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# Memo

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*to:* *RSC*

*from:* *D. Beavis*

*subject:* *ATF Experimental Beam Line Dumps*

The experimental area has three active beam dumps. Beam line 1 has a dump in the forward direction and one that is on the floor with a magnet bending the beam 90 degrees to direct it to the floor. Beam line 2 has one beam dump. The side wall and roof shielding will be examined in regards to the beam dumps.

The Pb beam dump at the end of ATF experimental beam line no. 2 was simulated in MCNPX to estimate the dose rate on the building roof. The beam dump has an open top with an opening angle of 60 degrees. The dump was approximated in cylindrical geometry for expediency. The Pb is 4 inches thick and extends 15 cm above the beam line. The beam strikes a stainless steel flange that I assumed is 1cm thick and had a 1 cm gap between it and the lead. The roof was approximated as light concrete 45 inches above the beam line. The thickness of the roof shielding over the beam line to the beam dump has been verified to be 1.5 feet of concrete[1]. Just before the dump location the roof is changed to a steel plate with 1 foot of light concrete. The height of the roof building roof has been taken to be eight feet above the top of the shielding[2].

Access to the shielding roof is prohibited with beam on. The entry way is locked and inside the experimental interlocked gate. Therefore, the dose was only calculated on the building roof. The peaks in the photon and neutron dose do not occur in the same location because of the effectiveness of Pb in attenuating the photons. The total dose rate on the building roof is (assuming 60 nano-amps at 85 MeV):

Photon->28 mrads/hr
Neutron->8 mrem/hr.

These are routine dose rates when the beam is transported to the dump. **The total dose rate on the building roof is 30-40 mrem/hr localized to a small area above the beam dump.** This would require the roof to be posted as a Radiation Area. The proposed low power operations would have a dose rate of about 1 mrem/hr on the building roof. The roof could be posted as a Controlled Area for low power operations. The steel I-beam that transfers the concrete loads to the walls in over the dump area. This may introduce uncertainties in the amount of shielding near

the beam dump. A careful radiation measurement over the dump would be the most expedient method to accurately determine the dose rate. From an ALARA point of view and for higher power operations it would be advised to make the beam dumps re-entrant, which was the design of the original beam dumps.

The beam dump has been modified[3] with four inches of lead over the top. The lead will reduce the dose rates on the roof (60 nano-A at 85 MeV) to:

Photon-> 0.3 mrad/hr
Neutron-> 4mrem/hr.

The roof could probably be posted a Controlled Area, although there is uncertainty in the actual shielding configuration. More detailed calculations can be conducted to more accurately estimate the radiation levels, or a detailed radiation survey on the roof be conducted.

The dose rates can also be estimated[4] through the side wall shielding. The beam dump in beam line two has four inches of Pb on the side wall. An MCNPX simulation was conducted for a three foot thick concrete wall. The dose can be estimated for the four-foot thick wall using TVLs. Correcting for the difference in distance from the beam line provides a factor of 1.3. The photon dose rate is 0.02 mrads/hr outside the shield wall. The area outside the shield wall is posted as a Controlled Area. The neutron dose rate is 0.4 mrem/hr. The rate for low power operations is much lower.

The beam dump in beam line one has no re-entrant structure. The dose results for the roof should be similar to those calculate for beam line 2 before the Pb was added. Operation of beam to this beam dump would require the roof to be posted as a radiation Area. The dose through the side wall can be scaled from the results of beam line 2 and will be larger due to the lack of lead and the closer distance. The photon dose would be a 2-3 mrads/hr and the neutron dose would be 0.6 mrem/hr for the adjacent Controlled Area when 5.1 Watts of 85 MeV beam strikes the stop.

Beam line 1 is discussed in the SAD as a low current beam line with a more than a factor of 100 times lower current than other beam lines. The dose rates off the beam stop would then be much lower and the numbers above would represent a fault dose if the process to limit the beam current fails.

Beam line 1 also has a dump on the floor, a 90-degree beam dump. The area where the beam strikes is covered by two inches of Pb and then has twelve inches of concrete. The dose rate on the building roof would decrease from the beam stop 1 estimate due to the backward direction and the increased distance. The dose rate through the side wall should be similar to that estimated for the zero degree beam dump in beam line one, but peaked at floor level.

**Recommendations:**

- Maintain controls on the building roof.
- Measure radiation from beam stops to side walls and modify the beam stops as appropriate.

- Obtain a survey of the building roof when this beam line first operates.
- Adjust posting and access controls of the roof accordingly.
- Document the process that limits the beam to beam line 1.

**References/Comments**

1. The previous calculation used 1.25 feet of light concrete and assumed to be light concrete.
2. This has not been verified and a smaller number was used in the previous report.
3. The number was verified and credit not taken for the Al plate support plate.
4. The side wall estimated was not provided in the previous note.