an effort to reduce or eliminate such concerns.**

At the time of the RSC meeting of Sept. 8, 2016[1] the final configuration of the shielding at the truck door was not finalized but the committee had an action item to review the final design and any cracks around the shield. The LE has committed to placing the normal RHIC shield in the truck door for initial operations. This shield is two layers and has not straight through cracks. This shield thickness is seven feet of light concrete and is more than sufficient to reduce x-ray levels to acceptable dose rates. The analysis for the HV conditioning noted that 50 cm of light concrete was sufficient to reduce fault levels to 0.8 mrads/hr.

The fence between the support building 1002D and the berm will be restored to the original configuration, except for an expanded metal piece to prevent access over the cable trays.

Ladders have been seen inside the area posted as no climbing and no ladders in the past. The IR2 sweep procedure is being modified to reduce the risk of this occuring in the future with added requirements that the sweep team examine the area for ladders and the posting. If ladders are present the sweep team will not sweep the area until the ladders are removed. If the posting for no ladders/no climbing is not installed the sweep team will not sweep the IR. The posting may change to “No Elevated Work” if deemed appropriate.

The minimum intended chipmunk configuration for the HV conditioning will be verified by the RSC check-off list for the gun conditioning, along with shielding, posting, barriers and other radiological controls. The chipmunks installed for the test are the labyrinth chipmunk near gate 2GE1, the chipmunk at 2GE2, the chipmunk to monitor dose near the cableway, and a chipmunk near the gun. The chipmunks in the IR are not alarming but are monitored by the computer system and can be easily converted to alarming. Other chipmunks may be installed in preparation for the gun beam test, CeCPoP testing and RHIC.

[1] RSC Meeting minutes of Sept. 8, 2016; http://www.c-ad.bnl.gov/esfd/RSC/Minutes/09_08_16Minutes.pdf

The shielding for the cableway has not been finalized as of the writing of this memo. Analysis was conducted based on a specific design and when the final design is available it will be evaluated for the radiation hazards prior to their introduction into the IR.

Most of the calculations for external radiation were given for fault conditions and not routine conditioning of the LEReC gun. The gun will be operated in a manner which protects this important machine component. The HV conditioning will initially be operated with a maximum possible current of less than 6 mA[2]. With a routine maximum voltage of less than 0.5 MV the maximum power during routine operations is less than 3 kW. This would result in a maximum dose rate[3] at 1 meter of 3000 Rads/hour. This upper limit is established by a pair of resistors in parallel. The HV conditioning will be substantially less than this upper limit to protect the machine from damage. The personnel in charge of conditioning the cavity will keep the current to as low a value as reasonable for conditioning purposes. An example of the dose rate detected near such a gun being conditioned at Cornell is shown in below. The detectors are either on or close to the gun. The dose rates are much lower than the large value given above for any duration close to an hour. Typically, the dose rates during conditioning near the gun are less than a few rads/hr.

From the data[4] obtained from Cornell it is clear that the routine dose rates are typically less than 1 rad/hour near the detector. Dose rate bursts of higher levels are expected for short periods of time. Based on the available data and experience it is anticipated that the **maximum routine dose rate in an hour is 3 rad/hr within one meter of the gun.** The routine dose rate can be used to estimate the routine dose out penetrations in the shielding. **The penetrations on the shielding at 18 feet would have a dose rate of 0.05 mrad/hr.** Failure of the operators to follow good practice for conditioning the cavity and potential failures in machine protection interlocks could allow the fault dose rate to rise to 3000 rads/hr at 1 meter from the gun. **The fault dose rate on the shielding outside of one of these small ports would be 48 mrads/hr.** The chipmunk inside the IR near the cable port would detect 60 rads/hr. It is not expected that the device can absorb 3KW of power without damage and failure in a short period of time.

A failure of the systems noted above couples with a failure of the resistor chain could allow fault dose rates to be between 150-200 mrads/hr outise one of these ports 18 feet up on the shielding. The gun would not be expected to survive such a condition.

On Oct. 31, 2016 H. Kahnhauser, C. Schaefer, and myself went out to IR2 and inspected the layout. Based on our inspections and discussions that did not think there were an substantial issues for the HV conditioning of the gun. They thought a memo such as this one would help reduce concerns.

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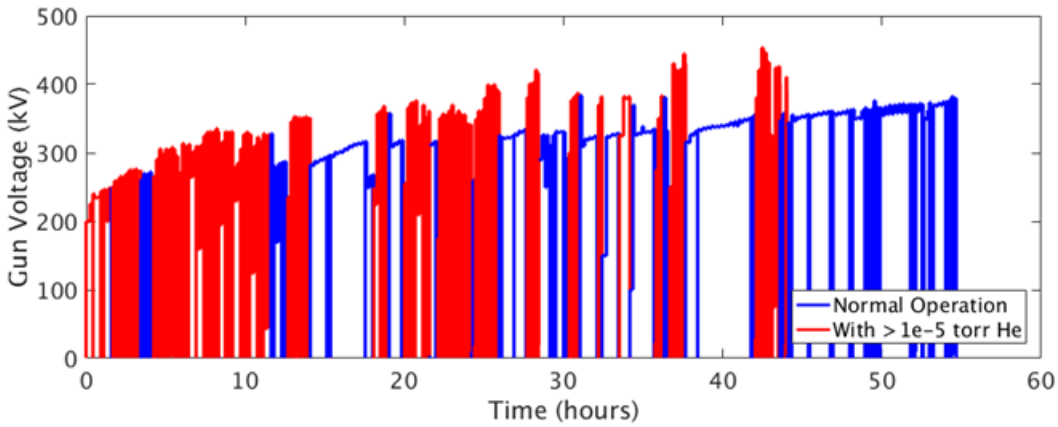
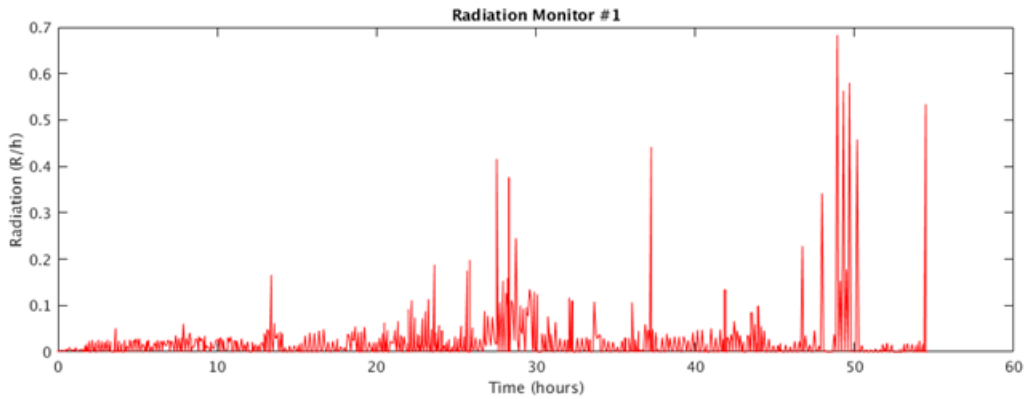
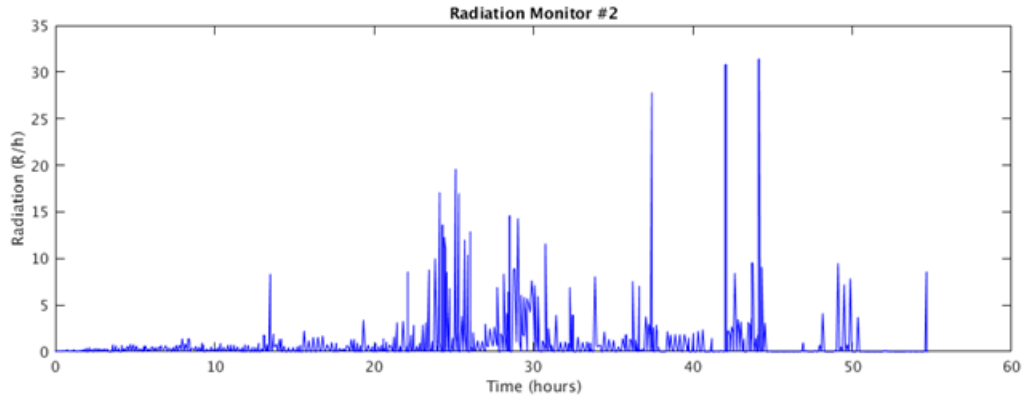
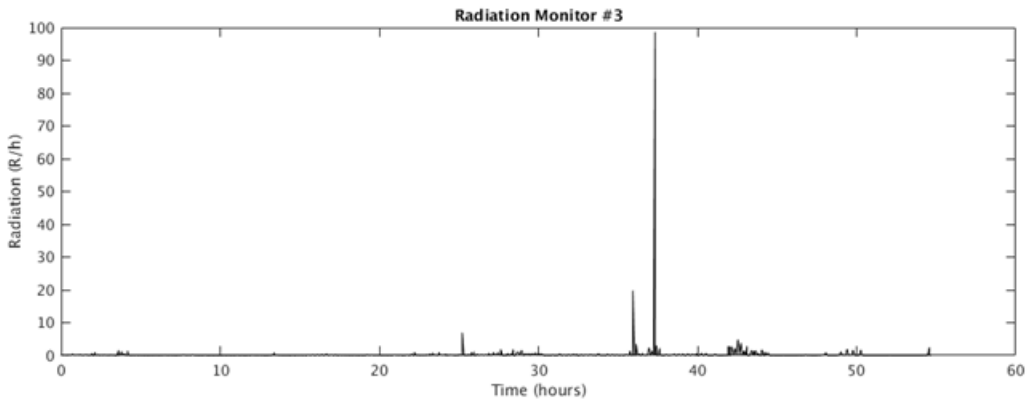
[2] J. Sandberg e-mail to D. Beavis Oct. 31, 2016.
[3] NCRP Report No. 51
[4] E-mail A. Fedotov to D. Beavis Sept. 8, 2016.


Gun Voltage (kV)
Time (hours)
Normal Operation
With > 1e-5 torr He


Radiation Monitor #1
Radiation (R/h)
Time (hours)


Radiation Monitor #2
Radiation (R/h)
Time (hours)
0
5
10
15
20
25
30
35
0
10
20
30
40
50
60


Radiation Monitor #3
Radiation (R/h)
Time (hours)
0
10
20
30
40
50
60
70
80
90
100
0
10
20
30
40
50
60