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064116

DEC 7 1998

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Mr. E. R. Skinnarland
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Department of Ecology
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Kennewick, Washington 99336-6018

Dear Messrs. Sherwood and Skinnarland:

ENGINEERING EVALUATION/COST ANALYSIS (EE/CA) FOR THE RADIATION AREA REMEDIAL ACTION (RARA) WASTE SITES, DOE/RL-97-88, DRAFT D

Please find attached a copy of the subject document for regulatory review. Comments previously provided by the U.S. Environmental Protection Agency and the State of Washington Department of Ecology have been incorporated into this draft.

The EE/CA will provide a pathway for including specific RARA Project stabilization activities to be conducted under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Benefits to the government include permit exemptions and disposal authorization of RARA generated remediation wastes at the existing Environmental Restoration Disposal Facility.

Please provide comments by no later than December 20, 1998. If you have any questions or require additional information, please contact me at 372-0649.

Sincerely,

Thomas Ferns

T. W. Ferns, Project Manager
Remedial Actions Project

RAP:TWF

Attachment

cc w/attach:
J. W. Donnelly, Ecology
P. S. Innis, EPA

cc w/o attach:
J. J. McGuire, BHI

0050180

DOE/RL-97-88
Draft D

Engineering Evaluation/ Cost Analysis for the Radiation Area Remedial Action Waste Sites

United States
Department of Energy

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Engineering Evaluation/Cost Analysis for the Radiation Area Remedial Action Waste Sites

October 1998

United States Department of Energy

P.O. Box 550, Richland, Washington 99352

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ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirements
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
NEPA	*National Environmental Policy Act of 1969*
OSHA	Occupational Safety and Health Act
PCB	polychlorinated biphenyls
PUREX	plutonium uranium extraction
RARA	Radiation Area Remedial Action
RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	reduction oxidation
RL	U.S. Department of Energy, Richland Operations Office
TSCA	*Toxic Substances Control Act of 1976*
UNH	uranyl nitrate hexahydrate
UPR	unplanned release
WAC	*Washington Administrative Code*

Metric Conversion Chart

The following conversion chart is provided to the reader as a tool to aid in conversion.

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	Millimeters	Millimeters	0.039	inches
inches	2.54	Centimeters	Centimeters	0.394	inches
feet	0.305	Meters	Meters	3.281	feet
yards	0.914	Meters	Meters	1.094	yards
miles	1.609	Kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.0836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
Ounces	28.35	grams	grams	0.035	ounces
Pounds	0.454	kilograms	kilograms	2.205	pounds
Ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters			
fluid ounces	30	milliliters			
cups	0.24	liters			
pints	0.47	liters	liters	2.1	pints
quarts	0.95	liters	liters	1.057	quarts
gallons	3.8	liters	liters	0.264	gallons
cubic feet	0.028	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.765	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	Subtract 32, then multiply by 5/9	Celsius	Celsius	Multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
curies	3.7×10^{10}	becquerel	becquerel	2.7×10^{-11}	curies

1.0 INTRODUCTION

The 100, 200, 300, and 1100 Areas of the Hanford Site were placed on the U.S. Environmental Protection Agency's (EPA) National Priorities List in November 1989 under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA). Located in the 100, 200, and 300 Areas are waste sites managed by the Radiation Area Remedial Action (RARA) program. The waste sites are from accidental spills or contamination spreads, or were used as disposal sites for low-level liquid and/or solid waste from Hanford Site facility processes. The subject waste sites are monitored periodically.

This Engineering Evaluation/Cost Analysis (EE/CA) describes the alternatives and selection criteria based on the necessary protective requirements to maintain these waste sites in a safe and stable condition, and to be protective of human health and the environment, before final waste site response action.

The U.S. Department of Energy (DOE), Richland Operations Office (RL), in cooperation with EPA and the Washington State Department of Ecology (Ecology) has prepared this EE/CA in accordance with 40 *Code of Federal Regulations* (CFR) 300.415. The EE/CA will provide the framework to evaluate and select an appropriate removal action from a viable set of alternatives. The EPA, Ecology, and RL will prepare and sign an Action Memorandum documenting the selected alternative following public review.

2.0 SITE CHARACTERIZATION

2.1 BACKGROUND AND SITE DESCRIPTION

The Hanford Site (Figure 2-1) is located in south central Washington State and was selected as the nation's first large-scale nuclear materials production site in January 1943. The reactors located in the 100 Area used uranium fuel elements in a critical configuration to produce plutonium. The fuel elements were manufactured and research activities were conducted in the 300 Area. After the fuel was irradiated, it was taken to separation plants located in the 200 Area, where the cladding was removed from the fuel elements and the plutonium was extracted. The 400 Area contains facilities constructed to conduct test components that could be used in liquid-metal fast breeder reactors. The 600 Area includes all portions of the Hanford Site not contained within the 100, 200, 300, and 400 Areas. Various facilities were constructed to support these and other related activities. Wastes generated from the activities conducted in these facilities were disposed onsite in various engineered structures (e.g., cribs, ditches, and ponds) now known as waste sites.

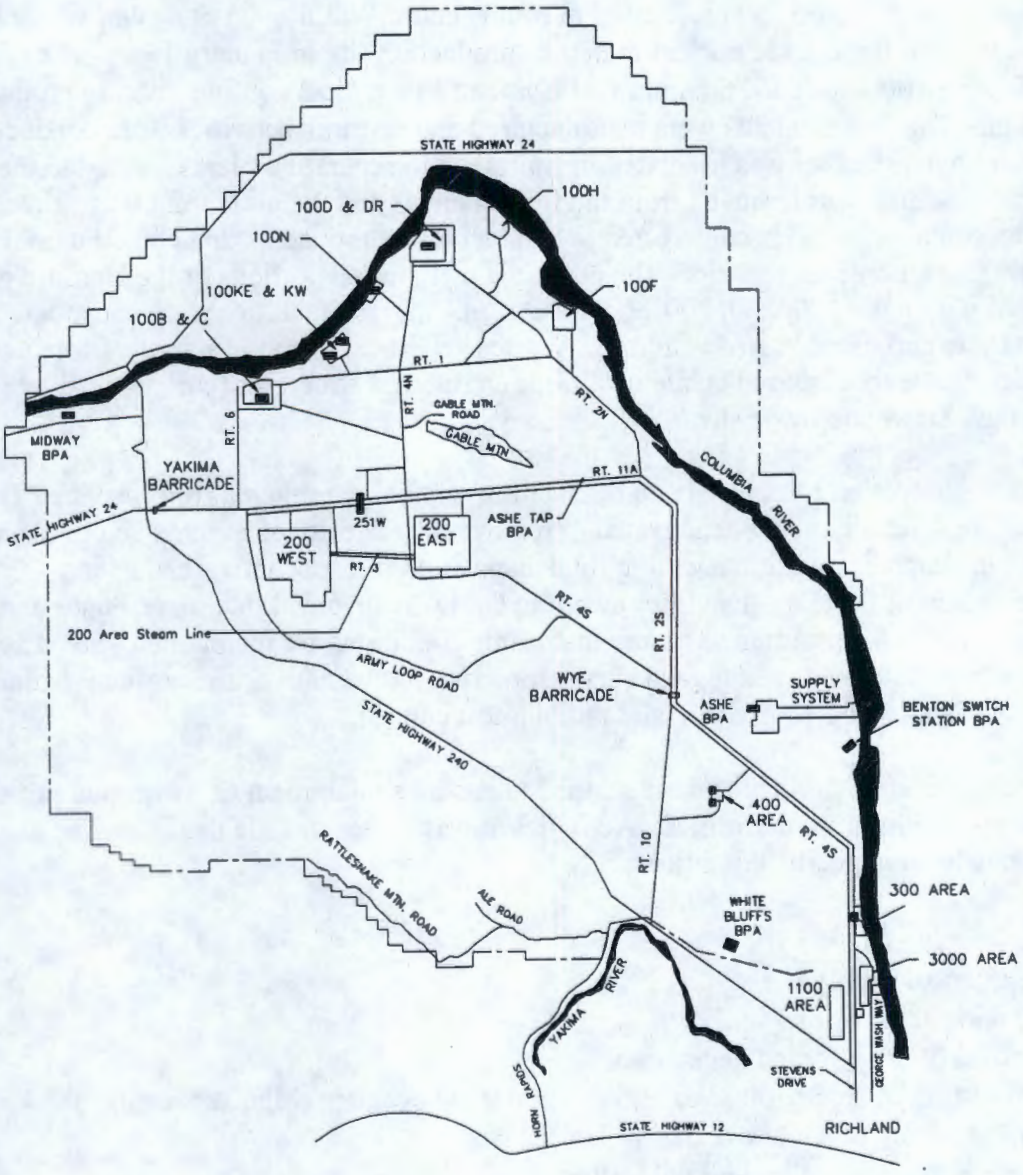
Plutonium production has ceased and the facilities are being removed from service. The facilities are generally being deactivated to remove the majority of hazards and to place the facilities in a stable condition awaiting final disposition (i.e., decontamination and decommissioning [D&D]). Facilities awaiting D&D are included in a surveillance and maintenance (S&M) program to ensure that stable conditions are maintained. S&M activities include site inspections; radiological surveys; routine, preventative, and corrective maintenance of facility systems and equipment; and radiological control.

The waste sites are inspected and maintained to ensure containment of hazardous substances until cleanup actions are performed. Activities at waste sites include the following as appropriate to site-specific conditions:

- Site walkdowns
- Radiological surveys
- Herbicide applications
- Removal of deep-rooted vegetation
- Load testing of some 200 Area burial grounds (to evaluate collapse potential)
- Camera survey of some wooden structured waste sites
- Repair of surface covers and void filling
- Stabilization (e.g., placement of soil cover or fixative) of surface contaminated areas
- Removal of contaminated material.

The level of activities conducted at the waste sites depends on many factors, including the levels of contamination, construction characteristics, structural stability, etc. The effort is a dynamic program and facilities and waste sites are included or removed from the project as deactivation, decommissioning and cleanup activities proceed.

Figure 2-1. Hanford Site.



2.1.1 Land Use and Public Access

Public access to the Hanford Site is currently restricted. The current land use consists of waste management and cleanup activities. For the purposes of conducting cleanup activities, the land areas have been grouped into operable units. An operable unit is an area of land that contains similar types of facilities and waste sites.

The Columbia River, adjacent to the Hanford Site, is accessible to the public for recreational use, (e.g., hunting, boating, and sport fishing). The river is currently under consideration for designation as a National Wild and Scenic River. In pre-contact and post-contact times, the areas along the banks of the Columbia River were a focal point for camping, fishing, and village sites for Northwestern Native American tribes. More recently, before the government acquired the land in January 1942, the areas were used for irrigated, dry land farming, and livestock grazing.

2.1.2 Ecological Setting

The ecological setting of the Hanford Site is described in *Hanford Site National Environmental Policy Act (NEPA) Characterization* (Neitzel 1997). The habitats affected by the actions described in this document include the 100, 200, and 300 Area operable units. The 100 and 300 Area operable units contain terrestrial habitats of sagebrush/cheatgrass, previously farmed fields consisting of cheatgrass/Sandberg's bluegrass, and highly disturbed industrialized areas covered with rocky soils and sparse weedy vegetation dominated by cheatgrass and Russian thistle. The 100 and 300 Areas also contain riparian habitats that include sloughs, backwaters, shorelines, and islands associated with the Columbia River flood plain and the aquatic habitats in the river. The 200 Area operable units contain sagebrush/grassland habitats, shrubless grassland habitats, and highly disturbed industrialized areas similar to the 100 Areas.

Before initiating any project covered by this EE/CA, a project-specific ecological resources review will be conducted to determine the presence or absence of species or habitats of concern. If ecological resources of concern are identified, mitigation actions will be prescribed to reduce or prevent injury. If injury to a habitat of concern (DOE-RL 1996) is unavoidable, mitigation for that habitat will be conducted.

Currently, there are no threatened or endangered plants listed by the federal government (50 CFR 17) on the Hanford Site. However, nine species of plants that grow at the Hanford Site are listed as threatened or endangered by Washington State (Neitzel 1997). Washington State has also listed mature sagebrush habitats as "priority habitat" because of the decline of these areas due to agricultural development.

Four animal species are listed by the federal government as threatened or endangered on the Hanford Site. They are as follows:

- Aleutian Canada goose (endangered)
- Bald eagle (threatened)
- Peregrine falcon (endangered)
- Steelhead trout (endangered).

The Chinook salmon is currently under consideration for listing. If there is a potential to affect a federally listed species, consultation with the appropriate U.S. Department of Interior agency or U.S. Department of Commerce (National Marine and Fishing Service) is required under the *Endangered Species Act of 1973* to establish mitigation actions to prevent impact. This consultation for the bald eagle and the peregrine falcon is documented in the *Bald Eagle Site Management Plan for the Hanford Site, South-Central Washington* (DOE-RL 1994). A similar plan will be developed for the steelhead trout (and the Chinook salmon if listed) that will define preapproved mitigation actions and determine when further consultation will be required.

Under Washington State listings for threatened and endangered species, there are an additional four animal species as follow:

- American white pelican
- Ferruginous hawk
- Sandhill crane
- Pygmy rabbit.

These species are not likely to be impacted by activities described in this EE/CA. However, if any of these species are identified in a project-specific ecological review, mitigation actions will be taken to prevent impacts.

2.1.3 Cultural, Archeological, Pre-Contact, and Post-Contact Resources

The following information is excerpted from PNNL 6415 (Neitzel 1997). This document should be consulted for additional details concerning cultural, archaeological, pre-contact, and post-contact resources at the Hanford Site.

With construction of dams elsewhere in the Columbia River system, the Hanford Reach is one of the most archaeologically rich areas in the western Columbia Plateau. The Hanford Reach contains numerous well-preserved archaeological sites representing pre-contact and post-contact periods and is still thought of as a homeland by many Native American people. Post-contact period resources include sites, buildings, and structures from the pre-Hanford Site, Manhattan Project, and Cold War eras. Sitewide management of Hanford's cultural resources follows the draft *Hanford Cultural Resources Management Plan* (Chatters 1989).

More than 830 cultural resource sites and isolated finds are recorded in the files of the Hanford Cultural Resources Laboratory. Forty-nine of them are listed in the National Register of Historic Places (Natural Register), including 1 reactor building, 2 single archaeological sites, 2 Rattlesnake Spring sites, and 44 archaeological sites in 6 archaeological districts. In addition to the National Register sites and districts already listed in the National Register, several National Register nominations are pending, and nine individual archaeological sites have been determined to be eligible for listing.

2.1.3.1 Native American Cultural Resources. In pre-contact and post-contact times, Native Americans of various tribal affiliations populated the Hanford Reach of the Columbia River. The Wanapum and the Chamnapum bands dwelt along the Columbia River from the City of Richland upstream to Vantage. Some Native American descendants still live nearby at Priest Rapids (Wanapum), while others reside in the Yakama and Umatilla Reservations. The Palus tribe, who lived on the lower Snake River, joined the Wanapum and Chamnapum to fish the Hanford Reach of the Columbia River, and some inhabited the east bank of the river. Descendants of the Palus tribe now live on the Colville Reservation. The Nez Perce, Walla Walla, and Umatilla tribes also made periodic visits to fish in the area. Descendants of these people retain traditional secular and religious ties to the region, and many have knowledge of the ceremonies and lifeways of their ancestral culture.

The Washani religion, which has ancient roots and had its start on the Hanford Site, is still practiced by many people (i.e., the Wanapum tribe and Native Americans on the Yakama, Umatilla, Warm Springs, and Nez Perce Reservations). Native plant and animal foods, some of which can be found on the Hanford Site, are used in the ceremonies performed by tribal members. Tribes have expressed an interest in renewing their use of these resources, and the DOE is assisting them in this effort. Certain landforms, especially Rattlesnake Mountain, Gable Mountain, Gable Butte, Goose Egg Hill, and various sites along and including the Columbia River, remain sacred to tribal members.

2.1.3.2 Pre-Contact Archaeological Resources. More than 300 pre-contact archaeological sites and isolated finds have been recorded on the Hanford Site, of which almost 50 contain pre-contact and post-contact components. Pre-contact archaeological sites common to the Hanford Site include remains of numerous pit house villages, various types of open campsites, cemeteries, spirit quest monuments (rock cairns), hunting camps, game drive complexes, quarries in nearby mountains and rocky bluffs, hunting/kill sites in lowland stabilized dunes, and small temporary camps near perennial sources of water located away from the river.

2.1.3.3 Post-Contact Archaeological Resources. About 470 post-contact archaeological sites and isolated finds have been recorded on the Hanford Site. Forty-eight archaeological sites contain pre-contact and post-contact components. Numerous post-contact properties associated with the pre-Hanford Site era have also been recorded. Properties from this period include semi-subterranean structures near McGee Ranch; the Hanford Irrigation and Power Company's pumping plant at Coyote Rapids; the Hanford Irrigation Ditch; the former Hanford Townsite pumping plant and high school; Wahluke Ferry; the White Bluffs Townsite and bank; the Richmond Ferry; the Arrowsmith Townsite; a cabin at East White Bluffs ferry landing; the White Bluffs road; the Chicago, Milwaukee, St. Paul, and Pacific Railroad (Priest Rapids –

Hanford Line) and associated whistle stops; and Bruggeman's fruit warehouse. The Hanford Cultural Resources Laboratory has recorded post-contact archaeological sites, including an assortment of farmsteads, corrals, and dumps, since 1987. Environmental Research Technology and Educational Consultancy Northwest was responsible for minor test excavations at some of the post-contact sites, including the former Hanford Townsite. Resources from the pre-Hanford Site period are scattered over the entire Hanford Site and include numerous areas of gold mine tailings along the riverbanks of the Columbia River and remains of homesteads, agricultural fields, ranches, and irrigation-related features.

2.1.3.4 Post-Contact Architectural Resources. Post-contact architectural resources documented from the Manhattan Project and Cold War eras include buildings and structures primarily found in the 100, 200, 300, 400, and 600 Areas. The most important of these are the plutonium production and test reactors, and chemical separation and fuel fabrication/processing facilities. The first reactors, 100-B, 100-D, and 100-F, were constructed during the Manhattan Project. Plutonium produced in the 100-B Facility was used for the first atomic explosion and the bomb that destroyed Nagasaki to end World War II. Additional reactors and processing facilities were constructed after World War II, during the Cold War period. All reactor containment buildings still stand, although many ancillary structures were removed.

Post-contact contexts were completed for the Manhattan Project and Cold War eras as part of a National Register Multiple Property Documentation Form prepared for the Hanford Site to assist with the evaluation of National Register eligibility of buildings and structures sitewide. To date, 455 Manhattan Project and Cold War facilities have been inventoried and recorded as historic property inventory forms. One hundred eighty-five Manhattan Project and Cold War buildings/structures and complexes have been determined eligible for the National Register as contributing properties within the Historic District recommended for mitigation.

2.2 WASTE SITE DESCRIPTIONS

Waste sites received liquid and solid waste contaminated with hazardous substances. Several million liters of liquid wastes from various processes were discharged to engineered ground disposal sites (i.e., cribs, ponds, ditches, trenches, french drains, reverse wells, sand filters, septic systems, retention basins, outfall structures, diversion boxes, pipelines, storage tanks, storage vaults, brine pits, and sumps).

Many of the liquid waste sites (cribs, ponds, ditches, french drains, sand filters, and septic systems) were designed to percolate wastewater through the bottom of the waste sites into the underlying soil (i.e., vadose zone) and groundwater. As a result, contamination is present in the vadose zone beneath the waste sites and in the groundwater. The contaminants present at these waste sites are generally several meters below grade. These waste sites, except for ponds and ditches, were constructed below grade and sometimes used timber or steel structures and were backfilled to grade before waste disposal. Ponds and ditches remained open during operations and were generally backfilled after operations ceased. Additional backfill has since been added to some sites to confine contamination.

Other liquid waste sites (retention basins, storage tanks, brine pits, and sumps) were designed to contain or convey (ditches, trenches, diversion boxes, pipelines, and outfall structures) liquid discharges. The retention basins and outfall structures were closed-bottom structures that were open to the air during operations. The retention basins have either been backfilled (30 to 60 cm of pit-run gravel) or demolished after operations ceased. The outfall structures and associated concrete overflow flumes have been partially demolished (the aboveground portion) and are, in most instances, entirely covered with clean backfill (30 to 60 cm of pit-run gravel). Storage tanks, brine pits, sumps, diversion boxes, and pipelines were completely enclosed structures generally constructed below grade. Ditches and trenches were open, unlined, earthen structures that were backfilled after operations ceased. Leaks to the ground occurred from these various sites that were designed to contain or convey liquid wastes. Additional backfill has since been added to some sites to contain contamination.

Radioactively contaminated solid wastes were disposed to the ground in burial trenches that were subsequently backfilled with pit-run gravel. Debris from demolition of facilities was often buried in place and covered with clean fill.

Nonradioactive equipment, material, and debris were also disposed in pits or directly on the surface. Other miscellaneous waste sites are associated with pre-Hanford town sites, construction camps, and military installations used to defend the Hanford Site. It is not anticipated that contaminants have migrated any significant distance beneath burial grounds or other solid waste sites.

Unplanned releases were created from radioactive contamination spread from waste sites (i.e., burial grounds) or process facilities, failures in associated waste transfer lines, or other types of spills. Many of these sites have been stabilized with clean soil.

As discussed above, most of the waste sites have been stabilized with additional clean-fill material (e.g., gravel). Many of the nonradioactive debris sites and other enclosed structures are not covered with clean fill. The majority of the waste sites in the 100 Area is devoid of vegetation and is sprayed to eliminate unwanted vegetation, such as sagebrush and tumbleweed. Such vegetation tends to absorb radioactivity through deep-root systems, increasing the potential to spread contamination. Waste sites in other areas are often vegetated with shallow-rooted grasses to stabilize the sites and reduce infiltration.

2.2.1 100 Area Waste Sites

The 100 Area sites primarily received waste resulting from the operation of water-cooled, graphite-moderated plutonium production reactors and their associated support facilities. Waste were also generated from an experimental animal farm operated in the 100-F Area to study the effects of occupational exposure of ionizing radiation on fish, plants, and animals.

The 100 Area also contains waste sites associated with temporary housing camps for Hanford Site construction workers, temporary construction support facilities for the Manhattan Project, and former town sites that preceded Hanford Site operations. In general, the sites consist of

surface debris, municipal solid and sanitary waste dumps, oil spills, building foundations, waste construction materials, and ash piles. Other areas supported military installations to defend the Hanford Site.

Reactor operations generated cooling water, equipment decontamination solutions, reactor exhaust filtration fluids, and sanitary wastes. The first three liquid streams were known to contain radionuclide and chemical contaminants (primarily inorganics), which varied in type and concentration depending on the waste stream. There are no records of hazardous or radioactive waste being disposed in the septic systems; however, sampling has shown that contamination may be present in some of the systems that serviced facilities that contained or used hazardous or radioactive materials.

Radioactively contaminated solid waste and debris resulting from reactor operations were disposed to the ground. Burial grounds near the reactor buildings consist of only one trench or pit. A typical major burial ground serving a reactor area was a few hundred meters wide by several hundred meters long. These large burial grounds contain numerous burial trenches and pits of various sizes and orientations, which are generally 6-meters deep. Small railroad-tie disposal pits were often used to dispose of small reactor hardware with high dose rates. Vertical steel pipes and/or culverts (1.5 to 2 meters in diameter), otherwise referred to as caissons, were also used for these wastes and would be located with a section of a larger burial trench.

The majority of the radioactively contaminated materials in the burial grounds are aluminum spacers, lead-cadmium pieces, boron splines, carbon materials, aluminum process tubes, and lead. Miscellaneous waste includes gunbarrels, thimbles, control rods, nozzles, pigtails, and cadmium sheets. Soft waste includes contaminated plastic, paper, and clothing packaged in cardboard boxes (Miller and Wahlen 1987). Mercury was used in manometers and other instruments in the 100 Areas. Because these instruments were occasionally broken, it is assumed that mercury was either buried or drained to a crib or trench in the area (Miller and Wahlen 1987).

None of the wastes disposed in the trenches were specially treated or packaged and generally were not segregated by waste type. In the 1960s, combustibles were incinerated in the burial trenches. The trenches were backfilled, and the entire burial grounds covered with clean gravel.

Ash from the coal-fired steam plants was slurried to earthen basins via pipelines. The basins are currently configured as they were during operations, and some of the basins are separated into halves by an earthen berm. Vegetated ash piles generally surround the basins. The coal source was the same for all steam plants at the Hanford Site. Studies have shown that ash from Hanford Site power plants is nonradioactive and nonhazardous.

Burn pits were used to dispose nonradioactive, combustible materials (e.g., paint waste, office waste, and chemical solvents). Other miscellaneous sites include buried demolished structures, debris sites, unplanned releases, petroleum storage tanks, brine pits, sumps, military installations, pre-Hanford town sites, construction debris, etc.

The 100 Area waste sites and the associated debris or adjacent contaminated soils to be removed, past activities at the site, and findings based on field investigations and post-contact data are discussed below. Table 2-1 lists the contaminants of concern for each waste site as well as the estimated weight of the waste.

- The **128-K-2 Burn Pit** located about 0.4 kilometers southwest of the K Area perimeter fence is an inactive trash dump site containing mainly metal and glass construction wastes and some office, shop, and lab wastes paints, solvents, and friable and nonfriable asbestos.

- Surrounding soils around the **100-H-13 French Drain.** The french drain was operated from 1949 to 1965 and is located about 20 feet east of the 105-H Reactor. It received drainage from a 6-cm stainless steel line from the 105-H Reactor east wall, bends downward, and ends at the drain.

- The **100-H-12 French Drain Debris** is located near a concrete expansion box which was installed to provide drainage for any leakage from a 1.5-meter steel reactor effluent pipeline. The location is adjacent to the east wall of the south wing on the 105-H Reactor Building and was used from 1949 to 1965.

- The **116-H-9 Seal Pit Crib Contaminated Filter** is located in a gravel-filled crib southwest of the 105-H Building. The site was operated in conjunction with the demolished 117-H Air Filter Building from 1960 to 1965.

- The **100-H-1 Rod Cave Contaminated wood and debris** was where horizontal control rods were placed after use in the 105-H Reactor Building. The facility was used from 1949 to 1965.

- The **126-B-1 (105-B) Coal Ash Pit** operated from 1944 to 1969 occupies about 4 hectares (198 meters by 198 meters) north of the 184-B Powerhouse. It is a large vegetation covered depression (61 meters by 61 meters by 3 meters deep) bounded on the north, east, and west sides by large ash piles (about 9 to 10 meters high).

- The **116-D-8 100 D Cask Storage Pad** is a rectangular concrete pad (about 30.5 meters by 22.8 meters) with two drains used from 1946 to 1975. The drain, which handled pad decontamination and rain runoff, discharged into the 105-DR process sewer. Potential contaminants of concern are the long-lived fission products and the heavy metals associated the decontamination of metal surfaces (reactor piping and equipment), water purification and pH control, and corrosion protection (e.g. lead-based paints).

- The **100 Area Rail Road Tracks within the Exclusion Areas** were used to transport "cask cars" containing spent nuclear fuel to the 200-Areas. The rail track was contaminated by reactor fuel pool water (in the fuel casks), spills, and leaks from contaminated equipment shipping containers. The same fission product contaminants of concern found in the reactor

Table 2-1. Contaminants Found in the 100 Area Waste Sites.

Site	Contaminants of Concern	Estimated Weight
128-K-2 Burn Pit asbestos containing debris	Asbestos, Cd, Co, Cr, Pb, Zn	54.5 metric tons
100-H-13 contaminated soils, roofing materials	$^{134,137}Cs$, ^{60}Co, $^{152,154,155}Eu$, ^{63}Ni, $^{238,239/240}Pu$, ^{90}Sr, ^{238}U	4.5 metric tons
100-H-12 French Drain debris	$^{134,137}Cs$, ^{60}Co, $^{152,154,155}Eu$, ^{63}Ni, $^{238,239/240}Pu$, ^{90}Sr, ^{238}U	0.45 metric tons
116-H-9 Crib contaminated vent filter	$^{134,137}Cs$, ^{60}Co, $^{152,154,155}Eu$, ^{63}Ni, $^{238,239/240}Pu$, ^{90}Sr, ^{238}U, Asbestos	0.45 metric tons
100-H-1 Rod Cave contaminated wood and soil	$^{134,137}Cs$, ^{60}Co, $^{152,154,155}Eu$, ^{63}Ni, $^{238,239/240}Pu$, ^{90}Sr, ^{238}U	0.45 metric tons
126-B-1 contaminated filter frames and boxes	^{60}Co, ^{137}Cs, $^{152,154}Eu$	18.1 metric tons
116-D-8 casks	^{14}C, ^{60}Co, ^{137}Cs, $^{152,154,155}Eu$, ^{63}Ni, $^{238,239/240}Pu$, ^{226}Ra, ^{228}Th, ^{90}Sr, ^{99}Tc, ^{238}U, Cr	18.1 metric tons
100 Area Rail Tracks within exclusion areas including railroad rails, ties, ballast, and soil	^{14}C, ^{60}Co, ^{137}Cs, $^{152,154,155}Eu$, ^{63}Ni, $^{238,239/240}Pu$, ^{226}Ra, ^{228}Th, ^{90}Sr, ^{99}Tc, ^{238}U, Urea+Boric acid and Diuron+Bromacil herbicides	390 metric tons
107-KE/KW/F effluent pipe and associated metal in Retention Basins	^{14}C, ^{60}Co, ^{137}Cs, $^{152,154,155}Eu$, ^{63}Ni, $^{238,239/240}Pu$, ^{226}Ra, ^{228}Th, ^{90}Sr, ^{99}Tc, ^{238}U	45.4 metric tons

C – carbon
Cd – cadmium
Co – cobalt
Cr – chromium
Cs – cesium
Eu – europium
Ni – nickel
Pb – lead
Pu – plutonium
Ra - radium
Sr – strontium
Tc – technetium
Th – thorium
U – uranium
Zn – zinc

cooling water retention tanks (e.g. 116-C-5) can be expected to found in the soil beneath the railroad tracks. The rail track ties were treated at manufacture with creosote and the rail bed has been treated with Urea + Boric acid, and Bromacil + Diuron for weed control.

- The **107 KE/KW/F Effluent Piping** was used to direct contaminated cooling water from the 105-KE/KW and 105-F reactors to the retention basins located north of the reactors. The 105-KE/KW reactors were operated from 1954 to 1971 and 105-F was operated from 1945 to 1968.

2.2.2 200 Area Waste Sites

The 200 Area sites received liquid and solid wastes contaminated with hazardous substances primarily from facilities that processed fuel irradiated in the 100 Area Reactors and the associated support facilities (e.g., laboratories). Solid waste from most areas of the Hanford Site was disposed in the 200 Areas. The 200 Area Operable Units actually contain waste sites that are located in the 600 Area.

The 200 Area liquid waste sites received process wastes, steam condensate, cooling water, chemical sewer waste, laboratory wastes, tank farm waste, miscellaneous wastes, and sanitary wastes. These waste streams were known to contain radionuclide, organic, and inorganic contaminants (except for some sanitary systems), which varied in type and concentration, depending on the process that generated the waste stream.

Some waste sites received solid waste and debris from operating and maintaining the facilities. The 218 burial grounds are radiological landfills located in the 200 East Area and 200 West Area. The burial grounds contain transuranic solid waste, low-level radioactive solid waste, and debris. The burial grounds also contain wooden burial boxes that present a cave-in potential.

Miscellaneous sites include railroad unloading stations and buried demolished facilities, burn pits, debris sites, military installation related sites, and unplanned releases.

The 200 Area waste sites and the associated debris or adjacent contaminated soils to be removed, past activities at the site, and findings based on field investigations and post-contact data are discussed below. Table 2-2 lists the contaminants of concern for each waste site as well as the estimated weight of the waste.

- Surrounding soils around the **216-A-3 Crib** operated from 1956 to 1981 is located about 150 meters north of the PUREX plant received approximately 3.5 million liters of aqueous solutions contaminated with uranyl nitrate hexahydrate (UNH) and nitrate salts in condensates and UNH storage pit drainage. The product UNH storage tanks contained no significant levels of fission product radioactivity. UNH containing low levels of fission product radioactivity was recycle back into PUREX plant.

Table 2-2. Contaminants Found in the 200 Area Waste Sites

Site	Contaminant of Concern	Estimated Weight
216-A-3 contaminated vent filter and railroad tie	^{238}U, uranium nitrate	0.45 metric tons
200-W-63 Pad contaminated concrete and soil	^{14}C, ^{60}Co, ^{137}Cs, $^{152,154,155}Eu$, ^{63}Ni, $^{238,239/240}Pu$, ^{226}Ra, ^{228}Th, ^{90}Sr, ^{99}Tc, ^{238}U, Hg, Pb	54.4 metric tons
UPR-200-E-95 rails, ties, ballast and soil	^{14}C, ^{60}Co, ^{137}Cs, $^{152,154,155}Eu$, ^{63}Ni, $^{238,239/240}Pu$, ^{226}Ra, ^{228}Th, ^{90}Sr, ^{99}Tc, ^{238}U, Hg, Pb	299.3 metric tons
291-U-1 (291-U stack sump) contaminated debris, transite, power poles	Asbestos, Pb, creosote, ammonium nitrate, ^{137}Cs, ^{90}Sr, ^{238}U	18.1 metric tons
REDOX rail cut contaminated soil and debris	^{14}C, ^{60}Co, ^{137}Cs, $^{152,154,155}Eu$, ^{63}Ni, $^{238,239/240}Pu$, ^{226}Ra, ^{228}Th, ^{90}Sr, ^{99}Tc, ^{238}U, Hg, Pb, Urea+Boric Acid and Diuron+Bromacil herbicides, creosote	54.4 metric tons
UPR-200-E-83 (200-BC Area) soil	^{14}C, ^{60}Co, ^{137}Cs, $^{152,154,155}Eu$, ^{63}Ni, $^{238,239/240}Pu$, ^{226}Ra, ^{228}Th, ^{90}Sr, ^{99}Tc, ^{238}U, Hg, Pb	5,351.3 metric tons

C – carbon
Cd – cadmium
Co – cobalt
Cr – chromium
Cs – cesium
Eu – europium
Hg – mercury
Ni – nickel
Pb – lead
Pu – plutonium
Ra - radium
Sr – strontium
Tc – technetium
Th – thorium
U – uranium
Zn – zinc

- The **200-W-63 Bone Yard Pad** is a T-Plant surface contaminated concrete pad with up to 45,000-counts/minute beta/gamma radioactivity as of April 22, 1998. The pad was used to store contaminated tanks in the late 1980's.

- An unplanned release (UPR) **UPR-200-E-95 (UN-216-E-23)** was declared in December 1980 for an accumulation of low-level radioactive contamination (average 2000 cpm beta, one hot spot read 350,000 cpm beta) on about 213.5 meters of railroad track between the 216-E-2, 216-E-2A, 216-E-5, and 216-E-9 burial grounds located north of the 221-B Facility. The adjacent burial grounds received uranium and fission product contaminated equipment from the uranium recovery processes conducted in the B Plant before 1955.

- Debris and soils surrounding the **291-U-1** Stack. The stack, which began operation in 1945, is a 61 meters high by 4.25 meters in diameter (at base) concrete structure formerly used to discharge the ventilation air from the 221-U Plant Canyon Building. When stack flushing operations were completed the water was discharged to a trench. The trench was deactivated by removing the above-ground piping and backfilling the trench.

- The **REDOX Railroad Cut** has an accumulation of radioactive and chemical contamination due to spills from rail cars bearing fuel casks to the canyon building and from rail cars bearing waste burial boxes and packaged failed process equipment. The Reduction Oxidation (REDOX) plant was operated from 1952 through about 1967.

- The **UPR-200-E-83 (200-BC Area)** is the source of the area known as the BC Controlled Area adjacent to the BC Cribs and trenches. The cribs and trenches received large amounts of liquid radioactive process waste from the Uranium Recovery project (1952 to 1956). In 1958, radioactive rabbit and coyote feces were found scattered over the ground surface. It was determined that a badger or some other animal had burrowed into the 216-B-28 Trench and exposed a radioactive salt layer. Over time, rabbits ingested the contaminated salts and defecated over approximately 10 square kilometers of undisturbed sagebrush covered land.

- **Contaminated soils around 291-S** are located at the northeast corner of the 202-S (REDOX) Facility, north of the 291-S Stack. This site consists of one trench. The site is posted as "Underground Radioactive Material." This site provided subsurface liquid disposal for the 291-S Stack. The site operated only for the month of July in 1954. When flushing operations were completed, the site was deactivated by removing the above-ground piping and backfilling the trench.

2.2.3 300 Area Waste Sites

The 300 Area Operable Units actually consist of waste sites that are located within the 300, 400, and 600 Areas. Waste sites in the 300 and 600 Areas received liquid and solid wastes associated with fuels manufacturing and numerous research activities. The 400 Area sites primarily received waste generated from secondary cooling water or process water from the Fast Flux Test Facilities and associated supporting facilities.

The liquid waste sites received process wastes, steam condensate, water treatment salts, laboratory wastes, cooling water, filter backwash, sanitary waste, and various radiochemical and radiometallurgicial wastes generated in the research laboratories (e.g., isotope production, separations technologies, reactor technology research). These waste streams (with the possible exception of sanitary sewers) were known to contain radionuclide, organic, and inorganic contaminants, which varied in type and concentration, depending on the process that generated the waste stream.

Solid wastes generated in the 300 Area were either burned at aboveground burn sites or buried in burial grounds. Most received various low-level uranium-contaminated equipment, fission products, contaminated building materials, and/or other miscellaneous contaminated debris from the fuels manufacturing process. All the remaining burial grounds have been surface stabilized with clean fill. Drummed uranium-contaminated solvent is known to have been disposed in two of the burial grounds. Two other burial grounds received a broad spectrum of radioactive waste. The waste was primarily uranium-manufacturing products, but also included some plutonium-contaminated material. Waste were disposed in pipe storage units, trenches, and caissons. Miscellaneous waste sites include unplanned release sites and debris sites.

The 300 Area waste site and the associated debris or adjacent contaminated soils to be removed, past activities at the site, and findings based on field investigations and post-contact data are discussed below. Table 2-3 lists the contaminants of concern for each waste site as well as the estimated weight of the waste.

- The **600-47 Dumping Site** is located 1.25 kilometers north of the 300 Area north fence above the bank of the Columbia River west of Johnson Island. The initial site was made up of several areas of pre-Hanford demolition debris from what is now the 300 Area. A 1954 aerial photo shows a circular road indicating the site was a "drive through" dumping area. Environmental field screening and sampling of the debris found no radiological or chemical contamination. In 1993, four small radioactive contamination areas (up to 20,000 dpm) were incorporated into the general site boundaries. The site has been stabilized with a cover of two to three feet of clean backfill material.

Table 2-3. Contaminants Found in the 300 Area Waste Sites

Site	Contaminant Of Concern	Estimated Weight
600-47 Dumping Site contaminated metal shavings, debris, concrete, wood, soil	Asbestos, uranium	27.25 metric tons

2.3 SOURCE NATURE AND EXTENT OF CONTAMINATION

The following provides a summary of the source, nature, and extent of the contamination present at the facilities and waste sites.

The primary contaminants of concern and major risk drivers for the 100 Area waste sites are radionuclides (fission and activation products). Heavy metals, primarily chromium, cadmium, lead, and mercury, are also (potential) contaminants of concern. These contaminants are primarily found at waste sites that received process waste from the reactor operations. Organic contaminants may be present at some sites (e.g., petroleum from spills).

The 200 Area sites received a variety of radioactive and chemical contaminants. The primary contaminants that are present at most sites are radionuclides. Some of the sites contain volatile organics that could pose a hazard to workers conducting S&M at these sites. Solvents (e.g., carbon tetrachloride and its breakdown products) persist in the soils in many of the cribs. Carbon tetrachloride is a major contaminant at waste sites near Z Plant (216-Z-9, 216-Z-18, and 216-Z-12). However, ongoing soil vapor extraction activities to remove carbon tetrachloride from the vadose zone have reduced the threat of contamination to site workers and the environment.

The 300 Area fuel manufacturing processes produced uranium fines and other uranium scraps, metal wastes, and a variety of uranium-contaminated solvent and acid wash solutions. The 300 Area research and development activities resulted in a broad spectrum of waste contaminated with uranium, fission products, transuranics, acids, solvent, metals, and inorganics.

Discharging and conveyance of liquids to waste sites has resulted in the contamination of the ground around and beneath the waste sites (vadose zone) and the underlying groundwater. The extent of vadose zone contamination varies and depends on the volume of water and the nature of the contamination. Many of the contaminants (i.e., plutonium) readily adhere to the soil particles; as a result, the contaminants are not very mobile in the environment and can be detected in the vadose zone near the bottom of the waste site. Other contaminants (i.e., strontium-90) are more dispersed throughout the vadose zone and are found in the groundwater underlying the site. The mobility of certain contaminants can be enhanced by the presence of other chemicals, such as solvents or acids. The primary contaminants present in the groundwater include radionuclides and chromium (primarily from cooling water discharges), although organic contaminants are present in the groundwater beneath the 200 and 300 Areas.

It is not anticipated that contaminants have migrated any significant distance beneath the burial grounds where radioactively and chemically contaminated solid wastes were disposed. An excavation treatability study of the 118-B-1 burial ground was conducted during 1994. Soil samples were collected from the bottom of each pit excavated. Results were compared with background data. The analytical results indicate that the soils underneath the buried waste are typically free of contamination (i.e., below background levels [DOE-RL 1995]).

Most of the waste sites that were contaminated with radioactive and chemical contaminants are covered with clean fill; as a result, they do not represent a direct hazard or risk to humans or the environment. However, at some sites, contaminants have migrated to the surface through biotic intrusion or other mechanisms and are managed as surface contamination areas or contamination areas. These areas represent a potential threat to human health and the environment, including workers. Contamination, if present at the surface, could be mobilized through wind or water erosion.

There is a considerable potential for the underground radioactive contamination to reach the surface via biotic intrusion (i.e., plant root penetration or burrowing animal penetration through the clean fill). Uptake of radionuclide contaminants by plants depends on the contaminant, soil structure and chemistry, and plant species. In general, radionuclides of high atomic number are discriminated against by plant uptake. Uranium and plutonium generally have low biological mobility, and if ingested by animals, do not readily move through the food chain. Cesium-137 and stronium-90 are readily taken up by plants and are absorbed by animal consumers. The potential risk for contaminant migration via plants and animals is dependent on the type and depth of contamination present at these sites. Many of the cribs, french drains, reverse wells, and septic systems are constructed well below the ground surface and may not be as accessible to the plants and animals as sites where contamination is closer to the ground surface (e.g., ponds, ditches).

Contaminant migration could potentially occur through subsidence at certain waste sites. A number of the cribs were constructed as wooden structures. These structures disintegrate with time and a potential exists for subsidence at these sites. The subsidence of a crib structure could result in a release of contaminants to the surface posing a threat to human health and the environment. However, the subsidence generally occurs slowly over time and is detectable. Some of the cribs containing wooden structures have subsided in the past. However, there is no documented evidence of the subsidence resulting in contamination being released to the surface. Many of the burial grounds contain wooden burial boxes that have been known to collapse. The collapse could cause a subsidence in the burial ground, creating a potential exposure pathway to the surface. In addition, deterioration of structural covers over some waste sites can provide a potential for collapse.

Another pathway of potential concern is the migration of contaminants through the soil column into the groundwater beneath the sites. The waste sites of concern in this document are inactive and the major driving force (i.e., liquid discharges) has been eliminated. Many of these sites contributed contaminants to the groundwater in the past, and some sites that contain organics, specifically carbon tetrachloride, currently may be contributing contamination to the groundwater. The migration of carbon tetrachloride is being addressed by ongoing soil vapor extraction activities. Many of the waste sites have been stabilized by the addition of clean gravel and/or soil, and in the 200 Area the sites have been revegetated with grasses that increase the evapotransporation and reduce the rainwater/snow melt available for infiltration into the waste site. Further actions to address the potential for any future impacts is outside the scope of this action.

2.4 SITE CONDITIONS THAT JUSTIFY A REMOVAL ACTION

Many of the waste sites currently undergoing stabilization activities are either known or suspected to be contaminated with radioactive and/or nonradioactive hazardous substances. If stabilization activities are not implemented, the integrity of the waste sites will degrade and the hazardous substances present may spread. The potential exposure and the potential threat of a future release justifies a removal action.

3.0 REMOVAL ACTION OBJECTIVES

Removal action objectives to protect human health and the environment include the following components:

- Reduce the threat of release of hazardous substances contained within the subject waste sites.
- Protect workers from industrial, chemical, and radiological hazards posed by the subject waste sites.
- Provide consistency with future disposition of waste site remedial actions.
- Reduce volume and mobility of hazardous substances.

4.0 REMOVAL ACTIONS ALTERNATIVES

The alternatives presented below apply to each of the waste sites listed in section 2.0 of this document.

4.1 NO ACTION

The no-action alternative consists of conducting inspections and surveillances at the waste sites. Inspections would be conducted to identify unfavorable conditions such as animal or insect intrusion, unwanted vegetation, physical instability (cave-in or depression), disturbed signs and barriers, or other conditions that could lead to the spread of contamination or inadvertent intruders. Camera surveys of some cribs and load testing of some burial grounds would be conducted to evaluate waste sites stability. Periodic radiation surveys of the surface of the waste sites would be conducted to detect the presence of contamination at the surface.

However, under the no-action alternative, no actions would be taken to maintain the waste sites or to respond to threats of or releases of hazardous substances. Contamination control measures have previously been implemented for most waste sites. Many of the waste sites have been covered with clean soil (the amount of cover differs from site to site, based on degree of contamination) and backfilled to grade. To the extent the covers remain intact, direct human contact with the contaminated soils and exposure to radionuclides would be prevented. However, these covers would receive no maintenance and would deteriorate naturally, resulting in the migration of contaminants to the ground surface (e.g., through biointrusion or soil water flux) and allowing for potential exposure to humans and the environment.

4.2 STABILIZATION

The stabilization alternative consists of the following actions.

- Removal of contaminated soil and debris necessary to install an effective barrier or cover between hazardous substances and the ambient air, or to allow waste site consolidation.

- Installation of clean backfill, fixative application, and/or revegetation to control future dispersal of contaminants.

Any hazardous substance generated or removed as part of the stabilization will be disposed of at the Environmental Restoration Disposal Facility (ERDF), in accordance with BHI-00139, *Environmental Restoration Disposal Facility Waste Acceptance Criteria* (BHI 1998). Other offsite facilities may be utilized provided EPA approval is obtained. Waste shipments will be coordinated with ERDF planning personnel and EPA to avoid negatively impacting remedial actions at other sites in accordance with previously established milestones through the *Hanford Federal Facility Agreement and Consent Order* (Ecology, et al. 1996).

5.0 IDENTIFICATION OF STANDARDS AND REQUIREMENTS

Applicable or relevant and appropriate requirements (ARAR) are standards, requirements, criteria, or limitations promulgated under federal or state environmental laws that must be met or waived for actions conducted under CERCLA. Only the substantive provisions of requirements that are ARARs must be met (or waived) for actions conducted entirely onsite (CERCLA Sec. 121(d)(2)). Such onsite actions are exempted from obtaining federal, state, and local permits (Sec. 121(e)(1)). To-be-considered (TBC) materials are non-promulgated standards that may be referenced to the extent necessary for the response action to be adequately protective; these materials include DOE orders, proposed regulations, and non-promulgated regulatory guidance.

Key ARARs for the stabilization alternative includes waste management standards, air emission control standards, radiation control standards, and standards for protection of cultural and ecological resources. Other standards to be met by the response action include various DOE, federal, and state worker safety standards.

5.1 WASTE MANAGEMENT STANDARDS

The *Resource Conservation and Recovery Act of 1976* (RCRA) regulates managing and disposing hazardous (dangerous) waste. Authority for much of the federal RCRA program has been delegated to Washington State. Implementing state regulations contained in *Washington Administrative Code* (WAC) 173-303 requires identification and appropriate management of dangerous wastes and dangerous components of mixed wastes, and establishes standards for treatment, storage, and disposal of these wastes. Federal RCRA requirements pertaining to hazardous wastes are identified in 40 CFR 260 through 270. Federal and state RCRA requirements are applicable to any wastes managed (i.e., the physical disruption of waste residing in waste sites) as a part of the stabilization alternative that meet the regulatory definition of hazardous (dangerous) or mixed waste. The most probable application of these requirements would be to the onsite storage of any newly containerized dangerous wastes within waste sites. Pertinent standards for these storage activities are identified in WAC 173-303-630, and include requirements for waste/container compatibility, container identification, container management, inspection of storage areas, segregation of incompatible wastes, and provision of secondary containment for containers holding liquid dangerous wastes.

WAC 173-304 requires identification and appropriate management of solid wastes. It is applicable to any solid waste that is generated as a part of the stabilization alternative.

Solid, dangerous, low-level, and/or mixed waste may be managed as waste undergoing the stabilization alternative. Actions proposed to manage such waste would be designed to satisfy waste management ARARs. Wastes that must be managed per these ARARs are those materials residing in waste sites that are physically disturbed during stabilization activities. All wastes would be evaluated and managed in compliance with the appropriate requirements. Prior to

disposal, dangerous, low-level, or mixed wastes would be managed in a protective manner to prevent releases to the environment or inadvertent exposure to workers. Waste minimization efforts will be implemented where feasible to reduce waste volumes.

It is anticipated that most of the waste managed during stabilization activities would satisfy the waste acceptance criteria for the ERDF (BHI 1998). The ERDF is engineered to meet RCRA minimum technological requirements for landfills, including standards for a double liner, a leachate collection system, leak detection, and final cover. The ERDF also meets the appropriate performance standards under 10 CFR 61 for disposal of low-level waste and mixed waste. Treatment requirements, if any, that are necessary to dispose of wastes in the ERDF, would be identified in accordance with BHI-00139, which were developed to implement the ERDF Record of Decision, and has been approved by EPA and the state. Specific packaging and transportation requirements for waste generated as a part of the stabilization alternative will be identified and implemented before moving any waste. In the event that disposal of waste generated by a stabilization activity must take place at a facility other than ERDF (e.g., any waste that does not satisfy the ERDF waste acceptance criteria), the selected disposal facility must meet all applicable standards.

5.2 AIR EMISSION CONTROL STANDARDS

The *Clean Air Act of 1955* regulates both toxic and radioactive airborne emissions. Under implementing regulations found in 40 CFR 61, Subpart H, and WAC 246-247, radionuclide airborne emissions from all combined operations at the Hanford Site may not exceed 10 mrem/year effective dose equivalent to the offsite maximally exposed individual. WAC 246-247 requires verification of compliance, typically through periodic confirmatory air sampling. WAC 173-400 establishes requirements for controlling and preventing the emission of air contaminants, including dust.

The radionuclide emission standards would apply to any fugitive, diffuse, and point-source air emissions of radionuclides generated under the stabilization alternative. If the potential exists for any non-zero radioactive emissions, "best available radionuclide control technology" would be required. If activities generate an increase of toxic air pollutants to the atmosphere above the small quantity emission rates, implementation of "best available control technology for toxics" would be required.

5.3 CULTURAL AND ECOLOGICAL RESOURCE PROTECTION STANDARDS

The *National Historic Preservation Act of 1966* (implemented via 36 CFR 800) requires federal agencies to take into account the effect of an activity on any significant cultural resource. The *Archeological and Historical Preservation Act of 1974* requires action to recover and preserve artifacts in areas where activity may cause irreparable harm, loss, or destruction of significant artifacts. The *Endangered Species Act of 1973* (implemented via 50 CFR 402) and

WAC 232-12-297 prohibits activities that threaten the continued existence of listed species or destroys critical habitat. The *Migratory Bird Treaty Act* makes it illegal to take, capture, or kill (as applicable) any migratory bird, or any part, nest, or egg of any such birds.

The cultural resource protection requirements apply because of the presence of potentially significant archeological sites, artifacts on the Hanford Site, and the potential post-contact significance of site facilities. The stabilization alternative is not expected to impact buildings of significant historical value, nor is it likely that the stabilization alternative would impact archeological sites. Waste site-specific ecological reviews will be conducted prior to outdoor activities to identify potential adverse impacts.

Threatened and endangered species are known to be present in the 100 Areas, but there are no adverse impacts on protected species or critical habitat from any activities associated with the stabilization alternative.

5.4 COLUMBIA RIVER PROTECTION STANDARDS

40 CFR 122 addresses technology-based limitations and standards, control of toxic pollutants, and monitoring for discharges to waters of the United States, including storm water. Public law 100-605, *Study of the Hanford Reach of the Columbia River*, requires new activities near the Columbia River to minimize direct and adverse effects on the values for which the Columbia River is under study.

Wastewater discharges to the Columbia River, other than storm water, are not planned during activities associated with the stabilization alternative. The EPA has issued two general permits that authorize discharges of storm water; one for storm water discharges associated with industrial activities, and one for storm water discharges from construction activities that are associated with industrial activities. The Hanford Site has issued a storm water pollution prevention plan to address storm water discharges from industrial activities. The substantive requirements of the these permits and the storm water pollution prevention plan will be met for activities having the potential to discharge storm water to the Columbia River

WAC 173-216 addresses discharges of waste materials from industrial, commercial, and municipal operations into groundwater and surface waters of the state. A consent order has been issued by Ecology that addresses compliance with WAC 173-216. Per the consent order a plan and schedule has been developed to address stormwater, condensate, cooling water, construction, maintenance, and hydrotest discharges to the ground. Washing of equipment used during inspection and stabilization activities may result in fluids that are discharged to the ground. Equipment washing is conducted to prevent the spread of contamination. Control of these discharges will be addressed in the removal design report or other appropriate project documentation.

5.5 PROTECTION STANDARDS

Occupational Radiation Protection (10 CFR 835) establishes radiation protection standards, limits, and program requirements for protecting workers and visitors from ionizing radiation resulting from the conduct of DOE activities. It also requires that measures be taken to maintain radiation exposure as low as reasonably achievable. This regulation is applicable to activities associated with the stabilization alternative.

A combination of personal protective equipment, personnel training, physical design features (e.g., confinement, remote handling, shielded containers), and administrative controls (e.g., limiting time in radiation zones) would be used to ensure that the requirements for worker and visitor protection are met.

5.6 POLYCHLORINATED BIPHENYLS

The *Toxic Substances Control Act of 1976* (TSCA) and WAC 173-303 regulate the management and disposal of polychlorinated biphenyls (PCB) and PCB waste. Implementing regulations in 40 CFR 761 contain requirements for the management of spills and cleanup of materials suspected to contain PCB waste. The ERDF is authorized to accept certain PCB waste for disposal. All waste suspected to contain PCBs will be evaluated to determine whether it meets the ERDF waste acceptance criteria. Any PCB waste that does not meet the ERDF waste acceptance criteria will be sent to a PCB storage area meeting the substantive requirements of TSCA and will be transported for disposal at a TSCA-approved disposal facility.

5.7 ASBESTOS

Removing and disposing of asbestos and asbestos-containing materials are regulated under the *Clean Air Act of 1955*, (40 CFR 61, Subpart M) and by the Occupational Safety and Health Administration (OSHA) (29 CFR 1910.1101 and WAC 296-62). These regulations provide for special precautions to prevent exposure of workers or airborne emissions of asbestos fibers during removal actions anticipated as a part of the stabilization alternative.

5.8 ENVIRONMENT, SAFETY, AND HEALTH STANDARDS

Worker protection standards are described in OSHA regulations, national consensus standards, and DOE Orders (e.g., 29 CFR 1910, 29 CFR 1926, NFPA 1990, WAC 296-62, and DOE Order 5400.5, *Radiation Protection of the Public and Environment*). Exposure limits, personnel protection requirements, and decontamination methods for hazardous chemicals are established in 29 CFR 1910. Additionally, 29 CFR 1910 requires identification and mitigation of physical hazards posed by a facility to workers including (but not limited to) confined spaces, falling hazards, fire, and electrical shock. The 29 CFR 1926 provisions establish requirements for worker safety during construction activities.

The following DOE Orders and standards establish additional requirements relating to safety, health, and environmental protection. The substantive requirements of these standards will be met for any activity conducted as a part of the stabilization alternative. Known and suspected inventories in each site will be screened during the design phase against the criteria of DOE-STD-1027-92 (DOE 1992) to determine the appropriate environmental, safety, and health DOE Order requirements. Site- and activity-specific requirements and controls will be identified in work plan documents and procedures, including contingency plans and emergency response plans. In addition, the following DOE Orders contain requirements that are to be considered for the stabilization alternative:

- The requirements in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, which limit exposure of the public to radioactive releases.

- The requirement in DOE O 451.1, *National Environmental Policy Act Compliance Program*, to address the NEPA values as part of CERCLA response actions.

- The requirement in DOE Order 5480.3, *Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances and Hazardous Waste*, to comply with U.S. Department of Transportation or equivalent packaging standards

- The requirements in DOE Order 5820.2A, *Radioactive Waste Management*, for management of low-level waste or, if class 3 or greater waste is encountered during stabilization activities, transuranic waste.

6.0 EVALUATION OF ALTERNATIVES

6.1 OVERALL PROTECTION

This criterion evaluates whether the alternative achieves adequate overall elimination, reduction, or control of risks to human health and the environment that are posed by the likely exposure pathways. Reducing the potential threat to acceptable levels is a threshold requirement and is the primary objective of the remedial program.

The no-action alternative provides no additional protection of human health and the environment, except by decay of radioactive contaminants over a long period of time. The waste sites will continue to degrade over time and eventually containment is likely to be breached, resulting in a spread of hazardous substances outside the existing waste site.

The stabilization alternative protects human health and the environment through identifying and taking actions as appropriate to minimize or mitigate hazards posed by waste sites.

6.2 COMPLIANCE WITH ARARS

The ARARs are standards, requirements, criteria, or limitations promulgated under federal or state environmental laws that must be met or waived for actions conducted under CERCLA. Only the substantive provisions of requirements that are ARARs must be met (or waived) for actions conducted entirely onsite [CERCLA Sec. 121(d)(2)]; such onsite actions are exempted from obtaining federal, state, and local permits [Sec. 121(e)(1)]. Nonpromulgated codes and standards may be incorporated as to-be-considered requirements if they add to protection of human health and the environment. Under the no-action alternative, exposure to hazardous substances could eventually occur at levels exceeding ARARs for protection of human health and the environment since actions to respond to a release or threat of release of a hazardous substance would not be performed.

Sections 5.0 through 5.8 provide an analysis of key ARARs associated with the stabilization alternative. It is expected that the stabilization alternative would comply with all ARARs.

6.3 LONG-TERM EFFECTIVENESS

The long-term effectiveness and permanence criterion assesses whether the alternative leaves an unacceptable risk after completion of remedial activities. The no-action alternative would increase, rather than decrease, risk in the long term because waste sites would be allowed to deteriorate, likely resulting in migration of contamination or a release to the environment.

The stabilization alternative is more effective at addressing threats posed by waste sites. Although contamination is left in place, this alternative minimizes exposure pathways while contaminants naturally decay to acceptable levels or until more aggressive remediation measures are selected. Institutional controls, inspections, vegetation management, and waste stabilization are all proven technologies that would maintain the waste site until final disposition.

6.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

This criterion, the reduction of toxicity, mobility, or volume through treatment, assesses whether the alternative permanently and significantly reduces the hazard posed. Destroying the contaminants, reducing the quantity of contaminants, or irreversibly reducing the mobility of the contaminants could accomplish this.

The no-action alternative provides no near-term reduction in toxicity, mobility, or volume through treatment. Toxicity would be reduced for radioactive contaminants as they decay over time, but for long-lived radionuclides (e.g., plutonium and nonradioactive contaminants), this would not be a practical means of reducing risk. Mobility of hazardous substances will eventually increase because the soil barriers for waste sites would not be maintained.

Under the stabilization alternative, stabilization of the waste site (e.g., placement of a soil cover or fixative) would be performed when necessary to prevent potential spread of contamination. Stabilizing the waste site reduces contaminant mobility at waste sites. Toxicity of radioactive contaminants will decrease through natural decay. When appropriate, removal of contaminated surface soil and disposal in an appropriate onsite or offsite facility would reduce the mobility of hazardous substances. Treatment beyond fixation has not been considered at this time; however, other treatment may be required to meet waste disposal criteria for waste that is removed and disposed.

6.5 SHORT-TERM EFFECTIVENESS

This criterion assesses whether the alternative provides adequate protection of human health and the environment while implementing the response action, and discusses how long it will take for the action to achieve the established objectives. Risks present to the worker conducting the ongoing surveillance would increase since maintenance and removal actions would not occur under the no-action alternative. A time frame does not exist in which the no-action alternative will achieve the removal action objectives identified in section 3.0.

The stabilization alternative is effective for waste sites in the short term since maintenance and removal actions would be taken to address a release or threat of release of a hazardous substance. The requirement to continue entering waste sites boundaries for maintenance and removal actions presents a potential exposure risk to workers. This situation would be mitigated by identification of specific entry requirements for each waste site.

6.6 IMPLEMENTABILITY

The implementability criterion assesses whether the alternatives are technically and administratively feasible; all alternatives are implementable. In general, components of the stabilization alternative represent established technologies and procedures that are routinely implemented at the Hanford Site

6.7 COST

The cost criterion evaluates whether the alternatives are cost effective. The cost for the no-action alternative, which includes conducting inspections and monitoring the waste sites and facilities, is 20% of the total cost of the stabilization alternative presented below. Table 6-1 shows the stabilization costs for the waste sites in the 100, 200, and 300 Areas.

6.8 STATE ACCEPTANCE

The state acceptance criterion evaluates whether the technical and administrative concerns of the state have been addressed. The criterion will be evaluated following the comment period of this plan.

6.9 COMMUNITY ACCEPTANCE

The community acceptance criterion evaluates how the alternative addresses the concerns of the local community. The criterion will be evaluated following the public comment period of this plan.

6.10 OTHER CONSIDERATIONS

In accordance with DOE orders and NEPA policy, DOE CERCLA documents are required to incorporate NEPA values, such as analysis of cumulative, offsite, ecological, and socioeconomic impacts to the extent practicable.

The no-action alternative may cause cumulative impacts to areas waste sites due to eventual release of contaminants. Cumulative impacts detrimental to human health and the environment are not expected to occur for the stabilization alternatives because these activities are conducted in areas that are already disturbed; hazardous substances would be contained and actions would be taken to minimize the potential spread of contamination from waste sites. The overall cumulative effects of the stabilization alternative would be to enhance protection of human health and the environment. Few RARA sites exist in undisturbed habitat; however, cumulative impacts will be mitigated through revegetation and protection of sensitive biological species.

Table 6-1. Stabilization Costs for the 100, 200, and 300 Area Waste Sites.

WASTE SITE	WASTE ESTIMATE	DISPOSAL COSTS ($65.49 per metric ton)
100-H-12	0.45 metric tons	$29.47
100-H-13	4.5 metric tons	$294.71
116-H-9	0.45 metric tons	$29.47
100-H-1	0.45 metric tons	$29.47
126-B-1	18.1 metric tons	$1,185
116-D-8	18.1 metric tons	$1,185
100 Area Rail Tracks (inside the exclusion zones)	390 metric tons	$25,541
107-KE/KW/F Effluent Pipes	45.4 metric tons	$2,973
128-K-2	54.4 metric tons	$3,563
216-A-3	0.45 metric tons	$29.47
200-W-63	54.4 metric tons	$3,563
UPR-200-E-95	299.3 metric tons	$19,588
291-U-1 Stack Sump	18.1 metric tons	$1,185
REDOX Rail Cut	54.4 metric tons	$3,563
UPR-200-E-83	5,351.3 metric tons	$350,457
600-47	27.25 metric tons	$1,785

Offsite impacts include impacts to the public or the environment due to releases of contaminants resulting from an activity. The no-action alternative would be expected to result in offsite impacts in the long term. Implementation of the stabilization alternative would not have any potential to increase offsite impacts due to continued containment of hazardous substances.

Neither the no-action alternative nor the stabilization alternative would be expected to affect existing natural resource conditions. Although bald eagles frequent the Columbia River during the winter, no impacts to eagles or their roosts are anticipated because guidance provided in the *Bald Eagle Site Management Plan for the Hanford Site* (DOE-RL 1994) will be followed. Current evaluations indicate that proposed activities under the stabilization alternative are

unlikely to disturb sensitive plant or animal species. Prior to initiating any specific field activity, an ecological review of the surrounding area will be conducted to ensure that no impacts to natural resources (e.g., migratory birds) occur.

No unmitigated impacts to cultural resources are expected from either the no-action or the S&M alternative. One hundred eighty-five Hanford Site buildings/structures and complexes have been determined eligible for inclusion on the National Register of Historic Places. Appropriate actions will be taken to mitigate impacts from any stabilization activities undertaken at work sites in the vicinity of these structures.

Socioeconomic impacts from any of the alternatives would be minimal. The work force that is required for the stabilization alternative is small. The staff required to accomplish either of the alternatives would be drawn from the existing work force currently conducting the activities at the Hanford Site or through available subcontractors.

7.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Based on overall protection and short- and long-term effectiveness, the recommended removal alternative for waste sites is the stabilization alternative. This alternative provides for continued maintenance of the waste sites as well as the identification and response to potential releases of hazardous substances that could adversely impact human health and the environment. The stabilization alternative is protective of workers, satisfies response action goals, and is consistent with the anticipated future remedial actions.

8.0 REFERENCES

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

29 CFR 1926, "Occupational Safety and Health Standards for the Construction Industry," *Code of Federal Regulations*, as amended.

36 CFR 800, Protection of Historic and Cultural Properties," *Code of Federal Regulations*, as amended.

40 CFR 61, "National Emissions Standards in Hazardous Air Pollutants," *Code of Federal Regulations*, as amended.

40 CFR 122, "EPA Administered Permit Program: The National Pollutant Discharge Elimination System," *Code of Federal Regulations*, as amended.

40 CFR 260, "Hazardous Waste Management System: General," *Code of Federal Regulations*, as amended.

40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 262, "Standards Applicable to Generators of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 263, "Standards Applicable to Transporters of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.

40 CFR 266, "Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities." *Code of Federal Regulations*, as amended.

40 CFR 268, "Land Disposal Requirements," *Code of Federal Regulations*, as amended.

40 CFR 270, "EPA Administered Permit Program: The Hazardous Waste Permit Program," *Code of Federal Regulations*, as amended.

40 CFR 300.415, "National Oil and Hazardous Substances Pollution Contingency Plan," Hazardous Substance Response, 'Removal Action,' *Code of Federal Regulations*, as amended.

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing Distribution in Commerce, and Use Prohibitions." *Code of Federal Regulations*, as amended.

50 CFR 17, "Endangered and Threatened Wildlife and Plants," *Code of Federal Regulations*, as amended.

50 CFR 402, "Interagency Cooperation—Endangered Species Act of 1973, As Amended," *Code of Federal Regulations*, as amended.

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WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-304, "Minimum Functional Standards for Solid Waste Handling," *Washington Administrative Code*, as amended.

WAC 173-400, "General Regulations for Air Pollution Sources," *Washington Administrative Code*, as amended.

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