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: *April 22, 2016*

To: *RSC, A. Fedotov, E. Lessard, W. Fischer, and T. Roser*

From: *D. Beavis*

Subject: *LEReC and the ASO*

The LEReC Project has requested that gun testing be conducted at low and modest power with an exemption of the ASO. It will be suggested that rather than an exemption that this device be treated as a modification of the existing accelerator and go through the USI process. This suggestion is offered for both the gun testing and the entire LEReC Project.

A few "facts" are discussed below to partially support this approach.

A simple and conservative estimate of the potential dose from LEReC beam in IR2 can be compared to the radiation hazard from CeCPoP. The Project is proposing to operate at 0.5 MeV with low power and if possible up to 10 kW of beam power on the local beam dump near the gun. The 704 booster cavity will not be installed until the summer CY2018 shutdown so the beam is limited to the gun energy. Figure E.1 of NCRP Report No. 51 can be used for an estimate of the potential radiation hazard at different energies. The transverse dose rates from the figure are used to estimate the dose rates. The table below provides the numbers for LEReC at gun energy, LEReC[1] at 2.6 MeV, CeCPoP at full energy.

Device	**Energy (MeV)**	**Beam Power (kW)**	**Dose rate at 1 meter (R/hr)**	**Comment**
LEReC gun	0.5	10	9900	Gun current limited to 20 mA
LEReC gun plus booster	2.6	10	56,300	Gun current Limit of 0.52 mA
CeCPoP	25	8.5	43,900	Maximum

The table demonstrates that the proposed LEReC gun test would produce 4-5 times lower dose rates than the CeCPoP. The CeCPoP beam transport extends beyond the LEReC test beam in both directions along the IR. Both machines would utilize the same PLC systems for interlocks and have similar hazards in terms of RF x-rays. The CeCPoP has undergone both an IRR and

[1] This is the sum of the gun and 704 SRF booster cavity energies. This number is provided for future consideration of low power testing at full energy.

ARR with essentially no substantial findings[2]. The radiation from the CeCPoP is more intense than the radiation from the proposed gun tests and has higher photon energy distribution, which means the shielding is more effective for the LEReC photon distribution than the CeCPoP distribution.

The low electron beam energy of LEReC eliminates issues of activation for all phases of the project.

The remaining hazards are similar to CeCPoP and other electron and hadron machines that C-AD presently operates.

The LEReC is funded as an Accelerator Improvement Project (AIP) and has no users or external beam lines. It is located in a zone of RHIC that already contains another electron accelerator of higher radiation hazards when considering the proposed test for next year and the CeCPoP had IRR and ARR reviews. The proposed early beam test of LEReC and perhaps the entire LEReC effort should be considered as a "minor" modification to the RHIC machine and treated as such.

I would suggest that the Department consider having LEReC treated as a modification to the existing RHIC and reviewed through the USI process. Otherwise, I would suggest requesting an exemption from the ASO via section 3.c.(2) for early tests. Appropriate reviews of safety could be handled by BNL experts in a less formal manner than an ARR and IRR and perhaps incrementally as the machine is developed.

[2] My view and not intended to be a criticism of the review teams. I think this demonstrates that hazards are well understood for low energy electron machines and the associated RF equipment.