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Status Report for Inactive Miscellaneous Underground Storage Tanks at Hanford Site 200 Areas

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

Westinghouse
Hanford Company Richland, Washington

Management and Operations Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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T. B. Powers

Date Published
October 1995

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**STATUS REPORT FOR
INACTIVE MISCELLANEOUS UNDERGROUND
STORAGE TANKS AT HANFORD 200 AREAS**

EXECUTIVE SUMMARY

The purpose of this status report is to summarize updated data and information from the FY 1994 strategy plan that is associated with inactive miscellaneous underground storage tanks (IMUSTs). One aspect of the updated information is that 13 IMUSTs were officially added since the FY 1994 strategy plan was published, but there is also a list of unverified potential additional IMUSTs. Assumptions and processes to assess potential risks and operational concerns are documented in this report. Safety issue priorities are ranked based on a number of considerations, including risk ranking and cost effectiveness.

Sixty-three IMUSTs have been identified and placed on the official IMUST list as of this report. All the tanks are associated with past Hanford Site operations. Of the 63 tanks, 19 are catch tanks, 20 are vault tanks, 3 are neutralization tanks, 8 are settling tanks, 2 are solvent makeup tanks used to store hexone, 2 are flush tanks, 3 are decontamination tanks, 1 is a diverter station, 1 is a receiver tank, 1 is an experimental tank, and 3 are waste handling tanks. Waste in the 63 IMUSTs represents approximately 1 percent of the total waste in the existing 149 single-shell tanks (SSTs) and 28 double-shell tanks (DSTs). It is important to proactively deal with the risks imposed by these 63 tanks, and at the same time not jeopardize the existing commitments and schedules for mitigating and resolving identified safety issues related to the 177 SSTs and DSTs. Access controls and signs have been placed on all but the three official IMUSTs added most recently. An

accelerated effort to identify authorization documents and perform unreviewed safety question (USQ) screening has been completed.

According to a set of criteria consistent with the safety screening data quality objective (DQO) process, 6 IMUSTs are ranked high related to the hydrogen generation potential safety issue, 1 is ranked high related to the ferrocyanide potential safety issue, 6 are ranked high related to the flammability potential safety issue, and 25 are ranked high related to the vapor emissions potential safety issue.

The proposed ownership of the 63 IMUSTs is categorized as follows: 17 IMUSTs to Environmental Remediation function, 36 IMUSTs to Tank Waste Remediation System, 1 IMUST to Plutonium Finishing Plant, and 9 IMUSTs in process of resolution.

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LIST OF TERMS

μ Ci	microcurie
Btu/hr	British thermal units per hour
Ci	curie
CSER	criticality safety evaluation report
DBP	dibutyl phosphate
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DQO	data quality objective
DST	double-shell tank
FY	fiscal year
HLW	high-level waste
IMUST	inactive miscellaneous underground storage tank
OC	operational concern
SAR	safety analysis report
SI	safety issue
SST	single-shell tank
TBP	tributyl phosphate
TOC	total organic carbon
TRU	transuranic [waste]
TWRS	Tank Waste Remediation System
USQ	unreviewed safety question
WHC	Westinghouse Hanford Company
WT	waste type
wt%	weight percent

METRIC CONVERSION TABLE

To convert from	Multiply by	To obtain
gallons	3.785	liters
feet	0.3048	meters
Btu/hr	0.0002928	kilowatt-hours

1.0 INTRODUCTION

1.1 PURPOSE

There are 63 official inactive miscellaneous underground storage tanks (IMUSTs) located in the 200 East and 200 West areas on the Hanford Site. The purpose of this status report is to summarize updated data and information from the FY 1994 strategy plan (Wang and Powers 1994) that is associated with inactive miscellaneous underground storage tanks (IMUSTs). One aspect of the updated information is that 13 official IMUSTs were added to the 50 IMUSTs reported in the FY 1994 strategy plan. The 13 additional IMUSTs are 276-S-141, 276-S-142, 241-ER-311A, 241-AX-151, 241-TY-201, 216-BY-201, 242-TA-R1, 242-T-135, 243S-TK-1, 213-W-TK-1, 216-BC-201, 292T-TK-1, and 292T-TK-2. This report documents efforts in collecting historical data, searching for authorization documents, performing unreviewed safety question (USQ) screening and evaluation, identifying safety issues, and imposing operational controls and monitoring. The efforts were prioritized based on a number of considerations, including risk ranking and cost effectiveness.

1.2 BACKGROUND

The IMUSTs were used in the past for the following functions associated with plutonium and uranium separations and waste management activities in the 200 East and 200 West areas of the Hanford Site:

- Settling solids before disposal of supernate in cribs and a reverse well
- Neutralizing acidic process wastes before crib disposal
- Receiving and processing of single-shell tank waste for uranium recovery operations
- Collecting water that intruded into diversion boxes and transfer pipeline encasements and any leakage that occurred during waste transfer operations
- Storing hexone from S-Plant (REDOX)
- Receiving flush and decontamination solutions
- Diverting flow streams
- Waste handling and process experimentation.

Most of the IMUSTs contain some amount of wastes and are interim isolated and interim stabilized. Interim isolated means the tanks are isolated from facilities by sealing all inlet and outlet connections to the tanks. Interim stabilized means that all liquid that is technically and economically practical to remove has been removed.

To gain a proper perspective related to the priority the miscellaneous tanks should have, it is important to consider the comparison of nominal capacities and the volume of solids and liquids between the 149 single shell tanks (SSTs) and the IMUSTs as represented in Figure 1-1. The IMUSTs contain wastes that are similar in composition to those in the single-shell tanks (SSTs) and therefore the risks are believed to be bounded by the safety analyses for the SSTs. The sum of the nominal capacities of SSTs is 94.1 million gallons, whereas the sum of the nominal capacities for the IMUSTs is only about 1.3 million gallons. Thus, the IMUSTs have approximately 1 percent of the nominal capacity of the SSTs.

The SSTs contain 35.6 million gallons of solids and 0.6 million gallons of supernate liquids, whereas the IMUSTs contain about 0.2 million gallons of solids and about 0.04 million gallons of supernate liquids, not including volumes in the sumps of the vaults. The additional volume of solids and liquids in sumps is about 0.04 million gallons. Thus, the IMUSTs have approximately 0.6 percent and 7 percent of the SST solids and supernate liquids, respectively. If the volume of waste in the sumps is included, the waste in IMUST structures is 0.8 percent of the total waste volume in SSTs. Therefore, the priority of addressing the IMUSTs should not impact major commitments associated with the 177 DSTs and SSTs unless some IMUST has a safety issue that potentially presents a legitimate safety concern.

1.3 SUMMARY

This status report has been developed to document updated data and information related to the IMUSTs. Methods for prioritizing the IMUSTs according to potential safety issues and associated tasks are discussed.

This report (WHC-EP-0861) is referred to in the following text as the status report. The IMUST report published in September of 1994 (WHC-EP-0775) that addressed the strategy for dealing with the first 50 IMUSTs is referred to in the following text as the strategy plan (Wang and Powers 1994). The engineering study that was performed by Golder & Associates and that identified the first 50 IMUSTs (WHC-SD-EN-ES-040) is referred to in the following text as the engineering study (WHC 1994a).

Figure 1-1. Comparison of Waste Volumes Between SSTs and IMUSTs.

177 SST & DST Tanks

125.9 Million Gallons Capacity

40.4 Million Gallons Solids

21.3 Million Gallons Supernate

149 SST Tanks

94.1 Million Gallons Capacity

35.6 Million Gallons Solids

0.6 Million Gallons Supernate

MUST Tanks

<u>1.3 Million Gallons Capacity</u>	≈ 1.0% of SSTs
<u>0.2 Million Gallons Solids</u>	≈ 0.6% of SSTs
<u>0.04 Million Gallons Supernate</u>	≈ 7.0% of SSTs

Section 2.0 discusses the prioritization process of the potential safety issues and operational concerns. The criteria for prioritization and the priorities are discussed in this section. Section 3.0 describes the status of major task activities related to the IMUSTs. Section 4.0 lists proposed ownership of the IMUSTs. Section 5.0 is the reference section for the main body of the report. Appendix A discusses the bases for various Priority 1 safety issue criteria. Appendix B discusses the bases for various Priority 2 safety issue criteria. Appendix C discusses the bases for leak potential (Priority 3 safety issue) criteria. Appendix D discusses the bases for radiological hazards (operational concern) criteria. Appendix E lists the justification for the priority ranking for each IMUST on a potential safety issue or operational concern basis. Appendix F lists those tanks that were initially considered as potential IMUSTs but were evaluated as not meeting the criteria for being an IMUST. Appendix G is a copy of a letter report that documents a list of potential additional IMUSTs that have not been reviewed and verified as of this publication.

A notation is made here that there are some tank name differences between this status report and the engineering study and the strategy plan. The tank names in this status report have been verified as the correct names. The following table shows the names used previously in the engineering study and the strategy plan versus the correct names that are used in this status report.

Previously-used IMUST tank name	Correct IMUST tank name
241-B-301	241-B-301B
241-C-301	241-C-301C
241-TX-302XB	241-TX-302X
241-TX-302BR	241-TX-302B(R)
216-BY	216-BY-201
244-WR VAULT	241-WR VAULT
241-T-301B	241-T-301
241-ER-311	241-ER-311A

2.0 PRIORITIZATION OF IMUSTS

An engineering study (WHC 1994a) compiles all available information on the initial 50 inactive miscellaneous underground storage tanks and evaluates the information to determine the following:

- Potential safety issues in the current configuration
- Data needs and recommendations for resolving these issues
- Potential methods of monitoring the tanks and characterizing wastes
- Priorities for resolving safety issues and/or investigation and closure (or remediation) of the tanks
- Other operational concerns.

The engineering study prioritizes the initial 50 IMUSTs according to the risks associated with the various potential safety issues. The criteria for the priorities in the engineering study are not quantitatively defined, and thus the priorities are assumed to be based on subjective judgment. A quantitative approach to developing priorities is developed in the strategy plan and repeated in this status report. This approach results in some differences in priorities from the engineering study.

The original identification and prioritization of Hanford Site high-level waste tank safety issues was based on criteria specified by the U.S. Department of Energy (DOE) (Duffy 1990). These criteria are qualitative in nature and are quoted below as background information for the quantitative criteria discussed in Section 2.1.

<i>Priority 1</i>	Issues/situations that contain <u>most</u> necessary conditions that could lead to worker (onsite) or offsite radiation exposure through an uncontrolled release of fission products (e.g., tank 101-SY).
<i>Priority 2</i>	Issues/situations that have presented (or contain) <u>some</u> conditions that could lead to an uncontrolled release of fission products under extreme assumptions (e.g., ferrocyanide* or seismic issues).
<i>Priority 3</i>	Issues/situations that could lead to the future release of fission products if tanks are viewed as intermediate storage (5 to 30 years) of high-level waste (HLW) (e.g., corrosion/leakage, operating practices, buried single-wall transfer lines).

*Westinghouse Hanford Company has prioritized potential explosive mixture of ferrocyanide in tanks as Priority 1.

The italicized word 'Priority' was added to the quote for clarification purposes.

The Priority 1 safety issues are hydrogen generation, ferrocyanide* reactivity, organic salt reactivity, and high heat generation. The Priority 2 safety issues are criticality, flammable gases, and noxious vapors. The only Priority 3 safety issue considered is tank leakage.

The additional 13 IMUSTs that were identified and verified in FY 1995 are prioritized in this revision according to the risks associated with the various potential safety issues, considering that there is not much information on the tanks' waste contents.

2.1 QUANTITATIVE PRIORITIZATION FOR ASSESSING SAFETY ISSUES

The quantitative approach in developing priorities of potential safety issues for each IMUST was based on the data provided in the engineering study (WHC 1994a). Existing numerical criteria (same as in the safety screening DQO [Babad 1994]) served as the basis for the following potential safety issues: hydrogen generation and buildup, ferrocyanide reactivity, organic salt reactivity, criticality, and flammability. A change in the DQO criteria for total organic carbon related to organic salt reactivity is referenced in FAI/94-103 (Fauske & Associates 1995).

The following is a listing of the IMUSTs that are considered empty of waste (but may contain radionuclide contamination) for this prioritization assessment:

- 241-S-302B
- 241-TY-302B
- 241-CX-70
- 244-UR-004
- 241-WR-001
- 241-WR-002
- 241-WR-003
- 241-WR-004
- 241-WR-005
- 241-WR-005, sump
- 241-WR-006
- 241-WR-007
- 241-WR-008

All IMUSTs should be examined to verify whether the tank is empty before turning the tank over for closure and environmental remediation. The quantitative criteria for confirming each potential safety issue are discussed in the sections below. Criteria for a safety issue do not have to include all the necessary conditions to cause a release of fission products (otherwise it would be called an accident).

*Westinghouse Hanford Company has prioritized potential explosive mixture of ferrocyanide in tanks as Priority 1.

2.1.1 Quantitative Criteria for Priority 1 Safety Issues

2.1.1.1. Hydrogen Generation and Buildup. Hydrogen generation and buildup is a potential safety issue for the IMUSTs because radiolysis of water and other chemicals can produce hydrogen. Hydrogen can also be produced by chemical reactions not affected by radiation. If the IMUSTs are well isolated, hydrogen can build up to flammable concentrations in the tanks. Flammable concentrations of hydrogen and oxygen can be ignited if an ignition source is present. The criteria given below are less than the minimum conditions for hydrogen ignition, but they are consistent with the numerical criteria in the safety screening DQO and provide a basis for relative rankings.

The criteria for determining the priority rank of high, moderate, or low with regard to hydrogen generation and buildup as a potential safety issue are listed as follows:

Priority rank	Criterion
High	Hydrogen accumulation reaches more than 1 volume percent of the tank vapor space (25 percent of the lower flammability limit) within 10 years or less.
Moderate	Hydrogen accumulation reaches more than 1 volume percent of the tank vapor space within 10 to 25 years.
Low	A tank is either empty, or hydrogen accumulation reaches more than 1 volume percent of the tank vapor space in more than 25 years.

If there are no data to calculate hydrogen generation, and there is less than a 50 percent void space ratio, the tank is ranked moderate. If there are no data to calculate hydrogen generation, and there is greater than or equal to a 50 percent void space ratio, the tank is ranked low. If there is no data related to the amount of waste in the tank, the void space ratio is assumed to be less than 50 percent. The basis for the hydrogen generation criterion is discussed in Appendix A.1.

According to tank farm operations personnel, two tanks (241-A-302B and 241-TX-302B) are monitored daily, two tanks (240-S-302 and 241-S-302A) are monitored weekly, and one tank (241-CX-70) is monitored monthly. The monthly status report (Hanlon 1994) indicates that two tanks (241-A-302B and 241-TX-302B) are monitored for liquid level using a manual tape, and two tanks (240-S-302 and 241-S-302A) are monitored with Food Instrument Corporation level detectors in the intrusion mode. Tank 241-CX-70 is monitored with an intrusion leak detection system. Tank 241-AX-151 is monitored for liquid levels. These instruments are the only known possible spark sources for any of the 63 IMUSTs. Based on previous instrumentation failure analysis, at least one instrument component failure would be required to yield a spark

sufficient to ignite a flammable mixture of hydrogen. Some monitoring activities require opening of the tank riser; this tends to reduce the hydrogen accumulation level.

2.1.1.2 Ferrocyanide Reactivity. Ferrocyanide reactivity is a potential safety issue for the IMUSTs that were connected to the ferrocyanide process flowpath. If the right concentration of ferrocyanide compounds and a high enough temperature exist in an IMUST, an explosive chemical reaction is possible. The criteria given below are less than the minimum conditions for an explosive chemical reaction, but they are consistent with the numerical criteria in the safety screening DQO and provide a basis for relative rankings.

The criteria listed below are based on information found in WHC-EP-0691 (Postma et al. 1994). The criteria for determining the priority rank of high, moderate, or low with regard to ferrocyanide reactivity as a potential safety issue are listed as follows:

Priority rank	Criterion
High	The potential ferrocyanide content of a tank must be estimated to be at least 8 weight percent of the solids, and the more realistic calculated waste temperature must be at least 90 °C (194 °F).
Moderate	The potential ferrocyanide content of a tank must be estimated to be at least 8 weight percent of the solids, and the more realistic calculated waste temperature is less than 90 °C (194 °F).
Low	The tank is either empty or the potential ferrocyanide content of a tank must be estimated to be less than 8 weight percent of the solids.

If there are no data to estimate the ferrocyanide content, the tank is ranked moderate. The basis for these criteria is discussed in Appendix A.2.

2.1.1.3 Organic Salt Reactivity. Organic salt reactivity is a potential safety issue for IMUSTs that could contain organic salts. If the right concentration of organic salts and a high enough temperature exist in an IMUST, an explosive chemical reaction is possible. The criteria given below are less than the minimum conditions for an explosive chemical reaction, but they are consistent with the numerical criteria in the safety screening DQO and the Fauske document (Fauske & Associates 1995), and provide a basis for relative rankings.

The criteria for determining the priority rank of high, moderate, or low with regard to organic salt reactivity as a potential safety issue are listed as follows:

Priority rank	Criterion
High	The potential total organic carbon content of a tank must be estimated to be at least 4.5 weight percent of the solids and the more realistic calculated waste temperature must be above 180 °C (356 °F).
Moderate	The potential total organic carbon content of a tank must be estimated to be at least 4.5 weight percent of the solids and the more realistic calculated waste temperature must be less than 180 °C (356 °F).
Low	The tank is either empty or the potential total organic carbon content of a tank is estimated to be less than 4.5 weight percent of the solids.

If there are no data to estimate the weight percent of total organic carbon in the tank, the tank is ranked moderate. If there are indications of organics in a tank but there is not enough information to judge that there is less than 4.5 weight percent total organic carbon, then more than 4.5 weight percent total organic carbon is assumed. The basis for these criteria is discussed in Appendix A.3.

2.1.1.4 High Heat. High heat is an independent safety concern for tanks within concrete vaults (23 tanks), tanks on a concrete foundation pad (6 tanks), and tanks constructed of concrete (9 tanks). Twenty-four of the rest of the tanks are direct-buried steel tanks and one is a fiberglass tank. If the temperature of the concrete exceeds 177 °C (350 °F), the concrete could be damaged. The criteria given below are less than the minimum conditions for guaranteed concrete damage, but they provide a basis for relative rankings.

The criteria for determining the priority rank of high, moderate, or low with regard to high heat as a potential safety issue are listed as follows:

Priority rank	Criterion
High	The more realistic waste temperature calculation exceeds 177 °C (350 °F).
Moderate	The more realistic waste temperature calculation is greater than 121 °C (250 °F) but less than 177 °C (350 °F).
Low	The tank is either empty or the more realistic waste temperature calculation is less than 121 °C (250 °F).

If there are no data related to temperature, the tank is ranked moderate. A discussion related to waste temperature is in Appendix A.2.

2.1.2 Quantitative Criteria for Priority 2 Safety Issues

2.1.2.1 Criticality. Criticality is a potential safety issue for the IMUSTs that could contain fissile materials. The right concentration and amount of fissile materials in the right configuration with optimum moderation and a lack of neutron poisons in an IMUST could cause a criticality event. The criteria given below are less than the minimum conditions for a criticality event, but they are consistent with the numerical criteria in the safety screening DQO and provide a basis for relative rankings.

The criteria related to criticality are based on information in the criticality unreviewed safety question resolution report (Braun et al. 1994). The criteria are also based on the concentration of plutonium from sample analyses and the subsequent calculation of estimated total quantity of plutonium in a tank.

The criteria for determining the priority rank of high, moderate, or low with regard to criticality as a potential safety issue are listed as follows:

Priority rank	Criterion
High	The plutonium concentration is more than 2.6 grams/liter.
Moderate	The plutonium concentration is more than 1 gram/liter but less than 2.6 grams/liter.
Low	The tank is either empty or the plutonium concentration is less than 1 gram/liter.

The basis for the criticality calculations is discussed in Appendix B.1. If no sample data exist for a tank and the tank is not empty, then the tank is ranked the same as the majority of the other IMUSTs (the majority of the other IMUSTs were ranked low).

2.1.2.2 Flammability. Flammability of gas mixtures in the IMUST vapor spaces is a potential safety issue for the IMUSTs that could produce flammable gases. Flammable gases include hydrogen, ammonia, methane and other organic gases. If flammable gases are produced and build up to the optimum concentration, they can be ignited if an ignition source is present. The criteria given below are less than the minimum conditions for flammable gas ignition, but they are consistent with the numerical criteria in the safety screening DQO and provide a basis for relative rankings.

IMUSTs are ranked high, moderate, or low, in relation to the potential flammability safety issue, based on the higher rank for that tank under the hydrogen generation or the organic salt reactivity potential safety issues. It is recognized that hydrogen is a flammable gas and many of the organics forming organic salts can contribute to a flammable gas mixture. A waste temperature that is elevated above ambient is required for the organics of concern to evaporate sufficiently to form a flammable gas mixture. To be consistent with the safety screening DQO for flammable gases, data are necessary to predict 25 percent of the lower flammability limit of the

flammable gases. Because these data are not available for tanks containing organics, the rankings for organic salt tanks were used for the flammable gas evaluation. Thus, all flammable gas rankings will be represented by the higher ranking of hydrogen generation or organic salt reactivity.

2.1.2.3 Noxious Vapor Emissions. Noxious vapor emissions from IMUSTs is a potential safety issue for the IMUSTs that could produce these vapors. If enough noxious vapors are produced and released from the tank, they can produce a hazardous environment for the tank farm workers. The criteria given below are less than the minimum conditions for a noxious vapor hazardous environment, but they provide a basis for relative rankings.

The criteria for determining if vapor emission is ranked high, moderate, or low as a potential safety issue are a combination of parts of the criteria from hydrogen generation, ferrocyanide reactivity, and organic reactivity potential safety issues. Vapor emissions are related to hydrogen generation, the possible degradation of ferrocyanide compounds, and the existence of organics in the IMUSTs. Vapor emissions are related to hydrogen generation because the chemical reactions that produce hydrogen also produce noxious gases in the waste tanks. Thus, the vapor emission criteria are listed as follows:

Priority rank	Criterion
High	<p>Hydrogen reaches more than 1 volume percent of the tank vapor space within 10 years or less, or</p> <p>the potential ferrocyanide content of a tank must be estimated to be at least 8 weight percent of the solids, or</p> <p>the potential total organic carbon content of a tank must be estimated to be at least 4.5 weight percent of the solids.</p>
Moderate	<p>Hydrogen reaches more than 1 volume percent of the tank vapor space within 10 to 25 years, or</p> <p>the potential ferrocyanide content of a tank must be estimated to be less than 8 weight percent of the solids, or</p> <p>the potential total organic carbon content of a tank is estimated to be less than 4.5 weight percent of the solids.</p>
Low	A tank is either empty or hydrogen reaches greater than 1 volume percent of the tank vapor space in more than 25 years.

If there are no data to calculate hydrogen generation and there is less than 50 percent void space ratio, the tank is ranked moderate. If there are no data to calculate hydrogen generation, and there is greater than or equal to a 50 percent void space ratio, the tank is ranked low. If there are no data related to the amount of waste in the tank, assume the void space ratio is less than 50 percent. Other gases that may be produced along with hydrogen are considered harmful vapors.

If there are no data to estimate the ferrocyanide content in the tank, the tank is ranked moderate. If there are no data to estimate the weight percent of total organic carbon in the tank, the tank is ranked moderate.

Further information on the basis for the vapor emission potential safety issue ranking is found in Appendix B.2.

2.1.3 Quantitative Criteria for Priority 3 Safety Issues

2.1.3.1 Leak Potential. The only Priority 3 safety issue under consideration in the IMUST safety program is the potential for tank leakage, which is an environmental concern. The criteria for determining the priority rank of high, moderate, or low with regard to leak potential are listed as follows:

Priority rank	Criterion
High	The tank contains more than 5,000 gallons of supernate.
Moderate	The tank contains less than 5,000 gallons but more than 400 gallons of supernate.
Low	The tank is either empty or the tank contains less than 400 gallons of supernate.

The basis for the 5,000- and 400-gallon supernate limits in the criteria is that those are the levels at which IMUSTs were considered to be interim stabilized when they were being isolated in the mid-1980s. The 5,000- and 400-gallon values for interim stabilization are discussed in a 1984 supporting document (Bell 1984). If liquid was too highly radioactive to be pumped to a tank truck without dilution, then overground piping was used. Supernate volumes of 5,000 gallons or less were considered to be economically and technically nonpumpable through the overground piping. If liquid was of low enough radioactivity to be pumped to a tank truck, then supernate volumes of 400 gallons or less were considered to be economically and technically nonpumpable to tank trucks.

If there are no data for the amount of supernate, it is assumed to be less than 5,000 gallons. The basis for the supernate volume is discussed in Appendix C.

2.2 QUANTITATIVE PRIORITIZATION FOR ASSESSING RADIOLOGICAL HAZARDS

Radiological hazard is an operational concern to workers rather than a safety issue. The measurable criteria for radiological hazards are developed and summarized in this section. These criteria and related data should be transmitted to Operations for survey and monitoring when tank entry is needed.

The criteria related to radiological hazards are based on estimated ^{137}Cs (or equivalent) content of the tanks. The criteria for determining the priority rank of high, moderate, or low with regard to radiological hazards as an operational concern are listed as follows:

Priority rank	Criterion
High	A tank contains more than 1,000 curies of ^{137}Cs (or equivalent).
Moderate	A tank contains more than 100 curies but less than 1,000 curies of ^{137}Cs (or equivalent).
Low	A tank contains less than 100 curies of ^{137}Cs (or equivalent).

The decision to use 100 and 1,000 curies as the criteria is an arbitrary decision used to show order of magnitude differences. If a tank is empty of waste, it could still have surface radiological contamination. The basis for the ^{137}Cs content calculations is discussed in Appendix D. If there are no analytical data for ^{137}Cs in a tank or the quantities of waste as supernate and sludge are not well known, then the tank is ranked moderate until it can be surveyed and posted to prevent unacceptable exposures when an entry to a tank is planned.

2.3 SUMMARY OF SAFETY ISSUE PRIORITIES

The priorities of each potential safety issue for each inactive miscellaneous underground storage tank are listed in Table 2-1. These priorities were made based on the criteria given in Section 2.1 of this status report. Additional notes explaining priority ranks of certain tanks are outlined in Appendix E. The tanks that had high ranks for Priority 1 safety issues, such as hydrogen, are listed first, then the tanks ranked high for Priority 2 safety issues, such as vapor emission, and then tanks with a Priority 3 safety issue, such as leak potential, are listed. Next, tanks that have a moderate ranking for Priority 1 safety issues as their highest ranking are listed, followed by tanks that have moderate rankings for Priority 2 and 3 safety issues as their highest ranking. Then, tanks with only low rankings for all safety issues are listed. Tanks with highest to lowest ranking for radiological concerns are listed last.

Six tanks related to the hydrogen generation potential safety issue are ranked high. These tanks (241-T-361, 244-BXR-003, 241-U-361, 241-B-361, 244-BXR-001, and 244-BXR-011) are calculated to generate enough hydrogen for a 1 percent vapor space concentration (25 percent of lower flammability limit) in less than 10 years.

One tank (241-TY-302A) related to the ferrocyanide reactivity potential safety issue is ranked high, and one tank (241-TX-302B) is ranked moderate. These tanks are two of the possible eight tanks on the ferrocyanide flow path that are estimated to potentially have an 8 weight percent ferrocyanide content or there are insufficient data to refute that supposition. The one tank ranked

high is assumed to have waste temperatures of greater than 90 °C (194 °F) because no data are available. There are no data on ferrocyanide content for the one tank ranked medium.

No tanks related to the organic salt reactivity potential safety issue are ranked high. Forty-seven tanks are ranked moderate. Indications are that these tanks could have at least 4.5 weight percent total organic carbon and are assumed to have a waste temperature of less than 180 °C (356 °F) based on the results of a more realistic temperature calculation (to be issued in September 1995).

No tanks related to the high heat potential safety issue are ranked high. This is based on the results of a more realistic temperature calculation (to be issued in September 1995).

All but one tank received a low ranking for the criticality potential safety issue. This tank (241-Z-361) contains an estimated 54 kilograms of plutonium, but because of the uncertainty of the distribution of plutonium in the tank, the tank was ranked moderate.

The same six tanks that were ranked high for the hydrogen generation potential safety issue are also ranked high for the flammability potential safety issue.

Twenty-five tanks are ranked high related to the vapor emissions safety issue. These tanks include the six high hydrogen generation tanks, the high and moderate ferrocyanide tanks, and some of the organic tanks that are estimated to contain more than 4.5 weight percent total organic carbon.

Table 2-1. Priorities of the Miscellaneous Tanks Given Resolution Action Is Occurring.
(5 pages)

Tank row # ↓	Tank	Tank type [a]	Relative ranking on potential safety issues [b] [c]									Sludge volume (gal) [d]	Liquid volume (gal) [d]	Total volume (gal) [d]	Notes
			H ₂	FeCN	Org	Heat	Crit	Flam	Vap	Leak	Rad				
	Priority 1, 2, 3, or Operational Concern →		1	1	1	1	2	2	2	3	OC				
1	241-T-361	S	H	L	M* [g]	L	L	H	H	L	H	24,500	0	24,500	
2	244-BXR-003	V	H	L	M*	L	L	H	H	L	L	1,450	360	1,810	Est. 8,300 gal. soft sludge in sump
3	241-U-361	S	H	L	M*	L	L	H	H	L	H	27,700	100	27,800	Little or no liquid
4	241-B-361	S	H	L	M	L	L	H	H	L	M	20,678	0	20,678	No pumpable liquids
5	244-BXR-001	V	H	L	M*	L	L	H	H	L	M	7,200	0	7,200	Minimum sludge in sump
6	244-BXR-011	V	H	L	L	L	L	H	H	L	M	7,000	100	7,100	Est. 4,200 gal. soft sludge in sump
7	241-TY-302A	C	L	H	M*	M	L	M	H	L	M	450	0	450	
8	241-TX-302B [f]	C	L	M	M*	M	L	M	H	M	M	- [e]	-	1,320	Monitored by leak detector.
9	241-A-302B	C	L	L	M*	M	L	M	H	M	M	-	-	3,600	Monitored by leak detector.
10	241-B-301B	C	L	L	M*	L	L	M	H	M	L	21,660	590	22,250	
11	241-B-302B	C	L	L	M*	M	L	M	H	M	M	690	4,240	4,930	
12	241-BX-302B	C	L	L	M*	M	L	M	H	L	M	950	90	1,040	
13	241-BX-302C	C	L	L	M*	M	L	M	H	L	M	640	230	870	
14	241-C-301C	C	L	L	M*	L	L	M	H	M	L	9,000	1,470	10,470	
15	240-S-302	C	L	L	M*	M	L	M	H	M	M	-	-	2,276	Monitored by leak detector. Est. 100 gal. interstitial liquid
16	241-S-302A	C	L	L	M*	M	L	M	H	M	M	-	-	5,130	Monitored by leak detector. 2 ft grout over 1 ft sand

Table 2-1. Priorities of the Miscellaneous Tanks Given Resolution Action Is Occurring.
(5 pages)

Tank row # ↓	Tank	Tank type [a]	Relative ranking on potential safety issues [b] [c]									Sludge volume (gal) [d]	Liquid volume (gal) [d]	Total volume (gal) [d]	Notes
			H ₂	FeCN	Org	Heat	Crit	Flam	Vap	Leak	Rad				
	Priority 1, 2, 3, or Operational Concern →		1	1	1	1	2	2	2	3	OC				
17	241-SX-302	C	L	L	M*	M	L	M	H	L	M	1,050	300	1,350	
18	241-T-301	C	L	L	M*	L	L	M	H	M	L	21,660	590	22,250	
19	241-TX-302A	C	L	L	M*	L	L	M	H	L	L	2,450	30	2,480	
20	241-TX-302X	C	L	L	M*	M	L	M	H	L	M	110	250	360	
21	241-CX-71	N	L	L	M*	L	L	M	H	L	L	930	0	930	Grout over 4 ft limestone and 2.35 ft sludge
22	244-BXR-002	V	L	L	M*	L	L	M	H	L	L	1,800	380	2,180	Est. 280 gal. sludge in sump
23	244-UR-001	V	L	L	M*	L	L	M	H	L	L	1,850	390	2,240	Liquid and sludge in sump
24	244-UR-002	V	L	L	M*	L	L	M	H	M	L	2,300	570	2,870	Conflicting liquid level data (214 or 570 gal.)
25	244-UR-003	V	L	L	M*	L	L	M	H	L	M	1,570	0	1,570	Liquid and sludge in sump
26	241-WR-009	V	L	L	M	M	L	M	M	H	M	0	23,000	23,000	Conflicting volume data (may be empty)
27	241-ER-311A	C	M	M	M	M	L	M	M	M	M	-	-	-	- Abandoned catch tank near active tank 241-ER-311
28	241-AX-151	DV	M	M	M	M	L	M	M	M	M	-	-	-	- Diverter station with a tank in each of 4 cells
29	216-TY-201	F	M	M	M	M	L	M	M	M	M	-	-	-	
30	216-BY-201	F	M	M	M	M	L	M	M	M	M	-	-	-	
31	242-TA-R1	R	M	M	M	M	L	M	M	M	H	-	-	-	- Very hot radiologically

Table 2-1. Priorities of the Miscellaneous Tanks Given Resolution Action Is Occurring.
(5 pages)

Tank row # ↓	Tank	Tank type [a]	Relative ranking on potential safety issues [b] [c]									Sludge volume (gal) [d]	Liquid volume (gal) [d]	Total volume (gal) [d]	Notes
			H ₂	FeCN	Org	Heat	Crit	Flam	Vap	Leak	Rad				
	Priority 1, 2, 3, or Operational Concern →		1	1	1	1	2	2	2	3	OC				
32	242-T-135	DC	M	M	M	M	L	M	M	M	M	-	-	-	
33	243S-TK-1	DC	M	M	M	M	L	M	M	M	M	-	-	-	
34	213-W-TK-1	DC	M	M	M	M	L	M	M	M	M	-	1875	-	Believed to be full of rainwater
35	216-BC-201	S	M	M	M	M	L	M	M	M	M	-	-	-	
36	292T-TK-1	WH	M	M	M	M	L	M	M	L	M	-	-	-	
37	292T-TK-2	WH	M	M	M	M	L	M	M	L	M	-	-	-	
38	276-S-141 (276-S-306A)	SM	L	M	M	M	L	M	M	L	M	-	200	-	
39	276-S-142 (276-S-306B)	SM	L	M	M	M	L	M	M	L	M	-	200	-	
40	270-E-1	N	M	L	M	M	L	M	M	L	M	3,800	0	3,800	Possible 1,400 gal. interstitial liquid
41	270-W	N	L	L	M	M	L	M	M	M	M	-	-	-	contents unknown
42	241-Z-8	S	L	L	M	M	L	M	M	L	M	500	0	500	Liquid removed 10-19-74
43	241-CX-72	E	L	L	M	M	L	M	M	L	M	650	0	650	Filled with grout over sludge
44	231-W-151-001	S	L	L	M	M	L	M	M	M	L	0	1,430	1,430	
45	241-Z-361	S	L	L	L	M	M ^h [h]	M	M	L	M	20,000	200	20,200	Layered "mud-like" sludge
46	244-TXR-003	V	L	L	M	L	L	M	M	L	M	6,500	0	6,500	Minimum sludge in sump
47	231-W-151-002	S	L	L	M	L	L	M	M	M	L	10	950	960	
48	244-TXR-001	V	L	L	M	L	L	M	M	L	L	2,300	50	2,350	Minimum sludge in sump

Table 2-1. Priorities of the Miscellaneous Tanks Given Resolution Action Is Occurring.
(5 pages)

Tank row # ↓	Tank	Tank type [a]	Relative ranking on potential safety issues [b] [c]									Sludge volume (gal) [d]	Liquid volume (gal) [d]	Total volume (gal) [d]	Notes	
			H ₂	FeCN	Org	Heat	Crit	Flam	Vap	Leak	Rad					
	Priority 1, 2, 3, or Operational Concern →		1	1	1	1	2	2	2	2	3	OC				
49	244-TXR-002	V	L	L	M	L	L	M	M	M	L	M	2,950	0	2,950	Minimum sludge in sump
50	241-TX-302B(R) [f]	C	L	L	L	M	L	L	L	L	M	M	-	-	-	contents unknown
51	241-BX-302A	C	L	L	L	L	L	L	L	L	L	M	840	0	840	
52	241-S-302B	C	L	L	L	L	L	L	L	L	L	M	0	0	0	Emptied
53	241-TY-302B	C	L	L	L	L	L	L	L	L	L	M	0	0	0	Emptied
54	241-CX-70	WH	L	L	L	L	L	L	L	L	L	M	0	0	0	Flushed and emptied
55	241-WR-001	V	L	L	L	L	L	L	L	L	L	M	-	-	12,000	Tank believed empty; est. 12,000 gal. in sump
56	241-WR-002	V	L	L	L	L	L	L	L	L	L	M	-	-	35,000	Tank believed empty; est. 35,000 gal. in sump
57	241-WR-003	V	L	L	L	L	L	L	L	L	L	M	-	-	0	Believed empty; unknown sump waste volume
58	241-WR-004	V	L	L	L	L	L	L	L	L	L	M	-	-	0	Believed empty; unknown sump waste volume
59	241-WR-005	V	L	L	L	L	L	L	L	L	L	M	-	-	-	Value unknown (may be empty)
60	244-UR-004	V	L	L	L	L	L	L	L	L	L	L	min.	min.	min.	minimum heel
61	241-WR-006	V	L	L	L	L	L	L	L	L	L	L	-	-	min.	Minimum heel of thorium solution
62	241-WR-007	V	L	L	L	L	L	L	L	L	L	L	-	-	0	Believed empty
63	241-WR-008	V	L	L	L	L	L	L	L	L	L	L	-	-	0	Believed empty

Table 2-1. Priorities of the Miscellaneous Tanks Given Resolution Action Is Occurring.
(5 pages)

Tank row # ↓	Tank	Tank type [a]	Relative ranking on potential safety issues [b] [c]								Sludge volume (gal) [d]	Liquid volume (gal) [d]	Total volume (gal) [d]	Notes	
			H ₂	FeCN	Org	Heat	Crit	Flam	Vap	Leak					Rad
	Priority 1, 2, 3, or Operational Concern →		1	1	1	1	2	2	2	3	OC				

Notes:

[a] C = catch tank; DC = decontamination tank; DV = diverter station; E = experimental tank; F = flush tank;
N = neutralization tank; R = receiver tank; S = settling tank; SM = solvent makeup tank; V = vault tank;
WH = waste handling tank;

[b] Relative rankings: H = high; M = moderate; M* = see Note [g] below; M^ = see Note [h] below; L = low

[c] Issue abbreviations:

H ₂	Hydrogen generation and buildup	Flam	Flammability
FeCN	Ferrocyanide reactivity	Vap	Emission of radioactive or toxic vapors
Org	Organic salt reactivity	Leak	Leak potential
Heat	High heat	Rad	Radioactivity
Crit	Criticality		

[d] Volumes have been rounded to the nearest 10 gallons.

[e] - = No data

[f] The original tank 241-TX-302B was removed from the ground and replaced with a tank named 241-TX-302B(R). When 241-TX-302B(R) leaked it was left in the ground and a new tank was installed nearby that was named 241-TX-302B and still exists in the ground.

[g] Under the organic salt reactivity potential safety issue column a moderate ranking with an asterisk (M*) means it has > 4.5 wt% total organic carbon (TOC) but the temperature analysis makes it moderate.

[h] This tank was ranked low according to the criteria, but based on the uncertainty in the measurement of the Pu concentration, it was elevated to a moderate ranking.

One tank is ranked high for the leakage safety issue. This tank is ranked high because it contains more than 5,000 gallons of supernate. The 5,000-gallon limit of supernate was the criterion, used in the mid-1980s, at which IMUSTs were considered to be interim stabilized. This 5,000-gallon value for interim stabilization is discussed in a 1984 supporting document (Bell 1984).

Three tanks are ranked high for the radiological hazards by direct exposure potential operational concern. Two of these tanks (241-T-361 and 241-U-361) contain over 1,000 curies of ^{137}Cs . Tank 241-T-361 is estimated to contain over 15,000 curies, and tank 241-U-361 is estimated to contain about 1,400 curies. The third tank (242-TA-R1) is known to be very hot radiologically. But 44 tanks are ranked moderate because they contain between 100 and 1,000 curies or because insufficient information is available. Radiological hazards are not related to safety issues; however, attention should be given to protecting workers during planned entries to IMUSTs.

A summary of the number of IMUSTs having a given rank for each potential safety issue or operational concern is shown in Table 2-2.

Table 2-2. Summary of Priorities of the Miscellaneous Tanks Given Resolution Action Is Occurring.

Potential safety issues (SIs) or operational concerns (OCs)		Number of IMUSTs in each ranking category		
Priority of SIs or designation as OC		High	Moderate	Low
1	Hydrogen generation and buildup	6	12	45
1	Ferrocyanide reactivity	1	14	48
1	Organic salt reactivity	0	47*	16
1	High heat	0	31	32
2	Criticality	0	1	62
2	Flammability	6	43	14
2	Emission of radioactive or toxic vapors	25	24	14
3	Leak potential	1	22	40
OC	Radioactivity	3	44	16

23 of the 47 have > 4.wt% TOC but not high enough temperature to rank high based on more realistic temperature analysis. These 23 are indicated by M in Table 2-1.

3.0 STATUS OF MAJOR TASK ACTIVITIES

The status of major task activities that are either completed or are ongoing is discussed below.

3.1 IDENTIFY TANKS

The first task is to identify all the inactive miscellaneous underground storage tanks (IMUSTs). This task is ongoing, but only on a limited effort. As of this report 63 official IMUSTs have been identified. All tanks are associated with past Hanford Site operations. Of the 63 tanks, 19 are catch tanks, 20 are vault tanks, 3 are neutralization tanks, 8 are settling tanks, 2 are solvent makeup tanks used to store hexone, 2 are flush tanks, 3 are decontamination tanks, 1 is a diverter station, 1 is a receiver tank, 1 is an experimental tank, and 3 are waste handling tanks. All of these tanks have contained radioactive waste except for 5 of the tanks in the waste retrieval vault. Because these "cold" tanks are in a vault with tanks that have contained radioactive waste, and the walls between the "cold" and "hot" sides of the vault have leaked contamination, these 5 tanks are also considered radioactive IMUSTs. The initial 50 IMUSTs are identified and documented in an engineering study (WHC 1994a). The other 13 IMUSTs were suggested by various personnel but are not documented in a single document. A contract was completed to interview over 20 retirees to identify potential additional IMUSTs.

Status: Initial 50 IMUSTs were identified by May 1994. An additional 10 IMUSTs were identified by February 1995. Three additional IMUSTs were identified by July 1995. The interview contract was completed and documented in August 1995 (see Appendix G).

3.2 OBTAIN HISTORICAL DATA

This task is to obtain all historical data and relevant information that is available on the 63 IMUSTs already identified. This task is documented for the initial 50 IMUSTs in the same engineering study (WHC 1994a). Efforts will continue through FY 1995 to find information on the additional 10 IMUSTs.

Status: Historical data were collected for the initial 50 IMUSTs by May 1994. Efforts were made to collect historical data for the additional IMUSTs during FY 1995, but very little data were able to be identified.

3.3 IDENTIFY POTENTIAL SAFETY ISSUES

This task is essentially complete and is documented in Section 2.0 of this report.

Status: Completed by September 1994.

3.4 SAFETY ASSESSMENT

This major task consists of four subtasks as described below.

3.4.1 Identify Applicable "Authorization Basis Documents"

The first subtask was to identify applicable "authorization basis documents." The following steps were taken:

The authorization basis documents listed in Appendix G of WHC-IP-0842, Rev. 3 (WHC 1994b), and any safety basis documents identified by cognizant plant and safety personnel, were reviewed for applicability to the IMUSTs.

A search for additional safety basis and authorization basis documents was conducted by contacting cognizant plant and safety personnel.

The following documents are considered the current authorization basis documents for the Waste Tank Farm:

- a. Waste Tanks: WHC-SD-WM-ISB-001, Rev. 1 (WHC 1995a)
- b. Interim Operational Safety Requirements:
WHC-SD-WM-OSR-004, Rev. 1 (WHC 1995b)
WHC-SD-WM-OSR-005, Rev. 0 (WHC 1995c)
WHC-SD-WM-OSR-016, Rev. 0 (WHC 1995d)
- c. Tank Farm Compliance Implementation Plan: WHC-IP-0954 (WHC 1993).

Status: Completed by October 1994 and revised in September 1995.

3.4.2 Perform Discovery USQ Screening

The second subtask was to perform discovery USQ screening related to the potential safety issues associated with the IMUSTs. The following steps were taken:

- WHC-IP-0842, Revision 3 (WHC 1994b) was applied to the IMUSTs in order to determine if the IMUST "occurrence" is indeed a USQ "discovery."
- This process involved answering the three questions shown in Appendix B, WHC-IP-0842, Revision 3.
- MRP 5.12 (WHC-CM-1-3), Revision 2, was also consulted as needed.

Status: Completed by December 1994 and documented in an occurrence report dated January 20, 1995 (Dechter 1995).

3.4.3 Perform Additional Preliminary Hazard Analysis

The third subtask was to perform a safety evaluation to answer the eight questions in Appendix B, WHC-IP-0842, Revision 3. The safety evaluation for the IMUST was a preliminary hazard analysis.

The results of the preliminary hazard analysis were compared to appropriate safety analyses for similar, "bounding" facilities. The results of these comparisons were used to evaluate potential accidents in the IMUSTs and their potential risks.

Status: Completed by June 1995 and documented in a supporting document (WHC-SD-WM-HA-001, Rev. 0) (WHC 1995e).

3.4.4 Complete USQ Evaluation if Required

The fourth subtask was to complete a USQ evaluation if required. If any of the eight questions in Figure B-3, Appendix B, WHC-IP-0842, Revision 3, are not answered satisfactorily, even after the safety evaluation is performed, then additional safety analyses must be undertaken to close this process.

Status: Completed by June 1995 and documented in a supporting document (WHC-SD-WM-HA-001, Rev. 0) (WHC 1995e).

3.5 ESTABLISH PREVENTIVE CONTROLS

3.5.1 Short-Term

In the short-term, some access control will be implemented to restrict access to various IMUSTs ranked high for H₂/flammable gas, vapor emission, or radiological hazards. These forms of access control may be as simple as posting signs indicating the location of these IMUSTs; or the access controls may require fencing off the surface area above the IMUSTs.

Status: The initial 60 IMUSTs were access controlled and posted with signs by the end of March 1995. The last 3 IMUSTs have not been posted with signs or access controlled as of September 1995.

3.5.2 Based on USQ Evaluation

Based on the results of the USQ evaluation subtasks, some additional forms of access control may be implemented, or additional IMUSTs may require access controls.

Status: Based on the USQ evaluation completed in June 1995, no additional access controls are required.

3.6 CHARACTERIZATION

Vapor sampling of at least one IMUST and criticality evaluation will be performed.

3.6.1 Vapor Sampling

Vapor sampling will be performed on at least one IMUST during FY 1995.

Status: To be completed by October 1995.

3.6.2 Criticality Evaluation

Criticality concerns related to different geometries other than the larger 50,000-gallon single-shell tanks (SSTs) must also be evaluated.

Status: A criticality safety evaluation report (CSER) will be written by the end of October 1995.

3.7 SAFETY ISSUE CONFIRMATION/VERIFICATION

Once the vapor sampling and evaluation subtask above is performed for at least one IMUST in FY 1995, then safety issues detectable by vapor sampling can be confirmed, or it can be verified that there are no safety issues detectable by vapor sampling.

Status: To be determined.

3.8 SAFETY ISSUE RESOLUTION

If a safety issue is confirmed, a plan will be developed and implemented to resolve the issue.

Status: A safety issue resolution plan will be developed after step 3.7 is completed, if needed.

4.0 PROPOSED OWNERSHIP OF IMUSTS

The proposed ownership of the 63 IMUSTs, as identified in this report, is represented in Table 4-1 below. This table is based on the proposed ownership as documented in a letter from Westinghouse Hanford Company (WHC) to the U.S. Department of Energy, Richland Operations Office (DOE-RL) (Lee 1995) and discussions with personnel from DOE-RL and Tank Waste Remediation System/Environmental Restoration (TWRS/ER) programs.

Table 4-1. Proposed Ownership of IMUSTs.

Tank #	Owner	Tank #	Owner	Tank #	Owner
240-S-302	TWRS*	231-W-151-001	TWRS	244-BXR-002	TWRS
241-WR-001	ER	231-W-151-002	TWRS	244-BXR-003	TWRS
241-WR-002	ER	241-Z-8	TWRS	244-BXR-011	TWRS
241-WR-003	ER	241-A-302B	TWRS	244-TXR-001	TWRS
241-WR-004	ER	241-B-301B	TWRS	244-TXR-002	TWRS
241-WR-005	ER	241-B-302B	TWRS	244-TXR-003	TWRS
241-WR-006	ER	241-BX-302A	TWRS	244-UR-001	ER*
241-WR-007	ER	241-BX-302B	TWRS	244-UR-002	ER*
241-WR-008	ER	241-BX-302C	TWRS	244-UR-003	ER*
241-WR-009	ER	241-C-301C	TWRS	244-UR-004	ER*
241-B-361	ER	241-S-302A	TWRS	241-ER-311A	TWRS
241-CX-70	ER	241-S-302B	TWRS	241-AX-151	TWRS
241-CX-71	ER	241-SX-302	TWRS	216-TY-201	TWRS
241-CX-72	ER	241-T-301	TWRS	216-BY-201	TWRS
241-T-361	ER	241-TX-302A	TWRS	242-TA-R1	TWRS
241-U-361	ER	241-TX-302B	TWRS	242-T-135	TWRS
270-W	TWRS*	241-TX-302B(R)	TWRS	243S-TK-1	TWRS
276-S-141 (276-S-306A)	ER	241-TX-302X	TWRS	213-W-TK-1	TWRS
276-S-142 (276-S-306B)	ER	241-TY-302A	TWRS	216-BC-201	ER*
270-E-1	TWRS	241-TY-302B	TWRS	292T-TK-1	T-Plant*
241-Z-361	PFP	244-BXR-001	TWRS	292T-TK-2	T-Plant*

* = Proposed Owner
 ER = Environmental Remediation Function
 PFP = Plutonium Finishing Plant
 TWRS = Tank Waste Remediation System

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APPENDIX A

BASES RELATED TO POTENTIAL PRIORITY 1 SAFETY ISSUES

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APPENDIX A

BASES RELATED TO POTENTIAL PRIORITY 1 SAFETY ISSUES

A.1 BASIS FOR HYDROGEN GENERATION CRITERIA

To develop a quantitative basis for the hydrogen generation criteria, a spreadsheet calculation was performed of how many years it would take each inactive miscellaneous underground storage tank (IMUST) to generate a 1 volume percent hydrogen concentration in the tank vapor space. The concentrations of ^{137}Cs and ^{90}Sr were the basis for calculating the hydrogen generation from radiolysis. It is recognized that the concentrations of radionuclides change over time, and that this hydrogen calculation was conservative from that viewpoint. Key assumptions related to the concentrations affect the calculations significantly. The first assumption is that ^{137}Cs is only considered to be in the supernate unless sample analysis shows it in the solids. If there is no supernate sample for a tank but there is a solid sample, then the ^{137}Cs concentration is assumed to be a factor of 10 higher in the supernate than in the solids. If there is no solids sample for a tank but there is a supernate sample, then ^{90}Sr concentration assumed for the solids is a factor of 10 higher than for the supernate. The formula used in the spreadsheet for calculating years until 1 volume percent hydrogen concentration in a tank vapor space is as follows:

$$A/(B \cdot C) = \text{Years to reach 1\% hydrogen in vapor space of an IMUST}$$

- A = Volume of hydrogen required for 1% hydrogen in the vapor space in gallons
- B = Heat rate in Btu/hr
- C = Conversion of heat rate to gallons of hydrogen generated per year

A, B, and C are further defined as follows:

- A = Tank vapor space in gallons * 0.01 (fraction of volume to yield 1%)
- B = $\frac{[(\text{Sr-sol} \cdot \text{Sol} + \text{Sr-sup} \cdot \text{Sup}) \cdot \text{SR}] + [(\text{Cs-sol} \cdot \text{Sol} + \text{Cs-sup} \cdot \text{Sup}) \cdot \text{CS}]}{1,000,000}$

NOTE: Division by 1,000,000 converts μCi to Ci

- Sr-sol = ^{90}Sr concentration in solids in $\mu\text{Ci/gal}$
- Sol = volume of solids in gallons
- Sr-sup = ^{90}Sr concentration in supernate in $\mu\text{Ci/gal}$
- Sup = volume of supernate in gallons
- SR = 0.0229 Btu/hr-Ci (heat rate per Ci for ^{90}Sr)
- Cs-sol = ^{137}Cs concentration in solids in $\mu\text{Ci/gal}$
- Cs-sup = ^{137}Cs concentration in supernate in $\mu\text{Ci/gal}$
- CS = 0.0161 Btu/hr-Ci (heat rate per Ci for ^{137}Cs)

$$C = d * e * f * g * h * i * j * k \div l$$

d	=	0.293 Watt-hr/Btu
e	=	1 Joule/Watt-sec
f	=	0.8 [F factor (fraction of energy absorbed)]
g	=	100 Electron Volts/1.6E-17 Joules
h	=	0.45 molecules/100 Electron Volts [G(H ₂) {gas generation per unit of energy absorbed}]
i	=	1 liter of gas/2.7E+22 molecules at standard temperature (0 °C) and pressure (760 millimeters of mercury)
j	=	3,600 sec/hr
k	=	8760 hr/year
l	=	3.785 liters/gallon

The above calculations for all the tanks is represented in Table A-1. Where there are blanks in the "Yrs to 1%" column, no data were available for performing the calculation.

The sources for the ⁹⁰Sr and ¹³⁷Cs concentration numbers in Table A-1 are shown in Table A-2.

Table A-1. Spreadsheet Results of Hydrogen Generation Calculations. (3 pages)

MHYD-RV1.WQ1		Assumptions: 1% hydrogen of concern 0.0229 ⁹⁰ Sr heat rate per Ci (Btu/hr-Ci) 0.0161 ¹³⁷ Cs heat rate per Ci (Btu/hr-Ci)									
	Yrs to 1%	Normal capacity (gal)	Solids volume (gal)	Supernate volume (gal)	Total waste volume (gal)	Vapor space volume (gal)	Vapor space void %	⁹⁰ Sr-sol (μCi/gal)	⁹⁰ Sr-sup (μCi/gal)	¹³⁷ Cs-sol (μCi/gal)	¹³⁷ Cs-sup (μCi/gal)
241-A-302B		13500	no data	no data	3600	9900	73				
241-B-301B	631	36000	21660	590	22250	13750	38				11400
241-B-302B		17684	690	4240	4930	12754	72				
241-BX-302A	609	17684	835	0	835	16849	95	7190	719		358
241-BX-302B		11389	950	94	1044	10345	91				
241-BX-302C		11378	635	228	863	10515	92				
241-C-301	30	36000	9016	1470	10486	25514	71	17000	1700		25500
240-S-302		17684	no data	no data	2276	15408	87				
241-S-302A		17684	no data	no data	5130	12554	71				
241-S-302B		14314	0	0	0	14314	100				
241-SX-302		17684	1050	305	1355	16329	92				
241-T-301	45	36000	21658	588	22246	13754	38	3040	304		1600
241-TX-302A	296	17684	2450	30	2480	15204	86	4540	454		48
241-TX-302B(R)		12000	no data	no data	0	12000	100				
241-TX-302B		17684	no data	no data	1320	16364	93				
241-TX-302X		14314	108	245	353	13961	98				
241-TY-302A		17684	450	0	450	17234	97				
241-TY-302B		14314	0	0	0	14314	100				
270-E-1		4185	3800	0	3800	385	9				
270-W		3780	no data	no data	0	3780	100				
241-B-361	1	36000	20678	0	20678	15322	43	112301		6836	68360
241-T-361	0	36000	24500	0	24500	11500	32	1149	115	647341	6473410
241-U-361	1	36000	27734	98	27832	8168	23	27634	2763	49629	496290

Table A-1. Spreadsheet Results of Hydrogen Generation Calculations. (3 pages)

MHYD-RV1.WQ1		Assumptions: 1% hydrogen of concern 0.0229 ⁹⁰ Sr heat rate per Ci (Btu/hr-Ci) 0.0161 ¹³⁷ Cs heat rate per Ci (Btu/hr-Ci)									
	Yrs to 1%	Normal capacity (gal)	Solids volume (gal)	Supernate volume (gal)	Total waste volume (gal)	Vapor space volume (gal)	Vapor space void %	⁹⁰ Sr-sol (μCi/gal)	⁹⁰ Sr-sup (μCi/gal)	¹³⁷ Cs-sol (μCi/gal)	¹³⁷ Cs-sup (μCi/gal)
241-Z-361		40500	20000	200	20200	20300	50				
241-Z-8		15435	500	0	500	14935	97				
231-W-151-001	12148	4000	0	1430	1430	2570	64		32		0.12
231-W-151-002	241361	1000	12	955	967	33	3	0.00 15	0.02 65	0.00 11	0.00 643
241-CX-70		30000	0	0	0	30000	100				
241-CX-71	102	1000	930		930	70	7	160	16		6
241-CX-72		2300	653	0	653	1647	72				
244-BXR-001	4	50000	7215	0	7215	42785	86	348220	34822		38229
244-BXR-002	39	15000	1805	380	2185	12815	85	38270	3827		1964
244-BXR-003	1	15000	1449	356	1805	13195	88	3174480	317448		22824
244-BXR-011	5	50000	7020	98	7118	42882	86	183673	18367	72795	727950
244-TXR-001	4480	50000	2291	49	2340	47660	95	750	75		16995
244-TXR-002	2336	15000	2945	0	2945	12055	80	380	38		83270
244-TXR-003		15000	6460	0	6460	8540	57				
244-UR-001	384	50000	1852	390	2242	4775	96	14000	1400		1800
244-UR-002	3338	15000	2304	570	2874	12126	81	220	22		670
244-UR-003	50	15000	1568	0	1568	13432	90	37000	3700		950
244-UR-004		8230	0	0	0	8230	100				
241-WR-001		50000	minimal?	minimal?	0	50000	100	7080	708		6
241-WR-002		50000	minimal?	minimal?	0	50000	100	2170	217		20
241-WR-003		50000	minimal?	minimal?	0	50000	100				
241-WR-004		50000	minimal?	minimal?	0	50000	100				

Table A-1. Spreadsheet Results of Hydrogen Generation Calculations. (3 pages)

MHYD-RV1.WQ1		Assumptions: 1% hydrogen of concern 0.0229 ⁹⁰ Sr heat rate per Ci (Btu/hr-Ci) 0.0161 ¹³⁷ Cs heat rate per Ci (Btu/hr-Ci)									
	Yrs to 1%	Normal capacity (gal)	Solids volume (gal)	Supernate volume (gal)	Total waste volume (gal)	Vapor space volume (gal)	Vapor space void %	⁹⁰ Sr-sol (μCi/gal)	⁹⁰ Sr-sup (μCi/gal)	¹³⁷ Cs-sol (μCi/gal)	¹³⁷ Cs-sup (μCi/gal)
241-WR-005		50000	minimal?	minimal?	0	50000	100				
241-WR-006		50000	minimal?	minimal?	0	50000	100				
241-WR-007		50000	minimal?	minimal?	0	50000	100				
241-WR-008		50000	minimal?	minimal?	0	50000	100				
241-WR-009		50000	minimal?	23000	23000	27000	54				
276-S-141 (276-S-306A)		23000	no data	<200	<200	22,800	99				
276-S-142 (276-S-306B)		23000	no data	<200	<200	22,800	99				
241-ER-311A		no data	no data	no data	no data	no data	no data				
241-AX-151		no data	no data	no data	no data	no data	no data				
216-TY-201		no data	no data	no data	no data	no data	no data				
216-BY-201		no data	no data	no data	no data	no data	no data				
242-TA-R1		no data	no data	no data	no data	no data	no data				
242-T-135		no data	no data	no data	no data	no data	no data				
243S-TK-1		550	no data	no data	no data	no data	no data				
213-W-TK-1		1875	no data	1875*	0*	0*	0*				
216-BC-201		no data	no data	no data	no data	no data	no data				
292T-TK-1		55	no data	no data	no data	no data	no data				
292T-TK-2		55	no data	no data	no data	no data	no data				

* Supernate volume is all rainwater.

Table A-2. Basis for Sr and Cs Hydrogen Generation Calculations. (3 pages)

Tank #	Total β , $\mu\text{Ci/gal}$	Gamma energy analysis, $\mu\text{Ci/gal}$	^{90}Sr sludge concentration, $\mu\text{Ci/gal}$	^{90}Sr supernate concentration, $\mu\text{Ci/gal}$	^{137}Cs sludge concentration, $\mu\text{Ci/gal}$	Cs^{137} supernate concentration, $\mu\text{Ci/gal}$
241-B-301B						11,400 ¹⁾
241-BX-302A		358 ²⁾	7,190 ³⁾	719 ⁴⁾		358 ²⁾
241-C-301	1,700 ⁵⁾		17,000 ³⁾	1,700 ⁶⁾		25,500 ⁷⁾
241-T-301	304 ⁸⁾		3,040 ³⁾	304 ⁹⁾		1,600 ¹⁰⁾
241-TX-302A			4,540 ³⁾	454 ¹¹⁾		48 ¹¹⁾
241-B-361			112,301 ¹²⁾		6,836 ¹³⁾	68,360 ⁴⁹⁾
241-T-361			1,149 ¹⁴⁾	115 ¹⁵⁾	647,341 ¹⁶⁾	647,341 ⁴⁹⁾
241-U-361			27,634 ¹⁷⁾	2,763 ¹⁵⁾	49,629 ¹⁸⁾	496,290 ⁴⁹⁾
231-W-151-001				32 ¹⁹⁾		0.12 ²⁰⁾
231-W-151-002			0.0015 ²¹⁾	0.0265 ²²⁾	0.0011 ²³⁾	0.0064 ²⁴⁾
241-CX-71			160 ³⁾	16 ²⁵⁾		6 ²⁵⁾
244-BXR-001	73,051 ²⁶⁾	38,229 ²⁷⁾	348,220 ³⁾	34,822 ²⁸⁾		38,229 ²⁹⁾
244-BXR-002	5,791 ³⁰⁾	1,964 ³¹⁾	38,270 ³⁾	3,827 ²⁸⁾		1964 ²⁹⁾
244-BXR-003	340,272 ³²⁾	22,824 ³³⁾	3,174,480 ³⁾	317,448 ²⁸⁾		22,824 ²⁹⁾
244-BXR-011			183,673 ³⁴⁾	18,367 ¹⁵⁾	72,795 ³⁵⁾	727,950 ⁴⁹⁾
244-TXR-001	17,070 ³⁶⁾	16,995 & ³⁷⁾	750 ³⁾	75 ²⁸⁾		16,995 ²⁹⁾
244-TXR-002			380 ³⁾	38 ³⁸⁾		83,270 ³⁹⁾
244-UR-001	3,200 ⁴⁰⁾			1,400 ⁴¹⁾		1,800 ⁴²⁾
244-UR-002			220 ³⁾	22 ⁴³⁾		670 ⁴³⁾
244-UR-003			37,000 ³⁾	3700 ⁴⁴⁾		950 ⁴⁴⁾

Table A-2. Basis for Sr and Cs Hydrogen Generation Calculations. (3 pages)

241-WR-001			7,080 ³⁾	708 ⁴⁵⁾		6 ⁴⁶⁾
241-WR-002			2,170 ³⁾	217 ⁴⁷⁾		20 ⁴⁸⁾
<p>1) WHC-SD-EN-ES-040, Rev.0, page A-4 (WHC 1994).</p> <p>2) WHC-SD-EN-ES-040, Rev.0, page A-10, $94.6 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 358 \mu\text{Ci/gal}$.</p> <p>3) If concentration is only given for supernate, then it is assumed that the concentration in the sludge is 10 times larger.</p> <p>4) WHC-SD-EN-ES-040, Rev.0, page A-10, $1.9\text{E}+2 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 719 \mu\text{Ci/gal}$.</p> <p>5) WHC-SD-EN-ES-040, Rev.0, page A-19, Total β of $1.7\text{E}+3 \mu\text{Ci/gal}$ appears to be in conflict with the ^{137}Cs concentration of $2.55\text{E}+4 \mu\text{Ci/gal}$ because Cs^{137} gives off a β so the Total β should include the ^{137}Cs and thus should be larger than the ^{137}Cs concentration (^{90}Sr also gives off a β).</p> <p>6) Assumed to be the same as the Total β concentration for this calculation. See also note 5).</p> <p>7) WHC-SD-EN-ES-040, Rev.0, page A-19.</p> <p>8) WHC-SD-EN-ES-040, Rev.0, page A-33, Total β of $3.04\text{E}+2 \mu\text{Ci/gal}$ appears to be in conflict with the ^{137}Cs concentration of $1.6\text{E}+3 \mu\text{Ci/gal}$ because ^{137}Cs gives off a β so the Total β should include the ^{137}Cs and thus should be larger than the ^{137}Cs concentration (^{90}Sr also gives off a β).</p> <p>9) Assumed to be the same as the Total β concentration for this calculation. See also note 8).</p> <p>10) WHC-SD-EN-ES-040, Rev.0, page A-33.</p> <p>11) WHC-SD-EN-ES-040, Rev.0, page A-37.</p> <p>12) WHC-SD-EN-ES-040, Rev.0, page A-58, $23.0 \mu\text{Ci/gram} * 1.29 \text{ grams/cm}^3 * 1000 \text{ cm}^3/\text{L} * 3.785 \text{ L/gal} = 112,301 \mu\text{Ci/gal}$.</p> <p>13) WHC-SD-EN-ES-040, Rev.0, page A-58, $1.4 \mu\text{Ci/gram} * 1.29 \text{ grams/cm}^3 * 1000 \text{ cm}^3/\text{L} * 3.785 \text{ L/gal} = 6,836 \mu\text{Ci/gal}$.</p> <p>14) WHC-SD-EN-ES-040, Rev.0, page A-61, $0.12 \mu\text{Ci/gram} * 2.53 \text{ grams/cm}^3 * 1000 \text{ cm}^3/\text{L} * 3.785 \text{ L/gal} = 1,149 \mu\text{Ci/gal}$.</p> <p>15) If concentration is only given for sludge, then it is assumed that the Strontium concentration in the supernate is 10 times smaller.</p> <p>16) WHC-SD-EN-ES-040, Rev.0, page A-61, $67.6 \mu\text{Ci/gram} * 2.53 \text{ grams/cm}^3 * 1000 \text{ cm}^3/\text{L} * 3.785 \text{ L/gal} = 647,341 \mu\text{Ci/gal}$.</p> <p>17) WHC-SD-EN-ES-040, Rev.0, page A-64, $4.9 \mu\text{Ci/gram} * 1.49 \text{ grams/cm}^3 * 1000 \text{ cm}^3/\text{L} * 3.785 \text{ L/gal} = 27,634 \mu\text{Ci/gal}$.</p> <p>18) WHC-SD-EN-ES-040, Rev.0, page A-64, $8.8 \mu\text{Ci/gram} * 1.49 \text{ grams/cm}^3 * 1000 \text{ cm}^3/\text{L} * 3.785 \text{ L/gal} = 49,629 \mu\text{Ci/gal}$.</p> <p>19) WHC-SD-EN-ES-040, Rev.0, page A-75, $8.5 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 32 \mu\text{Ci/gal}$.</p> <p>20) WHC-SD-EN-ES-040, Rev.0, page A-75, $3.1\text{E}-2 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 0.12 \mu\text{Ci/gal}$.</p>						

Table A-2. Basis for Sr and Cs Hydrogen Generation Calculations. (3 pages)

- 21) WHC-SD-EN-ES-040, Rev.0, page A-77, $3.9\text{E-}4 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 0.0015 \mu\text{Ci/gal}$.
- 22) WHC-SD-EN-ES-040, Rev.0, page A-77, $0.7\text{E-}2 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 0.0265 \mu\text{Ci/gal}$.
- 23) WHC-SD-EN-ES-040, Rev.0, page A-77, $3.0\text{E-}4 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 0.0011 \mu\text{Ci/gal}$.
- 24) WHC-SD-EN-ES-040, Rev.0, page A-77, $1.7\text{E-}3 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 0.0064 \mu\text{Ci/gal}$.
- 25) WHC-EP-0560, Rev. 0, page 3-6.
- 26) WHC-SD-EN-ES-040, Rev.0, page A-86, $1.93\text{E+}4 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 73,051 \mu\text{Ci/gal}$.
- 27) WHC-SD-EN-ES-040, Rev.0, page A-86, $1.01\text{E+}4 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 38,229 \mu\text{Ci/gal}$.
- 28) Subtracted Gamma Energy Analysis concentration (assumed to be ^{137}Cs) from Total β concentration to get ^{90}Sr concentration.
- 29) Assumed the Gamma Energy Analysis concentration was the ^{137}Cs concentration.
- 30) WHC-SD-EN-ES-040, Rev.0, page A-88, $1.53\text{E+}3 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 5,791 \mu\text{Ci/gal}$.
- 31) WHC-SD-EN-ES-040, Rev.0, page A-88, $5.19\text{E+}2 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 1,964 \mu\text{Ci/gal}$.
- 32) WHC-SD-EN-ES-040, Rev.0, page A-90, $8.99\text{E+}4 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 340,272 \mu\text{Ci/gal}$.
- 33) WHC-SD-EN-ES-040, Rev.0, page A-90, $6.03\text{E+}3 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 22,824 \mu\text{Ci/gal}$.
- 34) WHC-SD-EN-ES-040, Rev.0, page A-93, $(0.54 + 85.5) \mu\text{Ci/gram} * 0.564 \text{ grams/cm}^3 * 1000 \text{ cm}^3/\text{L} * 3.785 \text{ L/gal} = 183,673 \mu\text{Ci/gal}$.
- 35) WHC-SD-EN-ES-040, Rev.0, page A-93, $(11.1 + 23.0) \mu\text{Ci/gram} * 0.564 \text{ grams/cm}^3 * 1000 \text{ cm}^3/\text{L} * 3.785 \text{ L/gal} = 72,795 \mu\text{Ci/gal}$.
- 36) WHC-SD-EN-ES-040, Rev.0, page A-96, $4.51\text{E+}3 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 17,070 \mu\text{Ci/gal}$.
- 37) WHC-SD-EN-ES-040, Rev.0, page A-96, $4.49\text{E+}3 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 16,995 \mu\text{Ci/gal}$.
- 38) WHC-SD-EN-ES-040, Rev.0, page A-99, $10 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 38 \mu\text{Ci/gal}$.
- 39) WHC-SD-EN-ES-040, Rev.0, page A-99, $22,000 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 83,270 \mu\text{Ci/gal}$.
- 40) WHC-SD-EN-ES-040, Rev.0, page A-105.
- 41) Subtracted ^{137}Cs concentration from Total β concentration to get ^{90}Sr concentration.
- 42) WHC-SD-EN-ES-040, Rev.0, page A-105.
- 43) WHC-SD-EN-ES-040, Rev.0, page A-108.
- 44) WHC-SD-EN-ES-040, Rev.0, page A-111.
- 45) WHC-SD-EN-ES-040, Rev.0, page A-118, $187 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 708 \mu\text{Ci/gal}$.
- 46) WHC-SD-EN-ES-040, Rev.0, page A-118, $1.5 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 6 \mu\text{Ci/gal}$.
- 47) WHC-SD-EN-ES-040, Rev.0, page A-120, $57.3 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 217 \mu\text{Ci/gal}$.
- 48) WHC-SD-EN-ES-040, Rev.0, page A-120, $5.27 \mu\text{Ci/L} * 3.785 \text{ L/gal} = 20 \mu\text{Ci/gal}$.
- 49) If concentration is only given for sludge, then it is assumed that the Cesium concentration in the supernate is 10 times larger.

A.2 BASIS FOR FERROCYANIDE CRITERIA

Two spreadsheet calculations were performed to develop a quantitative basis for the ferrocyanide criteria. The first calculation defines what fraction of an inactive miscellaneous underground storage tank's (IMUST's) capacity would have had to leak to the specific IMUST to result in an 8 weight percent ferrocyanide mixture in the IMUST. The calculation was performed for only those IMUSTs that were identified in the engineering study (WHC 1994) as being in the ferrocyanide process routing path or as being suspected of containing ferrocyanide; this represented only eight IMUSTs (241-C-301, 241-T-301, 241-TX-302B(R), 241-TX-302B, 241-TY-302A, 244-BXR-002, 241-WR-001, and 241-WR-002).

The second calculation is a conservative center line temperature calculation based on an assumed line source of the ^{90}Sr and ^{137}Cs contents estimated to be in a specific IMUST. A subsequent calculation is being documented as this report is being drafted. This calculation is a more realistic waste temperature calculation that considers the dispersion of the radionuclide heat sources throughout the waste. The results of this calculation indicate that *temperature is not of concern for any of the tanks with radionuclide heat source data*. Documentation of this more realistic waste temperature calculation will be completed by the end of September 1995.

Ferrocyanide Calculations

The formula used in the spreadsheet for calculating gallons of ferrocyanide scavenged solution that would have had to leak to create 8 weight percent in the IMUST is as follows:

gallons	=	gal
liters	=	L
milliliters	=	mL
grams	=	gm

$(A \text{ gal})(3.785 \text{ L/gal})(1000 \text{ mL/L})(B \text{ gm/mL})(C)(D)(1 \text{ gm-mole Na}_2\text{NiFe(CN)}_6/317 \text{ gm})/(E \text{ gm-mole/L})(3.785 \text{ L/gal}) = F \text{ gallons of leaked ferrocyanide waste solution}$

A	=	volume of solid waste in the specific IMUST
B	=	density of solid waste in the specific IMUST
C	=	fraction of solid's weight that is not water
D	=	fraction of solid's weight that is ferrocyanide (0.08) to be potentially reactive
E	=	molarity of ferrocyanide solution used in scavenging
F	=	gallons of ferrocyanide waste solution contributing to 8 weight percent of solids

NOTE: $^{137}\text{Cs}_2\text{NiFe(CN)}_6$ would have precipitated in the tanks, but $\text{Na}_2\text{NiFe(CN)}_6$ would also have precipitated. There is probably 1,000 times more $\text{Na}_2\text{NiFe(CN)}_6$ than $^{137}\text{Cs}_2\text{NiFe(CN)}_6$ due to the excess of $\text{Na}_4\text{Fe(CN)}_6$ used in the process, so $\text{Na}_2\text{NiFe(CN)}_6$ should be used to calculate the number of gm-moles represented by 8 weight percent of the sludge.

Thus, for a miscellaneous waste tank containing 450 gallons of sludge, a sludge density of 1.29 grams/milliliter, 40 percent free water (60 percent water free solids), and 0.005 molar concentration of $\text{Na}_4\text{Fe}(\text{CN})_6$, the gallons of solution to yield 8 weight percent ferrocyanide solids is 17,596.

This amount of leakage into a 17,000-gallon-capacity miscellaneous tank over about a one-year period does not seem incredible.

The formula used in the spreadsheet for calculating the fraction of IMUST capacity that is represented by the F gallons ferrocyanide solution is as follows:

$$F \text{ gallons} / (G \text{ gallons, capacity of an IMUST}).$$

The above calculations for the eight tanks suspected to have ferrocyanide waste are represented in Table A-3.

If an IMUST suspected of containing ferrocyanide waste was calculated to have a fraction of capacity of less than 2.00 or there was not enough data to perform the calculation, the IMUST was considered to have an 8 weight percent ferrocyanide solids content for ranking purposes. The calculated fraction of capacity of less than 2.00 conservatively indicates that the IMUST would have had to have been filled to capacity twice to yield an 8 weight percent ferrocyanide solids content. The value of 2.00 was chosen as a conservative value because the catch-tank-type IMUSTs were not expected to ever receive twice their capacity as spillage during ferrocyanide operations.

Temperature Calculations

The formulas used in the spreadsheet to calculate the center line temperature are as follows:

$$B\text{-sol} = [((\text{Sr-sol} * \text{Sol}) * \text{SR}) + ((\text{Cs-sol} * \text{Sol}) * \text{CS})] / 1,000,000$$

$$B\text{-sup} = [((\text{Sr-sup} * \text{Sup}) * \text{SR}) + ((\text{Cs-sup} * \text{Sup}) * \text{CS})] / 1,000,000$$

NOTE: Division by 1,000,000 converts μCi to Ci

$$\begin{aligned} B\text{-sol} &= \text{Heat rate of the solids (Btu/hr) due to } ^{90}\text{Sr} \text{ and } ^{137}\text{Cs} \\ B\text{-sup} &= \text{Heat rate of the supernate (Btu/hr) due to } ^{90}\text{Sr} \text{ and } ^{137}\text{Cs} \end{aligned}$$

$$\begin{aligned} \text{Sr-sol} &= ^{90}\text{Sr} \text{ concentration in solids in } \mu\text{Ci/gal} \\ \text{Sol} &= \text{volume of solids in gallons} \\ \text{SR} &= 0.0229 \text{ Btu/hr-Ci (heat rate per Ci for } ^{90}\text{Sr)} \\ \text{Cs-sol} &= ^{137}\text{Cs} \text{ concentration in solids in } \mu\text{Ci/gal} \\ \text{CS} &= 0.0161 \text{ Btu/hr-Ci (heat rate per Ci for } ^{137}\text{Cs)} \\ \text{Sr-sup} &= ^{90}\text{Sr} \text{ concentration in supernate in } \mu\text{Ci/gal} \\ \text{Sup} &= \text{volume of supernate in gallons} \\ \text{Cs-sup} &= ^{137}\text{Cs} \text{ concentration in supernate in } \mu\text{Ci/gal} \end{aligned}$$

Table A-3. Spreadsheet Results of Ferrocyanide Calculations.

MUST-FeC.WQ1	Assumptions: Default density = 1.29 gm/mL Default % H ₂ O in Solids = 40% Default concentration of Na ₂ Fe(CN) ₆ = 0.005 gm-moles/L									
	Nominal capacity (gal)	Solids volume (gal)	Supernate volume (gal)	Total waste volume (gal)	Density of solids (gm/mL)	% H ₂ O in solids	Moles of Na ₂ NiFe(CN) ₆ (gm-moles)	Concentration of Na ₂ Fe(CN) ₆ (moles/L)	Gallons leaked to get 8 wt% (gal)	Fraction of capacity to have leaked
241-C-301	36000	9016	1470	10486			6666	0.005	352221	9.78
241-T-301	36000	21658	588	22246			16012	0.0025	1692194	47.01
241-TX-302B(R)	12000	no data	no data	0			0	0.0025	0	0.00
241-TX-302B	17684	no data	no data	1320			0	0.0025	0	0.00
241-TY-302A	17684	450	0	450			0		0	0.99
244-BXR-002	15000	1805	380	2185			1334	0.0025	141029	9.40
241-WR-001	50000	minimal?	minimal?	0			0	0.0025	0	0.00
241-WR-002	50000	minimal?	minimal?	0			0	0.0025	0	0.00

The following formula assumes the heat generation is from a line source on the center line of the vertical cylindrical tank. The formula below was derived for application to a hollow cylinder but is used assuming the line source is contained within a hollow cylinder of 0.01-foot radius:

$$\Delta T = q * \Delta r / (k * A_{lm})$$

- ΔT = difference in temperature between center line temperature and the temperature at the outside of the cylinder (or tank), assuming the temperature at the outside of the tank is 13 °C (55 °F)
- Δr = difference in radius between "hollow cylinder" radius (0.01 foot) and the radius of the outside of the cylinder (or tank)
- k = thermal conductivity of the solid waste (Btu/hr-ft- °F), assumed to be 0.25 Btu/hr-ft- °F for dry solids from Rockwell report (Campbell 1981, page 24)
- A_{lm} = log mean area normal to heat flow, $(A_2 - A_1)/[\ln(A_2/A_1)]$
- A_2 = is the perimeter of the tank times the solid waste height in the tank,
- A_1 = is the perimeter of the 'hollow cylinder' of the line source times the solid waste height in the tank. For tanks that were horizontal cylindrical tanks or rectangular tanks, some modifications were made to the above formula to represent these tanks as if they were vertical cylindrical tanks. The radius of the tank was taken as 1/2 of the longest dimension (either length for horizontal cylinder or length of rectangular tank). The waste heights in horizontal tanks were calculated by dividing the volume of solids in the tank by the planar area of the tank. The planar area is defined as the length times the diameter of a horizontal tank.

The calculations of the conservative (higher than real) center line temperature are represented in Table A-4 as the temperature change above 13 °C (55 °F). Where there are blanks in the table, no data were available for performing the calculation. Again, it is noted that a more realistic waste temperature calculation is being documented that indicates that temperature is of no concern for the IMUSTs. This calculation will be documented after this report has been released; therefore, the calculation can't be referenced in this report. The results of this more realistic waste temperature calculation are represented in Table A-5 as modifications of the conservative center line calculations.

Table A-4. Spreadsheet Results of Conservative Center Line Temperature Calculation. (4 pages)

MUST-HEA.WQ1		Assumptions: 0.01 All heat from sludge and supernate is located as a vertical line source in the sludge with radius of 0.01 ft 0.25 Thermal conductivity of solid waste (Btu/hr-ft-F) 0.0229 ⁹⁰ Sr heat rate per Ci (Btu/hr-Ci) 0.0161 ¹³⁷ Cs heat rate per Ci (Btu/hr-Ci)												
Tanks	Solids heat rate (Btu/hr)	Supernate heat rate (Btu/hr)	Total heat rate (Btu/hr)	ΔT above 13 °C (55 °F)	Dia. of vert. tank (ft)	Longest dimension of horiz. or rectang. tank (ft)	Perimeter of horiz. or rectang. tanks (ft)	Planar area of tank (ft ²)	Solid volume (gal)	Super-nate volume (gal)	⁹⁰ Sr conc. in solids (μCi/gal)	⁹⁰ Sr conc. in supernate (μCi/gal)	¹³⁷ Cs conc. in solids (μCi/gal)	¹³⁷ Cs conc. in supernate (μCi/gal)
241-A-302B						30	76.0	240	no data	no data				
241-B-301B	0.0	0.1	0.1	0.1	20				21660	590				11400
241-B-302B						35.79	89.6	322	690	4240				
241-BX-302A	0.1	0.0	0.1	2.4		36	90.0	324	835	0	7190	719		358
241-BX-302B						18	56.0	180	950	94				
241-BX-302C						18	56.0	180	635	228				
241-C-301C	3.5	0.7	4.2	4.8	20				9016	1470	17000	1700		25500
240-S-302						36	90.0	324	no data	no data				
241-S-302A						35.79	89.4	319	no data	no data				
241-S-302B						32.33	82.7	291	0	0				
241-SX-302						35.79	89.6	322	1050	305				
241-T-301	1.5	0.0	1.5	0.7	20				21658	588	3040	304		1600
241-TX-302A	0.3	0.0	0.3	1.5		35.79	89.6	322	2450	30	4540	454		48
241-TX-302B(R)						32.79	81.6	262	no data	no data				
241-TX-302B						35.79	89.6	322	no data	no data				
241-TX-302X						28.83	75.7	260	108	245				
241-TY-302A						35.79	89.6	322	450	0				
241-TY-302B						32.33	82.7	291	0	0				

Table A-4. Spreadsheet Results of Conservative Center Line Temperature Calculation. (4 pages)

MUST-HEA.WQ1		Assumptions: 0.01 All heat from sludge and supernate is located as a vertical line source in the sludge with radius of 0.01 ft 0.25 Thermal conductivity of solid waste (Btu/hr-ft-F) 0.0229 ⁹⁰ Sr heat rate per Ci (Btu/hr-Ci) 0.0161 ¹³⁷ Cs heat rate per Ci (Btu/hr-Ci)												
Tanks	Solids heat rate (Btu/hr)	Supernate heat rate (Btu/hr)	Total heat rate (Btu/hr)	ΔT above 13 °C (55 °F)	Dia. of vert. tank (ft)	Longest dimension of horiz. or rectang. tank (ft)	Perimeter of horiz. or rectang. tanks (ft)	Planar area of tank (ft ²)	Solid volume (gal)	Super-nate volume (gal)	⁹⁰ Sr conc. in solids (μCi/gal)	⁹⁰ Sr conc. in supernate (μCi/gal)	¹³⁷ Cs conc. in solids (μCi/gal)	¹³⁷ Cs conc. in supernate (μCi/gal)
270-E-1					9				3800	0				
270-W					9				no data	no data				
241-B-361	55.5	0.0	55.5	27.7	20				20678	0	112301		684	68360
241-T-361	256.0	0.0	256.0	108.0	20				24500	0	1149	115	64734	6473410
241-U-361	39.7	0.0	39.7	14.8	20				27734	98	27634	2763	4963	496290
241-Z-361						26	78.0	338	20000	200				
241-Z-8						40	96.0	320	500	0				
231-W-151-001		0.0	0.0	ERR	9				0	1430		32		0.12
231-W-151-002	0.0	0.0	0.0	0.0	5				12	955	0.0015	0.0265	0.0011	0.00643
241-CX-70				ERR	20				0	0				
241-CX-71	0.0	0.0	0.0	0.0	5				930		160	16		6
241-CX-72					3.33				653	0				
244-BXR-001	57.5	0.0	57.5	82.4	20				7215	0	348220	34822		38229
244-BXR-002	1.6	0.0	1.6	4.3	14				1805	380	38270	3827		1964
244-BXR-003	105.3	2.7	108.1	358.1	14				1449	356	3174480	317448		22824
244-BXR-011	37.8	0.1	37.8	55.7	20				7020	98	183673	18367	72795	7280
244-TXR-001	0.0	0.0	0.1	0.2	20				2291	49	750	75		16995
244-TXR-002	0.0		0.0	0.0	14				2945	0	380	38		83270

Table A-4. Spreadsheet Results of Conservative Center Line Temperature Calculation. (4 pages)

MUST-HEA.WQ1		Assumptions: 0.01 All heat from sludge and supernate is located as a vertical line source in the sludge with radius of 0.01 ft 0.25 Thermal conductivity of solid waste (Btu/hr-ft-F) 0.0229 ⁹⁰ Sr heat rate per Ci (Btu/hr-Ci) 0.0161 ¹³⁷ Cs heat rate per Ci (Btu/hr-Ci)												
Tanks	Solids heat rate (Btu/hr)	Supernate heat rate (Btu/hr)	Total heat rate (Btu/hr)	ΔT above 13 °C (55 °F)	Dia. of vert. tank (ft)	Longest dimension of horiz. or rectang. tank (ft)	Perimeter of horiz. or rectang. tanks (ft)	Planar area of tank (ft ²)	Solid volume (gal)	Super-nate volume (gal)	⁹⁰ Sr conc. in solids (μCi/gal)	⁹⁰ Sr conc. in supernate (μCi/gal)	¹³⁷ Cs conc. in solids (μCi/gal)	¹³⁷ Cs conc. in supernate (μCi/gal)
244-TXR-003	0.0		0.0	0.0	14				6460	0				
244-UR-001	0.6	0.0	0.6	3.4	20				1852	390	14000	1400		1800
244-UR-002	0.0	0.0	0.0	0.0	14				2304	570	220	22		670
244-UR-003	1.3	0.0	1.3	4.1	14				1568	0	37000	3700		950
244-UR-004	0.0	0.0	0.0	ERR	10				0	0				
241-WR-001				ERR	20				minimal?	minimal?	7080	708		6
241-WR-002				ERR	20				minimal?	minimal?	2170	217		20
241-WR-003					20				minimal?	minimal?				
241-WR-004					20				minimal?	minimal?				
241-WR-005					20				minimal?	minimal?				
241-WR-006					20				minimal?	minimal?				
241-WR-007					20				minimal?	minimal?				
241-WR-008					20				minimal?	minimal?				
241-WR-009					20				minimal?	23000				

Table A-5. Modification of Conservative Center Line Temperature Calculation by More Realistic Axisymmetric Thermal Model Results.

Tanks	Conservative center line calculation ΔT ($^{\circ}\text{F}$) above 55 $^{\circ}\text{F}$	More realistic axisymmetric thermal model modification factor	More realistic estimate of ΔT ($^{\circ}\text{F}$) above 55 $^{\circ}\text{F}$	More realistic estimate of ΔT ($^{\circ}\text{C}$) above 13 $^{\circ}\text{C}$
241-B-301B	0.1	1/6	0.0	0.0
241-BX-302A	2.4	1/6	0.4	0.2
241-C-301C	4.8	1/6	0.8	0.4
241-T-301	0.7	1/6	0.1	0.1
241-TX-302A	1.5	1/6	0.3	0.1
241-B-361	27.7	1/6	4.5	2.6
241-T-361	108.0	1/6	18.0	10.0
241-U-361	14.8	1/6	2.5	1.4
231-W-151-002	0.0	1/6	0.0	0.0
241-CX-71	0.0	1/6	0.0	0.0
244-BXR-001	82.4	1/6	13.7	7.6
244-BXR-002	4.3	1/6	0.7	0.4
244-BXR-003	358.1	1/6	59.7	33.2
244-BXR-011	55.7	1/6	9.3	5.2
244-TXR-001	0.2	1/6	0.0	0.0
244-TXR-002	0.0	1/6	0.0	0.0
244-TXR-003	0.0	1/6	0.0	0.0
244-UR-001	3.4	1/6	0.6	0.3
244-UR-002	0.0	1/6	0.0	0.0
244-UR-003	4.1	1/6	0.7	0.4

A.3 BASIS FOR ORGANIC SALTS CRITERIA

Two spreadsheet calculations were performed to develop a quantitative basis for the organic salts criteria. The first calculation defines the percent of total organic carbon (TOC) in each of the waste types (WT) suspected to have been received by any of the IMUSTs as noted in Appendix A of the engineering study (WHC 1994). The compositions of the various waste types represented in the engineering study are found in Appendix A of a Westinghouse Hanford Company report (WHC 1991). The second calculation is a conservative center line temperature calculation based on an assumed line source of the ^{90}Sr and ^{137}Cs contents estimated to be in a specific IMUST.

The formulas used in the spreadsheet for first calculation are as follows:

$$\Sigma(X_i * Y_i) = \Sigma Z_i$$

X_i = atomic weight (gm/gm-mole) for each (i) element, ion or molecule in the composition of the waste type

Y_i = concentration (in gm-moles/L) for each (i) element, ion or molecule in the composition of the waste type

Z_i = concentration (gm/L) for each (i) element, ion or molecule in the composition of the waste type

ΣZ_i = total grams in one liter of waste type

$$\{\Sigma(X_c/X_i)(Z_i)\}/\{\Sigma Z_i\} * 100 = V$$

X_c = atomic weight (gm/gm-mole) for the carbon in the organic molecules that were part of the composition of the waste type

V = percentage of carbon in the waste type composition as a measure of percent TOC

The calculations of percent of TOC in each waste type are represented in Table A-6. Table A-7 indicates which IMUSTs contain which waste types that could contribute to TOC. The prioritizing criteria for total organic carbon, 4.5 percent, is found in the Fauske document (Fauske & Associates 1995).

The second calculation of the conservative (higher than real) center line temperature is described in Section A.2 and shown in Table A-4 in the previous section, Section A.2, as the temperature change above 13 °C (55 °F). Blanks in the table indicate no data were available for performing the calculation. Again, it is noted that a more realistic waste temperature calculation is being documented that indicates that temperature is of no concern for the IMUSTs. This calculation will be documented after this report has been released; therefore, the calculation can't be referenced in this report. The results of this more realistic waste temperature calculation are represented in Table A-5 as modifications of the conservative center line calculations.

Table A-6. Spreadsheet Results of Total Organic Carbon in Waste Types. (2 pages)

toc-cal.wq1		B-WT		BL-WT		SSW-WT		224-WT		Z-WT	
Element	Atomic weight	conc. (moles/L)	conc. (grams/L)	conc. (moles/L)	conc. (grams/L)	conc. (moles/L)	conc. (grams/L)	conc. (moles/L)	conc. (grams/L)	conc. (moles/L)	conc. (grams/L)
Al	27	0.079	2.13	0.55	14.85					0.5	13.50
Ba	137	0.000032				0.0002	0.03			0.000003	0.00
Bi	209							0.0062	1.30		
Ca	40	0.0001	0.00	0.000005	0.00	0.0049	0.20			0.00071	0.03
Ce	140					0.0017	0.24				
C2H3O2	59					1.34	79.06				
C6H5O7	189	0.12	22.68	0.92	173.88						
Cl	35.5									0.041	1.46
CO3	60			2.61	156.60						
Cr	52	0.002	0.10					0.0009	0.05	0.0014	0.07
F	19							0.31	5.89	0.047	0.89
Fe	56	0.0029	0.16			0.03	1.68			0.0007	0.04
H2C2O4	90							0.028	2.52		
K	39					0.078	3.04	0.26	10.14	0.0007	0.03
La	139							0.0014	0.19		
Mg	24									0.000021	0.00
Mn	55	0.00029	0.02	0.0029	0.16			0.0046	0.25	0.0007	0.04
Na	23	1.29	29.67	5.55	127.65	4.9	112.70	1.75	40.25	4	92.00
Ni	59	0.002	0.12	0.0092	0.54					0.00057	0.03
NO2	46									0.014	0.64

Table A-6. Spreadsheet Results of Total Organic Carbon in Waste Types. (2 pages)

toc-cal.wq1		B-WT		BL-WT		SSW-WT		224-WT		Z-WT	
Element	Atomic weight	conc. (moles/L)	conc. (grams/L)	conc. (moles/L)	conc. (grams/L)	conc. (moles/L)	conc. (grams/L)	conc. (moles/L)	conc. (grams/L)	conc. (moles/L)	conc. (grams/L)
NO3	62	1.27	78.74	5.28	327.36	2.1	130.20	1.06	65.72	3.5	217.00
OH	17					1.32	22.44	0.59	10.03	0.0001	0.00
Pb	207			0.014	2.90	0.034	7.04			0.00036	0.07
PO4	95							0.049	4.66	0.00014	0.01
Pu	239	0.000001	0.00	0.00087	0.21						
Re	186					0.0069	1.28				
106Ru	106	0.000003	0.00								
SiO3	76			0.0029	0.22						
SO4	96									0.0014	0.13
Sr	88					0.0005	0.04			0.000021	0.00
Tc	43	0.000048	0.00								
TOC											3.00
TRU	240									0.00006	0.01
U	238	0.0029	0.69	0.37	88.06					0.00001	0.00
Zr	91	0.000048	0.00								
			134.32		892.43		357.95		141.00		328.98
wt% TOC			6.43		7.42		8.98		0.48		0.91

Table A-7. IMUSTs Containing Potential Organic Wastes. (2 pages)

MUST-ORG.WQ1	Waste types (WT) containing organics that contribute to total organic carbon (TOC)					Analysis shows TOC < 3%
	WTs with TOC > 3%			WTs with TOC < 3%		
	B-WT	BL-WT	SSW-WT	224-WT	Z-WT	
241-A-302B	X					
241-B-301B		X		X		
241-B-302B	X	X				
241-BX-302A						YES
241-BX-302B	X	X				
241-BX-302C		X		X		
241-C-301		X	X			
240-S-302	X	X		X		
241-S-302A	X	X		X		
241-S-302B						empty
241-SX-302	X	X		X		
241-T-301		X		X		
241-TX-302A	X	X				
241-TX-302B(R)				X		
241-TX-302B	X	X		X		
241-TX-302X	X	X				
241-TY-302A		X				
241-TY-302B		X				empty
270-E-1						
270-W						
241-B-361						
241-T-361	Volatiles & semivolatiles indicated					
241-U-361	Semivolatile organics (kerosene, TBP) & volatile organics indicated					
241-Z-361	TBP, DBP & ion exchange resin indicated					YES
241-Z-8						
231-W-151-001						
231-W-151-002						
241-CX-70						empty
241-CX-71	Organic compounds found in tank, salts likely to exist					
241-CX-72						
244-BXR-001	Small amounts of organics exist in tank					
244-BXR-002	Organic salts may exist					
244-BXR-003	Organic salts may exist					

Table A-7. IMUSTs Containing Potential Organic Wastes. (2 pages)

MUST-ORG.WQ1	Waste types (WT) containing organics that contribute to total organic carbon (TOC)					Analysis shows TOC < 3%
	WTs with TOC > 3%			WTs with TOC < 3%		
	B-WT	BL-WT	SSW-WT	224-WT	Z-WT	
244-BXR-011						YES
244-TXR-001						
244-TXR-002						
244-TXR-003						
244-UR-001	TBP containing waste in this tank					
244-UR-002	TBP containing waste in this tank					
244-UR-003	TBP containing waste in this tank					
244-UR-004						empty
241-WR-001						minimal waste left
241-WR-002						minimal waste left
241-WR-003						minimal waste left
241-WR-004						minimal waste left
241-WR-005						minimal waste left
241-WR-006						minimal waste left
241-WR-007						minimal waste left
241-WR-008						minimal waste left
241-WR-009						
276-S-141 (276-S-306A)						
276-S-142 (276-S-306B)						
241-ER-311A						
241-AX-151						
216-TY-201						
216-BY-201						
242-TA-R1						
242-T-135						
243S-TK-1						
213-W-TK-1						

APPENDIX A

REFERENCES

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APPENDIX B

BASES RELATED TO POTENTIAL PRIORITY 2 SAFETY ISSUES

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APPENDIX B**BASES RELATED TO POTENTIAL PRIORITY 2 SAFETY ISSUES****B.1 BASIS FOR CRITICALITY CRITERIA**

A spreadsheet calculation represents an estimate of the plutonium concentration in the solid wastes in the IMUSTs. The formulas used in the spreadsheet for this calculation really just convert sample analysis data to a consistent basis of grams plutonium per liter. The liter measure represents solids if just solid sample data exists, supernate if just supernate sample data exists, or total waste if both solid and supernate sample data exist.

If solid sample data exist in the form of $\mu\text{Ci/gm}$, then a density value must exist to convert the sample data to $\mu\text{Ci/mL}$. This value is then converted to gm/L by dividing by the specific activity for ^{239}Pu ($6.13 \times 10^{-2} \text{ Ci/gm}$) and using conversion factors for μCi to Ci and mL to L .

If solid sample data exist in the form of gm of plutonium/ gm of waste solids, then a density value must exist to convert the sample data to g/mL . This value is then converted to gm/L by using the conversion factor for mL to L .

If liquid sample data exist in the form of $\mu\text{Ci/mL}$ or $\mu\text{Ci/L}$, they are then converted to gm/L by dividing by the specific activity for ^{239}Pu ($6.13 \times 10^{-2} \text{ Ci/gm}$) and using conversion factors for μCi to Ci and mL to L , as necessary.

If liquid sample data exist in the form of gm/gal , then they are converted to gm/L by multiplying by the conversion factor of 1 gal per 3.785 L.

If liquid sample data exist in the form of $\mu\text{gm/L}$, then they are converted by multiplying by 1 gm per 1,000,000 μgm .

The calculations of the plutonium concentration in gm/L from sample data are shown in Table B-1. Blanks in the table indicate no sample data were available for performing the calculation.

A criticality safety evaluation report (CSER) is being written related to 62 of the 63 IMUSTs (excluding 241-Z-361, which has its own CSER) as this report is being written. The CSER on the 62 IMUSTs has the following title and document number and is estimated to be finished by the end of October 1995: *Criticality Safety Evaluation Analysis for Inactive Miscellaneous Underground Tanks*, WHC-SD-SQA-SCS-30004.

Table B-1. Spreadsheet Results of Plutonium Concentrations Based on Sample Data. (4 pages)

MUST-CRT.WQ1			Assumptions: 0.0613 curies of ²³⁹ Pu per gram									
Tanks	Total Pu (kg)	Pu conc. (g/L)	Nominal capacity (gal)	Solids volume (gal)	Supernate volume (gal)	Total waste (gal)	Vapor space volume (gal)	Void %	Pu conc. in solids	<--Units	Pu conc. in supernate	<--Units
241-A-302B			13500	no data	no data	3600	13500	100				
241-B-301B	3.88E-07	1.74E-07	36000	21660	590	22250	13750	38			6.58E-07	g/gal
241-B-302B			17684	690	4240	4930	12754	72				
241-BX-302A	0.00	6.55E-08	17684	835	0	835	16849	95			6.55E-08	g/L
241-BX-302B			11389	950	94	1044	10345	91				
241-BX-302C			11378	635	228	863	10515	92				
241-C-301	9.67E-07	1.74E-07	36000	9016	1470	10486	25514	71			6.58E-07	g/gal
240-S-302			17684	no data	no data	2276	17684	100				
241-S-302A			17684	no data	no data	5130	17684	100				
241-S-302B			14314	0	0	0	14314	100				
241-SX-302			17684	1050	305	1355	16329	92				
241-T-301	3.87E-07	1.74E-07	36000	21658	588	22246	13754	38			6.58E-07	g/gal
241-TX-302A			17684	2450	30	2480	15204	86				
241-TX-302B(R)			12000	no data	no data	0	12000	100				
241-TX-302B			17684	no data	no data	1320	17684	100				
241-TX-302X			14314	108	245	353	13961	98				
241-TY-302A			17684	450	0	450	17234	97				
241-TY-302B			14314	0	0	0	14314	100				
270-E-1			4185	3800	0	3800	385	9				
270-W			3780	no data	no data	0	3780	100				

Table B-1. Spreadsheet Results of Plutonium Concentrations Based on Sample Data. (4 pages)

MUST-CRT.WQ1			Assumptions: 0.0613 curies of ²³⁹ Pu per gram									
Tanks	Total Pu (kg)	Pu conc. (g/L)	Nominal capacity (gal)	Solids volume (gal)	Supernate volume (gal)	Total waste (gal)	Vapor space volume (gal)	Void %	Pu conc. in solids	<--Units	Pu conc. in supernate	<--Units
241-B-361	5.60	0.072	36000	20678	0	20678	15322	43	3.4	μCi/g @1.29g/mL	6.10E-07	μCi/mL
241-T-361	5.40	0.058	36000	24500	0	24500	11500	32	0.000023	g/g @ 2.53g/mL		
241-U-361	2.53E-06	2.41E-08	36000	27734	98	27832	8168	23	9.97E-07	μCi/g @1.49g/mL		
241-Z-361	54.50	0.72	40500	20000	200	20200	20300	50	0.72	g/L		
241-Z-8	1.44	0.76	15435	500	0	500	14935	97	0.76	g/L		
231-W-151-001	2.56E-07	4.73E-08	4000	0	1430	1430	2570	64			0.0029	μCi/L
231-W-151-002	0.23	0.06*	1000	12	955	967	33	3			101	μCi/g @3.05g/mL
241-CX-70			30000	0	0	0	30000	100				
241-CX-71			1000	930		930	70	7				
241-CX-72	0.20	0.08*	2300	653	0	653	1647	72				
244-BXR-001			50000	7215	0	7215	42785	86				
244-BXR-002			15000	1805	380	2185	12815	85				
244-BXR-003			15000	1449	356	1805	13195	88				
244-BXR-011	0.01	0.00021	50000	7020	98	7118	42882	86	3.78E-07	g/g @0.564g/mL		
244-TXR-001			50000	2291	49	2340	47660	95				
244-TXR-002	8.03E-06	7.20E-07	15000	2945	0	2945	12055	80			0.72	ug/L
244-TXR-003			15000	6460	0	6460	8540	57				

Table B-1. Spreadsheet Results of Plutonium Concentrations Based on Sample Data. (4 pages)

MUST-CRT.WQ1			Assumptions: 0.0613 curies of ²³⁹ Pu per gram									
Tanks	Total Pu (kg)	Pu conc. (g/L)	Nominal capacity (gal)	Solids volume (gal)	Supernate volume (gal)	Total waste (gal)	Vapor space volume (gal)	Void %	Pu conc. in solids	<--Units	Pu conc. in supernate	<--Units
244-UR-001			50000	1852	390	2242	47758	96				
244-UR-002	3.04E-06	0.000001	15000	2304	570	2874	12126	81			0.000005	g/gal
244-UR-003			15000	1568	0	1568	13432	90				
244-UR-004			8230	0	0	0	8230	100				
241-WR-001	0.00	0.000001	50000	minimal?	minimal?	0	50000	100			0.000001	g/L
241-WR-002	0.00	7.22E-07	50000	minimal?	minimal?	0	50000	100			7.22E-07	g/L
241-WR-003			50000	minimal?	minimal?	0	50000	100				
241-WR-004			50000	minimal?	minimal?	0	50000	100				
241-WR-005			50000	minimal?	minimal?	0	50000	100				
241-WR-006			50000	minimal?	minimal?	0	50000	100				
241-WR-007			50000	minimal?	minimal?	0	50000	100				
241-WR-008			50000	minimal?	minimal?	0	50000	100				
241-WR-009			50000	minimal?	23000	23000	27000	54				
276-S-141 (276-S-306A)			23000	no data	<200	<200	22800	99				
276-S-142 (276-S-306B)			23000	no data	<200	<200	22800	99				
241-ER-311A			no data	no data	no data	no data	no data	no data				
241-AX-151			no data	no data	no data	no data	no data	no data				
216-TY-201			no data	no data	no data	no data	no data	no data				

Table B-1. Spreadsheet Results of Plutonium Concentrations Based on Sample Data. (4 pages)

MUST-CRT.MQ1		Assumptions: 0.0613 curies of ²³⁹ Pu per gram										
Tanks	Total Pu (kg)	Pu conc. (g/L)	Nominal capacity (gal)	Solids volume (gal)	Supernate volume (gal)	Total waste (gal)	Vapor space volume (gal)	Void %	Pu conc. in solids	<--Units	Pu conc. in supernate	<--Units
216-BY-201			no data	no data	no data	no data	no data	no data				
242-TA-R1			no data	no data	no data	no data	no data	no data				
242-T-135			no data	no data	no data	no data	no data	no data				
243S-TK-1			no data	no data	no data	no data	no data	no data				
213-W-TK-1			no data	no data	1875"	0"	0"	0"				
216-BC-201			no data	no data	no data	no data	no data	no data				
292T-TK-1			55	no data	no data	no data	no data	no data				
292T-TK-2			55	no data	no data	no data	no data	no data				

NOTES:

*CALCULATED AS "X"kg of Total Pu/gal of Total Waste * 1000g/kg * gal/3.785L = "Y"g/L

" Supernate volume is all rainwater.

B.2 BASIS FOR VAPOR EMISSION CRITERIA

Because the vapor emission criteria consist of parts of the hydrogen generation, ferrocyanide reactivity, and organic reactivity criteria, Table B-2 below shows which parts resulted in the final ranking for each tank related to vapor emissions.

Table B-2. Basis for Vapor Emission Rankings. (5 pages)

Tanks	H ₂ years to 1%	FeCN	Organic	Vapor Emission
		> 8 wt% FeCN	> 4.5 wt% TOC	Ranking
241-A-302B	no data void space $\geq$ 50%	not in FeCN flowpath	Y-WT	H
	<u>L</u>	<u>L</u>	<u>H</u>	
241-B-301B	631	not in FeCN flowpath	Y-WT	H
	<u>L</u>	<u>L</u>	<u>H</u>	
241-B-302B	no data void space $\geq$ 50%	not in FeCN flowpath	Y-WT	H
	<u>L</u>	<u>L</u>	<u>H</u>	
241-BX-302A	609	not in FeCN flowpath	No-analysis	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-BX-302B	no data void space $\geq$ 50%	not in FeCN flowpath	Y-WT	H
	<u>L</u>	<u>L</u>	<u>H</u>	
241-BX-302C	no data void space $\geq$ 50%	not in FeCN flowpath	Y-WT	H
	<u>L</u>	<u>L</u>	<u>H</u>	
241-C-301C	30	No-9.78	Y-WT	H
	<u>L</u>	<u>M</u>	<u>H</u>	
240-S-302	no data void space $\geq$ 50%	not in FeCN flowpath	Y-WT	H
	<u>L</u>	<u>L</u>	<u>H</u>	
241-S-302A	no data void space $\geq$ 50%	not in FeCN flowpath	Y-WT	H
	<u>L</u>	<u>L</u>	<u>H</u>	
241-S-302B	empty	not in FeCN flowpath	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-SX-302	no data void space $\geq$ 50%	not in FeCN flowpath	Y-WT	H
	<u>L</u>	<u>L</u>	<u>H</u>	

Table B-2. Basis for Vapor Emission Rankings. (5 pages)

Tanks	H ₂ years to 1X	FeCN	Organic	Vapor Emission
		> 8 wt% FeCN	> 4.5 wt% TOC	Ranking
241-T-301	45	No-47.01	Y-WT	H
	<u>L</u>	<u>M</u>	<u>H</u>	
241-TX-302A	296	not in FeCN flowpath	Y-WT	H
	<u>L</u>	<u>L</u>	<u>H</u>	
241-TX-302B(R)	empty	empty	N-WT	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-TX-302B	no data void space $\geq$ 50%	no data	Y-WT	H
	<u>L</u>	<u>M</u>	<u>H</u>	
241-TX-302X	no data void space $\geq$ 50%	not in FeCN flowpath	Y-WT	H
	<u>L</u>	<u>L</u>	<u>H</u>	
241-TY-302A	no data void space $\geq$ 50%	Yes-0.99	Y-WT	H
	<u>L</u>	<u>H</u>	<u>H</u>	
241-TY-302B	empty	not in FeCN flowpath	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
270-E-1	no data void space $\leq$ 50%	not in FeCN flowpath	no data	M
	<u>M</u>	<u>L</u>	<u>M</u>	
270-W	no data void space $\geq$ 50%	not in FeCN flowpath	no data	M
	<u>L</u>	<u>L</u>	<u>M</u>	
241-B-361	1	not in FeCN flowpath	no data	H
	<u>H</u>	<u>L</u>	<u>M</u>	
241-T-361	0	not in FeCN flowpath	Y-indicated	H
	<u>H</u>	<u>L</u>	<u>H</u>	
241-U-361	1	not in FeCN flowpath	Y-indicated	H
	<u>H</u>	<u>L</u>	<u>H</u>	
241-Z-361	no data void space $\geq$ 50%	not in FeCN flowpath	No-analysis	M
	<u>L</u>	<u>L</u>	<u>M</u>	

Table B-2. Basis for Vapor Emission Rankings. (5 pages)

Tanks	H ₂ years to 1%	FeCN	Organic	Vapor Emission
		> 8 wt% FeCN	> 4.5 wt% TOC	Ranking
241-Z-8	no data void space $\geq$ 50%	not in FeCN flowpath	no data	M
	<u>L</u>	<u>L</u>	<u>M</u>	
231-W-151-001	12148	not in FeCN flowpath	no data	M
	<u>L</u>	<u>L</u>	<u>M</u>	
231-W-151-002	241361	not in FeCN flowpath	no data	M
	<u>L</u>	<u>L</u>	<u>M</u>	
241-CX-70	empty	not in FeCN flowpath	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-CX-71	102	not in FeCN flowpath	Y-indicated	H
	<u>L</u>	<u>L</u>	<u>H</u>	
241-CX-72	no data void space $\geq$ 50%	not in FeCN flowpath	no data	M
	<u>L</u>	<u>L</u>	<u>M</u>	
244-BXR-001	4	not in FeCN flowpath	Y-indicated	H
	<u>H</u>	<u>L</u>	<u>H</u>	
244-BXR-002	39	No-9.40	Y-indicated	H
	<u>L</u>	<u>M</u>	<u>H</u>	
244-BXR-003	1	not in FeCN flowpath	Y-indicated	H
	<u>H</u>	<u>L</u>	<u>H</u>	
244-BXR-011	5	not in FeCN flowpath	No-analysis	H
	<u>H</u>	<u>L</u>	<u>M</u>	
244-TXR-001	4480	not in FeCN flowpath	no data	M
	<u>L</u>	<u>L</u>	<u>M</u>	
244-TXR-002	2336	not in FeCN flowpath	no data	M
	<u>L</u>	<u>L</u>	<u>M</u>	
244-TXR-003	no data void space $\geq$ 50%	not in FeCN flowpath	no data	M
	<u>L</u>	<u>L</u>	<u>M</u>	
244-UR-001	384	not in FeCN flowpath	Y-indicated	H
	<u>L</u>	<u>L</u>	<u>H</u>	

Table B-2. Basis for Vapor Emission Rankings. (5 pages)

Tanks	H ₂ years to 1%	FeCN	Organic	Vapor Emission
		> 8 wt% FeCN	> 4.5 wt% TOC	Ranking
244-UR-002	3338	not in FeCN flowpath	Y-indicated	H
	<u>L</u>	<u>L</u>	<u>H</u>	
244-UR-003	50	not in FeCN flowpath	Y-indicated	H
	<u>L</u>	<u>L</u>	<u>H</u>	
244-UR-004	empty	not in FeCN flowpath	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-WR-001	empty	empty	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-WR-002	empty	empty	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-WR-003	empty	not in FeCN flowpath	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-WR-004	empty	not in FeCN flowpath	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-WR-005	empty	not in FeCN flowpath	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-WR-006	empty	not in FeCN flowpath	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-WR-007	empty	not in FeCN flowpath	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-WR-008	empty	not in FeCN flowpath	empty	L
	<u>L</u>	<u>L</u>	<u>L</u>	
241-WR-009	no data void space $\geq$ 50%	not in FeCN flowpath	no data	M
	<u>L</u>	<u>L</u>	<u>H</u>	
276-S-141 (276-S-306A)	no data void space $\geq$ 50%	no data	no data	M
	<u>L</u>	<u>H</u>	<u>H</u>	
276-S-142 (276-S-306B)	no data void space $\geq$ 50%	no data	no data	M
	<u>L</u>	<u>H</u>	<u>H</u>	

Table B-2. Basis for Vapor Emission Rankings. (5 pages)

Tanks	H ₂ years to 1%	FeCN	Organic	Vapor Emission
		> 8 wt% FeCN	> 4.5 wt% TOC	Ranking
241-ER-311A	no data	no data	no data	M
	<u>M</u>	<u>M</u>	<u>M</u>	
241-AX-151	no data	no data	no data	M
	<u>M</u>	<u>M</u>	<u>M</u>	
216-TY-201	no data	no data	no data	M
	<u>M</u>	<u>M</u>	<u>M</u>	
216-BY-201	no data	no data	no data	M
	<u>M</u>	<u>M</u>	<u>M</u>	
242-TA-R1	no data	no data	no data	M
	<u>M</u>	<u>M</u>	<u>M</u>	
242-T-135	no data	no data	no data	M
	<u>M</u>	<u>M</u>	<u>M</u>	
243S-TK-1	no data	no data	no data	M
	<u>M</u>	<u>M</u>	<u>M</u>	
213-W-TK-1	no data	no data	no data	M
	<u>M</u>	<u>M</u>	<u>M</u>	
216-BC-201	no data void space < 50%	no data	no data	M
	<u>M</u>	<u>M</u>	<u>M</u>	
292T-TK-1	no data void space < 50%	no data	no data	M
	<u>M</u>	<u>M</u>	<u>M</u>	
292T-TK-2	no data void space < 50%	no data	no data	M
	<u>M</u>	<u>M</u>	<u>M</u>	

NOTES:

1. Under the FeCN > 8 wt% FeCN column, a notation like "No-9.78" means that the tank was not considered to have > 8 wt% FeCN because the ratio of leakage to capacity of the tank would have had to have been "9.78" which is greater than the criteria of '2.00'.
2. Under the Organic > 4.5 wt% TOC column, a notation "Y-WT" means that the tank was considered to have > 4.5 wt% TOC because the waste types potentially received by the tank contained > 4.5 wt% TOC.
3. Under the Organic > 4.5 wt% TOC column, a notation "No-analysis" means that the tank was not considered to have > 4.5 wt% TOC because analysis indicated < 4.5 wt% TOC.
4. Under the Organic > 4.5 wt% TOC column, a notation "Y-indicated" means that the tank was considered to have > 4.5 wt% TOC because reference information indicated organics in the tank.

APPENDIX C

BASES FOR LEAK POTENTIAL (PRIORITY 3 SAFETY ISSUE) CRITERIA

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APPENDIX C

BASES FOR LEAK POTENTIAL (PRIORITY 3 SAFETY ISSUE) CRITERIA

To develop a quantitative basis for the leak potential criteria, information from the engineering study (WHC 1994) was used to tabulate the volume of supernate in each of the tanks. The basis for the 5,000-gallon supernate limit in the criteria is that 5,000 gallons is the level at which IMUSTs were considered to be interim stabilized when they were being isolated in the mid-1980's. This 5,000-gallon value for interim stabilization is discussed in a 1984 supporting document (Bell 1984). This tabulation is shown in Table C-1 below.

Table C-1. Supernate and Total Waste Volumes of IMUSTs. (3 pages)

Tanks	Supernate volume (gal)	Total waste volume (gal)
241-A-302B	no data	3600
241-B-301B	590	22250
241-B-302B	4240	4930
241-BX-302A	0	835
241-BX-302B	94	1044
241-BX-302C	228	863
241-C-301C	1470	10486
240-S-302	no data	2276
241-S-302A	no data	5130
241-S-302B	0	0
241-SX-302	305	1355
241-T-301	588	22246
241-TX-302A	30	2480
241-TX-302B(R)	no data	0
241-TX-302B	no data	1320
241-TX-302X	245	353
241-TY-302A	0	450
241-TY-302B	0	0
270-E-1	0	3800
270-W	no data	unknown

Table C-1. Supernate and Total Waste Volumes of IMUSTs. (3 pages)

Tanks	Supernate volume (gal)	Total waste volume (gal)
241-B-361	0	20678
241-T-361	0	24500
241-U-361	98	27832
241-Z-361	200	20200
241-Z-8	0	500
231-W-151-001	1430	1430
231-W-151-002	955	967
241-CX-70	0	0
241-CX-71	no data	930
241-CX-72	0	653
244-BXR-001	0	7215
244-BXR-002	380	2185
244-BXR-003	356	1805
244-BXR-011	98	7118
244-TXR-001	49	2340
244-TXR-002	0	2945
244-TXR-003	0	6460
244-UR-001	390	2242
244-UR-002	570	2874
244-UR-003	0	1568
244-UR-004	0	0
241-WR-001	minimal?	0
241-WR-002	minimal?	0
241-WR-003	minimal?	0
241-WR-004	minimal?	0
241-WR-005	minimal?	0
241-WR-006	minimal?	0
241-WR-007	minimal?	0
241-WR-008	minimal?	0

Table C-1. Supernate and Total Waste Volumes of IMUSTs. (3 pages)

Tanks	Supernate volume (gal)	Total waste volume (gal)
241-WR-009	23000	23000
276-S-141 (276-S-306A)	<200	<200
276-S-142 (276-S-306B)	<200	<200
241-ER-311A	no data	no data
241-AX-151	no data	no data
216-TY-201	no data	no data
216-BY-201	no data	no data
242-TA-R1	no data	no data
242-T-135	no data	no data
243S-TK-1	no data	no data
213-W-TK-1	1875*	0*
216-BC-201	no data	no data
292T-TK-1	no data	no data
292T-TK-2	no data	no data

* Supernate volume is all rainwater.

APPENDIX C

REFERENCES

Bell, N. E., 1984, *Guideline for Declaring Auxiliary Tanks Interim Stabilized*, WHC-SD-WM-TI-129, Rev. 0, Rockwell Hanford Company, Richland, Washington.

WHC, 1994, *Engineering Study of 50 Miscellaneous Inactive Underground Radioactive Waste Tanks Located at the Hanford Site, Washington*, WHC-SD-EN-ES-040, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

APPENDIX D

BASES FOR RADIOLOGICAL HAZARDS (OPERATIONAL CONCERN) CRITERIA

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APPENDIX D**BASES FOR RADIOLOGICAL HAZARDS (OPERATIONAL CONCERN) CRITERIA**

To develop a quantitative basis for the radiological hazards criteria, the analyst performed a spreadsheet calculation. This calculation quantifies the estimated amount of ^{137}Cs in a specific IMUST. The formula used in the spreadsheet for this calculation is as follows:

$$B = (\text{Cs-sol} * \text{Sol} + \text{Cs-sup} * \text{Sup}) / 1,000,000$$

NOTE: Division by 1,000,000 converts μCi to Ci.

Cs-sol	=	^{137}Cs concentration in solids in $\mu\text{Ci/gal}$
Sol	=	volume of solids in gallons
Cs-sup	=	^{137}Cs concentration in supernate in $\mu\text{Ci/gal}$
Sup	=	volume of supernate in gallons

The calculations of the estimated amount of ^{137}Cs in a specific IMUST is represented in Table D-1. Blanks in the table indicate no data were available for performing the calculation.

Table D-1. Spreadsheet Results of ^{137}Cs Contents Based on Sample Data. (3 pages)

MUST-RAD.WQ1	Cesium (curies)	Nominal capacity (gal)	Solids volume (gal)	Supernate volume (gal)	Total waste volume (gal)	^{137}Cs solids concentration ($\mu\text{Ci/gal}$)	^{137}Cs supernate concentration ($\mu\text{Ci/gal}$)
Tanks							
241-A-302B		13500	no data	no data	3600		
241-B-301B	6.73	36000	21660	590	22250		11400
241-B-302B		17684	690	4240	4930		
241-BX-302A	?	17684	835	0	835		358
241-BX-302B		11389	950	94	1044		
241-BX-302C		11378	635	228	863		
241-C-301C	37.49	36000	9016	1470	10486		25500
240-S-302		17684	no data	no data	2276		
241-S-302A		17684	no data	no data	5130		
241-S-302B		14314	0	0	0		
241-SX-302		17684	1050	305	1355		
241-T-301	0.94	36000	21658	588	22246		1600
241-TX-302A	0.00	17684	2450	30	2480		48
241-TX-302B(R)		12000	no data	no data	0		
241-TX-302B		17684	no data	no data	1320		
241-TX-302X		14314	108	245	353		
241-TY-302A		17684	450	0	450		
241-TY-302B		14314	0	0	0		
270-E-1		4185	3800	0	3800		
270-W		3780	no data	no data	0		
241-B-361	141.35	36000	20678	0	20678	6836	684
241-T-361	15859.85	36000	24500	0	24500	647341	64734
241-U-361	1376.90	36000	27734	98	27832	49629	4963

Table D-1. Spreadsheet Results of ^{137}Cs Contents Based on Sample Data. (3 pages)

MUST-RAD.WQ1	Cesium (curies)	Nominal capacity (gal)	Solids volume (gal)	Supernate volume (gal)	Total waste volume (gal)	^{137}Cs solids concentration ($\mu\text{Ci/gal}$)	^{137}Cs supernate concentration ($\mu\text{Ci/gal}$)
Tanks							
241-Z-361		40500	20000	200	20200		
241-Z-8		15435	500	0	500		
231-W-151-001	0.00	4000	0	1430	1430		0.12
231-W-151-002	0.00	1000	12	955	967	0.0011	0.00643
241-CX-70		30000	0	0	0		
241-CX-71	0.00	1000	930		930		6
241-CX-72		2300	653	0	653		
244-BXR-001	?	50000	7215	0	7215		38229
244-BXR-002	0.75	15000	1805	380	2185		1964
244-BXR-003	8.13	15000	1449	356	1805		22824
244-BXR-011	511.73	50000	7020	98	7118	72795	7280
244-TXR-001	0.83	50000	2291	49	2340		16995
244-TXR-002	?	15000	2945	0	2945		83270
244-TXR-003		15000	6460	0	6460		
244-UR-001	0.70	50000	1852	390	2242		1800
244-UR-002	0.38	15000	2304	570	2874		670
244-UR-003	?	15000	1568	0	1568		950
244-UR-004	0.00	8230	0	0	0		
241-WR-001		50000	minimal?	minimal?	0		6
241-WR-002		50000	minimal?	minimal?	0		20
241-WR-003		50000	minimal?	minimal?	0		
241-WR-004		50000	minimal?	minimal?	0		
241-WR-005		50000	minimal?	minimal?	0		

Table D-1. Spreadsheet Results of ^{137}Cs Contents Based on Sample Data. (3 pages)

MUST-RAD.WQ1	Cesium (curies)	Nominal capacity (gal)	Solids volume (gal)	Supernate volume (gal)	Total waste volume (gal)	^{137}Cs solids concentration ($\mu\text{Ci/gal}$)	^{137}Cs supernate concentration ($\mu\text{Ci/gal}$)
Tanks							
241-WR-006		50000	minimal?	minimal?	0		
241-WR-007		50000	minimal?	minimal?	0		
241-WR-008		50000	minimal?	minimal?	0		
241-WR-009		50000	minimal?	23000	23000		
276-S-141 (276-S-306A)		23000	no data	<200	<200		
276-S-142 (276-S-306B)		23000	no data	<200	<200		
241-ER-311A		no data	no data	no data	no data		
241-AX-151		no data	no data	no data	no data		
216-TY-201		no data	no data	no data	no data		
216-BY-201		no data	no data	no data	no data		
242-TA-R1	Very hot radiologi cally	no data	no data	no data	no data		
242-T-135		no data	no data	no data	no data		
243S-TK-1		no data	no data	no data	no data		
213-W-TK-1		no data	no data	1875*	0*		
216-BC-201		no data	no data	no data	no data		
292T-TK-1		55	no data	no data	no data		
292T-TK-2		55	no data	no data	no data		

* Supernate volume is all rainwater.

APPENDIX E
BASIS FOR RANKINGS

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Basis for Rankings (10 pages)

Tanks	H ₂ years to 1%	FeCN		Organic		Heat °F	Crit g/L	Flam	Vap See Appendix B, part 2 for rankings	Leak gallons of supernate	Rad curies cesium
		> 8 wt% FeCN	Temp. > 90 °C	> 4.5 wt% TOC	Temp. > 180 °C						
241-A-302B	no data void space ≥ 50 %	not in FeCN flowpath		Y-WT	no data	no data	no data	Org	H	no data assume < 5000 gal	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>M</u>
241-B-301B	631	not in FeCN flowpath		Y-WT	No-13 ° C	13 °C	2E-7	Org	H	590	6.7
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L</u>	<u>M</u>		<u>M</u>	<u>L</u>
241-B-302B	no data void space ≥ 50 %	not in FeCN flowpath		Y-WT	no data	no data	no data	Org	H	4240	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>M</u>
241-BX-302A	609	not in FeCN flowpath		No-analysis	No-13.2 °C	13.2 °C	7E-8	Org	L	0	no data
	<u>L</u>	<u>L</u>		<u>L</u>		<u>L</u>	<u>L</u>	<u>L</u>		<u>L</u>	<u>M</u>
241-BX-302B	no data void space ≥ 50 %	not in FeCN flowpath		Y-WT	no data	no data	no data	Org	H	94	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>M</u>
241-BX-302C	no data void space ≥ 50 %	not in FeCN flowpath		Y-WT	no data	no data	no data	Org	H	228	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>M</u>
241-C-301C	30	No-9.78	No- 13.4 °C	Y-WT	No- 13.4 °C	13.4 °C	2E-7	Org	H	1470	37
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L</u>	<u>M</u>		<u>M</u>	<u>L</u>
240-S-302	no data void space ≥ 50 %	not in FeCN flowpath		Y-WT	no data	no data	no data	Org	H	no data assume < 5000 gal	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>M</u>

Basis for Rankings (10 pages)

Tanks	H ₂ years to 1%	FeCN		Organic		Heat °F	Crit g/L	Flam	Vap See Appendix B, part 2 for rankings	Leak gallons of supernate	Rad curies cesium
		> 8 wt% FeCN	Temp. > 90 °C	> 4.5 wt% TOC	Temp. > 180 °C						
241-S-302A	no data void space ≥ 50 %	not in FeCN flowpath		Y-WT	no data	no data	no data	Org	H	no data assume < 5000 gal	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>M</u>
241-S-302B	empty	not in FeCN flowpath		empty	no data	empty	empty	Org	L	empty	no data
	<u>L</u>	<u>L</u>		<u>L</u>		<u>L</u>	<u>L</u>	<u>L</u>		<u>L</u>	<u>M</u>
241-SX-302	no data void space ≥ 50 %	not in FeCN flowpath		Y-WT	no data	no data	no data	Org	H	305	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>M</u>
241-T-301	45	No-47.01	No- 13.1 °C	Y-WT	No- 13.1 °C	13.1 °C	2E-7	Org	H	588	.94
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L</u>	<u>M</u>		<u>M</u>	<u>L</u>
241-TX-302A	296	not in FeCN flowpath		Y-WT	No- 13.1 °C	13.1 °C	no data	Org	H	30	0.00
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>L</u>
241-TX-302B (R)	empty	empty	no data	N-WT	no data	no data	no data	Org	L	no data assume < 5000 gal	no data
	<u>L</u>	<u>L</u>		<u>L</u>		<u>M</u>	<u>L-similar</u>	<u>L</u>		<u>M</u>	<u>M</u>
241-TX-302B	no data void space ≥ 50 %	no data	no data	Y-WT	no data	no data	no data	Org	H	no data assume < 5000 gal	no data
	<u>L</u>	<u>M</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>M</u>
241-TX-302X	no data void space ≥ 50 %	not in FeCN flowpath		Y-WT	no data	no data	no data	Org	H	245	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>M</u>

Basis for Rankings (10 pages)

Tanks	H ₂ years to 1%	FeCN		Organic		Heat °F	Crit g/L	Flam	Vap See Appendix B, part 2 for rankings	Leak gallons of supernate	Rad curies cesium
		> 8 wt% FeCN	Temp. > 90 °C	> 4.5 wt% TOC	Temp. > 180 °C						
241-TY-302A	no data void space ≥ 50 %	Yes-0.99	no data	Y-WT	no data	no data	no data	Org	H	0	no data
	<u>L</u>	<u>H</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>M</u>
241-TY-302B	empty	not in FeCN flowpath		empty	no data	empty	empty	Org	L	empty	no data
	<u>L</u>	<u>L</u>		<u>L</u>		<u>L</u>	<u>L</u>	<u>L</u>		<u>L</u>	<u>M</u>
270-E-1	no data void space < 50 %	not in FeCN flowpath		no data	no data	no data	no data	Org	M	0	no data
	<u>M</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>M</u>
270-W	no data void space ≥ 50 %	not in FeCN flowpath		no data	no data	no data	no data	Org	M	no data assume < 5000 gal	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>M</u>
241-B-361	1	not in FeCN flowpath		no data	No- 15.6 °C	15.6 °C	0.072	H ₂	H	0	141
	<u>H</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L</u>	<u>H</u>		<u>L</u>	<u>M</u>
241-T-361	0	not in FeCN flowpath		Y-indicated	No- 23 °C	23 °C	0.058	H ₂	H	0	15,860
	<u>H</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L</u>	<u>H</u>		<u>L</u>	<u>H</u>
241-U-361	1	not in FeCN flowpath		Y-indicated	No- 14.4 °C	14.4 °C	2E-8	H ₂	H	98	1425
	<u>H</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L</u>	<u>H</u>		<u>L</u>	<u>H</u>
241-Z-361	no data void space ≥ 50 %	not in FeCN flowpath		No-analysis	no data	no data	0.72	H ₂	M	200	no data
	<u>L</u>	<u>L</u>		<u>L</u>		<u>M</u>	<u>M</u>	<u>M</u>		<u>L</u>	<u>M</u>

Basis for Rankings (10 pages)

Tanks	H ₂ years to 1%	FeCN		Organic		Heat °F	Crit g/L	Flam	Vap See Appendix B, part 2 for rankings	Leak gallons of supernate	Rad curies cesium
		> 8 wt% FeCN	Temp. > 90 °C	> 4.5 wt% TOC	Temp. > 180 °C						
241-Z-8	no data void space ≥ 50 %	not in FeCN flowpath		no data	no data	no data	0.76	Org	M	0	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L</u>	<u>M</u>		<u>L</u>	<u>M</u>
231-W-151-001	12148	not in FeCN flowpath		no data	no data	no data	5E-8	Org	M	1430	0.0
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L</u>	<u>M</u>		<u>M</u>	<u>L</u>
231-W-151-002	241361	not in FeCN flowpath		no data	No- 13 °C	13 °C	no data	Org	M	955	0.0
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>L</u>
241-CX-70	empty	not in FeCN flowpath		empty	no data	empty	empty	Org	L	empty	data not conclusive that no rad
	<u>L</u>	<u>L</u>		<u>L</u>		<u>L</u>	<u>L</u>	<u>L</u>		<u>L</u>	<u>M</u>
241-CX-71	102	not in FeCN flowpath		Y-indicated	No- 13 °C	13 °C	no data	Org	H	assume < 400 gal	0.0
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>L</u>
241-CX-72	no data void space ≥ 50 %	not in FeCN flowpath		no data	no data	no data	0.08	Org	M	0	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>M</u>	<u>L</u>	<u>M</u>		<u>L</u>	<u>M</u>
244-BXR-001	4	not in FeCN flowpath		Y-indicated	No- 20.6 °C	20.6 °C	no data	H ₂	H	0	no data
	<u>H</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L-similar</u>	<u>H</u>		<u>L</u>	<u>M</u>
244-BXR-002	39	No-9.40	No-15.4 °C	Y-indicated	No- 13.4 °C	13.4 °C	no data	Org	H	380	0.75
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>L</u>

Basis for Rankings (10 pages)

Tanks	H ₂ years to 1%	FeCN		Organic		Heat °F	Crit g/L	Flam	Vap See Appendix B, part 2 for rankings	Leak gallons of supernate	Rad curies cesium
		> 8 wt% FeCN	Temp. > 90 °C	> 4.5 wt% TOC	Temp. > 180 °C						
244-BXR-003	1	not in FeCN flowpath		Y-indicated	Y- 46.2 °C	46.2 °C	no data	Org	H	356	8.1
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L-similar</u>	<u>H</u>		<u>L</u>	<u>L</u>
244-BXR-011	5	not in FeCN flowpath		No-analysis	No- 18.2 °C	18.2 °C	0.00021	H ₂	H	98	580
	<u>H</u>	<u>L</u>		<u>L</u>		<u>L</u>	<u>L</u>	<u>H</u>		<u>L</u>	<u>M</u>
244-TXR-001	4480	not in FeCN flowpath		no data	No- 13 °C	13 °C	no data	Org	M	49	0.83
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>L</u>
244-TXR-002	2336	not in FeCN flowpath		no data	No- 13 °C	13 °C	7E-7	Org	M	0	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L</u>	<u>M</u>		<u>L</u>	<u>M</u>
244-TXR-003	no data void space ≥ 50 %	not in FeCN flowpath		no data	No- 13 °C	13 °C	no data	Org	M	0	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>M</u>
244-UR-001	384	not in FeCN flowpath		Y-indicated	No- 13.3 °C	13.3 °C	no data	Org	H	390	0.70
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>L</u>
244-UR-002	3338	not in FeCN flowpath		Y-indicated	No- 13 °C	13 °C	0.000001	Org	H	570	0.38
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L</u>	<u>M</u>		<u>M</u>	<u>L</u>
244-UR-003	50	not in FeCN flowpath		Y-indicated	No- 13.4 °C	13.4 °C	no data	Org	H	0	no data
	<u>L</u>	<u>L</u>		<u>M</u>		<u>L</u>	<u>L-similar</u>	<u>M</u>		<u>L</u>	<u>M</u>
244-UR-004	empty	not in FeCN flowpath		empty	no data	empty	empty	Org	L	empty	0.0
	<u>L</u>	<u>L</u>		<u>L</u>		<u>L</u>	<u>L</u>	<u>L</u>		<u>L</u>	<u>L</u>

Basis for Rankings (10 pages)

Tanks	H ₂ years to 1%	FeCN		Organic		Heat °F	Crit g/L	Flam	Vap See Appendix B, part 2 for rankings	Leak gallons of supernate	Rad curies cesium
		> 8 wt% FeCN	Temp. > 90 °C	> 4.5 wt% TOC	Temp. > 180 °C						
241-WR-001	empty	empty	no data	empty	no data	empty	empty (0.000001)	Org	L	empty	no data
	L	L		L		L	L	L		L	M
241-WR-002	empty	empty	no data	empty	no data	empty	empty (7E-7)	Org	L	empty	no data
	L	L		L		L	L	L		L	M
241-WR-003	empty	not in FeCN flowpath		empty	no data	empty	empty	Org	L	empty	no data
	L	L		L		L	L	L		L	M
241-WR-004	empty	not in FeCN flowpath		empty	no data	empty	empty	Org	L	empty	no data
	L	L		L		L	L	L		L	M
241-WR-005	empty	not in FeCN flowpath		empty	no data	empty	empty	Org	L	empty	no data
	L	L		L		L	L	L		L	M
241-WR-006	empty	not in FeCN flowpath		empty	no data	empty	empty	Org	L	empty	no data but cold side tank
	L	L		L		L	L	L		L	L
241-WR-007	empty	not in FeCN flowpath		empty	no data	empty	empty	Org	L	empty	no data but cold side tank
	L	L		L		L	L	L		L	L
241-WR-008	empty	not in FeCN flowpath		empty	no data	empty	empty	Org	L	empty	no data but cold side tank
	L	L		L		L	L	L		L	L

Basis for Rankings (10 pages)

Tanks	H ₂ years to 1% void space ≥ 50 %	FeCN		Organic		Heat °F	Crit g/L	Flam	Vap See Appendix B, part 2 for rankings	Leak gallons of supernate	Rad curies cesium
		> 8 wt% FeCN	Temp. > 90 °C	> 4.5 wt% TOC	Temp. > 180 °C						
241-WR-009	no data void space ≥ 50 %	not in FeCN flowpath		no data	no data	no data	no data	Org	M	23,000	no data but cold side tank
	L	L		M		M	L-similar	M		M	M
276-S-141 (276-S-306A)	no data void space ≥ 50%	no data	no data	no data	no data	no data	no data	Org	M	<200	no data
	L	M		M		M	L-similar	M		L	M
276-S-142 (276-S-306B)	no data void space ≥ 50%	no data	no data	no data	no data	no data	no data	Org	M	<200	no data
	L	M		M		M	L-similar	M		L	M
241-ER-311A	no data assume void space < 50%	no data	no data	no data	no data	no data	no data	Org	M	no data	no data
	M	M		M		M	L-similar	M		M	M
241-AX-151	no data assume void space < 50%	no data	no data	no data	no data	no data	no data	Org	M	no data	no data
	M	M		M		M	L-similar	M		M	M
216-TY-201	no data assume void space < 50%	no data	no data	no data	no data	no data	no data	Org	M	no data	no data
	M	M		M		M	L-similar	M		M	M
216-BY-201	no data assume void space < 50%	no data	no data	no data	no data	no data	no data	Org	M	no data	no data
	M	M		M		M	L-similar	M		M	M

Basis for Rankings (10 pages)

Tanks	H_2 years to 1%	FeCN		Organic		Heat °F	Crit g/L	Flam	Vap See Appendix B, part 2 for rankings	Leak gallons of supernate	Rad curies cesium
		> 8 wt% FeCN	Temp. > 90 °C	> 4.5 wt% TOC	Temp. > 180 °C						
242-TA-R1	no data assume void space < 50%	no data	no data	no data	no data	no data	no data	Org	<u>M</u>	no data	no data, but reportedly very hot radio- logically
	<u>M</u>	<u>M</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>H</u>
242-T-135	no data assume void space < 50%	no data	no data	no data	no data	no data	no data	Org	<u>M</u>	no data	no data
	<u>M</u>	<u>M</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>M</u>
243S-TK-1	no data assume void space < 50%	no data	no data	no data	no data	no data	no data	Org	<u>M</u>	no data	no data
	<u>M</u>	<u>M</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>M</u>
213-W-TK-1	no data assume void space < 50%	no data	no data	no data	no data	no data	no data	Org	<u>M</u>	no data	no data
	<u>M</u>	<u>M</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>M</u>
216-BC-201	no data assume void space < 50%	no data	no data	no data	no data	no data	no data	Org	<u>M</u>	no data	no data
	<u>M</u>	<u>M</u>		<u>M</u>		<u>M</u>	<u>L-similar</u>	<u>M</u>		<u>M</u>	<u>M</u>

Basis for Rankings (10 pages)

Tanks	H ₂ years to 1% space < 50%	FeCN		Organic		Heat °F	Crit g/L	Flam	Vap See Appendix B, part 2 for rankings	Leak gallons of supernate	Rad curies cesium
		> 8 wt% FeCN	Temp. > 90 °C	> 4.5 wt% TOC	Temp. > 180 °C						
292T-TK-1	no data assume void space < 50%	no data	no data	no data	no data	no data	no data	Org	M	55 gallon tank	no data
		M	M	M	M	M	L-similar	M		L	M
292T-TK-2	no data assume void space < 50%	no data	no data	no data	no data	no data	no data	Org	M	55 gallon tank	no data
		M	M	M	M	M	L-similar	M		L	M

Basis for Rankings (10 pages)

Tanks	H_2 years to 1%	FeCN		Organic		Heat °F	Crit g/L	Flam	Vap See Appendix B, part 2 for rankings	Leak gallons of supernate	Rad curies cesium
		> 8 wt% FeCN	Temp. > 90 °C	> 4.5 wt% TOC	Temp. > 180 °C						

NOTES:

1. Under the FeCN > 8 wt% FeCN column, a notation like "No-9.78" means that the tank was not considered to have > 8 wt% FeCN because the ratio of leakage to capacity of the tank would have had to have been "9.78" which is greater than the criteria of '2.00'.
2. Under the Organic > 4.5 wt% TOC column, a notation "Y-WT" means that the tank was considered to have > 4.5 wt% TOC because the waste types potentially received by the tank contained > 4.5 wt% TOC.
3. Under the Organic > 4.5 wt% TOC column, a notation "No-analysis" means that the tank was not considered to have > 4.5 wt% TOC because analysis indicated < 4.5 wt% TOC.
4. Under the Organic > 4.5 wt% TOC column, a notation "Y-indicated" means that the tank was considered to have > 4.5 wt% TOC because reference information indicated organics in the tank.
5. Under the Crit column, a notation "L-similar" means that the majority of tanks with plutonium concentration analyses indicated a low ranking and therefore all tanks with no analysis were similarly ranked low.
6. Under the Flam and Vap columns, a notation of "Org" or " H_2 " or "FeCN" indicates which of the potential safety categories contributed the highest ranking for the flammability or vapor emission potential safety issue ranking.
7. If * is used with a relative ranking, see Table 2-1/notes.

APPENDIX F

TANKS CONSIDERED AS POTENTIAL IMUSTS BUT REJECTED AS IMUSTS

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TANKS CONSIDERED AS POTENTIAL IMUSTS BUT REJECTED AS IMUSTS

Tank row letter	Tank no.	Location	Reason not an IMUST
A	218-W-7	South of 222-S N34129/W73540	Inactive dry waste vault, not a tank.
B	?	Under Building 201-C	Tanks located inside cells under building. Cells filled with grout. Inaccessible.
C	?	200 feet north of SY Farm	Fiberglass tank, nonradioactive.
D	?	South of 3706A	Fuel oil tank, nonradioactive. Because this tank is in 300 Area, it is not an IMUST for this report.
E	216-A-08	Northwest of A Farm N41372/W47385	Valve pit, not a tank.
F	241-A-302A	Behind PUREX N39744/W48245	Active catch tank.
G	?	TX Farm	Unidentified risers, subsequently confirmed as vertical storage facility. Not a tank.
H	?	Under 323 Building	Three tanks filled with sand, one with waste. Because these tanks are in 300 Area, they are not IMUSTs for this report.

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APPENDIX G

POTENTIAL ADDITIONAL IMUSTS THAT HAVE NOT BEEN REVIEWED AND VERIFIED AS IMUSTS

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POTENTIAL ADDITIONAL IMUSTS THAT HAVE NOT BEEN REVIEWED AND VERIFIED AS IMUSTS

This appendix includes a copy of a letter report prepared by A. Jim Low of SAIC that documents interviews with retirees from the Hanford Site. This report lists information regarding possible additional IMUSTs. This list has not been completely reviewed and none of the items on the list have been verified as true IMUSTs as of the writing of this status report. This review and verification will need to be done following the completion of this report.

Three neutralization tanks near PUREX (216-A-1, 216-A-2, & 216-A-5) are being considered for official addition to the IMUST list.

Science Applications International Corporation
An Employee-Owned Company

August 15, 1995

Mr. Thomas Powers
Westinghouse Hanford Company
P.O. Box 1970
MSIN H4-64
Richland, WA 99352

SUBJECT: INTERVIEWS TO OBTAIN ADDITIONAL IMUST INFORMATION, WHC
CONTRACT MW6-SWV-168681, TASK ORDER 16

Dear Mr. Powers:

This letter and appendices report the results of interviews with former and present Hanford Site employees. The aims were to recall Inactive Miscellaneous Underground Storage Tanks (IMUSTs) and related information that may have been overlooked in the reference¹ and the list you provided (Appendix C).

Sixty-three IMUSTs have been previously identified (Appendices A, B, and C).

The Statement of Work for this task (Task Order 16) listed 23 former or present Hanford employees to be interviewed. Nineteen of these were interviewed in person and two out-of-town persons were contacted by phone and letter. Two could not be reached: Herm Winters (retired) and Dave Bowers (WHC).

As you will all eventually find out, memory does not improve with age and so our detail and accuracy may be short of what was hoped for. Nevertheless, it appears that we did recall some IMUSTs beyond those already identified and these are summarized on pages 2 through 7.

The interview technique was to briefly summarize the objectives and then to give the person copies of Appendices A through E, and ask if that information suggested any IMUSTs that may have been overlooked. Additionally, interviewees were asked for their recollections of tank size, construction material, content, dates, special "events," etc., that might be

¹ WHC-SD-EN-ES-040, Rev. 0, "Engineering Study of 50 Miscellaneous Inactive Underground Radioactive Waste Tanks Located at the Hanford Site, Washington," February 1994, WORKING COPY.

Mr. Thomas Powers
Page 2
August 15, 1995

pertinent. They were all willing, but it was tough to do on such short notice and having been out of touch for several years.

We lacked information on what systems are considered "active" or were removed and so I'm sure we got into some areas outside of our charter. I attempted to check for duplication of our IMUSTs with the information in Appendices A, B, and C, but our inability to put specific identity numbers on many of our comments made this difficult. For the few I could identify, those are omitted from the summary and plots (Pages 2 through 7), but remain in the record of the complete interviews, Appendix G.

If you have any questions or comments, or require additional information, please do not hesitate to contact me at (509) 943-4236.

Sincerely,

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

A. Jim Low
Consultant

AJL/drs

cc: G. Dukelow - WHC
A. Low - SAIC
D. Martin - SAIC Records
J. Young - SAIC
LB

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- B WHC-SD-EN-ES-040, Rev. 0, Page A-iv
- C List of Additional IMUSTs provided by Tom Powers, WHC
- D 200-West Plot of IMUSTs, provided by Tom Powers, WHC
- E 200-East plot of IMUSTs, provided by Tom Powers, WHC
- F Summary of non-IMUST information that interview contact felt was worth reporting, and some suggestions as to other knowledgeable contacts regarding IMUSTs
- G A.J. Low's complete record of interviews and/or the letter responses

INTERVIEW RESPONSE SUMMARY
IMUSTs - TASK 16
 (All contacts recalling the item are listed)

IMUSTs	Area	Interview Contact
1. The Redox extraction column removal facility, north of 202-S, had a sump.	2W	Low
2. 270-T Neutralization Tank.	2W	Low Lyon
3. CS-3 Catch Tank at 212-B.	2E	Low
4. 221-BB Tanks, south side of 221-B.	2E	Low Lyon
5. B Plant sand filter water seals.	2E	Low
6. 291-B, 291-T, 291-S, 291-U, and 291-C stack drain catch tanks.	2W/2E	Lorenzen Low Bayless Strunk Preston Harty
7. Redox UNH Silica Gel Facility had a catch tank or sump.	2W	Low Saueressig Hanson
8. Catch Tank outside 233-S for decontamination flushes of the 233-S Operating Gallery.	2W	Lorenzen
9. Possibility of sand filter catch tanks at 291-U, 291-T, 291-S, and 291-B.	2W/2E	Low Lorenzen Strunk Preston
10. 300 series catch tanks between 202-S and the SX Tank Farm.	2W	Strunk
11. A 241-S diversion box catch tank east of the SX Tank Farm and south of the S Farm. Perhaps it's still active.	2W	Strunk
12. 216-A (?) catch tank for the Purex stack and gas sampling building.	2E	Hodges
13. Diversion box catch tank just north and outside of 241-BY. Can't recall number.	2E	Hodges

INTERVIEW RESPONSE SUMMARY
IMUSTs - TASK 16
 (All contacts recalling the item are listed)

IMUSTs	Area	Interview Contact
14. Underground tank east of 241-BY Farm and across the north-south roadway. Can't recall number.	2E	Hodges
15. 222-S ventilation stack drain catch tank. Active??	2W	Hanson
16. Vault tanks, SE of 222-S.	2W	Hanson
17. High level lab waste tanks for lab and sampling equipment; 222-S, 222-T, 222-B.	2W/2E	Hanson Forest
18. 222-S charcoal filter catch tank.	2W	Hanson
19. 231-Z catch tank (<i>could mean tanks 001/002 - J. Low</i>).	2W	Hanson
20. Former "clean" Hexone storage tanks sump.	2W	Hanson
21. Catch tanks between Z-9 crib and 234-5 Building.	2W	Hanson
22. PNL facility catch tanks near 241-B Farm.	2E	Hanson
23. PNL Critical Mass Lab catch tanks.	2E	Hanson
24. Old 241-TX and 241-C Evaporator facilities SST underground tanks.	2E/2W	Hanson
25. Purex acid recovery SST tanks, U-1 and U-2.	2E	Preston Geier
26. Purex UNH Tank enclosure sump.	2E	Preston Geier
27. 221-U recovered organic tank vault (276-U?); sump.	2W	Low Lyon
28. Cesium cask loading station sump at north or NW end of 241-C Farm.	2E	Lyon Harty
29. 242-T Evaporator had a catch tank.	2W	Guenther Tyler
30. The ITS unit in 241-BY probably had a condensate catch tank.	2E	Guenther
31. Hot Semi-Works stack had a contaminated seal pot.	2E	Saueressig

INTERVIEW RESPONSE SUMMARY
IMUSTs - TASK 16
 (All contacts recalling the item are listed)

IMUSTs	Area	Interview Contact
32. Thinks 240-S-151 diversion box is still active for lab waste??	2W	Saueressig
33. 241-ER-151 diversion box had two catch tanks: 311 and 311-A.	2E	Saueressig
34. the 221-BF facility south of WESF had several underground tanks.	2E	Saueressig
35. The 241-BY Farm had a tank that was used for cleaning ITS heating units.	2E	Boyd Tyler
36. Old settling tank between BX and BY Farms.	2E	Boyd
37. A diversion box catch tank north and east of the 244-UR vault.	2W	Boyd
38. The catch tank outside and north of 241-BY Farm was associated with an old crib.	2E	Tyler
39. Diversion box and catch tank near 241-BY-109 (<i>may be catch tank 241-BX-302A - J. Low</i>).	2E	Tyler
40. Hot Semi-Works stack catch tank was 20-30 feet east of stack building.	2E	Tyler
41. Underground tank between 222-B and 224-B.	2E	Tyler
42. Diversion box catch tanks between 241-BXR Vault and 241-BX-302A.	2E	Tyler
43. Several diversion box catch tanks in 200-E serving B, BX, BY, A, C, and AX Farms that have been polyurethane and hard covered. Can't recall numbers.	2E	Tyler
44. Purex silica gel facility catch tank or sump.	2E	Preston
45. Two 291-B stack catch tanks.	2E	Preston
46. Pu-contaminated 221-B septic tank.	2E	Preston
47. Old Pu-contaminated catch tank; vicinity of 221-B.	2E	Preston
48. Purex stack and RR tunnel catch tank.	2E	Tyler Walser

INTERVIEW RESPONSE SUMMARY
IMUSTs - TASK 16
 (All contacts recalling the item are listed)

IMUSTs	Area	Interview Contact
49. Purex catch tank in the process condensate system.	2E	Walser
50. Diversion box catch tank east of 221-T.	2W	Bayless
51. Catch tank serving 292-T.	2W	Bayless
52. Diversion box catch tanks associated with 241-T, 241-U, 241-C, and 241-B 200-series underground tanks.	2E/2W	Strunk Bayless
53. Vehicle decontamination facility catch tank near 241-T.	2W	Forest
54. Heavy equipment decontamination facility catch tank near 244-T.	2W	Forest
55. 219-S-102 Tank.	2W	Jenkins
56. Tanks for solid 300 Area waste; in 200-W.	2W	Harty
57. Pump capsule in 241-B.	2E	Harty
58. Underground lateral casings in 200-E.	2E	Harty
59. 241-A had a condenser catch tank.	2E	Harty
60. Cask load-out station south of Purex.	2E	Harty
61. 200 NPR likely had underground tanks.	200 NPR	Harty
62. Cross-Site Waste Transfer Line Vent Station	Between 2W & 2E	Harty Vandercook
63. Steam trap pits on south side of Purex	2E	Vandercook
64. Hot Semi-Works Tank 70	2E	Vandercook
65. Hot Semi-Works 291-C Filter Drain Tank	2E	Vandercook
66. 200-W Catch Tank replaced 5-6 years ago	2W	Vandercook
67. Recalls 241-155-TX diversion box catch tank being replaced with a stainless steel tank at the same time the 241-153-TX catch tank was replaced.	2W	Knight

2

ive Miscellaneous Storage Tanks

200 East
Under

← (G-2)

Area Inactive Miscellaneous ground Storage Tanks

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