Department of Energy

Richland Operations Office
P.O. Box 550
Richland, Washington 99352

87-GTB-169

DEC 08 1987

Those on Attached List

Ladies and Gentlemen:

IODINE-129 STRATEGY

This letter transmits the Iodine-129 strategy as developed within the last two months. Please contact Mr. K. M. Thompson on (509) 376-6421 if you have any questions.

Sincerely,

/s/

John H. Anttonen, Assistant Manager
for Commercial Nuclear Waste

BWI:DHD

Attachment

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WM Project: WM-10
PDR w/encl
(Return to WM, 623-SS)

WM Record File: 101.2
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Department of Energy

Washington, DC 20585

HQO.871014.0305

OCT 14 1987

Mr. John Anttonen
Assistant Manager for Commercial Nuclear Waste
U.S. Department of Energy
Basalt Waste Isolation Division
Federal Building
825 Jadwin Avenue
Richland, Washington 99352

Dear Mr. Anttonen:

Enclosed please find the copy of a report entitled "I-129 Evaluation Proposal". The agreed upon proposal is the result of a series of meetings and teleconferences between members of your staff and mine regarding questions raised about the presence of radioactive Iodine-129 (I-129) in ground waters at the Hanford Site.

The proposal describes actions to be taken by BWIP before and during the pre-exploratory shaft geohydrology program to ensure that:

1) Contamination of deep ground waters by I-129 is minimized during drilling and construction activities;
2) The areal and vertical distribution of I-129 (as well as other isotopes) is obtained in order to establish a baseline for the Hanford site;
3) Interference with the pre-ES geohydrology test plan is minimized; and
4) The various potential sources of I-129 found in the basalts can be differentiated from one another.

As we discussed last week in Dallas, samples of ground water from new and existing boreholes and stored ground-water samples are already being collected and analyzed for I-129 and other constituents in order to distinguish between the various potential sources of I-129 and related isotopes.

It is my understanding that the intent as well as specific work described in the proposal will be incorporated into the project study plans and procedures that guide the investigative activities at your site. This report represents an important step, on the part of the DOE, toward resolving the issue of vertical communication between the near-surface and deep ground waters at the Hanford site.

Sincerely,

Ralph Stein

Ralph Stein, Director
Engineering and Geotechnology Division

cc: S. Kale
T. Isaacs
S. Brocoum
D. Siefken, Weston

I-129 Evaluation Proposal

PROBLEM STATEMENT

Introduction of unknown concentrations and quantities of ^{129}I into basalt groundwaters may preclude the future evaluation of the insitu concentrations of ^{129}I. This may limit the usefulness of ^{129}I as an indicator of the potential presence of a disqualifying condition, specifically groundwater travel time less than 1,000 years.

BACKGROUND

The vertical and areal distribution of concentrations of ^{129}I and other species in and around the CASZ can be indicative of vertical hydraulic communication. ^{129}I has a long half-life, exhibits conservative behavior and can thus be used as a tracer to determine whether hydraulic communication between the unconfined and confined aquifers exists, thus providing a potential measure of radionuclide transport from the repository to the accessible environment.

The iodine data must be interpreted in terms of the associated occurrence of stable and unstable isotopes, introduced and natural tracers, geologic structure, and the hydraulic regime.

Fluids from the unconfined and confined aquifers, up and down gradient from the proposed repository location will be analyzed for ^{129}I and associated species. Samples for iodine analyses should be from (existing and future) wells developed under appropriate conditions for optimal clean up. Well yield must be sufficient to provide adequate sample size to achieve the required analytical sensitivity. A geochemical baseline of drilling fluids will also be developed while drilling and developing new monitoring facilities to use in interpreting future hydrochemical samples.

In implementing this strategy the Project will attempt to provide a reasonable balance between obtaining "perishable" hydraulic data identified in the Options Paper and data pertinent to the iodine concern. Acquiring these data is part of the hydrologic and hydrochemical characterization programs.

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Ralph Stein, Director
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Proposal

This proposal addresses questions raised about the presence of ^{129}I in Hanford groundwater and provides information during the Pre-ES Geohydrology program to initiate resolution of these questions. Recommendations include sampling suitable wells throughout the reservation, collecting and analyzing drilling fluid, analyzing existing samples, and completing drilling and sampling of borehole DC-18.

The objectives of this program are:

(1) minimize, to the extent practicable, contaminating the basalt aquifers with ^{129}I from activities associated with the pre-ES geohydrology program through appropriate drilling, development and construction practices,

(2) obtain aerial and vertical ^{129}I data in the near-term to begin defining the ^{129}I baseline throughout the Hanford Reservation within the deep basalts. In addition to ^{129}I, ^{127}I, ^{3}H, ^{14}C, ^{99}Tc and a comprehensive suite of major anions, cations and stable isotopes will be analyzed; and,

(3) minimize interference with the implementation of the pre-ES geohydrology program.

(4) differentiate, as much as is practicable, among the possible sources of ^{129}I that may be present in the deep ground water (see attachment).

It is possible to achieve analytical sensitivities in off-site laboratories as low as 10^{-7} to 10^{-8} pCi/L from samples of 1 to 10 L in volume. Onsite laboratories may achieve sensitivities of 10^{-5} pCi/L. Analysis for ^{129}I is a complex chemical process at the trace level concentrations expected and may require a minimum of 2 months to complete. The ^{129}I results, therefore, of samples taken during drilling will not be available for real-time decisions during well construction and development. Details of the proposed program are presented below:

1. Tentatively plan to use Hanford System water (^{129}I= 10^{-6} to 10^{-5} pCi/L), for the drilling and installation of the piezometers. Alternate sources of drilling fluid make-up water will be investigated and used if practicable and significantly lower in ^{129}I than current plant sources. Alternate sources may include groundwater from borehole DB-11 or the McGee Well. Investigations will include expedited analysis of the ground water from these wells for ^{129}I. Consultation and concurrence with DOE-HQ is required prior to initiating drilling with Hanford system water

   If the decision is made to use Columbia River water for the drilling of wells in the Pre-ES testing program, planning will immediately begin to mitigate the contamination of deep basalt aquifers that may result from drilling activities in the post-ES program and to verify that any residual contamination will not significantly interfere with the ability to successfully perform the hydrochemistry program. As part of this program, alternate sources of drilling fluids will be investigated, alternate drilling procedures will be investigated and experiments will be carried out to assess the potential for the degree of contamination that could be expected from surface-based activities associated with drilling; increases in contamination due to drilling will be addressed through monitoring drilling fluids while drilling DC-24, etc.. These plans will be incorporated into the appropriate Study Plans.

To mitigate the contamination of deep basalt aquifers in the pre-ES program, new drilling fluids will be used after each string of casing is installed in DC-24, DC-25, DC-32 and DC-33.

2. Baseline all drilling fluid used (mud and water).

   - Sample drilling fluid pit prior to cycling through borehole
   - Sample fluid returns while drilling through 12 horizons

- Data will be used to evaluate hydrochemistry data in future tests where evaluation criteria of Option Paper will be applied

3. Sample selected existing facilities outside the CASZ for ^{129}I and other information as described in objective 2 above. Wells to be evaluated for sampling include those listed below:

   - Enyeart or Ford wells (Rosalia)
   - DC-6 [composite Grande Ronde (mainly from top of N2/R2 break)]
   - DC-14 (two flows below the Umtanum)
   - DB-15 (Wanapum)
   - DB-7 (Mabton)
   - DB-15 (Grande Ronde)
   - Four wells east of Columbia River near Ringold (upper to middle Saddle Mountains)

     - Webber Ranch (12/29-30 J1)
     - Ringold Association (12/29-32 R1)
     - Sunset Association (11/29-16A1)
     - White Bluffs Association (11/29-20N1)

4. The drilling fluids for DC-24, 25, 32 and 33 and the drilling fluids used in the deepening of RRL-2B will be tagged with an appropriate chemical tracer (e.g. Lithium Bromide) to provide real-time time-series clean-up data during well development. Wells will be developed sufficiently to provide future hydrochemical, including

^{129}I, data of sufficient quality to evaluate insitu conditions if practicable, balanced against baseline needs and future data sources. To assure adequate development, time series tracer samples, including ^{129}I, will be taken during pumping.

During LHS testing at RRL-2B, time-series groundwater samples will be taken to determine clean-up success and for evaluation of insitu conditions (which may have been impacted by previous activities).

5. Analysis and evaluation of existing samples and data will be performed. Archived samples such as those listed below will be evaluated for analysis:

   - DC-23 GR (Rosalia, Sentinel Gap, Ginkgo and Umtanum)
   - DC-18 (Wanapum)
   - RRL-2C (Development samples from composite Grande Ronde [mainly the Birkett flow top]).

   Analytical results (as opposed to achievable analytical sensitivity) are a function of (1) borehole development (i.e., cleanup), and (2) the respective ^{129}I concentrations of the insitu groundwater and the contaminated drilling fluid injected into formations.

6. The program will utilize opportunistic tests to obtain further data such as drilling, sampling and analysis at DC-18.

Approve: Ralph Stein — Ralph Stein, Director
Engineering and Geotechnology Division
Date: 10/14/87

Approve: [signature] — John Antonnen, Assistant Manager
for Commercial Nuclear Waste
Richland Operations Office
Date: 10/19/87

Attachment

DIFFERENTIATION OF POSSIBLE SOURCES OF ^{129}I IN DEEP GROUNDWATER

Groundwater geochemistry, including Iodine-129, will be used to differentiate between native groundwater and water that may have been introduced from other systems. The sources of water other than native groundwater include groundwater that has infiltrated through the geologic system from overlying contaminated units, water introduced through previous drilling activities that has carried foreign chemistries into the lower aquifers, and waters that may be introduced through planned drilling activities. The specific question that should be answered is:

How will BWIP differentiate Iodine-129 contaminated waters from the following sources:

A. Naturally occurring iodine in the deep confined aquifers,

B. Groundwater infiltrating through the rock system from the unconfined aquifer,

C. Contaminated water and drilling fluids introduced during past drilling?

D. Potentially contaminated water to be used during planned drilling?

Response should not be limited to iodine solely, but should include any companion elements or nuclides that may be used to differentiate between groundwaters on the Hanford Site.

Naturally Occurring Iodine

Naturally occurring iodine-129 in the deep confined aquifers should be found at levels significantly less than 1 x 10-5 pCi/L. Accompanying low levels of iodine-129 should be relatively high elemental iodine concentrations in the part per million range. Tritium and recent carbon-14 should be absent from these waters.

Downward Migrating Groundwater

Groundwater infiltrating through the rock system from the unconfined aquifer may contain defense waste leachates. In this case, the iodine-129 activity can be well over one pCi/L. In addition, nitrate and sulfate may be present. Other isotopic tracers that may be present include tritium, technetium-99 and carbon-14 because of the recent age of the groundwaters. The concentration of elemental iodine in these waters can be on the order of several parts per billion, due to flushing of salts from the rocks by actively flowing groundwater.

Previous Drilling Operations

Water introduced to the confined aquifers by previous drilling operations should be identifiable on the basis of the iodine-129 to elemental iodine

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ratio, the presence of tritium, and reduced concentration of chloride ion. The iodine-129 to iodine-127 ratio from this source will be similar to that potentially derived from downward migrating water, however, the occurrence of nitrate and sulfate ions should be significantly different.

Planned Drilling Operations

Water that is to be used will be analyzed to ascertain the concentrations of critical constituents and also be tagged with an appropriate tracer such as fluorescein dye or lithium bromide. Analysis of recirculating drilling muds will be made to track any changes in concentrations as the drilling process continues. Following completion of drilling a pumping program to remove a sufficient amount of water from the flow top to purge contaminating fluids (development testing) will be carried out. By monitoring the tracers introduced during drilling, tritium (present in the system water used for drilling but not present in the confined basalt aquifers), and chloride (present at higher concentrations in the formation water than in the system water), a representative sample of the formation water can be collected. This sample will provide the maximized opportunity to distinguish background I-129 concentrations from introduced contamination. Columbia River water contains iodine-129 at a concentration of about 10-5 pCi/L. Development testing within a flow top should result in a formation water sample having less than this iodine-129 activity.

SCENARIO	I-129/I-127	Tc-99	H-3	C-14	NO_3	SO_4	Cl	TRAC
CONFINED AQUIFER (background)	L	L	VL	VL	VL	M-H	H	---
AQUIFER INTERCOM.	H	H	H	H	H	L-M	L-M	----
PAST DRILLING	M	M	M	L-M	L	M	H	----
PLANNED DRILLING	M	M	M	H	L	L	L	YES

LEGEND
VL VERY LOW
L LOW
M MODERATE
H HIGH
---- NOT EXPECTED

GROUNDWATER DISCRIMINATORS

WM DOCKET CONTROL
CENTER

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WM Record File 101.2

WM Project 10
Docket No.
PDR ✓
× LPDR ✓ (B)

Distribution:
Linehan
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Youngblood