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		Design Agent				1	1	N.W. Kirch (Process Eng.)	[signature]	3/10/00	
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Abstract: This document describes the screening process and criteria used to determine the design constraints found in the Double-shell Tank (DST) engineering-basis documents that apply to the DST System.

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Engineering-Basis Document Review Supporting Double-Shell Tank System Specification Development

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

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Office of River Protection under Contract DE-AC06-99RL14047

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Engineering-Basis Document Review Supporting Double-Shell Tank System Specification Development

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CONTENTS

APPENDICES

TABLES

TERMS

DST	double-shell tank
N/A	not applicable
OSD	operational specification document

1.0 INTRODUCTION

The Double-Shell Tank (DST) System is required to transition from its current storage mission to a storage and retrieval mission supporting the River Protection Project Phase 1 privatization, defined in HNF-SD-WM-MAR-008, *Tank Waste Remediation System Mission Analysis Report.* Requirements for the DST subsystems are being developed using the top-down systems engineering process outlined in HNF-SD-WM-SEMP-002, *Tank Waste Remediation System Systems Engineering Management Plan.* This top-down process considers existing designs to the extent that these designs impose unavoidable constraints on the Phase 1 mission. Existing engineering-basis documents were screened, and the unavoidable constraints were identified. The constraints identified herein will be added to the DST System specification (HNF-SD-WM-TRD-007, *System Specification for the Double-Shell Tank System*). While the letter revisions of the DST System specification were constructed with a less rigorous review of the existing engineering-basis documents, the Revision 0 release of the specification must incorporate the results of the review documented herein.

The purpose of this document is to describe the screening process and criteria used to determine which constraints are unavoidable and to document the screening results.

2.0 SCREENING PROCESS

The goal of the screening process was to capture limits driven by existing DST subsystem designs that necessarily constrain DST System designs for Phase 1. The requirements need to be appropriate for a system-level specification to avoid unnecessarily restricting design solutions. Operating specification documents (OSD) were selected as the primary targets for screening. Other documents were selected for screening based on the likelihood that they would contain relevant constraints or that they would identify issues and/or engineering-basis documents for consideration. Table 1 lists the documents that were screened.

A team was established to screen the relevant engineering-basis documents. This team was composed of individuals with an understanding of tank farm designs, tank chemistry, criticality concerns, structural issues, and the River Protection Project top-down systems engineering process. The following individuals participated on the team:

- W. J. Powell/Lockheed Martin Hanford Corporation
- N. W. Kirch/Lockheed Martin Hanford Corporation
- L. Stauffer/Lockheed Martin Hanford Corporation
- T.J. Conrads/Numatec Hanford Corporation
- M. A. deLamare/TRW.

The requirements that were screened and associated information are provided in Appendix A. A summary of recommended changes to the DST System specification, noted in Appendix A, is provided in Appendix B.

Additionally, Mark Scott/COGEMA supported the screening team by separately reviewing and summarizing various design-analysis reports for specific types of requirements. This summary is provided as Appendix C. A list of these and other reference documents is provided in Section 5.0 of this report.

Table 1. Engineering Documents Screened for Double-Shell Tank System Constraints.

Number	Title
ARH-1437, Jan 1970 and Suppl. 1, Aug 1970	*Design Criteria – Purex AZ Tank Farm*, and Supplement 1, *Design Criteria – Purex AZ Tank Farm*, Atlantic Richfield Hanford Company, Richland, Washington.
ARH-2930, Nov 1973 and Suppl. 1, Sept 1974	*Functional Design Criteria Saltcake Storage Facilities 241SY102 Tank Farm*, and Supplement 1, *Project B-101, Functional Design Criteria 241SY102 Feed Tank Conversion*, Atlantic Richfield Hanford Company, Richland, Washington.
ARH-CD-304, May 1975	*Functional Design Criteria Additional High Level Waste Storage and Handling Facilities (Project 77-2)*, Atlantic Richfield Hanford Company, Richland, Washington.
ARH-CD-362, Rev. 4, 1980	*Functional Design Criteria Additional High Level Waste Storage Facilities, Project B-120,* Rockwell Hanford Operations, Richland, Washington.
ARH-CD-549, March 1976	*Functional Design Criteria Additional High Level Waste Handling and Storage Facilities*, Rockwell Hanford Operations, Richland, Washington.
HNF-SD-WM-TSR-006, Rev. 1-B, 1999	*Tank Waste Remediation System Technical Safety Requirements*, Fluor Daniel Hanford, Inc., Richland, Washington.
OSD-T-151-00007, Rev. H-19, 1997	*Operating Specifications for the 241-AN, AP, AW, AY, AZ & SY Tank Farms*, Fluor Daniel Hanford, Inc., Richland, Washington.
OSD-T-151-00008, Rev. E-2, 1994	*Operating Specifications for the 204-AR Waste Unloading Facility,* Fluor Daniel Hanford, Inc., Richland, Washington.
OSD-T-151-00011, Rev. C-4, 1996	*Operating Specifications for Salt Well Receiver Vessels,* Westinghouse Hanford Company, Richland, Washington.
OSD-T-151-00014, Rev. A-6, 1999	*Operating Specifications for 244-AR Vault Facility,* Fluor Daniel Hanford, Inc., Richland, Washington.
OSD-T-151-00017, Rev. D-10, 1997	*Operating Specifications for Aging-Waste Operations in 241-AY and 241-AZ,* Fluor Daniel Hanford, Inc., Richland, Washington.
SD-340-FDC-001, Rev. 2, 1986	*Functional Design Criteria (241AP Tank Farm)*, Rockwell Hanford Operations, Richland, Washington

The team reviewed each requirement in the documents listed on Table 1, examining the basis of and need for each requirement. The requirements were screened against the criteria listed in Table 2, and the results were documented. The requirements meeting these criteria were marked for inclusion in the specification. Other requirements not directly applicable to the specification were marked as not applicable ("N/A"), and the criteria against which they failed were noted. However, if the team believed that the requirement pointed to a root issue that needed to constrain the DST System, a requirement was recommended for inclusion in the specification. Note that the OSDs listed in Table 1 are redline/strikeout versions of the OSDs, wherein deleted text is explicitly shown. Because a deleted OSD requirement also could point to a root issue that needs to constrain the DST System, deleted OSD requirements also were considered in the team's review. When making decisions about a requirement's relevance, the team examined basis documents and other relevant rationale. Some of the requirements encountered did not come from a basis that the team considered solid. In such cases, available design analysis reports and other references were examined to find a stronger basis.

Table 2. Criteria for Applicability to the Double-Shell Tank System Specification.

1.	The requirement applies to the design of the DST System or a DST subsystem.
2.	The requirement is established for the purpose of system/equipment protection, or defines a DST System-level requirement.
3.	The requirement specifically addresses tank structure or another element that cannot/will not be changed to support the Phase 1 mission.
4.	The requirement value will be unaffected even if active control measures are applied.
5.	The Phase 1 mission scenarios are not expected to invalidate the relevance of the requirement.
6.	No higher level requirement is applicable to the DST System that takes precedence over the requirement in question or from which this requirement can be derived.

DST = double-shell tank.

3.0 CRITERIA

The criteria in Table 2 were applied to each requirement to determine the relevance of the requirement. If a requirement failed *any* of the criteria, it was rejected from incorporation into the DST System specification. Every criterion that a given requirement failed was identified in the results. Each criterion is discussed in more detail below.

Criterion 1: The requirement applies to the design of the DST System or a DST subsystem.

This criterion was used to cull requirements that either did not apply to the DST System or applied to non-design aspects of the system. For example, a requirement that governs excavation in the DST farms would be rejected, because it applies to construction of new items rather than to system behavior or required physical limits. Likewise, requirements reflecting operational preferences or administrative limits also would be rejected on this basis.

Criterion 2: The requirement is established for the purpose of system/equipment protection, or defines a DST System-level requirement.

This criterion was used to cull all requirements that either did not apply to the DST System as a whole or did not apply to a DST subsystem for the expressed purpose of equipment protection. (Note: Equipment protection requirements are established to protect the equipment from accidental/processing damage during its operational phase and are a separate concern from requirements intended to protect the system from potential threats or to protect personnel, the public, or the environment.) Demanding that a requirement apply to the whole system described by a specification (without preconceived ideas of subtier architecture) is a good systems engineering practice that helps ensure system optimization, supports traceability of decisions, and precludes unnecessary constraints on architectural solutions and operational flexibility. One question that was asked by the team to help bring this issue into focus was, "If we were building the DST System today and knew nothing about its configuration other than that it contains underground storage tanks arranged in the current six-tank farm configuration, would we specify this requirement?" Alternately, the team asked if the requirement helps define the DST System functional requirements (defined by DST functional flow block diagrams) or system-level interface. Section 3.1 of the DST System specification (HNF-SD-WM-TRD-007) was used as a guide.

An exception was allowed for requirements that protect existing subsystems. This part of the criterion recognized that there are existing DST subsystems that must be used to accomplish the Phase 1 mission and that their physical designs have real limits. This part of the criterion was further modified by Criterion 3.

Criterion 3: The requirement specifically addresses tank structure or another element that cannot/will not be changed to support the Phase 1 mission.

This criterion preserves only those requirements that apply to subsystems that cannot be changed, even if the change is needed. An example of this is the DST structural and material designs. The DSTs are made of carbon steel and cannot be changed. The DST primary and annulus tank structures were designed to specific codes and standards that were in effect at the time of tank construction. These specific design attributes cannot be changed or modified and thus are considered immutable for the purposes of this screening. Such attributes will drive system design considerations. Other immutable attributes were sought when performing this review, but none were found. An example of requirements that fail this criterion are those that apply to the DST Ventilation Subsystem, which can be modified to suit the mission needs.

An exception was made to allow subsystems that will not be changed either because of factors external to the River Protection Project or because of edict. The 204-AR Waste Unloading Facility is the only known DST subsystem that will be preserved to protect the interface with external waste generators. No other subsystems were identified that met this criterion.

Criterion 4: The requirement value will be unaffected even if active control measures are applied.

This criterion was used to cull existing requirements that passed the first three criteria, but that can be dealt with using active system controls or operational procedures. Such requirements would unnecessarily constrain design solutions and often are an operational means of dealing with the existing DST subsystems. They do not represent a true system-level constraint, because control exerted by a subsystem can resolve the issue. An example is the requirement to maintain a minimum liquid level in the tanks to prevent uplift of the tank bottom. This requirement does protect the tank, an immutable subsystem, but the minimum level can change and can be eliminated if the DST Ventilation Subsystem (a changeable subsystem) is operated at lower levels or shut down. This particular requirement could change even to meet the need of the current storage mission. (One also could argue that this is not a design requirement and thus would fail criterion 1).

Criterion 5: The Phase 1 mission scenarios are not expected to invalidate the relevance of the requirement.

This criterion was used to cull requirements that are valid for the current DST mission, but that potentially would be invalidated by Phase 1 mission scenarios. An example of this type of requirement is the minimum waste depth of 162.56 cm (64 in.) in the AY and AZ farm tanks. This requirement exists because of the distance of the pit drain pipe above the bottom of the tank. However, the requirement is counterproductive to the Phase 1 mission, and the potential for radioactive release issues caused by this configuration can be circumvented by a change to either operations or subsystem designs.

Criterion 6: No higher level requirement is applicable to the DST System that takes precedence over the requirement in question or from which this requirement can be derived.

This criterion was used to cull requirements that are applicable to the DST System, but that are driven by a higher precedence requirement or a root issue that should be captured instead. An example of this type of requirement is the flammable gas and organic tank controls for DSTs. These controls do impose some design-related constraints, such as the use of non-sparking equipment. However, the specific requirements in the OSD are derived from, and in some cases implement, other nationally recognized codes, laws, or standards such as the National Fire Protection Association codes. For system-level requirements, we defer to these codes, laws, or standards, as appropriate. These requirements should not be confused with those addressed in Criterion 3, which apply to unchangeable system elements designed to codes and standards that were in effect at the time of construction.

4.0 RESULTS

Each requirement screened was entered into a matrix that identified the requirement, its disposition as a result of screening, and the rationale for the disposition. Recommended changes to the April 1998 Revision D of the DST System specification (HNF-SD-WM-TRD-007) also are documented in the rationale column. The matrix is provided in Appendix A of this document. In addition, a summary list of recommended changes to the DST System specification is provided in Appendix B. In the case of hydrostatic load, temperature limits, and dome loading, more work is required to establish final limits. For more discussion, please refer to Appendix A for the following OSD sections: 7.2.4, 7.2.6.a, 7.2.6.b, 7.2.6.c, 7.2.7, 17.2.3, 17.2.4, 17.2.5, 17.2.6.a, 17.2.6.b, 17.4.5.A, 17.4.5.B, and 17.4.5.C.

5.0 RESOURCES

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The documents listed below and some of those listed above were reviewed while recommended requirements were being determined. These documents were reviewed in addition to the operational specification documents, technical safety requirement, and functional design criteria listed in Table 1.

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WHC-SD-WM-WP-089, *Integrity Assessment Plan for 241-AP Tank Farm and Designated Ancillary Equipment*, 1991,Westinghouse Hanford Company, Richland Washington.

APPENDIX A

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OSD-T-151-00007: *Operating Specifications for the 241-AN, AP, AW, AY, AZ & SY Tank Farms*, Rev. H-21 (9 sheets) Release Date: 09/29/1998

OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
7.2.1	Tank Composition: Specifies tank waste nitrate, nitrite, and hydroxide composition requirements for two temperature ranges. Purpose is to inhibit uniform corrosion, pitting corrosion, and stress corrosion cracking.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	This requirement was established as one means of protecting the steel tank liners from significant uniform corrosion and reducing the propensity for pitting corrosion and stress corrosion cracking (SCC). As a precaution against SCC, the primary tank welds were stress relieved during construction, and the calculated maximum stress of the primary tanks was typically limited to not exceed 90% of the minimum specified yield strength of the material of construction. Laboratory tests indicated that the prescribed environment would result in significantly less than the design 1 mil (0.001≅) per year of uniform corrosion and would help to minimize the propensity for pitting corrosion and SCC. Some of the original functional design criteria (FDC) for tanks required allowances for 50 mils (0.050≅) of material loss from corrosion mechanisms over a 50-year operating life [see SD-340-FDC-001 and ARH-CD-362]. Structural analysis shows that the primary tanks will remain structurally adequate, given a 50-mil uniform loss of material. An uncertainty exists for the AY and AZ tanks, because the maximum allowable material was neither specified nor calculated. (Note that the final safety analysis report, HNF-SD-WM-SAR-067 [Table 2-9], lists a 30-year design life for the AY and AZ tanks and 50 years for the AN, AP, AW, and SY tanks. Other documents have listed 40 years for AY and 20 to 25 years for AZ [WHC-SD-WM-ER-556 and WHC-SD-TWR-RPT-002] based on property management amortization tables). Because tank liners cannot be modified or replaced, and the U.S. Department of Energy has prohibited tank replacement (i.e., no new tanks will be provided either to provide additional space or to replace old tanks), it is necessary to establish equipment protection requirements as a constraint on the DST System. During Phase 1, erosion/corrosion from in-tank processing may become a new concern. However, previous Pacific Northwest National Laboratory erosion/corrosion studies on simulated aging wastes indicated erosion/corrosion to be of no concern (PNL-7816). In addition, the tanks have experienced corrosion since being put into service. Thus far, only six tanks have been examined ultrasonically (UT) to determine the extent of corrosion. Plans are to examine the remaining tanks, prioritized by the UT results obtained from the sampling of the initial six tanks. The constraint imposed on the DST System needs to identify the maximum allowable uniform corrosion and protect tank integrity by mitigating or precluding other forms of corrosion. This will provide both equipment protection and design/processing flexibility. The constraint imposed will be marked with a TBR (i.e., to be refined) to indicate the uncertainties associated with the proper requirements for AY and AZ Farm tanks. Thus, it is recommended the constraint imposed on the DST System be: [Appendix B, Item 1.] *The system shall be designed and operated so that the maximum uniform corrosion of the primary tank does not exceed 1.3 mm (0.050 in.) (TBR) over the needed life of the system and so that the propensity for other corrosion mechanisms, such as pitting corrosion, erosion corrosion, and SCC, is minimized over the needed life of the system.*

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
			This requires an assessment of the current corrosion condition of the tanks, based on UT inspections, and a determination of the expected corrosion rates for any active corrosion mechanisms, properly adjusted for any long-term changes in stored waste chemistry. Continued periodic UT inspection is required to verify or update the projected corrosion condition of the primary tanks from both a structural-integrity and leak–potential perspective. The following also is recommend: 1. That the assessment of the existing system against this specification verify tank integrity for all farms through the end of Phase 1 2. That the design-life requirement be changed to cover through the end of Phase 1 rather than through Phase 2 3. That the chemical composition requirements be retained within the operating specification document as one selected means of limiting corrosion within the primary tanks.
7.2.2.a	Primary Tank Liquid Level: Establishes a minimum liquid level in DSTs while the ventilation system is operating. It is intended to prevent uplift of tank bottom caused by reduced atmospheric pressure inside the tank while the ventilation system is operating.	N/A. Fails criteria 4 and 5.	Phase 1 scenarios could empty a tank below the specified levels (especially in AY and AZ). Requirement values can change with active ventilation control and thus this requirement does not represent a constraint on the DST System.

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
7.2.2.b	Leak-Detection Pit Liquid Level: Specifies the maximum liquid level in the tertiary leak-detection pits.	N/A Fails criterion 3.	The leak-detection pit exists to monitor leaks from the secondary tank and is not required by regulation. This requirement is established to protect the secondary tank structure from damage when water levels reach the secondary tank's underside. The scenario for damage would require filling the leak-detection pit to a sufficient depth to either ?float≅ the tank or cause the bottom to buckle from the uplift pressure. However, this problem can be eliminated by simply filling the leak-detection pit with concrete. Thus, the leak-detection pit liquid-level requirement does not impose a constraint on the DST System - at the system level. It may apply at the subsystem level as long as the pits exist.
7.2.2.c	Encasement Leak-Detection Pit Liquid Level for AY and AZ.	N/A. Fails criteria 2.	This requirement is not established for the purpose of protecting the tank structure from damage.
7.2.3	Hydrostatic Head: Sets minimum hydrostatic-head requirements for AY and AZ tanks.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	Hydrostatic head is defined as the sum of primary tank pressure and liquid level. This minimum hydrostatic head requirement was established to prevent uplifting the bottom of the tank by counter-balancing the vacuum within the tank with the weight of fluid in the tank. However, the root cause of the problem is uplifting of the tank bottom or other ?crush≅ damage caused by excessive differential pressures. The difference between the primary and annulus tank pressures determines the force applied to the tank bottom that can cause the undesired uplift. The difference between atmospheric pressure and annulus pressure can also cause damage to the annulus. These differential pressures were specified in the tank farm FDCs. HNF-2317, *241-AY-102 High Vacuum Annulus Ventilation System Operability Test Report*, documented further analysis that expanded the FDC limits for AY and AZ farms. It is recommended that the differential pressure requirements should be used rather than hydrostatic head. The DST System requirements should be specified as follows: [See Appendix B, Item 2] The system shall maintain existing DSTs within the following pressure limits: Secondary Tanks: -508 mm (20 in.) # tank pressure # 1,524 mm (+60 in.) water gauge (AP, AY farm) -152 mm (6 in.) # tank pressure # 1,524 mm (+60 in.) water gauge (AN, AW, SY, AZ farms)

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
			Primary Tanks: -152 mm (6 in.) # tank pressure # 1,524 mm (+60 in.) water gauge (AP, AN, AW, SY, AY*, AZ* farms). *See HNF-2317 for exceptions to -152 mm (6-in.) water gauge requirement for AY, AZ farms. [see the FDCs listed in Table 1 of this report for requirements references]. Maximum hydrostatic load is provided in Section 17.2.3 of this table.
7.2.4	Section Deleted: Dome Loading.	Applies. However, specify consistently with most recent dome loading requirements documentation.	This requirement was moved to HNF-SD-WM-TSR-006. Dome loading and live loading can be traded based on varying operational conditions. A dome load limit is needed to protect the tanks from damage during Phase 1 processing. The limit needs to be based on design strength, an assessment of tank degradation over time, earthquake and other natural loads, and thermal stresses on the tank. The DST System specification (HNF-SD-WM-TRD-007) needs to use a value that will provide a sufficient margin to prevent dome failure during repeated processing scenarios. Thus, recommend that the following requirement be imposed on the DST System to protect the existing tanks: [See Appendix B, Item 3.] Maximum dome loading on existing DSTs shall be in accordance with HNF-IP-1266, *Tank Farms Operations Administrative Controls*. Note: If new tank structures are needed, then RPP-PRO-097 will be used.
7.2.5	Vapor Space Pressure: NO CONTROL LIMITS	N/A	No control limits were specified; however, pressure differentials are important to protecting the tank structure. See hydrostatic head, above.
7.2.6.a	Solution Temperatures for AN, AP, AW, AY, AZ and SY Tanks: Specifies maximum waste temperature.	Applies. However, specify a different value based on design-basis information.	The OSD calls out the limited conditions for operation (LCO) limits. The LCO limits are not the correct values to use for design constraints, because they do not represent the true tank design limits; however, specifying a maximum waste temperature is valid for equipment protection. The maximum waste temperature values given in the original tank farm FDCs represent the true design limits of the tanks for the design life specified —50 years (see Appendix A, p. A-31, DST FDC Comparison). This 50-year DST design life is within the time window of DST usage during Phase 1. However, further DST usage during Phase 2 will require a reevaluation of these tank temperature limits (for some farms) to determine their applicability during Phase 2. The correct values for Phase 1 are as follows: [See Appendix B, Item 4.]

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
			Tank Farm — Maximum Temperature of Waste in Tanks AP — 99 °C (210 °F) AN, AW, AY, AZ — 187 °C (350 °F) SY — 124 °C (250 °F).
7.2.6.b	Temperature Change Over Time (Waste): Specifies maximum hourly and daily rate of temperature change.	Applies.	These requirements are based on physical limits and protect the tank structure. Phase 1 does not change the need for this requirement. However, the bases for the values cited in the OSD are questionable. Mark Scott's review of engineering-basis documents showed much more conservative values than the OSD allows (see Appendix C). The studies that Mark reviewed assumed a 1.9 °C (3 °F/day) temperature rate of change, but did not compute the limit. The OSD values have been in use for about 14 years, and we will continue to use them until further analysis suggests otherwise. These values should be marked with a TBR (i.e., to be refined), indicating that they need to be reevaluated to determine the absolute limit. This TBR requirement should be tracked on the River Protection Project risk list to instigate its resolution. [See Appendix B, Item 4.]
7.2.6.c	Temperature Gradients of Solution in Tanks.	Applies.	These requirements are based on physical limits and protect the tank structure. Phase 1 does not change the need for this requirement. However, the bases for the values cited in the OSD are questionable, but none other are available at this time. These values should be marked with a ?TBR≅ (i.e., to be refined), indicating that they need to be reevaluated to determine the absolute limit. A review of the analysis of record is needed. The values are as follows: [See Appendix B, Item 4] Tank Farm — Maximum Temperature Gradient for Waste AN, AP, AW, SY — 113 °C/m (55 °F/ft) AY, AZ — 113 °C/m (55 °F/ft).

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
7.2.7.a	Concrete Temperature: Specifies maximum tank concrete structure temperature.	Applies.	These requirements are based on physical limits and protect the tank structure. Phase 1 does not change the need for this requirement. However, the bases for the values cited in the OSD are questionable. Use the most conservative values from Mark Scott's review of engineering-basis documents (see Appendix C). These values should be marked with a TBR (i.e., to be refined), indicating that they need to be reevaluated to determine the absolute limit. Note also that Appendix C only provides a value for AP and AW farms. Until shown otherwise, it is assumed that this value can be applied to all DST tank farms. The values are as follows: [See Appendix B, Item 4.] Tank Farm — Maximum Temperature of Concrete All DST farms — 116 °C (236 °F).
7.2.7.b	Temperature Gradients of Concrete.	Applies.	These requirements are based on physical limits and protect the tank structure. Phase 1 does not change the need for this requirement. However, the bases for the values cited in the OSD are questionable, but none other are available at this time. These values should be marked with a TBR (i.e., to be refined), indicating that they need to be reevaluated to determine the absolute limit. A review of the analysis of record is needed. The values are as follows: [See Appendix B, Item 4.] Tank Farm — Maximum Temperature Gradient for Concrete AN, AP, AW, SY — 0.72 °C/cm (35 °F/ft) AY, AZ — 0.37 °C/cm (18 °F/ft).
7.2.8	Section Deleted. Heat Generation Rate.	N/A. Fails criteria 2 and 3.	Tank waste generates heat as a result of both chemical reaction and radioactive decay. This requirement was specified to prevent boiling of waste in non-aging waste tanks. It exists to protect the ventilation systems and prevent releases. These values could change if the ventilation systems were upgraded or additional cooling were provided. Thus, these requirements are not valid constraints at the DST System level.

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
7.2.9	Section Deleted. Primary Tank Leak Detection: requires at least one detector to be operable.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	The requirements for leak detection are required by higher precedence documents such as the *Code of Federal Regulations* and the *Washington Administrative Code*. Thus, this OSD requirement should not be used as a DST constraint. Use the higher precedence documents instead (i.e., WAC-173-303). This requirement already is specified in the DST System specification (HNF-SD-WM-TRD-007).
7.2.10	Section Deleted. Transfer Leak Detection: Requires transfer system leak detectors to be verified as operable before transfer.	N/A. Fails criterion 1.	This is an operational requirement that does not constrain design at the system level.
7.2.11	Section Deleted. Criticality: Specifies criticality prevention parameters.	N/A. Fails criteria 2 and 4. However, specify a different parameter based on the higher precedence requirement or the root issue.	These requirements were established to ensure compliance with CPS-T-149-00010. The criticality prevention specification (CPS) is based on specific scenarios analyzed for waste storage and documented in a criticality safety evaluation report (CSER). The results of this analysis may change because of specific Phase 1 scenarios. Thus, this requirement should not be used as is. Rather, HNF-IP-1266, Section 5.7, which drives the limits used in a CSER and the resulting CPS, should be called out as the system level requirement. The radionuclide limits on tank waste should be specified in the DST System specification as follows: [See Appendix B, Item 5.] The system shall store radionuclides in a manner that prevents criticality in accordance with HNF-IP-1266, Section 5.7.
7.2.12	Total Fuel Concentration: Specifies the maximum joules per gram for fuels in tank	N/A. Fails criteria 5 and 6.	This requirement is a specific safety limit imposed to minimize deflagration damage in the tank. It is based on specific safety analysis, which is subject to change as the tank farm scenarios change. The parent requirement for this is the requirement for safety analysis.

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
7.2.13	Section Deleted. Ferrocyanide: Specifies the maximum tank content for ferrocyanide.	N/A. Fails criteria 4 and 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	Requirement was established to protect the tank from fires, deflagrations, and explosions. The OSD requirement is a specific scenario governed by a higher level constraint (i.e., DOE Order 6430.1A and the National Fire Protection Association codes). DOE Order 6430.1A already is specified in the DST System specification. National Fire Protection Association codes are invoked for flammable gas controls, which are treated in this appendix under OSD-T-151-00017, Section 17.5.
7.2.14	Section Deleted. Toxic Vapor: Specifies limits on the release of toxic vapors.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	Covered by higher precedence documents. In this case, RPP-PRO-450 governs this type of release for the River Protection Project at the system level. This requirement already is specified in the DST System specification.
7.3.1.A	HEPA Filters: Specifies pressure drop across ventilation HEPA filters.	N/A. Fails criterion 3.	Does not specify requirements for a tank structure or subsystem that cannot/will not change.
7.3.1.B	Air Filter Temperature: Specifies the maximum temperature at the HEPA filter air inlet.	N/A. Fails criterion 3.	Does not specify requirements for a tank structure or subsystem that cannot/will not change.

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
7.3.1.C	Filter Efficiency: Specifies required HEPA filter efficiency.	N/A. Fails criteria 3 and 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	Does not specify requirements for a tank structure or subsystem that cannot/will not change. However, allowable releases from the tank vapor space are governed by higher level constraints already specified in the DST System specification (i.e., RPP-PRO-450).
7.3.1.E	Gaseous Discharges from Ventilation System: Specifies annual, weekly, and instantaneous concentrations allowed for release at a stack.	N/A. Fails criteria 3 and 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	This requirement does not address an item that cannot/will not change to support Phase 1 if analysis indicates that it should. Further, the vent-stack release limits are for a single point source and are set by analysis from higher precedence-level constraints. The point-source limits can change as necessary within the limits of the higher level constraints. These higher constraints more appropriately specify system requirements. See RPP-PRO-450. This requirement already is specified in the DST System specification.

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OSD-T-151-00008, *Operating Specifications for the 204-AR Waste Unloading Facility*, Rev.E-3 (2 sheets) Release Date: 10/23/1998

OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
8.2.1	Corrosion Specifications: Specifies pH, chloride, and HCl limits for waste received at this facility and for chemical restrictions for decontamination.	Applies.	This requirement establishes a DST System-level input requirement, constraining chemistry of all external waste input into the 204-AR Waste Unloading Facility. It exists to protect the 204-AR stainless steel tanks and pipes, which need to be maintained for use during Phase 1. These requirements belong in the DST System specification interface section (3.2.3) and in related interface control documents. This requirement already is specified in the DST System specification.
8.2.2	Discharge Waste Composition: Specifies waste composition requirements for discharge from this facility to the DSTs.	N/A. Fails criterion 4.	This requirement constrains the chemistry of discharges from the 204-AR Waste Unloading Facility to meet the tank chemistry requirements established for the purpose of preventing corrosion. However, if waste volumes are low, this requirement is not necessary. Also, the waste chemistry requirements are one solution for meeting the 50-mil lifetime corrosion limit and were not considered appropriate for the DST System-level specification. See the resolution to OSD requirements 7.2.1 and 17.4.1.1.
8.2.3	Radionuclide Concentrations: Specifies limits on fissile materials in waste received at the facility and subsequently discharged to the DSTs.	N/A. Fails criteria 2 and 4.	This requirement is established to ensure compliance with CPS-T-149-00010. The CPS is based on specific scenarios analyzed for waste storage and documented in a CSER. The results of this analysis may change because of specific Phase 1 scenarios. Thus, this requirement should not be used as is. Rather, HNF-IP-1266, Section 5.7, which drives the limits used in a CSER and the resulting CPS, should be called out as the system-level requirement. The radionuclide limits on input through 204-AR should be specified as follows: The system shall accept radionuclides from external waste generators in accordance with HNF-IP-1266, Section 5.7.
8.2.4	Liquid Levels: Specifies limits on the maximum liquid level in the facility catch tank.	N/A. Fails criteria 2, 3, and 6.	This requirement is not established for equipment protection and does not address an item that cannot/will not change to support Phase 1 if analysis indicates that it should. It was established as a means to prevent overflow of the 204-AR tank, which is governed by higher level environmental protection requirements already specified in the DST System specification (e.g., WAC-173-303-640 (5) from Section 3.3.6.3.2, Spill Prevention and Controls).

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
8.3.1	HEPA Filter Pressure Drops: Specifies pressure differential between HEPA filter stages in the facility ventilation system.	N/A. Fails criterion 3.	This requirement does not address an item that cannot/will not change to support Phase 1 if analysis indicates that it should.
8.3.2	Catch Tank Vent Temperature: Specifies the maximum HEPA filter air inlet temperature.	N/A. Fails criterion 3.	This requirement does not address an item that cannot/will not change to support Phase 1 if analysis indicates that it should.
8.3.3	Effluent Controls: Specifies the maximum averaged annual, daily, and 4-hour effluent release limits of alpha and beta emitters at the facility vent stack.	N/A. Fails criteria 3 and 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	This requirement does not address an item that cannot/will not change to support Phase 1 if analysis indicates that it should. Further, the vent-stack release limits are for a single point source and are set by analysis from higher precedence level constraints. The point source limits can change as necessary within the limits of the higher level constraints. These higher constraints more appropriately specify system requirements. See RPP-PRO-450. This requirement is already specified in the DST System specification.

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OSD-T-151-00011, *Operating Specifications for the Saltwell Receiver Vessels*, Rev. C-4 (2 sheets) Release Date: 07/22/1996

OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
11.2.A	Tank Content Composition: Specifies hydroxide, nitrate, and nitrite requirements for double contained receiver tanks (DCRT) 244-BX, -S, -TX, and -U and the 244-CR Vault.	N/A. Fails criteria 3 and 5.	We are not *constrained* to use DCRTs. A decision to use the DCRTs is below the level of concern of the DST System specification, because they represent a specific solution. We may or may not choose to use them to complete the Phase 1 mission. If we choose to use the DCRTs, then these requirements will be evaluated for use in component specifications.
11.2.B	Liquid Levels: Specifies the maximum waste liquid levels in DCRTs.	N/A. Fails criteria 3 and 5.	We are not *constrained* to use DCRTs. A decision to use the DCRTs is below the level of concern of the DST System specification, because they represent a specific solution. We may or may not choose to use them to complete the Phase 1 mission. If we choose to use the DCRTs, then these requirements will be evaluated for use in component specifications.
11.2.C	Hydrostatic Load: Specifies the maximum hydrostatic load for DCRTs.	N/A. Fails criteria 3 and 5.	We are not *constrained* to use DCRTs. A decision to use the DCRTs is below the level of concern of the DST System specification, because they represent a specific solution. We may or may not choose to use them to complete the Phase 1 mission. If we choose to use the DCRTs, then these requirements will be evaluated for use in component specifications.
11.2.D	Vault Loading: Specifies the maximum soil covering for DCRTs.	N/A. Fails criteria 3 and 5.	We are not *constrained* to use DCRTs. A decision to use the DCRTs is below the level of concern of the DST System specification, because they represent a specific solution. We may or may not choose to use them to complete the Phase 1 mission. If we choose to use the DCRTs, then these requirements will be evaluated for use in component specifications.
11.2.E	Primary Tank Pressure: Specifies the maximum and minimum tank air pressure in DCRTs	N/A. Fails criteria 3 and 5.	We are not *constrained* to use DCRTs. A decision to use the DCRTs is below the level of concern of the DST System specification, because they represent a specific solution. We may or may not choose to use them to complete the Phase 1 mission. If we choose to use the DCRTs, then these requirements will be evaluated for use in component specifications.
11.2.F	Primary Tank Temperature: Specifies the maximum temperature of tank contents for DCRTs.	N/A. Fails criteria 3 and 5.	We are not *constrained* to use DCRTs. A decision to use the DCRTs is below the level of concern of the DST System specification, because they represent a specific solution. We may or may not choose to use them to complete the Phase 1 mission. If we choose to use the DCRTs, then these requirements will be evaluated for use in component specifications.

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
11.3.A	Pressure Drop Across HEPA Filters: Specifies pressure differential allowed between HEPA stages for DCRT ventilation.	N/A. Fails criteria 3 and 5.	We are not constrained to use DCRTs. A decision to use the DCRTs is below the level of concern of the DST System specification, because they represent a specific solution. We may or may not choose to use them to complete the Phase 1 mission. If we choose to use the DCRTs, then these requirements will be evaluated for use in component specifications.
11.3.B	HEPA Filter Efficiencies: Specifies particulate filtration efficiency for DCRT ventilation	N/A. Fails criteria 3 and 5.	We are not constrained to use DCRTs. A decision to use the DCRTs is below the level of concern of the DST System specification, because they represent a specific solution. We may or may not choose to use them to complete the Phase 1 mission. If we choose to use the DCRTs, then these requirements will be evaluated for use in component specifications.
11.3.C	Radionuclide Discharges: Specifies the maximum averaged annual, two-week and instantaneous radionuclide release quantities from DCRT ventilation.	N/A. Fails criteria 3 and 5.	We are not constrained to use DCRTs. A decision to use the DCRTs is below the level of concern of the DST System specification, because they represent a specific solution. We may or may not choose to use them to complete the Phase 1 mission. If we choose to use the DCRTs, then these requirements will be evaluated for use in component specifications.
11.3.D	Requirement For HEPA Filtration: Specifies the use of filtration on inlet and exhaust for DCRT ventilation.	N/A. Fails criteria 3 and 5.	We are not constrained to use DCRTs. A decision to use the DCRTs is below the level of concern of the DST System specification, because they represent a specific solution. We may or may not choose to use them to complete the Phase 1 mission. If we choose to use the DCRTs, then these requirements will be evaluated for use in component specifications.
11.3.E	Requirements For Ventilation System Operation: Specifies the conditions for when DCRT ventilation operation is required.	N/A. Fails criteria 3 and 5.	We are not constrained to use DCRTs. A decision to use the DCRTs is below the level of concern of the DST System specification, because they represent a specific solution. We may or may not choose to use them to complete the Phase 1 mission. If we choose to use the DCRTs, then these requirements will be evaluated for use in component specifications.

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OSD-T-151-00014, *Operating Specifications for the 244-AR Vault*, Rev.A-6 — Release Date: 08/05/1999

OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
14.2.1.A	Composition of Tank Contents: Specifies limits on chloride, separable organics, and flammable gas for the 244-AR Vault.	N/A. Fails criteria 3 and 5.	The 244-AR Vault is a nonoperable facility that is not planned for use during Phase 1. We are not constrained to use it. Thus, these requirements should not be used as constraints on the DST System.
14.2.1.B	Liquid Levels: Specifies tank liquid levels for tanks within the vault.	N/A. Fails criteria 3 and 5.	The 244-AR Vault is a nonoperable facility that is not planned for use during Phase 1. We are not constrained to use it. Thus, these requirements should not be used as constraints on the DST System.
14.2.1.C	Tank Vapor Space Pressure: Section missing from document	N/A. Fails criteria 3 and 5.	The 244-AR Vault is a nonoperable facility that is not planned for use during Phase 1. We are not constrained to use it. Thus, these requirements should not be used as constraints on the DST System.
14.2.1.D	Tank Temperatures: Sets limit on tank (waste?) temperature in 244-AR.	N/A. Fails criteria 3 and 5.	The 244-AR Vault is a nonoperable facility that is not planned for use during Phase 1. We are not constrained to use it. Thus, these requirements should not be used as constraints on the DST System.
14.2.2.A	General 244-AR Ventilation Requirements: Specifies HEPA stage differential pressures, filter efficiency, and gaseous discharge requirements.	N/A. Fails criteria 3 and 5.	The 244-AR Vault is a nonoperable facility that is not planned for use during Phase 1. We are not constrained to use it. Thus, these requirements should not be used as constraints on the DST System.
14.2.2.B	Canyon Ventilation System: Specifies 244-AR exhauster flow rate.	N/A. Fails criteria 3 and 5.	The 244-AR Vault is a nonoperable facility that is not planned for use during Phase 1. We are not constrained to use it. Thus, these requirements should not be used as constraints on the DST System.

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OSD-T-151-00017, *Operating Specifications for Aging Waste Operations in 241-AY and 241-AZ*, Rev.D-10 (9 sheets) Release Date: 10/01/1997

OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
17.2.1.1	Primary Tank Liquid Level: Specifies the minimum primary tank liquid levels.	N/A. Fails criteria 2, 4 and 5.	This requirement is not established for equipment protection, but to prevent uncovering of air-lift circulator outlets. This requirement is specific to a design that can change. Even if the design is not changed, uncovering the outlet is permissible through active control of tank pressure. Finally this requirement cannot be levied if the Phase 1 mission is to be performed, because its objective to eliminate tank waste leads to empty tanks.
17.2.1.2	Leak Detection Pit Liquid Level: Specifies the maximum leak-detection pit levels.	N/A. Fails criterion 3.	See the rationale for OSD-T-151-00007, Section 7.2.2.b.
17.2.2	Section Deleted. Primary Tank Leak Detection.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	This requirement was moved to the technical safety requirements (TSR). The DST System specification needs to use the *Washington Administrative Code* requirements, which require leak detection rather than the OSD or TSR (i.e., WAC-173-303). This requirement already is specified in the DST System specification.

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OSD-T-151-00017, *Operating Specifications for Aging Waste Operations in 241-AY and 241-AZ*, Rev.D-10 (9 sheets) Release Date: 10/01/1997

OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
17.2.3	Hydrostatic Load: Specifies minimum/maximum hydrostatic head at the primary tank walls.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	For minimum hydrostatic load, use the recommendation above provided for OSD-T-151-00007, Section 7.2.3. For the maximum hydrostatic load, use the values indicated below. The bases cited in the OSDs appeared inadequate. A search for analysis was conducted by Mark Scott/COGEMA for relevant limits. The results were documented in Appendix C of this document. The position is to use values from Appendix C to set the requirement. These values should be used until additional analysis is performed to allow stretching of the limit. Please note that OSD-T-151-00007 did not cover equivalent requirements for the AW, AN, AP, and SY tank farms. Despite this, values are provided below for these tanks as well. [See Appendix B, Item 6] The maximum hydrostatic load applied to each tank by the waste shall be as specified below: __Tank Farm__ / __Load as exerted by:__ / __Basis Documents:0__ AN / 4,410 m^3 (1.16 Mgal) @ 1.7 sp. gr. and a depth of 10.7 m (422 in.) / RHO-C-60 considered most credible (see Attachment C) AW / 4,410 m^3 (1.16 Mgal) @ 1.7 sp. gr. and a depth of 10.7 m (422 in.) / RHO-C-60 considered most credible (see Attachment C) SY / 4,330 m^3 (1.14 Mgal) @ 1.7 sp. gr. and a depth of 10.7 m (422 in.) / RHO-C-059 considered most credible(see Attachment C) AY / 3,790 m^3 (0.998 Mgal) @ 1.22 sp. gr. and a depth of 9.25 m (364 in.) / SD-RE-TI-041 (see Attachment C) AZ / 3,790 m^3 (0.998 Mgal) @ 1.22 sp. gr. and a depth of 9.25 m (364 in.) / SD-RE-TI-041 (see Attachment C) AP / 4,410 m^3 (1.16 Mgal) @ 2.0 sp. gr. and a depth of 10.7 m (422 in.) / Multiple (see Attachment C).

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
17.2.4	Section Deleted: Dome Loading.	Applies. However, specify a different value based on design-basis information.	See the rationale for OSD-T-151-00007, Section 7.2.4 above.
17.2.5	Section Deleted: Live Loads.	Applies. However, specify a different value *based on* design-basis information.	See the rationale for OSD-T-151-00007, Section 7.2.4 above.
17.2.6.a	Max Dome Concrete Temperature: Specifies the maximum dome concrete temperature.	Applies. However, specify a different value based on design-basis information.	The OSD calls out the LCO limits. Because they do not represent the true tank design limits, the LCO limits are not the correct values to use for design constraints. However, specifying a maximum dome temperature is valid for equipment protection. See the rationale for OSD-T-151-00007, Section 7.2.7.a.
17.2.6.b	Temperature Gradient: Specifies the maximum *temperature gradient* allowed in the dome concrete.	Applies.	This restriction protects an unchangeable portion of the tank structure. The value is based on computer code runs. While the value may change in the future with better analysis, this requirement represents the maximum for which the tanks were analyzed. [See Appendix B, Item 4.]
17.2.6.c	Minimum thermocouples: Specifies the position and minimum number of thermocouples in the whole tank concrete structure.	N/A. Fails criteria 3, 4, and 5.	The thermocouple number and position are not an unchangeable part of the DST System design solution. Other means or instrument positions could be used to measure temperature. Such a requirement is not relevant to a system specification and is more appropriate for a component specification.

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
17.3.1	Section Deleted: Waste Transfer Leak Detection. Requires verification of operability before transfer .	N/A. Fails criterion 1.	Requirement is for operations and does not impact design.
17.3.2	Section Deleted: Composition of Transferred Waste. Specified plutonium concentration.	N/A. Fails criteria 2, 3, and 4.	This requirement puts a limit on waste concentration to prevent criticality. It does not constrain the DST System. It is not there for equipment protection and can be violated for specific transfers based on tank plutonium content.
17.3.3	Section Deleted: 90-Day Rule.	N/A. Fails criteria 2 and 4.	This rule was employed to prevent temperature excursions in aging waste tanks caused by compaction of waste. This rule is considered obsolete. This rule does not exist to protect the tank and can be overcome readily by adding active control measures (e.g., mixer pump operation).
17.4.1.1.1	Section Deleted: Criticality Prevention. Specifies plutonium concentrations per tank.	OSD requirement is N/A. Fails criteria 2 and 4. However, specify a requirement based on the root issue.	This requirement is established to ensure compliance with CPS-T-149-00010. The CPS is based on specific scenarios analyzed for waste storage and documented in a CSER. The results of this analysis may change because of specific Phase 1 scenarios. Thus, this requirement should not be used as is. Rather, HNF-IP-1266, Section 5.7, which drives the limits used in a CSER and the resulting CPS, should be called out as the system-level requirement. *The radionuclide limits on tank waste should be specified as follows* [See Appendix B, Item 7]: The system shall store radionuclides in a manner that prevents criticality in accordance with HNF-IP-1266, Section 5.7.
17.4.1.1.2	The 5–Molar Sodium Rule: Specifies the maximum sodium concentration.	N/A. Fails criteria 4 and 6.	*This requirement was established to avoid precipitation leading to localized waste* overheating and steam bumps. This problem can be mitigated with active control (e.g., mixer pump). In addition, this requirement is already covered by maximum tank temperature limits.

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
17.4.1.1.3	Hydroxide: Specifies the maximum hydroxide concentrations.	N/A. Fails criterion 6. However, specify a different parameter based on the higher precedence requirement or the root issue.	This requirement, in combination with Section 17.4.1.1.4, was established to inhibit tank corrosion. See the resolution to Section 7.2.1, above.
17.4.1.1.4	Corrosion Control: Specifies the nitrite and nitrate concentration limits.	N/A. Fails criterion 6. However, specify a different parameter based on the higher precedence requirement or the root issue.	see Section 17.4.1.1.3, above.
17.4.2	Section Deleted: Steam Condensate.	N/A. Fails criterion 3.	Requirement applies to equipment that is currently inoperable, inactive, and not necessary for Phase 1.
17.4.3	Section Deleted: Liquid Organic Waste section prohibits discharge of liquid organic waste to the ground.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	Covered by a higher level requirement that is more appropriate to apply at the system level (i.e., WAC 173-303). This requirement already is specified in the DST System specification.

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
17.4.4	Section Deleted: Maximum Waste Heat Content.	N/A. Fails criteria 2 and 3.	This requirement exists to prevent exceeding the capability of the existing ventilation system, not to protect the tank. Further, the requirement could change if the ventilation subsystem were upgraded or if additional cooling were provided. Thus, this requirement is not valid at the DST System level.
17.4.5 .A, .B, .C	Waste Temperatures: Specifies the maximum waste/sludge temperatures and maximum heat-up rate.	Applies.	These requirements are based on physical limits and protect the tank structure. Phase 1 does not change the need for this requirement. Also see the rationale for OSD-T-151-00007, Section 7.2.6.a.
17.4.5 .D, .E, .F	Waste Temperatures: minimum number of thermocouples.	N/A. Fails criteria 3, 4, and 5.	The thermocouple number and position are not an unchangeable part of the DST System design solution. Other means or instrument positions could be used to measure temperature. Such a requirement is not relevant to a system specification and is more appropriate for a component specification.
17.4.6	Airlift Circulator Operation: Specifies the airlift circulator (ALC) flow rate, reliability, restart time, and backup power requirements.	N/A. Fails criterion 4.	ALCs are not required. Alternative control measures may be implemented.
17.4.7	Vapor Space Pressure: Requirement title is misleading. Specifies averaged 4-hour and instantaneous radionuclide release requirements. (Seems mistitled).	N/A. Fails criteria 3 and 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	This requirement does not address an item that cannot/will not change to support Phase 1 if analysis indicates that it should. Further, the vent-stack release limits are for a single point source and are set by analysis from higher precedence level constraints. The point source limits can change as necessary within the limits of the higher level constraints. These higher constraints more appropriately specify system requirements. See RPP-PRO-450. This requirement already is specified in the DST System specification.
17.4.8	Section Deleted: Spare Aging Waste Tank	Applies.	*Add the following statement to the DST System specification: [See Appendix B, Item 9.]* The system shall provide excess storage capacity beyond the mission need, of sufficient capacity to store the contents of one tank. (Reference DOE Order 5820.2A, Chapter I, paragraph 3.b.(4)(d)).

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
17.4.9	Total Fuel Concentration: Specifies maximum joules per gram for fuels in tank.	N/A. Fails criteria 5 and 6.	This requirement is a specific safety limit imposed to minimize deflagration damage in the tank. It is based on a specific safety analysis that is subject to change as the tank farm scenarios change. The parent requirement for this is the requirement for safety analysis.
17.4.10	Section Deleted: Maximum total cyanide by weight.	N/A. Fails criteria 4 and 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	The requirement was established to protect the tank from fires, deflagrations, and explosions. The OSD requirement is a specific scenario governed by a higher level constraint (i.e., DOE Order 6430.1A and the National Fire Protection Association codes). [See Appendix B, Item 8.]
17.4.11	Section Deleted: Organic Salts.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	The requirement was established to protect the tank from fires, deflagrations, and explosions. The OSD requirement is a specific scenario governed by a higher level constraint (i. e, DOE Order 6430.1A and the National Fire Protection Association codes). [See Appendix B, Item 8.]

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
17.4.12	Section Deleted: Toxic Vapor	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	Covered by RPP-PRO-450. This requirement already is specified in the DST System specification.
17.5	Section Deleted: Flammable Gas and Organic Controls for the Aging Waste Facility.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	The OSD/TSR values are specific derived values for specific scenarios. The scenarios may change for Phase 1; thus it is appropriate to call out the parent codes and standards. The tank waste generates flammable gases such as hydrogen and ammonia during storage. For DSTs, hydrogen has been selected as the overriding gas for design-requirement purposes. These gases have the potential of igniting, resulting in undesirable consequences. To protect against these consequences, the DST System and subsystems must be designed and operated in a manner so as to make ignition of these gases improbable. To achieve this, the River Protection Project Flammable Gas Advisory Board has identified codes and standards that shall be applied to system design and operation. They are listed below: [See Appendix B, Item 8a.] NFPA 70 (Class 1, Division 1, Group B) for that which contacts the waste directly in the tank. NFPA 70 (Class 1, Division 2, Group B) for that which operates in the tank vapor space. NFPA 496 (Type X) for that which contacts the waste directly in the tank. NFPA 496 (Type Z) for that which operates in the tank vapor space. NFPA 77 whether in contact with the waste in the tank or whether just in the vapor space. NEC Articles 500 and 501 whether in contact with the waste in the tank or whether just in the vapor space.

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OSD Section	Title/Description	Disposition (re: DST System Specification)	Rationale
			These codes and standards form the basis of system design requirements and ignition control sets. For the DST System specification, the following design requirements are recommended: The portions of the system within the tanks that contact waste shall be designed and operated in accordance with the requirements of NFPA 70 (for Class 1, Division 1, Group B), NEC Articles 500 and 501, NFPA 77, and NFPA 496 (Type X). The portions of the system within the tank vapor space that do not contact the waste shall be designed and operated in accordance with the same codes and standards, except that Class 1 Division 2, Group B (NFPA 70) and Type Z (NFPA 496) apply.

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HNF-SD-WM-TSR-006, *Tank Waste Remediation System Technical Safety Requirements*, Rev. 1-B (7 sheets)			Release: 01/31/00
TSR Section	**Title/Description**	**Disposition (re: DST System Specification)**	**Rationale**
2.1.1	Waste Temperature Limits: Safety limit for the maximum allowable waste temperature for DSTs.	N/A. Fails criteria 1, 2, and 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	This value is based on a safety limit that is not for equipment protection. This safety limit is an operational constraint that is not based on the design of the tank structure. It should not constrain the DST System. A more authoritative engineering basis exists. See resolution to OSD temperature limits. [See Appendix B, Item 4.]
3.1.1	Transfer System Covers: Requires seals and doors to be operable and closed.	N/A. Fails criteria 2, 3, and 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	Applies to operation of a subsystem whose design can be changed to suit the needs of Phase 1, if needed. The purpose of the requirement is to prevent worker, public, and environmental exposure to radiation. This need is covered by a higher precedence requirement for environmental and worker safety (i.e., DOE/RL-96-109 and HNF-SD-WM-HSP-002). These requirements already are specified in the DST System specification.
3.1.2	Service Water Pressure Detection System: Requires the service water pressure system to be operable.	N/A. Fails criteria 2 and 3.	This requirement exists to prevent the potential for waste backflow into service water lines. This is based on a design below the level of concern of the DST System specification and does not apply for protection of equipment. This requirement is not for equipment protection and applies to a changeable subsystem.

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TSR Section	Title/Description	Disposition (re: DST System Specification)	Rationale
3.1.3	Transfer Leak Detection Systems: Requires transfer leak-detection systems to be operable.	N/A. Fails criteria 1 and 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	This is an operations requirement that does not impose a constraint on the DST System. The need for leak detection is covered by a higher precedence requirement for providing leak detection (i.e., WAC-173-303). This requirement is already specified in the DST System specification.
3.1.4	Vent Stack CAM Interlock Systems.	N/A. Fails criteria 1 and 2.	This LCO requires the continuous air monitor (CAM) to be operable. It does not constrain the system design and is not there for equipment protection of an unchangeable subsystem.
3.1.4.A	Stack Radiation Monitor Systems.	N/A. Fails criteria 2 and 3.	This requirement does not address an item that cannot/will not change to support Phase 1.
3.1.5	Replacement cross-site Transfer Line System pressure-regulating valve (PRV) and Rupture Disk.	N/A. Fails criterion 3.	This requirement does not address an item that cannot/will not change to support Phase 1.

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HNF-SD-WM-TSR-006, *Tank Waste Remediation System Technical Safety Requirements*, Rev. 1-B (7 sheets) — Release: 01/31/00

TSR Section	Title/Description	Disposition (re: DST System Specification)	Rationale
3.2.1	DST and AWF Tank Vent System: Requires vent systems to be operable because of flammable gas issues.	N/A. Fails criteria 1 and 6. However, this requirement points to a higher level need. Therefore, specify a different requirement based on that need.	This operations requirement imposes a constraint on the DST System. The strategy for controlling flammable gas hazards comprises three components – ventilation, monitoring, and ignition controls. This requirement imposes the necessary ventilation control. The approach taken in developing this control was that the existing ventilation systems were more than adequate for controlling steady-state hydrogen generation, and thus simply verifying that the systems are operating provides sufficient confidence that steady-state hydrogen will not accumulate in concentrations that will approach the lower flammability limit. This verification of operability may or may not be adequate for the waste feed delivery mission. However, there still is a fundamental requirement to provide forced ventilation in all DSTs to control flammable gas hazards (i.e., analysis shows that with only barometric breathing, steady-state hydrogen will accumulate and eventually reach the lower flammability limit). Quantifying the ventilation subsystem flow rates to achieve the desired flammable gas controls during the waste feed delivery mission are the subject of ventilation subsystem studies that resulted in the DST Ventilation Subsystem specific requirements that were documented in that subsystem's specification. The appropriate system-level requirement for inclusion in the DST System specification is as follows [see Appendix B, Item 8b]: *The DSTs shall be actively ventilated to limit the build-up of flammable gases to less than 25 percent of the lower flammability limit.*
3.3.2	Tank Temperature Controls.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	These values are based on safety limits that are not for equipment protection. A more authoritative engineering basis exists. See the resolution to OSD temperature limits. [See Appendix B, Item 4.]
4.0	Surveillance Requirements.	N/A	SEE RESOLUTIONS FOR SECTION 3.

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TSR Section	**Title/Description**	**Disposition (re: DST System Specification)**	**Rationale**
5.7	Nuclear Criticality Safety.	N/A. Fails criteria 5 and 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	Requirements cited are derived from CPSs. The CPSs were determined to be scenario specific and need to be revisited for specific Phase 1 scenarios. Refer to the solution for OSD-T-151-00007, Section 7.2.11, above.
5.8	Source Inventory Controls.	N/A. Fails criterion 5	Source inventory control values are determined by process needs and thus are not constraints on system design.
5.9	Flammability Controls.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	Flammable gas issues are covered by higher precedence requirements for design. Refer to the solution for HNF-SD-WM-TSR-006, Sections 3.2.1 and 5.10, for requirements related to flammable gas hazards.

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TSR Section	Title/Description	Disposition (re: DST System Specification)	Rationale
5.10	Ignition Controls.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	Flammable gas issues are covered by higher precedence requirements for design. Refer to the solution for OSD-T-151-00017, Section 17.5, above.
5.11	Flammable Gas Monitoring Controls.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	Flammable gas issues are covered by higher precedence requirements for design. Refer to the solution for HNF-SD-WM-TSR-006, Sections 3.2.1 and 5.10, for requirements related to flammable gas hazards
5.12	Transfer Controls.	N/A. Fails criteria 1, 2, 3, and 6.	These are operational procedures that do not impose a constraint on the DST System design. They are not established for system safety, nor do they apply to an immutable part of the existing system.
5.13	Encasement Seal Loop Controls.	N/A. Fails criteria 2 and 3	These controls were established to reduce the consequence of leak in a primary pipe. Encasement piping is drained toward a pit with a leak-detection system. This requirement does not exist for equipment protection or address an immutable part of the system.
5.14	Emergency Preparedness.	N/A. Fails criterion 1.	The requirement is operational in nature, and does not specify design.

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TSR Section	Title/Description	Disposition (re: DST System Specification)	Rationale
5.16	Dome Loading.	N/A. Fails criterion 6. However, this requirement points to a higher level need. Therefore, specify a different parameter based on that need.	This control is governed by higher precedence requirements. See the response to OSD-T-151-00007, Section 7.2.4, above. [See Appendix B, Item 3.]
5.17	Excavation Controls.	N/A. Fails criterion 1.	This control applies to excavation, which is not a design constraint on the system. It applies to construction and maintenance.
5.18	HEPA Filters.	N/A. Fails criterion 3.	This requirement does not address an item that cannot/will not change to support Phase 1 if analysis indicates that it should.
5.19	Process Instrumentation and Measuring and Test Equipment.	N/A. Fails criterion 1.	This control requires implementation of a *program* that will control functional testing and calibration of process instrumentation and test equipment. Program implementation does not impose constraints on DST System design.
5.20	Transfer Pump Administrative Lock Controls.	N/A. Fails criteria 1 and 6.	These controls are operational in nature and do not impose constraints on DST System design.
5.21	Tank Service Water Intrusion Monitoring Program.	N/A. Fails criterion 2.	This control was established to monitor for service water intrusion into DSTs. This requirement is not for equipment protection, and the desired results can be achieved by other means. It is not an appropriate constraint on system design.
5.22	Transfer System Cover Removal Control.	N/A. Fails criterion 1.	This control establishes an operational control over pit cover blocks to prevent release of contamination. It is not a constraint on DST System design.
5.23	Caustic Transfer Controls.	N/A. Fails criteria 2 and 3.	This control applies to the transfer of caustic, not waste. It is not for equipment protection and does not apply to an immutable portion of the system. It is not an appropriate constraint on system design.

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TSR Section	Title/Description	Disposition (re: DST System Specification)	Rationale
5.24	Safety Management Programs.	N/A. Fails criterion 1.	This is a programmatic requirement relating to the establishment of safety management programs, such as radiation protection and hazardous material protection, and does not impose design requirements on the DST System.
5.25	Vent Controls.	N/A. Fails criteria 2 and 3.	These controls are not established for equipment protection and apply to subsystems that are not immutable.
5.26	Tank 241-C-106 Waste Temperature Controls.	N/A. Fails criterion 1.	This control applies to a single-shell tank, not to DSTs.
Section 5 Addendum	Transitional Requirements.	N/A	The requirements of the TSR Addendum are related to rotary-mode core sampling, which are authorized only in single-shell tanks.

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Double-Shell Tank Functional Design Criteria Requirements Comparison by Farm
(Note: For applicability of these requirements, see related requirements in the operational specification document tables above.) (3 sheets)

DST Farm Requirement	AP Farm SD-340-FDC-001	AN Farm ARH-CD-304	AN-107 ARH-CD-549	AW Farm ARH-CD-362	SY Farm ARH-2930 and Supplement 1	AZ Farm ARH-1437 and Supplement 1	AY Farm ARH-205
Maximum Volume and Hydrostatic Load (Vol. @ sp. gr.)	4,410 m^3 (1.16 Mgal) @ 2.0 sp. gr.	3,800 m^3 (1.0 Mgal) @ 2.0 sp. gr.	3,800 m^3 (1.0 Mgal) @ 2.0 sp. gr.	3,800 m^3 (1.0 Mgal) @ 2.0 sp. gr.	3,800 m^3 (1.0 Mgal) @ 1.7 sp. gr.	3,800 m^3 (1.0 Mgal) @ 1.6 sp. gr. (liquid) and @ 2.5 sp. gr. (sludge)	3,800 m^3 (1.0 Mgal) @ 1.6 sp. gr. (liquid) and @ 2.5 sp. gr. (sludge)
Maximum Waste Temperature	--	187 °C (350 °F)	187 °C (350 °F)	187 °C (350 °F)	124 °C (250 °F)	106 °C (220 °F) vapor maximum, 131 °C (260 °F) liquid maximum, 187 °C (350 °F) sludge maximum	106 °C (220 °F) vapor maximum 131 °C (260 °F) liquid maximum 187 °C (350 °F) sludge maximum
Maximum Steel Temperature	156 °C (300 °F) (primary)	--	--	--	--	--	--
Maximum Concrete Temperature	--	--	--	--	--	187 °C (350 °F) (@ base)	--
pH or Concentration	01M ≤ NaOH ≤ 8M	--	--	--	≤8.0 pH	--	8 to 10
Maximum Corrosion	≤ 0.025 mm/yr (≤ 0.001 in./yr)	--	--	≤ 0.025 mm/yr (≤ 0.001 in./yr)	--	--	--
Design Life	50 Years	50 Years	50 Years	50 Years	50 Years	--	--
Stress Limits	ASME Pressure Vessel Code Section VIII, Division 2	--	ASME Pressure Vessel Code Section VIII, Division 2	ASME Pressure Vessel Code Section III, Class 1	--	ASME Pressure Vessel Code Section III	ASME Pressure Vessel Code Section VIII

APPENDIX A

REVIEW RECORD TABLES

Double-Shell Tank Functional Design Criteria Requirements Comparison by Farm
(Note: For applicability of these requirements, see related requirements in the operational specification document tables above.) (3 sheets)

DST Farm Requirement	AP Farm SD-340-FDC-001	AN Farm ARH-CD-304	AN-107 ARH-CD-549	AW Farm ARH-CD-362	SY Farm ARH-2930 and Supplement 1	AZ Farm ARH-1437 and Supplement 1	AY Farm ARH-205
Pressure Differential	-305 mm (-12 in.) ≤ P ≤ + 1,524 mm (+60 in.) w.g. (primary to annulus) -305 mm (-20 in.) ≤ P ≤ +1,524 mm (+60 in.) w.g. (annulus to atmosphere)	-152 mm (-6 in.) ≤ P ≤ +1,524 mm (+60 in.) w.g.	-152 mm (-6 in.) ≤ P ≤ +1,524 mm (+60 in.) w.g.	-152 mm (-6 in.) ≤ P ≤ +1,524 mm (+60 in.) w.g.	-152 mm (-6 in.) ≤ P ≤ +1,524 mm (+60 in.) w.g.	-152 mm (-6 in.) ≤ P ≤ +1,524 mm (+60 in.) w.g.	-152 mm (-6 in.) ≤ P ≤ +1,524 mm (+60 in.) w.g.
Fill/Drain Cycling	Maximum 4 cycles/yr @ 10.1 L/s (160 gal/min) @ 1.7 sp. gr. @ 124 °C (250 °F) (supernate) Maximum 4 cycles/lifetime @ 6.3 L/s (100 gal/min) @ 2.0 sp. gr. @ 156 °C (300 °F) (slurry)	--	--	--	--	--	--

APPENDIX A

REVIEW RECORD TABLES

Double-Shell Tank Functional Design Criteria Requirements Comparison by Farm
(Note: For applicability of these requirements, see related requirements in the operational specification document tables above.) (3 sheets)

DST Farm Requirement	AP Farm SD-340-FDC-001	AN Farm ARH-CD-304	AN-107 ARH-CD-549	AW Farm ARH-CD-362	SY Farm ARH-2930 and Supplement 1	AZ Farm ARH-1437 and Supplement 1	AY Farm ARH-205
Dead/Live Loads	≥ 1.98 m (6.5-ft) earth cover @ maximum compaction density and 191 N/m^2 (40 lbf/ft^2) uniform and 4.45 x 10^5 N (50-ton) concentration at any point.	≥ 1.98 m (6.5-ft) earth cover @ maximum compaction density and 191 N/m^2 (40 lbf/ft^2) uniform and 4.45 x 10^5 N (50-ton) concentration at any point.	≥ 1.98 m (6.5-ft) earth cover @ maximum compaction density and 191 N/m^2 (40 lbf/ft^2) uniform and 4.45 x 10^5 N (50-ton) concentration at any point.	≥ 1.98 m (6.5-ft) earth cover @ maximum compaction density and 191 N/m^2 (40 lbf/ft^2) uniform and 4.45 x 10^5 N (50-ton) concentration at any point.	≥ 1.98 m (6.5-ft) earth cover @ maximum compaction density and 191 N/m^2 (40 lbf/ft^2) uniform and 4.45 x 10^5 N (50-ton) concentration at any point.	≥ 1.98 m (6.5-ft) earth cover @ maximum compaction density and 191 N/m^2 (40 lbf/ft^2) uniform and 4.45 x 10^5 N (50-ton) concentration at any point.	≥ 1.98 m (6.5-ft) earth cover @ maximum compaction density and 191 N/m^2 (40 lbf/ft^2) uniform and 4.45 x 10^5 N (50-ton) concentration at any point.
Maximum Radiation	0.5 mRad/h based on 1.6 x 10^3 Ci of 137 Cs/m^3 (6 Ci of ^{137}Cs/gal)	1 mr/h dose rate based on 1.6 x 10^3 Ci of 137 Cs/m^3 (6 Ci of ^{137}Cs/gal)	1 mr/h dose rate based on 1.6 x 10^3 Ci of 137 Cs/m^3 (6 Ci of ^{137}Cs/gal)	1 mr/h dose rate based on 1.6 x 10^3 Ci of 137 Cs/m^3 (6 Ci of ^{137}Cs/gal)	--	--	--
Maximum Heat Generation	29,300 W (100,000 Btu/h)	29,300 W (100,000 Btu/h)	29,300 W (100,000 Btu/h)	29,300 W (100,000 Btu/h)	14,650 W (50,000 Btu/h)	--	--

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ARH-1437, 1970, *Design Criteria – Purex AZ Tank Farm*, Atlantic Richfield Hanford Company, Richland, Washington.

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ASME Boiler and Pressure Vessel Code, Section VIII, American Society of Mechanical Engineers, New York, New York.

CPS-T-149-00010, Criticality Prevention Specification.

DOE Order 5820.2A, 1988, *Radioactive Waste Management*, U.S. Department of Energy, Washington, D.C.

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DOE/RL-96-109, 1999, *Hanford Radiological Control Manual,* Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

HNF-2317, 1998, *Project W-320 High Vacuum 241-AY-102 Annulus Ventilation System, Operability Test Report*, Rev. 0, Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-IP-1266, 1999, *Tank Farms Operations Administrative Controls,* Rev. 2, DE&S Hanford, Incorporated, for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-WM-HSP-002, 1999, *Tank Farms Health and Safety Plan,* Rev. 3B, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-WM-SAR-067, 1999, *Tank Waste Remediation System Final Safety Analysis Report,* Rev. 1, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-WM-TRD-007, 1998, *System Specification for the Double-Shell Tank System*, Rev. E, COGEMA Engineering Corporation, Numatec Hanford Corporation, and TRW for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-WM-TSR-006, 1999, *Tank Waste Remediation System Technical Safety Requirements,* Rev. 1-B, Fluor Daniel Hanford Inc., Richland, Washington.

NFPA 70, 1999, *National Electrical Code*, articles 500 and 501, National Fire Protection Association, Quincy, Massachusetts.

NFPA 77, 1993, *Static Electricity*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 496, 1998, *Purged and Pressurized Enclosures for Electrical Equipment,* National Fire Protection Association, Quincy, Massachusetts.

OSD-T-151-00007, 1997, *Operating Specifications for the 241-AN, AP, AW, AY, AZ & SY Tank Farms,* Rev. H-19, Fluor Daniel Hanford, Inc., Richland, Washington.

OSD-T-151-00008, 1994, *Operating Specifications for the 204-AR Waste Unloading Facility*, Rev. E-2, Fluor Daniel Hanford, Inc., Richland, Washington.

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WHC-SD-TWR-RPT-002, 1996, *Structural Integrity and Potential Failure Modes of Hanford High-Level Waste Tanks,* Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-WM-ER-556, 1996, *Double-Shell Tank Useful Life Analysis,* Rev. 0, Westinghouse Hanford Company, Richland, Washington.

APPENDIX B

RECOMMENDED CHANGES TO THE DOUBLE-SHELL TANK SYSTEM SPECIFICATION REVISION D, APRIL 1998

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APPENDIX B

RECOMMENDED CHANGES TO THE DOUBLE-SHELL TANK SYSTEM SPECIFICATION REVISION D, APRIL 1998

As a result of reviewing specific DST System engineering-basis documentation, the following changes to the DST System specification (HNF-SD-WM-TRD-007, Rev. D, April 1998) are recommended. New DST System specification text is shown in *italics*.

1. TANK WASTE COMPOSITION/CORROSION.

Delete the existing DST tank waste storage composition requirements contained in Section 3.3.6.2.2, page 44. Rewrite Section 3.3.6.2.1, page 43, as two paragraphs (see below). For rationale, reference Appendix A of this document regarding OSD-T-151-00007, Section 7.2.1, and OSD-T-151-00017, Sections 17.4.1.1.3 and 17.4.1.1.4.

3.3.6.2.1 Corrosion Prevention and Control. *The system shall incorporate corrosion prevention and control features in accordance with WAC 173-303-640(3).*

3.3.6.2.1.1 Allowable DST Corrosion. *The maximum allowable corrosion for each primary Double Shell Tank steel liner shall be less than or equal to 1.3 mm (0.050 in.) (TBR) over the life of the tank.*

It is further recommended that:

a. Assessment of the existing system against this requirement verify tank integrity through the end of Phase 1

b. Chemical composition limits be maintained in the OSDs as one selected means for achieving this requirement

c. Consider also changing the design life requirement for the system (Section 3.2.5.2.1, page 41) to cover only the Phase 1 time period

d. Consider changing the title of section 3.3.6.2 from "System Safety" to "Equipment Protection" to reduce confusion in expectations about this section.

2. HYDROSTATIC HEAD/TANK PRESSURE.

Add a requirement to the System Safety Section 3.3.6.2, limiting pressures between tank structures and the atmosphere. For rationale, reference Appendix A of this document regarding OSD-T-151-00007, Section 7.2.3.

3.3.6.2.x DST Pressure Limits. *The system shall maintain existing DSTs within the following pressure limits:*

Secondary Tanks:

- -508 mm (20 in.) ≤ tank pressure ≤ +1524 mm (60 in.) water gauge (AP, AY farm)
- -152 mm (6 in.) ≤ tank pressure ≤ +1524 mm (60 in.) water gauge (AN, AW, SY, AZ farms)

Primary Tanks:

- -152 mm (6 in.) ≤ tank pressure ≤ +1524 mm (60 in.) water gauge (AP, AN, AW, SY, AY*, AZ* farms)

*See HNF-2317 for exceptions to –152 mm (6 in.) water gauge requirements for AY, AZ farms.

3. DOME LOADING.

Replace Section 3.3.6.2.4, page 44, with the requirement below. For rationale, reference Appendix A of this document regarding OSD-T-151-00007, Section 7.2.4 and OSD-T-151-00017, Sections 17.2.4 and 17.2.5.

3.3.6.2.4 Dome Loading. *Maximum dome loading on existing DSTs shall be in accordance with HNF-IP-1266,* Tank Farms Operations Administrative Controls.

4. TEMPERATURE LIMITS.

Replace Section 3.3.6.2.3, page 44, with the requirements listed below. For rationale, reference Appendix A of this document regarding OSD-T-151-00007, Sections 7.2.6 and 7.2.7, and OSD-T-151-00017, Sections 17.2.6 and 17.4.5.

3.3.6.2.3 Tank Temperature Limits. The system shall maintain waste temperatures in each DST with the limits specified in Table 3-14.

Table 3-14. Double-Shell Tank Temperature Limits. (2 sheets)

VARIABLE	*LIMITS*
Waste Temperature in Tanks	*≤ 99 °C (210 °F) (AP)* *≤ 124 °C (250 °F) (SY)* *≤ 187 °C (350 °F) (AN, AW, AY, AZ)*
Rate of Temperature Change for Waste and Concrete	*For temperature < 78 °C (125 °F) (all farms)* *≤ 6.25 °C/h (10 °F/h) (TBR)* *For temperature ≤ 78 °C (125 °F) (AP, AN, AW, SY)* *≤ 12.5 °C/day (20 °F/day) (TBR)*

Table 3-14. Double-Shell Tank Temperature Limits. (2 sheets)

VARIABLE	*LIMITS*
	For temperature ≤ 78 °C (125 °F) (AY, AZ) ≤ 1.9 °C/day (3 °F/day) or *≤ 15 °C/day (24 °F/day) provided the tank is kept ≤ 1.9 °C/day (3 °F/day) for 8 consecutive days thereafter. (TBR)*
Concrete Temperature	*≤ 116 °C (236 °F) (all DST Farms)*
Concrete Temperature Gradient	*≤ 0.72 °C/cm (35 °F/ft) (AP, AW, AN, SY)* *≤ 0.37 °C/cm (18 °F/ft) (AY, AZ)*
Temperature Gradients of Waste in Tanks (waste and waste/vapor interface)	*≤ 113 °C/m (55 °F/ft) (all DST farms)*

5. 204-AR WASTE UNLOADING FACILITY FISSILE MATERIAL LIMITS

Replace the limit in Table 3-10, item 5, for fissile material (page 35) with "*HNF-IP-1266, Section 5.7.*" For rationale, reference Appendix A of this document regarding OSD-T-151-00008, Section 8.2.3.

6. DOUBLE-SHELL TANK HYDROSTATIC LOAD

Add a new limit to the DST System specification for tank hydrostatic load as specified below. For rationale, reference Appendix A of this document regarding OSD-T-151-00017, Section 17.2.3.

3.3.6.2.x Tank Hydrostatic Load. *The system shall not exceed hydrostatic loads internal to existing DSTS within the limits specified in Table 3-x.*

Table 3-x. Existing Double-Shell Tank Hydrostatic Load Limits

Tank Farm	*Hydrostatic Load*
AN	*Maximum hydrostatic load as exerted by 4410 m^3 (1.16 Mgal) of fluid @ 1.7 sp. gr. and a depth of 10.7 m (422 in.)*
AW	*Maximum hydrostatic load as exerted by 4410 m^3 (1.16 Mgal) of fluid @ 1.7 sp. gr. and a depth of 10.7 m (422 in.)*
AP	*Maximum hydrostatic load as exerted by 4410 m^3 (1.16 Mgal) of fluid @ 2.0 sp. gr. and a depth of 10.7 m (422 in.)*
SY	*Maximum hydrostatic load as exerted by 4330 m^3 (1.14 Mgal) of fluid @ 1.7 sp. gr. and a depth of 10.7 m (422 in.)*
AY	*Maximum hydrostatic load as exerted by 3790 m^3 (0.998 Mgal) of fluid @ 1.22 sp. gr. and a depth of 9.25 m (364 in.)*
AZ	*Maximum hydrostatic load as exerted by 3790 m^3 (0.998 Mgal) of fluid @ 1.22 sp. gr. and a depth of 9.25 m (364 in.)*

7. CRITICALITY PREVENTION

Replace the text of Section 3.3.8.1 for criticality safety as stated below. For rationale, reference Appendix A of this document regarding OSD-T-151-00017, Section 17.4.1.1.1.

3.3.8.1 Criticality Safety. *The system shall store radionuclides in a manner that prevents criticality in accordance with HNF-IP-1266, Section 5.7.*

8. FLAMMABLE GAS

a. Replace the text of Section 3.3.6.3.7, page 45, as stated below. For rationale, reference Appendix A of this document regarding OSD-T-151-00017, Section 17.5.

3.3.6.3.7 Flammable Gas Ignition Controls. *The portions of the system within the tanks that contact waste shall be designed and operated in accordance with the requirements of NFPA 70 (for Class 1, Division 1, Group B), NEC Articles 500 and 501, NFPA 77, and NFPA 496 (Type X). The portions of the system within the tank vapor space that do not contact the waste shall be designed and operated in accordance with the same codes and standards, except that Class 1 Division 2, Group B applies (NFPA 70) and Type Z (NFPA 496).*

b. Add a new constraint to Section 3.3.6.3 of the DST System specification for flammable gas limits. For rationale, reference Appendix A of this document regarding HNF-SD-WM-TSR-006, Section 3.2.1.

3.3.6.3.x Flammable Gas Limits. *The DSTs shall be actively ventilated to limit the build-up of flammable gases to less than 25 percent of the lower flammability limit.*

9. EXCESS STORAGE CAPACITY

Add a new constraint to Section 3.3.1.x for excess storage capacity as stated below. For rationale, reference Appendix A of this document regarding OSD-T-151-00017, Section 17.8.

3.3.1.x Excess Storage Capacity. *The system shall provide storage capacity beyond that required to perform the Phase 1 mission in accordance with DOE Order 5820.2A Chapter I, Para. 3.b.(4)(d).*

10. SAFETY SECTION

Delete all text under the 3.3.6 Safety heading (not including the heading itself or the numbered subparagraphs). This is just a heading title for this section. The text currently there instructs the reader to interpret that section in light of the Basis for Interim Operation (BIO). However, given the results of this review, the BIO is no longer a reference for system design requirements. The BIO governed operation of the current DST System and should not be used to constrain future design changes needed to achieve the RPP mission. Furthermore, the BIO has been superceded by HNF-SD-WM-SAR-067, *Tank Waste Remediation System Final Safety Analysis Report* (FSAR). The requirements of the safety section of the DST System specification will drive design requirements for the Phase 1 system. As necessary, the FSAR will be changed to reflect Phase 1B system design changes.

OTHER CHANGES NOT RESULTING DIRECTLY FROM THE OSD REVIEW

11. TABLE 3-10 VALUE

Change the 0.1M limit on item 1 to 1.0M. The table repeated a typographical error in the OSD. A pH = 14 is equivalent to a molarity of 1.0 for OH.

12. TRUCK TRANSFER OF WASTE DIRECT TO A DOUBLE-SHELL TANK

Add Section 3.2.3.1.b as stated below. As part of the operational concept, external waste generators may be allowed to dump waste directly into a tank from a truck. The DST System specification needs to specify waste requirements for such a transfer.

b. ***Properties of Waste for Direct Tank Input.*** *The system shall provide the capability to accept waste from external waste generators via direct transfer from a transport truck into a tank.*

REFERENCES

DOE Order 5820.2A, *Radioactive Waste Management.*

HNF-2317, 1998, *Project W-320 High Vacuum 241-AY-102 Annulus Ventilation System, Operability Test Report*, Rev. 0, Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-IP-1266, 1999, *Tank Farms Operations Administrative Controls,* Rev. 2, DE&S Hanford, Incorporated, for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-WM-SAR-067, 1999, *Tank Waste Remediation System Final Safety Analysis Report*, Rev. 1, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-WM-TRD-007, 1998, *System Specification for the Double-Shell Tank System*, Rev. E, COGEMA Engineering Corporation, Numatec Hanford Corporation, and TRW for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-WM-TSR-006, 2000, *Tank Waste Remediation System Technical Safety Requirements,* Rev. 1-B, Fluor Daniel Hanford Inc., Richland, Washington.

NFPA 496, 1998, *Purged and Pressurized Enclosures for Electrical Equipment,* National Fire Protection Association, Quincy, Massachusetts.

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OSD-T-151-00007, 1997, *Operating Specifications for the 241-AN, AP, AW, AY, AZ & SY Tank Farms,* Rev. H-19, Fluor Daniel Hanford, Inc., Richland, Washington.

OSD-T-151-00008, 1994, *Operating Specifications for the 204-AR Waste Unloading Facility*, Rev. E-2, Fluor Daniel Hanford, Inc., Richland, Washington.

OSD-T-151-00017, 1997, *Operating Specifications for Aging Waste Operations in 241-AY and 241-AZ*, Rev. D-10, Fluor Daniel Hanford, Inc., Richland, Washington.

WAC 173-303-640, 1999, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

APPENDIX C

EVALUATION OF THE OPERATIONAL BASIS LIMITS ON DOUBLE-SHELL TANKS BASED O N STRUCTURAL ANALYSIS DOCUMENTATION

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COGEMA
ENGINEERING CORP.

April 16, 1998

COGEMA-98-311

Mr. T. J. Conrads
Numatec Hanford Corporation
Post Office Box 1300 MSIN H5-25
Richland, Washington 99352

Dear Mr. Conrads:

EVALUATION OF THE OPERATIONAL BASIS LIMITS ON DOUBLE-SHELL TANKS BASED ON STRUCTURAL ANALYSIS DOCUMENTATION

The purpose of this evaluation is to review the basis documents that support the operating limits placed on the double shell tanks and to identify the analyses that could be used to increase these limits. The review of the supporting analysis for the operational limits of the double-shell tanks (DST) due to structural limitations raises some issues related to the completeness and accuracy of the analyses and the resulting limits. The attached list shows the basis documents that are used in defining the operating limits. The issues related to these baseline documents are defined as follows for the various tank groups:

AP — The AP tank analyses are the most recently completed relative to the thermal loading. The limits imposed by Vollerts' analysis in SD- RE-TI-008 utilized the tank vendor analysis (United States Steel, American Bridge Division) results for the AP tank. This analysis did not consider the long term thermal/creep deflections from thermal creep analyses or compare to the defined values in the design specification. The design specification values should be compared to the current analyses to assure conservatism was used in the analysis or to seek relief from the imposed temperature limitation of 210°F in the primary steel tank wall. The analyses appear to be an incomplete assessment of the temperature and thermal effects. Additionally, the deflections plots presented in the thermal/creep analyses completed by Rashid are not consistent with the mechanical response expected from the tanks under creep. The Rashid analyses assessed the thermal/creep and cyclic degradation of the AN, AP and AW tanks.

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AN/AW — The same analytical approach used by Vollert, to reduce the tank wall stress in the AP tanks by limiting the temperature to 210°F, was not applied to the AW tanks. Due to the similarity in design and construction, it is assumed that the same restrictions would apply. The assumptions should be validated and the vendor and design analysis reports should be reviewed in detail to assure that the crossover of operational limits in these two tank farms is acceptable. These assumptions were also used in WHC-SD-WM-ER-126, *Structural Integrity Evaluation of 241-AW-Tank Farm Dangerous Waste Storage Waste Facilities.*

AY/AZ — The main analysis supporting the operating parameters for the AY/AZ tanks has several improper analytical assumptions that require resolution. This analysis (SD-RE-TI-041) completed in 1983 used the models from the AP and AW analyses. The primary tank analysis did not consider the resulting displacements from the long term thermal/creep analysis. The long term thermal/creep analysis of the concrete secondary tank structure utilized an improper load factoring method that resulted unconservatively larger ultimate load capacities and errant modeling methods that resulted in upward displacement of the tank dome under load application. Additionally, the creep analysis was not reviewed or checked for accuracy. Page 78 of SD-RE-TI-008, Rev.4, which is used as the basis for greater heat up rates for the concrete, refers to an older 1968 analysis, instead of the thermal/creep analyses being completed during the time of release of the letter. Vollerts' judgement for the increased heat up rates stated in pages 18 through 24 of the same document do not have an analytical basis and are inconsistent with the thermal/creep analyses being completed at that time. There is no subsequent analysis to justify these high rates.

SY — The most recent SY analysis by Giller (WHC-SD-WM-DA-087) utilizes the completed high temperature concrete test data. The high temperature concrete computer analysis code, ANACAP2D, utilized in Gillers' analysis for the increased fluid level, was newly developed but never verified or validated. The results from the analysis are consistent with previous analyses. The lower operating temperature limits (250°F) of the waste greatly reduce the resulting stresses in the primary tank. Additionally at these lower temperatures, the thermal creep effects on the concrete secondary tank structure are minimal.

In summary, the analyses that define the bases for the double-shell tank operating parameters are inconsistent. Historically, several efforts have been started to establish a consistent basis for operation for each of the tank farm facilities. The convoluted combination of results from one

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tank farm analysis being applied to another tank farm has created uncertainties with respect to demonstrating structural integrity of the Hanford tank farms under the varied operational, historical and projected natural phenomena loading.

The conservative values for the current operating basis should be used in defining the low level waste operating parameters. Any utilization of the original analyses as a basis for altering or expanding the parameters should be cautiously applied. A proper compilation of the existing analyses and thorough review and comment of their adequacy by experienced, competent, qualified structural analysts is recommended.

If you have any other questions related to this review, please feel free to contact me at 376-5152.

Sincerely,

Mark A. Scott, P.E., S.E.

MAS:cmh

cc:	M. A. Delamare (NHC)	H5-61
	W. J. Powell (LMHC)	S5-13
	L. A. Stauffer (LMHC)	R2-11

Attachment

ATTACHMENT
DOUBLE SHELL TANK LIMITS
FOR
TEMPERATURE, VOLUME and SPECIFIC GRAVITY

TANKS	TEMPERATURE T_{MAX}	ΔT_{MAX}	VOLUME Ht. of Liq.	SpG	REFERENCES	COMMENTS
AN	210° F[1]		1.16 Mgal	1.7		All references appear to group AN with AW.
	200° F Wall 300° F Cont	3°F/day	1.0 Mgal	2.0	WHC, Pfluger, 1990 WHC-SD-WM-WP-066	Structural Integrity Assessment
AP	300°F[1]	3°F/day	1.16 Mgal	2.0	VITRO/Chang, 1981	The concrete thermal creep analysis refers to RHO-C-17.
	236°F[2]		422 inches		VITRO-R-730	
	300°F[1] 258°F[2]	3°/day to 212°F[2] 5°/day To 258°F[2]	1.16 Mgal	2.0	KEH/Chang, 1982 KEH-R-82-21	
	210°F[1]	NA	1.16 Mgal	2.0	RHO/Vollert, 1985 SD-RE-TI-008, pg70	
	200° F Wall	20°F/day	1.16 Mgal	2.0	2.0WHC, Pfluger, 1990	This Integrity Assessment Plan utilizes SD-RE-TI-008 and the 1986 DST SAR as the basis for limits.
	300° F Cont	>125°F 10°F/Hr <125°F			WHC-SD-WM-WP-089	This document does not identify the reference source

ATTACHMENT
DOUBLE SHELL TANK LIMITS FOR TEMPERATURE, VOLUME and SPECIFIC GRAVITY

TANKS	TEMPERATURE T_{MAX}	TEMPERATURE ΔT_{MAX}	VOLUME Ht. of Liq.	SpG	REFERENCES	COMMENTS
AW	350°F[1]	NA	1.00 Mgal	2.0	URS/Blume, 1976	This structural evaluation for the proposed AW Tanks did not assess the effects on the concrete secondary: only effects on the primary steel shell were assessed.
			363 inches		ARH-R-218	
	350°F[1]	3°F/day	1.0 Mgal	2.0	URS/Blume, 1976	The concrete thermal creep analysis utilizes the preliminary hi-temp data. The follow on work should be utilized for correct concrete behavior.
			363 inches		ARH-R-219	
			1.0 Mgal 363 inches		American Bridge, 1978 RHO-R-18	Primary tank analysis only.
			1.0 Mgal 363 inches		American Bridge, 1980 RHO-R-19	Primary tank analysis only.
	236°F[2]	3°F/day	1.00 Mgal 363 inches	2.0	URS/Blume, 1978 RHO-C-17	
	236°F[2]	3°F/day	1.16 Mgal 422 inches	1.7	URS/Blume, 1981 RHO-C-60	

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DOUBLE SHELL TANK LIMITS
FOR
TEMPERATURE, VOLUME and SPECIFIC GRAVITY

TANKS	TEMPERATURE T_{MAX}	ΔT_{MAX}	VOLUME Ht. of Liq.	SpG	REFERENCES	COMMENTS
AW (Cont)	210°F[1]L 300°F[1]S	5°F/day	1.16 Mgal 422 inches	1.7	WHC/Karwoski WHC-SD-WM-ER-126	Structural Integrity Assessment No basis for 5°F/day defined.
AY	350°F[1]	3°F/day	.998 Mgal 364 inches	1.22[4]	RHO/Vollert, 1982 SD-RE-TI-041:	It should be noted that the structural analysis of the primary shell used the AP analysis as the basis. The tank sidewall temperatures were evaluated at 260°F with the sludge at 380°F in the bottom 18 inches.
AZ	350° F[1]	3°F/day 7yrs	.998 Mgal 364 inches	1.22[4]	RHO/Vollert, 1982 SD-RE-TI-041:	It should be noted that the structural analysis of the primary shell used the AP analysis as the basis. The tank sidewall temperatures were evaluated at 260°F with the sludge at 380°F in the bottom 18 inches.
SY	250° F[1]	6°F/day	1.0 Mgal 363 inches	1.7	URS/Blume, 1974 ARH-R-172	The thermal creep analysis is primitive compared to the follow on analyses. It is also only steady state once at temperature with no thermal cycling, which caused the lower rates in the follow on analyses.

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DOUBLE SHELL TANK LIMITS
FOR
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TANKS	TEMPERATURE T_{MAX}	ΔT_{MAX}	VOLUME Ht. of Liq.	SpG	REFERENCES	COMMENTS
SY (Cont)	250° F[1]	6°F/day	1.14 Mgal 422 inches	1.7	URS/Blume, 1981 RHO-C-59	This analysis refers to ARH-R-172 for the thermal/creep analysis of the concrete.
	250° F[1]		1.14 + Mgal 450 inches	1.7	WHC/Giller, 1991 WHC-SD-WM-DA-087	The computer program this was not verified or validated prior to the completion of the analysis.

1 Waste Temperature
2 Concrete Temperature
3 Primary Tank Temperature
4There is a letter in the EM-TF-071 file that states the AY/AZ tanks can take a Sp. Gr. of 2.0, however the supporting analysis package present has not been prepared or reviewed. The file does contain the computer I/O file.

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