Draft Waste Incidental to Reprocessing Evaluation for the 200 West Area Tank Treatment Mission at the Hanford Site, Washington

U.S. Department of Energy, Hanford Field Office

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EXECUTIVE SUMMARY

This *Draft Waste Incidental to Reprocessing Evaluation for the 200 West Area Tank Treatment Mission at the Hanford Site, Washington* (Draft WIR Evaluation) concerns radioactive waste from underground tanks at the U.S. Department of Energy (DOE) Hanford Site, in the State of Washington. The waste will be retrieved from single-shell tanks (SSTs)[1] from the S, SX, and U Tank Farms in the Hanford 200 West Area. DOE will also remove waste from double-shell tanks (DSTs) in the SY Tank Farm, to provide tank space for pretreatment operations. DOE proposes to pretreat and solidify the waste (from both the SSTs and the DSTs) for disposal outside the State of Washington. DOE will complete analysis pursuant to National Environmental Policy Act (NEPA) and other applicable requirements before making a final decision.

This Draft WIR Evaluation assesses whether this tank waste, after separation, pretreatment, and solidification, is waste incidental to reprocessing (WIR) of spent nuclear fuel, is not high-level radioactive waste, and may be managed as low-level radioactive waste (LLW), under the criteria (WIR criteria) in Chapter II.B.(2)(a) of DOE M 435.1-1, *Radioactive Waste Management Manual*.

The WIR criteria in Chapter II.B.(2)(a) of DOE M 435.1-1 provide, in relevant part, that the wastes:

"(1) Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and

(2) Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*; and

(3) Are to be managed, pursuant to DOE's authority under the *Atomic Energy Act of 1954*, as amended, and in accordance with the provisions of Chapter IV of this Manual, provided the waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55, *Waste Classification*[.]"

The 200 West Area Tank Treatment Mission includes retrieving (removing), separating, and pretreating Hanford tank waste in a manner that protects the workers, the public, and the environment. The tank waste was generated, in part, by the prior reprocessing of spent nuclear fuel during the Manhattan Project and Cold War eras, for defense-related nuclear research, development and weapons-production activities.

[1] Single-shell tanks are waste tanks which do not have full secondary containment. Double-shell tanks are tanks that have full secondary containment (essentially a tank within a tank). Groups of tanks are called "tank farms".

DOE plans to retrieve supernate (including dissolved saltcake and interstitial liquid) from SSTs located in the S, SX, and U Tank Farms. DOE will transfer the retrieved waste to the SY Tank Farm for pretreatment.[2]

To pretreat the retrieved waste, DOE plans to undertake the West Area Risk Management (WARM) project, which includes constructing a WARM pretreatment capability located adjacent to the SY Tank Farm. Under the WARM project, the retrieved waste will be transferred to DSTs (receipt, qualification and feed tanks) in the SY Tank Farm and will be pretreated using multiple settling and decanting steps,[3] followed by filtration and ion-exchange columns (IXCs) in the WARM pretreatment capability.

The WARM pretreatment capability will consist of two process modules. Each module will have a dead-end filtration unit to remove entrained solids (including insoluble long-lived radionuclides), and four IXCs to remove primarily cesium-137 (Cs-137).

After pretreatment in the applicable WARM process module, the pretreated liquid waste will be transferred to the Pretreated Waste Storage Tank (PWST) prior to transfer to Load-In and Load-Out (LILO) station, where it will be pumped into U.S. Department of Transportation (DOT)-compliant tanker trucks and/or portable tanks. The tanker trucks and/or portable tanks will transport the pretreated liquid waste to one or more onsite or offsite solidification facilities. Potential facilities that could solidify the pretreated waste include:

1. Perma-Fix Northwest (PFNW) in Richland, Washington
2. Energy*Solutions* near Clive, Utah [Energy*Solutions* (Clive)]
3. Waste Control Specialists (WCS) near Andrews, Texas
4. Onsite facility, Hanford Site

[2] Supernate is the upper liquid above the solid material that was formed by precipitation of sludge and saltcake in the tanks. The supernate contains lower concentrations of insoluble long-lived radionuclides, whereas the sludge contains most of the insoluble long-lived radionuclides, which may persist in the environment and may be harmful to humans if ingested or inhaled.

Retrieval of waste from the SSTs is consistent with the Hanford Federal Facility Agreement and Consent Order (HFFACO or Tri Party Agreement) and amendment to the Consent Decree in State of Washington v. United States Department of Energy, E.D. Wash., No. 2:08-cv-5085-RMP. DOE, the Washington State Department of Ecology (Ecology), and the U.S. Environmental Protection Agency (EPA) engaged in mediated Holistic Negotiations, and reached agreement on, among other things, modification of milestones in the HFFACO and amendment to the Consent Decree in State of Washington v. United States Department of Energy, *id.* For example, retrieval of waste from the SSTs will be consistent with the new interim milestone M-045-135 in the HFFACO Action Plan, Appendix D "Work Schedule Milestones and Target Dates", to complete retrieval of 22 SSTs located in S, SX, and U tank farms by 2040, contingent on DOE having a regulatory pathway to grout and dispose of the waste offsite. In this regard, DOE may also retrieve waste from two additional SSTs in the S, SX, and U tank farms under certain circumstances, as provided in the amended Consent Decree in State of Washington v. United States Department of Energy, E.D. Wash., No. 2:08-cv-5085-RMP, ECF No. 269 (Jan. 8, 2025).

[3] Settling is a process by which solids, containing higher concentrations of insoluble long-lived radionuclides, settle by gravity to the bottom of the tank. Decanting is the process of pumping only the liquid fraction from the tank without disturbing the settled solids.

5. Offsite commercial facility, Richland, Washington.

DOE will only ship waste offsite to a licensed, commercial, MLLW solidification facility in accordance with the facility's license limits and waste acceptance criteria (WAC). Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial solidification facility if it meets the facility's WAC and licensed capacity.

In terms of the solidification facility, a new onsite and/or offsite commercial solidification facility may be considered that has yet to be constructed, and the pretreated waste must meet the WAC for any such facility. In general, at the solidification facility, the waste will be solidified to meet the WAC of the offsite disposal facility. DOE will dispose of the pretreated and solidified waste as mixed LLW (MLLW) at one or more offsite, licensed, commercial disposal facilities, potentially Energy*Solutions* (Clive Disposal Facility) near Clive, Utah, and/or the WCS Federal Waste Facility (WCS FWF), near Andrews, Texas. DOE has not made decisions on the location of either the solidification facility(ies) or the disposal facility(ies).

Energy*Solutions* (Clive) is both a solidification and disposal facility. However, it is limited to accepting Class A LLW[4] and MLLW. DOE considers Energy*Solutions* (Clive) to be a potential option if the pretreated and solidified waste meets concentration limits for Class A LLW as discussed in Appendix D of this Draft WIR Evaluation.

PFNW does not have disposal capability and will accept and solidify LLW and MLLW within the limits of its radioactive materials license. Therefore, waste solidified at PFNW would be disposed of at either Energy*Solutions* (Clive Disposal Facility) near Clive, Utah (for Class A LLW and MLLW only), and/or WCS FWF near Andrews, Texas (for Class A, B, and C LLW and MLLW).

This Draft WIR Evaluation shows that the criteria in Chapter II.B.(2)(a) of DOE M 435.1-1 will be met. As to the first criterion, DOE will use multiple steps (settling, decanting, filtration and IXCs) to remove key radionuclides to the maximum extent technically and economically practical. For example, DOE expects to remove approximately 99.9% of the Cs-137 (and daughter Ba-137m).

Regarding the second criterion, the solidified waste (regardless of the location where solidification occurs) will meet the WAC for offsite disposal at Energy*Solutions* (Clive Disposal Facility) and/or WCS FWF, as applicable. Meeting the WAC will ensure that the performance objectives, including doses, will be met for LLW disposal set forth in the *Utah Administrative*

[4] The NRC regulations at 10 C.F.R. 61.55, and comparable Utah and Texas regulations, classify LLW as Class A, Class B, or Class C LLW based on the concentrations of radionuclides, with Class A having the lowest concentrations of radionuclides.

Code and the *Texas Administrative Code* respectively, which are comparable to the U.S. Nuclear Regulatory Commission (NRC) performance objectives at 10 CFR Part 61, Subpart C.[5]

With respect to the third criterion, the separated, pretreated, and solidified waste will be in a solid physical form. The solidified waste will also be below the concentration limits for Class C LLW as shown in this Draft WIR Evaluation.

DOE is planning to consult with the NRC concerning this Draft WIR Evaluation. DOE is also planning to make this Draft WIR Evaluation available for comments by States, Tribal Nations, stakeholders, and the public.

DOE will prepare a Final WIR Evaluation that considers the planned consultation with NRC as well as comments from States, Tribal Nations, stakeholders, and the public. Based on the Final WIR Evaluation, DOE may determine, in a future WIR Determination, whether the waste is incidental to reprocessing, is not high-level radioactive waste, and may be managed (disposed of) as LLW.

If DOE issues a WIR Determination in the future, the pretreated waste will be managed as LLW, subject to the analysis and commitments in the Final WIR Evaluation and the WIR Determination, including: 1) the wastes will be incorporated in a solid physical form at a concentration that does not exceed the concentration limits for Class C LLW in 10 CFR 61.55; 2) the wastes will be disposed of in accordance with safety requirements comparable to the performance objectives in 10 CFR Part 61, Subpart C; and 3) the wastes will be properly characterized and classified, and will meet the WAC of the receiving facility.

[5] DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial disposal facility if it meets the applicable facility's WAC and license limits. Meeting the WAC will ensure that the 10 CFR Part 61, Subpart C performance objectives will be met.

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ABBREVIATIONS AND ACRONYMS

ALARA	as low as reasonably achievable
BBI	Best-Basis Inventory
BPP	bismuth phosphate batch processing
CFR	*Code of Federal Regulations*
CST	crystalline silicotitanate
DFLAW	direct-feed low-activity waste
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DST	double-shell tank
DWMRC	Division of Waste Management and Radiation Control
Ecology	Washington State Department of Ecology
EDTA	ethylenediaminetetraacetic acid
EPA	U.S. Environmental Protection Agency
FR	*Federal Register*
FWF	Federal Waste Facility
H2C	Hanford Tank Waste Operations & Closure
HEDTA	hydroxyethylethylenediaminetriacetic acid
HFFACO	*Hanford Federal Facility Agreement and Consent Order*
HLW	high-level waste
IDF	Integrated Disposal Facility
ITPS	in-tank pretreatment system
IX	ion exchange
IXC	ion-exchange column
LAW	low-activity waste
LDR	Land Disposal Restrictions
LILO	load-in, load-out
LLW	low-level radioactive waste
MLLW	mixed low-level radioactive waste
mrem/yr	millirem per year
NEPA	*National Environmental Policy Act of 1969,* as amended

NRC	U.S. Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
PFNW	Perma-Fix Northwest
PM	process module
PUREX	Plutonium and Uranium Extraction
PWST	Pretreated Waste Storage Tank
RAI	Request for Additional Information
RCRA	*Resource Conservation and Recovery Act of 1976*, as amended
REDOX	Reduction and Oxidation
ROD	Record of Decision
RPP	River Protection Project
S2-SltSlr	saltcake from the second 242-S Evaporator campaign using tank 241-SY-102 feed
SNF	spent nuclear fuel
SST	single-shell tank
TAC	*Texas Administrative Code*
TBI	Test Bed Initiative
TCEQ	Texas Commission on Environmental Quality
TER	Technical Evaluation Report
TPA	Tri-Party Agreement
TRU	transuranic
TSCR	tank-side cesium removal
TWINS	Tank Waste Information Network System
UAC	*Utah Administrative Code*
WAC	waste acceptance criteria
WARM	West Area Risk Management
WCS	Waste Control Specialists
WIR	waste incidental to reprocessing
WTP	Waste Treatment and Immobilization Plant

1.0 INTRODUCTION

Section Purpose

The purpose of this section is to provide introductory information that lays the foundation for detailed discussions in later sections.

Section Contents

This section describes the purpose and scope of this Draft WIR Evaluation, provides background information concerning the Hanford Site, describes pretreatment, solidification, and offsite disposal, identifies the technical requirements on which this Draft Evaluation is based, and outlines the contents of the rest of the Draft WIR Evaluation.

Key Points

- This Draft WIR Evaluation concerns separated, pretreated, and solidified radioactive waste to be retrieved from underground SSTs in the S, SX, and U Tank Farms located at the Hanford Site in the State of Washington.[6] The waste also includes some of the waste to be removed from DSTs in the SY Tank Farm, which will be used to support pretreatment operations. The waste retrieved from these tanks (both the SSTs and DSTs) will be separated and pretreated at the Hanford Site, then solidified onsite or offsite, and disposed of offsite outside the State of Washington.

[6] Single-shell tanks are waste tanks which do not have full secondary containment. A double-shell tank is a tank that has full secondary containment (essentially a tank within a tank).

- This Draft WIR Evaluation assesses whether the separated, pretreated, and solidified waste is waste incidental to reprocessing (WIR)[7] of spent nuclear fuel (SNF),[8] is not high-level radioactive waste (HLW),[9] and may be managed as low-level radioactive waste (LLW)[10] under the criteria set forth in Chapter II.B.(2)(a) of the U.S. Department of Energy (DOE) M 435.1-1, *Radioactive Waste Management Manual*. As shown in this Draft WIR Evaluation, the waste at issue will satisfy the criteria in Chapter II.B.(2)(a) of DOE M 435.1-1.
- The waste was generated, in part, by the prior reprocessing of spent nuclear fuel during the Manhattan Project and Cold War eras, for defense-related nuclear research, development, and weapons production.

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7 Waste incidental to reprocessing is referred to as "WIR" in this document.

The term "reprocessing" is defined in Attachment 2 of DOE M 435.1-1, "*Radioactive Waste Management Manual*," as: "Actions necessary to separate fissile elements (U-235, Pu-239, U-233, and Pu-241) and/or transuranium elements (e.g., Np, Pu, Am, Cm, Bk) from other materials (e.g., fission products, activated metals, cladding) contained in spent nuclear fuel for the purposes of recovering desired materials. Separation processes include aqueous separation processes, e.g., the REDOX and the PUREX processes, and nonaqueous processes, e.g., pyrometallurgical and pyrochemical processes. Wastes that are produced upstream of these separations processes, from processes such as chemical or mechanical decladding, cladding separations, conditioning, or accountability measuring, are not high-level waste. Such wastes are considered processing wastes and should be managed in accordance with the appropriate Chapters of DOE M 435.1-1, as either transuranic, mixed low-level, or low-level waste. Likewise, wastes that are produced downstream of these separations processes, from such processes as decontamination, rinsing, washing, treating, vitrifying, or solidifying, are also not high-level waste and should be managed accordingly. Upstream and downstream wastes are not high-level waste because they do not result from reprocessing."

8 The term "spent nuclear fuel" is defined in Section 2(23) of the *Nuclear Waste Policy Act of 1982*, as amended (42 U.S.C. 10101, et seq.) as "fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing." Section 11.ee of the *Atomic Energy Act of 1954*, as amended (42 U.S.C. 2011 et seq.), and Section 2(15) of the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, as amended (P.L. 102-579), incorporate the above definition. The term "spent nuclear fuel" is defined in Attachment 2 of DOE M 435.1-1 in relevant part as: "Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing. Test specimens of fissionable material irradiated for research and development only, and not production of power or plutonium, may be classified as waste, and managed in accordance with the requirements of this Order when it is technically infeasible, cost prohibitive, or would increase worker exposure to separate the remaining test specimens from other contaminated material."

9 "High-level radioactive waste" is defined in Section 2(12) of the *Nuclear Waste Policy Act of 1982*, supra, as: "(A) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and (B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation." Section 11.ee of the *Atomic Energy Act of 1954*, supra, and Section 2(10) of the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, supra, incorporate the above definition. A similar definition is found in DOE M 435.1-1.

10 Low-level radioactive waste is essentially defined in relevant part in Section 2(9) of the *Low-Level Radioactive Waste Policy Amendments Act of 1985*, as amended (Public Law 99-240), and Section 2(16) of the *Nuclear Waste Policy Act of 1982*, supra, as "radioactive material … that is not high-level radioactive waste, spent nuclear fuel, or byproduct material (as defined in … the *Atomic Energy Act of 1954*)[.]" DOE M 435.1-1 similarly defines low-level waste in relevant part as "radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, [or] byproduct material[.]"

- DOE plans to retrieve supernate (essentially the upper-most liquid layer of tank waste as well as dissolved saltcake and interstitial liquid) from underground SSTs located in the 200 West Area of the Hanford Site.
- DOE will transfer the SST supernate (including dissolved saltcake and interstitial liquid) to the SY Tank Farm for pretreatment using hose-in-hose-transfer-lines (HIHTLs).
- DOE will pretreat the waste transferred to the SY Tank Farm using several settling and decanting steps, which are expected to remove solids containing insoluble long-lived radionuclides.[11] DSTs (SY-101, SY-102, and SY-103) in the SY Tank Farm will be used as receipt, qualification, and feed tanks. Following the settling and decanting steps, the waste will be pretreated by filtration and ion exchange columns (IXCs) in the West Area Risk Management (WARM) process module, which DOE plans to construct adjacent to the SY Tank Farm.
- The WARM pretreatment capability will consist of two modules. Each module will have a dead-end filtration unit to further remove entrained solids (including insoluble long-lived radionuclides), and four ion exchange columns (IXCs) to remove primarily cesium-137(Cs-137).
- After the waste is processed in the applicable WARM process module, the pretreated liquid waste will be sent to the pretreated waste storage tank (PWST) and then to the load-in and load-out station (LILO) via transfer piping. DOT-compliant tanker trucks and/or portable tanks will be used to transport the pretreated liquid to one or more onsite or offsite solidification facility(ies) (potentially Perma-Fix Northwest (PFNW) in Richland, Washington; Energy*Solutions* near Clive, Utah; Waste Control Specialists [WCS] near Andrews, Texas). A new onsite solidification facility or offsite solidification facility may be considered that has yet to be constructed. At the solidification facility, the pretreated waste will be solidified to meet the WAC of the disposal facility.
- DOE plans to dispose of the separated, pretreated, and solidified West Area tank waste as mixed LLW (MLLW)[12] at one or more offsite disposal facilities, potentially Energy*Solutions* (Clive Disposal Facility) near Clive, Utah, and/or the WCS Federal Waste Facility (FWF) near Andrews, Texas. The Energy*Solutions* (Clive Disposal Facility) is licensed and permitted for disposal of Class A LLW and Class A MLLW. The WCS FWF is licensed and permitted for disposal of Class A, B, and C LLW and MLLW. DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's licensed capacity. Meeting the applicable facility's WAC will ensure that the 10 CFR Part 61, Subpart C performance objectives will be met.
- DOE is planning to consult with the U.S. Nuclear Regulatory Commission (NRC) concerning this Draft WIR Evaluation. DOE is also planning to make this Draft WIR Evaluation available for comments by States, Tribal Nations, stakeholders, and the public.
- Based on the Final WIR Evaluation, DOE may, in a future WIR Determination, determine whether the separated, pretreated, and solidified waste is WIR, is not HLW, and may be managed as LLW.

1.1 OVERVIEW

This Draft WIR Evaluation concerns separated, pretreated, and solidified waste to be retrieved primarily from underground SSTs located in the S, SX, and U Tank Farms at the Hanford Site, in

[11] Settling is a process by which insoluble solids, containing higher concentrations of long-lived radionuclides, settle by gravity to the bottom of the tank. Decanting is the process of pumping only the liquid fraction from the tank without disturbing the settled solids.

[12] All Hanford tank waste is considered mixed radioactive and hazardous waste, regulated under the *Atomic Energy Act of 1954*, supra, and the *Resource Conservation and Recovery Act of 1976,* as amended (RCRA), 42 U.S.C. 6901 et seq. For convenience in this Draft WIR Evaluation, mixed low-level waste is hereafter referred to as simply LLW, except as otherwise noted.

the State of Washington. The waste also includes some of the waste currently stored in DSTs in the SY Tank Farm, which will be removed to provide tank space for pretreatment operations. This Draft WIR Evaluation assesses whether this waste (from both the SSTs and the DSTs) is incidental to the reprocessing of SNF, is not HLW, and may be managed as LLW, under the criteria in Chapter II.B.(2)(a) of DOE M 435.1-1.

At the Hanford site, the 200 West Area mission includes retrieving, separating, and pretreating Hanford tank waste in a manner that protects the workers, the public, and the environment. The waste was generated, in part, by the prior reprocessing of SNF by DOE and its predecessors during the Manhattan Project and Cold War, for defense-related nuclear research, development, and weapons production.

Subject to NEPA analysis and an associated decision to proceed, DOE plans to retrieve supernate (essentially the upper-most liquid layer of tank waste, as well as dissolved saltcake and interstitial liquid) from underground SSTs located in the 200 West Area of the Hanford Site.[13] DOE will transfer the retrieved SST supernate (including dissolved saltcake and interstitial liquid) to the SY tank farm for pretreatment using hose-in-hose-transfer- lines (HIHTLs).

To pretreat the retrieved waste in the SY Tank Farm, DOE plans to undertake a new project called the 200 West Area Risk Management (WARM) project. Under the WARM project, DOE will pretreat the waste using multiple settling and decanting steps in DSTs (SY-101, SY-102, and SY-103), which will serve as receipt, qualification, and feed tanks. After the settling and decanting steps, the waste will be further pretreated by filtration and IXCs in the WARM pretreatment capability, to be constructed adjacent to the SY Tank Farm. These processes are described further below.

The list of DSTs and SSTs planned for retrieval as part of the WARM project are listed in Table 1-1. The DSTs are included to support pretreatment operations.

[13] Retrieval of waste from the SSTs is consistent with the Hanford Federal Facility Agreement and Consent Order (HFFACO or Tri Party Agreement) and amendment to the Consent Decree in State of Washington v. United States Department of Energy, E.D. Wash., No. 2:08-cv-5085-RMP. DOE, the Washington State Department of Ecology (Ecology), and the U.S. Environmental Protection Agency (EPA) engaged in mediated Holistic Negotiations, and reached agreement on, among other things, modification of milestones in the HFFACO and amendment to the Consent Decree in State of Washington v. United States Department of Energy, *id.* For example, retrieval of waste from the SSTs will be consistent with the new interim milestone M-045-135 in the HFFACO Action Plan, Appendix D "Work Schedule Milestones and Target Dates", to complete retrieval of 22 SSTs located in S, SX, and U tank farms by 2040, contingent on DOE having a regulatory pathway to grout and dispose of the waste offsite. In this regard, DOE may also retrieve waste from two additional SSTs in the S, SX, and U tank farms under certain circumstances, as provided in the amended Consent Decree in State of Washington v. United States Department of Energy, E.D. Wash., No. 2:08-cv-5085-RMP, ECF No. 269 (Jan. 8, 2025).

Table 1-1. 200 West Area Feed Tanks.

SY Farm[a]	S Farm[b]	SX Farm	U Farm
SY-101	S-101	SX-101	U-101
SY-102	S-102	SX-102	U-102
	S-103	SX-103	U-103
	S-104	SX-104	U-104
	S-105	SX-105	U-105
	S-106	SX-106	U-106
	S-107	SX-107	U-107
	S-108	SX-108	U-108
	S-109	SX-109	U-109
	S-110	SX-110	U-110
	S-111	SX-111	U-111
		SX-112	U-112
		SX-113	U-201
		SX-114	U-202
		SX-115	U-203
			U-204

[a] DSTs SY-101 and SY-102 will be retrieved to provide tank space for subsequent S, SX, and U farm SST retrievals. Waste from tank SY-103 will be transferred to tank SY-102 prior to SST retrievals, and will be processed with waste from SY-102 in the WARM pretreatment capability.

(RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document*).

[b] Tank S-112 is excluded from consideration since waste retrieval from this tank was completed in March of 2007 (HNF-EP-0182, *Waste Tank Summary Report for Month Ending November 30, 2025, Rev. 455)*.

The retrieved SST waste will be transferred to a receipt tank (DST) located in the SY Tank Farm. In the receipt tank, the insoluble solids, containing long-lived radionuclides, will be allowed to settle prior to decanting into the feed qualification tank where the waste will be sampled and analyzed. After further settling in the qualification tank (pending sample analysis duration of approximately 90 days), the waste will again be decanted to the feed tank for the WARM pretreatment capability.

Following the settling and decanting steps, the waste will be pretreated in the WARM pretreatment capability. The WARM pretreatment capability will consist of two modules. Each module will contain a dead-end filtration unit to remove entrained solids (containing insoluble long-lived radionuclides), and four IXCs to remove primarily cesium-137 (Cs-137).

After pretreatment in the applicable WARM process module, the pretreated waste will be transferred to the PWST and then to the LILO station via transfer piping, where tanker trucks and/or portable tanks will be used to transport the pretreated liquid to one or more onsite or offsite solidification facilities. The potential facilities that could solidify the pretreated waste include:

1. Perma-Fix Northwest (PFNW) in Richland, Washington
2. Energy*Solutions* near Clive, Utah [Energy*Solutions* (Clive)]
3. Waste Control Specialists (WCS) near Andrews, Texas
4. Onsite facility, Hanford Site[14,15]
5. Offsite commercial facility, Richland, Washington.

At the solidification facility(ies), the waste will be further treated to meet Land Disposal Restrictions (LDRs) as needed prior to disposal.

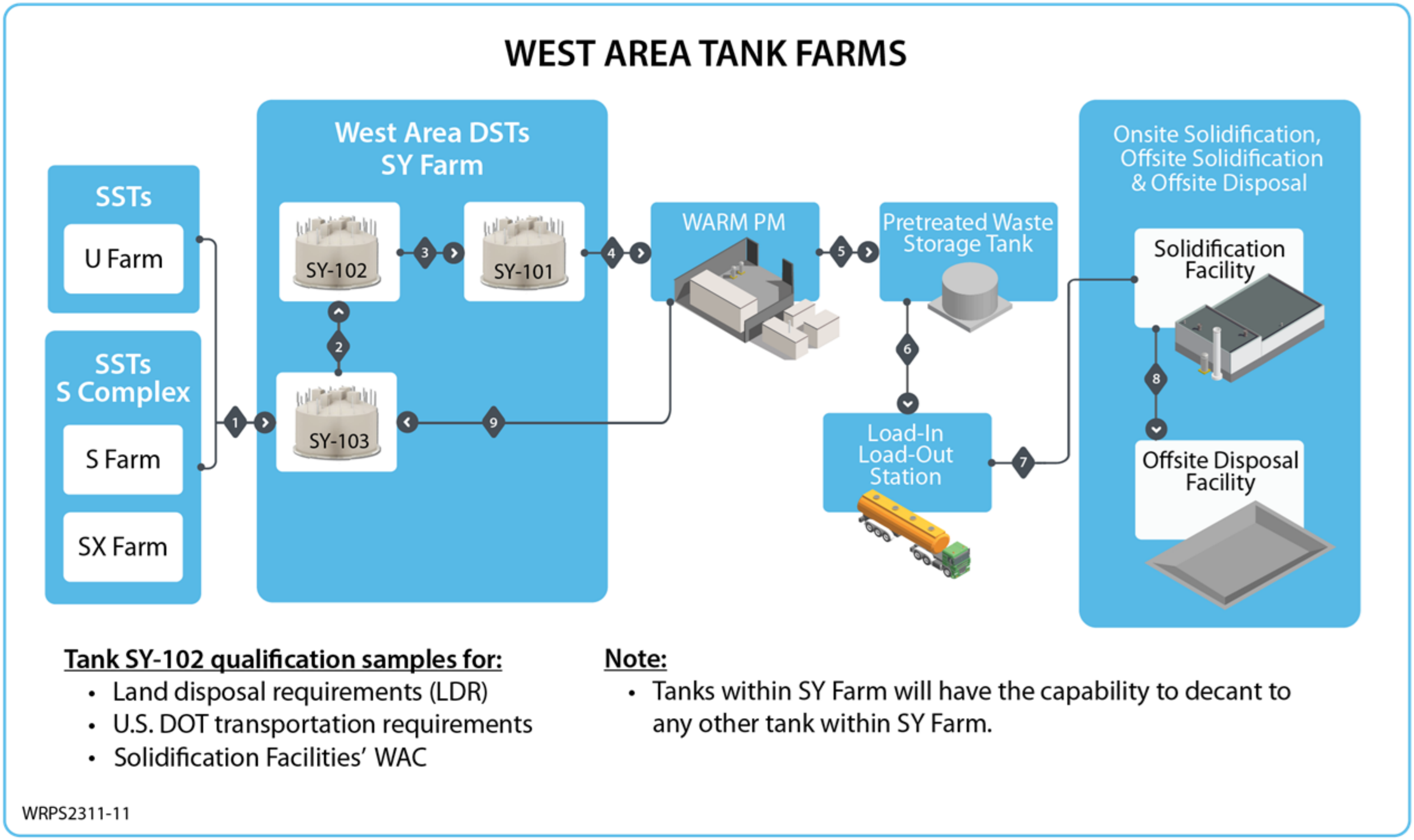
Following solidification, DOE plans to dispose of the solidified waste as MLLW at one or more offsite, licensed, and permitted disposal facility(ies), potentially Energy*Solutions* (Clive Disposal Facility) near Clive, Utah, and/or the WCS FWF near Andrews, Texas. The pretreated and solidified waste will be disposed of in accordance with the WAC for the applicable disposal facility(ies). DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's licensed capacity. Meeting the applicable facility's WAC ensures that the 10 CFR Part 61, Subpart C performance objectives will be met.

[14] 231127-BWT-23, *Expression of Interest for the Grouting and Disposal of Mixed Low-Level Waste from Hanford Tanks*. The pretreated waste must meet the WAC for any new solidification facility used.

[15] See solicitation number 38174, *Grouting and Disposal of Mixed-Low-Level Waste* that includes H2C's solicitation under the Integrated Tank Disposition Contract (ITDC), Prime Contract Number 89303324DEM000096. Through this solicitation, H2C intends to award multiple Master Indefinite Delivery/Indefinite Quantity Subcontracts (IDIQM) to qualified organizations. This solicitation seeks proposals for providing services that include an onsite pretreated tank waste treatment facility.

Although meeting Class A concentration limits is not a WIR criterion of DOE M 435.1-1, DOE considers Energy*Solutions* (Clive) to be a potential option if the pretreated and solidified waste meets Class A concentration limits as discussed in Appendix D of this Draft WIR Evaluation. At this time, DOE has not decided which solidification or disposal facility(ies) would be used.

A block diagram depicting all elements of pretreatment, solidification, and disposal is shown in Figure 1-1 A description of each numbered stream presented in Figure 1-1 is provided in Table 1-2. Note that this block figure is for illustrative purposes only. The final WARM design will consider flexibility to interchangeably utilize each of the DSTs (SY-102, SY-102, and SY-103) as a receipt, qualification, or feed tank if necessary.



DOT	= Department of Transportation	SST	= single-shell tank
DST	= double-shell tank	WAC	= waste acceptance criteria
PM	= process module	WARM	= West Area Risk Management

Figure 1-1. Block Diagram of the 200 West Area Tank Treatment Process.

Table 1-2. Block Flow Diagram Stream Identification.

Stream	Stream Description	From	To	Primary Flow
1	Single-shell tanks retrieval waste	S Farm, SX Farm, and U Farm Tanks	Tank SY-103	Retrieved waste
2	West Waste Feed decant	Tank SY-103	Tank SY-102	Retrieved waste
3	Qualified feed decant	Tank SY-102	Tank SY-101	Qualified feed
4	Qualified feed to pretreatment	Tank SY-101	WARM PM	Qualified feed
5	Pretreated waste to PWST	WARM PM	PWST	Pretreated waste
6	Pretreated waste to LILO station	PWST	LILO station	Pretreated waste
7	Pretreated waste to solidification facility(ies)	LILO station	Solidification facility(ies)	Pretreated waste
8	Solidified waste to offsite disposal site(s)	Solidification facility(ies)	Off-site disposal facility(ies)	Solidified waste
9[a]	Filters backflush and IXCs blowdown	WARM PM	Tank SY-103	Filters backflush and IXCs blowdown

RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document.*

IXC = ion-exchange column
LILO = load-in and load-out
PWST = pretreated waste storage tank
WARM PM = West Area Risk Management Process Module (pretreatment capability)

[a] Spent IXCs will be flushed with dilute caustic (0.1 M NaOH) and water, air-dried, and transferred to an interim storage pad. Waste streams generated by back flushing of the filters and caustic and water flushing of spent IXCs will be transferred to SY-103, the receipt tank for waste retrieved from the single-shell tanks.

1.2 PURPOSE

The purpose of this Draft WIR Evaluation is to analyze whether separated, pretreated, and solidified waste will meet the criteria in Chapter II.B.(2)(a) of DOE M 435.1-1, is not HLW, and may be managed as LLW.

If DOE issues a Final WIR Evaluation and WIR Determination in the future, the pretreated liquid waste discharged from the WARM process modules—from which key radionuclides have been removed to the maximum extent technically and economically practical—will be managed as LLW, subject to the analysis and commitments in the Final WIR Evaluation and the WIR Determination, including: 1) the waste will be incorporated in a solid physical form at a concentration that does not exceed the concentration limits for Class C LLW in 10 CFR 61.55; 2) the waste will be disposed of in accordance with safety requirements comparable to the performance objectives in 10 CFR Part 61, Subpart C; and 3) the waste will be properly characterized and classified, and will meet the WAC of the receiving facility.

1.3 SCOPE

This Draft WIR Evaluation applies to supernate (including dissolved saltcake and interstitial liquid) primarily from underground SSTs located in S, SX, and U Tank Farms. This Draft WIR Evaluation also includes some of the waste currently stored in DSTs located in SY Tank Farm, which will be removed and provide tank space for pretreatment operations. The tank waste (from both the SSTs and the DSTs) will be separated and pretreated via settling and decanting, followed by pretreatment using filtration and IX in the WARM process module, then solidified onsite and/or offsite and disposed of offsite.

This Draft WIR Evaluation does not address the treatment or disposal of other wastes, equipment, facilities, or systems, or closure of the SSTs. This Draft WIR Evaluation is premised on the facts, assumptions, and analyses contained or referenced herein. Accordingly, a WIR Determination made in reliance on the Final WIR Evaluation can only cover situations consistent with those facts, assumptions, and analyses.

1.4 TECHNICAL BASIS FOR THIS DRAFT EVALUATION

Waste Incidental to Reprocessing
DOE M 435.1-1 provides two methods for determining whether waste resulting from SNF reprocessing is incidental to reprocessing and can be managed as LLW: the citation method and the evaluation method. The citation process applies to radioactive wastes that are the result of reprocessing plant operations, such as, but not limited to, contaminated job wastes including laboratory items such as clothing, tools, and equipment. The tank waste addressed in this Draft WIR Evaluation does not fall within a category of materials to which DOE considers the citation process can be applied. Therefore, the evaluation method is used for the subject waste as described in this Draft WIR Evaluation.

This Draft WIR Evaluation has been prepared in accordance with DOE M 435.1-1. The method used involves evaluating separated, pretreated, and solidified supernate (including dissolved saltcake and interstitial liquid) from underground SSTs in the S, SX, and U Tank Farms. This Draft WIR Evaluation also includes some of the waste (supernate) from DSTs located in SY Tank Farm, that will be removed and provide tank space for pretreatment operations. This Draft WIR Evaluation assesses whether the waste is waste incidental to reprocessing (WIR), is not HLW, and may be managed under DOE's authority in accordance with requirements for LLW. The criteria in Chapter II.B.(2)(a) of DOE M 435.1-1 provide, in relevant part, that the wastes:

> " (1) Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and
>
> (2) Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*; and
>
> (3) Are to be managed, pursuant to DOE's authority under the *Atomic Energy Act of 1954*, as amended, and in accordance with the provisions of Chapter IV of this Manual, provided the waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55, *Waste Classification*[.]" [16]

This Draft WIR Evaluation focuses on the WIR criteria in DOE M 435.1-1, Chapter II.B.(2)(a), which are discussed in Section 3.0 of this Draft WIR Evaluation and addressed in detail in Sections 4.0, 5.0, and 6.0, respectively.

Although the WIR criteria in DOE M 435.1-1 are generally similar to the provisions in Section 3116(a) of the *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005* (Public Law 108-375), Section 3116 only applies to certain waste in South Carolina and Idaho. Nevertheless, as a matter of policy, DOE has considered the Section 3116(a) criteria for perspective and general consistency. This matter is addressed in detail in Appendix B.

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[16] This provision in DOE M 435.1 also includes the following language: "or will meet alternative requirements for waste classification and characterization as DOE may authorize." DOE is not using or relying upon this language in this Draft WIR Evaluation.

1.5 BACKGROUND

The following general information is provided in this section as background to put this Draft WIR Evaluation into context. Section 2.0 provides more detailed information on reprocessing of SNF at the Hanford Site, tank waste sampling and characterization, as well as tank waste histories, retrieval, pretreatment, solidification, and disposal of tank waste.

1.5.1 The Hanford Site and Its History[17]

The Hanford Site occupies approximately 586 square miles in southeastern Washington State along the Columbia River (Figure 1-2). The Hanford Site mission included defense-related nuclear research, development, and nuclear production activities from the early 1940s until approximately 1989. Since that time, Hanford's mission has been to remediate the site, especially the radioactive and hazardous waste from plutonium production that may pose a risk to the public or environment, including the Columbia River.

[17] This brief history was compiled primarily from the *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (DOE 2012) and *A Short History of Hanford Waste Generation, Storage, and Release* (PNNL-13605) except as otherwise noted.

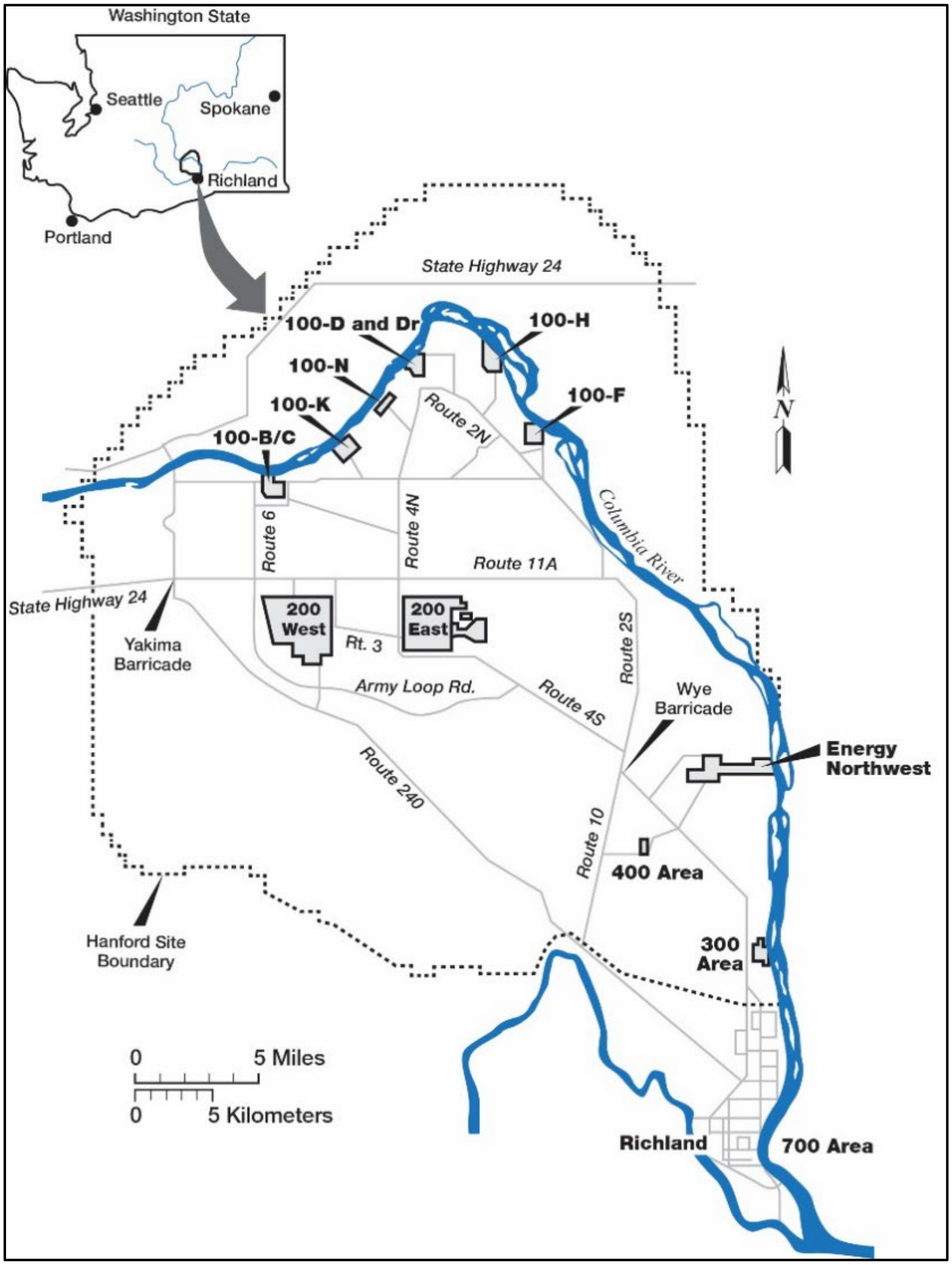

Figure 1-2. Hanford Site Map.

The *Hanford Federal Facility Agreement and Consent Order* (HFFACO, also referred to as the Tri-Party Agreement or TPA) (Ecology et al. 1989), was signed by DOE, Washington State Department of Ecology (Ecology), and the U.S. Environmental Protection Agency (EPA) on May 15, 1989, and, as amended, is an enforceable agreement that establishes, amongst other things, requirements for DOE's clean-up of contamination at the site. In addition to the

HFFACO, activities at the site are also governed by a Consent Decree, as amended, that provides, amongst other things, milestones for DOE to retrieve certain tank waste.[18]

> DOE, Ecology, and EPA engaged in mediated negotiations, called Holistic Negotiations, and reached agreement on the modification of certain milestones in the HFFACO, and amendments to the Consent Decree.[19] For example, retrieval of waste from the SSTs in the S, SX, and U Tank Farms will be consistent with new interim milestone M-045-135 in the HFFACO Action Plan, Appendix D "Work Schedule Milestones and Target Dates", to complete retrieval of 22 SSTs located in S, SX, and U Tank Farms by 2040, contingent on DOE having a regulatory pathway to grout and dispose of the waste offsite. The specific SSTs to be retrieved under this interim milestone will be identified in future Tank Waste Retrieval Work Plans. In this regard, DOE may also retrieve waste from two additional SSTs in the S, SX, and U Tank Farms under certain circumstances, as provided in the amended Consent Decree.

This Draft WIR Evaluation considers the retrieval from all SSTs located in the S, SX, and U Tank Farms.

1.5.2 Hanford Tank Waste[20]

The DOE is responsible for the retrieval, treatment, and disposal of the Hanford tank waste in a manner that protects the workers, the public, and the environment. The tank waste at the Hanford Site consists of approximately 56 million gallons of mixed radioactive waste that is stored in 177 underground tanks located within the 200 East and 200 West Areas of the Hanford Site.[21] As shown in Figure 1-3, waste in the SSTs generally consists of three phases: supernate, saltcake, and sludge. This waste is managed as waste generated, in part, by prior reprocessing.

This Draft WIR Evaluation concerns supernate (including dissolved saltcake and interstitial liquids) retrieved primarily from underground SSTs in the S, SX, and U Tank Farms located in the 200 West Area of the Hanford Site, in the State of Washington. This Draft WIR Evaluation also includes supernate from DSTs in SY Tank Farm used as receipt, qualification, and feed tanks for pretreatment operations.

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[18] *Washington v. Dep't of Energy*, No. 2:08-CV-5085-RMP, ECF Nos. 59 (Oct. 25, 2010), 222 (Mar. 11, 2016), 232 (Apr. 12, 2016), 242 (Oct. 12, 2018), 251 (Dec. 10, 2020), 259 (July 18, 2022), 264 (July 30, 2024), and 269 (Jan. 8, 2025).

[19] The proposed amendments to the HFFACO were issued for public comment in May 2024. The amendments to the HFFACO were finalized after consideration of public comments and revisions in response to those comments.

[20] This brief history was compiled primarily from the *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (DOE 2012), and *A Short History of Hanford Waste Generation, Storage, and Release*, (PNNL-13605) except as otherwise noted.

[21] These tanks include 149 SSTs and 28 DSTs.

1.5.3 Spent Nuclear Fuel Reprocessing

To support defense-related activities and production of material for nuclear weapons, plutonium and other nuclear materials were separated (reprocessed) from spent nuclear fuel and targets using various chemical precipitation and solvent extraction techniques at the Hanford Site.[22] In 1989, the reprocessing plants were shut down, and no new wastes were generated from reprocessing at the Hanford Site. As shown in Figure 1-3, waste from the SSTs generally consists of three phases: supernate, saltcake, and sludge. This waste is managed as waste generated, in part, by prior reprocessing.

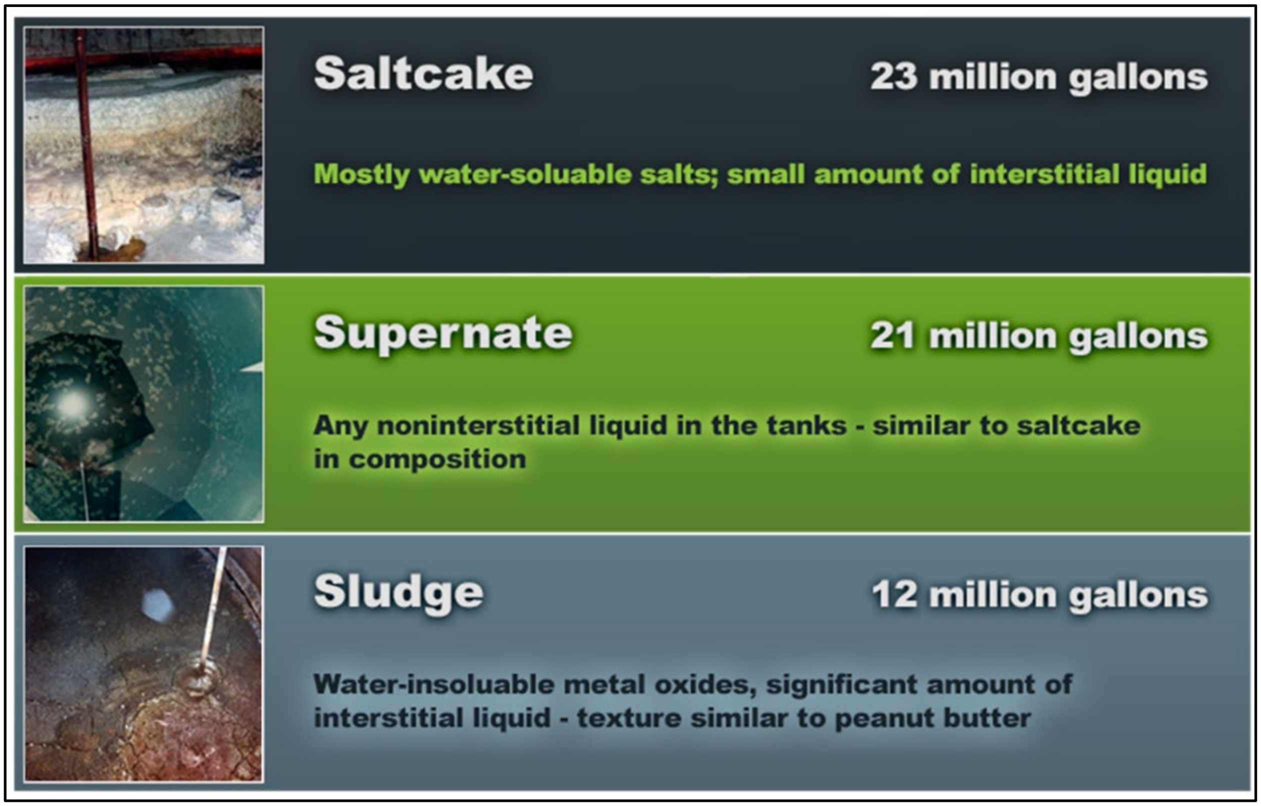

Figure 1-3. Hanford Waste Tank Contents.

The waste from reprocessing was stored in 177 large underground storage tanks. Beginning in the 1960s, some of the tank waste was treated to remove a portion of the cesium and strontium,

22 Starting in late 1944 and 1945, the T and B Plants used a bismuth phosphate batch processing technology. Later, the Reduction and Oxidation (REDOX) and Plutonium and Uranium Extraction (PUREX) plants were brought online beginning in the 1950s. The Hanford Site reprocessed irradiated uranium and generated several hundred thousand metric tons of chemical and radioactive waste during its production period. The resulting liquid wastes from these processes were stored in large underground storage tanks.

and the treated waste was returned to the tanks.[23] Thereafter, additional waste from reprocessing was added to the tanks. Currently, radioactive waste is stored in underground tanks on the Central Plateau at Hanford. Figure 1-4 shows the Central Plateau, which contains the underground storage tanks and their support infrastructure where waste from reprocessing is stored. Retrieval of waste from these tanks is the focus of ongoing work by DOE.

Figure 1-4. Hanford Central Plateau.

1.5.4 Characterization of the Tank Waste

Hanford maintains the tank waste radionuclide inventory in the Tank Waste Information Network System (TWINS) database known as the Best-Basis Inventory (BBI).[24] This inventory includes 54 radionuclides and 38 chemicals. Inventories are provided for each tank using waste sample data and process history modeling and are updated quarterly. The BBI process was developed using the best available information to estimate compositions and inventories of the 177 underground waste tank contents. It characterizes the contents of the underground waste storage tanks at Hanford by using sample data, process knowledge, surveillance data, and waste stream composition information from the Hanford Defined Waste computer model (WHC-SD-WM-TI-731, *Predominant Radionuclides in Hanford Site Waste Tanks*). The most current BBI report for the SSTs in the S, SX and U Tank Farm tanks consists of a blend of waste from different processes, due to historical practices and due to waste retrieval and consolidation

[23] Beginning in the 1960s, some waste was retrieved from SSTs, and transferred to the Hanford Site B Plant, where cesium and strontium were extracted, placed in capsules, and stored in a separate facility. This process removed significant fission product inventory from the tank waste (DOE/EIS-0391).

[24] BBI can be found at: https://phoenix.pnnl.gov/phoenix/apps/gallery/index.html. It is updated quarterly.

activities in the tank farms. Sections 2.0 and 4.0 of this Draft WIR Evaluation provide more detail on the characterization and treatment process.

As explained in more detail in Section 6.0 of this Draft WIR Evaluation, the pretreated and solidified tank waste for each West Area waste tank will be below the NRC concentration limits for Class C LLW set forth in 10 CFR 61.55. The limits set forth in 10 CFR 61.55 are mirrored in 30 *Texas Administrative Code* (TAC) 336, "Radioactive Substance Rules," Rule 336.362, Appendix E, "Classification and Characteristics of Low-Level Radioactive Waste."

Although meeting Class A concentration limits is not a WIR criterion of DOE M 435.1-1, DOE considers Energy*Solutions* (Clive) a potential option if the pretreated and solidified waste meets Class A concentration limits as shown in Appendix D of this Draft WIR Evaluation and set forth in 10 CFR 61.55. These limits are mirrored in the *Utah Administrative Code* (UAC) Title R313, "Environmental Quality, Waste Management and Radiation Control, Radiation," R313-15, "Standards for Protection Against Radiation," R313-15-1009, "Classification and Characteristics of Low-Level Radioactive Waste."

1.6 HANFORD 200 WEST AREA TANK FARMS RISK MANAGEMENT PROJECT

1.6.1 Background

Underground storage tanks are located in the 200 West Area of the Central Plateau at the Hanford Site. Waste from these tanks may consist of three phases: supernate, saltcake, and sludge, which are managed as waste generated, in part, by prior reprocessing. According to the most current BBI report, these tanks contain a blend of waste from different processes, due to historical practices and due to waste retrieval and consolidation activities in the tank farms. Some of the cesium and strontium was also removed from the tanks, beginning in 1967 (*Sixteen Years of Cesium Recovery Processing at Hanford's B Plant* [Barton 1986]).

The WARM project evolved based on the DOE's need to reduce and/or mitigate risks by adding operational capabilities to pretreat retrieved waste from S, SX, and U Tank Farms in the 200 West Area. As a result, the 200 West Area mission includes pretreatment of tank waste supernate (including dissolved saltcake and interstitial liquid) retrieved primarily from underground SSTs located in S, SX, and U Tank Farms. Some of the waste from the DSTs in the SY tank farm (that will be used as receipt, qualification, and feed tanks during pretreatment) will also be retrieved. The WARM project was created to plan, design, and construct a 200 West Area pretreatment capability adjacent to the SY Tank Farm.

DOE will separate and pretreat the waste using multiple settling and decanting steps in tanks SY-101, SY-102, and SY-103 in the SY Tank Farm followed by pretreatment using filtration and IX in the WARM pretreatment capability that DOE plans to construct adjacent to the SY Tank Farm. The WARM pretreatment capability will consist of two modules. Each module will have a dead-end filtration unit to remove entrained solids (including insoluble long-lived radionuclides) from the waste, and four IXCs to remove primarily Cs-137.[25]

Most of the entrained solids in the retrieved waste streams from the West Area SSTs are expected to settle in the receipt tank, a DST. Once the receipt tank is filled, the retrieved liquid supernate will be decanted from the receipt tank into the qualification tank for further settling while awaiting results of qualification sampling.[26] Once qualified, the liquid waste will be decanted from the qualification tank to the feed tank that provides feed to the WARM process module, located adjacent to the SY Tank Farm. The pretreated liquid waste will be transported in DOT-compliant tankers and/or portable tanks to one or more onsite or offsite facilities for solidification prior to offsite disposal.

1.6.2 Incorporation into a Solid Physical Form

The separated and pretreated supernate (including dissolved saltcake and interstitial liquid) will be collected in DOT-compliant tanker trucks and/or portable tanks. These tanker trucks and/or portable tanks will be used to transport the pretreated liquid in accordance with applicable requirements to one or more onsite or offsite solidification facility(ies) where it will be solidified.[27]

The solidified waste will comply with applicable *Resource Conservation and Recovery Act of 1976* (RCRA) treatment standards to enable the waste to meet requirements for land disposal of hazardous waste.[28] Incorporation of the waste into a solid physical form is also required to meet the WAC for offsite land disposal of waste, potentially at Energy*Solutions* (Clive Disposal

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[25] Long-lived radionuclides persist well into the future and may pose a risk to humans if inhaled or ingested, while short-lived radionuclides (e.g., Cs-137) emit radiation in a relatively short time, which, absent shielding or controls, may be harmful to humans simply by proximity without inhalation or ingestion.

[26] Waste qualification in the context of this Draft WIR Evaluation means sampling and/or process knowledge to demonstrate that it meets the WAC for the receiving onsite or offsite solidification facility(ies) and offsite disposal facility(ies).

[27] Currently considered to be potentially:

1. Perma-Fix Northwest (PFNW) in Richland, Washington
2. Energy*Solutions* near Clive, Utah [Energy*Solutions* (Clive)]
3. Waste Control Specialists (WCS) near Andrews, Texas
4. Onsite facility, Hanford Site
5. Offsite commercial facility, Richland, Washington.

Prior to transport of the waste to the applicable solidification facility, DOE will confirm that the pretreated liquid meets the facility’s WAC. DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility’s license limits and WAC.

[28] For additional information outside the scope of this Draft WIR Evaluation, both inorganic and organic constituents will be addressed, as needed to meet applicable RCRA treatment standards.

Facility) and/or the WCS FWF. When the pretreated liquid is solidified, the volume will expand by a grout expansion factor. The lower value of the potential range of the expansion factor (1.5) represents the smallest expansion factor which results in the largest estimated radionuclide concentration for comparison to Class C and Class A concentration limits (PNNL-22747) for the WCS FWF and Energy*Solutions* (Clive Disposal Facility). The expansion factor, final volume, and impacts will vary based on the tank waste composition and grout formulation used.

1.6.3 Waste Disposal Facilities

DOE will dispose of the solidified tank waste in one or more offsite, licensed, commercial disposal facilities, potentially Energy*Solutions* (Clive Disposal Facility) near Clive, Utah, or the WCS FWF near Andrews, Texas.[29]

The Energy*Solutions* (Clive Disposal Facility) is located in the West Desert of Utah, approximately 75 miles west of Salt Lake City, and services both the commercial and government nuclear industry. Energy*Solutions* is licensed and permitted by the Utah Division of Waste Management and Radiation Control (DWMRC) for disposal of Class A LLW and Class A MLLW.

The WCS waste disposal facility is located near Andrews, Texas, on a semi-arid, isolated, 1,338-acre site. It is licensed and permitted by the State of Texas,[30] Texas Commission on Environmental Quality (TCEQ), for near-surface disposal of Class A, B, and C LLW, including federal Class A, B, and C LLW and MLLW. Waste generated by Federal entities, which includes LLW generated by DOE, is disposed of in a separate landfill disposal unit at the WCS called the Federal Waste Facility (FWF).

[29] The onsite and offsite treatment facility(ies) will solidify the pretreated waste and ship the pretreated and solidified waste directly to Energy*Solutions* Clive Disposal Facility near Clive, Utah, or WCS FWF near Andrews, Texas. The onsite or offsite treatment facility(ies) will be the shipper of record. As required by Section I. F(4)(e) of DOE M 435.1-1, notice will be given to DOE Headquarters offices and the Program Secretarial Officer of the basis for using a non-DOE radioactive waste disposal facility prior to disposal at the Energy*Solutions* Clive Disposal Facility or at the WCS FWF. In addition, DOE will continue to coordinate with WCS and Energy*Solutions* prior to transport of the treated and solidified waste for disposal to their facilities.

[30] Utah and Texas are both NRC Agreement States and, as NRC Agreement States, regulate and license certain radioactive materials within their borders, including the disposal of certain LLW. The Utah and Texas programs are periodically reviewed by the NRC. Under the NRC Agreement State Program, NRC evaluates technical licensing and inspection issues from Agreement States, and periodically evaluates State rules for health and safety and compatibility with NRC requirements. Pursuant to applicable law, including Title 30 of the *Texas Administrative Code*, WCS was issued a license, with conditions, by the TCEQ in 2009 for a federal waste disposal facility. The license was subsequently amended several times. Likewise, under the *Utah Administrative Code*, Energy*Solutions* (formerly "Environcare") was issued a license by the Utah Division of Waste Management and Radiation Control (DWMRC) to receive containerized Class A radioactive waste in June 2001, which was subsequently amended several times.

1.6.4 Planned Consultation with the U.S. Nuclear Regulatory Commission and Opportunity for Comment by States, Tribal Nations, and the Public

DOE is planning to consult with the NRC concerning this Draft WIR Evaluation. DOE is also planning to make this Draft WIR Evaluation available for comments by States, Tribal Nations, stakeholders, and the public.

DOE plans to prepare a Final WIR Evaluation that considers the planned consultation with NRC as well as comments from States, Tribal Nations, stakeholders, and the public. Based on the Final WIR Evaluation, DOE may determine, in a future WIR Determination, whether the waste is incidental to reprocessing, is not high-level radioactive waste, and may be managed (disposed of) as LLW.

1.7 ORGANIZATION OF THIS DRAFT WIR EVALUATION

Information in the remainder of this Draft WIR Evaluation is presented as follows:

Section 2.0 describes the processes used to generate Hanford tank waste, the origin of waste stored in each of the West Area SSTs and DSTs planned for WARM pretreatment, and a detailed description of the WARM process including retrieval, separation, pretreatment, onsite and/or offsite solidification, and offsite disposal.

Section 3.0 describes DOE M 435.1-1 WIR criteria.

Section 4.0 describes how key radionuclides will be removed to the maximum extent technically and economically practical.

Section 5.0 discusses how safety requirements comparable to NRC performance objectives in 10 CFR 61, Subpart C—Performance Objectives will be met, and how disposal will be in accordance with the WAC for the Energy*Solutions* (Clive Disposal Facility), or the WCS FWF, as applicable.

Section 6.0 explains that the radionuclide concentrations will be well below Class C LLW concentration limits. Section 6.0 further explains that the pretreated supernate will be managed as LLW in accordance with Chapter IV of DOE M 435.1-1.

Section 7.0 summarizes DOE’s conclusion that this Draft WIR Evaluation demonstrates that the WIR criteria, as set out in Chapter II.B.(2)(a) of DOE M 435.1-1, will be satisfied.

Section 8.0 identifies the references cited in this Draft WIR Evaluation.

Appendix A discusses the NRC, State of Texas, and State of Utah requirements for LLW disposal.

Appendix B discusses the criteria in Section 3116 of the *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005*.

Appendix C provides the United States' opening brief in the case NRDC v. Abraham, No. 03-35711 (9th Cir.).

Appendix D shows that DOE expects IX will remove soluble Sr-90 and that some of the West Area SSTs will meet Class A concentration limits per 10 CFR 61.55. Meeting Class A concentration limits is not a WIR criterion in DOE M 435.1-1.

2.0 BACKGROUND

Section Purpose

The purpose of this section is to provide detailed background information to support the discussions in the sections that follow.

Section Contents

This section describes SNF reprocessing, the contents of the underground waste storage tanks at the conclusion of reprocessing, the sources of the tank waste at issue in this Draft WIR Evaluation, the radiological characterization of the wastes, and the waste management plans.

Key Points

- Several processes were used at Hanford to separate plutonium from SNF and nuclear targets.
- Reprocessing liquids were sent to 177 underground storage tanks located on the Hanford Central Plateau.
- This Draft WIR Evaluation addresses waste from SSTs in the S, SX, and U Tank Farms. This Draft WIR Evaluation also includes some of the waste currently stored in DSTs in the SY Tank Farm, which will be removed and provide tank space for pretreatment operations. The applicable SSTs and DSTs are collectively referred to as West Area tanks.
- As part of WARM project, supernate from the applicable West Area tanks will be separated and pretreated to remove key radionuclides to the maximum extent technically and economically practical, using physical and chemical treatment methods, specifically settling, decanting, filtration, and IX.
- Prior to transport via tanker trucks and/or portable tanks to one or more onsite or offsite treatment facility(ies) for solidification, the waste will be sampled in the qualification tank to demonstrate via sample data, process knowledge, and other technically valid means of characterization, that it meets the receiving facility's WAC.
- Solidification onsite and/or offsite will stabilize the waste in a solid physical form for disposal in one or more offsite disposal facility(ies). Solidification will occur at one or more facilities, potentially:
    1. PFNW in Richland, WA
    2. Energy*Solutions* near Clive, Utah
    3. WCS, near Andrews, Texas
    4. Onsite facility, Hanford Site
    5. Offsite commercial facility, Richland, Washington.
- The solidified waste will be disposed of in one or more offsite disposal facility(ies), potentially the Energy*Solutions* (Clive Disposal Facility near Clive, Utah) and/or the WCS FWF (near Andrews, Texas).
- DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's licensed capacity.

2.1 INTRODUCTION

This section establishes the context for the evaluations of the pretreated supernate that are described in Sections 4.0, 5.0, and 6.0 by providing the following information:

Section 2.2 provides a brief overview of nuclear fuel reprocessing conducted at the Hanford Site.

Section 2.3 includes BBI estimates of key radionuclides in the tank waste prior to retrieval, identifies all potential West Area tanks, and provides projected tank waste retrieval volumes.

Section 2.4 describes the 200 West Area mission including pretreatment of retrieved waste, onsite or offsite solidification, and offsite disposal.

The sections below include descriptions of prior reprocessing activities, the BBI estimates, and the WARM process module approach to provide context for this Draft WIR Evaluation. This Draft WIR Evaluation concerns supernate (including dissolved saltcake and interstitial liquid) retrieved from underground SSTs located in the S, SX, and U Tank Farms. This Draft WIR Evaluation also includes waste from DSTs in the SY Tank Farm, which will be removed and provide tank space for pretreatment operations. The applicable SSTs and DSTs are collectively referred to as West Area tanks.

2.2 SPENT NUCLEAR FUEL REPROCESSING[31]

The primary actinide separations processes at Hanford were bismuth-phosphate precipitation, reduction and oxidation (REDOX), and plutonium and uranium extraction (PUREX). The actinide separations process generally used batch processing steps to dissolve the fuel cladding of the irradiated fuel and subsequently, to dissolve the fuel itself. Similarly, the targets were dissolved and processed. Then, depending on the process, uranium and plutonium were recovered in precipitation or continuous solvent extraction processes.

2.2.1 The Basic Process

Reprocessing operations were conducted in several facilities. The reprocessing plants separated the plutonium in SNF and irradiated targets[32] from unwanted radionuclides and chemicals[33]

[31] WHC-MR-0132, *A History of the 200 Area Tank Farms.*

[32] Such targets were irradiated to produce isotopes for medical and other purposes.

[33] It was recognized early on that Hanford's liquid waste from reprocessing had lower heat and radioactivity (e.g., fission product content) than wastes from commercial reprocessing. The Atomic Energy Commission noted in 1970 that the tank wastes at Hanford and Savannah River "…differ materially in radioactivity level, heat output and chemical composition from wastes produced by licensed fuel reprocessing plants planned or under construction. For example, the Savannah River and Hanford wastes have been chemically neutralized, contain large volumes of non-fission product materials, and have heat and radioactivity outputs many times lower than the licensed plant wastes." (35 FR 17530, "Licensing of Production and Utilization Facilities").

using various chemical precipitation and solvent extraction techniques. Five processing plants were built in the 200 Area. Starting in late 1944 and 1945, T and B Plants used a bismuth phosphate batch processing technology (BPP) to recover plutonium from uranium metal fuel. This batch processing technology relied on multiple, highly selective chemical precipitation processes to separate and purify plutonium.

As the higher-efficiency solvent extraction technologies REDOX and then PUREX became available in the 1950s, the BPP recovery operations were terminated. The fifth processing plant (U Plant) did not reprocess SNF but was used to recover uranium that the BPP discharged as tank waste.

From the time of early Hanford Site operations, the tank waste management process involved neutralizing the acidic waste with sodium hydroxide and sodium carbonate to minimize corrosion of the carbon steel tanks. Under long-term caustic storage conditions, the tank waste has separated into insoluble solids and liquid fractions. The supernate (liquid fraction) has also undergone evaporation to result in saltcake (undissolved solids) formation while neutralization caused most of the fission product elements to precipitate out and form sludge (solids at the bottom of the tank).

The liquids and solids were transferred to underground storage tanks located in 18 tank farms (groups of tanks are called “tank farms”) which contain a total of 177 tanks. Following construction of the tank farm, soil was replaced to completely cover the tops of the tanks. The tank tops are at varying depths from the surface but average approximately 12 feet, with access to the tank contents via pipes (risers) that connect from the tank top to above the ground surface.

2.2.2 Contents of the Waste Storage Tanks

The acidic liquids from reprocessing were neutralized with sodium hydroxide to protect the integrity of the carbon steel tank liners. Unlike stainless steel, carbon steel corrodes quickly in the presence of acids and therefore neutralization was imperative, even though this created waste that would be more difficult to manage in the future.

For most tanks, the waste generated from the individual separations processes have been co-mingled over the years. Wastes were historically mixed, based on compatible chemistry, to accommodate actinide recovery processing. More recently, retrieval of waste from the SSTs into the DSTs has continued the co-mingling of waste across tank farms.[34]

Information on the contents and volumes of the tanks is maintained in the BBI database, which is based on analytical data from samples, model data, and process knowledge. The BBI is documented in the TWINS database, maintained and operated by Hanford Tank Waste Operations and Closure (H2C). Members of the public who require access to TWINS data may

[34] DSTs are newer tanks that have secondary containment to capture potential leaks – essentially a tank within a tank. In contrast, the initial underground waste storage tanks constructed at the Hanford Site were SSTs, that is, tanks without secondary containment.

do so by contacting the local DOE office of communications. After obtaining access, TWINS BBI data is available at: https://phoenix.pnnl.gov/phoenix/apps/gallery/index.html.

2.3 BEST-BASIS INVENTORY ESTIMATES FOR TANK WASTE

The inventory for each standard BBI analyte (24 chemicals and 46 radionuclides) is provided for each waste phase. The standard BBI analytes account for approximately 99 weight percent (wt%) of the chemical inventory (not including percent water, free hydroxide, bound hydroxide, or oxygen associated with metallic oxides), and the radionuclides account for over 99% of the activity (in curies) in terms of short- and long-term risk (WHC-SD-WM-TI-731).

The BBI provides accepted values for tank waste volumes and inventory estimates for each individual waste phase and for all waste in a tank. The waste phases for most tanks, as shown in Figure 2-1, are supernate, saltcake, and sludge (or some combination thereof). For SSTs and DSTs, volumes of supernate, saltcake, and sludge are updated quarterly (HNF-EP-0182, *Waste Tank Summary Report for Month Ending November 30*, *2025*, Rev. 455).[35]

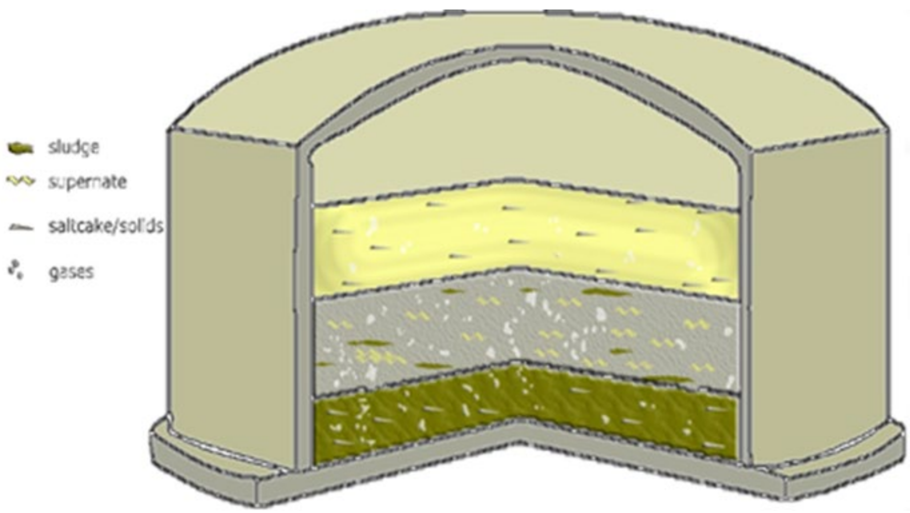

Figure 2-1. Tank Waste Phases in Best-Basis Inventory.

For West Area tanks, the tank retrieval volumes for each DST and SST are provided in Table 6-6. Note that the tank volumes shown are approximate and may be higher or lower depending on retrieval operations. The first two waste batches are from processing supernate present in tanks SY-101 and SY-102 which are included to support pretreatment operations. All other feeds consist of waste from retrieval from SSTs in S, SX, and U Tank Farms.

West Area tank waste comprised of supernate (including dissolved saltcake and interstitial liquid) will be retrieved from underground SSTs located in S, SX, and U Tank Farms.[36] Some of

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35 BBI information is available at: https://phoenix.pnnl.gov/phoenix/apps/gallery/index.html.

36 Retrieval of waste from the SSTs is consistent with the HFFACO and Consent Order and amendment to the Consent Decree in State of Washington v. United States Department of Energy, E.D. Wash., No. 2:08-cv-5085-RMP. DOE, the Washington State Department of Ecology (Ecology), and the U.S. Environmental Protection Agency (EPA) engaged in mediated Holistic Negotiations, and reached agreement on, among other things,

the waste in tanks SY-101 and SY-102 will also be retrieved to support pretreatment operations. DSTs SY-101 and SY-102 will be retrieved to provide tank space for subsequent S, SX, and U Tank Farm SST retrievals. Waste from tank SY-103 will be transferred to tank SY-102 prior to SST retrievals, and will be processed with waste from SY-102 in the WARM pretreatment capability (RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document*).

Table 2-1 includes inventory estimates from the BBI for key radionuclides in all West Area SSTs and DSTs as of September 2024 and decayed to January 1, 2022.[37] As a result of in-tank settling, the majority of the insoluble longer-lived radionuclides (e.g., plutonium, americium, neptunium, and curium) are expected to settle to the bottom of the tank. Decanting from SY Farm tanks following SST retrieval separates these longer-lived radionuclides (if present) from West Area tank waste supernate.[38]

Table 2-1. Best-Basis Inventory Key Radionuclide Inventory Estimates for West Area Tank Treatment.[a] (2 pages)

Key Radionuclide	Supernate (Ci)	Saltcake[b] (Ci)	Sludge[c] (Ci)	Total (Ci)
H-3	2.81E+00	2.34E+02	1.82E+02	4.19E+02
C-14	2.67E+00	1.33E+02	1.41E+01	1.50E+02
Co-60	4.67E-01	5.50E+01	1.45E+01	7.00E+01
Ni-63	1.64E+01	1.15E+04	6.12E+03	1.76E+04
Sr-90	7.91E+02	9.56E+05	9.59E+06	1.05E+07
Tc-99	1.40E+02	4.62E+03	5.56E+02	5.32E+03
I-129	1.42E-01	4.47E+00	4.65E-01	5.08E+00

modification of milestones in the HFFACO and amendment to the Consent Decree in State of Washington v. United States Department of Energy, *id.* For example, retrieval of waste from the SSTs will be consistent with the new interim milestone M-045-135 in the HFFACO Action Plan, Appendix D "Work Schedule Milestones and Target Dates", to complete retrieval of 22 SSTs located in S, SX, and U tank farms by 2040, contingent on DOE having a regulatory pathway to grout and dispose of the waste offsite. In this regard, DOE may also retrieve waste from two additional SSTs in the S, SX, and U tank farms under certain circumstances, as provided in the amended Consent Decree in State of Washington v. United States Department of Energy, E.D. Wash., No. 2:08-cv-5085-RMP, ECF No. 269 (Jan. 8, 2025).

37 This estimate is 100% of the BBI reported in these tanks for illustrative purposes and does not reflect tank waste retrieval operations with respect to key radionuclide inventories present in tank waste feed as shown in Table 4-4.

38 Settling is a process by which insoluble solids, containing higher concentrations of insoluble long-lived radionuclides, settle by gravity to the bottom of the tank. Decanting is the process of pumping only the liquid fraction from the tank without disturbing the settled solids.

Table 2-1. Best-Basis Inventory Key Radionuclide Inventory Estimates for West Area Tank Treatment.[a] (2 pages)

Key Radionuclide	Supernate (Ci)	Saltcake[b] (Ci)	Sludge[c] (Ci)	Total (Ci)
Cs-137	1.29E+05	3.21E+06	8.73E+05	4.21E+06
Np-237	2.62E-02	2.70E+01	3.51E+00	3.05E+01
Pu-238	3.30E-02	8.16E+01	3.63E+02	4.45E+02
Pu-239	4.93E-01	2.32E+03	9.33E+03	1.17E+04
Pu-240	1.02E-01	4.97E+02	1.96E+03	2.46E+03
Am-241	2.73E+00	5.45E+03	1.28E+04	1.83E+04
Pu-241	2.48E-01	1.44E+03	5.79E+03	7.23E+03
Cm-242	8.24E-03	7.64E+00	8.01E+00	1.57E+01
Pu-242	2.58E-04	2.97E-02	1.94E-01	2.24E-01
Am-243	1.62E-03	3.26E+00	4.91E+00	8.17E+00
Cm-243	2.47E-04	1.94E-01	1.31E+00	1.50E+00
Cm-244	4.56E-03	3.63E+00	2.25E+01	2.61E+01
Total	1.30E+05	4.19E+06	1.05E+07	1.48E+07

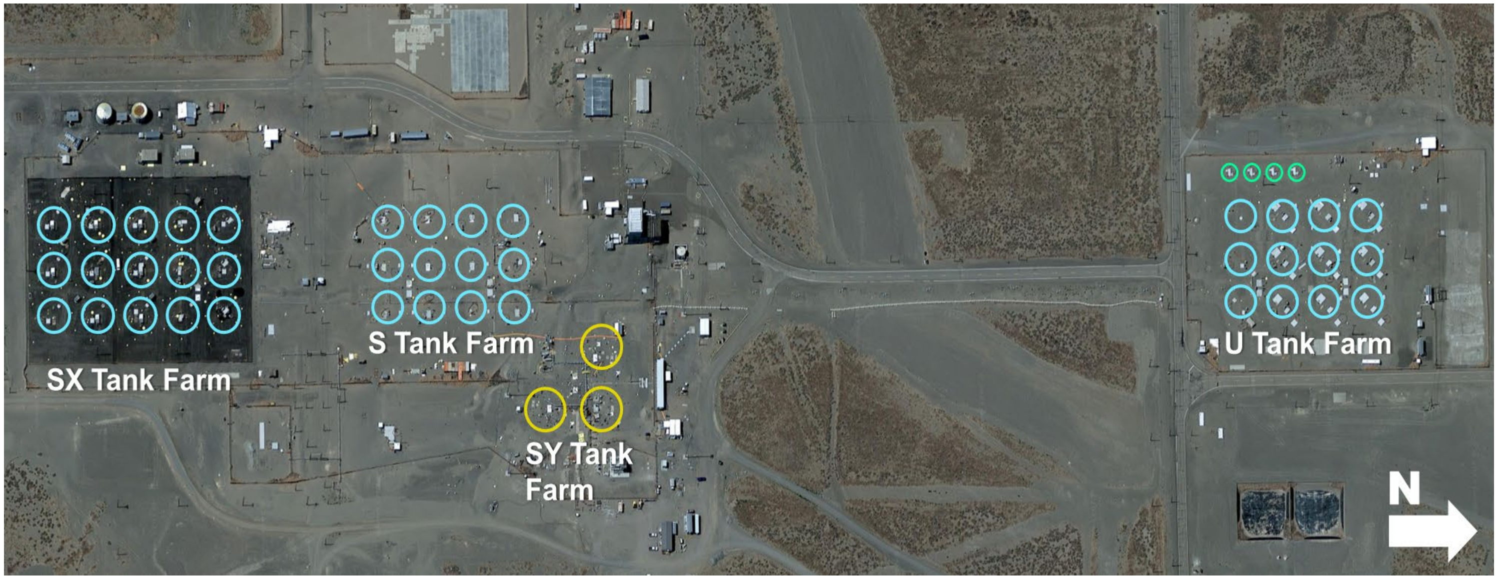
[a] From BBI available in Tank Waste Information Network System as of September 2024 with radionuclides decayed to January 1, 2022, with values rounded to three significant figures.

[b] Saltcake includes saltcake solids, interstitial liquid, and solids and liquid waste phases.

[c] Sludge includes sludge solids, interstitial liquid, and solids and liquid waste phases.

2.4 200 WEST AREA BACKGROUND

This Draft WIR Evaluation concerns supernate (including dissolved saltcake and interstitial liquid), primarily retrieved from SSTs located in S, SX, and U Tank Farms and transferred via HIHTLs to DSTs located in SY Tank Farm. Figure 2-2 shows the relative locations of S, SX, U, and SY Tank Farms in the West Area of the Hanford Site.



	Description	Year Constructed
SX Farm	15 – 1,000,000-gal capacity SSTs	1953-54
S Farm	12 – 758,000-gal capacity SSTs	1950-51
SY Farm	3 – 1,160,000-gal capacity (not accounting for operating limits) DSTs	1974-76
U Farm	12 – 530,000-gal capacity SSTs and 4 – 55,000-gal capacity 200 series SSTs	1943-44

KEY
DST
SST
200 Series SST

DST = double-shell tank SST = single-shell tank

Figure 2-2. 200 West Area Tank Farms.

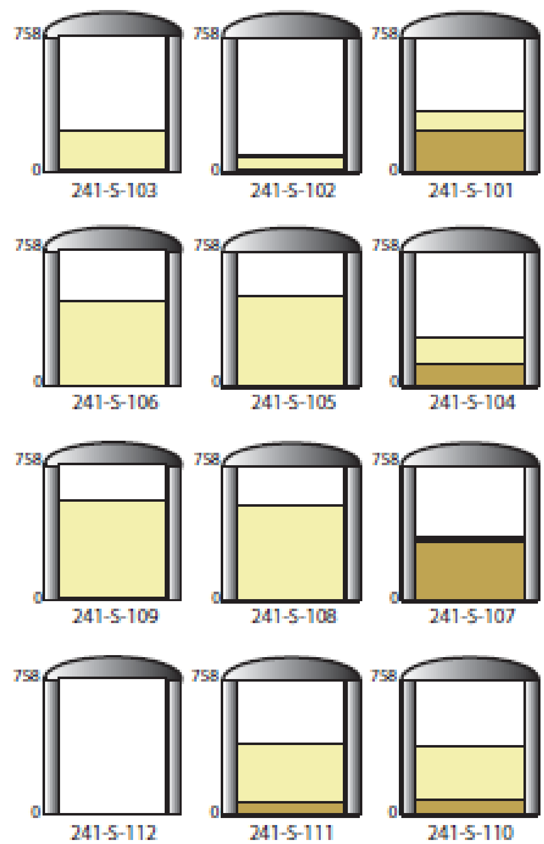
2.4.1 Description of S and SX Tank Farms

The S Complex consists of S and SX Tank Farms and is located in the southwest portion of the 200 West Area near the REDOX plant. The S and SX Tank Farms were constructed in the 1950s to support operations at the REDOX plant, which operated from 1952 through 1967. The S Tank Farm contains twelve 100-series SSTs that were constructed between 1950 and 1951 and put into service in 1951. The SX Tank Farm contains fifteen 100-series SSTs that were constructed between 1953 and 1954 and put into service in 1954. The two tank farms were used to store and transfer waste until the late 1970s and early 1980s.

Currently, the drainable interstitial liquid wastes have been removed from the S and SX Farm tanks and all tanks have been interim stabilized with the exception of tank S-102. Tank S-102 was excluded from the interim stabilization requirements as the waste was being retrieved, however, retrievals halted before interim stabilization criteria were met. Tank S-112 (S-112) was declared interim stabilized in 2005 after retrieval was completed as a closure activity. Figure 2-3 and Figure 2-4 show the estimated volume of waste stored in the S Farm and SX Farm tanks as of November 30, 2025 (HNF-EP-0182, Rev. 455).

S-Tank Farm- Constructed 1950-1951
12 @ 758 Kgal Tank Capacity, Single-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-S-101	235	116	0
241-S-102	22	68	6
241-S-103	9	221	1
241-S-104	132	148	1
241-S-105	2	506	0
241-S-106	0	482	0
241-S-107	327	26	2
241-S-108	5	537	0
241-S-109	13	540	0
241-S-110	91	296	0
241-S-111	72	325	0
241-S-112	2.5	0	0

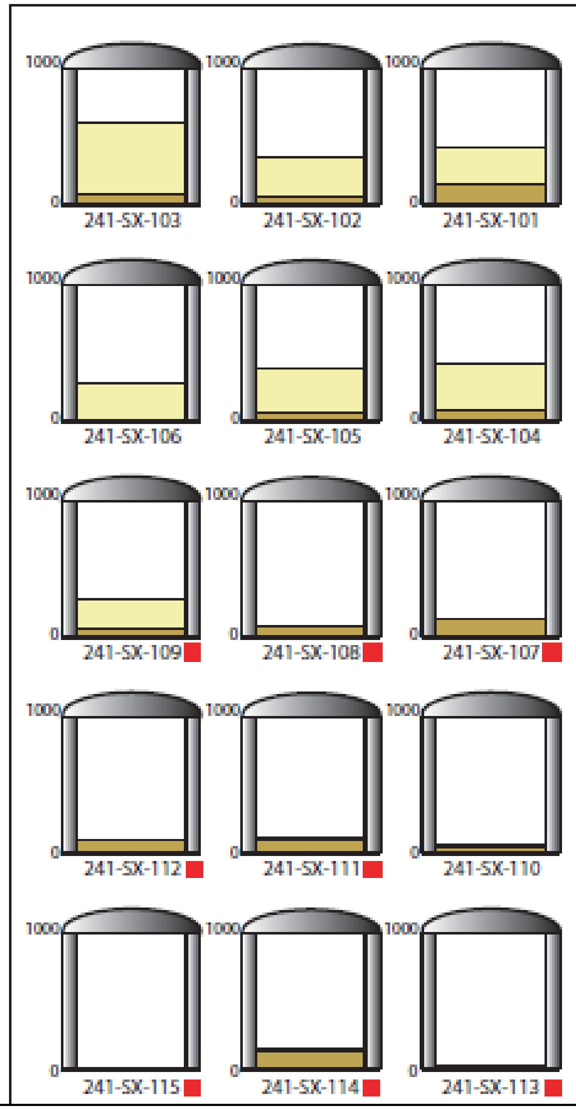


LEGEND: Sludge | Saltcake | Supernatant | Available Space | Assumed/Confirmed Leaker

Figure 2-3. S Tank Farm.

SX-Tank Farm- Constructed 1953-1955
15 @ 1,000 Kgal Tank Capacity, Single-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-SX-101	141	275	0
241-SX-102	55	287	0
241-SX-103	80	519	0
241-SX-104	68	354	0
241-SX-105	65	311	0
241-SX-106	0	279	2
241-SX-107■	130	0	0
241-SX-108■	84	0	0
241-SX-109■	66	206	0
241-SX-110	49	10	0
241-SX-111■	97	20	0
241-SX-112■	90	0	0
241-SX-113■	19	0	0
241-SX-114■	127	29	0
241-SX-115■	4	0	0



LEGEND
Sludge | Saltcake | Supernatant | Available Space | Assumed/Confirmed Leaker ■

Figure 2-4. SX Tank Farm.

The REDOX waste stream stored in the S and SX Tank Farms contains high concentrations of short-lived radionuclides that generated considerable heat. Management of that heat dominated the operational history of the S and SX Tank Farms.

2.4.1.1 Single Shell Tanks

The twelve S Farm tanks are second-generation 100-series SSTs that are each 75 feet in diameter and approximately 37.3 feet tall from base to dome. Each S Farm tank has a 12-inch dish bottom, a 23-foot operating depth, and an operating capacity of 758,000 gallons. The 15 SX Farm tanks are third-generation 100-series SSTs that are each 75 feet in diameter and approximately 44 feet tall from base to dome. Each SX Farm tank has a dished bottom, a 30-foot operating depth, and an operating capacity of 1 million gallons.

The S and SX tanks were all constructed in place with a carbon steel liner covering the bottom and sides of a reinforced concrete shell. All tanks sit below grade with at least 8.1 feet of soil cover at the S Tank Farm and 6 feet of soil cover at the SX Tank Farm. Both S Farm and SX Farm SSTs were constructed with cascade overflow lines in a three-tank series to allow gravity flow of liquid waste between the tanks.

The S Farm tanks were designed to withstand pH values of 8 to 10 and fluid temperatures up to 220°F. The SX Farm tanks were designed to withstand pH values of 8 to 10 and to hold self-boiling waste, with temperatures up to 250°F for a period of 1 to 5 years. The SX Farm tanks were the first SSTs designed for self-boiling (self-concentrating) waste; however, the S Farm tanks also received REDOX waste that self-boiled.

2.4.2 Description of U Tank Farm

The U Tank Farm is located in the central portion of the 200 West Area of the Hanford Site and contains twelve 100-series SSTs and four 200-series SSTs that were constructed from 1943 to 1944, put into service in 1944, and used to store and transfer waste until 1980. Because of its long operational history, the U Tank Farm received waste generated by essentially all of the Hanford Site major chemical processing operations including bismuth phosphate fuel processing, uranium recovery, PUREX fuel processing, and fission product recovery.

During its operational history, there were a number of confirmed or suspected waste loss events in U Farm tanks. These included suspected tank leaks and known waste losses from diversion boxes, pipelines, and the 244-UR vault. In addition, uncontaminated and slightly contaminated water from facilities outside U Tank Farm were discharged to several nearby ditches, particularly 216-U-14. Currently, the drainable interstitial liquid wastes have been removed from the U Farm tanks, and the tanks have been interim stabilized. Figure 2-5 shows the estimated volume of waste stored in the U Farm tanks as of November 30, 2025 (HNF-EP-0182, Rev. 455).

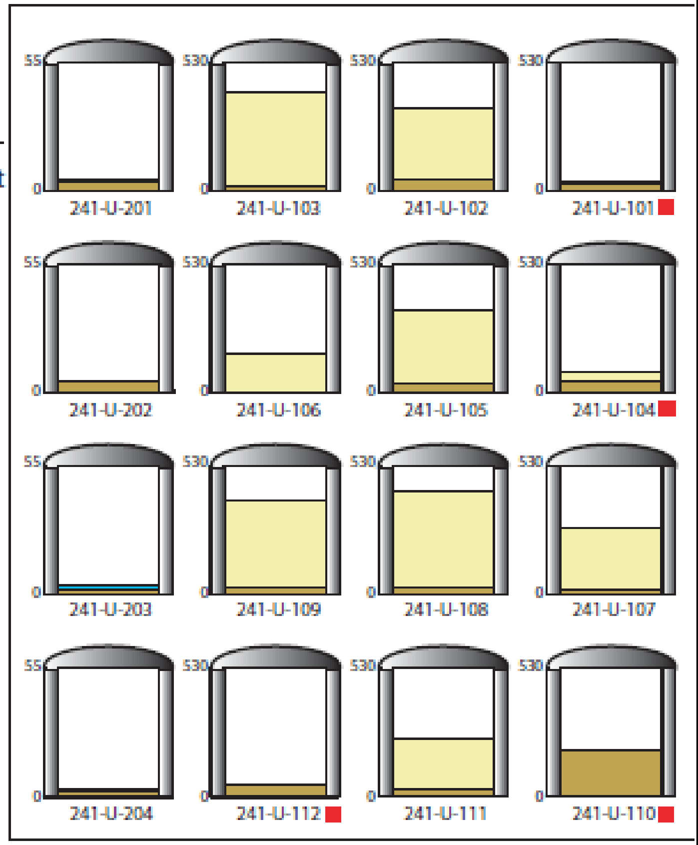
2.4.2.1 Single Shell Tanks

The U Farm 100-series tanks are 75 feet in diameter and 30 feet tall. The tanks have a 15-foot operating depth, and an operating capacity of 530,000 gallons each. The 200-series tanks are 20 feet in diameter and 37 feet tall from base to dome. The tanks have a 24-foot operating depth and an operating capacity of 55,000 gallons each.

The 100-series tanks and 200-series tanks sit below grade with 7 feet and 11 feet of soil cover, respectively, to provide shielding from radiation exposure to operating personnel. Tank pits are located on top of the tanks and provide access to the tank, pumps, and monitoring equipment.

U-Tank Farm- Constructed 1943-1944
12 @ 530 Kgal Tank Capacity, Single-Shell
4 @ 55 Kgal Tank Capacity, Single-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-U-101 ■	21	0	10
241-U-102	43	296	4
241-U-103	13	396	3
241-U-104 ■	45	39	0
241-U-105	32	311	2
241-U-106	0	163	2
241-U-107	16	259	0
241-U-108	29	399	0
241-U-109	32	357	1
241-U-110 ■	186	0	0
241-U-111	26	211	0
241-U-112 ■	44	0	4
241-U-201	4	0	1
241-U-202	5	0	0.3
241-U-203	2.4	0	1.1
241-U-204	2	0	1



LEGEND: Sludge; Saltcake; Supernatant; Available Space; Assumed/Confirmed Leaker ■

Figure 2-5. U Tank Farm.

2.4.3 Description of SY Tank Farm Double-Shell Tanks

2.4.3.1 Tank SY-101

Tank SY-101 is one of three DSTs in the SY Tank Farm. It was constructed between 1974 and 1976 and was designed for use as a concentrated waste holding tank. Tank SY-101 entered service in 1977.[39]

39 As part of the Test Bed Initiative (TBI) Demonstration, approximately 2,000 gallons of tank SY-101 supernate were separated via settling and decanting followed by pretreatment via filtration, and IX using an in-tank pretreatment system (ITPS), which is akin to the WARM process module only designed to pretreat waste at a smaller scale. The *Final Waste Incidental to Reprocessing Evaluation for the Test Bed Initiative Demonstration at the Hanford Site, Washington*, (DOE/ORP-2022-02) and the *Waste Incidental to Reprocessing Determination for the Test Bed Initiative Demonstration at the Hanford Site, Washington* (ORP-68455) were issued in March 2023.

In April 1977, the tank received double-shell slurry from the 242-S Evaporator. In the fourth quarter of 1977, the tank received concentrated complexant waste from tank SY-102.[40] During 1978, tank SY-101 received supernate from tanks A-106, SX-106, and U-111. These additions nearly filled the tank by October 1980. From that time, only water and dilute lab waste were added to the tank, until pumping campaigns in late 1999 and early 2000 removed waste.

After waste was added to tank SY-101, the waste began to exhibit slurry growth, causing an increase in the overall waste volume. After 1980, slurry growth continued and was coupled with episodic gas release events. A strategy was developed to mitigate the slurry growth and gas release events that included transfers from the convective slurry and back dilutions of water. These transfers and back dilutions were done in three campaigns, which took place between December 1999 and March 2000. Following each of the transfers, back dilutions were made to the top and bottom of the waste.

As of January 2001, only a supernate and a saltcake layer existed in tank SY-101. The three dilution and waste transfer operations between December 1999 and March 2000 removed more than 520,000 gallons of waste from the tank and added 434,000 gallons of dilution water. Since January 2001, the supernate has been removed and replaced five times.

From September to October 2003, tank SY-101 received retrieval liquid from S-112. The recent transfer history includes supernate transfers from tank SY-101 in February and March 2007 to tanks AP-101 and AY-101. Transfers of dilute waste from 219-S were received between 2007 and 2018 as well as a small amount of waste from UX-302-A in 2012.

Tank SY-101 is the designated 222-S Laboratory waste receipt tank. It is expected that this tank will continue to receive intermittent waste transfers from the 219-S tank system that provides treatment and storage of 222-S Laboratory waste. The waste type for the saltcake is S2-SltSlr based on process knowledge (Revision 4 of the Hanford Defined Waste model).[41] No waste type is assigned to the supernate because of the diverse sources of the transfers to tank SY-101 (RPP-RPT-48774, *Derivation of Best-Basis Inventory for Tank 241-SY-101 as of October 1, 2020*).

2.4.3.2 Tank SY-102

Tank SY-102 was designed for use as a concentrated waste holding tank. Tank SY-102 went into service during the second quarter of 1977 when it began receiving supernate from various SSTs as the feed tank for the 242-S Evaporator until 1980.

Sludge solids were received from the Plutonium Finishing Plant between 1983 and 1988, accounting for the bottom solids layer in this tank. The tank was core sampled in 2000 and the

[40] Concentrated complexant waste is generated when dilute waste containing organic complexants is concentrated in an evaporator such as hydroxyethylethylenediaminetriacetic acid (HEDTA), ethylenediaminetetraacetic acid (EDTA), and citric acid. Complexants “hold” metals in solution much better than just a normal aqueous solution.

[41] S2-SltSlr refers to saltcake from the second 242-S Evaporator campaign using tank 241-SY-102 feed.

sludge layer is attributed to undissolved solids received from the transfer of saltcake waste from the 242-S Evaporator between 1977 and 1980 and S2-SltSlr from tank SY-101 in early 2000. Additional solids have accumulated from use of tank SY-102 to collect saltwell liquid and retrieval of waste from tanks S-102 and S-112.

Retrieval of waste solids from tank S-112 to tank SY-102 began in November 2003 and was completed in February 2007. Retrieval of waste solids from tank S-102 began December 2004 and was halted in July 2007. Retrieval activities alternated between tanks S-102 and S-112 between 2005 and 2007. Bulk retrieval was performed by saltcake dissolution using low-velocity raw water until no longer effective in dissolving solids. A high-pressure water lance was deployed to break up the solids remaining after bulk retrieval in tank S-112, and solids were transferred to tank SY-102 by water sluicing. After sluicing became ineffective, three caustic additions were used, followed by additional water sluicing. The final caustic addition occurred in February 2007.

Bulk retrieval of waste from tank S-102 was performed by water dissolution. Dissolution kinetics were slower than in tank S-112, necessitating the use of several different pumps and devices to break up the solids. It is likely that some undissolved solids were transferred to tank SY-102 due to vigorous spraying, recirculation, and sparging required to promote saltcake dissolution. Retrieval of tank S-102 halted following a flush hose failure in July 2007.

The saltcake fraction from tanks S-102 and S-112 was assumed to dissolve and mix with the existing supernate in tank SY-102. Heel solids were transferred at the end of tank S-112 retrieval. Since bulk saltcake retrieval has not been completed, no removal of heel solids has occurred in tank S-102. Although some solids appear to have been entrained from tank S-102, it appears that no significant amount of REDOX sludge has been sluiced from tank S-102 as saltcake is still present overlaying the sludge.

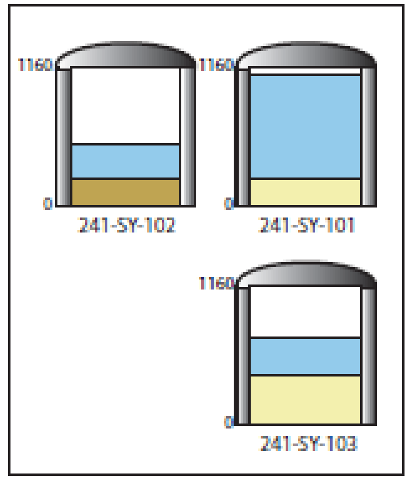
The sludge waste phase designations in tank SY-102 were based on core sampling extrusion results (brown solids, sludge slurry, etc.), grab sample data, and the ratio of key soluble to insoluble analyte concentrations.

Tank SY-102 has received transfers from many tanks since the 2000 sampling. Many of the transfers were supernate or saltwell liquid from S, SX, and U Tank Farms. Solid wastes were retrieved from tanks S-112 and S-102 using saltcake dissolution, caustic conditioning, and sluicing methods. New solids have accumulated in tank SY-102 as the result of saltwell pumping and solid waste retrieval (RPP-RPT-44643, *Derivation of Best-Basis Inventory for Tank 241-SY-102 as of December 1, 2024*).

Figure 2-6 shows the estimated volume of waste stored in the SY Farm tanks as of November 30, 2025 (HNF-EP-0182, Rev. 455).

SY-Tank Farm- Constructed 1974-1976
3 @ 1,160 Kgal Tank Capacity, Double-Shell

Tank	Sludge (Kgal)	Saltcake (Kgal)	Supernatant (Kgal)
241-SY-101	0	223	882
241-SY-102	220	0	293
241-SY-103	0	410	323



LEGEND: Sludge, Saltcake, Supernatant, Available Space, Assumed/Confirmed Leaker

Figure 2-6. SY Tank Farm.

2.4.3.3 Tank SY-103

Tank SY-103 was constructed from 1974 to 1977 in the 200 West Area and has a design capacity of 1,160 kgals. Tank SY-103 was originally designed for use as a concentrated waste holding tank.

Tank SY-103 went into service in 1977 when it received residual evaporator liquor. From the first quarter of 1978 through the third quarter of 1980, the tank received concentrated complexant waste. The majority of this concentrated waste was transferred out of the tank in the third quarter of 1980, leaving a heel of about 123 kgal. During the fourth quarter of 1980, tank SY-103 received approximately 420 kgal of double-shell slurry from the 242-S Evaporator campaign of October-November 1980. From June to November 1985, approximately 55 kgal of uranium saltcake from IX processing was placed on top of the double-shell slurry. In July and August 1988, approximately 131 kgal of saltwell liquor from tank SX-104 was added to tank SY-103. Between June 1985 and August 1989, small additions of wastewater from West Area catch tanks, tanker trucks, the 003 UR sump, and 242-S Evaporator flushes were added to the tank.

Tank SY-103 has experienced periodic gas release events since its last waste transfer from tank SX-104; consequently, tank SY-103 was added to the Flammable Gas Watch List in January 1991. A standard hydrogen monitoring system was installed in May 1992. The Flammable Gas Safety Issue was closed in August 2001, and all remaining tanks were removed from the Flammable Gas Watch List.

Tank SY-103 is currently inactive, containing 750 kgal of concentrated complexant waste. Tank SY-103 waste is composed of a supernatant layer over a saltcake layer, with a non-uniform, incomplete crust floating on the liquid. Tank SY-103 is actively ventilated and listed as sound (RPP-RPT-60540, *Derivation of Best-Basis Inventory for Tank 241-SY-103 as of January 1, 2024*).

Tank SY-103 is a Waste Group A remediation tank; therefore, remediation to remove its current inventory is required such that this tank can be reclassified as less than Waste Group A.[42] This tank will undergo remediation from Waste Group A status prior to implementation of the retrieval of West Area tank waste. Some of the current waste inventory in the SY Tank Farm tanks, including tank SY-103, will be processed through the WARM process module in the first two batches of West Area tank waste.

2.4.4 The West Area Tank Treatment Process

For West Area tanks, this Draft WIR Evaluation considers waste retrieved from SSTs located in S, SX, and U Tank Farms as well as waste transferred from SY Tank Farm DSTs.[43] These tanks contain both soluble and insoluble radionuclides. All the West Area SST retrieval streams will be received into the SY Tank Farms. Most of the large and heavy insoluble radionuclides, which are

[42] Waste Group A tanks have the potential to create spontaneous buoyant displacement gas release events of flammable gases that could achieve 100% of the lower flammability limit gas concentration in the headspace if all the retained gases were released at once. All transfers involving Waste Group A tanks are prohibited without DOE approval (RPP-13033, *Tank Farms Documented Safety Analysis*).

[43] This Draft WIR Evaluation is based on retrieval of waste from SSTs in S, SX, and U Tank Farms as well as some of the waste from DSTs SY-101 and SY-102. The current waste inventory in tank SY-103 will also be processed through the WARM process module as part of Group A tank remediation. Final WARM design will consider flexibility to interchangeably utilize each of the three SY DSTs as a receipt, qualification, or feed tank if necessary. DSTs SY-101 and SY-102 will be retrieved to provide tank space for subsequent S, SX, and U farm SST retrievals. Waste from tank SY-103 will be transferred to tank SY-102 prior to SST retrievals, and will be processed with waste from SY-102 in the WARM pretreatment capability (RPP-RPT-65190).

Retrieval of waste from the SSTs is consistent with the HFFACO and Consent Order and amendment to the Consent Decree in State of Washington v. United States Department of Energy, E.D. Wash., No. 2:08-cv-5085-RMP. DOE, the Washington State Department of Ecology (Ecology), and the U.S. Environmental Protection Agency (EPA) engaged in mediated Holistic Negotiations, and reached agreement on, among other things, modification of milestones in the HFFACO and amendment to the Consent Decree in State of Washington v. United States Department of Energy, *id.* For example, retrieval of waste from the SSTs will be consistent with the new interim milestone M-045-135 in the HFFACO Action Plan, Appendix D "Work Schedule Milestones and Target Dates", to complete retrieval of 22 SSTs located in S, SX, and U tank farms by 2040, contingent on DOE having a regulatory pathway to grout and dispose of the waste offsite. In this regard, DOE may also retrieve waste from two additional SSTs in the S, SX, and U tank farms under certain circumstances, as provided in the amended Consent Decree in State of Washington v. United States Department of Energy, E.D. Wash., No. 2:08-cv-5085-RMP, ECF No. 269 (Jan. 8, 2025).

In addition to the removal of 99.9% of the Cs-137, Appendix D of this Draft WIR Evaluation shows that DOE expects IX will remove some soluble Sr-90. Appendix D shows that the resulting pretreated liquid and solidified waste from some tanks has the potential to meet Class A concentration limits in 10 CFR 61.55. Meeting Class A concentration limits is not a WIR criterion in DOE M 435.1-1, however.

the majority of long-lived transuranic isotopes and actinides (e.g., plutonium, americium, neptunium, and curium), are expected to settle out in the receipt tank. The separated supernate volume will be considered a batch and each batch is decanted from the receipt tank to the feed qualification tank, where it will be allowed to settle further during the qualification sample duration period of approximately 90 days.[44] The waste qualification sample data will be used to screen against the WAC for the applicable treatment and disposal facilities.[45]

Once a batch is qualified, the settled supernate will be decanted to the feed tank to feed the WARM process module. The WARM process module will consist of two modules. Each module will have a dead-end filtration unit to remove entrained solids (including insoluble long-lived radionuclides) from the feed, and four IXCs to remove primarily Cs-137.

The decanted supernate will be filtered first to remove any entrained solids (including insoluble long-lived radionuclides) that may be present. Filtration is also beneficial for maintaining the performance of the IX media by preventing any potential plugging due to entrained solids.

Table 4-4 shows after settling, decanting, filtration, and IX, approximately 99.9% of the Cs-137, a key radionuclide, is removed. Radionuclides present in the supernate will be those radionuclides that are completely or partially soluble, including Cs-137 and daughter Ba-137m, Tc-99, I-129, H-3, and C-14. Some Sr-90, including daughter Y-90, may be present in soluble form.[46] The predominant radionuclide in the decanted supernate will be Cs-137 (and daughter Ba-137m), a short-lived radionuclide,[47] which, when present in high enough concentrations, poses a risk to the health and safety of workers and the public merely by proximity to the waste.

Figure 2-7 illustrates the sequence of SST retrieval and pretreatment process for each West Area tank waste batch. Note that this figure is for illustrative purposes only. The final WARM design will consider flexibility to interchangeably utilize each SY Farm tank as a receipt, qualification, or feed tank if necessary.

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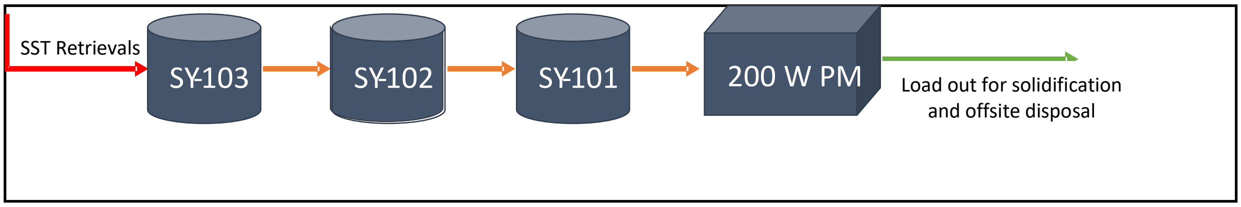
44 Settling is a process by which insoluble solids, containing higher concentrations of insoluble long-lived radionuclides, settle by gravity to the bottom of the tank. Decanting is the process of pumping only the liquid fraction from the tank without disturbing the settled solids.

45 Waste qualification in the context of this Draft WIR Evaluation means sampling and/or process knowledge to demonstrate that it meets the WAC for the receiving onsite or offsite solidification facility(ies) and offsite disposal facility(ies).

46 Sr-90 (and daughter Y-90) is primarily insoluble but can be soluble in some tanks with higher complexant concentrations. Complexant waste was originally stored in some of the S Farm and U Farm tanks. However, since supernate was removed from the S Farm and U Farm tanks during interim stabilization, it is likely that much of the complexant-driven soluble Sr-90 has already been removed from the tanks and is now stored in 200 East Area DSTs.

47 Cs-137 has a half-life of 30.1 years (*Nuclides and Isotopes, Fifteenth Edition of the Chart of the Nuclides* [Parrington et al. 1996]).



PM = process module SST = single-shell tank

Figure 2-7. 200 West Area Retrieval and Pretreatment.

After being processed to remove solids and Cs-137, the pretreated liquid waste will be stored in the PWST, and subsequently transferred to a LILO station to fill tanker trucks and/or portable tanks for transporting to onsite or offsite facilities for further solidification and LDR treatment (as needed).[48]

After processing in the WARM process module, the pretreated liquid will be shipped to an onsite or offsite solidification facility. The waste will be transported to the onsite or offsite solidification facility via tanker trucks and/or portable tanks as shown in Figure 2-8.[49] The onsite or offsite solidification facility will ship the pretreated, solidified waste in appropriate containers directly to an offsite disposal facility in compliance with all applicable requirements.[50]

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48 For additional information outside the scope of this Draft WIR Evaluation, both inorganic and organic constituents will be addressed to meet applicable RCRA treatment standards.

49 For onsite transportation, in addition to following the QA requirements of DOE Order 414.1D, DOE will follow the same DOT requirements in 49 CFR Parts 171-180 (Hazardous Materials Regulations [HMR]) or show an equivalent level of safety using a Transportation Safety Document approved by the Head of Operations Office.

50 Solidification will occur at one or more facilities, potentially:

1. PFNW in Richland, Washington
2. Energy*Solutions* near Clive, Utah
3. WCS near Andrews, Texas.
4. Onsite facility, Hanford site
5. Offsite commercial facility, Richland, Washington.

DOE is exploring a potential onsite solidification capability and other potential, commercial offsite treatment and solidification facilities near the Hanford Site. At this time, DOE has not decided which solidification facility or combination of facilities will be used. DOE plans to dispose of the pretreated and solidified waste as MLLW at one or more offsite, licensed, and permitted disposal facility(ies), potentially Energy*Solutions* (Clive Disposal Facility) near Clive, Utah, or the WCS FWF, near Andrews, Texas.

Although meeting Class A concentration limits is not a WIR criterion of DOE M 435.1-1, DOE considers Energy*Solutions* (Clive) a potential option if the pretreated and solidified waste meets Class A concentration limits as shown in Appendix D of this Draft WIR Evaluation.

Figure 2-8. U.S. Department of Transportation-Compliant Tanker Trucks.

2.4.5 Waste Characterization

Qualification samples will be taken from the qualification tank in SY Farm to verify that each batch of West Area tank waste meets the WARM process module feed WAC, and will be able to meet waste transportation requirements, the WAC for the applicable solidification facility(ies), the WAC for the offsite disposal facility(ies) and Land Disposal Restrictions (LDRs). These qualification samples will be characterized for all radioactive isotopes expected in the tank and for hazardous constituents to enable appropriate treatment to be identified.

The applicable solidification facility will be responsible for ensuring that the solidified waste meets the Energy*Solutions* (Clive Disposal Facility) and/or WCS FWF WAC and support waste profile documentation. This characterization data will be provided to Energy*Solutions* or WCS, and DOE.[51]

2.4.6 Waste Solidification and Disposal

Once characterized onsite and demonstrated to meet the WAC of the onsite or offsite treatment and solidification facility, the pretreated waste will be shipped to the onsite or offsite treatment facility(ies) for solidification. Solidification will occur at one or more facilities, potentially:

1. PFNW in Richland, Washington
2. Energy*Solutions* near Clive, Utah
3. WCS near Andrews, Texas
4. Onsite facility, Hanford site
5. Offsite commercial facility, Richland, Washington.

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[51] Acceptable methods include sampling data, process knowledge, and other technically valid means of characterization.

At this time, DOE has not decided which solidification facility or combination of facilities would be used.

Following solidification, DOE plans to dispose of the pretreated and solidified waste offsite as MLLW at one or more licensed and permitted disposal facility(ies), potentially Energy*Solutions* (Clive Disposal Facility) near Clive, Utah, and/or the WCS FWF, near Andrews, Texas. The pretreated and solidified waste will be disposed in accordance with the WAC for the applicable disposal facility.

Energy*Solutions* (Clive) is both a treatment and disposal facility. It is limited to accepting Class A LLW and MLLW.

WCS is both a treatment and disposal facility. WCS can treat and dispose of all waste classes including Class A, Class B, and Class C LLW and MLLW.

PFNW does not have disposal capability and will accept and treat waste within the limits of its radioactive materials license (WDOH 2024).[52] Required disposal documentation will be provided to DOE upon shipment of the waste offsite for disposal.[53]

DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's licensed capacity.

2.4.7 Protection of Workers and the Public During Processing Operations at the Hanford Site

The DOE requirements[54] in 10 CFR Part 835, "Occupational Radiation Protection," and DOE Order 458.1, *Radiation Protection of the Public and the Environment* will apply during operations at the Hanford Site for the 200 West Area mission. DOE regulatory and contractual requirements for DOE facilities and activities ensure compliance with DOE regulations at 10

[52] PFNW can possess a maximum quantity of 380 curies which includes a limit of 0.5 curies of I-129 in accordance with Section 8.A. of *State of Washington Radioactive Material License No. WN-I0508-1 Amendment 46* (WDOH 2024). Therefore, shipments of MLLW containing key radionuclides would need managed as not to exceed these limits.

[53] As required by DOE disposal contracts, commercial disposal facilities must provide documentation confirming the disposal of shipped waste and provide validation that it conforms to the requirements of that facility.

[54] This section includes background information concerning worker (and public) protection during operations at the Hanford Site. This Draft WIR Evaluation differs from the situation in certain other WIR Evaluations, where disposal occurred or is planned to occur at DOE sites. In those situations, protection of workers and the public during disposal operations (and the comparability of DOE and NRC requirements) was considered under the criterion in DOE M 435.1-1, Chapter II.B.(2)(a)(2) (which cross-references the NRC performance objectives). The approach taken in this Draft WIR Evaluation is not necessarily the approach that will be taken in other WIR Evaluations.

CFR 835, relevant DOE Orders, and supplemental technical standards that establish dose limits for the public and the workers during operations.

The DOE Tank Operations Contractor, H2C, LLC, is required to maintain a radiation protection program.

The H2C radiological protection program is described in HNF-MP-5184, *Hanford Tank Waste Operations and Closure LLC Radiation Protection Program*. The H2C radiation protection program includes an administrative control limit of 500 mrem per year. Additional information on the program can be found in HNF-5183, *Integrated Tank Disposition Contract Radiological Control Manual*.

Filtration and IX of settled and decanted supernate will occur inside of the WARM process module, in accordance with the H2C radiation protection programs, to protect the workers and ensure that worker doses do not exceed the H2C administrative control level of 500 mrem per year.

The radiation dose to workers involved in pretreatment operations at the SY Tank Farm will be minimized by evaluating the need for shielding in the design. Transfer of waste between the SY Tank Farm and the WARM process module will be via buried pipe-in-pipe transfer lines. The WARM process module and associated piping will be designed with shielding to meet radiation dose limits for workers. Once through the WARM process module, the pretreated waste will be placed into the PWST that will also be designed with shielding to meet radiation dose limits for workers. Any waste exiting the PWST will be through a double-contained transfer system to the tanker trucks and/or portable tanks. This pretreated waste will have already had most of the Cs-137 and other key radionuclides removed and will also be in compliance with the H2C radiological control program.

With regard to worker radiation exposure, DOE's mission is to retrieve and treat Hanford's waste and close the SST farms to protect the Columbia River. In 2019, workers supporting the DOE mission received an average dose of 36 mrem, which is less than 6% of the average dose received from natural background and other radiological doses unrelated to Hanford operations. The collective dose to workers supporting the DOE mission was approximately 22.6 person-rem according to the *U.S. Department of Energy Occupational Radiation Exposure Report for CY 2022* (DOE 2022). Because the system will be designed to existing limits, dose to workers involved in the preparation of the pretreated tank waste for shipment are expected to be below the 500 mrem per year administrative limit.

The calendar year (CY) 2022 dose to the offsite maximally exposed individual was 0.32 mrem (3.2 µSv) per year for air emissions releases and releases to Columbia River water combined, which is well below dose limits specified in DOE O 458.1, *Radiation Protection of the Public and the Environment.*

Collective dose was estimated for the entire population living within a 50-mile radius of the air emissions sources and also individuals obtaining drinking water from the Columbia River downstream of the Hanford Site. The CY2022 collective dose of 3.1 person-rem was calculated as the sum of doses to all individual members of the exposed population. In summary, doses to the public from the greater Hanford Site operations fall well within the limits established in 40 CFR Part 61, "National Emission Standards for Hazardous Air Pollutants," Subpart H—National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities (essentially 10 mrem per year from airborne sources) and DOE Order 458.1 and are much lower than those from natural background radiation (DOE/RL-2023-20, *Hanford Annual Site Environmental Report for Calendar Year 2022*).

3.0 WASTE INCIDENTAL TO REPROCESSING DETERMINATION CRITERIA

Section Purpose

The purpose of this section is to describe the criteria applicable to this Draft WIR Evaluation.

Section Contents

This section provides brief background information on DOE criteria that apply to this Draft WIR Evaluation and provides additional details on this matter beyond those provided in Section 1.

Key Points

Applicable criteria appear in Chapter II.B.(2)(a) of DOE M 435.1-1.

3.1 WASTE INCIDENTAL TO REPROCESSING DETERMINATION CRITERIA BACKGROUND

Chapter II.B.(2)(a) of DOE M 435.1-1 sets forth criteria, using the evaluation method, to determine whether waste from reprocessing is incidental to reprocessing, is not HLW, and may be managed as LLW.

3.2 APPLICABLE CRITERIA

Chapter I.1.B of DOE M 435.1-1 provides that all radioactive waste subject to DOE Order 435.1, *Radioactive Waste Management* and the requirements of the Manual shall be managed as HLW, transuranic (TRU) waste, LLW or MLLW. Chapter II.B of DOE M 435.1-1 also states, in relevant part, that waste resulting from the reprocessing of SNF, that is determined to be incidental to reprocessing, is not HLW, and shall be managed in accordance with the requirements for LLW. The determination that waste is incidental to SNF reprocessing, and therefore not HLW, is called a “waste incidental to reprocessing determination,” which is also referred to in this Draft WIR Evaluation as a WIR Determination.

DOE M 435.1-1, Chapter II.B(2)(a), lists, in relevant part, three criteria to demonstrate, using the evaluation method, that wastes resulting from SNF reprocessing are not HLW and may be managed as LLW:

(1) Criterion 1 – the wastes have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical;

(2) Criterion 2 – the wastes will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*; and

(3) Criterion 3 – the wastes are to be managed, pursuant to DOE’s authority under the *Atomic Energy Act of 1954*, as amended, and in accordance with the provisions of Chapter IV of DOE M 435.1-1, provided the waste will be incorporated in a solid physical form at a

> concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55, *Waste Classification*.[55]

As explained more fully in the United States' opening brief in the case *NRDC v. Abraham*, No. 03-35711 (9th Cir.)[56] and other documents, DOE has the legal authority to evaluate and determine that certain waste which meets the criteria in DOE M 435.1-1 is incidental to the reprocessing of SNF, and may be managed as LLW.

DOE issued DOE Order 435.1 and DOE M 435.1-1 under the authority of the *Atomic Energy Act of 1954*, as amended, 42 U.S.C. 2011 *et seq.*; the *Energy Reorganization Act*, 42 U.S.C. 5801 *et seq*.; and the *Department of Energy Organization Act*, 42 U.S.C. 7101, *et seq*. The Order and Manual permit DOE to apply the WIR evaluation process to classify a specific waste stream from the reprocessing of SNF as either HLW or WIR, depending upon the degree of hazard the waste presents. That is precisely what DOE is doing here.

The WIR evaluation criteria in DOE M 435.1-1 were adopted after public notice and comment[57] and are based on and consistent with longstanding practices of the Atomic Energy Commission, NRC, the Energy Research and Development Administration, and DOE with respect to the classification of waste resulting from the reprocessing of SNF.[58] The criteria reflect that the definition of HLW in the *Atomic Energy Act of 1954*, as amended, the *Nuclear Waste Policy Act of 1982*, as amended, and the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992* is based on both the source of the waste and the hazard level of the waste. Specifically, HLW must both "result from the reprocessing of spent nuclear fuel" and be "highly radioactive." The criteria provide a sound technical and legal basis for evaluating whether a particular waste from

[55] DOE is not authorizing or applying alternative requirements for waste classification and characterization in this Draft WIR Evaluation.

[56] This brief is included for reference in Appendix C of this Draft WIR Evaluation.

[57] See 63 FR 42012, "Notice of Availability; Draft DOE Order and Manual on Radioactive Waste Management" (August 6, 1998) (announcing availability of draft documents for public comment), and 64 FR 37948, "DOE Order and Manual on Radioactive Waste Management and Implementation Guide" (July 14, 1999) (announcing availability of final documents, including a summary of the significant and most frequent public comments received and DOE's responses).

[58] See, for example, pages 48-53 of the United States' opening brief in the case *NRDC v. Abraham*, No. 03-35711 (9th Cir.).

reprocessing is "highly radioactive."[59] The criteria are essentially the same as the criteria set forth in Section 3116 (a) of the *Ronald W. Reagan National Defense Authorization Act of 2005*.[60] As demonstrated in the next three sections of this Draft WIR Evaluation, DOE has evaluated the waste against these criteria, and, for the reasons presented, this Draft WIR Evaluation shows that the pretreated and solidified waste will meet the applicable criteria in DOE M 435.1-1.

59 In addition to providing a basis for evaluating whether waste from reprocessing is highly radioactive, the criteria also provide that key radionuclides be removed to the extent technically and economically practical. This Draft WIR Evaluation fully analyzes this criterion and concludes that it is met. See Section 4.0. Nothing, however, in the statutory definition of HLW requires that radionuclides be removed to the maximum extent technically and economically practical prior to determining whether waste is HLW.

60 Section 3116(a), *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005*, P.L. 108-375. See Appendix B of this Draft WIR Evaluation.

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4.0 CRITERION 1: THE WASTE HAS BEEN OR WILL BE PROCESSED TO REMOVE KEY RADIONUCLIDES TO THE MAXIMUM EXTENT THAT IS TECHNICALLY AND ECONOMICALLY PRACTICAL

Section Purpose

The purpose of this section is to identify key radionuclides and evaluate whether key radionuclides will be removed to the maximum extent that is technically and economically practical.

Section Contents

This section summarizes the key radionuclides and shows that the key radionuclides will be removed from the West Area tank waste to the maximum extent technically and economically practical by separation via settling and decanting followed by pretreatment using filtration and IX.

Key Points

The key radionuclides are those radionuclides that, using a risk-informed approach, could contribute significantly to radiological risks to workers, the public, and the environment and include those radionuclides listed in Table 1 and Table 2 of 10 CFR 61.55 (and comparable to provisions in the *Utah Administrative Code* and *Texas Administrative Code*), and those radionuclides included in Energy*Solutions* (Clive Disposal Facility) and WCS FWF WAC.

DOE will use multiple settling and decanting steps to remove insoluble long-lived key radionuclides followed by pretreatment using filtration and IX to remove additional key radionuclides to the maximum extent technically and economically practical.[61]

4.1 INTRODUCTION

This section identifies the key radionuclides and evaluates the technologies that will be used to remove key radionuclides from the applicable WARM tank waste, using a risk-informed approach. This section also demonstrates that the first criterion in DOE M 435.1-1, removal of key radionuclides to the maximum extent technically and economically practical, will be met.

Section 4.2 describes the factors relevant to identifying key radionuclides in the applicable West Area tank waste.

Section 4.3 describes the pretreatment methods that will be used for the removal of key radionuclides to the maximum extent technically and economically practical.

Section 4.4 summarizes the conclusions that the key radionuclides will be removed to meet the first criterion.

[61] Settling is a process by which insoluble solids, containing higher concentrations of insoluble long-lived radionuclides, settle by gravity to the bottom of the tank. Decanting is the process of pumping only the liquid fraction from the tank without disturbing the settled solids.

4.2 KEY RADIONUCLIDES

This section describes the various factors considered to identify key radionuclides for this Draft WIR Evaluation. Consideration of this information will ensure that those radionuclides present in the applicable West Area tank waste that could contribute significantly to radiological risks to workers, the public, and the environment are identified and taken into account.

4.2.1 Identification of Key Radionuclides

The key radionuclides identified in this Draft WIR Evaluation are based on consideration of the following information:

- NRC requirements for classification of radioactive waste for near-surface disposal, that appear in Table 1 and Table 2 of 10 CFR 61.55 and are mirrored in the *Texas Administrative Code*, 30 TAC Rule 336.362, Appendix E
- Radionuclides important to meeting the performance objectives in 10 CFR 61, Subpart C, the comparable provisions in the *Texas Administrative Code* and the *Utah Administrative Code*, and the WAC for the potential disposal facility(ies) here, the WCS FWF and Energy*Solutions* (Clive Disposal Facility)[62]
- Radionuclides present in West Area tank waste.

4.2.2 Key Radionuclides

DOE views "key radionuclides" as those radionuclides that are listed in Tables 1 and 2 of 10 CFR 61.55. Specifically, these are long-lived radionuclides (C-14, Ni-59, Nb-94, Tc-99, I-129, Pu-241, Cm-242, and alpha-emitting TRU nuclides with half-lives greater than 5 years) and short-lived radionuclides (H-3, Co-60, Ni-63, and Sr-90 including daughter Y-90, and Cs-137 including daughter Ba-137m).[63] In addition, key radionuclides are those that are important to satisfying the performance objectives in 10 CFR 61, Subpart C, the comparable provisions in the *Texas Administrative Code* and *Utah Administrative Code*, and the WAC for the potential disposal facility(ies) here, the WCS FWF and Energy*Solutions* (Clive Disposal Facility).

4.2.3 U.S. Nuclear Regulatory Commission Requirements in 10 CFR 61.55, Texas and Utah Administrative Codes

The radionuclides are listed in 10 CFR 61.55 in the form of two tables, which are reproduced here as Table 4-1 and Table 4-2.[64]

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[62] *Bulk Waste Disposal and Treatment Facilities Waste Acceptance Criteria* (Energy*Solutions* 2025) and *Federal Waste Facility (FWF) Generator Handbook* (WCS 2025).

[63] Following settling, decanting, and filtration, most of the long-lived, insoluble radionuclides will be present in lesser amounts in the resultant supernate and therefore would not contribute to the long-term dose to a member of the public.

[64] *Texas Administrative Code* (Title 30 Rule 336.362, Appendix E) and *Utah Administrative Code* (R313-15-1009) have similar requirements.

The tables in the *Texas Administrative Code* (30 TAC Rule 336.362, Appendix E, Tables I and II) and the *Utah Administrative Code* (UAC R313-15-1009) mirror the 10 CFR 61.55 tables with the exception of Ra-226, which is included by both the State of Texas and the State of Utah.

Because Ra-226 is a decay product of U-238, which has a half-life of 4.5 billion years, and it is in very low quantities in Hanford Site tank waste (per the BBI), this radionuclide is not included as a key radionuclide.

Table 4-1. Long-Lived Radionuclides (10 CFR 61.55, Table 1).

Radionuclides[a]
C–14
C–14 in activated metal
Ni–59 in activated metal
Nb–94 in activated metal
Tc–99
I–129
Alpha-emitting transuranic nuclides with half-life greater than 5 years
Pu–241
Cm–242

[a] Adapted from 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart D—Technical Requirements for Land Disposal Facilities, § 61.55, "Waste Classification," Table 1.

Table 4-2. Short-Lived Radionuclides (10 CFR 61.55, Table 2).

Radionuclides[a]
Total of all nuclides with less than 5-year half-life
H-3
Co-60
Ni-63
Ni-63 in activated metal
Sr-90
Cs-137

[a] Adapted from 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart D—Technical Requirements for Land Disposal Facilities, § 61.55, "Waste Classification," Table 2.

4.2.4 Radionuclides Important to Meeting Performance Objectives of the Energy*Solutions* (Clive Disposal Facility) and Waste Control Specialists Federal Waste Facility

The *Utah Administrative Code*, R313-25-19 "General Requirement" through R313-25-23, "Stability of the Disposal Site after Closure," and the *Texas Administrative Code* in 30 TAC Rules 336.723, "Performance Objectives," through 336.727, "Stability of the Disposal Site after Closure" set forth performance objectives for LLW disposal facilities, which are akin to the NRC performance objectives in 10 CFR 61, Subpart C, as further discussed in Section 5.2 and Appendix A of this Draft WIR Evaluation. Meeting the WAC in the *Bulk Waste Disposal and Treatment Facilities Waste Acceptance Criteria* (Energy*Solutions* 2025) and/or the *Federal Waste Facility (FWF) Generator Handbook* (WCS 2025) will ensure that the applicable State of Utah or State of Texas performance objectives will be achieved.[65, 66]

DOE considers all radionuclides listed in Tables 1 and 2 of 10 CFR 61.55 (corresponding to 30 TAC Rule 336.362, Appendix E, Tables I and II, and *Utah Administrative Code* R313-15-1009) and radionuclides in Energy*Solutions* (2025) and WCS (2025) to be key radionuclides for the purposes of this Draft WIR Evaluation. Table 4-3 lists these radionuclides.

Because Ra-226 is a decay product of U-238, which has a half-life of 4.5 billion years, and it is in very low quantities in Hanford Site tank waste (per the BBI), this radionuclide is not included as a key radionuclide.[67]

[65] The WAC in Energy*Solutions* (2025) and WCS (2025) ensures that compliance with the performance objectives will be achieved. The rationale for this conclusion for Energy*Solutions* (Clive Disposal Facility) and the WCS FWF is summarized as follows:

1. *Texas Administrative Code*, Title 30, Rules 336.723-727 and the *Utah Administrative Code* R313-25-19 through R313-25-23 set forth performance objectives for LLW disposal facilities comparable to those of 10 CFR 61, Subpart C;
2. Disposal site performance, in compliance with the performance objectives, is determined by meeting the WAC of the LLW disposal facility;
3. The WAC is based on the projected total inventory, thus linking these criteria directly to the calculated disposal site performance;
4. The treated and solidified supernate from West Area waste tanks will meet the WAC, as set forth in Energy*Solutions* (2025) and WCS (2025); and,
5. Meeting the WAC will therefore ensure that the performance objectives will be achieved, because waste meeting these criteria would not increase the assumed waste inventory used in the performance assessment analyses.

[66] DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's licensed capacity.

[67] For perspective, the total BBI estimate of Ra-226 in all Hanford Tank Farms is 9.35E-03 curies. The total inventory of key radionuclides in all West Area tank waste prior to pretreatment is 3.28E+06 curies as shown in Table 4-4.

Table 4-3. Key Radionuclides in West Area Tank Waste.

Radionuclide	10 CFR 61.55 Long-Lived Radionuclides	10 CFR 61.55 Short-Lived Radionuclides	Radionuclides Identified in *Federal Waste Facility (FWF) Generator Handbook*	Radionuclides Identified in *Bulk Waste Disposal and Treatment Facilities Waste Acceptance Criteria*
H-3		X	X	X
C-14	X		X	X
Co-60		X	X	X
Ni-63		X	X	X
Sr-90		X	X	X
Tc-99	X		X	X
I-129	X		X	X
Cs-137		X	X	X
Np-237[a]	X		X	X
Pu-238[a]	X		X	X
Pu-239[a]	X		X	X
Pu-240[a]	X		X	X
Pu-241	X		X	X
Pu-242[a]	X		X	X
Am-241[a]	X		X	X
Am-243	X		X	X
Cm-242	X		X	X
Cm-243[a]	X		X	X
Cm-244[a]	X		X	X

Sources: 10 CFR 61.55, "Licensing Requirements for Land Disposal of Radioactive Waste," "Waste Classification," which is mirrored in *Texas Administrative Code* (Rule 336.362, Appendix E, Tables I and II) and *Utah Administrative Code* (UAC R313-15-1009); *Federal Waste Facility (FWF) Generator Handbook* (WCS 2025).

[a] Alpha-emitting transuranic radionuclides with half-life greater than 5 years (NUREG-0945, *Final Environmental Impact Statement on 10 CFR 61 "Licensing Requirements for Land Disposal of Radioactive Waste*," Table 4).

Waste Control Specialists Federal Waste Facility

The WCS is licensed for disposal of LLW and MLLW in the WCS FWF under *Radioactive Material License No. R04100* issued by the TCEQ.[68,69]

The total activity in the separated and pretreated waste from all SSTs in S, SX, and U Tank Farms plus some of the waste from DSTs SY-101 and SY-102 is estimated to be approximately 122,000 curies.[70,71] The curie contribution will likely be lower if some of the waste is disposed of at Energy*Solutions* (Clive Disposal Facility).

The WAC for the WCS FWF in the *Federal Waste Facility (FWF) Generator Handbook* (WCS 2025) lists the radionuclides identified in Table 4-3 of this Draft WIR Evaluation, plus Ra-226. Radium-226, however, is not considered to be a key radionuclide in this Draft WIR Evaluation for the reasons explained previously.

Energy*Solutions* Clive Disposal Facility

Energy*Solutions* (Clive Disposal Facility) is licensed under *Radioactive Material License UT 2300249 Amendment 29* (UDEQ 2025) issued by the Utah Department of Environmental Quality Division of Waste Management and Radiation Control to receive Class A LLW and Class A MLLW.

Although meeting Class A concentration limits is not a WIR criterion of DOE M 435.1-1, DOE considers Energy*Solutions* (Clive) a potential option if the pretreated and solidified waste meets Class A concentration limits.[72]

The WAC for Energy*Solutions* (Clive) in the *Bulk Waste Disposal and Treatment Facilities Waste Acceptance Criteria* (Energy*Solutions* 2025) includes (by cross-reference) the radionuclides identified in Table 4.3 of this Draft WIR Evaluation, with the addition of Ra-226. As explained previously, Ra-226 is not considered to be a key radionuclide.

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68 The TCEQ license for WCS has been amended several times. The current license, as amended by license amendment 41, was issued on November 14, 2025.

69 DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's permits and licensed capacity.

70 DSTs SY-101 and SY-102 will be retrieved to provide tank space for subsequent S, SX, and U Tank Farm SST retrievals. Waste from tank SY-103 will be transferred to tank SY-102 prior to SST retrievals, and will be processed with waste from SY-102 in the WARM pretreatment capability (RPP-RPT-65190).

71 This activity is based on contributions from key radionuclides in pretreated waste considering all SSTs in S, SX, and U Tank Farms. This activity estimate conservatively assumes that 100 percent of this waste would be above Class A concentration limits, and may be disposed of at the WCS FWF.

72 Some removal of soluble Sr-90 by IX is also expected. However, the extent to which soluble Sr-90 will be removed is uncertain given the 200 West Area tank waste chemistry. Therefore, this Draft WIR Evaluation assumes no removal of soluble Sr-90 by IX in Table 4-6 and Table 4-7. Potential removal of Sr-90 by IX is addressed in Appendix D of this Draft WIR Evaluation.

Based on the waste acceptance criteria for the WCS FWF and Energy*Solutions* Mixed Waste Landfill Facility, discussed above, no additional key radionuclides were identified. DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's licensed capacity.

4.3 CRITERION 1: REMOVAL TO THE MAXIMUM EXTENT TECHNICALLY AND ECONOMICALLY PRACTICAL

In evaluating whether key radionuclides will be removed to the maximum extent that is "technically and economically practical," DOE has considered the plain meaning of the phrase "technically and economically practical" as well a risk-based approach consistent with NRC guidance (NUREG-1854, *NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations – Draft Final Report for Interim Use*).

Removal to the maximum extent "technically and economically practical" is not removal to the extent "practicable" or theoretically "possible." Nor does the criterion connote removal which may be notionally capable of being done. Rather, the adverbs "technically" and "economically" modify and add important context to that which is contemplated by the criterion.

Moreover, a "practical" approach, as specified in the first criterion, is "adapted to actual conditions" (*A Dictionary of Modern English Usage* [Fowler 1930]); "adapted or designed for actual use" (*Random House Unabridged Dictionary* [Random House 1997]); "useful" (Random House 1997); selected "mindful of the results, usefulness, advantages or disadvantages, etc., of [the] action or procedure" (Random House 1997); fitted to "the needs of a particular situation in a helpful way" (*Cambridge Dictionaries Online* [Cambridge, 2024], ["practical"], http://dictionary.cambridge.org); "effective or suitable" (Cambridge 2024); "suitable for the situation in which something is used" (*Cambridge Dictionary,* [Cambridge 2024, http://dictionary.cambridge.org]); "appropriate or suited for actual use" (*Brittanica Dictionary* [Brittanica 2024, https://www.britannica.com]); "capable of being put to use or account" (*Merriam Webster Dictionary* [Merriam Webster 2024, https://www.merriam-webster.com/]).

Therefore, the evaluation as to whether a particular key radionuclide has been or will be removed to the "maximum extent that is technically and economically practical" will vary from situation to situation, based not only on reasonably available technologies but also on the overall costs and benefits of deploying a technology with respect to a particular waste stream.

The "maximum extent that is technically and economically practical" standard contemplates, among other things, consideration of expert judgment and opinion; environmental, health, timing, or other exigencies; the risks and benefits to public health, safety, and the environment arising from further radionuclide removal as compared with countervailing considerations that may ensue from not removing or delaying removal; life cycle costs; net social value; the cost (monetary as well as environmental and human health and safety costs) per curie removed; radiological removal efficiency; the point at which removal costs increase significantly in relationship to removal efficiency; the service life of equipment; the reasonable availability of proven technologies; the limitations of such technologies; the usefulness of such technologies; project schedule or funding constraints; and the sensibleness of using such technologies.

What may be removal to the maximum extent technically and economically practical in a particular situation or at one point in time may not be that which is technically and economically practical, feasible, or sensible in another situation or at a prior or later point in time. In this regard, it may not be technically and economically practical to undertake further removal of certain radionuclides because further removal is not sensible or useful in light of the overall benefit to human health and the environment. Such a situation may arise if certain radionuclides are present in such extremely small quantities that they make an insignificant contribution to potential doses to workers, the public, and the hypothetical inadvertent human intruder.[73]

4.3.1 Technical Practicality Assessment

The majority of insoluble key radionuclides will be removed through a series of steps that include in-tank settling, decanting, filtration, and IX.

Separation and pretreatment of each batch of West Area tank waste will entail the following:

- In-tank settling.[74]
- Decanting after the settling period to separate supernate from the solids in which insoluble, long-lived actinides (e.g., plutonium, americium, neptunium, and curium) tend to reside.
- Filtering to remove any remaining insoluble radionuclides. Following filtration, no visibly detectible solids are expected to be present. The majority of the radionuclides

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73 DOE normally would view radionuclides as making an insignificant contribution if the contribution to dose from those radionuclides does not exceed any of the following:

(1) 10% of the 25-mrem per year all-pathways annual dose to the public performance objective,

(2) 10% of the 500-mrem acute dose limit to the intruder, and

(3) 10% of the annual worker dose in 10 CFR Part 20, "Standards for Protection Against Radiation."

This methodology is based on NRC consultation and is intended to be consistent with the guidance and general approach in NUREG-1757, *Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria Final Report* (Volume 2, Rev. 2 at p. xxx), which defines insignificant radionuclides and pathways as follows: "*Insignificant Radionuclides and Pathways*. Radionuclides and pathways that can be excluded from further detailed consideration, because they cumulatively contribute no more than 10 percent of the dose standard[.]" The above-referenced NUREG-1757, which applies to NRC licensees, is being used only as general guidance, and DOE's use of this NUREG as guidance should not be construed to suggest that it is a requirement under DOE M 435.1-1 or that either the NUREG or 10 CFR Part 20, Subpart E—Radiological Criteria for License Termination, is applicable to DOE.

74 Settling will occur in the SY Tank Farm DSTs prior to decanting the waste from the receipt and qualification tanks into the feed tank for further processing through WARM pretreatment modules (containing filtration and IXCs).

present in the tank waste feed are those radionuclides that are partially or completely soluble, primarily Cs-137 and Sr-90 (and daughter Y-90).[75]

- Passing through crystalline silicotitanate (CST) IX to remove primarily large fractions of Cs-137 (and daughter Ba-137m).[76]

4.3.1.1 Settling

From the time of early Hanford Site operations, management of tank waste involved neutralization of the acidic waste by the addition of sodium hydroxide and sodium carbonate to minimize corrosion of the carbon steel tanks. Under long-term caustic storage conditions, the tank waste has separated into insoluble solids and liquid fractions. As shown in Table 2-1, tank solids (undissolved saltcake and/or sludge) contain insoluble long-lived radionuclides such as plutonium, americium, neptunium, and curium which may persist in the environment and are harmful if ingested or inhaled. Settling of retrieved West Area tank waste in the receipt, qualification, and feed tank will ensure that these longer-lived radionuclides are separated from the feed prior to being processed through the WARM process module.

Retrieved tank supernate (including dissolved saltcake and interstitial liquid), contains soluble radionuclides. Table 4-4 shows that the radionuclide inventory in West Area tank waste feed is predominately short-lived radionuclides such as Cs-137 (and daughter Ba-137m) and Sr-90 (and daughter Y-90).[77] These short-lived radionuclides, when present at high enough levels, emit radiation in a relatively short time, which, absent shielding or controls, may be harmful to humans simply by proximity.

4.3.1.2 Decanting

West Area tank waste involves waste that includes some of the SY Farm tank waste. The retrieved SST supernate (including dissolved saltcake and interstitial liquid) will be decanted (separated and removed) from the settled solids in the receipt, qualification, and feed tanks. Decanting is the process of pumping only the liquid fraction from the tank without disturbing the settled solids. The bulk of the key radionuclides such as insoluble strontium and TRU constituents (neptunium, plutonium isotopes, americium, and curium) are contained in the

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[75] Sr-90 (and daughter Y-90) is primarily insoluble but can be soluble in some tanks with higher complexant concentrations. Complexant concentrate waste results from evaporating dilute complexed waste which contained high concentrations of organic complexants, such as HEDTA, EDTA, and citric acid. Complexants “hold” metals in solution much better than just a normal aqueous solution. Complexant waste was originally stored in some of the S Farm and U Farm tanks. However, since supernate was removed from the S Farm and U Farm tanks during interim stabilization, it is likely that much of the complexant-driven soluble Sr-90 has already been removed from the tanks and is now stored in 200 East Area DSTs.

[76] Some removal of soluble Sr-90 by IX is also expected. However, the extent to which soluble Sr-90 will be removed is uncertain given the 200 West Area tank waste chemistry. Therefore, this Draft WIR Evaluation assumes no removal of soluble Sr-90 by IX in Table 4-6 and Table 4-7. Potential removal of Sr-90 by IX is addressed in Appendix D of this Draft WIR Evaluation.

[77] For example, the approximate half-life of Cs-137 (and daughter Ba-137m) is slightly longer than 30 years (*Nuclides and Isotopes, Fifteenth Edition of the Chart of the Nuclides* [Parrington et al. 1996]).

insoluble fraction (i.e., solids) of the tank waste. The bulk of the Cs-137 (and daughter Ba-137m), Tc-99, I-129, C-14, and H-3 is contained in the soluble fraction of the tank waste. The settling and decanting separations processes will ensure that the majority of the longer-lived, insoluble key radionuclides present in the solids are separated from, and not included in, the supernate prior to being fed to the WARM process module.

4.3.1.3 Filtration

The decanted supernate in the feed tank will be sent to the WARM process module, where it will be filtered using a dead-end filtration process to remove entrained solids (including insoluble long-lived radionuclides).[78] This filtration will remove insoluble compounds which may contain TRU radionuclides. After filtration, the majority of the radionuclides present in the supernate will be those radionuclides that are completely or partially soluble, primarily Cs-137 (and daughter Ba-137m), Tc-99, I-129, H-3, C-14, and Sr-90 (and daughter Y-90).[79] Each filtration unit will consist of two banks of dead-end filters; one bank is on-line, and the other bank is on stand-by to come on-line every 24 hours of operation to allow for backflushing, which occurs every 24 hours. Waste streams generated by back flushing of the filters will be transferred to tank SY-103, the SST retrieval receipt tank. Filtration is also beneficial for maintaining the performance of the IX media by reducing the risk of potential plugging due to any entrained solids.

4.3.1.4 Ion Exchange

Following filtration, the supernate waste will be processed through IX media. Processing by IX media using CST is a proven technology, which DOE will use for other waste streams at the Hanford Site. In the WARM process, removal of Cs-137 by IX media using CST in the WARM process modules is based the rates at which cesium will be removed from 200 East Area waste streams by the Tank Side Cesium Removal (TSCR) unit (and for Phase 2, a second TSCR unit or a filtration and cesium removal capability) pursuant to the Direct Feed Low-Activity Waste (DFLAW) approach. See *Final Waste Incidental to Reprocessing Evaluation for Vitrified*

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[78] Dead-end filtration testing similar to the WARM process module filter assembly, which can be back-flushed, has been performed at the bench-scale using tanks AP-107 and AW-102 supernate (PNNL-28780, *Fiscal Year 2019 Filtration of Hanford Tank AP-107 Supernatant*; PNNL-28783*, Dead-End Filtration and Crystalline Silicotitanate Cesium Ion Exchange with Hanford Tank Waste AW-102*).

[79] Sr-90 (and daughter Y-90) can be soluble in some tanks with higher complexant concentrations. Complexant concentrated waste results from evaporating dilute complexed waste which contained high concentrations of organic complexants, such as HEDTA, EDTA, and citric acid. Complexants "hold" metals in solution much better than just a normal aqueous solution (DOW 2018).

Complexant waste was originally stored in some of the S and U farm tanks that will become waste feed. However, since supernate was removed from the S and U farm tanks during interim stabilization, it is likely that some of the complexant driven soluble Sr-90 (and daughter Y-90) has been removed from the tanks. DOE expects IX could potentially remove some soluble Sr-90 and that some of the waste will meet concentration limits for Class A LLW, as discussed in Appendix D of this Draft WIR Evaluation. Both inorganic and organic constituents will be addressed to meet applicable RCRA treatment standards which is outside the scope of this Draft WIR Evaluation.

Low-Activity Waste and Secondary Wastes at the Hanford Site, Washington, DOE/ORP-2022-03, (January 2023), U.S. Department of Energy, Richland, Washington and references cited therein.

See also PNNL-28783, *Dead-End Filtration and Crystalline Silicotitanate Cesium Ion Exchange with Hanford Tank Waste AW-102*) (PNNL-28783). DOE has also used IX pretreatment via an In-Tank Pretreatment System (ITPS) within Tank SY-101 for the Test Bed Initiative Demonstration. See *Final Waste Incidental to Reprocessing Evaluation for the Test Bed Initiative Demonstration at the Hanford Site, Washington,* DOE/ORP-2022-02, (March 2023), U.S. Department of Energy, Richland, Washington. Additionally, IX using CST has been successfully used internationally at the Fukushima Daiichi cleanup in Japan, at DOE's Oak Ridge National Laboratory (ORNL), in DOE's Savannah River Site Tank Closure Cesium Removal process (ORNL/TM-2001/129, *Wastewater Triad Project: Final Summary Report*).

Furthermore, cesium removal tests performed at the Hanford Site 222-S Laboratory demonstrated that the CST IX was successful in removing greater than 99% of Cs-137, including daughter Ba-137m (SESC-EN-RPT-005, *Hanford Complexant Concentrate Cesium Removal Using Crystalline Silicotitanate* and SESC-EN-RPT-006, *Hanford Salt Cake Cesium Removal Using Crystalline Silicotitanate*). The effectiveness of Cs-137 removal anticipated by IX is provided in Table 4-4.[80]
Table 4-4, Table 4-5,Table 4-6, and Table 4-7 of this Draft WIR Evaluation assume no removal of soluble Sr-90 by IX. Potential removal of Sr-90 by IX is addressed in Appendix D of this Draft WIR Evaluation.

Table 4-4. Total Key Radionuclides in All West Area Tank Waste Feed and Pretreated Waste. (2 pages)

(1) Key Radionuclide	(2) West Area Waste Feed Inventory (Ci)	(3) West Area Pretreated Tank Waste Inventory (Ci)	(4) Percent of Curies Removal
H-3	2.21E+02	2.20E+02	0.43%
C-14	1.40E+02	1.39E+02	0.41%
Co-60	2.89E+00	2.88E+00	0.39%
Ni-63	1.08E+03	1.08E+03	0.37%
Sr-90	1.12E+05	1.12E+05	0.32%
Tc-99	5.40E+03	5.38E+03	0.40%

80 Spent IXCs will be flushed with dilute caustic (0.1 M NaOH) and water, air-dried, and transferred to an interim storage pad located in the 200 West Area adjacent to the SY Tank Farm, pending disposition and future decisions. The spent IXCs are in a different waste form which will not be processed through the WARM pretreatment capability.

Table 4-4. Total Key Radionuclides in All West Area Tank Waste Feed and Pretreated Waste. (2 pages)

(1) Key Radionuclide	(2) West Area Waste Feed Inventory (Ci)	(3) West Area Pretreated Tank Waste Inventory (Ci)	(4) Percent of Curies Removal
I-129	5.12E+00	5.09E+00	0.40%
Cs-137	3.16E+06	2.76E+03	99.91%
Np-237	5.25E+00	5.23E+00	0.39%
Pu-238	3.97E+00	3.96E+00	0.30%
Pu-239	1.62E+02	1.61E+02	0.29%
Pu-240	3.33E+01	3.32E+01	0.29%
Am-241	2.54E+02	2.54E+02	0.33%
Pu-241	4.85E+01	4.84E+01	0.30%
Cm-242	3.87E+00	3.86E+00	0.40%
Pu-242	1.85E-03	1.84E-03	0.31%
Am-243	1.57E-01	1.56E-01	0.34%
Cm-243	1.67E-01	1.66E-01	0.40%
Cm-244	2.65E+00	2.64E+00	0.40%

Source: RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document.* Note: This evaluation conservatively assumes no Sr-90 removal and no solids removal by filtration in the WARM PM. Only Cs-137 is removed by ion exchange operation. Any minor differences noted between the feed inventory and the pretreated liquid inventory for other radionuclides are an artifact of mass balance calculation uncertainty and do not represent removal via ion exchange.

Percent of Curies removed: Column (4) = [[Column (2) – Column (3)]/Column (2)] × 100

West Area tank waste refers to all the SSTs in S, SX, and U tank farms as well as some of the waste from DSTs SY-101 and SY-102.

Column (3) and Column (4) do not reflect potential removal of soluble Sr-90 by IX.

4.3.1.5 Key Radionuclides Present in West Area Tank Waste

This section provides an estimate of the key radionuclides present in West Area tank waste using the best available data from the BBI.

Table 4-4 shows the total inventory of key radionuclides considering waste from all West Area tanks using the BBI estimates available on September 28, 2023, with a radionuclide decay date of January 1, 2030.[81]

Column (1) identifies the key radionuclides while Column (2) and Column (3) identify the curies present in the feed before and after pretreatment. In general, the majority of the removal is attributed to IX which removes primarily Cs-137 (approximately 99.9%).

Table 4-5 shows the inventory and removal of key radionuclides for each of the West Area tanks located in S, SX, and U Tank Farms as well as DSTs SY-101 and SY-102 on a tank-by-tank basis. Table 4-5 includes all SSTs located in S, SX, and U Tank Farms (plus tanks SY-101 and SY-102).[82]

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[81] Radionuclides decayed to January 1, 2030, since that is the assumed start date for processing the first batch of West Area tank waste through the WARM process module.

[82] DSTs SY-101 and SY-102 will be retrieved to provide tank space for subsequent S, SX, and U farm SST retrievals. Waste from tank SY-103 will be transferred to tank SY-102 prior to SST retrievals, and will be processed with waste from SY-102 in the WARM pretreatment capability (RPP-RPT-65190).

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Table 4-5. 200W Feed Stream Key Radionuclide Activity. (2 pages)

Tank	H-3 (Ci)	C-14 (Ci)	Co-60 (Ci)	Ni-63 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	I-129 (Ci)	Cs-137 (Ci)	Np-237 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Am-241 (Ci)	Pu-241 (Ci)	Cm-242 (Ci)	Pu-242 (Ci)	Am-243 (Ci)	Cm-243 (Ci)	Cm-244 (Ci)	Feed Stream Total Activity (Ci)	Pretreated Waste Total Activity (Ci)	Percent Removed (%)
SY-101	1.56E-01	2.06E+00	1.81E-01	3.56E+01	2.36E+03	3.76E+02	3.00E-01	3.92E+01	8.48E-03	1.19E-01	7.14E-01	1.54E-01	3.83E+00	3.28E-01	2.43E-01	9.88E-05	2.30E-03	3.38E-02	5.44E-01	2.03E+05	2.81E+03	99%
SY-102	1.73E-01	2.23E+00	2.33E-01	4.66E+01	2.49E+03	4.84E+02	3.75E-01	4.80E+01	1.07E-02	1.61E-01	9.53E-01	2.05E-01	5.36E+00	4.45E-01	3.42E-01	1.32E-04	3.22E-03	4.76E-02	7.65E-01	2.57E+05	3.08E+03	99%
S-101	5.55E+00	2.12E+00	6.83E-02	1.77E+01	3.27E+03	1.62E+02	9.21E-02	5.92E+01	1.22E-02	7.92E-02	2.83E+00	5.59E-01	2.88E+00	5.93E-01	7.92E-02	4.56E-05	1.46E-03	1.04E-02	1.67E-01	1.27E+05	3.53E+03	97%
S-102	3.23E+00	1.59E+00	1.72E-02	1.52E+01	1.25E+03	5.40E+01	4.40E-02	2.67E+01	2.76E-02	2.15E-02	6.69E-01	1.39E-01	5.58E-01	2.23E-01	4.28E-02	1.20E-05	3.31E-04	2.47E-03	3.97E-02	4.99E+04	1.36E+03	97%
S-103	4.63E+00	4.11E+00	6.26E-02	1.78E+01	2.47E+03	1.46E+02	1.44E-01	2.09E+01	8.07E-02	3.29E-02	1.32E+00	2.73E-01	9.81E-01	4.21E-01	4.15E-02	1.55E-05	5.94E-04	1.34E-03	2.15E-02	1.03E+05	2.67E+03	97%
S-104	2.21E+00	1.78E+00	1.41E-02	8.38E+00	2.76E+03	5.63E+01	5.42E-02	4.26E+01	4.40E-02	5.92E-02	2.56E+00	5.20E-01	1.37E+00	6.14E-01	7.06E-03	2.06E-05	5.78E-04	1.78E-04	2.81E-03	4.33E+04	2.88E+03	93%
S-105	7.33E+00	8.49E+00	8.39E-02	1.87E+01	2.42E+03	2.54E+02	2.51E-01	1.11E+02	8.67E-02	2.08E-02	8.21E-01	1.73E-01	5.48E+00	2.78E-01	2.01E-02	9.39E-06	3.44E-03	4.17E-04	6.67E-03	4.74E+04	2.82E+03	94%
S-106	6.17E+00	7.38E+00	2.51E-02	1.39E+01	3.33E+03	2.20E+02	2.19E-01	6.52E+01	2.82E-01	1.27E-02	4.52E-01	9.77E-02	2.31E+00	1.76E-01	1.89E-02	5.87E-06	1.45E-03	3.86E-04	6.16E-03	1.05E+05	3.64E+03	97%
S-107	1.84E+01	2.21E+00	3.79E-02	8.44E+00	2.23E+03	3.71E+01	3.20E-02	1.21E+02	4.01E-02	1.58E-01	8.53E+00	1.76E+00	3.45E+00	2.48E+00	8.27E-03	8.34E-05	7.93E-04	2.29E-04	3.53E-03	4.99E+04	2.43E+03	95%
S-108	1.45E+01	8.41E+00	3.37E-02	1.97E+01	4.07E+03	2.61E+02	2.58E-01	9.08E+01	3.67E-01	4.80E-02	1.90E+00	4.04E-01	4.16E+00	6.61E-01	7.25E-02	2.23E-05	2.56E-03	1.51E-03	2.40E-02	1.64E+05	4.47E+03	97%
S-109	9.41E+00	1.05E+01	6.67E-02	2.06E+02	3.67E+03	3.30E+02	3.29E-01	1.55E+02	5.44E-01	4.29E-02	2.56E+00	5.05E-01	1.02E+00	5.00E-01	1.67E-02	1.74E-05	5.48E-04	3.38E-04	5.41E-03	4.78E+04	4.38E+03	91%
S-110	8.03E+00	7.04E+00	6.14E-02	4.57E+01	3.36E+03	2.11E+02	2.08E-01	5.56E+01	3.39E-01	1.17E-01	6.95E+00	1.37E+00	5.20E+00	1.42E+00	4.97E-02	4.90E-05	2.61E-03	1.01E-03	1.61E-02	7.99E+04	3.70E+03	95%
S-111	5.67E+00	4.61E+00	1.87E-02	1.11E+01	3.83E+03	1.63E+02	1.63E-01	2.94E+02	2.99E-01	2.91E-02	1.49E+00	3.00E-01	1.06E+00	3.71E-01	1.42E-02	1.26E-05	5.77E-04	2.88E-04	4.60E-03	6.84E+04	4.31E+03	94%
U-201	4.38E-01	2.77E-01	5.93E-04	5.42E-01	1.81E+02	1.01E+01	1.02E-02	8.72E-01	1.89E-02	1.26E-03	5.89E-02	1.21E-02	3.22E-02	1.64E-02	4.70E-04	5.55E-07	1.83E-05	9.56E-06	1.53E-04	4.14E+03	1.94E+02	95%
U-202	4.12E-01	1.92E-01	3.93E-04	4.74E-01	1.24E+02	6.92E+00	6.94E-03	4.43E-01	1.29E-02	8.38E-04	3.90E-02	8.00E-03	2.12E-02	1.10E-02	3.05E-04	3.71E-07	1.22E-05	6.19E-06	9.90E-05	2.80E+03	1.33E+02	95%
U-203	2.79E-01	1.02E-01	2.04E-04	3.41E-01	6.44E+01	3.59E+00	3.59E-03	1.94E-01	6.65E-03	4.29E-04	1.99E-02	4.09E-03	1.08E-02	5.61E-03	1.54E-04	1.90E-07	6.26E-06	3.12E-06	4.99E-05	1.45E+03	6.90E+01	95%
U-204	2.01E-01	6.06E-02	1.20E-04	2.58E-01	3.85E+01	2.09E+00	2.09E-03	1.02E-01	3.86E-03	3.84E-04	2.22E-02	4.39E-03	9.04E-03	5.10E-03	8.80E-05	1.70E-07	3.65E-06	1.79E-06	2.86E-05	8.45E+02	4.13E+01	95%
U-101	1.38E+00	3.07E-01	1.26E-03	1.74E+00	1.42E+03	8.57E+00	9.65E-03	5.74E-01	1.61E-02	9.59E-03	6.47E-01	1.25E-01	1.89E-01	1.14E-01	4.54E-04	3.91E-06	5.83E-05	7.44E-06	1.19E-04	8.08E+03	1.44E+03	82%
U-102	5.03E+00	3.45E+00	1.11E-01	1.31E+02	3.70E+03	1.01E+02	1.13E-01	2.15E+02	1.26E-01	1.85E-01	9.28E+00	1.86E+00	4.41E+00	2.38E+00	5.28E-02	8.06E-05	2.37E-03	1.11E-03	1.78E-02	9.58E+04	4.17E+03	96%
U-103	5.61E+00	6.13E+00	1.01E-01	3.98E+01	4.29E+03	1.82E+02	1.85E-01	3.14E+01	5.31E-01	1.61E-01	7.05E+00	1.46E+00	1.76E+01	2.14E+00	1.34E-01	7.22E-05	1.07E-02	2.76E-03	4.43E-02	1.44E+05	4.59E+03	97%
U-104	1.17E+00	1.09E+00	4.96E-02	9.28E+00	1.02E+03	3.22E+01	3.34E-02	1.04E+01	1.01E-01	2.75E-02	1.08E+00	2.25E-01	2.66E+00	3.85E-01	1.77E-02	1.28E-05	1.59E-03	3.66E-04	5.86E-03	2.70E+04	1.08E+03	96%
U-105	8.18E+00	5.50E+00	2.66E-01	5.52E+01	5.51E+03	2.00E+02	1.59E-01	1.29E+02	1.22E-01	5.61E-01	2.39E+01	4.92E+00	2.62E+01	7.95E+00	4.35E-01	2.62E-04	1.41E-02	9.08E-03	1.46E-01	1.34E+05	5.97E+03	96%
U-106	2.89E+00	2.80E+00	5.95E-01	4.53E+01	5.10E+03	8.98E+01	8.22E-02	1.26E+01	5.60E-02	2.73E-01	1.01E+01	2.15E+00	3.63E+01	3.82E+00	3.69E-01	1.27E-04	2.27E-02	7.54E-03	1.21E-01	7.87E+04	5.31E+03	93%
U-107	6.29E+00	4.74E+00	2.45E-01	4.75E+01	2.99E+03	2.00E+02	1.94E-01	8.33E+01	1.67E-01	2.67E-01	9.53E+00	2.04E+00	1.59E+01	3.79E+00	2.80E-01	1.26E-04	9.79E-03	5.78E-03	9.25E-02	8.59E+04	3.37E+03	96%
U-108	1.03E+01	6.72E+00	1.01E-01	2.26E+01	3.55E+03	2.46E+02	2.44E-01	3.15E+02	2.93E-01	1.70E-01	7.45E+00	1.62E+00	2.93E+00	2.73E+00	1.04E-01	7.87E-05	1.67E-03	2.15E-03	3.45E-02	1.34E+05	4.17E+03	97%
U-109	7.63E+00	5.46E+00	1.41E-01	5.55E+01	3.09E+03	1.93E+02	1.91E-01	1.58E+02	2.47E-01	5.58E-02	2.18E+00	4.69E-01	2.77E+00	8.28E-01	4.05E-02	2.60E-05	1.71E-03	8.34E-04	1.34E-02	1.07E+05	3.52E+03	97%
U-110	9.34E-01	8.48E-01	1.70E-02	7.18E+00	8.65E+02	2.63E+01	2.61E-02	1.41E+01	2.78E-02	1.27E-02	7.76E-01	1.43E-01	4.53E-01	1.58E-01	4.19E-03	5.31E-06	2.35E-04	8.55E-05	1.37E-03	1.34E+04	9.16E+02	93%
U-111	3.06E+00	3.12E+00	6.49E-02	3.39E+01	2.15E+03	1.10E+02	1.09E-01	1.05E+02	1.19E-01	9.23E-02	4.24E+00	8.54E-01	2.29E+00	1.22E+00	5.41E-02	4.10E-05	1.33E-03	1.12E-03	1.79E-02	5.98E+04	2.41E+03	96%
U-112	2.74E+00	1.03E+00	2.13E-02	1.23E+01	3.28E+03	3.48E+01	3.38E-02	2.06E+00	3.41E-02	2.50E-02	1.17E+00	2.35E-01	5.76E-01	3.31E-01	1.65E-02	1.11E-05	2.86E-04	3.40E-04	5.46E-03	2.39E+04	3.33E+03	86%
SX-101	9.51E+00	3.76E+00	1.51E-02	1.45E+01	3.74E+03	1.22E+02	1.45E-01	9.94E+01	5.05E-02	7.94E-02	3.55E+00	7.22E-01	2.03E+01	8.95E-01	2.05E-01	3.02E-05	1.09E-02	4.39E-03	6.89E-02	1.09E+05	4.01E+03	96%
SX-102	5.02E+00	4.06E+00	1.33E-02	1.13E+01	2.82E+03	1.37E+02	1.46E-01	3.68E+01	1.54E-01	3.84E-02	1.63E+00	3.41E-01	5.43E+00	5.09E-01	1.63E-01	1.72E-05	3.07E-03	3.37E-03	5.36E-02	1.38E+05	3.02E+03	98%
SX-103	8.44E+00	7.70E+00	3.24E-02	2.37E+01	6.06E+03	2.55E+02	2.61E-01	6.41E+01	3.56E-01	1.30E-01	5.93E+00	1.21E+00	7.73E+00	1.56E+00	4.07E-01	5.31E-05	4.61E-03	8.38E-03	1.34E-01	2.23E+05	6.43E+03	97%
SX-104	6.11E+00	4.63E+00	2.36E-02	1.44E+01	2.94E+03	1.56E+02	1.65E-01	7.22E+01	2.09E-01	9.83E-02	5.57E+00	1.10E+00	3.82E+00	1.14E+00	8.49E-02	3.93E-05	1.87E-03	1.74E-03	2.77E-02	1.06E+05	3.21E+03	97%
SX-105	6.37E+00	5.26E+00	7.87E-02	1.64E+01	5.36E+03	1.60E+02	1.64E-01	6.27E+01	2.56E-01	2.85E-01	1.56E+01	3.09E+00	9.15E+00	3.05E+00	1.48E-01	1.05E-04	5.65E-03	5.58E-03	8.19E-02	1.11E+05	5.64E+03	95%
SX-106	3.83E+00	4.14E+00	6.93E-02	3.07E+01	2.73E+03	1.61E+02	1.63E-01	6.14E+01	1.34E-01	2.83E-01	1.06E+01	2.24E+00	5.22E+00	3.90E+00	2.21E-01	1.30E-04	3.14E-03	5.06E-03	7.95E-02	1.06E+05	3.01E+03	97%

Table 4-5. 200W Feed Stream Key Radionuclide Activity. (2 pages)

Tank	H-3 (Ci)	C-14 (Ci)	Co-60 (Ci)	Ni-63 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	I-129 (Ci)	Cs-137 (Ci)	Np-237 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Am-241 (Ci)	Pu-241 (Ci)	Cm-242 (Ci)	Pu-242 (Ci)	Am-243 (Ci)	Cm-243 (Ci)	Cm-244 (Ci)	Feed Stream Total Activity (Ci)	Pretreated Waste Total Activity (Ci)	Percent Removed (%)
SX-107	2.86E+00	7.67E-01	9.24E-03	8.08E+00	1.37E+03	2.90E+01	2.69E-02	1.84E+01	1.63E-02	5.20E-02	2.06E+00	4.30E-01	6.14E+00	6.65E-01	3.33E-02	2.22E-05	4.39E-03	7.77E-04	1.22E-02	2.59E+04	1.43E+03	94%
SX-108	2.88E+00	4.42E-01	3.25E-03	3.82E+00	1.07E+03	1.57E+01	1.31E-02	1.69E+01	5.60E-03	2.79E-02	1.19E+00	2.45E-01	3.31E+00	3.27E-01	3.69E-02	1.10E-05	2.34E-03	1.40E-03	2.06E-02	2.11E+04	1.12E+03	95%
SX-109	1.20E+01	1.96E+00	7.40E-03	1.38E+01	4.25E+03	6.67E+01	4.75E-02	9.19E+01	1.10E-02	5.11E-02	1.80E+00	3.75E-01	1.66E+01	5.08E-01	3.86E-02	1.66E-05	1.24E-02	1.56E-03	2.28E-02	5.93E+04	4.46E+03	92%
SX-110	2.39E+00	2.40E-01	5.88E-04	1.48E+00	9.12E+02	9.87E+00	1.03E-02	2.35E+00	7.74E-04	8.70E-03	1.74E-01	3.99E-02	1.85E+00	7.23E-02	6.16E-03	2.24E-06	1.46E-03	2.71E-04	3.92E-03	1.15E+04	9.30E+02	92%
SX-111	6.13E+00	4.96E-01	7.28E-04	2.56E+00	1.81E+03	2.15E+01	2.97E-02	4.66E+00	7.54E-04	1.76E-02	4.56E-01	9.91E-02	2.08E+00	1.51E-01	1.64E-02	4.79E-06	1.64E-03	7.33E-04	1.06E-02	3.25E+04	1.85E+03	94%
SX-112	3.81E+00	2.82E-01	2.81E-04	1.36E+00	1.05E+03	1.21E+01	1.83E-02	2.63E+00	2.11E-04	9.78E-03	2.69E-01	5.79E-02	7.46E-01	8.48E-02	1.08E-02	2.70E-06	5.96E-04	4.82E-04	6.97E-03	2.16E+04	1.07E+03	95%
SX-113	1.66E+00	1.31E-01	8.96E-05	4.50E-01	2.91E+02	5.35E+00	8.28E-03	9.46E-01	1.65E-04	1.63E-03	5.77E-02	1.19E-02	2.06E-01	1.49E-02	4.29E-03	4.88E-07	1.14E-04	1.92E-04	2.77E-03	8.83E+03	2.99E+02	97%
SX-114	6.10E+00	6.26E-01	6.94E-03	6.63E+00	2.42E+03	2.21E+01	2.16E-02	1.95E+01	8.59E-03	2.75E-02	8.93E-01	1.87E-01	1.84E+01	2.48E-01	1.54E-02	8.06E-06	1.47E-02	6.83E-04	9.87E-03	3.27E+04	2.50E+03	92%
SX-115	9.32E-01	9.12E-02	1.30E-03	9.02E-01	1.69E+02	3.32E+00	3.22E-03	5.51E-01	1.27E-03	1.05E-01	1.96E+00	4.56E-01	2.62E+00	8.54E-01	3.74E-03	2.62E-05	2.10E-03	1.66E-04	2.41E-03	4.41E+03	1.81E+02	96%
Total	2.20E+02	1.39E+02	2.88E+00	1.08E+03	1.12E+05	5.38E+03	5.10E+00	2.76E+03	5.23E+00	3.96E+00	1.61E+02	3.32E+01	2.54E+02	4.84E+01	3.86E+00	1.84E-03	1.56E-01	1.66E-01	2.64E+00	3.28E+06	1.22E+05	96%

Source: RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document.*

4.3.1.6 Waste Classification Evaluation

The results of the waste classification evaluation are summarized in Table 4-6 and Table 4-7. The concentration of each key radionuclide for each West Area waste tank was compared to the NRC concentration limits for Class C LLW. The waste classification will be based on the sum of the fractions results for both long-lived and short-lived radionuclides, using the sum of the fractions rule set forth in 10 CFR 61.55(a)(7) and comparable provisions in the Texas and Utah administrative codes. The sum of fractions rule from 10 CFR 61.55 is used to determine the classification of waste that contains a mixture of radionuclides. It involves dividing each nuclide's concentration by the appropriate limit and adding the resulting values. The sum of fractions must be less than 1.0 for the waste class to be determined by that column. Based on the sum of fractions results for 10 CFR 61.55 Table 1 and Table 2, long-lived and short-lived radionuclide concentration limits, all West Area waste tanks after pretreatment and solidification will be below Class C concentration limits as shown in Table 4-6 and Table 4-7, and as discussed further in Section 6 of this Draft WIR Evaluation.[83]

Table 4-6. Tank-By-Tank Comparison of Pretreated Waste Concentrations to 10 CFR 61.55 Class C Concentration Limits Based on Table 1 and Table 2 Sum of Fractions. (3 pages)

Waste Tank	10 CFR 61.55 Table 1 Class C Sum of Fractions	10 CFR 61.55 Table 2 Class C Sum of Fractions
SY-101	5.53E-02	1.26E-04
SY-102	7.16E-02	1.37E-04
S-101	4.91E-02	2.30E-04
S-102	1.73E-02	1.14E-04
S-103	1.96E-02	1.01E-04
S-104	2.55E-02	1.79E-04
S-105	3.43E-02	9.63E-05
S-106	1.82E-02	8.98E-05
S-107	6.17E-02	1.62E-04
S-108	2.27E-02	9.61E-05
S-109	2.78E-02	1.56E-04
S-110	4.58E-02	1.38E-04
S-111	1.81E-02	1.35E-04
U-201	1.23E-02	7.15E-05
U-202	9.21E-03	5.38E-05

83 The Class C concentration limits are mirrored in WCS (2025).

Table 4-6. Tank-By-Tank Comparison of Pretreated Waste Concentrations to 10 CFR 61.55 Class C Concentration Limits Based on Table 1 and Table 2 Sum of Fractions. (3 pages)

Waste Tank	10 CFR 61.55 Table 1 Class C Sum of Fractions	10 CFR 61.55 Table 2 Class C Sum of Fractions
U-203	7.22E-03	4.27E-05
U-204	6.84E-03	3.64E-05
U-101	4.28E-03	6.91E-05
U-102	4.14E-02	1.82E-04
U-103	5.37E-02	1.23E-04
U-104	3.03E-02	1.02E-04
U-105	1.21E-01	2.00E-04
U-106	1.99E-01	3.48E-04
U-107	6.76E-02	1.11E-04
U-108	3.35E-02	1.06E-04
U-109	2.33E-02	1.11E-04
U-110	1.76E-02	1.10E-04
U-111	3.22E-02	1.17E-04
U-112	5.58E-03	8.44E-05
SX-101	5.61E-02	1.28E-04
SX-102	2.85E-02	1.10E-04
SX-103	3.72E-02	1.59E-04
SX-104	3.93E-02	1.27E-04
SX-105	6.63E-02	1.82E-04
SX-106	5.14E-02	1.06E-04
SX-107	7.26E-02	1.75E-04
SX-108	5.18E-02	1.77E-04
SX-109	5.01E-02	1.73E-04
SX-110	4.44E-02	2.74E-04
SX-111	2.37E-02	1.99E-04
SX-112	1.57E-02	1.67E-04

Table 4-6. Tank-By-Tank Comparison of Pretreated Waste Concentrations to 10 CFR 61.55 Class C Concentration Limits Based on Table 1 and Table 2 Sum of Fractions. (3 pages)

Waste Tank	10 CFR 61.55 Table 1 Class C Sum of Fractions	10 CFR 61.55 Table 2 Class C Sum of Fractions
SX-113	8.81E-03	8.28E-05
SX-114	9.83E-02	1.90E-04
SX-115	1.64E-01	8.59E-05

The sum of fractions rule from 10 CFR 61.55 is used to determine the classification of waste that contains a mixture of radionuclides. It involves dividing each nuclide's concentration by the appropriate Class C concentration limit and adding the resulting values. The sum of fractions must be less than 1.0 for the waste (in this case) to be Class C waste.

Waste from tank SY-103 will be transferred to tank SY-102 prior to SST retrievals, and will be processed with waste from SY-102 in the WARM pretreatment capability (RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document*).

DOE considers Energy*Solutions* (Clive) a potential option for solidification if the pretreated waste meets Class A concentration limits as discussed in Appendix D of this Draft WIR Evaluation.

Once pretreated, the pretreated liquid will be sent to one or more onsite or offsite solidification facilities. Potential facilities that could solidify the pretreated waste include:

1. Perma-Fix Northwest (PFNW) in Richland, Washington
2. Energy*Solutions* near Clive, Utah [Energy*Solutions* (Clive)]
3. Waste Control Specialists (WCS) near Andrews, Texas
4. Onsite facility, Hanford Site
5. Offsite commercial facility, Richland, Washington.

At the solidification facility(ies), the waste will be solidified prior to disposal. DOE will dispose of the pretreated and solidified waste as MLLW at one or more offsite, licensed, commercial disposal facilities, potentially Energy*Solutions* (Clive Disposal Facility) near Clive, Utah, and/or the WCS FWF, near Andrews, Texas. DOE has not made decisions on the location of either the solidification facility(ies) or the disposal facility(ies).

Table 4-7. Tank-By-Tank Comparison of Solidified Waste Concentrations to 10 CFR 61.55 Class C Concentration Limits Based on Table 1 and Table 2 Sum of Fractions. (2 pages)

Waste Tank	10 CFR 61.55 Table 1 Class C Sum of Fractions	10 CFR 61.55 Table 2 Class C Sum of Fractions
SY-101	3.37E-02	8.37E-05
SY-102	4.36E-02	9.07E-05
S-101	2.75E-02	1.51E-04
S-102	9.86E-03	7.59E-05
S-103	1.16E-02	6.69E-05
S-104	1.31E-02	1.21E-04
S-105	2.07E-02	6.54E-05
S-106	1.11E-02	5.98E-05
S-107	2.75E-02	1.08E-04
S-108	1.31E-02	6.35E-05
S-109	1.72E-02	1.03E-04
S-110	2.49E-02	9.14E-05
S-111	1.06E-02	8.90E-05
U-201	7.47E-03	4.74E-05
U-202	5.58E-03	3.59E-05
U-203	4.37E-03	2.86E-05
U-204	3.95E-03	2.44E-05
U-101	1.93E-03	4.67E-05
U-102	1.97E-02	1.21E-04
U-103	2.58E-02	8.18E-05
U-104	1.44E-02	6.80E-05
U-105	5.64E-02	1.32E-04
U-106	8.93E-02	2.34E-04
U-107	3.25E-02	7.39E-05
U-108	1.81E-02	7.05E-05
U-109	1.31E-02	7.33E-05

Table 4-7. Tank-By-Tank Comparison of Solidified Waste Concentrations to 10 CFR 61.55 Class C Concentration Limits Based on Table 1 and Table 2 Sum of Fractions. (2 pages)

Waste Tank	10 CFR 61.55 Table 1 Class C Sum of Fractions	10 CFR 61.55 Table 2 Class C Sum of Fractions
U-110	9.11E-03	7.30E-05
U-111	1.65E-02	7.73E-05
U-112	2.76E-03	5.69E-05
SX-101	2.69E-02	8.57E-05
SX-102	1.53E-02	7.22E-05
SX-103	2.01E-02	1.04E-04
SX-104	2.10E-02	8.35E-05
SX-105	3.21E-02	1.20E-04
SX-106	2.51E-02	7.03E-05
SX-107	3.26E-02	1.17E-04
SX-108	2.36E-02	1.19E-04
SX-109	2.31E-02	1.17E-04
SX-110	2.09E-02	1.85E-04
SX-111	1.14E-02	1.34E-04
SX-112	7.67E-03	1.12E-04
SX-113	4.55E-03	5.57E-05
SX-114	4.13E-02	1.28E-04
SX-115	6.75E-02	5.77E-05

The sum of fractions rule from 10 CFR 61.55 is used to determine the classification of waste that contains a mixture of radionuclides. It involves dividing each nuclide's concentration by the appropriate Class C concentration limit and adding the resulting values. The sum of fractions must be less than 1.0 for the waste (in this case) to be Class C waste.

Waste from tank SY-103 will be transferred to tank SY-102 prior to SST retrievals, and will be processed with waste from SY-102 in the WARM pretreatment capability (RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document*).

4.3.1.7 Summary of Removal of Key Radionuclides to the Maximum Extent Technically Practical

Key radionuclide removal from each batch of tank waste resulting from settling, decanting, filtration, and IX can be summarized based on the assessment of BBI estimates and resultant waste classification results for pretreated waste and solidified waste presented in Table 4-4, Table 4-6, and Table 4-7. Settling, decanting, filtration, and IX are proven technologies that will remove key radionuclides to the maximum extent technically practical. For example, approximately 99.9% of the Cs-137 will be removed. This soluble key radionuclide with a short half-life, when present at high enough concentrations, poses a risk to the health and safety of workers and the public merely by proximity to the waste. Therefore, IXCs and transfer-associated equipment will be shielded to protect the workers and the public during handling and transporting of the waste. Once these wastes are pretreated, the risk to the workers and the public will be very low based on CEES-CALC-604-C-005, *Dose Rate for the Test Bed Initiative Ion Exchange Column*.

As shown in Table 4-6 and Table 4-7, the pretreated waste and the solidified waste from each West Area tank will meet the WCS FWF WAC.[84] Meeting the WAC will ensure that the performance objectives will be achieved because waste meeting these criteria would not increase the assumed waste inventory used in the performance assessment analyses.

Given the removal efficiencies for settling, decanting, filtration, and IX and the minimal amounts of key radionuclides remaining in the pretreated waste, it would not be technically practical, sensible, or useful, using the risk-based approach, to further pretreat the waste to remove additional key radionuclides. As shown above, key radionuclides will be removed to the maximum extent technically practical.

4.3.2 Economic Practicality Assessment

The assessment of "economic practicality" includes consideration of benefits to worker and public health, safety, and the environment arising from further radionuclide removal, when compared to the cost—monetary as well as time/schedule, environmental, human health, and risk to safety—of additional removal of key radionuclides. Economic practicality includes consideration of total lifecycle costs, the cost per curie removed, the relationship between costs and removal of key radionuclides, and the point in this relationship at which removal costs increase significantly and thus become impractical. In this regard, removal of key radionuclides to the "maximum extent …economically practical" includes consideration of expert judgment, and whether the benefits to health and safety outweigh the disadvantages. In essence, "economic practicality" focuses on whether further radionuclide removal would be useful and sensible in light of the overall benefit to human health, safety, and the environment.[85]

[84] The Class C concentration limits are mirrored in WCS (2025). DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's licensed capacity.

[85] Both DOE and the NRC recognize that economic practicality may be shown by comparing the costs of additional removal of key radionuclides to the resulting benefits. This comparison may be quantitative or qualitative. See NUREG-1854, *NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations*.

As background, DOE will separate the LAW from other waste in the Hanford Site tanks and vitrify some of the LAW using the DFLAW approach, and will separate, pretreat, solidify, and dispose of additional pretreated supernate from tank SY-101 offsite under the Test Bed Initiative (TBI) Demonstration. In addition, as part of WARM project, DOE is planning to pretreat tank waste from SSTs in S, SX, and U Tank Farms, as well as some of the waste from DSTs in the SY Tank Farm (which will serve as receipt, qualification, and feed tanks). Specifically, the WARM project will involve pretreatment, solidification, and offsite disposal. The filtration and IX pretreatment processes for the 2,000-gallon TBI Demonstration using the In Tank Pretreatment System (ITPS),[86] the DFLAW approach using Tank Side Cesium Removal (TSCR),[87] and the WARM process modules are identical technologies which differ only in scale and configuration.

Numerous studies by the National Academies of Science, the Government Accountability Office, Federally Funded Research and Development Center teams, and DOE have recognized that using grout as a solidification approach may significantly reduce total lifecycle costs when compared to vitrification with certain assumptions, uncertainties, and funding.[88] When compared to vitrification, grouting is a less complex process, uses less energy, produces fewer carbon emissions, and produces minimal secondary waste. Grouting may expedite the schedule and disposition of Hanford tank waste. This approach may mitigate the need to construct new DSTs. Table 4-8 includes these studies by source.

Table 4-8. Studies that Include Potential Alternative Low-Activity Waste Treatment Approaches. (2 pages)

Study	Document
Pacific Northwest National Laboratory (2013)	*Supplemental Immobilization of Hanford Low-Activity Waste: Cast Stone Screening Tests*

86 See *Final Waste Incidental to Reprocessing Evaluation for the Test Bed Initiative Demonstration* (DOE/ORP-2022-02) and the *Waste Incidental to Reprocessing Determination for the Test Bed Initiative Demonstration at the Hanford Site, Washington* (ORP-68455).

87 See *Final Waste Incidental to Reprocessing Evaluation for Vitrified Low-Activity Waste and Secondary Waste at the Hanford Site, Washington* (DOE/ORP-2022-03) and the *Waste Incidental to Reprocessing Determination for Vitrified Low-Activity Waste and Secondary Wastes at the Hanford Site, Washington* (ORP-68704).

88 This Draft WIR Evaluation focuses on separation and pretreatment of tank waste from DSTs in SY Tank Farm and from SSTs in S, SX, and U Tank Farms located in the 200 West Area of the Hanford Site.

Alternative low-activity waste (LAW) treatment of other wastes in the above-referenced reports are outside the scope of this Draft WIR Evaluation. These reports are mentioned here for additional context and information and speak for themselves.

Table 4-8. Studies that Include Potential Alternative Low-Activity Waste Treatment Approaches. (2 pages)

Study	Document
National Academies of Sciences (2018a)	*Review of the Analysis of Supplemental Treatment Approaches of Low-Activity Waste at the Hanford Nuclear Reservation: Review #1*
National Academies of Sciences (2018b)	*Review of the Draft Analysis of Supplemental Treatment Approaches of Low-Activity Waste at the Hanford Nuclear Reservation: Review #2*
National Academies of Sciences (2019)	*Review of the Final Draft Analysis of Supplemental Treatment Approaches of Low-Activity Waste at the Hanford Nuclear Reservation: Review #3*
National Academies of Sciences (2020)	*Final Review of the Study on Supplemental Treatment Approaches of Low-Activity Waste at the Hanford Nuclear Reservation: Review #4*
U.S. Government Accountability Office, GAO-17-306 (2017)	*Nuclear Waste: Opportunities Exist to Reduce Risks and Costs by Evaluating Different Waste Treatment Approaches at Hanford*
Savannah River National Laboratory, SRNL-RP-2018-00687 (2018)	*Report of Analysis of Approaches to Supplemental Treatment of Low-Activity Waste at the Hanford Nuclear Reservation*
U.S. Department of Energy (2019)	*Department of Energy Test Bed Initiative at Hanford*, *Report to Congress*
U.S. Department of Energy, SRNL-STI-2020-00228 (2020a)	*Evaluation of Technologies for Enhancing Grout for Immobilizing Hanford Supplemental Low-Activity Waste (SLAW)*
U.S. Department of Energy, ORP-11242 (2020)	*River Protection Project System Plan*, Rev. 9
U.S. Government Accountability Office, GAO-22-104365 (2021)	*NUCLEAR WASTE DISPOSAL* *Actions Needed to Enable DOE Decision That Could Save Tens of Billions of Dollars*
Savannah River National Laboratory,	*Follow-on Report of Analysis of Approaches to Supplemental Treatment of Low-Activity Waste at the Hanford Nuclear Reservation*

Table 4-8. Studies that Include Potential Alternative Low-Activity Waste Treatment Approaches. (2 pages)

Study	Document
SRNL-STI-2023-00007, Volume I and II (2023)	

The WARM project includes retrieval of tank waste from SSTs located in the S, SX, and U tank farms into DSTs located in SY tank farms. Implementation of this project will:

- Support SST retrieval independent of ongoing DFLAW operations.
- Facilitate pretreatment of 200 West Area tank waste.
- Support the 200 West Area mission including Consent Decree milestones for retrieving SSTs.

Additionally, the WARM project will:

- Verify the capability to pretreat tank waste using settling, decanting, and filtration and IX in the WARM process modules.
- Verify the ability of the pretreated tank waste to meet the WAC for onsite or offsite, solidification facility(ies) and offsite, licensed, and permitted disposal facility(ies) at an operational scale level.[89]
- Verify the efficiency, cost-effectiveness, and feasibility of full-scale operations using offsite disposal.
- Verify at an operational capacity that all activities (pretreating, transporting, solidifying, and disposing) for Hanford tank waste can be performed safely and will protect human health and the environment.
- Produce no liquid secondary waste.
- Include the use of and quantify the benefits of using commercial offsite facilities for disposal.
- Provide a cost savings for disposing of tank waste offsite versus vitrifying waste onsite.

[89] DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's licensed capacity.

4.3.2.1 Evaluation of Whether Further Pretreatment for Additional Removal of Key Radionuclides is Economically Practical

As explained previously, the "maximum extent …economically practical" criterion involves consideration of whether further radionuclide removal would be useful and sensible in light of costs and the overall benefit to human health, safety, and the environment.

Table 4-4 shows that most of the curies attributable to key radionuclides will be removed by settling, decanting, filtration, and IX. For example, 99.9% of the Cs-137 will be removed by IX. Once these wastes are pretreated, the risk to the workers and the public will be very low during operations and after disposal (CEES-CALC-604-C-005).

As shown in Table 4-6 and Table 4-7, the pretreated and solidified waste will meet the WCS FWF WAC.[90,91] Meeting the WAC will ensure that the performance objectives will be achieved because waste meeting these criteria would not increase the assumed waste inventory used in the performance assessment analyses.[92] Under these circumstances, further removal of key radionuclides using additional passes through IX or other removal technology would provide a negligible reduction in dose to the workers, the public, or the hypothetical inadvertent human intruder.

Additional pretreatment to further remove key radionuclides would increase costs and schedule of pretreatment, solidification, and offsite disposal of tank waste. These costs and schedule impacts include the following:

- Financial costs of additional pretreatment processes for radionuclide removal.
- Increase in amounts of spent IX resin media used and an increase in spent columns requiring disposition.

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[90] The Class C concentration limits are mirrored in WCS (2025).

[91] DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's licensed capacity.

[92] The WAC in WCS (2025) ensures that compliance with the performance objectives will be achieved. The rationale for this conclusion for the WCS FWF is summarized as follows:

1. *Texas Administrative Code* in Title 30 Rules 336.723-727 set forth performance objectives for LLW disposal facilities comparable to those of 10 CFR 61, Subpart C;
2. Disposal site performance, in compliance with the performance objectives, is determined by meeting the WAC of the LLW disposal facility;
3. The WAC are based on the projected total inventory, thus linking these criteria directly to the calculated disposal site performance;
4. The treated and solidified supernate will meet the WAC, as set forth in WCS (2025); and,
5. Meeting the WAC will therefore ensure that the performance objectives will be achieved, because waste meeting these criteria would not increase the assumed waste inventory used in the performance assessment analyses.

- Potential increase in radiological dose to workers.
- The potential need to construct new DSTs to replace SSTs that may leak due to mission delays and continued storage.
- Risk missing Consent Decree milestones for SST retrieval.
- Delay associated with future SST leaks due to aging tanks.[93] DOE recognizes that tank leaks could extend tank waste treatment efforts by 25 years and cost an additional $91 billion.[94]

Table 4-9 lists potential costs and benefits associated with further removal of key radionuclides from the pretreated West Area tank waste.

Table 4-9. Potential Costs and Benefits Associated with Performing Additional Radionuclide Removal.

Potential Benefits	Potential Costs
Potential negligible reduction in dose from disposal to a member of the public and the hypothetical inadvertent human intruder.	Financial costs of additional radionuclide removal.
Potential negligible reduction in radiological dose to workers and members of the public during waste stabilization, handling, and transportation.	Increase in amounts of spent resin requiring disposition.
	Potential increase in dose to radiological workers during pretreatment.

[93] RPP-10435, *Single-Shell Tank System Integrity Assessment Report* states, "The tanks were built from 1943 to 1964 resulting in a current average tank life of about 50 years. Although no design life is formally declared in the SST final design specifications, the common understanding is that the intended SST design life is about 25 years, indicating that all tanks are well beyond their intended design life."

[94] See ORP-11242, *River Protection Project System Plan*, Rev. 7. This cost figure is based on a comparison between Case 1 (Consent Decree Compliant Case) and Case 4 (Leaking Tanks Case). The net schedule effect is a lifecycle mission duration of 25 years longer for Case 4 (2020-2075) versus Case 1 (2020-2050) and includes escalation during these intervals. No new DSTs were assumed to be constructed in Case 4. The costs for Tank Waste and Characterization Staging and Low-Activity Waste Pretreatment System were in Case 4 and were not in Case 1, which added some costs, but most of the increased costs were due to the longer mission duration.

Table 4-9. Potential Costs and Benefits Associated with Performing Additional Radionuclide Removal.

Potential Benefits	Potential Costs
	The potential need to construct new DSTs to replace those SSTs that may leak due to mission delays and continued storage.
	Risk missing Consent Decree milestones for single-shell tank retrieval.
	Delay associated with future tank leaks due to aging tanks. U.S. Department of Energy recognizes that tank leaks could extend tank waste treatment efforts by 25 years and cost an additional $91 billion.

4.4 SUMMARY AND CONCLUSIONS

The technical practicality assessment as discussed in Section 4.3.1 shows that settling, decanting, filtration, and CST IX will remove key radionuclides to the maximum extent technically practical. Based on the inventory estimates of key radionuclides, the majority of the curies attributable to key radionuclides will be removed. For example, 99.9% of the Cs-137 will be removed by IX. Once this waste is pretreated, the pretreated and solidified waste will be below the NRC Class C concentration limits in 10 CFR 61.55 as shown in Table 4-6.

As demonstrated, the pretreated and solidified waste will meet the WAC as specified in WCS (2025) even considering the potential disposal of 100% of the pretreated and solidified waste at the WCS FWF. DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to WCS if it can be accommodated by the WCS FWF licensed capacity.

Furthermore, potential disposal of the pretreated and solidified waste at the Energy*Solutions* (Clive Disposal Facility) would be based on meeting the Class A concentration limits and the Energy*Solutions* (Clive) WAC. Although meeting Class A concentration limits is not a WIR criterion of DOE M 435.1-1, DOE considers Energy*Solutions* (Clive) a potential option if the pretreated and solidified waste meets Class A concentration limits as discussed in Appendix D of this Draft WIR Evaluation.

The economic practicality assessment discussed in Section 4.3.2 shows that additional pretreatment would have significant costs and result in a negligible reduction in dose to workers, members of the public, and the hypothetical inadvertent human intruder. Accordingly, this Draft WIR Evaluation demonstrates that key radionuclides will be removed to the maximum extent technically and economically practical.

5.0 CRITERION 2: THE WASTE WILL BE MANAGED TO MEET SAFETY REQUIREMENTS COMPARABLE TO THE PERFORMANCE OBJECTIVES AT 10 CFR 61, SUBPART C

Section Purpose

The purpose of this section is to evaluate whether the pretreated and solidified supernate from West Area tanks will be managed to meet safety requirements comparable to the performance objectives at 10 CFR 61, Subpart C for offsite disposal of LLW.

Section Contents

This section addresses whether disposal of the pretreated and solidified supernate from West Area tanks will meet safety requirements comparable to the performance objectives in 10 CFR 61, Subpart C for offsite disposal of LLW and explains that there is reasonable assurance that those performance objectives will be met.

Key Points

The performance objectives in the *Utah Administrative Code* and the *Texas Administrative Code* applicable to Energy*Solutions* (Clive Disposal Facility) and WCS LLW disposal facility for federal waste mirror the performance objectives in 10 CFR 61, Subpart C, and the facilities must be operated to provide reasonable assurance that those performance objectives will be met.

Disposal of the pretreated and solidified supernate at WCS FWF and/or Energy*Solutions* (Clive Disposal Facility) will meet safety requirements comparable to the performance objectives at 10 CFR 61, Subpart C. Although meeting Class A concentration limits is not a WIR criterion of DOE M 435.1-1, DOE considers Energy*Solutions* (Clive Disposal Facility) a potential option if the pretreated and solidified waste meets Class A concentration limits as discussed in Appendix D of this Draft WIR Evaluation. DOE has not made decisions on the location of either the solidification facility(ies) or the disposal facility(ies).

5.1 INTRODUCTION

The second criterion of Chapter II.B(2)(a)(2) of DOE M 435.1-1 provides:

> "[The waste w]ill be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*."

This section addresses this criterion as follows:

Section 5.2 summarizes NRC performance objectives for disposal of LLW and compares these to the State of Utah and State of Texas requirements.

Section 5.3 discusses the WAC for Energy*Solutions* (Clive Disposal Facility) and WCS FWF and how meeting those criteria will ensure that the performance objectives will be met.

5.2 PERFORMANCE OBJECTIVES

DOE will dispose of the pretreated and solidified supernate at one or more offsite facilities, potentially Energy*Solutions* (Clive Disposal Facility) or WCS FWF.[95,96]

Energy*Solutions* (Clive Disposal Facility) is required to comply with the State of Utah requirements set forth in the *Utah Administrative Code* R313-25-19 through R313-25-23. The WCS FWF is required to comply with the State of Texas performance objectives set forth in *Texas Administrative Code,* Title 30, Rules 336.723 through 727. The requirements and performance objectives in the State of Utah and the State of Texas regulations are akin to the NRC performance objectives at 10 CFR 61, Subpart C (i.e., they are essentially identical except for the use of different section numbers).

WCS has developed waste acceptance criteria (WAC) and other requirements set forth in WCS (2025), for disposal at the FWF. The WAC are premised on meeting the disposal site's limits and ensure continued compliance with the State of Texas performance objectives. Disposal of the pretreated and solidified supernate in accordance with the facility's WAC will therefore provide reasonable assurance that the performance objectives will be achieved.

Energy*Solutions* has developed its WAC and other requirements, set forth in Energy*Solutions* (2025), for disposal at Energy*Solutions* (Clive Disposal Facility). The WAC are premised on meeting the disposal site's limits and ensuring continued compliance with the State of Utah requirements. Disposal of the treated and solidified supernate in accordance with the facility's WAC will therefore provide reasonable assurance that the Utah requirements will be achieved.

DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's approved and licensed capacity. To the extent activity limits and volume limitations are part of any facility's WAC, this further ensures the 10 CFR Part 61, Subpart C performance objectives are met.

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[95] DOE M 435.1-1, Section I.2.F(4) requires approval of an exemption for such offsite disposal at a non-DOE site, and notification to certain DOE offices and the Program Secretarial Officer of the basis for using any non-DOE radioactive waste disposal facility prior to the use of such facility.

[96] Waste generated by Federal entities, which includes LLW generated by DOE, is disposed of in a separate landfill disposal unit at the WCS called the Federal Waste Facility (FWF). The waste acceptance process requires the generator to identify the waste class prior to shipment.

5.2.1 General Requirement

The general requirement in NRC's performance objectives for licensed LLW disposal facilities at 10 CFR 61.40, "General Requirement" sets forth the following requirement:

> "Land disposal facilities must be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to humans are within the limits established in the performance objectives in §§ 61.41 through 61.44."

The State of Texas performance objective requirement (*Texas Administrative Code*, 30 TAC Rule 336.723) mirrors the NRC general requirement, as shown in Appendix A.

The *Utah Administrative Code* sets forth the following in R313-25-19, "General Requirement":

> "Land disposal facilities shall be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to individuals do not exceed the limits stated in Sections R313-25-20 and 25-23."

The Utah requirement is akin to the NRC general requirement, as shown in Appendix A.

5.2.2 Protection of the General Population from Releases of Radioactivity

The NRC performance objective at 10 CFR 61.41, "Protection of the General Population from Releases of Radioactivity" provides:

> "Concentrations of radioactive material which may be released to the general environment in groundwater, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable."

The State of Texas requirement for protection of the general population mirrors the NRC requirement as shown in Appendix A.

The *Utah Administrative Code* R313-25-20, "Protection of the General Population from Releases of Radioactivity," sets forth the following requirement:

> "Concentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants or animals shall not result in an annual dose exceeding an equivalent of 0.25 mSv (0.025 rem) to the whole body, 0.75 mSv (0.075 rem) to the thyroid, and 0.25 mSv (0.025 rem) to any other organ of any member of the public. No greater than 0.04 mSv (0.004 rem) committed effective dose equivalent or total effective dose

> equivalent to any member of the public shall come from groundwater. Reasonable efforts should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable."

The Utah requirement for protection of the general population is akin to the NRC requirement as shown in Appendix A.

5.2.3 Protection of Individuals from Inadvertent Intrusion

The NRC performance objective at 10 CFR 61.42, "Protection of Individuals from Inadvertent Intrusion" sets forth the following requirement:

> "Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed."

Pursuant to NRC guidance in *NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations, Draft Final Report for Interim Use* (NUREG-1854), which references the *Final Environmental Impact Statement on 10 CFR Part 61 "Licensing Requirements for Land Disposal of Radioactive Waste",* Volume 2 (NUREG-0945), NRC applies an annual whole body dose equivalent limit of 500 mrem per year, after removal of active institutional controls, to assess intruder scenarios and protection of the hypothetical inadvertent human intruder.

The State of Texas performance objective for protection of individuals from inadvertent intrusion is similar to the NRC performance objective as shown in Appendix A.

The *Utah Administrative Code* R313-25-21, "Protection of Individuals from Inadvertent Intrusion," provides:

> "Design, operation, and closure of the land disposal facility shall ensure protection of any individuals inadvertently intruding into the disposal site and occupying the site or contacting the waste after active institutional controls over the disposal site are removed."

The State of Utah requirement for protection of individuals from inadvertent intrusion is akin to the NRC performance objective as shown in Appendix A.

5.2.4 Protection of Individuals During Operations

The NRC performance objective at 10 CFR 61.43, Protection of Individuals during Operations, provides:

> "Operations at the land disposal facility must be conducted in compliance with the standards for radiation protection set out in part 20 of this chapter, except for

> releases of radioactivity in effluents from the land disposal facility, which shall be governed by § 61.41 of this part. Every reasonable effort shall be made to maintain radiation exposures as low as is reasonably achievable."

The State of Texas requirement in the *Texas Administrative Code*, 30 TAC Rule 336.726, "Protection of Individuals during Operations," is comparable to the NRC performance objective in 10 CFR 61.43. In addition, the "Standards for Protection Against Radiation" in the *Texas Administrative Code*, 30 TAC Rule 336.305, "Occupational Dose Limits for Adults," *et seq.*, parallel the NRC requirements in 10 CFR Part 20, "Standards for Protection Against Radiation," cross-referenced in 10 CFR 61.43.

The *Utah Administrative Code* R313-25-22, "Protection of Individuals during Operations" sets forth the following requirement for the protection of individuals during operations:

> "Operations at the land disposal facility shall be conducted in compliance with the standards for radiation protection set out in Rule R313-15 of these rules, except for release of radioactivity in effluents from the land disposal facility, which shall be governed by Section R313-25-20. Every reasonable effort should be made to maintain radiation exposures as low as is reasonably achievable, ALARA."

The State of Utah requirement is comparable to the NRC requirement in 10 CFR 61.43. Furthermore, the *Utah Administrative Code*, R313-15 *et seq*. mirrors the NRC requirements in 10 CFR Part 20, cross-referenced in 10 CFR 61.43.

5.2.5 Stability of the Disposal Site After Closure

The NRC performance objective at 10 CFR 61.44, "Stability of the Disposal Site After Closure," provides:

> "The disposal facility must be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required."

The WCS license application (*Application for License to Authorize Near-Surface Land Disposal of Low-Level Radioactive Waste, Section 8: Performance Assessment* [WCS 2007]) – in Volume 2, Section 6, "Closure" – describes features of the planned closure system for that facility to meet the State requirements and the NRC requirements for stability of the disposal site after closure. These features include a depth of disposal significantly greater than 5 m (16.4 ft) for all waste.[97]

[97] In addition, WCS FWF will become the property of DOE after site closure, which accepts only federally generated waste for disposal. DOE will assume the requirements for long-term surveillance and maintenance.

The State of Texas requirement for stability of the disposal site after closure mirrors the NRC requirement as shown in Appendix A.

The State of Utah sets forth the requirement for Stability of the Disposal Site After Closure in the *Utah Administrative Code*, R313-25-23, which provides:

> "The disposal facility shall be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate, to the extent practicable, the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required."

The State of Utah requirement for stability of the disposal site after closure mirrors the NRC requirement as shown in Appendix A.[98]

5.3 THE PRETREATED AND SOLIDIFIED WASTE WILL MEET THE DISPOSAL SITE WASTE ACCEPTANCE CRITERIA

To help establish the relationship between the WAC and the performance objectives of the waste disposal site, this subsection provides a summary of the disposal site WAC and addresses meeting Energy*Solutions* (Clive Disposal Facility) and WCS FWF WAC.

5.3.1 Meeting the Energy*Solutions* (Clive Disposal Facility) and Waste Control Specialists Federal Waste Facility Waste Acceptance Criteria

The WCS WAC document, *Federal Waste Facility (FWF) Generator Handbook* (WCS 2025), addresses matters such as operations and regulatory parameters, pre-shipment requirements, documentation, and transportation and provides various forms including a waste profile sheet. The *Federal Waste Facility (FWF) Generator Handbook* also contains the license volume and curie limitations for the WCS FWF.

Energy*Solutions* (Clive Disposal Facility) WAC document, *Bulk Waste Disposal and Treatment Facilities Waste Acceptance Criteria* (Energy*Solutions* 2025), addresses matters such as operations and regulatory parameters, pre-shipment requirements, documentation, and transportation and provides various forms including a waste profile sheet.

[98] The design and operation of the Energy*Solutions* disposal site provides a long-term disposal solution with a minimal need for active maintenance after closure. Energy*Solutions* uses an above ground engineered disposal cell. The design of these cells is patterned after DOE and EPA specifications for the VITRO disposal embankment. Each licensed disposal embankment meets or exceeds the applicable regulatory requirement from Energy*Solutions* (2025).

The WCS license, *Radioactive Material License No. R04100* issued by the TCEQ, contains additional requirements related to waste disposal, including total activity (total decay corrected activity) limitations for the WCS FWF.[99,100]

DOE will only ship waste offsite for disposal in the WCS FWF in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite for disposal in the WCS FWF if it can be accommodated by the facility's licensed capacity. Meeting the WAC for the WCS FWF will ensure that the 10 CFR Part 61, Subpart C performance objectives will be met.

The total activity in the separated and pretreated waste after solidification from SSTs in S, SX, and U Tank Farms (plus some of the waste from DSTs in the SY tank farm) for potential disposal in the WCS FWF is anticipated to be less if some portion of the pretreated waste were sent to WCS and another portion to Energy*Solutions*, based on meeting the WAC of the applicable disposal facility.[101]

Although meeting Class A concentration limits is not a WIR criterion of DOE M 435.1-1, DOE considers Energy*Solutions* (Clive Disposal Facility) a potential option if the pretreated and solidified waste meets Class A concentration limits as discussed in Appendix D of this Draft WIR Evaluation. DOE has not made decisions on the location of the disposal facility(ies).

The solidification facility(ies) will follow all requirements necessary for characterization and documentation for demonstrating that the pretreated and solidified waste will meet the WAC for disposal at Energy*Solutions* (Clive Disposal Facility) and/or the WCS FWF prior to shipment.[102]

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[99] Decay correction is a method of estimating the amount of radioactive decay at some set time before it was measured. Considering all SSTs located in S, SX, and U Tank Farms as well as DSTs SY-101 and SY-102, 122,000 curies was estimated from key radionuclides in the pretreated waste are not decay corrected. If the activity were decay corrected, the resulting activity would be less.

[100] The TCEQ license for WCS has been amended several times. The current license, as amended by license amendment 41, was issued on November 14, 2025.

[101] This activity is based on contributions from key radionuclides in pretreated waste considering all SSTs in S, SX, and U Tank Farms. This activity estimate conservatively assumes that 100 percent of this waste would be above Class A concentration limits, and may be disposed of at the WCS FWF.

[102] DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's licensed capacity.

6.0 CRITERION 3: THE WASTE WILL BE IN A SOLID PHYSICAL FORM AND WILL NOT EXCEED CLASS C LOW-LEVEL WASTE CONCENTRATION LIMITS

Section Purpose

The purpose of this section is to demonstrate that the pretreated and solidified waste will be in a solid physical form, will not exceed Class C concentration limits, and will be managed as LLW.

Section Contents

Table 6-3, Table 6-4, Table 6-5, and Table 6-6 of this section provide information showing that the all the pretreated and solidified West Area tank waste will not exceed the concentration limits for Class C LLW in 10 CFR 61.55 and will be managed as LLW.

Key Points

- The pretreated and solidified waste will be in a solid physical form prior to disposal.
- The radioactivity in the pretreated and solidified waste will not exceed Class C concentration limits.
- The pretreated and solidified tank waste will be disposed of at an offsite LLW disposal facility in accordance with applicable requirements for LLW.

6.1 INTRODUCTION

The third and final criterion of DOE M 435.1-1, Chapter II.B(2)(a)(3), provides:

> "[The wastes are] to be managed, pursuant to DOE's authority under the *Atomic Energy Act of 1954*, as amended, and in accordance with the provisions of Chapter IV of this Manual, provided the waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55, *Waste Classification*[.]"

6.2 10 CFR 61.55 WASTE CONCENTRATION LIMITS

The following analysis evaluates whether the pretreated and solidified waste will meet concentration limits for Class C LLW as set out in 10 CFR 61.55 and 30 Texas Administrative Code Rule 336.362, Appendix E, (a)(7).[103] In this analysis, a significant amount of Cs-137 (approximately 99.9%) will be removed by the IXCs. The filtration step will remove entrained solids (including insoluble long-lived radionuclides).

The NRC concentration limits for Class C LLW at 10 CFR 61.55 are set forth in two tables, reproduced below, and in comparable tables in the Texas Administrative Code.

[103] Class A concentration limits per 10 CFR 61.55 are included in Appendix D of this Draft WIR Evaluation. As discussed in Appendix D, some of the waste may meet Class A concentration limits and thus potentially be disposed of at Energy*Solutions* (Clive Disposal Facility). Meeting Class A concentrations is not a WIR criterion under DOE Manual 435.1-1, Chapter II.B(2)(a), however.

Table 6-1. U.S. Nuclear Regulatory Commission 10 CFR 61.55 Table 1 Radionuclide Concentration Limits.

Radionuclide	Concentration (Ci/m^3)
C-14	8
C-14 in activated metal	80
Ni-59 in activated metal	220
Nb-94 in activated metal	0.2
Tc-99	3
I-129	0.08
Alpha emitting transuranic nuclides with half-life greater than 5 years	100[a]
Pu-241	3,500[a]
Cm-242	20,000[a]

[a] Units are nanocuries per gram.

Source: Title 10, *Code of Federal Regulations*, Part 61, Subpart D—Technical Requirements for Land Disposal Facilities, § 61.55, "Waste Classification" (10 CFR 61.55).

Table 6-2. U.S. Nuclear Regulatory Commission 10 CFR 61.55 Table 2 Radionuclide Concentration Limits.

Radionuclide	Concentration (Ci/m^3)		
	Column 1	Column 2	Column 3
Total of all nuclides with less than 5-year half-life	700	[a]	[a]
H-3	40	[a]	[a]
Co-60	700	[a]	[a]
Ni-63	3.5	70	700
Ni-63 in activated metal	35	700	7,000
Sr-90	0.04	150	7,000
Cs-137	1	44	4,600

[a] There are no limits established for these radionuclides in Class B and C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentration of these wastes. These wastes shall be Class B unless the concentrations of other nuclides in Table 2 determine the waste to be Class C independent of these nuclides.

Source: Title 10, *Code of Federal Regulations*, Part 61, Subpart D, 61.55, "Waste Classification" (10 CFR 61.55).

In accordance with 10 CFR 61.55, the determination of the class of the waste is made by one of four different methods.

1) If the waste contains only the long-lived radionuclides listed in 10 CFR 61.55 Table 1, then classification is determined by 10 CFR 61.55(a)(3), as follows:

10 CFR 61.55 (a)(3) – "*Classification determined by long-lived radionuclides.* If radioactive waste contains only radionuclides listed in Table 1, classification shall be determined as follows:

(i) If the concentration does not exceed 0.1 times the value in Table 1, the waste is Class A.

(ii) If the concentration exceeds 0.1 times the value in Table 1 but does not exceed the value in Table 1, the waste is Class C.

(iii) If the concentration exceeds the value in Table 1, the waste is not generally acceptable for near-surface disposal.

(iv) For wastes containing mixtures of radionuclides listed in Table 1, the total concentration shall be determined by the sum of fractions rule described in paragraph (a)(7) of this section."

2) If the waste contains only the short-lived radionuclides contained in 10 CFR 61.55 Table 2, then classification is determined by 10 CFR 61.55(a)(4). 10 CFR 61.55(a)(4) provides:

10 CFR 61.55 (a)(4) – "*Classification determined by short-lived radionuclides.* If radioactive waste does not contain any of the radionuclides listed in Table 1, classification shall be determined based on the concentrations shown in Table 2. However, as specified in paragraph (a)(6) of this section, if radioactive waste does not contain any nuclides listed in either Table 1 or 2, it is Class A.

(i) If the concentration does not exceed the value in Column 1, the waste is Class A.

(ii) If the concentration exceeds the value in Column 1, but does not exceed the value in Column 2, the waste is Class B.

(iii) If the concentration exceeds the value in Column 2, but does not exceed the value in Column 3, the waste is Class C.

(iv) If the concentration exceeds the value in Column 3, the waste is not generally acceptable for near-surface disposal.

(v) For wastes containing mixtures of the nuclides listed in Table 2, the total concentration shall be determined by the sum of fractions rule described in paragraph (a)(7) of this section."

3) If the waste, as here, contains a mixture of short-lived and long-lived radionuclides, classification is determined by 10 CFR 61.55(a)(5) and the sum of fractions rule in 10 CFR 61.55(a)(7), discussed below. 10 CFR 61.55 (a)(5) provides:

10 CFR 61.55 (a)(5) – "*Classification determined by both long- and short-lived radionuclides.* If radioactive waste contains a mixture of radionuclides, some of which are listed in Table 1, and some of which are listed in Table 2, classification shall be determined as follows:

(i) If the concentration of a nuclide listed in Table 1 does not exceed 0.1 times the value listed in Table 1, the class shall be determined by the concentration of nuclides listed in Table 2.

(ii) If the concentration of a nuclide listed in Table 1 exceeds 0.1 times the value listed in Table 1 but does not exceed the value in Table 1, the waste shall be Class C, provided the concentration of nuclides listed in Table 2 does not exceed the value shown in Column 3 of Table 2."

4) If the waste does not contain any of the radionuclides listed in either of the tables, then classification is determined by 10 CFR 61.55(a)(6), as follows:

10 CFR 61.55 (a)(6) – "*Classification of wastes with radionuclides other than those listed in Tables 1 and 2.* If radioactive waste does not contain any nuclides listed in either Table 1 or 2, it is Class A."

This provision does not apply to the waste addressed by this Draft WIR Evaluation.

The NRC regulations further provide that for wastes which contain a mixture of radionuclides, the classification is determined by the sum of the fractions rule, as set forth in 10 CFR 61.55(a)(7). 10 CFR 61.55(a)(7) provides:

10 CFR 61.55 (a)(7) "*The sum of the fractions rule for mixtures of radionuclides.* For determining classification for waste that contains a mixture of radionuclides, it is necessary to determine the sum of fractions by dividing each nuclide's concentration by the appropriate limit and adding the resulting values. The appropriate limits must all be taken from the same column of the same table. The sum of the fractions for the column must be less than 1.0 if the waste class is to be determined by that column. Example: A waste contains Sr-90 in a concentration of 50 Ci/m^3 and Cs-137 in a concentration of 22 Ci/m^3. Since the concentrations both exceed the values in Column 1, Table 2, they must be compared to Column 2 values. For Sr-90 fraction 50/150 = 0.33; for Cs-137 fraction, 22/44 = 0.5; the sum of the fractions = 0.83. Since the sum is less than 1.0, the waste is Class B."

The pretreated and solidified LLW to be disposed of will contain a mixture of short-lived and long-lived radionuclides from NRC Table 1 and Table 2. Therefore, the waste concentration limits are determined in accordance with 10 CFR 61.55(a)(5) and the sum of fractions rule as specified in 10 CFR 61.55(a)(7) and 30 *Texas Administrative Code* section 336.362 Appendix E, (a)(7), which parallels the NRC regulations.

As provided in 10 CFR 61.55(a)(5), if the concentration of a radionuclide listed in 10 CFR 61.55, Table 1 does not exceed 0.1 times the value listed in Table 1, the class shall be that determined by the concentration of nuclides listed in Table 4-2 (10 CFR 61.55, Table 2). If, however, the 0.1 threshold is exceeded, but the sum of fractions is still below 1.0, then the waste is Class C according to Table 1. As shown in Table 6-3 and Table 6-5 below and all West Area tanks exceed the 0.1 threshold. Table 6-4 and Table 6-6 below show that the Class C sum of fractions for 10 CFR 61.55 Table 2 radionuclides are below 1.0, which means the waste is Class C LLW.

Table 6-3. Waste Classification Evaluation for Pretreated Liquid Based on 10 CFR 61.55 Table 1 Class C Sum of Fractions for Long-Lived Radionuclides. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class C Sum of Fractions
SY-101	8.21E-05	1.20E-03	4.00E-02	2.42E-05	3.14E-06	1.40E-02	5.53E-02
SY-102	8.86E-05	1.49E-03	5.12E-02	3.18E-05	4.27E-06	1.87E-02	7.16E-02
S-101	1.20E-04	5.23E-04	2.46E-02	6.15E-05	1.44E-06	2.38E-02	4.91E-02
S-102	1.09E-04	3.04E-04	9.94E-03	3.02E-05	1.02E-06	6.92E-03	1.73E-02
S-103	1.35E-04	4.72E-04	1.28E-02	2.71E-05	4.68E-07	6.11E-03	1.96E-02
S-104	9.59E-05	2.92E-04	8.08E-03	6.54E-05	1.32E-07	1.70E-02	2.55E-02
S-105	2.58E-04	7.64E-04	2.06E-02	1.53E-05	1.93E-07	1.27E-02	3.43E-02
S-106	1.63E-04	4.82E-04	1.29E-02	7.40E-06	1.39E-07	4.66E-03	1.82E-02
S-107	1.25E-04	1.81E-04	5.61E-03	2.82E-04	1.65E-07	5.55E-02	6.17E-02
S-108	1.61E-04	4.92E-04	1.33E-02	2.40E-05	4.60E-07	8.76E-03	2.27E-02
S-109	2.41E-04	7.53E-04	2.01E-02	2.04E-05	1.19E-07	6.67E-03	2.78E-02
S-110	2.18E-04	6.44E-04	1.74E-02	7.98E-05	4.87E-07	2.74E-02	4.58E-02
S-111	1.24E-04	4.37E-04	1.16E-02	1.94E-05	1.30E-07	5.83E-03	1.81E-02
U-201	9.21E-05	3.38E-04	8.99E-03	1.10E-05	5.51E-08	2.89E-03	1.23E-02
U-202	6.99E-05	2.52E-04	6.71E-03	8.26E-06	4.02E-08	2.16E-03	9.21E-03
U-203	5.59E-05	1.97E-04	5.26E-03	6.51E-06	3.12E-08	1.70E-03	7.22E-03

Table 6-3. Waste Classification Evaluation for Pretreated Liquid Based on 10 CFR 61.55 Table 1 Class C Sum of Fractions for Long-Lived Radionuclides. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class C Sum of Fractions
U-204	4.68E-05	1.61E-04	4.31E-03	8.42E-06	2.54E-08	2.31E-03	6.84E-03
U-101	1.29E-05	4.05E-05	9.58E-04	1.07E-05	7.49E-09	3.26E-03	4.28E-03
U-102	1.03E-04	3.37E-04	8.05E-03	1.40E-04	5.44E-07	3.28E-02	4.14E-02
U-103	1.39E-04	4.21E-04	1.11E-02	9.53E-05	1.05E-06	4.19E-02	5.37E-02
U-104	8.63E-05	2.65E-04	6.83E-03	6.19E-05	4.99E-07	2.31E-02	3.03E-02
U-105	1.54E-04	4.45E-04	1.49E-02	4.26E-04	4.08E-06	1.05E-01	1.21E-01
U-106	1.53E-04	4.49E-04	1.31E-02	4.11E-04	6.95E-06	1.85E-01	1.99E-01
U-107	1.28E-04	5.24E-04	1.44E-02	2.02E-04	2.62E-06	5.24E-02	6.76E-02
U-108	1.47E-04	5.32E-04	1.43E-02	1.15E-04	7.63E-07	1.83E-02	3.35E-02
U-109	1.36E-04	4.76E-04	1.28E-02	4.06E-05	3.47E-07	9.84E-03	2.33E-02
U-110	8.53E-05	2.63E-04	7.04E-03	3.24E-05	1.51E-07	1.02E-02	1.76E-02
U-111	1.20E-04	4.19E-04	1.13E-02	9.30E-05	7.22E-07	2.03E-02	3.22E-02
U-112	2.22E-05	7.32E-05	2.01E-03	1.59E-05	1.39E-07	3.45E-03	5.58E-03
SX-101	1.05E-04	4.05E-04	9.04E-03	4.79E-05	1.92E-06	4.65E-02	5.61E-02
SX-102	1.31E-04	4.69E-04	1.18E-02	3.06E-05	1.71E-06	1.61E-02	2.85E-02
SX-103	1.68E-04	5.69E-04	1.48E-02	6.20E-05	2.83E-06	2.15E-02	3.72E-02

Table 6-3. Waste Classification Evaluation for Pretreated Liquid Based on 10 CFR 61.55 Table 1 Class C Sum of Fractions for Long-Lived Radionuclides. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class C Sum of Fractions
SX-104	1.60E-04	5.70E-04	1.44E-02	7.23E-05	9.44E-07	2.41E-02	3.93E-02
SX-105	1.49E-04	4.66E-04	1.21E-02	1.63E-04	1.39E-06	5.34E-02	6.63E-02
SX-106	1.22E-04	4.80E-04	1.27E-02	2.28E-04	2.26E-06	3.79E-02	5.14E-02
SX-107	7.97E-05	2.80E-04	8.03E-03	1.40E-04	1.22E-06	6.40E-02	7.26E-02
SX-108	6.04E-05	1.79E-04	5.72E-03	8.90E-05	1.76E-06	4.57E-02	5.18E-02
SX-109	6.57E-05	1.59E-04	5.96E-03	3.38E-05	4.49E-07	4.39E-02	5.01E-02
SX-110	6.20E-05	2.67E-04	6.79E-03	3.70E-05	5.52E-07	3.73E-02	4.44E-02
SX-111	4.68E-05	2.80E-04	5.41E-03	2.91E-05	5.54E-07	1.80E-02	2.37E-02
SX-112	3.87E-05	2.51E-04	4.44E-03	2.42E-05	5.38E-07	1.09E-02	1.57E-02
SX-113	3.21E-05	2.02E-04	3.48E-03	7.74E-06	3.89E-07	5.09E-03	8.81E-03
SX-114	4.13E-05	1.42E-04	3.89E-03	3.42E-05	3.71E-07	9.42E-02	9.83E-02
SX-115	3.84E-05	1.35E-04	3.72E-03	7.54E-04	5.78E-07	1.59E-01	1.64E-01

Source: RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document.*

Table 6-4. Waste Classification Evaluation for Pretreated Liquid Based on 10 CFR 61.55 Table 2 Class C Sum of Fractions for Short-Lived Radionuclides. (2 pages)

Source Tank	Ni-63	Sr-90	Cs-137	Table 2 Class C Sum of Fractions
SY-101	1.62E-05	1.07E-04	2.72E-06	1.26E-04
SY-102	2.11E-05	1.13E-04	3.31E-06	1.37E-04
S-101	1.15E-05	2.12E-04	5.85E-06	2.30E-04
S-102	1.20E-05	9.90E-05	3.21E-06	1.14E-04
S-103	6.67E-06	9.27E-05	1.19E-06	1.01E-04
S-104	5.16E-06	1.70E-04	3.99E-06	1.79E-04
S-105	6.48E-06	8.39E-05	5.89E-06	9.63E-05
S-106	3.49E-06	8.38E-05	2.50E-06	8.98E-05
S-107	5.48E-06	1.44E-04	1.20E-05	1.62E-04
S-108	4.30E-06	8.88E-05	3.02E-06	9.61E-05
S-109	5.38E-05	9.58E-05	6.17E-06	1.56E-04
S-110	1.61E-05	1.19E-04	2.99E-06	1.38E-04
S-111	3.39E-06	1.17E-04	1.37E-05	1.35E-04
U-201	2.06E-06	6.89E-05	5.04E-07	7.15E-05
U-202	1.97E-06	5.16E-05	2.80E-07	5.38E-05
U-203	2.14E-06	4.04E-05	1.85E-07	4.27E-05
U-204	2.28E-06	3.40E-05	1.36E-07	3.64E-05
U-101	8.35E-07	6.82E-05	4.19E-08	6.91E-05
U-102	4.47E-05	1.26E-04	1.11E-05	1.82E-04
U-103	1.04E-05	1.12E-04	1.24E-06	1.23E-04
U-104	8.42E-06	9.24E-05	1.44E-06	1.02E-04
U-105	1.76E-05	1.76E-04	6.28E-06	2.00E-04
U-106	2.83E-05	3.18E-04	1.19E-06	3.48E-04
U-107	1.47E-05	9.26E-05	3.92E-06	1.11E-04

Table 6-4. Waste Classification Evaluation for Pretreated Liquid Based on 10 CFR 61.55 Table 2 Class C Sum of Fractions for Short-Lived Radionuclides. (2 pages)

Source Tank	Ni-63	Sr-90	Cs-137	Table 2 Class C Sum of Fractions
U-108	5.63E-06	8.85E-05	1.20E-05	1.06E-04
U-109	1.58E-05	8.82E-05	6.86E-06	1.11E-04
U-110	8.25E-06	9.94E-05	2.46E-06	1.10E-04
U-111	1.49E-05	9.47E-05	7.01E-06	1.17E-04
U-112	3.06E-06	8.13E-05	7.76E-08	8.44E-05
SX-101	4.60E-06	1.19E-04	4.81E-06	1.28E-04
SX-102	4.17E-06	1.04E-04	2.06E-06	1.10E-04
SX-103	5.91E-06	1.51E-04	2.43E-06	1.59E-04
SX-104	5.70E-06	1.16E-04	4.34E-06	1.27E-04
SX-105	5.31E-06	1.73E-04	3.09E-06	1.82E-04
SX-106	1.04E-05	9.22E-05	3.15E-06	1.06E-04
SX-107	9.60E-06	1.62E-04	3.33E-06	1.75E-04
SX-108	5.96E-06	1.67E-04	4.01E-06	1.77E-04
SX-109	5.30E-06	1.63E-04	5.35E-06	1.73E-04
SX-110	4.37E-06	2.69E-04	1.05E-06	2.74E-04
SX-111	2.76E-06	1.95E-04	7.64E-07	1.99E-04
SX-112	2.13E-06	1.64E-04	6.28E-07	1.67E-04
SX-113	1.26E-06	8.11E-05	4.02E-07	8.28E-05
SX-114	5.00E-06	1.83E-04	2.24E-06	1.90E-04
SX-115	4.33E-06	8.12E-05	4.03E-07	8.59E-05

Source: RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document.*

Table 6-5. Waste Classification Evaluation for Solidified Waste Based on 10 CFR 61.55 Table 1 Class C Sum of Fractions for Long-Lived Radionuclides. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class C Sum of Fractions
SY-101	5.44E-05	7.93E-04	2.65E-02	1.10E-05	1.43E-06	6.35E-03	3.37E-02
SY-102	5.85E-05	9.83E-04	3.38E-02	1.48E-05	1.99E-06	8.74E-03	4.36E-02
S-101	7.91E-05	3.45E-04	1.62E-02	2.82E-05	6.58E-07	1.09E-02	2.75E-02
S-102	7.27E-05	2.02E-04	6.60E-03	1.30E-05	4.36E-07	2.97E-03	9.86E-03
S-103	8.97E-05	3.15E-04	8.53E-03	1.17E-05	2.02E-07	2.63E-03	1.16E-02
S-104	6.49E-05	1.97E-04	5.47E-03	2.84E-05	5.72E-08	7.37E-03	1.31E-02
S-105	1.75E-04	5.18E-04	1.40E-02	7.29E-06	9.21E-08	6.04E-03	2.07E-02
S-106	1.08E-04	3.21E-04	8.60E-03	3.27E-06	6.16E-08	2.06E-03	1.11E-02
S-107	8.35E-05	1.21E-04	3.74E-03	1.19E-04	6.96E-08	2.35E-02	2.75E-02
S-108	1.06E-04	3.25E-04	8.79E-03	1.06E-05	2.03E-07	3.87E-03	1.31E-02
S-109	1.60E-04	5.00E-04	1.34E-02	9.63E-06	5.64E-08	3.15E-03	1.72E-02
S-110	1.44E-04	4.28E-04	1.16E-02	3.71E-05	2.27E-07	1.28E-02	2.49E-02
S-111	8.19E-05	2.89E-04	7.70E-03	8.35E-06	5.59E-08	2.51E-03	1.06E-02
U-201	6.11E-05	2.25E-04	5.97E-03	4.59E-06	2.30E-08	1.21E-03	7.47E-03
U-202	4.66E-05	1.68E-04	4.47E-03	3.37E-06	1.64E-08	8.83E-04	5.58E-03
U-203	3.73E-05	1.32E-04	3.51E-03	2.61E-06	1.25E-08	6.83E-04	4.37E-03

Table 6-5. Waste Classification Evaluation for Solidified Waste Based on 10 CFR 61.55 Table 1 Class C Sum of Fractions for Long-Lived Radionuclides. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class C Sum of Fractions
U-204	3.13E-05	1.08E-04	2.89E-03	3.35E-06	1.01E-08	9.17E-04	3.95E-03
U-101	8.70E-06	2.74E-05	6.48E-04	4.09E-06	2.86E-09	1.24E-03	1.93E-03
U-102	6.82E-05	2.24E-04	5.34E-03	5.98E-05	2.32E-07	1.40E-02	1.97E-02
U-103	9.25E-05	2.79E-04	7.34E-03	4.10E-05	4.50E-07	1.80E-02	2.58E-02
U-104	5.74E-05	1.76E-04	4.54E-03	2.58E-05	2.08E-07	9.61E-03	1.44E-02
U-105	1.02E-04	2.95E-04	9.86E-03	1.87E-04	1.79E-06	4.59E-02	5.64E-02
U-106	1.03E-04	3.02E-04	8.78E-03	1.78E-04	3.01E-06	8.00E-02	8.93E-02
U-107	8.53E-05	3.48E-04	9.59E-03	8.65E-05	1.12E-06	2.24E-02	3.25E-02
U-108	9.74E-05	3.53E-04	9.52E-03	5.03E-05	3.35E-07	8.05E-03	1.81E-02
U-109	9.01E-05	3.14E-04	8.48E-03	1.73E-05	1.49E-07	4.21E-03	1.31E-02
U-110	5.66E-05	1.74E-04	4.67E-03	1.33E-05	6.20E-08	4.19E-03	9.11E-03
U-111	7.97E-05	2.78E-04	7.47E-03	3.96E-05	3.07E-07	8.65E-03	1.65E-02
U-112	1.50E-05	4.93E-05	1.36E-03	6.14E-06	5.36E-08	1.33E-03	2.76E-03
SX-101	6.99E-05	2.70E-04	6.04E-03	2.11E-05	8.46E-07	2.05E-02	2.69E-02
SX-102	8.58E-05	3.08E-04	7.74E-03	1.36E-05	7.65E-07	7.19E-03	1.53E-02
SX-103	1.10E-04	3.73E-04	9.73E-03	2.84E-05	1.29E-06	9.86E-03	2.01E-02

Table 6-5. Waste Classification Evaluation for Solidified Waste Based on 10 CFR 61.55 Table 1 Class C Sum of Fractions for Long-Lived Radionuclides. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class C Sum of Fractions
SX-104	1.06E-04	3.76E-04	9.52E-03	3.30E-05	4.31E-07	1.10E-02	2.10E-02
SX-105	9.81E-05	3.07E-04	7.96E-03	7.22E-05	6.15E-07	2.37E-02	3.21E-02
SX-106	8.13E-05	3.19E-04	8.42E-03	9.72E-05	9.65E-07	1.62E-02	2.51E-02
SX-107	5.33E-05	1.87E-04	5.38E-03	5.87E-05	5.14E-07	2.69E-02	3.26E-02
SX-108	4.05E-05	1.20E-04	3.84E-03	3.81E-05	7.51E-07	1.96E-02	2.36E-02
SX-109	4.43E-05	1.07E-04	4.01E-03	1.46E-05	1.94E-07	1.89E-02	2.31E-02
SX-110	4.18E-05	1.80E-04	4.57E-03	1.60E-05	2.38E-07	1.60E-02	2.09E-02
SX-111	3.15E-05	1.88E-04	3.64E-03	1.22E-05	2.32E-07	7.51E-03	1.14E-02
SX-112	2.61E-05	1.69E-04	2.99E-03	9.94E-06	2.21E-07	4.48E-03	7.67E-03
SX-113	2.16E-05	1.36E-04	2.35E-03	3.12E-06	1.57E-07	2.05E-03	4.55E-03
SX-114	2.77E-05	9.55E-05	2.61E-03	1.40E-05	1.52E-07	3.85E-02	4.13E-02
SX-115	2.58E-05	9.09E-05	2.50E-03	3.07E-04	2.35E-07	6.46E-02	6.75E-02

Source: RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document.*

Table 6-6. Waste Classification Evaluation for Solidified Waste Based on 10 CFR 61.55 Table 2 Class C Sum of Fractions for Short-Lived Radionuclides. (2 pages)

Source Tank	Ni-63	Sr-90	Cs-137	Table 2 Class C Sum of Fractions
SY-101	1.07E-05	7.11E-05	1.80E-06	8.37E-05
SY-102	1.39E-05	7.45E-05	2.19E-06	9.07E-05
S-101	7.59E-06	1.40E-04	3.85E-06	1.51E-04
S-102	7.99E-06	6.58E-05	2.13E-06	7.59E-05
S-103	4.44E-06	6.17E-05	7.93E-07	6.69E-05
S-104	3.49E-06	1.15E-04	2.70E-06	1.21E-04
S-105	4.40E-06	5.70E-05	4.00E-06	6.54E-05
S-106	2.32E-06	5.58E-05	1.66E-06	5.98E-05
S-107	3.65E-06	9.63E-05	7.99E-06	1.08E-04
S-108	2.84E-06	5.87E-05	1.99E-06	6.35E-05
S-109	3.57E-05	6.36E-05	4.10E-06	1.03E-04
S-110	1.07E-05	7.87E-05	1.98E-06	9.14E-05
S-111	2.24E-06	7.77E-05	9.06E-06	8.90E-05
U-201	1.37E-06	4.57E-05	3.35E-07	4.74E-05
U-202	1.31E-06	3.44E-05	1.87E-07	3.59E-05
U-203	1.43E-06	2.70E-05	1.24E-07	2.86E-05
U-204	1.53E-06	2.28E-05	9.13E-08	2.44E-05
U-101	5.64E-07	4.61E-05	2.83E-08	4.67E-05
U-102	2.97E-05	8.36E-05	7.38E-06	1.21E-04
U-103	6.87E-06	7.41E-05	8.26E-07	8.18E-05
U-104	5.60E-06	6.14E-05	9.55E-07	6.80E-05
U-105	1.17E-05	1.17E-04	4.16E-06	1.32E-04
U-106	1.90E-05	2.14E-04	8.02E-07	2.34E-04
U-107	9.76E-06	6.15E-05	2.60E-06	7.39E-05

Table 6-6. Waste Classification Evaluation for Solidified Waste Based on 10 CFR 61.55 Table 2 Class C Sum of Fractions for Short-Lived Radionuclides. (2 pages)

Source Tank	Ni-63	Sr-90	Cs-137	Table 2 Class C Sum of Fractions
U-108	3.74E-06	5.88E-05	7.95E-06	7.05E-05
U-109	1.05E-05	5.83E-05	4.53E-06	7.33E-05
U-110	5.47E-06	6.59E-05	1.63E-06	7.30E-05
U-111	9.90E-06	6.28E-05	4.65E-06	7.73E-05
U-112	2.06E-06	5.48E-05	5.23E-08	5.69E-05
SX-101	3.07E-06	7.94E-05	3.22E-06	8.57E-05
SX-102	2.74E-06	6.81E-05	1.35E-06	7.22E-05
SX-103	3.88E-06	9.90E-05	1.59E-06	1.04E-04
SX-104	3.76E-06	7.68E-05	2.87E-06	8.35E-05
SX-105	3.50E-06	1.14E-04	2.04E-06	1.20E-04
SX-106	6.89E-06	6.13E-05	2.10E-06	7.03E-05
SX-107	6.42E-06	1.09E-04	2.23E-06	1.17E-04
SX-108	4.00E-06	1.12E-04	2.69E-06	1.19E-04
SX-109	3.57E-06	1.10E-04	3.61E-06	1.17E-04
SX-110	2.94E-06	1.81E-04	7.10E-07	1.85E-04
SX-111	1.86E-06	1.31E-04	5.14E-07	1.34E-04
SX-112	1.43E-06	1.11E-04	4.23E-07	1.12E-04
SX-113	8.45E-07	5.46E-05	2.71E-07	5.57E-05
SX-114	3.36E-06	1.23E-04	1.50E-06	1.28E-04
SX-115	2.91E-06	5.45E-05	2.71E-07	5.77E-05

Source: RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document.*

Reference: 10 Code of Federal Regulations (CFR) Part 61, “Licensing Requirements for Land Disposal of Radioactive Waste,” Subpart D—Technical Requirements for Land Disposal Facilities, § 61.55, Waste classification (10 CFR 61.55).

Meeting Class A concentration limits is not a WIR criterion in DOE M 435.1-1; however, DOE considers Energy*Solutions* (Clive) a potential option if some of the pretreated and solidified waste meets Class A concentration limits as discussed in Appendix D of this Draft WIR Evaluation. DOE has not made decisions on the location of the disposal facility(ies).

6.3 SOLID PHYSICAL FORM

The third criterion in Chapter II.B.2(a) of DOE M 435.1-1 also provides that the waste will be managed in accordance with the requirements of Chapter IV of the Manual, concerning LLW. However, DOE Order 435.1 provides that requirements in the Order that duplicate or conflict with requirements of an applicable Agreement State do not apply to facilities and activities licensed by the Agreement State. Therefore, the provisions in Chapter IV of DOE M 435.1-1 concerning matters such as monitoring, WAC, performance assessments, composite analysis, disposal facility operations, disposal authorizations, institutional control, and disposal facility closure do not apply to the Energy*Solutions* or WCS facilities; instead, these matters are governed by the State of Utah or State of Texas requirements and license conditions.

The pretreated waste will be solidified and treated at one or more facilities potentially:

1. Perma-Fix Northwest (PFNW) in Richland, Washington
2. Energy*Solutions* near Clive, Utah [Energy*Solutions* (Clive)]
3. Waste Control Specialists (WCS) near Andrews, Texas
4. Onsite facility, Hanford Site
5. Offsite commercial facility, Richland, Washington.

At the solidification facility(ies), the waste will be incorporated into a dry solid matrix and will be in a solid physical form prior to disposal. This is consistent with the third criterion in Chapter II.B.2(a) of DOE M 435.1-1, which provides that “the waste will be incorporated in a solid physical form[.]”

Accordingly, as demonstrated above, disposal of the pretreated and solidified waste meets the third criterion of DOE M 435.1-1, Chapter II.B.2(a).

7.0 CONCLUSION

This Draft WIR Evaluation assesses whether separated, pretreated, and solidified waste from Hanford tanks is waste incidental to reprocessing of spent nuclear fuel, pursuant to the WIR criteria in Chapter II.B(2)(a) of DOE M 435.1-1. The waste will be retrieved from West Area tanks at the Hanford Site and will consist primarily of supernate (including dissolved saltcake and interstitial liquid) from SSTs in the S, SX, and U tank farms, as well as supernate from DSTs in SY tank farm used in pretreatment operations. The waste will be pretreated at the Hanford Site, solidified, and disposed of at one or more commercial, licensed facilities outside of the State of Washington.

As shown in this Draft WIR Evaluation, pretreatment will entail multiple settling, decanting, filtration and IX steps, using proven technologies. This pretreatment will successfully remove key radionuclides to the maximum extent technically and economically practical, thereby satisfying the first WIR criterion. For example, pretreatment will remove approximately 99.9 % of the Cs-137 from the waste.

Regarding the second WIR criterion, the pretreated and solidified waste will meet the WAC for offsite commercial disposal at the WCS FWF and/or Energy*Solutions* (Clive Disposal Facility), as applicable.[104] Meeting the WAC will ensure that the performance objectives, including doses, will be met for LLW disposal as set forth in the *Texas Administrative Code* and the *Utah Administrative Code* respectively, which are comparable to the U.S. Nuclear Regulatory Commission (NRC) performance objectives at 10 CFR Part 61, Subpart C.

With respect to the third WIR criterion, the pretreated waste will be incorporated into a solid matrix and will be in a solid physical form. The solidified waste also will be below the concentration limits for Class C LLW, as shown in this Draft WIR Evaluation.

DOE is planning to consult with the NRC concerning this Draft WIR Evaluation and is also planning to issue this Draft WIR Evaluation for comments by States, Tribal Nations, stakeholders, and the public. Following the planned consultation with the NRC, and consideration of comments from States, Tribal Nations, stakeholders, and the public, DOE plans to issue a Final WIR Evaluation. Based on the Final WIR Evaluation, DOE may determine (in a future WIR Determination) whether the pretreated and solidified waste meets the WIR criteria in Chapter II.B.(2)(a) of DOE M 435.1-1, is waste incidental to the reprocessing of spent nuclear fuel, is not HLW, and may be managed (disposed of) as LLW.

If DOE issues a WIR Determination in the future, the pretreated waste will be managed as LLW, subject to the analysis and commitments in the Final WIR Evaluation and the WIR

[104] DOE will only ship waste offsite to a licensed commercial MLLW facility in accordance with the facility's license limits and WAC. Waste addressed in this Draft WIR Evaluation would only be shipped offsite to a commercial facility if it can be accommodated by the facility's licensed capacity.

Determination, including: 1) the wastes will be incorporated in a solid physical form at a concentration that does not exceed the concentration limits for Class C LLW in 10 CFR 61.55; 2) the wastes will be disposed of in accordance with safety requirements comparable to the performance objectives in 10 CFR Part 61, Subpart C; and 3) the wastes will be properly characterized and classified, and will meet the WAC of the receiving facility.

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8.0 REFERENCES

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APPENDIX A
U.S. NUCLEAR REGULATORY COMMISSION, TEXAS AND UTAH REQUIREMENTS FOR LOW-LEVEL RADIOACTIVE WASTE DISPOSAL

Appendix Purpose

The purpose of this Appendix is to show U.S. Nuclear Regulatory Commission (NRC), State of Utah, and State of Texas requirements for disposal of low-level radioactive waste (LLW).

Appendix Content

This Appendix identifies NRC, State of Utah, and State of Texas performance objectives.

Key Points

- Requirements for LLW disposal are embodied in sets of performance objectives for the waste disposal facility.
- The NRC performance objectives are described in 10 *Code of Federal Regulations* (CFR) Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart C—Performance Objectives.
- The performance objectives in the *Texas Administrative Code* that apply to the Waste Control Specialists (WCS) LLW disposal facility—which are included in the Title 30, "Environmental Quality," Part 1, "Texas Commission on Environmental Quality," Chapter 336, "Radioactive Substance Rules," Subchapter H, "Licensing Requirements for Near-Surface Land Disposal of Low-Level Radioactive Waste," Rules 336.723, "Performance Objectives," through 336.727, "Stability of the Disposal Site after Closure"—mirror the NRC performance objectives.
- The performance objectives in the *Utah Administrative Code* that apply to the Energy*Solutions* Mixed Waste Landfill Cell—set forth in R313-25, "License Requirements for Land Disposal of Radioactive Waste - General Provisions," R313-25-19, "General Requirement," through R313-25-23, "Stability of the Disposal Site after Closure"—mirror the NRC performance objectives.

A.1 INTRODUCTION

This Appendix identifies performance objectives for disposal of LLW by NRC, the State of Utah, and the State of Texas, then compares these performance objectives. As noted previously, the performance objectives in the State of Utah and the State of Texas regulations are akin to the NRC performance objectives at 10 CFR 61, Subpart C (i.e., they are nearly identical except for the use of different section numbers). The purpose of this Appendix is to show that meeting the safety requirements in the Texas or Utah regulations, as applicable, will meet "safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C" as called for by DOE M 435.1-1, *Radioactive Waste Management Manual*, Chapter II.B.(2)(a)(2).[105]

[105] DOE will dispose of the solidified waste at one or more commercial, licensed facilities located outside the State of Washington. DOE has not made decisions on the location of the disposal facility(ies).

A.2 APPLICABLE PERFORMANCE OBJECTIVES

The NRC requirements appear in Subpart C of 10 CFR 61, which lists one general requirement and four performance objectives, which are set forth below.

10 CFR 61.40, "General Requirement":

> "Land disposal facilities must be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to humans are within the limits established in the performance objectives in §§ 61.41 through 61.44."

10 CFR 61.41, "Protection of the General Population from Releases of Radioactivity":

> "Concentrations of radioactive material which may be released to the general environment in groundwater, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable."

10 CFR 61.42, "Protection of Individuals from Inadvertent Intrusion":

> "Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed."

10 CFR 61.43, "Protection of Individuals During Operations":

> "Operations at the land disposal facility must be conducted in compliance with the standards for radiation protection set out in part 20 of this chapter, except for releases of radioactivity in effluents from the land disposal facility, which shall be governed by § 61.41 of this part. Every reasonable effort shall be made to maintain radiation exposures as low as is reasonably achievable."

10 CFR 61.44, "Stability of the Disposal Site After Closure":

> "The disposal facility must be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required."

The State of Utah requirements for LLW disposal at *Utah Administrative Code* R313-25-19 through R313-25-23 and State of Texas requirements for LLW disposal at *Texas Administrative Code*, Title 30, Part 1, Chapter 336, Subchapter H, Rules 336.723-727 are based on the NRC requirements at Subpart C of 10 CFR Part 61 and are similar except for the minor wording differences identified below.

A.3 GENERAL REQUIREMENTS

NRC

The NRC regulation in 10 CFR 61.40 provides in relevant part:

> "Land disposal facilities must be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to humans are within the limits established in the performance objectives in §§ 61.41 through 61.44."

STATE OF TEXAS

The State of Texas regulation Title 30 (Rule 336.723) mirrors the NRC regulations in 10 CFR 61.40.

STATE OF UTAH

The State of Utah sets forth the General Requirement per R313-25-19:

> "Land disposal facilities shall be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to individuals do not exceed the limits stated in Sections R313-25-20 and 25-23."

The Utah performance objective requirement is akin to the NRC general requirement in 10 CFR 61.40.

A.4 PROTECTION OF THE GENERAL POPULATION FROM RELEASES OF RADIOACTIVITY

NRC

NRC regulation in 10 CFR 61.41 is expressed as follows:

> "Concentrations of radioactive material which may be released to the general environment in groundwater, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 mrem to the whole body,

> 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable."

STATE OF TEXAS

The State of Texas regulation (Rule 336.724, "Protection of the General Population from Releases of Radioactivity" mirrors the NRC regulation in 10 CFR 61.41 with two minor wording differences. The Texas rule uses the phrase "shall not result in an annual dose above background" instead of "must not result in an annual dose." In the second sentence, the Texas rule uses the phrase "Effort shall be made" instead of "Reasonable effort should be made."

STATE OF UTAH

The State of Utah regulation R313-25-20, "Protection of the General Population from Releases of Radioactivity", provides:

> "Concentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants or animals shall not result in an annual dose exceeding an equivalent of 0.25 mSv (0.025 rem) to the whole body, 0.75 mSv (0.075 rem) to the thyroid, and 0.25 mSv (0.025 rem) to any other organ of any member of the public. No greater than 0.04 mSv (0.004 rem) committed effective dose equivalent or total effective dose equivalent to any member of the public shall come from groundwater. Reasonable efforts should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable."

The State of Utah regulation is akin to the NRC regulation in 10 CFR 61.41 with the exception that the State of Utah regulation includes the words "No greater than 0.04 mSv (0.004 rem) committed effective dose equivalent or total effective dose equivalent to any member of the public shall come from groundwater."

The State of Utah and the State of Texas regulations are comparable to the NRC regulations.

A.5 PROTECTION OF INDIVIDUALS FROM INADVERTENT INTRUSION

NRC

NRC requirements of 10 CFR 61.42 are expressed as follows:

> "Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed."

STATE OF TEXAS
The State of Texas regulations (Rule 336.725, "Protection of Individuals from Inadvertent Intrusion") mirror the NRC regulations in 10 CFR 61.42.

STATE OF UTAH
The State of Utah sets forth the "Protection of Individuals from Inadvertent Intrusion" requirement per R313-25-21:

> "Design, operation, and closure of the land disposal facility shall ensure protection of any individuals inadvertently intruding into the disposal site and occupying the site or contacting the waste after active institutional controls over the disposal site are removed."

The State of Utah regulations (R313-25-21) are akin to the NRC regulations in 10 CFR 61.42.

A.6 PROTECTION OF INDIVIDUALS DURING OPERATIONS

NRC
The NRC requirement in 10 CFR 61.43 is expressed as follows:

> "Operations at the land disposal facility must be conducted in compliance with the standards for radiation protection set out in part 20 of this chapter, except for releases of radioactivity in effluents from the land disposal facility, which shall be governed by § 61.41 of this part. Every reasonable effort shall be made to maintain radiation exposures as low as is reasonably achievable."

STATE OF TEXAS
The State of Texas regulations (Rule 336.726, "Protection of Individuals during Operations" mirror the NRC regulations in 10 CFR 61.43. In addition, the "Standards for Protection Against Radiation," in the *Texas Administrative Code*, Rule 336.305, "Occupational Dose Limits for Adults," *et seq*., parallel the NRC requirements in 10 CFR Part 20, "Standards for Protection Against Radiation," cross-referenced in 10 CFR 61.43.

STATE OF UTAH
The State of Utah regulation R313-25-22, "Protection of Individuals during Operations", provides:

> "Operations at the land disposal facility shall be conducted in compliance with the standards for radiation protection set out in Rule R313-15 of these rules, except for release of radioactivity in effluents from the land disposal facility, which shall be governed by Section R313-25-20. Every reasonable effort should be made to maintain radiation exposures as low as is reasonably achievable, ALARA."

The State of Utah regulation (R313-25-22) is akin to the NRC regulation in 10 CFR 61.43. The State of Texas and State of Utah radiation dose standards are comparable to the NRC dose standards.

A.7 STABILITY OF THE DISPOSAL SITE AFTER CLOSURE

NRC
The NRC requirement in 10 CFR 61.44 states that:

> "The disposal facility must be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required."

STATE OF TEXAS
The State of Texas regulation (Rule 336.727) mirrors the NRC regulation in 10 CFR 61.44.

STATE OF UTAH
The State of Utah regulation R313-25-23, "Stability of the Disposal Site After Closure", provides:

> "The disposal facility shall be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate, to the extent practicable, the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required."

The State of Utah regulation (R313-25-23) is akin to the NRC regulation in 10 CFR 61.44.

A.8 REFERENCES

10 CFR 20, "Standards for Protection Against Radiation," *Code of Federal Regulations*.

10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," *Code of Federal Regulations*.

- 61.40, "General Requirement."
- 61.41, "Protection of the General Population from Releases of Radioactivity."
- 61.42, "Protection of Individuals from Inadvertent Intrusion."
- 61.43, "Protection of Individuals during Operations."
- 61.44, "Stability of the Disposal Site After Closure."
  - Subpart C—Performance Objectives.

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- 336.305, "Occupational Dose Limits for Adults."
- 336.723, "Performance Objectives."
- 336.724, "Protection of the General Population from Releases of Radioactivity."
- 336.725, "Protection of Individuals from Inadvertent Intrusion."
- 336.726, "Protection of Individuals during Operations."
- 336.727, "Stability of the Disposal Site after Closure."

Utah Administrative Code, Title R313 "Environmental Quality, Waste Management and Radiation Control, Radiation,"

- R313-15, "Standards for Protection Against Radiation."
- R313-25-19, "General Requirement."
- R313-25-20, "Protection of the General Population from Releases of Radioactivity."
- R313-25-21, "Protection of Individuals from Inadvertent Intrusion."
- R313-25-22, "Protection of Individuals during Operations."
- R313-25-23, "Stability of the Disposal Site after Closure."

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APPENDIX B
CONSIDERATION OF THE CRITERIA IN SECTION 3116 OF THE RONALD W. REAGAN NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2005

Appendix Purpose

The purpose of this Appendix is to discuss the criteria in Section 3116 of the *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005* with respect to this Draft WIR Evaluation.

Appendix Content

This Appendix describes the subject criteria in relation to U.S. Department of Energy (DOE) plans for disposal of the solidified and treated waste.

Key Points

- Section 3116 of the *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005* does not apply to the pretreated and solidified waste from West Area waste tanks.
- However, disposal of the waste at the Waste Control Specialists (WCS) Federal Waste Facility (FWF) and/or the Energy*Solutions* (Clive Disposal Facility) as low-level radioactive waste (LLW) would be consistent with the criteria of Section 3116 of the *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005*.

B.1 INTRODUCTION

Sections 4 through 6 in the main body of this *Draft Waste Incidental to Reprocessing Evaluation for the 200 West Area Tank Treatment Mission at the Hanford Site, Washington* (Draft WIR Evaluation) demonstrate that the pretreated and solidified waste meets the criteria of U.S. Department of Energy (DOE) M 435.1-1, *Radioactive Waste Management Manual* for determining that the waste is waste incidental to reprocessing, is not high-level radioactive waste (HLW), and will be managed and disposed of as low-level radioactive waste (LLW). Section 3116 of the *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005* contains similar criteria and provides that the Secretary of Energy, in consultation with the U.S. Nuclear Regulatory Commission (NRC), may determine that waste resulting from reprocessing of spent nuclear fuel (SNF) at DOE facilities in South Carolina and Idaho, that is to be disposed of within those states, is not HLW where the criteria in Section 3116(a)(1)-(3) are met.

Subsection (b) of Section 3116 addresses monitoring by NRC. Subsection (c) addresses inapplicability to certain materials (i.e., materials transported from the covered state). Subsection (d) identifies the covered states (South Carolina and Idaho). Subsection (e) addresses certain matters concerning construction of Section 3116 and provides that the section does not establish any precedent in any State other than South Carolina and Idaho. Subsection (f) provides for judicial review of determinations made pursuant to Section 3116 and of any failure by NRC to carry out its monitoring responsibilities.

Although Section 3116 of *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005* does not apply to the pretreated and solidified waste at the Hanford Site, the following discussion addresses the relevant criteria in Section 3116(a)(1)-(3) for perspective and information and shows that disposal of the waste as LLW at the WCS facility and/or the Energy*Solutions* facility would be consistent with relevant criteria in Section 3116(a)(1)-(3).

B.2 CONSIDERATION OF WHETHER THE PRETREATED AND SOLIDIFIED WASTE REQUIRES PERMANENT ISOLATION IN A DEEP GEOLOGIC REPOSITORY

The first criterion or clause in Section 3116(a), as set forth in Section 3116(a)(1), provides that the waste "does not require permanent isolation in a deep geologic repository for spent fuel or high-level radioactive waste."

With respect to the first criterion or clause, as provided in Section 3116(a)(1), DOE has explained:

> "Clause (1), noted above, is a broader criterion for the Secretary, in consultation with the NRC, to consider whether, notwithstanding that waste from reprocessing meets the other two criteria, there are other considerations that, in the Secretary's judgment, require its disposal in a deep geologic repository. Generally, such considerations would be an unusual case because waste that meets the third criterion would be waste that will be disposed of in a manner that meets the 10 CFR 61, Subpart C performance objectives and either falls within one of the classes set out in 10 CFR 61.55 that the NRC has specified are considered "generally acceptable for near-surface disposal" or for which the Secretary has consulted with NRC concerning DOE's disposal plans. As the NRC explained in *In the Matter of Louisiana Energy Services, L.P. (National Enrichment Services)* (NRC 2005), the 10 CFR Part 61, Subpart C performance objectives in turn "set forth the ultimate standards and radiation limits for (1) protection of the general population from releases of radioactivity; (2) protection of individuals from inadvertent intrusion; (3) protection of individuals during operations; and (4) stability of the disposal site after closure." It follows that if disposal of a waste stream in a facility that is not a deep geologic repository will meet these objectives, in the ordinary case that waste stream does not "require disposal in a deep geologic repository" because non-repository disposal will be protective of public health and safety.
>
> It is possible that in rare circumstances a waste stream that meets the third criterion might have some other unique radiological characteristic or may raise unique policy considerations that warrant its disposal in a deep geologic repository. Clause (1) is an acknowledgement by Congress of that possibility. For example, the waste stream could contain material that, while not presenting a

> health and safety danger if disposed of at near- or intermediate-surface, nevertheless presents non-proliferation risks that the Secretary concludes cannot be adequately guarded against absent deep geologic disposal. Clause (1) gives the Secretary, in consultation with NRC, the authority to consider such factors in determining whether waste that meets the other two criteria needs disposal in a deep geologic repository in light of such considerations."[106]

That is not the case here. As demonstrated in Section 4.0 in the main body of this Draft WIR Evaluation, key radionuclides will be removed to the maximum extent technically and economically practical. Moreover, the pretreated and solidified waste will be in a solid physical form, and will not exceed the concentration limits for Class C LLW in 10 *Code of Federal Regulations* (CFR) Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart D—Technical Requirements for Land Disposal Facilities, § 61.55, "Waste Classification" (10 CFR 61.55), as described in Section 6.0 of the main body of this Draft WIR Evaluation. As explained in Section 5.0 of the main body of this Draft WIR Evaluation, management and disposal of the pretreated and solidified waste as LLW at WCS FWF and/or Energy*Solutions* (Clive Disposal Facility) would also meet safety requirements comparable to the NRC performance objectives in 10 CFR 61, Subpart C—Performance Objectives, so as to provide for the protection of human health and safety and the environment. As such, the disposal of the pretreated waste as LLW does not present a danger to human health and safety, such that disposal in a deep geologic repository would be warranted.

Furthermore, the waste does not present unique radiological characteristics, or raise non-proliferation risks or other unique policy considerations, which, while not manifesting a danger to human health, nevertheless would command deep geologic disposal. Accordingly, the planned disposal of the pretreated and solidified waste as LLW at WCS FWF and/or Energy*Solutions* (Clive Disposal Facility) would be consistent with the first criterion of Section 3116(a).

B.3 CONSIDERATION OF REMOVAL OF HIGHLY RADIOACTIVE RADIONUCLIDES

The second criterion of Section 3116(a) specifies that the waste "has had highly radioactive radionuclides removed to the maximum extent practical." DOE M 435.1-1, Chapter II.B.(2)(a)(1), contains a similar provision, which specifies that such wastes "[h]ave been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical".

Section 4.0, Table 4-4, in the main body of this Draft WIR Evaluation identifies key radionuclides for the waste. As can be seen in this table, all radionuclides in Tables 1 and 2 of 10 CFR 61.55 were considered. Furthermore, Section 4.0 of this Draft WIR Evaluation describes

[106] DOE/NE-ID-11226, *Basis for Section 3116 Determination for the Idaho Nuclear Technology and Engineering Center Tank Farm Facility*.

how key radionuclides will be removed to the maximum extent technically and economically practical, thus satisfying the DOE criterion and evincing consistency with the second criterion of Section 3116(a).

B.4 CONSIDERATION OF RADIONUCLIDE CONCENTRATION LIMITS AND WASTE DISPOSAL PERFORMANCE OBJECTIVES

The third criterion in Section 3116(a)(3) concerns whether the waste meets the concentration limits for Class C LLW in 10 CFR 61.55 and whether the waste will be disposed of in accordance with the performance objectives at 10 CFR 61, Subpart C. The criteria in DOE M 435.1-1, Section II (B)(2)(a)(2) and (a)(3) similarly provide that waste "[w]ill be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C" and "will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55," respectively.

Section 6.0 in the main body of this Draft WIR Evaluation demonstrates that the pretreated and solidified waste will not exceed the Class C concentration limits in 10 CFR 61.55 (which are mirrored in *Texas Administrative Code*, Title 30, "Environmental Quality," Part 1, "Texas Commission on Environmental Quality," Chapter 336, "Radioactive Substance Rules," Subchapter D, "Standards for Protection Against Radiation," Rule 336.362, "Appendix E. Classification and Characteristics of Low-Level Radioactive Waste"). Further, Appendix D of this Draft WIR Evaluation shows that if removal of Sr-90 by IX occurs, then the sum of fractions for the resulting pretreated liquid and solidified waste in some of the tanks will meet Class A concentration limits per 10 CFR 61.55, mirrored in the *Utah Administrative Code*, Title R313, "Environmental Quality, Waste Management and Radiation Control, Radiation," R313-15, "Standards for Protection Against Radiation," R313-15-1009, "Classification and Characteristics of Low-Level Radioactive Waste."[107] In addition, the treated and solidified waste will be packaged in a shipping container and in a solid physical form as discussed in Section 6.0. Section 5.0 of the main body of this Draft WIR Evaluation further shows that management and disposal of the waste will meet safety requirements comparable to NRC performance objectives in 10 CFR 61, Subpart C. Given these considerations, disposal of pretreated and solidified[108] supernate from West Area waste tanks will meet the above-referenced DOE criteria and would be consistent with the third criterion of Section 3116(a).

[107] The demonstration in this Draft WIR Evaluation that Class A concentration limits may be met should not be interpreted as a requirement of DOE M 435.1-1 and is not necessarily applicable to other wastes. DOE M 435.1-1 does not require that Class A concentration limits be met; however, meeting Class A concentration limits allows DOE to include Energy*Solutions* (Clive) as a potential option for solidification and disposal. DOE has not made decisions on the location of the solidification facility or the disposal facility.

B.5 REFERENCES

10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," *Code of Federal Regulations.*

61.55, "Waste Classification."

- Subpart C—Performance Objectives.
- Subpart D—Technical Requirements for Land Disposal Facilities

Atomic Energy Act of 1954, 42 U.S.C. sections 2011-2021, 2022-2286i, 2296a-2297h-13, United States Congress.

DOE M 435.1-1, 2021, *Radioactive Waste Management Manual*, Chg. 3, U.S. Department of Energy, Washington, D.C.

DOE/NE-ID-11226, 2006, *Basis for Section 3116 Determination for the Idaho Nuclear Technology and Engineering Center Tank Farm Facility*, Rev. 0, U.S. Department of Energy, Idaho National Laboratory, Idaho Falls, Idaho.

NRC, 2005, *In the Matter of Louisiana Energy Services, L.P. (National Enrichment Services)*, CLI-05-05, U.S. Nuclear Regulatory Commission, Washington, D.C.

Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, Public Law 108-375, October 28, 2004.

SRNL-RP-2018-00687, 2019, *Report of Analysis of Approaches to Supplemental Treatment of Low-Activity Waste at the Hanford Nuclear Reservation*, Savannah River National Laboratory, Aiken, South Carolina.

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Utah Administrative Code, Title R313, "Environmental Quality, Waste Management and Radiation Control, Radiation," R313-15, "Standards for Protection Against Radiation," R313-15-1009, "Classification and Characteristics of Low-Level Radioactive Waste."

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APPENDIX C
UNITED STATES' OPENING BRIEF IN *NRDC V. ABRAHAM,* NO. 03-35711 (9TH CIR.)

No. 03-35711

IN THE UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT

NATURAL RESOURCES DEFENSE COUNCIL, et al.

Plaintiffs-Appellees,

v.

SPENCER ABRAHAM, Secretary, Department of Energy, et al.,

Defendants-Appellants.

ON APPEAL FROM A FINAL JUDGMENT OF THE
UNITED STATES DISTRICT COURT FOR THE DISTRICT OF IDAHO

BRIEF OF THE APPELLANTS

THOMAS L. SANSONETTI
Assistant Attorney General
GREER S. GOLDMAN
RONALD M. SPRITZER
Attorneys, Department of Justice
Environment & Nat. Resources Division
P.O. Box 23795, L'Enfant Station
Washington, D.C. 20026
(202) 514-3977

OF COUNSEL:
MARC JOHNSTON
MARC KASISCHKE
Office of General Counsel
U.S. Department of Energy
1000 Independence Ave., SW
Washington, D.C. 20585

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STATEMENT OF JURISDICTION

A. District Court Jurisdiction. Plaintiffs alleged that an order issued by the United States Department of Energy violates the Nuclear Waste Policy Act ("NWPA"), 42 U.S.C. 10101 *et seq*., and the Administrative Procedure Act ("APA"), 5 U.S.C. 551 *et seq*. The district court had jurisdiction pursuant to 28 U.S.C. 1331 and 1345.

B. Court of Appeals Jurisdiction. The district court's final order granting summary judgment against the Defendants (hereafter "DOE") was entered on July 3, 2003 and resolved all pending claims. DOE filed a timely notice of appeal on August 27, 2003. This Court has jurisdiction pursuant to 28 U.S.C. 1291.

QUESTIONS PRESENTED

This case concerns DOE Order 435.1 ("the Order"), which prescribes procedures to be used by DOE and its contractors in the management of radioactive waste stored at atomic energy defense facilities. DOE issued the Order under the authority of the Atomic Energy Act of 1954 ("AEA"), 42 U.S.C. 2011 *et seq.;* the Energy Reorganization Act ("ERA"), 42 U.S.C. 5801 *et seq*.; and the Department of Energy Organization Act ("DOEOA"), 42 U.S.C. 7101 *et seq*. The Order permits DOE to classify waste from the reprocessing of spent nuclear fuel ("SNF") as either high-level radioactive waste ("HLW") or waste incidental to reprocessing ("WIR"), depending upon the degree of hazard the waste presents. The Natural Resources Defense Council and other organizations (hereafter collectively "NRDC") challenged the Order on the ground that it allows DOE to manage waste as WIR that they claim must be managed as HLW, allegedly in violation of the NWPA.

The questions presented are:

1. Whether Order 435.1 is ripe for judicial review even though the Order does not make any site-specific waste management decision, but rather sets forth general criteria for such decisions.

2. Whether the district court erred in holding that, despite the NWPA's provision that it does not apply to the Secretary's management of defense nuclear waste or to any atomic energy defense facility, the NWPA applies to the Secretary's decision to manage certain defense nuclear waste at such facilities as WIR.

3. Whether, assuming arguendo the NWPA applies, DOE's criteria for distinguishing between HLW and WIR are consistent with the NWPA.

STATEMENT OF THE CASE

DOE approved Order 435.1 on July 9, 1999. On January 4, 2000, NRDC filed a petition for review in this Court under section 119(a) of the NWPA, 42 U.S.C. 10139(a), which vests exclusive jurisdiction in the courts of appeals to review actions of the Secretary taken under Part A of Subchapter I of the NWPA. In response, DOE argued that Order 435.1 was issued pursuant to the AEA rather than the NWPA and therefore the case should have been filed in district court. This Court agreed, dismissed the case for lack of jurisdiction, and transferred it to the District of Idaho. NRDC v. Abraham, 244 F.3d 742 (9th Cir. 2001).

The district court denied DOE's motion to dismiss, which had argued, among other things, that Order 435.1 was not ripe for review because it had not been applied to any specific waste, and that the AEA rather than the NWPA controls the management of HLW at defense facilities. Excerpts of Record ("ER") 045. Both sides moved for summary judgment. DOE raised the issues briefed in the motion to dismiss, and also contended that the Order is valid even if the NWPA applies. On the merits, the district court concluded that liquid and solid reprocessing wastes "are treated differently by the Act. While the NWPA allows DOE to treat the solids to remove fission products, thereby permitting reclassification of the waste, NWPA does not offer the option of reclassification

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for liquid waste produced directly in reprocessing." ER359.[1] While the court recognized that DOE could treat solid waste derived from liquid reprocessing waste and "reclassify" it as non-HLW, the court determined that DOE's criteria for doing so were inconsistent with the NWPA. ER360-61. Accordingly, the district court granted summary judgment to NRDC and denied the defendants' summary judgment motion. ER365-66. DOE, the court concluded, "has violated NWPA by promulgating Order 435.1 as it relates to incidental waste." Id.

STATEMENT OF FACTS

A. Statutory Background.

1. The Atomic Energy Act of 1954. The AEA "established a comprehensive regulatory scheme for military and domestic nuclear energy," NRDC v. Abraham, 244 F.3d at 744, that is "'virtually unique in the degree to

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[1] Although the district court's various references to "reclassification" of waste do not alter the substance of its ruling, the district court mischaracterized Order 435.1 by claiming that it allows DOE to reclassify HLW as incidental waste. ER360-61. In fact, Order 435.1 contains criteria for distinguishing between HLW and waste that is not highly radioactive. This is a distinction that is rooted in the statutory definition of HLW.

The district court also erred in stating that "[i]t is undisputed that waste stored at Hanford, INEEL, and Savannah River is highly radioactive and the result of reprocessing." ER360. In fact, DOE pointed out at the argument on the summary judgment motions that the tanks contain a variety of wastes, some of which are HLW and some of which are low-level waste. ER348. DOE's position is supported by the record. ER331.

which broad responsibility is reposed in the administrative agency, free of close prescription in its charter as to how it shall proceed in achieving the statutory objectives.'" San Luis Obispo Mothers for Peace v. NRC, 751 F.2d 1288, 1294 (D.C. Cir. 1984) (quoting Siegel v. Atomic Energy Comm'n, 400 F.2d 778, 783 (D.C. Cir. 1968)). The AEA vested in the Atomic Energy Commission ("AEC") the exclusive responsibility to regulate the materials covered by the Act. See 42 U.S.C. 2201(b). The Act also granted the AEC the authority to conduct research into military applications of atomic energy, produce atomic weapons, and "provide for safe storage, processing, transportation, and disposal of hazardous waste (including radioactive waste) resulting from nuclear materials production, weapons production and surveillance programs, and naval nuclear propulsion programs." 42 U.S.C. 2121(a)(3).

In 1974, Congress abolished the AEC and transferred its functions to the Department of Energy's predecessor agency – the Energy Research and Development Administration ("ERDA") – and to the Nuclear Regulatory Commission ("NRC"). *See* Energy Reorganization Act of 1974 ("ERA"), Sections 104, 201(f), Pub. L. No. 93-438, 88 Stat. 1233, 1237-38, 1242-44, *codified at* 42 U.S.C. 5814, 5841(f). Under the ERA, the NRC assumed responsibility for commercial licensing of nuclear power plants and related regulatory functions.

The ERDA assumed the AEC's remaining functions, including its weapons production and waste management authority. The ERA also authorized the Administrator of ERDA to "prescribe such policies, standards, criteria, procedures, rules, and regulations as he may deem to be necessary or appropriate to perform functions now or hereafter vested in him." 42 U.S.C. 5815(a).

In 1977, Congress abolished the ERDA and transferred its functions to DOE. *See* Department of Energy Organization Act ("DOEOA") Section 301(a), Pub. L. No. 95-91, 91 Stat. 565, 577-78 (1977), *codified at* 42 U.S.C. 7151(a). Among other things, the DOEOA specifically assigned responsibility for the military applications of nuclear energy to DOE. Additionally, the DOEOA made clear that DOE retained radioactive waste management responsibilities including: (1) control over existing Government facilities for the treatment and storage of nuclear wastes, including all containers, casks, buildings, vehicles, equipment, and other materials associated with such facilities; (2) control over all existing nuclear waste in the possession or control of the Government; (3) the establishment of temporary and permanent facilities for storage, management, and ultimate disposal of nuclear wastes; and (4) the establishment of programs for the treatment, management, storage, and disposal of nuclear wastes. See 42 U.S.C. 7133(a)(8)(A), (B), (C), and (E). "This left control over existing government

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facilities and defense nuclear waste in DOE." NRDC v. Abraham, 244 F.3d at 745.

2. The Nuclear Waste Policy Act. In 1982, Congress enacted the NWPA as a specific program for siting and operating geologic repositories for the permanent disposal of SNF and HLW. Pub. L. 97-425, 96 Stat. 2202 (Jan. 7, 1983) (codified, as amended, at 42 U.S.C. 10101 et seq.). See generally NRDC v. Abraham, 244 F.3d at 743.

Section 8 of the NWPA, 42 U.S.C. 10107, entitled "Applicability," defines the regulatory scope of the Act. In subsection 8(a), entitled "Atomic energy defense activities," Congress directed that:

> Subject to the provisions of subsection (c) of this section, the provisions of this chapter shall not apply with respect to any atomic energy defense activity or to any facility used in connection with any such activity.

42 U.S.C. 10107(a). The NWPA defines "atomic energy defense activity" to include

> any activity of the Secretary [of Energy] performed in whole or in part in carrying out * * * * defense nuclear waste and materials by-products management.

42 U.S.C. 10101(3)(E). NWPA subsection 8(c), referred to in subsection 8(a), provides the only qualification to the general rule that the NWPA does not apply

to any atomic energy defense activity. Subsection 8(c), entitled, "Applicability to certain repositories," provides:

> The provisions of this chapter shall apply with respect to any repository not used exclusively for the disposal of high-level radioactive waste or spent nuclear fuel resulting from atomic energy defense activities, research and development activities of the Secretary, or both.

42 U.S.C. 10107(c).

Subsection 8(b), unlike 8(c), is not presented as an exception to the general rule of non-applicability to atomic energy defense activities established by section 8(a). Subsection 8(b)(1) requires the President to "evaluate the use of disposal capacity at one or more repositories to be developed under [the NWPA] for the disposal of high-level radioactive waste resulting from atomic energy defense activities." 42 U.S.C. 10107(b)(1). "Unless the President finds, after conducting the evaluation required in paragraph (1), that the development of a repository for the disposal of high-level radioactive waste resulting from atomic energy defense activities only is required * * * the Secretary shall proceed promptly with arrangement for the use of one or more of the repositories to be developed under [the NWPA] for the disposal of such waste." Section 8(b)(2), 42 U.S.C. 10107(b)(2).

The NWPA defines "high-level radioactive waste" as:

(A) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and

(B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation.

42 U.S.C. 10101(12).

B. Waste from the reprocessing of SNF. Because the Order sets guidelines for waste management but does not make specific waste management decisions, the administrative record does not provide detailed information about the wastes in particular tanks. And because this is a facial challenge to the Order, the outcome does not depend on specific facts about particular wastes. See *infra* at 61.

Nevertheless, the administrative record provides some general background concerning waste from reprocessing SNF at atomic energy defense facilities. "Reprocessing" is not defined in any statute but is considered by DOE to be those actions necessary to separate fissile elements and/or transuranium elements from other materials (*e.g.*, fission products, activated metals, cladding) contained in spent nuclear fuel for the purposes of recovering the desired materials. ER238. The waste from reprocessing is stored in underground tanks at facilities managed by DOE pursuant to its authority under the AEA. In general, the tanks contain liquids, sludges derived from the liquid reprocessing waste, and other solids also derived from the liquid waste. ER076-77. For example, at the Savannah River Site in South Carolina and the Hanford Nuclear Reservation in Washington, "the acidic waste is neutralized, dehydrated, then stored as damp crystalline salt, sludge, and 'supernate' liquid." ER076.

However, there is additional material in some of the tanks.

> At Hanford, many of the primary reprocessing wastes were generated using older separation technologies which resulted in substantial dilution of those wastes with nonradioactive materials. In addition, many of the tanks at Hanford contain mixtures of wastes from both reprocessing sources and other sources.

ER331.

C. Order 435.1

This case involves DOE Order 435.1, entitled *Radioactive Waste Management*. In 1998, DOE published a Notice of Availability of the draft Order and the accompanying Manual and accepted public comments. 63 Fed. Reg. 42,012 (August 6, 1998). DOE approved the revised Order, the Manual, and an accompanying Implementation Guide (DOE G 435.1-1) on July 9, 1999. ER319. DOE also published a Notice of Availability of the final documents. 64 Fed. Reg. 37,948 (July 14, 1999).

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DOE Order 435.1 defines how DOE implements its AEA and ERA authority and sets forth objectives and requirements for DOE programs and contractors in managing radioactive waste at DOE-owned or leased facilities. 64 Fed. Reg. at 37,948-49. The activities regulated by the Order and Manual include waste characterization, treatment, disposal, and environmental monitoring. ER139-179. The Guide "discusses, in a non-prescriptive manner, acceptable methods for meeting the requirements of the Order and Manual." 64 Fed. Reg. at 37,948. Order 435.1 and the Manual replace and cancel DOE Order 5820.2A (also entitled *Radioactive Waste Management* (September 26, 1988)). 64 Fed. Reg. at 37,949.

Order 435.1 and the Manual govern waste generated as a product of the reprocessing of spent nuclear fuel. ER139-40. DOE Order 435.1 breaks down DOE's waste management activities by waste type including, *inter alia*, high-level waste, transuranic waste, and low-level waste.[2] This case involves the process and criteria used by DOE to determine whether radioactive waste is HLW or WIR. Wastes determined to be WIR are not high-level wastes and are managed as transuranic, mixed low-level, or low-level wastes. See, *e.g.*, ER239-40 (example and Table).

2 The terms "spent nuclear fuel," "high-level waste," "transuranic waste," and "low-level waste" are defined in the Manual. DOE M 435.1-1, Attachment 2, pages 3, 4, 6, and 7, ER181-82, 184-85.

DOE determines whether waste is WIR by using either a "citation" process or an "evaluation" process. ER246. The citation process (which NRDC has not challenged) encompasses specific categories of wastes which are the result of reprocessing operations. These include contaminated job wastes and laboratory items such as clothing and tools. ER252-53. The evaluation process focuses on the hazard-related characteristics of the waste. In substance, DOE determines whether reprocessing wastes that will be disposed of in a solid physical form, and have been or will be processed to remove key radionuclides to the maximum extent that is technically and economically practical, can meet stringent, protective criteria that assure low risks to the public, workers, and the environment. See ER139-40, 236,250-51.[3] If DOE determines that waste meets either the citation or evaluation criteria, the waste is WIR rather than HLW, and DOE manages it as low-level or transuranic waste. Id. At this time, DOE plans to dispose of high-level wastes in a geologic repository that is to be developed under the NWPA. ER292, 294. Low-level and transuranic waste will not be sent to a geologic repository for high-level waste. The "goal of the waste incidental to reprocessing determination process is to safely manage and dispose of a limited number of

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[3] The criteria are explained in more detail at pages 54-55, *infra*.

reprocessing waste streams that do not warrant disposal in a geologic repository because of their lack of long-term threats to the environment and man." ER251.

The concept of and management processes for WIR have been used by the NRC, the DOE, and their predecessor agencies since at least the late 1960's. See *infra* at 46-53. Order 435.1 formalizes this concept.

STANDARD OF REVIEW

A grant of summary judgment is reviewed de novo. Balint v. Carson City, 180 F.3d 1047, 1050 (9th Cir. 1999) (en banc). This includes de novo review of the district court's statutory interpretations. Friend v. Reno, 172 F.3d 638, 641 (9th Cir. 1999).

To the extent the relevant statutory provisions are ambiguous, the Court defers to the permissible interpretation of the agency charged with administering the statute. United States v. Mead, 533 U.S. 218, 227-29 (2001); Chevron U.S.A., Inc. v. Natural Resources Defense Council, Inc., 467 U.S. 837, 842-43 (1984). See General Electric Uranium Management Corporation v. United States Department of Energy, 764 F.2d 896, 905 (D.C. Cir. 1985). The Supreme Court in Mead reaffirmed that, when Congress expressly or implicitly delegates authority to an agency to issue rules or decisions having the force of law, the courts should afford Chevron deference to agency interpretations of ambiguous statutory provisions made in the course of exercising that authority. 533 U.S. at 227-29. See generally Wilderness Society v. United States Fish and Wildlife Service, __ F.3d __, 2003 WL 23025466 at * 5 (9th Cir. Dec. 30, 2003) (en banc).

This court defers to an agency's interpretation of its own regulations unless the interpretation is clearly erroneous or inconsistent with the regulation. Singh-Bhathal v. INS, 170 F.3d 943, 945 (9th Cir. 1999).

SUMMARY OF ARGUMENT

The judgment of the district court should be reversed. First, NRDC's challenge to the Order is not ripe because it depends upon predictions concerning waste management decisions it expects DOE to make and consequences NRDC anticipates may result from such future decisions. Because the Order does not make specific waste managements, such speculative claims are not ripe for review. The Order should be reviewed in a concrete factual setting in which DOE has made a specific waste management decision that the Court can review.

Even if NRDC's claims are ripe, the district court erred in holding that the NWPA supersedes DOE's authority under the AEA to determine how best to manage defense nuclear waste at atomic energy defense facilities. Order 435.1 was issued under the authority granted to DOE under the AEA, the ERA, and the DOEOA. The text of section 8 of the NWPA shows that, with only one limited exception not relevant here, the NWPA does not apply to DOE's management of defense nuclear waste. Contrary to the district court's ruling, the NWPA does not mandate that all such waste be disposed in a geologic repository but rather authorizes DOE to pursue other options.

In Order 435.1 DOE established rational criteria, based upon its expert judgment, to distinguish between the various waste streams and ensure that WIR is not "highly radioactive" and does not pose a threat to human health or the environment if managed as low-level or transuranic waste. Assuming arguendo that the NWPA applies, the district court's claim that the evaluation criteria are inconsistent with the NWPA failed to take account of all the Order's requirements and was thus in error.

ARGUMENT

I

ORDER 435.1 IS NOT RIPE FOR JUDICIAL REVIEW

NRDC's challenge to Order 435.1 is not ripe for review. In determining whether an agency's decision is ripe for review, courts apply both constitutional and prudential principles. Ripeness is a justiciability doctrine drawn from both Article III limitations on judicial power and from prudential reasons for refusing to exercise jurisdiction. Reno v. Catholic Social Services, Inc., 509 U.S. 43, 57 n.18

(1993). It is "designed 'to prevent the courts, through avoidance of premature adjudication, from entangling themselves in abstract disagreements over administrative policies, and also to protect the agencies from judicial interference until an administrative decision has been formalized and its effects felt in a concrete way by the challenging parties.' Abbott Laboratories v. Gardner, 387 U.S. 136, 148-49 (1967); accord, Ohio Forestry Ass'n, Inc. v. Sierra Club, 523 U.S. 726, 732-33 (1998)." National Park Hospitality Ass'n v. Department of the Interior, 538 U.S. 803 (2003) (parallel citations omitted) ("NPHA").

Determining whether administrative action is ripe for judicial review requires a court to evaluate (1) the fitness of the issues for judicial decision and (2) the hardship to the parties of withholding court consideration. Abbott Laboratories, 387 U.S. at 149. The Supreme Court has stated that, in conducting this evaluation, "'Absent [a statutory provision providing for immediate judicial review], a regulation is not ordinarily considered the type of agency action 'ripe' for judicial review under the [Administrative Procedure Act (APA)] until the scope of the controversy has been reduced to more manageable proportions, and its factual components fleshed out, by some concrete action applying the regulation to the claimant's situation in a fashion that harms or threatens to harm him.'" NPHA, 123 S. Ct. at 2030 (quoting Lujan v. National Wildlife Fed'n, 497 U.S. 871, 891 (1990)).

The Forest Plan at issue in Ohio Forestry is similar to Order 435.1 in that both set general standards and guidelines to govern future site-specific management actions. The Court in Ohio Forestry held that since the Forest Plan caused no immediate harm to plaintiffs and they would have the opportunity to challenge site-specific decisions at the time they were made, a general challenge to the Forest Plan was not ripe for review.

For the same reason, NRDC's challenges to Order 435.1 are not ripe. NRDC challenged the future application of the WIR evaluation process to decisions regarding the disposition of wastes in tanks at the Hanford Site, the Idaho National Engineering and Environmental Laboratory ("INEEL"), and Savannah River. See, e.g., Complaint at ¶¶ 1, 5, 6, 47, 48, ER001, 003, 016. NRDC acknowledged, however, that these decisions are still being formulated, describing them as "plans." See id. at ¶¶ 40, 47, ER014, 016. Such allegations cannot establish direct and immediate harm until such time that the Department makes a decision regarding waste disposal at a particular site. The Order does not make any waste disposal decision. Order 435.1 formalizes evaluation criteria and a process to determine whether waste is WIR and requires that such determinations be made on a case-by-case basis. ER250. The Order does not make any waste disposal decision or determine what waste streams may or may not be found to be WIR. Like the challenged Forest Plan provisions addressed in Ohio Forestry, Order 435.1 does not "now inflict[] significant practical harm" and NRDC will "have ample opportunity later to bring its legal challenge at a time when harm is more imminent and more certain" such as when the Department applies the Order within a waste disposal decision which allegedly causes some harm. 523 U.S. at 734.

The Court would benefit from delaying judicial review until such time as DOE's policies have been applied in a concrete factual situation. As the Supreme Court recognized in Ohio Forestry, waiting until the consequences of a challenged policy have been "'reduced to more manageable proportions,'" and where the factual components have been "'fleshed out, by some concrete action,'" would significantly advance and aid in the resolution of the legal issues presented. 523 U.S. at 736 (quoting Lujan, 497 U.S. at 891). This is particularly true in this case where, as discussed above, it is uncertain how the Department may address numerous different waste streams under the challenged criteria. See National Ass'n of Reg. Util.Comm'rs v. DOE, 851 F.2d 1424, 1428-1429 (D.C. Cir. 1988).

The district court found NRDC's claims ripe largely because it thought it would be unable to grant NRDC an effective remedy if review were postponed until a decision was made to close a particular tank. ER051 ("Tank closures, once undertaken aren't readily altered."). The practical reality is that a WIR determination is likely to be publicly disclosed by state regulatory officials and through the environmental review process under the National Environmental Policy Act ("NEPA"), 42 U.S.C. 4332, well before implementation.[4] Moreover, this Court has held that it can provide a plaintiff with an effective remedy even if the challenged government conduct has already occurred. See Van Abemma v. Fornell, 807 F.2d 633, 636-37 (9th Cir. 1986); Columbia Basin Land Protection Ass'n v. Schlesinger, 643 F.2d 585, 591 n.1 (9th Cir. 1981). DOE, as the agency threatened with such a prospect, will have ample incentive to be sure that the public is notified of a planned tank closure well before it actually occurs.

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[4] For example, at the Savannah River Site, the South Carolina Department of Health and Environmental Controls reviews and approves the site's General Closure Plan as well as the specific individual tank closure modules (which include a copy of the WIR determination for each tank). See ER 338-41. The Record of Decision for the Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single Shell Tanks at the Hanford Site Final Environmental Impact Statement will be published in the Federal Register. See Notice of Intent to prepare EIS at 68 Fed. Reg. 1052 (January 8, 2003). The closure of double shell tanks will be the subject of future NEPA documentation. Id.

II

THE NWPA DOES NOT APPLY TO THE ACTIVITIES OF THE SECRETARY IN MANAGING DEFENSE NUCLEAR WASTE AT ATOMIC ENERGY DEFENSE FACILITIES

A. Under settled principles of statutory construction, the NWPA does not apply to the Secretary's management of defense nuclear waste. When construing statutory language, it is settled practice that this Court first looks to the plain meaning of the statute. Local Joint Executive Bd. of Culinary/Bartender Trust Fund v. Las Vegas Sands, Inc., 244 F.3d 1152, 1157 (9th Cir. 2001). Courts presume that Congress "'says in a statute what it means and means in a statute what it says there.'" United States v. Romo-Romo, 246 F.3d 1272, 1274-75 (9th Cir. 2001) (quoting Hartford Underwriters Ins. Co. v. Union Planters Bank, N.A., 530 U.S. 1, 6 (2000)). If the language of the statute is clear – as it is here – there is no need to look further than that language in determining the statute's meaning. Oregon Natural Resources Council, Inc. v. Kantor, 99 F.3d 334, 339 (9th Cir. 1996). See also Hughes Aircraft Co. v. Jacobson, 525 U.S. 432, 438 (1999).

1. The meaning of Section 8(a) of the NWPA is clear: the NWPA does not apply to the Secretary's management of defense nuclear waste. Section 8 of the NWPA, entitled "Applicability," defines the scope of the Act. Section 8(a) of

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the NWPA provides that it does not apply to "any atomic energy defense activity or to any facility used in connection with any such activity." 42 U.S.C. 10107(a). The NWPA expressly defines "atomic energy defense activities" to include "any activity of the Secretary [of Energy] performed in whole or in part in carrying out * * * * defense nuclear waste and materials by-products management." 42 U.S.C. 10101(3)(E). Thus, Congress did not intend the NWPA to apply to any activity of the Secretary that involves, in whole or in part, the management of defense nuclear waste.

There can be no doubt that Order 435.1 in general, and the WIR provisions in particular, concern DOE activities "performed in whole or in part in carrying out * * * * defense nuclear waste and materials by-products management." 42 U.S.C. 10101(3)(E). DOE Order 435.1 provides waste management guidelines for DOE components and contractors. Order 435.1 and its accompanying Manual and Guide "catalog" DOE's existing waste management procedures and practices which ensure "all DOE elements and contractors continue to manage DOE's radioactive waste in a manner that is protective of worker and public health, safety, and the environment." ER117. As this Court previously stated, "DOE Order 435.1 addresses management of wastes at DOE facilities." <u>NRDC v.</u>

Abraham, 244 F.3d at 744. Thus, under the plain meaning of section 8(a), the NWPA does not apply to Order 435.1. 42 U.S.C. 10107(a).

NWPA section 8(c), 42 U.S.C. 10107(c), provides the only caveat to section 8(a), but it is of no relevance to this case. Section 8(c) only clarifies that if, as permitted under the NWPA, a civilian repository is also used for the disposal of defense HLW, then that repository shall be regulated under the NWPA. But that is the only circumstance where the NWPA applies to defense nuclear waste. See NRDC v. Abraham, 244 F.3d at 744 (except to the extent that defense HLW is emplaced in a repository with commercial SNF and HLW, "[s]ection 10107(a) provides that NWPA does not apply to any atomic energy defense activity or facility"). Thus, with only this one narrow exception, the enactment of the NWPA left essentially undisturbed the statutory framework under which DOE is responsible for the management of radioactive waste at atomic energy defense facilities.

The district court relied upon section 8(b) for its holding that all defense HLW must be disposed of in a NWPA repository. But section 8(b), unlike section 8(c), is not mentioned as an exception to the general rule of nonapplicability in section 8(a). The fact that Congress included an exception to section 8(a)'s general rule of nonapplicability shows that Congress knew how to draft an exception when it wanted. Accordingly, no further exceptions should be implied. See City of Chicago v. Environmental Defense Fund, 511 U.S. 328, 337-38 (1994). Moreover, "[t]he canon of '*expressio unius est exclusio alterius* . . . as applied to statutory interpretation creates a presumption that when a statute designates certain persons, things, or manners of operation, all omissions should be understood as exclusions.'" Perdomo-Padilla v. Ashcroft, 333 F.3d 964, 970 (9th Cir. 2003), cert. denied, 2004 WL 46643 (Jan. 12, 2004) (quoting Boudette v. Barnette, 923 F.2d 754 (9th Cir. 1991)). The fact that Congress specified only section 8(c) as an exception to the general rule precludes interpreting section 8(b) as an additional exception.

Thus, the plain language of NWPA section 8 and established principles of statutory construction show that, except as specified in section 8(c), Congress did not intend to disturb the Secretary's authority under the AEA, the ERA, and the DOEOA to manage defense nuclear waste. The lower court's ruling that section 8(b) mandates the disposal of all HLW from defense SNF reprocessing at a geologic repository curtails the Secretary's waste management authority under those statutes, precisely what Congress did not intend to do.

2. DOE's interpretation of section 8 gives effect to all of its provisions. "It is the cardinal principle of statutory construction that it is our duty to give effect, if

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possible, to every clause and word of a statute rather than to emasculate an entire section." Bennett v. Spear, 520 U.S. 154, 174-75 (1997) (internal quotation marks, ellipses, and brackets omitted). DOE's plain meaning reading of section 8 gives effect to sections 8(a) and 8(b), but the district court's ruling effectively reads section 8(a) out of the statute.

DOE's reading is that section 8(b) requires the agency to bear a proportionate share of the costs of a geologic repository developed under the NWPA that will provide the capacity for the disposal of defense HLW, in the event the President decided not to develop a repository solely for defense nuclear waste. At the same time, section 8(a) preserves DOE's authority to manage such waste under the AEA, the ERA, and the DOEOA. By providing that the NWPA does not apply to DOE activities "performed in whole or in part in carrying out * * * * defense nuclear waste and materials by-products management," Congress made clear that the NWPA does not control the Secretary's decision whether, and to what extent, DOE will use the capacity of a geologic repository in the management of defense nuclear waste. 42 U.S.C. 10107(a), 10101(3)(E). This reading is consistent with, and follows from, this Court's ruling that the NWPA applies to the development of nuclear repositories, not to the management of nuclear waste at atomic energy defense facilities. NRDC v. Abraham, 244 F.3d at 742.

This reading, unlike the district court's, gives effect to both section 8(a) and section 8(b). Under section 8(b)(2), when the President found that a defense-only repository was not required, the Secretary was directed to make "arrangement[s] for the use" of a commercial repository for the disposal of defense HLW. 42 U.S.C. 10107(b)(2). Notably, the statutory directive is not that the Secretary "shall dispose" of defense HLW in such a repository, or even that he "shall use" such a repository, but simply that he shall "arrange[ ] for the use" of such a repository. The statutory text explains what this means: "Such arrangements shall include the allocation of costs of developing, constructing, and operating this repository," and the "costs resulting from permanent disposal of high-level radioactive waste from atomic energy defense activities shall be paid by the Federal Government, into the special account established under section 302." Section 8(b)(2), 42 U.S.C. 10107(b)(2). In other words, the Secretary is directed to "allocate" that portion of the costs associated with a commercial repository that would be attributable to any defense HLW that is disposed of there, and the Government is required to pay that allocated share into the Nuclear Waste Fund established by Section 302, 42 U.S.C. 10222.

Section 302 established a Nuclear Waste Fund ("NWF") to finance the development and operation of a repository; required commercial generators to enter into contracts with DOE in order to dispose of HLW or SNF in a repository; and provided that the payments under such contracts are to be deposited in the NWF and, cumulatively, must ensure " full cost recovery" of the all the expenses incurred in repository development and operation. With respect to defense HLW, Section 302 (b)(4) provided that "[n]o high-level radioactive waste * * * generated or owned by any department of the United States * * * may be disposed of by the Secretary in any repository constructed under this chapter unless such department transfers to the Secretary for deposit in the Nuclear Waste Fund, amounts equivalent to the fees that would be paid * * * under the contracts referred to in this section if such waste * * * were generated by any other person." 42 U.S.C. 10222(b)(4).

~~Thus~~, the "arrangement for the use" of a repository that the Secretary was required to make under Section 8(b)(2) is the equivalent of the contracts that were required for commercial generators. This reading is consistent with accepted rules of statutory construction. "[I]t is a commonplace of statutory construction that the specific governs the general." Morales v. Trans World Airlines, 504 U.S. 374, 384 (1992) (citation omitted). Similarly, under the principle of *ejusdem generis*, when a general term is preceded or followed by specific examples, the general term should be understood as a reference to subjects similar to those that are specifically enumerated. See Breininger v. Sheet Metal Workers Int'l Assoc., 493 U.S. 67, 91-92 (1989); McBoyle v. United States, 283 U.S. 25 (1931) (Holmes, J.); Microsoft Corp. v. C.I.R., 311 F.3d 1178, 1185 (9th Cir. 2002); 2A Norman J. Singer, *Sutherland-Statutory Construction* § 47.17 (2000 Revision). And a word is understood by words that are associated with it. Microsoft Corp., 311 F.3d at 1185.

Applying these principles, the requirement in section 8(b)(2) that the Secretary proceed with the arrangement for the use of one or more of the repositories means that the Secretary should make the specifically enumerated financial arrangements, and that he should make other arrangements that may be necessary should DOE elect to dispose of defense HLW in a geologic repository developed pursuant to the NWPA. However, requiring DOE to dispose of all defense HLW in a geologic repository would be a requirement of an entirely different nature than is indicated by the examples Congress provided.

The NWPA established a comprehensive program to develop and pay for repositories (see 42 U.S.C. 10131(b) ("Purposes")), but it nowhere contains any requirement that any HLW or SNF actually be disposed of in a repository. In fact, NWPA section 222, 42 U.S.C. 10202, directed the Secretary to "continue and accelerate a program of research, development, and investigation of alternative means and technologies" for disposing of both commercial and defense radioactive wastes (emphasis added). Commercial generators, to be sure, have a strong incentive under the Act to arrange for the disposal of their HLW and SNF in an NWPA repository: if they fail to enter into contracts under Section 302, the NRC "shall not issue or renew" their licenses. 42 U.S.C. 10222(b). However, whether or not they enter into Section 302 contracts, commercial generators are free to pursue other potential alternatives, such as exporting SNF for reprocessing. No statutory or contractual provision requires them to actually tender any material for disposal.

With respect to defense HLW, the lack of any requirement that disposal actually occur is even more stark. For DOE there is no "hammer," like the loss of NRC licensing which faces commercial generators. Quite the contrary, DOE has independent statutory authority to provide for storage, processing, transportation, and disposal of radioactive waste resulting from nuclear materials production and other military programs. 42 U.S.C. 2121(a)(3). And the NWPA specifically provides that "[n]othing in this chapter shall be construed to amend or otherwise detract from the licensing requirements of the Nuclear Regulatory Commission established in title II of the Energy Reorganization Act of 1974." NWPA Section 114 (f)(5), 42 U.S.C. 10134(f)(5). Under ERA Section 202, 42 U.S.C. 5842, the NRC can license facilities expressly authorized by Congress for the long-term storage of defense HLW. Thus, the NWPA implicitly recognizes DOE's authority to pursue alternatives to disposal of HLW in a geologic repository.

3. Legislative history also supports DOE's reading of section 8. The House Committee reports on H.R. 3809, the bill that eventually became the NWPA, confirm that the statute does not mandate that defense HLW be disposed of in a geologic repository. The House Committee on Interior and Insular Affairs explained:

> H.R. 3809 as amended by the Committee does not mandate actions or affect in any way current regulatory requirements or exemptions applicable to repositories or other storage or management facilities for high level waste created by nuclear defense activities or nuclear research activities of the Department of Energy or the Department of Defense. The Committee rejected an amendment proposed to explicitly exempt from the Act any facilities for disposal of defense nuclear wastes, in order to assure that facilities constructed and operated under this Act could be available for disposal of wastes from the Department of Energy or the Department of Defense activities if those agencies should elect to use these facilities.
>
> * * *
>
> This legislation does not prohibit the Secretary from constructing and operating another waste disposal facility under some other authority, consistent with other applicable laws. The Secretary is currently undertaking such a program. The Waste Isolation Pilot Plant project has been authorized

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> for development of a facility for disposal of transuranic wastes, which may eventually be converted to a disposal facility for high level wastes.

H.R. Rep. No. 97-491, Part 1, at 44 (1982), reprinted at 1982 U.S.C.C.A.N. 3792, 3810 (emphasis added).

Thus, the legislative history confirms what the statutory text says: the NWPA does not apply to defense nuclear waste management; facilities constructed under the NWPA can, however, be used for the disposal of defense waste "if those agencies should elect to use these facilities"; the NWPA does not, however, prohibit the Secretary from constructing and/or using other facilities for HLW management.

The House Armed Services Committee added new section 5 to H.R. 3809, the bill that was eventually enacted by both Houses of Congress, and section 5 was included in section 8(a) as enacted.[5] Compare H. R. Rep. 97-491, Part II, at 3 (July 16, 1982) with 42 U.S.C. 10107(a). In discussing the management of defense nuclear waste, the Committee noted (quoting an earlier Committee Report) that:

> The processes involved in the production of special nuclear material for use in nuclear weapons and other defense activities of the Department of Energy are inseparable from the management of the byproducts generated in the production, use, and recycling of those

[5] The only change between section 5 as recommended by the Committee and section 8(a) as enacted was the addition of the exception for section 8(c) discussed previously.

> materials. No production decision can be made without, at the same time, a decision regarding the storage, processing, recovery, or disposal of the byproducts that such production inevitably produces.

H. R. Rep. 97-491, Part 2, at 9, reprinted in 1982 U.S.C.C.A.N. 3841. The United States, the Committee explained, had "no choice but to continue the Department of Energy's defense programs." Id. at 11. Therefore, the Committee decided to amend H.R. 3809 to place atomic energy defense activities outside the scope of the NWPA in order "to prevent the vital atomic energy defense activities of the United States from being impeded or burdened by extraneous activities not related to national defense or national security." Id.

Thus, the legislative history shows that the provision that became section 8(a) was intended to prevent just the type of intrusion into atomic energy defense activities that the district court's decision represents.

B. The district court's reasons for refusing to give effect to the plain meaning of section 8(a) are without merit. The district court appears to have concluded that the Secretary's authority under the AEA, the ERA, and the DOEOA to manage defense nuclear waste never included the authority to classify and dispose of such waste. See ER054. This conclusion is at least in serious tension with, if not contrary to, this Court's holding that DOE's authority to issue Order 435.1 addressing the management of wastes at DOE facilities comes from the AEA, the ERA, and DOEOA. NRDC v. Abraham, 244 F.3d at 744. It is also at odds with this Court's suggestion that one such authority transferred to DOE that underlies the Order is DOE's AEA-granted authority over long-term storage facilities for HLW. Id. at 744-45.

The district court's conclusion that DOE lacks this authority is plainly wrong. There is no reason to interpret DOE's broad authority under the AEA, the ERA, and the DOEOA to control and manage defense nuclear waste as excluding such essential components of waste management as disposing of waste and classifying it for the purpose of disposal. Indeed, section 91(a)(3) of the AEA provides that "[t]he Commission is authorized to * * * provide for safe storage, processing, transportation, and *disposal* of hazardous waste (including radioactive waste) resulting from nuclear materials production, weapons production and surveillance programs, and naval nuclear propulsion programs." 42 U.S.C. 2212(a)(3) (emphasis added). This authority was among those transferred to ERDA by section 104 of the ERA (subject to NRC licensing in the case of new facilities expressly authorized by Congress for long-term storage of HLW) and then to DOE by section 301 of the DOEOA. 42 U.S.C. 5814, 7151(a). While the words "characterization" and "classification" are not on the list describing this authority, it would be absurd to suggest that the AEC could not perform these functions – as indeed it did for many years. Thus, when this Court ruled the ERA and DOEOA "left control over existing government facilities and defense nuclear waste in DOE," 244 F.3d at 745, that control included the authority to characterize, classify, and dispose of such waste.

The district court also relied upon the fact that the NWPA includes definitions of "disposal" and high level radioactive waste" to support its holding. ER054, 056. But section 8, not the definitions section, governs the applicability of the NWPA. The district court appears to have assumed that the definition of "disposal" indicates Congressional intent that the NWPA regulate the Secretary's decisions concerning the disposal of defense nuclear waste. ER054. In fact, the definition of disposal serves an entirely different purpose. The NWPA defines a "repository" as a system for the deep geologic "disposal" of HLW and SNF. 42 U.S.C. 10101(18). By defining "disposal" as "the emplacement in a repository of high-level radioactive waste, spent nuclear fuel, or other highly radioactive material with no foreseeable intent of recovery," Congress made clear that a "repository" is a facility from which such materials are not expected to be recovered. 42 U.S.C. 10101(9). Similarly, the fact that the NWPA includes a definition of HLW in no way restricts the plain meaning application of section 8(a). The term "high-level radioactive waste" also appears in the definition of "repository," as well as in various other provisions of the NWPA. Congress included the definitions to clarify the statutory text, not to extend the reach of the statute beyond its applicability as defined in section 8.

In addition, the district court pointed to a House Committee report containing a general statement that the NWPA was a response to "the need for legislation to address problems besetting nuclear waste management." ER055 (citing H.R. Rpt. 97-491 at 26 (April 27, 1982)) (emphasis by district court omitted). Such general statements of legislative purpose provide little guidance in interpreting a specific statutory provision. See United States v. Granderson, 511 U.S. 39, 49 (1994); Busic v. United States, 446 U.S. 398, 408 (1980); National Wildlife Federation v. Gorsuch, 693 F.2d 156, 178 (D.C. Cir. 1982). The district court failed to consider the much more relevant and specific legislative history discussed above that shows that Congress intended to preserve the Secretary's existing authority to manage defense nuclear waste. That history shows that, as is frequently the case with statutes, the NWPA reflects several legislative purposes and concerns. As the D.C. Circuit has observed, "statutes are rarely, if ever, unidimensionally directed towards achieving or vindicating a single public policy." NRDC v. EPA, 822 F.2d 104, 113 (D.C. Cir. 1987). In the case of the NWPA, the limitation upon the applicability of the NWPA was part of the "compromise and accommodation" that permitted its enactment. Id. The district court erred in disregarding that limitation.

The district court thought the general statement of legislative purpose in the House Report made it "inconceivable that Congress intended to allow the DOE unfettered discretion in the management of radioactive waste." ER055. But DOE made no claim of "unfettered discretion." DOE argued that its management of defense nuclear waste continues to be governed by the AEA, the ERA, and the DOEOA. Those statutes do not confer "unfettered discretion" on DOE but rather grant the agency only the authority to "provide for the *safe* storage, processing, transportation, and disposal of" radioactive waste resulting from defense-related activities. 42 U.S.C. 2121(a)(3) (emphasis added).

The district court also relied on comments by Senator Simpson. ER053. Comments by one legislator are of little value in interpreting the will of Congress. Brock v. Pierce County, 476 U.S. 253, 263 (1986); Chrysler Corp. v. Brown, 441 U.S. 281, 311 (1979). See also Coalition for Clean Air v. Southern Cal. Edison, 971 F.2d 219, 227 (9th Cir. 1992). Furthermore, Senator Simpson's comments pertain to S. 1662, a bill that passed the Senate but not the House. Finally, the comments made by Senator Simpson went only to whether a geologic repository developed under the NWPA should be available for defense HLW. See 128 Cong.

Rec., Part 6, at 8219. Senator Simpson believed that "the amendment [being proposed] is essential to insure that the *option* of using the repositories to be developed under S. 1662 for the disposal of both defense and civilian high-level radioactive waste is given full and fair consideration." Id. (emphasis added). No statement of Senator Simpson shows that even he, much less Congress as a whole, intended that defense HLW must be disposed of in such a repository.

The district court's insistence that all defense HLW must be disposed of in a repository would, in fact, be impossible to implement. Under the NWPA, Yucca Mountain is the only site under consideration for a geologic repository. If it is ultimately licensed by the NRC, survives pending and anticipated legal challenges, and is built, Section 114(d) of the NWPA, 42 U.S.C. 10134(d), will limit Yucca Mountain's capacity to the equivalent of 70,000 metric tons of heavy metal unless and until a second repository is not only authorized but "in operation." In its *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, February 2002 (the "Yucca Mountain FEIS"), DOE determined that approximately 63,000 metric tons of the total capacity of Yucca Mountain should be reserved for commercial spent nuclear fuel. FEIS at 2-2.[6] The remaining 7,000 metric tons (or 10 percent) of the repository's capacity would be available for the disposal of 2,333 metric tons of DOE spent nuclear fuel and approximately 8,315 canisters (4,667 metric tons) containing solidified high-level radioactive waste from both the West Valley Demonstration Project and defense sources. FEIS at 8-6. DOE estimates, however, that if all commercial nuclear facilities licenses are extended for ten years, by 2046 there will be in existence approximately 105,000 metric tons of commercial spent nuclear fuel, and that by 2035 there will be approximately 2,500 metric tons of DOE spent nuclear fuel and 22,280 canisters of DOE HLW. See FEIS Appendix A at Tables A-8, A-20 and A-27, at pages A-16, A-27 and A-40, respectively. In other words, Yucca Mountain does not have the space for all defense HLW waste.

It is unreasonable to read the NWPA as requiring the impossible. Since the President has determined that a defense-only repository is not required, the NWPA allows DOE to dispose of defense HLW at Yucca Mountain to the extent it has made "arrangement[s] * * * for the disposal of such waste." To the extent that

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[6] Available at http://www.ocrwm.doe.gov/technical/doclist.shtml. The FEIS is not part of the administrative record for the Order, but the Court may take judicial notice of the facts set forth in the text above. See American Indians Residing on Maricopa-Ak Chin Reservation v. United States, 667 F.2d 980, 999 (Ct. Cl. 1981); Fed. R. Evid. 201(f).

DOE has not and could not have arranged for the disposal of defense HLW at Yucca Mountain, however, the NWPA does "not apply" to DOE's continuing nuclear waste management activities (Section 8(a), 42 U.S.C. 10107(a)) and does not "detract from the licensing" authority of the NRC under the ERA insofar as it affects those activities (Section 114(f)(5), 42 U.S.C. 10134(f)(5)).

At bottom, the district court's ruling that all HLW must be disposed of in a repository rests on the notion that NWPA section 8(b) displaced DOE's long-established waste management authority under the AEA and NRC's licensing authority under ERA Section 202. The district court's conclusion violates the fundamental rule of statutory construction against repeals by implication. See, *e.g.*, J.E.M. AG Supply , Inc. v. Pioneer Hi-Bred International, Inc., 514 U.S. 124, 142-43 (2001); Morton v. Mancari, 417 U.S. 535, 549-550 (1974). Not only does the NWPA not provide any clear evidence of Congressional intent to implicitly repeal the statutory authority ~~of the~~ DOE or the NRC, but NWPA sections 8(a) and 114(f)(5) make clear that was not Congress' intent. 42 U.S.C. 10107(A), 10134(f)(5).

C. If the statute is unclear, the interpretations of the NRC and the DOE that the NWPA does not supersede DOE's preexisting authority to manage defense wastes are entitled to judicial deference. The NRC has concluded that the NWPA

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does not mandate the disposal of defense HLW in a geologic repository. The NRC, under Section 202 of the ERA, has continuing authority to license DOE facilities expressly authorized by Congress for the long-term storage of defense HLW. See 65 Fed. Reg. 62377 (Oct. 18, 2000). The NRC has stated: "Neither the NWPA nor 10 C.F.R. Part 60 requires HLW to be disposed of in a geologic repository." Id. at 62378 n. 10; see also 52 Fed. Reg. 5992, 5994 (Feb. 27, 1987) (NRC Advance Notice of Proposed Rulemaking to Define High-Level Waste) ("the NWPA does not require that materials regarded as HLW pursuant to this definition [of HLW in the NWPA] be disposed of in a geological repository").

The NRC's interpretation of ambiguous provisions of the NWPA is entitled to Chevron deference in the event the Court concludes the statute is ambiguous. Congress has assigned the NRC a substantial role in the regulation of HLW under both the ERA and the NWPA. 42 U.S.C. 5842(4), 10141(b). The NRC's October 18, 2000, decision interprets the scope of that regulatory authority. Deference under Chevron is appropriate when an agency has interpreted a statute pursuant to an informal adjudicatory process that the agency has established to carry out its general regulatory responsibilities. See NationsBank of North Carolina, N.A. v. Variable Annuity Life Ins. Co., 513 U.S. 251, 256-57 (1995).

For any agency statutory interpretation to which Chevron deference does not apply, DOE and the NRC would be entitled to deference under Skidmore v. Swift & Co., 323 U.S. 134, 140 (1944). DOE concluded in the Implementation Guide accompanying the Order and Manual that the NWPA

> does not mandate that materials regarded as high-level waste pursuant to [the NWPA] definition be disposed of in a geologic repository. Indeed, [the NWPA] directs the Secretary of Energy to continue and accelerate a program of research, development, and investigation of alternative means and technologies for the permanent disposal of high-level waste.

ER235 (emphasis added; citation omitted). In Alaska Dept. of Env. Conservation v. EPA, __ S. Ct.___, 2004 WL 86284 at *16 (Jan. 21, 2004), the Supreme Court held that while agency guidance memoranda were not entitled to Chevron deference, "[c]ogent 'administrative interpretations . . . not [the] products of formal rulemaking . . . nevertheless warrant respect.'" Id. (quoting Washington State Dept. of Social and Health Servs. v. Guardianship Estate of Keffeler, 537 U.S. 371, 385 (2003)). Such deference would be particularly appropriate here, both because the two expert agencies have reached the same conclusion and because "the regulatory scheme is highly detailed, and [the agencies] can bring the benefit of specialized experience to bear" on the questions presented. Mead, 533 U.S. at 235.

III

ASSUMING ARGUENDO THE NWPA APPLIES, ORDER 435.1 IS CONSISTENT WITH THE NWPA

A. DOE has correctly interpreted the NWPA's definition of HLW. The NWPA, 42 U.S.C. 10101(12)(A), defines HLW as "the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations." The district court thought that the phrase "contains fission products in sufficient concentrations" modifies only "solid material derived from such waste," not "liquid waste produced directly in reprocessing." See ER359-60. Accordingly, the court concluded that "[w]hile NWPA allows DOE to treat the solids to remove fission products, thereby permitting reclassification of the waste, NWPA does not offer the option of reclassification for liquid waste produced directly in reprocessing." ER359.

DOE believes that the NWPA is better interpreted to allow the agency to consider the concentration of fission products in both liquid waste produced directly in reprocessing and in the solids derived from that waste.[7] However, to

[7] Since the solids are derived from the liquids, they are likely to share chemical and physical characteristics, making it much more likely that Congress intended DOE to have the authority to assess the concentration of fission products (continued...)

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uphold the WIR evaluation process in Order 435.1, it is sufficient that the district court recognized that DOE may treat and classify solid reprocessing waste as low-level or transuranic waste. The WIR evaluation process applies only to SNF reprocessing wastes that have been treated and "will be incorporated in a solid physical form." ER139-40. The purpose of the WIR criteria is to determine whether solid reprocessing waste is "highly radioactive material" and/or "contains fission products in sufficient concentrations" so that it requires geologic disposal, 42 U.S.C. 10101(12), or whether such solid waste can instead be managed as low-level or transuranic waste. Because the evaluation criteria in Order 435.1 require that waste "be incorporated in a solid physical form," the district court's attempted distinction between the NWPA's treatment of solid and liquid reprocessing wastes does not affect the validity of the Order.

In any event, regardless of how this Court may interpret the district court's decision, on its face the NWPA's definition of HLW authorizes DOE to consider

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[7](...continued)
in both. "When several words are followed by a clause which is applicable as much to the first and other words as to the last, the natural construction of the language demands that the clause be read as applicable to all." Porto Rico Ry., Light & Power Co. v. Mor, 253 U.S. 345, 348 (1920). See also League of Wilderness Defenders v. Forsgren, 309 F.3d 1181, 1186 (9th Cir. 2002); Shendock v. Director, OWCP, 893 F.2d 1458, 1464 (3d Cir. 1990); United States v. Pritchett, 470 F.2d 455, 456 (D.C. Cir. 1972).

the hazard as well as the source of solid reprocessing waste. As the Guide explains, the NWPA's definition of HLW

> would classify solidified reprocessing waste as high-level waste only if such waste "contains fission products in sufficient concentrations." This phrase implies that liquid reprocessing waste may be partitioned or otherwise treated so that some of the solidified products will contain substantially reduced concentrations of radionuclides and thus not be high-level waste, i.e, incidental waste.

ER236.

It is also significant that Congress provided that HLW is "*highly radioactive material* resulting from the reprocessing of spent nuclear fuel," 42 U.S.C. 10101(12)(A) (emphasis added), not just "material" resulting from reprocessing. See Solid Waste Agency of Northern Cook County v. United States Army Corps of Engineers, 531 U.S. 159, 171-72 (2001) ("SWANCC"). The phrase "highly radioactive material" in the definition of HLW, like the term "navigable waters" at issue in SWANCC, has independent significance. Id. The words "highly radioactive material" reveal Congressional intent that the hazard of reprocessing waste, as well as its source, is relevant to determining whether it is HLW. See also South Dakota v. Yankton Sioux Tribe, 522 U.S. 329, 347 (1998) ("[T]he Court avoids interpreting statutes in a way that 'renders some words altogether redundant.'") (quoting Gustafson v. Alloyd Co., 513 U.S. 561, 574 (1995)).

The legislative history of the NWPA's definition of HLW confirms that Congress intended the definition to turn on both the source of the material and whether it is in fact highly radioactive, *i. e.*, its hazard. H.R. 3809 (the House bill eventually enacted by Congress), as reported by the House Committee on Interior and Insular Affairs, did not contain the language that allowed DOE to take into account the concentration of fission products. H. R. Rep. 97-491, Part I, at 2 (April 27, 1982). H.R. 3809 was subsequently referred to the House Armed Services Committee. That Committee ordered H.R. 3809 to be reported with twelve substantive amendments, one of which was a substitute for the definition of HLW then contained in the bill. After that Committee modified the definition of HLW, it provided:

> The term "high-level radioactivity waste" means the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products and transuranic wastes in such concentrations that the Administrator determines by rule that such products and waste require permanent isolation.

H. R. Rep. 97-491, Part II, at 2 (July 16, 1982) (emphasis added). The Committee explained the reason for the change as follows:

> This amendment strikes out the definition of the term "high-level radioactive waste" contained in the bill * * * and substitutes a new definition of the term "high-level radioactive waste." The

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> recommended definition takes into consideration both the source and the hazard of the waste and permits the regulatory agency responsible under law for setting standards for radioactivity (the Environmental Protection Agency (EPA)) to determine the concentration of fission products and transuranic elements that require permanent isolation.

H. R. Rep. 97-491, Part II, at 4, reprinted in 1982 U.S.C.A.A.N. 3837 (emphasis added). As this statement shows, the amendment was intended to permit consideration of both the source and hazard of radioactive waste from reprocessing.

As finally enacted, the definition was divided into clauses A and B, DOE was authorized to make sufficient concentration determinations under clause A, and the NRC rather than EPA was assigned responsibility for making determinations under clause B. 42 U.S.C. 10101(12). Nothing in the legislative history, however, shows that these changes were intended to alter or eliminate the authority to consider both the source and hazard of the waste.

The House Armed Services Committee's amendment to the definition of HLW reflected the comments provided by DOE at the request of the Committee. In a letter to the Chairman of the Committee on Armed Services, a copy of which was attached to the Committee Report, DOE Acting General Counsel Eric Fygi stated:

> [T]he Department believes that the definition of "high-level radioactive waste" should reflect not only the source of waste (e.g., from reprocessing,) but also the relative hazard. Such a definition would permit the regulatory agencies to exclude materials from "high-

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> level radioactive waste" that need not be disposed of in a repository because of low activity.

Id. at 17, reprinted in 1982 U.S.C.C.A.N. 3847-3849. Congress' decision to follow this recommendation strongly supports DOE's interpretation that section 10101(12) permits consideration of the hazard and the source of radioactive waste.

B. To the extent the NWPA's definition of HLW may be ambiguous, the Court should defer to the longstanding interpretation of the AEC, the NRC, and DOE that low-hazard waste from reprocessing may properly be classified as WIR.

The evaluation process set forth in the Manual makes clear DOE's position that it may distinguish between incidental waste and HLW on the basis of the hazardous characteristics of the waste. ER139-40. This has long been DOE's interpretation. See ER311-12. NRC has for many years also distinguished between incidental waste and HLW. ER247-49.

These statutory interpretations of DOE and NRC are entitled to Chevron deference. DOE issued the Order and Manual pursuant to broad grants of authority under the AEA to promulgate legislative rules. 42 U.S.C. 2201(b), (i)(3). DOE not only administers provisions of the AEA concerning the management of defense nuclear waste, but DOE "is indubitably entrusted with the administration of the [NWPA]." General Electric Uranium, 764 F.2d at 905. DOE's regulatory determination that it may consider the hazard as well as the source of reprocessing waste in determining whether it is HLW was issued pursuant to the AEA, but it is equally applicable to the NWPA because the AEA incorporates the NWPA's definition of HLW. 42 U.S.C. 2014(dd). It is thus "apparent from the agency's generally conferred authority and other statutory circumstances that Congress would expect the agency to be able to speak with force of law when it addresses ambiguity in the statute or fills a space in the enacted law." Mead, 533 U.S. at 229. The Order and Manual were promulgated following public notice and comment, are binding upon DOE and its contractors, and carry the force of law. See pages 10-11, *supra*; ER109-118. Thus, under Mead, they should be afforded Chevron deference.

Similarly, the NRC has through informal adjudication ruled that incidental waste may properly be distinguished from HLW. 65 Fed. Reg. 62377 (Oct. 18, 2000); 58 Fed. Reg. 12,342 (March 4, 1993). The NRC has also stated that there is "no substantive difference" between its regulatory definition of HLW (in 10 C.F.R. Part 60 and 10 C.F.R. Part 50, Appendix F) and the NWPA definition. 66 Fed. Reg. 55732, 55735 (Nov 2, 2001). The NRC determinations, arrived at through informal adjudication and rulemaking, are entitled to Chevron deference. NationsBank, 513 U.S. at 256-57.

In any event, whether or not Chevron deference applies, "the well-reasoned views of the agencies implementing a statute 'constitute a body of experience and informed judgment to which courts and litigants may properly resort for guidance.'" Bragdon v. Abbott, 524 U.S. 624, 642 (1998) (quoting Skidmore v. Swift & Co., 323 U.S. 134, 139-140 (1944)). See also NRDC v. NRC, 582 F.2d 166, 171 (2d Cir. 1978) ("[a]dministrative interpretation, practice, and usage are accorded 'great weight' as an extrinsic aid in the interpretation of statutes by the Courts.'") (citing 3 Sutherland Statutory Construction § 65.05 (4th ed. 1974)).

The WIR processes (*i.e.*, citation and evaluation) stem from the policies developed by the AEC (the predecessor of DOE and NRC) for the siting of commercial SNF reprocessing plants and related waste management facilities. Beginning in the late 1960's, the AEC declined to define high-level waste to include all wastes originating from reprocessing plant operations. Rather, it viewed certain wastes that result from reprocessing, such as ion-exchange beds, sludges, contaminated laboratory items, clothing, tools, radioactive hulls, and other irradiated and contaminated fuel structure hardware, as incidental wastes that might well be managed and disposed of differently from HLW. See 34 Fed. Reg. 8712 (paragraphs 6 & 7) (June 3, 1969) (Statement of Proposed Policy for

10 C.F.R. Part 50, Appendix D [now Appendix F]); 35 Fed. Reg. 17,530 (November 14, 1970).[8]

Although paragraphs 6 & 7 from the 1969 Proposed Statement of Policy (regarding waste that need not be managed as high-level waste) were not included in the Final Appendix to 10 C.F.R. Part 50,[9] the AEC and its successor agencies have consistently distinguished incidental waste in waste management and design activities. In a 1987 Advanced Notice of Proposed Rulemaking for the definition of "High-Level Radioactive Waste" in 10 C.F.R. Part 60, the NRC proposed to refine the definition "so as to follow more closely the statutory definition in the Nuclear Waste Policy Act of 1982." 52 Fed. Reg. 5992 (Feb. 27, 1987). The NRC stated that the term high-level waste

> does not include incidental wastes resulting from reprocessing plant operations such as ion-exchange beds, sludges, and contaminated laboratory items, clothing, tools, and equipment. Neither are radioactive hulls and other irradiated and contaminated fuel structural hardware within the [high-level waste] definition.

Id. at 5993 (emphasis supplied). The NRC explained that "incidental wastes generated in further treatment of [high-level waste]," such as decontaminated salts with lower residual activity levels for certain key radionuclides at DOE's

[8] Appendix F provided the first codified definition of high-level waste.

[9] See 35 Fed. Reg. 17,530, 17,532.

Savannah River Site, would fall outside its proposed revision of the Appendix F definition of HLW. Id. Subsequent NRC notices have reiterated this interpretation. Proposed Rule, 53 Fed. Reg. 17,709 (May 18, 1988) (explaining that although HLW includes the primary reprocessing waste streams at DOE facilities, it does not include "incidental wastes produced in reprocessing"); Final Rule, 54 Fed. Reg. 22,578, 22,581 (May 25, 1989) (explaining that DOE and NRC agreed that, with respect to the Savannah River Site, decontaminated salts "generated incidentally in the course of reprocessing, should not be classified as [high-level waste]").

In its March 1993 denial of a Petition for Rulemaking submitted by the States of Washington and Oregon, which questioned DOE's authority to manage and dispose of "incidental wastes," the NRC again reiterated its historic view that HLW does not include incidental waste. 58 Fed. Reg. 12,342 (March 4, 1993). The NRC explained that, under ERA section 202, 42 U.S.C. 5842, the NRC had no regulatory authority over DOE facilities used for the processing and disposal of incidental wastes because these wastes are not high-level wastes. According to the NRC,

> The responsibility for safely managing [incidental] wastes rests with the Department of Energy. The basis for the Commission's conclusion is that the reprocessing wastes disposed of in the grout

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> facility would be 'incidental' wastes because of DOE's assurance that they:
>
> (1) Have been processed (or will be further processed) to remove key radionuclides to the maximum extent that is technically and economically practicable;
>
> (2) will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C [low-level waste] as set out in 10 C.F.R. pt. 61; and
>
> (3) are to be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 C.F.R. Part 61 are satisfied.

58 Fed. Reg. 12,345. The NRC found that DOE's management was consistent with the regulatory objectives embodied in 10 C.F.R. Part 50, Appendix F. Those objectives require that facilities achieve an acceptable level of decontamination so that residual radioactive contamination is sufficiently low that it will not endanger public health and safety. 58 Fed. Reg. at 12,344-12,345.

The NRC has continued to be of the view that certain waste from reprocessing may properly be classified as WIR rather than HLW. See Final Policy Statement on Decommissioning Criteria for the West Valley Demonstration Project, 67 Fed. Reg. 5003, 5005, 5009, 5011 (Feb. 1, 2002). The NRC provided comments on the draft guidance for Order 435.1. The NRC agreed with DOE "that it is appropriate [for DOE] to make incidental waste classification determinations by either the 'citation' or the 'evaluation' process." ER343.

DOE has also long made clear its view that not all reprocessing waste is HLW. In the 1983 Defense Waste Management Plan, which DOE submitted to Congress pursuant to statutory directive,[10] DOE defined HLW as

> the highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic * * * waste and fission products in concentrations as to require permanent isolation.

ER076. This definition made plain DOE's view that whether a waste is HLW depends upon its hazardous characteristics – whether the concentrations are sufficient to "require permanent isolation" – as well as its source.

The evaluation process in the Order also reflects this interpretation. In responding to comments on the WIR waste issue, DOE referred to and relied upon the NRC's longstanding view that it is appropriate to distinguish between incidental waste and HLW. ER310. DOE also noted its own prior use of the incidental waste concept in preparing environmental impact statements for the management of HLW at the Savannah River Site, the Hanford Site, and INEEL.

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[10] Congress required the President to submit the Report in Pub. L. No. 97-90, Title II, § 213, 95 Stat. 1171 (Dec. 4, 1981), reprinted in 42 U.S.C. 2021a (note).

ER311. DOE explained that "the concept of incidental waste is well established in DOE's waste management planning and practice, and the inclusion of this concept in the Order and Manual does not reflect any change in policy." ER312.

C. The Order's criteria for determining whether solid waste from reprocessing may be classified as WIR are reasonable, consistent with the NWPA, and entitled to deference. By providing that solid reprocessing waste is HLW if it contains fission products in "sufficient" concentrations and is "highly radioactive," but not providing definitions of those terms, Congress made an implicit delegation to DOE to determine when those criteria are met. See Chevron, 467 U.S. at 843. Under Chevron, an agency's interpretation of a statutory ambiguity must be upheld unless it is based upon an impermissible reading of the statute.

The Order passes that test, and accordingly the judgment of the district court should be reversed. The Order mandates compliance with safety requirements comparable to the performance objectives that appear in the NRC's "Licensing Requirements for Land Disposal of Radioactive Waste." 10 C.F.R. Part 61. Such requirements ensure that the disposal of WIR managed as low-level or transuranic waste will not pose a health risk to the public. This is an entirely reasonable interpretation and one that is entitled to deference.

The Order was adopted after extensive review by both the NRC and a panel of experts in the field of radioactive waste management.[11] The Manual requires that three criteria must be satisfied before waste may be managed as low-level waste. First, key radionuclides must be removed to the maximum extent technically and economically practical. Second, the residual waste must meet safety requirements comparable to the performance objectives set forth in 10 C.F.R., Part 61, Subpart C, for low-level waste, so that reasonable assurance exists that any exposures to humans will be within the safety limits established in 10 C.F.R. 61.41 through 61.44 for low-level waste. Third, the waste must (a) be managed pursuant to DOE's authority under the AEA and in accordance with the provisions of Chapter IV of the Manual; and (b) the waste must be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 C.F.R. 61.55,

[11] DOE convened an Order Revision Team, ER273, and a Senior Review Panel was established to review and provide technical advice. ER274. The panel was composed of top-level experts from outside the DOE in the field of radioactive waste management. ER274, 276. The Senior Review Panel favorably reviewed the Order. See ER107-08.

Waste Classification, or the waste must meet alternative requirements for waste classification and characterization as DOE may authorize. ER139-40.[12]

The district court concluded that the Order is in excess of DOE's statutory authority based on its misunderstanding that the Order contains no real protective criteria, and would allow DOE to classify waste as WIR based solely on economic or technical considerations. ER360-61. The principal reason the district court reached this conclusion is that it fundamentally misinterpreted the second criterion, which requires WIR to meet safety criteria comparable to those NRC has established in 10 C.F.R. Part 61 for low-level waste. The district court misunderstood this to mean that "DOE will treat waste that it deems to be low-level

[12] Similar requirements apply to transuranic waste. The district court did not address those criteria. In any event, the transuranic waste criteria are consistent with the NWPA for the same reasons as the low-level waste criteria. To be managed as transuranic waste under the Manual, waste must meet the following criteria: (1) key radionuclides must be removed to the extent technically and economically practical; (2) the waste must be incorporated into a solid physical form that meets such requirements for waste classification and characteristics for transuranic waste as DOE may authorize; and (3) it must be managed in accordance with DOE's requirements for transuranic waste as set forth in Chapter III of the Manual. ER140. Chapter III provides, among other things, that "Transuranic waste shall be disposed in accordance with the requirements of 40 C.F.R. Part 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes.*" ER160. Thus, the Order's criteria for determining whether solidified reprocessing waste can be managed as transuranic waste, like the criteria for deciding whether it can be managed as low-level waste, require that DOE be able to manage the waste under stringent standards for the protection of public health.

waste as low-level waste," and that therefore this criterion was "not a benchmark that could be 'met'". ER360.

In fact, Part 61 sets out a series of safety performance objectives that waste disposed of in land disposal facilities must meet in order to protect the public health and safety. Most importantly, in order to assure that land disposal of radioactive waste does not pose a threat to the public, Part 61 requires that "[c]oncentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public." 10 C.F.R. 61.41. Part 61 also specifies dose limits for inadvertent intruders and workers,10 C.F.R. 61.42, 61.43, and sets site stability requirements, 10 C.F.R. 61.44.

Not only are the Part 61 standards "benchmarks," but these safety performance objectives are more stringent than the NRC's general radiation dose limits for individual members of the public from operations by NRC licensees, see 10 C.F.R. 20.1301, and are equivalent to EPA's radiation protection standards for the public from nuclear power operations, 40 C.F.R. 190.10.

Contrary to the district court's mistaken assumption, the Order does not provide that "if DOE determines that it is too expensive or too difficult to treat HLW, DOE is free to reclassify it as incidental waste." ER361. Any waste classified as WIR must be managed according to the stringent safety performance objectives referred to in the second criterion. The relevance of the first criterion, which requires removal of key radionuclides to the extent technically and economically practical, is not as a substitute for compliance with these safety standards, but as an *additional* measure of protection. Thus, even if waste could meet the second criterion, the Order also requires DOE to remove key radionuclides to the maximum extent technically and economically practical. If the safety standards cannot be met, the waste cannot be managed as low level radioactive waste even if key radionuclides have been removed to the required extent.

The district court also mis-read the third criterion. First, it disregarded that criterion's requirement that WIR must be managed in accordance with Chapter IV of the Manual. Chapter IV requires, among other things, a site specific performance assessment that must provide a reasonable expectation that the safety performance objectives in the second criterion can be met for a 1,000-year period. ER173.

Second, the district court misunderstood, in two key ways, the other portion of the third criterion, which requires that WIR incorporated into a solid form either meet concentration levels for Class C low-level waste or meet such alternative requirements for waste classification and characterization as DOE may authorize. The district court objected that the provision for "alternative requirements" effectively allowed DOE to devise any alternative requirements it wanted, and that it therefore made waste classification decisions "subject to the whim of DOE." ER361.

That is incorrect for two reasons. First, as noted above, the three criteria are conjunctive. Therefore, even if the district court were correct that the third criterion imposes no constraint on DOE's classification decisions, DOE would still be constrained by the other two criteria, which are sufficient on their own to protect the public safety and properly classify waste. Second, the third criterion does not allow DOE to impose any requirements it pleases. The third criterion only permits DOE to impose "alternative requirements" that will assist it in determining whether waste is "highly radioactive" and/or "contains fission products in sufficient concentrations" to require permanent isolation in a deep geological repository, or whether it may safely be disposed as low-level waste. See ER139 (Manual's definition of HLW). One way DOE can satisfy itself on that point is if the waste meets Class C concentration levels, since the NRC has determined that such waste may safely be disposed of in a surface facility. But there is no reason to believe that meeting the Class C concentration levels is the only possible basis for reaching this conclusion. Indeed, the NRC itself does not believe that it is. It has a provision in its own rules, 10 C.F.R. 61.58, under which it may, on a case-by-case basis, permit radioactive materials that exceed Class C concentration limits to be classified as low-level waste and disposed of in a land disposal facility if the performance objectives in 10 C.F.R. Part 61, Subpart C, are met. Section 61.58, entitled "Alternative requirements for waste classification and characteristics," served as the model for Order 435.1's alternative requirements provision, which, in conjunction with the second criterion, operates in identical fashion to NRC's section 61.58.

Moreover, allowing waste with concentrations of radionuclides that exceed Class C to qualify as low-level waste is entirely consistent with statutory definitions of the term. The NWPA defines "low-level radioactive waste" as

radioactive material that --

> (A) is not high-level radioactive waste, spent nuclear fuel, transuranic waste, or by-product material as defined in section 11e(2) of the Atomic Energy Act of 1954 (42 U.S.C. 2014(e)(2)); and

(B) the Commission, consistent with existing law, classifies as low-level radioactive waste.

42 U.S.C. 10101(16). The Low-Level Waste Policy Act ("LLWPA"), 42 U.S.C. 2021b, has an almost identical definition. And the LLWPA also specifically identifies as a category of low-level waste "low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the [NRC] for class C radioactive waste, as defined by section 61.55 of title 10, Code of Federal Regulations, as in effect on January 26, 1983." 42 U.S.C. 2021c(b)(1)(D). The "alternative requirements" provision only allows DOE to manage waste with radionuclide concentrations greater than Class C as low-level waste if it meets requirements equivalent to those in the NRC's section 61.58. That is consistent with the NWPA and with the LLWPA's definition of low-level waste.

An agency always has the choice to proceed by general rule or by case-by-case decision-making. See SEC v. Chenery Corp., 332 U.S. 194, 202-03 (1947). DOE, like the NRC, has simply provided that, on a case-by-case basis, it may develop alternative requirements for waste that has radionuclide concentrations greater than the NRC's Class C limits but that nevertheless can be safely managed as low-level waste. Whether DOE will in fact develop alternative requirements for any particular waste remains uncertain. The appropriate occasion for judicial review of any such agency action will be when and if any such decision is actually made. No claim concerning the alternative requirements clause is presently ripe for judicial review.

Furthermore, this is a facial challenge to the Order for inconsistency with the NWPA. To prevail in such a facial challenge, it is not enough for the NRDC to show that it is possible that DOE could promulgate "alternative requirements" that would be inconsistent with the NWPA. "That the [Order] may be invalid as applied in such cases, however, does not mean that the regulation is facially invalid because it is without statutory authority." INS v. National Center for Immigrants' Rights, 502 U.S. 183, 188 (1991); see also Babbitt v. Sweet Home Ch. of Communities for a Great Oregon, 515 U.S. 687, 699 (1995).[13] As we have demonstrated above, the various statutes relating to radioactive waste explicitly

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[13] There has been considerable discussion within the Supreme Court whether a facial challenge fails if a plaintiff only demonstrates that a statute or rule might operate unlawfully under some conceivable set of circumstances, or whether it fails unless a plaintiff demonstrates that there is no set of circumstances in which it could operate lawfully. See, e.g., City of Chicago v. Morales, 527 U.S. 41, 55 n.22 (1999) (plurality). This Court need not address this question, since at most NRDC can only show that the Order might operate unlawfully under some set of circumstances, which all of the Justices have agreed is insufficient to satisfy the burden in a facial challenge. Similarly, this Court need not consider whether the facial/as applied distinction creates additional burdens for challenges to agency action brought purely on APA "arbitrary and capricious" grounds as opposed to, as here, on the ground that the agency exceeded its statutory authority.

recognize that there is waste that exceeds Class C limitations but that is "low-level" rather than "high-level" waste. Accordingly, it is also entirely possible that DOE could develop alternative requirements that will be entirely consistent with all aspects of this statutory regime, including the NWPA. In light of the "presumption of regularity [that] attaches to the actions of government agencies," United States Postal Service v. Gregory, 534 U.S. 1 (2001), this court should assume, for purposes of NRDC's facial challenge, that that is precisely what DOE will do. That is enough to defeat NRDC's facial challenge, and to require it to wait for real, rather than hypothetical, "alternative requirements" to challenge (or not) on an as-applied basis.

CONCLUSION

For the foregoing reasons, the judgment of the district court should be reversed and the district court should be directed to enter summary judgment for the defendants.

Respectfully submitted,

OF COUNSEL:
MARC JOHNSTON
MARC KASISCHKE
Office of General Counsel
U.S. Department of Energy
1000 Independence Ave., SW
Washington, D.C. 20585

THOMAS L. SANSONETTI
Assistant Attorney General

GREER S. GOLDMAN
RONALD M. SPRITZER
Attorneys, Department of Justice
Environment & Nat. Resources
Division
P.O. Box 23795, L'Enfant Station
Washington, D.C. 20026
(202) 514-3977

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STATEMENT OF RELATED CASES

Pursuant to Rule 28-2.6 of the rules of this Court, I certify that this case is related to NRDC v. Abraham, 244 F.3d 742 (9th Cir. 2001), for the reasons explained at page 3 of the Brief.

CERTIFICATE PURSUANT TO CIRCUIT RULE 32-1 AND FEDERAL RULE OF APPELLATE PROCEDURE 32(a)(7)(C)

Pursuant to Ninth Circuit Rule 32-1 and Federal Rule of Appellate Procedure 32(a)(7)(C), I certify that the foregoing Brief is proportionally spaced, has a typeface of 14 points, and contains 13,949 words.

RONALD M. SPRITZER
Attorney, Department of Justice
Washington, D.C. 20530
(202) 514-3977

CERTIFICATE OF SERVICE

I certify that two copies of the Brief and one copy of the Excerpts of Record have been served upon counsel by first class mail, postage prepaid, on this 29th day of January 2004, addressed to:

Geoffrey H. Fettus
Natural Resources Defense Council
1200 New York Avenue, N.W.
Suite 400
Washington, D.C. 20005

Lawrence J. Lucas
Law Offices of Lawrence J. Lucas
P.O. Box 1343
Boise, ID 83701

Thomas Zeilman
Confederated Tribes and Bands of the Yakama Nation
P.O. Box 151
401 Fort Road
Toppenish, WA 98948

Dan Israel
Shoshone-Bannock Tribes
1020 10th Street
Boulder, CO 80302

David K. Mears
Joseph E. Shorrin III
Washington Office of the Attorney General
2425 Bristol Court, SW
Olympia, WA 98502

Darrell G. Early
Idaho Office of the Attorney General
1410 North Hilton, 2nd Floor
Boise, ID 83706

David E. Leith
Oregon Department of Justice
1162 Court Street, NE
Salem, OR 97301-4096

Samuel L. Finklea III
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, SC 29201

Charles M. Brocius
Executive Director
Environmental Defense Institute
P.O. Box 220
Troy, ID 83871

RONALD M. SPRITZER
Attorney, Department of Justice
Washington, D.C. 20530
(202) 514-3977

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APPENDIX D
10 CFR 61.55 TABLE 1 AND TABLE 2 CLASS A SUM OF FRACTIONS ANALYSIS FOR ALL WEST AREA TANKS

Appendix Purpose

The purpose of this Appendix is to demonstrate that, considering Sr-90 removal by ion exchange (IX) (in addition to removal of Cs-137), the pretreated waste from some of the West Area tanks has the potential to meet Class A concentration limits in 10 CFR 61.55. Meeting Class A concentration limits is not a waste incidental to reprocessing (WIR) criterion in U.S. Department of Energy (DOE) M 435.1-1, Radioactive Waste Management Manual, however.

Appendix Content

This Appendix provides information showing that the pretreated and solidified waste from certain West Area tanks, from which 96.8% of Sr-90 (Decontamination Factor of 31) is removed by IX, will not exceed the concentration limits for Class A low-level radioactive waste (LLW) in 10 CFR 61.55. Meeting Class A concentration limits allows DOE to include the Energy*Solutions* Clive Disposal Facility near Clive, Utah [Energy*Solutions* (Clive)] as a potential option for solidification and disposal. DOE has not made a decision on the location of the solidification facility(ies) or the disposal facility(ies).

Key Points

After 96.8% removal of Sr-90 by IX from West Area tank waste:

- The pretreated waste will be solidified and will be in a solid physical form prior to disposal
- The radioactivity in the pretreated and solidified waste will not exceed Class A concentration limits for LLW
- Once solidified, the pretreated tank waste will be disposed of at an offsite LLW disposal facility in accordance with applicable requirements for LLW.

D.1 INTRODUCTION

Sections 4 through 6 in the main body of this Draft WIR Evaluation demonstrate that the pretreated and solidified tank waste meets the criteria of DOE M 435.1-1 for determining that the waste is WIR, is not high-level radioactive waste, and may be managed and disposed of as LLW. Specifically, Sections 4 through 6 in the main body of this Draft WIR Evaluation consider that after settling, decanting, filtration, and IX (that removes 99.9% of Cs-137), the waste does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55.

This Appendix demonstrates, based on preliminary information, that in addition to the removal of 99.9% of the Cs-137 by IX, IX could potentially also remove some soluble Sr-90.[109] If 96.8% removal of soluble Sr-90 by IX occurs, the sum of fractions for the resulting pretreated liquid and solidified waste shows that waste from some of the tanks has the potential to meet Class A concentration limits per 10 CFR 61.55.

[109] DOE's experience using IX for pretreatment of approximately 2,000 gallons of Hanford tank waste in the Test Bed Initiative Demonstration confirms that IX is effective in removing Sr-90.

In the calculations to support this Appendix, the Sr-90 Decontamination Factor (DF)[110] was varied, and the resulting number of feeds meeting 10 CFR 61.55 Table 2 Class A limits using the sum of fractions approach were observed. Increasing the Sr-90 DF above 31 did not increase number of feeds meeting 10 CFR 61.55 Table 2 Class A limits (RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document*). Also, the conservative assumption used in the above-referenced report represents no filter efficiency and, therefore, all radionuclides in solid phase are allowed to pass through the WARM process module filters. Hence, a relatively significant Sr-90 activity in solids occurs since the IX media only removes Sr-90 in the liquid phase. Increasing Sr-90 DF does not have any impact on the activity contributed by Sr-90 in the solid phase.

D.2 WASTE CLASSIFICATION ANALYSIS

This Appendix provides waste classification results for pretreated liquid and solidified waste from West Area tanks with the assumption that soluble Sr-90 can be removed by IX media in the Hanford 200 West Area Risk Management (WARM) process module (with a Sr-90 DF of 31). This DF value is equivalent to a 96.8% removal efficiency.[111] Removal of soluble Sr-90 by IX, although expected, is uncertain, relative to 200 West Area waste chemistry.[112]

This Appendix considers waste classifications for all West Area tanks. The results are shown on a tank-by-tank basis after pretreatment (which includes 99.9% removal of Cs-137 and 96.8% removal of Sr-90 by IX) and solidification using the sum of fractions method. The concentrations of key radionuclides in the pretreated liquid waste prior to and after solidification

[110] The decontamination factor (DF) is the ratio of the initial amount of activity in a stream to the final amount of activity in a stream following the treatment by a given process. Therefore, if a given process has a DF of 2, the final activity level is one half of the original activity.

[111] This Appendix provides waste classification results for the pretreated liquid waste and solidified waste for a scenario that assumes removal of Sr-90. Specifically, this scenario includes an assumption that the Sr-90 will be removed by ion exchange media in the 200 West Area process module (200W PM) based on decontamination factor (DF) of 31, which equates to removal efficiency of 96.8%. A Sr-90 DF of 31 is the minimum DF that results in highest number of feeds that meet Class A concentration limits in Title 10, Code of Federal Regulations (CFR), Part 61, Subpart D, § 61.55,"Waste Classification" (10 CFR 61.55).

[112] Sr-90 (and daughter Y-90) is primarily insoluble but can be soluble in some tanks with higher complexant concentrations. Complexant concentrated waste results from evaporating dilute complexed waste which contained high concentrations of organic complexants, such as HEDTA, EDTA, and citric acid. Complexants "hold" metals in solution much better than just a normal aqueous solution (DOW 2018).

Complexant waste was originally stored in some of the S and U farm tanks that will become waste feed. However, since supernate was removed from the S and U farm tanks during interim stabilization, it is likely that some of the complexant driven soluble Sr-90 (and daughter Y-90) has been removed from the tanks. DOE expects IX could potentially remove some soluble Sr-90 and that some of the waste will meet concentration limits for Class A LLW, as discussed in this Appendix.

were compared to Class A concentration limits from Table 1 (long-lived radionuclides) and Table 2 (short-lived radionuclides) in 10 CFR 61.55. The tables in the *Utah Administrative Code* (UAC) Title R313, "Environmental Quality, Waste Management and Radiation Control, Radiation," R313-15, "Standards for Protection Against Radiation," R313-15-1009, "Classification and Characteristics of Low-Level Radioactive Waste" mirror the 10 CFR 61.55 tables with the addition of Ra-226.[113]

[113] Because Ra-226 is a decay product of U-238, which has a half-life of 4.5 billion years, and it is in very low quantities in Hanford Site tank waste (per the Best-Basis Inventory), this radionuclide is not included as a key radionuclide.

Table D-1 provides the waste classification results for pretreated liquid waste against Class A limits in 10 CFR 61.55 Table 1. Data in this table shows the sum of fractions for all long-lived radionuclides in each source tank. Based on the results for 10 CFR 61.55 Table 1, pretreated waste from three tanks (U-105, U-106, and SX-115) exceeds Class A concentration limits. The sum of fractions values that exceed 1 are highlighted in red.

Table D-1. Waste Classification Evaluation for Pretreated Liquid Based on 10 CFR 61.55 Table 1 Class A Sum of Fractions for Long-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class A Sum of Fractions
SY-101	8.21E-04	1.20E-02	4.00E-01	2.42E-04	3.14E-05	1.40E-01	5.53E-01
SY-102	8.86E-04	1.49E-02	5.12E-01	3.18E-04	4.27E-05	1.87E-01	7.16E-01
S-101	1.20E-03	5.23E-03	2.46E-01	6.15E-04	1.44E-05	2.38E-01	4.91E-01
S-102	1.09E-03	3.04E-03	9.94E-02	3.02E-04	1.02E-05	6.92E-02	1.73E-01
S-103	1.35E-03	4.72E-03	1.28E-01	2.71E-04	4.68E-06	6.11E-02	1.96E-01
S-104	9.59E-04	2.92E-03	8.08E-02	6.54E-04	1.32E-06	1.70E-01	2.55E-01
S-105	2.58E-03	7.64E-03	2.06E-01	1.53E-04	1.93E-06	1.27E-01	3.43E-01
S-106	1.63E-03	4.82E-03	1.29E-01	7.40E-05	1.39E-06	4.66E-02	1.82E-01
S-107	1.25E-03	1.81E-03	5.61E-02	2.82E-03	1.65E-06	5.55E-01	6.17E-01
S-108	1.61E-03	4.92E-03	1.33E-01	2.40E-04	4.60E-06	8.76E-02	2.27E-01
S-109	2.41E-03	7.53E-03	2.01E-01	2.04E-04	1.19E-06	6.67E-02	2.78E-01
S-110	2.18E-03	6.44E-03	1.74E-01	7.98E-04	4.87E-06	2.74E-01	4.58E-01
S-111	1.24E-03	4.37E-03	1.16E-01	1.94E-04	1.30E-06	5.83E-02	1.81E-01
U-201	9.21E-04	3.38E-03	8.99E-02	1.10E-04	5.51E-07	2.89E-02	1.23E-01

Table D-1. Waste Classification Evaluation for Pretreated Liquid Based on 10 CFR 61.55 Table 1 Class A Sum of Fractions for Long-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class A Sum of Fractions
U-202	6.99E-04	2.52E-03	6.71E-02	8.26E-05	4.02E-07	2.16E-02	9.21E-02
U-203	5.59E-04	1.97E-03	5.26E-02	6.51E-05	3.12E-07	1.70E-02	7.22E-02
U-204	4.68E-04	1.61E-03	4.31E-02	8.42E-05	2.54E-07	2.31E-02	6.84E-02
U-101	1.29E-04	4.05E-04	9.58E-03	1.07E-04	7.49E-08	3.26E-02	4.28E-02
U-102	1.03E-03	3.37E-03	8.05E-02	1.40E-03	5.44E-06	3.28E-01	4.14E-01
U-103	1.39E-03	4.21E-03	1.11E-01	9.53E-04	1.05E-05	4.19E-01	5.37E-01
U-104	8.63E-04	2.65E-03	6.83E-02	6.19E-04	4.99E-06	2.31E-01	3.03E-01
U-105	1.54E-03	4.45E-03	1.49E-01	4.26E-03	4.08E-05	1.05E+00	1.21E+00
U-106	1.53E-03	4.49E-03	1.31E-01	4.11E-03	6.95E-05	1.85E+00	1.99E+00
U-107	1.28E-03	5.24E-03	1.44E-01	2.02E-03	2.62E-05	5.24E-01	6.76E-01
U-108	1.47E-03	5.32E-03	1.43E-01	1.15E-03	7.63E-06	1.83E-01	3.35E-01
U-109	1.36E-03	4.76E-03	1.28E-01	4.06E-04	3.47E-06	9.84E-02	2.33E-01
U-110	8.53E-04	2.63E-03	7.04E-02	3.24E-04	1.51E-06	1.02E-01	1.76E-01
U-111	1.20E-03	4.19E-03	1.13E-01	9.30E-04	7.22E-06	2.03E-01	3.22E-01
U-112	2.22E-04	7.32E-04	2.01E-02	1.59E-04	1.39E-06	3.45E-02	5.58E-02
SX-101	1.05E-03	4.05E-03	9.04E-02	4.79E-04	1.92E-05	4.65E-01	5.61E-01
SX-102	1.31E-03	4.69E-03	1.18E-01	3.06E-04	1.71E-05	1.61E-01	2.85E-01

Table D-1. Waste Classification Evaluation for Pretreated Liquid Based on 10 CFR 61.55 Table 1 Class A Sum of Fractions for Long-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class A Sum of Fractions
SX-103	1.68E-03	5.69E-03	1.48E-01	6.20E-04	2.83E-05	2.15E-01	3.72E-01
SX-104	1.60E-03	5.70E-03	1.44E-01	7.23E-04	9.44E-06	2.41E-01	3.93E-01
SX-105	1.49E-03	4.66E-03	1.21E-01	1.63E-03	1.39E-05	5.34E-01	6.63E-01
SX-106	1.22E-03	4.80E-03	1.27E-01	2.28E-03	2.26E-05	3.79E-01	5.14E-01
SX-107	7.97E-04	2.80E-03	8.03E-02	1.40E-03	1.22E-05	6.40E-01	7.26E-01
SX-108	6.04E-04	1.79E-03	5.72E-02	8.90E-04	1.76E-05	4.57E-01	5.18E-01
SX-109	6.57E-04	1.59E-03	5.96E-02	3.38E-04	4.49E-06	4.39E-01	5.01E-01
SX-110	6.20E-04	2.67E-03	6.79E-02	3.70E-04	5.52E-06	3.73E-01	4.44E-01
SX-111	4.68E-04	2.80E-03	5.41E-02	2.91E-04	5.54E-06	1.80E-01	2.37E-01
SX-112	3.87E-04	2.51E-03	4.44E-02	2.42E-04	5.38E-06	1.09E-01	1.57E-01
SX-113	3.21E-04	2.02E-03	3.48E-02	7.74E-05	3.89E-06	5.09E-02	8.81E-02
SX-114	4.13E-04	1.42E-03	3.89E-02	3.42E-04	3.71E-06	9.42E-01	9.83E-01
SX-115	3.84E-04	1.35E-03	3.72E-02	7.54E-03	5.78E-06	1.59E+00	1.64E+00

Table D-2 provides the waste classification results for pretreated liquid waste against Class A concentration limits in 10 CFR 61.55 Table 2. Data in this table shows the sum of fractions for all short-lived radionuclides in each source tank. The sum of fractions values that exceed 1 are highlighted in red. For the majority of tanks that have a sum of fractions exceeding Class A concentration limits, activity from Sr-90 in the solids is the main contributing factor since this calculation only considers, as a conservative approach, removal of soluble Sr-90 by IX; therefore, all entrained solids in the WARM process module feed stream are allowed to pass through the filtration system and contribute dose to the pretreated waste (RPP-RPT-65190).

Table D-2. Waste Classification Evaluation for Pretreated Liquid Based on 10 CFR 61.55 Table 2 Class A Sum of Fractions for Short-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	H-3	Co-60	Ni-63	Sr-90	Cs-137	Total Rad w/ half-life < 5 years	Table 2 Class A Sum of Fractions
SY-101	1.25E-06	8.25E-08	3.24E-03	6.06E-01	1.25E-02	5.27E-05	6.22E-01
SY-102	1.37E-06	1.06E-07	4.22E-03	6.56E-01	1.52E-02	5.95E-05	6.75E-01
S-101	6.31E-05	4.44E-08	2.30E-03	2.26E+01	2.69E-02	1.33E-03	2.26E+01
S-102	4.46E-05	1.36E-08	2.41E-03	2.58E+00	1.47E-02	1.67E-04	2.60E+00
S-103	3.04E-05	2.35E-08	1.33E-03	1.46E+00	5.48E-03	9.09E-05	1.47E+00
S-104	2.38E-05	8.69E-09	1.03E-03	1.55E+01	1.84E-02	9.13E-04	1.56E+01
S-105	4.46E-05	2.92E-08	1.30E-03	7.56E-01	2.71E-02	8.00E-05	7.84E-01
S-106	2.72E-05	6.32E-09	6.98E-04	8.15E-01	1.15E-02	6.21E-05	8.28E-01
S-107	2.09E-04	2.46E-08	1.10E-03	1.09E+01	5.51E-02	6.96E-04	1.09E+01
S-108	5.55E-05	7.35E-09	8.61E-04	1.33E+00	1.39E-02	9.45E-05	1.34E+00
S-109	4.30E-05	1.74E-08	1.08E-02	2.85E+00	2.84E-02	2.01E-04	2.89E+00
S-110	4.96E-05	2.17E-08	3.23E-03	6.84E+00	1.37E-02	4.09E-04	6.86E+00
S-111	3.05E-05	5.75E-09	6.78E-04	6.41E+00	6.30E-02	4.52E-04	6.48E+00
U-201	2.91E-05	2.25E-09	4.12E-04	3.87E-01	2.32E-03	2.53E-05	3.89E-01
U-202	3.00E-05	1.63E-09	3.94E-04	2.86E-01	1.29E-03	1.82E-05	2.88E-01

Table D-2. Waste Classification Evaluation for Pretreated Liquid Based on 10 CFR 61.55 Table 2 Class A Sum of Fractions for Short-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	H-3	Co-60	Ni-63	Sr-90	Cs-137	Total Rad w/ half-life < 5 years	Table 2 Class A Sum of Fractions
U-203	3.06E-05	1.28E-09	4.28E-04	2.23E-01	8.53E-04	1.39E-05	2.24E-01
U-204	3.11E-05	1.06E-09	4.56E-04	1.86E-01	6.27E-04	1.15E-05	1.87E-01
U-101	1.16E-05	6.04E-10	1.67E-04	3.84E-01	1.93E-04	2.22E-05	3.84E-01
U-102	3.00E-05	3.80E-08	8.94E-03	5.92E+00	5.12E-02	4.07E-04	5.98E+00
U-103	2.55E-05	2.62E-08	2.07E-03	1.65E+00	5.72E-03	1.02E-04	1.65E+00
U-104	1.85E-05	4.50E-08	1.68E-03	9.16E-01	6.61E-03	6.14E-05	9.25E-01
U-105	4.56E-05	8.49E-08	3.52E-03	2.61E+00	2.89E-02	1.88E-04	2.64E+00
U-106	3.15E-05	3.71E-07	5.65E-03	4.42E+00	5.48E-03	2.60E-04	4.43E+00
U-107	3.40E-05	7.58E-08	2.94E-03	1.42E+00	1.80E-02	1.06E-04	1.44E+00
U-108	4.48E-05	2.52E-08	1.13E-03	5.15E-01	5.50E-02	1.04E-04	5.71E-01
U-109	3.81E-05	4.02E-08	3.17E-03	5.83E-01	3.15E-02	7.60E-05	6.18E-01
U-110	1.88E-05	1.96E-08	1.65E-03	3.18E+00	1.13E-02	1.97E-04	3.20E+00
U-111	2.35E-05	2.86E-08	2.98E-03	2.07E+00	3.22E-02	1.62E-04	2.10E+00
U-112	1.19E-05	5.29E-09	6.12E-04	5.70E-01	3.57E-04	3.31E-05	5.71E-01
SX-101	5.30E-05	4.80E-09	9.20E-04	7.05E+00	2.21E-02	4.33E-04	7.08E+00
SX-102	3.23E-05	4.90E-09	8.33E-04	4.19E+00	9.49E-03	2.52E-04	4.20E+00
SX-103	3.68E-05	8.06E-09	1.18E-03	1.25E+01	1.12E-02	7.30E-04	1.25E+01
SX-104	4.23E-05	9.34E-09	1.14E-03	6.53E+00	2.00E-02	4.00E-04	6.55E+00
SX-105	3.61E-05	2.55E-08	1.06E-03	1.64E+01	1.42E-02	9.54E-04	1.64E+01
SX-106	2.26E-05	2.34E-08	2.07E-03	7.60E-01	1.45E-02	6.31E-05	7.77E-01
SX-107	5.95E-05	1.10E-08	1.92E-03	1.32E+01	1.53E-02	7.77E-04	1.33E+01

Table D-2. Waste Classification Evaluation for Pretreated Liquid Based on 10 CFR 61.55 Table 2 Class A Sum of Fractions for Short-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	H-3	Co-60	Ni-63	Sr-90	Cs-137	Total Rad w/ half-life < 5 years	Table 2 Class A Sum of Fractions
SX-108	7.88E-05	5.07E-09	1.19E-03	1.51E+01	1.85E-02	8.86E-04	1.51E+01
SX-109	8.01E-05	2.84E-09	1.06E-03	1.47E+01	2.46E-02	8.71E-04	1.47E+01
SX-110	1.23E-04	1.73E-09	8.74E-04	3.32E+01	4.85E-03	1.90E-03	3.32E+01
SX-111	1.16E-04	7.85E-10	5.53E-04	2.03E+01	3.51E-03	1.17E-03	2.03E+01
SX-112	1.05E-04	4.40E-10	4.26E-04	1.49E+01	2.89E-03	8.58E-04	1.50E+01
SX-113	8.13E-05	2.50E-10	2.51E-04	4.58E-01	1.85E-03	2.87E-05	4.60E-01
SX-114	8.05E-05	5.23E-09	9.99E-04	1.82E+01	1.03E-02	1.06E-03	1.82E+01
SX-115	7.84E-05	6.24E-09	8.67E-04	4.58E-01	1.85E-03	2.87E-05	4.61E-01

Source: RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document*.

Waste from tank SY-103 will be transferred to tank SY-102 prior to single-shell tank retrievals, and will be processed with waste from SY-102 in the West Area Risk Management pretreatment capability (RPP-RPT-65190).

Table D-3 provides sum of fractions results for the solidified waste against Class A concentration limits in 10 CFR 61.55 Table 1. Assuming a volume increase associated with solidifying the pretreated waste, all solidified waste for West Area tanks will meet Class A limits (sum of fractions are less than 1).[114]

Table D-3. Waste Classification Evaluation for Solidified Waste Based on 10 CFR 61.55 Table 1 Class A Sum of Fractions for Long-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class A Sum of Fractions
SY-101	5.44E-04	7.93E-03	2.65E-01	1.10E-04	1.43E-05	6.35E-02	3.37E-01
SY-102	5.85E-04	9.83E-03	3.38E-01	1.48E-04	1.99E-05	8.74E-02	4.36E-01
S-101	7.91E-04	3.45E-03	1.62E-01	2.82E-04	6.58E-06	1.09E-01	2.75E-01
S-102	7.27E-04	2.02E-03	6.60E-02	1.30E-04	4.36E-06	2.97E-02	9.86E-02
S-103	8.97E-04	3.15E-03	8.53E-02	1.17E-04	2.02E-06	2.63E-02	1.16E-01
S-104	6.49E-04	1.97E-03	5.47E-02	2.84E-04	5.72E-07	7.37E-02	1.31E-01
S-105	1.75E-03	5.18E-03	1.40E-01	7.29E-05	9.21E-07	6.04E-02	2.07E-01
S-106	1.08E-03	3.21E-03	8.60E-02	3.27E-05	6.16E-07	2.06E-02	1.11E-01
S-107	8.35E-04	1.21E-03	3.74E-02	1.19E-03	6.96E-07	2.35E-01	2.75E-01
S-108	1.06E-03	3.25E-03	8.79E-02	1.06E-04	2.03E-06	3.87E-02	1.31E-01
S-109	1.60E-03	5.00E-03	1.34E-01	9.63E-05	5.64E-07	3.15E-02	1.72E-01
S-110	1.44E-03	4.28E-03	1.16E-01	3.71E-04	2.27E-06	1.28E-01	2.49E-01
S-111	8.19E-04	2.89E-03	7.70E-02	8.35E-05	5.59E-07	2.51E-02	1.06E-01
U-201	6.11E-04	2.25E-03	5.97E-02	4.59E-05	2.30E-07	1.21E-02	7.47E-02
U-202	4.66E-04	1.68E-03	4.47E-02	3.37E-05	1.64E-07	8.83E-03	5.58E-02

[114] When the pretreated liquid is solidified, the volume will expand by a grout expansion factor. The lower value of the potential range of the expansion factor (1.5) represents the smallest expansion factor which results in the largest estimated radionuclide concentration for comparison to Class C and Class A concentration limits (PNNL 22747). The expansion factor, final volume, and impacts will vary based on the tank waste composition and grout formulation used.

Table D-3. Waste Classification Evaluation for Solidified Waste Based on 10 CFR 61.55 Table 1 Class A Sum of Fractions for Long-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class A Sum of Fractions
U-203	3.73E-04	1.32E-03	3.51E-02	2.61E-05	1.25E-07	6.83E-03	4.37E-02
U-204	3.13E-04	1.08E-03	2.89E-02	3.35E-05	1.01E-07	9.17E-03	3.95E-02
U-101	8.70E-05	2.74E-04	6.48E-03	4.09E-05	2.86E-08	1.24E-02	1.93E-02
U-102	6.82E-04	2.24E-03	5.34E-02	5.98E-04	2.32E-06	1.40E-01	1.97E-01
U-103	9.25E-04	2.79E-03	7.34E-02	4.10E-04	4.50E-06	1.80E-01	2.58E-01
U-104	5.74E-04	1.76E-03	4.54E-02	2.58E-04	2.08E-06	9.61E-02	1.44E-01
U-105	1.02E-03	2.95E-03	9.86E-02	1.87E-03	1.79E-05	4.59E-01	5.64E-01
U-106	1.03E-03	3.02E-03	8.78E-02	1.78E-03	3.01E-05	8.00E-01	8.93E-01
U-107	8.53E-04	3.48E-03	9.59E-02	8.65E-04	1.12E-05	2.24E-01	3.25E-01
U-108	9.74E-04	3.53E-03	9.52E-02	5.03E-04	3.35E-06	8.05E-02	1.81E-01
U-109	9.01E-04	3.14E-03	8.48E-02	1.73E-04	1.49E-06	4.21E-02	1.31E-01
U-110	5.66E-04	1.74E-03	4.67E-02	1.33E-04	6.20E-07	4.19E-02	9.11E-02
U-111	7.97E-04	2.78E-03	7.47E-02	3.96E-04	3.07E-06	8.65E-02	1.65E-01
U-112	1.50E-04	4.93E-04	1.36E-02	6.14E-05	5.36E-07	1.33E-02	2.76E-02
SX-101	6.99E-04	2.70E-03	6.04E-02	2.11E-04	8.46E-06	2.05E-01	2.69E-01
SX-102	8.58E-04	3.08E-03	7.74E-02	1.36E-04	7.65E-06	7.19E-02	1.53E-01
SX-103	1.10E-03	3.73E-03	9.73E-02	2.84E-04	1.29E-05	9.86E-02	2.01E-01
SX-104	1.06E-03	3.76E-03	9.52E-02	3.30E-04	4.31E-06	1.10E-01	2.10E-01
SX-105	9.81E-04	3.07E-03	7.96E-02	7.22E-04	6.15E-06	2.37E-01	3.21E-01
SX-106	8.13E-04	3.19E-03	8.42E-02	9.72E-04	9.65E-06	1.62E-01	2.51E-01
SX-107	5.33E-04	1.87E-03	5.38E-02	5.87E-04	5.14E-06	2.69E-01	3.26E-01

Table D-3. Waste Classification Evaluation for Solidified Waste Based on 10 CFR 61.55 Table 1 Class A Sum of Fractions for Long-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	C-14	I-129	Tc-99	Pu-241	Cm-242	Total Alpha	Table 1 Class A Sum of Fractions
SX-108	4.05E-04	1.20E-03	3.84E-02	3.81E-04	7.51E-06	1.96E-01	2.36E-01
SX-109	4.43E-04	1.07E-03	4.01E-02	1.46E-04	1.94E-06	1.89E-01	2.31E-01
SX-110	4.18E-04	1.80E-03	4.57E-02	1.60E-04	2.38E-06	1.60E-01	2.09E-01
SX-111	3.15E-04	1.88E-03	3.64E-02	1.22E-04	2.32E-06	7.51E-02	1.14E-01
SX-112	2.61E-04	1.69E-03	2.99E-02	9.94E-05	2.21E-06	4.48E-02	7.67E-02
SX-113	2.16E-04	1.36E-03	2.35E-02	3.12E-05	1.57E-06	2.05E-02	4.55E-02
SX-114	2.77E-04	9.55E-04	2.61E-02	1.40E-04	1.52E-06	3.85E-01	4.13E-01
SX-115	2.58E-04	9.09E-04	2.50E-02	3.07E-03	2.35E-06	6.46E-01	6.75E-01

Table D-4 provides sum of fractions results for solidified waste against Class A concentration limits in 10 CFR 61.55 Table 2. Sum of fractions values exceeding 1 are highlighted in red, indicating that the waste classification is above the Class A concentration limits. Activity from Sr-90 in the solids is the main contributing factor since this calculation assumes 0% filter efficiency; therefore, all entrained solids in the WARM process module feed stream are allowed to pass through the filtration system and contribute dose to the solidified waste.

Table D-4. Waste Classification Evaluation for Solidified Waste Based on 10 CFR 61.55 Table 2 Class A Sum of Fractions for Short-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	H-3	Co-60	Ni-63	Sr-90	Cs-137	Total Rad w/ half-life < 5 years	Table 2 Class A Sum of Fractions
SY-101	8.26E-07	5.46E-08	2.15E-03	4.01E-01	8.29E-03	3.49E-05	4.12E-01
SY-102	9.05E-07	6.99E-08	2.79E-03	4.33E-01	1.01E-02	3.93E-05	4.46E-01
S-101	4.15E-05	2.92E-08	1.52E-03	1.49E+01	1.77E-02	8.73E-04	1.49E+01
S-102	2.96E-05	9.04E-09	1.60E-03	1.71E+00	9.80E-03	1.11E-04	1.72E+00
S-103	2.02E-05	1.56E-08	8.88E-04	9.72E-01	3.65E-03	6.05E-05	9.77E-01
S-104	1.61E-05	5.88E-09	6.98E-04	1.05E+01	1.24E-02	6.18E-04	1.05E+01
S-105	3.02E-05	1.98E-08	8.80E-04	5.13E-01	1.84E-02	5.43E-05	5.32E-01
S-106	1.81E-05	4.21E-09	4.65E-04	5.43E-01	7.66E-03	4.13E-05	5.51E-01
S-107	1.39E-04	1.64E-08	7.31E-04	7.25E+00	3.68E-02	4.64E-04	7.29E+00
S-108	3.67E-05	4.86E-09	5.69E-04	8.77E-01	9.17E-03	6.25E-05	8.87E-01
S-109	2.86E-05	1.16E-08	7.14E-03	1.89E+00	1.88E-02	1.34E-04	1.92E+00
S-110	3.30E-05	1.44E-08	2.14E-03	4.54E+00	9.13E-03	2.72E-04	4.55E+00
S-111	2.01E-05	3.80E-09	4.49E-04	4.24E+00	4.17E-02	2.99E-04	4.29E+00
U-201	1.93E-05	1.50E-09	2.73E-04	2.57E-01	1.54E-03	1.68E-05	2.58E-01
U-202	2.00E-05	1.09E-09	2.63E-04	1.91E-01	8.59E-04	1.21E-05	1.92E-01
U-203	2.05E-05	8.53E-10	2.86E-04	1.49E-01	5.70E-04	9.30E-06	1.50E-01

Table D-4. Waste Classification Evaluation for Solidified Waste Based on 10 CFR 61.55 Table 2 Class A Sum of Fractions for Short-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	H-3	Co-60	Ni-63	Sr-90	Cs-137	Total Rad w/ half-life < 5 years	Table 2 Class A Sum of Fractions
U-204	2.08E-05	7.07E-10	3.05E-04	1.25E-01	4.20E-04	7.72E-06	1.25E-01
U-101	7.82E-06	4.08E-10	1.13E-04	2.60E-01	1.30E-04	1.50E-05	2.60E-01
U-102	1.99E-05	2.52E-08	5.93E-03	3.93E+00	3.40E-02	2.70E-04	3.97E+00
U-103	1.70E-05	1.74E-08	1.37E-03	1.09E+00	3.80E-03	6.76E-05	1.10E+00
U-104	1.23E-05	2.99E-08	1.12E-03	6.09E-01	4.39E-03	4.08E-05	6.15E-01
U-105	3.03E-05	5.63E-08	2.34E-03	1.73E+00	1.92E-02	1.25E-04	1.75E+00
U-106	2.12E-05	2.49E-07	3.80E-03	2.97E+00	3.69E-03	1.75E-04	2.98E+00
U-107	2.26E-05	5.04E-08	1.95E-03	9.44E-01	1.20E-02	7.02E-05	9.58E-01
U-108	2.98E-05	1.68E-08	7.48E-04	3.42E-01	3.66E-02	6.90E-05	3.80E-01
U-109	2.52E-05	2.65E-08	2.09E-03	3.85E-01	2.08E-02	5.02E-05	4.08E-01
U-110	1.25E-05	1.30E-08	1.09E-03	2.11E+00	7.51E-03	1.31E-04	2.12E+00
U-111	1.56E-05	1.90E-08	1.98E-03	1.37E+00	2.14E-02	1.07E-04	1.39E+00
U-112	8.02E-06	3.56E-09	4.12E-04	3.84E-01	2.41E-04	2.23E-05	3.85E-01
SX-101	3.54E-05	3.21E-09	6.15E-04	4.71E+00	1.48E-02	2.89E-04	4.73E+00
SX-102	2.12E-05	3.22E-09	5.47E-04	2.75E+00	6.23E-03	1.66E-04	2.76E+00
SX-103	2.42E-05	5.29E-09	7.76E-04	8.21E+00	7.33E-03	4.79E-04	8.22E+00
SX-104	2.79E-05	6.16E-09	7.53E-04	4.31E+00	1.32E-02	2.64E-04	4.32E+00
SX-105	2.38E-05	1.68E-08	6.99E-04	1.08E+01	9.37E-03	6.28E-04	1.08E+01
SX-106	1.50E-05	1.55E-08	1.38E-03	5.05E-01	9.64E-03	4.20E-05	5.17E-01
SX-107	3.98E-05	7.34E-09	1.28E-03	8.85E+00	1.02E-02	5.20E-04	8.87E+00
SX-108	5.28E-05	3.40E-09	7.99E-04	1.01E+01	1.24E-02	5.94E-04	1.01E+01

Table D-4. Waste Classification Evaluation for Solidified Waste Based on 10 CFR 61.55 Table 2 Class A Sum of Fractions for Short-Lived Radionuclides with Assumed Strontium-90 Removal Efficiency of 96.8%. (3 pages)

Source Tank	H-3	Co-60	Ni-63	Sr-90	Cs-137	Total Rad w/ half-life < 5 years	Table 2 Class A Sum of Fractions
SX-109	5.40E-05	1.91E-09	7.14E-04	9.88E+00	1.66E-02	5.87E-04	9.90E+00
SX-110	8.29E-05	1.17E-09	5.88E-04	2.23E+01	3.27E-03	1.28E-03	2.23E+01
SX-111	7.78E-05	5.28E-10	3.72E-04	1.37E+01	2.37E-03	7.85E-04	1.37E+01
SX-112	7.04E-05	2.96E-10	2.86E-04	1.01E+01	1.94E-03	5.77E-04	1.01E+01
SX-113	5.48E-05	1.68E-10	1.69E-04	3.08E-01	1.24E-03	1.93E-05	3.10E-01
SX-114	5.40E-05	3.51E-09	6.71E-04	1.22E+01	6.91E-03	7.09E-04	1.22E+01
SX-115	5.27E-05	4.19E-09	5.82E-04	3.08E-01	1.25E-03	1.93E-05	3.10E-01

Source: RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document*.

Waste from Tank SY-103 will be transferred to Tank SY-102 prior to single-shell tank retrievals, and will be processed with waste from SY-102 in the West Area Risk Management pretreatment capability (RPP-RPT-65190).

Table D-3 and Table D-4 show that considering 96.8% removal of Sr-90 in addition to 99.9% removal of Cs-137 by IX, 15 West Area tanks after pretreatment and after solidification are Class A waste. Meeting Class A concentration limits is not a WIR criterion under DOE M 435.1-1; however, meeting Class A concentration limits allows DOE to include Energy*Solutions* (Clive) as a potential option for solidification and disposal. DOE has not made decisions on the location of either the solidification facility or the disposal facility. Some tanks exceed Class A concentration limits, but do not exceed Class C concentration limits; therefore, the waste classification for these tanks after pretreatment and after solidification is Class C waste. As such, these tanks would not meet the waste acceptance criteria (WAC) for Energy*Solutions* (Clive Disposal Facility).

Table D-5 lists the 15 tanks that meet Class A concentration limits as identified in Table D-3 and Table D-4 along with their total activity from key radionuclides, waste retrieval volumes, and estimated disposal volumes.

Table D-5. Summary of Activity, Retrieval, and Estimated Disposal Volume for Class A Waste Tanks.

Source Tank	Pretreated Waste Total Activity from Key Radionuclides (Ci)	Retrieved Waste Volume (kgal)	Estimated Disposal Volume[a] (kgal)
SY-101	535	831	1,247
SY-102	673	836	1,254
S-105	532	1,102	1,653
S-106	501	1,576	2,364
U-201	18	97	146
U-202	13	90	135
U-203	7	61	92
U-204	4	44	66
U-101	59	775	1,163
U-104	116	400	600
U-108	735	1,559	2,339
U-109	543	1,399	2,099
U-112	187	1,545	2,318
SX-106	413	1,184	1,776
SX-113	18	109	164
Total	4,354	11,608,000 (gallons)	17,412,000 (gallons)

Source: RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document*, (Table A-5).

[a] When the pretreated liquid is solidified, the volume will expand by a grout expansion factor. The lower value of the potential range of the expansion factor (1.5) represents the smallest expansion factor which results in the largest estimated radionuclide concentration for comparison to Class C and Class A concentration limits (PNNL 22747). The expansion factor, final volume, and impacts will vary based on the tank waste composition and grout formulation used.

D.3 THE PRETREATED AND SOLIDIFIED WASTE WILL MEET THE DISPOSAL SITE WASTE ACCEPTANCE CRITERIA

To help establish the relationship between the WAC and the performance objectives of the waste disposal site, this section provides a summary of the disposal site WAC and addresses meeting the Energy*Solutions* (Clive Disposal Facility) WAC.

Table D-5 shows that the volume of the pretreated and solidified waste from West Area tanks that meet Class A concentration limits after 96.8% removal of Sr-90 by IX. Additionally, Table D-5 shows the total activity from key radionuclides. After removal of Sr-90, some waste will meet the WAC for disposal at Energy*Solutions* (Clive Disposal Facility) prior to shipment.

D.4 CONCLUSION

The waste classification (using the sum of fractions approach) for each West Area tank after pretreatment and after solidification is shown in Table D-1, Table D-2, Table D-3, and Table D-4 on a tank-by-tank basis.

This Appendix demonstrates that 15 West Area tanks after pretreatment and solidification will be below the concentration limits for Class A LLW based on 96.8% removal of Sr-90 in addition to 99.9% removal of Cs-137 by IX. As such, this waste will be acceptable for disposal at Energy*Solutions* (Clive Disposal Facility) near Clive, Utah, in compliance with the WAC and other requirements for this facility. The disposal of this waste will meet the performance objectives for LLW disposal set forth in 10 CFR 61, Subpart C—Performance Objectives, and comparable provisions in the *Utah Administrative Code* as discussed in Section 5.0 of this Draft WIR Evaluation.

D.5 REFERENCES

10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," *Code of Federal Regulations*.

Subpart C—Performance Objectives.

Subpart D—Technical Requirements for Land Disposal Facilities, § 61.55, "Waste Classification."

DOE M 435.1-1, 2021,*Radioactive Waste Management Manual*, Chg. 3, U.S. Department of Energy, Washington, D.C.

RPP-RPT-65190, *Supplemental Data for the 200 West Area Tank Treatment Mission Waste Incidental to Reprocessing Evaluation and NEPA Document*, Rev. 1, Hanford Tank Waste Operations & Closure, LLC, Richland, Washington.

SRNL-RP-2018-00687, 2019, *Report of Analysis of Approaches to Supplemental Treatment of Low-Activity Waste at the Hanford Nuclear Reservation*, Savannah River National Laboratory, Aiken, South Carolina.

Utah Administrative Code Title R313, "Environmental Quality, Waste Management and Radiation Control, Radiation," R313-15, "Standards for Protection Against Radiation," R313-15-1009, "Classification and Characteristics of Low-Level Radioactive Waste."