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DOE/RL-94-101

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Proposed Plan for Interim Remedial Measures at the 100-HR-1 Operable Unit

Hanford Site
Richland, Washington

9413293.3787

Date Published
September 1994

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

SEP 1994
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DISCLM-4.CHP (1-91)

94U3293.3788

PROPOSED PLAN FOR INTERIM REMEDIAL MEASURES AT THE 100-HR-1 OPERABLE UNIT

Hanford Site, Richland, Washington

DOE, EPA, AND ECOLOGY ANNOUNCE PROPOSED PLAN

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This proposed plan introduces the interim remedial measures for addressing contaminated soil at the 100-HR-1 Operable Unit, located at the Hanford Site. In addition, this plan includes a summary of other alternatives analyzed and considered for the 100-HR-1 Operable Unit. This document is issued by the Washington State Department of Ecology (Ecology), as the lead agency; the U.S. Environmental Protection Agency (EPA), the support agency; and the U.S. Department of Energy (DOE), responsible agency.

> The EPA, DOE, and Ecology believe that a combination of removal, treatment, and disposal technologies, where appropriate, would significantly reduce the potential threats to human health and the environment at the 100-HR-1 Operable Unit high-priority waste sites. The remedial actions described in this proposed plan are designed to minimize human health and ecological risks and ensure that additional contaminants originating from these waste sites are not transported to the groundwater.

In order to protect human health and the environment, the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA)[1] enables the EPA to respond to potential threats of contamination at sites identified on the *Superfund National Priorities List*. The 100 Areas of the Hanford Site were placed on the *National Priorities List* on November 3, 1989, because of soil and groundwater contamination resulting from the past operation of nuclear facilities.

The DOE conceived and implemented the Environmental Restoration Program in response to the 100 Areas being placed on the *National Priorities List*. The objective of the Environmental Restoration Program is remediation of the contaminated waste sites in the 100 Areas in accordance with applicable regulations. The Environmental Restoration Program proposes using past-practice waste site remediation along with reactor and facility decontamination and demolition to prepare the 100 Areas for removal of the site from the *Superfund National Priorities List*.

This proposed plan is intended to be a fact sheet for public review that summarizes the comparison analysis of different remedial alternatives. This analysis is presented in greater detail in the *100-HR-1 Focused Feasibility Study Report*. The public is encouraged to review the following documents to gain a comprehensive understanding of the 100-HR-1 Operable Unit:

- *Resource Conservation and Recovery Act Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-1 Operable Unit* (DOE/RL-88-35)
- *100-HR-1 Limited Field Investigation* (DOE/RL-93-51)
- *Qualitative Risk Assessment for the 100-HR-1 Operable Unit Report* (WHC-SD-EN-RA-004)
- *100-HR-1 Focused Feasibility Study Report* (DOE/RL-94-63)
- *100 Areas Feasibility Study, Phases 1 and 2* (DOE/RL-92-11)

[1]Technical terms and words are defined in the glossary located at the end of the document.

These documents are available at the following locations:

- U. S. DOE, Richland Operations
  Administrative Record Center
  2440 Stevens Center Place
  Richland, Washington 99352

- EPA Region 10
  Superfund Record Center
  Park Place Building, 7th Floor
  Seattle, Washington 98101

- Washington State Dept. of Ecology
  Administrative Record
  719 Sleater-Kinney Road S. E.
  Capital Finance Building, Suite 200 Lacey,
  Washington 98503

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SITE BACKGROUND

The H Reactor is a former DOE plutonium production nuclear reactor that was in operation between 1949 and 1965. The operation of the reactor resulted in contamination of many support facilities, adjacent soil, and groundwater. For the purposes of DOE's Environmental Restoration Program, contaminated areas at the 100-H reactor were subdivided into three operable units: 100-HR-1, 100-HR-2, and 100-HR-3.

The 100-HR-1 Operable Unit, shown in Figure 1, encompasses an area of approximately 100 acres (40.5 hectares). Solid waste burial grounds in the vicinity of the H Reactor comprise the 100-HR-2 Operable Unit (not shown on Figure 1). Groundwater underlying the 100-HR-1 and 100-HR-2 Operable Units is addressed as part of the 100-HR-3 Operable Unit.

WASTE SITE HISTORIES

100-HR-1 Operable Unit high-priority waste sites are presented in Table 1. The table summarizes information on the former use of each site and provides information on approximate waste site dimensions. Waste site locations are shown on Figure 2 (except for those waste sites that have already been decommissioned and decontaminated, as identified in Table 1). Following is a brief description of each site.

Retention Basin (116-H-7). The retention basin was an integral component of the H Reactor cooling system. The basin held reactor cooling water for brief periods of time, allowing radioactive decay and thermal cooling to occur before the water was discharged to the Columbia River. The retention basin has the capacity to hold 24 million gallons of cooling water. Cracks in the concrete walls and floor of the basin resulted in extensive cooling water leakage to adjacent soils. Principal soil contaminants include isotopes of cesium, cobalt, europium, plutonium, radium, and strontium, as well as lead and arsenic. Today, the basin is fully backfilled and stabilized with clean soil.

Process Effluent Trenches (116-H-1). The process effluent trenches consist of a series of 3 earthen trenches that are located about 350 feet south of the retention basins (116-H-7). During their life, the trenches received an estimated 23 million gallons of waste fluid that was contaminated with radionuclides and hazardous chemicals. The waste fluid was diverted from the retention basin during reactor outages due to fuel element failures. The trenches also received sludge during deactivation of the retention basin. Principal radioactive soil contaminants are isotopes of cesium, cobalt, plutonium, and europium. In addition, arsenic, lead, chromium, and chrysene are present. The trenches have been fully backfilled and stabilized with clean soil.

Pluto Crib (116-H-4). The Pluto crib was an earthen pit that received an estimated 260 gallons of radioactive liquid waste. The liquid waste consisted of contaminated cooling water from reactor process tubes containing ruptured fuel elements. The liquid flowed through the crib, downward into the soil column. The crib was exhumed in 1960 so that the 132-H-2 filter building could be constructed at the same location. Soil from the crib was placed in the 118-H-5 burial ground (in the 100-HR-2 Operable Unit) and remaining soil contamination, if any, is not known. The Pluto crib site today is a fenced, flat, gravel-covered area.

Process Effluent Pipelines (100-H). During reactor operation, buried pipelines were used to transport cooling water form the H Reactor to support facilities such as the retention basin and disposal trenches. Soil contamination resulting from pipeline leakage has not been identified to date. The pipelines, however, are believed to be contaminated and to contain sludge and residue contaminants. Principal pipeline contaminants are isotopes of cesium, cobalt, europium, plutonium, radium, and strontium. Arsenic and lead are also

Figure 1. 100-HR-1 Operable Unit

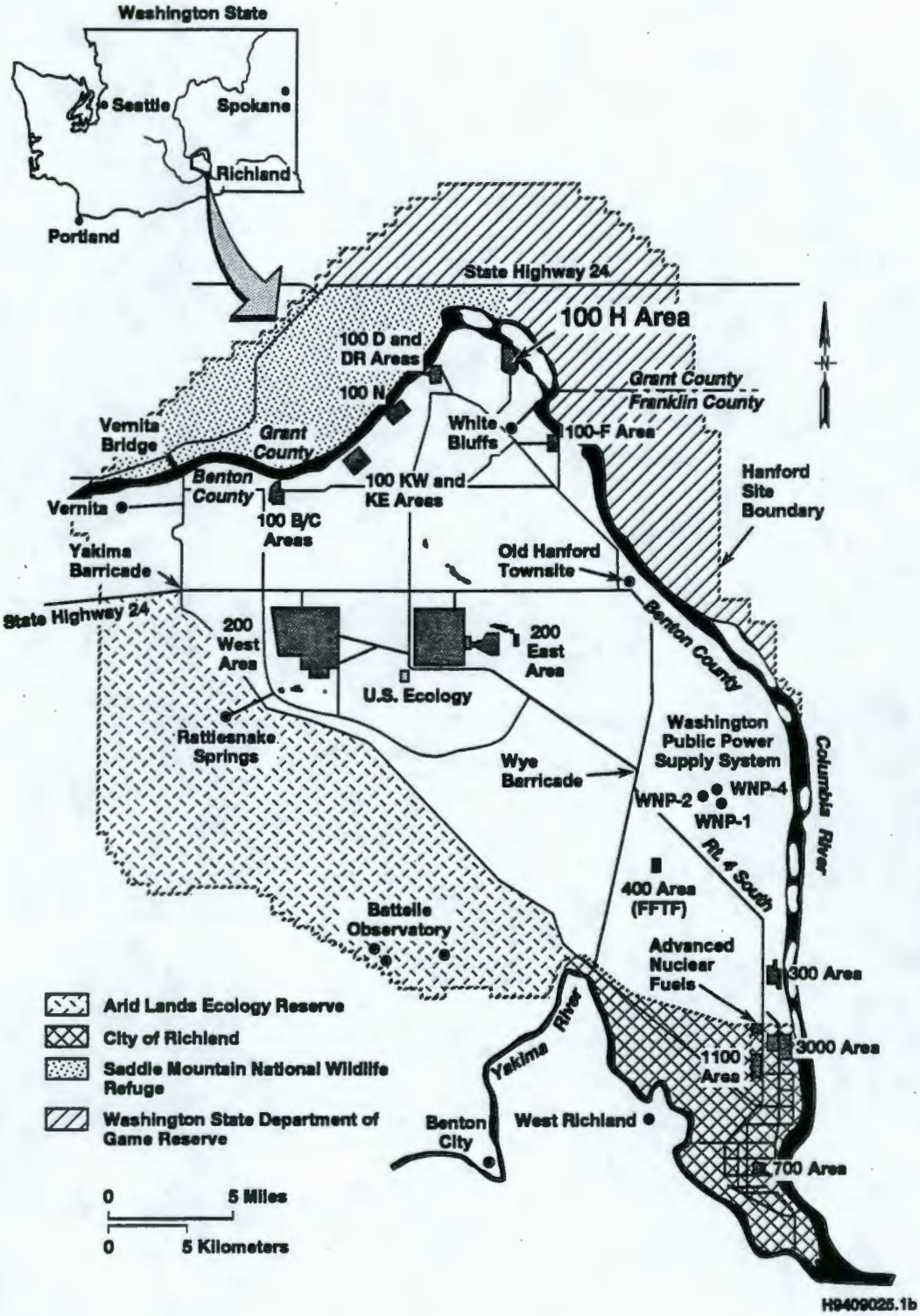

Table 1. Description and History of 100-HR-1 Operable Unit IRM Candidate Sites.

Waste Site Category	Waste Site Group	Waste Site Number	Former Waste Site Use	Approximate Site Dimensions
Soil	Retention Basins	116-H-7	Held cooling water effluent from H Reactor for cooling/decay before release to the Columbia River. Large leaks of effluent to soil.	Reinforced concrete retention basin, single containment. 183 m x 83 m x 6 m deep; estimate volume and area of contaminated soil are 56,483 m^3 and 18,828 m^2, respectively.
	Process Effluent Trenches	116-H-1	Received high activity effluent produced by failed fuel elements. Received sludge from 116-H-7 retention basin when 100 H Area was deactivated.	Unlined trench. 91 m x 30 m x 4.6 m deep; estimated volume and area of contaminated soil are 25,607 m^3 and 21,970 m^2, respectively.
	Cribs	116-H-4	Received cooling water discharge contaminated by failed fuel elements. Crib was excavated and material buried in 118-H-5 burial ground. 132-H-2 building was later built on the same site.	Unlined pluto crib. 1.2 m x 1.2 m x 0.6 m deep; not known if any soil contamination remains following the excavation of the crib.
	Pipelines	100-H	Transported reactor cooling water from reactors to retention basins, outfall structures, and disposal trenches, contains contaminated sludge and scale.	Buried process effluent pipelines. Total length ≈ 610m pipe diameter - 152 cm buried 6 m below surface; no known soil contamination.
Solid Waste	Decontamination Decommissioning	132-H-1	Reactor exhaust stack, decontaminated and demolished in-place during 1983 and covered with 1 m of clean fill.	Demolished concrete exhaust 51 m high x 5 m diameter.
	Decontamination Decommissioning	132-H-2	Exhaust air filter building used to filter reactor building air before releasing to 132-H-1 stack; decontaminates and demolished in-place during 1984 and covered with clean fill.	Demolished reinforced concrete building 18 m x 12 m x 11 m high.
	Decontamination Decommissioning	132-H-3	Effluent pumping stations that collected and pumped water from the H Reactor drains into the 116-H-7 basin; water and sludge were removed from the station before decontamination and decommissioning in 1987; covered with 5 m of clean fill.	Four concrete sumps, capacity of about 1.2 million gallons.

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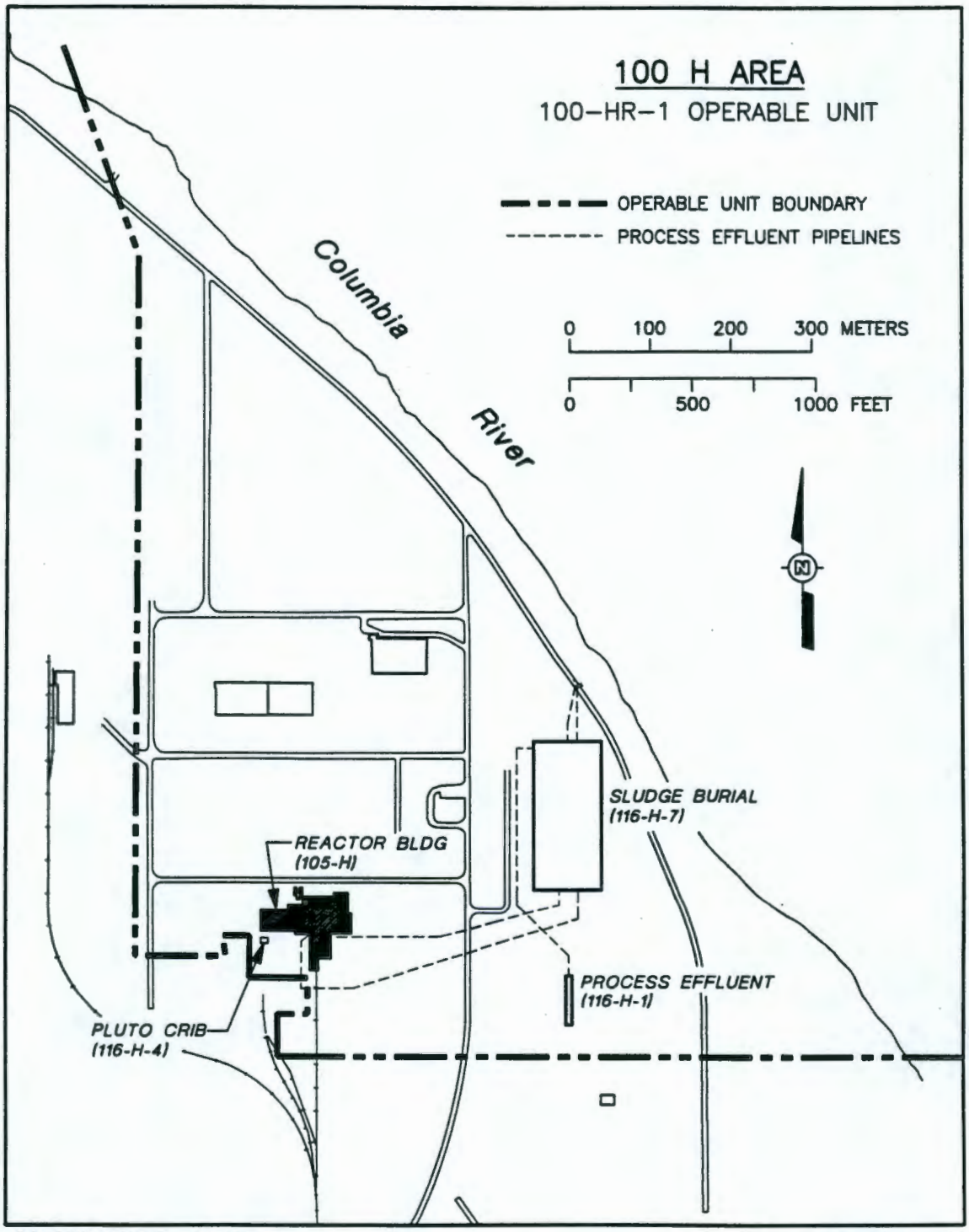
Figure 2. Waste Site Locations.



SOURCE: DOE/RL 94-63

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present. Today, the pipelines remain buried about 20 feet beneath the surface.

Decontamination/Decommissioning Solid Waste Sites. In addition to the four soil waste sites described above, the 100-HR-1 Operable Unit also includes three solid waste sites for facilities that have already been decontaminated and decommissioned. These sites include the former H Reactor exhaust stack (132-H-1), the former exhaust airfilter building (132-H-2), and the former effluent pumping station (132-H-3). These sites are described in Table 1. Because these high priority sites have been decontaminated and decommissioned, they are not the focus of additional interim remedial measures and will not be discussed further in this proposed plan. Final plans for these waste sites will be addressed as part of the final record of decision for the 100-HR-1 Operable Unit.

The contaminants present at the 100-HR-1 Operable Unit waste sites pose a potential health threat to future users of the site. Isotopes of cesium, cobalt, europium, plutonium, and strontium, as well as chromium and arsenic, are classified by EPA as human carcinogens. Lead is a toxin to children and adults. Chysene has not been identified as a human carcinogen or as a toxic compound. Humans can be readily exposed to these contaminants through ingestion of soil, inhalation of soil particules, or direct contact. An additional environmental hazard posed by the contaminated soil is the threat to contamination of groundwater as contaminants migrate downward through the soil column over time.

SUMMARY OF SITE RISK

A qualitative risk assessment was conducted at the 100-HR-1 Operable Unit to estimate the potential future human health and environmental risks that could result if soil contaminants were not remediated and left in place at waste sites. A detailed description of the findings, assumptions, and methods used can be found in the *Qualitative Risk Assessment for the 100-HR-1 Source Operable Unit*. Currently, there are no residential or recreational users in the 100-HR-1 Operable Unit. Thus, risks estimated in the qualitative risk assessment are not actual risks but, instead, provide estimates of potential future risks if the area were to become inhabited.

In preparing the qualitative risk assessment, conservative assumptions were used that weigh in favor of protecting human health (e.g., greatest known soil contaminant concentrations found at depth were used as surface soil concentrations). The results of the risk assessment help determine if remedial actions are necessary to protect human health and the environment. The goal of the qualitative risk assessment was to identify high-priority sites for expedited response actions and interim remedial measures by estimating a range of risk (very low to high) for the contaminated soils.

Human Health Risk - The human health risk evaluation used two hypothetical exposure scenarios, frequent- and occasional-use, to provide estimates of potential future risk that correspond with residential and recreational exposure scenarios defined in the *Hanford Site Risk Assessment Methodology*. The frequent-use scenario assumes a person is exposed to contaminated soil every day for one year. The occasional-use scenario assumes a person is exposed to contaminated soil for seven days a year. The selection of land use (i.e., residential or recreational) is based on probable uses considered for the Hanford Site following environmental restoration. The most probable exposures at the Hanford Site are addressed by the occasional-use exposure scenario. The regulators use the occasional-use scenario at the Hanford Site to make decisions concerning the need for interim remedial measures. Therefore, the results of the occasional use exposure scenario are discussed in this proposed plan.

Three potential pathways were evaluated as the most likely routes of human exposure to contaminants at the 100-HR-1 Operable Unit. These included soil ingestion; inhalation of fugitive dust; and external radionuclide exposure from soils. The pathway associated with the greatest estimated risk to human health was from the external radionuclide exposure from soils. In evaluations for specific 100-HR-1 Operable Unit waste sites, the human health evaluation considered carcinogenic and noncarcinogenic contaminants. The qualitative risk estimations for carcinogenic contaminants were ranked according to the following human health categories, based on the calculated lifetime incremental cancer risk (ICR):

- High: Greater than 1 in 100
- Medium: 1 in 100 to 1 in 10,000
- Low: 1 in 10,000 to 1 in 1,000,000
- Very low: Less than 1 in 1,000,000

Table 2 summarizes risks to human health for 100-HR-1 Operable Unit high priority waste sites.

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Risk estimates for noncarcinogenic contaminants are reported in terms of a hazard quotient. A hazard quotient above 1.0 indicated that an adverse toxic effect in humans could occur. A hazard quotient less than 1.0 indicated a much lower likelihood of adverse toxic effects in humans could occur.

If the calculated lifetime incremental cancer risk is low or very low, a remedial action is usually not warranted. However, the qualitative human health evaluation resulted in the finding that the contaminants in 100-HR-1 that posed the greatest potential risk of causing cancer and other adverse human health effects in an hypothetical occasional-use scenario included cesium-137, cobalt-60, europium-152, and europium-154. The findings are based on concentrations of radionuclides decayed to the year 2018.

Ecological Risk - An ecological evaluation estimated risk from existing contaminants in the 100-HR-1 Operable Unit using selected ecological receptors. An ecological hazard quotient was calculated that estimates risk in a manner similar to the hazard quotient used to assess human health risk, except that it is applied to an ecological receptor exposed to contaminants. An ecological hazard quotient greater than 1.0 indicates that an adverse effect to ecological receptors could result. For example, sites that receive a 1 rad/day threshold for ecological receptors would have an ecological hazard quotient greater than 1.0. Table 2 summarizes risks to ecological receptors for 100-HR-1 Operable Unit high priority waste sites. For those waste sites that exceeded an ecological hazard quotient of 1.0, all of the ecological risk was attributable to strontium-90.

The EPA, DOE, and Ecology believe that a combination of removal, treatment, and disposal technologies, where appropriate, would significantly reduce the potential threats to human health and the environment at the 100-HR-1 Operable Unit high-priority waste sites. The remedial actions described in this proposed plan are designed to minimize human health and ecological risks and ensure that additional contaminants originating from these waste sites are not transported to the groundwater. The preferred remedial alternatives would reduce risk to an individual attributed to a particular waste site to acceptable levels for the occasional-use scenario.

Actual or threatened releases of hazardous substances from this operable unit, if not addressed by implementing the remedial actions selected by this proposed plan, may present a current or potential threat to human health, welfare, or the environment.

> The DOE, EPA, and Ecology encourage you to comment during the public comment period on all of the interim remedial measures described in this proposed plan. The DOE, EPA, and Ecology may modify the preferred alternative or select another response action presented in this plan and the 100-HR-1 *Focused Feasibility Study Report* based on new information or public comments.

SCOPE AND ROLE OF ACTION

Contamination present in soil of the 100-HR-1 Operable Unit represents a potential threat to future occasional users and the current ecology of the 100 H Area. This contamination in the waste sites described in this proposed plan has been designated as high priority in the *100-HR-1 Operable Unit Limited Field Investigation Report* for interim remedial measures.

The final record of decision will address remedy selection for high priority sites to determine what additional actions (if any) are required to release the site for public use.

The following are low-priority systems and other sites at the 100-HR-1 Operable Unit that are not addressed with interim remedial measures:

- H Reactor Building (118-H-6)
- Effluent Disposal Trench (116-H-2)
- French Drain (116-H-3)
- Outfall Structure (116-H-5)
- Solar Evaporation Basins (116-H-6)
- Sludge Burial Trench (116-H-7)
- Seal Crib (116-H-9)
- Sanitary Septic System (1607-H-2)
- Sanitary Septic System (116-7-H-4)
- Sanitary Sewer Pipelines (no number)

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Table 2. Summary of Risks for 100-HR-1 IRM[1] Candidate Sites.

Waste Site Category	Waste Site Group	Waste Site Number	Qualitative Risk Assessment		Refined Contaminants of Potential Concern[5]
			[2]Human Health	Ecological Risk	
Soil	Retention Basins	116-H-7	High	Yes	Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239/240, Ra-226, Sr-90, arsenic, lead
	Process Effluent Trenches	116-H-1	Medium	Yes	Cs-137, Co-60, Eu-152, Eu-154, Pu-239/240, Ra-226, arsenic, lead, chromium chrysene
	Pipelines	Process Effluent Pipelines (soil)	Very Low	No	Cs-137, Co-60, Eu-152, Eu-154, Ni-63, Pu-238, Pu239240, Sr-90
		Process Effluent Pipelines (sludge)	High	No	Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239/240, Ra-226, Sr-90, arsenic, lead
	Cribs	116-H-4	Low	4	None Known

[1]IRM Interim Remedial Measure
[2]Human health risk, using an recreational occasional-use scenario, is based upon the incremental lifetime cancer risk (ICR) which is grouped into the following risk categories: high (ICR greater than 1 in 100); medium (ICR greater than 1 in 10,000 to 1 in 100); low (ICR of 1 in 1,000,000 to 1 in 10,000); and very low (ICR less than 1 in 1,000,000).
[3]Ecological risk is based on an ecological hazard quotient (EHQ). An EHQ greater than 1.0 indicates that an adverse effect to ecological receptors could occur and results in a "Yes" entry on this table. A "No" entry means that the EHQ is less than 1.0.
[4]Not rated by the qualitative ecological risk assessment
[5]Cs-137 = ^{137}Cesium
Co-60 = ^{60}Cobalt
Eu-152 = ^{152}Europium
Pu-238 = ^{238}Plutonium
Pu239/240 = $^{239/240}$Plutonium
Ra-226 = ^{226}Radium
Sr-90 = ^{90}Strontium

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Remedial investigations and planning activities for the 100 Areas have been conducted in accordance with the *Hanford Past-Practice Strategy*. The goal of the Hanford Past-Practice Strategy is to streamline the remedial action process by emphasizing early action at high-priority sites through expedited response actions and interim remedial measures. The sites not defined as IRM candidates in the 100-HR-1 *Source Operable Unit Limited Field Investigation* have been deferred at this time, but will be addressed in the final 100 Area aggregate final Record of Decision. Streamlining of the whole process is achieved by limiting data collection and by placing high-priority waste sites on the interim remedial measure pathway.

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The intent of an interim remedial measure is to expedite the response to soil contamination that poses a potential threat to human health and the environment. It is assumed that an interim remedial measure would be applied until the year 2008. After the year 2008, the final site remedy determined in *100 Areas Aggregate Remedial Investigation and Feasibility Studies* would be implemented, if different than selected interim remedial measures.

Contaminants are present in the soil at the IRM waste sites in concentrations that represent a threat to future occasional users of the 100-HR-1 Operable Unit. Additionally, the contaminants represent an ongoing threat for contamination of groundwater. Therefore, DOE, Ecology, and EPA have selected removal, treatment, and disposal for contaminate soil at the retention basin and process effluent trenches; removal and disposal for the pipelines; and no interim action for the pluto crib as preferred alternatives for these waste sites. These alternatives include the following actions that are described in greater detail in the Summary of Considered Alternatives section of this proposed plan:

- Removal of contaminated soils from the retention basin, process effluent trenches, and pipelines.
- Treatment of soil from the retention basin and process effluent trenches, if appropriate, using technologies such as soil washing or thermal desorption. The purpose of treatment is primarily to reduce the volume of contaminated soil destined for disposal.
- Disposal of contaminated soils at the proposed Environmental Restoration Disposal Facility, or other appropriate onsite facility.
- No interim action of the pluto crib is appropriate because the waste site is no longer present and is not associated with unacceptable risk.

These measures are consistent with remedial action objectives because their implementation would reduce potential risks to future site users and ecological receptors. Remediation of these sites would eliminate further contaminant migration from the sites to the groundwater. The measures are also in compliance with Applicable or Relevant and Appropriate Requirements (ARARs). Costs for these alternatives represent the most effective remedies for the least expenditures.

SUMMARY OF CONSIDERED ALTERNATIVES

The *100 Area Source Operable Unit Focused Feasibility Study Report* identified six soil and solid waste general response actions that could be applied to source operable units in the 100 Areas. The remedial alternatives are applicable for the remediation of contaminated soil at the 100-HR-1 Operable Unit. The alternatives for soil and solid waste remediation are as follows:

- No interim action (SS-1)
- Institutional Controls (SS-2)
- Containment (SS-3)
- Removal/Disposal (SS-4)
- In Situ Treatment (SS-8A and SS-8B)
- Removal/Treatment/Disposal (SS-10).

Elements of the alternatives are presented in Table 3. Table 4 presents the estimated cost and estimated duration for each remedial alternative. A summary of alternatives is provided for the contaminated soil waste site categories. Details of each alternative be found in the *100-HR-1 Operable Unit Focused Feasibility Study Report*.

No Interim Action (Alternative SS-1) - The "no interim action" alternative applies to soil sites and serves as a baseline for evaluating remedial actions. It represents a hypothetical scenario where no additional restrictions, controls, or active remedial measures other than those currently existing (through the year 2008) are applied to a site. Contamination is allowed to dissipate through natural processes.

Table 3. Summary of Technology Components for 100-HR-1 Operable Unit Remedial Alternatives.

Technology	Retention Basin (116-H-7)			Pipelines (100-H)			Process Effluent Trenches (116-H-1)		Pluto Crib (116-H-4)
	Alt SS4	Alt SS8A	Alt SS10	Alt SS3	Alt SS4	Alt SS8B	Alt SS4	Alt SS10	Alt SS1
No Interim Action									●
Deed Restrictions		●		●		●			
Removal	●		●		●		●	●	
Soil Washing			●					●	
Thermal Desorption								●	
Compaction									
Disposal	●		●		●		●	●	
RCRA Barrier				●		●			
Surface Water Controls		●		●		●			
Void Grouting						●			
In Situ Vitrification		●							

NOTES: 1) Shaded area represents the preferred alternative
2) RCRA - Resource Conservation and Recovery Act
3) See text for descriptions of Alternatives SS-1, 3, 4, 8A, 8B, and 10

Table 4. Summary of Estimated Costs for 100-HR-1 Operable Unit Remedial Alternatives.

Waste Site Number	Containment (SS-3)				Removal/Disposal (SS-4)				In Situ Treatment (SS-8A and SS-8B)				Removal/Treatment/Disposal (SS-10)			
	CAP	O&M	PW	YRS	CAP	O&M	PW	YRS	CAP	O&M	PW	YRS	CAP	O&M	PW	YRS
116-H-7	na	na	na	na	$29.4	$0	$28.0	0.5	$6.69	$5.49	$98.0	8.1	$31.9	$40.5	$34.2	1.0
116-H-1	na	na	na	na	$6.08	$0	$5.79	0.2	na	na	na	na	$6.53	$0.83	$7.02	0.2
116-H-4	No interim action proposed at site (no associated cost)															
pipelines	$9.76	$4.64	$11.9	0.5	$2.27	$0	$2.16	0.3	$0.94	$0	$0.90	0.1	na	na	na	na

Costs are in million of dollars
CAP - capital
O&M - operation and maintenance
PW - present worth
na - not applicable to the waste site (reasons for exclusion are discussed in the FFS Report)
YRS - estimated duration for completion of remedial alternative in years

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Institutional Controls (Alternative SS-2) - This alternative applies to contaminated soil sites and involves the following:

- deed restrictions
- groundwater surveillance monitoring.

Deed restrictions would consist of limitations on certain types of land-uses (e.g., prohibiting drilling) at an individual waste site. Groundwater monitoring and sampling beneath the 100-HR-1 Operable Unit, which is currently being conducted as part of the 100-HR-3 Operable Unit, would continue to monitor for potential impacts to the groundwater underlying the waste sites. These institutional controls would limit exposure to human or ecological receptors and would protect groundwater.

Containment (Alternative SS-3 and SW-3) - This alternative includes the following elements:

- deed restrictions
- groundwater surveillance monitoring
- surface water controls
- installation of a modified RCRA barrier.

As described under the institutional control alternative, deed restrictions and groundwater surveillance monitoring would be implemented along with surface water controls during and after installation of a modified RCRA barrier (physical barrier) to restrict the runon and runoff of surface water. Surface water controls (e.g., drainage channels and culverts) would be implemented both during and after barrier construction. This would be necessary to reduce the potential for infiltration through the contaminated soil and the spread of contamination. The modified barrier would consist of layers of clean soil and natural grasses underlain by layers of sand, gravel, and asphalt. The effective or constraining layer to prevent infiltration of water would be the asphalt layer. The barrier would prevent contact with the contaminated soil, and would protect groundwater by minimizing the spread of contamination by erosion and infiltration.

Risk to human and ecological receptors would be reduced at the waste sites by eliminating exposure pathways through the construction of a physical barrier that inhibits contact with the contaminants and through protection of the groundwater by minimizing the spread of contamination by erosion and infiltration.

Removal/Disposal (Alternative SS-4) - This alternative includes the following elements:

- removal of the contaminated media
- disposal at an approved facility.

Under this alternative, the contaminated soil would be excavated, transported to, and disposed at the proposed Environmental Restoration Disposal Facility or another appropriate onsite facility. As the contaminated soil is excavated it would be visually characterized and segregated prior to transportation to the disposal facility. Excavation would continue until all contaminated media exceeding a predetermined concentration that protects groundwater are removed. Excavation may extend to the water table, if necessary. Clean soil would be backfilled at the site and the site contoured to as near original condition as possible. Risk to human or ecological receptors at the site would be eliminated by the physical removal of the contaminants.

In Situ Treatment (Alternative SS-8A) - This alternative applies to contaminated soil sites that do not contain buried pipelines and includes the following elements:

- deed restrictions
- groundwater surveillance monitoring
- surface water control
- in situ vitrification.

Deed restrictions, groundwater surveillance monitoring, and surface water controls would be implemented as described under the institutional control and containment alternatives after completion of the in situ vitrification process. Under this alternative, the contaminated soil would be vitrified in place and covered with a minimum of one meter of clean soil. Risk to human and ecological receptors would be reduced at the waste site by the elimination of exposure pathways through the solidification of the contaminated soils and addition of clean backfill. Protection of groundwater would also be achieved by minimizing the spread of contamination by erosion and infiltration through the soil cover.

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In Situ Treatment (Alternative SS-8B) - This alternative applies to contaminated soil sites with buried pipelines and includes the following elements:

- deed restrictions
- groundwater surveillance monitoring
- surface water control
- void grouting
- installation of a modified RCRA barrier, as required.

Under this alternative, deed restrictions, groundwater surveillance monitoring, and surface water controls would be implemented as described under the institutional control and containment alternatives. Prior to grouting, the buried pipelines would be surveyed by video to assist in determining the proper injection grout mixture and appropriate location of injection points. The buried pipelines would be pressure injected in place with grout that would immobilize contamination in the pipeline (i.e., the contaminated metal, scale, and sediments in the pipe) through encapsulation.

A modified RCRA barrier (physical barrier), if required, would be installed (as described in the containment alternative) over soils that indicate potential contamination through visual inspection. Risk to human and ecological receptors would be reduced at the waste site by immobilizing any potential contamination present in the pipeline through encapsulation. In addition, risk would be further reduced at the waste site by eliminating exposure pathways through the construction of a physical barrier that inhibits contact with the contaminants and protects groundwater by minimizing the spread of contamination by erosion and infiltration.

Removal/Treatment/Disposal (Alternative SS-10) - This alternative applies to contaminated soil sites and includes the following elements:

- removal of the contaminated soil
- thermal desorption, as required
- soil washing, as appropriate
- disposal at an approved facility.

Under this alternative, the contaminated soils would be excavated as described under the removal/disposal alternative. Organically contaminated soils would be treated by thermal desorption, as required, then recombined with the remaining contaminated soils prior to soil washing. Soil washing, which reduces the volume of contaminants, would be implemented as appropriate. The excavation would be backfilled with washed soils and clean imported soil to fill the excavation to original contours. Contaminated soil and/or contaminated products from the soil washing process would be transported to and disposed of at the proposed Environmental Restoration Disposal Facility or another appropriate onsite facility. Risk to human or ecological receptors at the site would be eliminated by the physical removal of the contaminants.

PREFERRED INTERIM REMEDIAL MEASURES

Based on an evaluation of criteria presented in the *100-HR-1 Operable Unit Focused Feasibility Study Report*, the preferred measures described below have been chosen for the Retention Basin (116-H-7), Process Effluent Trenches (116-H-1), Pipelines (100-H), and Pluto Crib (116-H-4). The preferred alternative for contaminated soils present at the retention basin and process effluent disposal trenches is the removal, treatment, and disposal trenches. The preferred alternative chosen for the pluto cribs no interim action. The preferred alternative for the pipelines is the removal and disposal. These alternatives are protective of human health and the environment in both the short and long term. All applicable or relevant and appropriate requirements are met. Table 3 indicates the preferred alternative for each waste site group using shading. Table 4 presents the estimated cost for each remedial alternative.

Soil Waste Sites - The soil waste sites for 100-HR-1 Operable Unit consist of the following:

- retention basin (116-H-7)
- process effluent disposal trench (116-H-1)
- process effluent pipelines (100-H)
- pluto cribs (116-H-4).

Retention Basin (116-H-7) and Process Effluent Disposal Trench (116-H-1) - The preferred alternative for these waste sites is excavation and removal of contaminated soil, treatment of contaminated soils to reduce volume or toxicity (as appropriate), and disposal of the remaining contaminated fraction in the proposed Environmental Restoration Disposal Facility or other appropriate

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onsite facilities. Treatment at individual waste sites will include soil washing, as appropriate, to address radionuclide contamination unless waste site-specific conditions make soil washing inappropriate. If organics are present, thermal desorption would be used to remove organic contaminants. Organic contaminants are not in the general conceptual models for the waste site groups, but may be present at some individual waste sites. The applicability of each treatment will be determined on a waste site by waste site basis.

Soil Washing - Soil washing would be used to reduce to the maximum feasible extent the volume of contaminated soil requiring disposal. Soil washing is a means to reduce contaminated soil waste volume by concentrating contaminants in the fine soil fractions; the clean cobble and gravel fraction will then be used as fill.

Although pilot-scale treatability testing in the 100 Areas at the Hanford Site have shown that soil washing can be generally effective, there are limits to the applicability of this treatment. Soil washing is a desirable treatment only when significant volume reduction can be achieved. To achieve significant volume reduction, contamination in the coarse soil fractions must be below cleanup levels after soil washing. When any of the following conditions exist, soil washing is the most effective in meeting cleanup and volume reduction goals:

- Concentrations of strong bonding contaminants in the total soil matrix (all particle sizes), such as cesium-137, are below twice the cleanup level.
- Concentrations of strong bonding contaminants, such as cesium-137, are below cleanup levels in the coarse soil fractions.
- The preponderance of the radionuclide contamination is concentrated in the fine soil fraction.
- The preponderance of fines in the soil matrix provides sufficient surface for concentration of contaminants.

When any of these conditions exist, soil washing can reduce the level of contamination in the coarse soil fractions below cleanup levels and waste volume reduction will be achieved.

However, in instances when contamination in the coarse soil fraction can be reduced below cleanup levels, the resulting volume reduction may still be insufficient to implement soil washing. For example, the cost of soil washing may exceed the cost of disposing the entire waste volume without treatment when reduction of waste volume with treatment is not sufficient to offset costs. In other words, the ability to achieve sufficient volume reduction results may be related to some threshold soil volume to make treatment cost effective, at a particular site, or there may be soil characteristics limitations.

- Volume reduction is proportional to total waste volume. For large sites, the volume of clean gravels resulting from soil washing would also be large.
- When the coarse soil fraction is a large percentage of the total soil matrix, the volume of clean gravels resulting from treatment will be large.

In addition, volume reduction potential from soil washing has been shown to be a function of the choice of soil washing methods (e.g., wet sieving, scrubbing) that can be performed at varying levels of cost. Achieving volume reduction goals at some sites may be technically feasible, but not cost-effective. Specific conditions that enhance the applicability of soil washing and may exist at specific 100-HR-1 Operable Unit waste sites are identified below. If these conditions are found to exist during remedial design and implementation, soil washing would likely be chosen as a treatment alternative, and the contaminated soil would be disposed of in the proposed Environmental Restoration Disposal Facility or another appropriate onsite facility after volume reduction. Based on existing knowledge, soil washing may be appropriate for use at a waste site if:

- Laboratory results indicate that the concentration of cesium-137 is less than twice the cleanup goal.
- Laboratory results of coarse cobbles and gravels indicate cesium-137 concentration is below the cleanup goal; critical applicability information is expected from these studies.
- The volume of contaminated soil is above the threshold level for cost effective implementation of volume reduction.

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A design investigation would be conducted during remedial design to determine the site-specific conditions applicable to soil washing. If all identified criteria are met for implementation of soil washing at a specific waste site, a pilot-scale treatability study would be conducted to determine final design parameters for the soil washing system. The decision criteria will be finalized in the record of decision (ROD). The bench scale treatability study would also identify any unforeseen problems or site conditions that may alter the treatment selection.

Thermal Desorption - If organic compounds are found, thermal desorption would be used to reduce toxicity and to meet proposed Environmental Restoration Disposal Facility waste acceptance criteria. Thermal desorption involves the heating of soil to evaporate volatile contaminants. Organic compounds are not generally present in 100-HR-1 Operable Unit waste sites, but may be present at individual sites. When organic contamination is present, thermal desorption would be used as an additional treatment. Thermal desorption would be used as part of the specific waste site remediation if soil samples confirm the presence of organic compounds above Environmental Restoration Disposal Facility waste acceptance criteria. The presence of organics and the need for thermal desorption would be determined on a site-specific basis during remedial design.

Pipelines (100-HR) - The preferred alterative for the buried effluent pipelines is Removal and Disposal.

Pluto Crib (116-H-4) - The preferred alternative for this waste site is No Interim Action. The crib was previously excavated and no contamination remains at the site.

EVALUATION OF ALTERNATIVES

Each of the 100-HR-1 Operable Unit remedial alternatives were evaluated in detail to determine the preferred remedy for each of the waste site groups. The first seven of nine criteria established by the *Comprehensive Environmental Response, Compensation, and Liability Act* were used to evaluate the remedial alternatives in the detailed and comparative analyses process. The last two criteria, state acceptance and community acceptance, will be evaluated following comment on this proposed plan and interim record of decision. The nine criteria encompass statutory requirements and include other technical, economic, and practical factors that assist in gauging the overall feasibility and acceptability of the cleanup alternatives. A summary of the comparative analysis of the alternatives presented in the *Focused Feasibility Study Report* is presented in Table 5.

Overall Protection of Human Health and the Environment - The preferred alternatives would provide the most protection of human health and the environment from soil and solid waste contamination. The preferred alternatives would physically remove treated waste from the site eliminating risk.

Compliance with Applicable or Relevant and Appropriate Requirements - All the remedial alternatives would comply with applicable or relevant and appropriate requirements in federal and state environmental statutes.

Long-Term Effectiveness and Permanence - The removal/disposal alternatives would be effective and permanent in the long-term. These alternatives would reduce the magnitude of risk, and the treatment is considered permanent. The preferred alternatives would reduce risk, but the treatment process would not be as permanent as compared to vitrification.

Reduction of Toxicity, Mobility, or Volume - The in situ vitrification alternatives would be the most effective in reducing mobility and to some extent volume. The preferred alternatives would not control mobility, but do result in the reduction of volume.

Short-Term Effectiveness - The removal/disposal and in situ vitrification alternatives would be the most effective in the short-term. The preferred alternatives treatment processes may create adverse impacts during construction and operation.

Implementability - The containment alternatives would be the most implementable for the solid waste sites. The removal/disposal alternatives would be the most implementable for the soil sites. The preferred alternatives would be implementable for either soil or solid waste sites.

Cost - The removal/disposal alternative is associated with the least cost, but the remove/treat/dispose alternative would be the most cost effective. If disposal costs remain at the assumed values the preferred alternatives allow for removal and disposal without treatment. However, assumed disposal costs used to compare alternatives involve a high degree of

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Table 5. Comparative Analysis Summary for 100-HR-1 Operable Unit.

CERCLA Comparative Evaluation Criteria	Waste Sites	Retention Basin 116-H-7			Process Effluent Trenches 116-H-1		Pipelines 100-H		
	Alternatives[b]	SS-4	SS-8A	SS-10	SS-4	SS-10	SS-3	SS-4	SS-8B
Overall Protection of Human Health and Environment		Better	Good	Best	Better	Best	Good	Best	Better
Compliance with ARAR		Best	Best	Best	Best	Best	Best	Best	Best
Long-Term Effectiveness and Permanence		Best	Better	Best	Best	Best	Good	Best	Better
Reduction of Toxicity, Mobility, and Volume		Fair	Best	Good	Fair	Better	Good	Better	Best
Short-Term Effectiveness		Better	Best	Good	Better	Good	Best	Good	Better
Implementability		Best	Good	Better	Best	Better	Best	Better	Good
Present Worth ($ millions)		28.0	98.0	34.2	5.8	7.0	11.9	2.2	0.9

ARAR - applicable or relevant and appropriate requirement

[a]Comparative Analysis Summary is based on Tables 6-1 through 6-3 in the *100-HR-1 FFS Focused Feasibility Study Report*. Comparisons are made between relevant alternatives for each individual waste site group only.

[b]Alternatives are as follows:

- SS-3 Containment
- SS-4 Removal & Disposal
- SS-8A In Situ Treatment of Soils
- SS-8B In Situ Treatment of Pipelines
- SS-10 Removal, Treatment & Disposal of Soil

Key:

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EXPLANATION OF CERCLA EVALUATION CRITERIA

1. *Overall Protection of Human Health and the Environment* addresses whether or not a remedial action provides adequate protection and describes how potential risks posed through each exposure route are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. *Compliance with Applicable or Relevant and Appropriate Requirements* addresses whether or not a remedial action will meet all of the applicable or relevant and appropriate requirements and other federal and state environmental statutes or provide grounds for invoking a waiver of the requirements.

3. *Long-Term Effectiveness and Permanence* refers to the magnitude of residual risk and the ability of a remedial action to maintain reliable protection of human health and the environment after remedial goals have been met.

4. *Reduction of Toxicity, Mobility, or Volume Through Treatment* evaluates the anticipated performance of the treatment technologies that may be employed in a remedy.

5. *Short-Term Effectiveness* refers to the speed with which the remedial action achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment that may result during the construction and implementation period.

6. *Implementability* refers to the technical and administrative feasibility of a remedial action, including the availability of materials and services needed to implement the selected solution.

7. *Cost* evaluates capital, operation and maintenance costs for each alternative by performing present worth cost analyses.

8. *State Acceptance*, based on review of the remedial investigation and focused feasibility study reports, and the proposed plan, indicates whether the state concurs with, opposes, or has no comment on the preferred interim alternative.

9. *Community Acceptance* is an assessment of the general public response to the proposed plan following a review of the public comments received on the remedial investigation, focused feasibility study, and proposed plan during the public comment period and open community meetings.

uncertainty. If actual disposal costs differ substantially from assumed values, then the relative cost rankings of alternatives could also change.

SCHEDULE OF FUTURE ACTIVITIES

The following activities for interim remedial action are planned for the 100-HR-1 Operable Unit:

- During the period of ? to ? the public will have the opportunity to comment and question, both in writing and during an open public meeting on ? on the Proposed Plan for the 100-HR-1 Operable Unit.

INFORMATION REPOSITORIES

Final Reports
U. S. Department of Energy - Richland Operations
Public Reading Room
2440 Stevens Center Place
Richland, Washington 99352
509/376-7411
Hrs: Mon-Fri 8-12am and 1-4:30pm

Final Reports
EPA Region 10
Superfund Record Center
1200 Sixth Avenue
Park Place Building, 7th Floor
Mail Stop: HW-074
Seattle, Washington 98101
206/553-4493
Hrs: 8am - 4:30pm

Final Reports
Washington State Department of Ecology
Nuclear Waste Library
719 Sleater-Kinney Road SE
Capital Financial Building, Suite 200
Lacey, Washington 98503
206/407-7097
Hrs: Mon-Fri 8am - 5pm

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EPA (Region 10)
Paul Beaver
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509/376-8665

Washington State Department of Ecology Representative
Steve Alexander
Kennewick Manager
509/735-7581

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OPPORTUNITIES FOR COMMUNITY INVOLVEMENT

Community Meeting Announcement

You are invited to attend an upcoming meeting regarding the *Ecology's Proposed Plan for Interim Remedial Measures at the 100-HR-1 Operable Unit* at the Hanford Site. The Ecology, EPA, and DOE representatives will report on the remedial alternatives, including the preferred alternative, and will answer your questions.

DATE: ?
TIME: ?
PLACE:?

You will have an opportunity at the meeting to direct questions to Ecology and the regulatory representatives and comment on the remedial alternatives. If you have any questions regarding the meeting, you should contact Steve Alexander at 509/735-7581

Public Comment Period Announcement

A 30-day public comment period will begin on ?. The Ecology, EPA, and DOE request your written comments on the *Proposed Plan for Interim Remedial Measures at the 100-HR-1 Operable Unit*. Written comments should be postmarked no later than ?, and sent to: Steve Alexander at the Washington Department of Ecology.

GLOSSARY

Applicable or Relevant and Appropriate Requirements (ARARs) - These assure compliance with all substantitive elements of federal laws and more stringent state laws that apply or are determined to be relevant and appropriate.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - A federal law that establishes a program which enables the Environmental Protection Agency to identify abandoned hazardous waste sites, ensure that they are cleaned up, and allow other government entities to evaluate damages to natural resources. It is also known as the "Superfund Law." CERCLA applies to the 100-HR-1 Operable Unit.

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Contaminants of Potential Concern - These are chemical and radioactive constituents that must be addressed by remedial action.

Environmental Restoration Program - DOE's plan, in conjunction with EPA and Ecology,, for cleanup of environmental contamination at the Hanford Site that resulted from former practices.

Environmental Restoration Disposal Facility (ERDF) - A proposed disposal facility, for contaminated soils and solid waste, which is assumed to be available at the Hanford Site to support interim remedial measures.

Expedited Response Action (ERA) - A response action that could be taken to address contamination problems that pose time-critical risks.

Focused Feasibility Study (FFS) - An engineering study on a waste site that evaluates a limited number of remedial alternatives for cleaning up environmental contaminants.

Groundwater - Underground water that fills the spaces between particles of soil, sand, gravel, or fractures in rocks.

Hazard Quotient - The ratio of exposure to toxicity for receptors of contaminationts. When the hazard quotient exceeds 1.0, a possible human health risk is assumed to exist.

In Situ - This refers to an activity or action that is being conducted in place.

In Situ Vitrification - A thermal treatment process that converts soil and other material into stable glass or glass-like crystalline substances, which stabilizes the contaminants in-place.

Interim Action - The implementation of the selected interim remedy for an operable unit or site.

Interim Record of Decision (IROD) - The formal document in which the lead regulatory agency sets forth the selected interim remedial measure and the reasons for its selection.

Interim Remedial Measure (IRM) - A remedial action that is taken at a site to address one or more of the contamination problems, but not necessarily all of the contamination problems. The remedial action is based on a Limited Field Investigation/Focused Feasibility Study and is selected in an interim record of decision.

Limited Field Investigation (LFI) - Part of the interim remedial measure process that assesses the applicability of interim remedial measures for reducing human health and environmental risks.

Operable Unit (OU) - This is a subset of a larger Superfund CERCLA site, typically the subject of Ouspecific investigations and remedial actions.

Qualitative Risk Assessment (QRA) - An evaluation of risk for a predefined set of human and environmental exposure scenarios that assists Tri-Party signatories in making defensible decisions on the necessity of interim remedial measures.

Receptor Pathway - A series of hypothetical events by which a contaminant can migrate to and be taken up by a human or environmental receptor.

Remedial Investigation (RI) - An in-depth study to gather data necessary to determine the nature and extent of contamination. The purpose of a remedial investigation is to provide sufficient information to identify feasible engineering solutions and evaluate potential human health and environmental risks.

Superfund National Priorities List (NPL) - A list of top-priority hazardous waste sites in the United States that are eligible for investigation and cleanup under the Superfund program.

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