Radiation Physics

Note #32

Observations on Excavation of Radioactive Dirt and Demolition of Radioactive Concrete

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During the summer of 1980 the earth berm between G-3 manhole and the upstream end of enclosure 99 was removed. In addition, G-3 and the upstream end of E-99 were demolished. The excavation was done with scrapers, dozers and backhoes, the concrete demolition was done with water cooled saw cutting and a crane with a wrecking ball.

Figs. 1 and 2 indicate typical beam off dose rates in the areas, they also indicate the radioactivity levels of the concrete after the beam elements were removed. A sample of the hottest concrete was analyzed for isotopes and concentrations. The results are in Table I. Figs. 3 and 3a show the radiation levels of the dirt found during the excavation. These readings were taken with a 1" x 1" NaI crystal, at contact with a backhoe bucketful of dirt in a low background area. Readings taken at the excavation were higher due to the background from the concrete or the beam pipe. Table II shows typical data from soil reading 20,000 cpm at contact with a bucketful.

During the demolition of upstream E-99 air samples were taken inside the enclosure. These read only normal background. In addition, numerous air samples were taken outside during the excavation of hot dirt and demolition of concrete. Again all samples read normal background. However, the outside air sample

only has a sensitivity of 10^{-9} μCi/cc due to its low flow rate.

During various stages of the construction project there were severe rainstorms. After each storm, water samples were taken of any runnoff or from significant pools of standing water. In all cases, except one, the concentrations were less than 10pCi/ml of tritiated water and 0.3pCi/ml of sodium-22. G-3 filled with water soon after power was shut off. The water stood in the enclosure for about two months; it contained 120pCi/ml of sodium-22.

The only time equpment became contaminated was when a backhoe ran through mud with levels reading greater than 100,000cpm (NaI). Most of this contamination was found in the treads of the backhoe at levels of 4000cpm. Personnel were routinely checked for contamination. Nothing above background was ever found.

The following general conclusions can be drawn from the construction project:

1. Airborne radiation levels are at background if the dirt being moved is less than 300,000cpm (NaI) or it the concrete being demolished is less than 10mrem/hr.
2. Water run off is about 100 times lower than can be legally discarded offsite.
3. Contamination of equipment or personnel is not measurable with field instruments until the levels in the soil exceed 100,000cpm (NaI).
4. The "hot" dirt pile does not need to be covered with polyethylene when the highest radiation levels are

300,000cpm (NaI). However, to minimize possible contamination of equipment if exposed dirt reads greater than 100,000cpm it should be covered over with several inches of dirt which reads less than 100,000cpm. Furthermore in the process of moving the hot dirt it usually mixes well with other soil such that the highest levels normally found when the area was backfilled was 10,000cpm (NaI).

5. Ingestion of radionuclids from the soil is not a problem as indicated in Table II and as indicated by the lack of contamination found on personnel. For example, assuming all the Na-22 in the soil were absorbed in the body (gross overestimate) one would have to keep an inventory of 200 grams of soil in the body for one year to receive 5000mrem/year.
6. The major difficulty encountered was segregating the radioactive dirt and debris and keeping it segregated such that it could be replaced as close to the beam line and enclosure as possible. The contractor would move the "hot" dirt several times which tended to make the radioactive dirt pile become larger.

TABLE I

10mr/hr. concrete at G-3 manhole

Isotope	Concentration nCi/gr.
Be-7	2.7
Mn-54	0.2
Na-22	0.95

TABLE II

Typical Soil Reading 20,000cpm (NaI)

Isotope	Concentration nCi/gr.	Body Burden* nCi
Be-7	47	6×10^5
Mn54	1	2×10^4
Sc46	2.3	1×10^4
Co-60	2	1×10^4
Na-22	50	1×10^4

*Body Burden for whole body irradiation for soluble nuclides

Enclosure 99

Fig. 1

Residual Dose Rates

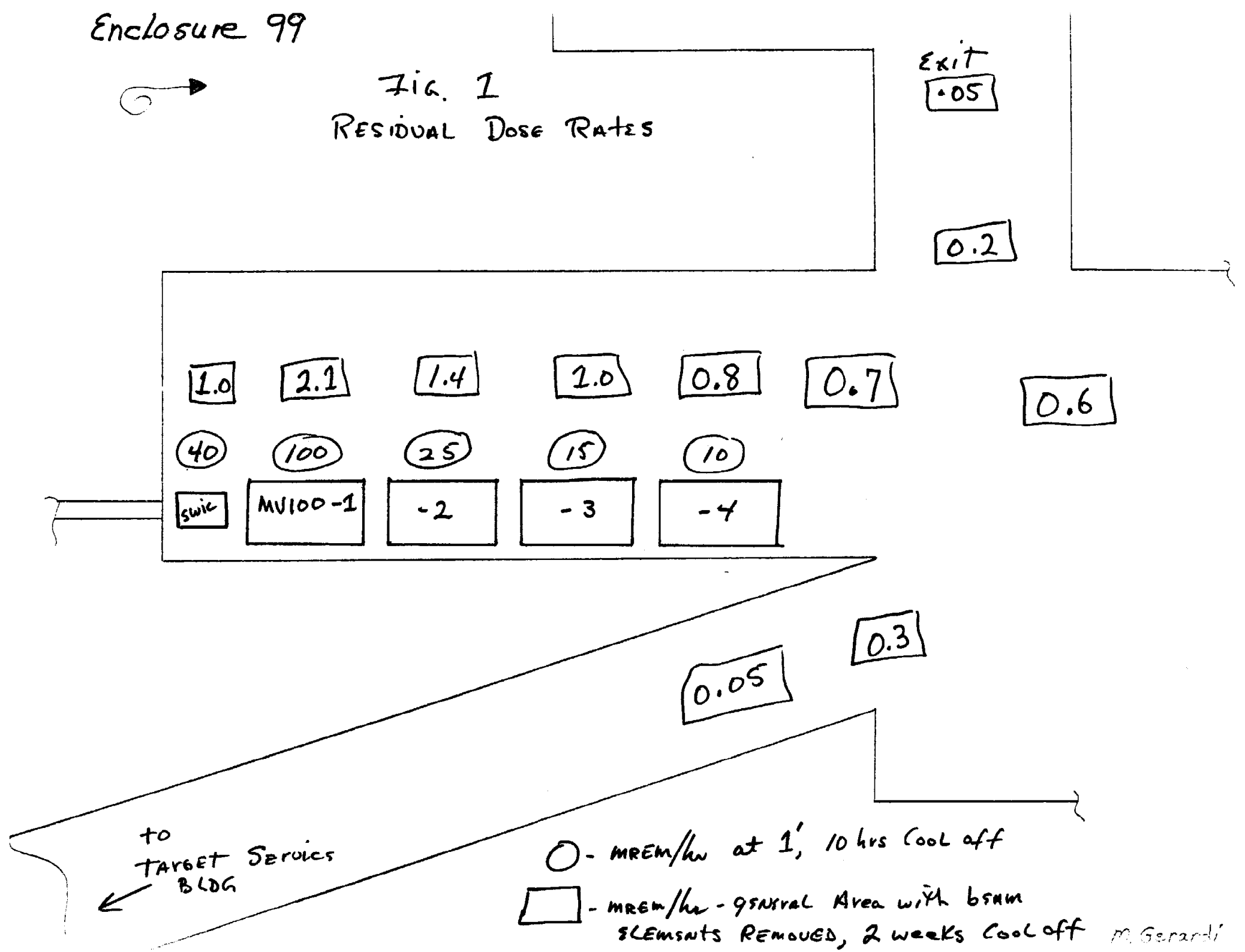

Fig. 2 Residual Dose Rate

G-3

○ mrem/hr at 1'

□ mrem/hr at contact – beam elements removed, 2 weeks cool off.

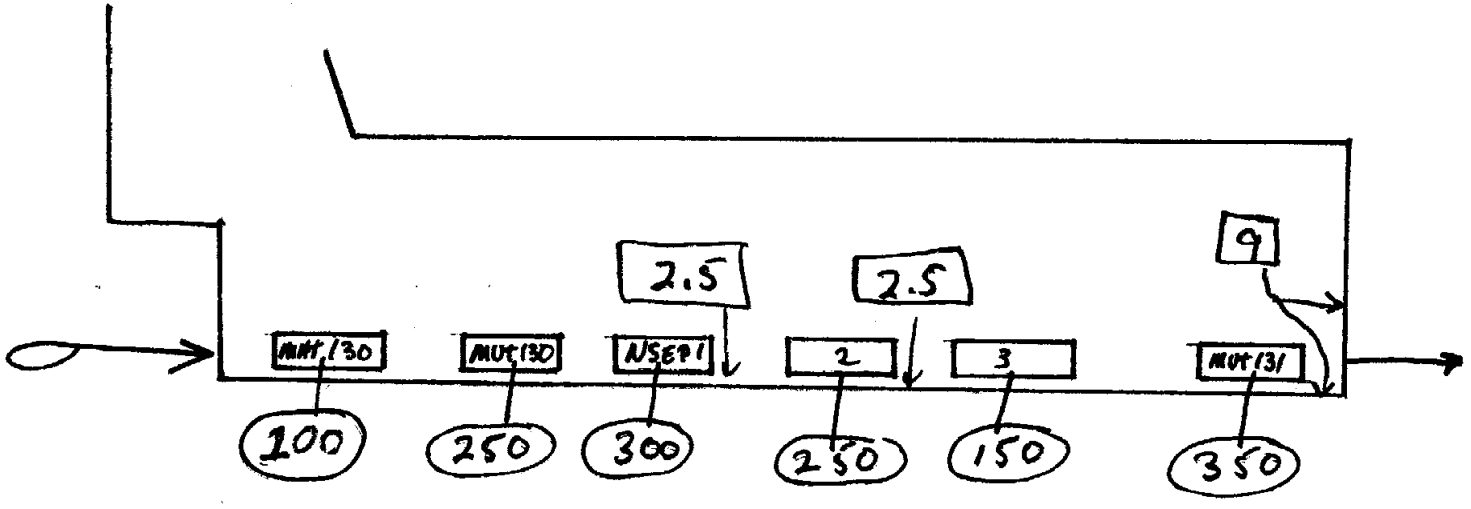

FIG. 3 RESIDUAL RADIATION LEVELS IN SOIL

PLAN VIEW - NO SCALE

ALL READINGS ARE TAKEN with a portable 1"x1" NaI Crystal detector

THE READINGS ARE within 2' of the beam pipe OR ENCLOSURE wall UNLESS OTHERWISE NOTED

DUE to high background ALL READINGS WERE taken at contact with a back hoe bucket full of soil IN a low Background AREA.

- 0 - 5000 cpm above BKG.
- 5000 - 20,000 cpm
- 20,000 - 100,000cpm
- 100,000 - 300,000cpm

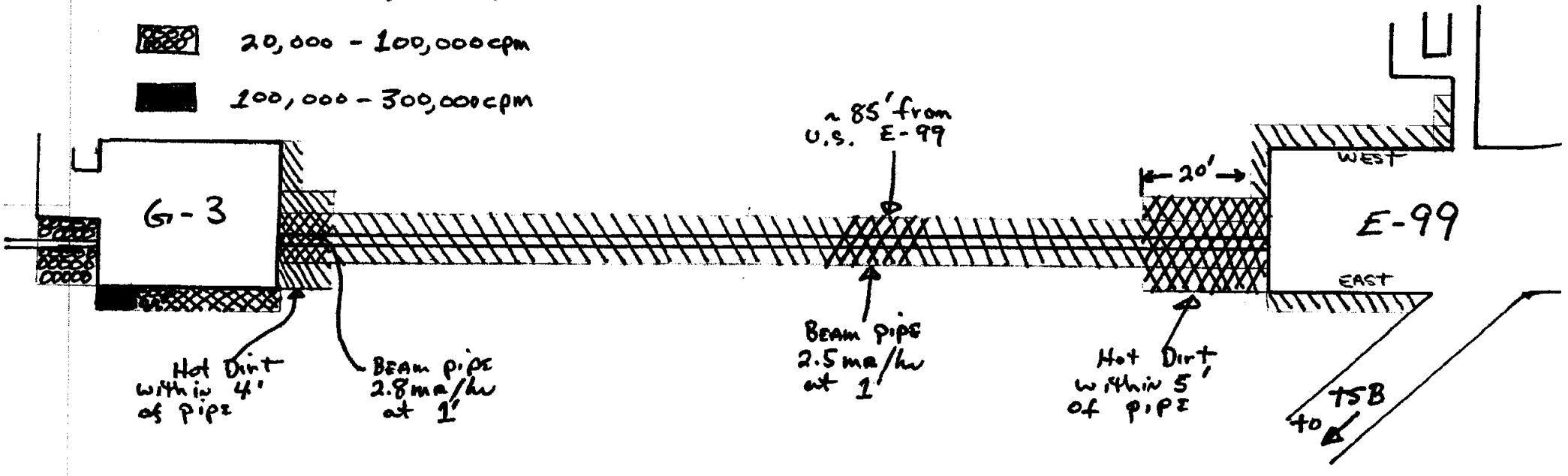

Fig 3a Residual Radiation Levels in Soil

Elevation View - No Scale