Report of Hanford Site Access of 11/12/02

SUMMARY:
Nine rooted vegetation samples were collected from Hanford on November 12, 2002, under a Hanford Site access agreement. One rabbit brush sample and one tumbleweed sample were treated as "background" for quality control purposes of the other deep-rooted samples. One moss + soil sample had no background reference, and so only tentative results are presented. Radiological analyses of the other 6 samples are reported here.

Each of the 6 samples tested positive for at least one artificial radionuclide, probably of Hanford origin. These positive results show upward migration to the land surface vis deep-rooted plants that introduce the radioactivity into surface biota.

Hanford's strategy of cleaning up the topmost 15 feet of soil on the site is thus seen to rely on preclusion of deep-rooted, arid land vegetation. The "irrigated agriculture" and "rural residential" land use scenarios envision shallow-rooted plants that would not take buried waste up to the land surface. These positive results suggest that realistic land use scenarios should assume deep-rooted, arid land plants.

Present use of the 300-Area is essentially industrial. The main operator, DOE/RL, prevents uptake of buried radioactivity through deep-rooted vegetation by covering the ground with gravel and intensive application of herbicides. The real time fallibility of such institutional controls is seen by the feasibility of collecting deep-rooted plants from pre-selected locations in the 300-Area. While Hanford clean-up and future site management strategies take some account of the surprisingly short utility of institutional controls, the important lesson here is that institutional controls tend to be ineffective even from the outset.

The combination of clean-up strategies that do not account for unfavorable conditions that can be expected together with reliance on institutional controls that won't control bodes ill for safety and environmental quality in the future of Hanford site.

NARRATIVE:
N. Buske and M. Callison accessed Hanford Site on November 12, 2002, under terms of an agreement with DOE/RL dated September 05, 2002. They were escorted by DOE/RL and other agency personnel, in accord with an agreed study plan.

Purpose of study northeast of KE-Reactor: To see if a hypothetical groundwater pathway from the KE-Basin to the river could be mapped by strontium-90 in deep-rooted vegetation. Biota in unfenced areas northeast of KE-Reactor was checked with a geiger counter in order to select relatively radioactive samples to collect. This method proved inadequate for the purpose, because of excessive time required for adequately sensitive measurements. Instead, three samples of rabbit brush were somewhat arbitrarily collected from areas having relatively high geiger counts.

Next to the north side of the KE-Reactor building (N46° 39.001', W119° 35.803') a clump of grass with geiger counts exceeding 50 times background was observed. This item was not in the sampling plan, so no sample was collected.

Purpose of study in 300-Area: To check uptake of buried radioactive wastes by deep-rooted and other plants. At present, plant uptake of buried radioactivity is limited by institutional controls, namely covering the ground with gravel and application of herbicides to eliminate deep-rooted plants. This study addresses the question of the adequacy of shallow waste burial as a clean-up method and the efficacy of institutional controls, even during active Hanford operations.

Five, rooted tumbleweed samples were collected from the 300-Area, along with one sample of moss with soil.

This site access was documented by digital photographs taken by DOE/RL. These photos are available.

The site access was completed successfully, in a timely and professional manner. DOE/RL is thanked and commended for the access and assistance.

ANALYSIS:
Each of the 9 samples was dried to 100C and counted for 23 hours in a stabilized sodium-iodide, photon detector, with an energy window of 10-4000KeV. The acquired spectra were transformed to constant photopeak width, and blank and other reference spectra were then subtracted. Absolute results and results relative to a background of the same sample medium were obtained. Results reported here are the root products of the absolute and above-background activities. No background material was available for Sample No. 8. Tentative, absolute results are presented in parentheses for Sample No. 8.

Samples were split with DOE/RL. The DOE/RL splits were to be archived, pending report of results. Results, below, were reported to DOE/RL on January 12, 2003. DOE/RL review is pending and will be uploaded when it is received.

RESULTS:
Am-241 = americium-241, a transuranic, activation product. Halflife: 433 years.
Cs-137 = cesium-137, a fission product. Halflife: 30 years.
Sr-90 = strontium-90, a fission product. Halflife: 29 years.
ThNat = natural thorium, also used as feed for U-233 production. Halflife: 14 billion years.
UNat = natural uranium, also used as feed for Pu-239 production. Halflife: 4 billion years. No distinction of uranium isotopes is made in this study.
- Results have been checked but not validated.
- Results are in units of picocuries/kilogram (dry weight).

- These samples conformed to a requirement <4 times background radioactivity. No other standard is known to apply directly to these samples.

Sample Coordinates
Number North 46° West 119° Location Medium
1 39.169' 35.866' N of KE-Reactor gray rabbit brush
No results reported: used as background for gray rabbit brush.

2 39.248' 35.891' further North of KE gray rabbit brush
Am-241 = 100pCi/Kg

3 39.273' 35.850' NE of KE gray rabbit brush
Cs-137 = 50pCi/Kg
ThNat = 100pCi/Kg

4 22.068' 16.564' NE of 309 Bldg. tumbleweed
Cs-137 = 60pCi/Kg
UNat = 1800pCi/Kg

5 22.139' 16.439' NE of 324 Bldg. tumbleweed
Am-241 = 100pCi/Kg
Cs-137 = 30pCi/Kg

6 22.180' 16.589' NW of 3707F Bldg. tumbleweed
No results reported: used as background for tumbleweeds.

7 22.326' 16.879' S of 305 Bldg. tumbleweed
Cs-137 = 30pCi/Kg
ThNat = 60pCi/Kg
Unidentified beta emitter

8 22.306' 16.788' E of 313 Bldg. moss+soil
Sample collected from joint between concrete slabs.
Results are tentative:
(Cs-137 = 90pCi/Kg)
(Sr-90 = trace)
(ThNat = 1900pCi/Kg)
(UNat = 4300pCi/Kg)

9 22.196' 16.878' E of 321 Bldg. tumbleweed
Sr-90 = 3200pCi/Kg
UNat = 220pCi/Kg

DISCUSSION:
Rabbit brush is the prevalent, deep-rooted plant in the unfenced areas north of KE-

Reactor. Gray rabbit brush was thus selected as the candidate medium to be sampled in this area, to map a hypothetical, Sr-90 contaminated groundwater pathway to the river.

This attempt was already doubtful, because previous analysis of rabbit brush from N-Springs where Sr-90 contamination is prevalent had been negative. That is, rabbit brush, unlike mulberry leaves, is not a good biological indicator of the presence of Sr-90 in groundwater below.

On the other hand, the rabbit brush did provide an opportunity to begin exploring the area between K-Reactors and the publicly accessible river shore.

Detection of Am-241 in Sample Nos. 2 and 5 was unexpected. Am-241 is usually considered immobile. These positive results invite confirmation by analysis the DOE/RL sample splits.

Cs-137 = 0.05pCi/g in Sample No. 3 was both absolute and above background. This result invites confirmation by analysis of the DOE/RL sample split. This is an indication of uptake of underground radioactivity by deep-rooted plants outside an area posted for underground radioactive waste.

The area between K-Reactors and the river invites study of the boundary between Hanford remediation and the unremediated river corridor.

The 300-Area invites study of the efficacy of clean-up to a standard for industrial use. In the present industrial use, waste is covered by clean overburden with a gravel surface, and herbicide is applied intensively and extensively to defoliate the area.

As the mere existence of rooted plants sampled in the 300-Area shows, institutional controls on form of the ground surface and by application of herbicide to not preclude growth of vegetation, even as these controls are applied. The radiological results of Sample Nos. 4, 5, 7, 8, and 9 reveal uptake of Hanford radioactive waste from the ground where defoliation is ineffective.

Questions and comments are welcome. Results of analyses of the DOE/RL samples are awaited.

CONCLUSIONS:

1. Deep-rooted plants are taking buried, radioactive contaminants up to the Hanford land surface and into the food chain, even in the presently active phase of Hanford Site clean-up.

2. This uptake by deep-rooted plants renders present clean-up to 15 feet below grade unprotective of the surface environment (due to plant uptake) if deep-rooted plants like tumbleweeds or sage brush are allowed to grow on site. Thus, DOE/RL's future use scenarios of rural residential use or irrigated agricultural use are seen merely to avoid

administratively the problem of natural arid land vegetation tapping into the buried waste below. The proposed land use scenarios are thus seen to presume institutional control of the site, in perpetuity.

3. Even present-day, institutional control through intensive herbicide application in the 300-Area fails to stop radionuclide uptake by deeply-rooted plants, tumbleweeds in particular, even while the institutional control is operational. This is a warning against reliance on institutional controls even for the present, much less for long-term protection of health and environment at Hanford.

4. These last two conclusions suggest the course of present-day strategies for Hanford clean-up are on a collision course with reality. The expected casualties of this collision will be long-term public health and environmental quality in the area.

5. Some radioactive waste is inevitably "lost in the cracks" of active site management, as evidenced by the moss-and-soil sample No. 8. Clean-up strategies and future site use scenarios should consider estimates of future risks from what is missed or *lost-in-the-crack*s of as-designed and as-completed clean-up processes.