[6450-01-P]

Record of Decision
Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington

AGENCY: Department of Energy

ACTION: Record of Decision; Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington

SUMMARY: The Department of Energy has considered the environmental impacts, benefits and costs, and institutional and programmatic needs associated with the decommissioning of eight surplus production reactors at the Hanford Site, Richland, Washington. Based on this review, the Department of Energy has decided on safe storage followed by deferred one-piece removal of these eight surplus production reactors at the Hanford Site. The Department of Energy intends to complete this decommissioning action consistent with the proposed Hanford cleanup schedule for remedial actions included in the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement). Therefore, the safe storage period would be for less than the 75-year time frame outlined in the Final Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington (DOE/EIS-0119F, December 1992). Also, the Department of Energy intends to evaluate the priority of this decommissioning action relative to Comprehensive Environmental Response, Compensation, and Liability Act and Resource Conservation and Recovery Act remediation of the past practice units in the 100 Area being conducted under the Tri-Party Agreement. Should this decision prove to be inconsistent with subsequent Comprehensive Environmental Response, Compensation, and Liability Act and Resource Conservation and Recovery Act decisions, the Department of Energy will re-evaluate the appropriateness of proceeding with this course of action on an Operable Unit-by-

Operable Unit basis. Until decommissioning is initiated, the Department of Energy will continue to conduct routine maintenance, surveillance, and radiological monitoring activities to ensure continued protection of the public and the environment during the safe-storage period.

FOR FURTHER INFORMATION CONTACT:

For further information on the Final Environmental Impact Statement, contact Michael Talbot, Acting Director, Office of Communications, Richland Operations Office, U.S. Department of Energy, Richland, Washington, 99352 Telephone: (509) 376-7501. For further information on the Department of Energy National Environmental Policy Act process, contact Carol M. Borgstrom, Director, Office of NEPA Oversight (EH-25), Office of Environment, Safety and Health, U.S. Department of Energy, 1000 Independence Avenue SW, Washington, DC 20585 Telephone: (202) 586-4600 or (800) 472-2756.

SUPPLEMENTAL INFORMATION:

The Department of Energy prepared this Record of Decision pursuant to the Council on Environmental Quality Regulations for implementing the procedural provisions of the National Environmental Policy Act (40 CFR Parts 1500-1508, December 15, 1987) and Department of Energy regulations implementing the National Environmental Policy Act (10 CFR Part 1021). This Record of Decision is based on the Department of Energy Final Environmental Impact Statement for the Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington (DOE/EIS-0119F).

The Hanford Site manufactured nuclear materials for the Nation's defense programs for over 40 years. To assist in this nuclear materials production, nine watercooled, graphite-moderated plutonium-production reactors were constructed along the Columbia River by the U.S. Government at the Hanford Site near Richland, Washington, between the years 1943 and 1963. Eight of these reactors (B, C, D, DR, F, H, KE, and KW), operated between the years 1944 and 1971, have been retired from service. These reactors have been declared surplus by the Department and are available for decommissioning. The ninth reactor, N-Reactor, is in transition to deactivation. The N-Reactor is not available for decommissioning at the present time and is not within the scope of the Final Environmental Impact Statement or this Record of Decision. The Department will prepare appropriate environmental documentation when N-Reactor becomes available for decommissioning. The Department has nominated the B-Reactor for inclusion in the National Register of Historic Places in accordance with the opinion of the Washington State Historic Preservation Officer and the provisions of 36 CFR Part 800, "Protection of Historic and Cultural Properties." On April 3, 1992, the National Park Service entered the Reactor in the National Register.

Today, the primary mission of the Hanford Site is environmental restoration. On May 15, 1989, the Department of Energy, the U.S. Environmental Protection Agency and the Washington State Department of Ecology signed an agreement to remediate radioactive and chemical waste at the Hanford Site. This agreement is the Hanford Federal Facilities Agreement and Consent Order, commonly known as the Tri-Party Agreement. The purpose of the proposed decommissioning activity at the eight reactor facilities is to isolate any remaining radioactive, mixed or hazardous waste in a manner that will ensure environmental impacts remain at an acceptable level, especially potential health and safety impacts to the public.

Analysis of the existing environment and the potential environmental impacts associated with decommissioning of the eight surplus production reactors is presented in the Final Environmental Impact Statement for Decommissioning Eight Surplus Production Reactors at the Hanford Site, Richland, Washington.

In March, 1989, the Department of Energy issued a Draft Environmental Impact Statement (DOE/EIS-0119D) to analyze the impacts of the proposed action. Comments received during the public and agency review process of the Draft Environmental Impact Statement did not require the Department to modify any alternatives, to develop and evaluate any new alternatives, or to supplement, improve, or modify its analyses of the decommissioning alternatives. Therefore, the Department prepared and distributed an Addendum to the Draft Environmental Impact Statement in accordance with 40 CFR 1503.4(c). The Addendum (December 1992) states the Department of Energy's response to issues raised by commentors. The Draft Environmental Impact Statement and the Addendum constitute the Final Environmental Impact Statement (DOE/EIS-0119F) under the provisions of the Council on Environmental Quality regulations (40 CFR Part 1503.4(c)). The Notice of Availability of the Final Environmental Impact Statement was published in the Federal Register on January 15, 1993 (58 FR 4690). In addition to the proposed action of safe storage followed by deferred one-piece removal, the document discusses a no-action alternative for continuation of surveillance, monitoring and maintenance activities; an immediate one-piece removal alternative; a safe storage followed by deferred dismantlement alternative; and an in-situ decommissioning alternative. The proposed action and alternatives are described further below.

Alternatives Considered

1. *Proposed Action*: The proposed action is safe storage followed by deferred

one-piece removal. The proposed action consists of a safe storage period during which surveillance, monitoring, and maintenance are continued, followed by transport of each reactor block, intact on a tractor-transporter, from its present location in the 100 Area to the 200 West Area for disposal (a distance of about 5 to 14 miles, depending on the reactor location relative to the disposal site). Contaminated materials associated with the fuel storage basins would also be removed for disposal in the 200 West Area, along with contaminated equipment and components associated with the reactors. Uncontaminated portions of the fuel storage basin would be removed to provide access for the tractor-transporter. Other uncontaminated structures and equipment would be demolished and placed in landfills in the vicinity of the reactor sites. During preparation for safe-storage, building components and structures would be repaired as needed to ensure the safety and security of the facility during the safe-storage period. Building security, radiation monitoring, and fire detection systems would be upgraded to provide safety, security, and surveillance as long as required. The total cost for safe storage followed by deferred one-piece removal of all eight reactors was estimated to be about $235 million in 1990 dollars. Occupational radiation doses were estimated to be about 51 person-rem for this alternative; short-term public radiation doses were estimated to be near zero. A hypothetical safe storage period of 75 years was used to estimate additional radiological inventory decay and surveillance and maintenance costs. Of the possible accidents associated with the proposed action, only the scenario involving the accidental dropping of a reactor block during transport was analyzed in detail because this scenario would yield the largest potential radiological consequences. This scenario would involve atmospheric resuspension of graphite powder that would cause an estimated population dose of 300 person-rem, which would most likely produce no health effect. Near-term ecological impacts would be minimal because the area under consideration has already been disturbed as a result of other radioactive waste management activities and nuclear facility operations.

2. *No Action*: The no-action alternative is to continue the present action of routine surveillance, monitoring, and maintenance of the reactor structures for an indefinite period. These activities are the same as those required by safe-storage followed by deferred one-piece removal. Over the 100-year analysis period considered in the Environmental Impact Statement (and over any subsequent 100-year period), the cost to continue the present action was estimated to be approximately $44 million in 1990 dollars. The occupational radiation dose over the first 100-year period for surveillance, monitoring, and maintenance was estimated to be about 24 person-rem; short-term public radiation doses were estimated to be near zero. At the end of the 100-year surveillance, monitoring and maintenance period, decommissioning would still be required and subsequent environmental impacts would be similar to those from the other alternatives discussed.

Also considered was a second no-action alternative: doing nothing further, which would include the closure of the facilities and the discontinuation of all related activities. This no-action alternative was not analyzed in detail, because it would not: 1) properly isolate the remaining contaminated materials in the facility from the environment, 2) provide any maintenance or repair of the structures and 3) make any other provisions for protection of human health and safety.

3. *Immediate One-Piece Removal*: Immediate one-piece removal involves transportation of each reactor block, intact on a tractor-transporter, from its

present location in the Hanford 100 Area to the Hanford 200 West Area for disposal. The reactor block includes the graphite core, the thermal and biological shields, and the concrete base. Contaminated portions of the associated fuel storage basins would also be removed and disposed of in the 200 West Area, along with other contaminated equipment and components in buildings that house the reactors and fuel storage basins. Uncontaminated portions of the fuel storage basins would then be removed to provide access for the tractor-transporter. Other uncontaminated structures would be salvaged if usable or demolished and placed in waste areas at or near the reactor sites. The total cost for immediate one-piece removal of all eight reactors was estimated to be about $228 million 1990 dollars. Occupational radiation doses were estimated to be about 159 person-rem for this alternative, and short-term public radiation doses were estimated to be near zero. Under a postulated accident (dropped reactor block scenario, discussed above), population dose would be approximately the same as the dose evaluated for the proposed action. Near-term ecological impacts would be minimal because the area under consideration has already been disturbed as a result of other radioactive waste management activities and nuclear facility operations.

4. *Safe Storage Followed by Deferred Dismantlement*: Safe storage followed by deferred dismantlement means a safe-storage period during which surveillance, monitoring, and maintenance are continued, followed by piece-by-piece dismantlement of each reactor, and transport of radioactive waste to the 200 West Area for disposal. Activities during preparation for safe storage and during the safe storage period are approximately the same as those in the safe storage followed by deferred one-piece removal alternative. At the end of the safe storage period, each reactor block would be disassembled piece-by-piece, and all

contaminated equipment and components would be packaged and transported to the 200 West Area for disposal. Contaminated portions of the associated fuel storage basins, along with contaminated equipment and components, would also be removed for disposal in the 200 West Area. Uncontaminated structures and equipment would be demolished and placed in landfills in the vicinity of the reactor sites. The total cost for safe storage followed by deferred dismantlement of all eight reactors was estimated to be about $311 million in 1990 dollars. Occupational radiation doses were estimated to be about 532 person-rem for this alternative; short-term public radiation doses were estimated to be near zero. A safe-storage period of 75 years was used to estimate additional radiological inventory decay and surveillance and maintenance costs. Of the accidents postulated for this alternative, a severe weather accident (storm) during dismantlement and a rail car accident involving fire during transport of radioactive wastes to the burial ground were determined to have the largest potential radiological consequences. If these accidents were to occur they would result in a maximum population dose of 300 person-rem from the severe weather scenario and 800 person-rem from the rail car accident (i.e., each scenario would most likely produce no health effect). Ecological impacts would be minimal because much of the area under consideration has already been disturbed as a result of radioactive waste management activities and nuclear facility operations.

5. *In-Situ Decommissioning*: In-situ decommissioning involves preparing each reactor block for covering with a protective mound and engineered barrier and constructing the mound and barrier. Surfaces within the facility would be painted with a fixative to ensure retention of contamination during subsequent activities. Roofs, superstructures, and concrete shield walls would be removed down to the level of the top of the reactor block. Structures surrounding the

shield walls would be demolished and left in place. Voids, piping and other channels of access would be back-filled with grout/gravel or similar material to ensure isolation of the reactor from the environment. Finally, the reactor block, its adjacent shield walls, and the spent fuel storage basin, together with the contained radioactivity, gravel, and grout, would be covered to a depth of at least five meters with a mound containing earth and gravel and topped with an engineered barrier designed to limit water infiltration to 0.1 centimeter per year. Riprap on the sides of the mounds would ensure structural stability of the mounds and mitigate the impacts of any flood that might reach the reactors. The total cost of in-situ decommissioning of all eight reactors was estimated to be about $193 million in 1990 dollars. Occupational radiation doses were estimated to be about 33 person-rem for this alternative, and short-term public radiation doses during the decommissioning period were estimated to be near zero. No accident scenarios which would result in a radiological release were postulated for this alternative. Near-term ecological impacts would be minimal because the area under consideration has already been disturbed as a result of other radioactive waste management activities and nuclear facility operations. The mounds and subsequent monitoring systems would be maintained for an institutional control period of at least 100 years.

Decision

Based on its review of the environmental impacts, of total project cost, and of the results of the public review process, the Department has decided on safe-storage of the eight reactors followed by deferred one-piece removal. Because the environmental impacts of the alternatives do not offer a strong basis for selection, the Department also considers this to be one of three environmentally preferable alternatives. This selection is consistent with both the Department of Energy's preferred alternative in the Final Environmental Impact Statement and the Tri-Party Agreement. The Department proposes to complete the decommissioning of the eight surplus production reactors, consistent with related activities scheduled under the Hanford Tri-Party Agreement. The Department intends to integrate and prioritize this decision with the related Comprehensive Environmental Response, Compensation, and Liability Act or Resource Conservation and Recovery Act remediation activities scheduled under the Tri-Party Agreement. Should this decommissioning decision eventually be shown to be inconsistent with subsequent remediation decisions, the Department of will reevaluate the appropriateness and timing of proceeding with this decision on an operable unit-by-operable unit basis.

The environmental impacts of the alternatives do not offer a strong basis for selection among the alternatives (see Table 1). Although there are apparent differences in occupational radiation dose among the alternatives, all of the estimated doses are small and no occupational cancer fatalities would be expected for any of the alternatives. The action alternatives would result in very similar environmental impacts. Estimated radiation doses and impacts from drinking water from a hypothetical well drilled near a waste disposal site were low for all of the action alternatives. Estimated radiation doses and impacts from potential accidents were also low for all action alternatives. Impacts associated with long-term population dose estimates for the action alternatives would be essentially the same and small.

The No Action Alternative would result in greater radiation doses from drinking water from a hypothetical well drilled near a reactor site than any of the action alternatives. The impacts associated with long-term population dose for the No

Table 1. Factors Considered in Selecting a Decommissioning Alternative.[a]

Decommissioning Alternative	Occupational Radiation Dose (Person-Rem)	Occupational Cancer Fatalities	Total Cost (millions of 1990 $)	Population Dose over 10,000 years[b] (person-rem)	Population Cancer Fatalities over 10,000 years	Maximum Well Dose[c] (rem/yr)
No action (continue present action)	24	0	44	50,000	20	1.2
Immediate one-piece removal	159	0	228	1,900	1	0.04
Safe storage followed by deferred one-piece removal	51	0	235	1,900	1	0.04
Safe storage followed by deferred dismantlement	532	0	311	1,900	1	0.04
In situ decommissioning	33	0	193	4,700	2	0.03

(a) Quantities are for all eight reactors. Costs are for 100 years.
(b) The Department of Energy used a conversion factor of 400 cancer deaths per one million person-rem.
(c) This is the maximum dose rate to a person drinking water from a well drilled near the waste disposal site at any time up to 10,000 years.

Action Alternative would also be greater than for any of the action alternatives.

The Department did not select the No Action Alternative or the In-Situ Decommissioning Alternative because neither of these alternatives would remove the reactor cores from the 100 Area; removal of the reactor cores from the vicinity of the Columbia River was favored by the majority of the commentors, and because of the increased long-term and drinking water impacts as compared to the action alternatives.

The Department does not prefer the Safe Storage Followed by Deferred Dismantlement Alternative because it would result in a higher occupational radiation dose and because the costs would be substantially higher than costs of other action alternatives and provide no commensurate additional benefits. Safe Storage Followed by Deferred One-Piece Removal consistent with the time frame of the Tri-Party Agreement would result in removal of the reactor cores on a schedule that would be somewhat delayed from the 12-year schedule for immediate one-piece removal. While the majority of commentors prefer immediate one-piece removal, leaving the reactors in place during the safe storage period would pose no significant environmental risks. The slightly higher total cost for Safe Storage Followed by Deferred One-Piece Removal as compared with Immediate Removal is attributable to surveillance and maintenance costs during the safe storage period. The cost differential would be reduced by the reduction in the safe storage period from the 75 years used in the analysis. In choosing safe storage followed by deferred one-piece removal, the Department considered the priority of this proposed action relative to other remedial actions the Department may need to conduct at the Hanford Site.

Environmentally Preferred Alternative: The Department of Energy regards the Safe Storage Followed by Deferred Dismantlement, Safe Storage Followed by One-Piece Removal, and Immediate One-Piece Removal Alternatives as equally favorable based solely on the evaluation of environmental impacts. Therefore, the selected alternative is also identified as one of the environmentally preferred alternatives.

Environmental Impacts and Mitigation Measures: The environmental impacts associated with the selected action include consequences related to routine and non-routine conditions. Modeling assumptions and accident scenarios used in this evaluation are considered conservative by the Department of Energy. The analyses were conducted in such a manner that the calculated environmental impacts would exceed those actually expected or experienced. In assessing the radiological consequences from postulated accidents for this selected course of action, for example, it was assumed that the reactor block drops from the tractor-transporter, crushing one edge. As a result, it was assumed that approximately 1% of the total block volume (about 10 cubic meters) will be reduced to a fine powder, of which approximately 1% would be resuspended by wind for an 8-hour period before recovery operations stabilize the material. These assumptions and values are very conservative when compared to values provided by the U.S. Environmental Protection Agency for fugitive emissions from a number of industries in the United States. These assumptions are not intended to be predictions of actual future consequences.

Environmental impacts associated with the selected course of action could result from decommissioning actions; accidents during decommissioning actions; and long-term, post-decommissioning releases of radionuclides from the disposal of low-level radioactive waste. Occupational radiation doses were estimated at 51 person-rem for the decommissioning of all eight surplus production reactors, and public radiation doses during the decommissioning period were estimated to be nearly zero. Radiological consequences to the general public from a postulated accident (dropped reactor block scenario discussed above) were assessed. It was determined that the dose to the maximally exposed individual would be 80 millirem, and the population dose would be 300 person-rem. No adverse health effects would be expected from such an exposure. Long-term radiological releases to the ground water from the 200 Area disposal site and associated consequences were also calculated. It was estimated that the population dose from this long-term release would be about 1,900 person-rem over a postulated 10,000-year period (This same population would receive 9 billion person-rem from natural radiation sources over the 10,000-year time frame.). It was also assumed that loss of institutional control occurs after 100 years, and that the Hanford Site is used for other purposes. Maximum individual doses to persons that might drink water from wells drilled near the waste disposal site over a 10,000-year period were calculated, assuming dilution, to be approximately 0.04 rem per year. Also, a full garden scenario in which it was assumed that an individual would use contaminated water from a well that intercepts all of the contamination leached from one reactor for irrigation, livestock and drinking water was assessed. Based on extremely conservative assumptions for this scenario, it was estimated that an individual using a well located 5 kilometers from the 200 West Area disposal site would receive a lifetime (70 years) dose of 95 rem [The estimated probability that this individual would die from cancer induced by this radiation dose would be about 5 x 10-2 (or 1 chance in 20)], with the maximum dose occurring at 6,160 years following disposal. Migration of radioactive waste from the 200 West

Area disposal site to the Columbia River is estimated to result in an inconsequential maximum lifetime dose of $1.1x10^{-5}$ rem to an individual living along the River.

Ecological impacts from the preferred alternative would be minimal because much of the area under consideration has been previously disturbed as a result of past radioactive waste management activities. Temporary disturbance of wildlife would occur resulting from activities required to prepare the reactor buildings for decommissioning. Additional temporary ecological impacts may occur as a result of local excavation to obtain soil for backfilling the 100 Areas after removal of the surplus reactors.

Adverse environmental impacts that can be mitigated would include impacts resulting from occupational radiation doses, disruption of land areas, and migration of chemicals and radionuclides caused by water infiltration through waste disposal sites. The principle of maintaining radiation exposures as low as reasonably achievable will be applied in every phase of engineering planning that deals with radioactive material. All workers engaged in decommissioning activities will be required to wear dosimeters to detect excess radiation doses. All radiation zones will be monitored and approved before workers will be allowed to enter. Protective shields, remotely operated tools and contamination control envelopes will be employed when appropriate. Sites used for backfill soil, dirt and gravel will be surveyed for archeological resources and endangered or threatened species, and will be rehabilitated once the proposed action is complete. Water migration through the waste disposal sites will be mitigated by the installation of a multi-layer, engineered barrier consisting of a capillary layer of fine-textured soil underlain by an impervious layer of soil/bentonite clay.

Socioeconomic impacts are caused primarily by the influx (or egress) of workers required by the project. The maximum number of workers required onsite at any one time for any decommissioning alternative is 100. This number is less than 1% of the workers presently on the Site and would produce negligible socioeconomic impacts.

Resources committed to the decommissioning of the Hanford surplus reactors would include the land on which the reactors now stand, the land required for low-level waste disposal for the one-piece removal alternative, and for the energy necessary to carry out the alternative.

The Department of Energy nominated the B-Reactor for inclusion in the National Register of Historic Places in accordance with the opinion of the Washington State Historic Preservation Officer and the provisions of 36 CFR Part 800, "Protection of Historic and Cultural Properties." On April 3, 1992, the National Park Service entered the B-Reactor in the National Register. Specific actions to mitigate the cumulative impacts of decommissioning on the historic preservation of B-Reactor will be determined later in accordance with 36 CFR Part 800. Actions to preserve this historic resource may include extensive recordation by photographs, drawings, models, exhibits and written histories, and may also include preservation of some portions of the B-Reactor for display on or near its present location or at some other selected location.

CONCLUSION

The Department of Energy has considered the short- and long-term environmental impacts, costs, results of the public hearing process, and the priority of this proposed action relative to other remedial actions being conducted at the Hanford Site for decommissioning the eight surplus reactors. The Department of Energy has decided to decommission the reactors by safe-storage followed by one-piece removal in coordination with other actions at Hanford, and consistent with environmental standards applicable at the time the action is taken. The Department of Energy will continue to evaluate the benefits of measures to avoid or minimize environmental impacts associated with this decision.

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