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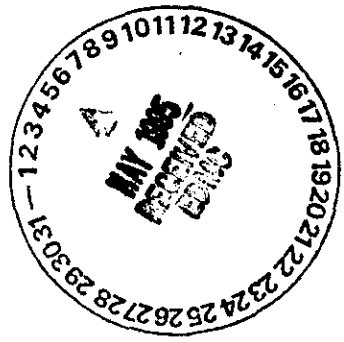
Draft A

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

Hanford Site
Richland, Washington



United States
Department of Energy
Richland, Washington

Approved for Public Release

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Hanford Site
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Date Published
May 1995

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

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

Hanford Site, Richland, Washington

DOE, EPA, AND ECOLOGY ANNOUNCE PROPOSED PLAN

This proposed plan introduces the preferred alternative for **interim remedial measures** to address contaminated soil at the 100-KR-1 **Operable Unit**, located at the Hanford Site. In addition, this plan includes a summary of other alternatives that were analyzed and considered for the 100-KR-1 Operable Unit.

This proposed plan is being issued by the U.S. Environmental Protection Agency (EPA), the lead agency; the Washington State Department of Ecology (Ecology), the support agency; and the U.S. Department of Energy (DOE), the responsible agency. This proposed plan is intended to provide the public with information that describes the data and process used for selecting the preferred alternative and to facilitate public participation. It is consistent with Section 117(a) of the ***Comprehensive Environmental Response Compensation, and Liability Act*** **(CERCLA)** commonly known as the "Superfund Program," and the *National Environmental Policy Act of 1969* (NEPA).

The preferred alternative presented in this proposed plan is to remove, treat (as appropriate or required), and dispose of the contaminated soil and associated structures, as necessary or appropriate for cost effectiveness, from the 100-KR-1 Operable Unit. The remedial actions described herein are intended to reduce potential human health and ecological risks and to ensure that contaminants present at this waste site will not adversely affect groundwater or the Columbia River.

This preferred alternative is the initial recommendation of the EPA, Ecology, and the DOE. The final resolution will be selected only after the public has had the opportunity to comment on this recommendation and all comments have been reviewed and considered. Comments may be made in person at the public meetings or may be submitted in writing. Written comments must be submitted by _____. Public comments will be addressed in a responsiveness summary as part of the record of decision (ROD), which will be prepared after this proposed plan. The ROD is the legal decision document that selects the cleanup remedy.

Send written comments to:
U.S. Environmental Protection Agency
Attention: Kevin Oates
712 Swift Blvd., Suite 5
Richland, WA 99352

The public is encouraged to review the *100-KR-1 Focused Feasibility Study Report* (DOE-RL-94-66), and the *100-Area Source Operable Unit Focused Feasibility Report (DOE/RL-92-61)*. These reports and other documents listed at the end of this proposed plan provide greater detail about 100-KR-1.

MARK YOUR CALENDAR

A 45-day public comment period for the *100-KR-1 Proposed Plan* will be from ___ to___

A public meeting on this proposed plan will be held as follows:

Date: ???
Time: ???
Place: ???

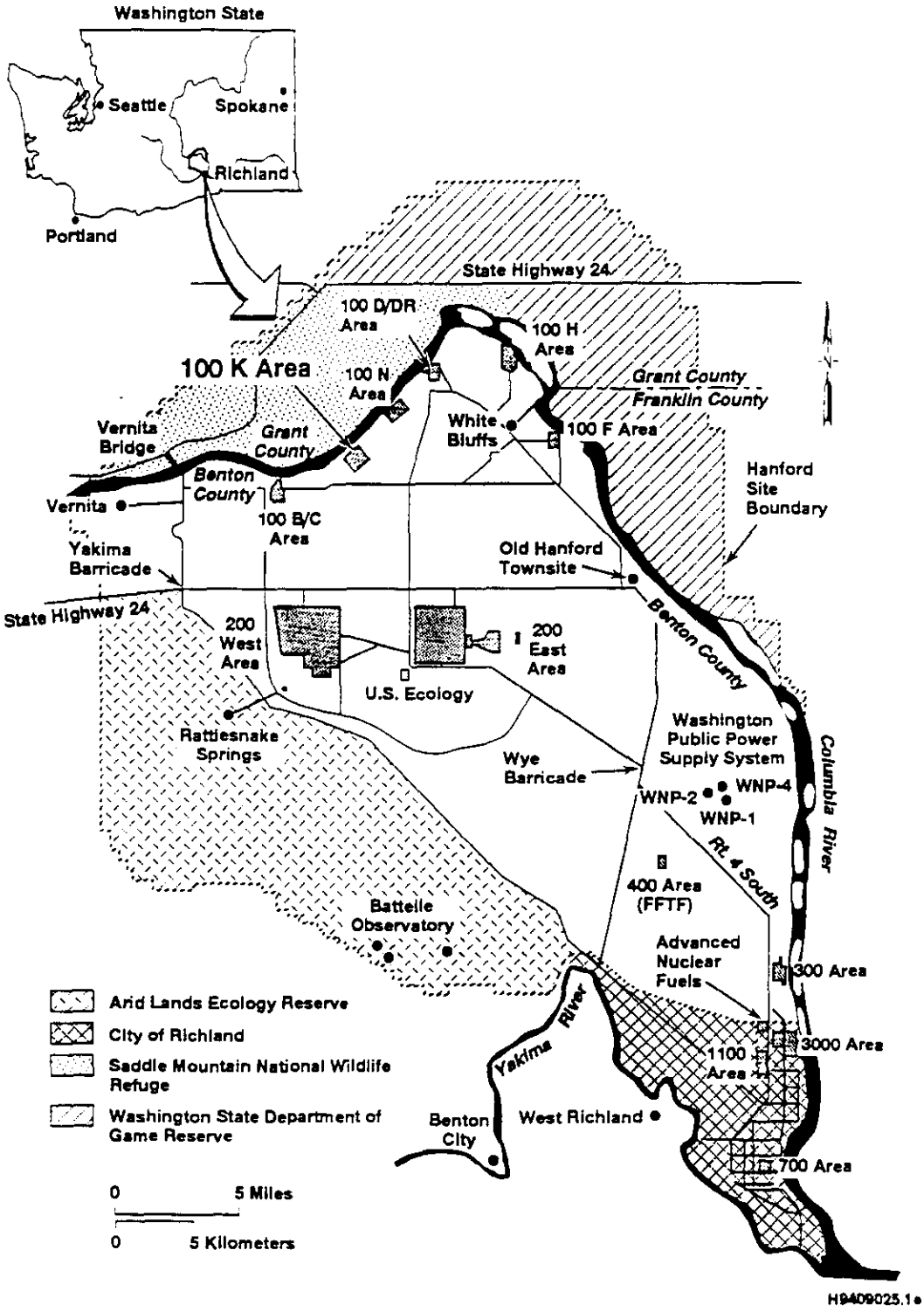
You will have an opportunity at the meeting to direct questions to Ecology, EPA, and DOE

SITE BACKGROUND

The Hanford Site is located in southeastern Washington (Figure 1). The 100 Area of the Hanford Site is located along the Columbia River and includes nine reactors that were used for plutonium

Technical terms and other text in bold are defined in the glossary at the end of this document.

Figure 1. 100-KR-1 Operable Unit.



production between 1943 and 1988. In 1989, the EPA placed the 100 Area on the **National Priorities List** because of the soil and groundwater contamination that have resulted from past operations of the nuclear facilities. The 100-KR Area includes three operable units: 100-KR-1, 100-KR-2, and 100-KR-4.

The 100-KR-1 source operable unit encompasses an area of approximately 1.55km^2 (0.6 mi^2) and is located immediately adjacent to the Columbia River. In general, it contains facilities associated with disposal of cooling water effluent from the 105KE and 105KW nuclear reactors in the 100-K Area (see Figure 2).

During preparation of the 100-KR-1 work plan, the known and suspected areas of contamination were classified as high-priority based on the collective knowledge of the operable unit managers (representatives from the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the Washington Department of Ecology) . High-priority sites were judged to pose sufficient risk(s) through one or more pathways to require evaluation for an interim remedial measure (IRM).

In the 100-KR-1 Operable Unit, six facilities were identified as high-priority waste sites: the 116-K-1 crib, the 116-K-2 trench, the 116-KW-3 retention basin, the 116-KE-4 retention basin, the 116-K-3 outfall, and the process effluent pipelines. The outfall structure (116-K-3) is not addressed as part of this IRM proposal plan. It is being considered as a separate action as part of an environmental restoration act (ERA). The sites fall into two general categories: shallow sites, where both soil exposure and groundwater impacts may be of concern; and deep sites, where groundwater impact is the primary concern. The descriptions for sites are summarized in Table 1.

SUMMARY OF SITE RISKS

Potential risks to human health and ecological receptors were evaluated in the *Qualitative Risk Assessment Report*. The results of the **qualitative risk assessment** are summarized in Table 2 and described in the following sections of this proposed plan. These results indicate that interim remedial measures are warranted at the high priority sites.

In the Superfund process, potential risks to human health and the environment are evaluated to determine whether significant risks exist due to site contaminants. Two types of potential human health effects due to contact with site contaminants are evaluated at Superfund sites. The first is the potential increase in cancer risks. This potential increase is expressed exponentially as 1 x 10^{-4}, 1 x 10^{-5}, 1 x 10^{-6} (one in ten thousand, one in one hundred thousand, one in a million, respectively). This means that for a 1 x 10^{-4} risk, if 10,000 people were exposed to a contaminant of concern for some period of time, 2,501 cancer diagnoses could be expected. Based on current national cancer rates, 2,500 people out of 10,000 are expected to be diagnosed with cancer. Remedial actions generally are not required at risk levels below 1 x 10^{-4} unless there are other considerations (such as adverse environmental impacts, the potential for future migration, or uncertainty regarding future land use). For the second type of potential human health effect, non-carcinogenic health impacts, a **Hazard Index** (HI) is calculated. An HI greater than or equal to 1 may pose a potential adverse human health risk.

Human Health Risk: Human health risks were evaluated for 100-KR-1 sites in order to select sites that should be addressed through interim remedial measures. Human health risks were evaluated using a qualitative risk assessment. The qualitative risk assessment used a limited set of exposure assumptions and pathways to estimate health risks. Contaminants detected in soils at the 100-KR-1 Operable Unit high priority radioactive liquid waste disposal sites pose a potential increased health risk to future users of the site. The level of potential health risk posed by these contaminants differs depending upon the future site use. Two scenarios were evaluated: (1) an occasional use scenario, which corresponds to a recreational use; and (2) a frequent use scenario, which corresponds to a residential use. In either case, future users could be exposed to contaminants in soil through ingestion of soil, inhalation of wind-blown dust, or external exposure to radiation.

Based on the qualitative risk assessment, The human health risks for the 100-KR-1 Operable Unit are primarily from external exposure to radionuclides. The contaminants in soil providing the highest contribution to potential increased cancer risks included cesium-137, cobalt-60, europium-152, and europium-154. Noncancer hazard indices at 100-KR-1 Operable Unit sites were all less than 1.0.

Figure 2. Waste Site Locations.

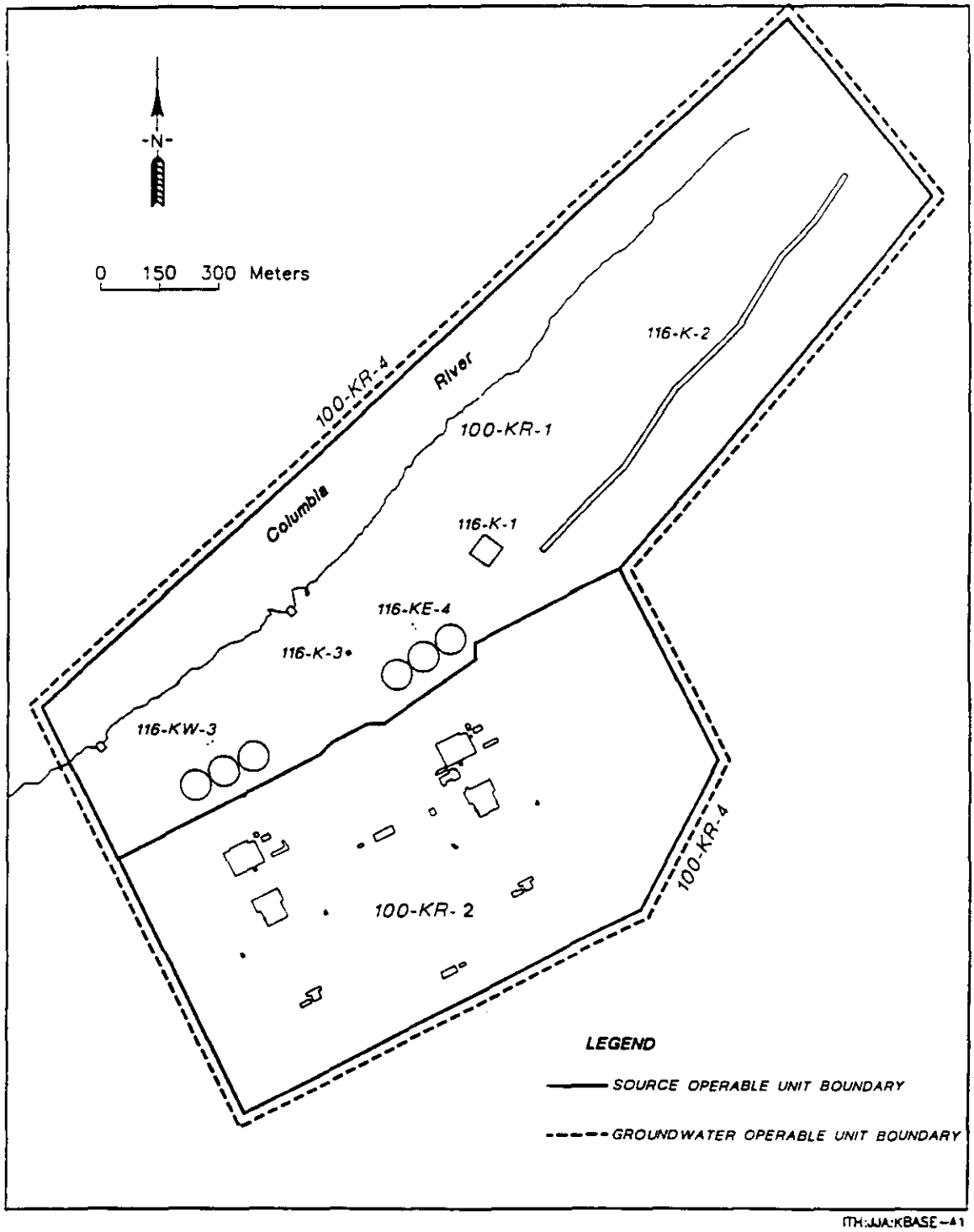


Table 1. Description and History of 100-KR-1 Operable Unit IRM Candidate Sites.

Waste Site Name	Former Waste Site Use	Physical Waste Site Description	[1]Contaminants of Potential Concern
116-K-1 Crib	Received radioactive reactor cooling effluent wastes. 40,000,000ℓ contaminated by fuel cladding ruptures.	Crib area is 61 m x 61 m. Crib bottom elevation is 126 m. Crib surrounded by earthen embankment extending 6.1 m above crib bottom. Outer edge of embankment encompasses area 122 m x 122 m.	Cs-137, Co-60, Eu-152, Eu-154, K-40, Pu-239/240
116-K-2 100 K "Mile Long Trench"	Received 30,000,000,000 ℓ of contaminated effluent that included radioactive reactor cooling effluent and contaminated water from floor drains in 105-KE and 105-KW Reactors. Also buried in trench is a construction tractor and all "hydride" tanks from 100 K.	Open trench 1249.7 m long 13.7 m wide and 7.6 m deep. Trench was excavated 5.3 m below grade and surrounded by a berm 2.3 m high. About 6.6 m of fill placed in trench in 1971, except at inlet end of trench. First 290 m of trench, the inlet end, now contains about 6.8 m of fill.	Cs-137, Co-60, Eu-152, Eu-154, Pu-239/240, Sr-90, chromium VI, mercury
116-KW-3 Retention Basins	Held cooling water effluent from 105-KW Reactor for cooling/decay before release to the Columbia River.	Three open-topped welded carbon steel tanks 76.2 m dia. x 8.8 m high. Approximately 3/4 of the tank walls have been removed.	Cs-137, Co-60, Eu-152, Eu-154, Eu-155, Th-228, Th-232, U-233/234, U-238, Sr-90, cobalt, K-40
116-KE-4 Retention Basins	Held cooling water effluent from 105-KE Reactor for cooling/decay before release to the Columbia River.	Three open-topped welded carbon steel tanks 76.2 m dia. x 7.62 m high. Approximately 3/4 of the tank walls have been removed.	Cs-137, Co-60, Eu-152, Eu-154, Eu-155, Th-228, Th-232, U-233/234, U-238, cobalt, K-40
Buried Process Effluent Pipelines	Transported reactor cooling water to retention basins; 116-K-3 outfall structure, 116-K-1 crib; and 116-K-2 trench. Contain contaminated sludge and scale.	Lines are 183 cm, 168 cm, 152 cm, 107 cm, 91 cm, and 30 cm in diameter; buried 1.9 m to 5.2 m average depth.	Cs-137, Co-60, Eu-152, Eu-154, Eu-155, Th-228, Th-232, U-233/234, U-238, cobalt, K-40

[1]The contaminants of potential concern were identified from the Qualitative Risk Assessment

Cs-137 = ^{137}Cesium
Co-60 = ^{60}Cobalt
Eu-152 = ^{152}Europium
Eu-154 = ^{154}Europium
Eu-155 = ^{155}Europium
K-40 = ^{40}Potassium
Pu-238 = ^{238}Plutonium
Pu-239/240 = $^{239/240}$Plutonium
Sr-90 = ^{90}Stronium
Th-228 = ^{228}Thorium
Th-232 = ^{232}Thorium
U-233/234 = $^{233/234}$Uranium
U-238 = ^{238}Uranium

Table 2. Summary of risks for 100-KR-1 IRM Candidate Sites.[1]

Waste Sites	Human Health Risk Estimates[2]				Ecological Risk Estimates[2] (Environmental Hazard Quotient)	
	Residential Land Use[3]		Recreational Land Use[4]			
	Increased Cancer Risk[5]	NonCancer Hazard Index[6]	Increased Cancer Risk[5]	NonCancer Hazard Index[6]	Radionuclides	Inorganics or Organics
116-K-1 Crib	$>1 \times 10^{-2}$	<1.0	3×10^{-4}	<1.0	<1.0	<1.0
116-K-2 Process Effluent Trench	$>1 \times 10^{-2}$	<1.0	1×10^{-2}	<1.0	>1.0	<1.0
116-KW-3 Retention Basin	1×10^{-2}	<1.0	5×10^{-4}	<1.0	>1.0	<1.0
116-KE-4 Retention Basin	1×10^{-2}	<1.0	4×10^{-4}	<1.0	<1.0	<1.0
Buried Process Effluent Pipelines	$>1 \times 10^{-2}$ [7]	NA[8]	$>1 \times 10^{-2}$ [7]	NA[8]	<1.0[9]	ND[10]

1 A qualitative risk assessment provides an evaluation of the need for interim remedial measures at 100-KR-1 sites.
2 Human health and ecological risks estimated in the qualitative risk assessment are based on conservative assumptions that may overstate the level of potential risks. Actual risks associated with the 100-KR-1 sites are likely to be lower than presented here.
3 Corresponds to a frequent use scenario.
4 Corresponds to an occasional use scenario.
5 Based on soils within the waste site and assuming radioactive decay through the year 2018.
6 Based on soils within the waste site.
7 Rating is qualitative, based on process information.
8 NA = Not applicable.
9 Based on analogous soil data from outside 100-Area pipeline.
10 ND = No data available.

The risk estimates presented in Table 2 represent potential future risks if the area were to be used for recreational or residential purposes. The cancer risks indicated are outside of EPA's acceptable risk range and show that remedial actions should be taken at these sites.

Past disposal of radioactive liquid wastes to the soils at the 100-KR-1 Operable Unit has resulted in impacts to the underlying groundwater. Should groundwater under the site be used, future users could be exposed to contaminants by drinking the groundwater. The existing groundwater contamination that resulted from these source operable units is part of the 100-KR-4 Operable Unit, and will be addressed in a future proposed plan for groundwater.

Ecological Risk - Ecological risks for the waste sites within the 100-KR-1 Operable Unit were estimated by evaluating potential impacts to the Great Basin pocket mouse. Risks to the mouse were estimated assuming the food pathway was the primary route of exposure to both radionuclides and inorganic/organic contaminants. An **Environmental Hazard Quotient** (EHQ) equal to or greater than 1.0 was considered to indicate that individual mice were at risk.

Radiological risks to the mouse exceeded an EHQ of 1.0 at the 116-K-2 Process Effluent Trench and at the 110-KW-3 Retention Basin. Nearly all of the radiological risks at this operable unit were attributable to strontium-90. Radiological risks were below an EHQ of 1.0 at the 116-K-1 Crib, the 116-KE-4 Retention Basin and the buried process effluent pipelines (Table 2). Exposure to inorganic and organic chemical contaminants did not exceed an EHQ of 1.0 at any of the interim remedial measure sites.

SCOPE AND ROLE OF ACTION

This proposed plan presents interim remedial measures at five high priority radioactive sites at the 100-KR-1 Operable Unit. The objective of the proposed interim remedial measures is to reduce potential future threats to human health and the environment from these waste sites. It is expected that no additional remedial measures will be required at these sites. A limited number of additional waste sites may be remediated during the interim remedial measures if they are adjacent to or within the excavation area for the five high priority sites.

The public, through various forums including the **Hanford Future Site Uses Working Group**, has provided information to the DOE for the future use of the 100 Area. However, a final land use determination for the 100 Area of the Hanford Site has not been established. Remedial action objectives and cleanup goals may be revisited if land use and groundwater use determinations are inconsistent with the goals presented in this plan.

For the purposes of this proposed plan, the EPA, Ecology, and the DOE have agreed to cleanup goals that, to the extent practical, would support a goal not to limit future uses of the 100 Area land. Cleanup of contaminants would be accomplished through remediation that will address the potential direct effects of exposure, as well as potential releases to the air and groundwater. Remediation would minimize ecological and cultural impacts. The development of mitigation plans to address site-specific ecological and cultural resources will occur during the remedial design phase that follows after the ROD is signed.

In addition to evaluating whether the alternatives pose a risk to human and ecological receptors, the different remedial alternatives were compared relative to the potential impacts the action might have on cultural and natural resources, transportation, and regional socioeconomics. The comparative evaluation of alternatives also considered avoidance and mitigation of the above impacts, what commitment of resources may be necessary, and how the actions at this operable unit relate to actions being planned or executed at other operable units (cumulative impacts).

The levels of impact from the alternatives will vary depending on requirements such as equipment and services, the need for backfill materials, and the need for people to support each alternative. Significant impacts are expected to be limited to the potential exposure of remediation workers to hazardous or radioactive substances, short term impacts to wildlife from construction activities, and the commitment of the land area used for disposal. The extent of physical disturbance caused by the action was also evaluated because this has a direct relationship to the potential for impacting cultural and natural resources.

The development of avoidance and mitigation measures will be initiated as soon as the remedial alternative is selected. There are significant issues related to potential impacts to human burial and prehistoric archaeological sites adjacent to the waste

sites that need to be addressed with the Yakima Nation and the Wanapum Tribe. Also, avoidance of bald eagle winter roosting areas will be required. Several of the waste sites to be remediated occur within areas previously disturbed by reactor construction and operations, and pre-Hanford agricultural activities, so remediation and revegetation actions will likely result in improving rather than degrading ecological conditions in the area.

INTERIM REMEDIAL ACTION GOALS

Interim remedial action goals represent contaminant concentrations in soils that are considered to be protective of human health and the environment. Cleanup goals are based on the three laws and the draft regulation listed below.

- State of Washington *Model Toxics Control Act* for organic and inorganic chemical constituents in soil to support unrestricted (residential) use.

- Draft EPA and Nuclear Regulatory Commission proposed standard of 15 mrem/yr in soils above background for radionuclides for human health.

- Groundwater protection such that contaminants remaining in the soil after remediation do not result in an impact to groundwater that could exceed **Maximum Contaminant Levels** under the *Safe Drinking Water Act*. This applies to waste sites where groundwater has not been affected.

- Columbia River protection such that contaminants remaining in the soil after remediation do not result in an impact to groundwater and, therefore, the Columbia River. These contaminants should not exceed the Ambient Water Quality Criteria under the *Clean Water Act* for consumption of fish. This act applies to sites where groundwater has already been affected.

For deep sites the extent of remediation may be balanced against several factors, including reduction of risk by decay of radionuclides, protection of human health and the environment, costs, sizing of the Environmental Restoration Disposal Facility, worker safety, presence of ecological and cultural resources, the use of institutional controls, and long term monitoring costs. In the event that contaminated soil above cleanup goals are left in place, additional public comment may be solicited.

SUMMARY OF ALTERNATIVES CONSIDERED

The *100 Area Source Operable Unit Focused Feasibility Study Report (DOE/RL-94-61)* identified six general response actions that could be applied to waste sites in the 100 Areas, including the 100-KR-1 Operable Unit. The alternatives evaluated for interim remediation are as follows:

- No action
- Institutional Controls
- Containment
- Remove/Dispose
- In Situ Treatment
- Remove/Treat/Dispose.

NOTE: The no action, institutional controls, containment, and in situ treatment alternatives would limit the future uses of the 100 Area. A summary of alternatives considered is provided below.

No Action - The no action alternative was evaluated to provide a baseline for comparison to the other alternatives. It represents a hypothetical scenario where no additional restrictions, controls, or active remedial measures other than those currently existing are applied to a site.

Institutional Controls - This alternative involves the following:

- deed and/or access restrictions
- groundwater monitoring.

Deed restrictions would consist of limitations on certain types of land-uses (e.g., prohibiting drilling or excavation) at an individual waste site. Access restrictions would include fences or signs. Groundwater monitoring would include sampling for potential changes in groundwater contaminant concentrations underlying the waste sites. These institutional controls would limit exposure to humans and would monitor changes in groundwater quality until a final response action could be evaluated and implemented.

Containment - This alternative includes the following elements:

- institutional controls
- groundwater monitoring
- surface water controls
- installation of a barrier at the surface

As described under the institutional control alternative, deed restrictions and/or access restrictions, combined with groundwater monitoring, would be implemented along with surface water controls during and after installation of a surface barrier, such as the Hanford Barrier.

Remove/Dispose - This alternative applies to contaminated soils and structures, and includes the following:

- remove contaminated media
- dispose media at an approved disposal facility
- backfill excavated areas and revegetation.

Under this alternative, contaminated media would be excavated, transported, and disposed at an appropriate facility (e.g., the Environmental Restoration Disposal Facility or 218-W-5 Burial Ground, Trench 31 [W025]), in accordance with waste acceptance criteria established for the disposal facility. Any material that exceeds the disposal facility acceptance criteria would be stored onsite consistent with requirements until the material is treated to meet acceptance criteria or a variance/waiver is approved. As the contaminated material is excavated, it would be characterized and segregated prior to transportation. Excavation would continue until all contaminated material exceeding the cleanup goal is removed. The site would then be backfilled and the area revegetated. Site specific revegetation plans will be developed during remedial design with input from affected stakeholders, such as Natural Resource Trustees and Native American Tribes.

In Situ Treatment (for soil) - This alternative applies to contaminated soil and includes the following elements:

- institutional controls
- groundwater monitoring
- surface water controls
- **in situ vitrification.**

Institutional controls (such as deed restrictions and/or access restrictions, groundwater monitoring, and surface water controls) would be implemented as discussed 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 soil. The disturbed area would then be revegetated.

In Situ Treatment (for Buried Process Effluent Pipelines) - This alternative applies to buried process effluent pipelines and contaminated soils. It includes the following elements:

- institutional controls
- groundwater monitoring
- void grouting
- installation of a surface barrier, if needed.

Under this alternative, deed and/or access restrictions, groundwater monitoring, and surface water controls would be implemented as previously described. The buried process effluent 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 surface barrier would be installed (as described in the containment alternative) over soils and buried pipelines if needed to reduce infiltration of rainwater.

Remove/Treat/Dispose - This alternative applies to sites with contaminated soil and structures, and includes the following elements:

- remove contaminated media
- **thermal desorption**, if required, for soil
- **soil washing**, as appropriate
- disposal at an approved facility
- backfill of excavated areas and revegetation.

Under this alternative, the contaminated soils would be excavated as described under the removal/disposal alternative. Soils contaminated with organic chemicals at levels exceeding waste disposal acceptance criteria would be treated by thermal desorption, then recombined with the remaining contaminated soils prior to soil washing.

Soil washing could reduce the volume of contaminated soil for disposal. The application of soil washing to a waste site will depend on several factors, including soil conditions, contaminant specific cleanup goals, and the level of contaminants present. Soil washing is a desirable treatment only when significant volume reduction can be achieved. It would only be performed when such volume reduction could be achieved in a cost-effective manner. The greatest cost benefit would be achieved at large volume sites with low levels of contaminants. Treatability studies are currently in progress to evaluate the applicability of soil washing in the 100 Area.

Following removal and treatment, contaminated soil and/or contaminated products resulting from treatment technologies would be disposed of in the same manner as the remove/dispose alternative. The excavation would be backfilled with washed soils and other soils, as needed, then revegetated.

PREFERRED INTERIM REMEDIAL MEASURES

The preferred alternatives described below were selected based on an evaluation of criteria presented in the *100-KR-1 Operable Unit Focused Feasibility Study Report*. The preferred alternative is the removal, treatment (where appropriate or required), and disposal alternative for the contaminated soil present at 116-KW-3 and 116-KE-4, the 116-K-2 effluent disposal trench, and the 116-K-1 crib. For the pipelines, the preferred alternative is remove and dispose. These alternatives are protective of human health and the environment in both the short and long-term. The preferred alternative is implementable, utilizes proven technologies and equipment to complete the action, and is cost effective. Table 3 presents the estimated cost for each cleanup alternative.

EVALUATION OF ALTERNATIVES

The preferred alternatives are believed to provide the best balance of tradeoffs among the alternatives with respect to the nine evaluation criteria used to evaluate remedies. The criteria fall into three categories: The first two (Overall Protection of Human Health and the Environment, and Compliance with **Applicable or Relevant and Appropriate Requirements [ARARs]**) are considered *threshold* criteria and, in general, must be met unless waivers are granted. The next five are considered *balancing* criteria, and are used to compare technical and cost aspects of the alternatives. The final two criteria (State and Community Acceptance) are considered *modifying* criteria. Modifications to remedial actions may be made based upon state and local comments and concerns. These will be evaluated after all public comments have been received. The following paragraphs discuss how the alternatives address the criteria for the 100-KR-1 Operable Unit.

OVERALL PROTECTION

The no action alternative does not meet this criteria. Institutional controls alone cannot be relied on to indefinitely provide protection, and therefore do not meet this criteria. The containment alternative would provide protection by encapsulating wastes for the pipelines, but would not provide adequate protection for the cribs, retention basins, and trench. The in situ alternative would provide overall protection for the retention basin and pipelines, but would not adequately address the cribs or effluent trench. The remove/dispose and remove/treat/dispose alternatives would provide overall protection of human health and the environment.

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The no action, institutional controls, containment and in-situ treatment alternatives would not meet all of the principal ARARs identified for all of the sites. The remove/dispose and the remove/treat/dispose alternatives would meet the ARARs, with the potential exception of land disposal restrictions under the *Resource Conservation and Recovery Act*. If land disposal restricted contaminants are encountered, contaminated soil would be treated or a variance/waiver could be requested.

LONG TERM EFFECTIVENESS

The no action and institutional controls alternatives would not meet cleanup goals and, therefore, would not provide for long-term effectiveness. Containment and in-situ treatment would provide a greater degree of long term effectiveness by stabilizing and isolating the wastes in place. The remove/dispose and remove/treat/dispose alternatives would provide the greatest long-term effectiveness and permanence.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

The no action and institutional controls alternatives do not reduce the mobility, toxicity, or volume of the contaminants. The containment and institutional controls alternatives do not include treatment. The containment, in-situ treatment, and remove/dispose alternatives would reduce the mobility of contaminants but not the toxicity or volume. The remove/treat/dispose alternative provides the most significant level of treatment and would reduce volume and mobility.

Table 3. Summary of Estimated Costs for 100-KR-1 Operable Unit Remedial Alternatives.

100-KR-1 Sites	Containment			Removal/Disposal			In Situ Treatment			Removal/Treatment/Disposal		
	Capital	O&M	Present Worth	Capital	O&M	Present Worth	Capital	O&M	Present Worth	Capital	O&M	Present Worth
116-K-1	$2.46	$1.11	$2.97	$3.40	$0.00	$3.24	$8.92	$6.29	$14.5	$3.97	$.278	$4.06
116-K-2	NA	NA	NA	$75.6	$0.00	$70.2	NA	NA	NA	$76.3	$10.1	$79.0
116-KW-3	$16.8	$7.99	$20.5	$105	$0.00	$98.5	NA	NA	NA	$111	$33.1	$130
116-KE-4	$19.1	$9.12	$23.3	$62.0	$0.00	$59.1	$176	$135	$200	$67.5	$14.9	$76.8
Buried Effluent Pipeline	$37.30	$18.01	$44.58	$42.69	$0.00	$39.78	$8.26	$0.00	$7.87	NA	NA	NA

- Costs are in millions of dollars
- NA = Not applicable to the Waste Site (see FFS Report)
- Costs presented are based on a different exposure scenario than the selected scenario, but the relative differences between alternatives is similar (see FFS Report for detailed cost analysis).
- Costs presented are preliminary, and are presented for comparison purposes only.

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 variance/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.

SHORT-TERM EFFECTIVENESS

The no action and institutional controls alternatives require minimal effort to implement. The containment and in-situ treatment options require technology that is readily available. The remove/dispose alternative would provide a greater degree of short-term protectiveness than the remove/treat/dispose alternative because it requires less time to implement, uses standard technologies, and presents less short-term risk to workers and the environment.

IMPLEMENTABILITY

The institutional controls alternative would require administrative actions such as deed restrictions. The containment and in-situ treatment alternatives are implementable with existing technologies. The remove/dispose alternative is easier to implement than the remove/treat/dispose alternative.

COST

Table 3 provides a summary of costs for the 100-KR-1 waste sites.

EVALUATION OF POTENTIAL ENVIRONMENTAL IMPACTS

In addition to evaluating whether the alternatives pose a risk to human and ecological receptors, the different remedial alternatives were compared relative to the potential impacts the action might have on cultural and natural resources, transportation, and regional socioeconomics. The evaluation of alternatives also considered avoidance and mitigation

EPA, Ecology, and DOE believe the assumptions relied upon in developing the preliminary cost estimates for the cleanups has resulted in estimates that are too high. There is a high level of uncertainty in the cost estimates due to the lack of actual remediation experience at 100 Area waste sites. The Tri-Parties are working together to implement a demonstration project this summer in the 100-BC Area to address a number of concerns related to cleanup, including the verification of cost models. It is expected that contaminated materials from those actions will be disposed of at the 218-W-5 Burial Ground, Trench 31 (W025) in the 200 Area, or stored for future disposal at the Environmental Restoration Disposal Facility.

of the above impacts, what commitment of resources may be necessary, and how the actions at this operable unit relate to actions being planned or executed at other operable units (cumulative impacts).

The levels of impact from the alternatives will vary depending on requirements (such as equipment and services), the need for borrow materials, and people that are needed to support each alternative. Significant impacts are expected to be limited to (1) potential exposure of remediation workers to hazardous or radioactive substances; (2) short term indirect impact to wildlife from construction activities; and (3) the commitment of the land area used for disposal. The extent of physical disturbance caused by the action was also evaluated because this has a direct relationship to the potential for impacting cultural and natural resources.

The development of avoidance and mitigation measures will be initiated as soon as the remedial alternative is selected. The waste sites to be remediated occur within areas previously disturbed by reactor operations and agricultural activities, so remediation and revegetation actions will likely result in improving rather than degrading ecological conditions in the area.

SUPPORTING DOCUMENTS

The public is encouraged to review the following documents to gain a better understanding of the 100-KR-1 Operable Unit:

- *Remedial Investigation/Feasibility Study Work Plan for the 100-KR-1 Operable Unit* (DOE/RL-90-20)
- *Limited Field Investigation Report for the 100-KR-1 Operable Unit* (DOE/RL-93-78)
- *Qualitative Risk Assessment for the 100-KR-1 Operable Unit Report* (WHC-SD-EN-RA-009)
- *100-KR-1 Operable Unit Focused Feasibility Study Report* (DOE/RL-94-66)
- *100-Area Source Operable Unit Focused Feasibility Study Report* (DOE/RL-94-61)
- 100 Areas Feasibility Study, Phases 1 and 2 (DOE/RL-92-11)

ADMINISTRATIVE RECORD

The Administrative Record can be reviewed at the following locations:

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

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

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

POINTS OF CONTACT

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EPA (Region 10)
Kevin Oates
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509/376-8665

Washington State Department of Ecology Representative
David Holland
Unit Manager
509/736-3027

INFORMATION REPOSITORIES

Supporting documents are available for review at the following repositories:

University of Washington, Suzzallo Library
Government Publications Room
Mail Stop FM-25
Seattle, Washington 98195

Gonzaga University, Foley Center
E. 502 Boone
Spokane, Washington 98195

Portland State University, Branford Price Millar Library
Science and Engineering Floor
SW Harrison and Park
P.O. Box 1151
Portland, Oregon 97207

U.S. Department of Energy Richland Public Reading Room
Washington State University, Tri-Cities
100 Sprout Road, Room 130
Richland, Washington 99352

GLOSSARY

Applicable or Relevant and Appropriate Requirements (ARARs) - These are federal and state requirements that apply to cleanup actions under CERCLA.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - This is a federal law that establishes a program that enables the Environmental Protection Agency to identify hazardous waste sites, ensure that they are cleaned up, and allow other government entities to evaluate damages to natural resources. CERCLA is also known as the "Superfund law."

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

Environmental Hazard Quotient - The ratio of exposure toxicity for ecological receptors of contaminants. When the Environmental Hazard Quotient exceeds 1.0, a possible ecological risk is assumed to exist.

Environmental Restoration Disposal Facility - A disposal facility for contaminated soils and solid waste that will be available in October 1996 at the Hanford Site to support interim remedial measures.

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.

Hanford Future Site Uses Working Group - A working group made up of representatives of interested parties concerned with the cleanup and possible future uses of the Hanford Site. The group was active in 1992 and produced a report identifying possible future site uses and an examination of the cleanup necessary to make those uses possible.

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

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

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 a record of decision.

Maximum Contaminant Level (MCL) - The maximum concentration of a particular contaminant allowable in drinking water under the *Safe Drinking Water Act* of 1974, as amended.

National Priority List - A list of top-priority hazardous waste sites in the United States that are eligible for investigation and cleanup under the Superfund law.

Operable Unit - This is a subset of a larger Superfund CERCLA site; it is typically the subject of Operable Unit-specific investigations and remedial actions.

Qualitative Risk Assessment - 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.

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

Soil Washing - Soil washing is a means to reduce contaminated soil waste volume by concentrating contaminants in the fine (i.e., clay, silt, and sand) soil fractions. Only the contaminated fines, rather than the entire range of particle sizes, are disposed of at an approved waste disposal facility, thereby conserving space at the disposal facility. The uncontaminated gravel and cobble fractions can then be returned to the waste site excavation.

Thermal Desorption - A process that uses indirect low temperatures to thermally remove volatile and semi-volatile organic compounds from contaminated soil, sediment, or sludge.