Fermilab

December 11, 1990

TO: John Peoples

FROM: Don Cossairt

SUBJECT: Generic Shielding Criteria for Compliance with Chapter 6 of the Fermilab Radiation Guide

In view of this morning's discussion at the Laboratory Scheduling Meeting, I am proposing the attached "generic" shielding criteria to be used in determinations of shielding adequacy as a screening tool to identify areas where further calculations, analysis of beam loss conditions, and/or measurements may be indicated. The calculations upon which these criteria are based have been taken from TM-1140, " A Collection of CASIM Calculations" which I wrote in 1982. The calculations were done for worst case scenarios involving point losses of beam. The calculations described in detail in that document used here were all done for 1 TeV protons. For the present situation, the difference between the results and those which would be obtained for 800 GeV gives us a bit of a cushion which is insignificant. The calculations all assume the soil shielding to have a density of 2.24 g/cm^3. In the attachment, I list the dose per hour (where interlocked detectors are not intended to be used) and dose per pulse (where interlocked detectors are provided) regions stated in Tables 2A and 2B of the above referenced chapter in the Radiation Guide along with the quantities of earth-equivalent overburden required to attenuate the radiation sufficiently to qualify for the precautions specified in the Radiation Guide for that particular range of dose/hour or dose/interlock trip.

This is done for three situations deemed to be typical; the point loss of beam on the upstream face of a typically sized conventional magnet placed 3 ft. below the ceiling of a beam enclosure, the loss of beam on the end of a 4 inch diameter aluminum beam pipe with 1/8 inch thick walls placed 3 ft. below the ceiling of an enclosure, and the point loss of beam on the end of a 1 ft. diameter steel beam pipe with 1/2 inch thick walls buried in soil. The results for the enclosure overburden include the modeled 1 ft. thick concrete ceiling. I assumed a beam intensity of 2 X 10^{13} protons per spill and 60 spills per hour of operation. This is appropriate for the imminent fixed target run but does not address future operations at potentially higher intensities.

This criteria considers accidental losses of beam only. Radiation fields due to normal operations should be well documented by routine surveys, etc. The results of calculations involving thick shields are typically good to about a factor of 2-3 where we have compared them with well-understood measurements. This corresponds to about 1-1.5 ft. of earth-equivalent. I suspect that the error in the shielding calculations thus is roughly equivalent to our understanding of shielding thicknesses in most locations.

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Attachment 4

Earth Overburden Needed for Various Ranges of Dose/Hour or Dose/Interlock Trip

Earth Overburden:		magnet in enclosure (feet)	pipe in enclosure (feet)	buried pipe (feet)
No Interlocked Detectors Used Dose/Hour Allowed (mrem)				
D<1	no occupancy limit	22	20	24
1<D<~~10~~ 5	minimal occupancy	~~19~~ 19.9	~~17~~ 17.9	~~21~~ 21.9
5 ~~10~~<D<100	signs and ropes	16.5	15.5	18
100<D<500	signs, fences, locked gates	15	13	16.5
500<D<1000	signs, fences, interlocked gat	14	12	15.5
Interlocked Detectors Used Dose/Trip (mrem)				
D<0.25	no occupancy limit	19	17	20
4trps/hr 0.25<D<2.5	minimal occupancy	16	14	17
10trps/hr ~~0.25~~ 2.5<D<10	signs and ropes, minimal occ.	14.5	12.5	15.5
(ditto) 10<D<50	signs, fences, locked gates	13	11	14
(ditto) 50<D<100	signs, fences, interlocked gat	12	10	13
100<D<250	8' high fences, etc. etc.	11	9	12

Attachment 4