Date: March 31, 2006
To: RSC, A. Pendzick, J. Alessi, K. Gardner
From: D. Beavis
Subject: Relocation of the Linac Building Second Floor Stairs

The planned installation of EBIS will require the relocation of the stairs for the second floor of the linac building. These stairs are required to satisfy the life safety requirements for the second floor. It has been proposed to place a potion of the stairs in an area, which is enclosed in the Booster fence (see Figure 1).

It is proposed:

1) The stairs be place a depicted in Figure 1.
2) A six-foot high fence will replace the linac building as the boundary of the Booster outside area near the proposed stairs.
3) The stairs be posted as a Controlled Area, which is the posting of the first and second floor of the linac building.
4) A fault study will be conducted with Booster beam to check the potential maximum fault level that can be produced on the stairs.
5)

Two section views of this area were examined to estimate the amount of direct shielding and distance between the Booster beam and the stairs. One section (AA) was at the location of the proposed exit from the linac building. The other location was the area where the stairs go over the existing retaining wall. Some errors in the contour plots used to estimate the amount of dirt (shielding) may exist. The resulting numbers are:

Location	Berm Thickness (ft)	Total Distance (ft)
AA	17	24.6
BB	21.75	26.75

A thick target formula has been usde to estimate the potential dose in a fault condition. **The thick target dose has been reduced by a factor of ten based on experience.** It is assumed that the fault is caused by 3 GeV protons at 1.8*10**17 protons/hr (ASE). The maximium dose is nearly energy independent since the ASE is given in nucleons-GeV provided energies of 1 GeV or higher are used. The table below gives the estimates for Booster faults:

Location	Dose Eq. (mrem/hr)	Dose Eq. (mrem/sec.)
AA	240	0.07
BB	13.5	0.004

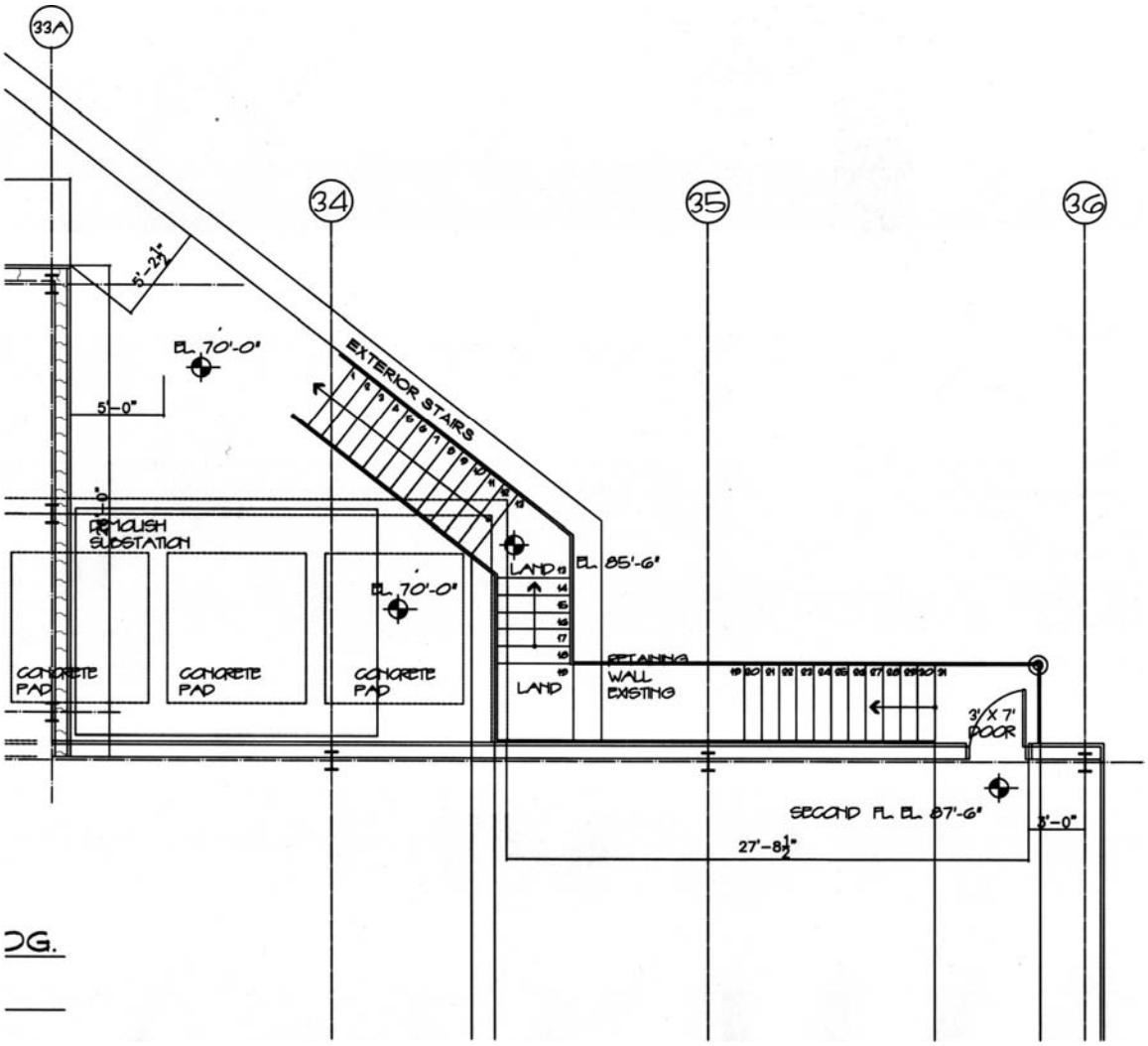

Figure 1.

There is a section of the booster berm in cross-section BB that appears to be 15 feet thick. Rays from the booster do not directly shine onto the stairs but do intersect the building roof. Using a thick target formula scaled by 1/10 the dose rate on the roof could be 200 mrem/hr. This number would be further reduced due to the component of low energy neutrons, which are not as directional. These low energy neutrons could contribute to the dose on the stairs (groundshine). The dose rate on the Booster berm is estimated to be 800 mrem/hr.

Based on the contours there appears to be one downstream of the stairs, which may have only 13 feet of dirt for shielding. The estimated dose rate on the berm is 3000 mrem/hr. This section does not appear to have direct shine on the stairs or the linac-building roof, although it could contribute to groundshine for the stairs and the roof.

The potential dose rates due to linac beam faults are expected to be small. Using a thick target formula for 10**15 protons at 200 MeV give dose rates of 1 mrem/hr or less.

Should the Booster fault studies demostrate that the dose for a fault is too high several modifications can be proposed including:

1) Change the posting of the stairs and the building as a Radiation Area.
2) Examine if the EBIS chipmunk that is proposed can provide protection.
3) Add a chipmunk to the second floor of the linac building.

Since the existing building is adjacent to the stairs any required changes for the proposed stairs should also be made for the second floor of the linac building.

Dose rates from routine operations are expected to be small. For heavy ion and polarized proton operations the fault levels are approximately a factor of 100 times lower.

CC: RSC Booster file
RSC EBIS file