39 K_d values for neptunium. The observed K_d for neptunium at Hanford is typically about 2.5, making it highly mobile and a major risk driver.

40 27) For some wastes, colloidal transport is likely. This is particularly true for contaminants in tank wastes contacting soils, as evidenced by the principal investigators reports over the last several years. Colloidal transport must be included in the analyses of contaminant fate and transport.

41 28) The contaminant fate and transport model should be revised to include transport into and impacts on the Columbia River environment. Assessment of the interaction of the river and groundwater will require significant characterization to verify the assumptions employed in analyses to date. Upwelling of contaminated groundwater into the river requires additional clarification studies by DOE to assess potential impacts to the river environment.

42 29) The variability of the magnitude of release and the temporal distribution curves presented in Appendix L clearly demonstrates the wide range of uncertainty in the modeling results. This uncertainty should lead to future characterization and modeling studies of each individual site during siting, along with waste characterization and treatment studies necessary to develop model predictions that exhibit greater certainty.

43 30) The existing groundwater model should be upgraded to reflect the inverse U-Code analysis of the groundwater model, which showed: a) large movements of water through the fractured basalt between the confined and unconfined aquifers, and b) large inputs of water from the confined aquifer to the unconfined aquifer from the various discontinuities across the site, including the Umtanum, Yakima and Rattlesnake ridges.

44 31) As discussed in the EIS, the use of reactive barriers, engineering redundant systems, and aggressive immobilization techniques will be required to avoid exceeding dose and risk values in the future. At a minimum, DOE should use existing hazardous waste cell designs, coupled with vadose and in-cell monitoring methods, and robust final caps to redundantly engineer protectiveness into the final product. Modeling of the "as constructed" buried waste containment system should be completed prior to finalizing the ROD, using a waste form that exhibits appropriate performance criteria.

45 32) The analysis of future site risks – as the foundation for decision making – contains significant uncertainty. For example, the revised EIS presents two distinctly different groundwater flow paths. Reliable information about groundwater flow beneath the Hanford site and specifically the 200 area must be obtained before an analysis of impacts can be conducted with confidence. Prior to finalizing this EIS, DOE should install new groundwater monitoring wells. Further, DOE should allow time to collect data to project future groundwater elevations that would indicate future flow paths.

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Waste Transport

33) The transportation analysis is inadequate. Among its deficiencies: it is based on 1990 census data; it does not fully evaluate rail transport; and it does not adequately address potential impacts from a terrorist attack or diversion of nuclear material.

46

a) Population densities along portions of the proposed routes have changed significantly from 1990 to 2000. The most current census data should be used in the analysis.
b) While the EIS does provide limited information on rail transport, it also states that "an analysis of rail transport does not appear warranted" (Page H-44). This statement is not consistent with planning already underway to prepare for the shipment of transuranic waste from Hanford to the Waste Isolation Pilot Plant (WIPP) as early as 2005. The document attempts to satisfy this issue by stating that "If rail shipment is proposed it will be evaluated under future National Environmental Policy Act reviews" (Summary, page S-21). As stated earlier, it is not acceptable to defer needed analysis to future, unspecified dates.
c) The EIS states that a terrorist attack on a shipment is not a likely event, in part, because the majority of shipments will occur on the Hanford Site. That statement ignores upper bound projections which could result in as many as 9,600 shipments of transuranic waste to and from the Hanford Site, and an additional 24,000 shipments of LLW and MLLW to Hanford. Further, the draft EIS ignores the threat of diversion of radioactive materials for use in a Radiation Dispersion Device or "dirty bomb." The EIS should include an analysis of these possibilities.

47 In addition, the section describing transportation impacts is horribly difficult for a layperson to understand the information that is provided. The final EIS should present the results of a new transportation analysis in clear language, rather than using scientific notation.

Risk Assessment

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34) DOE needs to develop a comprehensive analysis of the total mass of radioactive and hazardous materials that have already been disposed into the 200-Area subsurface in order to appropriately assess the impact of the additional 33.8 million curies of waste the revised EIS proposes disposing into the subsurface. The mass of material disposed into the Environmental Restoration Disposal Facility, left as residual material, and disposed into the U.S. Ecology Site create a total impact that has not been evaluated. Further, estimating the impact of waste disposal proposed by this EIS, without considering the additions of other wastes from ongoing programs, does not fully anticipate future effects. By understanding the impact proposed, appropriate engineering and mitigation actions can be designed, planned and taken that would minimize overall impacts of Hanford Operations.

49 35) DOE should present an analysis of variation of risks over time from the contaminants proposed for burial at the Hanford site. A temporal analysis is necessary to gauge the effects

of the burial for the foreseeable future. Radioactive waste will decay over the next million
years, however many of the inorganic contaminants will never diminish in toxicity. Thus,
49 these sites will always present a base level of human health and ecological risk that will
preclude any future use. This analysis is required to assess the affect of proposed actions and
is necessary to plan appropriate mitigation strategies.

36) In December 2003, uranium is scheduled to be regulated as a toxic metal rather than as a
50 radioactive element. DOE should incorporate this change in regulatory status in both the
final EIS and subsequent ROD.

37) Analyzing groundwater impacts at a distance (1 kilometer from waste site boundary) tends to
51 statistically minimize risk. The point of analysis should be placed at the boundary of the
waste site.

38) DOE should ensure that engineering design optimization reflects the uncertainty in the
contaminant inventory, waste form behavior, temporal variability, range of leaching
52 behaviors, infiltration, and cap failure modes. For example, DOE should present a
reasonable worst case scenario that indicates the amount of material that could be released in
a year. If the design is effective, the modeled release should not adversely affect human
health and the environment. DOE should not optimize the design to the extent that key
redundancy features are not incorporated.

39) Appendix F needs rationale for choosing parameters for analysis. The final EIS must explain
53 why the Industrial and Resident Gardener exposure scenarios were chosen and what other
scenarios were considered. DOE should explain why default values were used for Hanford
soil density instead of actual values.

40) Exposure scenarios in Appendix F are inconsistent. Resident Gardener is assumed to receive
54 the same dermal soil exposure as an industrial worker (F.37). Resident Gardener scenario
includes local game consumption but no Columbia River fish consumption. This
inconsistency should be resolved.

Alternatives

41) Engineering design optimization must be reflective of the uncertainty in the contaminant
55 inventory, waste form behavior, temporal variability, range of leaching behaviors,
infiltration, and cap failure modes. DOE should not optimize the design to the extent that
key redundancy features are not incorporated.

42) In the preferred alternative, as described on page 3-60, Oregon concurs that all future
facilities must meet more stringent design standards than the present unlined LLW design
standards. Oregon suggests that DOE incorporate various components to provide redundant
56 features to sequester contaminants. These components include:

a) Meet RCRA Land Disposal Restrictions, meet Universal Treatment Standards, treat to
immobilize waste, and reduce the source terms.

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b) Disposal features should include reactive barriers within the liner system, providing sequestering agents (zeolites, phosphates, or proprietary agents) in the cushion layer. Additionally, DOE should consider providing bulk treatments to reduce the leachability of the buried waste. The leachate collection system should include a leak detection system to determine the source of the leachate to indicate potential leak source and to suggest potential solutions.

c) Closure features should include modified cap designs to provide engineered failure components to enhance future performance in the event of failure. These features could include aggregates that decompose to clays, amendments that mobilize and react with deeper materials, use of self-healing natural materials, and air-voids to inhibit deep root growth.

d) Monitoring requirements should be clearly established in the ROD to define essential components for monitoring the vadose zone and aquifer beneath each disposal site. Monitoring should incorporate a full range of potential technologies, including sensors that would be installed during construction such as time domain reflectometry waveguides, neutron probes, and electrical resistivity tomography pairs. Groundwater wells should be constructed using both single and multiple screening levels to allow for vertical segregation.

Alternative Implementation

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43) Oregon expects the DOE to use a "defense-in-depth" design philosophy when planning for the disposal of waste at Hanford. This means that each major component of the waste disposal system, including the waste form and containers themselves, will be designed with defense-in-depth as a primary criterion and the integrated system will also use defense-in-depth principles in its design. Following are some specific expectations and recommendations for future operations of solid waste disposal facilities at Hanford:

a) Ensure that selected alternatives comply with prevailing state and federal regulations for the disposal of hazardous and radioactive waste. When conflicts arise, apply the more stringent regulation due to the uncertainty associated with risk assessment and numerical modeling of contaminants. For example, DOE has indicated that radiological dose (25 mrem/yr.) will be exceeded in the future. EPA requirements are more stringent and based on a risk threshold of 3×10^{-4}. This risk level corresponds to about 15 mrem/yr. Therefore, DOE should include redundancy factors in the design of facility to meet this tighter performance threshold.

b) Conduct landfill-siting studies to determine the meso-scale physical structure of the waste site including the vadose zone. Conduct direct hydrological testing to verify the placement of vadose and groundwater monitoring wells. Establish a consistent infiltration value. The EIS and key supporting documents used different infiltration rates that vary over several orders of magnitude. (0.01cm to 0.50 mm/yr.). Actual infiltration in disturbed areas has been observed to be as high as 50-100 cm/yr. Problems with operational design have aggravated this further by creating slopes that drive water into contaminated areas, such as the T tank farm. This results in local inundation and flooding which is not easily modeled with a fixed infiltration rate approach.

c) Incorporate redundant elements into landfill design such as reactive layers, geosynthetic and clay liners, and soil amendments in the cushion to provide defense-in-depth against the leaching and transport of contaminants. Capillary break barriers should be incorporated into the design.

d) Modify daily cover materials to provide additional contaminant adsorption sites by blending apatite or similar materials to sequester the contaminants.

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e) Conduct site specific numerical fate and transport modeling to demonstrate impact on the environment, including the vadose and saturated zone directly beneath the waste site. The Representative Elemental Volume used in the modeling should be matched to the density of information collected. The model must reflect the level of aquifer mixing that occurs based upon detailed field information collected during the sites hydraulic test.

f) Evaluate each contaminant's partitioning coefficient (K_d) in soils taken directly from the proposed site, recognizing the waste form chemistry may effect the mobility of contaminant.

g) Construct a section of the proposed final cover to verify the 0.01 cm/yr. infiltration rate incorporated into the EIS. The proposed final cover should also be used to verify the establishment and subsequent durability of the proposed plant community.

h) Install soil moisture monitors into the waste form, cushion, and below the liner system to monitor changes in soil moisture in response to construction and eventual closure of the landfill cells.

i) Develop a landfill-filling plan that is based upon waste compatibility issues and baseline projections of annual waste stream volumes and mass. The filling plan should be related to the operations and maintenance plan. During operations, management of leachate will be a primary concern.

j) Develop a preliminary closure and monitoring plan, to meet the substantive requirements of the Model Toxics Control Act.

k) Present all plans and documents to stakeholders prior to construction.

l) Gather information necessary to complete the Natural Resource Damage Assessment for the 200 Area prior to construction of the first landfill cell. Much of the 200 area seems to be slated for long term disposal of radioactive and hazardous waste. This action eliminates future use of the existing habitat and establishes a requirement for long term actions to manage the disposal site. Quantifying injury to natural resources under