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PACIFIC NORTHWEST LABORATORY
MONTHLY ACTIVITIES REPORT
FEBRUARY 1974

Division of Production and Materials
Management and Hanford Plant
Assistance Programs

Battelle

Pacific Northwest Laboratories
Richland, Washington 99352

March 1974

Prepared for the U.S. Atomic Energy
Commission under Contract AT(45-1):1830

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PRELIMINARY REPORT

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PACIFIC NORTHWEST LABORATORY
MONTHLY ACTIVITIES REPORT

FEBRUARY 1974

Division of Production and Materials Management
and
Hanford Plant Assistance
Programs

by the

Staff of Battelle-Northwest
E. L. Alpen, Director

March 1974

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Division of Production and Materials Management
and
Hanford Plant Assistance
Program

by the

Staff of Battelle-Northwest
E. L. Rypke, Director

March 1974

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PACIFIC NORTHWEST LABORATORY
MONTHLY ACTIVITIES REPORT
DIVISION OF PRODUCTION AND MATERIALS MANAGEMENT
AND HANFORD PLANT ASSISTANCE PROGRAMS

ASSISTANCE TO ATLANTIC RICHFIELD HANFORD COMPANY

Summary

PROCESS TECHNOLOGY, ENGINEERING DEVELOPMENT DEPARTMENT

Storage of High-Level Liquid Radioactive Waste

Injection grouting with an asphalt emulsion - sand - Portland cement mixture shows promise for sealing soil-monitoring well casing interfaces to prevent waste solutions from flowing downward along the casing surface.

Design details, firm purchase prices and delivery dates were obtained for two types of corrosion probes. Installation of both types of probes in four underground waste tanks is scheduled to be complete July 1, 1974.

Studies on the use of cathodic protection for extending the life of underground waste tank liners were continued. Conductivity measurements were made on simulated waste as a function of water content. Polarization measurements were made on cathodically polarized mild steel specimens.

Concentration cells are being investigated as a possible source of preferential attack of mild steel in alkaline wastes.

The detailed fault trees for the tank farm systems are being integrated into a fault tree which contains all modes of transport mechanisms for radioactive releases to assure consistent treatment of these problems in a range of programs.

A program plan for the Tank Leak Model task was completed in February. A simple near-field soil model has been set up for the PNL partially saturated hydrology computer model.

Acoustic properties of simulated stored waste are being determined for use in studies of ultrasonic logging of waste tank contents.

Further tests with a commercially available RF frequency modulation system for in-tank measurement of liquid level continue to indicate the system will function adequately.

A computer-based model of the 242-T Evaporator system was set up and runs were made simulating leak rates from 0 to 40,000 gals/day. The model permits estimating the time before a leak of a given rate would be detected based on material balance.

A field test is planned of a concept for improved waste tank leak detection based on changes in the electrical resistivity of soil due to tank leakage.

A visit to the Savannah River Plant was made to study their systems, components, procedures and problems associated with storage and handling of radioactive liquid waste.

PROCESS TECHNOLOGY - RESEARCH DEPARTMENT

Plutonium Trench Soil Characteristics

The plutonium content of soil samples from near the 216-Z-9 crib which had been contacted with a high salt-Pu polymer solution was too low for a Pu distribution study. Three more plutonium particles from the sludge overlying Core 4-11 taken from the 216-Z-9 trench were identified by x-ray diffraction as PuO_2 .

Prevention of Accidental Release

• Surficial Contamination and Airborne Release Studies

The Sr-90:Cs-137 ratio measured in 19 specimens collected from the surface of the B-C Control Zone 1 ranged from 0.9 to 9.1 with no apparent trend by material or plot.

The fraction of soil made airborne when dropped into flowing air was almost directly related to air velocity and ranged from 2.2 percent of the soil at 3.2 mph to 12 percent at 20 mph.

Airborne radioactivity at B-C Area included Sr-90 and Zr-Nb-95 as well as Cs-137. Aircraft air sampling during a non-dusty day indicates that air concentrations at elevations to 1,000 feet can be measured by this technique during dusty periods.

Computed wind trajectories for a source aerosol released from the B-C Crib site resulted in about 10 percent more transport to the Tri-Cities

than a release from the 200-West Area. Wind conditions for both releases were those collected for an 18-day period.

Two more tests involving a tracer gas and a constant volume balloon demonstrated the value of the balloon in keeping the sampling aircraft in the plume.

Instrumentation development for environmental surveillance involved testing a system for nondestructive alpha analysis of particulate filters and acquisition of a flowmetering system for use in tank leak studies.

- Groundwater Management Studies

A new transmissivity distribution for the project groundwater system was calculated during the month. The new aquifer parameters were combined and used in a steady-state simulation of a proposed irrigation project.

A three-year simulation from the measured 1968 water table to 1971 was started as verification of the new aquifer parameters.

A set of travel times from project waste disposal facilities were calculated and are now being analyzed.

Temperature logging of the project wells has been completed and a map is now being drawn.

Work was initiated in January, and continued in February, to find a method for reducing the number of distribution (K_d) measurements required to predict sorption in the PERCOL and transport models.

- Biological Transport Studies

Cesium-137 body burdens in experimental goldfish in the Gable Mountain pond showed no significant changes in late December and early January. Pond weeds collected in November 1973 had lower concentrations of Cs-137, Zr-95 and Co-60 than those collected in May 1973.

ASSISTANCE TO ATLANTIC RICHFIELD HANFORD COMPANY
PROCESS TECHNOLOGY - DEVELOPMENT ENGINEERING DEPARTMENT

Storage of High-Level Liquid Radioactive Waste

Task 1. Systems Study of Waste Storage and Monitoring System
(J. L. McElroy, Process Evaluation Section)

A stress analysis of a typical waste tank was initiated to obtain information about probable crack formations in the reinforced concrete shells.

This study will provide needed input to the tank leak model being developed in Task 5.

Task 2. Waste Characterization
(R. E. Burns, Chemical Technology Department)

Soil-casing interfaces of monitoring wells in the waste tank area are potential paths for waste leaked from the tanks to reach groundwater. A concept for sealing these paths is being studied. It consists of perforating the existing well casing, inserting an inner casing sealed at the bottom and injecting a high alkalinity stable grout into the annulus and out into the soil surrounding the perforated casing.

Screening of asphalt emulsion types is complete. Armak pH 12-13 MR Pond Sealant performed best with respect to flow and pumping characteristics as well as to soil penetration and bonding action.

A fine sand (30 mesh) is added to the emulsion to provide body for void filling and Type I or II Portland cement is added to maintain suspension. Further work is needed to optimize the proportions of these materials for flow-through perforations, filling void spaces and bonding to soil and casing.

In initial laboratory tests with surface soils and a non-typically perforated section of casing, complete ring sealing in the perforated region was obtained but casing coverage was not complete. Further tests with tank farm soil and a typically perforated casing section are planned. Samples of the grout have been submitted to ARHCO personnel for study of the compatibility of the grout with waste solutions.

Inquiries have been made as to the transmission of pressure through soil during a grouting operation. The concern is whether significant pressure could

be exerted on the waste tank walls. No experimental data were found; personnel at El Paso Natural Gas claim the pressure falls off as the square of the distance from the source. An appropriate experiment to define pressure transmission is needed.

Task 3 - Tank Integrity

(R. F. Maness, Corrosion Research and Engineering Section)

A design for a corrosion probe (Corrator) which operates on the linear polarization principle and which can be inserted in underground tanks containing alkaline high-level waste was obtained from the Petrolite Corporation. A firm purchase price of \$275/unit and an estimated delivery time of four to six weeks was quoted. Responsibility for procurement and installation of the probes will be assumed by ARHCO.

A design for a Corrosometer probe satisfactory for use in underground storage tanks was received from Magna Corporation. A firm purchase price of \$260/unit was quoted. Acceptance of orders is subject to their results of prototype evaluation, hopefully to be completed by March 1, 1974. The Corrosometer and Corrator probes will be installed simultaneously.

Studies were continued on cathodic protection to reduce corrosion of mild steel waste tank liners. Resistivity data at 35-50°C were obtained for two waste compositions, one containing 20% and one 5% caustic, as a function of water content. The resistance of salt cake containing less than 1% water was very high, about 10^6 ohm-cm. The resistance of salt cake containing 1% water was about 10,000 ohm-cm for the waste composition containing 20% NaOH and about 40,000 ohm-cm for the waste containing 5% NaOH. At 15% water, the resistance was only 50 ohm-cm.

The degree of polarization of three mild steel specimens cathodically polarized at 2.5, 5.0 and 10 ma/ft² was found to be unchanged after one exposure month. Weight loss measurements on the cathodically polarized mild steel specimens to determine the amount of corrosion protection offered will be made.

Concentration cells which might be established in alkaline high-level waste are being evaluated as a potential cause of localized attack of mild steel. Voltage measurements on mild steel coupons immersed in air-free and in air-sparged 6 M NaOH solution at 90°C indicated an ennobling effect of the 100 mv as a result of the air sparge. Polarization characteristics and corrosion

evaluation by weight loss of coupled specimens are planned. Cells produced by immersing mild steel electrodes in concentrated vs dilute NaOH and NaOH-NaNO₃ vs NaOH (all at 90°C) were found to be of little or no consequence. Attempts to produce preferential attack of mild steel at the liquid-vapor interface in air-sparged simulated alkaline high-level waste solution were not successful. General corrosion and pitting attack in the vapor phase was accelerated as a result of the air sparge, whereas attack in the liquid phase was inhibited.

Four steel plates containing stress corrosion cracks are being radiographed in preparation for further evaluation of other nondestructive means for characterizing the condition. Both conventional ultrasonic and electromagnetic acoustic techniques will be evaluated when radiography is complete.

Task 4 - Failure Mode Analysis

(R. I. Smith and P. A. Crosetti, Safety Analysis Section)

The detailed fault trees prepared for the tank farm systems are being integrated into a fault tree which contains all modes of transportation mechanisms for radioactive releases. This integration will assure consistent treatment of these problems within a range of programs, including the Hanford Waste Management Environmental Impact Statement.

A detailed fault tree is being constructed for the existing Liquid Level Monitoring System to examine that system for potential sources of trouble and to pinpoint possible areas of improvement.

Task 5 - Tank Leak Model

(B. C. Fryer, Fluid and Energy Systems Section)

The objective of this task is to develop a tank leak model that can be used to estimate tank leak rates. A work plan for the task was completed in February. It was expanded in scope to include some effort toward obtaining soil/fluid property data needed to model the fluid mechanics of the near-field soil.

Definition and cataloging of parameters relevant to the waste tank leak model was continued during February. These parameters include tank geometries, probable liquid depths, liquid types, etc.

A simple first case, near-field soil hydrology model has been set up for computer analysis. In the absence of better soil/fluid physical data, this first case will use waste tank near-field soil data as related to water.

Task 6 - Leak Detection

- Liquid Level Measurement
(G. L. Posakony, Nondestructive Testing Section
and O. H. Koski, Chemical Development Section)

Technical audit of the existing waste tank liquid level measurement system is continuing with emphasis on the new counters and failsafe electronic boards.

In ultrasonic logging studies, samples of simulated waste were obtained and are being evaluated for acoustic properties. A bread board system for further feasibility studies is planned.

Prior work established the sensitivity of a RF frequency modulating liquid level system manufactured by Automation Systems, Inc. to be within the range of milli inches of liquid level, a sensitivity which warrants further evaluation as an in-tank liquid level measuring device. Current work is on development of a workable electrical analog model for the probe and tank configuration.

Experiments conducted using a 6-inch glass tank with an external ground plane, a 6-inch stainless steel tank and a 1-1/2 inch tank (pipe), as well as a study of temperature effects and liquid conductivity suggested that the workable system analog may be a capacitance for the wetted air of the probe or antenna and a capacitance shunted resistance for the liquid phase.

A test of a probe configuration which greatly increased the capacitive impedance resulted in a lower temperature coefficient, better linearity, and greater insensitivity to liquid conductivity but at the expense of sensitivity. Sensitivity was, however, approximately 2000 frequency unit/inch, which is several magnitudes better than required for an acceptable system. The temperature coefficient translated to liquid level is 0.018 inches/°F for a sensitivity of 2000 frequency units/inch.

- Material Balance
(D. P. Grandquist, Safeguards Systems Section)

A computer-based model of the 242-T Evaporator System was programmed and run during the past period. The runs simulated leaks of D, 750, 1500, 3000, 4500, 7500, 15,000, 20,000, 30,000, and 40,000 gallons per day. Five hundred individual cases were calculated for each leak rate.

The output of the code is the number of "days" which the evaporator can run before exceeding a set of operating limits for MUF (material unaccounted for). For example, at a leak rate of 4,500 gal/day and with a 2σ limit for a daily MUF of $\pm 15,000$ gallons and with a 2σ limit of 1,000 gal/day for the 15 day average MUF, the following results were obtained:

<u>No. of Cases</u>	<u>% of Cases</u>	<u>Days to Shutdown</u>
25	5.0	1
106	21.2	2
164	32.8	3
133	26.6	4
54	10.8	5
16	3.2	6
<u>2</u>	<u>0.4</u>	7
Total: 500	100	

Thus based only on the computer print-out for this case, a statement could be made that leaks of up to (6) (4,500) = 27,000 gallons can be detected by material balance in 99.6% of the cases.

The maximum leak calculated varies with the assumed leak rate. While a large number of assumptions were required to formulate the model, it probably represents about the best that can be done with available data.

• External Measurements
(M. R. Krieter, Process Evaluation Section)

A concept for improved waste tank leak detection based on changes in soil electrical transmissivity characteristics with leakage is being investigated to establish leakage resolution limits. The concept was reviewed in a meeting with personnel from the Boeing Company Special Instrumentation Group. The following conclusions were reached.

- (a) The system basis is a transmitter electrode (waste tank) surrounded by sensor electrodes (wells). Power requirements are estimated to be 2 amperes at 2 volts 1000 Hz.
- (b) It may be possible to use existing wells if the irregular geometry can be mathematically compensated.

- (c) Interference from adjacent tanks must be recognized but is not intolerable.
- (d) Waste tank corrosion of negligible amount is expected.
- (e) Cathodic protection systems of existing tanks would require a DC filter system to prevent interference.
- (f) Electrode contact with soil is not expected to be a problem.
- (g) Interference from interconnected tanks complicates leak detection capability on individual tanks.

A forthcoming field test will be designed to study leak detection resolution, effect of precipitation, effect of irregular geometrical location of sensor electrodes and effect of leak rate.

In a meeting of ARHCO and PNL personnel, eleven different characteristics of the region around underground waste tanks were identified as candidates for measurement to detect tank leakage. Some of these are currently under study. The remainder have been assigned to PNL personnel for feasibility evaluation.

Task 7 - Emergency Procedures

(W. S. Kelly and J. D. Smith, Fluid and Energy Systems Section)

The work in this task is an evaluation of emergency procedures associated with ARHCO's underground storage and handling of high and intermediate level radioactive liquid waste in the 200 Areas. Review of procedures and documents pertinent to the study was continued. A visit was made to the Savannah River Plant to compare systems, components, procedures and problems associated with the storage and handling of radioactive liquid waste. Several Savannah River documents were identified as necessary input to this study and these documents will be procured.

PROCESS TECHNOLOGY - RESEARCH DEPARTMENTPlutonium Trench Soil CharacteristicsPlutonium Trench Soil Chemistry and Mineralogy

(J. L. Swanson, Chemical Development Section and
L. L. Ames, Water and Waste Management Section)

The plutonium content of two of the soil samples from near the 216-Z-9 trench which were treated with high salt-Pu polymer solutions was too low to permit a study of Pu distribution on the soil particles. These samples (P22-1 and P44-2) required exposure times of more than 60 hours to obtain a usable autoradiograph and the results were difficult to interpret because of bubbles in the impregnating plastic. It appears that about 0.1 mg Pu/g soil, (instead of 0.01 g Pu/g soil as used in these samples) is required for practical results.

The third sample (P51-C) reacted vigorously with the impregnating plastic and usable mounts could not be prepared. The difference between this sample and the above two is that the latter had an acid rinse and the former did not.

Three more plutonium particles from the sludge layer overlying core 4-11 taken from the 216-Z-9 trench were identified by an x-ray diffraction. All three particles were PuO_2 . One of the particles, analyzed by the microprobe, was greater than 96 wt/% PuO_2 .

Prevention of Accidental Releases

- Surficial Contamination and Airborne Release Studies

B-C Crib Studies

(J. Mishima and L. C. Schwendiman, Particulate and Gaseous Waste Research Section)

Potential Airborne Release of Surface Contamination During a Range Fire

Six additional experiments were performed to evaluate the fractional airborne release of Cs-137 and Sr-90 from contaminated surface materials during heating. Specimens collected from random surface plots in the 8-C Control Area were heated to 200°C in an upswipe of air. The loss in weight (volatiles) from various materials were:

Animal droppings	37 to 53 percent
Organic debris	26 to 48 percent
Sagebrush	73 to 91 percent

Samples of the residues and airborne material collected have been submitted for analysis.

Strontium-90:Cesium-137 in Contaminated Surface Materials from B-C Control Area

The Sr-90:Cs-137 ratios were determined for 21 specimens of contaminated materials collected from random 1 m² plots in the B-C Control Area. Ratios calculated for 19 specimens (a high and low value are omitted) range from 0.9 to 9.1 with no apparent trend by material or area. The average and median values are 3.3 and 2.4, respectively.

Potential Airborne Release of Surface Contamination During Decontamination Operations

Four experiments were performed in the 242-B Building wind tunnel to evaluate the potential airborne release if soil-moving operations were performed in the B-C Control Area. Soil was dropped continuously into air moving at speeds from 3.2 to 20 mph. The fraction of soil made airborne was 2.2, 6.0, 9.6, and 11.8 percent at air speeds of 3.2, 10.4, 15.2, and 20 mph, respectively.

Characterization of Radioactive Particles in ARHCO Facilities Gaseous Effluents (J. Mishima and L. C. Schwendiman, Particulate and Gaseous Waste Research Section)

Requirements for the routine and alert monitoring systems for the 234-5Z stack and other ARHCO facilities were discussed with ARHCO personnel. Following these discussions, a study outline to review the performance and requirements for all ARHCO radioactive effluents was submitted. Potential methods for the determination of HF and CCl₄ concentrations in the 234-5 Building stack gases have been initiated. An investigation of Kr-85 procedures to measure the adequacy of gas mixing from injections to a sampling point in stack was initiated.

Sampling arrangements and equipment were designed to permit sampling the airstream of the 221-B plant upstream of the pre-filters. The scope of this work includes velocity measurements as well as size and nature of the airborne particles in this exhaust.

Potential Risks During Conversion of Stored High-Level Liquid Waste to Salt Cake
(J. Mishima and L. C. Schwendiman, Particulate and Gaseous Waste Research Section)

Information on current and projected work in the conversion of stored liquid wash to salt cake has been accumulated to prepare a study outline of risks involved.

Resuspension from Contaminated Surfaces -- Field Studies
(G. A. Sehmel, F. D. Lloyd, and L. C. Schwendiman, Particulate and Gaseous Waste Research Section)

Additional radiochemical analyses were made on the filters collected at B-C Area in June and September. Airborne material included Sr-90 and Zr-Nb-95 as well as the originally reported Cs-137. Airborne concentrations will be determined when radiochemical analyses are completed.

As previously reported for Cs-137, resuspended airborne activity has not always shown a significant or a consistent decrease with an increase in sampler height to 20 feet. It appears that Sr-90 airborne concentrations are also often nearly independent of heights to 20 feet. Consequently, some air samples will also be obtained at greater heights using 100-foot towers and an aircraft-mounted sampler.

A 100-foot tower has been erected at the U-Pond area for monitoring particle air samplers. Samplers mounted on the tower will be activated as a function of windspeed incremental from 3 to 8 mph, 8 to 13 mph, and >13 mph when the wind is blowing across the pond into the sampler tower. Equipment installation is continuing.

An aircraft-mounted sampler was used to determine airborne activity at heights of 500, 1000, and 4000 feet. Sampling at each height was from 800 to 840 cfm for one hour. Sampling location was between Hanford Number 2 and H-Area. During sampling the average wind speed was only 8 to 9 mph and the average wind direction was SSW to WSW at the 400 foot level of the meteorological tower. Air concentrations of Cs-137 were low, but indicated a decrease in concentration with an increase in height. For these non-dusty conditions, air concentration at 500 feet was $6 \times 10^{-15} \mu\text{Ci}/\text{cm}^3$; at 1000 feet it was $3 \times 10^{-15} \mu\text{Ci}/\text{cm}^3$; and at 4000 feet it was not detectable. These results suggest that aircraft sampling can be used to determine gross resuspension from the plant during dusty conditions. Aircraft sampling will continue when dusty days occur simultaneously with aircraft availability.

Activity collected on the aircraft filters is low and counting statistics are poor with the instrument used. Nevertheless, some generalizations can be made. The air mass at 4000 feet likely reached the region of sampling without interacting with the project land surfaces since no detectable activity was reported. Further support for this assumption is that this filter was much dirtier than samples taken at lower elevations. The air at 500 feet and 1000 feet elevations probably interacted with contaminated surfaces within the plant area. Detectable Cs-137 concentration of 10^{-15} $\mu\text{Ci}/\text{cm}^3$ on February 13 for samples taken with the aircraft was about equal to or lower than the 10^{-15} to 10^{-13} $\mu\text{Ci}/\text{cm}^3$, determined at U-Area from February 11 to February 14. All concentrations are orders of magnitude lower than MPC_{air} concentrations of 2×10^{-8} $\mu\text{Ci Cs-137}/\text{cm}^3$ for continuous exposure.

Wind Trajectory Studies

(L. L. Wendell and W. F. Sandusky, Atmospheric Physics Section)

The trajectory program was rerun on the April 16 through May 2, 1973 data set with the B-C crib as the point of release. For this release location 17 out of 32 (53%) twelve-hour releases showed significant transport to the Tri Cities. This is about 10 percent increase over the 200-West Area release location. Before attaching too much significance to these figures, one must realize that the data set is limited to an 18-day period. To increase the statistical representativeness of a transport climatology, all available and appropriate wind data which have been collected at the Hanford site is being screened and assimilated in an attempt to establish a data base for a long-term trajectory study.

A meso scale diffusion model has been successfully converted and tested on the local CYBER system. Given source strength, hourly averaged wind fields and stability class mixing depth, the model will compute time integrated concentrations for a continuous point source. The continuous release is approximated by a series of overlapping puffs. A contouring program which outputs on the printer was converted to the CYBER for displaying the concentration fields.

Two more tests were conducted involving the airborne sampling system and constant volume balloons. In the first test the balloon encountered some telephone lines about 10 minutes after release and was apparently damaged enough that it was lost. From that point on the aircraft sampling crew experienced great difficulty in locating the plume. In the second test the balloon was

tracked for three hours over sharply curved trajectory. Strong indications of the trace gas was found in the vicinity of the balloon along the entire trajectory even though the balloon height ranged from 200 to 2000 feet above the ground. The contrasting results of these two tests seems to demonstrate the importance of the balloon in locating the tracer.

Extraction of terrain height on a 55 x 55 mile grid of points was begun during this reporting period for the work in evaluating terrain effects on transport and dispersion of material on and around the Hanford site.

Instrumentation for Environmental Surveillance (O. H. Koski, Chemical Development Section)

A system composed of an alpha detector, photomultiplier tube, power supply, linear amplifier, count rate meter and scaler is being tested prior to delivery to the plant for use in nondestructive analysis of airborne particulate filters. A flow measuring system composed of a 0 to 5 gpm flowmeter, flowmeter converter and recorder was acquired for use in conjunction with simulated waste tank leak studies.

● Groundwater Management Studies

Simulations and Transmissivity Distribution Generation (K. L. Kipp, Water and Land Resources Systems Section)

An iteration on the transmissivity distribution was completed and a transmissivity map and a hydraulic conductivity map of the project was prepared. The hydraulic conductivity map was digitized and transmitted to the UNIVAC 1108 for inclusion in the VTT Model.

Using measured contamination travel times in the groundwater system, the storage coefficient was adjusted in block fashion to produce better correlation with known data. After adjustments were made the ratio of observed to computed travel times vary by a factor of 1.5 to 5.

Using the September 1973 water table map, a series of flow path and travel time calculations were made. A table of travel times from various disposal sites was prepared for the Hanford Environmental Impact Statement.

A steady-state groundwater flow simulation with the latest aquifer parameters was run with the VTT Model. The simulation was done to study the

effects of irrigating two sections of project land adjacent to the 100 Area Fire Station. The projected rise beneath the irrigated area was less than two feet and the one foot contour extended to an area south of the Gable Mountain - Gable Butte gap.

A three-year transient simulation of the groundwater model was begun to serve as a comparative verification for the aquifer parameters. The final data on these runs are not yet available.

As an additional aid in the investigation of the internal consistency of the computed aquifer parameters, a new program has been defined and is being developed. The program will define a box that may be moved about the surface and at any place a line integral calculation around the box will be performed summing the flow entering and leaving the box taking into account the gradients, permeability, aquifer thickness and the nodal spacing. The volumetric difference should compare with the temporal rate of change map in the defined box.

This program will help identify areas where the measured potential surface, measured temporal rate of change, assumed storage coefficient and calculated hydraulic conductivity values are inconsistent. This will aid in identifying areas where the model data needs to be improved.

Field Measurements and Monitoring Assistance
(A. E. Reisenauer, Water and Land Resources Systems Section)

The 28-day gears on the water level recorders have been replaced by 7-day gears and the recorders are now operating.

Temperature logging of the project wells has been completed and a groundwater surface temperature map is now being drawn for the Impact Statement.

Moisture content of the soils in the lysimeter was monitored with the neutron probe on February 5 and 6 and again repeated on February 20 and 21, 1974.

Soil-Waste Reactions
(R. C. Routson, Water and Waste Management Section)

A study was initiated in January, and continued in February, to find a method of reducing the number of sorption (K_d) measurements required to predict sorption of a radionuclide as a function of equilibrium macroion concentrations which are required input sorption parameters to the PERCOL and transport models.

Two-level factorial design experiments are presently used to develop predictive empirical regression equations. At present, 128 Kd measurements are required per radionuclide per soil to predict sorption for the Na, K, Ca, and Mg aqueous system, provided two chemical subranges are adequate. For each further subrange, an additional doubling of the experiment is required. As an alternative, it may be possible to measure sorption in pure Na, K, Ca, and Mg aqueous systems and to calculate sorption in mixed systems. Such a procedure could possibly reduce the required number of measurements to as few as eight.

As a beginning, it was necessary to determine if a functional relationship could be found between sorption and equilibrium solution concentration in pure chemical systems. Last month it was found that plots of the $\ln$ of KdSr versus the $\ln$ of solution Na and Ca concentrations were linear for a tank farm sandy loam soil. To extend the above observation to a second soil, measurements of the KdSr in an all Ca system and an all Na system were made for Burbank sand soil. Sodium and Ca were varied between 0.0015 M and 3 M and 0.002 M and 0.2 M, respectively. Plots of the $\ln$ KdSr versus the $\ln$ Ca and $\ln$ Na concentrations were also linear for this second soil. Correlation coefficients of these Na and Ca equations were -1.00 and -0.98, respectively. This strongly suggests that the KdSr may be predictable over wide concentration ranges from a few measurements in pure systems.

Measurement of the KdSr in mixed Na, Ca systems will next be made and attempts will be made to calculate these values from the above pure system data.

● Biological Transport Studies

Aquatic Studies at Gable Mountain Pond

(D. G. Watson and C. E. Cushing, Freshwater Ecology Section)

Cesium-137 body burdens in experimental goldfish showed no significant changes in late December and early January. Native free-ranging goldfish have had Cs-137 concentrations similar to the experimental fish at the E transect; however, three native fish evidently trapped within the B transect pen had higher Cs-137 concentrations than those of other native fish and similar to those of experimental fish at B transect.

Pondweeds collected on November 6, 1973, had lower concentrations of Cs-137, Zr-95, and Co-60 than plants collected last May.

TECHNICAL ASSISTANCE TO THE HANFORD PLANT

Summary

Environmental Evaluations

Isolated areas of slightly elevated radiation levels on Columbia River islands downstream of the site boundary were measured, apparently from previous Hanford reactor operations. Dose consequences to the public would be minimal.

Radiation Protection

Phase three of the in-vivo computer program is now complete and acceptance testing is now proceeding although somewhat behind schedule because of the heavy load on the CYBER.

Radiation Standards and Engineering

An annual recalibration of standard instruments has been initiated. An alternate method of alpha air monitor calibration is being considered. An improved thermal neutron dosimeter calibrator is under development.

TECHNICAL ASSISTANCE TO THE HANFORD PLANTEnvironmental Evaluations

(J. P. Corley, Environmental Evaluations Section)

Additional ground-level surveys of islands and shoreline were performed as follow-up to the EG&G survey of the Columbia River downstream from the Hanford site boundary with an ultrasensitive helicopter-mounted radiation detection system. The surveys were able to measure residual radioactivity from past Hanford reactor operations at isolated locations on the river islands. Approximately 80 percent of the surface of the islands (10 million square feet) showing the highest concentrations during the aerial survey were resurveyed by PNL using routine survey techniques with portable instruments. The most likely points of radioactivity accumulation along the river banks were also surveyed. The maximum radiation level found near ground level was about 0.04 mR/hr; less than 20 percent of the island areas and only one of the river bank areas surveyed had radiation levels greater than the background level of 0.01 mR/hr. The predominant radionuclide was Co-60, but Mn-54, Ru-106, Eu-152, Eu-155, and Cs-137 were also present in samples taken from these areas. It is estimated that typical river users such as picnickers, water skiers, and fishermen would receive a radiation exposure of less than 1 mR/yr from this source.

During the ground-level island surveys, several radioactive particles were found buried in one to two inches of sand and at a frequency of about one per five miles of shoreline surveyed. These were located in the areas showing the highest radiation level but did not significantly contribute to the dose rates measured. The particles were metallic in nature, with Co-60 the only identifiable radionuclide. Should a person be directly exposed to one of these particles, despite the overwhelming odds against it, the potential consequences would still be minimal.

A portion of the long-lived radioactivity from former operation at the Hanford single-pass reactors remains deposited along and in the river bed. The routine Hanford monitoring program includes surveys of locations along the river downstream from the Hanford site. The elevations and locations at which the radioactivity is found, bearing in mind the lack of high river flows during 1973, indicate deposition at present locations prior to August 1972.

A sudden rise and decline in gross beta activity in airborne particulates was noted during January at most air sampling stations. The maximum concentration was about 0.1 pCi/m^3 gross beta, much less than previous activity peaks, with a nuclide mixture typical of aged fallout. A Hanford source was not indicated.

Radiation Protection

(H. V. Larson, Personnel Dosimetry Section)

There were 3-PNL and 2-Other Hanford Contractor loss of contamination control incidents reported. None of these is expected to result in a significant deposition of any radionuclide.

HEHF will administer DTPA via aerosol at the first aid stations in the outer areas. Specific procedures required to support this early chelation therapy are under consideration by Radiation Monitoring. HEHF has requested a report from the Personnel Dosimetry Section on the effectiveness of DTPA administration for the years 1972 and 1973.

The annual reporting of external whole body exposure, to satisfy AEC Appendix 0502, has been completed. Since no Hanford employee fell in the reportable category for internal exposure, that report did not have to be included.

Because AEC Manual 0525 is being revised this year, annual reports of external and internal whole body exposure were the only required reports for the year end 1973.

Phase three of the in-vivo computer program is now complete and acceptance testing is proceeding although somewhat behind schedule because of the ever increasing load on the CYBER. The period of acceptance testing should not last more than a month unless some serious unforeseen problems arise. In order to provide a complete set of in-vivo results for this year, the plan is to start processing data from the first week in January and become current as of April.

Radiation Standards and Engineering

(J. M. Selby, Radiation Standards and Engineering Section)

Victoreen Model 555 (Radacon) integrating rate meters have been used almost exclusively to replace the Victoreen R-meters for exposure measurement at Calibrations. A program is presently underway to compare the calibration of

the Radacon chambers with a set of intercomparison standard chambers. The intercomparison standards will be returned annually to the National Bureau of Standards for recalibration.

Radon-222 and daughters cause interference and false alarms on Pu-239 alpha air monitors. All new alpha air monitors (and by retro-fit almost all older air monitors) have built-in compensators to subtract out the radon interference. Calibration of the compensators presently requires a temperature inversion to provide an appropriate radon spectrum. A study is in progress to determine an alternate method of radon compensator calibration.

Work is underway to develop a new thermal neutron dosimeter calibration system. The new system will reduce the time required to calibrate dosimeters by a factor of forty and eliminate the background radiation in the north room of 3745 caused by operation of the present system (Sigma Pile).

Meteorological Services
(E. H. Phinney, Synoptic Meteorology Section)

Meteorological services, viz., weather forecasts and observations and climatological services were provided to plant operations and management on a routine basis.

February 1974

<u>Type</u>	<u>No. Made</u>	<u>% Reliability</u>
Production Forecasts:	56	80.4
General Forecasts:	56	90.6
Special Forecasts:	213	91.1
Other Requests:	280	
Publications Distributed:	147	
Number of Calls Processed by Code-A-Phone:	<u>3,370</u>	
Total Service Actions:	4,122	

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- Atlantic Richfield Company
- 26 G. E. Backman
- 27 G. L. Borsheim
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- 29 L. E. Bruns
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- 33 R. G. Geier
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- 36 W. P. Ingalls
- 37 R. E. Isaacson
- 38 H. Jensen
- 39 L. M. Knights
- 40 D. J. Larkin

41 W. D. Luening
42 C. W. Malody
43 T. R. McKenzie
44 B. J. McMurray
45 G. A. Nicholson
46 G. C. Oberg
47 J. V. Panesko
48 K. R. Price
49 H. P. Shaw
50 W. W. Schulz
51 A. E. Smith
52 R. E. Smith
53 G. T. Stocking
54 M. J. Szulinski
55 W. J. Van Slyke
56 D. D. Wodrich

Westinghouse Hanford Company

57 G. J. Alkire
58 A. G. Blasewitz

Battelle-Northwest

59 R. E. Burns
60 E. D. Clayton
61 J. P. Corley
62 J. R. Eliason
63 R. F. Foster
64 T. R. Garland
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75 L. C. Schwendiman
76 G. A. Sehmel
77 A. J. Shuckrow
78 C. L. Simpson
79 W. G. N. Slinn
80 R. E. Smith
81 H. H. Van Tuyl
82 B. E. Vaughan
83 D. G. Watson
84 R. E. Wildung
85 R. K. Woodruff
86 J. R. Young
87-89 Technical Information Files

The Radcon chambers with a set of instrumentation standard chambers. The instrumentation standards will be returned annually to the National Bureau of Standards for recalibration.

Radon-222 and radon-220 cause interference and false alarms on PA-222 alarm air monitors. All new alarm air monitors (and by retro-fit almost all other air monitors) have built-in compensators to subtract out the radon interference. Calibration of the compensators presently requires a laboratory known to provide an appropriate radon standard. A study is in progress to determine an alternate method of radon compensator calibration.

Work is underway to develop a new thermal neutron dosimeter calibration system. The new system will reduce the time required to calibrate dosimeters by a factor of four and eliminate the background radiation in the workshop of this caused by operation of the present system (Rite).

Meteorological Services (E. K. Pritchett, Project Technology Section)

Meteorological services, viz., weather forecasts and observations and climate related services were provided for plant operations and management on a routine basis.

February 1974

Type	No. Made	% Reliability
Production Forecasts	28	80.4
General Forecasts	28	92.8
Special Forecasts	213	97.7
Off-Request	200	
Reliability Distributed	147	
Total % of Call Processed by Code-A-Response	3,370	
Total Service Actions	4,152	