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ENVIRONMENTAL EVALUATION HANFORD
GROUT LYSIMETER FACILITY

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June 1984

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DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
ENVIRONMENTAL EVALUATION

PROJECT NUMBER B-475
HANFORD GROUT LYSIMETER FACILITY

JUNE, 1984

BATTELLE
PACIFIC NORTHWEST LABORATORY
RICHLAND, WASHINGTON

ENVIRONMENTAL EVALUATION
HANFORD GROUT LYSIMETER FACILITY
PROJECT#: B-475

PACIFIC NORTHWEST LABORATORY
OPERATED BY
BATTELLE MEMORIAL INSTITUTE
FOR

U.S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
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ENVIRONMENTAL EVALUATION HANFORD GROUT LYSIMETER FACILITY (HGLF)

A. SUMMARY

The Hanford Grout Lysimeter Facility (HGLF) will be constructed to test the leaching and migration of radioactive and nonradioactive tracers embedded in a solidification agent (grout) under actual burial conditions in Hanford soil. Three different water treatment rates will be used: natural precipitation, 4 times and 8 times natural precipitation.

Six lysimeters will be assembled. Each unit will measure 6 feet in diameter, 25 feet deep. Their construction and instrumentation will be performed during June-July, 1984 by J. A. Jones Construction Company and/or their subcontractor. The routine monitoring will be performed by Battelle staff over a 5.5 year period beginning in November 1984. The total estimated project cost will be approximately \$200,000.

The only anticipated environmental impact from this project will be a temporary nuisance-type local dust problem during the construction phase. This will not be a detriment to the environment. The results of dose calculations indicate that dose rates from the grouted waste cans will be quite low when the cans are covered by a meter or more of earth. Dose rates at or near the surface of the individual cans are not high enough to preclude their handling. The facility area will be fenced, posted as a radiation zone and operated under a radiation work procedure.

B. DESCRIPTION OF THE PROPOSED ACTION

The proposed action is to have the J. A. Jones Construction Company and/or their subcontractor excavate large diameter boreholes on the Hanford Reservation for the purpose of constructing lysimeters for the Hanford Grout Lysimeter Facility (HGLF). The study at this facility involves the continuous monitoring of the leaching and migration of both radioactive and nonradioactive tracers after their solidification in a grout and their placement in the lysimeters. The location of this excavation/construction is in the NW 1/4 of Section 28, Township 11N, Range 28E. Figure 1 shows the location of the HGLF area.

The proposed facility will consist of six lysimeters, each being a large diameter borehole lined in a vertical fashion with a watertight, sealed steel liner (caisson) of welded steel pipe with a welded steel bottom or other suitable material. The lysimeters will be 6 feet in diameter, 25 feet deep and arranged in three sets of two. The layout of the project is shown in Figure 2. A detailed drawing of one of the lysimeters is shown in Figure 3. Small drum-like blocks composed of a solidification agent (grout) and quantities of either radioactive or nonradioactive tracers will be placed in each lysimeter.

The waste forms used in this study will consist of the sulfate-type Hanford facility waste. The preliminary solidification agent (grout) to be used is a mixture of: cement (40%), fly ash (40%) and clay (20%). The radioactive composition and quantity of the hot-waste form blocks are listed in Table 1 and Table 2. The cold-waste form blocks will contain similar quantities of nonradioactive tracers. Three lysimeters will contain three hot-waste form

blocks each while the remaining lysimeters will contain three cold-waste form blocks each. Each block is about the size of a 2 gallon paint can.

Instrumentation will be installed inside each lysimeter as the caissons are filled with specially selected and compacted soils and the waste-forms. Instrumentation includes thermocouples, heat dissipating fiberglass blocks, suction candles, access tubes, scintillation and pumping devices. Additionally, an irrigation system will be used for four of the six lysimeters. This system, which will use ground water from a nearby well, is already set up from a current lysimeter facility in the immediate vicinity.

J. A. Jones Construction Company and/or their subcontractor will drill the six boreholes to a sufficient size to accommodate the 6 foot diameter, 25 foot deep caissons of welded steel pipe with a welded steel bottom or other suitable material. They will install the caissons. If temporary casings are used during the drilling process, these will be removed when the caissons are installed.

The caissons will be installed such that no part of them will protrude above ground level. J. A. Jones Construction Company and/or their subcontractor will cover the caissons with 1/2-inch plywood caps during the construction phase for safety reasons, and grade the immediate areas to blend with the surrounding terrain grade so as to provide reasonable access to the caissons and so that no severe puddling or subsidence will occur around the covered caissons. In addition, they will collect duplicate 1 quart soil samples, during the drilling process, at 5 foot depth intervals and/or where sediment changes occur.

After the six boreholes are drilled and the caissons are emplaced, J. A. Jones Construction Company and/or their subcontractor will complete the construction of the lysimeters. They will backfill the caissons with specially selected Hanford soil, install all instrumentation and waste-forms and connect the irrigation systems to the appropriate lysimeters.

Operations will consist of monitoring, by Battelle staff, the leaching and migration of radioactive and nonradioactive tracers in the lysimeters. Monitoring will be performed on a routine basis. As shown in Figure 2, the lysimeters will be arranged in three sets of two. Each set will contain one hot waste-form and one cold waste-form setup. Each set will also have a different water treatment (irrigation) rate. Set 1 will have no irrigation, thus a natural precipitation rate; set 2 will have irrigation at four times the natural precipitation rate; set 3 will be at eight times the natural precipitation rate.

Construction is planned for June-July, 1984 and operation will span the period of November, 1984 through at least November, 1989.

The cost of the proposed action will be a total of approximately \$200,000 over a 5.5 year period.

C. PURPOSE OF PROPOSED ACTION

The purpose of this HGLF is to test the leaching and migration rates of radioactive and nonradioactive tracers embedded in a solidification agent (grout) under actual burial conditions in Hanford soil. Radioactive and nonradioactive waste-forms will be encapsulated in grouts using identical

formulations, mixing equipment and procedures. After curing, both radioactive and nonradioactive grout waste-forms will be tested under identical conditions. The two data-sets, one for radioactive and one for nonradioactive waste-forms, will be compared and any differences explained. This study will provide information for future burial operations.

D. ANTICIPATED ENVIRONMENTAL IMPACTS

The attached checklist, Exhibit 1, has been examined for any anticipated impacts that potentially could result from the proposed action. The items marked "yes" on the checklist are further described below:

No. 1 (a):

The only potential impact expected from this project will be a temporary dust problem during the construction stage and from lysimeter removal, if removal is necessary. This will be more of a nuisance-type problem rather than a detriment to the environment.

Other potential impacts will be mitigated through optimum use of design engineering, as exemplified below. No other environmental impacts are expected to result from this study. Exhibit 2 details the calculated dose rates from the radioactive waste-forms at the HGLF. The results of these calculations show that the dose rates from the grouted waste cans will be quite low when the cans are covered by a meter or more of earth. Dose rates at or near the surface of the individual cans are not high enough to preclude their handling.

Mitigating Measures

The following mitigating measures will be performed during construction, operation or site restoration of this project:

- o Vegetation will be kept from growing on the facility area to prevent any radionuclide uptake.
- o No radionuclides are expected to migrate from the buried waste to surface soils; however, the site will be closely monitored to detect any migration.
- o The facility area will be designated a radiation zone and operated under a radiation work procedure.
- o All contaminated soil/backfill will be removed and disposed of as radioactive waste according to proper procedures.
- o Contaminated lysimeters/caissons will either be decontaminated or removed and buried in the 200 Area burial ground according to proper procedures.
- o Once the study at the HGLF is completed, the original excavated soil will be backfilled into the caissons or into the boreholes if the caissons are dismantled.

E. CONCLUSIONS

It is concluded that the only environmental impact resulting from the

proposed HGLF is the generation of slight dust during facility construction. This will be more of a nuisance-type problem rather than a detriment to the environment. Calculations show that the dose rates from the grouted waste cans will be quite low when the cans are covered by a meter or more of earth. Dose rates at or near the surface of the individual cans are not sufficiently high enough to preclude their handling.

It is concluded that this EE presents an adequate description of the proposed action and the resulting environmental impacts. It is also concluded that no further environmental documentation is required.

TABLE 1. Waste Form Composition

	<u>Gi/l</u>
CO - 60	33.0
CO - 58	2.50
Fe - 59	5.00
Cr - 51	3.90
Mn - 54	2.80
Ru - 103	0.60
Pu	0.14

Note: Maximum composition will not exceed 10 times these concentrations.

TABLE 2. Optional Waste Form Composition

	<u>Gi/l</u>
CO - 60	33.0
CO - 58	2.50
Fe - 59	5.00
Cr - 51	3.90
Mn - 54	2.80
Ru - 103	0.60
Pu	0.14
Cs - 137	33.0
Sr - 90	33.0

Note: Maximum composition will not exceed 10 times these concentrations.

Figure 1. Location Map of Hanford Grout Lysimeter Facility (HGLF)

Figure 2. Hanford Grout Lysimeter Facility (HGLF) Layout and Cut-away Views

Scale: 1" = 1.5 meters

Figure 3. Enlarged Cut-away View of "Composite" Lysimeter

ENVIRONMENTAL EVALUATION CHECKLISTENVIRONMENTAL IMPACTS

(Explanations of all "yes" answers are required)

	<u>CONSTRUCTION</u>		<u>OPERATION</u>	
	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>
(1) <u>Air</u> . Will the Project:				
(a) Violate State/County Emissions Standards? (Particulates, Opacity, Dust, etc.)	Slight Dust <u>X</u>	<u> </u>	<u> </u>	<u>X</u>
(b) Violate Ambient Air Quality Standards? (CO, Hydrocarbons, Particulates, etc.)	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(c) Release Hazardous Air Pollutants? (Asbestos, Beryllium, Mercury, etc.)	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(d) Release Airborne Radioactivity?	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(e) Cause any other atmospheric disturbance?	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(f) Require PSD or other permits?	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(2) <u>Water</u> . Will the Project?				
(a) Violate State Water Quality Standards? (COD, BOD, TOC, DO, TDS, pH, temperature, etc.)	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(b) Require NPDES ⁽¹⁾ or Corps of Engineers Permits?	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(c) Require shoreline modifications (Hydraulic Modification Permit ⁽²⁾)?	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(d) Increase volume of sewage or process waste for disposal?	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(e) Effect ground water?	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(f) Effect any source of drinking water?	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(g) Discharge radioactive waste water?	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(h) Discharge hazardous water pollutants?	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>
(i) Require an Oil or Chemical Spill Control and Prevention Plan?	<u> </u>	<u>X</u>	<u> </u>	<u>X</u>

(1) NPDES--National Pollution Discharge Elimination System.

(2) Obtained by RL as a matter of comity.

CONSTRUCTION		OPERATION	
Yes	No	Yes	No

(3) Land Use. Will the Project:

(a) Conflict with existing zoning or land use plans?	___	<u>X</u>	___	<u>X</u>
(b) Be located on wetlands or the 100 year or 500 year floodplain?	___	<u>X</u>	___	<u>X</u>
(c) Contribute to volumes of solid waste for disposal				
i. Nonradioactive?	___	<u>X</u>	___	<u>X</u>
ii. Hazardous?	___	<u>X</u>	___	<u>X</u>
iii. Radioactive?	___	<u>X</u>	___	<u>X</u>
(d) Require licensing as a hazardous waste storage, treatment or disposal site?	___	<u>X</u>	___	<u>X</u>
(e) Cause erosion?	___	<u>X</u>	___	<u>X</u>
(f) Be located on ALE ⁽³⁾ ?	___	<u>X</u>	___	<u>X</u>
(g) Conflict with NERP ⁽⁴⁾ activities?	___	<u>X</u>	___	<u>X</u>
(h) Require installation of wells?	___	<u>X</u>	___	<u>X</u>

(4) General. Will the Project:

(a) Increase noise levels?	___	<u>X</u>	___	<u>X</u>
(b) Impact archaeological or historic sites?	___	<u>X</u>	___	<u>X</u>
(c) Require use of carcinogens, pesticides or toxic substances?	___	<u>X</u>	___	<u>X</u>
(d) Impact wildlife or habitat?	___	<u>X</u>	___	<u>X</u>
(e) Effect endangered species or critical habitat?	___	<u>X</u>	___	<u>X</u>
(f) Require long-term commitment of nonrenewable resources?	___	<u>X</u>	___	<u>X</u>
(g) Require new utilities or modifications to existing utilities?	___	<u>X</u>	___	<u>X</u>
(h) Increase offsite radiation dose?	___	<u>X</u>	___	<u>X</u>
(i) Impair recreation?	___	<u>X</u>	___	<u>X</u>
(j) Require modifications to the site-wide Environmental Surveillance Program?	___	<u>X</u>	___	<u>X</u>

(3) ALE--Arid Lands Ecology Reserve; contact Dr. L. E. Rogers, PNL.

(4) NERP--National Environmental Research Park, contact Dr. W. H. Rickard, PNL.

Battelle

Pacific Northwest Laboratories

Project Number _____

Internal Distribution

Date: May 17, 1984

To: George Last

From: Kathryn A. Hawley *Kathy*

G. A. Bruno

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File/L3

Subject: Calculated Dose Rates for Hanford
Grout Lysimeter Study

Radiation dose rates have been calculated for the waste-filled canisters proposed for this special study. Calculations were performed for two compositions of waste, two concentrations, and seven shielding configurations. The attached report describes the calculations performed, the models and other assumptions used, and presents the results of the calculations.

KAH:ncv

Attachment

HANFORD GROUT LYSIMETER STUDY

CALCULATED DOSE RATES

For the calculations, it was assumed that the solidified waste would be packaged in paint-can sized containers; each can holding approximately two gallons of material. In all calculations the can was treated as a right cylinder with a diameter of 20.06 cm (7.9 inches) and a length of 24.1 cm (9.5 inches). The can was presumed to be constructed of steel with a 0.15-cm (0.063 inch) wall thickness. The solidification agents used to contain the waste were estimated to have a density of 2.4 gm/cm³; the soil used to cover the cans was estimated to have a density of 1.8 gm/cm³.

For all dose rate calculations, the computer code ISOSHLD (Engle 1966) was used. This code uses point-kernel methodology to calculate dose rates from selected exposure geometries considering different shielding materials. ISOSHLD considers only photons as contributing to the dose rate, but does include bremsstrahlung gammas generated by betas interacting with the waste and shielding material. The exposure geometry used as a basis for calculating dose rates from the grouted waste is shown in Figure 1.

Figure 1. Exposure Geometry for the Grouted Waste Cans

The radionuclide concentration and total content of the cans for each waste type are shown in Table 1. Dose rates for cans with radionuclide inventories up to ten times the amount in Table 1 were also figured.

Table 1. Radionuclide Contents of Grouted Waste Cans

<u>Nuclide</u>	<u>Waste Form 1 Composition (uCi/L)</u>	<u>Can Contents (Ci)</u>	<u>Optional Waste Form 2 Composi- tion (uCi/L)</u>	<u>Can Contents (Ci)</u>
^{60}Co	33.0	2.5E-04	33.0	2.5E-04
^{58}Co	2.50	1.9E-05	2.50	1.9E-05
^{59}Fe	5.00	3.8E-05	5.00	3.8E-05
^{51}Cr	3.90	2.9E-05	3.90	2.9E-05
^{54}Mn	2.80	2.1E-05	2.80	2.1E-05
^{103}Ru	0.60	4.5E-06	0.60	4.5E-06
^{239}Pu (a)	0.14	1.1E-06	0.14	1.1E-06
^{137}Cs (b)	-	-	33.0	2.5E-04
^{90}Sr	-	-	33.0	2.5E-04

(a) Reported as plutonium in data base.

** (b) Reported as cesium-139 in data base.

Dose Rates from Unshielded Waste Cans

For each waste type, calculations were performed to determine dose rates from the unshielded cans. Calculations were performed for two configurations: the surface of the can and 0.15 meters from the surface. Table 2 lists the dose rates for these configurations.

Table 2. Dose Rates from Unshielded Waste Cans (mR/hr)

<u>Point of Exposure</u>	<u>Waste Form 1</u>	<u>10 x Concentration Waste Form 1</u>	<u>Waste Form 2</u>	<u>10 x Concentration Waste Form 2</u>
Surface	24	240	29	290
15 cm from Surface	3.3	33	3.9	39

** Note: Data base (Table 2 of text) had a typographical error which has been corrected. The correct nuclide designation is ^{137}Cs .

Dose Rates from Shielded Waste Cans

Each lysimeter will contain three waste cans arranged in the geometry shown in Figure 2. Dose rates were calculated at one meter above the ground surface for a single waste can buried under 0.5, 1, 2, 3, 4, or 5 meters of soil. The total dose rate at one meter above the lysimeter is approximately three times the value calculated for the single waste can. The dose rates are listed in Tables 3 and 4.

Lysimeter (6' diameter)

Top View

Side View

Figure 2. Waste Can Geometry

Table 3. Dose Rates One Meter Above Ground From Grouted Waste Form 1 (mR/hr)

<u>Shielding</u>	<u>Waste Form 1 (Single Can)</u>	<u>10 x Waste Form 1 (Single Can)</u>	<u>Waste Form 1 (Three Cans)</u>	<u>10 x Waste Form 1 (Three Cans)</u>
0.5 m soil	1.5×10^{-3}	1.5×10^{-2}	4.5×10^{-3}	4.5×10^{-2}
1 m soil	7.5×10^{-6}	7.5×10^{-5}	2.3×10^{-5}	2.3×10^{-4}
2 m soil	1.9×10^{-10}	1.9×10^{-9}	5.7×10^{-10}	5.7×10^{-9}
3 m soil	5.4×10^{-15}	5.4×10^{-14}	1.6×10^{-14}	1.6×10^{-13}
4 m soil	1.8×10^{-19}	1.8×10^{-18}	5.4×10^{-19}	5.4×10^{-18}
5 m soil	7.3×10^{-24}	7.3×10^{-23}	2.2×10^{-23}	2.2×10^{-22}

ATTACHMENT 2

DOCUMENTATION OF HANFORD GROUT LYSIMETER STUDY DOSE CALCULATION

Facility Name:	Hanford Grout Lysimeter Study
Releases:	None
Meteorological Conditions:	NA
Dispersion Model:	NA
X/Q:	NA
Release Height:	NA
Population Distribution:	NA
Computer Code:	ISOSHL D
Files Addressed:	File 9 (ISOSHL D Photon Production Library, ISOSHL D Beta End Point Library, and Photon Attenuation Library for 20 shield materials)