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To: RSC, S. Brooks, D. Trbojevic, M. Palmer, and K. Kusche

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Subject: eRHIC Test of a 40 degree ARC in Beam Line One

Experiment AD-028-2017-Jan-19 will operate near the end of beam line 1 (BL1). The experiment will place an arc of permanent magnets that are intended to bend the beam 40 degrees. An initial discussion of the experiment is given in the RSC minutes\(^1\) of a subgroup. The arc experiment is being planned for 1 or two short runs. Therefore, some “leniency” in the design of the stop can be applied since it is not a long term structure and not used for long beam runs at high current.

The large Pb shield will not be used at the end of the arc. Its present position may require it to be moved to allow clearance for the arc. It will be used as a shadow shield in the forward direction.

To allow access along the east wall the beam dump for the end of the arc will be mounted on a movable table. This is based on the understanding that an isle-way must be made when the EH is open for personnel. The initial entry will have the arc beam stop and the magnet arc moved to create a sufficient isle-way along the east wall.

The dose rate external to the shielding for the magnet arc running in normal conditions was estimated by placing a 10 cm thick Pb stop 50 cm in front of a light concrete wall. 85 MeV electrons were used to strike the front surface of the Pb. The dose was tallied in a two-dimensional Lego plot. Figure 1 displays the absorbed dose as a function of depth into the shielding. At 45 degrees the wall has an effective thickness of 170 cm along the beam axis. 0.05 watts of beam would produce an absorbed dose rate of 0.05 mrad/hr in the Controlled Area. The radial distribution was used to estimate the entrance dose rate into the ports high on the wall to be 300 mrad/hr for 1 Watt of beam. Using an attenuation of 0.01 and an experimental beam power of 0.05 Watts the dose rate outside the ports is expected to be 0.15 mrad/hr.

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A Pb wall 10cm thick will shadow the forward direction from the existing beam stop to the arc beam stop. The wall can be constructed as continuous or be made of staggered Pb blocks along the arc. Figure 1 displays the radial distribution of the absorbed dose on light concrete 2 meters downstream of the 10 cm Pb wall being struck with 1 Watt of 85 MeV beam electrons. This can be scaled to the distance to the end-wall where scattering would occur to generate dose towards the labyrinth gate. The distance of 3.9 meters gives a reduction of 0.27. The dose rates expected at the back wall are approximately 750 mrad/hr to 250 mrad/hr. An albedo factor of 0.03 is used and a dose rate at the gate is estimated\(^2\) to be 40 mrad/hr for 1 Watt. This implies for the experiment the dose rate at the gate 2 mrad/hr. This would be a fault dose rate for loss of the entire experimental beam. The chipmunk at the gate interlocks at 20 mrem/hr. If 5 cm of Pb is used the dose rates would increase by a factor of 10. This thinner shadow wall may be sufficient for the fault conditions.

It is suggested that simple administrative controls preventing multietrain operation and other means to escalate the beam current is sufficient. The simple stop and fault shielding should be sufficient for this short term experiment.

\(^2\) A correction factor of 1.33 as been applied (for the 10cm of light concrete), a distance of 120 cm to the gate was used, and an area of reflection of 270cm by 100cm was used.
Figure 2: Radial distribution of the absorbed dose for 1 Watt of 85 MeV electrons striking 10 cm of Pb. The dose is tallied in the first 10 cm of light concrete 200 cm downstream of the Pb.