WHC-MR-0170

Environmental Impact of KE Basin Operation

Prepared for the U.S. Department of Energy
Office of Environmental Restoration
and Waste Management

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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Printed in the United States of America

DISCLM-2.CHP (2-89)

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Date Published
June 1990

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Richland, Washington 99352

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Reference 2

UNITED NUCLEAR INDUSTRIES, INC.

NUCLEAR OPERATIONS DIVISION

DATE May 24, 1979

TO J. W. Riches

FROM T. E. Dabrowski T E Dabrowski

SUBJECT ENVIRONMENTAL IMPACT OF KE BASIN OPERATION

DISTRIBUTION:
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Environmental & Occupational Safety has summarized the evaluations that have been performed of the environmental impact of operation of the KE fuel storage basin. The attached report provides a synopsis of these evaluations.

Should you have any questions concerning this information, please contact me on 2-1315.

TED/cb

Attachment

ANALYSIS OF THE ENVIRONMENTAL IMPACT OF KE BASIN OPERATION

1.0 Background

The 105-KE fuel storage facility is a reactivated and significantly modified non-reactor nuclear facility. Under a directive from ERDA-RL, Project H-501 was initiated in 1974 to reactivate the KE fuel storage basin to provide additional storage space for N Reactor fuel.

The 105-KE Reactor is a standby production unit that was operated from 1954 until January 1971. The original fuel storage facility, attached to the reactor, provided shielding and single pass water coolant for the irradiated fuel during KE Reactor operation. The single pass basin cooling system discharged to the K trench but was modified in 1974 and 1975 during Project H-501 to provide a recirculating system with filters and heat exchangers.

The KE fuel storage facility was originally constructed with a secondary seepage barrier in the form of an asphalt membrane under the basin floor. This two inch thick membrane was installed under the entire storage basin except for the pickup chute area and was designed to collect leakage in perforated pipes that lie on top of the membrane. These pipes drain to a sump (see Figure 1 in the attachments). Two automatic pumps were installed in the sump under Project H-501 to return any seepage back to the basin.

2.0 Operating History

During testing that was conducted in 1974 as part of Project H-501, a 15 day basin drawdown established a 4 gpm seepage rate from the basin system.[1] At least 90 percent of this seepage was thought to be collected by the membrane system and sump. It was decided to install automatic pumps to return this seepage to the basin. The other

Note D-1

Note D-1 Continued

10 percent of the seepage was assumed to discharge to the soil beneath the basin.

In mid-February 1977, an unusually high seep rate (13.5 gpm) was identified. Radionuclide concentrations in the basin were decreasing at this time due to the increased seepage. Improved basin water level monitoring was started immediately and investigative action initiated. The increased seepage was determined to have been caused by reduced basin water temperature, which caused concrete contraction to expand existing minor cracks in the basin. Detailed analysis showed that no radioactivity was being released in liquid effluents from K Area and no water was being collected in the membrane drainage sump, therefore, all of the seepage was assumed to be going to ground either through or past the membrane. An assessment of the impact of the seepage on the environs and the soil column was performed to determine if the impact was as low as technically and economically practical (see page 3 of this report).

During 1977, the following steps were taken to control and reduce the basin leakage.

- Seepage was stabilized at about 8 gpm by maintaining higher basin temperatures. Basin nuclide concentrations increased again after seepage was reduced.

- Underwater acoustic testing was used in March 1977 to identify five probable seep areas. These areas were repaired in June of that year; however, these repairs did not significantly reduce the seepage rate from the basin.

- The ion exchange system was to begin initial operation in October 1977. This was expected to decrease cesium concentrations.

Note F-2

Note F-2 Continuation

- Process Change Authorization (PCA) was implemented to improve seepage monitoring.

- An assessment was made of the environmental impact of the seepage.

3.0 Recent Seepage Experience

Drawdown testing of the basin performed in January 1979 indicated a seep rate of 7.5 gpm, which was in excess of the assessment level in the PCA controlling basin level monitoring. As a result, another evaluation of the impact of the seepage was performed. Note G-1

During March the seep rate reached a high of 9.5 gpm, but has since dropped to about 8 gpm. A plot of the seepage history is shown in Figure 2 in the attachments.

4.0 Assessment of Acceptability of Operation

Evaluations of the acceptability of continued operation of the KE basin with seepage of basin water to the soil column were performed in 1977 and 1979. The evaluations considered the following factors:

- Maginitude of the activity being released to the soil. Note F-5

- Potential for releases of radioactive material to the Columbia River.

- Impact of releases on ultimate disposition of the soil.

Each item is discussed separately below:

- Activity Being Released to Soil

  The concentration of radionuclides in the KE basin water began increasing after basin startup in July of 1975 but stabilized by late 1976. The concentrations began decreasing slightly in 1978 (see Figures 3 and 4).

COMPARISON OF KE BASIN AND 1301-N TRENCH RELEASES

Nuclide	Basin Concentration[1] (pCi/ℓ)	KE Basin Annual Release (Ci) at 7.5 gpm	Annual Release to 1301-N Facility (Ci)[2]
H-3	6.2×10^5	9.2	320
Co-60	1.2×10^5	1.8	920
Sr-90	3.8×10^7	560	120
Cs-137	2.2×10^7	330	351
Pu-238	3.0×10^3	0.044	22
Pu-239/240	1.7×10^4	0.25	2.23

[1] Average, January through December 1978
[2] Based on CY 1978 releases

The total inventories in the soil beneath the N trench and the KE basin (due to operation since 1975) are shown below:

Nuclide	KE Basin Soil Inventory, Ci	1301-N Soil Inventory, Ci
Co-60	3.6	4000
Sr-90	1470	600
Cs-137	1050	1700
Pu-238	0.21	1.3
Pu-239/240	1.3	5.5

- Potential for Release to Columbia River

The average seep rate of about 8 gpm from the KE basin is very low relative to other ground disposal facilities that have been used at Hanford. For example, the flow rate to the

1301-N crib system is 1800 gpm. The much lower flow rate from the KE basin will permit more effective filtration and ion exchange reactions in the soil. In addition, none of the typically more soluble radionuclides (such as I 131) are found in the KE basin water except for tritium.

The KE basin is located 2.5 times farther from the river than the 1301-N crib which increases the effective length of the soil column.

Finally, site characterization studies performed in the deactivated mile long K trench clearly show that over 95 percent of the Pu, Cs and Sr activity released to the trench is found in the first ten to fifteen feet of the soil column (see Figures 5 and 6 and Table 1).[2] Other studies performed in the 200 Areas also confirm the effectiveness of the Hanford soils in removing radioactivity from liquid effluents.[3]

- <u>Impact of Releases on Disposition of Soil Column</u>

During the 16 year operating history of the KE Reactor, radioactive material most likely seeped from the basin to the soil beneath the facility through the same pathway that is open today. No direct measurements have been taken of the radionuclide inventories beneath the basin; however, analyses of the sludge that accumulated on the basin floor before storage of N fuel have been performed. It is reasonable to assume that the soil at the seepage site would have shown similar radionuclide concentrations as the sludge (since the sludge would have seeped through this same location).

The ultimate disposition of the soil beneath the basin will be determined by the Pu concentration in that soil because all other radionuclides will decay to releasable levels within several hundred years. BNW has recommended an unrestricted release level for Pu in soil at 1 to 10 pCi/gm. The concentration in the sludge from the KE basin before N fuel storage was 3600 pCi/gm. Based on the level of Pu in the sludge and the assumed level in the seepage area soil, it was concluded that the soil beneath the KE basin would have to be removed for ultimate disposal. Continued operation of the basin with seepage would not change this conclusion although it could somewhat increase the amount of soil that would have to be removed. This increase in volume would not significantly affect the cost of the ultimate D&D efforts.

<u>References</u>

1. Letter, "Supplemental N Reactor Irradiated Fuel Storage," N. R. Miller to P. W. Gottschalk, December 7, 1975.

2. UNI-946 "Radiological Characterization of the Retired 100 Areas," May 25, 1978.

3. ERDA-1538 "Final Environmental Statement - Waste Management Operations - Hanford Reservation, Richland, Washington," December 1975.

TABLE 1

PLUTONIUM PENETRATION IN SOIL

(DATA FROM UNI-946 "100 AREA SITE CHARACTERIZATION")

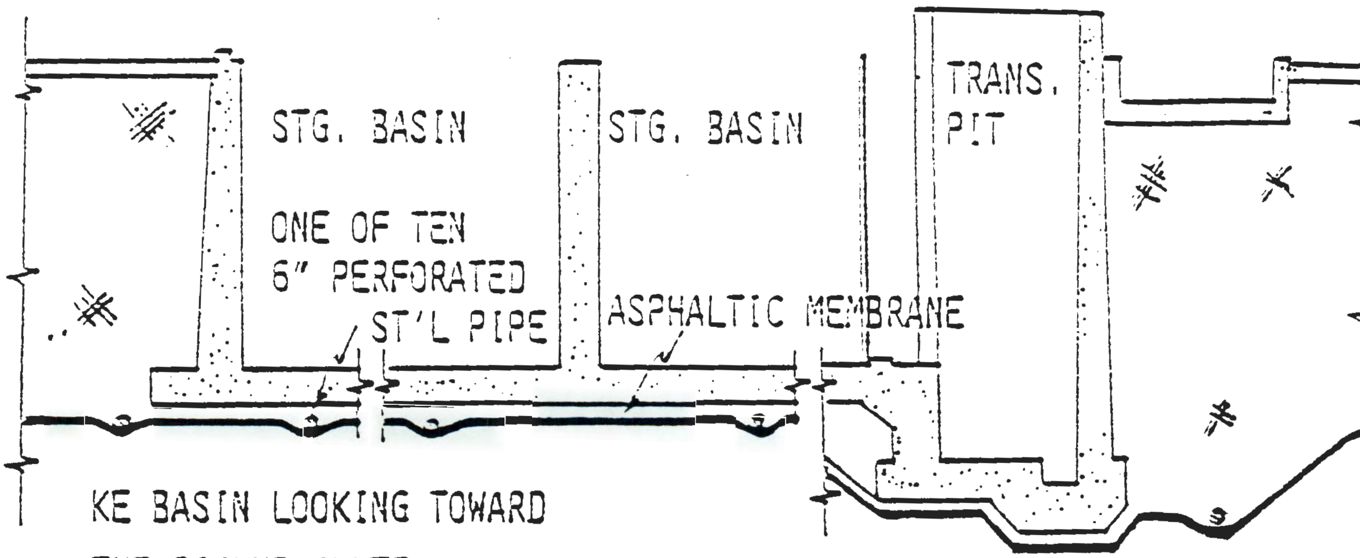
107 B RETENTION BASIN

- ON BASIN FLOOR - 340 pCi/GM
- 5' BELOW FLOOR - 6.4 pCi/GM
- 13' BELOW FLOOR - 0.12 pCi/GM
- 5' FROM BASIN SIDE* - 0.8 pCi/GM

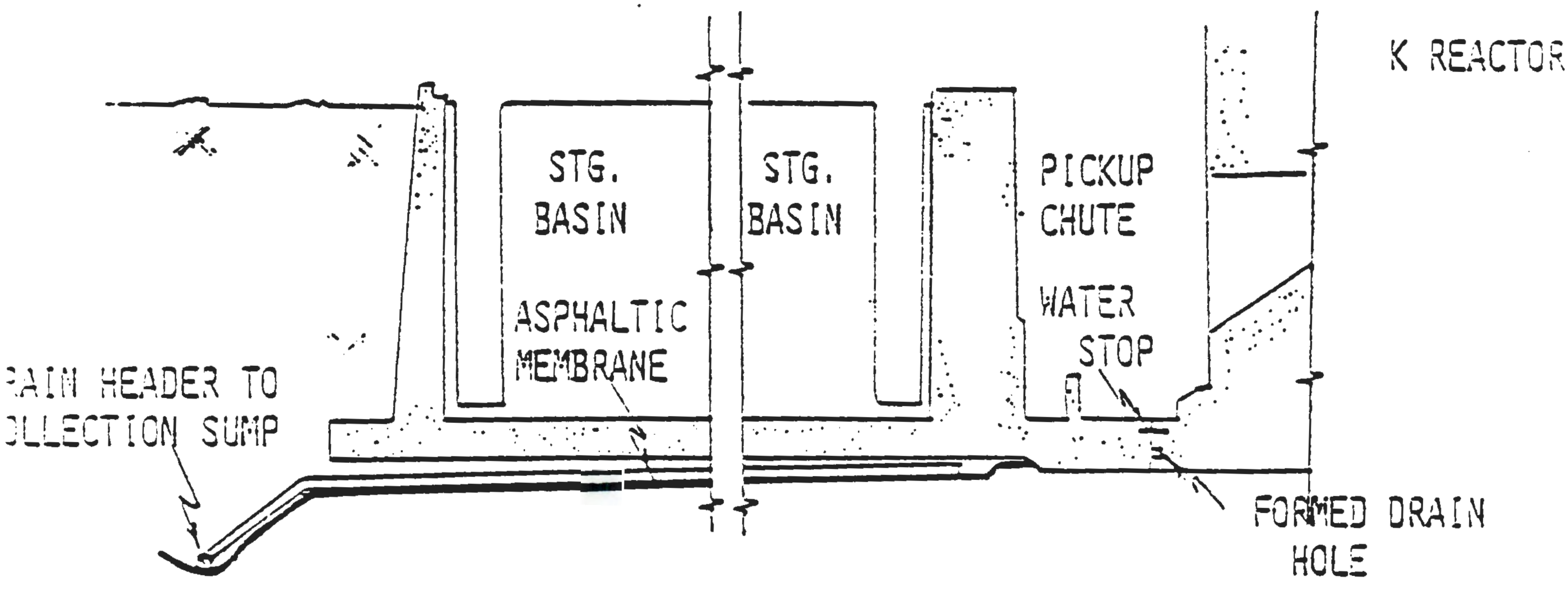
* LEAKAGE OF UP TO 10,000 GPM WAS REPORTED IN THIS AREA DURING BASIN OPERATION.

FIGURE 1

KE BASIN MEMBRANE



KE BASIN LOOKING TOWARD THE PICKUP CHUTE



CROSS SECTION OF BASIN THRU PICKUP CHUTE

FIGURE 2

KE BASIN SEEPAGE AND TEMPERATURE

Note F-4

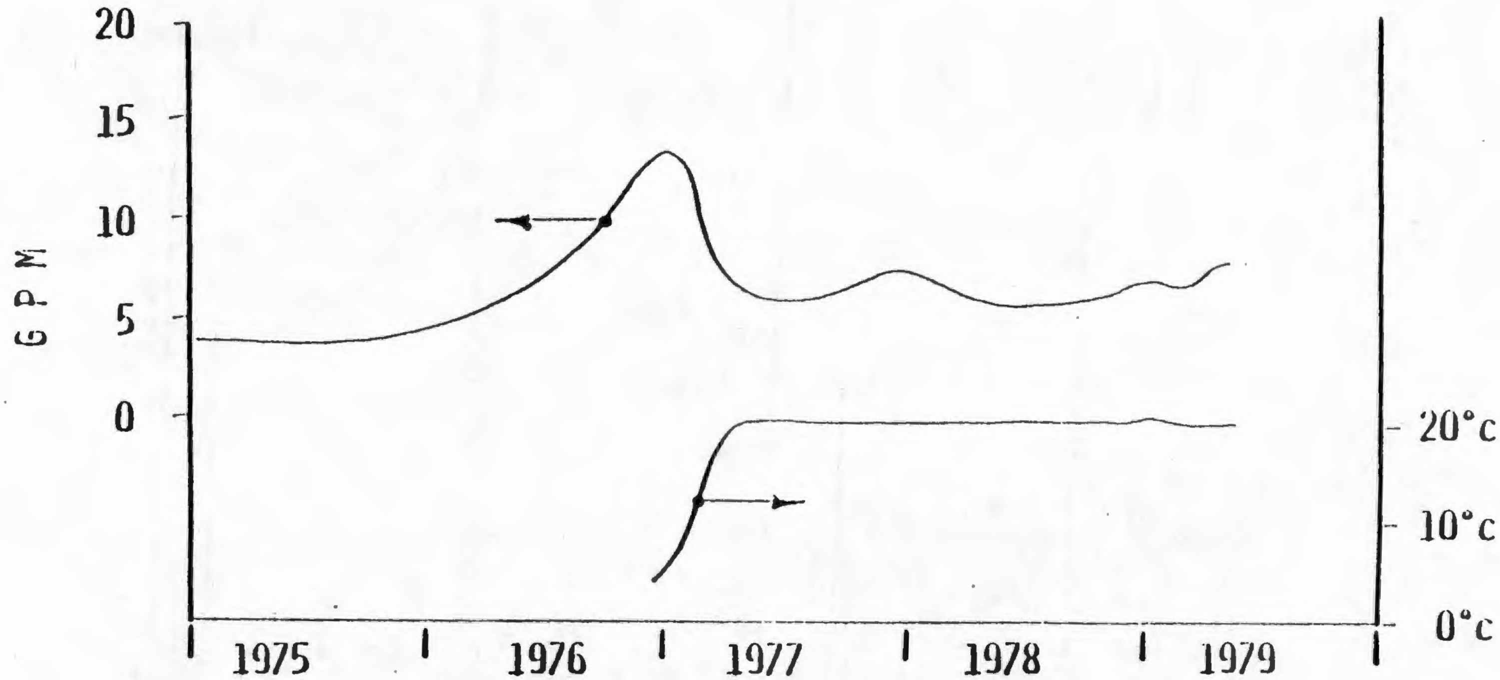
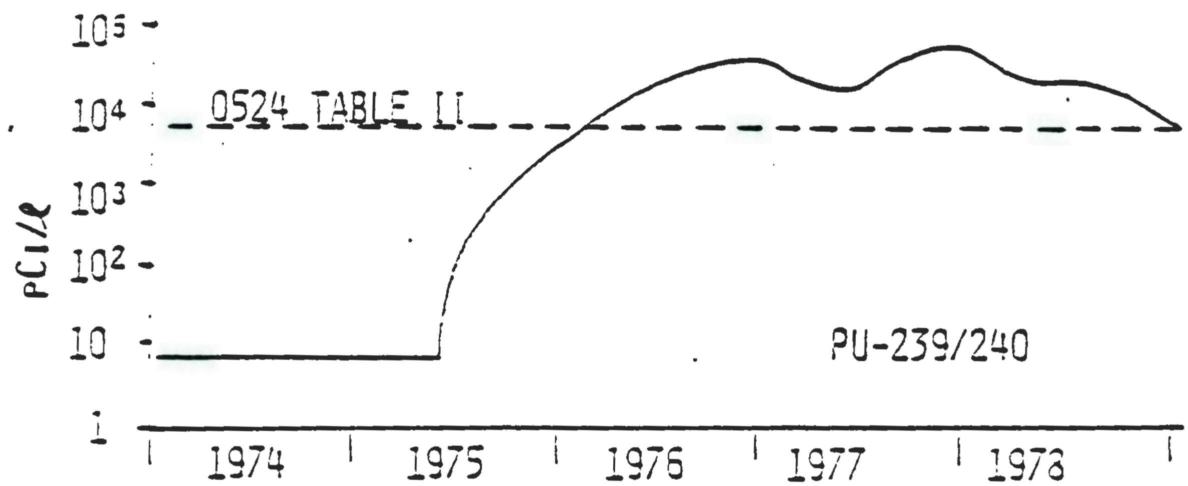


FIGURE 3

KE BASIN CONCENTRATIONS



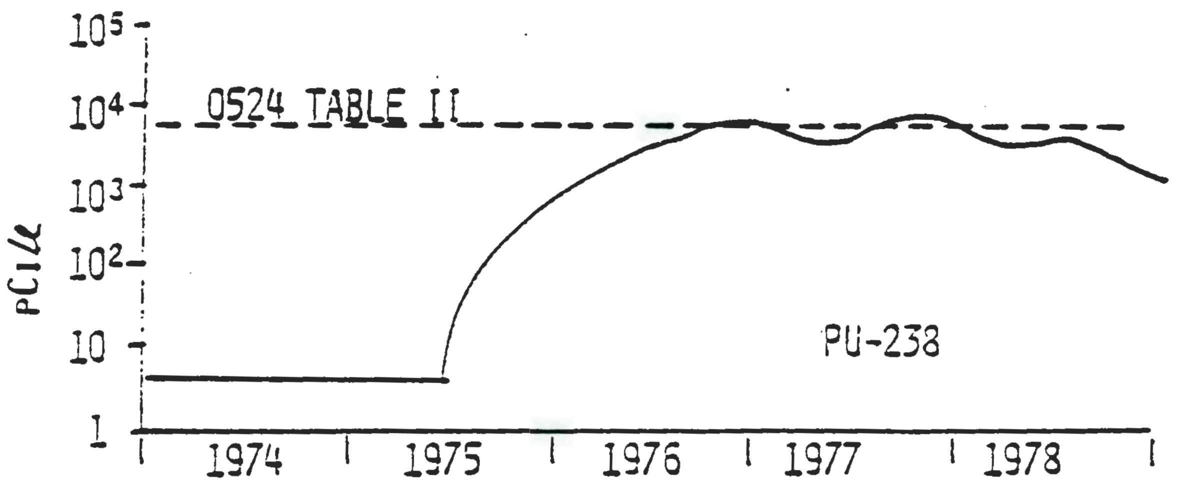


FIGURE 4

KE BASIN CONCENTRATIONS

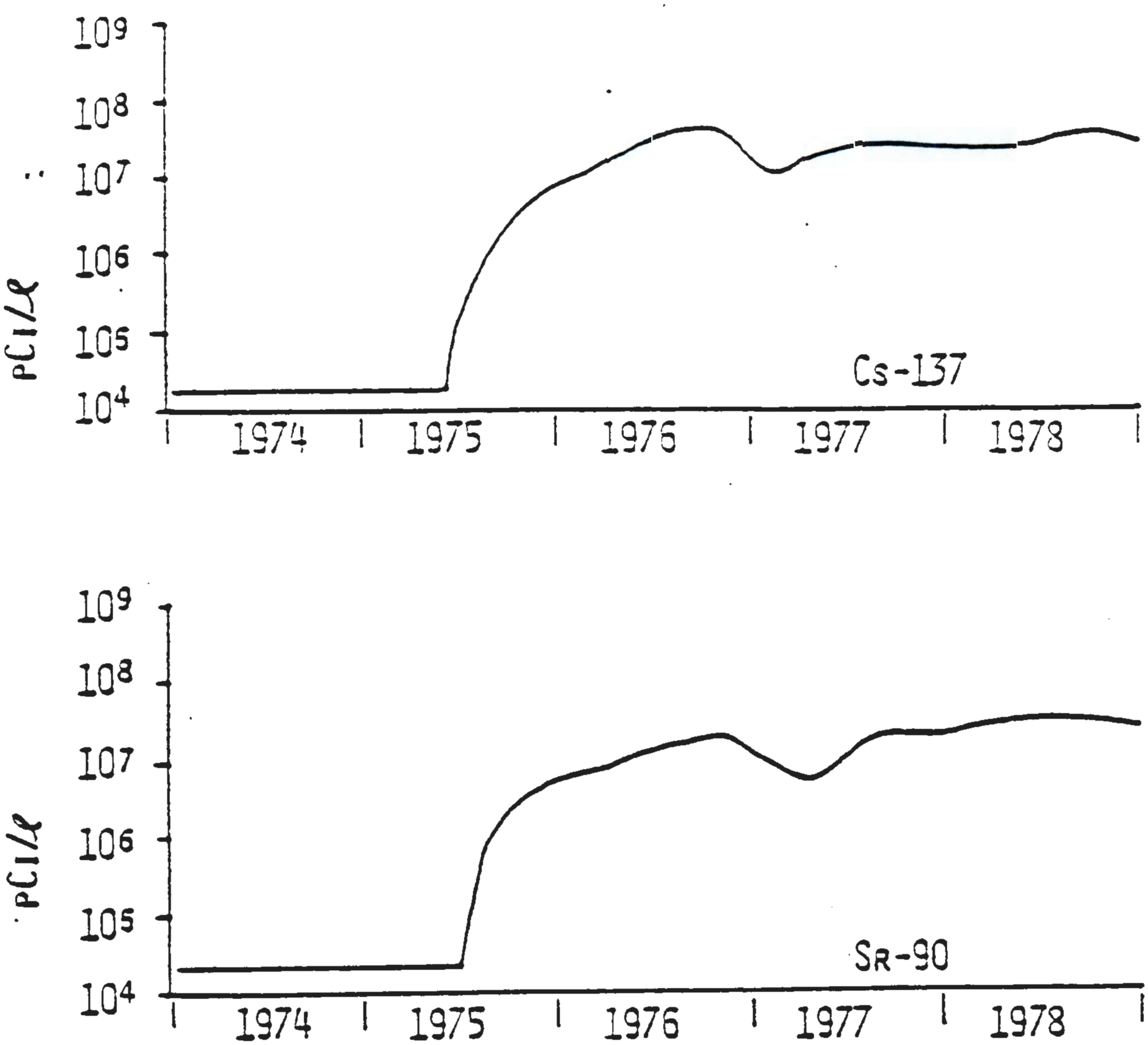


FIGURE 5

K-TRENCH Pu 239/240 CONTOURS(PCi/gm)

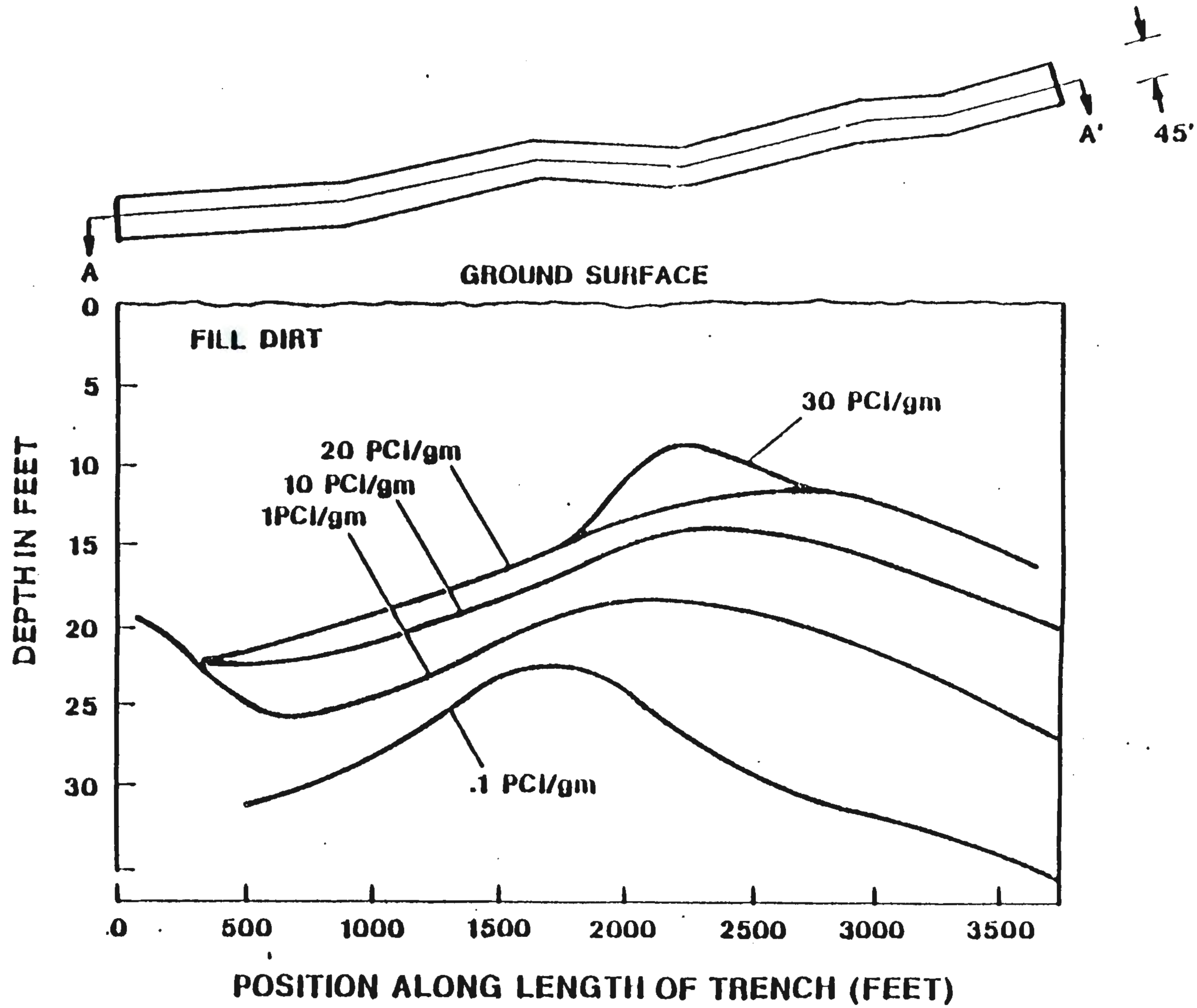
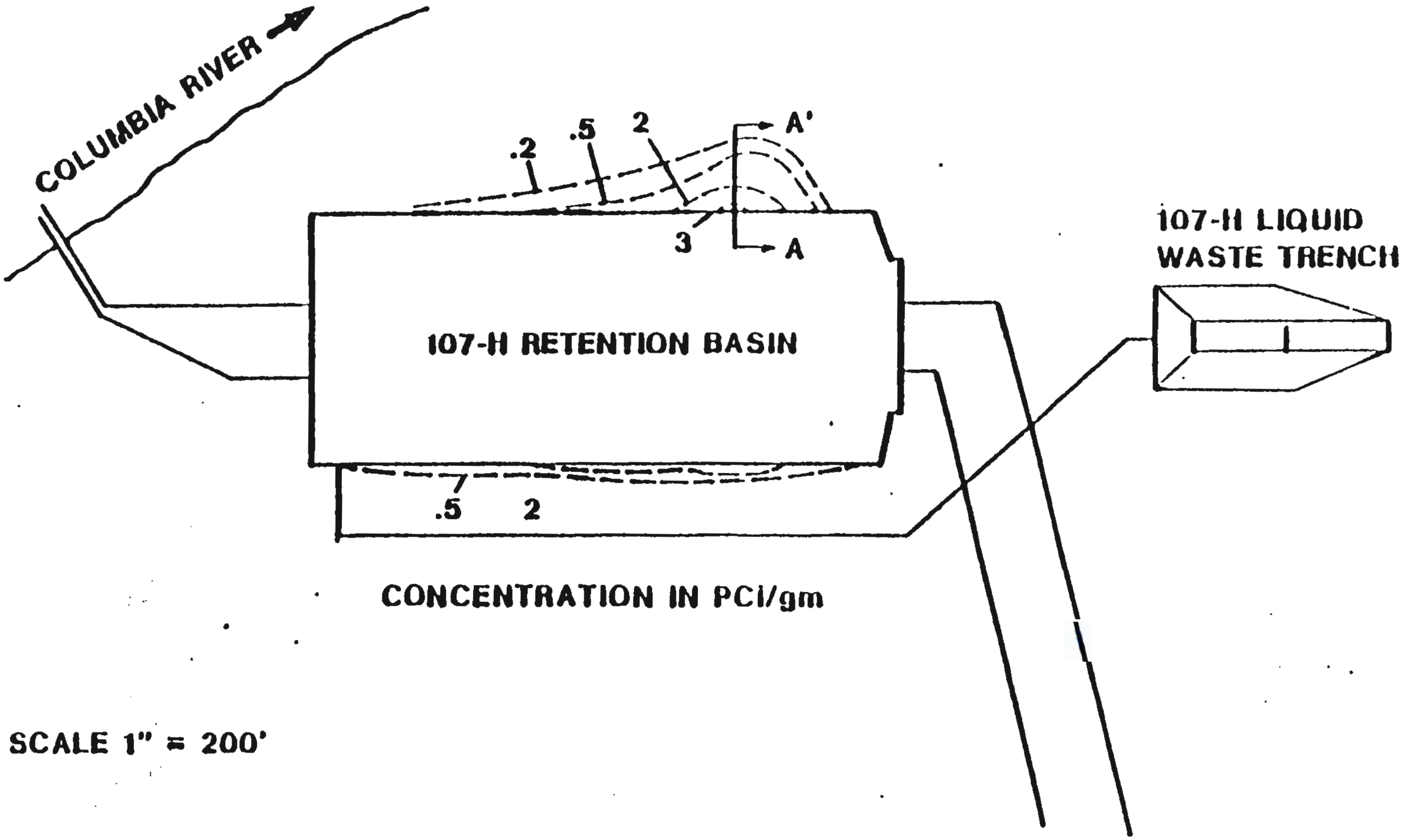


FIGURE 6

Pu239/240 CONTOURS(PCi/gm)
107-H RETENTION BASINS LEAKAGE



CONCENTRATION IN PCi/gm

SCALE 1" = 200'