Date: September 20, 2005

To: Nuclear Regulatory Commission
Division of Waste Management and Environmental Protection
Office of Nuclear Materials Safety and Safeguards

Subject: Comments on Overview of the Hanford Site, Office of River Protection

Reference: 1) Paperiello, C. J., 1997, Director, Office of Nuclear Material Safety and Safeguards, U. S. Nuclear Regulatory Commission, Washington, D.C., letter dated June 9, 1997 to J. Kinzer, Assistant Manager, Office of Tank Waste Remediation System, U. S. Department of Energy, Richland, WA

Attachments: 1) Boldt, Allyn L., *History of Hanford Tank Waste Classification and Regulatory Activities*, 2003.

2) Boldt, Allyn L., *Concerns With Hanford Solid Waste EIS*, April 9, 2004.

3) Day, Delbert E., et.al., Final Report for DE-FG07-96ER45618, *Iron Phosphate Glasses: An Alternative for Vitrifying Certain Nuclear Wastes*, University of Missouri-Rolla, Rolla, MO, December 28, 2004.

The Nuclear Regulatory Commission (NRC) Office of Nuclear Materials Safety and Safeguards held an open meeting in Richland WA on September 20, 2005 on Hanford tank wastes. This letter provides my comments for the public meeting.

Tank waste at Hanford is proposed to be retrieved and separated into high-level waste (HLW) and low-activity waste (LAW) fractions for treatment and disposal on-site and off-site. The HLW fraction is proposed to be disposed of at the Yucca Mountain geologic repository. The LAW fractions being considered for on-site disposal result from the proposed partition and treatment systems. The LAW tank waste fractions include the tanks and tank heel residuals, the Waste Treatment Plant (WTP) Immobilized Low-Activity Waste (ILAW) glass logs, the proposed bulk vitrification containers, a potentially large volume of undefined secondary waste from the Effluent Treatment Facility (ETF), and failed equipment.

The 1997 Department of Energy (DOE) consultation with NRC (reference 1) on incidental waste considered only the WTP ILAW glass logs. The NRC stated the staff preliminary finding of the proposed LAW fraction as incidental waste is a provisional agreement and not sufficient to make an absolute determination at that time. If the Hanford tank waste is not managed using a program comparable to the technical basis analyzed in the reference letter, the waste classification must be revisited by DOE.

The current incidental waste declarations require evaluation of four waste forms prior to disposal at Hanford as incidental waste. The four waste forms are:

1) Tanks and tank heel residuals;
2) Waste Treatment Plant ILAW glass logs;
3) Proposed bulk vitrification containers; and
4) Secondary waste from the Effluent Treatment Facility.

The bulk vitrification test program has revealed that the bulk vitrification process distributes the volatile technetium and iodine radionuclides in several waste forms. The bulk vitrification process may retain technetium-99 in the container glass, in metallic iron deposits in the bottom of the container, as soluble deposits in the insulating sand external to the ceramic liner, and to the vitrification process scrubber solutions and condensates. The iodine-129 may be distributed to the container glass, as soluble deposits in the insulating sand external to the ceramic liner, and to the vitrification process scrubber solutions and condensates. The disposal performance of the bulk vitrification containers must sum the disposal performance of all contributing phases in the containers. The vitrification process fractionates the waste into a secondary waste that must also be evaluated as incidental waste.

Waste Classification

Current law requires on site disposal of wastes be classified low-level waste (LLW) or high-level waste (HLW) be reclassified as incidental waste. A "History of Hanford Tank Waste Classification and Regulatory Activities" is included as attachment 1.

The Federal regulations contain two definitions for HLW. The Nuclear Regulatory Commission (NRC) uses the source based HLW definition in 10 CFR Part 60.2. The DOE uses the HLW definition in the Nuclear Waste Policy Act (NWPA) of 1982. The NWPA definition of HLW is "the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations … that the Commission, consistent with existing law, determines by rule requires permanent isolation".

The NWPA HLW definition does not provide a specific concentration of radionuclide(s). In 1987, the NRC published Advanced Notice of Proposed Rulemaking, announcing its intent to revise the definition of HLW in 10 CFR Part 60 in a manner that would apply the term HLW to materials in amounts and concentrations exceeding numerical values that would be stated explicitly in the form of a table. In 1988, the NRC withdrew the proposed Rulemaking for changing HLW source based definition to a concentration or risk based definition. Instead, the Commission continued to embrace the definition at 10 CFR Part 60.

It is futile to define HLW with a radionuclide concentration(s) in the waste. The impact of the proposed waste disposal on the environment and the public is a function of the waste form/leach rate and the site hydrology/geology. No single waste concentration can be defined for all disposal sites and all proposed waste forms. Previous performance assessments of waste disposal at the Hanford site have shown that Hanford is a very poor site for disposal of mobile radionuclides such as iodine-129, technetium-99, and uranium. Disposal of Class A or B LLW at Hanford can result in exceeding maximum allowable dose to the public via the groundwater path. Waste disposal performance at Hanford is dictated by the waste form leach performance.

The Federal regulations also contain two definitions of maximum dose to the public that can be utilized in classification of wastes that require permanent isolation. DOE uses 10 CFR Part 61. The Environmental Protection Agency (EPA) has Maximum Contaminant Levels (MCL) in 40 CFR Part 141.16. The two regulations have differences in the allowable maximum exposure levels and concentrations. For example, 10 CFR Part 61.41 has a maximum general population thyroid dose of 75 mrem/yr while 40 CFR Part 141.16 allows a maximum thyroid dose of 4 mrem/yr. This is a factor of 19 difference in the regulations. The Ronald Regan National Defense Authorization Act for Fiscal Year 2005 gives the authority to declare some waste not to be high-level waste if the disposal is pursuant to a State-approved closure plan or State-issue permit. Washington State uses the EPA MCL regulations for closure plans and permits.

I propose that the HLW definition include any proposed waste disposal that results in the summed MCL fractions exceeding 1.0 be classified HLW and require permanent isolation in a licensed repository.

Performance Assessments

The results of performance assessments are largely determined by the infiltration of water through the waste. The Hanford performance assessments assume the use of vegetation with transpiration and evaporation of water to reduce water infiltration over the life of the disposal system. The Hanford barrier performance assumes that infiltration rates lower than existed prior to the Hanford occupation in 1942 will exist for 10,000 years. The performance assessments assume institutional control with industrial zoning and maintenance of an effectively undisturbed vegetation growth over the infiltration barrier for 10,000 years. The assumption of institutional controls for over 10,000 years is unrealistic and not a conservative assumption.

The 2004 Hanford Solid Waste Environmental Impact Statement (HSW-EIS) and Record of Decision was challenged in court by Washington State as being inadequate. As DOE was collecting information and data owed to the state as part of the legal discovery process, errors were found in the section of the study that analyzed possible effects on ground water beneath the waste disposal area. DOE will be preparing a supplemental document with correct information and told that court that the examination of the ground water information would include an opportunity for public review and comment. The errors include inventory and distribution of I-129 and Tc-99 in the solid wastes. Attachment 2 is a presentation on my concerns with the original 2004 HSW-EIS.

Other concerns with the performance assessments are:

> Inventories of the different tank waste streams. The split of radionuclides between the streams appear to be enabling assumptions without technical basis.
>
> Assumed waste form release rates without an adequate technical basis.
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> A one dimensional model for sediment retardation in the soil column with a perfect, homogenous soil column. The model has no input for lateral hydraulic flow. Past models do not have a mass diffusion/concentration gradient component. The model is not conservative.
>
> Enabling assumptions for recharge rates. DOE has recently provided new assumptions for the recharge rates of the as built and post 1,000 year failed infiltration barriers without supporting documentation. The factor of 9 reduction for the failed/degradated barrier would enable a factor of 9 increase in inventory. (All engineered barriers and institutional controls ultimately fail or degrade, the issue is when and to what extent.) The model assumptions are not conservative.
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> DOE, in the past, has not summed the contributions from individual source terms and performance assessments. All evaluations and decisions are made assuming a single insult to the environment (groundwater). The groundwater is a common sink to all the past and future waste disposal sites. DOE is proposing a "composite performance assessment" in the future.

Secondary Waste

The Waste Treatment Plant has evolved into a system with multiple melter types, multiple glass compositions, and a large volume of secondary waste, potentially as large as the vitrified tank LAW. This system evolved as a result of ill conceived attempts to solve high volumes of LAW borosilicate glass resulting from increased tank inventories of sulfate. Borosilicate glasses with high sodium oxide concentration have limited sulfate solubility. Higher tank waste sulfate inventories require reducing the sodium oxide loading to keep below the sulfate solubility limit in the glass. As the characterization of tank wastes evolved, the sulfate inventory and resulting glass volume increased. The tank waste sulfate inventory was originally assumed to be 2,040 metric tons, is currently assumed to be 3,640 metric tons based on incomplete tank sampling, and may ultimately be 5,000 metric tons based on the global inventory determination. The sulfate issue/problem may increase in the future.

In an ill conceived solution to reduce sulfate recycled to the melter and resulting sulfate concentrations in the LAW glass, a decision was made to route melter scrubber effluent from the ILAW vitrification facility to the bulk vitrification and to route bulk vitrification melter scrubber effluent to the Effluent Treatment Facility (ETF). The ETF is used for final treatment of evaporator steam condensates by reverse osmosis prior to soil column discharge of the treated water.

The intentional routing of sulfate and chemicals added in the scrubbing solution results in routing of a high fraction of the volatile I-129 and Tc-99 radionuclides to the ETF also. The most recent estimate of new chemicals routed to the ETF I have seen results in approximately 50 tons of new sodium in the ETF waste stream for every 100 tons of tank waste sodium vitrified in the bulk vitrification system. This amount of new sodium could result in a volume of grouted ETF waste equal in volume to the total ILAW glass volume produced by both the ILAW vitrification facility and the bulk vitrification facilities. The ETF was not designed to remove this volume of salt and modifications are required to significantly increase capacity. In addition, a large facility will be required to treat and immobilize the salt waste from the ETF. No treatment process and waste form for the ETF waste currently exists, development is in progress.

The low temperature immobilization of secondary wastes being researched for potential ETF waste treatment may not result in low enough leach rate for disposal at the Hanford site. The ETF waste stream may require classification as HLW due to excessive releases of I-129 and Tc-99 to the groundwater.

Potential Solution for Treatment of Hanford Tank Wastes

The problems with the Hanford tank waste treatment system result from the low solubility of sulfate in high sodium oxide loaded borosilicate glasses. An alternate iron phosphate glass composition has been developed that does not have a sulfate solubility problem, see attachment 3. In addition the iron phosphate glass offers increased sodium oxide loading (reduced ILAW glass volume) and processing conditions that increase retention of I-129 and Tc-99. The more favorable processing conditions are lower melting temperature, reduced melter residence time, and low viscosity that eliminates the melter air sparging requirement. The glass composition also has better stability and leach performance than proposed borosilicate glasses.

DOE has failed to seriously consider the conversion of the Waste Treatment Plant ILAW vitrification facility to iron phosphate glass. The iron phosphate glass offers approximately twice the sodium oxide loading as the sulfate solubility limited borosilicate glasses. The installation of a third melter in the vacant third melter bay with iron phosphate glass in all three melters would increase the Waste Treatment Plant tank waste ILAW sodium oxide vitrification capacity by a factor of three, allow elimination of the proposed bulk vitrification, and allow internal recycle of sulfate to the ILAW melters to eliminate the ETF secondary waste issue.

DOE apparently has declined to consider the use of iron phosphate glass because of the "not invented here" issue and/or potential Waste Treatment Plant cost increases due to contractual "change in scope" renegotiations.

Thank you,

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