SLAC Memorandum **Date:** January 8, 2004

To: Sayed Rokni

From: H. Y. Khater

Subject: Analysis of the New 8-Pack Penetrations in the NLCTA Roof (Revised)

The 8-Pack project requested adding five new penetrations to the roof of the NLCTA [1]. These penetrations will be used for rf waveguide and instrumentation cables. The five additional penetrations are identical to and in the same line with the existing six penetrations in the NLCTA roof. The diameter of each penetration is 7". Figures 1 and 2 show the elevation and top view of the NLCTA roof penetrations, respectively. The six penetrations currently present in the NLCTA roof were analyzed for a beam power of 1.3 kW and beam energy of 1.1 GeV. On the other hand, the NLCTA SAD Shielding Design specifies initial and upgraded power levels of 3.23 and 5.75 kW, respectively. Analysis of radiation streaming through the new penetrations is performed for the three different power levels. In addition to radiation streaming through the penetrations, direct dose rates are also calculated on the top of the 4' concrete.

Dose rates on the roof are calculated by using conservative reflection coefficients that are included in the NCRP Report No. 51 [2], for monoenergetic x-rays ($\alpha_\gamma = 0.03$) and neutrons ($\alpha_n = 0.02$). The SHIELD11 code was utilized to calculate the neutrons and gamma doses at the entrance of each penetration. The SHIELD11 calculations assumed a mis-steering beam hitting a thick target at a 90° angle with respect to the penetrations. Based on the penetrations geometries shown in Figures 1 and 2, equal angles (60°) of incidence and reflection were assumed while estimating the reflection coefficients from the NCRP report. Since the full body is not exposed to the streaming radiation, the calculated effective dose equivalent values are reduced by a factor of 4. In addition all calculations assumed that the streaming radiation undergo a single reflection (bounce) within each penetration.

Table I. Summary of dose rates (mrem/hr) on top of the NLCTA roof.

Power (kW)	**Radiation Streaming through Penetrations**	**Direct Radiation through the 4' Concrete**
1.3	460	640
3.23	1140	1590
5.75	2035	2830

Table I shows a comparison between the dose rates resulting form radiation streaming through the penetrations and the direct dose rates on top of the 4' concrete roof. As shown in the table, the dose rates caused by radiation streaming through the penetration are less than the direct dose rates on the roof. Similar to the existing penetrations, radiation streaming through the new penetrations results in dose rates of less than 1 rem/h on the NLCTA roof, if the maximum beam power is limited to 1.3 kW. On the other hand, the initial and upgraded power levels specified in the NLCTA SAD Shielding Design result in dose rates on the NLCTA roof that exceeds 1 rem/h.

Summary

Adding the new penetrations to the roof of the NLCTA may proceed under the following conditions:

1. Beam power is limited to 1.3 kW.
2. Unused penetrations are blocked.
3. Proper RSWCF are issued.

References

[1] K. Jobe, "New Penetrations in NLCTA Accelerator Housing," Memo to Radiation Physics, August 27, 2003 (Revised on January 7, 2004).

[2] National Council on Radiation Protection and Measurements, "Radiation Protection Design Guidelines for 0.1-100 MeV Particle Accelerator Facilities," NCRP Report No. 51, 1977.

Cc: K. Jobe, M. Ross, D. Schultz, Fred Asiri, RP file.

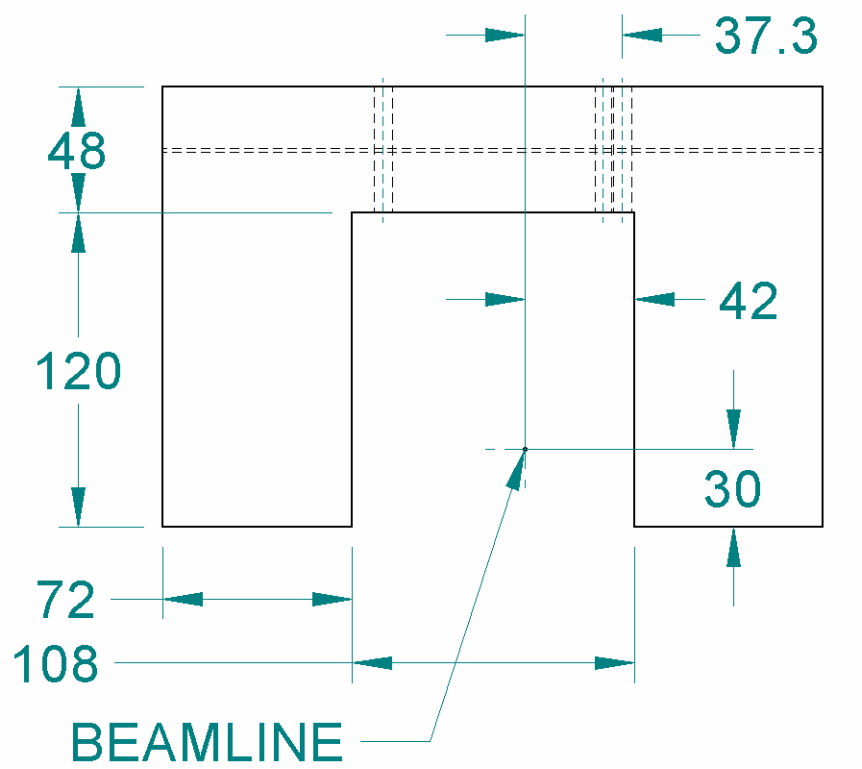

Fig. 1. Elevation view of the NLCTA roof penetrations.

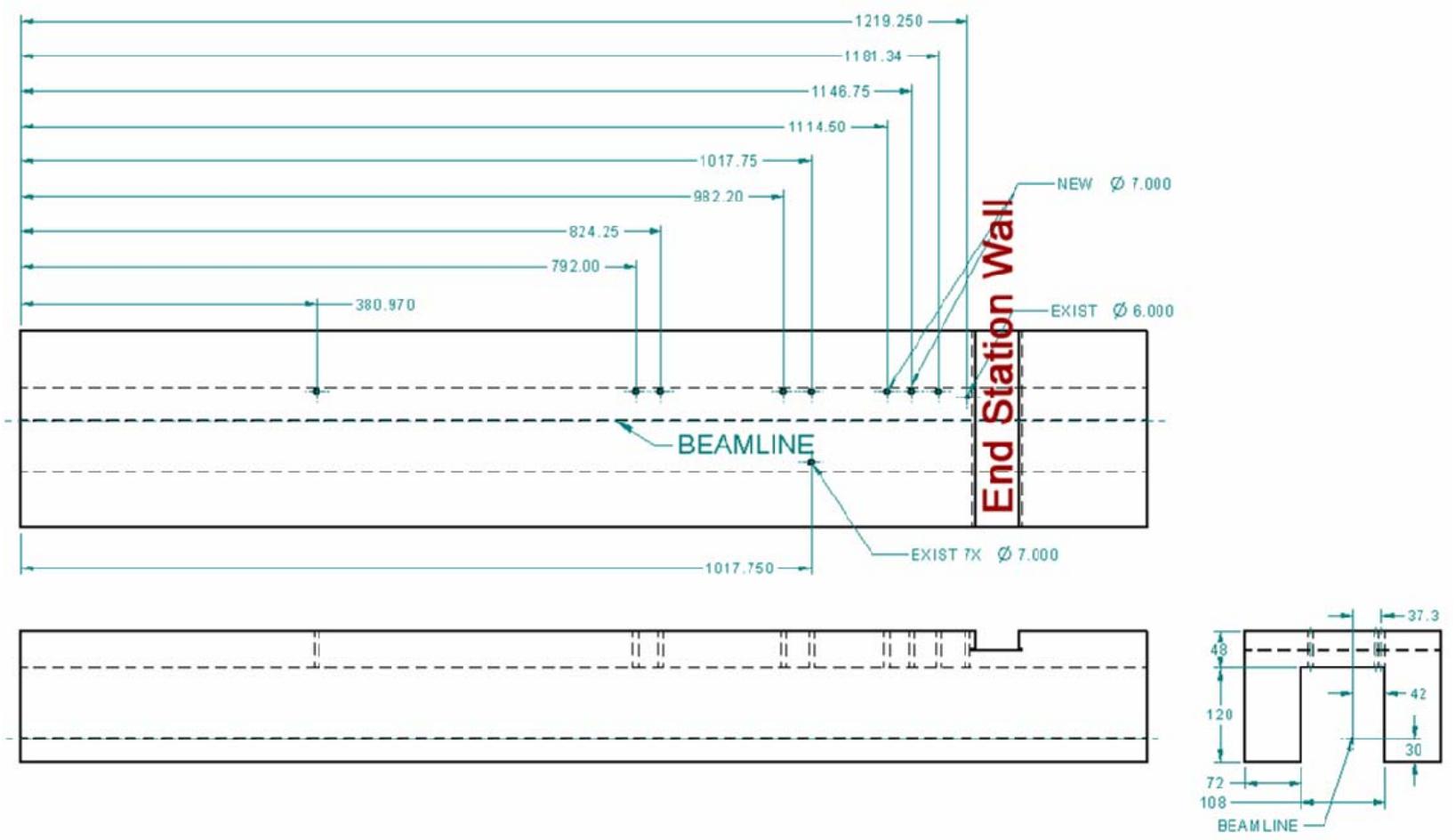

Fig. 2. Top view of the NLCTA roof penetrations.