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DETERMINATION OF SIGNIFICANCE AND ADOPTION OF EXISTING ENVIRONMENTAL DOCUMENT

Description of current proposal Construction of the 200 Area Effluent Treatment Facility (Project C-018H) at the Hanford Site. The plant will treat for disposal, radioactive and hazardous process waste. The treated effluent will be discharged into the soil column.

Proponent U.S. Department of Energy and Westinghouse Hanford Company

Location of current proposal The treatment plant would be built near the 200 East Area of the Hanford Site. A pipeline and discharge area will be selected nearby.

Title of document being adopted Hanford Environmental Compliance Project - NEPA Environmental Assessment (DOE/EA-0383)

Agency preparing the document being adopted U.S. Department of Energy

Date adopted document was prepared March 1992

Description of document (or portion) being adopted An Environmental Assessment (EA) prepared under the National Environmental Policy Act of the Hanford Environmental Compliance Project. The EA includes an analysis of the alternatives, the affected environment, and environmental impacts of Project C-018H. A supplemental addendum prepared by Ecology is attached.

If the document being adopted has been challenged (WAC 197-11-630), please describe:

We are not aware of any challenge

The document is available to be read at (place/time) Public comments will be accepted from October 15, 1993, until December 14, 1993. The document is available from the contact person listed below or at the Hanford Public Information Repositories:

Gonzaga University	University of Washington
Foley Center	Suzzallo Library
E. 502 Boone	Government Publications Room
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EIS REQUIRED. The lead agency has determined this proposal is likely to have a significant adverse impact on the environment. To meet the requirements of RCW 43.21C.030(2)(c), the lead agency is adopting the document described above. Under WAC 197-11-630, there will be no scoping process for this EIS.

We have identified and adopted this document as being appropriate for this proposal after independent review. The document meets our environmental review needs for the current proposal and will accompany the proposal to the decision maker.

Name of agency adopting the document Department of Ecology, Nuclear and Mixed Waste Management Program

Contact person, if other than responsible official Geoff Tallent Phone (206) 407-7112

Responsible official Dru Butler

Position Manager, Nuclear and Mixed Management Waste Program Phone (206) 407-7150

Address Department of Ecology, P.O. Box 47600, Olympia, WA 98504-7600

Date 11 + 6 1993 Signature DRU BUTLER

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The following information is incorporated by reference into this DS under WAC 197-11-635 and, upon request to the address above, is available for review during the comment period:

Document: Project C-018H Waste Water Engineering Alternatives Report - Supplementary Information on Engineered Disposal Structures (WHC-SD-C018H-ER-003)

Relevant Content: This report provides justification for the selection of a method and identification of a preferred site for the disposal of effluent from Project C-018H.

Document: Hanford Site NEPA Characterization (PNL-6415)

Relevant Content: This document, referenced throughout the checklist, describes the existing environment at the Hanford Site including plant and animal life and historic areas.

Document: 200 Area Effluent Treatment Facility: Delisting Petition (DOE/RL-92-72)

Relevant Content: This document contains the most recent information on the volumes and types of wastewater Project C-018H is designed to treat. It also provides detailed information on the proposals removal efficiencies.

ADDENDUM

Washington State Department of Ecology
Supplemental Analysis of the 200 Area Effluent Treatment Facility (Project C-018H)

Purpose

This addendum has been prepared to supplement and update the U.S. Department of Energy (USDOE) Hanford Environmental Compliance Environmental Assessment's analysis of the 200 Area Effluent Treatment Facility (ETF)[1]. Ecology has adopted the Environmental Assessment under the State Environmental Policy Act in lieu of preparing an Environmental Impact Statement for the ETF. The analysis provides background on the role of ETF at Hanford and the ETF effluent, including tritium. The analysis goes on to examine the proposed alternatives for tritium treatment by comparing tritium removal technologies and tritium discharge options. Finally, the addendum looks at the conditions Ecology will consider for the preferred option and evaluates other potential uses for ETF.

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Background

There are approximately 61 million gallons of waste stored in single and double-shell tanks at Hanford. The single-shell tanks have outlived their design life and some have begun to leak. USDOE proposes to move waste from those tanks into the more recently constructed double-shell tanks. In order to make room for this transfer, USDOE intends to use the 242-A Evaporator and the Liquid Effluent Retention Facility (LERF) basins. The evaporator concentrates liquid double-shell tank waste and returns the reduced volume of waste to the tanks. The by-product from the evaporator is a high volume, dilute wastewater which is sent to the LERF basins.

USDOE proposes to construct ETF to purify the wastewater stored in the LERF basins. The ETF will make use of filtration, oxidation, reverse osmosis, and ion exchange demineralization in series to remove more than 95 percent by weight of the expected total organic constituents and more than 99 percent by weight of the total inorganic constituents occurring in process wastewater[2]. The facility, however, is not designed to remove any tritiated water from the wastewater stream due to lack of available removal technology. Instead, USDOE is proposing to use the soil column to dispose of the treated effluent with the intent of allowing the natural decay of much of the tritium while traveling through the soil and groundwater ultimately to the Columbia River. Disposal would occur in an area selected to minimize the possibility of further impacts to existing groundwater problems.

Tritium, the radioactive form of hydrogen, has a half-life of 12.3 years and is a low-energy beta emitter which decays to helium-3. At the Hanford Site, tritium is found in stored wastes as well as in past practice soil and groundwater contamination. For example, a large tritium plume occurs in the groundwater beneath the 200 Area of the Hanford Site that has concentrations ranging up to more than 2,000,000 pCi/l [3]. The U.S. Environmental Protection Agency (EPA) Drinking Water Standard for tritium is 20,000 pCi/l, a value established by estimation of the health risk of ingestion of tritiated water.

Past disposal practices at Hanford have resulted in discharges of more than 440 billion gallons of contaminated process water from the 100 and 200 Areas into the soil column. From there it has percolated through the soil which has allowed for some radioactive decay and absorption of radionuclides before seeping into the Columbia River.

ETF is expected to discharge up to 172 gallons per minute (gpm) of wastewater. The facility will treat 150 gpm of cleanup wastewater and will discharge an additional 22 gpm of cooling water. It will operate up to 24 hours per day and produce up to 57 million gallons of effluent annually[2]. The treated effluent is expected to have an average concentration of less than 6,300,000 pCi/l with a maximum level of 24,000,000 pCi/l[4]. ETF could release from 200-2000 Ci over any given year[4,5]. Over the treatment plant's operating life it is not anticipated to exceed a total release of 3,300 Ci[4].

Tritium Separation Process

Ecology has found four tritium separation alternatives currently available which could theoretically meet the tritium separation requirement of ETF. All of the options have three similar drawbacks: they are very expensive, they have been applied only in small scale operations, and they were not designed to remove tritium - rather to concentrate it. The four options, evaluated in greater detail below, are: water-hydrogen sulfide gas exchange, cryogenic hydrogen distillation, water distillation, and combined electrolysis and catalytic exchange (CECE). Much of the analysis below is based on a report by E.D. Waters[6]. Research by Ecology staff has concurred with Waters' findings[7].

Water-Hydrogen Sulfide Gas Exchange

The first process is also known as the Girdler-Sulfide or GS process. This process has been used extensively for heavy water (deuterium) production. When applied to tritium rather than deuterium the reaction equation becomes:

Tritiated Water + Hydrogen Sulfide Gas = Water + Tritiated Hydrogen Sulfide Gas

The chemical exchange in a single stage does not provide adequate separation. A cascade of several columns is, therefore, generally used. It has not been used in detritiation because of the toxic and corrosive nature of the process (hydrogen sulfide gas). Using this method to separate tritium would result in a secondary large volume hazardous waste stream, including toxic and corrosive compounds. This is the least expensive of the tritium removal alternatives at a cost in excess of $90 million annually.

Cryogenic Distillation

The second process, cryogenic distillation, can be used in conjunction with electrolysis to provide a high degree of separation of hydrogen from tritium in the gas phase. The gaseous stream from the cathode of an electrolysis cell can be distilled to produce separate hydrogen and tritium gas streams. The degree of tritium separation from water that can be obtained with this combined approach is in the range of 99 percent. This is an extremely energy intensive process. Energy costs alone are projected to be over $79,000 per day to use this form of removal.

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Water Distillation

The third process is water distillation. It has several inherent advantages: simplicity of operation, reliability, proven technology with numerous industrial/government applications, no secondary waste streams, does not involve water-hydrogen gas conversion, is not sensitive to minor operating parameter upsets, and its ability to operate over a wide range of tritium feed concentrations and volumes. The degree of tritium separation from water that can be obtained is in the range of 90 to 99 percent. Westinghouse Hanford Company issued a report in 1990 which found that the water distillation process is the lead candidate for tritium cleanup of the reactor coolant system[8]. However, a cost estimate for a 4 gpm unit is $72 million. A treatment system to handle C-018H's 150 gpm would be very expensive.

Combined Electrolysis and Catalytic Exchange (CECE)

The fourth option, the CECE process with Atomic Energy of Canada Ltd. (AECL) hydrophobic catalyst, is ideally suited for extracting tritium from water because of its high separation factors and mild operating conditions. Belgium and Japan have also developed independently, similar processes called ELEX and EXEL which are also based on AECL's invention of hydrophobic catalyst. However, the design flow rates associated with these systems have been substantially less than one gallon per minute. In addition, process instabilities are expected at low tritium concentrations. This process is also the most costly process among these four processes.

In addition to the four processes addressed above, there are emerging technologies. One of them is a membrane process. Battelle Pacific Northwest Laboratory currently is conducting laboratory tests of aryloxy polyphosphazene pervaportation polymer membranes. Tests conducted to date indicate that a single stage can remove up to 80 percent of the tritium from a liquid waste stream. That means a two-stage membrane system achieves up to 96 percent removal efficiency and a three-stage system up to 99 percent. The operating and maintenance costs are expected to be low because of process simplicity. The newly developed membrane is the most promising technology for cost effective tritium separation. The expected development time for possible ETF application is about 4-10 years.

In summary, tritium removal for ETF, given today's technologies, is expensive and impractical. Future technologies, however, show promise of an affordable and effective treatment system. Once available, these treatment systems can be added to ETF. Ecology will require USDOE to add any feasible future treatment systems once available. Ecology will also, through the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement), require USDOE to continue evaluating emerging technologies and develop the ones which show promise. Without tritium removal technology today, however, some tritium discharge is inevitable if the tank wastes are to be treated. The next section examines the options for tritium discharge.

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Wastewater Discharge Options

Because tritium treatment technology is not currently feasible, Ecology must evaluate the available wastewater discharge options. The two greatest factors in selecting a discharge option are: 1) slowing the effluent travel to allow for decay of the tritium and other short-lived radionuclides, and 2) diffusing the released radionuclides to concentrations below health and safety limits. The goal of these two factors is to minimize the threat to human health and the environment. There are a number of methods for achieving these goals. Those include deep well injection, cascading discharge tanks, evaporation, soil disposal, and discharge to the Columbia River. Factors such as cost, regulatory feasibility, and secondary impacts preclude some of the discharge options. Ecology concurs with USDOE's selection, in the Hanford Environmental Compliance Environmental Assessment, of the three alternatives for discharge: groundwater, evaporation, and river discharge. Below, these alternatives and their public exposure estimates are examined.

Public exposures were estimated by the Washington Department of Health[9]. The estimates include exposure from all radionuclides released from ETF of which tritium and iodine (I^{129}) are major contributors. Although iodine is discussed below, Ecology has found that ETF provides sufficient treatment for iodine.

Soil Column Discharge Option

In this option, the treated effluent would be pumped into a shallow underground disposal trench (crib) adjacent to the 200 West Area for disposal to the soil column. Discharge through the soil to the slow-moving groundwater allows some natural decay of the radionuclides before resurfacing at a spring or the Columbia River. Additionally, use of the groundwater in this area is expected to be restricted for the next century. Due to its longer half-life, very little decay of radioactive iodine would occur.

Under this option, two public exposure pathways were examined. The first exposure pathway considers consumption, from a well or spring, of groundwater contaminated by ETF after some portion of the Hanford Site passes to "unrestricted use". Unrestricted use of the entire 100 Areas is assumed by 2118 (this date was taken as 100 years from the end of Hanford cleanup as suggested by the Hanford Future Site Uses Working Group)[10]. During the 124 years of control, the tritium would have decayed to 1/1000 of its original concentration. It is conservatively assumed that tritium and iodine are not held up in the vadose zone and that they are diluted by 50 percent in the aquifer. The maximally exposed individual's dose is estimated to be 2 mrem/yr. Additionally, because of the geographic limits of this pathway, the number of exposed individuals is expected to be lower than the other options.

The second public exposure pathway is consumption of river water once the contaminated wastewater has reached the Columbia River. Based on a study by Mark Freshley and Michael Graham, Ecology has estimated groundwater travel time may range from 5 to 100 years[11]. For public exposure, Ecology has conservatively assumed that the contaminated groundwater plume first reaches the Columbia River, and subsequently the maximally exposed individual at the Ringold Townsite, in 5 years. Public exposure is conservatively estimated to be 0.0005 mrem/yr.

Evaporation Option

In this option the effluent is heated and discharged to the atmosphere as vapor. If the quantity of liquid anticipated from this process is evaporated to the north of the 200 West Area, the nearest unrestricted "maximally exposed individual" at the site boundary would be located at the Ringold Townsite.

This option uses the air as a pathway to quickly dilute and disperse the radionuclides to levels below safety concerns. Air is the most variable in direction and unrestricted in dispersion of all pathways considered. Inhalation is also the most immediate pathway to the body of an off site individual. Air does, however, allow for the most immediate dilution of radionuclide concentrations. Public exposure is conservatively estimated to be 0.2 mrem/yr.

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River Discharge Option

In this option the treated effluent is piped to the Columbia River. The river as a pathway would use the water to dilute the effluent to below drinking water standards (an individual exposure of 4 mrem/yr). This option would be permitted under an EPA National Pollutant Discharge Elimination System Permit provided all the requirements for an appropriate mixing zone could be met. Public exposure estimates are assumed to be downriver from the discharge at the Ringold Townsite. As with air, this would be an unrestricted pathway, although the exposure route would be more predictable. Public exposure is conservatively estimated to be 0.2 mrem/yr.

In summary, Ecology has found that all three alternatives meet regulatory limits for dose to the public (<4 mrem/yr for drinking water and <10 mrem/yr for air). They all rely on established methods of dealing with radioactively contaminated wastewater. They are also economically and regulatorily feasible. Because no treatment system is available and the benefits to tank waste cleanup from operation of ETF are so great, Ecology accepts USDOE's selection of soil column discharge as the preferred alternative.

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Soil Column Discharge

In agreeing with USDOE on the preferred option, Ecology continues to maintain decision making authority over several aspects of the discharge. Ecology will issue a State Waste Discharge Permit in accordance with Chapter 173-216 WAC (Washington Administrative Code). The enforcement limits on contaminant concentrations in the discharge will be taken from Washington's groundwater quality standards (Chapter 173-200 WAC). The contaminant criterion for tritium discharge to the environment is 20,000 pCi/l.

Ecology requires "all known available and reasonable treatment" (AKART) along with compliance with groundwater criteria. ETF treatments meet AKART with the exception of tritium. The tritium in the waste is already present, so that prevention is impossible. Due to excessive costs, no reasonable method of treatment is known. Control of this discharge is proposed to be accomplished by discharge in an area so remote from surface water that a significant fraction of the radioactivity will be decayed before the tritiated discharge emerges from the ground.

Ecology will also put several conditions on ETF. First, wastewater going to ETF for treatment will be limited to quantities justified by cleanup needs. Second, the discharge point in the permit will be located at a position away from any previously known contaminant plume. This will minimize driving previously contaminated water toward the Columbia River more quickly than it is flowing at present. Third, monitoring wells will be required both to verify that the discharge plume is behaving as predicted and as a confirmation of the end of pipe sampling program.

Other Uses for ETF

ETF is a general purpose treatment system which has been designed to treat most waste types or concentrations to acceptable limits. This facility could be used to treat other waste streams. Of the many possibilities Ecology is currently considering groundwater remediation streams and K-Basin wastewater.

ETF could be used to treat some groundwater remediation waste streams. ETF would represent a proven treatment system already in place that could be used once groundwater remediation begins. One potential problem is that the contaminated groundwaters are very large volume, low-level wastewaters. The ETF is not able to accept additional large volumes and is less effective at lower concentrations. Its greatest potential would be with nearby, higher concentration contaminated plumes.

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Conclusion

From the information evaluated in this addendum, Ecology accepts USDOE's proposal to discharge the tritiated effluent from the Effluent Treatment Facility to the ground. Presently there are no reasonable treatment technologies to remove tritium from this effluent. In addition, Ecology finds the discharge option which USDOE has selected will adequately protect human health and the environment.

In accepting the ground discharge option, Ecology continues to maintain several controls over the discharge. Ecology will issue a wastewater discharge permit for the effluent. In that permit Ecology will consider the siting of the discharge and its impacts on already contaminated groundwater and soils, the relationship of this treatment system to other cleanup activities at Hanford, future consumption of Hanford groundwater, and discharge limits. Furthermore, Ecology will continue to encourage USDOE to develop tritium removal technology through the establishment of milestones within the Tri-Party Agreement.

References

1. U.S. Department of Energy, *Hanford Environmental Compliance Project Environmental Assessment* (DOE/EA-0383), U.S. Department of Energy, Richland, Washington, March 1992.

2. U.S. Department of Energy, *200 Area Effluent Treatment Facility: Delisting Petition* (DOE/RL-92-72), U.S. Department of Energy, Richland, Washington, August, 1993

3. R.E. Jacquish and P.J. Mitchell, *Environmental Monitoring at Hanford for 1987*, Prepared for U.S. Department of Energy by Pacific Northwest Laboratory, Richland, Washington, 1988

4. J. M. Hennig, U.S. Department of Energy, Letter to Dru Butler, Manager, Washington Department of Ecology, Nuclear and Mixed Waste Management Program, October 5, 1993.

5. Westinghouse Hanford Company, *Project C-018H Waste Water Engineering Alternatives Report* (WHC-SD-C018H-ER-001), Prepared for the U.S. Department of Energy by Westinghouse Hanford Company, Richland, Washington, 1992

6. E.D. Waters, *Consideration of Disposal Alternatives for Tritium-Contaminated Wastewater Streams at Hanford* (WHC-EP-0118), Prepared for the U.S. Department of Energy by Westinghouse Hanford Company, Richland, Washington, March 1988

7. Mike Gordon, *Tritium Removal Technology*, Memorandum to Toby Michelena, Technology Assessment Unit Supervisor, Washington Department of Ecology Nuclear and Mixed Waste Management Program, 1993

8. R.L. Ferguson and Associates, Inc., *Investigation Results for WNP-1 Tritium Cleanup Technology* (WHC-SD-WNP-ER-043), Prepared for Westinghouse Hanford Company, Richland, Washington by R.L. Ferguson and Associates, Inc., 1990.

9. John Erickson, Washington Department of Health, Environmental Radiation Section, Memo to David Jansen, Washington Department of Ecology, Nuclear and Mixed Waste Management Program, September 7, 1993.

10. Hanford Future Site Uses Working Group, *The Future for Hanford: Uses and Cleanup*, Washington, December, 1992

11. Mark D. Freshley and Michael J. Graham, *Estimation of Ground-Water Travel Time at the Hanford Site: Description, Past Work, and Future Needs*, Prepared for the U.S. Department of Energy, Richland, Washington by Pacific Northwest Laboratory, Richland Washington, 1988

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