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Document Number:	WHC-SD-WM-TI-651, REV 0
Document Title:	WASTE TANK CHARACTERIZATION SAMPLING LIMITS
Release Date:	9/2/94

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WHC Information Release Administration Specialist:

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SUPPORTING DOCUMENT

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6. Author

Name: L. A. Tusler

LA Tusler
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7. Abstract

This document is a result of the Plant Impementation Team Investigation into delayed reporting of the exotherm in Tank 241-T-111 waste samples. The corrective actions identified are to have immediate notification of appropriate Tank Farm Operations Shift Management if analyses with potential safety impact exceed established levels. This document establishes levels for specified analyses that require notification of the appropriate shift manager.

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WASTE TANK CHARACTERIZATION SAMPLING LIMITS

Leslie A. Tusler

August 25, 1994

WASTE TANKS PROCESS CONTROL

TABLE OF CONTENTS

ACRONYMS

CEA	Criticality Engineering Analysis
CES	Consensus Exposure Standard
CPS	Criticality Prevention Specification
DHHS	Department of Health and Human Services
DQO	Data Quality Objective
DST	Double Shell Tank
IDLH	Immediately Dangerous to Life and Health
LFL	Lower Flammability Limit
NIOSH	National Institute of Occupational Safety and Health
OSD	Operating Safety Document
SST	Single Shell Tank
SWP	Safe Worker Practice
TFHASP	Tank Farm Health and Safety Plan
TOC	Total Organic Carbon
TWRS	Tank Waste Remediation System
WHC	Westinghouse Hanford Company

1.0 INTRODUCTION

This document is a result of the Plant Implementation Team Investigation into delayed reporting of the exotherm in Tank 241-T-111 waste samples. The corrective actions identified are to have immediate notification of appropriate Tank Farm Operations Shift Management if analyses with potential safety impact exceed established levels. A procedure, WHC-IP-0842 Section 12.18, "TWRS Approved Sampling and Data Analysis by Designated Laboratories" (WHC 1994), has been established to require all tank waste sampling (including core, auger and supernate) and tank vapor samples be performed using this document. This document establishes levels for specified analyses that require notification of the appropriate shift manager.

The following categories provide numerical values for analysis that may indicate that a tank is either outside the operating specification or should be evaluated for inclusion on a Watch List. The information given is intended to translate an operating limit such as heat load, expressed in Btu/hour, to an analysis related limit, in this case cesium-137 and strontium-90 concentrations. By using the values provided as safety flags, the analytical laboratory personnel can notify a shift manager that a tank is in potential violation of an operating limit or that a tank should be considered for inclusion on a Watch List. The shift manager can then take appropriate interim measures until a final determination is made by engineering personnel.

2.0 DOUBLE SHELL TANKS

2.1 Tank Composition

Variable	Notification Limit
pH	pH < 12
NO_2^-	NO_2^- < 0.011M

The previous variables and their specification limits are taken from the Double-Shell Tank Operating Specifications Document (OSD) (Harris 1992) and the Waste Compatibility Data Quality Objective (DQO) (Carothers 1994). The hydroxide (OH^-) and nitrite (NO_2^-) concentrations were generalized to simplify the limits. The hydroxide concentration was converted to a pH level. The smallest limit values for NO_2^- were used as the notification limit. Values outside these limits could indicate that the tank is outside the corrosion specification for double shell tanks. Comparison of the analysis results to the OSD will be performed by Waste Tank Plant Engineering.

2.2 Criticality

Variable	Notification Limit
Maximum Pu density after in-tank concentration	> 1 g/L (6.2 x 10^4 μCi/L) in solids
Solids/Pu mass ratio (Solids are any non-fissile material)	< 1,000
pH	< 9.0

The variables and limits given above are from the Aging Waste OSD (Bergmann 1989), the Tank Safety Screening DQO (Babad 1994) and the DST Criticality Prevention Specification (Vail 1994). The Pu density was converted to μCi/L assuming that all Pu was Pu-239. Exceeding any of the above limits indicates that the tank may be outside the criticality specification for aging waste tanks. Comparison of the results to the OSD will be done by Waste Tank Plant Engineering.

2.3 Organic Material

Variable	Notification Limit
Organic Material	Any detectable separate phase organic

The double shell tank organic material limit was taken from the Double Shell Tank OSD (Harris 1992). Any detectable separate phase organic in a tank will signify that the tank could be on the Organic Watch List. Evaluation against the watch list criteria will be performed by Waste Tank Safety Program.

2.4 Heat Generation Rate

Variable	Notification Limit
For 241-AN, AP & AW	
Maximum heat generation	70,000 Btu/h (> 5.74 x 10^5 μCi/L Cs-137) (> 4.04 x 10^5 μCi/L Sr-90)
For 241-SY	
Maximum heat generation	50,000 Btu/h (> 4.10 x 10^5 μCi/L Cs-137) (> 2.88 x 10^5 μCi/L Sr-90)

The heat generation variables were taken from the Double Shell Tank OSD (Harris 1992). The heat load was translated to Cs-137 and Sr-90 concentrations assuming that the tank holds one million gallons, and Cs-137 and Sr-90 is at 50 percent of the heat load limit. The heat load was then

converted to μCi/liter using the Radionuclide Specific Activity and Heat Generation Chart (Wilkins 1984). Exceeding any of the above limits means the tank may surpass the heat load specification for double shell tanks. Calculation of the actual heat load will be performed by Waste Tank Plant Engineering.

2.5 Total Fuel Concentration

Variable	Notification Limit
Total Fuel Conc. (Energetics)	> 115 cal/g

The above limit is found in several documents: Ferrocyanide DQO (Buck et al. 1993), *Ferrocyanide Safety Program Safety Criteria for Ferrocyanide Watch List Tanks* (Postma et al. 1994), Tank Safety Screening DQO (Babad 1994), Organic DQO (Babad et al. 1994), and the Crust Burn/Flammable Gas DQO (Johnson 1994). Exceeding the total fuel content could put the tank on the ferrocyanide, organic or flammable gas Watch List. Waste Tank Plant Engineering will evaluate the total fuel content and compare the results to the watch list criteria.

3.0 SINGLE SHELL TANKS

3.1 Heat Generation Rate

Variable	Notification Limit
Maximum heat generation rate	40,000 Btu/h (> 3.28×10^5 μCi/L Cs-137) (> 2.30×10^5 μCi/L Sr-90)

The limit for heat generation was found in the OSD for Watch List Tanks (Raymond 1994) and the Tank Safety Screening DQO (Babad 1994). The heat load was translated to concentrations of Cs-137 and Sr-90 using the same assumptions that were used for the DST heat generation rates. If the tank is above the limit it could exceed the heat load for single shell tanks. Further calculations will be done by Waste Tank Plant Engineering to determine the actual heat load.

3.2 Total Alpha

Variable	Notification Limit
Total Alpha	> 1 g/L (6.2×10^4 μCi/L) in solids

The total alpha safety limit is found in the Tank Safety Screening DQO (Babad 1994). Assuming that all Pu is Pu-239, the total alpha limit given in the DQO was converted to μCi/L using the Radionuclide Specific Activity and Heat Generation table (Wilkins 1984). A tank that surpasses this limit may

have a problem with its criticality specification limits. Waste Tank Plant Engineering will evaluate the values to determine if this is the case.

3.3 Ferrocyanide and Potential Ferrocyanide Watch List Tanks

Variable	Notification Limit
Total Cyanide (wt%)	> 3.9 wt%

The ferrocyanide (FeCN) limits were found in *Ferrocyanide Safety Program Safety Criteria for FeCN Watch List Tanks* (Postma 1994) and the Ferrocyanide DQO (Buck et al. 1993). If either of these limits is exceeded the tank could be a candidate for the FeCN Watch List. Further analysis will be done by the Waste Tank Safety Program to determine if the tank meets the watch list criteria.

3.4 Organic and Potential Organic Watch List Tanks

3.4.1 Organic Salts

Variable	Notification Limit
Organic Salts	≥ 3 wt% Total Organic Carbon (TOC) (equivalent to 10 wt% sodium acetate)

The organic salts notification limit is from the OSD for Watch List Tanks (Raymond 1994), the Tank Safety Screening DQO (Babad 1993), and the Organic DQO (Babad et al 1994). Exceeding this limit may put the tank on organic watch list. Analyses show that propagating reactions (sodium acetate-nitrate/nitrite reactions) could occur with sufficient fuel at elevated temperatures and reduced moisture levels (Babad and Turner, 1993). Further evaluation by the Waste Tank Safety Program will be done to determine if the tank meets the criteria for a watch list tank.

3.4.2 Moisture

Variable	Notification Limit
% moisture	< 17 wt%[1]

The notification limit in regards to moisture is found in the Tank Safety Screening DQO (Babad 1994) and the Organic DQO (Babad et al. 1994). A tank that drops below the limit for moisture could potentially not have water as a mitigating factor against energetic reactions. The Waste Tank Safety Program will determine whether the tank meets the safe, conditionally safe or unsafe criteria (Babad & Turner, 1993).

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[1]The limit for percent moisture is in question and is currently being evaluated. The notification limit given is to be used only as a flag.

3.5 Total Fuel Concentration

Variable	Notification Limit
Total Fuel Conc. (Energetics)	> 115 cal/g

The above limit is found in several documents: Ferrocyanide DQO (Buck et al. 1993), *Ferrocyanide Safety Program Safety Criteria for Ferrocyanide Watch List Tanks* (Postma et al. 1994), Tank Safety Screening DQO (Babad 1994), Organic DQO (Babad et al. 1994), and the Crust Burn/Flammable Gas DQO (Johnson 1994). Exceeding the total fuel content could put the tank on the ferrocyanide, organic or flammable gas watch list. Evaluation of the total fuel content will be done by Waste Tank Plant Engineering.

4.0 AGING WASTE TANKS

4.1 Chemical Composition

4.1.1 Sodium Concentration

Variable	Notification Limit
Maximum sodium conc.	
Tank 101-AZ:	> 5.5M
Other tanks:	> 5.0M

The sodium concentration variables are taken directly from the Aging Waste Tanks OSD (Bergmann 1989). If the maximum sodium concentration is exceeded, high solids precipitation could occur. Waste Tank Plant Engineering will compare the results to the OSD.

4.1.2 Hydroxide

Variable	Notification Limit
[OH]	0.01 M ≤ [OH] ≤ 1.0M

The waste hydroxide concentration was taken from the Aging Waste Tanks OSD (Bergmann 1989). The notification limit given is to be used only as a flag. The Aging Waste OSD Section 17.4.1.1.3 (Bergmann 1989) should be used for the specific limits. If the limit is exceeded, $Al(OH)_3$ (aluminum hydroxide) could precipitate. Comparison of the analysis results to the OSD will be performed by Waste Tank Plant Engineering.

4.1.3 Corrosion

Variable	Notification Limit
Waste Nitrite concentration [NO_2]	0.011 $\underline{M} \leq [NO_2]$

The waste nitrite concentration limit is from the Aging Waste Tanks OSD (Bergmann 1989). The notification limit given is to be used only as a flag. The Aging Waste OSD Section 17.4.1.1.4 (Bergmann 1989) contains specific limits for the waste nitrite concentrations. If the waste nitrite concentration is below the limit the tank may be outside the corrosion specification for aging waste tanks. Waste Tank Plant Engineering will determine if the analysis is within the OSD limit.

4.2 Heat Generation Rate

Variable	Notification Limit
Maximum waste heat content	4×10^6 Btu/h ($> 3.28 \times 10^7$ μCi/L Cs-137) ($> 2.31 \times 10^7$ μCi/L Sr-90)

The heat generation rate limits were obtained from the Aging Waste Tanks OSD (Bergmann 1989). It was assumed that cesium-137 or strontium-90 is at 50 percent of the heat load limit and the tank volume is one million gallons. Using this information the heat load was converted to μCi/L using the Radionuclide Specific Activity and Heat Generation Chart (Wilkins 1984). If the heat load exceeds any of the notification limits, the tank may be above the heat load specification for aging waste tanks. Calculations to determine the actual heat load will be done by Waste Tank Plant Engineering.

4.3 Total Fuel Concentration

Variable	Notification Limit
Total Fuel Conc. (Energetics)	> 115 cal/g

The above limit is found in several documents: Ferrocyanide DQO (Buck et al. 1993), *Ferrocyanide Safety Program Safety Criteria for Ferrocyanide Watch List Tanks* (Postma et al. 1994), Tank Safety Screening DQO (Babad 1994), Organic DQO (Babad et al. 1994), and the Crust Burn/Flammable Gas DQO (Johnson 1994). Exceeding the total fuel content could put the tank on the ferrocyanide, organic or flammable gas watch list. Calculation of the total fuel content will be done by Waste Tank Plant Engineering.

5.0 VAPOR SAMPLING

5.1 Compounds With Toxicological Properties

Variables	Notification Limit
Compounds with toxicological properties	> 50% level designated by NIOSH as immediately dangerous to life and health (IDLH)

When the shift manager receives a call about a potentially high concentration of a chemical in a tank vapor space, he will compare the data received with the SWP (Safe Worker Practice) that is found in the TFHASP (Tank Farm Health and Safety Plan) (Erickson, 1994). If the shift manager has further questions about the safety of tank farm workers, an industrial hygienist from Waste Tank Safety Support should be contacted to help determine the magnitude of the risk. The IDLH levels for common chemicals can be found in the NIOSH (National Institute of Occupational Safety and Health) Pocket Guide to Chemical Hazards, DHHS (Department of Health and Human Services) Publication Number 90-117. Below is a list of the most common vapors that are most likely to indicate tank concentrations at or above half the IDLH. The complete list is not limited to those below.

Vapor	IDLH (ppm)
n-butanol	8,000
ammonia	500
nitric oxide	100
nitrogen dioxide	50

5.2 Flammable Gases and Vapors

Variable	Notification Limit
Tank headspace vapors	≥ 20% of LFL

The above vapor safety limit is from the Watch List OSD (Raymond, 1994). If the LFL limit is surpassed, the tank may be a Flammable Gas or Organic Watch List tank. Waste Tank Safety Program will determine if the tank exceeds the watch list criteria.

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