Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste

T. A. Hu

CH2M HILL Hanford Group

Richland, WA 99352

U.S. Department of Energy Contract DE-AC27-99RL14047

EDT/ECN: N. A.

UC: N. A.

Cost Center: 7B300

Charge Code: 501027

B&R Code: N. A.

Total Pages: 543

Key Words: Hydrogen Generation, Flammable Gas, Ammonia, Rate Equation Model, Liquid/vapor equilibrium, Lower Flammability Limit

Abstract: This report assesses the steady-state flammability level under normal and off-normal ventilation conditions. Hydrogen rate is presented for 177 tanks using the rate equation model. Ammonia liquid/vapor equilibrium is incorporated into the methodology for ammonia analysis. Revision 3 updates the input data to July 2003 BBI.

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9-30-03
Release Approval Date

Release Stamp

Approved For Public Release

[illegible]

RPP-5926, Rev. 3

Page 1

(2) Title
Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste

Change Control Record

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

CH2MHILL
Hanford Group, Inc.

Richland, Washington

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC27-99RL14047

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T. A. Hu
CH2M HILL Hanford Group, Inc.

J. J. Zach
Longenecker & Associates, Inc.
for CH2M HILL Hanford Group, Inc.

Date Published
September 2003

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CH2MHILL
Hanford Group, Inc.

P. O. Box 1500
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EXECUTIVE SUMMARY

Flammable gases such as hydrogen, ammonia, and methane are observed in the tank dome space of the Hanford Site high-level waste tanks. This report assesses the steady-state flammability level under normal and off-normal ventilation conditions in the tank dome space for 177 double-shell tanks and single-shell tanks at the Hanford Site. The steady-state flammability level was estimated from the gas concentration of the mixture in the dome space using estimated gas release rates, Le Chatelier's rule and lower flammability limits of fuels in an air mixture. A time-dependent equation of gas concentration, which is a function of the gas release and ventilation rates in the dome space, has been developed for both soluble and insoluble gases. With this dynamic model, the time required to reach the specified flammability level at a given ventilation condition can be calculated.

In the evaluation, hydrogen generation rates can be calculated for a given tank waste composition and its physical condition (e.g., waste density, waste volume, temperature, etc.) using the empirical rate equation model provided in *Empirical Rate Equation Model and Rate Calculations of Hydrogen Generation for Hanford Tank Waste*, HNF-3851. The release rate of other insoluble gases and the mass transport properties of the soluble gas can be derived from the observed steady-state gas concentration under normal ventilation conditions. The off-normal ventilation rate is assumed to be natural barometric breathing only. A large body of data is required to do both the hydrogen generation rate calculation and the flammability level evaluation. For tank waste that does not have sample-based data, a statistical-based value from probability distribution regression was used based on data from tanks belonging to a similar waste group.

This report (Revision 3) updates the input data of hydrogen generation rates calculation for 177 tanks using the waste composition information in the Best-Basis Inventory Detail Report¹ in the *Tank Waste Information Network System*, and the waste temperature data in the Surveillance Analysis Computer System (SACS)² (dated July 2003). However, the release rate of methane, ammonia, and nitrous oxide is based on the input data (dated October 1999) as stated in Revision 0 of this report. Scenarios for adding waste to existing waste levels (dated July 2003) have been studied to determine the gas generation rates and the effect of smaller dome space on the flammability limits to address the issues of routine water additions and other possible waste transfer operations. In the flammability evaluation with zero ventilation, the sensitivity to waste temperature and to water addition was calculated for double-shell tanks 241-AY-102, 241-AN-102, 241-AZ-101, 241-AN-107, 241-AY-101 and 241-AZ-101. These six have the least margin to flammable conditions among 28 double-shell tanks.

¹ TWINS, 2001, *Tank Waste Information Network System*, Internet address: <http://twins.pnl.gov:8001> queried July 15, 2003 (the data downloaded is contained on a compact disk (CD) attached to selected copies of this report (see distribution)).

² SACS, 2001, Surveillance Analysis Computer System, Queried July 15, 2002 through July 15, 2003, SACSPROD database; also available at <http://twins.pnl.gov:8001>.

Overall, the flammability assessment indicates that no tank will exceed 25% of the lower flammability limit under normal ventilation conditions. Off-normal ventilation conditions evaluated in this report included shutdown of the active ventilation system coupled with closure of the air inlet for actively ventilated systems and isolation of the high-efficiency particulate air breather filter for passively ventilated tanks. The shortest time to reach 25% of the lower flammability limit during off-normal ventilation conditions with barometric breathing rate is 11 days for double-shell tanks (e.g., tank 241-AY-102) and 38 days for single-shell tanks (e.g., tank 241-B-203); and is 10 days for double-shell tanks (e.g., tank 241-AY-102) and 30 days for single-shell tanks (e.g., tank 241-B-203) in the water addition and zero ventilation scenario. Note that off-normal ventilation conditions occur rarely. The temperature sensitivity and water addition study on double-shell tanks (under zero ventilation using case of current temperature plus 5 °C) results in the shortest time to reach 25% and 100% of the lower flammability limit for double-shell tank 241-AY-102 are 10 and 39 days, respectively.

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LIST OF TERMS

atm	atmosphere
BBI	best-basis inventory
DST	double-shell tank
eV	electron volt
g-mole/L-atm	gram mole per liter per atmosphere
GRE	gas release event
HEPA	high-efficiency particulate air
HGR	hydrogen generation rate
kJ/mole	kiloJoule per mole
LFL	lower flammability limit
SACS	Surveillance Analysis Computer System
SST	single-shell tank
TCD	Tank Characterization Database
TOC	total organic carbon
TWINS	Tank Waste Information Network System

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1.0 INTRODUCTION AND BACKGROUND

This report provides the methodology to predict the steady-state gas release rate and to evaluate the steady-state flammability level of the tank dome space under both normal and off-normal ventilation operating conditions for 177 underground nuclear waste storage tanks at the Hanford Site. Revision 0 of this report replaced two previous calculation notes: *Calculation Note Hydrogen Generation Rates At Steady State Flammable Gas Concentrations for Single-Shell Tanks*, HNF-SD-WM-CN-116, and *Calculations of Hydrogen Release Rate at Steady State for Double-Shell Tanks*, HNF-SD-WM-CN-117, and provided the technical basis for establishing flammable gas controls. The focus of this report is the loss of ventilation transient such that technical safety requirement surveillance frequencies and action times can be established. This report also provides the following:

- Estimates of the flammable gas release rates in the tank dome space
- Estimates of the time to reach 25% of the lower flammability limit (LFL) and the LFL following the loss of normal ventilation in actively and passively ventilated double-shell tanks (DST) and single-shell tanks (SST)
- Estimates of the minimum ventilation rate required to maintain less than 25% of the LFL
- Estimates of the maximum dome space concentrations following an extended loss of normal ventilation.

The report also provides the methodology that can be used in other applications.

To clarify the application of the subject document, "steady-state" has been defined as the condition of no active operational changes to the tank, and the non-GRE (gas release event) condition with GRE defined as a 500-ppm rise in hydrogen concentration followed by exponential decay. For this application the following assumptions were used: (1) long-term variations in ventilation rates brought about by seasonal effects or ventilation rate changes within the exhaust system operating range are minimal and neglected; (2) the variability of the hydrogen concentration about the baseline is less than that produced by a GRE. When the results from only one sample were available, the sample was assumed to have been taken at steady-state condition unless clear documentation shows the existence of a GRE condition.

This report is organized as follows: Chapter 2.0 describes the hydrogen generation rate (HGR) model calculation and summarizes the empirical equation of HGRs. Chapter 3.0 describes the methodology to evaluate the flammability level of the gas mixture in the dome space. Details of the validity of the LFLs in air, ammonia liquid-vapor equilibrium model, time-dependent gas concentration model, and the flammability level calculations are discussed. Chapter 4.0 discusses the input data and results of the gas generation calculations and the flammability evaluations under various ventilation conditions. Chapter 5.0 provides the results of the flammability assessment on waste addition scenarios for DSTs. Chapter 6.0 gives the overall summary and conclusions. Detailed formula, input data, and calculation results are given in Appendices A through H.

1.1 REVISION 1

Revision 1 of this report differs from Revision 0 in the following ways:

- The mass balance equation (Equation 3-5) and its derived equations in the methodology of flammability assessment section (Chapter 3.0) were modified by redefining the ventilation rate as the outlet measurement or calculated outlet flow for natural breathing plus gas generation to reflect total gas leaving the tank.
- The input data and calculations for tank 241-SY-101 were updated to reflect the tank waste status after 616 kilo-gallons (kgal) of active flammable-gas-generation waste material were transferred between December 1999 and February 2000, as provided in *Evaluation of Hanford High-Level Waste Tank 241-SY-101*, RPP-6517. As of April 2001, the HGR in tank 241-SY-101 is 3.1 E-3 cubic feet per minute (ft³/min), which is one-tenth the generation rate before the remediation task. Other than the data for tank 241-SY-101, all the input data used were from Revision 0, which presents data as of October 1999, unless noted in Revision 1.
- The liquid/vapor equilibrium model was added to address the behavior of the highly soluble gas ammonia.
- The off-normal ventilation calculations used in the flammability assessment were more clearly defined and text was added.

1.2 REVISION 2

Revision 2 was issued to cover the following items:

- The U.S. Department of Energy's comments on Revision 1 were resolved. Primarily, the off-normal ventilation conditions were redefined and it was clarified that the off-normal conditions rarely occur. Second, the discussions on the discrepancies of the ammonia mass transport properties between the field data-derived values and the direct calculation of mass transport coefficient h and using 100% surface area were redone. Third, several editorial errors were identified and corrected.
- The HGRs for 177 tanks were updated using the waste composition information in the latest best-basis inventory (BBI) detailed calculation report generated by the *Tank Waste Information Network System* (TWINS) and temperature data in Surveillance Analysis Computer System (SACS) (dated November 2001) as the input data. In this revision, tank 241-AY-102 has the highest HGR instead of tank 241-AN-102 (Revision 1). This is because the updated input data for tank 241-AY-102 include the waste received from tank 241-C-106, and the tank also shows higher tank waste temperature than previously.
- The flammability calculations for the 177 tanks were updated to reflect the updated HGRs. For off-normal ventilation condition, the updated flammability calculations were performed at barometric breathing rate for DSTs, and at both barometric breathing and

zero ventilation rates for SST. The SSTs was sealed off as much as possible under the interim stabilization project.

- Using BBI data dated November 15, 2001, tank 241-A-101 has the highest HGR among the SSTs, but the tank is undergoing saltwell pumping, which will reduce both the HGR and flammability. The HGR and flammability are recalculated based on the latest waste volume information (February 28, 2002) to reflect the saltwell pumping activity.
- To address routine water addition and other possible waste transfer operations, flammability assessments were performed on several waste addition cases. The resulting information can be used to determine the flammable gas control for the ventilation surveillance frequency and the waste compatibility program.

1.3 REVISION 2A

Revision 2A made no changes to the text or Appendices A through H. It added a new Appendix I (subsequently changed to Appendix H in Revision 3). The new Appendix I contained flammability evaluations on the sensitivity of waste temperature and water addition under zero ventilation condition for top three flammability-level and aging-waste DSTs.

Appendix I contains a complete set of equations derived for flammability evaluations under zero ventilation condition for both soluble and insoluble gases. A simple and conservative heat transfer model (RPP-6213, *Hanford Waste Tank Bump Accident and Consequence Analysis*), used in evaluation of the steam bump hazard, is used for tank waste temperature increase analysis in the gas generation rate calculations.

1.4 REVISION 3

Revision 3 updated the HGR calculation and thus the change on flammability evaluation based on the latest best basis inventory (BBI) data from July 15, 2003, which resulted in changes to Appendices A, B, D, and H. The text was modified to reflect the changes.

1.5 GAS GENERATION

The gases generated in the tank waste are a mixture of hydrogen, nitrogen, ammonia, nitrous oxide, a small amount of methane, and other hydrocarbons. Hydrogen is the most abundant gas and contributes more than 90% of the flammable components in the dome space for most of the storage tanks containing gas-generating waste. All of these gases except ammonia have little solubility and are either fully released to the dome space or partially trapped in the solid layers of waste. Because of its high solubility, 99% of the ammonia generated is dissolved and stored in the liquid waste (*Composition and Quantities of Retained Gas Measured in Hanford Waste Tanks 241-AW-101, A-101, AN-105, AN-104, and AN-103*, PNNL-11450) rather than being released to the dome space. For most of the tanks, little methane is generated, but methane is the major species among the observed hydrocarbon vapors. Nitrous oxide is not flammable by itself, but it is an oxidizer. Studies provided in *Flammability and Flame Propagation in H₂-N₂O-CH₄-NH₃-O₂-N₂ Mixtures*, Explosion Dynamics Laboratory Report FM97-4,

(Pfahl and Shepherd 1997) show that concentrated nitrous oxide can lower the flammability limit of fuels in an air mixture.

Understanding gas generation phenomena and predicting the gas generation and gas release rates are important in controlling the flammable gas hazard and planning daily operations in the tank farms. For example, the overall rate of generation is needed to verify that any given tank has sufficient ventilation to ensure that the level of flammable gases is maintained below the operational flammability limit in the dome space. In the past decade, many studies (*Flammable Gas Project Topical Report*, HNF-SP-1193) have been conducted on the mechanisms of gas generation, gas release, and gas retention of tank waste using simulated or actual waste. Systematic tank waste characterization programs and various tank safety programs have generated a tremendous amount of tank waste data. All of this information provided the basis for the *Empirical Rate Equation Model of Hydrogen Generation*, HNF-3851. The model is tank-waste-constituent- and tank-condition-based and provides a tool to estimate the generation rate for not only the current tank waste contents, but also tanks with contents that have changed. The other observed gases, ammonia, methane, and nitrous oxide, do not have a general rate equation for calculating generation rates as a function of waste constituents.

The report provides the methodology for calculating gas release rates. The hydrogen HGR equation model (HNF-3851) is used to estimate the hydrogen release rate by subtracting the field-observed gas accumulation rate, if any, from the model-calculated generation rate. The gas release rates for ammonia, methane, and nitrous oxide, the minor gases of interest observed in the dome space, are derived from vapor concentration data, ventilation rates in the dome space, and other information about tank waste.

While updating the tank 241-SY-101 calculations for the Revision 1 of the report, the dome space steady-state ammonia concentration in tank 241-SY-101 rose from a preremediation concentration of 4 ppm (before the waste was transferred) to 400 ppm (January 14, 2001). Based on the value of 400 ppm, the derived ammonia release rate, if used as a constant, will predict a value of 108% of the LFL as the steady-state ammonia concentration under the off-normal condition of a loss of ventilation. This is a factor of 50 larger than the equilibrium value predicted by the model. Apparently, treating the ammonia release rate as constant is over-conservative when the ammonia concentration in the dome space is high. Therefore, the liquid-vapor equilibrium model provided in *Methodology for Predicting Flammable Gas Mixtures in Double-Contained Receiver Tanks*, RPP-4941, is introduced into the methodology to address the dome space calculations for ammonia. A time-dependent equation for gas concentration in the tank dome space was developed by solving the mass balance equations for the gas volume. Once the steady-state gas release rates or the mass transport properties of soluble gas are obtained, a time-dependent gas concentration can be derived from the equation for a given ventilation condition. Therefore, the flammability level of the gas mixture in the dome space can be calculated under both normal and off-normal ventilation conditions. Also, the time required to reach a specified flammability level in the dome space and the minimum ventilation rate required to prevent reaching that level can be estimated.

1.6 DOCUMENT ORGANIZATION

Attachment A to TFC-ENG-DESIGN-C-10, *Engineering Calculations*, provides a list of certain sections to be included in engineering documents. The following notes where the sections in this document correspond to the TFC-ENG-DESIGN-C-10 attachment.

1. Title and Identifier (required) – See title page.
2. Objective/Purpose (required) – See Chapter 1.0.
3. Summary of Results and Conclusions (optional depending on calculation length or complexity) – Not included.
4. Introduction/Background (optional) – See Chapter 1.0.
5. Input Data (required) – See Appendix A.
6. Assumptions (required if assumptions are made) – See Chapters 2.0 and 3.0.
7. Method of Analysis (required) – Calculational methods are in Chapter 3.0 and spreadsheets in appendices.
8. Use of Computer Software (required if software is used) – The only software used are Excel³ spreadsheets.
9. Results (required) – See Section 6.0 as well as various summary tables.
10. Conclusions (required) – See Section 6.0.
11. Recommendations (optional) – None included.

³ Excel is a registered trademark of Microsoft Corporation.

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2.0 HYDROGEN GENERATION RATE MODEL

Several hydrogen rate models have been proposed (*Criteria for Flammable Gas Watch List Tanks*, WHC-EP-0702; *Methodology for Flammable Gas Evaluations*, WHC-SD-WM-TI-724; *Topical Report on Flammable Gases in Non-Burping Waste Tanks*, WHC-SD-WM-SARR-015; *Status and Integration of Studies of Gas Generation in Hanford Wastes*, PNNL-11297; and HNF-SD-WM-CN-117) to estimate the HGR for Hanford tank waste, but these models are based on either the waste simulant data or very limited tank waste data. A more comprehensive HGR model (described in *Empirical Rate Equation Model of Hydrogen Generation for Hanford Tank Waste*, paper presented at American Nuclear Society, 1999 Winter Meeting, and HNF-3851) was developed and validated based on a large body of tank waste data. The model constructed a set of semi-empirical rate equations to simulate the gas generation mechanisms of thermal chemical reactions, radiolysis of water and organic components, and corrosion processes. The rate equations are formulated as a function of physical and chemical properties of tank waste and are able to estimate the HGR of waste under current conditions, including the rates for newly mixed waste with known properties. The model has been applied to calculate the generation rate for more than 30 SSTs and DSTs and shows good agreement with field-observed rates.

2.1 SEMI-EMPIRICAL RATE EQUATIONS

The total HGR (HNF-3851) in units of hydrogen yield per day per kilogram of total waste consists of the thermal rate (HGR_{thm}), the radiolysis rate (HGR_{rad}), and the corrosion rate (HGR_{corr}). Equation 2-1 takes into account the dependence of the rate on tank waste composition, temperature, radiation level, and liquid fraction:

$$HGR = HGR_{thm} + HGR_{rad} + HGR_{corr} \quad (2-1)$$

where:

$$HGR_{thm} = a_{thm} \times r_f \times [TOC] \times [Al]^{0.4} \times L_f \times e^{-(E_{thm}/RT)}$$

$$HGR_{rad} = (G_{H_2O} + G_{ORG} \times L_f) \times H_{load} \times CF_1$$

$$HGR_{corr} = R_{corr} \times A_{wetted} / M_{tank} \times CF_2$$

with

$$G_{ORG} = a_{rad} \times e^{(-E_{rad}/RT)} \times (r_f \times [TOC])$$

$$G_{H_2O} = 0.45 - 0.56 \times [NO_3^-]^{1/3} - 0.43 \times [NO_2^-]^{1/3}$$

and

$$E_{thm} = \text{activation energy for thermal reaction (89.3 kJ/mole)}$$

$$E_{rad} = \text{activation energy for radiolytic reaction (44.3 kJ/mole)}$$

$$a_{thm} = \text{pre-exponential factor for thermal reaction (2.76 E+09 mole/kg-day)}$$

$$a_{rad} = \text{pre-exponential factor for radiolytic reaction (2.49 E+06 H}_2\text{/100 eV)}$$

$$R = \text{universal gas constant}$$

T	= temperature in Kelvin
TOC	= total organic carbon concentration in moles per liter
Al	= aluminum concentration in moles per liter
NO ₂ ⁻	= nitrite ion concentration in moles per liter
NO ₃ ⁻	= nitrate ion concentration in moles per liter
G _{ORG}	= hydrogen yield per 100eV energy from organic radiolysis
G _{H₂O}	= hydrogen yield per 100eV energy from water radiolysis (G _{H₂O} has a minimum value of 0.005 H ₂ /100 eV)
r _f	= TOC reactivity coefficient (average value is 0.7 for DSTs and 0.4 for SSTs)
R _{corr}	= corrosion coefficient [1.831 E-08 for DSTs and 3.666 E-08 for SSTs (m ³ /min-m ²) at 25 °C]
H _{load}	= heat load (Watt/kg)
L _f	= liquid weight fraction in the waste
A _{wetted}	= wetted surface area of the tank (m ²)
M _{tank}	= total waste mass (kg) in the tank
CF ₁	= conversion factor to convert the units from (H ₂ /100eV)(Watts/kg) to (mole/kg-day)
CF ₂	= conversion factor to convert the units from (m ³ /kg-min) to (mole/kg-day).

In general, the HGR caused by chemical reactions follows Arrhenius behavior and the rate from radiolysis is proportional to the radiation dose. In addition, the HGRs from radiation effects in tank waste samples have been observed to be temperature dependent as provided in *Thermal and Radiolytic Gas Generation on Material from Tanks 241-U-103, 241-AW-101, 241-S-106, and 241-S-102: Status Report*, PNNL-12181. The analysis of all available gas generation data provided in HNF-3851 shows that this temperature-dependent reaction follows Arrhenius behavior, which may result from a multi-step degradation of organic compounds initiated by radiolysis, followed by thermal reactions. The water radiolysis rate is assumed to be temperature independent, with the G_{H₂O} value reduced by scavenging effects.

The numerical parameters in the equations are established by analyzing gas generation kinetic data from waste samples with the aid of tank field surveillance data and tank waste characterization data. The reactivity coefficient, r_f, was used to adjust for differences in reactivity of total organic carbon (TOC) among the tanks. HNF-3851 describes this model in detail.

3.0 METHODOLOGY TO ESTIMATE STEADY-STATE FLAMMABILITY LEVEL

This chapter describes the methodology used to evaluate the steady-state flammability level in the dome space for all DSTs and SSTs. The methodology also provides a technical basis for flammable gas controls in tank farm operations. The evaluation will address the flammability level in the dome space under both normal and off-normal ventilation conditions. In the evaluation, the steady-state gas release rates and ventilation rates are needed to derive the steady-state gas concentration under given ventilation conditions. Based on the flammable gas concentrations, the level of flammability of the mixture can be calculated. Under current normal ventilation conditions, the steady-state flammability level in the tank dome space is below 25% of the LFL for all tanks (*Adequacy of Ventilation Rates to Remediate Flammable Gas Levels in Headspace of Hanford Tanks – Status Report*, HNF-3294). The primary evaluation is focused on the flammable gas level under off-normal ventilation conditions.

The major gases of concern were identified as hydrogen, ammonia, nitrous oxide, and methane in the tank dome space. Among these identified gases, hydrogen is the primary flammable gas in the tank dome space. The gas release rate of hydrogen in the dome space can be determined by subtracting the gas accumulation rate from the generation rate calculated with the rate equation model described in Chapter 2.0. The other two flammable gases, ammonia and methane, have much lower concentrations in the dome space and have no general model for calculating their gas generation rates; therefore, the steady-state gas release rates for ammonia and methane are estimated by their steady-state gas concentrations under normal ventilation conditions. Nitrous oxide is an oxidizer; the concern is whether its concentration is high enough to lower the LFL of hydrogen, ammonia, and methane as established in air. The gas release rate of nitrous oxide also is derived by the steady-state gas concentration under normal ventilation conditions.

To evaluate the flammable gas level, a time-dependent gas concentration model was established. This model can calculate the steady-state flammability level for a given ventilation condition. The model also can estimate the time required to reach certain flammability levels in the dome space under different ventilation conditions and calculate the minimum ventilation rate to keep the dome space below the specified flammability limit.

3.1 LOWER FLAMMABILITY LIMITS

The National Fire Protection Agency codes require that operations be terminated when the concentration of flammable gases exceeds 25% of the LFL. Based on the empirical rule developed by Le Chatelier in the late 19th century, the LFL of mixtures of multiple flammable gases in air can be determined. Le Chatelier's rule (*Limits of Flammability of Gases and Vapors*, Coward and Jones 1952) can be written in terms of the LFL concentration of the fuel mixture, LFL_m , as follows:

$$LFL_m = \frac{100}{\sum_i^n \left(\frac{C_i}{LFL_i} \right)} \quad (3-1)$$

where:

C_i = volume percent of fuel gas i in the fuel gas mixture

LFL_i = volume percent of fuel gas i at its LFL in air alone.

If LFL_m is greater than 100%, the mixture is above the LFL. In the tank dome space, hydrogen gas is the fuel of concern; other gas fuels identified are ammonia and methane. *Laboratory Flammability Studies of Mixtures of Hydrogen, Nitrous Oxide, and Air*, WHC-SD-WM-ES-219, have shown experimentally that the LFL_m of a mixture of hydrogen, ammonia, and methane in an air-nitrous oxide atmosphere can be computed using Le Chatelier's rule as presented in Equation 3-2.

$$LFL_m = \frac{[H_2]}{LFL_{H_2}} + \frac{[NH_3]}{LFL_{NH_3}} + \frac{[CH_4]}{LFL_{CH_4}} \quad (3-2)$$

where:

$[H_2]$ = volume percent of hydrogen in the fuel gas mixture

$[NH_3]$ = volume percent of ammonia in the fuel gas mixture

$[CH_4]$ = volume percent of methane in the fuel gas mixture

LFL_{H_2} = volume percent of hydrogen at its LFL in air alone

LFL_{NH_3} = volume percent of ammonia at its LFL in air alone

LFL_{CH_4} = volume percent of methane at its LFL in air alone.

For simplicity, in Equation 3-2, flammable gases with concentrations lower than that of methane are omitted. The flammability of the individual gases in air is fairly well characterized. The LFL_{H_2} , LFL_{NH_3} and LFL_{CH_4} are 4, 15, and 5%, respectively, at the upward propagation LFL, which is more conservative than the downward propagation LFL. In addition to the flammable gases included in Equation 3-2, nitrous oxide was observed in the tank dome space. Nitrous oxide plays the role of oxidizer in the mixture and has the potential to decrease the amount of fuel required to reach the LFL. The effect of the multiple oxidizers (e.g., N_2O and O_2) was not addressed in Equation 3-2.

Pfahl and Shepherd (1997) from the California Institute of Technology have conducted a series of flammability studies on gas mixtures generated from Hanford Site tank waste. The studies show that the established LFLs of individual fuels in the air will decrease if concentrated N_2O is present in the mixtures. For example, in the mixture NH_3 - N_2O -air with a ratio of 13.2-19.8-67.0, the system will be flammable, although the ammonia volume percent is 13.2 and is lower than the LFL_{NH_3} of 15% in air. This fuel-oxidizer mixture will be flammable with the ammonia volume percent as low as 8% if the N_2O concentration is 65%. For NH_3 - N_2O -air mixtures, Pfahl and Shepherd (Figure 32 in 1997 report) suggest that the ammonia flammability limit will

be 15% if the N_2O does not exceed 8%. These test results are for turbulent conditions, with an ignition energy of 8 J. For a CH_4-N_2O -air mixture, the data show that the ratio of 4.5-10.1-85.4 is not flammable. For an H_2-N_2O -air mixture, the data show that a mixture with the ratio of 5.7-10-84.3 has incomplete combustion. It should be noted here that the ignition energy of 8 J used in these experiments is very large compared to the energy in most electrostatic discharge sparks (typically a few millijoules) that might occur inside a Hanford Site tank.

This information suggests that the flammability limit established in the fuel-air mixture for each gas will not be reduced unless the N_2O volume percent exceeds 8%. In this evaluation, the volume percents of 4, 15, and 5% will be used for LFL_{H_2} , LFL_{NH_3} and LFL_{CH_4} , respectively, in Equation 3-2. In each case, the concentration of nitrous oxide was evaluated and did not exceed 8%, therefore, the oxidizer effect of lowering these flammability limits can be ignored.

3.2 VENTILATION CONDITIONS IN TANK DOME SPACE

Under normal operating conditions, the ventilation conditions can be active ventilation or passive ventilation. The tank dome spaces of all DSTs and some SSTs are equipped with an active ventilation system. For active ventilation systems, the main ventilation flow is designed to go through an installed inlet filter. The 241-AP Tank Farm is an exception to this system; inlet air flows through cover blocks or gaps in riser covers, and other tank openings. The size of the inlet openings was designed to be either fully adjustable or to have just an on-off valve. These filtered inlets are used to control the ventilation rate and to adjust the negative pressure to prevent leakage of tank hazardous materials or to provide control for any other operational needs. For passively ventilated tanks, the ventilation flow goes mainly through high-efficiency particulate air (HEPA) breather filters. Under normal operating conditions, the active ventilation rates range from 100 to 700 ft^3/min , while the passive ventilation rates typically range from 0.5 to 10 ft^3/min . On actively ventilated tanks, the off-normal operating ventilation condition considered in the flammability assessment is that the ventilation system is shut down and the air inlet is closed; on passively ventilated tanks, the HEPA breather filter isolation valve is closed or a blank is installed. For these conditions, the only venting flow is through the gaps between the cover blocks or riser covers. The off-normal condition allows three possible tank ventilation conditions: no ventilation flow, ventilation flow caused only by barometric breathing, or ventilation flow caused by natural breathing, which is a combination of ventilation by barometric breathing plus thermal convection. The barometric breathing rate, V_{bb} , is estimated as 0.45% of the dome space volume per day (*Barometric Pressure Variations*, WHC-EP-0651) and is given in Equation 3-3:

$$V_{bb} = 0.45\% \cdot Vol_{headspace} \left(\frac{ft^3}{day} \right) \quad (3-3)$$

where:

$Vol_{headspace}$ = volume of the tank dome space (ft^3).

During off-normal operating conditions, the most likely ventilation rate is either natural breathing or barometric breathing. The natural breathing rate is estimated to be 5 to 10 times the barometric breathing rate, but the estimation of the thermal convection flow is not available. In general, the zero-flow condition is considered to be impossible because of the many openings into the tanks. However, since 1980, a great effort has been made to seal-off the openings as much as possible for SSTs under the interim stabilization project to prevent water intrusion. In this evaluation, the barometric breathing rate, which is more conservative but reasonable, will be used for the ventilation rate for DSTs when normal ventilation is not present. For SSTs, both barometric breathing rate and zero ventilation rate will be evaluated under off-normal ventilation condition. As shown in the calculations later (Table 4-4), there is not much difference between the zero and barometric breathing rate in terms of time to reach 25% and 100% of the LFL because the barometric breathing rate is very small and close to zero. Using a tracer gas, the measured passive ventilation rates (*Waste Tank Ventilation Rates Measured with A Tracer Gas Method, Fiscal Year 1998 Summary*, PNNL-11925) under normal ventilation conditions in SSTs ranged from 1.7 to 10 ft³/min for most tanks. No similar measurements for the passive rates (i.e., the active ventilation system is shut down with the air-inlet open) are available for DSTs. Unfortunately, no ventilation rate measurements have been made for the condition where the air inlet is shut off. For the off-normal condition, based on Equation 3-3, the calculated barometric breathing rate for most tanks is around 0.5 ft³/min or less (as shown in Table D-2 of Appendix D), which is one-third to one-twentieth of normal conditions.

3.3 TIME-DEPENDENT GAS CONCENTRATION MODEL

An equation was developed to calculate the time-dependent flammable gas concentration in the dome space. The concentration is a function of the gas release rate and the ventilation rate. Figure 3-1 shows a simplified tank dome space system.

In general, most of the tanks contain supernatant liquid and sludge/saltcake layers. A few tanks, including tank 241-AN-103, have a thin crust layer above the supernatant liquid. The gas release rate (R_g) is the net result of the generation rate (G_r) and the accumulation rate (A_r). The gas accumulation rate refers to the rate at which gas is trapped in the sludge/saltcake layer. The ventilation flows (V_r) are available as field measurements taken at the output streams. These flows are the sum of air inflows from the inlets and tank cracks and openings and the gases released from tank waste. The gas volume change rate can be formulated from a mass balance as provided in Equation 3-4:

$$\begin{array}{l} \text{Gas Change Rate in} \\ \text{Tank Dome Space} \end{array} = \begin{array}{l} \text{Gas Release Rate from} \\ \text{the Waste Surface} \end{array} - \text{Gas Exit Rate} \quad (3-4)$$

Figure 3-1. A Simplified Tank System for Time-Dependent Gas Concentration Model.

3.3.1 Insoluble Gas

For the less soluble gases such as hydrogen or methane, the gas release rate can be considered to be constant; therefore, the mass balance equation can be written as a differential equation as given in Equation 3-5:

$$Vol \frac{\partial [C_g]}{\partial t} = R_g - V_r \cdot [C_g] \quad (3-5)$$

where:

- $[C_g]$ = gas concentration (volume percent)
- Vol = volume of the tank dome space (volume)
- R_g = gas release rate from the waste surface (volume/time)
- V_r = ventilation rate in the dome space (volume/time).

As given in Equation 3-5, the gas exhaust rate is simply the gas concentration times the output ventilation rate. By solving the differential Equation 3-5, a time-dependent gas concentration at time t , $[C_g](t)$, in units of volume percent is given in Equation 3-6:

$$[C_g]_{\%}(t) = [C_g]_{\%}(t_0) \exp(-\lambda t) + \left[\frac{R_g}{V_r} \right]_{\%} [1 - \exp(-\lambda t)] \quad (3-6)$$

with

$$\lambda = V_r / \text{Vol}$$

where:

R_g = hydrogen release rate from the waste surface (volume/time)

V_r = ventilation rate in the dome space (volume/time)

$[C_g](t_0)$ = initial gas concentration at time t (volume percent)

Vol = volume of the tank dome space (volume)

λ = decay parameter from the venting (inverse time).

In Equation 3-6, the first term represents how the initial gas concentration decays away exponentially with the factor of $e^{(-\lambda t)}$ and second term represents how the gas level builds up in the form of $[R_g/V_r]_{\%}$ with the factor of $[1 - e^{(-\lambda t)}]$ as time goes on.

3.3.2 Soluble Gas

For a highly soluble gas, such as ammonia, the gas release rate from liquid waste is not a constant, but depends on the material transport properties and the ammonia concentration gradient between the liquid and vapor phases and appropriate Henry's Law constants. Thus the differential equation of mass balance in Equation 3-5 and the time-dependent gas concentration Equation 3-6 have different formats. For a closed system, Henry's Law describes the relationship of a soluble gas in the liquid and vapor phases as provided in Equation 3-7:

$$C_l = K_H \cdot P_g \quad (3-7)$$

where:

C_l = ammonia concentration in the liquid phase (mole/L)

K_H = Henry's Law constant (mole/L-atm)

P_g = partial pressure of the ammonia (atm).

The Henry's Law constant is a function of temperature in pure water. In mixed salt solutions, Henry's Law constants are functions of both temperature and the concentrations of the ions in the solution. "The Estimation of Gas Solubility in Salt Solutions at Temperature from 273 K to 363 K," AICHE Journal (Weisenberger and Schumpe 1996), provide a formula to calculate Henry's Law constant as given in Equation 3-8:

$$K_H = K_H^o \cdot 10^{-\sum_i (h_i + h_g) \cdot C_i} \quad (3-8)$$

with

$$K_H^o = e^{(-8.0964 + 3917.5/T - 0.00314T)}$$

where:

- K_H^o = Henry's Law constant in the pure water (g-mole/L-atm),
- h_i = ionic dependent coefficient,
- h_g = gas specific constant for ammonia, and
- C_i = ion concentration in the solution.

However, the Weisenberger and Schumpe (1996) formula is good only for the solution up to 5 M. RPP-4941 reported Henry's Law constants for tank 241-SY-101 simulant waste at different dilution conditions and temperatures. This study covers solution concentrations ranging from 5 to 21 M at temperatures of 20 °C to 70 °C. These results provide a correction factor to the calculated Henry's Law constant from the Weisenberger and Schumpe (1996) formula. For example, the measured Henry's Law constant is five times the calculation from the Weisenberger and Schumpe (1996) formula for the undiluted sample of 21 M at 70 °C.

For soluble gas, the gas release rate depends on the equilibrium mechanism between the liquid and vapor phases described earlier. A comprehensive soluble gas transfer methodology applied to Hanford Site waste has been described in RPP-4941.

Consider the two-film theory of gas transfer. The ammonia release will encounter the resistance from two films, the liquid film and the gas film, between the bulk liquid and bulk vapor phases. The release rate is proportional to the difference between the ammonia liquid concentration and the ammonia vapor concentration before reaching equilibrium. It also is proportional to the mass transport coefficient, h , and the effective area, A . Therefore, the release rate can be derived as provided in Equation 3-9:

$$R_g = h \cdot A \cdot (C_l - C_l^{EQ}) = h \cdot A \cdot (C_l - K_H \cdot P_g) = h \cdot A \cdot (C_l - K_H \cdot P \cdot v \cdot C_g) \quad (3-9)$$

where:

- h = overall mass transport coefficient from liquid to vapor (m/sec)
- A = effective area for the transport (1000 x m²)
- C_l^{EQ} = corresponding liquid ammonia concentration in equilibrium at the current ammonia vapor pressure (g-mole/L)
- C_l = current ammonia concentration in liquid (g-mole/L)
- P_g = ammonia gas partial pressure (atm)
- P = dome space total pressure (atm)
- v = specific molar volume of gas in the dome space (L/mole)
- C_g = current ammonia concentration in the dome space (g-mole/L)

K_H = Henry's Law constant (mole/L-atm).

As Equation 3-9 shows, the ammonia gas release rate clearly is a function of the ammonia concentrations in the liquid and vapor phases and the Henry's Law constant for ammonia in the solution. In the two-film-theory of gas transfer, the overall mass transport coefficient h contains the transport coefficient h_l for gas through the liquid film and h_g for the gas through the gas film. Equations of the calculated h are described in detail in RPP-4941 and summarized in Appendix B.

A sensitivity study indicates that the overall mass transport coefficient h varies by several factors, while the effective tank waste surface area A for mass transport is difficult to determine, particularly for the SSTs, where the waste surfaces are mostly crusts. Dome space ammonia concentrations would be overestimated by several orders of magnitude if the full area for the SST is used as the effective transport surface. As discussed in Section 3.4, however, the product of h and A can be determined by field data at steady-state conditions. Once h times A is determined, the gas release rate can be calculated by Equation 3-9. Applying the ammonia release rate from Equation 3-9 to the mass balance in Equation 3-5 results in Equation 3-10:

$$Vol \frac{\partial [C_g]}{\partial t} = h \cdot A \cdot (C_l - K_H \cdot P \cdot v \cdot C_g) - [V_r] \cdot [C_g] \quad (3-10)$$

Dividing by Vol and rearranging the terms, Equation 3-10 becomes Equation 3-11:

$$\frac{\partial [C_g]}{\partial t} = k_2 - k_1 \cdot [C_g] \quad (3-11)$$

with

$$k_1 = [V_r + h \cdot A \cdot K_H \cdot P \cdot v] / [Vol]$$

and

$$k_2 = [h \cdot A \cdot C_l] / [Vol].$$

The solution of Equation 3-11 is given as Equation 3-12:

$$[C_g](t) = [C_g](t_0) \exp(-k_1 \cdot t) + \left[\frac{k_2}{k_1} \right] [1 - \exp(-k_1 \cdot t)]. \quad (3-12)$$

3.4 STEADY-STATE GAS CONCENTRATION AND GAS RELEASE RATE

For insoluble gas, when the systems reach steady state (set time, t , to infinity in Equation 3-6), the exponential term drops out from Equation 3-6 and a steady-state gas concentration is given in Equation 3-13:

$$[C_g]_{\%}^{ss} = \left[\frac{R_g}{V_r} \right] \times 100 \quad (3-13)$$

where:

- $[C_g]_{\%}^{ss}$ = steady-state gas concentration (volume percent)
 R_g = gas release rate (volume/time)
 V_r = ventilation rate in the dome space (volume/time).

Using Equation 3-13, the steady-state gas concentrations in the tank dome space can be calculated by knowing the gas release rate and the ventilation rate.

The gas release rate, R_g , can be estimated by subtracting the gas accumulation rate from the gas generation rate as shown in Equation 3-14:

$$R_g = G_r - A_r \quad (3-14)$$

where:

- G_r = gas generation rate from waste (volume/ time)
 A_r = gas accumulation rate due to gas trapping (volume/ time).

For hydrogen, the generation rate can be calculated using the empirical rate equation described in Section 2.1. The accumulation rate (HNF-3851) can be determined in the field, based on the waste level change rate and the gas composition data from the retained gas sampler. If the waste level does not change noticeably, the hydrogen release rate will be the same as the HGR.

For other insoluble gases, no gas generation rate model is available. Therefore, the steady-state gas release rate can be estimated from the known steady-state concentration in the dome space under normal ventilation conditions by rearranging Equation 3-13 as shown in Equation 3-15:

$$R_g = \left(\frac{[C_g]_{\%}^{ss}}{100} \right) \cdot V_r \quad (3-15)$$

where:

- $[C_g]_{\%}^{ss}$ = steady-state gas concentration (volume percent)
 R_g = gas release rate (volume/time)
 V_r = ventilation rate in the dome space (volume/time).

In this report, the gas release rates for methane and nitrous oxide were obtained from their steady-state concentrations under normal ventilation conditions using Equation 3-15. Then the calculated gas release rate was used to calculate the steady-state concentrations for off-normal conditions. This methodology is a reasonable way to determine methane concentrations under

off-normal conditions because methane is insoluble and whatever gases are generated are directly released to the dome space.

For highly soluble gases, from Equation 3-12, the steady-state concentration can be expressed as Equation 3-16:

$$[C_g]^{ss} = \left[\frac{k_2}{k_1} \right] = \left[\frac{h \cdot A \cdot C_l}{V_r + h \cdot A \cdot K_H \cdot P \cdot v} \right] \quad (3-16)$$

As discussed in Section 3.3, the mass transport properties, the product of h and A , are difficult to estimate directly from tank waste properties, particularly for tank waste covered with an irregular crust layer. However, for the known steady-state vapor concentration C_g^{ss} , the liquid concentration C_l , along with Henry's Law constant and the ventilation rate V_r , the product of h and A can be determined. By rearranging Equation 3-16, the product of h and A can be expressed as Equation 3-17:

$$h \cdot A = \left[\frac{C_g^{ss} \cdot V_r}{(C_l - K_H \cdot P \cdot v \cdot C_g^{ss})} \right] \quad (3-17)$$

Once the product of h and A is determined from the steady state under normal ventilation conditions, the steady-state concentration under off-normal condition can be calculated using Equation 3-16. In addition, under the off-normal ventilation conditions, the ammonia concentration can be estimated using the time-dependent gas concentration of Equation 3-12, as well as the gas release rate of Equation 3-9.

Note that the product of h and A depends on the waste configuration and will be different if the waste is perturbed or changed physically. For the off-normal ventilation calculations, the overall steady-state ammonia concentration is governed by the liquid ammonia concentration. The product of h and A will change only the ammonia release rate, which indicates how fast the system will reach the steady state.

The steady-state flammability evaluation of this work is based on current tank waste data at storage conditions. For those tanks actively receiving waste, including tanks 241-AP-108 and 241-AN-101 as dilute receiver tanks, the flammability level will be reevaluated during the waste transfer compatibility assessment based on the predicted post-transfer condition of the tank waste. For hydrogen, the release rate still can be calculated based on the predicted tank waste condition using this rate equation model. For methane, because steady-state methane vapor data are not available before the waste transfer, the release rate will be estimated as 10% of the model-calculated HGR. This is a reasonable estimate because, for all tanks, methane is less than 10 volume percent of the hydrogen in the generated gas as given in the gas generation study by PNNL-12181 and retained gas sampler results in *Retained Gas Sampling Results for the Flammable Gas Program*, PNNL-13000. For ammonia, instead of estimating the release rate, the ammonia vapor concentration at thermodynamic equilibrium for a given waste condition will be used as a bounding value in the flammability level evaluation. This ammonia vapor

concentration can be calculated based on the measured liquid ammonia concentration and other tank waste conditions using Henry's Law and the Weisenberger and Schumpe (1996) model as described earlier. For the off-normal ventilation condition, which is about 0.5 ft³/min or less, an equilibrium prediction of the ammonia concentration is reasonable and conservative.

3.5 TIME TO REACH LOWER FLAMMABILITY LIMIT

For active ventilation system interruptions, the time for the dome space to build up to flammable gas concentrations exceeding the LFL is one of the main concerns of this evaluation.

A time-dependent LFL, $LFL_m(t)$ of the mixture can be calculated using the time-dependent gas concentration (Equation 3-6 for insoluble gas or Equation 3-12 for soluble gas) and Le Chatelier's rule (Equation 3-2) as provided in Equation 3-18:

$$LFL_m(t) = \frac{[H_2](t)}{LFL_{H_2}} + \frac{[NH_3](t)}{LFL_{NH_3}} + \frac{[CH_4](t)}{LFL_{CH_4}} \quad (3-18)$$

where:

- $[H_2](t)$ = hydrogen concentration (volume percent) at time t
- $[NH_3](t)$ = ammonia concentration (volume percent) at time t
- $[CH_4](t)$ = methane concentration (volume percent) at time t
- LFL_{H_2} = volume percent of hydrogen at its LFL in air alone
- LFL_{NH_3} = volume percent of ammonia at its LFL in air alone
- LFL_{CH_4} = volume percent of methane at its LFL in air alone.

The volume percent of the LFLs; LFL_{H_2} , LFL_{NH_3} , and LFL_{CH_4} are 4, 15, and 5%, respectively, which have been established for a fuel-air mixture.

The time to reach a specified gas concentration under given ventilation conditions for insoluble gas can be obtained by rewriting Equation 3-6 as Equation 3-19:

$$t = \frac{\ln \left\{ \frac{R_g - V_r \cdot C_g(t_0)}{R_g - V_r \cdot C_g(t)} \right\}}{\lambda} \quad (3-19)$$

With

$$\lambda = V_r / Vol$$

where:

- R_g = gas release rate (volume/time)
- V_r = barometric breathing rate (volume/time)
- $[C_g](t_0)$ = initial gas concentration at time t_0 (ppmv)

$[C_g](t)$ = gas concentration at time t (ppmv).

Similarly, for soluble gases, the time to reach a specified gas concentration under a given ventilation condition can be obtained by rewriting Equation 3-12 as Equation 3-20:

$$t = \frac{\ln \left\{ \frac{k_2 - k_1 \cdot C_g(t_0)}{k_2 - k_1 \cdot C_g(t)} \right\}}{k_1} \quad (3-20)$$

with

$$k_1 = [V_r + h \cdot A \cdot K_H \cdot P \cdot v] / [Vol]$$

and

$$k_2 = [h \cdot A \cdot C_i] / [Vol].$$

However, the time to reach a specified flammability limit of the mixture was not calculated explicitly. A customized Excel macro function, which was developed using Visual Basic⁴ and is based on Equation 3-19 for an insoluble gas and Equation 3-20 for a soluble gas, is used to calculate the time to reach a specific flammability limit.

3.6 THE MINIMUM VENTILATION RATE TO MAINTAIN DOME SPACE BELOW 25 OR 100 PERCENT OF THE LFL

Whether the dome space of a tank will reach the specified flammability limit or not depends on the competition between the gas release rates and the ventilation rates of the system. For steady state, the flammability limit of the mixture in the dome space can be calculated using Equation 3-2. For insoluble gas, the required steady-state gas concentrations in Equation 3-2 can be calculated using Equation 3-13 for insoluble gas and Equation 3-16 for soluble gas, where the ventilation rate is embedded in both equations. If the ventilation rate is zero (i.e., no gas exits the tank), the system will reach the LFL sooner or later, and then flammability will continue to increase beyond 100% of the LFL. The ventilation will reduce the steady-state concentration. A ventilation rate, defined as the minimum vent rate, which the steady-state concentrations will just reach the specified flammability limit using Equation 3-2 for parameters in Equations 3-13 and 3-16. If the dome space ventilation rate is larger than this minimum, the system will never reach the specified flammability limit. Again the ventilation rate is embedded in the equation, and a customized Excel macro function developed using Visual Basic code is used to calculate the minimum ventilation needed to reach the specified flammability limit.

⁴ Visual Basic is a registered trademark of Microsoft Corporation.

4.0 EVALUATIONS OF STEADY-STATE FLAMMABILITY LEVEL

In this chapter, steady-state gas releases from the 28 DSTs and 149 SSTs are evaluated quantitatively against tank ventilation conditions using the methodology described in Chapters 2.0 and 3.0 to determine if the resulting flammability level becomes a safety concern.

Section 4.1 contains the calculated HGRs and discusses collection of input data and setup of the Excel spreadsheet for rate calculations. Section 4.2 covers the data collection, estimation of ventilation rates for both normal and off-normal conditions, and the steady-state gas concentrations for the normal ventilation rate. Section 4.3 discusses the steady-state gas release rates for the flammability level evaluation. For hydrogen, the gas release rate is the net result of the model-calculated gas generation rate minus the field-estimated gas accumulation rate. For ammonia, methane, and nitrous oxide, the gas release rates were extrapolated from steady-state concentrations at normal ventilation rates. For those tanks showing higher predicted steady-state ammonia concentrations (more than 0.5%) under off-normal ventilation conditions and flammability levels exceeding 25% of the LFL in Revision 0, the ammonia concentration has been reanalyzed with the liquid/vapor equilibrium model as described in Section 3.4. Section 4.4 describes the evaluation of flammability levels in the tank dome space for all 177 tanks. The evaluations include the following:

- Calculation of total flammability level, as well as the distribution from each flammable gas under both normal and off-normal ventilation conditions
- The time required for the flammable gases concentration in the tank dome space to reach various flammability levels when the normal ventilation system is shut down
- The minimum ventilation rate required to keep the dome space concentration below the specified flammability limit.

Details of the results of the inventory data from BBI and surveillance data from SACS, HGR calculations, ammonia mass transport properties, and flammability evaluations in the tank dome space for the 177 tanks are given in Appendices A through F and H. Appendix G validates the HGR calculation from empirical rate equations and the flammability evaluations independently using tank 241-AN-102 as an example. Appendix G also gives a preliminary uncertainty analysis on both the HGR calculation and the flammability evaluation using a Monte Carlo simulation for tank 241-AN-104. Appendix I provides the Peer Review Checklist. In Revision 3, the main effort is to update the input data of HGR calculation with BBI from July 15, 2003 and results in changes to the main text and Appendices A, B, D, and H.

4.1 HYDROGEN GENERATION RATE MODEL CALCULATIONS

In the evaluation, the HGR were calculated for each tank based on the semi-empirical rate equation model. The total generation rate was calculated for each waste layer in each tank. The generation rate is a function of tank waste conditions; thus, a large tank waste database is needed. The analytical and surveillance data necessary to perform the rate calculations are

available for some tanks. For those tanks without current measured data, process history data and waste type information were used.

An Excel spreadsheet was set up to calculate HGRs for all 177 Hanford Site DSTs and SSTs. The spreadsheet has four sections covering input data (Section 4.1.1), derived data (Section 4.1.2), and calculated unit rates and total rates (Section 4.1.3). The spreadsheet was set up to allow for easy upgrades and to facilitate checking the rate calculations.

4.1.1 Input Data

The data required to estimate hydrogen generation include the concentrations of TOC, nitrate ion, nitrite ion, and aluminum in the liquid phase; the total heat load for cesium and strontium; liquid and bulk densities; total solids and supernatant liquid tank waste volumes; the weight percent of water for liquid and sludge layers; tank waste temperature, and the tank dome space temperature. The organic species present provide the source term for thermolysis and organic radiolysis and the TOC data are used as an indicator of organic species. Aluminate is a catalyst in the thermal reaction and the aluminate concentration was used in the thermolysis rate calculation. Nitrate and nitrite concentrations are used to estimate the scavenger effect for radiolysis of pure water. Tank waste temperature is needed to calculate the radiolysis G-value and to account for the Arrhenius behavior of the thermolysis rate. The cesium and strontium concentrations are used to estimate the heat load of the tank waste, which is the power source for both water and organic radiolysis. Weight-percent water data were used to estimate the liquid fraction of the waste because the model considers that gas generation reactions occur most effectively in the liquid phase. The density and waste volume are used to calculate the total mass of the waste and to estimate the wetted tank surface area to calculate the corrosion rates. The temperature in the tank dome space is used to convert the total gas generation rate from mole to volume per unit time.

The BBI, Tank Characterization Database (TCD), and SACS were queried to obtain the required waste properties and compositions. Data missing from the database were estimated, based on the methodology presented in *Flammable Gas Safety Analysis Data Review*, SNL-000198.

In Revision 0 of this report, the input data used were prepared based on data available as of October 1999 and documented in *Input Data for Hydrogen Generation Rate Model Calculation*, RPP-6069. In Revision 3 of this report, the input data of waste compositions including TOC, nitrate ion, nitrite ion, aluminum, cesium, strontium, density, and volume were queried from the BBI detail calculation database (dated July 15, 2003). The required temperature data of the tank waste and tank headspace were obtained from the SACS (dated July 15, 2003). The required weight-percent water data and preferred density of each waste layer for 177 tanks were not available from the BBI, so these values were prepared (Appendix A, Internal Office Memo 7G410-03-KMB-001) for this study. In addition, for about 40 SSTs, the concentrations of TOC, NO_3 ion, NO_2 ion, and aluminum in liquid phase were not available from the BBI detail calculations so the values prepared in Revision 0 were used.

The BBI detail calculation database (dated July 15, 2003) was used in the calculations. Note that the date of data quoted in the parenthesis is referred to as the date of data published, but is not the date of data gathering. The actual date of the data gathering can be found in the inventory derivation documents. This database has the elements of the required input data for waste

composition except weight-percent water and preferred density of each waste layer, which were prepared for these calculations. The weight-percent water and preferred density will be included in the future update of BBI database. To extract the information from the BBI detail report to the format of the required input data, several things were done:

- The required data were downloaded from BBI detail calculation database and listed in Appendix A.
- In BBI detail calculations, more than one density was used in a waste layer for a number of tanks. A single representative density labeled as preferred density was chosen for each waste layer for 177 tanks, and the preferred density along with weight percent water data were listed in Appendix A.
- In BBI detail calculations, the multiplier was introduced to compensate for differences in weight-percent water and density when the concentration data came from different data sources for a given waste layer. The concentrations used in the input data of Revision 3 of this report were recalculated by dividing the inventory of each analyte with the preferred density and the waste volume as

$$\text{In BBI:} \quad \text{Inventory} = \text{density} \times \text{Volume} \times \text{Concentration} \times \text{Multiplier} \quad (4-1)$$

$$\text{In this report:} \quad \text{NewConcentration} = \text{Inventory} \div (\text{SelectedDensity} \times \text{Volume}) \quad (4-2)$$

- The input data required the information from the supernatant liquid layer, solid layer (the waste below the supernatant liquid layer), and the total waste. The values of waste composition from various waste types of the solid layer were weight averaged to one value.
- The concentrations of TOC, nitrate ion, nitrite ion, and aluminum in the liquid phase and the liquid density for solid layer were assigned the same value as the supernatant liquid layer if no interstitial liquid data were available. The final waste inventory data are listed in Table A-1 of Appendix A.
- The TWINS/BBI database is frequently updated. Since it is difficult and time-consuming to restore the database to a given time, TWINS/BBI information should be downloaded and stored electronically to allow re-creation of the data collection. Attached to selected copies of this report (see distribution sheet) is a compact disk (CD) which contains the information downloaded from the BBI detail calculations.

In BBI development, the total waste volume is divided into three parts: solid, liquid, and retained gas (if there is any). In the detail calculation report, the volume of retained gas is not reported because it has no contribution to the analytes inventory. Although the retained gas has no contribution to the HGR calculations, it is part of the total waste volume and will impact the headspace volume calculation, and thus the flammability calculations. Table A-2 in Appendix A lists the tanks with reported retained gas inventory from the BBI derivation document in TWINS.

The temperature data of tank waste and tank headspace were obtained from SACS. The maximum temperature from July 15, 2002, to July 15, 2003, was used to obtain an averaging

temperature within each waste layer (supernatant and solid layers) and the headspace. The maximum value over a 1-year period throughout the tank was used to cover the seasonal effect. The temperature sensitivity study on the aging waste tanks was performed in Appendix H to prevent the possible underestimation of the temperature gradient vertically caused by cooling for using the average value.

With the given tank waste inventory data, physical properties like volume and density, and the waste and headspace temperature data as discussed above, an input data spreadsheet for HGR calculation was prepared and is listed in Table B-1 of Appendix B. For these data not available from the Appendix A, the information and data from Revision 0 of this report are used.

In Revision 0 of this report, missing data were estimated, based on the methodology presented in SNL-000198. Waste tanks were first classified into one of six groups, based on the volumes of the liquid, saltcake, and sludge layers. The criteria for the various tank classifications also are presented in SNL-000198. Data from tanks in a given classification were used to create a distribution that was assumed to describe the total population of data for a given tank classification. This distribution then was used to provide a range of data including the missing data. In cases where insufficient data were available to create a statistically valid distribution, data from similar groups of tanks were combined to create a distribution of data (SNL-000198). For single-point calculations, the mean of the distribution is used to describe the missing values. In Monte Carlo statistical analyses, the full range of data for the tank waste classification was used.

This methodology of providing values and distributions for missing data was not optimized to provide the "best" waste properties or compositions with respect to waste chemical makeup. This methodology was prepared to determine missing data for flammable gas safety analyses. Because sufficient analytical data for all waste types are not available to estimate the missing data at the waste-type level, the methodology in SNL-000198 was used to determine overall composition ranges when a finer resolution of data was not statistically justified. As a result, the mean values used in this analysis were not optimized based on waste characteristics, but were developed to fit the available data related to flammable gas safety analyses.

The tank 241-A-105 HGR has not been calculated. The steel liner leaked and the tank has been interim stabilized. The waste moisture content is unknown, but is expected to be very low. The HGR is very sensitive to moisture content (the main hydrogen source). Because this key parameter is unknown and cannot be estimated, no attempt is made to estimate the corresponding HGR. The input data of tank 241-AY-102 are from the latest core sampling results (provided in TWINS, *Report Generator, Automated Tank Characterization Report, 241-AY-102, Means and Confidence Intervals*). The latest sampling has reflected a depleted nitrate and nitrite values (i.e., zero) in the tank and results in several factors of H_2 rate increase compared to the H_2 rate calculated by the BBI data on July 15, 2003.

4.1.2 Derived Data

Once the input data were provided, the derived data were calculated before performing the final rate calculations. In the "derived data section" the input data are converted to the system of units used in the equations and other necessary parameters are derived. The derivation includes waste

level, the tank surface area wetted by the waste, total mass, liquid fractions of the layers, layer heat load, layer density, total heat load, conversion of NO_3 ion and NO_2 ion to units of "moles per liter," conversion of TOC and aluminum to units of "weight percent," and water radiolysis and total radiolysis G-values. The derived data section has a twofold purpose. First, necessary unit conversions were built into the spreadsheet so the spreadsheet can take the input data directly from the TCD. Second, it prepares the necessary parameters, which reduces the cumbersome task of completing the rate calculations and makes error checking easier and more effective. Details of the derived data are provided in Appendix B, Table B-2.

4.1.3 Calculated Hydrogen Generation Rates

The HGRs were calculated for the total tank waste, as well as for different waste layers. The waste layers are the convective layer (supernatant liquid) and the nonconvective layer (sludge/saltcake); a few tanks have a crust layer on top of the convective layer. The rates for each layer are presented as radiolysis rates, thermolysis rates, corrosion rates, and total generation rates in units of mole per kilogram per day and moles per cubic meter per second.

Details of the calculated rates per unit mass or per unit volume are provided in the Appendix B, Table B-3. Note that the unit rate of the corrosion rate is a function of wetted surface area, so the unit volume rate depends on the waste volume. The unit rate from corrosion is an average rate for a given tank waste volume. The total gas generation rate for a tank (in units of cubic feet per minute and liters per day) was calculated by multiplying the unit rates by the total waste volume; the results are provided in Appendix B, Table B-4. For the water addition study, the input data are modified by adding 10 kgal of water to 100 series tank and 1 kgal to 200 series tank and listed in Appendix B, Table B-5. Table 4-1 lists the eleven tanks with the highest model-calculated hydrogen generation based on the current waste content.

Table 4-1. Calculated Hydrogen Generation Rate In Dome Space for Tanks with Highest Rates On Current Waste Content. (2 sheets)

Tank	HGR from radiolysis G_{rad} (ft^3/min)	HGR from thermolysis G_{therm} (ft^3/min)	HGR from corrosion G_{corr} (ft^3/min)	Percent of HGR from radiolysis (G_{rad})%	Percent of HGR from thermolysis (G_{therm})%	Percent of HGR from corrosion (G_{corr})%	Total HGR from model G_{mod} (ft^3/min)
241-AY-102	5.51E-02	8.92E-04	6.08E-04	97%	2%	1%	5.66E-02
Supernatant	2.66E-05	3.79E-04	2.48E-04	4%	58%	38%	6.54E-04
Solid Layer	5.50E-02	5.13E-04	3.60E-04	98%	1%	1%	5.59E-02
241-AN-107	6.00E-03	3.20E-03	7.42E-04	60%	32%	7%	9.94E-03
Supernatant	4.38E-03	2.58E-03	3.70E-04	60%	35%	5%	7.33E-03
Solid Layer	1.62E-03	6.24E-04	3.72E-04	62%	24%	14%	2.61E-03
241-AN-102	3.92E-03	5.10E-03	7.37E-04	40%	52%	8%	9.76E-03
Supernatant	3.43E-03	4.59E-03	4.10E-04	41%	54%	5%	8.43E-03
Solid Layer	4.84E-04	5.16E-04	3.27E-04	36%	39%	25%	1.33E-03
241-SX-103	6.97E-04	6.48E-03	9.80E-04	9%	79%	12%	8.16E-03
Supernatant	na	na	na	na	na	na	na
Solid Layer	6.97E-04	6.48E-03	9.80E-04	9%	79%	12%	8.16E-03

Table 4-1. Calculated Hydrogen Generation Rate In Dome Space for Tanks with Highest Rates On Current Waste Content. (2 sheets)

Tank	HGR from radiolysis G_{rad} (ft ³ /min)	HGR from thermolysis G_{therm} (ft ³ /min)	HGR from corrosion G_{corr} (ft ³ /min)	Percent of HGR from radiolysis (G_{rad})%	Percent of HGR from thermolysis (G_{therm})%	Percent of HGR from corrosion (G_{corr})%	Total HGR from model G_{mod} (ft ³ /min)
241-AZ-101	3.91E-03	2.58E-03	7.85E-04	54%	35%	11%	7.27E-03
Supernatant	1.93E-03	2.36E-03	4.60E-04	41%	50%	10%	4.75E-03
Solid Layer	1.98E-03	2.22E-04	3.25E-04	78%	9%	13%	2.52E-03
241-AW-104	8.55E-04	4.36E-03	7.61E-04	14%	73%	13%	5.98E-03
Supernatant	7.11E-04	3.92E-03	3.83E-04	14%	78%	8%	5.01E-03
Solid Layer	1.45E-04	4.48E-04	3.78E-04	15%	46%	39%	9.71E-04
241-AW-106	6.70E-04	3.31E-03	7.30E-04	14%	70%	15%	4.71E-03
Supernatant	5.28E-04	2.49E-03	3.34E-04	16%	74%	10%	3.36E-03
Solid Layer	1.42E-04	8.18E-04	3.95E-04	10%	60%	29%	1.36E-03
241-SX-105	3.41E-04	3.29E-03	8.83E-04	8%	73%	20%	4.52E-03
Supernatant	na	na	na	na	na	na	na
Solid Layer	3.41E-04	3.29E-03	8.83E-04	8%	73%	20%	4.52E-03
241-A-101	3.47E-04	3.04E-03	9.31E-04	8%	70%	22%	4.31E-03
Supernatant	na	na	na	na	na	na	na
Solid Layer	3.47E-04	3.04E-03	9.31E-04	8%	70%	22%	4.31E-03
241-A-104	3.11E-03	4.27E-04	5.72E-04	76%	10%	14%	4.11E-03
Supernatant	na	na	na	na	na	na	na
Solid Layer	3.11E-03	4.27E-04	5.72E-04	76%	10%	14%	4.11E-03
241-AZ-102	2.84E-03	4.69E-04	7.38E-04	70%	12%	18%	4.05E-03
Supernatant	1.44E-03	3.99E-04	4.06E-04	64%	18%	18%	2.25E-03
Solid Layer	1.40E-03	7.04E-05	3.32E-04	78%	4%	18%	1.80E-03

Notes:

To convert cubic feet to liters, multiply the value by 28.454 L/ft³.

HGR = hydrogen generation rate.

na = not applicable.

Tank 241-AZ-102 has the largest HGR, 5.66 E-2 ft³/min; this rate is approximately four times the value of 1.4 E-2 ft³/min calculated in Revisions 0 and 1 of this report. This rate difference has several reasons. The first is the tank waste composition in Revision 3 has been updated to reflect receiving the waste from the high heat tank 241-C-106; and the second is the highest waste temperature in the past year has increased by more than 20 °F compared to Revision 1 and Revision 0 of this report. The temperature went up not only due to receiving hot waste, but also because the cooling system in the annulus was turned off for one day. Thirdly, the latest core sampling results show that both the nitrate and nitrite values are less than detection limit, which results in a water radiolysis G value of 0.45 H₂ per 100 electron volts because there is no scavenging effect from the nitrite salts. Generation rates from radiolysis, thermolysis, and corrosion also are listed in Table 4-1 for solid and liquid layers for each tank. The contribution

from thermolysis and radiolysis varied from tank to tank. Corrosion contributed 20% or less to the overall HGR for the listed tanks. Tanks without sample-based data use the default data from the waste grouping analysis, which have a larger uncertainty.

4.2 TANK VENTILATION RATES AND STEADY-STATE GAS CONCENTRATIONS

Tank ventilation and steady-state gas concentration data collection and data reduction are documented in *Collection And Analysis Of Selected Tank Headspace Parameter Data*, RPP-5660. Ventilation rates at the tank outlet were determined by a number of methods, including tracer studies, Standard Hydrogen Monitoring System hydrogen composition decay curves, direct measurement, and calculations from earlier flammable gas hazard analyses. The ventilation rates were for normal ventilation conditions, either passive or active, in conjunction with steady-state gas concentration data to estimate the gas release rates.

Dome space gas composition data were based on analytical data from RPP-5660, when available. The TWINS database was queried to obtain all gas sample data. The data were reduced using mean values for single-point calculations and derived distributions for Monte Carlo analyses. Values for missing data were determined using the methodology described in SNL-000198. The ventilation rates and the steady-state gas concentrations under normal operating conditions, along with waste volumes and dome space volumes for all 177 tanks, are listed in Appendix D, Table D-1. For sludge tanks, dome space gas concentrations are very small, less than 50 ppm hydrogen, methane, and ammonia. For these tanks, the ratios between the various gases are questionable and are not an accurate analysis of gas generation rates.

4.3 STEADY-STATE GAS RELEASE RATES FOR H₂, NH₃, CH₄, AND N₂O

To evaluate the steady-state flammability levels under different ventilation conditions, the steady-state gas release rates were used to calculate the flammable gas concentrations for a given ventilation condition. For hydrogen, the steady-state release rates were calculated by subtracting the gas accumulation rate from the model calculated generation rate. The HGRs are calculated in Section 4.1 and listed in Appendix B. In the past, a few tanks had a noticeable waste level increase. The waste level increase rate can be converted to a total waste volume increase rate, which then is multiplied by the hydrogen fraction obtained from the retained gas sample analysis. The steady-state gas release rates of CH₄, NH₃, and N₂O were derived from the steady-state concentrations under normal ventilation rates using Equation 3-15. The calculated gas release rates of H₂, NH₃, CH₄, and N₂O are listed in Appendix D, Table D-1.

For ammonia, however, the method described in the previous paragraph would largely overestimate the steady-state concentrations under off-normal ventilation conditions for those tanks having relatively large release rates calculated from the steady-state concentration. For example, for tank 241-SY-101, the steady-state release rate obtained from the dome space concentration of 400 ppm under normal ventilation conditions predicts a steady-state concentration of 108% of the LFL for the off-normal ventilation condition. This value is two orders of magnitude larger than the current estimated value of 0.4% of the LFL using the

liquid-vapor equilibrium mechanism. In Revision 0, similar overestimations of ammonia concentration also were reported for tanks 241-AN-102 and 241-AN-107.

As described in Chapter 3.0, ammonia is very soluble, and the gas release rate is not a constant but is governed by the liquid-vapor equilibrium defined by Henry's Law, the mass transport coefficient, h , and the effective transport surface area, A . The ammonia release rate is driven by the gradient between the vapor and liquid phases before reaching equilibrium. Therefore, a greater difference results in a larger release rate.

For a closed system (i.e., a zero ventilation rate), the final release rate is zero when the system reaches equilibrium. An open system will never reach the equilibrium concentration, but will reach a steady-state release condition. At steady state, the concentration is lower than the equilibrium value, and the larger the ventilation rate, the lower the steady-state concentration of ammonia. For a given system, the release rate at steady state also is proportional to the ventilation rate. Therefore, if the steady-state release rate obtained at a high ventilation rate (i.e., normal active ventilation) is used as a constant to predict the steady-state concentrations for the off-normal low ventilation condition, the ammonia dome space concentration for the off-normal ventilation condition could be greatly overestimated.

Figure 4-1 demonstrates the relationship of the equilibrium value, the steady-state concentration, and the release rate of ammonia under both normal and off-normal conditions for tank 241-SY-101 after remediation. As shown in Figure 4-1 for the normal ventilation rate of $486 \text{ ft}^3/\text{min}$, the steady-state concentration of ammonia is 400 ppm, which is far below the equilibrium value of 3,895 ppm. For an off-normal ventilation rate of $0.18 \text{ ft}^3/\text{min}$, the ammonia concentration is computed to increase exponentially and took less than 8 days to reach steady state with the concentration of 3,882 ppm, which is lower than but very close to the equilibrium value. Also, note that the steady-state release rate from $0.19 \text{ ft}^3/\text{min}$ under normal ventilation conditions of $486 \text{ ft}^3/\text{min}$ is computed to drop exponentially to $7.6 \text{ E-4 ft}^3/\text{min}$ for the off-normal ventilation condition of $0.18 \text{ ft}^3/\text{min}$.

Figure 4-1. Ammonia Concentration and Release Rate for Tank 241-SY-101 Before and After Loss of Active Ventilation.

For many SSTs and some of the DSTs with lower concentrations of ammonia, the ammonia release rate was too small to contribute significantly to reaching 25% of the LFL even under off-normal ventilation conditions. Therefore, this method of considering ammonia release rates as constants would be a simple method to screen out tanks with small release rates. This would avoid having to use the liquid-vapor equilibrium method, which requires liquid and dome space ammonia concentration data and more complex calculations.

4.4 STEADY-STATE MASS TRANSPORT PROPERTIES "h" AND "A" FOR AMMONIA

As discussed in Chapter 3.0, it is difficult to estimate the effective area, A , of the mass transport in the liquid-vapor equilibrium model. The effective area is the actual waste surface area available for ammonia transport, and will be the full or partial tank cross-sectional area depending on how much true liquid surface is available. The ammonia concentration could be overestimated by two orders of magnitude in the liquid-vapor equilibrium model if 100% of the effective area is used. In this report, the ammonia concentration analysis follows the logic in the following steps to perform the dome space ammonia calculations:

1. The ammonia concentration in all DSTs was analyzed using the liquid-vapor equilibrium model as described in Chapter 3.0. The mass transport properties, the product of h and A , were obtained from the steady-state concentration under normal conditions by applying Equation 3-17. Then, using this product of h and A , the time-dependent ammonia concentration and flammability under off-normal conditions were calculated.
2. The ammonia concentrations for the SSTs were first evaluated by assuming a constant release rate. If the ammonia concentrations computed using this conservative approach were more than 0.5% and the total flammability was above 20% of the LFL, the ammonia concentration was reanalyzed more accurately using the liquid-vapor equilibrium method as was done for the DSTs.

The input data collected included the ammonia concentrations in the liquid and in the dome space under normal ventilation conditions, the waste volume and ionic composition, and the temperatures of the waste and the dome space under both normal and off-normal conditions. Appendix C, Table C-1, gives the liquid concentrations in the DSTs and selected SSTs for the ions such as nitrate, nitrite, and aluminum used in the calculation of the HGR. The additional ion constituents required are carbonate, chloride, chromium, fluorine, hydroxide, iron, nickel, phosphate, potassium, sodium, and sulfate. Other required data include the tank waste density, temperature, and weight-percent water. These data were obtained from the BBI reports. Where tank ion concentrations or waste properties were not available in the BBI detail report, an average value from the sample analysis data contained in the TCD was used. The tank waste temperature values were the only figures not taken from the BBI or the TCD. They were obtained from Table 3-2, "SACS [Surveillance Analysis Computer System] Database Waste Temperatures" (RPP-5660). However, the input data for ammonia calculation are not updated in Revision 3 because the required liquid ammonia data is not available. The ammonia calculations remain the same as in Revision 1 of the report; however, ammonia has a minor contribution to the flammability at steady-state.

Based on Equation 3-8, the Henry's Law constants were calculated and are listed in Appendix C, Table C-2. Table C-2 also includes the summations of ion concentrations, the Henry's Law constants in pure water, and the correction factors for the calculated Henry's Law constants, K_H , for salt solutions. The correction factors were assigned using the tank waste concentrations and temperatures according to the study results for ammonia solubility in high-concentration salt solutions (RPP-4941). The mass transport properties of the product h and A were calculated using Equation 3-17 and are listed in Appendix C, Table C-3. Based on the products of h and A , the time-dependent ammonia concentration and percent of the LFL under off-normal ventilation conditions were calculated, as discussed in Section 4.5. As discussed in Chapter 3.0, the product of h and A depends on the waste configuration and physical and chemical properties, particularly the surface area, A , which is the effective surface for gas transport from the liquid to the vapor phase. For example, if the waste was disturbed or the configuration of the waste surface changed, both the effective surface area and h could change, so the product of h and A would change. Therefore, what has been calculated as the product of h and A in this report reflects only the current ammonia transport status of storage tank waste at steady state.

As a comparison, Table 4-2 lists the products of h and A from the values derived from the field data under normal conditions using Equation 3-17 and from the calculated h using the equations in Appendix F with a 100% tank surface area, A . For most of the tanks, the values for h and A

derived from field data are a few orders of magnitude smaller than the values from the calculated h and 100% area A . Several possible factors can contribute to this discrepancy. First, many tanks may not have 100% transport area A , particularly for those tanks having a large crust layer or solid waste on the surface. Second, from Equation 3-17, the field-data-derived values of h and A rely mainly on the ammonia vapor data and ventilation rate in the headspace, and the corresponding value of liquid concentration in the waste (usually the value of $K_H P_v C_g^{ss}$ is much smaller than C_l). The uncertainties of these input data and the fact that these data are not measured simultaneously can contribute to errors in the field-derived h and A .

Next, the ammonia underneath the liquid surface could be depleted and present a large gradient throughout the tank. In this case, the measured liquid-phase ammonia data from the middle or bottom sections of the tank will be too large for the observed vapor data. Also, the equations used to calculate h in Appendix F may involve large uncertainties. In all cases, note that the values of the product of h and A determine how fast the ammonia will be released to the dome space. The bounding value for the flammability is the steady-state ammonia concentration in the dome space. The last column of Table 4-2 lists the steady-state ammonia concentrations under off-normal conditions. For all calculated values, the ammonia concentration is less than 8,300 ppm, which contributes less than 6% of the LFL to the total flammability.

Table 4-2. The Calculation of Ammonia Transport Properties. (2 sheets)

Tank	(NH ₃) ^{ss} in Dome Under Normal Vent (ppm)	Liquid [NH ₃] in Waste (μg/mL)	Normal Vent Rate in the Dome Space (ft ³ /min)	Product $h A$ (ft ³ /min) From Field Data at Normal Vent	Product $h A$ (ft ³ /min) From Calculated h and 100% A	(NH ₃) ^{ss} at Off-Normal Vent (ppm)
241-AN-101	11	40	113	2.85 E-02	1.02 E+00	55
241-AN-102	300	210	119	1.80 E-01	2.03 E+00	857
241-AN-103	7	345	100	1.33 E-03	3.50 E+00	2,034
241-AN-104	21	246	100	5.92 E-03	3.08 E+00	2,011
241-AN-105	15	210	100	5.02 E-03	2.91 E+00	1,523
241-AN-106	1	210	117	3.99 E-04	1.12 E+00	123
241-AN-107	400	210	129	3.60 E-01	1.94 E+00	759
241-AP-101	125	439	108	2.57 E-02	1.26 E+00	827
241-AP-102	75	439	135	1.83 E-02	1.15 E+00	728
241-AP-103	1	250	200	5.76 E-04	1.48 E+00	248
241-AP-104	3	133	71	1.23 E-03	1.18 E+00	136
241-AP-105	7	324	176	2.79 E-03	1.75 E+00	800
241-AP-106	5	68	111	6.54 E-03	1.11 E+00	104
241-AP-107	5	1060	342	1.16 E-03	7.14 E-01	909
241-AP-108	27	800	129	3.14 E-03	8.82 E-01	852
241-AW-101	5	10	100	3.92 E-02	3.05 E+00	89
241-AW-102	3	74	292	7.16 E-03	7.74 E-01	80
241-AW-103	138	512	134	3.63 E-02	7.06 E-01	437

Table 4-2. The Calculation of Ammonia Transport Properties. (2 sheets)

Tank	(NH ₃) ^{ss} in Dome Under Normal Vent (ppm)	Liquid [NH ₃] in Waste (µg/mL)	Normal Vent Rate in the Dome Space (ft ³ /min)	Product h A (ft ³ /min) From Field Data at Normal Vent	Product h A (ft ³ /min) From Calculated h and 100% A	(NH ₃) ^{ss} at Off-Normal Vent (ppm)
241-AW-104	6	169	141	3.64 E-03	6.99 E-01	142
241-AW-105	43	1010	194	5.97 E-03	5.49 E-01	625
241-AW-106	28	355	158	8.59 E-03	2.06 E+00	1,164
241-AY-101	5	113	250	7.69 E-03	1.55 E+00	286
241-AY-102	4	74	250	1.05 E-02	1.60 E+00	207
241-AZ-101	1	125	150	8.31 E-04	2.79 E+00	331
241-AZ-102	6	438	112	1.01 E-03	1.96 E+00	1,181
241-SY-101	400	1044	486	1.42 E-01	2.09 E+00	3,870
241-SY-102	12	1150	363	2.67 E-03	1.24 E+00	1,771
241-SY-103	59	1290	116	3.88 E-03	3.14 E+00	5,581
241-A-101	394	531	10	5.17 E-03	3.74 E+00	8,253
241-A-103	261	531	8	2.61 E-03	3.21 E+00	2,922
241-C-103	324	1210	10	1.94 E-03	1.88 E+00	3,159
241-S-101	765	1210	6	2.94 E-03	2.59 E+00	5,817
241-S-102	588	1700	2	5.47 E-04	3.01 E+00	4,312
241-SX-103	31	1800	53	6.11 E-04	3.55 E+00	4,977
241-U-102	651	745	2	1.66 E-03	2.08 E+00	2,157
241-U-103	722	1400	2	9.56 E-04	2.47 E+00	4,582
241-U-105	1936	1600	5	5.64 E-03	2.22 E+00	6,909
241-U-107	448	403	12	1.34 E-02	1.98 E+00	1,380
241-U-108	684	1050	4	1.87 E-03	2.57 E+00	4,345

Note: To convert the unit of ft³ to L, multiply the value by 28.454 L/ft³.

4.5 FLAMMABILITY EVALUATION AND RESULTS

With the collected ventilation rates and steady-state gas concentrations, the flammable gas concentrations, expressed as a percent of the LFL, in the tank dome space under normal ventilation conditions were calculated using Equation 3-18 and are listed in Appendix D, Table D-1. The highest observed level is < 4% of the LFL (241-U-106). This suggests that the tank dome space of all tanks under current ventilation rates, whether actively or passively ventilated, will not exceed 25% of the LFL.

For off-normal ventilation conditions, there is no guarantee that every tank will have a pathway for barometric breathing due to the sealing-off action for interim stabilization; thus the flammability calculation will be performed under both barometric breathing rate and zero ventilation rate for current waste content and water addition. Detailed calculation results on the case of current tank waste are given in Appendix D. The summarized results are given in Tables 4-3 and 4-4 for both the current waste volume and the water addition study.

4.5.1 Off-Normal Condition With Barometric Breathing

For off-normal ventilation rates, assuming only barometric breathing rate, V_{bb} , is available (discussed in Section 4.2), the steady-state concentration can be calculated using Equation 3-14 for insoluble gas and using Equation 3-17 for the soluble gas; the results are listed in Appendix D, Table D-2. In the calculation for the off-normal condition, the initial concentrations are assumed to be the steady-state concentrations under normal ventilation conditions; these concentrations are listed in Appendix D, Table D-1. As listed in Table D-2, under the off-normal condition with barometric breathing rate, 36 tanks are computed to exceed 25% of the LFL when the system reaches steady state, and 10 tanks are predicted to reach 100% of the LFL.

Equation 3-18 gives the formula to calculate the flammable gas concentrations at a given time with the aid of a time-dependent gas concentration equation (Equation 3-6 for insoluble gas and Equation 3-12 for soluble gas). Because the time variable cannot be expressed explicitly in an equation, a customized Excel macro was developed using Visual Basic to iterate the calculations by increasing the time until the specified LFLs in Equation 3-18 are met. The calculated times to reach 25% and 100% of the LFL (time-to 25% LFL and 100% LFL) under the off-normal ventilation condition with barometric breathing rate are listed in Appendix D, Tables D-3 and D-4, respectively. In the calculations, the flammability level of each flammable gas also is calculated for each case to understand the distribution of each gas's contribution to the total LFL.

Another needed variable is the minimum ventilation rate required to prevent the tank dome space from exceeding 25% of the LFL. Equation 3-18 gives the time-dependent flammable gas concentration in terms of percent of the LFL; however, the ventilation rate is embedded in the time-dependent concentration as given in Equations 3-6 and 3-12. No explicit solution was developed to find the minimum ventilation rate in Equation 3-18. For those tanks exceeding the specified flammability level, the minimum ventilation rate can be found by gradually increasing the ventilation rate from zero until a total flammability level of less than the specified 25% or 100% of the LFL, is obtained. A customized Excel macro was developed using Visual Basic code to iterate this equation automatically to find the minimum ventilation rate. Details of the calculated minimum ventilation rates are listed in Appendix D, Tables D-3 and D-4, for 25% and 100% of the LFL, respectively.

Table 4-3 lists all the tanks (15 DSTs and 10 SSTs) that will reach 25% of the LFL with current waste content and barometric breathing only. In the off-normal condition with barometric breathing rate, tanks 241-AY-102 and 241-B-203 give the shortest time to 25% of the LFL as 11 and 38 days for DSTs and SSTs, respectively. Overall, five DSTs and two SSTs are computed to reach 100% of the LFL if the off-normal condition persists long enough. It takes 50 and 248 days to reach 100% of the LFL for tanks 241-AY-102 and 241-B-203, respectively. Note that the results of this calculation listed in Table 4-3 are based on the BBI information dated July 15, 2003.

4.5.2 Off-Normal Condition with Zero Ventilation

A zero ventilation condition means a closed system. Without considering or including other possible mechanisms for gas leaving the system such as diffusion through the dome space

concrete wall, it is expected that every single tank will reach 100% of the LFL under zero ventilation and is just a matter of time. A complete set of equations for flammability evaluation is given in Appendix H for both soluble and insoluble gases. In this model calculation, it is reasonable to assume that the tank will not be pressurized, thus the newly generated gas will slowly push the old gas composition out and form a new concentration of flammable gas without increasing the pressure.

Table 4-3. Time to Reach 25% and 100% of the Lower Flammability Limit for Current Tank Waste under Barometric Breathing Conditions.

DSTs	Time to reach 25% LFL $t_{25\%}$ (days)	Time to reach 100% LFL $t_{100\%}$ (days)	SSTs	Time to reach 25% LFL $t_{25\%}$ (days)	Time to reach 100% LFL $t_{100\%}$ (days)
241-AY-102	11	50	241-B-203	38	248
241-AN-107	30	162	241-B-204	42	298
241-AN-102	31	175	241-SX-103	104	will not occur
241-AW-104	50	376	241-T-203	156	will not occur
241-AZ-101	53	431	241-T-204	159	will not occur
241-AP-108	71	will not occur	241-A-101	244	will not occur
241-AW-101	89	will not occur	241-B-201	296	will not occur
241-AZ-102	99	will not occur	241-SX-105	332	will not occur
241-AW-106	102	will not occur	241-T-201	335	will not occur
241-AN-104	106	will not occur	241-B-202	355	will not occur
241-AN-105	112	will not occur	241-U-103	1089	will not occur
241-SY-101	140	will not occur			
241-AN-103	199	will not occur			
241-AP-104	277	will not occur			
241-AP-105	309	will not occur			
241-SY-103	336	will not occur			
241-AP-106	352	will not occur			

Notes:

¹Tanks not listed here will not reach 25% of the LFL under barometric breathing conditions.

²Calculation based on the BBI and PCSACS data of July 15, 2003.

DST = double-shell tank.

LFL = lower flammability limit

SST = single-shell tank.

In the flammability calculations, there are several tanks that the N_2O concentration has increased to the model limit of 8% before the total flammability reached 100% of the LFL due to zero ventilation assumption. As mentioned in Section 3.2, the flammability level for individual flammable gas is 4%, 15%, and 5% for hydrogen, ammonia, and methane, respectively if the N_2O is less than 8%. When the mixture has more than 8% of N_2O , the individual flammable gas

required less concentration than listed above to reach the flammability level of the LFL. For those tanks having high N_2O concentration, the calculations of "the time to reach 100% of the LFL" simply represents the time for the N_2O reach 8% while the total flammability is still less than 100% of the LFL.

Table 4-4 summarizes the flammability calculation under off-normal ventilation condition at zero ventilation scenarios for the water addition study. Under the zero ventilation the ratio of time to 100% to 25% of the LFL should be roughly four (some that are higher than four means the ammonia contribution is more significant and the ammonia concentration is not linearly increasing by time but governs by the liquid-vapor equilibrium mechanism). Those tanks with ratio less than four means the "time to reach 100% of the LFL" is the time to reach the 8% N_2O model limit but the flammability is not 100% of the LFL yet. The minimum vent rates to keep the dome space below 100% of the LFL for most tanks, except a half dozen tanks (all DSTs), are equal or less than $0.1 \text{ ft}^3/\text{min}$.

Table 4-4. Hydrogen Generation Rates, Time to 25% and 100% of LFL, and Minimum Vent Rate to Remain Below 25% and 100% of the LFL for Water Addition Under Zero Ventilation.
(6 pages)

Tank	Hydrogen generation rate, $R_r(H_2)$ (ft^3/min)	Time to Reach 25% of the LFL (Days)	Time to Reach 100% of the LFL (Days)	Minimum Vent Rate to Keep below 25% LFL (ft^3/min)	Minimum Vent Rate to Keep below 100% LFL (ft^3/min)
241-AN-101	4.18E-04	1,500	1,500	0.05	0.01
241-AN-102	9.69E-03	28	118	1.02	0.25
241-AN-103	2.83E-03	130	537	0.31	0.08
241-AN-104	3.51E-03	82	344	0.38	0.09
241-AN-105	2.63E-03	85	355	0.29	0.07
241-AN-106	3.72E-04	1,500	1,500	0.04	0.01
241-AN-107	9.86E-03	27	112	1.06	0.26
241-AP-101	1.00E-03	221	317	0.12	0.03
241-AP-102	1.48E-04	1,387	1,393	0.02	0.00
241-AP-103	1.81E-03	246	995	0.19	0.05
241-AP-104	1.74E-03	153	615	0.18	0.04
241-AP-105	1.32E-03	160	434	0.15	0.04
241-AP-106	1.38E-03	169	682	0.14	0.04
241-AP-107	5.01E-04	1,489	1,496	0.06	0.01
241-AP-108	3.94E-03	59	240	0.40	0.10
241-AW-101	3.35E-03	71	288	0.35	0.09
241-AW-102	3.29E-04	1,500	1,500	0.03	0.01
241-AW-103	9.84E-04	237	961	0.12	0.03

Table 4-4. Hydrogen Generation Rates, Time to 25% and 100% of LFL, and Minimum Vent Rate to Remain Below 25% and 100% of the LFL for Water Addition Under Zero Ventilation.
(6 pages)

Tank	Hydrogen generation rate, $R_r(H_2)$ (ft ³ /min)	Time to Reach 25% of the LFL (Days)	Time to Reach 100% of the LFL (Days)	Minimum Vent Rate to Keep below 25% LFL (ft ³ /min)	Minimum Vent Rate to Keep below 100% LFL (ft ³ /min)
241-AW-104	5.95E-03	43	176	0.68	0.17
241-AW-105	4.53E-04	1,500	1,500	0.05	0.01
241-AW-106	4.68E-03	80	332	0.49	0.12
241-AY-101	9.45E-04	1,058	1,500	0.11	0.03
241-AY-102	5.66E-02	10	44	5.70	1.42
241-AZ-101	7.25E-03	47	190	0.79	0.20
241-AZ-102	4.04E-03	78	319	0.48	0.12
241-SY-101	2.01E-03	100	438	0.26	0.06
241-SY-102	1.54E-03	273	1,140	0.19	0.05
241-SY-103	2.70E-03	173	784	0.34	0.08
241-A-101	4.68E-03	133	657	0.51	0.12
241-A-102	6.07E-04	1,384	1,500	0.11	0.03
241-A-103	2.76E-03	280	1,217	0.31	0.07
241-A-104	6.04E-03	184	770	0.61	0.15
241-A-105	na	na	na	na	na
241-A-106	2.24E-03	360	1,500	0.31	0.08
241-AX-101	1.99E-03	436	1,500	0.20	0.05
241-AX-102	9.59E-04	1,072	1,500	0.11	0.03
241-AX-103	3.25E-03	312	1,275	0.36	0.09
241-AX-104	1.49E-03	795	1,500	0.15	0.04
241-B-101	7.98E-04	789	1,500	0.09	0.02
241-B-102	5.58E-04	1,295	1,500	0.06	0.01
241-B-103	5.81E-04	1,182	1,500	0.06	0.02
241-B-104	8.54E-04	426	1,500	0.10	0.02
241-B-105	7.71E-04	616	1,500	0.08	0.02
241-B-106	6.32E-04	906	1,500	0.07	0.02
241-B-107	6.78E-04	824	1,500	0.08	0.02
241-B-108	6.03E-04	995	1,500	0.07	0.02
241-B-109	6.73E-04	838	1,500	0.08	0.02
241-B-110	7.89E-04	539	1,500	0.10	0.03
241-B-111	8.92E-04	509	1,500	0.11	0.03
241-B-112	5.66E-04	1,145	1,500	0.06	0.02
241-B-201	1.36E-04	156	626	0.02	0.004

Table 4-4. Hydrogen Generation Rates, Time to 25% and 100% of LFL, and Minimum Vent Rate to Remain Below 25% and 100% of the LFL for Water Addition Under Zero Ventilation.
(6 pages)

Tank	Hydrogen generation rate, $R_r(H_2)$ (ft ³ /min)	Time to Reach 25% of the LFL (Days)	Time to Reach 100% of the LFL (Days)	Minimum Vent Rate to Keep below 25% LFL (ft ³ /min)	Minimum Vent Rate to Keep below 100% LFL (ft ³ /min)
241-B-202	1.34E-04	169	678	0.02	0.00
241-B-203	1.95E-04	30	129	0.02	0.005
241-B-204	1.97E-04	33	143	0.02	0.005
241-BX-101	6.44E-04	946	1,500	0.08	0.02
241-BX-102	6.67E-04	900	1,500	0.07	0.02
241-BX-103	6.57E-04	801	1,500	0.09	0.02
241-BX-104	6.50E-04	688	1,500	0.12	0.03
241-BX-105	5.96E-04	816	1,500	0.10	0.02
241-BX-106	5.71E-04	1,074	1,500	0.07	0.02
241-BX-107	8.47E-04	440	1,500	0.10	0.03
241-BX-108	5.59E-04	1,193	1,500	0.06	0.02
241-BX-109	7.41E-04	660	1,500	0.09	0.02
241-BX-110	7.56E-04	633	1,500	0.09	0.02
241-BX-111	6.87E-04	735	1,500	0.08	0.02
241-BX-112	6.68E-04	616	1,500	0.10	0.03
241-BY-101	1.08E-03	490	1,500	0.12	0.03
241-BY-102	7.88E-04	631	1,500	0.11	0.03
241-BY-103	9.42E-04	535	1,500	0.11	0.03
241-BY-104	1.28E-03	342	1,500	0.18	0.05
241-BY-105	1.20E-03	319	1,500	0.16	0.04
241-BY-106	1.39E-03	337	1,435	0.14	0.04
241-BY-107	1.31E-03	374	1,500	0.27	0.07
241-BY-108	8.89E-04	587	1,500	0.25	0.06
241-BY-109	7.88E-04	712	1,500	0.10	0.02
241-BY-110	1.68E-03	262	1,354	0.31	0.08
241-BY-111	8.07E-04	737	1,500	0.09	0.02
241-BY-112	8.00E-04	666	1,500	0.10	0.03
241-C-101	6.98E-04	825	1,500	0.08	0.02
241-C-102	8.84E-04	366	1,500	0.15	0.04
241-C-103	2.31E-03	239	752	0.27	0.06
241-C-104	1.29E-03	265	1,018	0.23	0.06
241-C-105	8.75E-04	498	1,500	0.13	0.03
241-C-106	9.35E-04	678	1,500	0.11	0.03

Table 4-4. Hydrogen Generation Rates, Time to 25% and 100% of LFL, and Minimum Vent Rate to Remain Below 25% and 100% of the LFL for Water Addition Under Zero Ventilation.
(6 pages)

Tank	Hydrogen generation rate, $R_r(H_2)$ (ft ³ /min)	Time to Reach 25% of the LFL (Days)	Time to Reach 100% of the LFL (Days)	Minimum Vent Rate to Keep below 25% LFL (ft ³ /min)	Minimum Vent Rate to Keep below 100% LFL (ft ³ /min)
241-C-107	1.46E-03	320	1,431	0.15	0.04
241-C-108	6.16E-04	1,144	1,500	0.06	0.02
241-C-109	6.84E-04	984	1,207	0.07	0.02
241-C-110	6.86E-04	575	1,500	0.11	0.03
241-C-111	7.85E-04	904	1,500	0.08	0.02
241-C-112	8.90E-04	701	903	0.10	0.02
241-C-201	4.23E-05	1,185	1,500	0.004	0.001
241-C-202	4.16E-05	1,243	1,500	0.004	0.001
241-C-203	4.74E-05	867	1,500	0.006	0.001
241-C-204	4.58E-05	1,069	1,500	0.00	0.001
241-S-101	1.55E-03	311	1,464	0.19	0.04
241-S-102	1.27E-03	365	1,500	0.15	0.03
241-S-103	8.84E-04	719	1,500	0.09	0.02
241-S-104	9.02E-04	631	1,500	0.11	0.03
241-S-105	9.30E-04	522	1,500	0.11	0.03
241-S-106	1.01E-03	472	1,500	0.11	0.03
241-S-107	9.47E-04	544	1,500	0.12	0.03
241-S-108	1.06E-03	400	1,500	0.11	0.03
241-S-109	1.01E-03	373	1,500	0.12	0.03
241-S-110	1.08E-03	390	1,500	0.15	0.04
241-S-111	1.10E-03	459	1,500	0.11	0.03
241-S-112	1.11E-03	317	1,315	0.12	0.03
241-SX-101	1.99E-03	391	1,500	0.20	0.05
241-SX-102	2.27E-03	334	1,372	0.23	0.06
241-SX-103	8.77E-03	77	321	0.92	0.23
241-SX-104	2.27E-03	331	1,356	0.23	0.06
241-SX-105	5.42E-03	144	606	0.55	0.14
241-SX-106	1.25E-03	473	1,500	0.13	0.03
241-SX-107	8.41E-04	1,010	1,500	0.11	0.03
241-SX-108	2.25E-03	443	1,500	0.23	0.06
241-SX-109	2.58E-03	351	1,414	0.27	0.07
241-SX-110	8.75E-04	1,112	1,500	0.10	0.03
241-SX-111	1.01E-03	832	1,500	0.13	0.03

Table 4-4. Hydrogen Generation Rates, Time to 25% and 100% of LFL, and Minimum Vent Rate to Remain Below 25% and 100% of the LFL for Water Addition Under Zero Ventilation.
(6 pages)

Tank	Hydrogen generation rate, $R_r(H_2)$ (ft ³ /min)	Time to Reach 25% of the LFL (Days)	Time to Reach 100% of the LFL (Days)	Minimum Vent Rate to Keep below 25% LFL (ft ³ /min)	Minimum Vent Rate to Keep below 100% LFL (ft ³ /min)
241-SX-112	7.21E-04	1,140	1,500	0.10	0.02
241-SX-113	5.65E-04	1,500	1,500	0.06	0.02
241-SX-114	9.60E-04	747	1,500	0.14	0.04
241-SX-115	7.82E-04	1,482	1,500	0.08	0.02
241-T-101	6.73E-04	925	1,500	0.07	0.02
241-T-102	5.57E-04	1,262	1,500	0.06	0.01
241-T-103	5.60E-04	1,270	1,500	0.06	0.01
241-T-104	8.13E-04	465	1,500	0.10	0.03
241-T-105	6.15E-04	788	1,500	0.09	0.02
241-T-106	5.48E-04	1,003	1,500	0.07	0.02
241-T-107	7.00E-04	596	1,500	0.10	0.03
241-T-108	5.41E-04	1,286	1,500	0.06	0.01
241-T-109	5.79E-04	1,189	1,500	0.06	0.02
241-T-110	8.89E-04	462	1,500	0.09	0.02
241-T-111	9.34E-04	246	1,251	0.14	0.04
241-T-112	5.81E-04	1,040	1,500	0.07	0.02
241-T-201	1.34E-04	161	486	0.02	0.004
241-T-202	1.07E-04	270	912	0.01	0.003
241-T-203	1.57E-04	103	312	0.02	0.005
241-T-204	1.57E-04	107	291	0.02	0.005
241-TX-101	7.38E-04	1,052	1,500	0.08	0.02
241-TX-102	8.16E-04	664	1,500	0.13	0.03
241-TX-103	7.05E-04	889	1,500	0.09	0.02
241-TX-104	6.11E-04	1,352	1,500	0.07	0.02
241-TX-105	1.21E-03	326	1,315	0.13	0.03
241-TX-106	9.94E-04	447	1,500	0.15	0.04
241-TX-107	5.81E-04	1,152	1,500	0.10	0.02
241-TX-108	6.61E-04	1,151	1,500	0.07	0.02
241-TX-109	1.04E-03	371	1,064	0.20	0.05
241-TX-110	1.02E-03	370	1,500	0.29	0.07
241-TX-111	9.10E-04	489	1,500	0.25	0.06
241-TX-112	1.14E-03	266	1,189	0.14	0.03
241-TX-113	1.11E-03	309	1,249	0.12	0.03

Table 4-4. Hydrogen Generation Rates, Time to 25% and 100% of LFL, and Minimum Vent Rate to Remain Below 25% and 100% of the LFL for Water Addition Under Zero Ventilation.
(6 pages)

Tank	Hydrogen generation rate, $R_r(H_2)$ (ft ³ /min)	Time to Reach 25% of the LFL (Days)	Time to Reach 100% of the LFL (Days)	Minimum Vent Rate to Keep below 25% LFL (ft ³ /min)	Minimum Vent Rate to Keep below 100% LFL (ft ³ /min)
241-TX-114	9.84E-04	340	1,500	0.15	0.04
241-TX-115	1.05E-03	403	1,500	0.11	0.03
241-TX-116	1.03E-03	369	1,500	0.11	0.03
241-TX-117	9.32E-04	526	1,500	0.10	0.02
241-TX-118	8.79E-04	644	1,500	0.11	0.03
241-TY-101	6.27E-04	1,296	1,500	0.06	0.02
241-TY-102	5.94E-04	1,450	1,500	0.06	0.02
241-TY-103	8.15E-04	801	1,500	0.10	0.03
241-TY-104	5.63E-04	1,139	1,500	0.08	0.02
241-TY-105	7.66E-04	830	1,500	0.09	0.02
241-TY-106	5.44E-04	1,500	1,500	0.06	0.01
241-U-101	5.69E-04	969	1,500	0.08	0.02
241-U-102	1.37E-03	299	1,348	0.15	0.04
241-U-103	1.58E-03	200	942	0.18	0.04
241-U-104	8.50E-04	755	1,500	0.09	0.02
241-U-105	1.52E-03	211	539	0.20	0.04
241-U-106	1.48E-03	334	1,500	0.15	0.04
241-U-107	9.84E-04	438	753	0.11	0.03
241-U-108	1.38E-03	242	1,112	0.16	0.04
241-U-109	1.12E-03	343	1,417	0.12	0.03
241-U-110	7.35E-04	605	1,500	0.10	0.02
241-U-111	9.32E-04	393	1,500	0.13	0.03
241-U-112	5.84E-04	963	1,500	0.07	0.02
241-U-201	4.95E-05	817	1,500	0.01	0.002
241-U-202	4.86E-05	833	1,500	0.01	0.002
241-U-203	4.77E-05	1,011	1,500	0.01	0.001
241-U-204	4.60E-05	1,061	1,500	0.005	0.001

Notes:

¹Water addition is 10 kgal for 100-series tanks and 1 kgal for 200-series tanks.

²1,500 in the column of Time to 25% and 100% of the LFL means equal to or longer than 1,500 days.

LFL = lower flammability limit.

4.6 UNCERTAINTY ANALYSIS: TANK 241-AN-104 AS AN EXAMPLE

This section has not been updated and is the information from Revision 2. A Monte-Carlo analysis was performed to investigate the sensitivity of the model presented. Appendix E contains a MathCad⁵ model that performs a preliminary analysis of the model as applied to tank 241-AN-104. The evaluation was limited in scope and, because the sensitivity of the results to sample count has not been studied, the results might not be statistically valid. The number of samples was limited to 500. However, some interesting findings are presented. Typically, the characterization data were entered with an estimated uncertainty in the data listed as a standard deviation of 10% of the value. In the case of the waste temperature, a standard deviation of 5 K, or about 1.6% was used. Because of the exponential relationship between temperature and the HGR by thermolysis, the uncertainty in the results were amplified to about 50% for the thermolysis HGR term. In addition, the mean of the thermolysis generation rate distribution increased by approximately 25%. Although the radiolysis term also has an exponential relationship to temperature, the structure of the formula dampens the effect. (This is a result of the nontemperature-dependent G_{H_2O} term being added to the temperature-dependent G_{org} term.) For the total waste in tank 241-AN-104, Table 4-5 summarizes the differences in HGRs, in steady-state flammable gas concentrations, time to 25 and 50% of the LFL, and the required ventilation rates to maintain concentrations below 25 and 100% of the LFL.

Table 4-5. Preliminary Sensitivity Study Results from Revision 2 (Tank 241-AN-104).

Description	Single-Point Calculation	Monte Carlo Analysis Median	Monte Carlo Analysis Standard Deviation
HGR - Radiolysis	$1.1 \times 10^{-3} \text{ ft}^3/\text{min}$	$1.1 \times 10^{-3} \text{ ft}^3/\text{min}$	$1.0 \times 10^{-4} \text{ ft}^3/\text{min}$
HGR - Thermolysis	$3.0 \times 10^{-3} \text{ ft}^3/\text{min}$	$3.1 \times 10^{-3} \text{ ft}^3/\text{min}$	$1.6 \times 10^{-3} \text{ ft}^3/\text{min}$
HGR - Corrosion	$7.2 \times 10^{-4} \text{ ft}^3/\text{min}$	$8.0 \times 10^{-4} \text{ ft}^3/\text{min}$	$1.2 \times 10^{-5} \text{ ft}^3/\text{min}$
HGR - Total	$4.8 \times 10^{-3} \text{ ft}^3/\text{min}$	$4.8 \times 10^{-3} \text{ ft}^3/\text{min}$	$9.8 \times 10^{-4} \text{ ft}^3/\text{min}$
$[H_2]^{ss}$	0.12 %LFL	0.13 %LFL	0.019 %LFL
$[NH_3]^{ss}$	0.014 %LFL	0.014 %LFL	nc
$[CH_4]^{ss}$	0.004 %LFL	0.004 %LFL	nc
$[H_2]^{ss}$ (loss of ventilation)	71 %LFL	73 %LFL	22 %LFL
$[NH_3]^{ss}$ (loss of ventilation)	1.5 %LFL	1.5 %LFL	0.2 %LFL
$[CH_4]^{ss}$ (loss of ventilation)	2.4 %LFL	2.4 %LFL	0.9 %LFL
Time to reach 25 %LFL	84 days	77 days	5 days
Time to reach 50 %LFL	234 days	200 days	24 days
Min ventilation rate to maintain <25%LFL	0.52 ft^3/min	0.57 ft^3/min	0.04 ft^3/min
Min ventilation rate to maintain <100%LFL	0.13 ft^3/min	0.14 ft^3/min	0.04 ft^3/min

Notes:

To convert the unit of ft^3 to L, multiply the value by 28.454 L/ ft^3 .

HGR = hydrogen generation rate.

nc = not calculated.

LFL = lower flammability limit.

⁵ MathCad is a registered trademark of MathSoft Engineering & Education, Inc.

4.7 DISCUSSION

In Revision 3 of this report, the flammability calculations were updated because the HGRs were recalculated based on the latest BBI detail calculation report (dated on July 15, 2003) and SACS temperature data. In the off-normal ventilation condition, under barometric breathing rate the shortest time to 25% of the LFL is computed to be 10 days for tank 241-AY-102, which is shorter than the previous calculation because the tank has since received the waste from the high-heat tank 241-C-106. The latest tank sampling results show that the nitrite and nitrate are depleted, resulting in full hydrogen generation from water radiolysis. For SSTs, the shortest computed time to 25% of the LFL is 38 and 30 days for tank 241-B-203 under barometric breathing and zero ventilation rate, respectively. Although tank 241-B-203 has a very low HGR (on the order of $2 \text{ E-4 ft}^3/\text{min}$), it has the shortest time to reach 25% of the LFL. This is because the tank is very full resulting in a small dome vapor space, which results in a rapid rise in flammable gas concentration. Similar situations also occurred for tanks 241-B-204, 241-T-203 and 241-T-204. In Revision 1 and Revision 0, tank 241-A-101 has the shortest time to reach 25% and 100% of the LFL. However, this tank is undergoing saltwell pumping, the calculation has updated the waste volume to reflect the saltwell pumping.

One major upgrade in Revision 1 of this report was the incorporation of the liquid-vapor equilibrium model (RPP-4941) into the methodology to handle highly soluble ammonia. This model reduces the conservatism in estimating the ammonia flammability found in Revision 0. Appendix D, Table D-3, shows that the predicted ammonia concentrations are reduced from 2.7, 2.5, 1.0, 2.2, and 2.0% of LFL to 0.07, 0.07, 0.58, 0.09, and 0.08% of LFL, respectively.

In Revision 1, the dome space ammonia concentration in tank 241-SY-101 increased from 4 ppm (before-transfer data) to 400 ppm (January 2001 data), even though the liquid concentration decreased by a factor of 4 comparing data from before and after the waste was transferred out of the tank. The concentration increased because the thick crust had greatly reduced the ammonia transport from the waste to the dome space. After the waste had been transferred from tank 241-SY-101, most of the crust layer was removed and the effective area, A, for mass transport increased; therefore, the concentration in the dome space increased even though the concentration of the ammonia in the liquid decreased. Some thin crust has formed in tank 241-SY-101. Breaks in this crust appear periodically.

Following the transfer of waste from tank 241-SY-101, the dome space ammonia concentration increased from 50 to 400 ppm over the timeframe from July 2000 to January 2001, while the hydrogen concentration remained constant. This may be explained by changes in the effective surface area of mass transport. For example, calculations show that an effective surface area increase from 1.5% to 7% of the total tank waste surface area would account for the dome space concentration increase from 100 to 400 ppm. This effective area of 1.5% and 7% is roughly 70 and 300 ft^2 , respectively, and is consistent with the estimated liquid pool of 10 ft (*Evaluation of Hanford High-Level Waste Tank 241-SY-101*, RPP-6517) and 20 ft or more in diameter, respectively, observed on the surface in the corresponding time period. Calculations also indicated that most of the SSTs for which calculations were done had effective surface areas as small as several tenths of 1% of the total tank waste surface. Caution should be taken in using the results of the calculated product of h and A from Appendix C, Table C-3, because the accuracy is limited by the accuracy of the input data. Whether these data, such as dome space ammonia concentration, ventilation rate, and liquid concentration, are collected at the same time

also introduces uncertainty. Tank 241-SY-101 is an example that shows that the model calculations agree reasonably with field observations when the input data are accurate and are taken in the same time frame.

Another observation is that the area of liquid surface in tank 241-SY-101 seems to be changing continuously and, therefore, the ammonia transport rate will change accordingly. Calculations show that the steady-state dome space ammonia concentration under normal ventilation conditions would reach 2,573 ppm if the effective area were 100% for a given liquid ammonia concentration of 1,040 $\mu\text{g/mL}$. Using this concentration, the equilibrium vapor concentration of 3,895 ppm is calculated. For the scenario of the waste surface being fully open with a 100% effective mass transport area, the total flammable gas concentration is calculated to be 1.73% under normal ventilation conditions, and the total mass transport product of h and A is 2.09 ft^3/min . Therefore the calculated time to reach 25% of the LFL under the off-normal ventilation condition would become 145 days rather than the 146 days predicted by the previous methods. Monitoring data from July 2001 show that the ammonia concentration in the dome space went up to 1,700 ppm. This is a factor of four increase compared to the January 2001 data. The increase of ammonia concentration could result from the increase of open surface area as discussed earlier. It also is possible that the results are from the reduced ventilation flow rate because a similar increase also was observed for both hydrogen and nitrous oxide. In any case, the ammonia concentration of 1,700 ppm is still within the range of the ammonia calculation, which shows that the time to 25% would be around 146 days whether the ammonia concentration is 400 ppm or 2,573 ppm under the off-normal ventilation condition.

These HGR models assume that hydrogen generation occurs in the liquid phase. This model uses the liquid layer composition data when calculating generation rates. However, many SSTs do not have a supernatant liquid layer. The liquid information for these tanks is determined from the drainable liquid sample data or statistically from the other tanks in the same waste group. The liquid composition data are used to estimate the gas generation rate from the interstitial liquid portion of the solid layer. The liquid fraction is estimated based on the weight-percent-water data of the solid layer.

Times to 25% of the LFL were compared for the current work, using the model in RPP-3851 and the previous calculation notes, HNF-SD-WM-CN-116 and HNF-SD-WM-CN-117, respectively. HNF-SD-WM-CN-117 calculated HGRs for all DSTs using the HGR model, which is based on the tank-waste composition and condition. Based on additional gas generation data, that model was further refined to the revised rate equation model (HNF-3851), summarized in Section 2.1, and used in the current calculation. One of the main differences between the current (RPP-3851) and the previous model (HNF-SD-WM-CN-117) involves the basis for the generation term (G -value). In the previous model, the radiolysis G -value was calculated by scaling the single G -value from tank 241-SY-103 samples at 60 $^{\circ}\text{C}$. For most tanks, the temperatures are lower than 60 $^{\circ}\text{C}$; therefore, the radiolysis rates had been overestimated. The current model incorporates a radiolysis rate equation that is a function of temperature. In addition, the updated tank data also show cooler waste temperatures, although temperatures used in this study are the maximum for the past year and are usually higher than the mean annual temperatures used in Revision 1) and reduced heat loads caused by the decay of radionuclides (radionuclides now decayed to January 1, 2001). Also, the organic reactants are consumed as time goes on. Due to

revised radionuclide decay dates, the current HGRs for DSTs are expected to be lower than the previously calculated values.

5.0 FLAMMABILITY CALCULATIONS FOR WASTE ADDITION SCENARIOS

This entire section has not been updated and is the information from Revision 2. Chapter 4.0 explained the flammability evaluations of 177 underground tanks under current waste conditions. This chapter covers the case studies of the flammability levels resulting from water or waste additions to current DST levels. One scenario is to fill tanks with water from current waste levels to 1,140 kgal (414 in.); the other is to fill the tanks with tank waste similar to what presently is in the tank. The fill-up level of 1,140 kgal is based on current operating capacity for DSTs (*Operational Waste Volume Projection*, HNF-SD-WM-ER-029). These scenarios are the bounding cases for possible tank waste operations such as routine flushing water addition, caustic water addition, and waste transfers among DSTs to make space for receiving waste. The intent of these case studies is to provide an additional technical basis for flammable gas controls on DSTs.

To model the case of filling the tank with similar tank waste, the total gas generation rates of hydrogen and methane are estimated by the gas generation rate per unit waste volume multiplied by the total volume of 1,140 kgal. The gas generation rates per unit waste volumes are calculated by dividing the total gas generation rates listed in Appendix B, Table B-3, by the volumes listed in Table B-1. In the scenario of filling the tank with similar waste, the ammonia concentration in the liquid would remain the same. However, the mass transport coefficient, h , will be conservatively calculated directly, as described in Appendix A, using 100% surface area, A , because the waste surface configuration would be different from current storage conditions.

For the case of filling the tank with water, the gas generation rates have been rederived because the waste has been diluted by water addition. In the model calculation, the added water is expected to be well mixed only with the supernatant liquid layer; therefore, only the generation rate of the liquid layer needs to be recalculated. The ratio of the amount of water added to make up 1,140 kgal and the sum of the added water and the original supernatant liquid was used as a dilution factor to scale the chemical concentrations as well as the density and weight-percent water of the supernatant liquid layer. Below is the discussion whether the way to handle the input parameters of H_2 calculation mathematically rather than chemically for water addition is valid (and conservative). For nitrate and nitrite ions, if the supernatant is saturated with NO_2 and NO_3 , then adding water would cause additional NO_2 and NO_3 to dissolve and the solution NO_2 and NO_3 concentrations would return to the saturated concentrations. The water radiolysis will be further scavenged by the saturated concentration and the H_2 rate will be slightly lower than presented here. For most tanks, the TOC is not saturated, so the supernatant TOC concentration should be mathematically diluted. Because the TOC is not saturated, adding more water will not cause more solids to dissolve, instead it will dilute the TOC concentration in the liquid. Besides, most of the TOC stayed in solids as oxalate and had no contribution to hydrogen generation. For aluminum, the solubility is complex; however it plays a catalysis role and is less sensitive in the H_2 model calculation. These arguments should definitely hold for each small amount of water addition, such as flush water. If a large quantity, such as the amount specified in the GRE evaluation of water or flush water, is added at once, the gas generation rate should be reevaluated.

In addition, the temperatures of the waste and dome space were expected to remain the same as before waste or when water is added. In practice, unless the added water is heated up to or beyond the temperature of the supernatant liquid, this temperature assumption would be conservative in terms of the HGR recalculation. The ion concentration and Henry's Law constant were recalculated for the ammonia calculation based on the dilution factor. The mass transport properties of the product of h and A used the calculated h and 100% area, A , because the water addition changed the configuration of the waste surface; therefore, the original field-data-derived product of h and A no longer holds. For methane and nitrous oxide, the total generation rates remain the same, assuming the water addition has no effect on the total generation of methane or nitrous oxide because no tank-waste-dependent model exists for calculating the rate of methane and nitrous oxide. This assumption would result in a conservative total flammability calculation.

Table 5-1 summarizes the flammability assessments of the waste addition to DSTs for the top five active tanks, including tank waste volume, HGR, barometric breathing rate, and times to 25% and 100% of the LFL.

Table 5-1. Top Five Double-Shell Tanks from Flammability Assessment on Waste Addition (From Revision 2).

Description	241-AN-102	241-AN-107	241-AY-102	241-AZ-101	241-AZ-102
Current Tank Waste Volume (As of November 2001) (kgal)	1,054	1,041	635	944	997
Waste Addition	Fill to 1,140 kgal with Water				
Tank Waste Volume (kgal)	1,140	1,140	1,140	1,140	1,140
Total H ₂ Generation Rate (ft ³ /min)	1.2 E-2	8.7 E-3	2.7 E-2	6.2 E-3	9.8 E-3
Barometric Breathing (ft ³ /min)	0.11	0.11	0.11	0.11	0.11
Time to 25% of the LFL (days)	21	28	9	40	24
Time to 100% of the LFL (days)	107	149	39	246	125
Waste Addition	Fill to 1,140 kgal with the Same Waste				
Tank Waste Volume (kgal)	1,140	1,140	1,140	1,140	1,140
Total H ₂ Generation Rate (ft ³ /min)	1.3 E-2	1.1 E-2	5.6 E-2	8.1 E-3	1.2 E-2
Barometric Breathing (ft ³ /min)	0.11	0.11	0.11	0.11	0.11
Time to 25% of the LFL (days)	19	23	4	29	19
Time to 100% of the LFL (days)	91	115	18	156	94

Notes:

To convert the unit of ft³ to L, multiply the value by 28.454 L/ft³.

To convert the unit of kgal to kL, multiply the value by 3.785 kL/kgal.

LFL = lower flammability limit.

Details of the calculation results for these waste addition studies are given in Appendix G. Tables G-1 through G-4 list the input data and the calculation results for HGRs. Appendix G,

Tables G-5 and G-6, show the results of Henry's Law constant and the mass transport properties. Tables G-7 through G-10 give the results of flammability calculations and times to 25% and 100% of the LFL.

As shown in Tables 5-1 and 4-4 of Revision 2, the total HGRs increase in the case of filling the tank with similar waste compared with the rates of current waste conditions, but they decrease in the case of adding water because of the water dilution. Tank 241-AY-102 has the highest HGRs in all cases. The total generation rate is $3.18 \text{ E-2 ft}^3/\text{min}$ at current conditions and becomes 2.73 E-2 and $5.62 \text{ E-2 ft}^3/\text{min}$ when filling with water and similar waste, respectively. Note that the current waste volume in tank 241-AY-102 is 635 kgal and the tank is a little over half full; that is why the total HGR goes up almost a factor of two in the case of filling with similar waste. The flammability distributions among H_2 , NH_3 , and CH_4 are given in Appendix G, Tables G-9 and G-10; the tables show that hydrogen is the major contributor, contributing over 90%, to the total flammability in all cases.

The times to 25% and 100% of the LFL are listed in the last two rows of Table 5-1 for each type of addition. Under current conditions, as shown in Table 4-3, tank 241-AY-102 has the shortest time to 25% and 100% of the LFL, 23 days and 57 days, respectively. The next shortest times to 25% and 100% of the LFL are 27 days and 144 days, respectively, for tank 241-AN-102. In the cases of waste addition, whether with water or similar waste, the times to 25% and 100% of the LFL are shorter than for the current conditions for all top five tanks, even though the HGRs decrease in the case of water addition. This occurs because the calculated barometric breathing rate is proportional to the tank headspace volume. All the rates went down to $0.11 \text{ ft}^3/\text{min}$ when filled with water or similar waste. When filling tank 241-AY-102 with waste, the times to 25% and 100% of the LFL is 4 days and 18 days, respectively, and 9 days and 39 days, respectively, for the case of filling with water. The next shortest times to 25% and 100% LFL for the waste addition studies are 19 days and 91 days, respectively, for the case of filling with waste, and 21 days and 107 days, respectively, for the case of filling with water for tank 241-AN-102.

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6.0 SUMMARY AND CONCLUSIONS

The results of this report may be used to establish technical safety requirements for ventilation in tanks, establish maximum permissible down times for active ventilation systems, develop procedures for operations that require closing vent valves to HEPA filters on passively ventilated tanks, and support the technical basis for flammable gas control strategies.

HGRs were calculated for the 177 SSTs and DSTs using a rate equation model and tank waste data. For tanks that do not have complete information, a waste grouping method was used to obtain missing data. Flammable gas concentrations, in terms of percent of the LFL in the tank dome space, were evaluated under both normal and off-normal conditions for all 177 tanks. For normal ventilation conditions, all tanks are computed to remain well below 25% of the LFL with the highest flammable gas concentration level at 4% of the LFL in tank 241-U-106. With barometric breathing rate, the shortest time to reach 25% of the LFL for current tank waste is 38 days for SST 241-B-203 and 11 days for DST 241-AY-102; with zero ventilation scenario, the shortest time to reach 25% of the LFL for water addition is 30 days for SST 241-B-203 and 10 days for DST 241-AY-102.

Calculated HGRs for DSTs ranged from 5.7 E-2 to $1.5 \text{ E-4 ft}^3/\text{min}$ with the highest rate found in tank 241-AY-102. For SSTs, the rate ranged from 8.2 E-3 to $4.3 \text{ E-5 ft}^3/\text{min}$, with tank 241-SX-103 having the highest rate. For most DSTs, the tank data are sample based. For quite a few SSTs, the tanks were stabilized and no liquid samples were available. The waste grouping method was used to generate default values for missing tank waste data by creating a distribution from all property data for a similar class of waste (SNL-000198).

The steady-state flammability level in the tank dome space was evaluated based on the steady-state gas concentrations of hydrogen, ammonia, and methane using Le Chatelier's rule. Overall, the calculations under off-normal conditions show that 25 tanks will reach 25% of the LFL and 7 tanks will reach 100% of the LFL if allowed to reach steady state with the off-normal ventilation rates of barometric breathing.

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APPENDIX A

**INPUT DATA FOR HYDROGEN GENERATION CALCULATIONS FROM
BEST BASIS INVENTORY DETAIL CALCULATION REPORT AND
DERIVATION DOCUMENT (DATED ON JULY 15, 2003)**

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APPENDIX A

**INPUT DATA FOR HYDROGEN GENERATION CALCULATIONS FROM
BEST BASIS INVENTORY DETAIL CALCULATION REPORT AND
DERIVATION DOCUMENT (DATED ON JULY 15, 2003)**

Interoffice Memo 7G410-03-KMB-001	A-3
Table A-1 Tank Waste Inventory from BBI Detail Report (July 2003) for Hydrogen Generation Rate Calculations	A-23
Table A-2 Tanks with Retained Gas Estimates in the BBI Derivation Document	A-39

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INTEROFFICE MEMO

CH2MHILL
Hanford Group, Inc.

From: Flowsheet and Process Models 7G410-03-KMB-001
 Phone: 372-3667
 Date: August 18, 2003
 Subject: DENSITY AND WEIGHT PERCENT WATER ESTIMATES FOR THE BEST BASIS INVENTORY

To: N. W. Kirch R1-44

Copies: J. G. Field R1-44
 D. C. Hedengren R1-44
 B. A. Higley R1-44
 T. A. Hu R1-44
 A. N. Naiknimbalkar R1-44
 D. E. Place R1-44
 file/LB

The best basis inventory (BBI) currently uses the density associated with each sample event or estimate to calculate individual analyte inventories. Thus, if analyte inventories are estimated from different sample events, the calculation will show different densities for each analyte. The use of multiple values makes it difficult for end users to apply the data in a consistent manner. Specifically, flammable gas generation calculations need to use a single 'best estimate' of density and weight percent water for each phase in the tank. Unlike other BBI analytes, a single best estimate of the density and weight percent water for each waste phase and type has not been provided in the past.

This memo documents the rationale for determining a 'best estimate' density and weight percent water for each tank phase and type. Table 1 (Attachment 1) provides a density and weight percent water estimate for each tank waste phase and type, along with the source of the information. Table 1 values are applicable to the inventories effective April 2, 2003 or earlier for each tank. These values will be loaded in best basis inventory management tool (BBIM) and Tank Waste Information Network System (TWINS) for each tank component (waste phase and type). They will then be update/maintained as needed to account for transfers, new data, and evaporation through the normal BBI update process. This information will be incorporated into *Best Basis Inventory Process Requirements* (RPP-7625, Rev. 3) via the engineering change notice process.

The component density and weight percent water are taken from sample mean data, process estimate, or template following protocols established in RPP-7625, Rev. 3, Section 3.2 for determining the most representative or 'best' estimate. Weight percent water is normally measured during sample analysis. However, if not measured directly, it may be estimated from:

1. Weight Percent (wt%) Solid analyses ($\text{wt\% water} = 100\% - \text{wt\% solids}$)
2. Weight Loss Transition 1 data

If not taken from a direct measurement, the method of determination should be addressed in the BBI derivation text. It should also be included in the sample or process knowledge vector in BBIM with a comment on how it was derived if appropriate.

N. W. Kirch
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There are several cases where a separate calculation of density and/or weight percent water was required. These are addressed below:

Tank 241-AP-102 Sludge Weight Percent Water Estimate

Tank 241-AP-102 sludge concentrations are estimated by assuming the sludge layer is made up of a calcium phosphate ($\text{Ca}_3(\text{PO}_4)_2$) layer and an aluminum (Al) solids layer as described the BBI derivation text, and calculated in the spreadsheet \\AP001\StdInv\TIR\AP-102\FY03 Q2\AP102 Sludge Composition.xls.

The $\text{Ca}_3(\text{PO}_4)_2$ layer is 60.1 wt% $\text{Ca}_3(\text{PO}_4)_2$, with the remainder assumed to be interstitial liquid at the same composition as the supernatant layer. From the spreadsheet, the sum of chemicals in the November 1, 2001 supernatant is $2.94\text{E}+05$ ppm. Weight percent water in the interstitial liquid is estimated by subtracting the chemical mass (Wt% water for interstitial liquid = $100\% - 29.4\% = 70.6\text{ wt}\%$). This can then be applied to the $\text{Ca}_3(\text{PO}_4)_2$ layer as a whole (Wt% water for $\text{Ca}_3(\text{PO}_4)_2$ layer = $(100\% - 60.1\%) * 70.6\% = 28.2\text{ wt}\%$).

Weight percent water in the Al layer is estimated as CWP1 solids. The mean weight percent water for the CWP1 solids template basis tanks (Tanks 241-C-103, 241-C-104, 241-C-105, and 241-C-111) is 33.5%.

Averaging the weight percent water in each layer using the density and approximate depth of each layer gives an average weight percent water in the Tank 241-AP-102 sludge of 31.1 wt% water $[(1.91 \text{ g/mL}) * (3.59 \text{ in.}) * (28.2\%) + (1.63 \text{ g/mL}) * (4.91 \text{ in.}) * (33.5\%)] / [(1.91 \text{ g/mL}) * (3.59 \text{ in.}) + (1.63 \text{ g/mL}) * (4.91 \text{ in.})] = 31.1 \text{ wt}\% \text{ water}]$.

Tank 241-TX-116 Diatomaceous Earth Density and Weight Percent Water Estimates

Diatomaceous earth (DE) was added to Tank 241-TX-116 to absorb liquid. Per the BBI derivation text for Tank 241-TX-116, the estimated porosity of the DE layer is 0.825 based on a silicone dioxide (SiO_2) particle density of 2.19 g/mL and packed DE density of 0.384 g/mL. The pore space is assumed to be filled with absorbed T2-saltcake liquid. The density and weight percent water of the liquid are 1.47 g/mL and 51.2% based on the T2-saltcake liquid template. The average density for the DE layer in Tank 241-TX-116 is 1.60 g/mL $[(0.175) * (2.19 \text{ g/mL}) + (0.825) * (1.47 \text{ g/mL}) = 1.60 \text{ g/mL}]$. The average weight percent water of the DE layer is 38.8 wt% water $[(0.175) * 2.19 \text{ g/mL} * (0\%) + (0.825) * (1.47 \text{ g/mL}) * (51.2\%)] / 1.60 \text{ g/mL} = 38.8 \text{ wt}\%$.

Tank 241-U-104 Diatomaceous Earth Density and Weight Percent Water Estimates

Diatomaceous earth (DE) was added to Tank 241-U-104 to absorb liquid. Per the BBI derivation text, the estimated porosity of the DE layer is 0.818 based on SiO_2 particle density of 2.19 g/mL. The pore space is assumed to be filled with absorbed R1 sludge liquid. The density and weight percent water of the liquid are 1.23 g/mL and 70.8% based on the R1 sludge liquid template. The average density for the DE layer in Tank 241-U-104 is 1.40 g/mL $[(0.182) * (2.19 \text{ g/mL}) + (0.818) * (1.23 \text{ g/mL}) = 1.405 \text{ g/mL}]$. The average weight percent water of the DE layer is 50.7 wt% water $[(0.182) * (2.19 \text{ g/mL}) * (0\%) + (0.818) * (1.23 \text{ g/mL}) * (70.8\%)] / (1.405 \text{ g/mL}) = 50.7 \text{ wt}\%$.

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Future Evaluations

During the development process, several discrepancies were identified between the BBI derivation text and data in BBI or means and confidence interval reports relating to water and density. In these cases, the data existing in the means and confidence interval reports were used. Several instances of unusually low weight percent water were also noted. These will be re-evaluated during the tanks' next update and updated as needed. The discrepancies are relatively minor and should have little impact on the overall tank inventories. These discrepancies and need for further evaluation are summarized in Table 2 (Attachment 2).

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K. M Bowen, Engineer
Flowsheet and Process Models

lbg

Attachments 2

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Attachment 1

**BEST BASIS INVENTORY - DENSITY AND WEIGHT PERCENT WATER
BY TANK, WASTE PHASE, AND WASTE TYPE**

Consisting of 14 pages,
including coversheet

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Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-A-101	Salt Cake (Liquids)	A1-SltCk (Liquid)	1.49	1996 segment reform, Liquid mean conc	46.9	1996 segment reform, Liquid mean conc
241-A-101	Salt Cake (Solids)	A1-SltCk (Solid)	1.74	A-101 Calculated saltcake solids	29.2	A-101 Calculated saltcake solids
241-A-101	Sludge	P2 (Solid)	1.36	Sludge Heel Means	9.1	Sludge Heel Means
241-A-102	Salt Cake (Liquids)	A1-SltCk (Liquid)	1.57	Est. comp of supernate as of May 1989	46.2	Est. comp of supernate as of May 1989
241-A-102	Salt Cake (Solids)	A1-SltCk (Solid)	1.70	96-AUG-003 sample	34.3	96-AUG-003 sample
241-A-102	Supernatant	A1-SltCk (Liquid)	1.57	Est. comp of supernate as of May 1989	46.2	Est. comp of supernate as of May 1989
241-A-103	Salt Cake (Liquids)	A1-SltCk (Liquid)	1.45	1986 Core Liquid Composite Mean	53.5	1986 Core Liquid Composite Mean
241-A-103	Salt Cake (Solids)	A1-SltCk (Solid)	1.35	1986 Core Solid Composite Mean	40.2	1986 Core Solid Composite Mean
241-A-103	Sludge	AR (Solid)	1.30	AR Solid Template	69.2	AR Solid Template
241-A-103	Supernatant	A1-SltCk (Liquid)	1.45	1986 Core Liquid Composite Mean	53.5	1986 Core Liquid Composite Mean
241-A-104	Sludge	AR (Solid)	1.64	1974 Sampling Event	42.3	1974 Sampling Event
241-A-104	Sludge	P1 (Solid)	1.64	1974 Sampling Event	42.3	1974 Sampling Event
241-A-105	Sludge	P2 (Solid)	1.54	1972 Solids Sample Data (wet/dry avg)	0.0	BBI text indicates that the waste is dry
241-A-106	Salt Cake (Solids)	A1-SltCk (Solid)	1.70	A-102 96-AUG-003 sample	34.3	A-102 96-AUG-003 sample
241-A-106	Sludge	AR (Solid)	1.70	A-102 96-AUG-003 sample	34.3	A-102 96-AUG-003 sample
241-A-106	Sludge	SRR (Solid)	1.70	A-102 96-AUG-003 sample	34.3	A-102 96-AUG-003 sample
241-AN-101	Supernatant	(null)	1.29	AN-101 2002 grab	61.5	AN-101 2002 grab
241-AN-102	Salt Cake	A2-SltSr (Solid)	1.57	1998/2000 Reconstr. Grab Upper SltCk	43.1	1998/2000 Reconstr. Grab Upper SltCk
241-AN-102	Salt Cake	A2-SltSr (Solid)	1.56	1999 Reconstituted Core-Lower SltCk	42.1	1999 Reconstituted Core-Lower SltCk
241-AN-102	Supernatant	(null)	1.49	May 2002 Grabs	56.4	May 2002 Grabs
241-AN-103	Salt Cake	A2-SltSr (Solid)	1.72	AN-103 1996 solid segment means	34.9	AN-103 1996 solid segment means
241-AN-103	Supernatant	A2-SltSr (Liquid)	1.48	AN-103 reconstituted liquid segment 1996	46.7	AN-103 reconstituted liquid segment 1996
241-AN-104	Salt Cake	A2-SltSr (Solid)	1.59	1996 core 163 & 164 silt slurry seg. Mean	45.7	1996 core 163 & 164 silt slurry seg. Mean
241-AN-104	Supernatant	A2-SltSr (Liquid)	1.40	1996 core 163 & 164 supernate seg. Means	51.1	1996 core 163 & 164 supernate seg. Means
241-AN-105	Salt Cake	A2-SltSr (Solid)	1.57	1996 core solids segment means	44.4	1996 core solids segment means
241-AN-105	Supernatant	A2-SltSr (Liquid)	1.42	1996 core supernatant segment data	49.9	1996 core supernatant segment data
241-AN-106	Salt Cake	NA	1.58	A1SltCk Solid Template	39.0	A1SltCk Solid Template
241-AN-106	Supernatant	NA	1.11	Supernatant as of 4-1-2003	84.8	Supernatant as of 4-1-2003
241-AN-107	Salt Cake	A2-SltSr (Solid)	1.48	2002 Core 304 Solids, Reconstituted	42.5	2002 Core 304 Solids, Reconstituted
241-AN-107	Supernatant	A2-SltSr (Liquid)	1.43	February 2003 Grab Means	51.5	February 2003 Grab Means
241-AP-101	Supernatant	(null)	1.31	February 2000 Grab Sample Means	61.5	Based on AP-101 data & transfer from AW-106.
241-AP-102	Sludge	(null)	1.75	Est Sludge Composition as of 4-1-02	31.1	Est Sludge Composition as of 4-1-02
241-AP-102	Supernatant	(null)	1.15	Supernatant as of 4-1-03	79.0	Supernatant as of 4-1-03
241-AP-103	Supernatant	(null)	1.35	AP-103 Supernatant as of 4-1-03	56.9	AP-103 Supernatant as of 4-1-03
241-AP-104	Supernatant	(null)	1.28	2001 Grab Sample Composite Means	67.1	2003 Grab Sample Means
241-AP-105	Salt Cake	A2-SltSr (Solid)	1.61	2002 core reconstituted saltcake	47.7	2002 core reconstituted saltcake
241-AP-105	Supernatant	A2-SltSr (Liquid)	1.30	2002 core supernatant seg. 1	61.3	2002 core supernatant seg. 1
241-AP-106	Supernatant	(null)	1.21	AP-106 2002 grab sample	72.4	AP-106 2002 grab sample
241-AP-107	Supernatant	(null)	1.32	Supernate as of 4/1/03	61.9	Supernate as of 4/1/03
241-AP-108	Supernatant	(null)	1.25	Supernate as of 4-1-2003	67.3	Supernate as of 4-1-2003

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Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-AW-101	Salt Cake	A2-SitSlr (Solid)	1.59	1996 Core Saltcake Segment Means	43.9	1996 Core Saltcake Segment Means
241-AW-101	Supernatant	A2-SitSlr (Liquid)	1.47	1998 grab composite liquid means	47.6	1998 grab composite liquid means
241-AW-102	Sludge	CWP1 (Solid)	1.49	CWP1 Sludge Template	38.6	CWP1 Sludge Template
241-AW-102	Supernatant	(null)	1.13	Supernatant as of 4/1/03	84.7	Supernatant as of 4/1/03
241-AW-103	Salt Cake	A1-SitCk (Solid)	1.69	1999 core segment 10 results	45.2	1997 core segment 10 mean results
241-AW-103	Sludge	CWZr2 (Solid)	1.47	Mean conc 1999 core segment solids	55.8	Mean conc. 1997 core segment solids
241-AW-103	Supernatant	(null)	1.24	Supernatant as of 7-1-01	59.6	Supernatant as of 7-1-01
241-AW-104	Salt Cake (Liquids)	A2-SitSlr (Liquid)	1.45	2001 core segment 6 liquid means	52.0	2001 core segment 6 liquid means
241-AW-104	Salt Cake (Solids)	A2-SitSlr (Solid)	1.60	1997 core solids means; segments 20-22	42.0	1997 core solids means; segments 20-22
241-AW-104	Sludge (Liquids)	PL2 (Liquid)	1.33	2001 core segment 3 liquid means	63.8	2001 core segment 3 liquid means
241-AW-104	Sludge (Solids)	PL2 (Solid)	1.28	1997 core solids means segments 18-19R	65.8	1997 core solids means segments 18-19R
241-AW-104	Supernatant	(null)	1.32	Supernatant as of 4/1/03	61.9	Supernatant as of 4/1/03
241-AW-105	Sludge (Liquids)	CWZr2 (Liquid)	1.10	2001 core DL segs 4 and 8U	84.3	2001 core DL segs 4 and 8U
241-AW-105	Sludge (Liquids)	PL2 (Liquid)	1.17	2001 core DL seg 8L	76.5	2001 core DL seg 8L
241-AW-105	Sludge (Solids)	CWZr2 (Solid)	1.47	2001 core segments 4 and 8U	49.7	2001 core segments 4 and 8U
241-AW-105	Sludge (Solids)	PL2 (Solid)	1.41	2001 core segment 8L	37.8	2001 core segment 8L
241-AW-105	Supernatant	(null)	1.06	2001 core segment 1	92.8	2001 core segment 1
241-AW-106	Salt Cake	A2-SitSlr (Solid)	1.58	A1-SitCk Solid Template	39.0	A1-SitCk Solid Template
241-AW-106	Supernatant	(null)	1.44	Supernatant as of 4/1/03	54.5	Supernatant as of 4/1/03
241-AX-101	Salt Cake (Liquids)	A1-SitCk (Liquid)	1.53	1998 Core Liquid Mean with recons solids	43.1	1998 Core Liquid Mean with recons solids
241-AX-101	Salt Cake (Solids)	A1-SitCk (Solid)	1.72	AX-101 Calculated saltcake solids	32.8	AX-101 Calculated saltcake solids
241-AX-101	Sludge	SRR (Solid)	1.32	SRR Sludge Template	60.5	SRR Sludge Template
241-AX-102	Salt Cake	A1-SitCk (Solid)	1.82	2002 analysis of archived 1998 composite	40.6	1998 analyses of 1998 sample Archive data adjust
241-AX-102	Sludge	B (Solid)	1.57	1974 Sludge Sample Concentration	42.5	1974 Sludge Sample Concentration
241-AX-103	Salt Cake (Liquids)	A1-SitCk (Liquid)	1.46	Mean A1-SitCk liquid density and wt% water	48.5	Mean A1-SitCk liquid density and wt% water.
241-AX-103	Salt Cake (Solids)	A1-SitCk (Solid)	1.61	1997 AX-103 Core Segment Means	43.2	1997 AX-103 Core Segment Means
241-AX-103	Sludge	P2 (Solid)	1.80	1997 Solid Mean Auger Sample Conc.	8.3	1997 Solid Mean Auger Sample Conc.
241-AX-104	Sludge	P2 (Solid)	1.80	1997 Solid Mean Auger Sample Conc.	8.3	1997 Solid Mean Auger Sample Conc.
241-AY-101	Sludge (Liquids)	(null)	1.14	AY-101 2000 Core Segment Dr Liquid	81.4	AY-101 2000 Core Segment Dr Liquid
241-AY-101	Sludge (Solids)	(null)	1.78	2000 Core Composite, Sludge Solids	35.1	2000 Core Composite, Sludge Solids
241-AY-101	Supernatant	(null)	1.19	2002 core supernatant means	79.3	2002 core supernatant means
241-AY-102	Sludge (Liquids)	BL (Liquid)	1.16	2002 Core 300 Interstitial Liquid	85.7	2002 Core 300 Interstitial Liquid
241-AY-102	Sludge (Solids)	BL (Solid)	1.56	2000 Cores 270 & 273 Comp.-Cent. Solids	34.7	2000 Cores 270 & 273 Comp.-Cent. Solids
241-AY-102	Supernatant	BL (Liquid)	1.17	2002 Core 300 Supernatant Means	82.1	2002 Core 300 Supernatant Means
241-AZ-101	Sludge (Liquids)	P3 (Liquid)	1.24	1999 Core 269 Liquid Composite Means	71.3	1999 Core 269 Liquid Composite Means
241-AZ-101	Sludge (Solids)	P3 (Solid)	1.68	1999 Core 269 Sludge Solids Means	40.1	1999 Core 269 Sludge Solids Means
241-AZ-101	Supernatant	P3 (Liquid)	1.24	1999 Core Supernate Segment Means	71.3	1999 Core Supernate Segment Means
241-AZ-102	Sludge	P3 (Solid)	1.41	Means for 1999 Core Comp Reconst. Solids	42.9	Mean Conc for 1999 Core Segment Solids
241-AZ-102	Supernatant	P3 (Liquid)	1.11	2002 Core Supernatant Segments	83.2	2002 Core Supernatant Segments
241-B-101	Salt Cake (Liquids)	B-SitCk (Liquid)	1.53	B-101 1995 Liquid Core Sample Means	50.0	B-101 1995 Liquid Core Sample Means

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Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-B-101	Salt Cake (Solids)	B-SitCk (Solid)	1.48	B-101 1995 Core Samples	32.0	B-101 1995 Core Samples
241-B-101	Sludge	B (Solid)	1.48	B-101 1995 Core Samples	32.0	B-101 1995 Core Samples
241-B-101	Sludge	BL (Solid)	1.48	B-101 1995 Core Samples	32.0	B-101 1995 Core Samples
241-B-101	Sludge	MW (Solid)	1.48	B-101 1995 Core Samples	32.0	B-101 1995 Core Samples
241-B-102	Salt Cake (Liquids)	B-SitCk (Liquid)	1.19	BSitCk Liquid Template	68.8	BSitCk Liquid Template
241-B-102	Salt Cake (Solids)	B-SitCk (Solid)	1.75	1994 Auger Sample Means	18.8	1994 Auger Sample Means
241-B-102	Supernatant	B-SitCk (Liquid)	1.19	BSitCk Liquid Template	68.8	BSitCk Liquid Template
241-B-103	Salt Cake (Liquids)	B-SitCk (Liquid)	1.19	BSitCk Liquid Template	68.8	BSitCk Liquid Template
241-B-103	Salt Cake (Solids)	B-SitCk (Solid)	1.75	B-103 1995 Auger Means	44.9	B-103 1995 Auger Means
241-B-103	Sludge	MW (Solid)	1.78	MW Sludge Template	22.3	MW Sludge Template
241-B-104	Salt Cake (Liquids)	B-SitCk (Liquid)	1.19	BSitCk Liquid Template	68.8	BSitCk Liquid Template
241-B-104	Salt Cake (Solids)	B-SitCk (Solid)	1.36	B104 1995 Core Segment Means Sample D	46.7	B-104 1995 Core Analytical Means
241-B-104	Sludge	1C (Solid)	1.36	B104 1995 Core Segment Means Sample D	46.7	B-104 1995 Core Analytical Means
241-B-104	Sludge	2C (Solid)	1.36	B104 1995 Core Segment Means Sample D	46.7	B-104 1995 Core Analytical Means
241-B-105	Salt Cake (Liquids)	B-SitCk (Liquid)	1.19	BSitCk Liquid Template	68.8	BSitCk Liquid Template
241-B-105	Salt Cake (Solids)	B-SitCk (Solid)	1.75	B-SitCk Solid Template	39.7	B-SitCk Solid Template
241-B-105	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-B-105	Sludge	2C (Solid)	1.27	2C Sludge Template	60.2	2C Sludge Template
241-B-106	Sludge	1C (Solid)	1.42	B-106 Sludge 1995 Core Means	56.8	B-106 Sludge 1995 Core Means
241-B-106	Sludge	TBP (Solid)	1.36	B-106-TBP 1995 Core Solids Means	61.6	B-106-TBP 1995 Core Solids Means
241-B-106	Supernatant	B-SitCk (Liquid)	1.19	BSitCk Liquid Template	68.8	BSitCk Liquid Template
241-B-107	Salt Cake (Liquids)	B-SitCk (Liquid)	1.34	B-107 1997 Saltcake Liquid Sample Means	57.5	B-107 1997 Saltcake Liquid Sample Means
241-B-107	Salt Cake (Solids)	B-SitCk (Solid)	1.70	B-107 1997 Saltcake Sample Means	33.1	B-107 1997 Saltcake Sample Means
241-B-107	Sludge	1C (Solid)	1.63	B-107 1997 1C Sludge Sample Means	42.1	B-107 1997 1C Sludge Sample Means
241-B-107	Sludge	CWP2 (Solid)	1.71	B-107 1997 CWP2 Sludge Sample Means	5.8	B-107 1997 CWP2 Sludge Sample Means
241-B-108	Salt Cake (Liquids)	B-SitCk (Liquid)	1.38	B-108 1996 Saltcake Liquid Sample Means	78.9	B-108 1996 Saltcake Liquid Sample Means
241-B-108	Salt Cake (Solids)	B-SitCk (Solid)	1.70	B-108 1996 Saltcake Solids Sample Means	31.6	B-108 1996 Saltcake Solids Sample Means
241-B-108	Sludge	CWP2 (Solid)	1.80	B-108 1996 CWP2 Sludge Solids Means	27.1	B-108 1996 CWP2 Sludge Solids Means
241-B-109	Salt Cake (Liquids)	B-SitCk (Liquid)	1.19	BSitCk Liquid Template	68.8	BSitCk Liquid Template
241-B-109	Salt Cake (Solids)	B-SitCk (Solid)	1.89	1996 Core 169 Seg 1 & Core 170 Seg 2 & 3	38.4	1996 Core 169 Seg 1 & Core 170 Seg 2 & 3
241-B-109	Sludge	CWP2 (Solid)	1.85	1996 Core 169 Seg 2/2A & Core 170 Seg 1	36.2	1996 Core 169 Seg 2/2A & Core 170 Seg 1
241-B-110	Sludge	2C (Solid)	1.36	1989 Sludge Composite Core Means	58.3	1989 Sludge Composite Core Means
241-B-110	Sludge	P2 (Solid)	1.36	1989 Sludge Composite Core Means	58.3	1989 Sludge Composite Core Means
241-B-110	Supernatant	(null)	1.01	DW Liquid Template	98.3	DW Liquid Template
241-B-111	Sludge	2C (Solid)	1.19	B-111 1991 Core Sample Means (ICP-A)	63.1	B-111 1991 Core Sample Means (ICP-A)
241-B-111	Sludge	P2 (Solid)	1.19	B-111 1991 Core Sample Means (ICP-A)	63.1	B-111 1991 Core Sample Means (ICP-A)
241-B-111	Supernatant	(null)	1.01	DW Liquid Template	98.3	DW Liquid Template
241-B-112	Salt Cake (Liquids)	BY-SitCk (Liquid)	1.46	BY-SitCk Liquid Template	52.6	BY-SitCk Liquid Template
241-B-112	Salt Cake (Solids)	BY-SitCk (Solid)	1.54	B-112 Auger Means	40.2	B-112 Auger Means
241-B-112	Sludge	2C (Solid)	1.54	B-112 Auger Means	40.2	B-112 Auger Means

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Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-B-112	Supernatant	(null)	1.01	DW Liquid Template	98.3	DW Liquid Template
241-B-201	Sludge	224 Pre-1949 (Solid)	1.26	B-201 1991 core segment solids means	64.2	B-201 1991 core segment solids means
241-B-202	Sludge	224 Post-1949 (Solid)	1.22	1991 core segment solids means	75.8	1991 core segment solids means
241-B-203	Sludge	224 Post-1949 (Solid)	1.19	1995 core segment solids means	75.7	1995 core segment solids means
241-B-203	Supernatant	224 (Liquid)	1.05	1995 core segment liquid mean	89.4	1995 core segment liquid mean
241-B-204	Sludge	224 Post-1949 (Solid)	1.19	B204 1995 core segment solids means	77.3	B204 1995 core segment solids means
241-B-204	Supernatant	224 (Liquid)	1.05	1995 core segment liquid means	91.4	1995 core segment liquid means
241-BX-101	Sludge	CWP2 (Solid)	1.71	CWP2 Sludge Template	29.3	CWP2 Sludge Template
241-BX-101	Sludge	TBP (Solid)	1.51	TBP Sludge Template	44.9	TBP Sludge Template
241-BX-102	Sludge	CWP2 (Solid)	1.71	CWP2 Sludge Template	29.3	CWP2 Sludge Template
241-BX-102	Sludge	DE (Solid)	0.38	Diatomaceous Earth	0.0	Based on BBIM inventory structure, waste is dry.
241-BX-103	Sludge	CWP2 (Solid)	1.64	1995 Core sample sludge	49.6	1995 Core sample sludge
241-BX-103	Sludge	TBP (Solid)	1.64	1995 Core sample sludge	49.6	1995 Core sample sludge
241-BX-103	Supernatant	CWP2 (Liquid)	1.11	1995 core sample liquid means	77.8	1995 core sample liquid means
241-BX-104	Sludge	CWP2 (Solid)	1.68	BX-104 1996 Core Solids	26.9	BX-104 1996 Core Solids
241-BX-104	Sludge	CWR1 (Solid)	1.68	BX-104 1996 Core Solids	26.9	BX-104 1996 Core Solids
241-BX-104	Sludge	MW (Solid)	1.68	BX-104 1996 Core Solids	26.9	BX-104 1996 Core Solids
241-BX-104	Supernatant	CWR1 (Liquid)	1.28	1996 Core Drainable Liquid	59.1	1996 Core Drainable Liquid
241-BX-105	Sludge	CWP1 (Solid)	1.69	BX-105 1994 Auger Sample	12.6	BX-105 1994 Auger Sample
241-BX-105	Sludge	MW (Solid)	1.78	MW Sludge Template	22.3	MW Sludge Template
241-BX-105	Sludge	TBP (Solid)	1.69	BX-105 1994 Auger Sample	12.6	BX-105 1994 Auger Sample
241-BX-105	Supernatant	CWP1 (Liquid)	1.29	1986 Drainable Liquid	68.7	1986 Drainable Liquid
241-BX-106	Sludge	CWP1 (Solid)	1.64	1995 Auger Sample	38.7	1995 Auger Sample
241-BX-106	Sludge	TBP (Solid)	1.64	1995 Auger Sample	38.7	1995 Auger Sample
241-BX-107	Sludge	1C (Solid)	1.44	BX-107 1992 solid segment means	50.5	BX-107 1992 solid segment means
241-BX-108	Sludge	1C (Solid)	1.51	BX-108 1994 Auger Sample of Sludge	17.2	BX-108 1994 Auger Sample of Sludge
241-BX-108	Sludge	TBP (Solid)	1.51	BX-108 1994 Auger Sample of Sludge	17.2	BX-108 1994 Auger Sample of Sludge
241-BX-109	Sludge	TBP (Solid)	1.52	BX-109 Solid Segment Means	50.6	BX-109 Solid Segment Means
241-BX-110	Salt Cake (Liquids)	BY-SitCk (Liquid)	1.44	BX-110 Core Liquid Segment	53.1	BX-110 Core Liquid Segment
241-BX-110	Salt Cake (Solids)	BY-SitCk (Solid)	1.79	BX-110 Core Solids Segment	36.6	BX-110 Core Solids Segment
241-BX-110	Sludge	1C (Solid)	1.79	BX-110 Core Solids Segment	36.6	BX-110 Core Solids Segment
241-BX-110	Supernatant	BY-SitCk (Liquid)	1.44	BX-110 Core Liquid Segment	53.1	BX-110 Core Liquid Segment
241-BX-111	Salt Cake (Liquids)	BY-SitCk (Liquid)	1.45	BX-111 1997 Core Liquid Segment	51.2	BX-111 1997 Core Liquid Segment
241-BX-111	Salt Cake (Solids)	BY-SitCk (Solid)	1.45	BX-111 solid segment data 1997	15.6	BX-111 solid segment data 1997
241-BX-111	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-BX-112	Sludge	1C (Solid)	1.31	1995 Core Solid Segment	63.3	1995 Core Solid Segment
241-BX-112	Supernatant	1C2 (Liquid)	1.18	1995 Core Drainable Liquid	67.6	1995 Core Drainable Liquid
241-BY-101	Salt Cake (Liquids)	BY-SitCk (Liquid)	1.46	BY-SitCk Liquid Template	52.6	BY-SitCk Liquid Template
241-BY-101	Salt Cake (Solids)	BY-SitCk (Solid)	1.87	1997 BY-101 Saltcke Segment Means	20.4	1997 BY-101 Saltcke Segment Means
241-BY-101	Sludge	TFeCN (Solid)	1.42	TFeCN Sludge Template	39.4	TFeCN Sludge Template

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Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-BY-102	Salt Cake (Liquids)	BY-SltCk (Liquid)	1.46	1996 push mode core drainable liq. Means	50.8	1996 push mode core drainable liq. Means
241-BY-102	Salt Cake (Solids)	BY-SltCk (Solid)	1.59	1996 push mode core saltcake means	27.9	1996 push mode core saltcake means
241-BY-103	Salt Cake (Liquids)	BY-SltCk (Liquid)	1.29	BY-103 1995 liquid grab sample means	59.0	BY-103 1995 liquid grab sample means
241-BY-103	Salt Cake (Solids)	BY-SltCk (Solid)	1.69	BY-103 1995 Auger 012	23.7	BY-103 1995 Auger 012
241-BY-103	Sludge	CWP2 (Solid)	1.71	CWP2 Sludge Template	29.3	CWP2 Sludge Template
241-BY-104	Salt Cake (Liquids)	BY-SltCk (Liquid)	1.46	BY-104 core saltcake drainable liquid	48.9	BY-104 core saltcake drainable liquid
241-BY-104	Salt Cake (Solids)	BY-SltCk (Solid)	1.75	saltcake solids seg. 1-7 except 7D	23.0	saltcake solids seg. 1-7 except 7D
241-BY-104	Sludge	PFeCN (Solid)	1.64	PFeCN Sludge Seg. 8 and 7D	29.0	PFeCN Sludge Seg. 8 and 7D
241-BY-105	Salt Cake (Liquids)	BY-SltCk (Liquid)	1.44	1998 Drainable Liquid Segment Means	51.3	1998 Drainable Liquid Segment Means
241-BY-105	Salt Cake (Solids)	BY-SltCk (Solid)	1.85	1998 Segments 1-8 (except 246R:8R)	14.6	1998 Segments 1-8 (except 246R:8R)
241-BY-105	Sludge	PFeCN (Solid)	1.79	1998 Seg. 9 & 9A Core 246; 9B Core 250	25.5	1998 Seg. 9 & 9A Core 246; 9B Core 250
241-BY-105	Sludge	Portland Cement	1.90	Portland Cement Composition	8.0	Based on HDW Model value for Port. Cement
241-BY-106	Salt Cake (Liquids)	BY-SltCk (Liquid)	1.31	1994-95 core drainable liquid, Seg 1-12	59.4	1994-95 core drainable liquid, Seg 1-12
241-BY-106	Salt Cake (Solids)	BY-SltCk (Solid)	1.68	1994-95 cores sample saltcake, Seg 1-12	23.3	1994-95 cores sample saltcake, Seg 1-12
241-BY-106	Sludge	PFeCN (Solid)	1.68	1995 rotary-core sample sludge Seg. 13	37.3	1995 rotary-core sample sludge Seg. 13
241-BY-107	Salt Cake (Liquids)	BY-SltCk (Liquid)	1.46	1996 core sample drainable liquid	48.6	1996 core sample drainable liquid
241-BY-107	Salt Cake (Solids)	BY-SltCk (Solid)	1.72	1996 core sample saltcake means	36.3	1996 core sample saltcake means
241-BY-107	Sludge	PFeCN (Solid)	1.78	1996 core sample sludge means	37.6	1996 core sample sludge means
241-BY-108	Salt Cake (Liquids)	BY-SltCk (Liquid)	1.33	BY-108 saltcake drainable liquid means	32.7	BY-108 saltcake drainable liquid means
241-BY-108	Salt Cake (Solids)	BY-SltCk (Solid)	1.50	1995 core sample saltcake solid means	25.5	1995 core sample saltcake solid means
241-BY-108	Sludge	PFeCN (Solid)	1.53	1995 core sample sludge means	31.0	1995 core sample sludge means
241-BY-109	Salt Cake (Liquids)	BY-SltCk (Liquid)	1.50	1997 core sample drainable liquid means	53.0	1997 core sample drainable liquid means
241-BY-109	Salt Cake (Solids)	BY-SltCk (Solid)	1.71	1997 push mode core sample saltcake mean	42.0	1997 push mode core sample saltcake mean
241-BY-109	Sludge	CWP2 (Solid)	2.00	1997 push mode core sample sludge means	28.4	1997 push mode core sample sludge means
241-BY-110	Salt Cake (Liquids)	BY-SltCk (Liquid)	1.44	1995 core sample sltck drainable liquid	39.9	1995 core sample sltck drainable liquid
241-BY-110	Salt Cake (Solids)	BY-SltCk (Solid)	1.54	1995 core sampling saltcake solid means	27.3	1995 core sampling saltcake solid means
241-BY-110	Sludge	PFeCN (Solid)	1.82	Rotary and Push Mode Core Sludge Means	28.7	Rotary and Push Mode Core Sludge Means
241-BY-111	Salt Cake (Liquids)	BY-SltCk (Liquid)	1.42	1996 push mode core sample sltck liquid	53.8	1996 push mode core sample sltck liquid
241-BY-111	Salt Cake (Solids)	BY-SltCk (Solid)	1.70	1996 push mode core sample saltcake	33.6	1996 push mode core sample saltcake
241-BY-112	Salt Cake (Liquids)	BY-SltCk (Liquid)	1.47	1996 Drainable Liquid Seg 5 Means	48.5	1996 Drainable Liquid Seg 5 Means
241-BY-112	Salt Cake (Solids)	BY-SltCk (Solid)	1.76	1996 Saltcake Solids Segment Means	28.3	1996 Saltcake Solids Segment Means
241-BY-112	Sludge	MW (Solid)	1.78	MW Sludge Template	22.3	MW Sludge Template
241-C-101	Sludge	CWP1 (Solid)	1.78	Means for 1995 auger data	23.4	Means for 1995 auger data
241-C-101	Sludge	TBP (Solid)	1.78	Means for 1995 auger data	23.4	Means for 1995 auger data
241-C-102	Sludge	CWP1 (Solid)	1.49	CWP1 Sludge Template	38.6	CWP1 Sludge Template
241-C-102	Sludge	CWP2 (Solid)	1.74	Core 2 composite, riser 3	29.3	CWP2 Sludge Template
241-C-102	Sludge	CWZR1 (Solid)	1.74	Core 2 composite, riser 3	64.2	CWZR1 Solids Template
241-C-102	Sludge	MW (Solid)	1.78	MW Sludge Template	22.3	MW Sludge Template
241-C-102	Sludge	TBP (Solid)	1.51	TBP Sludge Template	44.9	TBP Sludge Template
241-C-102	Sludge	TH1 (Solid)	1.25	TH1 Solids Template	64.6	TH1 Solids Template

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Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-C-103	Sludge	AR (Solid)	1.53	Sludge as of 4/1/03	55.7	Sludge as of 4/1/03
241-C-103	Sludge	CWP1 (Solid)	1.53	Sludge as of 4/1/03	55.7	Sludge as of 4/1/03
241-C-104	Sludge	(null)	1.69	Means for 96 Core Composite Solids	47.9	Means for 96 Core Composite Solids
241-C-104	Sludge	CWP1 (Solid)	1.69	Means for 96 Core Composite Solids	47.9	Means for 96 Core Composite Solids
241-C-104	Sludge	CWP2 (Solid)	1.69	Means for 96 Core Composite Solids	47.9	Means for 96 Core Composite Solids
241-C-104	Sludge	CWP1 (Solid)	1.69	Means for 96 Core Composite Solids	47.9	Means for 96 Core Composite Solids
241-C-104	Sludge	OWW3 (Solid)	1.69	Means for 96 Core Composite Solids	47.9	Means for 96 Core Composite Solids
241-C-104	Sludge	TH2 (Solid)	1.69	Means for 96 Core Composite Solids	47.9	Means for 96 Core Composite Solids
241-C-105	Sludge	CWP1 (Solid)	1.55	Means for Core 72 and 76 Segment Data	25.8	Means for Core 72 and 76 Segment Data
241-C-105	Sludge	TBP (Solid)	1.55	Means for Core 72 and 76 Segment Data	25.8	Means for Core 72 and 76 Segment Data
241-C-106	Sludge	AR (Solid)	1.52	1999-2000 core segment data C-106 layer	37.0	1999-2000 core segment data C-106 layer
241-C-106	Supernatant	BL (Liquid)	1.14	1999-2000 Core Supernatant Segment Means	87.5	1999-2000 Core Supernatant Segment Means
241-C-107	Sludge	1C (Solid)	1.55	2001 Core composite means, reconstituted	47.5	2001 Core composite means, reconstituted
241-C-107	Sludge	CWP2 (Solid)	1.55	2001 Core composite means, reconstituted	47.5	2001 Core composite means, reconstituted
241-C-107	Sludge	SRR (Solid)	1.55	2001 Core composite means, reconstituted	47.5	2001 Core composite means, reconstituted
241-C-108	Sludge	1C (Solid)	1.45	Means for 1994 auger segment data	38.2	Means for 1994 auger segment data
241-C-108	Sludge	TBP (Solid)	1.45	Means for 1994 auger segment data	38.2	Means for 1994 auger segment data
241-C-108	Sludge	TFeCN (Solid)	1.45	Means for 1994 auger segment data	38.2	Means for 1994 auger segment data
241-C-109	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-C-109	Sludge	CWP1 (Solid)	1.45	C109 1992 Segment Means	36.1	C109 1992 Segment Means
241-C-109	Sludge	HS (Solid)	1.45	C109 1992 Segment Means	36.1	C109 1992 Segment Means
241-C-109	Sludge	TFeCN (Solid)	1.45	C109 1992 Segment Means	36.1	C109 1992 Segment Means
241-C-110	Sludge	1C (Solid)	1.34	Core 37, 38, And 39 Solids Segment Means	60.2	Core 37-39 Solids Composite Means
241-C-110	Supernatant	1C1 (Liquid)	1.10	Core 37-30 Liquid Segment Means	81.7	1C1 Liquid Template
241-C-111	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-C-111	Sludge	CWP1 (Solid)	1.44	C-111 Average of 1994/1995 Sample Data	31.4	C-111 Average of 1994/1995 Sample Data
241-C-111	Sludge	HS (Solid)	1.44	C-111 Average of 1994/1995 Sample Data	31.4	C-111 Average of 1994/1995 Sample Data
241-C-111	Sludge	TFeCN (Solid)	1.44	C-111 Average of 1994/1995 Sample Data	31.4	C-111 Average of 1994/1995 Sample Data
241-C-112	Sludge	1C (Solid)	1.60	1992 core segment solids means	51.5	1992 core segment solids means
241-C-112	Sludge	CWP1 (Solid)	1.60	1992 core segment solids means	51.5	1992 core segment solids means
241-C-112	Sludge	TFeCN (Solid)	1.60	1992 core segment solids means	51.5	1992 core segment solids means
241-C-201	Sludge	HS (Solid)	1.44	2002 archive analysis of 1997 composite	8.7	1997 Composite - template scaled to original data
241-C-202	Sludge	HS (Solid)	1.44	2002 archive analysis of C-202 composite	4.7	1998 Composite - template scaled to original data
241-C-203	Sludge	HS (Solid)	1.62	1995 Auger Samples	41.7	2002 composite of 1995 auger
241-C-204	Sludge	HS (Solid)	1.59	2002 composite of 1995 auger	41.7	2002 composite of 1995 auger
241-S-101	Salt Cake (Liquids)	R-SltCk (Liquid)	1.47	Mean conc. for 2000 Liquid Grab Sample	50.7	Mean conc. for 2000 Liquid Grab Sample
241-S-101	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.47	Mean conc. for 2000 Liquid Grab Sample	50.7	Mean conc. for 2000 Liquid Grab Sample
241-S-101	Salt Cake (Liquids)	S2-SltCk (Liquid)	1.47	Mean conc. for 2000 Liquid Grab Sample	50.7	Mean conc. for 2000 Liquid Grab Sample
241-S-101	Salt Cake (Solids)	R-SltCk (Solid)	1.61	Mean conc for 1996 saltcake solids	43.0	Mean conc for 1996 saltcake solids
241-S-101	Salt Cake (Solids)	S1-SltCk (Solid)	1.61	Mean conc for 1996 saltcake solids	43.0	Mean conc for 1996 saltcake solids

RPP-5926 REV 3
Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-S-101	Salt Cake (Solids)	S2-SltSlr (Solid)	1.61	Mean conc for 1996 saltcake solids	43.0	Mean conc for 1996 saltcake solids
241-S-101	Sludge	CWR1 (Solid)	1.75	Mean conc for 1996 Sludge Solids segs.	34.5	Mean conc for 1996 Sludge Solids segs.
241-S-101	Sludge	R1 (Solid)	1.75	Mean conc for 1996 Sludge Solids segs.	34.5	Mean conc for 1996 Sludge Solids segs.
241-S-102	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.46	2002 archive analysis of 1998 grabs	48.5	2002 archive analysis of 1998 grabs
241-S-102	Salt Cake (Liquids)	S2-SltSlr (Liquid)	1.46	2002 archive analysis of 1998 grabs	48.5	2002 archive analysis of 1998 grabs
241-S-102	Salt Cake (Solids)	S1-SltCk (Solid)	1.63	S102 SltCk Solids all 96 core w/o 11L	26.1	S102 SltCk Solids all 96 core w/o 11L
241-S-102	Salt Cake (Solids)	S2-SltSlr (Solid)	1.63	S102 SltCk Solids all 96 core w/o 11L	26.1	S102 SltCk Solids all 96 core w/o 11L
241-S-102	Sludge	R1 (Solid)	1.88	Sludge Solids - 11L of Core 130	22.2	Sludge Solids - 11L of Core 130
241-S-103	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.45	S-103 1998 Grab Sample Means	49.8	S-103 1998 Grab Sample Means
241-S-103	Salt Cake (Liquids)	S2-SltSlr (Liquid)	1.45	S-103 1998 Grab Sample Means	49.8	S-103 1998 Grab Sample Means
241-S-103	Salt Cake (Solids)	S1-SltCk (Solid)	1.65	S1-SltCk Solid Template	32.4	S1-SltCk Solid Template
241-S-103	Salt Cake (Solids)	S2-SltSlr (Solid)	1.59	S2 SltSlr Solid Template	34.1	S2 SltSlr Solid Template
241-S-103	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-S-103	Supernatant	S1-SltCk (Liquid)	1.45	S-103 1998 Grab Sample Means	49.8	S-103 1998 Grab Sample Means
241-S-104	Salt Cake (Liquids)	R-SltCk (Liquid)	1.37	S-104 Saltcake liquid/ 1992 Core segment	55.1	S-104 Saltcake liquid/ 1992 Core segment
241-S-104	Salt Cake (Solids)	R-SltCk (Solid)	1.64	S-104 Saltcake/1992 Core Segments 1,2 & 3	41.0	S-104 Saltcake/1992 Core Segments 1,2 & 3
241-S-104	Sludge	CWR1 (Solid)	1.75	S-104 Sludge/1992 Core Segment 4,5&6	33.5	S-104 Sludge/1992 Core Segment 4,5&6
241-S-104	Sludge	R1 (Solid)	1.75	S-104 Sludge/1992 Core Segment 4,5&6	33.5	S-104 Sludge/1992 Core Segment 4,5&6
241-S-105	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.44	Mean S1-SltCk liquid density and wt% water	50.1	Mean S1-SltCk liquid density and wt% water. TE/
241-S-105	Salt Cake (Solids)	S1-SltCk (Solid)	1.65	S-105 Cores 293 & 294 S1-Solid Composite	3.6	S-105 Cores 293 & 294 S1-Solid Composite
241-S-105	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-S-106	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.43	1997 Push Core Segment Mean	54.2	1997 Push Core Segment Mean
241-S-106	Salt Cake (Solids)	S1-SltCk (Solid)	1.74	1997 Push Core Solid Segment Mean	33.5	1997 Push Core Solid Segment Mean
241-S-107	Salt Cake (Solids)	S1-SltCk (Solid)	1.57	1995 Core Seg. Samples of SltCk Solids	44.9	1995 Core Seg. Samples of SltCk Solids
241-S-107	Salt Cake (Solids)	S2-SltSlr (Solid)	1.57	1995 Core Seg. Samples of SltCk Solids	44.9	1995 Core Seg. Samples of SltCk Solids
241-S-107	Salt Cake (Solids)	T2-SltCk (Solid)	1.57	1995 Core Seg. Samples of SltCk Solids	44.9	1995 Core Seg. Samples of SltCk Solids
241-S-107	Sludge	CWR1 (Solid)	1.90	Sludge Solids as of 4/1/03	28.6	Sludge Solids as of 4/1/03
241-S-107	Sludge	CWR2 (Solid)	1.90	Sludge Solids as of 4/1/03	28.6	Sludge Solids as of 4/1/03
241-S-107	Sludge	CWZr1 (Solid)	1.90	Sludge Solids as of 4/1/03	28.6	Sludge Solids as of 4/1/03
241-S-107	Sludge	R1 (Solid)	1.90	Sludge Solids as of 4/1/03	28.6	Sludge Solids as of 4/1/03
241-S-107	Sludge (Liquids)	NA	1.31	Sludge Liquid as of 4/1/03	64.3	Sludge Liquid as of 4/1/03
241-S-108	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.44	Mean S1-SltCk liquid density and wt% water	50.1	Mean S1-SltCk liquid density and wt% water.
241-S-108	Salt Cake (Solids)	S1-SltCk (Solid)	1.65	S1-SltCk Solid Template	32.4	S1-SltCk Solid Template
241-S-108	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-S-109	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.49	S-109 1999 Grab Sample of SltCk Liquid	53.1	S-109 1999 Grab Sample of SltCk Liquid
241-S-109	Salt Cake (Solids)	S1-SltCk (Solid)	1.66	S-109 1996 Core Saltcake Solid Segment	9.1	S-109 1996 Core Saltcake Solid Segment
241-S-109	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-S-110	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.43	S-110 1998 Core Drainable Liquid	49.3	S-110 1998 Core Drainable Liquid
241-S-110	Salt Cake (Solids)	S1-SltCk (Solid)	1.65	S-110 1998 Core Saltcake Segments	12.5	S-110 1998 Core Saltcake Segments
241-S-110	Sludge	CWR1 (Solid)	1.75	S-110 1998 Core Sludge Segments	31.5	S-110 1998 Core Sludge Segments

RPP-5926 REV 3
Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-S-110	Sludge	R1 (Solid)	1.75	S-110 1998 Core Sludge Segments	31.5	S-110 1998 Core Sludge Segments
241-S-111	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.45	S-111 1999 liquid grab	51.0	S-111 1999 liquid grab
241-S-111	Salt Cake (Solids)	S1-SltCk (Solid)	1.53	S-111 Saltcake - Core 237 Segments	29.0	S-111 Saltcake - Core 237 Segments
241-S-111	Sludge	CWR1 (Solid)	1.67	S-111 Sludge Segments - Core 149	19.4	S-111 Sludge Segments - Core 149
241-S-111	Sludge	R1 (Solid)	1.67	S-111 Sludge Segments - Core 149	19.4	S-111 Sludge Segments - Core 149
241-S-112	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.45	2001 Liquid Grab Sample Means	52.2	2001 Liquid Grab Sample Means
241-S-112	Salt Cake (Solids)	S1-SltCk (Solid)	1.69	2001 Core 291 and 292 composite means	12.8	2001 Core 291 and 292 composite means
241-S-112	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-SX-101	Salt Cake (Liquids)	R-SltCk (Liquid)	1.48	Sample 1997 Core 225/227 Liquid Segment	49.1	Sample 1997 Core 225/227 Liquid Segment
241-SX-101	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.48	Sample 1997 Core 225/227 Liquid Segment	49.1	Sample 1997 Core 225/227 Liquid Segment
241-SX-101	Salt Cake (Liquids)	S2-SltSlr (Liquid)	1.48	Sample 1997 Core 225/227 Liquid Segment	49.1	Sample 1997 Core 225/227 Liquid Segment
241-SX-101	Salt Cake (Solids)	R-SltCk (Solid)	1.69	Sample, 1997 Core 225/227 Solid Segments	25.6	Sample, 1997 Core 225/227 Solid Segments
241-SX-101	Salt Cake (Solids)	S1-SltCk (Solid)	1.69	Sample, 1997 Core 225/227 Solid Segments	25.6	Sample, 1997 Core 225/227 Solid Segments
241-SX-101	Salt Cake (Solids)	S2-SltSlr (Solid)	1.69	Sample, 1997 Core 225/227 Solid Segments	25.6	Sample, 1997 Core 225/227 Solid Segments
241-SX-101	Sludge	R1 (Solid)	1.69	Sample, 1997 Core 225/227 Solid Segments	25.6	Sample, 1997 Core 225/227 Solid Segments
241-SX-102	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.46	1998 Core 243/44 Liquid Segment Means	48.1	1998 Core 243/44 Liquid Segment Means
241-SX-102	Salt Cake (Liquids)	S2-SltSlr (Liquid)	1.46	1998 Core 243/44 Liquid Segment Means	48.1	1998 Core 243/44 Liquid Segment Means
241-SX-102	Salt Cake (Solids)	S1-SltCk (Solid)	1.72	1998 Core 243/244 Solid Segment means	38.5	1998 Core 243/244 Solid Segment means
241-SX-102	Salt Cake (Solids)	S2-SltSlr (Solid)	1.72	1998 Core 243/244 Solid Segment means	38.5	1998 Core 243/244 Solid Segment means
241-SX-102	Sludge	R1 (Solid)	1.72	1998 Core 243/244 Solid Segment means	38.5	1998 Core 243/244 Solid Segment means
241-SX-103	Salt Cake (Liquids)	R-SltCk (Liquid)	1.47	1998 Core 235/239 DL segment means	46.6	1998 Core 235/239 DL segment means
241-SX-103	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.47	1998 Core 235/239 DL segment means	46.6	1998 Core 235/239 DL segment means
241-SX-103	Salt Cake (Solids)	R-SltCk (Solid)	1.72	1998 Core 239 segment 11R - R SltCk	37.3	1998 Core 239 segment 11R - R SltCk
241-SX-103	Salt Cake (Solids)	S1-SltCk (Solid)	1.72	1998 Core 235/239 Solid Segment Means	30.9	1998 Core 235/239 Solid Segment Means
241-SX-103	Sludge	R1 (Solid)	1.88	1998 Core 235/239 R1 Sludge Segments	21.9	1998 Core 235/239 R1 Sludge Segments
241-SX-104	Salt Cake (Liquids)	R-SltCk (Liquid)	1.47	241-SX-104 1998 Reconstituted Grab Mean	45.3	241-SX-104 1998 Reconstituted Grab Means
241-SX-104	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.47	241-SX-104 1998 Reconstituted Grab Mean	45.3	241-SX-104 1998 Reconstituted Grab Means
241-SX-104	Salt Cake (Solids)	R-SltCk (Solid)	1.72	RSltCk Solid Template	28.9	RSltCk Solid Template
241-SX-104	Salt Cake (Solids)	S1-SltCk (Solid)	1.65	S1-SltCk Solid Template	32.4	S1-SltCk Solid Template
241-SX-104	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-SX-105	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.47	1998 Drainable liquid Means	42.9	1998 Drainable liquid Means
241-SX-105	Salt Cake (Solids)	S1-SltCk (Solid)	1.64	1998 core saltcake solids means	37.1	1998 core saltcake solids means
241-SX-105	Sludge	R1 (Solid)	1.67	1998 core sludge solids means	22.7	1998 core sludge solids means
241-SX-106	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.29	1998 liquid grab sample means	49.4	1998 liquid grab sample means
241-SX-106	Salt Cake (Liquids)	S2-SltSlr (Liquid)	1.29	1998 liquid grab sample means	49.4	1998 liquid grab sample means
241-SX-106	Salt Cake (Solids)	S1-SltCk (Solid)	1.61	1997 solid core sample means	39.0	1997 solid core sample means
241-SX-106	Salt Cake (Solids)	S2-SltSlr (Solid)	1.61	1997 solid core sample means	39.0	1997 solid core sample means
241-SX-107	Salt Cake (Liquids)	R-SltCk (Liquid)	1.45	RSltCk Liquid Template	54.4	RSltCk Liquid Template
241-SX-107	Salt Cake (Solids)	R-SltCk (Solid)	1.72	RSltCk Solid Template	28.9	RSltCk Solid Template
241-SX-107	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template

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Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-SX-108	Sludge	R1 (Solid)	1.75	R1 Sludge Auger 1995	2.0	R1 Sludge Auger 1995
241-SX-109	Salt Cake (Solids)	R-SltCk (Solid)	1.72	RSltCk Solid Template	28.9	RSltCk Solid Template
241-SX-109	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-SX-110	Salt Cake (Solids)	R-SltCk (Solid)	1.72	RSltCk Solid Template	28.9	RSltCk Solid Template
241-SX-110	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-SX-111	Salt Cake (Liquids)	R-SltCk (Liquid)	1.45	RSltCk Liquid Template	54.4	RSltCk Liquid Template
241-SX-111	Salt Cake (Solids)	R-SltCk (Solid)	1.72	RSltCk Solid Template	28.9	RSltCk Solid Template
241-SX-111	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-SX-112	Salt Cake (Liquids)	R-SltCk (Liquid)	1.45	RSltCk Liquid Template	54.4	RSltCk Liquid Template
241-SX-112	Salt Cake (Solids)	R-SltCk (Solid)	1.72	RSltCk Solid Template	28.9	RSltCk Solid Template
241-SX-112	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-SX-113	Sludge	DE (Solid)	1.06	222S 1995 Auger sample	46.0	222S 1995 Auger sample
241-SX-113	Sludge	R1 (Solid)	1.06	222S 1995 Auger sample	46.0	222S 1995 Auger sample
241-SX-114	Salt Cake (Liquids)	R-SltCk (Liquid)	1.45	RSltCk Liquid Template	54.4	RSltCk Liquid Template
241-SX-114	Salt Cake (Solids)	R-SltCk (Solid)	1.72	RSltCk Solid Template	28.9	RSltCk Solid Template
241-SX-114	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-SX-115	Sludge	R1 (Solid)	1.75	1998 Grab sample	10.1	1998 Grab sample
241-SY-101	Salt Cake	S2-SltSlr (Solid)	1.52	Mean Conc April/June 2000 grab samples	50.4	Mean Conc April/June 2000 grab samples
241-SY-101	Supernatant	NA	1.34	November 2002 Grab	60.0	November 2002 Grab
241-SY-102	Salt Cake (Liquids)	NA	1.36	2000 Core Liquid Composite	63.2	2000 Core Liquid Composite
241-SY-102	Salt Cake (Solids)	NA	1.65	2000 Upper core segment	41.3	2000 Core solid composite - upper solids
241-SY-102	Sludge (Liquids)	Z (Liquid)	1.36	2000 Core Liquid Composite	63.2	2000 Core Liquid Composite
241-SY-102	Sludge (Solids)	Z (Solid)	1.65	2000 Lower core segment	41.3	2000 Core solid composite - Z sludge
241-SY-102	Supernatant	NA	1.28	Supernatant as of 4-1-2003	63.8	Supernatant as of 4-1-2003
241-SY-103	Salt Cake	S2-SltSlr (Solid)	1.61	2000 Solid Composite	36.5	2000 Solid Composite
241-SY-103	Supernatant	S2-SltSlr (Liquid)	1.47	2000 Liquid composite	43.2	2000 Liquid composite
241-T-101	Salt Cake (Liquids)	T2-SltCk (Liquid)	1.47	T2SltCk Liquid Template	51.2	T2SltCk Liquid Template
241-T-101	Salt Cake (Solids)	T2-SltCk (Solid)	1.67	T2 SltCk Solid Template	27.6	T2 SltCk Solid Template
241-T-101	Sludge	CWR2 (Solid)	1.62	CWR1 Sludge Template	22.6	CWR1 Sludge Template
241-T-102	Sludge	CWP2 (Solid)	1.79	T-102 1993 Core Solids	28.1	T-102 1993 Core Solids
241-T-102	Sludge	MW (Solid)	1.78	MW Sludge Template	22.3	MW Sludge Template
241-T-102	Supernatant	CSR (Liquid)	1.14	Mean Supernatant Concentration in 1994	79.8	Mean Supernatant Concentration in 1994
241-T-103	Sludge	CWP2 (Solid)	1.71	CWP2 Sludge Template	29.3	CWP2 Sludge Template
241-T-103	Sludge	CWR1 (Solid)	1.62	CWR1 Sludge Template	22.6	CWR1 Sludge Template
241-T-103	Sludge	MW (Solid)	1.78	MW Sludge Template	22.3	MW Sludge Template
241-T-103	Supernatant	BL (Liquid)	1.00	T-103 1996 Supernate Grab Sample	71.6	T-103 1996 Supernate Grab Sample
241-T-103	Supernatant	CSR (Liquid)	1.00	T-103 1996 Supernate Grab Sample	71.6	T-103 1996 Supernate Grab Sample
241-T-104	Sludge	1C (Solid)	1.29	T-104 Sludge 1992 Core Composites	70.5	T-104 Sludge 1992 Core Composites
241-T-105	Sludge	1C (Solid)	1.32	1993/1997 Upper Sludge Segments	61.8	1993/1997 Upper Sludge Segments
241-T-105	Sludge	2C (Solid)	1.51	1993/1997 lower sludge means	53.5	1993/1997 lower sludge means

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Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-T-105	Sludge	CWR1 (Solid)	1.32	1993/1997 Upper Sludge Segments	61.8	1993/1997 Upper Sludge Segments
241-T-105	Sludge	R1 (Solid)	1.32	1993/1997 Upper Sludge Segments	61.8	1993/1997 Upper Sludge Segments
241-T-106	Sludge	1C (Solid)	1.41	1995 Auger Sample	16.7	1995 Auger Sample
241-T-106	Sludge	CWR1 (Solid)	1.41	1995 Auger Sample	16.7	1995 Auger Sample
241-T-107	Sludge	1C (Solid)	1.56	1992/1993 Segment Solids	45.2	1992/1993 Segment Solids
241-T-107	Sludge	CWP2 (Solid)	1.56	1992/1993 Segment Solids	45.2	1992/1993 Segment Solids
241-T-107	Sludge	TBP (Solid)	1.56	1992/1993 Segment Solids	45.2	1992/1993 Segment Solids
241-T-108	Salt Cake (Liquids)	T1-SltCk (Liquid)	1.18	T1-SltCk Liquid Template	68.9	T1-SltCk Liquid Template
241-T-108	Salt Cake (Solids)	T1-SltCk (Solid)	1.55	1995 Auger Sample Solids	15.1	1995 Auger Sample Solids
241-T-108	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-T-109	Salt Cake (Liquids)	T1-SltCk (Liquid)	1.18	T1-SltCk Liquid Template	68.9	T1-SltCk Liquid Template
241-T-109	Salt Cake (Solids)	T1-SltCk (Solid)	1.55	T-109 1995 Auger Means	47.9	T-109 1995 Auger Means
241-T-110	Sludge	224 Post-1949 (Solid)	1.25	1996 segment solids means	75.5	1996 segment solids means
241-T-110	Sludge	2C (Solid)	1.25	1996 segment solids means	75.5	1996 segment solids means
241-T-110	Supernatant	2C1 (Liquid)	1.05	1997 Liquid Grab Means	86.8	1997 Liquid Grab Means
241-T-111	Sludge	224 Post-1949 (Solid)	1.24	1991 segment solids means	75.3	1991 segment solids means
241-T-111	Sludge	2C (Solid)	1.24	1991 segment solids means	75.3	1991 segment solids means
241-T-112	Sludge	224 Post-1949 (Solid)	1.28	1997 segment solids means	73.9	1997 segment solids means
241-T-112	Sludge	2C (Solid)	1.28	1997 segment solids means	73.9	1997 segment solids means
241-T-112	Supernatant	2C2 (Liquid)	1.10	1997 segment liquid means	85.1	1997 segment liquid means
241-T-201	Sludge	224 Pre-1949 (Solid)	1.31	241-T-201 1997 core segment solids	67.5	241-T-201 1997 core segment solids
241-T-201	Supernatant	224 (Liquid)	1.06	241-T-201 1997 core drainable liquid	91.2	241-T-201 1997 core drainable liquid
241-T-202	Sludge	224 Post-1949 (Solid)	1.18	T-202 1997 core solids segment level	75.8	T-202 1997 core solids segment level
241-T-203	Sludge	224 Post-1949 (Solid)	1.22	T-203 1997 core solids segment mean	76.2	T-203 1997 core solids segment mean
241-T-204	Sludge	224 Post-1949 (Solid)	1.18	T-204 1997 core solids segment mean	75.0	T-204 1997 core solids segment mean
241-TX-101	Salt Cake (Liquids)	T2-SltCk (Liquid)	1.47	T2SltCk Liquid Template	51.2	T2SltCk Liquid Template
241-TX-101	Salt Cake (Solids)	T2-SltCk (Solid)	1.67	T2 SltCk Solid Template	27.6	T2 SltCk Solid Template
241-TX-101	Sludge	MW (Solid)	1.78	MW Sludge Template	22.3	MW Sludge Template
241-TX-101	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-TX-101	Sludge	Z (Solid)	1.72	Z Solids Template	28.6	Z Solids Template
241-TX-102	Salt Cake (Liquids)	T2-SltCk (Liquid)	1.47	T2SltCk Liquid Template	51.2	T2SltCk Liquid Template
241-TX-102	Salt Cake (Solids)	T2-SltCk (Solid)	1.67	T2 SltCk Solid Template	27.6	T2 SltCk Solid Template
241-TX-102	Sludge	MW (Solid)	1.78	MW Sludge Template	22.3	MW Sludge Template
241-TX-103	Salt Cake (Liquids)	T1-SltCk (Liquid)	1.18	T1-SltCk Liquid Template	68.9	T1-SltCk Liquid Template
241-TX-103	Salt Cake (Liquids)	T2-SltCk (Liquid)	1.47	T2SltCk Liquid Template	51.2	T2SltCk Liquid Template
241-TX-103	Salt Cake (Solids)	T1-SltCk (Solid)	1.55	T1 SltCk Solid Template	22.5	T1 SltCk Solid Template
241-TX-103	Salt Cake (Solids)	T2-SltCk (Solid)	1.67	T2 SltCk Solid Template	27.6	T2 SltCk Solid Template
241-TX-104	Salt Cake (Liquids)	T2-SltCk (Liquid)	1.44	TX-104 1998 Core Drainable Liquid Means	51.9	TX-104 1998 Core Drainable Liquid Means
241-TX-104	Salt Cake (Solids)	T2-SltCk (Solid)	1.62	TX-104 1998 Saltcake Means	45.2	TX-104 1998 Saltcake Means
241-TX-104	Sludge	R1 (Solid)	1.89	TX-104 1998 Sludge Means	44.6	TX-104 1998 Sludge Means

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Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-TX-104	Supernatant	T2-SitCk (Liquid)	1.44	TX-104 1998 Core Drainable Liquid Means	51.9	TX-104 1998 Core Drainable Liquid Means
241-TX-105	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2SitCk Liquid Template	51.2	T2SitCk Liquid Template
241-TX-105	Salt Cake (Solids)	T2-SitCk (Solid)	1.67	T2 SitCk Solid Template	27.6	T2 SitCk Solid Template
241-TX-105	Sludge	MW (Solid)	1.78	MW Sludge Template	22.3	MW Sludge Template
241-TX-106	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2SitCk Liquid Template	51.2	T2SitCk Liquid Template
241-TX-106	Salt Cake (Solids)	T2-SitCk (Solid)	1.67	T2 SitCk Solid Template	27.6	T2 SitCk Solid Template
241-TX-106	Sludge	MW (Solid)	1.78	MW Sludge Template	22.3	MW Sludge Template
241-TX-106	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-TX-107	Salt Cake (Liquids)	R-SitCk (Liquid)	1.45	RSitCk Liquid Template	54.4	RSitCk Liquid Template
241-TX-107	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2SitCk Liquid Template	51.2	T2SitCk Liquid Template
241-TX-107	Salt Cake (Solids)	R-SitCk (Solid)	1.72	RSitCk Solid Template	28.9	RSitCk Solid Template
241-TX-107	Salt Cake (Solids)	T2-SitCk (Solid)	1.94	T2-SitCk 1996 Auger Sample	22.2	T2-SitCk 1996 Auger Sample
241-TX-108	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2SitCk Liquid Template	51.2	T2SitCk Liquid Template
241-TX-108	Salt Cake (Solids)	T2-SitCk (Solid)	1.67	T2 SitCk Solid Template	27.6	T2 SitCk Solid Template
241-TX-108	Sludge	MW (Solid)	1.78	MW Sludge Template	22.3	MW Sludge Template
241-TX-108	Sludge	TBP (Solid)	1.51	TBP Sludge Template	44.9	TBP Sludge Template
241-TX-109	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-TX-110	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2SitCk Liquid Template	51.2	T2SitCk Liquid Template
241-TX-110	Salt Cake (Solids)	T2-SitCk (Solid)	1.67	T2 SitCk Solid Template	27.6	T2 SitCk Solid Template
241-TX-110	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-TX-111	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2SitCk Liquid Template	51.2	T2SitCk Liquid Template
241-TX-111	Salt Cake (Solids)	T2-SitCk (Solid)	1.67	T2 SitCk Solid Template	27.6	T2 SitCk Solid Template
241-TX-111	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-TX-112	Salt Cake (Liquids)	T1-SitCk (Liquid)	1.18	T1-SitCk Liquid Template	68.9	T1-SitCk Liquid Template
241-TX-112	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2SitCk Liquid Template	51.2	T2SitCk Liquid Template
241-TX-112	Salt Cake (Solids)	T1-SitCk (Solid)	1.55	T1 SitCk Solid Template	22.5	T1 SitCk Solid Template
241-TX-112	Salt Cake (Solids)	T2-SitCk (Solid)	1.67	T2 SitCk Solid Template	27.6	T2 SitCk Solid Template
241-TX-113	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2SitCk Liquid Template	51.2	T2SitCk Liquid Template
241-TX-113	Salt Cake (Solids)	T2-SitCk (Solid)	1.67	TX-113 1999 segment core weighted means	9.4	TX-113 1999 segment core weighted means
241-TX-113	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-TX-114	Salt Cake (Liquids)	T1-SitCk (Liquid)	1.18	T1-SitCk Liquid Template	68.9	T1-SitCk Liquid Template
241-TX-114	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2SitCk Liquid Template	51.2	T2SitCk Liquid Template
241-TX-114	Salt Cake (Solids)	T1-SitCk (Solid)	1.55	T1 SitCk Solid Template	22.5	T1 SitCk Solid Template
241-TX-114	Salt Cake (Solids)	T2-SitCk (Solid)	1.67	T2 SitCk Solid Template	27.6	T2 SitCk Solid Template
241-TX-114	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-TX-115	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2SitCk Liquid Template	51.2	T2SitCk Liquid Template
241-TX-115	Salt Cake (Solids)	T2-SitCk (Solid)	1.67	T2 SitCk Solid Template	27.6	T2 SitCk Solid Template
241-TX-115	Sludge	TBP (Solid)	1.51	TBP Sludge Template	44.9	TBP Sludge Template
241-TX-116	Salt Cake (Liquids)	T1-SitCk (Liquid)	1.39	Based on 1981 analysis of saltwell liquid	53.0	Based on 1981 analysis of saltwell liquid
241-TX-116	Salt Cake (Solids)	T1-SitCk (Solid)	1.55	1976 Core T1 SitCk PK Vector	7.4	1976 Core T1 SitCk PK Vector

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Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-TX-116	Salt Cake (Solids)	T2-SitCk (Solid)	1.67	1976 Core T2-SitCk PK (Si Free Basis)	28.4	1976 Core T2-SitCk PK (Si Free Basis)
241-TX-116	Sludge	DE (Solid)	1.60	Special calculation to combine Interstitial an	38.8	Special calculation to combine interstitial and solid
241-TX-117	Salt Cake (Liquids)	T1-SitCk (Liquid)	1.18	T1-SitCk Liquid Template	68.9	T1-SitCk Liquid Template
241-TX-117	Salt Cake (Solids)	T1-SitCk (Solid)	1.55	T1-SitCk Solid Template	22.5	T1-SitCk Solid Template
241-TX-117	Salt Cake (Solids)	T2-SitCk (Solid)	1.67	T2-SitCk Solid Template	27.6	T2-SitCk Solid Template
241-TX-117	Sludge	DE (Solid)	0.38	Diatomaceous Earth	0.0	Assume completely dry based on photos showing
241-TX-118	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2-SitCk Liquid Template	51.2	T2-SitCk Liquid Template
241-TX-118	Salt Cake (Solids)	(null)	1.57	1999 Mean Conc Upper SitCk Seg solids	43.8	1999 Mean Conc Upper SitCk Seg solids
241-TX-118	Salt Cake (Solids)	T2-SitCk (Solid)	1.79	1999 Mean Conc Lower SitCk Seg Solids	44.9	1999 Mean Conc Lower SitCk Seg Solids
241-TY-101	Salt Cake (Liquids)	T1-SitCk (Liquid)	1.18	T1-SitCk Liquid Template	68.9	T1-SitCk Liquid Template
241-TY-101	Salt Cake (Solids)	T1-SitCk (Solid)	1.64	Core 1 composite	43.5	Core 1 composite
241-TY-101	Sludge	1CFeCN (Solid)	1.64	Core 1 composite	43.5	Core 1 composite
241-TY-102	Salt Cake (Liquids)	T1-SitCk (Liquid)	1.18	T1-SitCk Liquid Template	68.9	T1-SitCk Liquid Template
241-TY-102	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2-SitCk Liquid Template	51.2	T2-SitCk Liquid Template
241-TY-102	Salt Cake (Solids)	T1-SitCk (Solid)	1.88	1985 core sample concentrations	22.5	T1-SitCk Solid Template
241-TY-102	Salt Cake (Solids)	T2-SitCk (Solid)	1.88	1985 core sample concentrations	27.6	T2-SitCk Solid Template
241-TY-103	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.47	T2-SitCk Liquid Template	51.2	T2-SitCk Liquid Template
241-TY-103	Salt Cake (Solids)	T2-SitCk (Solid)	1.70	Solids	51.8	Solids
241-TY-103	Sludge	1CFeCN (Solid)	1.70	Solids	51.8	Solids
241-TY-103	Sludge	TBP (Solid)	1.70	Solids	51.8	Solids
241-TY-104	Sludge	1CFeCN (Solid)	1.69	Based on 1985 sample event	51.9	TY-104 1995 Auger Sample
241-TY-104	Sludge	TBP (Solid)	1.69	Based on 1985 sample event	51.9	TY-104 1995 Auger Sample
241-TY-104	Supernatant	DW (Liquid)	1.18	1985 Drainable Liquid Mean	77.5	1985 Drainable Liquid Mean
241-TY-105	Sludge	TBP (Solid)	1.53	1986 Core Sample Sludge Concentration	39.4	1986 Core Sample Sludge Concentration
241-TY-106	Sludge	DE (Solid)	1.40	2002 archive analysis of 1995 augers	38.1	2002 archive analysis of 1995 augers
241-TY-106	Sludge	TBP (Solid)	1.40	2002 archive analysis of 1995 augers	38.1	2002 archive analysis of 1995 augers
241-U-101	Sludge	R1 (Solid)	1.75	1996 Solid Grab Samples	29.8	1996 Solid Grab Samples
241-U-102	Salt Cake (Liquids)	T2-SitCk (Liquid)	1.48	1999 Liquid Grab Means	47.5	1999 Liquid Grab Means
241-U-102	Salt Cake (Solids)	S2-SitSir (Solid)	1.68	1996 Core Solids Means	34.7	1996 Core Solids Means
241-U-102	Salt Cake (Solids)	T2-SitCk (Solid)	1.68	1996 Core Solids Means	34.7	1996 Core Solids Means
241-U-102	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-U-102	Supernatant	T2-SitCk (Liquid)	1.48	1999 Liquid Grab Means	47.5	1999 Liquid Grab Means
241-U-103	Salt Cake (Liquids)	S1-SitCk (Liquid)	1.44	1999 liquid grab means	49.9	1999 liquid grab means
241-U-103	Salt Cake (Solids)	S1-SitCk (Solid)	1.72	1996/97 segment saltcake means	38.4	1996/97 segment saltcake means
241-U-103	Salt Cake (Solids)	S2-SitSir (Solid)	1.72	1996/97 segment saltcake means	38.4	1996/97 segment saltcake means
241-U-103	Sludge	R1 (Solid)	1.90	1996/97 Core Solids (Sludge)	47.4	1996/97 Core Solids (Sludge)
241-U-103	Supernatant	S1-SitCk (Liquid)	1.44	1999 liquid grab means	49.9	1999 liquid grab means
241-U-104	Sludge	DE (Solid)	1.40	Special calculation to combine DE solids an	50.7	Special calculation to combine DE solids & IL info
241-U-104	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-U-105	Salt Cake (Liquids)	S2-SitSir (Liquid)	1.46	1999 Grab Liquid Mean	51.6	1999 Grab Liquid Mean

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Best Basis Inventory - Density and Weight Percent Water
By Tank, Waste Phase, and Waste Type

waste_site_id	waste_phase	waste_type	Density	Density Source	Water conc (wt%)	wt% Water Source
241-U-105	Salt Cake (Liquids)	T2-SltCk (Liquid)	1.46	1999 Grab Liquid Mean	51.6	1999 Grab Liquid Mean
241-U-105	Salt Cake (Solids)	S2-SltSr (Solid)	1.70	1996 Core Saltcake Solids Segment Mean	28.4	1996 Core Saltcake Solids Segment Mean
241-U-105	Salt Cake (Solids)	T2-SltCk (Solid)	1.70	1996 Core Saltcake Solids Segment Mean	28.4	1996 Core Saltcake Solids Segment Mean
241-U-105	Sludge	CWR1 (Solid)	1.70	1996 Core Sludge Solids Segment Mean	22.4	1996 Core Sludge Solids Segment Mean
241-U-106	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.34	1996 core liquid means	48.6	1996 core liquid means
241-U-106	Salt Cake (Solids)	S1-SltCk (Solid)	1.62	1996 core segment saltcake means	39.8	1996 core segment saltcake means
241-U-106	Supernatant	S1-SltCk (Liquid)	1.34	1996 core liquid means	48.6	1996 core liquid means
241-U-107	Salt Cake (Liquids)	S2-SltSr (Liquid)	1.43	Nov 2002 grab sample means	49.6	1998 mean segment liquid
241-U-107	Salt Cake (Liquids)	T2-SltCk (Liquid)	1.43	Nov 2002 grab sample means	49.6	1998 mean segment liquid
241-U-107	Salt Cake (Solids)	S2-SltSr (Solid)	1.77	1998 mean segment solids	31.5	1998 mean segment solids
241-U-107	Salt Cake (Solids)	T2-SltCk (Solid)	1.77	1998 mean segment solids	31.5	1998 mean segment solids
241-U-107	Sludge	CWR1 (Solid)	1.62	CWR1 Sludge Template	22.6	CWR1 Sludge Template
241-U-108	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.40	1996 Core Liquid Segment Mean	49.9	1996 Core Liquid Segment Mean
241-U-108	Salt Cake (Liquids)	S2-SltSr (Liquid)	1.40	1996 Core Liquid Segment Mean	49.9	1996 Core Liquid Segment Mean
241-U-108	Salt Cake (Solids)	S1-SltCk (Solid)	1.73	1996 Core Solid Segment Mean	34.7	1996 Core Solid Segment Mean
241-U-108	Salt Cake (Solids)	S2-SltSr (Solid)	1.73	1996 Core Solid Segment Mean	34.7	1996 Core Solid Segment Mean
241-U-108	Sludge	CWR2 (Solid)	1.66	CWR2 Solids Template	47.9	CWR2 Solids Template
241-U-109	Salt Cake (Liquids)	S1-SltCk (Liquid)	1.47	1998 Push Core Liquid Mean Conc.	50.7	1998 Push Core Liquid Mean Conc.
241-U-109	Salt Cake (Solids)	S1-SltCk (Solid)	1.67	1995-98 Push Core Solid Saltcake Mean	27.0	1995-98 Push Core Solid Saltcake Mean
241-U-109	Salt Cake (Solids)	S2-SltSr (Solid)	1.67	1995-98 Push Core Solid Saltcake Mean	27.0	1995-98 Push Core Solid Saltcake Mean
241-U-109	Sludge	CWR1 (Solid)	1.71	1995/98 Push Core Solid Sludge Mean	22.7	1995/98 Push Core Solid Sludge Mean
241-U-110	Sludge	1C (Solid)	1.41	1989 segment 4 solids means	39.7	1989 segment 4 solids means
241-U-110	Sludge	CWR1 (Solid)	1.62	1989 segment 1 solids means	3.1	1989 segment 1 solids means
241-U-110	Sludge	R1 (Solid)	1.75	1989 segments 2 and 3 solids means	38.8	1989 segments 2 and 3 solids means
241-U-111	Salt Cake (Solids)	S1-SltCk (Solid)	1.65	S1-SltCk Solid Template	32.4	S1-SltCk Solid Template
241-U-111	Salt Cake (Solids)	S2-SltSr (Solid)	1.59	S2-SltSr Solid Template	34.1	S2-SltSr Solid Template
241-U-111	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-U-111	Sludge	R1 (Solid)	1.75	R1 Sludge Template	24.8	R1 Sludge Template
241-U-112	Sludge	1C (Solid)	1.41	1C Sludge Template	57.5	1C Sludge Template
241-U-112	Sludge	CWR1 (Solid)	1.86	1997 core segment solid means	26.0	1997 core segment solid means
241-U-112	Sludge	R1 (Solid)	1.86	1997 core segment solid means	26.0	1997 core segment solid means
241-U-201	Sludge (Solids)	CWR1 (Solid)	1.63	2002 archive analysis sludge average	27.1	1995 sample info - S/U201/003 is corrected to this
241-U-201	Supernatant	CWR1 (Liquid)	1.26	2002 archive liquid composite	69.3	2002 archive liquid composite
241-U-202	Sludge	CWR1 (Solid)	1.51	2002 Solids archive analysis cores 75 78	27.8	1995 sample info - S/U202/004 is corrected to this
241-U-202	Supernatant	CWR1 (Liquid)	1.28	2002 archive analysis cores 75 and 78	69.1	2002 archive analysis cores 75 and 78
241-U-203	Sludge	CWR1 (Solid)	1.59	U203 1995 mean segment solids	40.2	U203 1995 mean segment solids
241-U-203	Supernatant	CWR1 (Liquid)	1.28	2002 archive analysis core 79, segment 1	68.7	2002 archive analysis core 79, segment 1
241-U-204	Sludge	CWR1 (Solid)	1.47	U-204 1995 mean segment solids	26.2	U-204 1995 mean segment solids
241-U-204	Supernatant	CWR1 (Liquid)	1.11	1995 mean segment liquid	86.7	1995 mean segment liquid

7G410-03-KMB-001

Attachment 2

**BEST BASIS INVENTORY WATER AND DENSITY ESTIMATES NEEDING
ADDITIONAL EVALUATION**

Consisting of 2 pages,
including coversheet

**Table 2 – Best Basis Inventory Water and Density Estimates
Needing Additional Evaluation**

Tank	BBI Text	Analysis	Vector Affected	Discussion
241-A-102	33 wt%	34.4 wt%	S/A102/002	Text uses wrong water value. Multipliers calculated from incorrect water value.
241-A-106				No multipliers are used to scale template values to sample data. Evaluate need.
241-AP-101				Discussion need added to BBI text to address wt% water calculation
241-AP-102				Discussion need added to BBI text to address wt% water calculation
241-B-110	1.35 g/mL	1.31 g/mL	S/B110/005	Density doesn't match M&CI. Vector is a composite, not a segment mean as identified in the title. The text needs clarified Core 9 Segment Means are actually the composite results for sampling in November 1989. There is data for an earlier 1989 sampling (including another core identified as Core 9) available in the hardcopy TCR. The text is not clear as to which core 9 data is used.
241-BX-105			S/BX105/003	Wt% water from auger sample seems very low compared to previous data. Needs evaluated
241-S-104	55.9 wt%	55.1 wt%	S/S104/007	Text uses wrong water value. Multipliers calculated from incorrect water value.
241-SX-108			S/SX108/003	Wt% water from auger sample seems very low compared to template. Needs evaluated. ¹
241-TY-103	51.2 wt%	51.8 wt%	P/TY103/002	Text uses wrong water value. Multipliers calculated from incorrect water value.
241-TY-104	1.69 g/mL	1.65 g/mL	S/TY102/002 P/TY104/002	Both vectors use density from 1985 sample. Evaluate how averaging was done for 1985 results. Straight average of all results vs average 2 cores from same riser prior to average with other cores.
241-U-204	86.7 wt%	87 wt%		Text and multipliers use the 1995 core data instead of the 2002 analysis 'preferred' vector. No exception is noted.

¹BX-108, C-101, SX-113, T106, and T-108 may have similar problems with wt% water measurements associated with auger samples (differ radically from template values).

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Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-A-101	Total		1379	1.65E+04	3.26E+05	1.79E+05	6.05E+04	1.74E+05	4.35E+05
241-A-101	Sludge	P2 (Solid)	11	0.00E+00	9.27E+02	3.63E+01	2.95E+03	8.80E+04	1.68E+03
241-A-101	Salt Cake (Solids)	A1-SltCk (Solid)	1130	1.56E+04	2.69E+05	1.39E+05	4.52E+04	8.55E+04	3.44E+05
241-A-101	Salt Cake (Liquids)	A1-SltCk (Liquid)	238	8.92E+02	5.55E+04	3.93E+04	1.23E+04	1.78E+01	8.89E+04
241-A-102	Total		150	2.56E+03	2.19E+04	1.51E+04	1.29E+04	8.71E+04	4.38E+04
241-A-102	Supernatant	A1-SltCk (Liquid)	11	1.37E-04	1.42E+03	2.18E+01	1.80E+03	1.32E+01	5.85E+03
241-A-102	Salt Cake (Solids)	A1-SltCk (Solid)	106	2.56E+03	1.63E+04	1.50E+04	5.71E+03	8.71E+04	2.04E+04
241-A-102	Salt Cake (Liquids)	A1-SltCk (Liquid)	33	4.13E-04	4.26E+03	6.53E+01	5.41E+03	3.95E+01	1.75E+04
241-A-103	Total		1405	1.39E+04	2.29E+05	1.52E+05	4.43E+04	1.23E+05	3.10E+05
241-A-103	Supernatant	A1-SltCk (Liquid)	17	1.34E+02	3.26E+03	1.63E+03	9.89E+02	3.37E+01	4.67E+03
241-A-103	Sludge	AR (Solid)	8	0.00E+00	8.05E-07	2.35E+02	1.53E+01	7.34E+04	5.70E+03
241-A-103	Salt Cake (Solids)	A1-SltCk (Solid)	1035	1.10E+04	1.59E+05	1.17E+05	2.32E+04	4.89E+04	2.05E+05
241-A-103	Salt Cake (Liquids)	A1-SltCk (Liquid)	345	2.72E+03	6.62E+04	3.30E+04	2.01E+04	6.84E+02	9.47E+04
241-A-104	Total		106	0.00E+00	4.10E+02	3.01E+03	8.07E+03	2.49E+06	6.63E+04
241-A-104	Sludge	AR (Solid)	102	0.00E+00	1.03E-05	3.00E+03	7.76E+03	2.39E+06	6.38E+04
241-A-104	Sludge	P1 (Solid)	4	0.00E+00	4.10E+02	1.60E+01	3.04E+02	9.38E+04	2.50E+03
241-A-105	Total		139	0.00E+00	1.42E+04	5.57E+02	8.28E+03	3.12E+06	1.15E+05
241-A-105	Sludge	P2 (Solid)	139	0.00E+00	1.42E+04	5.57E+02	8.28E+03	3.12E+06	1.15E+05
241-A-106	Total		299	4.31E+03	5.03E+04	4.23E+04	1.47E+04	5.28E+05	6.88E+04
241-A-106	Sludge	AR (Solid)	79	1.14E+03	1.33E+04	1.12E+04	3.87E+03	1.40E+05	1.82E+04
241-A-106	Sludge	SRR (Solid)	110	1.59E+03	1.85E+04	1.56E+04	5.39E+03	1.94E+05	2.53E+04
241-A-106	Salt Cake (Solids)	A1-SltCk (Solid)	110	1.59E+03	1.85E+04	1.56E+04	5.39E+03	1.94E+05	2.53E+04
241-AN-101	Total		956	1.37E+03	1.12E+05	9.23E+04	1.54E+04	5.49E+01	1.11E+05
241-AN-101	Supernatant		956	1.37E+03	1.12E+05	9.23E+04	1.54E+04	5.49E+01	1.11E+05
241-AN-102	Total		4080	1.04E+05	8.32E+05	3.84E+05	7.59E+04	3.99E+05	1.66E+06
241-AN-102	Supernatant		3573	8.49E+04	7.12E+05	3.37E+05	6.42E+04	2.97E+05	1.46E+06
241-AN-102	Salt Cake	A2-SltSlr (Solid)	339	1.24E+04	9.10E+04	3.29E+04	4.96E+03	2.58E+04	5.93E+04
241-AN-102	Salt Cake	A2-SltSlr (Solid)	168	7.12E+03	2.98E+04	1.45E+04	6.77E+03	7.63E+04	1.47E+05
241-AN-103	Total		3419	1.05E+04	6.50E+05	4.30E+05	2.18E+05	6.32E+03	1.86E+06
241-AN-103	Supernatant	A2-SltSlr (Liquid)	1890	5.76E+03	2.43E+05	2.46E+05	5.66E+04	3.60E+01	1.28E+06
241-AN-103	Salt Cake	A2-SltSlr (Solid)	1529	4.76E+03	4.07E+05	1.84E+05	1.61E+05	6.29E+03	5.79E+05
241-AN-104	Total		3865	1.93E+04	7.32E+05	4.32E+05	1.41E+05	7.72E+04	2.01E+06
241-AN-104	Supernatant	A2-SltSlr (Liquid)	2299	7.22E+03	4.36E+05	2.74E+05	8.96E+04	2.03E+02	1.21E+06
241-AN-104	Salt Cake	A2-SltSlr (Solid)	1566	1.20E+04	2.96E+05	1.58E+05	5.13E+04	7.70E+04	8.01E+05
241-AN-105	Total		4152	2.23E+04	6.91E+05	4.59E+05	1.60E+05	3.10E+04	1.51E+06
241-AN-105	Supernatant	A2-SltSlr (Liquid)	2227	6.15E+03	3.48E+05	2.64E+05	9.28E+04	8.32E+01	6.98E+05
241-AN-105	Salt Cake	A2-SltSlr (Solid)	1925	1.62E+04	3.43E+05	1.94E+05	6.76E+04	3.09E+04	8.10E+05
241-AN-106	Total		622	3.93E+03	1.72E+04	1.87E+04	2.79E+03	5.38E+03	4.02E+04
241-AN-106	Supernatant	NA	557	3.08E+03	6.26E+03	9.95E+03	3.13E+02	1.82E+03	2.49E+04
241-AN-106	Salt Cake	NA	65	8.47E+02	1.10E+04	8.76E+03	2.48E+03	3.56E+03	1.53E+04
241-AN-107	Total		4093	1.54E+05	8.35E+05	2.72E+05	2.36E+04	5.30E+05	1.38E+06
241-AN-107	Supernatant	A2-SltSlr (Liquid)	3209	1.07E+05	6.90E+05	2.20E+05	3.71E+03	2.99E+05	1.05E+06
241-AN-107	Salt Cake	A2-SltSlr (Solid)	884	4.70E+04	1.45E+05	5.14E+04	1.99E+04	2.31E+05	3.23E+05
241-AP-101	Total		4216	8.26E+03	5.57E+05	1.77E+05	2.93E+04	3.62E+02	5.97E+05
241-AP-101	Supernatant		4216	8.26E+03	5.57E+05	1.77E+05	2.93E+04	3.62E+02	5.97E+05

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-AP-102	Total		694	9.58E+02	4.78E+04	3.22E+04	2.50E+04	1.41E+02	7.73E+04
241-AP-102	Supernatant		606	7.42E+02	4.02E+04	2.75E+04	9.30E+03	7.96E+01	6.39E+04
241-AP-102	Sludge		88	2.16E+02	7.58E+03	4.67E+03	1.57E+04	6.10E+01	1.34E+04
241-AP-103	Total		3389	2.46E+04	5.05E+05	2.72E+05	6.20E+04	8.78E+03	8.30E+05
241-AP-103	Supernatant		3389	2.46E+04	5.05E+05	2.72E+05	6.20E+04	8.78E+03	8.30E+05
241-AP-104	Total		4195	1.92E+04	4.77E+05	3.03E+05	6.11E+04	7.76E+03	8.94E+05
241-AP-104	Supernatant		4195	1.92E+04	4.77E+05	3.03E+05	6.11E+04	7.76E+03	8.94E+05
241-AP-105	Total		4282	1.44E+04	5.46E+05	2.15E+05	9.24E+04	2.70E+04	8.71E+05
241-AP-105	Supernatant	A2-SltSlr (Liquid)	3945	1.14E+04	4.83E+05	1.99E+05	8.77E+04	1.09E+04	8.02E+05
241-AP-105	Salt Cake	A2-SltSlr (Solid)	337	2.94E+03	6.31E+04	1.62E+04	4.73E+03	1.62E+04	6.93E+04
241-AP-106	Total		4312	1.49E+04	3.04E+05	1.78E+05	5.81E+04	5.51E+03	8.07E+05
241-AP-106	Supernatant		4312	1.49E+04	3.04E+05	1.78E+05	5.81E+04	5.51E+03	8.07E+05
241-AP-107	Total		882	2.05E+03	1.19E+05	7.79E+04	2.33E+04	2.53E+02	1.90E+05
241-AP-107	Supernatant		882	2.05E+03	1.19E+05	7.79E+04	2.33E+04	2.53E+02	1.90E+05
241-AP-108	Total		4313	1.06E+04	4.83E+05	3.15E+05	9.68E+04	3.25E+03	7.88E+05
241-AP-108	Supernatant		4313	1.06E+04	4.83E+05	3.15E+05	9.68E+04	3.25E+03	7.88E+05
241-AW-101	Total		4171	2.43E+04	8.16E+05	4.62E+05	1.24E+05	8.93E+04	1.72E+06
241-AW-101	Supernatant	A2-SltSlr (Liquid)	2768	1.11E+04	4.71E+05	3.32E+05	9.11E+04	1.11E+03	1.21E+06
241-AW-101	Salt Cake	A2-SltSlr (Solid)	1403	1.32E+04	3.46E+05	1.30E+05	3.34E+04	8.82E+04	5.09E+05
241-AW-102	Total		320	1.03E+03	1.18E+04	8.10E+03	2.56E+04	8.72E+04	2.79E+04
241-AW-102	Supernatant		207	1.73E+02	1.04E+04	6.79E+03	2.01E+03	1.53E+01	1.65E+04
241-AW-102	Sludge	CWP1 (Solid)	113	8.53E+02	1.38E+03	1.30E+03	2.36E+04	8.72E+04	1.14E+04
241-AW-103	Total		4170	1.06E+04	4.51E+05	1.57E+05	4.81E+04	1.37E+04	4.17E+05
241-AW-103	Supernatant		2986	6.36E+03	3.70E+05	1.19E+05	3.52E+04	3.94E+02	3.76E+05
241-AW-103	Sludge	CWZr2 (Solid)	1033	1.89E+03	4.22E+04	2.01E+04	3.59E+03	1.16E+04	3.56E+04
241-AW-103	Salt Cake	A1-SltCk (Solid)	151	2.31E+03	3.88E+04	1.86E+04	9.26E+03	1.70E+03	5.20E+03
241-AW-104	Total		4067	2.27E+04	5.48E+05	3.48E+05	1.11E+05	1.07E+04	1.04E+06
241-AW-104	Supernatant		3224	1.39E+04	4.55E+05	2.84E+05	8.70E+04	5.65E+03	8.23E+05
241-AW-104	Sludge (Solids)	PL2 (Solid)	188	2.84E+03	1.02E+04	5.82E+03	2.57E+03	0.00E+00	0.00E+00
241-AW-104	Sludge (Liquids)	PL2 (Liquid)	62	9.33E+02	4.38E+03	2.72E+03	8.37E+02	1.08E+03	1.31E+04
241-AW-104	Salt Cake (Solids)	A2-SltSlr (Solid)	457	4.51E+03	5.97E+04	4.17E+04	1.46E+04	6.00E+02	1.63E+05
241-AW-104	Salt Cake (Liquids)	A2-SltSlr (Liquid)	136	5.14E+02	1.89E+04	1.32E+04	5.67E+03	3.41E+03	4.14E+04
241-AW-105	Total		1611	5.13E+03	5.43E+04	1.33E+04	4.09E+03	3.54E+04	3.92E+04
241-AW-105	Supernatant		612	5.85E+02	1.54E+04	1.08E+03	6.04E+01	1.42E+01	6.37E+03
241-AW-105	Sludge (Solids)	CWZr2 (Solid)	660	2.66E+03	2.05E+04	6.28E+03	2.10E+03	8.09E+03	2.39E+04
241-AW-105	Sludge (Solids)	PL2 (Solid)	61	1.89E+03	2.89E+03	1.10E+03	1.49E+03	2.44E+04	5.46E+03
241-AW-105	Sludge (Liquids)	CWZr2 (Liquid)	266	0.00E+00	1.49E+04	4.55E+03	3.95E+02	2.94E+03	3.48E+03
241-AW-105	Sludge (Liquids)	PL2 (Liquid)	12	3.33E-03	6.15E+02	2.68E+02	4.93E+01	0.00E+00	0.00E+00
241-AW-106	Total		3652	2.14E+04	6.75E+05	4.58E+05	1.34E+05	5.09E+04	1.04E+06
241-AW-106	Supernatant		2748	9.63E+03	5.22E+05	3.36E+05	9.95E+04	1.31E+03	8.26E+05
241-AW-106	Salt Cake	A2-SltSlr (Solid)	904	1.18E+04	1.53E+05	1.22E+05	3.44E+04	4.96E+04	2.13E+05
241-AX-101	Total		1220	1.10E+04	3.01E+05	1.45E+05	4.52E+04	1.67E+05	3.89E+05
241-AX-101	Sludge	SRR (Solid)	11	5.78E+02	2.64E-04	2.82E+02	0.00E+00	8.90E+04	1.66E+03
241-AX-101	Salt Cake (Solids)	A1-SltCk (Solid)	1156	1.03E+04	2.86E+05	1.36E+05	4.26E+04	7.79E+04	3.68E+05
241-AX-101	Salt Cake (Liquids)	A1-SltCk (Liquid)	53	2.11E+02	1.44E+04	9.17E+03	2.67E+03	1.30E+01	1.94E+04

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-AX-102	Total		113	7.00E+03	2.97E+04	6.32E+03	3.80E+03	2.54E+05	2.90E+04
241-AX-102	Sludge	B (Solid)	23	3.67E+01	7.48E-04	6.61E+02	1.99E+03	2.18E+05	8.70E+03
241-AX-102	Salt Cake	A1-SltCk (Solid)	90	6.96E+03	2.97E+04	5.66E+03	1.80E+03	3.56E+04	2.03E+04
241-AX-103	Total		410	4.37E+03	6.47E+04	5.30E+04	1.52E+04	4.84E+05	1.12E+05
241-AX-103	Sludge	P2 (Solid)	30	0.00E+00	2.25E+03	1.21E+02	1.53E+03	4.67E+05	1.72E+04
241-AX-103	Salt Cake (Solids)	A1-SltCk (Solid)	285	2.14E+03	4.95E+04	4.27E+04	1.02E+04	1.48E+04	6.36E+04
241-AX-103	Salt Cake (Liquids)	A1-SltCk (Liquid)	95	2.24E+03	1.29E+04	1.02E+04	3.40E+03	2.58E+03	3.13E+04
241-AX-104	Total		28	0.00E+00	2.30E+03	1.13E+02	2.67E+03	2.21E+06	5.33E+04
241-AX-104	Sludge	P2 (Solid)	28	0.00E+00	2.30E+03	1.13E+02	2.67E+03	2.21E+06	5.33E+04
241-AY-101	Total		685	7.61E+03	3.59E+03	2.69E+04	3.66E+04	2.09E+06	8.60E+04
241-AY-101	Supernatant		320	4.38E+02	1.50E+03	1.09E+04	1.54E+03	3.24E+02	1.61E+04
241-AY-101	Sludge (Solids)		310	7.01E+03	1.71E+03	1.24E+04	3.50E+04	2.09E+06	6.47E+04
241-AY-101	Sludge (Liquids)		55	1.62E+02	3.71E+02	3.59E+03	2.91E+01	4.56E+01	5.17E+03
241-AY-102	Total		2711	6.59E+03	4.60E+02	9.81E+04	4.45E+04	5.00E+06	2.62E+05
241-AY-102	Supernatant	BL (Liquid)	2066	3.13E+03	3.73E+02	9.32E+04	2.95E+03	3.34E+03	6.01E+04
241-AY-102	Sludge (Solids)	BL (Solid)	407	2.95E+03	4.33E+01	2.52E+03	4.12E+04	4.99E+06	2.02E+05
241-AY-102	Sludge (Liquids)	BL (Liquid)	238	5.05E+02	4.33E+01	2.38E+03	2.93E+02	5.66E+03	0.00E+00
241-AZ-101	Total		3790	2.00E+03	2.27E+05	2.32E+05	4.21E+04	4.95E+06	5.99E+06
241-AZ-101	Supernatant	P3 (Liquid)	3593	1.09E+03	2.15E+05	2.19E+05	2.58E+04	3.03E+03	5.65E+06
241-AZ-101	Sludge (Solids)	P3 (Solid)	173	8.98E+02	1.03E+04	1.10E+04	1.61E+04	4.94E+06	2.98E+05
241-AZ-101	Sludge (Liquids)	P3 (Liquid)	24	8.05E+00	1.31E+03	1.63E+03	1.80E+02	2.24E+01	4.17E+04
241-AZ-102	Total		3750	4.46E+03	6.39E+04	1.26E+05	2.14E+04	2.99E+06	3.85E+06
241-AZ-102	Supernatant	P3 (Liquid)	3354	3.48E+03	5.70E+04	1.09E+05	1.46E+03	7.00E+03	3.35E+06
241-AZ-102	Sludge	P3 (Solid)	396	9.77E+02	6.87E+03	1.67E+04	1.99E+04	2.98E+06	4.92E+05
241-B-101	Total		411	9.41E+02	1.18E+05	3.31E+04	2.46E+04	9.58E+05	1.03E+04
241-B-101	Sludge	B (Solid)	19	5.32E+01	5.15E+03	1.31E+03	1.87E+03	3.98E+05	1.08E+03
241-B-101	Sludge	BL (Solid)	76	2.13E+02	2.06E+04	5.25E+03	7.28E+03	5.56E+05	0.00E+00
241-B-101	Sludge	MW (Solid)	11	3.08E+01	2.98E+03	7.60E+02	0.00E+00	1.64E+01	1.09E+03
241-B-101	Salt Cake (Solids)	B-SltCk (Solid)	230	6.44E+02	6.23E+04	1.59E+04	1.54E+04	6.64E+02	6.10E+03
241-B-101	Salt Cake (Liquids)	B-SltCk (Liquid)	75	7.29E-05	2.67E+04	9.86E+03	1.10E+02	2.69E+03	2.07E+03
241-B-102	Total		121	8.16E+02	2.02E+04	1.77E+03	5.52E+03	9.42E+02	2.72E+03
241-B-102	Supernatant	B-SltCk (Liquid)	15	6.97E-06	2.61E+03	2.73E+02	1.05E+01	2.58E+02	1.98E+02
241-B-102	Salt Cake (Solids)	B-SltCk (Solid)	80	8.16E+02	1.30E+04	1.02E+03	5.49E+03	2.37E+02	2.18E+03
241-B-102	Salt Cake (Liquids)	B-SltCk (Liquid)	26	1.21E-05	4.52E+03	4.73E+02	1.83E+01	4.47E+02	3.43E+02
241-B-103	Total		211	1.88E+02	3.46E+04	3.07E+03	1.07E+04	1.36E+03	5.44E+03
241-B-103	Sludge	MW (Solid)	4	4.56E+00	3.06E+02	1.35E+02	0.00E+00	8.02E+00	5.34E+02
241-B-103	Salt Cake (Solids)	B-SltCk (Solid)	155	1.84E+02	2.53E+04	1.99E+03	1.06E+04	4.59E+02	4.22E+03
241-B-103	Salt Cake (Liquids)	B-SltCk (Liquid)	52	2.42E-05	9.05E+03	9.46E+02	3.66E+01	8.94E+02	6.86E+02
241-B-104	Total		1417	2.62E+03	5.49E+05	5.33E+03	3.48E+03	4.24E+04	8.13E+04
241-B-104	Sludge	1C (Solid)	473	4.99E+02	1.86E+05	1.59E+03	1.18E+03	4.17E+03	1.63E+04
241-B-104	Sludge	2C (Solid)	697	1.94E+03	2.74E+05	2.35E+03	1.74E+03	3.71E+04	6.06E+04
241-B-104	Salt Cake (Solids)	B-SltCk (Solid)	210	1.87E+02	8.26E+04	7.08E+02	5.26E+02	4.27E+02	3.93E+03
241-B-104	Salt Cake (Liquids)	B-SltCk (Liquid)	37	1.72E-05	6.44E+03	6.73E+02	2.60E+01	6.36E+02	4.88E+02

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-B-105	Total		1098	1.34E+03	1.78E+05	1.45E+04	6.42E+04	6.57E+03	3.09E+04
241-B-105	Sludge	1C (Solid)	45	3.91E+01	7.36E+03	5.91E+02	9.83E+02	3.27E+02	1.28E+03
241-B-105	Sludge	2C (Solid)	60	1.17E+02	8.15E+03	7.92E+02	1.53E+02	2.23E+03	3.64E+03
241-B-105	Salt Cake (Solids)	B-SltCk (Solid)	918	1.19E+03	1.50E+05	1.18E+04	6.30E+04	2.72E+03	2.50E+04
241-B-105	Salt Cake (Liquids)	B-SltCk (Liquid)	75	3.49E-05	1.31E+04	1.37E+03	5.27E+01	1.29E+03	9.89E+02
241-B-106	Total		464	2.67E+02	1.15E+05	4.67E+03	3.79E+03	3.30E+04	1.04E+04
241-B-106	Supernatant	B-SltCk (Liquid)	4	1.86E-06	6.96E+02	7.28E+01	2.81E+00	6.87E+01	5.27E+01
241-B-106	Sludge	1C (Solid)	163	4.81E+01	3.94E+04	1.54E+03	6.11E+02	1.20E+03	2.47E+03
241-B-106	Sludge	TBP (Solid)	297	2.18E+02	7.48E+04	3.06E+03	3.18E+03	3.18E+04	7.91E+03
241-B-107	Total		611	7.52E+02	1.57E+05	3.47E+03	1.61E+04	1.22E+05	2.29E+04
241-B-107	Sludge	1C (Solid)	285	3.91E+02	9.65E+04	2.10E+03	9.77E+03	3.27E+03	1.28E+04
241-B-107	Sludge	CWP2 (Solid)	42	6.42E+01	1.76E+03	5.54E+01	1.11E+03	1.16E+05	2.41E+03
241-B-107	Salt Cake (Solids)	B-SltCk (Solid)	213	2.97E+02	3.52E+04	8.50E+02	5.18E+03	6.80E+02	6.25E+03
241-B-107	Salt Cake (Liquids)	B-SltCk (Liquid)	71	5.09E-05	2.35E+04	4.62E+02	1.43E+00	1.88E+03	1.44E+03
241-B-108	Total		349	4.10E+02	4.66E+04	8.05E+03	3.29E+04	2.16E+03	7.81E+03
241-B-108	Sludge	CWP2 (Solid)	104	1.54E+02	9.09E+03	2.42E+03	2.55E+04	7.49E+02	3.40E+03
241-B-108	Salt Cake (Solids)	B-SltCk (Solid)	184	2.56E+02	1.45E+04	2.35E+03	7.42E+03	5.85E+02	3.77E+03
241-B-108	Salt Cake (Liquids)	B-SltCk (Liquid)	61	2.23E-05	2.30E+04	3.28E+03	5.48E+01	8.25E+02	6.33E+02
241-B-109	Total		473	1.07E+03	8.78E+04	5.65E+03	4.21E+04	3.84E+05	1.53E+04
241-B-109	Sludge	CWP2 (Solid)	189	9.18E+02	1.21E+04	2.13E+03	3.63E+04	3.82E+05	7.94E+03
241-B-109	Salt Cake (Solids)	B-SltCk (Solid)	213	1.51E+02	6.33E+04	2.22E+03	5.73E+03	6.96E+02	6.40E+03
241-B-109	Salt Cake (Liquids)	B-SltCk (Liquid)	71	3.30E-05	1.24E+04	1.29E+03	4.99E+01	1.22E+03	9.36E+02
241-B-110	Total		929	4.79E+02	2.35E+05	1.30E+04	1.42E+03	1.05E+05	1.46E+04
241-B-110	Supernatant		4	0.00E+00	3.90E+01	4.44E+00	0.00E+00	0.00E+00	0.00E+00
241-B-110	Sludge	2C (Solid)	914	4.74E+02	2.32E+05	1.28E+04	1.40E+03	1.04E+05	1.45E+04
241-B-110	Sludge	P2 (Solid)	11	5.70E+00	2.80E+03	1.54E+02	1.69E+01	1.25E+03	1.74E+02
241-B-111	Total		914	1.16E+03	8.88E+04	4.87E+04	9.73E+02	2.24E+05	1.44E+05
241-B-111	Supernatant		4	0.00E+00	3.90E+01	4.44E+00	0.00E+00	0.00E+00	0.00E+00
241-B-111	Sludge	2C (Solid)	809	1.03E+03	7.89E+04	4.33E+04	8.65E+02	1.99E+05	1.28E+05
241-B-111	Sludge	P2 (Solid)	101	1.29E+02	9.86E+03	5.41E+03	1.08E+02	2.48E+04	1.59E+04
241-B-112	Total		132	6.50E+02	3.17E+04	4.58E+03	2.61E+03	5.17E+03	1.25E+04
241-B-112	Supernatant		11	0.00E+00	1.07E+02	1.22E+01	0.00E+00	0.00E+00	0.00E+00
241-B-112	Sludge	2C (Solid)	56	1.98E+02	1.38E+04	1.35E+03	2.60E+02	3.79E+03	6.19E+03
241-B-112	Salt Cake (Solids)	BY-SltCk (Solid)	49	3.02E+02	1.50E+04	1.63E+03	1.66E+03	9.19E+02	4.64E+03
241-B-112	Salt Cake (Liquids)	BY-SltCk (Liquid)	16	1.50E+02	2.78E+03	1.59E+03	6.91E+02	4.61E+02	1.66E+03
241-B-201	Total		115	3.43E+02	7.32E+03	1.28E+02	1.57E+02	2.67E+02	2.11E+01
241-B-201	Sludge	224 Pre-1949 (Solid)	115	3.43E+02	7.32E+03	1.28E+02	1.57E+02	2.67E+02	2.11E+01
241-B-202	Total		111	4.00E+02	8.32E+03	1.48E+02	2.32E+02	4.37E+02	1.11E+01
241-B-202	Sludge	224 Post-1949 (Solid)	111	4.00E+02	8.32E+03	1.48E+02	2.32E+02	4.37E+02	1.11E+01
241-B-203	Total		195	1.68E+01	1.44E+04	1.66E+02	1.19E+01	3.44E+02	7.65E+00
241-B-203	Supernatant	224 (Liquid)	2	1.92E-01	1.13E+02	3.14E+00	0.00E+00	2.57E-01	2.93E-01
241-B-203	Sludge	224 Post-1949 (Solid)	193	1.66E+01	1.43E+04	1.62E+02	1.19E+01	3.44E+02	7.36E+00
241-B-204	Total		192	1.65E+02	1.12E+04	1.34E+02	1.31E+01	3.15E+02	6.67E+00
241-B-204	Supernatant	224 (Liquid)	3	2.28E-05	1.04E+02	4.09E+00	0.00E+00	3.12E-01	3.56E-01
241-B-204	Sludge	224 Post-1949 (Solid)	189	1.65E+02	1.11E+04	1.29E+02	1.31E+01	3.14E+02	6.31E+00

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-BX-101	Total		180	1.96E+02	1.89E+04	4.04E+03	3.04E+04	2.86E+05	6.35E+03
241-BX-101	Sludge	CWP2 (Solid)	133	1.53E+02	5.66E+03	2.75E+03	3.02E+04	2.75E+05	5.73E+03
241-BX-101	Sludge	TBP (Solid)	47	4.31E+01	1.32E+04	1.28E+03	1.57E+02	1.12E+04	6.28E+02
241-BX-102	Total		424	1.92E+02	7.11E+03	3.46E+03	3.86E+04	3.46E+05	7.19E+03
241-BX-102	Sludge	CWP2 (Solid)	167	1.92E+02	7.11E+03	3.46E+03	3.80E+04	3.46E+05	7.19E+03
241-BX-102	Sludge	DE (Solid)	257	0.00E+00	0.00E+00	0.00E+00	5.74E+02	0.00E+00	0.00E+00
241-BX-103	Total		277	3.56E+03	2.86E+04	5.05E+03	2.56E+04	2.41E+05	5.79E+03
241-BX-103	Supernatant	CWP2 (Liquid)	42	1.82E+02	2.24E+03	7.04E+02	9.00E+02	1.08E+02	1.25E+02
241-BX-103	Sludge	CWP2 (Solid)	157	2.26E+03	4.57E+03	2.22E+03	2.44E+04	2.22E+05	4.62E+03
241-BX-103	Sludge	TBP (Solid)	78	1.12E+03	2.18E+04	2.12E+03	2.59E+02	1.85E+04	1.04E+03
241-BX-104	Total		379	2.72E+03	2.99E+04	1.47E+04	8.30E+04	1.29E+05	4.17E+04
241-BX-104	Supernatant	CWR1 (Liquid)	11	3.51E+01	1.47E+03	7.01E+02	3.12E+01	2.01E+01	1.46E+03
241-BX-104	Sludge	CWP2 (Solid)	51	3.72E+02	3.94E+03	1.94E+03	1.15E+04	1.79E+04	5.58E+03
241-BX-104	Sludge	CWR1 (Solid)	162	1.18E+03	1.25E+04	6.17E+03	3.65E+04	5.69E+04	1.77E+04
241-BX-104	Sludge	MW (Solid)	155	1.13E+03	1.20E+04	5.91E+03	3.50E+04	5.45E+04	1.70E+04
241-BX-105	Total		271	8.25E+02	1.70E+04	8.63E+03	8.18E+03	5.13E+04	2.24E+04
241-BX-105	Supernatant	CWP1 (Liquid)	18	1.70E+02	2.11E+03	1.41E+03	1.07E+02	1.46E+02	2.30E+03
241-BX-105	Sludge	CWP1 (Solid)	147	4.13E+02	8.22E+03	2.56E+03	3.90E+03	3.87E+04	1.07E+04
241-BX-105	Sludge	MW (Solid)	33	3.76E+01	2.53E+03	1.11E+03	0.00E+00	6.61E+01	4.41E+03
241-BX-105	Sludge	TBP (Solid)	73	2.05E+02	4.10E+03	3.55E+03	4.18E+03	1.24E+04	4.94E+03
241-BX-106	Total		142	9.21E+02	1.10E+04	4.43E+03	1.12E+04	3.32E+04	1.33E+04
241-BX-106	Sludge	CWP1 (Solid)	71	4.60E+02	5.51E+03	2.22E+03	5.61E+03	1.66E+04	6.63E+03
241-BX-106	Sludge	TBP (Solid)	71	4.60E+02	5.51E+03	2.22E+03	5.61E+03	1.66E+04	6.63E+03
241-BX-107	Total		1313	1.13E+03	2.59E+05	1.54E+04	2.70E+04	1.53E+04	2.72E+04
241-BX-107	Sludge	1C (Solid)	1313	1.13E+03	2.59E+05	1.54E+04	2.70E+04	1.53E+04	2.72E+04
241-BX-108	Total		119	1.76E+02	4.63E+04	4.30E+03	2.02E+03	2.95E+04	3.73E+03
241-BX-108	Sludge	1C (Solid)	38	6.44E+01	1.21E+04	9.72E+02	1.62E+03	5.38E+02	2.10E+03
241-BX-108	Sludge	TBP (Solid)	81	1.12E+02	3.42E+04	3.33E+03	4.06E+02	2.89E+04	1.63E+03
241-BX-109	Total		731	7.84E+02	2.17E+05	2.00E+04	2.22E+03	1.28E+05	1.28E+04
241-BX-109	Sludge	TBP (Solid)	731	7.84E+02	2.17E+05	2.00E+04	2.22E+03	1.28E+05	1.28E+04
241-BX-110	Total		776	3.07E+03	4.40E+05	1.97E+04	2.77E+04	1.63E+04	7.32E+04
241-BX-110	Supernatant	BY-SltCk (Liquid)	5	4.59E+01	2.06E+03	2.61E+02	2.20E+01	1.41E+02	5.07E+02
241-BX-110	Sludge	1C (Solid)	151	2.50E+02	4.69E+04	1.74E+03	3.96E+03	2.09E+03	5.08E+03
241-BX-110	Sludge	1C (Solid)	94	3.08E+02	6.45E+04	3.77E+03	6.27E+03	1.30E+03	8.16E+03
241-BX-110	Salt Cake (Solids)	BY-SltCk (Solid)	400	1.31E+03	2.75E+05	7.39E+03	1.69E+04	9.26E+03	4.67E+04
241-BX-110	Salt Cake (Liquids)	BY-SltCk (Liquid)	126	1.16E+03	5.20E+04	6.57E+03	5.54E+02	3.54E+03	1.28E+04
241-BX-111	Total		714	1.15E+03	4.01E+05	1.81E+04	1.66E+04	1.59E+04	7.68E+04
241-BX-111	Sludge	1C (Solid)	121	1.05E+02	1.98E+04	1.59E+03	2.64E+03	8.80E+02	3.44E+03
241-BX-111	Salt Cake (Solids)	BY-SltCk (Solid)	531	9.39E+02	3.70E+05	9.97E+03	1.09E+04	1.32E+04	6.67E+04
241-BX-111	Salt Cake (Liquids)	BY-SltCk (Liquid)	62	1.05E+02	1.15E+04	6.58E+03	3.02E+03	1.83E+03	6.59E+03
241-BX-112	Total		622	4.70E+02	6.19E+04	2.24E+04	1.00E+04	5.21E+03	3.53E+04
241-BX-112	Supernatant	1C2 (Liquid)	5	0.00E+00	4.93E+02	1.76E+02	2.39E-01	1.52E+02	1.73E+02
241-BX-112	Sludge	1C (Solid)	617	4.70E+02	6.14E+04	2.22E+04	1.00E+04	5.06E+03	3.51E+04

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-BY-101	Total		1400	6.37E+03	8.64E+05	1.93E+04	5.42E+04	2.65E+05	2.92E+05
241-BY-101	Sludge	TFeCN (Solid)	140	5.17E+02	1.16E+04	9.76E+03	5.98E+03	2.27E+05	1.02E+05
241-BY-101	Salt Cake (Solids)	BY-SltCk (Solid)	1189	5.19E+03	8.40E+05	2.44E+03	4.52E+04	3.61E+04	1.82E+05
241-BY-101	Salt Cake (Liquids)	BY-SltCk (Liquid)	71	6.67E+02	1.24E+04	7.05E+03	3.07E+03	2.04E+03	7.37E+03
241-BY-102	Total		1048	6.45E+03	1.82E+05	3.57E+04	4.99E+04	2.55E+04	1.22E+05
241-BY-102	Salt Cake (Solids)	BY-SltCk (Solid)	897	6.22E+03	1.59E+05	2.31E+04	4.14E+04	2.10E+04	1.06E+05
241-BY-102	Salt Cake (Liquids)	BY-SltCk (Liquid)	151	2.34E+02	2.23E+04	1.27E+04	8.54E+03	4.52E+03	1.63E+04
241-BY-103	Total		1575	3.21E+04	5.59E+05	2.78E+04	7.95E+04	1.05E+05	2.04E+05
241-BY-103	Sludge	CWP2 (Solid)	34	3.90E+01	1.45E+03	7.03E+02	7.73E+03	7.04E+04	1.46E+03
241-BY-103	Salt Cake (Solids)	BY-SltCk (Solid)	1327	3.17E+04	5.22E+05	1.56E+04	6.29E+04	3.49E+04	1.76E+05
241-BY-103	Salt Cake (Liquids)	BY-SltCk (Liquid)	214	4.08E+02	3.62E+04	1.15E+04	8.86E+03	2.09E+01	2.64E+04
241-BY-104	Total		1356	1.56E+04	5.04E+05	9.44E+04	6.55E+04	3.61E+05	2.07E+05
241-BY-104	Sludge	PFeCN (Solid)	172	3.23E+03	3.58E+04	1.20E+04	1.70E+04	1.71E+05	1.70E+04
241-BY-104	Salt Cake (Solids)	BY-SltCk (Solid)	1018	1.19E+04	4.37E+05	6.46E+04	3.66E+04	1.85E+05	1.71E+05
241-BY-104	Salt Cake (Liquids)	BY-SltCk (Liquid)	166	3.94E+02	3.12E+04	1.78E+04	1.20E+04	5.16E+03	1.86E+04
241-BY-105	Total		1821	9.51E+03	1.41E+06	4.17E+04	7.17E+04	1.59E+05	1.65E+05
241-BY-105	Sludge	PFeCN (Solid)	151	4.15E+03	4.38E+04	7.19E+03	5.97E+03	1.43E+05	4.64E+04
241-BY-105	Sludge	Portland Cement (Solid)	30	0.00E+00	0.00E+00	0.00E+00	1.57E+03	0.00E+00	0.00E+00
241-BY-105	Salt Cake (Solids)	BY-SltCk (Solid)	1489	4.99E+03	1.33E+06	2.41E+04	5.83E+04	1.60E+04	8.84E+04
241-BY-105	Salt Cake (Liquids)	BY-SltCk (Liquid)	151	3.67E+02	3.01E+04	1.04E+04	5.92E+03	1.57E+01	3.04E+04
241-BY-106	Total		1857	1.13E+04	9.37E+05	9.14E+04	6.16E+04	1.48E+05	3.58E+05
241-BY-106	Sludge	PFeCN (Solid)	120	4.11E+03	2.02E+04	8.13E+03	6.21E+03	1.37E+05	9.18E+04
241-BY-106	Salt Cake (Solids)	BY-SltCk (Solid)	1599	6.78E+03	9.01E+05	7.25E+04	4.99E+04	1.04E+04	2.40E+05
241-BY-106	Salt Cake (Liquids)	BY-SltCk (Liquid)	138	3.69E+02	1.52E+04	1.08E+04	5.49E+03	4.65E+00	2.57E+04
241-BY-107	Total		1028	6.37E+03	3.22E+05	7.56E+04	6.07E+04	8.24E+04	2.10E+05
241-BY-107	Sludge	PFeCN (Solid)	57	8.39E+02	9.68E+03	4.13E+03	4.74E+03	4.94E+04	3.37E+04
241-BY-107	Salt Cake (Solids)	BY-SltCk (Solid)	822	5.17E+03	2.93E+05	5.40E+04	4.83E+04	2.83E+04	1.60E+05
241-BY-107	Salt Cake (Liquids)	BY-SltCk (Liquid)	149	3.58E+02	1.96E+04	1.75E+04	7.62E+03	4.66E+03	1.68E+04
241-BY-108	Total		841	5.58E+03	2.29E+05	3.81E+04	8.49E+04	1.42E+05	5.16E+04
241-BY-108	Sludge	PFeCN (Solid)	151	2.32E+03	1.94E+04	9.87E+03	5.41E+03	1.25E+05	2.15E+04
241-BY-108	Salt Cake (Solids)	BY-SltCk (Solid)	587	3.01E+03	1.79E+05	2.01E+04	7.57E+04	1.34E+04	1.62E+04
241-BY-108	Salt Cake (Liquids)	BY-SltCk (Liquid)	103	2.44E+02	3.03E+04	8.09E+03	3.74E+03	3.84E+03	1.39E+04
241-BY-109	Total		1047	9.67E+03	1.29E+05	5.03E+04	7.22E+04	2.39E+05	1.03E+05
241-BY-109	Sludge	CWP2 (Solid)	89	1.21E+02	9.08E+03	3.03E+03	3.52E+04	2.18E+05	4.54E+03
241-BY-109	Salt Cake (Solids)	BY-SltCk (Solid)	812	9.28E+03	9.20E+04	3.52E+04	3.13E+04	1.64E+04	8.27E+04
241-BY-109	Salt Cake (Liquids)	BY-SltCk (Liquid)	146	2.75E+02	2.78E+04	1.21E+04	5.66E+03	4.29E+03	1.55E+04
241-BY-110	Total		1384	1.32E+04	2.43E+05	7.97E+04	4.67E+04	1.73E+05	1.99E+05
241-BY-110	Sludge	PFeCN (Solid)	162	2.64E+03	3.04E+04	1.19E+04	8.81E+03	1.17E+05	3.67E+04
241-BY-110	Salt Cake (Solids)	BY-SltCk (Solid)	1164	9.89E+03	2.06E+05	6.07E+04	3.41E+04	5.42E+04	1.55E+05
241-BY-110	Salt Cake (Liquids)	BY-SltCk (Liquid)	58	6.83E+02	7.20E+03	7.19E+03	3.81E+03	2.09E+03	7.54E+03
241-BY-111	Total		1144	1.12E+04	2.73E+05	3.09E+04	4.75E+04	2.66E+04	1.31E+05
241-BY-111	Salt Cake (Solids)	BY-SltCk (Solid)	1076	1.11E+04	2.65E+05	2.86E+04	4.57E+04	2.47E+04	1.25E+05
241-BY-111	Salt Cake (Liquids)	BY-SltCk (Liquid)	68	8.69E+01	8.25E+03	2.24E+03	1.75E+03	1.86E+03	6.70E+03

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-BY-112	Total		1083	1.49E+04	1.45E+05	5.34E+04	3.94E+04	2.82E+04	1.39E+05
241-BY-112	Sludge	MW (Solid)	8	9.11E+00	6.12E+02	2.69E+02	0.00E+00	1.60E+01	1.07E+03
241-BY-112	Salt Cake (Solids)	BY-SltCk (Solid)	988	1.47E+04	1.28E+05	4.09E+04	3.46E+04	2.54E+04	1.28E+05
241-BY-112	Salt Cake (Liquids)	BY-SltCk (Liquid)	87	1.49E+02	1.66E+04	1.22E+04	4.82E+03	2.74E+03	9.90E+03
241-C-101	Total		333	1.19E+03	6.14E+04	9.18E+03	6.53E+04	2.86E+05	3.64E+04
241-C-101	Sludge	CWP1 (Solid)	208	1.00E+03	3.80E+03	3.57E+03	6.46E+04	2.37E+05	3.36E+04
241-C-101	Sludge	TBP (Solid)	125	1.88E+02	5.76E+04	5.60E+03	6.84E+02	4.87E+04	2.74E+03
241-C-102	Total		1196	1.57E+03	7.32E+04	1.69E+04	8.25E+04	5.94E+05	2.98E+04
241-C-102	Sludge	CWP1 (Solid)	125	4.04E+02	1.53E+03	1.44E+03	2.61E+04	9.55E+04	1.36E+04
241-C-102	Sludge	CWP2 (Solid)	855	1.02E+03	3.66E+04	1.20E+04	5.21E+04	4.83E+05	1.18E+04
241-C-102	Sludge	CWZr1 (Solid)	38	4.54E+01	1.63E+03	5.31E+02	2.31E+03	2.47E+02	5.27E+02
241-C-102	Sludge	MW (Solid)	19	2.16E+01	1.45E+03	6.39E+02	0.00E+00	3.81E+01	2.54E+03
241-C-102	Sludge	TBP (Solid)	61	5.60E+01	1.71E+04	1.67E+03	2.04E+02	1.45E+04	8.15E+02
241-C-102	Sludge	TH1 (Solid)	98	2.49E+01	1.48E+04	6.86E+02	1.87E+03	5.96E+02	5.51E+02
241-C-103	Total		335	7.51E+03	9.15E+02	9.08E+03	1.06E+05	2.00E+06	5.71E+04
241-C-103	Sludge	AR (Solid)	134	3.00E+03	3.66E+02	3.63E+03	4.24E+04	8.00E+05	2.29E+04
241-C-103	Sludge	CWP1 (Solid)	201	4.51E+03	5.49E+02	5.45E+03	6.36E+04	1.20E+06	3.43E+04
241-C-104	Total		980	1.42E+04	1.96E+04	3.65E+04	9.01E+04	4.84E+05	9.55E+04
241-C-104	Sludge		150	2.17E+03	3.00E+03	5.59E+03	1.38E+04	7.41E+04	1.46E+04
241-C-104	Sludge	CWP1 (Solid)	332	4.80E+03	6.63E+03	1.24E+04	3.05E+04	1.64E+05	3.24E+04
241-C-104	Sludge	CWP2 (Solid)	227	3.28E+03	4.53E+03	8.46E+03	2.09E+04	1.12E+05	2.21E+04
241-C-104	Sludge	CWZr1 (Solid)	88	1.27E+03	1.76E+03	3.28E+03	8.09E+03	4.35E+04	8.57E+03
241-C-104	Sludge	OWW3 (Solid)	103	1.49E+03	2.06E+03	3.84E+03	9.47E+03	5.09E+04	1.00E+04
241-C-104	Sludge	TH2 (Solid)	80	1.16E+03	1.60E+03	2.98E+03	7.36E+03	3.95E+04	7.80E+03
241-C-105	Total		500	4.74E+03	8.14E+03	8.42E+03	1.72E+05	4.76E+05	8.18E+04
241-C-105	Sludge	CWP1 (Solid)	450	4.26E+03	7.32E+03	6.54E+03	1.55E+05	4.28E+05	7.36E+04
241-C-105	Sludge	TBP (Solid)	50	4.74E+02	8.14E+02	1.89E+03	1.72E+04	4.76E+04	8.18E+03
241-C-106	Total		52	1.56E+02	2.75E+01	3.45E+02	2.74E+03	4.17E+05	1.78E+04
241-C-106	Supernatant	BL (Liquid)	18	5.59E+01	1.02E+01	2.26E+02	3.58E+01	5.35E+01	9.61E+02
241-C-106	Sludge	AR (Solid)	34	1.00E+02	1.74E+01	1.19E+02	2.71E+03	4.17E+05	1.68E+04
241-C-107	Total		940	7.36E+02	4.78E+04	3.53E+04	5.86E+04	2.24E+06	6.35E+04
241-C-107	Sludge	1C (Solid)	511	4.00E+02	3.45E+04	2.07E+04	1.90E+04	3.69E+05	3.45E+04
241-C-107	Sludge	CWP2 (Solid)	90	7.05E+01	3.24E+03	2.61E+03	1.66E+04	6.50E+04	6.08E+03
241-C-107	Sludge	SRR (Solid)	339	2.66E+02	1.00E+04	1.21E+04	2.29E+04	1.81E+06	2.29E+04
241-C-108	Total		250	3.43E+02	1.57E+04	8.74E+03	1.89E+04	8.44E+03	8.15E+04
241-C-108	Sludge	1C (Solid)	110	1.51E+02	6.92E+03	3.84E+03	8.31E+03	3.71E+03	3.59E+04
241-C-108	Sludge	TBP (Solid)	95	1.30E+02	5.98E+03	3.32E+03	7.17E+03	3.21E+03	3.10E+04
241-C-108	Sludge	TFeCN (Solid)	45	6.17E+01	2.83E+03	1.57E+03	3.40E+03	1.52E+03	1.47E+04
241-C-109	Total		240	7.60E+02	1.80E+04	1.22E+04	2.34E+04	2.51E+05	1.71E+05
241-C-109	Sludge	1C (Solid)	38	3.31E+01	6.22E+03	4.99E+02	8.30E+02	2.76E+02	1.08E+03
241-C-109	Sludge	CWP1 (Solid)	86	3.09E+02	5.02E+03	4.99E+03	9.60E+03	1.07E+05	7.23E+04
241-C-109	Sludge	HS (Solid)	26	9.35E+01	1.52E+03	1.51E+03	2.90E+03	3.23E+04	2.19E+04
241-C-109	Sludge	TFeCN (Solid)	90	3.24E+02	5.26E+03	5.22E+03	1.00E+04	1.12E+05	7.57E+04

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-C-110	Total		674	5.22E+02	9.80E+04	6.53E+03	1.31E+04	3.72E+03	1.44E+04
241-C-110	Supernatant	1C1 (Liquid)	4	2.32E+00	2.41E+02	1.84E+01	8.34E-01	9.12E-02	1.60E+01
241-C-110	Sludge	1C (Solid)	670	5.20E+02	9.77E+04	6.51E+03	1.31E+04	3.72E+03	1.44E+04
241-C-111	Total		217	2.44E+02	1.73E+04	9.49E+03	2.86E+04	8.90E+05	1.96E+04
241-C-111	Sludge	1C (Solid)	49	4.26E+01	8.01E+03	6.43E+02	1.07E+03	3.56E+02	1.39E+03
241-C-111	Sludge	CWP1 (Solid)	60	7.21E+01	7.93E+02	7.47E+02	9.85E+03	3.18E+05	6.50E+03
241-C-111	Sludge	HS (Solid)	19	2.28E+01	3.33E-05	9.49E+02	3.12E+03	1.01E+05	2.06E+03
241-C-111	Sludge	TFcCN (Solid)	89	1.07E+02	8.46E+03	7.15E+03	1.46E+04	4.71E+05	9.64E+03
241-C-112	Total		393	2.42E+03	3.72E+04	2.78E+04	1.24E+04	6.48E+05	2.85E+05
241-C-112	Sludge	1C (Solid)	57	3.51E+02	5.39E+03	4.03E+03	1.79E+03	9.40E+04	4.13E+04
241-C-112	Sludge	CWP1 (Solid)	64	3.94E+02	6.05E+03	4.53E+03	2.01E+03	1.06E+05	4.64E+04
241-C-112	Sludge	TFcCN (Solid)	272	1.67E+03	2.57E+04	1.92E+04	8.55E+03	4.49E+05	1.97E+05
241-C-201	Total		4	1.92E+02	2.19E+02	2.85E+01	3.20E+00	6.62E+02	4.19E+01
241-C-201	Sludge	HS (Solid)	4	1.92E+02	2.19E+02	2.85E+01	3.20E+00	6.62E+02	4.19E+01
241-C-202	Total		3	1.41E+02	4.29E+02	1.25E+02	2.61E+01	9.43E+02	4.94E+01
241-C-202	Sludge	HS (Solid)	3	1.41E+02	4.29E+02	1.25E+02	2.61E+01	9.43E+02	4.94E+01
241-C-203	Total		10	3.41E+02	2.47E+03	1.49E+02	0.00E+00	4.85E+02	7.41E+01
241-C-203	Sludge	HS (Solid)	10	3.41E+02	2.47E+03	1.49E+02	0.00E+00	4.85E+02	7.41E+01
241-C-204	Total		9	3.07E+02	2.22E+03	1.34E+02	0.00E+00	4.37E+02	6.67E+01
241-C-204	Sludge	HS (Solid)	9	3.07E+02	2.22E+03	1.34E+02	0.00E+00	4.37E+02	6.67E+01
241-S-101	Total		1485	5.15E+03	3.77E+05	1.25E+05	1.84E+05	6.10E+05	3.10E+05
241-S-101	Sludge	CWR1 (Solid)	111	2.11E+02	2.43E+04	7.33E+03	2.36E+04	1.59E+03	1.66E+04
241-S-101	Sludge	R1 (Solid)	353	9.13E+02	7.74E+04	2.33E+04	7.49E+04	2.84E+05	5.28E+04
241-S-101	Salt Cake (Solids)	R-SltCk (Solid)	269	1.16E+03	7.50E+04	2.40E+04	2.52E+04	1.00E+05	6.07E+04
241-S-101	Salt Cake (Solids)	S1-SltCk (Solid)	356	1.54E+03	9.93E+04	3.17E+04	3.33E+04	1.33E+05	8.03E+04
241-S-101	Salt Cake (Solids)	S2-SltSlr (Solid)	245	1.06E+03	6.84E+04	2.18E+04	2.29E+04	9.15E+04	5.53E+04
241-S-101	Salt Cake (Liquids)	R-SltCk (Liquid)	46	8.23E+01	9.83E+03	5.19E+03	1.38E+03	1.89E+00	1.36E+04
241-S-101	Salt Cake (Liquids)	S1-SltCk (Liquid)	63	1.13E+02	1.35E+04	7.11E+03	1.89E+03	2.59E+00	1.86E+04
241-S-101	Salt Cake (Liquids)	S2-SltSlr (Liquid)	42	7.52E+01	8.98E+03	4.74E+03	1.26E+03	1.73E+00	1.24E+04
241-S-102	Total		1224	7.32E+03	4.67E+05	9.72E+04	4.22E+04	8.87E+04	2.96E+05
241-S-102	Sludge	R1 (Solid)	61	9.12E+02	5.55E+03	4.09E+03	4.79E+03	6.21E+04	9.25E+03
241-S-102	Salt Cake (Solids)	S1-SltCk (Solid)	294	1.87E+03	1.51E+05	1.68E+04	6.03E+03	9.96E+03	5.27E+04
241-S-102	Salt Cake (Solids)	S2-SltSlr (Solid)	491	3.12E+03	2.52E+05	2.81E+04	1.01E+04	1.66E+04	8.80E+04
241-S-102	Salt Cake (Liquids)	S1-SltCk (Liquid)	141	5.31E+02	2.19E+04	1.79E+04	7.93E+03	1.03E+01	5.44E+04
241-S-102	Salt Cake (Liquids)	S2-SltSlr (Liquid)	237	8.92E+02	3.68E+04	3.02E+04	1.33E+04	1.73E+01	9.14E+04
241-S-103	Total		897	6.08E+03	3.30E+05	8.52E+04	3.43E+04	4.10E+04	2.17E+05
241-S-103	Supernatant	S1-SltCk (Liquid)	4	1.87E+01	8.64E+02	5.88E+02	1.28E+02	1.59E+00	1.39E+03
241-S-103	Sludge	R1 (Solid)	34	1.01E+02	6.25E+03	2.29E+03	8.51E+03	3.15E+04	4.69E+03
241-S-103	Salt Cake (Solids)	S1-SltCk (Solid)	347	2.36E+03	1.54E+05	2.81E+04	1.00E+04	7.80E+03	6.53E+04
241-S-103	Salt Cake (Solids)	S2-SltSlr (Solid)	301	2.61E+03	1.23E+05	2.33E+04	8.90E+03	1.64E+03	7.29E+04
241-S-103	Salt Cake (Liquids)	S1-SltCk (Liquid)	116	5.43E+02	2.51E+04	1.70E+04	3.72E+03	4.61E+01	4.02E+04
241-S-103	Salt Cake (Liquids)	S2-SltSlr (Liquid)	95	4.44E+02	2.05E+04	1.40E+04	3.04E+03	3.78E+01	3.29E+04

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-S-104	Total		1090	1.81E+03	4.19E+05	4.61E+04	1.96E+05	4.28E+05	8.26E+04
241-S-104	Sludge	CWR1 (Solid)	91	1.62E+02	3.67E+04	3.66E+03	1.86E+04	4.10E+04	7.31E+03
241-S-104	Sludge	R1 (Solid)	409	1.07E+03	1.65E+05	1.65E+04	8.37E+04	1.84E+05	3.29E+04
241-S-104	Salt Cake (Solids)	R-SltCk (Solid)	450	5.16E+02	1.79E+05	2.06E+04	9.21E+04	2.03E+05	3.30E+04
241-S-104	Salt Cake (Liquids)	R-SltCk (Liquid)	140	5.55E+01	3.76E+04	5.35E+03	1.68E+03	6.05E+01	9.46E+03
241-S-105	Total		1536	3.55E+03	1.35E+06	2.53E+04	1.70E+04	1.14E+04	7.42E+04
241-S-105	Sludge	R1 (Solid)	8	2.38E+01	1.47E+03	5.39E+02	2.00E+03	7.41E+03	1.10E+03
241-S-105	Salt Cake (Solids)	S1-SltCk (Solid)	1371	1.40E+03	1.33E+06	9.44E+03	8.39E+03	5.90E+02	3.18E+04
241-S-105	Salt Cake (Liquids)	S1-SltCk (Liquid)	157	2.12E+03	1.97E+04	1.53E+04	6.58E+03	3.44E+03	4.13E+04
241-S-106	Total		1723	6.33E+03	9.84E+05	7.75E+04	5.15E+04	3.91E+04	2.90E+05
241-S-106	Salt Cake (Solids)	S1-SltCk (Solid)	1624	6.13E+03	9.61E+05	6.73E+04	4.78E+04	3.91E+04	2.66E+05
241-S-106	Salt Cake (Liquids)	S1-SltCk (Liquid)	99	1.96E+02	2.34E+04	1.03E+04	3.76E+03	5.22E+00	2.46E+04
241-S-107	Total		1212	3.77E+03	1.27E+05	6.57E+04	2.62E+05	3.43E+05	1.61E+05
241-S-107	Sludge (Liquids)	NA	81	9.57E+01	9.26E+03	5.76E+03	8.70E+02	5.55E+00	1.00E+04
241-S-107	Sludge	CWR1 (Solid)	390	1.09E+03	4.17E+04	2.13E+04	9.56E+04	1.23E+05	5.38E+04
241-S-107	Sludge	CWR2 (Solid)	184	5.16E+02	1.97E+04	1.00E+04	4.51E+04	5.81E+04	2.54E+04
241-S-107	Sludge	CWZr1 (Solid)	79	2.21E+02	8.44E+03	4.31E+03	1.94E+04	2.50E+04	1.09E+04
241-S-107	Sludge	R1 (Solid)	402	1.13E+03	4.29E+04	2.19E+04	9.85E+04	1.27E+05	5.54E+04
241-S-107	Salt Cake (Solids)	S1-SltCk (Solid)	34	3.22E+02	2.25E+03	1.04E+03	1.10E+03	4.25E+03	2.47E+03
241-S-107	Salt Cake (Solids)	S2-SltSlr (Solid)	15	1.42E+02	9.93E+02	4.61E+02	4.86E+02	1.87E+03	1.09E+03
241-S-107	Salt Cake (Solids)	T2-SltCk (Solid)	27	2.56E+02	1.79E+03	8.30E+02	8.76E+02	3.37E+03	1.96E+03
241-S-108	Total		2082	3.92E+05	1.42E+04	9.15E+05	1.68E+05	6.45E+04	6.40E+04
241-S-108	Sludge	R1 (Solid)	19	2.62E+03	5.65E+01	3.49E+03	1.28E+03	4.75E+03	1.76E+04
241-S-108	Salt Cake (Solids)	S1-SltCk (Solid)	2049	3.85E+05	1.39E+04	9.09E+05	1.66E+05	5.92E+04	4.61E+04
241-S-108	Salt Cake (Liquids)	S1-SltCk (Liquid)	14	3.68E+03	1.89E+02	1.75E+03	1.36E+03	5.87E+02	3.07E+02
241-S-109	Total		2017	2.24E+03	1.91E+06	2.33E+04	2.06E+04	6.05E+04	4.76E+04
241-S-109	Sludge	R1 (Solid)	49	1.46E+02	9.00E+03	3.30E+03	1.23E+04	4.54E+04	6.75E+03
241-S-109	Salt Cake (Solids)	S1-SltCk (Solid)	1905	2.02E+03	1.90E+06	1.46E+04	5.44E+03	1.51E+04	2.17E+04
241-S-109	Salt Cake (Liquids)	S1-SltCk (Liquid)	63	7.02E+01	8.29E+03	5.35E+03	2.89E+03	1.64E+01	1.92E+04
241-S-110	Total		1473	5.49E+03	9.04E+05	5.39E+04	1.24E+05	2.48E+05	1.78E+05
241-S-110	Sludge	CWR1 (Solid)	76	4.86E+01	1.33E+04	3.66E+03	2.24E+04	4.15E+04	1.08E+04
241-S-110	Sludge	R1 (Solid)	288	1.84E+02	5.05E+04	1.39E+04	8.48E+04	1.57E+05	4.09E+04
241-S-110	Salt Cake (Solids)	S1-Sltck (Solid)	994	4.99E+03	8.15E+05	2.65E+04	1.28E+04	4.65E+04	9.54E+04
241-S-110	Salt Cake (Liquids)	S1-Sltck (Liquid)	115	2.62E+02	2.50E+04	9.87E+03	3.56E+03	2.58E+03	3.09E+04
241-S-111	Total		1483	4.07E+03	5.02E+05	7.61E+04	1.27E+05	4.45E+05	2.76E+05
241-S-111	Sludge	CWR1 (Solid)	39	5.96E+01	2.60E+03	1.60E+03	1.40E+04	6.58E+02	5.18E+03
241-S-111	Sludge	R1 (Solid)	206	3.15E+02	1.37E+04	8.44E+03	7.41E+04	1.95E+05	2.74E+04
241-S-111	Salt Cake (Solids)	S1-SltCk (Solid)	963	3.28E+03	4.33E+05	4.31E+04	2.85E+04	2.50E+05	1.55E+05
241-S-111	Salt Cake (Liquids)	S1-SltCk (Liquid)	275	4.11E+02	5.29E+04	2.30E+04	1.00E+04	3.34E+01	8.84E+04
241-S-112	Total		2325	6.04E+03	1.39E+06	6.18E+04	3.72E+04	1.07E+05	2.18E+05
241-S-112	Sludge	R1 (Solid)	23	6.84E+01	4.23E+03	1.55E+03	5.76E+03	2.13E+04	3.17E+03
241-S-112	Salt Cake (Solids)	S1-SltCk (Solid)	2041	5.75E+03	1.34E+06	4.40E+04	2.18E+04	8.60E+04	1.56E+05
241-S-112	Salt Cake (Liquids)	S1-SltCk (Liquid)	261	2.17E+02	4.39E+04	1.62E+04	9.62E+03	9.07E+01	5.85E+04

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-SX-101	Total		1564	4.85E+03	7.39E+05	6.66E+04	1.58E+05	6.67E+05	2.97E+05
241-SX-101	Sludge	R1 (Solid)	546	1.85E+03	2.79E+05	2.14E+04	5.64E+04	4.80E+05	9.28E+04
241-SX-101	Salt Cake (Solids)	R-SltCk (Solid)	451	1.53E+03	2.30E+05	1.77E+04	4.66E+04	9.68E+04	7.67E+04
241-SX-101	Salt Cake (Solids)	S1-SltCk (Solid)	268	9.09E+02	1.37E+05	1.05E+04	1.56E+04	5.75E+04	4.56E+04
241-SX-101	Salt Cake (Solids)	S2-SltSlr (Solid)	151	5.12E+02	7.71E+04	5.92E+03	2.77E+04	3.24E+04	2.57E+04
241-SX-101	Salt Cake (Liquids)	R-SltCk (Liquid)	77	2.58E+01	8.30E+03	5.76E+03	6.17E+03	5.77E+00	2.90E+04
241-SX-101	Salt Cake (Liquids)	S1-SltCk (Liquid)	46	1.54E+01	4.96E+03	3.44E+03	3.68E+03	3.45E+00	1.73E+04
241-SX-101	Salt Cake (Liquids)	S2-SltSlr (Liquid)	25	8.37E+00	2.70E+03	1.87E+03	2.00E+03	1.87E+00	9.43E+03
241-SX-102	Total		1628	1.08E+04	6.21E+05	2.01E+05	7.18E+04	2.46E+05	4.07E+05
241-SX-102	Sludge	R1 (Solid)	208	1.47E+03	8.31E+04	2.52E+04	9.15E+03	3.39E+04	4.92E+04
241-SX-102	Salt Cake (Solids)	S1-SltCk (Solid)	1173	8.28E+03	4.69E+05	1.42E+05	5.16E+04	1.91E+05	2.78E+05
241-SX-102	Salt Cake (Solids)	S2-SltSlr (Solid)	125	8.83E+02	4.99E+04	1.51E+04	5.50E+03	2.04E+04	2.96E+04
241-SX-102	Salt Cake (Liquids)	S1-SltCk (Liquid)	110	1.66E+02	1.73E+04	1.66E+04	5.02E+03	2.43E+00	4.55E+04
241-SX-102	Salt Cake (Liquids)	S2-SltSlr (Liquid)	12	1.81E+01	1.89E+03	1.81E+03	5.47E+02	2.65E-01	4.96E+03
241-SX-103	Total		1860	1.24E+04	9.50E+05	1.74E+05	1.50E+05	5.45E+05	4.26E+05
241-SX-103	Sludge	R1 (Solid)	294	1.83E+03	8.90E+04	2.26E+04	1.02E+05	3.76E+05	4.77E+04
241-SX-103	Salt Cake (Solids)	R-SltCk (Solid)	75	7.07E+02	2.16E+04	9.10E+03	5.42E+03	6.59E+04	2.16E+04
241-SX-103	Salt Cake (Solids)	S1-SltCk (Solid)	1375	9.47E+03	8.21E+05	1.24E+05	3.78E+04	1.03E+05	3.06E+05
241-SX-103	Salt Cake (Liquids)	R-SltCk (Liquid)	24	8.11E+01	3.76E+03	3.78E+03	4.08E+03	2.13E+00	1.04E+04
241-SX-103	Salt Cake (Liquids)	S1-SltCk (Liquid)	92	3.11E+02	1.44E+04	1.45E+04	1.07E+03	8.17E+00	4.00E+04
241-SX-104	Total		1688	8.15E+03	6.04E+05	1.31E+05	1.79E+05	5.36E+05	2.94E+05
241-SX-104	Sludge	R1 (Solid)	515	1.53E+03	9.46E+04	3.47E+04	1.29E+05	4.77E+05	7.10E+04
241-SX-104	Salt Cake (Solids)	R-SltCk (Solid)	142	2.06E+02	7.16E+04	8.23E+03	1.91E+04	3.93E+04	2.16E+04
241-SX-104	Salt Cake (Solids)	S1-SltCk (Solid)	903	6.14E+03	4.01E+05	7.30E+04	2.61E+04	2.03E+04	1.70E+05
241-SX-104	Salt Cake (Liquids)	R-SltCk (Liquid)	111	2.36E+02	3.22E+04	1.30E+04	3.95E+03	9.45E+00	2.73E+04
241-SX-104	Salt Cake (Liquids)	S1-SltCk (Liquid)	17	3.61E+01	4.93E+03	1.99E+03	6.04E+02	1.45E+00	4.18E+03
241-SX-105	Total		1422	6.64E+03	4.84E+05	1.60E+05	1.01E+05	2.38E+05	2.62E+05
241-SX-105	Sludge	R1 (Solid)	238	6.68E+02	5.64E+04	2.17E+04	5.64E+04	2.16E+05	3.21E+04
241-SX-105	Salt Cake (Solids)	S1-SltCk (Solid)	1061	5.57E+03	4.07E+05	1.21E+05	3.88E+04	2.21E+04	1.85E+05
241-SX-105	Salt Cake (Liquids)	S1-SltCk (Liquid)	123	4.01E+02	2.02E+04	1.76E+04	5.42E+03	1.86E+01	4.47E+04
241-SX-106	Total		1501	8.24E+03	5.52E+05	1.69E+05	4.93E+04	1.05E+04	3.44E+05
241-SX-106	Salt Cake (Solids)	S1-SltCk (Solid)	244	1.40E+03	9.31E+04	2.66E+04	8.29E+03	4.84E+03	4.05E+04
241-SX-106	Salt Cake (Solids)	S2-SltSlr (Solid)	1108	6.37E+03	4.23E+05	1.21E+05	3.76E+04	5.63E+03	2.51E+05
241-SX-106	Salt Cake (Liquids)	S1-SltCk (Liquid)	27	8.48E+01	6.61E+03	4.02E+03	6.12E+02	8.67E+00	9.63E+03
241-SX-106	Salt Cake (Liquids)	S2-SltSlr (Liquid)	122	3.83E+02	2.99E+04	1.82E+04	2.76E+03	3.92E+01	4.35E+04
241-SX-107	Total		357	9.52E+02	7.95E+04	2.43E+04	8.11E+04	2.89E+05	5.24E+04
241-SX-107	Sludge	R1 (Solid)	298	8.87E+02	5.48E+04	2.01E+04	7.46E+04	2.76E+05	4.11E+04
241-SX-107	Salt Cake (Solids)	R-SltCk (Solid)	44	6.38E+01	2.22E+04	2.55E+03	5.92E+03	1.22E+04	6.70E+03
241-SX-107	Salt Cake (Liquids)	R-SltCk (Liquid)	15	1.73E+00	2.61E+03	1.65E+03	6.48E+02	4.32E+02	4.63E+03
241-SX-108	Total		276	3.08E+02	1.80E+05	7.56E+03	1.84E+04	1.34E+06	8.54E+04
241-SX-108	Sludge	R1 (Solid)	276	3.08E+02	1.80E+05	7.56E+03	1.84E+04	1.34E+06	8.54E+04
241-SX-109	Total		913	1.66E+03	3.90E+05	5.50E+04	1.48E+05	3.95E+05	1.36E+05
241-SX-109	Sludge	R1 (Solid)	219	6.52E+02	4.02E+04	1.48E+04	5.48E+04	2.03E+05	3.02E+04
241-SX-109	Salt Cake (Solids)	R-SltCk (Solid)	694	1.01E+03	3.50E+05	4.02E+04	9.33E+04	1.92E+05	1.06E+05

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-SX-110	Total		212	4.74E+02	7.19E+04	1.33E+04	4.11E+04	1.29E+05	3.07E+04
241-SX-110	Sludge	R1 (Solid)	109	3.24E+02	2.00E+04	7.34E+03	2.73E+04	1.01E+05	1.50E+04
241-SX-110	Salt Cake (Solids)	R-SltCk (Solid)	103	1.49E+02	5.19E+04	5.97E+03	1.39E+04	2.85E+04	1.57E+04
241-SX-111	Total		436	1.02E+03	1.15E+05	2.99E+04	8.87E+04	2.99E+05	6.80E+04
241-SX-111	Sludge	R1 (Solid)	289	8.60E+02	5.31E+04	1.95E+04	7.23E+04	2.68E+05	3.98E+04
241-SX-111	Salt Cake (Solids)	R-SltCk (Solid)	110	1.59E+02	5.54E+04	6.38E+03	1.48E+04	3.04E+04	1.67E+04
241-SX-111	Salt Cake (Liquids)	R-SltCk (Liquid)	37	4.26E+00	6.44E+03	4.07E+03	1.60E+03	1.06E+03	1.14E+04
241-SX-112	Total		283	7.10E+02	6.88E+04	1.93E+04	6.10E+04	2.11E+05	4.28E+04
241-SX-112	Sludge	R1 (Solid)	212	6.31E+02	3.90E+04	1.43E+04	5.31E+04	1.96E+05	2.92E+04
241-SX-112	Salt Cake (Solids)	R-SltCk (Solid)	53	7.68E+01	2.67E+04	3.07E+03	7.13E+03	1.47E+04	8.06E+03
241-SX-112	Salt Cake (Liquids)	R-SltCk (Liquid)	18	2.07E+00	3.13E+03	1.98E+03	7.78E+02	5.18E+02	5.56E+03
241-SX-113	Total		71	1.03E+01	6.38E+02	2.34E+02	2.28E+03	6.88E+03	3.15E+03
241-SX-113	Sludge	DE (Solid)	63	0.00E+00	0.00E+00	2.34E+02	1.42E+03	3.67E+03	2.67E+03
241-SX-113	Sludge	R1 (Solid)	8	1.03E+01	6.38E+02	0.00E+00	8.69E+02	3.21E+03	4.79E+02
241-SX-114	Total		588	9.52E+02	2.12E+05	4.10E+04	8.76E+04	2.38E+05	1.04E+05
241-SX-114	Sludge	R1 (Solid)	156	4.64E+02	2.87E+04	1.05E+04	3.90E+04	1.44E+05	2.15E+04
241-SX-114	Salt Cake (Solids)	R-SltCk (Solid)	328	4.76E+02	1.65E+05	1.90E+04	4.41E+04	9.07E+04	4.99E+04
241-SX-114	Salt Cake (Liquids)	R-SltCk (Liquid)	104	1.20E+01	1.81E+04	1.14E+04	4.49E+03	2.99E+03	3.21E+04
241-SX-115	Total		14	2.74E+01	3.07E+03	5.15E+01	1.19E+03	3.63E+05	2.30E+03
241-SX-115	Sludge	R1 (Solid)	14	2.74E+01	3.07E+03	5.15E+01	1.19E+03	3.63E+05	2.30E+03
241-SY-101	Total		4180	4.55E+04	5.18E+05	3.66E+05	1.34E+05	7.18E+04	9.81E+05
241-SY-101	Supernatant	NA	3196	1.80E+04	4.11E+05	2.92E+05	5.43E+04	9.98E+03	7.68E+05
241-SY-101	Salt Cake	S2-SltSlr (Solid)	984	2.75E+04	1.08E+05	7.42E+04	8.00E+04	6.18E+04	2.12E+05
241-SY-102	Total		3201	2.33E+04	3.36E+05	2.21E+05	7.84E+04	7.01E+04	6.30E+05
241-SY-102	Supernatant	NA	2651	8.64E+03	2.70E+05	1.86E+05	5.43E+04	2.87E+03	5.25E+05
241-SY-102	Sludge (Solids)	Z (Solid)	186	6.80E+03	2.36E+04	1.06E+04	8.87E+03	3.27E+04	3.43E+04
241-SY-102	Sludge (Liquids)	Z (Liquid)	83	3.86E+02	1.11E+04	6.07E+03	6.29E+02	1.33E+02	1.66E+04
241-SY-102	Salt Cake (Solids)	NA	194	7.10E+03	1.90E+04	1.25E+04	1.39E+04	3.42E+04	3.58E+04
241-SY-102	Salt Cake (Liquids)	NA	87	4.04E+02	1.16E+04	6.36E+03	6.60E+02	1.39E+02	1.74E+04
241-SY-103	Total		2756	2.67E+04	5.09E+05	3.99E+05	1.30E+05	7.33E+04	1.17E+06
241-SY-103	Supernatant	S2-SltSlr (Liquid)	1543	9.50E+03	2.59E+05	2.35E+05	5.80E+04	4.37E+03	7.15E+05
241-SY-103	Salt Cake	S2-SltSlr (Solid)	1213	1.72E+04	2.50E+05	1.64E+05	7.15E+04	6.89E+04	4.60E+05
241-T-101	Total		376	1.98E+03	1.20E+05	1.65E+04	3.58E+04	1.05E+04	4.62E+04
241-T-101	Sludge	CWR2 (Solid)	140	2.90E+02	5.44E+03	2.95E+03	2.84E+04	2.19E+03	8.01E+03
241-T-101	Salt Cake (Solids)	T2-SltCk (Solid)	177	1.05E+03	1.05E+05	7.86E+03	5.20E+03	6.71E+03	2.27E+04
241-T-101	Salt Cake (Liquids)	T2-SltCk (Liquid)	59	6.37E+02	9.79E+03	5.68E+03	2.21E+03	1.60E+03	1.55E+04
241-T-102	Total		121	1.06E+02	9.96E+03	2.31E+03	3.33E+04	2.29E+04	6.85E+03
241-T-102	Supernatant	CSR (Liquid)	49	2.20E+01	5.34E+03	1.13E+03	4.08E+02	5.14E+01	2.71E+03
241-T-102	Sludge	CWP2 (Solid)	64	7.50E+01	4.01E+03	9.16E+02	3.29E+04	2.29E+04	3.08E+03
241-T-102	Sludge	MW (Solid)	8	9.11E+00	6.12E+02	2.69E+02	0.00E+00	1.60E+01	1.07E+03
241-T-103	Total		102	1.17E+02	4.95E+03	2.42E+03	1.86E+04	1.34E+05	4.75E+03
241-T-103	Supernatant	BL (Liquid)	4	2.36E-03	2.06E+02	9.80E+00	2.82E+01	1.15E+02	0.00E+00
241-T-103	Supernatant	CSR (Liquid)	11	5.41E-03	9.76E+02	5.52E+02	1.34E+02	6.43E+02	3.72E+02
241-T-103	Sludge	CWP2 (Solid)	64	7.34E+01	2.73E+03	1.32E+03	1.46E+04	1.32E+05	2.76E+03
241-T-103	Sludge	CWR1 (Solid)	19	3.94E+01	7.39E+02	4.00E+02	3.85E+03	2.97E+02	1.09E+03
241-T-103	Sludge	MW (Solid)	4	4.56E+00	3.06E+02	1.35E+02	0.00E+00	8.02E+00	5.34E+02

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-T-104	Total		1199	8.81E+02	8.97E+04	6.55E+03	2.51E+04	3.38E+03	2.57E+02
241-T-104	Sludge	1C (Solid)	1199	8.81E+02	8.97E+04	6.55E+03	2.51E+04	3.38E+03	2.57E+02
241-T-105	Total		371	1.33E+03	1.25E+04	1.76E+04	2.43E+04	4.44E+04	2.84E+04
241-T-105	Sludge	1C (Solid)	7	4.24E+01	2.10E+02	2.99E+02	1.08E+03	2.16E+03	3.82E+02
241-T-105	Sludge	2C (Solid)	273	7.37E+02	9.52E+03	1.34E+04	9.17E+03	1.41E+04	2.30E+04
241-T-105	Sludge	CWR1 (Solid)	46	2.79E+02	1.38E+03	1.96E+03	7.12E+03	1.42E+04	2.51E+03
241-T-105	Sludge	R1 (Solid)	45	2.73E+02	1.35E+03	1.92E+03	6.97E+03	1.39E+04	2.46E+03
241-T-106	Total		82	1.63E+02	1.41E+04	1.98E+03	1.12E+04	1.28E+03	4.83E+03
241-T-106	Sludge	1C (Solid)	38	6.49E+01	1.22E+04	9.80E+02	1.63E+03	5.42E+02	2.12E+03
241-T-106	Sludge	CWR1 (Solid)	44	9.84E+01	1.84E+03	9.99E+02	9.60E+03	7.42E+02	2.71E+03
241-T-107	Total		655	8.82E+02	7.21E+04	1.13E+04	3.83E+04	1.11E+05	1.61E+04
241-T-107	Sludge	1C (Solid)	559	7.53E+02	6.15E+04	9.65E+03	1.87E+03	9.45E+04	1.38E+04
241-T-107	Sludge	CWP2 (Solid)	32	4.31E+01	3.52E+03	5.52E+02	3.74E+03	5.41E+03	7.88E+02
241-T-107	Sludge	TBP (Solid)	64	8.62E+01	7.04E+03	1.10E+03	3.27E+04	1.08E+04	1.58E+03
241-T-108	Total		60	1.74E+01	2.32E+04	7.34E+02	5.48E+02	3.31E+02	8.03E+02
241-T-108	Sludge	1C (Solid)	20	1.74E+01	3.27E+03	2.63E+02	4.37E+02	1.45E+02	5.69E+02
241-T-108	Salt Cake (Solids)	T1-SltCk (Solid)	30	4.86E-02	1.82E+04	2.87E+02	1.06E+02	4.96E+00	8.21E+01
241-T-108	Salt Cake (Liquids)	T1-SltCk (Liquid)	10	4.45E-06	1.74E+03	1.84E+02	4.65E+00	1.80E+02	1.52E+02
241-T-109	Total		235	1.75E-01	1.44E+04	1.22E+03	3.54E+02	1.08E+03	1.31E+03
241-T-109	Salt Cake (Solids)	T1-SltCk (Solid)	176	1.75E-01	4.09E+03	1.34E+02	3.27E+02	1.78E+01	4.09E+02
241-T-109	Salt Cake (Liquids)	T1-SltCk (Liquid)	59	2.63E-05	1.03E+04	1.09E+03	2.74E+01	1.06E+03	8.98E+02
241-T-110	Total		1400	1.64E+03	1.15E+05	1.09E+04	2.11E+03	3.07E+04	5.00E+04
241-T-110	Supernatant	2C1 (Liquid)	3	1.35E-01	5.49E+01	1.77E-01	0.00E+00	1.45E-03	9.40E-03
241-T-110	Sludge	224 Post-1949 (Solid)	37	3.66E+01	2.70E+03	2.50E+01	6.28E+00	6.98E+01	1.49E+00
241-T-110	Sludge	2C (Solid)	1360	1.60E+03	1.12E+05	1.09E+04	2.10E+03	3.06E+04	5.00E+04
241-T-111	Total		1692	7.26E+03	1.22E+05	1.57E+03	7.36E+02	9.23E+03	2.29E+02
241-T-111	Sludge	224 Post-1949 (Solid)	758	3.25E+03	5.45E+04	7.04E+02	3.30E+02	4.13E+03	1.02E+02
241-T-111	Sludge	2C (Solid)	934	4.01E+03	6.72E+04	8.67E+02	4.06E+02	5.09E+03	1.26E+02
241-T-112	Total		252	2.81E+02	5.62E+03	9.13E+03	1.48E+03	3.37E+03	5.15E+03
241-T-112	Supernatant	2C2 (Liquid)	26	1.14E+01	6.06E+02	1.01E+03	0.00E+00	5.21E+01	5.98E+01
241-T-112	Sludge	224 Post-1949 (Solid)	99	1.07E+02	2.20E+03	3.56E+03	6.48E+02	2.04E+02	4.36E+00
241-T-112	Sludge	2C (Solid)	127	1.63E+02	2.82E+03	4.56E+03	8.31E+02	3.12E+03	5.09E+03
241-T-201	Total		118	2.88E+01	6.67E+03	6.06E+01	1.18E+01	1.13E+01	4.40E+00
241-T-201	Supernatant	224 (Liquid)	8	6.29E-05	3.69E+02	2.68E+00	0.00E+00	8.61E-01	9.81E-01
241-T-201	Sludge	224 Pre-1949 (Solid)	110	2.88E+01	6.30E+03	5.79E+01	1.18E+01	1.04E+01	3.42E+00
241-T-202	Total		81	3.48E+01	5.89E+03	6.11E+01	7.02E+00	2.30E-01	2.61E+00
241-T-202	Sludge	224 Post-1949 (Solid)	81	3.48E+01	5.89E+03	6.11E+01	7.02E+00	2.30E-01	2.61E+00
241-T-203	Total		140	7.24E+01	1.00E+04	5.71E+01	9.69E+00	4.07E-01	2.87E+00
241-T-203	Sludge	224 Post-1949 (Solid)	140	7.24E+01	1.00E+04	5.71E+01	9.69E+00	4.07E-01	2.87E+00
241-T-204	Total		140	5.29E+01	9.34E+03	4.80E+01	9.08E+00	7.18E-01	1.21E+00
241-T-204	Sludge	224 Post-1949 (Solid)	140	5.29E+01	9.34E+03	4.80E+01	9.08E+00	7.18E-01	1.21E+00

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-TX-101	Total		344	1.26E+03	8.10E+04	2.19E+04	6.95E+04	2.48E+05	4.83E+04
241-TX-101	Sludge	MW (Solid)	11	1.25E+01	8.42E+02	3.70E+02	0.00E+00	2.20E+01	1.47E+03
241-TX-101	Sludge	R1 (Solid)	265	7.88E+02	4.87E+04	1.79E+04	6.63E+04	2.45E+05	3.65E+04
241-TX-101	Sludge	Z (Solid)	4	0.00E+00	3.53E+02	1.43E+00	1.18E+03	0.00E+00	0.00E+00
241-TX-101	Salt Cake (Solids)	T2-SltCk (Solid)	48	2.85E+02	2.85E+04	2.13E+03	1.41E+03	1.82E+03	6.16E+03
241-TX-101	Salt Cake (Liquids)	T2-SltCk (Liquid)	16	1.73E+02	2.66E+03	1.54E+03	5.98E+02	4.33E+02	4.19E+03
241-TX-102	Total		821	5.43E+03	4.31E+05	4.26E+04	2.49E+04	2.95E+04	1.22E+05
241-TX-102	Sludge	MW (Solid)	8	9.11E+00	6.12E+02	2.69E+02	0.00E+00	1.60E+01	1.07E+03
241-TX-102	Salt Cake (Solids)	T2-SltCk (Solid)	692	4.11E+03	4.10E+05	3.07E+04	2.03E+04	2.62E+04	8.88E+04
241-TX-102	Salt Cake (Liquids)	T2-SltCk (Liquid)	121	1.31E+03	2.01E+04	1.16E+04	4.53E+03	3.28E+03	3.17E+04
241-TX-103	Total		548	3.51E+03	2.93E+05	2.74E+04	1.63E+04	1.96E+04	7.77E+04
241-TX-103	Salt Cake (Solids)	T1-SltCk (Solid)	9	1.33E-02	2.96E+03	9.96E+01	2.46E+01	1.36E+00	3.11E+01
241-TX-103	Salt Cake (Solids)	T2-SltCk (Solid)	470	2.79E+03	2.79E+05	2.09E+04	1.38E+04	1.78E+04	6.03E+04
241-TX-103	Salt Cake (Liquids)	T1-SltCk (Liquid)	3	7.13E+02	5.22E+02	5.52E+01	1.40E+00	5.41E+01	4.57E+01
241-TX-103	Salt Cake (Liquids)	T2-SltCk (Liquid)	66	1.34E-06	1.10E+04	6.35E+03	2.47E+03	1.79E+03	1.73E+04
241-TX-104	Total		262	5.66E+02	1.07E+05	1.16E+04	4.14E+04	9.93E+04	3.31E+04
241-TX-104	Supernatant	T2-SltCk (Liquid)	9	1.22E+01	3.19E+03	8.48E+02	2.87E+01	2.36E+02	2.28E+03
241-TX-104	Sludge	R1 (Solid)	130	1.77E+02	4.92E+04	3.05E+03	3.84E+04	9.57E+04	1.42E+04
241-TX-104	Salt Cake (Solids)	T2-SltCk (Solid)	92	3.35E+02	4.37E+04	4.75E+03	2.89E+03	2.56E+03	8.66E+03
241-TX-104	Salt Cake (Liquids)	T2-SltCk (Liquid)	31	4.21E+01	1.10E+04	2.92E+03	9.89E+01	8.14E+02	7.87E+03
241-TX-105	Total		2181	1.33E+04	1.23E+06	1.02E+05	6.40E+04	8.04E+04	2.94E+05
241-TX-105	Sludge	MW (Solid)	31	3.53E+01	2.37E+03	1.04E+03	0.00E+00	6.21E+01	4.14E+03
241-TX-105	Salt Cake (Solids)	T2-SltCk (Solid)	2044	1.22E+04	1.21E+06	9.08E+04	6.01E+04	7.74E+04	2.62E+05
241-TX-105	Salt Cake (Liquids)	T2-SltCk (Liquid)	106	1.14E+03	1.76E+04	1.02E+04	3.96E+03	2.87E+03	2.78E+04
241-TX-106	Total		1318	8.50E+03	7.08E+05	6.67E+04	4.34E+04	6.24E+04	1.89E+05
241-TX-106	Sludge	MW (Solid)	4	4.56E+00	3.06E+02	1.35E+02	0.00E+00	8.02E+00	5.34E+02
241-TX-106	Sludge	R1 (Solid)	16	4.76E+01	2.94E+03	1.08E+03	4.00E+03	1.48E+04	2.21E+03
241-TX-106	Salt Cake (Solids)	T2-SltCk (Solid)	1147	6.82E+03	6.80E+05	5.10E+04	3.37E+04	4.35E+04	1.47E+05
241-TX-106	Salt Cake (Liquids)	T2-SltCk (Liquid)	151	1.63E+03	2.51E+04	1.45E+04	5.65E+03	4.09E+03	3.96E+04
241-TX-107	Total		112	7.03E+02	6.14E+04	7.52E+03	6.42E+03	1.00E+04	2.10E+04
241-TX-107	Salt Cake (Solids)	R-SltCk (Solid)	23	3.33E+01	1.16E+04	1.33E+03	3.09E+03	6.36E+03	3.50E+03
241-TX-107	Salt Cake (Solids)	T2-SltCk (Solid)	61	4.52E+02	4.51E+04	3.38E+03	2.24E+03	2.88E+03	9.76E+03
241-TX-107	Salt Cake (Liquids)	R-SltCk (Liquid)	8	9.20E-01	1.39E+03	8.80E+02	3.46E+02	2.30E+02	2.47E+03
241-TX-107	Salt Cake (Liquids)	T2-SltCk (Liquid)	20	2.16E+02	3.32E+03	1.92E+03	7.48E+02	5.42E+02	5.24E+03
241-TX-108	Total		489	2.96E+03	2.66E+05	2.32E+04	1.40E+04	2.18E+04	6.53E+04
241-TX-108	Sludge	MW (Solid)	5	5.70E+00	3.83E+02	1.68E+02	0.00E+00	1.00E+01	6.68E+02
241-TX-108	Sludge	TBP (Solid)	19	1.74E+01	5.34E+03	5.19E+02	6.34E+01	4.52E+03	2.54E+02
241-TX-108	Salt Cake (Solids)	T2-SltCk (Solid)	430	2.56E+03	2.55E+05	1.91E+04	1.26E+04	1.63E+04	5.52E+04
241-TX-108	Salt Cake (Liquids)	T2-SltCk (Liquid)	35	3.78E+02	5.81E+03	3.37E+03	1.31E+03	9.48E+02	9.17E+03
241-TX-109	Total		1375	1.20E+03	2.25E+05	1.80E+04	3.01E+04	9.99E+03	3.91E+04
241-TX-109	Sludge	1C (Solid)	1375	1.20E+03	2.25E+05	1.80E+04	3.01E+04	9.99E+03	3.91E+04
241-TX-110	Total		1767	9.95E+03	9.73E+05	7.58E+04	5.11E+04	6.23E+04	2.17E+05
241-TX-110	Sludge	1C (Solid)	140	1.22E+02	2.29E+04	1.84E+03	3.06E+03	1.02E+03	3.98E+03
241-TX-110	Salt Cake (Solids)	T2-SltCk (Solid)	1594	9.48E+03	9.45E+05	7.08E+04	4.69E+04	6.04E+04	2.04E+05
241-TX-110	Salt Cake (Liquids)	T2-SltCk (Liquid)	33	3.56E+02	5.48E+03	3.17E+03	1.23E+03	8.94E+02	8.65E+03

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-TX-111	Total		1383	7.46E+03	7.45E+05	5.70E+04	3.95E+04	4.73E+04	1.63E+05
241-TX-111	Sludge	1C (Solid)	162	1.41E+02	2.65E+04	2.13E+03	3.54E+03	1.18E+03	4.61E+03
241-TX-111	Salt Cake (Solids)	T2-SltCk (Solid)	1208	7.18E+03	7.16E+05	5.37E+04	3.55E+04	4.58E+04	1.55E+05
241-TX-111	Salt Cake (Liquids)	T2-SltCk (Liquid)	13	1.40E+02	2.16E+03	1.25E+03	4.86E+02	3.52E+02	3.41E+03
241-TX-112	Total		2398	1.42E+04	1.36E+06	1.08E+05	6.88E+04	8.67E+04	3.09E+05
241-TX-112	Salt Cake (Solids)	T1-SltCk (Solid)	75	1.11E-01	2.46E+04	8.30E+02	2.05E+02	1.13E+01	2.59E+02
241-TX-112	Salt Cake (Solids)	T2-SltCk (Solid)	2215	1.32E+04	1.31E+06	9.84E+04	6.51E+04	8.39E+04	2.84E+05
241-TX-112	Salt Cake (Liquids)	T1-SltCk (Liquid)	15	6.68E-06	2.61E+03	2.76E+02	6.98E+00	2.70E+02	2.28E+02
241-TX-112	Salt Cake (Liquids)	T2-SltCk (Liquid)	93	1.00E+03	1.54E+04	8.95E+03	3.48E+03	2.52E+03	2.44E+04
241-TX-113	Total		2416	1.58E+03	1.68E+06	1.50E+04	1.70E+04	6.39E+03	3.37E+04
241-TX-113	Sludge	1C (Solid)	351	3.05E+02	5.74E+04	4.61E+03	7.67E+03	2.55E+03	9.98E+03
241-TX-113	Salt Cake (Solids)	T2-SltCk (Solid)	2044	1.05E+03	1.62E+06	8.36E+03	8.55E+03	3.27E+03	1.83E+04
241-TX-113	Salt Cake (Liquids)	T2-SltCk (Liquid)	21	2.27E+02	3.49E+03	2.02E+03	7.85E+02	5.69E+02	5.50E+03
241-TX-114	Total		2015	1.07E+04	1.11E+06	8.35E+04	5.34E+04	6.81E+04	2.34E+05
241-TX-114	Sludge	1C (Solid)	15	1.30E+01	2.45E+03	1.97E+02	3.28E+02	1.09E+02	4.26E+02
241-TX-114	Salt Cake (Solids)	T1-SltCk (Solid)	173	2.56E-01	5.68E+04	1.91E+03	4.72E+02	2.61E+01	5.98E+02
241-TX-114	Salt Cake (Solids)	T2-SltCk (Solid)	1753	1.04E+04	1.04E+06	7.79E+04	5.15E+04	6.64E+04	2.25E+05
241-TX-114	Salt Cake (Liquids)	T1-SltCk (Liquid)	46	2.05E-05	8.00E+03	8.46E+02	1.05E+03	8.29E+02	7.00E+02
241-TX-114	Salt Cake (Liquids)	T2-SltCk (Liquid)	28	3.02E+02	4.65E+03	2.69E+03	2.14E+01	7.58E+02	7.34E+03
241-TX-115	Total		2096	1.28E+04	1.19E+06	9.79E+04	6.16E+04	8.45E+04	2.79E+05
241-TX-115	Sludge	TBP (Solid)	31	2.85E+01	8.71E+03	8.47E+02	1.03E+02	7.37E+03	4.14E+02
241-TX-115	Salt Cake (Solids)	T2-SltCk (Solid)	1962	1.17E+04	1.16E+06	8.72E+04	5.77E+04	7.43E+04	2.52E+05
241-TX-115	Salt Cake (Liquids)	T2-SltCk (Liquid)	103	1.11E+03	1.71E+04	9.91E+03	3.85E+03	2.79E+03	2.70E+04
241-TX-116	Total		2264	7.63E+03	1.43E+06	3.32E+04	6.86E+04	6.45E+03	1.06E+05
241-TX-116	Sludge	DE (Solid)	248	2.21E+03	3.40E+04	1.97E+04	7.65E+03	5.54E+03	5.36E+04
241-TX-116	Salt Cake (Solids)	T1-SltCk (Solid)	985	1.74E+00	8.78E+05	3.05E+02	2.64E+03	1.48E+02	4.12E+03
241-TX-116	Salt Cake (Solids)	T2-SltCk (Solid)	918	5.39E+03	4.74E+05	1.20E+04	5.83E+04	7.58E+02	4.54E+04
241-TX-116	Salt Cake (Liquids)	T1-SltCk (Liquid)	113	3.60E+01	4.28E+04	1.19E+03	9.93E-01	2.29E-01	2.50E+03
241-TX-117	Total		1819	6.26E+03	8.35E+05	5.43E+04	3.29E+04	4.05E+04	1.38E+05
241-TX-117	Sludge	DE (Solid)	110	0.00E+00	0.00E+00	0.00E+00	2.46E+02	0.00E+00	0.00E+00
241-TX-117	Salt Cake (Solids)	T1-SltCk (Solid)	626	9.26E-01	2.06E+05	6.93E+03	1.71E+03	9.45E+01	2.16E+03
241-TX-117	Salt Cake (Solids)	T2-SltCk (Solid)	1053	6.26E+03	6.24E+05	4.68E+04	3.09E+04	3.99E+04	1.35E+05
241-TX-117	Salt Cake (Liquids)	T1-SltCk (Liquid)	30	1.34E-05	5.22E+03	5.52E+02	1.40E+01	5.41E+02	4.57E+02
241-TX-118	Total		968	1.45E+04	1.06E+05	2.78E+04	1.54E+04	1.80E+05	6.96E+04
241-TX-118	Salt Cake (Solids)		256	9.24E+03	4.14E+03	1.03E+03	5.95E+03	1.14E+05	4.14E+03
241-TX-118	Salt Cake (Solids)	T2-SltCk (Solid)	573	3.74E+03	7.87E+04	1.34E+04	4.29E+03	6.20E+04	2.90E+04
241-TX-118	Salt Cake (Liquids)	T2-SltCk (Liquid)	139	1.50E+03	2.31E+04	1.34E+04	5.20E+03	3.77E+03	3.64E+04
241-TY-101	Total		447	4.84E+02	1.06E+05	9.33E+03	2.12E+04	6.34E+03	1.76E+02
241-TY-101	Sludge	1CFcCN (Solid)	273	2.97E+02	6.49E+04	7.91E+03	1.30E+04	3.87E+03	8.95E+01
241-TY-101	Salt Cake (Solids)	T1-SltCk (Solid)	172	1.87E+02	4.09E+04	1.39E+03	8.19E+03	2.44E+03	5.64E+01
241-TY-101	Salt Cake (Liquids)	T1-SltCk (Liquid)	2	8.90E-07	3.48E+02	3.68E+01	9.30E-01	3.61E+01	3.05E+01
241-TY-102	Total		261	5.00E+02	1.95E+05	9.71E+03	1.48E+03	2.64E+03	1.05E+04
241-TY-102	Salt Cake (Solids)	T1-SltCk (Solid)	89	5.47E+01	8.27E+04	9.85E+02	6.91E+01	5.35E+02	3.94E+02
241-TY-102	Salt Cake (Solids)	T2-SltCk (Solid)	109	6.70E+01	1.01E+05	4.84E+03	8.46E+01	6.56E+02	4.83E+02
241-TY-102	Salt Cake (Liquids)	T1-SltCk (Liquid)	28	1.25E-05	4.87E+03	5.15E+02	1.30E+01	5.05E+02	4.26E+02
241-TY-102	Salt Cake (Liquids)	T2-SltCk (Liquid)	35	3.78E+02	5.81E+03	3.37E+03	1.31E+03	9.48E+02	9.17E+03

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-TY-103	Total		587	1.49E+03	1.45E+05	4.37E+04	4.19E+03	7.55E+04	2.21E+04
241-TY-103	Sludge	1CFeCN (Solid)	170	3.33E+02	4.30E+04	1.24E+04	8.59E+02	2.30E+04	3.76E+03
241-TY-103	Sludge	TBP (Solid)	220	4.31E+02	5.57E+04	1.61E+04	1.11E+03	2.98E+04	4.87E+03
241-TY-103	Salt Cake (Solids)	T2-SltCk (Solid)	159	3.12E+02	4.02E+04	1.16E+04	8.03E+02	2.16E+04	3.52E+03
241-TY-103	Salt Cake (Liquids)	T2-SltCk (Liquid)	38	4.10E+02	6.31E+03	3.66E+03	1.42E+03	1.03E+03	9.96E+03
241-TY-104	Total		167	1.76E+03	3.76E+03	1.29E+04	2.50E+03	2.52E+04	8.82E+03
241-TY-104	Supernatant	DW (Liquid)	4	8.44E+00	3.96E+02	4.52E+01	2.28E+00	2.61E-01	4.91E+01
241-TY-104	Sludge	1CFeCN (Solid)	114	1.23E+03	2.35E+03	8.98E+03	1.75E+03	1.77E+04	6.14E+03
241-TY-104	Sludge	TBP (Solid)	49	5.28E+02	1.01E+03	3.86E+03	7.52E+02	7.59E+03	2.64E+03
241-TY-105	Total		874	1.08E+03	2.38E+05	2.68E+04	2.55E+03	2.13E+05	8.94E+03
241-TY-105	Sludge	TBP (Solid)	874	1.08E+03	2.38E+05	2.68E+04	2.55E+03	2.13E+05	8.94E+03
241-TY-106	Total		62	2.48E+02	1.43E+04	7.24E+02	1.91E+02	1.13E+04	5.25E+03
241-TY-106	Sludge	DE (Solid)	47	1.88E+02	1.09E+04	5.48E+02	1.45E+02	8.56E+03	3.98E+03
241-TY-106	Sludge	TBP (Solid)	15	5.99E+01	3.46E+03	1.75E+02	4.62E+01	2.73E+03	1.27E+03
241-U-101	Total		89	2.47E+02	1.52E+04	5.59E+03	2.08E+04	7.68E+04	1.14E+04
241-U-101	Sludge	R1 (Solid)	89	2.47E+02	1.52E+04	5.59E+03	2.08E+04	7.68E+04	1.14E+04
241-U-102	Total			1.42E+04	5.27E+05	1.01E+05	6.92E+04	2.12E+05	3.15E+05
241-U-102	Supernatant	T2-SltCk (Liquid)	4	4.48E+01	7.92E+02	5.84E+02	1.33E+02	2.90E+01	1.93E+03
241-U-102	Sludge	R1 (Solid)	163	4.85E+02	3.00E+04	1.10E+04	4.08E+04	1.51E+05	2.25E+04
241-U-102	Salt Cake (Solids)	S2-SltSlr (Solid)	307	3.97E+03	1.52E+05	2.34E+04	7.84E+03	1.93E+04	7.53E+04
241-U-102	Salt Cake (Solids)	T2-SltCk (Solid)	647	8.37E+03	3.21E+05	4.92E+04	1.65E+04	4.07E+04	1.59E+05
241-U-102	Salt Cake (Liquids)	T2-SltCk (Liquid)	117	1.31E+03	2.32E+04	1.71E+04	3.88E+03	8.47E+02	5.64E+04
241-U-103	Total			1.91E+04	5.04E+05	1.24E+05	4.86E+04	5.17E+04	3.09E+05
241-U-103	Supernatant	S1-SltCk (Liquid)	2	2.48E+01	3.04E+02	2.74E+02	8.18E+01	2.02E+01	9.55E+02
241-U-103	Sludge	R1 (Solid)	42	6.66E+02	6.21E+03	3.17E+03	8.46E+03	2.95E+04	4.39E+03
241-U-103	Salt Cake (Solids)	S1-SltCk (Solid)	891	1.21E+04	3.42E+05	7.45E+04	2.52E+04	1.91E+04	1.60E+05
241-U-103	Salt Cake (Solids)	S2-SltSlr (Solid)	356	4.84E+03	1.37E+05	2.98E+04	1.01E+04	1.95E+03	8.68E+04
241-U-103	Salt Cake (Liquids)	S1-SltCk (Liquid)	119	1.48E+03	1.81E+04	1.63E+04	4.87E+03	1.20E+03	5.68E+04
241-U-104	Total			3.84E+02	5.59E+04	2.00E+04	3.26E+04	1.27E+05	3.79E+04
241-U-104	Sludge	DE (Solid)	333	0.00E+00	3.22E+04	1.13E+04	3.16E+02	7.84E+03	2.01E+04
241-U-104	Sludge	R1 (Solid)	129	3.84E+02	2.37E+04	8.69E+03	3.23E+04	1.19E+05	1.78E+04
241-U-105	Total			4.02E+04	6.41E+05	1.01E+05	6.25E+04	1.97E+04	3.27E+05
241-U-105	Sludge	CWR1 (Solid)	121	2.02E+03	3.33E+04	4.09E+03	3.17E+04	1.99E+03	1.55E+04
241-U-105	Salt Cake (Solids)	S2-SltSlr (Solid)	825	2.79E+04	4.54E+05	6.23E+04	2.03E+04	5.19E+03	1.96E+05
241-U-105	Salt Cake (Solids)	T2-SltCk (Solid)	223	7.54E+03	1.23E+05	1.68E+04	5.50E+03	8.50E+03	5.31E+04
241-U-105	Salt Cake (Liquids)	S2-SltSlr (Liquid)	132	2.16E+03	2.39E+04	1.43E+04	3.93E+03	3.20E+03	4.93E+04
241-U-105	Salt Cake (Liquids)	T2-SltCk (Liquid)	35	5.74E+02	6.34E+03	3.78E+03	1.04E+03	8.48E+02	1.31E+04
241-U-106	Total			2.33E+04	2.03E+05	5.28E+04	1.11E+04	6.34E+04	1.56E+05
241-U-106	Supernatant	S1-SltCk (Liquid)	6	2.57E+02	1.49E+03	5.94E+02	7.22E+01	3.55E+02	1.81E+03
241-U-106	Salt Cake (Solids)	S1-SltCk (Solid)	478	1.62E+04	1.62E+05	3.63E+04	9.10E+03	5.36E+04	1.06E+05
241-U-106	Salt Cake (Liquids)	S1-SltCk (Liquid)	160	6.85E+03	3.98E+04	1.58E+04	1.92E+03	9.46E+03	4.84E+04

Table A-2. Tank Waste Inventory from BBI Detail Report (July 2003)
for Hydrogen Generation Rate Calculations. (16 sheets)

Tank Name	Waste Phase	Waste Type	Vol. (kL)	TOC (Kg)	NO3 (Kg)	NO2 (Kg)	Al (Kg)	90Sr (Ci)	137Cs (Ci)
241-U-107	Total			3.23E+03	6.91E+05	7.26E+04	4.00E+04	5.42E+03	1.58E+05
241-U-107	Sludge	CWR1 (Solid)	57	1.18E+02	2.22E+03	1.20E+03	1.15E+04	8.91E+02	3.26E+03
241-U-107	Salt Cake (Solids)	S2-SltSlr (Solid)	996	2.54E+03	6.52E+05	5.94E+04	2.43E+04	4.32E+03	4.91E+03
241-U-107	Salt Cake (Solids)	T2-SltCk (Solid)	40	1.02E+02	2.62E+04	2.38E+03	9.77E+02	1.73E+02	1.22E+05
241-U-107	Salt Cake (Liquids)	S2-SltSlr (Liquid)	72	4.52E+02	1.02E+04	9.17E+03	2.95E+03	3.44E+01	2.63E+04
241-U-107	Salt Cake (Liquids)	T2-SltCk (Liquid)	4	2.51E+01	5.69E+02	5.09E+02	1.64E+02	1.91E+00	1.46E+03
241-U-108	Total			1.21E+04	6.47E+05	1.37E+05	5.72E+04	1.97E+04	3.49E+05
241-U-108	Sludge	CWR2 (Solid)	110	0.00E+00	4.46E+03	1.24E+03	1.74E+04	3.79E+02	4.32E+02
241-U-108	Salt Cake (Solids)	S1-SltCk (Solid)	664	5.82E+03	3.34E+05	5.85E+04	1.83E+04	1.07E+04	1.48E+05
241-U-108	Salt Cake (Solids)	S2-SltSlr (Solid)	529	4.64E+03	2.66E+05	4.66E+04	1.46E+04	8.56E+03	1.18E+05
241-U-108	Salt Cake (Liquids)	S1-SltCk (Liquid)	128	9.05E+02	2.36E+04	1.72E+04	3.90E+03	3.86E+01	4.68E+04
241-U-108	Salt Cake (Liquids)	S2-SltSlr (Liquid)	101	7.14E+02	1.86E+04	1.35E+04	3.08E+03	3.05E+01	3.70E+04
241-U-109	Total			8.80E+03	5.98E+05	1.07E+05	5.74E+04	1.67E+04	2.70E+05
241-U-109	Sludge	CWR1 (Solid)	102	4.80E+02	7.71E+03	5.15E+03	2.97E+04	1.81E+03	1.21E+04
241-U-109	Salt Cake (Solids)	S1-SltCk (Solid)	602	4.02E+03	3.06E+05	4.58E+04	1.09E+04	7.99E+03	1.14E+05
241-U-109	Salt Cake (Solids)	S2-SltSlr (Solid)	511	3.41E+03	2.59E+05	3.89E+04	1.29E+04	6.78E+03	9.66E+04
241-U-109	Salt Cake (Liquids)	S1-SltCk (Liquid)	136	8.88E+02	2.52E+04	1.74E+04	3.97E+03	1.20E+02	4.74E+04
241-U-110	Total			1.25E+03	4.05E+04	1.17E+04	8.95E+04	1.98E+05	2.19E+04
241-U-110	Sludge	1C (Solid)	120	1.41E+02	7.03E+03	1.25E+03	8.33E+03	1.24E+03	6.00E+03
241-U-110	Sludge	CWR1 (Solid)	149	1.31E+02	2.48E+01	1.12E+01	1.84E+04	1.58E+02	7.40E+01
241-U-110	Sludge	R1 (Solid)	396	9.82E+02	3.35E+04	1.04E+04	6.28E+04	1.96E+05	1.58E+04
241-U-111	Total			7.09E+03	3.82E+05	7.18E+04	3.87E+04	5.58E+04	2.00E+05
241-U-111	Sludge	1C (Solid)	49	4.26E+01	9.00E+03	6.43E+02	1.07E+03	3.56E+02	1.39E+03
241-U-111	Sludge	R1 (Solid)	49	1.46E+02	8.01E+03	3.30E+03	1.23E+04	4.54E+04	6.75E+03
241-U-111	Salt Cake (Solids)	S1-SltCk (Solid)	318	2.16E+03	1.41E+05	2.57E+04	9.18E+03	7.15E+03	5.98E+04
241-U-111	Salt Cake (Solids)	S2-SltSlr (Solid)	549	4.74E+03	2.24E+05	4.22E+04	1.61E+04	2.97E+03	1.32E+05
241-U-112	Total			3.80E+02	1.82E+04	9.57E+02	4.12E+04	6.59E+04	1.46E+04
241-U-112	Sludge	1C (Solid)	47	4.09E+01	7.69E+03	6.17E+02	1.03E+03	3.42E+02	1.34E+03
241-U-112	Sludge	CWR1 (Solid)	58	1.32E+02	4.86E+03	1.58E+02	1.86E+04	9.97E+02	3.65E+03
241-U-112	Sludge	R1 (Solid)	67	2.07E+02	5.61E+03	1.82E+02	2.15E+04	6.45E+04	9.61E+03
241-U-201	Total		15	2.26E+00	8.79E+02	1.29E+02	3.52E+03	2.84E+00	2.07E+02
241-U-201	Supernatant	CWR1 (Liquid)	4	0.00E+00	5.71E+02	8.28E+01	5.65E-01	5.48E-02	1.17E+02
241-U-201	Sludge (Solids)	CWR1 (Solid)	11	2.26E+00	3.08E+02	4.64E+01	3.52E+03	2.78E+00	9.07E+01
241-U-202	Total		14	2.09E+00	8.43E+02	1.37E+02	3.04E+03	1.00E+00	1.51E+02
241-U-202	Supernatant	CWR1 (Liquid)	4	5.64E-01	6.07E+02	9.81E+01	9.54E-01	2.66E-03	8.39E+01
241-U-202	Sludge	CWR1 (Solid)	10	1.52E+00	2.36E+02	3.89E+01	3.03E+03	1.00E+00	6.68E+01
241-U-203	Total		13	1.14E+00	8.08E+02	1.12E+02	1.37E+03	1.94E+00	1.38E+02
241-U-203	Supernatant	CWR1 (Liquid)	4	0.00E+00	5.76E+02	7.74E+01	7.50E-01	2.33E-03	7.87E+01
241-U-203	Sludge	CWR1 (Solid)	9	1.14E+00	2.32E+02	3.49E+01	1.37E+03	1.93E+00	5.97E+01
241-U-204	Total		11	6.35E+00	3.54E+02	4.74E+01	2.27E+03	4.22E+01	8.41E+01
241-U-204	Supernatant	CWR1 (Liquid)	4	3.24E-01	2.21E+02	2.81E+01	5.85E-02	8.44E-04	2.92E+01
241-U-204	Sludge	CWR1 (Solid)	7	6.02E+00	1.34E+02	1.93E+01	2.27E+03	4.22E+01	5.49E+01

Note:

TWINS, 2003, *Tank Waste Information Network System*, internet address: <http://twins.pnl.gov:8001>, Data from BBI Detail Calculation Report, queried July 17, 2003

Table A-3. Tanks with Retained Gas Estimates in the
BBI Derivation Document

Tank	Retained Gas (kL)*	Retained Gas - SaltCake (kL)	Retained Gas - Sludge (kL)	Total Retained Gas (kL)
241-A-101	0	179	0	179
241-AN-103	0	208	0	208
241-AN-104	119	0	0	119
241-AN-105	109	0	0	109
241-AW-101	95	0	0	95
241-S-102	0	410	22	432
241-S-111	0	172	43	215
241-SY-101	0	57	0	57
241-SY-103	82	0	0	82
241-U-103	168	0	0	168
241-U-109	0	136	30	166

Notes: TWINS, 2003, Tank Waste Information Network System, internet address: <http://twins.pnl.gov:8001>, Data from BBI Detail Calculation Report, queried August 13, 2003.

*As of the query date, these retained gas quantities had not been allocated to either saltcake or sludge.

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APPENDIX B

**HYDROGEN GENERATION RATE CALCULATIONS FROM EMPIRICAL RATE
EQUATION MODEL FOR 177 HANFORD TANKS**

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APPENDIX B

**HYDROGEN GENERATION RATE CALCULATIONS FROM EMPIRICAL RATE
EQUATION MODEL FOR 177 HANFORD TANKS**

Table B-1 Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste	B-3
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Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-AN-101	1.43E+03	9.65E+04	1.17E+05	1.61E+04	4.45E-02	9.00E+01	1.29	1.29	956	0.6	0.6	21	22
Supernatant	1.43E+03	9.65E+04	1.17E+05	1.61E+04	4.45E-02	9.00E+01	1.29	1.29	956	0.6	0.6	21	22
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	na	0.00	0	na	na	24	22
241-AN-102	2.38E+04	9.43E+04	1.99E+05	1.80E+04	6.48E+01	2.72E+02	1.50	1.49	4,080	0.5	0.0	31	29
Supernatant	2.38E+04	9.43E+04	1.99E+05	1.80E+04	5.58E+01	2.74E+02	1.49	1.49	3,573	0.6	0.6	31	29
Solid Layer	2.38E+04	9.43E+04	1.99E+05	1.80E+04	1.29E+02	2.60E+02	1.57	1.49	507	0.4	na	31	29
241-AN-103	3.05E+03	1.30E+05	1.29E+05	2.99E+04	1.08E+00	3.51E+02	1.59	1.48	3,419	0.4	na	37	31
Supernatant	3.05E+03	1.30E+05	1.29E+05	2.99E+04	1.29E+02	4.58E+02	1.48	1.48	1,890	0.5	0.5	37	31
Solid Layer	3.05E+03	1.30E+05	1.29E+05	2.99E+04	2.39E+00	2.20E+02	1.72	1.48	1,529	0.3	na	37	31
241-AN-104	3.14E+03	1.19E+05	1.90E+05	3.90E+04	1.26E+01	3.54E+02	1.48	1.40	3,865	0.5	na	37	32
Supernatant	3.14E+03	1.19E+05	1.90E+05	3.90E+04	6.31E-02	3.76E+02	1.40	1.40	2,299	0.5	0.5	35	32
Solid Layer	3.14E+03	1.19E+05	1.90E+05	3.90E+04	3.09E+01	3.22E+02	1.59	1.40	1,566	0.5	na	39	32
241-AN-105	2.76E+03	1.19E+05	1.56E+05	4.17E+04	4.75E+00	2.43E+02	1.49	1.42	4,152	0.5	na	34	32
Supernatant	2.76E+03	1.19E+05	1.56E+05	4.17E+04	2.63E-02	2.21E+02	1.42	1.42	2,227	0.5	0.5	33	32
Solid Layer	2.76E+03	1.19E+05	1.56E+05	4.17E+04	1.02E+01	2.68E+02	1.57	1.42	1,925	0.4	na	35	32
241-AN-106	5.53E+03	1.79E+04	1.12E+04	5.62E+02	6.26E+00	5.16E+01	1.16	1.11	622	0.8	na	23	23
Supernatant	5.53E+03	1.79E+04	1.12E+04	5.62E+02	2.94E+00	4.03E+01	1.11	1.11	557	0.8	0.8	23	23
Solid Layer	5.53E+03	1.79E+04	1.12E+04	5.62E+02	3.47E+01	1.49E+02	1.58	1.11	65	0.4	na	22	23
241-AN-107	3.33E+04	6.86E+04	2.15E+05	1.16E+03	8.92E+01	2.33E+02	1.44	1.43	4,093	0.5	na	33	31
Supernatant	3.33E+04	6.86E+04	2.15E+05	1.16E+03	6.52E+01	2.29E+02	1.43	1.43	3,209	0.5	0.5	33	31
Solid Layer	3.33E+04	6.86E+04	2.15E+05	1.16E+03	1.77E+02	2.47E+02	1.48	1.43	884	0.4	na	33	31
241-AP-101	1.96E+03	4.20E+04	1.32E+05	6.95E+03	6.55E-02	1.08E+02	1.31	1.31	4,216	0.6	na	23	23
Supernatant	1.96E+03	4.20E+04	1.32E+05	6.95E+03	6.55E-02	1.08E+02	1.31	1.31	4,216	0.6	0.6	23	23
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.0	na	23	23

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO_2 in liquid [NO_2] ($\mu\text{g/mL}$)	NO_3 in liquid [NO_3] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	^{90}Sr in waste [Sr] ($\mu\text{Ci/g}$)	^{137}Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Liquid Density D_L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H_2O] (wt%)	Liquid water [H_2O] (wt%)	Waste temp., T_w ($^{\circ}\text{C}$)	Dome temp., T_d ($^{\circ}\text{C}$)
241-AP-102	1.22E+03	4.54E+04	6.63E+04	1.53E+04	1.50E-01	9.11E+01	1.23	1.15	694	0.7	na	32	36
Supernatant	1.22E+03	4.54E+04	6.63E+04	1.53E+04	1.14E-01	9.17E+01	1.15	1.15	606	0.8	0.8	33	36
Solid Layer	1.22E+03	4.54E+04	6.63E+04	1.53E+04	3.96E-01	8.70E+01	1.75	1.15	88	0.3	na	24	36
241-AP-103	7.26E+03	8.03E+04	1.49E+05	1.83E+04	1.92E+00	1.81E+02	1.35	1.35	3,389	0.6	0.0	25	24
Supernatant	7.26E+03	8.03E+04	1.49E+05	1.83E+04	1.92E+00	1.81E+02	1.35	1.35	3,389	0.6	0.6	25	24
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.0	na	24	24
241-AP-104	4.58E+03	7.22E+04	1.14E+05	1.46E+04	1.45E+00	1.66E+02	1.28	1.28	4,195	0.7	na	26	39
Supernatant	4.58E+03	7.22E+04	1.14E+05	1.46E+04	1.45E+00	1.66E+02	1.28	1.28	4,195	0.7	0.7	26	39
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.0	na	25	39
241-AP-105	2.89E+03	5.04E+04	1.22E+05	2.22E+04	4.31E+00	1.54E+02	1.32	1.30	4,282	0.6	na	23	24
Supernatant	2.89E+03	5.04E+04	1.22E+05	2.22E+04	2.13E+00	1.56E+02	1.30	1.30	3,945	0.6	0.6	24	24
Solid Layer	2.89E+03	5.04E+04	1.22E+05	2.22E+04	2.99E+01	1.28E+02	1.61	1.30	337	0.5	na	23	24
241-AP-106	3.46E+03	4.13E+04	7.05E+04	1.35E+04	1.06E+00	1.55E+02	1.21	1.21	4,312	0.7	na	24	24
Supernatant	3.46E+03	4.13E+04	7.05E+04	1.35E+04	1.06E+00	1.55E+02	1.21	1.21	4,312	0.7	0.7	24	24
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.0	na	24	24
241-AP-107	2.32E+03	8.83E+04	1.35E+05	2.64E+04	2.17E-01	1.63E+02	1.32	1.32	882	0.6	na	26	29
Supernatant	2.32E+03	8.83E+04	1.35E+05	2.64E+04	2.17E-01	1.63E+02	1.32	1.32	882	0.6	0.6	26	29
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.0	na	29	29
241-AP-108	2.46E+03	7.30E+04	1.12E+05	2.24E+04	6.03E-01	1.46E+02	1.25	1.25	4,313	0.7	na	43	23
Supernatant	2.46E+03	7.30E+04	1.12E+05	2.24E+04	6.03E-01	1.46E+02	1.25	1.25	4,313	0.7	0.7	43	23
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	na	na	23	23
241-AW-101	4.01E+03	1.20E+05	1.70E+05	3.29E+04	1.35E+01	2.74E+02	1.51	1.47	4,171	0.5	na	34	30
Supernatant	4.01E+03	1.20E+05	1.70E+05	3.29E+04	2.73E-01	2.97E+02	1.47	1.47	2,768	0.5	0.5	34	30
Solid Layer	4.01E+03	1.20E+05	1.70E+05	3.29E+04	3.95E+01	2.28E+02	1.59	1.47	1,403	0.4	na	34	30

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-AW-102	8.36E+02	3.28E+04	5.02E+04	9.71E+03	1.83E+02	6.95E+01	1.26	1.13	320	0.7	na	25	28
Supernatant	8.36E+02	3.28E+04	5.02E+04	9.71E+03	6.54E+02	7.05E+01	1.13	1.13	207	0.8	0.8	24	28
Solid Layer	8.36E+02	3.28E+04	5.02E+04	9.71E+03	5.18E+02	6.77E+01	1.49	1.13	113	0.4	na	28	28
241-AW-103	2.13E+03	3.99E+04	1.24E+05	1.18E+04	2.21E+00	7.92E+01	1.31	1.24	4,170	0.6	na	22	22
Supernatant	2.13E+03	3.99E+04	1.24E+05	1.18E+04	1.06E+01	1.02E+02	1.24	1.24	2,986	0.6	0.6	22	22
Solid Layer	2.13E+03	3.99E+04	1.24E+05	1.18E+04	7.50E+00	2.30E+01	1.50	1.24	1,184	0.5	na	22	22
241-AW-104	4.93E+03	8.68E+04	1.36E+05	2.82E+04	1.90E+00	1.89E+02	1.35	1.32	4,067	0.5	na	40	40
Supernatant	4.31E+03	8.81E+04	1.41E+05	2.70E+04	1.33E+00	1.93E+02	1.32	1.32	3,224	0.6	0.6	43	40
Solid Layer	7.31E+03	8.04E+04	1.18E+05	3.29E+04	4.07E+00	1.74E+02	1.48	1.41	843	0.5	0.6	31	40
241-AW-105	3.63E+02	1.14E+04	4.42E+04	1.03E+03	1.61E+01	1.87E+01	1.25	1.06	1,611	0.7	0.0	19	20
Supernatant	9.56E+02	1.76E+03	2.52E+04	9.87E+01	2.19E+02	9.82E+00	1.06	1.06	612	0.9	0.9	19	20
Solid Layer	1.20E+02	1.73E+04	5.58E+04	1.60E+03	2.60E+01	2.41E+01	1.36	1.10	999	0.6	0.8	19	20
241-AW-106	3.50E+03	1.22E+05	1.90E+05	3.62E+04	8.85E+00	1.94E+02	1.47	1.44	3,652	0.5	na	42	48
Supernatant	3.50E+03	1.22E+05	1.90E+05	3.62E+04	3.31E+01	2.09E+02	1.44	1.44	2,748	0.5	0.5	41	48
Solid Layer	3.50E+03	1.22E+05	1.90E+05	3.62E+04	3.47E+01	1.49E+02	1.58	1.44	904	0.4	na	44	48
241-AW-101	1.37E+03	3.41E+04	4.69E+03	4.81E+03	1.81E+03	8.03E+01	1.45	1.19	685	0.5	na	39	33
Supernatant	1.37E+03	3.41E+04	4.69E+03	4.81E+03	8.51E+01	4.23E+01	1.19	1.19	320	0.8	0.8	36	33
Solid Layer	1.37E+03	3.41E+04	4.69E+03	4.81E+03	3.40E+03	1.14E+02	1.68	1.14	365	0.4	0.8	40	33
241-AW-102	1.66E+03	3.68E+04	1.81E+02	1.38E+03	1.31E+03	7.17E+01	1.23	1.17	2,711	0.7	na	55	44
Supernatant	1.09E+03	4.10E+04	4.60E+02	1.56E+03	1.38E+00	2.49E+01	1.17	1.17	2,066	0.8	0.8	49	44
Solid Layer	1.94E+03	0.00E+00	0.00E+00	1.70E+02	5.48E+03	2.22E+02	1.52	1.16	645	0.4	0.8	71	44
241-AZ-101	3.05E+02	6.13E+04	5.96E+04	7.20E+03	8.02E+02	1.26E+03	1.26	1.24	3,790	0.7	na	68	64
Supernatant	3.03E+02	6.10E+04	5.98E+04	7.18E+03	6.80E+01	1.27E+03	1.24	1.24	3,593	0.7	0.7	68	64
Solid Layer	3.35E+02	6.79E+04	5.46E+04	7.50E+03	1.54E+04	1.06E+03	1.63	1.24	197	0.4	0.7	75	64

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid [NO ₃] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-AZ-102	1.04E+03	3.25E+04	1.70E+04	4.35E+02	5.65E+02	8.98E+02	1.14	1.11	3,750	0.8	na	51	46
Supernatant	1.04E+03	3.25E+04	1.70E+04	4.35E+02	1.88E+00	9.00E+02	1.11	1.11	3,354	0.8	0.8	49	46
Solid Layer	1.04E+03	3.25E+04	1.70E+04	4.35E+02	5.34E+03	8.81E+02	1.41	1.11	396	0.4	na	58	46
241-SY-101	5.63E+03	9.14E+04	1.29E+05	1.70E+04	1.15E+01	1.70E+02	1.38	1.34	4,180	0.6	0.0	26	31
Supernatant	5.63E+03	9.14E+04	1.29E+05	1.70E+04	2.33E+00	1.79E+02	1.34	1.34	3,196	0.6	0.6	26	31
Solid Layer	5.63E+03	9.14E+04	1.29E+05	1.70E+04	4.13E+01	1.42E+02	1.52	1.34	984	0.5	na	27	31
241-SY-102	3.50E+03	7.07E+04	1.07E+05	1.83E+04	1.41E+01	1.49E+02	1.33	1.28	3,201	0.6	na	31	32
Supernatant	3.26E+03	7.02E+04	1.02E+05	2.05E+04	8.46E-01	1.55E+02	1.28	1.28	2,651	0.6	0.6	31	32
Solid Layer	4.65E+03	7.31E+04	1.34E+05	7.58E+03	7.83E+01	1.21E+02	1.56	1.36	550	0.5	0.6	30	32
241-SY-103	6.16E+03	1.52E+05	1.68E+05	3.76E+04	1.66E+01	2.80E+02	1.53	1.47	2,756	0.4	0.0	32	29
Supernatant	6.16E+03	1.52E+05	1.68E+05	3.76E+04	1.93E+00	3.15E+02	1.47	1.47	1,543	0.4	0.4	31	29
Solid Layer	6.16E+03	1.52E+05	1.68E+05	3.76E+04	3.53E+01	2.36E+02	1.61	1.47	1,213	0.4	na	33	29
241-A-101	3.75E+03	1.65E+05	2.33E+05	5.17E+04	7.43E+01	1.86E+02	1.69	1.49	1,379	0.3	na	56	41
Supernatant	3.74E+03	1.65E+05	2.33E+05	5.18E+04	5.02E-02	2.51E+02	1.49	1.49	0	0.5	na	62	41
Solid Layer	3.75E+03	1.65E+05	2.33E+05	5.17E+04	7.43E+01	1.86E+02	1.69	1.49	1,379	0.3	0.5	56	41
241-A-102	1.25E-02	1.98E+03	1.29E+05	1.64E+05	3.48E+02	1.76E+02	1.66	1.57	150	0.4	0.0	34	33
Supernatant	1.25E-02	1.98E+03	1.29E+05	1.64E+05	7.64E-01	3.39E+02	1.57	1.57	11	0.5	0.5	33	33
Solid Layer	1.25E-02	1.98E+03	1.29E+05	1.64E+05	3.76E+02	1.63E+02	1.67	1.57	139	0.4	0.5	34	33
241-A-103	7.88E+03	9.57E+04	1.92E+05	5.83E+04	6.37E+01	1.60E+02	1.38	1.45	1,405	0.4	0.0	42	33
Supernatant	7.88E+03	9.59E+04	1.92E+05	5.82E+04	1.37E+00	1.89E+02	1.45	1.45	17	0.5	0.5	50	33
Solid Layer	7.88E+03	9.57E+04	1.92E+05	5.83E+04	6.45E+01	1.60E+02	1.37	1.45	1,388	0.4	0.5	42	33
241-A-104	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.43E+04	3.81E+02	1.64	1.17	106	0.4	na	74	34
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.43E+04	3.81E+02	1.64	1.17	0	0.8	na	76	34
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.43E+04	3.81E+02	1.64	1.17	106	0.4	na	74	34

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-A-105								NA		0.0	0.0		
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	NA	0	0.0	0.0	0	na
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.46E+04	5.37E+02	1.54	NA	139	0.0	0.0	0	na
241-A-106													
Supernatant	1.10E+04	3.60E+04	7.96E+04	4.94E+03	1.04E+03	1.35E+02	1.70	1.17	299	0.3	na	52	39
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	54	39
	1.10E+04	3.60E+04	7.96E+04	4.94E+03	1.04E+03	1.35E+02	1.70	1.17	299	0.3	na	52	39
241-AX-101													
Supernatant	3.98E+03	1.73E+05	2.72E+05	5.04E+04	8.01E+01	1.87E+02	1.71	1.53	1,220	0.3	na	44	32
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.53	0	0.5	na	35	32
	3.98E+03	1.73E+05	2.72E+05	5.04E+04	8.01E+01	1.87E+02	1.71	1.53	1,220	0.3	0.4	44	32
241-AX-102													
Supernatant	2.30E+04	1.07E+05	1.76E+05	2.75E+04	1.27E+03	1.45E+02	1.77	1.39	113	0.4	na	24	25
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.39	0	0.5	na	24	25
	2.30E+04	1.07E+05	1.76E+05	2.75E+04	1.27E+03	1.45E+02	1.77	1.39	113	0.4	na	24	25
241-AX-103													
Supernatant	2.36E+04	1.07E+05	1.36E+05	3.58E+04	7.43E+02	1.72E+02	1.59	1.46	410	0.4	na	39	33
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	43	33
	2.36E+04	1.07E+05	1.36E+05	3.58E+04	7.43E+02	1.72E+02	1.59	1.46	410	0.4	0.5	39	33
241-AX-104													
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.38E+04	1.06E+03	1.80	1.17	28	0.1	na	32	31
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	32	31
	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.38E+04	1.06E+03	1.80	1.17	28	0.1	na	32	31
241-B-101													
Supernatant	9.72E-04	1.31E+05	3.56E+05	1.47E+03	1.56E+03	1.69E+01	1.49	1.53	411	0.4	na	41	37
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	39	37
	9.72E-04	1.31E+05	3.56E+05	1.47E+03	1.56E+03	1.69E+01	1.49	1.53	411	0.4	0.5	41	37
241-B-102													
Supernatant	4.65E-04	1.82E+04	1.74E+05	7.03E+02	5.30E+00	1.43E+01	1.56	1.19	121	0.3	na	18	20
Solid Layer	4.65E-04	1.82E+04	1.74E+05	7.00E+02	1.45E+01	1.11E+01	1.19	1.19	15	0.7	0.7	18	20
	4.65E-04	1.82E+04	1.74E+05	7.04E+02	4.00E+00	1.48E+01	1.61	1.19	106	0.3	0.7	18	20

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-B-103	4.65E-04	1.82E+04	1.74E+05	7.04E+02	4.00E+00	1.60E+01	1.61	1.19	211	0.5	na	17	23
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	17	23
Solid Layer	4.65E-04	1.82E+04	1.74E+05	7.04E+02	4.00E+00	1.60E+01	1.61	1.19	211	0.5	0.7	17	23
241-B-104	4.65E-04	1.82E+04	1.74E+05	7.03E+02	2.20E+01	4.23E+01	1.36	1.19	1,417	0.5	na	20	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	20	20
Solid Layer	4.65E-04	1.82E+04	1.74E+05	7.03E+02	2.20E+01	4.23E+01	1.36	1.19	1,417	0.5	0.7	20	20
241-B-105	4.65E-04	1.83E+04	1.75E+05	7.03E+02	3.58E+00	1.68E+01	1.67	1.19	1,098	0.4	na	23	19
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	18	19
Solid Layer	4.65E-04	1.83E+04	1.75E+05	7.03E+02	3.58E+00	1.68E+01	1.67	1.19	1,098	0.4	0.7	23	19
241-B-106	4.65E-04	1.82E+04	1.74E+05	7.03E+02	5.16E+01	1.63E+01	1.38	1.19	464	0.6	na	23	19
Supernatant	4.65E-04	1.82E+04	1.74E+05	7.03E+02	1.44E+01	1.11E+01	1.19	1.19	4	0.7	0.7	18	19
Solid Layer	4.65E-04	1.82E+04	1.74E+05	7.03E+02	5.19E+01	1.63E+01	1.38	1.19	460	0.6	na	23	19
241-B-107	7.17E-04	6.51E+03	3.31E+05	2.01E+01	1.23E+02	2.30E+01	1.63	1.34	611	0.4	na	16	19
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.6	na	16	19
Solid Layer	7.17E-04	6.51E+03	3.31E+05	2.01E+01	1.23E+02	2.30E+01	1.63	1.34	611	0.4	0.6	16	19
241-B-108	3.66E-04	5.38E+04	3.77E+05	8.98E+02	3.70E+00	1.34E+01	1.67	1.38	349	0.4	na	18	19
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.8	na	16	19
Solid Layer	3.66E-04	5.38E+04	3.77E+05	8.98E+02	3.70E+00	1.34E+01	1.67	1.38	349	0.4	0.8	18	19
241-B-109	4.65E-04	1.82E+04	1.75E+05	7.03E+02	4.59E+02	1.83E+01	1.77	1.19	473	0.4	na	19	18
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.6	na	18	18
Solid Layer	4.65E-04	1.82E+04	1.75E+05	7.03E+02	4.59E+02	1.83E+01	1.77	1.19	473	0.4	0.7	19	18
241-B-110	0.00E+00	1.11E+03	9.75E+03	0.00E+00	8.33E+01	1.16E+01	1.36	1.01	929	0.6	na	21	20
Supernatant	0.00E+00	1.11E+03	9.75E+03	0.00E+00	0.00E+00	0.00E+00	1.01	1.01	4	1.0	1.0	21	20
Solid Layer	0.00E+00	1.11E+03	9.75E+03	0.00E+00	8.37E+01	1.17E+01	1.36	1.01	925	0.6	na	21	20

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid [NO ₃] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-B-111	0.00E+00	1.11E+03	9.75E+03	0.00E+00	2.06E+02	1.32E+02	1.19	1.01	914	0.6	na	22	22
Supernatant	0.00E+00	1.11E+03	9.75E+03	0.00E+00	0.00E+00	0.00E+00	1.01	1.01	4	1.0	1.0	24	22
Solid Layer	0.00E+00	1.11E+03	9.75E+03	0.00E+00	2.07E+02	1.33E+02	1.19	1.01	910	0.6	na	22	22
241-B-112	8.59E+03	9.12E+04	1.60E+05	3.96E+04	2.56E+01	6.19E+01	1.49	1.01	132	0.4	na	17	19
Supernatant	0.00E+00	1.11E+03	9.73E+03	0.00E+00	0.00E+00	0.00E+00	1.01	1.01	11	1.0	1.0	19	19
Solid Layer	9.38E+03	9.94E+04	1.74E+05	4.32E+04	2.79E+01	6.75E+01	1.53	1.46	121	0.4	0.5	17	19
241-B-201	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.84E+00	1.46E-01	1.26	1.17	115	0.6	na	17	19
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	16	19
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.84E+00	1.46E-01	1.26	1.17	115	0.6	na	17	19
241-B-202	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.23E+00	8.20E-02	1.22	1.17	111	0.8	na	21	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	21	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.23E+00	8.20E-02	1.22	1.17	111	0.8	na	21	21
241-B-203	9.60E+01	1.57E+03	5.65E+04	0.00E+00	1.48E+00	3.31E-02	1.19	1.05	195	0.8	na	18	12
Supernatant	9.60E+01	1.57E+03	5.65E+04	0.00E+00	1.22E-01	1.40E-01	1.05	1.05	2	0.9	0.9	18	12
Solid Layer	9.60E+01	1.57E+03	5.65E+04	0.00E+00	1.50E+00	3.20E-02	1.19	1.05	193	0.8	na	18	12
241-B-204	7.60E-03	1.36E+03	3.47E+04	0.00E+00	1.38E+00	2.94E-02	1.19	1.05	192	0.8	na	17	19
Supernatant	7.60E-03	1.36E+03	3.47E+04	0.00E+00	9.90E-02	1.13E-01	1.05	1.05	3	0.9	0.9	18	19
Solid Layer	7.60E-03	1.36E+03	3.47E+04	0.00E+00	1.40E+00	2.81E-02	1.19	1.05	189	0.8	na	17	19
241-BX-101	4.98E+03	6.43E+04	1.21E+05	5.17E+03	9.59E+02	2.13E+01	1.66	1.28	180	0.3	na	23	23
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.28	0	0.8	na	23	23
Solid Layer	4.98E+03	6.43E+04	1.21E+05	5.17E+03	9.59E+02	2.13E+01	1.66	1.28	180	0.3	na	23	23
241-BX-102	2.98E+03	3.60E+04	7.96E+04	4.94E+03	9.00E+02	1.87E+01	0.91	1.17	424	0.2	na	20	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	20	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	9.00E+02	1.87E+01	0.91	1.17	424	0.2	na	20	21

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid [NO ₃] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-BX-103	4.33E+03	1.68E+04	5.33E+04	2.14E+04	5.30E+02	1.29E+01	1.56	1.11	277	0.5	na	21	21
Supernatant	4.33E+03	1.68E+04	5.33E+04	2.14E+04	2.32E+00	2.68E+00	1.11	1.11	42	0.8	0.8	21	21
Solid Layer	4.33E+03	1.68E+04	5.33E+04	2.14E+04	6.24E+02	1.47E+01	1.64	1.11	235	0.5	na	21	21
241-BX-104	3.19E+03	6.37E+04	1.34E+05	2.84E+03	2.03E+02	6.63E+01	1.67	1.28	379	0.3	na	30	25
Supernatant	3.19E+03	6.37E+04	1.34E+05	2.84E+03	1.43E+00	1.04E+02	1.28	1.28	11	0.6	0.6	30	25
Solid Layer	3.19E+03	6.37E+04	1.34E+05	2.84E+03	2.09E+02	6.52E+01	1.68	1.28	368	0.3	na	30	25
241-BX-105	9.44E+03	7.83E+04	1.17E+05	5.94E+03	1.11E+02	5.01E+01	1.67	1.29	271	0.2	na	20	21
Supernatant	9.44E+03	7.83E+04	1.17E+05	5.94E+03	6.29E+00	9.91E+01	1.29	1.29	18	0.7	0.7	20	21
Solid Layer	9.44E+03	7.83E+04	1.17E+05	5.94E+03	1.19E+02	4.66E+01	1.70	1.29	253	0.1	na	20	21
241-BX-106	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.43E+02	5.69E+01	1.64	1.17	142	0.4	na	20	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	20	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.43E+02	5.69E+01	1.64	1.17	142	0.4	na	20	21
241-BX-107	2.98E+03	3.60E+04	7.96E+04	4.94E+03	8.09E+00	1.44E+01	1.44	1.17	1,313	0.5	na	20	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	21	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	8.09E+00	1.44E+01	1.44	1.17	1,313	0.5	na	20	21
241-BX-108	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.64E+02	2.08E+01	1.51	1.17	119	0.2	na	20	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	20	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.64E+02	2.08E+01	1.51	1.17	119	0.2	na	20	20
241-BX-109	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.15E+02	1.15E+01	1.52	1.17	731	0.5	na	22	22
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.7	na	22	22
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.15E+02	1.15E+01	1.52	1.17	731	0.5	na	22	22
241-BX-110	9.21E+03	5.21E+04	4.13E+05	4.40E+03	1.22E+01	5.45E+01	1.73	1.44	776	0.4	na	20	21
Supernatant	9.18E+03	5.22E+04	4.12E+05	4.40E+03	1.96E+01	7.04E+01	1.44	1.44	5	0.5	0.5	20	21
Solid Layer	9.21E+03	5.21E+04	4.13E+05	4.40E+03	1.21E+01	5.44E+01	1.73	1.44	771	0.4	0.5	20	21

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-BX-111	1.69E+03	1.06E+05	1.85E+05	4.87E+04	1.54E+01	7.45E+01	1.44	1.45	714	0.3	na	19	18
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	19	18
Solid Layer	1.69E+03	1.06E+05	1.85E+05	4.87E+04	1.54E+01	7.45E+01	1.44	1.45	714	0.3	0.5	19	18
241-BX-112	0.00E+00	3.52E+04	9.86E+04	4.78E+01	6.42E+00	4.33E+01	1.31	1.18	622	0.6	na	18	18
Supernatant	0.00E+00	3.52E+04	9.86E+04	4.78E+01	2.58E+01	2.93E+01	1.18	1.18	5	0.7	0.7	18	18
Solid Layer	0.00E+00	3.52E+04	9.86E+04	4.78E+01	6.26E+00	4.34E+01	1.31	1.18	617	0.6	na	18	18
241-BY-101	9.39E+03	9.93E+04	1.75E+05	4.32E+04	1.05E+02	1.15E+02	1.80	1.46	1,400	0.2	na	27	25
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	27	25
Solid Layer	9.39E+03	9.93E+04	1.75E+05	4.32E+04	1.05E+02	1.15E+02	1.80	1.46	1,400	0.2	0.5	27	25
241-BY-102	1.55E+03	8.41E+04	1.48E+05	5.66E+04	1.55E+01	7.43E+01	1.57	1.44	1,048	0.3	na	22	22
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.44	0	0.5	na	22	22
Solid Layer	1.55E+03	8.41E+04	1.48E+05	5.66E+04	1.55E+01	7.43E+01	1.57	1.46	1,048	0.3	0.5	22	22
241-BY-103	1.91E+03	5.37E+04	1.69E+05	4.14E+04	4.09E+01	7.91E+01	1.64	1.29	1,575	0.3	na	24	24
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.6	na	26	24
Solid Layer	1.91E+03	5.37E+04	1.69E+05	4.14E+04	4.09E+01	7.91E+01	1.64	1.29	1,575	0.3	0.6	24	24
241-BY-104	2.37E+03	1.07E+05	1.88E+05	7.23E+04	1.57E+02	8.96E+01	1.70	1.46	1,356	0.3	na	43	27
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	50	27
Solid Layer	2.37E+03	1.07E+05	1.88E+05	7.23E+04	1.57E+02	8.96E+01	1.70	1.46	1,356	0.3	0.5	43	27
241-BY-105	2.43E+03	6.89E+04	1.99E+05	3.92E+04	4.82E+01	5.01E+01	1.81	1.44	1,821	0.2	na	36	32
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.44	0	0.5	0.0	43	32
Solid Layer	2.43E+03	6.89E+04	1.99E+05	3.92E+04	4.82E+01	5.01E+01	1.81	1.44	1,821	0.2	0.5	36	32
241-BY-106	2.67E+03	7.83E+04	1.10E+05	3.98E+04	4.80E+01	1.16E+02	1.65	1.31	1,857	0.3	na	38	25
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.31	0	0.6	na	49	25
Solid Layer	2.67E+03	7.83E+04	1.10E+05	3.98E+04	4.80E+01	1.16E+02	1.65	1.31	1,857	0.3	0.6	38	25

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid [NO ₃] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-BY-107	2.40E+03	1.17E+05	1.32E+05	5.11E+04	4.75E+01	1.21E+02	1.69	1.46	1,028	0.4	na	32	27
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	28	27
Solid Layer	2.40E+03	1.17E+05	1.32E+05	5.11E+04	4.75E+01	1.21E+02	1.69	1.46	1,028	0.4	0.5	32	27
241-BY-108	2.37E+03	7.85E+04	2.94E+05	3.63E+04	1.14E+02	4.13E+01	1.48	1.33	841	0.3	na	35	30
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.3	na	45	30
Solid Layer	2.37E+03	7.85E+04	2.94E+05	3.63E+04	1.14E+02	4.13E+01	1.48	1.33	841	0.3	0.3	35	30
241-BY-109	1.88E+03	8.29E+04	1.90E+05	3.88E+04	1.34E+02	5.75E+01	1.71	1.50	1,047	0.4	na	18	17
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	18	17
Solid Layer	1.88E+03	8.29E+04	1.90E+05	3.88E+04	1.34E+02	5.75E+01	1.71	1.50	1,047	0.4	0.5	18	17
241-BY-110	1.18E+04	1.24E+05	1.24E+05	6.57E+04	7.98E+01	9.18E+01	1.57	1.44	1,384	0.3	na	37	26
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.4	na	45	26
Solid Layer	1.18E+04	1.24E+05	1.24E+05	6.57E+04	7.98E+01	9.18E+01	1.57	1.44	1,384	0.3	0.4	37	26
241-BY-111	1.28E+03	3.29E+04	1.21E+05	2.57E+04	1.38E+01	6.84E+01	1.68	1.42	1,144	0.3	na	27	25
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	30	25
Solid Layer	1.28E+03	3.29E+04	1.21E+05	2.57E+04	1.38E+01	6.84E+01	1.68	1.42	1,144	0.3	0.5	27	25
241-BY-112	1.71E+03	1.40E+05	1.91E+05	5.54E+04	1.50E+01	7.39E+01	1.74	1.47	1,083	0.3	na	30	25
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	26	25
Solid Layer	1.71E+03	1.40E+05	1.91E+05	5.54E+04	1.50E+01	7.39E+01	1.74	1.47	1,083	0.3	0.5	30	25
241-C-101	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.82E+02	6.13E+01	1.78	1.17	333	0.2	na	33	33
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.7	na	32	33
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.82E+02	6.13E+01	1.78	1.17	333	0.2	na	33	33
241-C-102	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.99E+02	1.50E+01	1.66	1.17	1,196	0.3	na	31	26
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	27	26
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.99E+02	1.50E+01	1.66	1.17	1,196	0.3	na	31	26

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-C-103	6.63E+03	1.96E+04	1.96E+03	1.06E+01	3.90E+03	1.12E+02	1.53	1.11	335	0.6	na	43	39
Supernatant	6.63E+03	1.96E+04	1.96E+03	1.06E+01	5.32E+01	8.10E+01	1.11	1.11	0	0.9	na	46	39
Solid Layer	6.63E+03	1.96E+04	1.96E+03	1.06E+01	3.90E+03	1.12E+02	1.53	1.11	335	0.6	na	43	39
241-C-104	5.60E+03	3.60E+04	7.96E+04	4.94E+03	2.92E+02	5.76E+01	1.69	1.17	980	0.5	na	38	34
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	36	34
Solid Layer	5.60E+03	3.60E+04	7.96E+04	4.94E+03	2.92E+02	5.76E+01	1.69	1.17	980	0.5	na	38	34
241-C-105	2.87E+03	3.70E+04	3.43E+04	9.02E+00	6.14E+02	1.06E+02	1.55	1.23	500	0.3	na	49	44
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.23	0	0.7	na	44	44
Solid Layer	2.87E+03	3.70E+04	3.43E+04	9.02E+00	6.14E+02	1.06E+02	1.55	1.23	500	0.3	na	49	44
241-C-106	3.11E+03	1.26E+04	5.67E+02	1.99E+03	5.28E+03	2.29E+02	1.39	1.14	52	0.5	na	30	31
Supernatant	3.11E+03	1.26E+04	5.67E+02	1.99E+03	2.61E+00	4.68E+01	1.14	1.14	18	0.9	0.9	30	31
Solid Layer	3.11E+03	1.26E+04	5.67E+02	1.99E+03	8.07E+03	3.25E+02	1.52	1.14	34	0.4	na	30	31
241-C-107	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.54E+03	4.36E+01	1.55	1.17	940	0.5	na	46	44
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	48	44
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.54E+03	4.36E+01	1.55	1.17	940	0.5	na	46	44
241-C-108	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.33E+01	2.25E+02	1.45	1.17	250	0.4	na	25	26
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	27	26
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.33E+01	2.25E+02	1.45	1.17	250	0.4	na	25	26
241-C-109	2.98E+03	3.60E+04	7.96E+04	4.94E+03	7.26E+02	4.93E+02	1.44	1.17	240	0.4	na	26	26
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	26	26
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	7.26E+02	4.93E+02	1.44	1.17	240	0.4	na	26	26
241-C-110	5.80E+02	4.60E+03	6.03E+04	2.09E+02	4.12E+00	1.60E+01	1.34	1.10	674	0.6	na	22	23
Supernatant	5.80E+02	4.60E+03	6.03E+04	2.09E+02	2.07E-02	3.64E+00	1.10	1.10	4	0.8	0.8	21	23
Solid Layer	5.80E+02	4.60E+03	6.03E+04	2.09E+02	4.14E+00	1.60E+01	1.34	1.10	670	0.6	na	22	23

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-C-111	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.86E+03	6.30E+01	1.43	1.17	217	0.4	na	25	25
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	25	25
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.86E+03	6.30E+01	1.43	1.17	217	0.4	na	25	25
241-C-112	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.03E+03	4.53E+02	1.60	1.17	393	0.5	na	28	28
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	28	28
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.03E+03	4.53E+02	1.60	1.17	393	0.5	na	28	28
241-C-201	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.15E+02	7.27E+00	1.44	1.17	4	0.1	na	16	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	16	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.15E+02	7.27E+00	1.44	1.17	4	0.1	na	16	20
241-C-202	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.18E+02	1.14E+01	1.44	1.17	3	0.0	na	16	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	16	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.18E+02	1.14E+01	1.44	1.17	3	0.0	na	16	20
241-C-203	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.99E+01	4.57E+00	1.62	1.17	10	0.4	na	15	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	20	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.99E+01	4.57E+00	1.62	1.17	10	0.4	na	15	20
241-C-204	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.05E+01	4.66E+00	1.59	1.17	9	0.4	na	17	16
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	17	16
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.05E+01	4.66E+00	1.59	1.17	9	0.4	na	17	16
241-S-101	1.79E+03	1.13E+05	2.14E+05	3.00E+04	2.51E+02	1.27E+02	1.64	1.47	1,485	0.4	na	43	34
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.6	na	46	34
Solid Layer	1.79E+03	1.13E+05	2.14E+05	3.00E+04	2.51E+02	1.27E+02	1.64	1.47	1,485	0.4	0.5	43	34
241-S-102	3.76E+03	1.27E+05	1.55E+05	5.62E+04	4.56E+01	1.52E+02	1.59	1.46	1,224	0.3	na	33	28
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	38	28
Solid Layer	3.76E+03	1.27E+05	1.55E+05	5.62E+04	4.56E+01	1.52E+02	1.59	1.46	1,224	0.3	0.5	33	28

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO_2 in liquid [NO_2] ($\mu\text{g/mL}$)	NO_3 in liquid [NO_3] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	^{90}Sr in waste [Sr] ($\mu\text{Ci/g}$)	^{137}Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Liquid Density D_L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H_2O] (wt%)	Liquid water [H_2O] (wt%)	Waste temp., T_w ($^{\circ}\text{C}$)	Dome temp., T_d ($^{\circ}\text{C}$)
241-S-103	4.68E+03	1.47E+05	2.16E+05	3.20E+04	2.88E+01	1.53E+02	1.59	1.45	897	0.4	na	27	25
Supernatant	4.68E+03	1.47E+05	2.16E+05	3.20E+04	2.74E-01	2.40E+02	1.45	1.45	4	0.5	0.5	28	25
Solid Layer	4.68E+03	1.47E+05	2.16E+05	3.20E+04	2.90E+01	1.52E+02	1.59	1.45	893	0.4	0.5	27	25
241-S-104	3.96E+02	3.82E+04	2.69E+05	1.20E+04	2.37E+02	4.58E+01	1.66	1.37	1,090	0.4	na	37	32
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.6	na	40	32
Solid Layer	3.96E+02	3.82E+04	2.69E+05	1.20E+04	2.37E+02	4.58E+01	1.66	1.37	1,090	0.4	0.6	37	32
241-S-105	1.35E+04	9.75E+04	1.25E+05	4.19E+04	4.57E+00	2.97E+01	1.63	1.44	1,536	0.1	na	24	24
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	25	24
Solid Layer	1.35E+04	9.75E+04	1.25E+05	4.19E+04	4.57E+00	2.97E+01	1.63	1.44	1,536	0.1	0.5	24	24
241-S-106	1.98E+03	1.04E+05	2.36E+05	3.80E+04	1.32E+01	9.79E+01	1.72	1.43	1,723	0.3	na	23	23
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	24	23
Solid Layer	1.98E+03	1.04E+05	2.36E+05	3.80E+04	1.32E+01	9.79E+01	1.72	1.43	1,723	0.3	0.5	23	23
241-S-107	1.18E+03	7.11E+04	1.14E+05	1.07E+04	1.54E+02	7.22E+01	1.84	1.31	1,212	0.3	na	37	29
Supernatant	1.18E+03	7.11E+04	1.14E+05	1.07E+04	5.23E-02	9.46E+01	1.31	1.31	0	0.7	na	40	29
Solid Layer	1.18E+03	7.11E+04	1.14E+05	1.07E+04	1.54E+02	7.22E+01	1.84	1.31	1,212	0.3	0.6	37	29
241-S-108	1.35E+04	9.71E+04	1.25E+05	4.19E+04	1.86E+01	1.14E+02	1.65	1.44	2,082	0.3	na	27	22
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	28	22
Solid Layer	1.35E+04	9.71E+04	1.25E+05	4.19E+04	1.86E+01	1.14E+02	1.65	1.44	2,082	0.3	0.5	27	22
241-S-109	1.11E+03	8.49E+04	1.32E+05	4.59E+04	1.81E+01	1.43E+01	1.66	1.49	2,017	0.1	na	28	25
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	29	25
Solid Layer	1.11E+03	8.49E+04	1.32E+05	4.59E+04	1.81E+01	1.43E+01	1.66	1.49	2,017	0.1	0.5	28	25
241-S-110	2.28E+03	8.58E+04	2.17E+05	3.10E+04	1.01E+02	7.29E+01	1.66	1.43	1,473	0.2	na	42	29
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	44	29
Solid Layer	2.28E+03	8.58E+04	2.17E+05	3.10E+04	1.01E+02	7.29E+01	1.66	1.43	1,473	0.2	0.5	42	29

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-S-111	1.49E+03	8.36E+04	1.92E+05	3.64E+04	1.95E+02	1.21E+02	1.54	1.45	1,483	0.3	na	31	27
Supernatant	1.49E+03	8.33E+04	1.92E+05	3.64E+04	8.39E-02	2.22E+02	1.45	1.45	0	0.5	na	32	27
Solid Layer	1.49E+03	8.36E+04	1.92E+05	3.64E+04	1.95E+02	1.21E+02	1.54	1.45	1,483	0.3	0.5	31	27
241-S-112	8.31E+02	6.21E+04	1.68E+05	3.69E+04	2.78E+01	5.63E+01	1.66	1.45	2,325	0.2	na	28	25
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	36	25
Solid Layer	8.31E+02	6.21E+04	1.68E+05	3.69E+04	2.78E+01	5.63E+01	1.66	1.45	2,325	0.2	0.5	28	25
241-SX-101	3.35E+02	7.48E+04	1.08E+05	8.01E+04	2.55E+02	1.14E+02	1.67	1.48	1,564	0.3	na	67	39
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	57	39
Solid Layer	3.35E+02	7.48E+04	1.08E+05	8.01E+04	2.55E+02	1.14E+02	1.67	1.48	1,564	0.3	0.5	67	39
241-SX-102	1.51E+03	1.51E+05	1.57E+05	4.56E+04	8.86E+01	1.47E+02	1.70	1.46	1,628	0.4	na	51	37
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	60	37
Solid Layer	1.51E+03	1.51E+05	1.57E+05	4.56E+04	8.86E+01	1.47E+02	1.70	1.46	1,628	0.4	0.5	51	37
241-SX-103	3.38E+03	1.58E+05	1.57E+05	4.44E+04	1.69E+02	1.32E+02	1.73	1.47	1,860	0.3	na	63	33
Supernatant	3.38E+03	1.58E+05	1.57E+05	4.44E+04	1.69E+02	1.32E+02	1.47	1.47	0	0.5	na	70	33
Solid Layer	3.38E+03	1.58E+05	1.57E+05	4.44E+04	1.69E+02	1.32E+02	1.73	1.47	1,860	0.3	0.5	63	33
241-SX-104	2.13E+03	1.17E+05	2.90E+05	3.56E+04	1.90E+02	1.04E+02	1.67	1.47	1,688	0.3	na	49	36
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	59	36
Solid Layer	2.13E+03	1.17E+05	2.90E+05	3.56E+04	1.90E+02	1.04E+02	1.67	1.47	1,688	0.3	0.5	49	36
241-SX-105	3.26E+03	1.43E+05	1.64E+05	4.41E+04	1.03E+02	1.13E+02	1.63	1.47	1,422	0.4	na	57	35
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.47	0	0.4	na	75	35
Solid Layer	3.26E+03	1.43E+05	1.64E+05	4.41E+04	1.03E+02	1.13E+02	1.63	1.47	1,422	0.4	0.4	57	35
241-SX-106	3.14E+03	1.49E+05	2.45E+05	2.26E+04	4.44E+00	1.45E+02	1.58	1.29	1,501	0.4	na	34	30
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	37	30
Solid Layer	3.14E+03	1.49E+05	2.45E+05	2.26E+04	4.44E+00	1.45E+02	1.58	1.29	1,501	0.4	0.5	34	30

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid [NO ₃] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-SX-107 Supernatant	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.66E+02	8.47E+01	1.73	1.45	357	0.3	na	73	53
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.8	na	75	53
241-SX-108 Supernatant	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.66E+02	8.47E+01	1.73	1.45	357	0.3	0.5	73	53
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.77E+03	1.77E+02	1.75	1.17	276	0.0	na	79	59
241-SX-109 Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	84	59
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.77E+03	1.77E+02	1.75	1.17	276	0.0	na	79	59
241-SX-110 Supernatant	9.20E+03	1.07E+05	1.76E+05	2.75E+04	2.50E+02	8.64E+01	1.73	1.39	913	0.3	na	54	48
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.39	0	0.5	na	57	48
241-SX-111 Supernatant	9.20E+03	1.07E+05	1.76E+05	2.75E+04	2.50E+02	8.64E+01	1.73	1.39	913	0.3	na	54	48
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.52E+02	8.34E+01	1.74	1.17	212	0.3	na	51	53
241-SX-112 Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	59	53
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.52E+02	8.34E+01	1.74	1.17	212	0.3	na	51	53
241-SX-113 Supernatant	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.00E+02	9.07E+01	1.72	1.45	436	0.3	na	77	59
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.8	na	85	59
241-SX-114 Supernatant	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.00E+02	9.07E+01	1.72	1.45	436	0.3	0.5	77	59
Solid Layer	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.33E+02	8.77E+01	1.73	1.45	283	0.3	na	62	52
241-SX-115 Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.8	na	56	52
Solid Layer	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.33E+02	8.77E+01	1.73	1.45	283	0.3	0.5	62	52
241-SX-116 Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	9.14E+01	4.18E+01	1.06	1.17	71	0.5	na	28	28
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	28	28
241-SX-117 Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	9.14E+01	4.18E+01	1.06	1.17	71	0.5	na	28	28
Solid Layer	1.15E+02	1.10E+05	1.74E+05	4.32E+04	2.41E+02	1.05E+02	1.68	1.45	588	0.3	na	73	52
241-SX-118 Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.8	na	57	52
Solid Layer	1.15E+02	1.10E+05	1.74E+05	4.32E+04	2.41E+02	1.05E+02	1.68	1.45	588	0.3	0.5	73	52

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO_2 in liquid [NO_2] ($\mu\text{g/mL}$)	NO_3 in liquid [NO_3] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	^{90}Sr in waste [Sr] ($\mu\text{Ci/g}$)	^{137}Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Liquid Density D_L (g/mL)	Non-RGS waste volume (KL)	Bulk water [H_2O] (wt%)	Liquid water [H_2O] (wt%)	Waste temp., T_w ($^\circ\text{C}$)	Dome temp., T_d ($^\circ\text{C}$)
241-SX-115	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.48E+04	9.39E+01	1.75	1.17	14	0.1	na	25	25
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	25	25
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.48E+04	9.39E+01	1.75	1.17	14	0.1	na	25	25
241-T-101	1.08E+04	9.63E+04	1.66E+05	3.75E+04	1.72E+01	7.59E+01	1.62	1.47	376	0.3	na	22	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.6	na	22	21
Solid Layer	1.08E+04	9.63E+04	1.66E+05	3.75E+04	1.72E+01	7.59E+01	1.62	1.47	376	0.3	0.5	22	21
241-T-102	4.49E+02	2.31E+04	1.09E+05	8.33E+03	1.06E+02	3.88E+01	1.53	1.14	121	0.4	na	18	18
Supernatant	4.49E+02	2.31E+04	1.09E+05	8.33E+03	9.19E-01	4.84E+01	1.14	1.14	49	0.8	0.8	18	18
Solid Layer	4.49E+02	2.31E+04	1.09E+05	8.33E+03	1.78E+02	3.22E+01	1.79	1.14	72	0.3	na	18	18
241-T-103	5.18E-01	3.75E+04	7.88E+04	1.08E+04	7.73E+02	2.90E+01	1.59	1.00	102	0.3	na	19	20
Supernatant	5.18E-01	3.75E+04	7.88E+04	1.08E+04	5.05E+01	2.48E+01	1.00	1.00	15	0.7	0.7	19	20
Solid Layer	5.18E-01	3.75E+04	7.88E+04	1.08E+04	8.98E+02	2.98E+01	1.69	1.18	87	0.3	na	19	20
241-T-104	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.19E+00	1.66E-01	1.29	1.17	1,199	0.7	na	19	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	20	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.19E+00	1.66E-01	1.29	1.17	1,199	0.7	na	19	21
241-T-105	2.98E+03	5.42E+04	3.71E+04	3.62E+02	8.19E+01	5.23E+01	1.46	1.18	371	0.6	na	17	16
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.18	0	0.8	na	17	16
Solid Layer	2.98E+03	5.42E+04	3.71E+04	3.62E+02	8.19E+01	5.23E+01	1.46	1.18	371	0.6	na	17	16
241-T-106	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.11E+01	4.18E+01	1.41	1.17	82	0.2	na	20	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	20	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.11E+01	4.18E+01	1.41	1.17	82	0.2	na	20	20
241-T-107	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.08E+02	1.58E+01	1.56	1.17	655	0.5	na	20	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	20	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.08E+02	1.58E+01	1.56	1.17	655	0.5	na	20	21

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-T-108	4.45E-04	1.84E+04	1.74E+05	4.65E+02	3.81E+00	9.28E+00	1.44	1.18	60	0.4	na	16	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.6	na	16	21
Solid Layer	4.45E-04	1.84E+04	1.74E+05	4.65E+02	3.81E+00	9.28E+00	1.44	1.18	60	0.4	0.7	16	21
241-T-109	4.46E-04	1.85E+04	1.75E+05	4.64E+02	3.15E+00	3.82E+00	1.46	1.18	235	0.5	na	19	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	19	20
Solid Layer	4.46E-04	1.85E+04	1.75E+05	4.64E+02	3.15E+00	3.82E+00	1.46	1.18	235	0.5	0.7	19	20
241-T-110	4.50E+01	5.90E+01	1.83E+04	0.00E+00	1.75E+01	2.86E+01	1.25	1.05	1,400	0.8	na	18	20
Supernatant	4.50E+01	5.90E+01	1.83E+04	0.00E+00	4.60E-04	2.98E-03	1.05	1.05	3	0.9	0.9	19	20
Solid Layer	4.50E+01	5.90E+01	1.83E+04	0.00E+00	1.76E+01	2.86E+01	1.25	1.05	1,397	0.8	na	18	20
241-T-111	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.39E+00	1.09E-01	1.24	1.17	1,692	0.8	na	19	23
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	21	23
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.39E+00	1.09E-01	1.24	1.17	1,692	0.8	na	19	23
241-T-112	4.38E+02	3.88E+04	2.33E+04	0.00E+00	1.05E+01	1.60E+01	1.26	1.10	252	0.7	na	19	20
Supernatant	4.38E+02	3.88E+04	2.33E+04	0.00E+00	1.82E+00	2.09E+00	1.10	1.10	26	0.9	0.9	19	20
Solid Layer	4.38E+02	3.88E+04	2.33E+04	0.00E+00	1.15E+01	1.76E+01	1.28	1.10	226	0.7	na	19	20
241-T-201	7.86E-03	3.35E+02	4.61E+04	0.00E+00	7.40E-02	2.99E-02	1.30	1.06	118	0.7	na	18	20
Supernatant	7.86E-03	3.35E+02	4.61E+04	0.00E+00	1.02E-01	1.16E-01	1.06	1.06	8	0.9	0.9	19	20
Solid Layer	7.86E-03	3.35E+02	4.61E+04	0.00E+00	7.20E-02	2.37E-02	1.31	1.06	110	0.7	na	18	20
241-T-202	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.41E-03	2.73E-02	1.18	1.17	81	0.8	na	17	19
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	18	19
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.41E-03	2.73E-02	1.18	1.17	81	0.8	na	17	19
241-T-203	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.38E-03	1.68E-02	1.22	1.17	140	0.8	na	18	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.9	na	19	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.38E-03	1.68E-02	1.22	1.17	140	0.8	na	18	20

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-T-204	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.35E-03	7.32E-03	1.18	1.17	140	0.8	na	18	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	19	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.35E-03	7.32E-03	1.18	1.17	140	0.8	na	18	20
241-TX-101	1.08E+04	9.63E+04	1.66E+05	3.74E+04	4.16E+02	8.14E+01	1.73	1.47	344	0.3	na	25	23
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.8	na	25	23
Solid Layer	1.08E+04	9.63E+04	1.66E+05	3.74E+04	4.16E+02	8.14E+01	1.73	1.47	344	0.3	na	25	23
241-TX-102	1.08E+04	9.59E+04	1.66E+05	3.74E+04	2.19E+01	9.02E+01	1.64	1.47	821	0.3	na	27	25
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	27	25
Solid Layer	1.08E+04	9.59E+04	1.66E+05	3.74E+04	2.19E+01	9.02E+01	1.64	1.47	821	0.3	0.5	27	25
241-TX-103	1.03E+04	9.28E+04	1.67E+05	3.58E+04	2.18E+01	8.64E+01	1.64	1.46	548	0.3	na	22	22
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	22	22
Solid Layer	1.03E+04	9.28E+04	1.67E+05	3.58E+04	2.18E+01	8.64E+01	1.64	1.46	548	0.3	0.5	22	22
241-TX-104	1.36E+03	9.42E+04	3.55E+05	3.19E+03	2.18E+02	7.36E+01	1.73	1.44	262	0.5	na	21	21
Supernatant	1.36E+03	9.42E+04	3.54E+05	3.19E+03	1.82E+01	1.76E+02	1.44	1.44	9	0.5	0.5	21	21
Solid Layer	1.36E+03	9.42E+04	3.55E+05	3.19E+03	2.25E+02	6.99E+01	1.74	1.44	253	0.5	0.5	21	21
241-TX-105	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.22E+01	8.11E+01	1.66	1.47	2,181	0.3	na	35	23
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	36	23
Solid Layer	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.22E+01	8.11E+01	1.66	1.47	2,181	0.3	0.5	35	23
241-TX-106	1.08E+04	9.60E+04	1.66E+05	3.74E+04	2.87E+01	8.72E+01	1.65	1.47	1,318	0.3	na	26	26
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	27	26
Solid Layer	1.08E+04	9.60E+04	1.66E+05	3.74E+04	2.87E+01	8.72E+01	1.65	1.47	1,318	0.3	0.5	26	26
241-TX-107	7.75E+03	1.00E+05	1.68E+05	3.91E+04	5.03E+01	1.05E+02	1.78	1.46	112	0.3	na	22	22
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	22	22
Solid Layer	7.75E+03	1.00E+05	1.68E+05	3.91E+04	5.03E+01	1.05E+02	1.78	1.46	112	0.3	0.5	22	22

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-TX-108	1.08E+04	9.63E+04	1.66E+05	3.74E+04	2.69E+01	8.05E+01	1.66	1.47	489	0.3	na	20	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	19	21
Solid Layer	1.08E+04	9.63E+04	1.66E+05	3.74E+04	2.69E+01	8.05E+01	1.66	1.47	489	0.3	0.5	20	21
241-TX-109	2.98E+03	3.60E+04	7.96E+04	4.94E+03	5.15E+00	2.02E+01	1.41	1.17	1,375	0.6	na	36	45
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	39	45
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	5.15E+00	2.02E+01	1.41	1.17	1,375	0.6	na	36	45
241-TX-110	1.08E+04	9.61E+04	1.66E+05	3.73E+04	2.14E+01	7.45E+01	1.65	1.47	1,767	0.3	na	28	22
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	28	22
Solid Layer	1.08E+04	9.61E+04	1.66E+05	3.73E+04	2.14E+01	7.45E+01	1.65	1.47	1,767	0.3	0.5	28	22
241-TX-111	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.09E+01	7.20E+01	1.64	1.47	1,383	0.3	na	25	23
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	26	23
Solid Layer	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.09E+01	7.20E+01	1.64	1.47	1,383	0.3	0.5	25	23
241-TX-112	9.26E+03	8.54E+04	1.67E+05	3.23E+04	2.18E+01	7.78E+01	1.66	1.43	2,398	0.3	na	22	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	23	21
Solid Layer	9.26E+03	8.54E+04	1.67E+05	3.23E+04	2.18E+01	7.78E+01	1.66	1.43	2,398	0.3	0.5	22	21
241-TX-113	1.08E+04	9.62E+04	1.66E+05	3.74E+04	1.62E+00	8.58E+00	1.63	1.47	2,416	0.2	na	22	22
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.6	na	23	22
Solid Layer	1.08E+04	9.62E+04	1.66E+05	3.74E+04	1.62E+00	8.58E+00	1.63	1.47	2,416	0.2	0.5	22	22
241-TX-114	4.08E+03	4.78E+04	1.71E+05	1.45E+04	2.06E+01	7.07E+01	1.64	1.29	2,015	0.3	na	21	18
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	21	18
Solid Layer	4.08E+03	4.78E+04	1.71E+05	1.45E+04	2.06E+01	7.07E+01	1.64	1.29	2,015	0.3	0.6	21	18
241-TX-115	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.43E+01	8.04E+01	1.66	1.47	2,096	0.3	na	21	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	22	21
Solid Layer	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.43E+01	8.04E+01	1.66	1.47	2,096	0.3	0.5	21	21

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Al in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-TX-116	3.19E+02	1.05E+04	3.79E+05	8.79E+00	1.78E+00	2.92E+01	1.60	1.39	2,264	0.2	na	21	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	21	20
Solid Layer	3.19E+02	1.05E+04	3.79E+05	8.79E+00	1.78E+00	2.92E+01	1.60	1.39	2,264	0.2	0.5	21	20
241-TX-117	4.47E-04	1.84E+04	1.74E+05	4.67E+02	1.44E+01	4.90E+01	1.54	1.18	1,819	0.3	na	21	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	21	20
Solid Layer	4.47E-04	1.84E+04	1.74E+05	4.67E+02	1.44E+01	4.90E+01	1.54	1.18	1,819	0.3	0.7	21	20
241-TX-118	1.08E-04	9.64E+04	1.66E+05	3.74E+04	1.10E+02	4.26E+01	1.69	1.47	968	0.5	na	24	23
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	23	23
Solid Layer	1.08E-04	9.64E+04	1.66E+05	3.74E+04	1.10E+02	4.26E+01	1.69	1.47	968	0.5	0.5	24	23
241-TY-101	4.45E-04	1.84E+04	1.74E+05	4.65E+02	8.67E+00	2.41E-01	1.64	1.18	447	0.4	na	19	20
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.6	na	19	20
Solid Layer	4.45E-04	1.84E+04	1.74E+05	4.65E+02	8.67E+00	2.41E-01	1.64	1.18	447	0.4	0.7	19	20
241-TY-102	6.00E+03	6.17E+04	1.70E+05	2.10E+04	5.79E+00	2.29E+01	1.75	1.34	261	0.3	na	16	19
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	16	19
Solid Layer	6.00E+03	6.17E+04	1.70E+05	2.10E+04	5.79E+00	2.29E+01	1.75	1.34	261	0.3	0.6	16	19
241-TY-103	1.08E+04	9.63E+04	1.66E+05	3.74E+04	7.63E+01	2.24E+01	1.69	1.47	587	0.5	na	21	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.8	na	30	21
Solid Layer	1.08E+04	9.63E+04	1.66E+05	3.74E+04	7.63E+01	2.24E+01	1.69	1.47	587	0.5	0.5	21	21
241-TY-104	2.11E+03	1.13E+04	9.90E+04	5.70E+02	8.96E+01	3.14E+01	1.68	1.18	167	0.5	na	20	20
Supernatant	2.11E+03	1.13E+04	9.90E+04	5.70E+02	5.53E-02	1.04E+01	1.18	1.18	4	0.8	0.8	20	20
Solid Layer	2.11E+03	1.13E+04	9.90E+04	5.70E+02	9.18E+01	3.19E+01	1.69	1.18	163	0.5	na	20	20
241-TY-105	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.59E+02	6.69E+00	1.53	1.17	874	0.4	na	26	23
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	26	23
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.59E+02	6.69E+00	1.53	1.17	874	0.4	na	26	23

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid [NO ₃] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-TY-106	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.30E+02	6.05E+01	1.40	1.17	62	0.4	na	16	19
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	16	19
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.30E+02	6.05E+01	1.40	1.17	62	0.4	na	16	19
241-U-101	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.93E+02	7.32E+01	1.75	1.17	89	0.3	na	22	22
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	19	22
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.93E+02	7.32E+01	1.75	1.17	89	0.3	na	22	22
241-U-102	1.12E+04	1.46E+05	1.98E+05	3.32E+04	1.02E+02	1.53E+02	1.67	1.48	1,238	0.3	na	28	26
Supernatant	1.12E+04	1.46E+05	1.98E+05	3.33E+04	4.90E+00	3.26E+02	1.48	1.48	4	0.5	0.5	27	26
Solid Layer	1.12E+04	1.46E+05	1.98E+05	3.32E+04	1.03E+02	1.52E+02	1.67	1.48	1,234	0.3	0.5	28	26
241-U-103	1.24E+04	1.37E+05	1.52E+05	4.09E+04	2.16E+01	1.29E+02	1.70	1.44	1,410	0.4	na	28	27
Supernatant	1.24E+04	1.37E+05	1.52E+05	4.09E+04	7.01E+00	3.32E+02	1.44	1.44	2	0.5	0.5	31	27
Solid Layer	1.24E+04	1.37E+05	1.52E+05	4.09E+04	2.16E+01	1.29E+02	1.70	1.44	1,408	0.4	0.5	28	27
241-U-104	9.58E+03	1.05E+05	2.07E+05	3.21E+04	1.83E+02	5.48E+01	1.50	1.40	462	0.4	na	28	24
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.40	0	0.6	na	28	24
Solid Layer	9.58E+03	1.05E+05	2.07E+05	3.21E+04	1.83E+02	5.48E+01	1.50	1.40	462	0.4	na	28	24
241-U-105	1.64E+04	1.08E+05	1.81E+05	2.98E+04	8.84E+00	1.47E+02	1.67	1.46	1,336	0.3	na	29	28
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.6	na	32	28
Solid Layer	1.64E+04	1.08E+05	1.81E+05	2.98E+04	8.84E+00	1.47E+02	1.67	1.46	1,336	0.3	0.5	29	28
241-U-106	4.28E+04	9.88E+04	2.49E+05	1.20E+04	6.36E+01	1.57E+02	1.55	1.34	644	0.4	na	27	27
Supernatant	4.28E+04	9.90E+04	2.48E+05	1.20E+04	4.42E+01	2.25E+02	1.34	1.34	6	0.5	0.5	27	27
Solid Layer	4.28E+04	9.88E+04	2.49E+05	1.20E+04	6.38E+01	1.56E+02	1.55	1.34	638	0.4	0.5	27	27
241-U-107	6.28E+03	1.27E+05	1.42E+05	4.10E+04	2.66E+00	7.76E+01	1.74	1.39	1,169	0.3	na	26	26
Supernatant	4.10E+03	1.16E+05	2.11E+05	2.79E+04	2.63E+01	1.95E+02	1.39	1.39	0	0.5	na	26	26
Solid Layer	6.28E+03	1.27E+05	1.42E+05	4.10E+04	2.66E+00	7.76E+01	1.74	1.43	1,169	0.3	0.5	26	26

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid [NO ₃] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-U-108	7.07E+03	1.34E+05	1.84E+05	3.05E+04	7.68E+00	1.36E+02	1.68	1.40	1,532	0.4	na	30	27
Supernatant	7.07E+03	1.34E+05	1.84E+05	3.05E+04	2.16E-01	2.61E+02	1.40	1.40	0	0.5	na	30	27
Solid Layer	7.07E+03	1.34E+05	1.84E+05	3.05E+04	7.68E+00	1.36E+02	1.68	1.40	1,532	0.4	0.5	30	27
241-U-109	6.53E+03	1.28E+05	1.85E+05	2.92E+04	7.48E+00	1.21E+02	1.65	1.47	1,351	0.3	na	28	27
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	27	27
Solid Layer	6.53E+03	1.28E+05	1.85E+05	2.92E+04	7.48E+00	1.21E+02	1.65	1.47	1,351	0.3	0.5	28	27
241-U-110	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.79E+02	1.98E+01	1.66	1.17	665	0.3	na	25	25
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	26	25
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.79E+02	1.98E+01	1.66	1.17	665	0.3	na	25	25
241-U-111	5.41E+03	1.20E+05	1.66E+05	3.66E+04	3.60E+01	1.29E+02	1.61	1.40	965	0.3	na	26	27
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.5	na	27	27
Solid Layer	5.41E+03	1.20E+05	1.66E+05	3.66E+04	3.60E+01	1.29E+02	1.61	1.40	965	0.3	na	26	27
241-U-112	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.20E+02	4.89E+01	1.74	1.17	172	0.3	na	21	21
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	1.17	0	0.8	na	21	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.20E+02	4.89E+01	1.74	1.17	172	0.3	na	21	21
241-U-201	0.00E+00	2.07E+04	1.43E+05	1.41E+02	1.17E-01	9.90E+00	1.53	1.26	15	0.4	na	18	19
Supernatant	0.00E+00	2.07E+04	1.43E+05	1.41E+02	1.09E-02	2.32E+01	1.26	1.26	4	0.7	0.7	19	19
Solid Layer	0.00E+00	2.07E+04	1.43E+05	1.41E+02	1.55E-01	5.06E+00	1.63	1.22	11	0.3	na	18	19
241-U-202	1.41E+02	2.45E+04	1.52E+05	2.39E+02	4.75E-02	7.84E+00	1.44	1.28	14	0.4	na	18	19
Supernatant	1.41E+02	2.45E+04	1.52E+05	2.39E+02	5.20E-04	1.64E+01	1.28	1.28	4	0.7	0.7	18	19
Solid Layer	1.41E+02	2.45E+04	1.52E+05	2.39E+02	6.62E-02	4.42E+00	1.51	1.22	10	0.3	na	18	19
241-U-203	0.00E+00	1.94E+04	1.44E+05	1.88E+02	9.35E-02	7.62E+00	1.49	1.28	13	0.5	na	18	19
Supernatant	0.00E+00	1.94E+04	1.44E+05	1.88E+02	4.55E-04	1.54E+01	1.28	1.28	4	0.7	0.7	18	19
Solid Layer	0.00E+00	1.94E+04	1.44E+05	1.88E+02	1.35E-01	4.17E+00	1.59	1.28	9	0.4	na	18	19

Table B-1. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid [NO ₃] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Liquid Density D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water [H ₂ O] (wt%)	Liquid water [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-U-204	8.10E+01	7.03E+03	5.53E+04	1.46E+01	2.61E+00	5.79E+00	1.34	1.11	11	0.4	na	18	18
Supernatant	8.10E+01	7.03E+03	5.53E+04	1.46E+01	1.90E-04	6.58E+00	1.11	1.11	4	0.9	0.9	18	18
Solid Layer	8.10E+01	7.03E+03	5.53E+04	1.46E+01	4.10E+00	5.34E+00	1.47	1.11	7	0.3	na	18	18

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, $[TOC]_M$ (wt%)	AI in liquid, $[AI]_M$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-AN-101	91.7	1.23E+06	100%	6,218	4.26E-04	5.25E+02	1.89	2.10	0.11	1.25	0.005	0.008
Supernatant	91.7	1.23E+06	100%	6,218	4.26E-04	5.25E+02	1.89	2.10	0.11	1.25	0.005	0.008
Solid Layer	na	na	na	na	na	na	na	na	na	na	na	na
241-AN-102	391.4	6.12E+06	97%	12,102	1.72E-03	1.06E+04	3.21	2.05	1.59	1.21	0.005	0.071
Supernatant	342.7	5.32E+06	100%	6,730	1.67E-03	8.89E+03	3.21	2.05	1.59	1.21	0.005	0.071
Solid Layer	48.6	7.94E+05	76%	5,373	2.09E-03	1.66E+03	3.21	2.05	1.59	1.21	0.005	0.071
241-AN-103	347.9	5.43E+06	88%	11,249	1.63E-03	8.84E+03	2.07	2.83	0.21	2.02	0.005	0.017
Supernatant	181.3	2.80E+06	100%	3,560	2.16E-03	6.05E+03	2.07	2.83	0.21	2.02	0.005	0.018
Solid Layer	166.6	2.63E+06	75%	7,689	1.06E-03	2.78E+03	2.07	2.83	0.21	2.02	0.005	0.017
241-AN-104	382.2	5.71E+06	95%	11,922	1.76E-03	1.00E+04	3.06	2.59	0.22	2.78	0.005	0.018
Supernatant	220.5	3.22E+06	100%	4,330	1.78E-03	5.72E+03	3.06	2.59	0.22	2.78	0.005	0.017
Solid Layer	161.6	2.49E+06	89%	7,591	1.73E-03	4.30E+03	3.06	2.59	0.22	2.78	0.005	0.020
241-AN-105	408.7	6.18E+06	95%	12,443	1.19E-03	7.34E+03	2.52	2.58	0.19	2.93	0.005	0.015
Supernatant	213.6	3.16E+06	100%	4,194	1.04E-03	3.30E+03	2.52	2.58	0.19	2.93	0.005	0.014
Solid Layer	195.1	3.02E+06	89%	8,249	1.34E-03	4.04E+03	2.52	2.58	0.19	2.93	0.005	0.016
241-AN-106	59.7	7.21E+05	92%	5,589	3.14E-04	2.26E+02	0.18	0.39	0.50	0.05	0.005	0.018
Supernatant	53.4	6.18E+05	100%	1,049	2.10E-04	1.30E+02	0.18	0.39	0.50	0.05	0.005	0.018
Solid Layer	6.2	1.03E+05	46%	4,540	9.37E-04	9.62E+01	0.18	0.39	0.50	0.05	0.005	0.017
241-AN-107	392.6	5.90E+06	96%	12,127	1.70E-03	1.00E+04	3.47	1.49	2.33	0.08	0.005	0.115
Supernatant	307.8	4.59E+06	100%	6,044	1.52E-03	6.97E+03	3.47	1.49	2.33	0.08	0.005	0.115
Solid Layer	84.8	1.31E+06	83%	6,083	2.35E-03	3.07E+03	3.47	1.49	2.33	0.08	0.005	0.117
241-AP-101	404.4	5.52E+06	100%	12,359	5.12E-04	2.83E+03	2.13	0.91	0.15	0.53	0.005	0.009
Supernatant	404.4	5.52E+06	100%	12,359	5.12E-04	2.83E+03	2.13	0.91	0.15	0.53	0.005	0.009
Solid Layer	na	na	na	na	na	na	na	na	na	na	na	na

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_{liq}$ (mole/L)	NO_2 in liquid, $[NO_2]_{liq}$ (mole/L)	TOC in liquid, $[TOC]_{liq}$ (wt%)	Al in liquid, $[Al]_{liq}$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-AP-102	66.6	8.51E+05	89%	5,725	4.31E-04	3.67E+02	1.07	0.99	0.11	1.33	0.005	0.010
Supernatant	58.1	6.97E+05	100%	1,141	4.34E-04	3.03E+02	1.07	0.99	0.11	1.33	0.005	0.010
Solid Layer	8.4	1.54E+05	39%	4,584	4.14E-04	6.38E+01	1.07	0.99	0.11	1.33	0.005	0.008
241-AP-103	325.1	4.58E+06	100%	10,801	8.71E-04	3.98E+03	2.40	1.74	0.54	1.36	0.005	0.021
Supernatant	325.1	4.58E+06	100%	10,801	8.71E-04	3.98E+03	2.40	1.74	0.54	1.36	0.005	0.021
Solid Layer	na	na	na	na	na	na	na	na	na	na	na	na
241-AP-104	402.4	5.37E+06	100%	12,319	7.97E-04	4.28E+03	1.83	1.57	0.36	1.14	0.005	0.016
Supernatant	402.4	5.37E+06	100%	12,319	7.97E-04	4.28E+03	1.83	1.57	0.36	1.14	0.005	0.016
Solid Layer	na	na	na	na	na	na	na	na	na	na	na	na
241-AP-105	410.7	5.67E+06	98%	12,483	7.59E-04	4.30E+03	1.97	1.10	0.22	1.71	0.005	0.011
Supernatant	378.4	5.13E+06	100%	7,430	7.54E-04	3.87E+03	1.97	1.10	0.22	1.71	0.005	0.011
Solid Layer	32.3	5.43E+05	78%	5,053	8.04E-04	4.36E+02	1.97	1.10	0.22	1.71	0.005	0.011
241-AP-106	413.6	5.22E+06	100%	12,539	7.39E-04	3.85E+03	1.14	0.90	0.29	1.11	0.005	0.013
Supernatant	413.6	5.22E+06	100%	12,539	7.39E-04	3.85E+03	1.14	0.90	0.29	1.11	0.005	0.013
Solid Layer	na	na	na	na	na	na	na	na	na	na	na	na
241-AP-107	84.6	1.16E+06	100%	6,079	7.73E-04	9.00E+02	2.18	1.92	0.18	2.00	0.005	0.011
Supernatant	84.6	1.16E+06	100%	6,079	7.73E-04	9.00E+02	2.18	1.92	0.18	2.00	0.005	0.011
Solid Layer	na	na	na	na	na	na	na	na	na	na	na	na
241-AP-108	413.7	5.39E+06	100%	12,541	6.95E-04	3.75E+03	1.81	1.59	0.20	1.80	0.005	0.022
Supernatant	413.7	5.39E+06	100%	12,541	6.95E-04	3.75E+03	1.81	1.59	0.20	1.80	0.005	0.022
Solid Layer	na	na	na	na	na	na	na	na	na	na	na	na
241-AW-101	409.2	6.30E+06	97%	12,453	1.39E-03	8.73E+03	2.74	2.61	0.27	2.24	0.005	0.019
Supernatant	265.5	4.07E+06	100%	5,213	1.41E-03	5.73E+03	2.74	2.61	0.27	2.24	0.005	0.019
Solid Layer	143.7	2.23E+06	92%	7,239	1.34E-03	3.00E+03	2.74	2.61	0.27	2.24	0.005	0.019

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_{liq}$ (mole/L)	NO_2 in liquid, $[NO_2]_{liq}$ (mole/L)	TOC in liquid, $[TOC]_{liq}$ (wt%)	AI in liquid, $[AI]_{liq}$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-AW-102	30.7	4.02E+05	77%	5,021	1.78E-03	7.15E+02	0.81	0.71	0.07	0.86	0.005	0.007
Supernatant	19.9	2.34E+05	100%	390	3.34E-04	7.81E+01	0.81	0.71	0.07	0.86	0.005	0.007
Solid Layer	10.8	1.68E+05	46%	4,631	3.79E-03	6.37E+02	0.81	0.71	0.07	0.86	0.005	0.008
241-AW-103	400.0	5.48E+06	97%	12,272	3.77E-04	2.06E+03	2.00	0.87	0.17	0.95	0.005	0.009
Supernatant	286.4	3.70E+06	100%	5,624	4.81E-04	1.78E+03	2.00	0.87	0.17	0.95	0.005	0.009
Solid Layer	113.6	1.77E+06	91%	6,648	1.59E-04	2.82E+02	2.00	0.87	0.17	0.95	0.005	0.009
241-AW-104	390.1	5.51E+06	98%	12,078	9.07E-04	4.99E+03	2.20	1.88	0.37	2.14	0.005	0.032
Supernatant	309.3	4.26E+06	100%	6,072	9.24E-04	3.93E+03	2.28	1.91	0.33	2.04	0.005	0.032
Solid Layer	80.9	1.25E+06	89%	6,006	8.49E-04	1.06E+03	1.90	1.75	0.52	2.33	0.005	0.027
241-AW-105	154.5	2.01E+06	78%	7,452	2.10E-04	4.23E+02	0.71	0.25	0.03	0.10	0.005	0.006
Supernatant	58.7	6.49E+05	100%	1,153	4.66E-05	3.02E+01	0.41	0.04	0.09	0.01	0.005	0.007
Solid Layer	95.8	1.36E+06	68%	6,299	2.88E-04	3.92E+02	0.90	0.38	0.00	0.14	0.005	0.005
241-AW-106	350.3	5.39E+06	92%	11,296	9.76E-04	5.26E+03	3.06	2.66	0.24	2.51	0.005	0.024
Supernatant	263.6	3.96E+06	100%	5,176	9.90E-04	3.92E+03	3.06	2.66	0.24	2.51	0.005	0.023
Solid Layer	86.7	1.43E+06	72%	6,121	9.38E-04	1.34E+03	3.06	2.66	0.24	2.51	0.005	0.026
241-AV-101	65.7	9.95E+05	68%	5,708	1.45E-02	1.44E+04	0.08	0.74	0.12	0.40	0.005	0.012
Supernatant	30.7	3.81E+05	100%	603	2.06E-04	7.83E+01	0.08	0.74	0.12	0.40	0.005	0.012
Solid Layer	35.0	6.15E+05	49%	5,105	2.33E-02	1.43E+04	0.08	0.74	0.12	0.42	0.005	0.013
241-AV-102	260.0	3.40E+06	86%	9,524	1.10E-02	3.73E+04	0.00	0.80	0.14	0.12	0.005	0.026
Supernatant	198.2	2.42E+06	100%	3,891	1.27E-04	3.07E+02	0.01	0.89	0.09	0.13	0.005	0.015
Solid Layer	61.9	9.81E+05	52%	5,633	3.77E-02	3.70E+04	0.00	0.00	0.17	0.01	0.450	0.504
241-AZ-101	363.5	4.78E+06	97%	11,556	1.29E-02	6.14E+04	0.96	1.33	0.02	0.58	0.005	0.012
Supernatant	344.7	4.46E+06	100%	6,767	6.00E-03	2.67E+04	0.97	1.33	0.02	0.58	0.005	0.012
Solid Layer	18.9	3.20E+05	60%	4,789	1.08E-01	3.47E+04	0.88	1.48	0.03	0.60	0.005	0.016

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_{li}$ (mole/L)	NO_2 in liquid, $[NO_2]_{li}$ (mole/L)	TOC in liquid, $[TOC]_{li}$ (wt%)	Al in liquid, $[Al]_{li}$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-AZ-102	359.7	4.28E+06	94%	11,481	8.91E-03	3.82E+04	0.27	0.71	0.09	0.04	0.005	0.016
Supernatant	321.7	3.72E+06	100%	6,317	4.27E-03	1.59E+04	0.27	0.71	0.09	0.04	0.005	0.016
Solid Layer	38.0	5.58E+05	52%	5,164	3.99E-02	2.23E+04	0.27	0.71	0.09	0.04	0.005	0.021
241-SY-101	406.4	5.78E+06	96%	12,398	8.85E-04	5.12E+03	2.07	1.99	0.42	1.27	0.005	0.018
Supernatant	306.6	4.28E+06	100%	6,020	8.64E-04	3.70E+03	2.07	1.99	0.42	1.27	0.005	0.018
Solid Layer	99.9	1.50E+06	84%	6,379	9.47E-04	1.42E+03	2.07	1.99	0.42	1.27	0.005	0.019
241-SY-102	307.1	4.25E+06	95%	10,447	8.10E-04	3.44E+03	1.73	1.54	0.27	1.43	0.005	0.016
Supernatant	254.3	3.39E+06	100%	4,993	7.37E-04	2.50E+03	1.64	1.53	0.25	1.60	0.005	0.016
Solid Layer	52.8	8.58E+05	75%	5,454	1.10E-03	9.42E+02	2.16	1.59	0.34	0.56	0.005	0.019
241-SY-103	272.2	4.22E+06	93%	9,763	1.43E-03	6.05E+03	2.71	3.31	0.42	2.56	0.005	0.024
Supernatant	148.0	2.27E+06	100%	2,906	1.50E-03	3.41E+03	2.71	3.31	0.42	2.56	0.005	0.023
Solid Layer	124.2	1.95E+06	84%	6,857	1.35E-03	2.64E+03	2.71	3.31	0.42	2.56	0.005	0.025
241-A-101	149.4	2.34E+06	68%	7,352	1.38E-03	3.22E+03	3.76	3.59	0.25	3.47	0.005	0.028
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	149.4	2.34E+06	68%	7,352	1.38E-03	3.22E+03	3.76	3.59	0.25	3.47	0.005	0.028
241-A-102	14.4	2.49E+05	81%	4,700	3.17E-03	7.90E+02	2.08	0.04	0.00	10.44	0.005	0.005
Supernatant	1.1	1.73E+04	100%	21	1.61E-03	2.78E+01	2.08	0.04	0.00	10.42	0.005	0.005
Solid Layer	13.3	2.32E+05	80%	4,680	3.29E-03	7.62E+02	2.08	0.04	0.00	10.44	0.005	0.005
241-A-103	134.8	1.93E+06	82%	7,064	1.18E-03	2.29E+03	3.09	2.08	0.54	4.02	0.005	0.029
Supernatant	1.6	2.47E+04	100%	32	9.05E-04	2.23E+01	3.09	2.08	0.54	4.01	0.005	0.042
Solid Layer	133.1	1.91E+06	82%	7,032	1.19E-03	2.27E+03	3.09	2.08	0.54	4.02	0.005	0.029
241-A-104	10.2	1.74E+05	56%	4,618	9.74E-02	1.69E+04	1.28	0.78	0.26	0.42	0.005	0.059
Supernatant	0.0	1.64E-01	100%	0	9.74E-02	1.60E-02	1.28	0.78	0.26	0.42	0.005	0.064
Solid Layer	10.2	1.74E+05	56%	4,618	9.74E-02	1.69E+04	1.28	0.78	0.26	0.42	0.005	0.059

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_{liq}$ (mole/L)	NO_2 in liquid, $[NO_2]_{liq}$ (mole/L)	TOC in liquid, $[TOC]_{liq}$ (wt%)	Al in liquid, $[Al]_{liq}$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-A-105	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Supernatant	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Solid Layer	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
241-A-106	28.7	5.08E+05	46%	4,981	7.59E-03	3.86E+03	1.28	0.78	0.94	0.42	0.005	0.077
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	28.7	5.08E+05	46%	4,981	7.59E-03	3.86E+03	1.28	0.78	0.94	0.42	0.005	0.077
241-AX-101	117.0	2.08E+06	77%	6,716	1.42E-03	2.96E+03	4.38	3.76	0.26	3.29	0.005	0.018
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	117.0	2.08E+06	77%	6,716	1.42E-03	2.96E+03	4.38	3.76	0.26	3.29	0.005	0.018
241-AX-102	10.8	2.00E+05	80%	4,631	9.17E-03	1.83E+03	2.83	2.33	1.65	1.98	0.005	0.031
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	10.8	2.00E+05	80%	4,631	9.17E-03	1.83E+03	2.83	2.33	1.65	1.98	0.005	0.031
241-AX-103	39.3	6.52E+05	85%	5,190	5.78E-03	3.77E+03	2.19	2.33	1.61	2.45	0.005	0.068
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	39.3	6.52E+05	85%	5,190	5.78E-03	3.77E+03	2.19	2.33	1.61	2.45	0.005	0.068
241-AX-104	2.7	5.04E+04	11%	4,471	2.98E-01	1.50E+04	1.28	0.78	0.26	0.42	0.005	0.011
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	2.7	5.04E+04	11%	4,471	2.98E-01	1.50E+04	1.28	0.78	0.26	0.42	0.005	0.011
241-B-101	39.4	6.12E+05	71%	5,192	1.05E-02	6.45E+03	5.74	2.86	0.00	0.10	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	39.4	6.12E+05	71%	5,192	1.05E-02	6.45E+03	5.74	2.86	0.00	0.10	0.005	0.005
241-B-102	11.6	1.89E+05	46%	4,646	1.02E-04	1.92E+01	2.80	0.40	0.00	0.06	0.005	0.005
Supernatant	1.4	1.79E+04	100%	28	1.49E-04	2.66E+00	2.81	0.40	0.00	0.06	0.005	0.005
Solid Layer	10.2	1.71E+05	40%	4,618	9.66E-05	1.65E+01	2.80	0.40	0.00	0.06	0.005	0.005

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_{li}$ (mole/L)	NO_2 in liquid, $[NO_2]_{li}$ (mole/L)	TOC in liquid, $[TOC]_{li}$ (wt%)	AI in liquid, $[AI]_{li}$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-B-103	20.2	3.40E+05	71%	4,815	1.02E-04	3.48E+01	2.81	0.40	0.00	0.06	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	20.2	3.40E+05	71%	4,815	1.02E-04	3.48E+01	2.81	0.40	0.00	0.06	0.005	0.005
241-B-104	135.9	1.92E+06	69%	7,087	3.48E-04	6.68E+02	2.81	0.40	0.00	0.06	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	135.9	1.92E+06	69%	7,087	3.48E-04	6.68E+02	2.81	0.40	0.00	0.06	0.005	0.005
241-B-105	105.3	1.84E+06	62%	6,486	1.04E-04	1.90E+02	2.82	0.40	0.00	0.06	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	105.3	1.84E+06	62%	6,486	1.04E-04	1.90E+02	2.82	0.40	0.00	0.06	0.005	0.005
241-B-106	44.5	6.40E+05	87%	5,292	4.23E-04	2.71E+02	2.81	0.40	0.00	0.06	0.005	0.005
Supernatant	0.4	4.76E+03	100%	8	1.49E-04	7.09E-01	2.81	0.40	0.00	0.06	0.005	0.005
Solid Layer	44.1	6.35E+05	87%	5,284	4.25E-04	2.70E+02	2.81	0.40	0.00	0.06	0.005	0.005
241-B-107	58.6	9.94E+05	66%	5,569	9.29E-04	9.23E+02	5.34	0.14	0.00	0.00	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	58.6	9.94E+05	66%	5,569	9.29E-04	9.23E+02	5.34	0.14	0.00	0.00	0.005	0.005
241-B-108	33.5	5.84E+05	47%	5,075	8.79E-05	5.14E+01	6.08	1.17	0.00	0.07	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	33.5	5.84E+05	47%	5,075	8.79E-05	5.14E+01	6.08	1.17	0.00	0.07	0.005	0.005
241-B-109	45.4	8.37E+05	59%	5,309	3.16E-03	2.64E+03	2.82	0.39	0.00	0.06	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	45.4	8.37E+05	59%	5,309	3.16E-03	2.64E+03	2.82	0.39	0.00	0.06	0.005	0.005
241-B-110	89.1	1.26E+06	59%	6,168	6.13E-04	7.74E+02	0.16	0.02	0.00	0.00	0.023	0.023
Supernatant	0.4	4.04E+03	100%	8	0.00E+00	0.00E+00	0.16	0.02	0.00	0.00	0.023	0.023
Solid Layer	88.7	1.26E+06	59%	6,160	6.15E-04	7.74E+02	0.16	0.02	0.00	0.00	0.023	0.023

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, $[TOC]_M$ (wt%)	Al in liquid, $[Al]_M$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-B-111	87.7	1.09E+06	59%	6,139	2.00E-03	2.18E+03	0.16	0.02	0.00	0.00	0.023	0.023
Supernatant	0.4	4.04E+03	100%	8	0.00E+00	0.00E+00	0.16	0.02	0.00	0.00	0.023	0.023
Solid Layer	87.3	1.08E+06	59%	6,132	2.01E-03	2.18E+03	0.16	0.02	0.00	0.00	0.023	0.023
241-B-112	12.7	1.96E+05	81%	4,666	4.77E-04	9.37E+01	2.58	1.98	0.85	3.92	0.005	0.014
Supernatant	1.1	1.11E+04	100%	21	0.00E+00	0.00E+00	0.16	0.02	0.00	0.00	0.024	0.024
Solid Layer	11.6	1.85E+05	79%	4,646	5.06E-04	9.37E+01	2.80	2.16	0.64	2.96	0.005	0.012
241-B-201	155.0	1.45E+05	86%	1,126	1.30E-05	1.89E+00	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	155.0	1.45E+05	86%	1,126	1.30E-05	1.89E+00	1.28	0.78	0.26	0.42	0.005	0.008
241-B-202	149.6	1.35E+05	91%	1,098	2.20E-05	2.98E+00	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	149.6	1.35E+05	91%	1,098	2.20E-05	2.98E+00	1.28	0.78	0.26	0.42	0.005	0.008
241-B-203	262.8	2.32E+05	85%	1,690	1.01E-05	2.34E+00	0.91	0.03	0.01	0.00	0.005	0.005
Supernatant	2.7	2.10E+03	100%	14	1.48E-06	3.11E-03	0.91	0.03	0.01	0.00	0.005	0.005
Solid Layer	260.1	2.30E+05	85%	1,676	1.02E-05	2.34E+00	0.91	0.03	0.01	0.00	0.005	0.005
241-B-204	258.8	2.28E+05	85%	1,669	9.36E-06	2.13E+00	0.56	0.03	0.00	0.00	0.005	0.005
Supernatant	4.0	3.15E+03	100%	21	1.20E-06	3.77E-03	0.56	0.03	0.00	0.00	0.005	0.005
Solid Layer	254.7	2.25E+05	85%	1,648	9.47E-06	2.13E+00	0.56	0.03	0.00	0.00	0.005	0.005
241-BX-101	17.3	2.98E+05	44%	4,757	6.52E-03	1.94E+03	1.95	1.40	0.39	0.40	0.005	0.011
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	17.3	2.98E+05	44%	4,757	6.52E-03	1.94E+03	1.95	1.40	0.39	0.40	0.005	0.011
241-BX-102	40.7	3.84E+05	29%	5,216	6.11E-03	2.35E+03	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	40.7	3.84E+05	29%	5,216	6.11E-03	2.35E+03	1.28	0.78	0.26	0.42	0.005	0.008

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, $[TOC]_M$ (wt%)	Al in liquid, $[Al]_M$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-BX-103	26.6	4.32E+05	68%	4,940	3.79E-03	1.64E+03	0.86	0.36	0.39	1.93	0.005	0.010
Supernatant	4.0	4.66E+04	100%	79	2.82E-05	1.31E+00	0.86	0.36	0.39	1.93	0.005	0.010
Solid Layer	22.5	3.85E+05	64%	4,860	4.24E-03	1.64E+03	0.86	0.36	0.39	1.93	0.005	0.010
241-BX-104	36.4	6.32E+05	47%	5,132	1.68E-03	1.06E+03	2.16	1.39	0.25	0.22	0.005	0.011
Supernatant	1.1	1.41E+04	100%	21	5.00E-04	7.04E+00	2.16	1.39	0.25	0.22	0.005	0.011
Solid Layer	35.3	6.18E+05	46%	5,111	1.71E-03	1.06E+03	2.16	1.39	0.25	0.22	0.005	0.011
241-BX-105	26.0	4.54E+05	24%	4,928	9.89E-04	4.49E+02	1.89	1.70	0.73	0.46	0.005	0.014
Supernatant	1.7	2.32E+04	100%	34	5.11E-04	1.19E+01	1.89	1.70	0.73	0.46	0.005	0.014
Solid Layer	24.3	4.31E+05	20%	4,894	1.02E-03	4.37E+02	1.89	1.70	0.73	0.46	0.005	0.014
241-BX-106	13.6	2.33E+05	52%	4,685	1.22E-03	2.85E+02	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	13.6	2.33E+05	52%	4,685	1.22E-03	2.85E+02	1.28	0.78	0.26	0.42	0.005	0.008
241-BX-107	125.9	1.89E+06	67%	6,891	1.22E-04	2.31E+02	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	125.9	1.89E+06	67%	6,891	1.22E-04	2.31E+02	1.28	0.78	0.26	0.42	0.005	0.008
241-BX-108	11.4	1.80E+05	23%	4,642	1.19E-03	2.15E+02	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	11.4	1.80E+05	23%	4,642	1.19E-03	2.15E+02	1.28	0.78	0.26	0.42	0.005	0.008
241-BX-109	70.1	1.11E+06	71%	5,795	8.25E-04	9.17E+02	1.28	0.78	0.26	0.42	0.005	0.009
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	70.1	1.11E+06	71%	5,795	8.25E-04	9.17E+02	1.28	0.78	0.26	0.42	0.005	0.009
241-BX-110	74.4	1.34E+06	73%	5,879	3.39E-04	4.56E+02	6.66	1.13	0.64	0.31	0.005	0.013
Supernatant	0.5	7.20E+03	100%	9	4.64E-04	3.34E+00	6.65	1.13	0.64	0.31	0.005	0.013
Solid Layer	74.0	1.34E+06	73%	5,870	3.39E-04	4.52E+02	6.66	1.13	0.64	0.31	0.005	0.013

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, $[TOC]_M$ (wt%)	AI in liquid, $[AI]_M$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-BX-111	68.5	1.03E+06	10%	5,763	4.55E-04	4.69E+02	2.99	2.31	0.12	3.36	0.005	0.006
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	68.5	1.03E+06	10%	5,763	4.55E-04	4.69E+02	2.99	2.31	0.12	3.36	0.005	0.006
241-BX-112	59.7	8.14E+05	94%	5,589	2.48E-04	2.02E+02	1.59	0.77	0.00	0.00	0.005	0.005
Supernatant	0.5	5.90E+03	100%	9	3.11E-04	1.84E+00	1.59	0.77	0.00	0.00	0.005	0.005
Solid Layer	59.2	8.08E+05	94%	5,580	2.47E-04	2.00E+02	1.59	0.77	0.00	0.00	0.005	0.005
241-BY-101	134.3	2.53E+06	27%	7,055	1.25E-03	3.15E+03	2.82	2.16	0.64	2.96	0.005	0.017
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	134.3	2.53E+06	27%	7,055	1.25E-03	3.15E+03	2.82	2.16	0.64	2.96	0.005	0.017
241-BY-102	100.5	1.65E+06	34%	6,392	4.55E-04	7.49E+02	2.38	1.83	0.11	3.93	0.005	0.006
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	100.5	1.65E+06	34%	6,392	4.55E-04	7.49E+02	2.38	1.83	0.11	3.87	0.005	0.006
241-BY-103	151.1	2.58E+06	34%	7,384	6.48E-04	1.67E+03	2.73	1.17	0.15	3.21	0.005	0.007
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	151.1	2.58E+06	34%	7,384	6.48E-04	1.67E+03	2.73	1.17	0.15	3.21	0.005	0.007
241-BY-104	130.1	2.31E+06	33%	6,972	1.47E-03	3.39E+03	3.03	2.33	0.16	4.95	0.005	0.013
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	130.1	2.31E+06	33%	6,972	1.47E-03	3.39E+03	3.03	2.33	0.16	4.95	0.005	0.013
241-BY-105	174.7	3.30E+06	35%	7,848	5.59E-04	1.85E+03	3.22	1.50	0.17	2.72	0.005	0.010
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	174.7	3.30E+06	35%	7,848	5.59E-04	1.85E+03	3.22	1.50	0.17	2.72	0.005	0.010
241-BY-106	178.1	3.07E+06	44%	7,915	8.72E-04	2.68E+03	1.78	1.70	0.20	3.04	0.005	0.012
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	178.1	3.07E+06	44%	7,915	8.72E-04	2.68E+03	1.78	1.70	0.20	3.04	0.005	0.012

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, $[TOC]_M$ (wt%)	Al in liquid, $[Al]_M$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-BY-107	98.6	1.73E+06	50%	6,354	8.93E-04	1.55E+03	2.12	2.55	0.16	3.50	0.005	0.009
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	98.6	1.73E+06	50%	6,354	8.93E-04	1.55E+03	2.12	2.55	0.16	3.50	0.005	0.009
241-BY-108	80.7	1.25E+06	51%	6,002	9.58E-04	1.20E+03	4.74	1.71	0.18	2.73	0.005	0.010
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	80.7	1.25E+06	51%	6,002	9.58E-04	1.20E+03	4.74	1.71	0.18	2.73	0.005	0.010
241-BY-109	100.4	1.79E+06	35%	6,390	1.17E-03	2.08E+03	3.07	1.80	0.13	2.58	0.005	0.006
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	100.4	1.79E+06	35%	6,390	1.17E-03	2.08E+03	3.07	1.80	0.13	2.58	0.005	0.006
241-BY-110	132.8	2.17E+06	28%	7,025	9.68E-04	2.10E+03	2.00	2.69	0.82	4.56	0.005	0.032
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	132.8	2.17E+06	28%	7,025	9.68E-04	2.10E+03	2.00	2.69	0.82	4.56	0.005	0.032
241-BY-111	109.7	1.93E+06	12%	6,573	4.16E-04	8.01E+02	1.96	0.72	0.09	1.81	0.005	0.007
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	109.7	1.93E+06	12%	6,573	4.16E-04	8.01E+02	1.96	0.72	0.09	1.81	0.005	0.007
241-BY-112	103.9	1.88E+06	12%	6,458	4.50E-04	8.46E+02	3.08	3.05	0.12	3.77	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	103.9	1.88E+06	12%	6,458	4.50E-04	8.46E+02	3.08	3.05	0.12	3.77	0.005	0.008
241-C-101	31.9	5.93E+05	32%	5,045	3.51E-03	2.08E+03	1.28	0.78	0.26	0.42	0.005	0.012
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	31.9	5.93E+05	32%	5,045	3.51E-03	2.08E+03	1.28	0.78	0.26	0.42	0.005	0.012
241-C-102	114.7	1.99E+06	19%	6,670	2.07E-03	4.11E+03	1.28	0.78	0.26	0.42	0.005	0.011
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	114.7	1.99E+06	19%	6,670	2.07E-03	4.11E+03	1.28	0.78	0.26	0.42	0.005	0.011

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_{LI}$ (mole/L)	NO_2 in liquid, $[NO_2]_{LI}$ (mole/L)	TOC in liquid, $[TOC]_{LI}$ (wt%)	AI in liquid, $[AI]_{LI}$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-C-103	32.1	5.13E+05	64%	5,049	2.66E-02	1.37E+04	0.03	0.43	0.60	0.00	0.005	0.033
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	32.1	5.13E+05	64%	5,049	2.66E-02	1.37E+04	0.03	0.43	0.60	0.00	0.005	0.033
241-C-104	94.0	1.66E+06	59%	6,264	2.23E-03	3.69E+03	1.28	0.78	0.48	0.42	0.005	0.022
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	94.0	1.66E+06	59%	6,264	2.23E-03	3.69E+03	1.28	0.78	0.48	0.42	0.005	0.022
241-C-105	48.0	7.75E+05	39%	5,360	4.60E-03	3.57E+03	0.55	0.80	0.23	0.00	0.005	0.020
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	48.0	7.75E+05	39%	5,360	4.60E-03	3.57E+03	0.55	0.80	0.23	0.00	0.005	0.020
241-C-106	5.0	7.22E+04	59%	4,516	3.98E-02	2.87E+03	0.01	0.27	0.27	0.17	0.054	0.060
Supernatant	1.7	2.05E+04	100%	34	2.39E-04	4.90E+00	0.01	0.27	0.27	0.17	0.054	0.060
Solid Layer	3.3	5.17E+04	42%	4,482	5.55E-02	2.87E+03	0.01	0.27	0.27	0.17	0.054	0.060
241-C-107	90.2	1.46E+06	27%	6,188	1.05E-02	1.53E+04	1.28	0.78	0.26	0.42	0.005	0.019
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	90.2	1.46E+06	27%	6,188	1.05E-02	1.53E+04	1.28	0.78	0.26	0.42	0.005	0.019
241-C-108	24.0	3.63E+05	51%	4,889	1.22E-03	4.42E+02	1.28	0.78	0.26	0.42	0.005	0.009
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	24.0	3.63E+05	51%	4,889	1.22E-03	4.42E+02	1.28	0.78	0.26	0.42	0.005	0.009
241-C-109	23.0	3.46E+05	53%	4,870	7.19E-03	2.49E+03	1.28	0.78	0.26	0.42	0.005	0.010
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	23.0	3.46E+05	53%	4,870	7.19E-03	2.49E+03	1.28	0.78	0.26	0.42	0.005	0.010
241-C-110	64.7	9.02E+05	44%	5,687	1.03E-04	9.31E+01	0.97	0.10	0.05	0.02	0.005	0.006
Supernatant	0.4	4.40E+03	100%	8	1.73E-05	7.63E-02	0.97	0.10	0.05	0.02	0.005	0.006
Solid Layer	64.3	8.98E+05	43%	5,680	1.04E-04	9.30E+01	0.97	0.10	0.05	0.02	0.005	0.006

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_{li}$ (mole/L)	NO_2 in liquid, $[NO_2]_{li}$ (mole/L)	TOC in liquid, [TOC] (wt%)	Al in liquid, [Al] (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-C-111	20.8	3.11E+05	50%	4,827	1.94E-02	6.05E+03	1.28	0.78	0.26	0.42	0.005	0.009
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	20.8	3.11E+05	50%	4,827	1.94E-02	6.05E+03	1.28	0.78	0.26	0.42	0.005	0.009
241-C-112	37.7	6.29E+05	69%	5,158	9.05E-03	5.69E+03	1.28	0.78	0.26	0.42	0.005	0.010
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	37.7	6.29E+05	69%	5,158	9.05E-03	5.69E+03	1.28	0.78	0.26	0.42	0.005	0.010
241-C-201	5.4	5.76E+03	12%	342	8.03E-04	4.63E+00	1.28	0.78	0.26	0.42	0.005	0.007
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	5.4	5.76E+03	12%	342	8.03E-04	4.63E+00	1.28	0.78	0.26	0.42	0.005	0.007
241-C-202	4.0	4.32E+03	6%	335	1.51E-03	6.54E+00	1.28	0.78	0.26	0.42	0.005	0.007
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	4.0	4.32E+03	6%	335	1.51E-03	6.54E+00	1.28	0.78	0.26	0.42	0.005	0.007
241-C-203	13.5	1.62E+04	56%	385	2.22E-04	3.60E+00	1.28	0.78	0.26	0.42	0.005	0.007
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	13.5	1.62E+04	56%	385	2.22E-04	3.60E+00	1.28	0.78	0.26	0.42	0.005	0.007
241-C-204	12.1	1.43E+04	56%	378	2.26E-04	3.24E+00	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	12.1	1.43E+04	56%	378	2.26E-04	3.24E+00	1.28	0.78	0.26	0.42	0.005	0.008
241-S-101	142.4	2.43E+06	81%	7,215	2.28E-03	5.55E+03	3.45	2.45	0.12	2.04	0.005	0.011
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	142.4	2.43E+06	81%	7,215	2.28E-03	5.55E+03	3.45	2.45	0.12	2.04	0.005	0.011
241-S-102	158.8	1.95E+06	66%	7,537	1.02E-03	1.99E+03	2.50	2.77	0.26	3.85	0.005	0.012
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	158.8	1.95E+06	66%	7,537	1.02E-03	1.99E+03	2.50	2.77	0.26	3.85	0.005	0.012

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, $[TOC]_M$ (wt%)	Al in liquid, $[Al]_M$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-S-103	86.0	1.42E+06	73%	6,107	9.16E-04	1.30E+03	3.49	3.19	0.32	2.21	0.005	0.011
Supernatant	0.4	5.80E+03	100%	8	1.14E-03	6.59E+00	3.48	3.20	0.32	2.21	0.005	0.012
Solid Layer	85.7	1.42E+06	73%	6,100	9.15E-04	1.30E+03	3.49	3.19	0.32	2.21	0.005	0.011
241-S-104	104.6	1.80E+06	70%	6,471	1.80E-03	3.25E+03	4.33	0.83	0.03	0.88	0.005	0.006
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	104.6	1.80E+06	70%	6,471	1.80E-03	3.25E+03	4.33	0.83	0.03	0.88	0.005	0.006
241-S-105	147.3	2.50E+06	5%	7,311	1.71E-04	4.27E+02	2.02	2.12	0.94	2.92	0.005	0.020
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	147.3	2.50E+06	5%	7,311	1.71E-04	4.27E+02	2.02	2.12	0.94	2.92	0.005	0.020
241-S-106	165.3	2.97E+06	64%	7,663	5.51E-04	1.64E+03	3.81	2.26	0.14	2.66	0.005	0.007
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	165.3	2.97E+06	64%	7,663	5.51E-04	1.64E+03	3.81	2.26	0.14	2.66	0.005	0.007
241-S-107	116.3	2.23E+06	48%	6,701	1.37E-03	3.05E+03	1.85	1.55	0.09	0.82	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	116.3	2.23E+06	48%	6,701	1.37E-03	3.05E+03	1.85	1.55	0.09	0.82	0.005	0.008
241-S-108	199.7	3.43E+06	3%	8,339	6.64E-04	2.28E+03	2.02	2.11	0.94	2.92	0.005	0.023
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	199.7	3.43E+06	3%	8,339	6.64E-04	2.28E+03	2.02	2.11	0.94	2.92	0.005	0.023
241-S-109	193.5	3.34E+06	20%	8,217	1.89E-04	6.30E+02	2.12	1.85	0.07	3.08	0.005	0.006
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	193.5	3.34E+06	20%	8,217	1.89E-04	6.30E+02	2.12	1.85	0.07	3.08	0.005	0.006
241-S-110	141.3	2.44E+06	24%	7,192	1.02E-03	2.50E+03	3.51	1.87	0.16	2.16	0.005	0.012
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	141.3	2.44E+06	24%	7,192	1.02E-03	2.50E+03	3.51	1.87	0.16	2.16	0.005	0.012

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, $[TOC]_M$ (wt%)	AI in liquid, $[AI]_M$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-S-111	162.9	2.28E+06	61%	7,616	1.88E-03	4.29E+03	3.10	1.82	0.10	2.51	0.005	0.007
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	162.9	2.28E+06	61%	7,616	1.88E-03	4.29E+03	3.10	1.82	0.10	2.51	0.005	0.007
241-S-112	223.0	3.87E+06	32%	8,797	4.52E-04	1.75E+03	2.71	1.35	0.06	2.54	0.005	0.006
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	223.0	3.87E+06	32%	8,797	4.52E-04	1.75E+03	2.71	1.35	0.06	2.54	0.005	0.006
241-SX-101	150.0	2.61E+06	56%	7,364	2.24E-03	5.86E+03	1.74	1.63	0.02	5.41	0.005	0.009
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	150.0	2.61E+06	56%	7,364	2.24E-03	5.86E+03	1.74	1.63	0.02	5.41	0.005	0.009
241-SX-102	156.2	2.77E+06	81%	7,484	1.29E-03	3.57E+03	2.54	3.28	0.10	3.13	0.005	0.012
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	156.2	2.77E+06	81%	7,484	1.29E-03	3.57E+03	2.54	3.28	0.10	3.13	0.005	0.012
241-SX-103	178.4	3.22E+06	65%	7,921	1.76E-03	5.66E+03	2.53	3.43	0.23	3.02	0.005	0.034
Supernatant	0.0	1.47E+00	100%	0	1.76E-03	2.59E-03	2.53	3.43	0.23	3.02	0.005	0.046
Solid Layer	178.4	3.22E+06	65%	7,921	1.76E-03	5.66E+03	2.53	3.43	0.23	3.02	0.005	0.034
241-SX-104	161.9	2.82E+06	67%	7,597	1.76E-03	4.98E+03	4.68	2.55	0.14	2.42	0.005	0.015
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	161.9	2.82E+06	67%	7,597	1.76E-03	4.98E+03	4.68	2.55	0.14	2.42	0.005	0.015
241-SX-105	136.4	2.32E+06	82%	7,096	1.22E-03	2.83E+03	2.65	3.11	0.22	3.00	0.005	0.026
Supernatant	na	na	na	na	na	na	0.00	0.00	na	na	na	na
Solid Layer	136.4	2.32E+06	82%	7,096	1.22E-03	2.83E+03	2.65	3.11	0.22	3.00	0.005	0.026
241-SX-106	144.0	2.37E+06	81%	7,245	7.18E-04	1.70E+03	3.95	3.24	0.24	1.75	0.005	0.012
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	144.0	2.37E+06	81%	7,245	7.18E-04	1.70E+03	3.95	3.24	0.24	1.75	0.005	0.012

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_{li}$ (mole/L)	NO_2 in liquid, $[NO_2]_{li}$ (mole/L)	TOC in liquid, [TOC] (wt%)	Al in liquid, [Al] (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{Tot} ($H_2/100eV$)
241-SX-107	34.2	6.19E+05	48%	5,090	3.52E-03	2.18E+03	2.81	2.39	0.01	2.98	0.005	0.007
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	34.2	6.19E+05	48%	5,090	3.52E-03	2.18E+03	2.81	2.39	0.01	2.98	0.005	0.007
241-SX-108	26.5	4.83E+05	3%	4,938	1.94E-02	9.37E+03	1.28	0.78	0.26	0.42	0.005	0.073
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	26.5	4.83E+05	3%	4,938	1.94E-02	9.37E+03	1.28	0.78	0.26	0.42	0.005	0.073
241-SX-109	87.6	1.58E+06	20%	6,137	2.08E-03	3.29E+03	2.83	2.33	0.66	1.98	0.005	0.061
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	87.6	1.58E+06	20%	6,137	2.08E-03	3.29E+03	2.83	2.33	0.66	1.98	0.005	0.061
241-SX-110	20.3	3.68E+05	36%	4,817	2.75E-03	1.01E+03	1.28	0.78	0.26	0.42	0.005	0.024
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	20.3	3.68E+05	36%	4,817	2.75E-03	1.01E+03	1.28	0.78	0.26	0.42	0.005	0.024
241-SX-111	41.8	7.49E+05	51%	5,239	3.11E-03	2.32E+03	2.81	2.39	0.01	2.98	0.005	0.007
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	41.8	7.49E+05	51%	5,239	3.11E-03	2.32E+03	2.81	2.39	0.01	2.98	0.005	0.007
241-SX-112	27.1	4.88E+05	50%	4,951	3.31E-03	1.62E+03	2.80	2.39	0.01	2.98	0.005	0.006
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	27.1	4.88E+05	50%	4,951	3.31E-03	1.62E+03	2.80	2.39	0.01	2.98	0.005	0.006
241-SX-113	6.8	7.53E+04	61%	4,552	8.09E-04	6.09E+01	1.28	0.78	0.26	0.42	0.005	0.010
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	6.8	7.53E+04	61%	4,552	8.09E-04	6.09E+01	1.28	0.78	0.26	0.42	0.005	0.010
241-SX-114	56.4	9.88E+05	58%	5,525	2.11E-03	2.08E+03	2.81	2.38	0.01	2.98	0.005	0.007
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	56.4	9.88E+05	58%	5,525	2.11E-03	2.08E+03	2.81	2.38	0.01	2.98	0.005	0.007

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, $[TOC]_M$ (wt%)	AI in liquid, $[AI]_M$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-SX-115	1.3	2.45E+04	13%	4,444	9.96E-02	2.44E+03	1.28	0.78	0.26	0.42	0.005	0.009
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	1.3	2.45E+04	13%	4,444	9.96E-02	2.44E+03	1.28	0.78	0.26	0.42	0.005	0.009
241-T-101	36.1	6.09E+05	57%	5,126	4.74E-04	2.89E+02	2.68	2.09	0.73	2.55	0.005	0.015
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	36.1	6.09E+05	57%	5,126	4.74E-04	2.89E+02	2.68	2.09	0.73	2.55	0.005	0.015
241-T-102	11.6	1.85E+05	54%	4,646	1.01E-03	1.86E+02	1.76	0.50	0.04	0.73	0.005	0.005
Supernatant	4.7	5.60E+04	100%	92	2.35E-04	1.32E+01	1.76	0.50	0.04	0.73	0.005	0.005
Solid Layer	6.9	1.29E+05	34%	4,553	1.34E-03	1.73E+02	1.76	0.50	0.04	0.73	0.005	0.005
241-T-103	9.8	1.62E+05	44%	4,610	5.62E-03	9.13E+02	1.27	0.81	0.00	1.08	0.005	0.005
Supernatant	1.4	1.50E+04	100%	28	4.55E-04	6.83E+00	1.27	0.81	0.00	1.08	0.005	0.005
Solid Layer	8.3	1.47E+05	38%	4,582	6.15E-03	9.06E+02	1.27	0.81	0.00	0.92	0.005	0.005
241-T-104	115.0	1.55E+06	84%	6,676	1.54E-05	2.38E+01	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	115.0	1.55E+06	84%	6,676	1.54E-05	2.38E+01	1.28	0.78	0.26	0.42	0.005	0.008
241-T-105	35.6	5.42E+05	69%	5,117	7.96E-04	4.31E+02	0.60	1.18	0.25	0.03	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	35.6	5.42E+05	69%	5,117	7.96E-04	4.31E+02	0.60	1.18	0.25	0.03	0.005	0.008
241-T-106	7.9	1.16E+05	22%	4,572	2.72E-04	3.14E+01	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	7.9	1.16E+05	22%	4,572	2.72E-04	3.14E+01	1.28	0.78	0.26	0.42	0.005	0.008
241-T-107	62.8	1.02E+06	46%	5,652	8.00E-04	8.17E+02	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	62.8	1.02E+06	46%	5,652	8.00E-04	8.17E+02	1.28	0.78	0.26	0.42	0.005	0.008

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, $[TOC]_L$ (wt%)	Al in liquid, $[Al]_L$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-T-108	5.8	8.65E+04	53%	4,531	6.94E-05	6.01E+00	2.81	0.40	0.00	0.04	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	5.8	8.65E+04	53%	4,531	6.94E-05	6.01E+00	2.81	0.40	0.00	0.04	0.005	0.005
241-T-109	22.5	3.42E+05	76%	4,860	3.91E-05	1.34E+01	2.82	0.40	0.00	0.04	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	22.5	3.42E+05	76%	4,860	3.91E-05	1.34E+01	2.82	0.40	0.00	0.04	0.005	0.005
241-T-110	134.3	1.75E+06	87%	7,055	2.52E-04	4.42E+02	0.30	0.00	0.00	0.00	0.030	0.030
Supernatant	0.3	3.15E+03	100%	6	1.72E-08	5.42E-05	0.30	0.00	0.00	0.00	0.030	0.030
Solid Layer	134.0	1.75E+06	87%	7,049	2.53E-04	4.42E+02	0.30	0.00	0.00	0.00	0.030	0.030
241-T-111	162.3	2.10E+06	73%	7,605	2.99E-05	6.28E+01	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	162.3	2.10E+06	73%	7,605	2.99E-05	6.28E+01	1.28	0.78	0.26	0.42	0.005	0.008
241-T-112	24.2	3.18E+05	88%	4,893	1.48E-04	4.70E+01	0.38	0.84	0.04	0.00	0.005	0.005
Supernatant	2.5	2.86E+04	100%	49	2.21E-05	6.31E-01	0.38	0.84	0.04	0.00	0.005	0.005
Solid Layer	21.7	2.89E+05	87%	4,844	1.60E-04	4.63E+01	0.38	0.84	0.04	0.00	0.005	0.005
241-T-201	159.0	1.53E+05	75%	1,147	6.29E-07	9.62E-02	0.74	0.01	0.00	0.00	0.005	0.005
Supernatant	10.8	8.46E+03	100%	56	1.23E-06	1.04E-02	0.74	0.01	0.00	0.00	0.005	0.005
Solid Layer	148.3	1.44E+05	74%	1,090	5.94E-07	8.58E-02	0.74	0.01	0.00	0.00	0.005	0.005
241-T-202	109.2	9.56E+04	101%	886	1.45E-07	1.39E-02	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	109.2	9.56E+04	101%	886	1.45E-07	1.39E-02	1.28	0.78	0.26	0.42	0.005	0.008
241-T-203	188.7	1.71E+05	89%	1,302	9.54E-08	1.63E-02	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	188.7	1.71E+05	89%	1,302	9.54E-08	1.63E-02	1.28	0.78	0.26	0.42	0.005	0.008

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, [TOC]%, (wt%)	AI in liquid, [AI]%, (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-T-204	188.7	1.65E+05	100%	1,302	6.37E-08	1.05E-02	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	188.7	1.65E+05	100%	1,302	6.37E-08	1.05E-02	1.28	0.78	0.26	0.42	0.005	0.008
241-TX-101	33.0	5.94E+05	35%	5,066	3.17E-03	1.88E+03	2.68	2.09	0.74	2.54	0.005	0.018
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	33.0	5.94E+05	35%	5,066	3.17E-03	1.88E+03	2.68	2.09	0.74	2.54	0.005	0.018
241-TX-102	78.8	1.35E+06	21%	5,964	5.73E-04	7.72E+02	2.68	2.08	0.74	2.55	0.005	0.019
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	78.8	1.35E+06	21%	5,964	5.73E-04	7.72E+02	2.68	2.08	0.74	2.55	0.005	0.019
241-TX-103	52.6	8.99E+05	29%	5,450	5.55E-04	4.99E+02	2.69	2.02	0.71	2.46	0.005	0.015
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	52.6	8.99E+05	29%	5,450	5.55E-04	4.99E+02	2.69	2.02	0.71	2.46	0.005	0.015
241-TX-104	25.1	4.52E+05	88%	4,911	1.81E-03	8.21E+02	5.72	2.05	0.09	0.22	0.005	0.006
Supernatant	0.9	1.30E+04	100%	17	9.54E-04	1.24E+01	5.72	2.05	0.09	0.22	0.005	0.006
Solid Layer	24.3	4.39E+05	88%	4,894	1.84E-03	8.08E+02	5.72	2.05	0.09	0.22	0.005	0.006
241-TX-105	209.2	3.62E+06	6%	8,526	5.32E-04	1.93E+03	2.68	2.09	0.73	2.54	0.005	0.027
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	209.2	3.62E+06	6%	8,526	5.32E-04	1.93E+03	2.68	2.09	0.73	2.54	0.005	0.027
241-TX-106	126.4	2.17E+06	26%	6,900	6.04E-04	1.31E+03	2.68	2.09	0.73	2.55	0.005	0.018
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	126.4	2.17E+06	26%	6,900	6.04E-04	1.31E+03	2.68	2.09	0.73	2.55	0.005	0.018
241-TX-107	10.7	1.99E+05	57%	4,629	8.35E-04	1.66E+02	2.71	2.17	0.53	2.67	0.005	0.013
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	10.7	1.99E+05	57%	4,629	8.35E-04	1.66E+02	2.71	2.17	0.53	2.67	0.005	0.013

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, $[TOC]_M$ (wt%)	Al in liquid, $[Al]_M$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-TX-108	46.9	8.11E+03	15%	5,339	5.61E-04	4.55E+02	2.68	2.09	0.73	2.55	0.005	0.014
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	46.9	8.11E+03	15%	5,339	5.61E-04	4.55E+02	2.68	2.09	0.73	2.55	0.005	0.014
241-TX-109	131.9	1.94E+06	62%	7,008	1.30E-04	2.52E+02	1.28	0.78	0.26	0.42	0.005	0.013
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	131.9	1.94E+06	62%	7,008	1.30E-04	2.52E+02	1.28	0.78	0.26	0.42	0.005	0.013
241-TX-110	169.5	2.91E+06	9%	7,746	4.96E-04	1.44E+03	2.68	2.09	0.73	2.54	0.005	0.019
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	169.5	2.91E+06	9%	7,746	4.96E-04	1.44E+03	2.68	2.09	0.73	2.54	0.005	0.019
241-TX-111	132.7	2.26E+06	10%	7,023	4.80E-04	1.09E+03	2.68	2.09	0.73	2.54	0.005	0.018
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	132.7	2.26E+06	10%	7,023	4.80E-04	1.09E+03	2.68	2.09	0.73	2.54	0.005	0.018
241-TX-112	230.0	3.97E+06	13%	8,934	5.14E-04	2.04E+03	2.69	1.86	0.65	2.26	0.005	0.014
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	230.0	3.97E+06	13%	8,934	5.14E-04	2.04E+03	2.69	1.86	0.65	2.26	0.005	0.014
241-TX-113	231.8	3.94E+06	5%	8,968	5.14E-05	2.03E+02	2.68	2.09	0.74	2.54	0.005	0.016
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	231.8	3.94E+06	5%	8,968	5.14E-05	2.03E+02	2.68	2.09	0.74	2.54	0.005	0.016
241-TX-114	193.3	3.31E+06	7%	8,213	4.72E-04	1.56E+03	2.76	1.04	0.32	1.12	0.005	0.009
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	193.3	3.31E+06	7%	8,213	4.72E-04	1.56E+03	2.76	1.04	0.32	1.12	0.005	0.009
241-TX-115	201.1	3.47E+06	8%	8,366	5.43E-04	1.89E+03	2.68	2.09	0.73	2.54	0.005	0.015
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	201.1	3.47E+06	8%	8,366	5.43E-04	1.89E+03	2.68	2.09	0.73	2.54	0.005	0.015

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, $[TOC]_M$ (wt%)	AI in liquid, $[AI]_M$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-TX-116	217.2	3.61E+06	8%	8,682	1.50E-04	5.43E+02	6.11	0.23	0.02	0.00	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	217.2	3.61E+06	8%	8,682	1.50E-04	5.43E+02	6.11	0.23	0.02	0.00	0.005	0.005
241-TX-117	174.5	2.81E+06	5%	7,844	3.29E-04	9.22E+02	2.81	0.40	0.00	0.04	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	174.5	2.81E+06	5%	7,844	3.29E-04	9.22E+02	2.81	0.40	0.00	0.04	0.005	0.005
241-TX-118	92.9	1.63E+06	31%	6,241	9.39E-04	1.53E+03	2.68	2.10	0.73	2.54	0.005	0.017
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	92.9	1.63E+06	31%	6,241	9.39E-04	1.53E+03	2.68	2.10	0.73	2.54	0.005	0.017
241-TY-101	42.9	7.32E+05	14%	5,260	5.91E-05	4.33E+01	2.81	0.40	0.00	0.04	0.005	0.005
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	42.9	7.32E+05	14%	5,260	5.91E-05	4.33E+01	2.81	0.40	0.00	0.04	0.005	0.005
241-TY-102	25.0	4.57E+05	54%	4,909	1.47E-04	6.72E+01	2.73	1.34	0.45	1.57	0.005	0.009
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	25.0	4.57E+05	54%	4,909	1.47E-04	6.72E+01	2.73	1.34	0.45	1.57	0.005	0.009
241-TY-103	56.3	9.89E+05	87%	5,523	6.16E-04	6.09E+02	2.68	2.09	0.73	2.54	0.005	0.015
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	56.3	9.89E+05	87%	5,523	6.16E-04	6.09E+02	2.68	2.09	0.73	2.54	0.005	0.015
241-TY-104	16.0	2.80E+05	67%	4,732	7.53E-04	2.11E+02	1.60	0.25	0.18	0.05	0.005	0.007
Supernatant	0.4	4.72E+03	100%	8	4.96E-05	2.34E-01	1.60	0.25	0.18	0.05	0.005	0.007
Solid Layer	15.6	2.75E+05	67%	4,725	7.65E-04	2.11E+02	1.60	0.25	0.18	0.05	0.005	0.007
241-TY-105	83.8	1.34E+06	29%	6,064	1.10E-03	1.47E+03	1.28	0.78	0.26	0.42	0.005	0.009
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	83.8	1.34E+06	29%	6,064	1.10E-03	1.47E+03	1.28	0.78	0.26	0.42	0.005	0.009

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, [TOC] (wt%)	Al in liquid, [Al] (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-TY-106	5.9	8.68E+04	51%	4,535	1.16E-03	1.00E+02	1.28	0.78	0.26	0.42	0.005	0.007
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	5.9	8.68E+04	51%	4,535	1.16E-03	1.00E+02	1.28	0.78	0.26	0.42	0.005	0.007
241-U-101	8.5	1.56E+05	39%	4,586	3.65E-03	5.68E+02	1.28	0.78	0.26	0.42	0.005	0.009
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	8.5	1.56E+05	39%	4,586	3.65E-03	5.68E+02	1.28	0.78	0.26	0.42	0.005	0.009
241-U-102	118.8	2.07E+06	73%	6,750	1.41E-03	2.91E+03	3.20	3.18	0.76	2.24	0.005	0.020
Supernatant	0.4	5.92E+03	100%	8	1.57E-03	9.32E+00	3.19	3.17	0.76	2.25	0.005	0.019
Solid Layer	118.4	2.06E+06	72%	6,742	1.41E-03	2.90E+03	3.20	3.18	0.76	2.24	0.005	0.020
241-U-103	151.4	2.40E+06	79%	7,390	7.54E-04	1.81E+03	2.45	2.98	0.86	2.84	0.005	0.022
Supernatant	0.2	2.88E+03	100%	4	1.62E-03	4.65E+00	2.45	2.98	0.86	2.84	0.005	0.026
Solid Layer	151.2	2.40E+06	79%	7,386	7.53E-04	1.80E+03	2.45	2.98	0.86	2.84	0.005	0.022
241-U-104	44.3	6.92E+05	77%	5,288	1.49E-03	1.03E+03	3.34	2.29	0.68	2.29	0.005	0.019
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	44.3	6.92E+05	77%	5,288	1.49E-03	1.03E+03	3.34	2.29	0.68	2.29	0.005	0.019
241-U-105	128.2	2.23E+06	59%	6,934	7.52E-04	1.68E+03	2.92	2.35	1.12	2.04	0.005	0.029
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	128.2	2.23E+06	59%	6,934	7.52E-04	1.68E+03	2.92	2.35	1.12	2.04	0.005	0.029
241-U-106	61.8	9.97E+05	86%	5,631	1.17E-03	1.16E+03	4.01	2.15	3.19	0.90	0.005	0.064
Supernatant	0.6	8.04E+03	100%	11	1.36E-03	1.09E+01	4.01	2.15	3.20	0.90	0.005	0.065
Solid Layer	61.2	9.89E+05	86%	5,620	1.17E-03	1.15E+03	4.01	2.15	3.19	0.90	0.005	0.064
241-U-107	112.1	2.03E+06	65%	6,620	3.85E-04	7.83E+02	2.29	2.77	0.45	2.95	0.005	0.013
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	112.1	2.03E+06	65%	6,620	3.85E-04	7.83E+02	2.29	2.77	0.44	2.87	0.005	0.013

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_{liq}$ (mole/L)	NO_2 in liquid, $[NO_2]_{liq}$ (mole/L)	TOC in liquid, $[TOC]_{liq}$ (wt%)	AI in liquid, $[AI]_{liq}$ (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-U-108	147.0	2.57E+06	75%	7,303	6.97E-04	1.79E+03	2.97	2.91	0.50	2.18	0.005	0.016
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	147.0	2.57E+06	75%	7,303	6.97E-04	1.79E+03	2.97	2.91	0.50	2.18	0.005	0.016
241-U-109	145.5	2.23E+06	57%	7,275	6.22E-04	1.39E+03	2.99	2.78	0.44	1.99	0.005	0.014
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	145.5	2.23E+06	57%	7,275	6.22E-04	1.39E+03	2.99	2.78	0.44	1.99	0.005	0.014
241-U-110	63.8	1.10E+06	41%	5,670	1.29E-03	1.42E+03	1.28	0.78	0.26	0.42	0.005	0.009
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	63.8	1.10E+06	41%	5,670	1.29E-03	1.42E+03	1.28	0.78	0.26	0.42	0.005	0.009
241-U-111	92.6	1.55E+06	67%	6,235	8.50E-04	1.32E+03	2.68	2.61	0.39	2.62	0.005	0.012
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	92.6	1.55E+06	67%	6,235	8.50E-04	1.32E+03	2.68	2.61	0.39	2.62	0.005	0.012
241-U-112	16.5	2.99E+05	44%	4,742	1.71E-03	5.10E+02	1.28	0.78	0.26	0.42	0.005	0.008
Supernatant	na	na	na	na	na	na	na	na	na	na	na	na
Solid Layer	16.5	2.99E+05	44%	4,742	1.71E-03	5.10E+02	1.28	0.78	0.26	0.42	0.005	0.008
241-U-201	20.2	2.30E+04	52%	420	4.36E-05	1.00E+00	2.30	0.45	0.00	0.01	0.005	0.005
Supernatant	5.4	5.04E+03	100%	28	1.10E-04	5.54E-01	2.30	0.45	0.00	0.01	0.005	0.005
Solid Layer	14.8	1.79E+04	39%	392	2.50E-05	4.48E-01	2.30	0.45	0.00	0.01	0.005	0.005
241-U-202	18.9	2.02E+04	55%	413	3.56E-05	7.20E-01	2.45	0.53	0.01	0.02	0.005	0.005
Supernatant	5.4	5.12E+03	100%	28	7.75E-05	3.97E-01	2.45	0.53	0.01	0.02	0.005	0.005
Solid Layer	13.5	1.51E+04	40%	385	2.14E-05	3.23E-01	2.45	0.53	0.01	0.02	0.005	0.005
241-U-203	17.5	1.94E+04	69%	406	3.44E-05	6.68E-01	2.32	0.42	0.00	0.01	0.005	0.005
Supernatant	5.4	5.12E+03	100%	28	7.27E-05	3.72E-01	2.32	0.42	0.00	0.01	0.005	0.005
Solid Layer	12.1	1.43E+04	59%	378	2.06E-05	2.95E-01	2.32	0.42	0.00	0.01	0.005	0.005

Table B-2. Derived Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Current Waste. (23 sheets)

Tank	Waste level, D_w (inch)	Total mass, M (kg)	Liquid in waste (wt%)	Wetted area, A_{wet} (ft ²)	Heat load per kg, H_L (watt/kg)	Tank heat load, H_L (watt)	NO_3 in liquid, $[NO_3]_M$ (mole/L)	NO_2 in liquid, $[NO_2]_M$ (mole/L)	TOC in liquid, [TOC] % (wt%)	Al in liquid, [Al] % (wt%)	G values for water, G_{H_2O} ($H_2/100eV$)	Total G values, G_{TOT} ($H_2/100eV$)
241-U-204	14.8	1.47E+04	51%	392	4.62E-05	6.80E-01	0.89	0.15	0.01	0.00	0.005	0.005
Supernatant	5.4	4.44E+03	100%	28	3.11E-05	1.38E-01	0.89	0.15	0.01	0.00	0.005	0.005
Solid Layer	9.4	1.03E+04	30%	364	5.27E-05	5.42E-01	0.89	0.15	0.01	0.00	0.005	0.005

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-AN-101	2.92E-08	3.29E-08	5.05E-07	5.67E-07	4.35E-10	4.91E-10	7.54E-09	8.47E-09
Supernatant	2.92E-08	3.29E-08	5.05E-07	5.67E-07	4.35E-10	4.91E-10	7.54E-09	8.47E-09
Solid Layer	na	na	na	na	na	na	na	na
241-AN-102	1.05E-06	1.37E-06	1.98E-07	2.62E-06	1.83E-08	2.38E-08	3.44E-09	4.55E-08
Supernatant	1.06E-06	1.42E-06	1.27E-07	2.60E-06	1.83E-08	2.44E-08	2.18E-09	4.49E-08
Solid Layer	1.00E-06	1.07E-06	6.78E-07	2.75E-06	1.82E-08	1.94E-08	1.23E-08	4.98E-08
241-AN-103	2.34E-07	4.18E-07	2.08E-07	8.60E-07	4.29E-09	7.68E-09	3.81E-09	1.58E-08
Supernatant	3.40E-07	4.91E-07	1.27E-07	9.58E-07	5.82E-09	8.40E-09	2.18E-09	1.64E-08
Solid Layer	1.21E-07	3.41E-07	2.93E-07	7.55E-07	2.41E-09	6.80E-09	5.83E-09	1.50E-08
241-AN-104	2.70E-07	5.31E-07	2.09E-07	1.01E-06	4.62E-09	9.08E-09	3.58E-09	1.73E-08
Supernatant	2.69E-07	4.60E-07	1.35E-07	8.64E-07	4.36E-09	7.46E-09	2.18E-09	1.40E-08
Solid Layer	2.71E-07	6.23E-07	3.05E-07	1.20E-06	4.99E-09	1.15E-08	5.62E-09	2.21E-08
241-AN-105	1.49E-07	3.49E-07	2.02E-07	7.00E-07	2.56E-09	6.02E-09	3.47E-09	1.21E-08
Supernatant	1.32E-07	3.17E-07	1.33E-07	5.81E-07	2.17E-09	5.21E-09	2.18E-09	9.55E-09
Solid Layer	1.66E-07	3.84E-07	2.73E-07	8.23E-07	3.02E-09	6.97E-09	4.97E-09	1.50E-08
241-AN-106	3.83E-08	4.47E-08	7.77E-07	8.60E-07	5.14E-10	5.99E-10	1.04E-08	1.15E-08
Supernatant	3.37E-08	4.88E-08	1.70E-07	2.53E-07	4.34E-10	6.27E-10	2.18E-09	3.24E-09
Solid Layer	6.57E-08	1.94E-08	4.43E-06	4.51E-06	1.20E-09	3.55E-10	8.10E-08	8.25E-08
241-AN-107	1.67E-06	8.88E-07	2.06E-07	2.76E-06	2.78E-08	1.48E-08	3.44E-09	4.60E-08
Supernatant	1.56E-06	9.19E-07	1.32E-07	2.61E-06	2.59E-08	1.52E-08	2.18E-09	4.33E-08
Solid Layer	2.03E-06	7.81E-07	4.66E-07	3.27E-06	3.47E-08	1.34E-08	7.98E-09	5.60E-08
241-AP-101	4.08E-08	3.78E-08	2.24E-07	3.03E-07	6.18E-10	5.74E-10	3.40E-09	4.59E-09
Supernatant	4.08E-08	3.78E-08	2.24E-07	3.03E-07	6.18E-10	5.74E-10	3.40E-09	4.59E-09
Solid Layer	na	na	na	na	na	na	na	na

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-AP-102	3.32E-08	9.90E-08	6.74E-07	8.06E-07	4.71E-10	1.40E-09	9.56E-09	1.14E-08
Supernatant	3.94E-08	1.34E-07	1.64E-07	3.38E-07	5.24E-10	1.79E-09	2.18E-09	4.50E-09
Solid Layer	na	na	na	na	na	na	na	na
241-AP-103	1.64E-07	2.61E-07	2.36E-07	6.62E-07	2.57E-09	4.08E-09	3.70E-09	1.03E-08
Supernatant	1.64E-07	2.61E-07	2.36E-07	6.62E-07	2.57E-09	4.08E-09	3.70E-09	1.03E-08
Solid Layer	na	na	na	na	na	na	na	na
241-AP-104	1.14E-07	1.72E-07	2.30E-07	5.16E-07	1.69E-09	2.55E-09	3.40E-09	7.65E-09
Supernatant	1.14E-07	1.72E-07	2.30E-07	5.16E-07	1.69E-09	2.55E-09	3.40E-09	7.65E-09
Solid Layer	na	na	na	na	na	na	na	na
241-AP-105	7.33E-08	9.52E-08	2.21E-07	3.89E-07	1.12E-09	1.46E-09	3.38E-09	5.96E-09
Supernatant	7.46E-08	9.82E-08	1.45E-07	3.18E-07	1.12E-09	1.48E-09	2.18E-09	4.78E-09
Solid Layer	6.03E-08	6.91E-08	9.33E-07	1.06E-06	1.12E-09	1.29E-09	1.74E-08	1.98E-08
241-AP-106	8.66E-08	1.15E-07	2.41E-07	4.42E-07	1.21E-09	1.61E-09	3.37E-09	6.20E-09
Supernatant	8.66E-08	1.15E-07	2.41E-07	4.42E-07	1.21E-09	1.61E-09	3.37E-09	6.20E-09
Solid Layer	na	na	na	na	na	na	na	na
241-AP-107	7.29E-08	1.10E-07	5.23E-07	7.06E-07	1.11E-09	1.68E-09	7.99E-09	1.08E-08
Supernatant	7.29E-08	1.10E-07	5.23E-07	7.06E-07	1.11E-09	1.68E-09	7.99E-09	1.08E-08
Solid Layer	na	na	na	na	na	na	na	na
241-AP-108	1.34E-07	8.62E-07	2.33E-07	1.23E-06	1.94E-09	1.25E-08	3.37E-09	1.78E-08
Supernatant	1.34E-07	8.62E-07	2.33E-07	1.23E-06	1.94E-09	1.25E-08	3.37E-09	1.78E-08
Solid Layer	na	na	na	na	na	na	na	na
241-AW-101	2.27E-07	4.53E-07	1.98E-07	8.78E-07	3.96E-09	7.92E-09	3.46E-09	1.53E-08
Supernatant	2.38E-07	4.72E-07	1.28E-07	8.38E-07	4.05E-09	8.02E-09	2.18E-09	1.43E-08
Solid Layer	2.06E-07	4.19E-07	3.25E-07	9.51E-07	3.80E-09	7.72E-09	5.98E-09	1.75E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-AW-102	6.12E-08	2.25E-08	1.25E-06	1.33E-06	8.91E-10	3.28E-10	1.82E-08	1.94E-08
Supernatant	2.11E-08	2.54E-08	1.67E-07	2.13E-07	2.76E-10	3.33E-10	2.18E-09	2.79E-09
Solid Layer	1.17E-07	1.85E-08	2.76E-06	2.89E-06	2.02E-09	3.19E-10	4.75E-08	4.99E-08
241-AW-103	3.05E-08	4.67E-08	2.24E-07	3.02E-07	4.64E-10	7.10E-10	3.41E-09	4.59E-09
Supernatant	3.93E-08	4.67E-08	1.52E-07	2.38E-07	5.65E-10	6.70E-10	2.18E-09	3.42E-09
Solid Layer	1.21E-08	4.68E-08	3.75E-07	4.34E-07	2.10E-10	8.11E-10	6.51E-09	7.53E-09
241-AW-104	2.47E-07	1.26E-06	2.20E-07	1.73E-06	3.87E-09	1.97E-08	3.44E-09	2.71E-08
Supernatant	2.66E-07	1.46E-06	1.43E-07	1.87E-06	4.06E-09	2.24E-08	2.18E-09	2.86E-08
Solid Layer	1.84E-07	5.70E-07	4.81E-07	1.23E-06	3.16E-09	9.79E-09	8.26E-09	2.12E-08
241-AW-105	6.82E-09	8.99E-10	3.71E-07	3.79E-07	9.86E-11	1.30E-11	5.36E-09	5.47E-09
Supernatant	2.86E-09	2.79E-09	1.78E-07	1.84E-07	3.51E-11	3.42E-11	2.18E-09	2.25E-09
Solid Layer	8.71E-09	7.05E-14	4.63E-07	4.72E-07	1.37E-10	1.11E-15	7.31E-09	7.45E-09
241-AW-106	1.93E-07	9.54E-07	2.10E-07	1.36E-06	3.29E-09	1.63E-08	3.59E-09	2.32E-08
Supernatant	2.07E-07	9.77E-07	1.31E-07	1.32E-06	3.45E-09	1.63E-08	2.18E-09	2.19E-08
Solid Layer	1.54E-07	8.88E-07	4.29E-07	1.47E-06	2.82E-09	1.62E-08	7.85E-09	2.69E-08
241-AY-101	8.56E-07	1.11E-07	5.75E-07	1.54E-06	1.44E-08	1.86E-09	9.66E-09	2.59E-08
Supernatant	2.13E-08	1.27E-07	1.59E-07	3.07E-07	2.93E-10	1.75E-09	2.18E-09	4.22E-09
Solid Layer	1.37E-06	1.01E-07	8.32E-07	2.31E-06	2.68E-08	1.96E-09	1.62E-08	4.49E-08
241-AY-102	2.54E-05	4.12E-07	2.81E-07	2.61E-05	3.69E-07	5.98E-09	4.07E-09	3.79E-07
Supernatant	1.73E-08	2.46E-07	1.61E-07	4.24E-07	2.34E-10	3.33E-09	2.18E-09	5.75E-09
Solid Layer	8.80E-05	8.21E-07	5.75E-07	8.94E-05	1.55E-06	1.45E-08	1.01E-08	1.57E-06
241-AZ-101	1.21E-06	7.96E-07	2.42E-07	2.25E-06	1.76E-08	1.16E-08	3.54E-09	3.28E-08
Supernatant	6.40E-07	7.80E-07	1.52E-07	1.57E-06	9.19E-09	1.12E-08	2.18E-09	2.26E-08
Solid Layer	9.10E-06	1.02E-06	1.50E-06	1.16E-05	1.71E-07	1.92E-08	2.82E-08	2.19E-07

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-AZ-102	1.03E-06	1.71E-07	2.69E-07	1.47E-06	1.37E-08	2.26E-09	3.55E-09	1.95E-08
Supernatant	6.03E-07	1.67E-07	1.70E-07	9.40E-07	7.75E-09	2.14E-09	2.18E-09	1.21E-08
Solid Layer	3.91E-06	1.97E-07	9.26E-07	5.03E-06	6.37E-08	3.21E-09	1.51E-08	8.21E-08
241-SY-101	1.39E-07	2.16E-07	2.15E-07	5.70E-07	2.23E-09	3.46E-09	3.44E-09	9.13E-09
Supernatant	1.40E-07	2.15E-07	1.41E-07	4.95E-07	2.17E-09	3.33E-09	2.18E-09	7.68E-09
Solid Layer	1.38E-07	2.20E-07	4.27E-07	7.85E-07	2.43E-09	3.86E-09	7.52E-09	1.38E-08
241-SY-102	1.10E-07	2.34E-07	2.46E-07	5.90E-07	1.68E-09	3.60E-09	3.78E-09	9.07E-09
Supernatant	1.02E-07	2.53E-07	1.47E-07	5.03E-07	1.52E-09	3.75E-09	2.18E-09	7.45E-09
Solid Layer	1.38E-07	1.59E-07	6.37E-07	9.33E-07	2.49E-09	2.87E-09	1.15E-08	1.69E-08
241-SY-103	2.84E-07	5.55E-07	2.32E-07	1.07E-06	5.03E-09	9.83E-09	4.11E-09	1.90E-08
Supernatant	3.06E-07	5.28E-07	1.28E-07	9.62E-07	5.21E-09	8.98E-09	2.18E-09	1.64E-08
Solid Layer	2.58E-07	5.86E-07	3.52E-07	1.20E-06	4.81E-09	1.09E-08	6.55E-09	2.23E-08
241-A-101	2.35E-07	2.06E-06	6.31E-07	2.93E-06	4.62E-09	4.04E-08	1.24E-08	5.74E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.35E-07	2.06E-06	6.31E-07	2.93E-06	4.62E-09	4.04E-08	1.24E-08	5.74E-08
241-A-102	1.16E-07	1.14E-12	3.78E-06	3.90E-06	2.20E-09	2.19E-14	7.27E-08	7.50E-08
Supernatant	7.20E-08	1.30E-12	2.41E-07	3.13E-07	1.31E-09	2.36E-14	4.37E-09	5.68E-09
Solid Layer	1.18E-07	1.13E-12	4.05E-06	4.16E-06	2.27E-09	2.18E-14	7.82E-08	8.04E-08
241-A-103	2.56E-07	1.34E-06	7.33E-07	2.33E-06	4.08E-09	2.15E-08	1.17E-08	3.72E-08
Supernatant	3.41E-07	3.78E-06	2.61E-07	4.38E-06	5.72E-09	6.35E-08	4.37E-09	7.36E-08
Solid Layer	2.55E-07	1.32E-06	7.39E-07	2.31E-06	4.06E-09	2.10E-08	1.18E-08	3.68E-08
241-A-104	2.89E-05	3.97E-06	5.33E-06	3.82E-05	5.49E-07	7.54E-08	1.01E-07	7.26E-07
Supernatant	5.56E-05	8.41E-06	2.30E-07	6.43E-05	1.06E-06	1.60E-07	4.37E-09	1.22E-06
Solid Layer	2.89E-05	3.97E-06	5.33E-06	3.82E-05	5.49E-07	7.54E-08	1.01E-07	7.26E-07

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-A-105 Supernatant Solid Layer	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA
241-A-106 Supernatant Solid Layer	2.38E-06 na 2.38E-06	1.53E-06 na 1.53E-06	1.97E-06 na 1.97E-06	5.87E-06 na 5.87E-06	4.69E-08 na 4.69E-08	3.00E-08 na 3.00E-08	3.87E-08 na 3.87E-08	1.16E-07 na 1.16E-07
241-AX-101 Supernatant Solid Layer	1.79E-07 na 1.79E-07	7.10E-07 na 7.10E-07	6.46E-07 na 6.46E-07	1.53E-06 na 1.53E-06	3.53E-09 na 3.53E-09	1.40E-08 na 1.40E-08	1.28E-08 na 1.28E-08	3.03E-08 na 3.03E-08
241-AX-102 Supernatant Solid Layer	2.06E-06 na 2.06E-06	3.67E-07 na 3.67E-07	4.65E-06 na 4.65E-06	7.07E-06 na 7.07E-06	4.21E-08 na 4.21E-08	7.52E-09 na 7.52E-09	9.51E-08 na 9.51E-08	1.45E-07 na 1.45E-07
241-AX-103 Supernatant Solid Layer	2.99E-06 na 2.99E-06	2.53E-06 na 2.53E-06	1.60E-06 na 1.60E-06	7.12E-06 na 7.12E-06	5.50E-08 na 5.50E-08	4.65E-08 na 4.65E-08	2.94E-08 na 2.94E-08	1.31E-07 na 1.31E-07
241-AX-104 Supernatant Solid Layer	3.35E-06 na 3.35E-06	1.05E-08 na 1.05E-08	1.78E-05 na 1.78E-05	2.12E-05 na 2.12E-05	6.98E-08 na 6.98E-08	2.19E-10 na 2.19E-10	3.71E-07 na 3.71E-07	4.41E-07 na 4.41E-07
241-B-101 Supernatant Solid Layer	3.34E-07 na 3.34E-07	2.64E-14 na 2.64E-14	1.70E-06 na 1.70E-06	2.04E-06 na 2.04E-06	5.75E-09 na 5.75E-09	4.55E-16 na 4.55E-16	2.93E-08 na 2.93E-08	3.51E-08 na 3.51E-08
241-B-102 Supernatant Solid Layer	2.22E-09 6.68E-09 1.75E-09	6.00E-16 1.30E-15 5.27E-16	4.94E-06 3.17E-07 5.42E-06	4.94E-06 3.24E-07 5.42E-06	4.00E-11 9.20E-11 3.26E-11	1.08E-17 1.79E-17 9.83E-18	8.91E-08 4.37E-09 1.01E-07	8.92E-08 4.46E-09 1.01E-07

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-B-103 Supernatant	3.25E-09	8.36E-16	2.84E-06	2.84E-06	6.06E-11	1.56E-17	5.30E-08	5.30E-08
Solid Layer	3.25E-09	8.36E-16	2.84E-06	2.84E-06	6.06E-11	1.56E-17	5.30E-08	5.30E-08
241-B-104 Supernatant	1.07E-08	1.19E-15	7.40E-07	7.51E-07	1.68E-10	1.87E-17	1.16E-08	1.18E-08
Solid Layer	1.07E-08	1.19E-15	7.40E-07	7.51E-07	1.68E-10	1.87E-17	1.16E-08	1.18E-08
241-B-105 Supernatant	2.87E-09	1.56E-15	7.09E-07	7.12E-07	5.56E-11	3.03E-17	1.37E-08	1.38E-08
Solid Layer	2.87E-09	1.56E-15	7.09E-07	7.12E-07	5.56E-11	3.03E-17	1.37E-08	1.38E-08
241-B-106 Supernatant	1.66E-08	2.07E-15	1.67E-06	1.68E-06	2.65E-10	3.31E-17	2.67E-08	2.69E-08
Solid Layer	6.67E-09	1.23E-15	3.17E-07	3.24E-07	9.19E-11	1.68E-17	4.37E-09	4.46E-09
241-B-107 Supernatant	1.66E-08	2.07E-15	1.67E-06	1.68E-06	2.65E-10	3.31E-17	2.67E-08	2.69E-08
Solid Layer	2.73E-08	2.06E-16	1.12E-06	1.15E-06	5.14E-10	3.88E-18	2.12E-08	2.17E-08
241-B-108 Supernatant	2.73E-08	2.06E-16	1.12E-06	1.15E-06	5.14E-10	3.88E-18	2.12E-08	2.17E-08
Solid Layer	1.84E-09	4.43E-16	1.74E-06	1.74E-06	3.57E-11	8.61E-18	3.38E-08	3.38E-08
241-B-109 Supernatant	1.84E-09	4.43E-16	1.74E-06	1.74E-06	3.57E-11	8.61E-18	3.38E-08	3.38E-08
Solid Layer	8.34E-08	8.61E-16	1.27E-06	1.36E-06	1.71E-09	1.76E-17	2.61E-08	2.78E-08
241-B-110 Supernatant	7.63E-08	0.00E+00	9.82E-07	1.06E-06	1.20E-09	0.00E+00	1.55E-08	1.67E-08
Solid Layer	0.00E+00	0.00E+00	3.74E-07	3.74E-07	0.00E+00	0.00E+00	4.37E-09	4.37E-09
241-B-110 Solid Layer	7.63E-08	0.00E+00	9.82E-07	1.06E-06	1.20E-09	0.00E+00	1.55E-08	1.67E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-B-111	2.48E-07	0.00E+00	1.14E-06	1.38E-06	3.42E-09	0.00E+00	1.56E-08	1.91E-08
Supernatant	0.00E+00	0.00E+00	3.74E-07	3.74E-07	0.00E+00	0.00E+00	4.37E-09	4.37E-09
Solid Layer	2.48E-07	0.00E+00	1.14E-06	1.38E-06	3.42E-09	0.00E+00	1.56E-08	1.91E-08
241-B-112	3.93E-08	6.50E-08	4.77E-06	4.88E-06	6.76E-10	1.12E-09	8.21E-08	8.39E-08
Supernatant	0.00E+00	0.00E+00	3.74E-07	3.74E-07	0.00E+00	0.00E+00	4.37E-09	4.37E-09
Solid Layer	4.16E-08	6.90E-08	5.04E-06	5.15E-06	7.37E-10	1.22E-09	8.91E-08	9.11E-08
241-B-201	7.67E-10	1.43E-08	1.56E-06	1.57E-06	1.12E-11	2.09E-10	2.27E-08	2.29E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	7.67E-10	1.43E-08	1.56E-06	1.57E-06	1.12E-11	2.09E-10	2.27E-08	2.29E-08
241-B-202	1.52E-09	2.54E-08	1.63E-06	1.65E-06	2.15E-11	3.59E-10	2.30E-08	2.33E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.52E-09	2.54E-08	1.63E-06	1.65E-06	2.15E-11	3.59E-10	2.30E-08	2.33E-08
241-B-203	3.94E-10	0.00E+00	1.46E-06	1.46E-06	5.42E-12	0.00E+00	2.02E-08	2.02E-08
Supernatant	6.76E-11	0.00E+00	1.35E-06	1.35E-06	8.21E-13	0.00E+00	1.64E-08	1.64E-08
Solid Layer	3.94E-10	0.00E+00	1.46E-06	1.46E-06	5.42E-12	0.00E+00	2.02E-08	2.02E-08
241-B-204	3.59E-10	0.00E+00	1.47E-06	1.47E-06	4.94E-12	0.00E+00	2.02E-08	2.02E-08
Supernatant	5.36E-11	0.00E+00	1.35E-06	1.35E-06	6.52E-13	0.00E+00	1.64E-08	1.64E-08
Solid Layer	3.59E-10	0.00E+00	1.47E-06	1.47E-06	4.94E-12	0.00E+00	2.02E-08	2.02E-08
241-BX-101	2.76E-07	1.40E-08	3.20E-06	3.49E-06	5.29E-09	2.70E-10	6.14E-08	6.69E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.76E-07	1.40E-08	3.20E-06	3.49E-06	5.29E-09	2.70E-10	6.14E-08	6.69E-08
241-BX-102	1.30E-07	6.95E-09	2.72E-06	2.86E-06	1.37E-09	7.29E-11	2.86E-08	3.00E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.30E-07	6.95E-09	2.72E-06	2.86E-06	1.37E-09	7.29E-11	2.86E-08	3.00E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-BX-103	2.22E-07	5.23E-08	2.29E-06	2.57E-06	4.01E-09	9.43E-10	4.14E-08	4.64E-08
Supernatant	2.59E-09	7.72E-08	3.40E-07	4.20E-07	3.33E-11	9.92E-10	4.37E-09	5.40E-09
Solid Layer	2.49E-07	4.92E-08	2.53E-06	2.83E-06	4.72E-09	9.35E-10	4.80E-08	5.37E-08
241-BX-104	7.27E-08	2.64E-08	1.63E-06	1.73E-06	1.40E-09	5.10E-10	3.14E-08	3.33E-08
Supernatant	4.71E-08	5.65E-08	2.95E-07	3.99E-07	6.98E-10	8.38E-10	4.37E-09	5.91E-09
Solid Layer	7.32E-08	2.57E-08	1.66E-06	1.76E-06	1.42E-09	5.01E-10	3.22E-08	3.42E-08
241-BX-105	2.83E-08	1.77E-08	2.18E-06	2.22E-06	5.49E-10	3.44E-10	4.22E-08	4.31E-08
Supernatant	6.55E-08	7.30E-08	2.93E-07	4.31E-07	9.78E-10	1.09E-09	4.37E-09	6.44E-09
Solid Layer	2.63E-08	1.48E-08	2.28E-06	2.32E-06	5.19E-10	2.91E-10	4.49E-08	4.57E-08
241-BX-106	4.67E-08	1.28E-08	4.04E-06	4.10E-06	8.87E-10	2.43E-10	7.66E-08	7.77E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	4.67E-08	1.28E-08	4.04E-06	4.10E-06	8.87E-10	2.43E-10	7.66E-08	7.77E-08
241-BX-107	6.00E-09	1.55E-08	7.31E-07	7.53E-07	1.00E-10	2.58E-10	1.22E-08	1.25E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	6.00E-09	1.55E-08	7.31E-07	7.53E-07	1.00E-10	2.58E-10	1.22E-08	1.25E-08
241-BX-108	2.00E-08	5.35E-09	5.18E-06	5.21E-06	3.50E-10	9.34E-11	9.06E-08	9.10E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.00E-08	5.35E-09	5.18E-06	5.21E-06	3.50E-10	9.34E-11	9.06E-08	9.10E-08
241-BX-109	4.48E-08	2.11E-08	1.05E-06	1.11E-06	7.88E-10	3.71E-10	1.84E-08	1.96E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	4.48E-08	2.11E-08	1.05E-06	1.11E-06	7.88E-10	3.71E-10	1.84E-08	1.96E-08
241-BX-110	2.84E-08	3.58E-08	8.78E-07	9.42E-07	5.68E-10	7.17E-10	1.76E-08	1.89E-08
Supernatant	5.37E-08	5.13E-08	2.62E-07	3.67E-07	8.95E-10	8.55E-10	4.37E-09	6.12E-09
Solid Layer	2.82E-08	3.57E-08	8.81E-07	9.45E-07	5.66E-10	7.17E-10	1.77E-08	1.90E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-BX-111 Supernatant Solid Layer	2.62E-09 na 2.62E-09	2.09E-09 na 2.09E-09	1.12E-06 na 1.12E-06	1.13E-06 na 1.13E-06	4.37E-11 na 4.37E-11	3.49E-11 na 3.49E-11	1.87E-08 na 1.87E-08	1.88E-08 na 1.88E-08
241-BX-112 Supernatant Solid Layer	1.04E-08 1.39E-08 1.04E-08	0.00E+00 0.00E+00 0.00E+00	1.38E-06 3.20E-07 1.38E-06	1.39E-06 3.34E-07 1.40E-06	1.58E-10 1.90E-10 1.57E-10	0.00E+00 0.00E+00 0.00E+00	2.09E-08 4.37E-09 2.10E-08	2.10E-08 4.56E-09 2.12E-08
241-BY-101 Supernatant Solid Layer	5.22E-08 na 5.22E-08	8.29E-08 na 8.29E-08	5.60E-07 na 5.60E-07	6.95E-07 na 6.95E-07	1.09E-09 na 1.09E-09	1.73E-09 na 1.73E-09	1.17E-08 na 1.17E-08	1.45E-08 na 1.45E-08
241-BY-102 Supernatant Solid Layer	8.99E-09 na 8.99E-09	1.02E-08 na 1.02E-08	7.79E-07 na 7.79E-07	7.98E-07 na 7.98E-07	1.63E-10 na 1.63E-10	1.86E-10 na 1.86E-10	1.42E-08 na 1.42E-08	1.45E-08 na 1.45E-08
241-BY-103 Supernatant Solid Layer	1.44E-08 na 1.44E-08	1.70E-08 na 1.70E-08	5.75E-07 na 5.75E-07	6.06E-07 na 6.06E-07	2.72E-10 na 2.72E-10	3.23E-10 na 3.23E-10	1.09E-08 na 1.09E-08	1.15E-08 na 1.15E-08
241-BY-104 Supernatant Solid Layer	5.58E-08 na 5.58E-08	1.97E-07 na 1.97E-07	6.06E-07 na 6.06E-07	8.59E-07 na 8.59E-07	1.10E-09 na 1.10E-09	3.88E-09 na 3.88E-09	1.19E-08 na 1.19E-08	1.69E-08 na 1.69E-08
241-BY-105 Supernatant Solid Layer	1.83E-08 na 1.83E-08	7.89E-08 na 7.89E-08	4.77E-07 na 4.77E-07	5.74E-07 na 5.74E-07	3.83E-10 na 3.83E-10	1.65E-09 na 1.65E-09	1.00E-08 na 1.00E-08	1.20E-08 na 1.20E-08
241-BY-106 Supernatant Solid Layer	4.28E-08 na 4.28E-08	1.56E-07 na 1.56E-07	5.17E-07 na 5.17E-07	7.16E-07 na 7.16E-07	8.19E-10 na 8.19E-10	2.98E-09 na 2.98E-09	9.90E-09 na 9.90E-09	1.37E-08 na 1.37E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-BY-107 Supernatant	3.69E-08	4.66E-07	7.36E-07	1.24E-06	7.20E-10	9.09E-09	1.43E-08	2.42E-08
Solid Layer	na	na	na	na	na	na	na	na
241-BY-108 Supernatant	3.69E-08	4.66E-07	7.36E-07	1.24E-06	7.20E-10	9.09E-09	1.43E-08	2.42E-08
Solid Layer	4.55E-08	1.03E-07	9.64E-07	1.11E-06	7.82E-10	1.78E-09	1.66E-08	1.91E-08
241-BY-109 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	4.55E-08	1.03E-07	9.64E-07	1.11E-06	7.82E-10	1.78E-09	1.66E-08	1.91E-08
241-BY-109 Supernatant	2.38E-08	7.05E-09	7.18E-07	7.49E-07	4.70E-10	1.39E-10	1.42E-08	1.48E-08
Solid Layer	na	na	na	na	na	na	na	na
241-BY-110 Supernatant	2.38E-08	7.05E-09	7.18E-07	7.49E-07	4.70E-10	1.39E-10	1.42E-08	1.48E-08
Solid Layer	7.74E-08	3.92E-07	6.49E-07	1.12E-06	1.41E-09	7.12E-09	1.18E-08	2.03E-08
241-BY-110 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	7.74E-08	3.92E-07	6.49E-07	1.12E-06	1.41E-09	7.12E-09	1.18E-08	2.03E-08
241-BY-111 Supernatant	2.91E-09	3.93E-09	6.85E-07	6.91E-07	5.66E-11	7.66E-11	1.33E-08	1.35E-08
Solid Layer	na	na	na	na	na	na	na	na
241-BY-112 Supernatant	2.91E-09	3.93E-09	6.85E-07	6.91E-07	5.66E-11	7.66E-11	1.33E-08	1.35E-08
Solid Layer	3.74E-09	1.04E-08	6.89E-07	7.03E-07	7.52E-11	2.09E-10	1.38E-08	1.41E-08
241-C-101 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	3.74E-09	1.04E-08	6.89E-07	7.03E-07	7.52E-11	2.09E-10	1.38E-08	1.41E-08
241-C-101 Supernatant	1.20E-07	3.64E-08	1.71E-06	1.86E-06	2.46E-09	7.50E-10	3.52E-08	3.84E-08
Solid Layer	na	na	na	na	na	na	na	na
241-C-102 Supernatant	1.20E-07	3.64E-08	1.71E-06	1.86E-06	2.46E-09	7.50E-10	3.52E-08	3.84E-08
Solid Layer	3.98E-08	1.70E-08	6.73E-07	7.30E-07	7.66E-10	3.26E-10	1.29E-08	1.40E-08
241-C-102 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	3.98E-08	1.70E-08	6.73E-07	7.30E-07	7.66E-10	3.26E-10	1.29E-08	1.40E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-C-103 Supernatant Solid Layer	5.13E-06 na 5.13E-06	4.61E-08 na 4.61E-08	1.98E-06 na 1.98E-06	7.15E-06 na 7.15E-06	9.09E-08 na 9.09E-08	8.16E-10 na 8.16E-10	3.50E-08 na 3.50E-08	1.27E-07 na 1.27E-07
241-C-104 Supernatant Solid Layer	2.58E-07 na 2.58E-07	2.11E-07 na 2.11E-07	7.59E-07 na 7.59E-07	1.23E-06 na 1.23E-06	5.05E-09 na 5.05E-09	4.13E-09 na 4.13E-09	1.48E-08 na 1.48E-08	2.40E-08 na 2.40E-08
241-C-105 Supernatant Solid Layer	3.15E-07 na 3.15E-07	1.73E-08 na 1.73E-08	1.39E-06 na 1.39E-06	1.72E-06 na 1.72E-06	5.65E-09 na 5.65E-09	3.10E-10 na 3.10E-10	2.49E-08 na 2.49E-08	3.08E-08 na 3.08E-08
241-C-106 Supernatant Solid Layer	1.26E-05 1.29E-07 1.26E-05	3.33E-08 5.68E-08 2.40E-08	1.25E-05 3.31E-07 1.74E-05	2.52E-05 5.17E-07 3.01E-05	1.46E-07 1.70E-09 2.22E-07	5.36E-10 7.49E-10 4.23E-10	2.02E-07 4.37E-09 3.06E-07	3.48E-07 6.82E-09 5.29E-07
241-C-107 Supernatant Solid Layer	4.90E-07 na 4.90E-07	1.32E-07 na 1.32E-07	8.52E-07 na 8.52E-07	1.47E-06 na 1.47E-06	8.79E-09 na 8.79E-09	2.37E-09 na 2.37E-09	1.53E-08 na 1.53E-08	2.64E-08 na 2.64E-08
241-C-108 Supernatant Solid Layer	5.13E-08 na 5.13E-08	2.11E-08 na 2.11E-08	2.71E-06 na 2.71E-06	2.78E-06 na 2.78E-06	8.61E-10 na 8.61E-10	3.54E-10 na 3.54E-10	4.54E-08 na 4.54E-08	4.66E-08 na 4.66E-08
241-C-109 Supernatant Solid Layer	3.27E-07 na 3.27E-07	2.67E-08 na 2.67E-08	2.82E-06 na 2.82E-06	3.17E-06 na 3.17E-06	5.46E-09 na 5.46E-09	4.45E-10 na 4.45E-10	4.71E-08 na 4.71E-08	5.30E-08 na 5.30E-08
241-C-110 Supernatant Solid Layer	2.31E-09 8.84E-10 2.31E-09	8.15E-10 1.56E-09 8.15E-10	1.27E-06 3.43E-07 1.27E-06	1.27E-06 3.46E-07 1.27E-06	3.58E-11 1.13E-11 3.58E-11	1.26E-11 1.99E-11 1.26E-11	1.97E-08 4.37E-09 1.97E-08	1.97E-08 4.40E-09 1.97E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-C-111 Supernatant	8.05E-07	2.16E-08	3.11E-06	3.94E-06	1.33E-08	3.58E-10	5.16E-08	6.53E-08
Solid Layer	8.05E-07	2.16E-08	3.11E-06	3.94E-06	na	na	na	na
241-C-112 Supernatant	5.69E-07	4.41E-08	1.65E-06	2.26E-06	1.33E-08	3.58E-10	5.16E-08	6.53E-08
Solid Layer	5.69E-07	4.41E-08	1.65E-06	2.26E-06	1.05E-08	8.16E-10	3.05E-08	4.18E-08
241-C-201 Supernatant	6.22E-09	1.67E-09	1.19E-05	1.19E-05	na	na	na	na
Solid Layer	6.22E-09	1.67E-09	1.19E-05	1.19E-05	1.04E-10	2.78E-11	1.99E-07	1.99E-07
241-C-202 Supernatant	6.25E-09	8.46E-10	1.56E-05	1.56E-05	1.04E-10	1.41E-11	2.60E-07	2.60E-07
Solid Layer	6.25E-09	8.46E-10	1.56E-05	1.56E-05	na	na	na	na
241-C-203 Supernatant	8.13E-09	7.15E-09	4.76E-06	4.78E-06	1.04E-10	1.41E-11	2.60E-07	2.60E-07
Solid Layer	8.13E-09	7.15E-09	4.76E-06	4.78E-06	1.52E-10	1.34E-10	8.93E-08	8.96E-08
241-C-204 Supernatant	8.70E-09	9.54E-09	5.29E-06	5.31E-06	1.52E-10	1.75E-10	9.74E-08	9.78E-08
Solid Layer	8.70E-09	9.54E-09	5.29E-06	5.31E-06	na	na	na	na
241-S-101 Supernatant	1.75E-07	2.37E-07	5.94E-07	1.01E-06	1.60E-10	4.50E-09	1.13E-08	1.91E-08
Solid Layer	1.75E-07	2.37E-07	5.94E-07	1.01E-06	3.31E-09	4.50E-09	1.13E-08	1.91E-08
241-S-102 Supernatant	7.41E-08	1.93E-07	7.77E-07	1.04E-06	1.36E-09	3.54E-09	1.43E-08	1.92E-08
Solid Layer	7.41E-08	1.93E-07	7.77E-07	1.04E-06	na	na	na	na
					1.36E-09	3.54E-09	1.43E-08	1.92E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-S-103 Supernatant Solid Layer	6.67E-08 1.18E-07 6.65E-08	9.77E-08 1.55E-07 9.74E-08	8.61E-07 2.61E-07 8.64E-07	1.03E-06 5.34E-07 1.03E-06	1.22E-09 1.98E-09 1.22E-09	1.79E-09 2.61E-09 1.79E-09	1.58E-08 4.37E-09 1.59E-08	1.88E-08 8.96E-09 1.89E-08
241-S-104 Supernatant Solid Layer	6.79E-08 na 6.79E-08	1.98E-08 na 1.98E-08	7.19E-07 na 7.19E-07	8.07E-07 na 8.07E-07	1.30E-09 na 1.30E-09	3.79E-10 na 3.79E-10	1.38E-08 na 1.38E-08	1.55E-08 na 1.55E-08
241-S-105 Supernatant Solid Layer	1.54E-09 na 1.54E-09	1.59E-08 na 1.59E-08	5.86E-07 na 5.86E-07	6.04E-07 na 6.04E-07	2.90E-11 na 2.90E-11	3.00E-10 na 3.00E-10	1.11E-08 na 1.11E-08	1.14E-08 na 1.14E-08
241-S-106 Supernatant Solid Layer	2.23E-08 na 2.23E-08	2.52E-08 na 2.52E-08	5.18E-07 na 5.18E-07	5.66E-07 na 5.66E-07	4.45E-10 na 4.45E-10	5.02E-10 na 5.02E-10	1.03E-08 na 1.03E-08	1.13E-08 na 1.13E-08
241-S-107 Supernatant Solid Layer	4.78E-08 na 4.78E-08	3.91E-08 na 3.91E-08	6.03E-07 na 6.03E-07	6.90E-07 na 6.90E-07	1.02E-09 na 1.02E-09	8.33E-10 na 8.33E-10	1.28E-08 na 1.28E-08	1.47E-08 na 1.47E-08
241-S-108 Supernatant Solid Layer	4.10E-09 na 4.10E-09	1.34E-08 na 1.34E-08	4.87E-07 na 4.87E-07	5.05E-07 na 5.05E-07	7.82E-11 na 7.82E-11	2.56E-10 na 2.56E-10	9.30E-09 na 9.30E-09	9.63E-09 na 9.63E-09
241-S-109 Supernatant Solid Layer	2.22E-09 na 2.22E-09	7.83E-09 na 7.83E-09	4.93E-07 na 4.93E-07	5.03E-07 na 5.03E-07	4.25E-11 na 4.25E-11	1.50E-10 na 1.50E-10	9.46E-09 na 9.46E-09	9.65E-09 na 9.65E-09
241-S-110 Supernatant Solid Layer	2.67E-08 na 2.67E-08	8.78E-08 na 8.78E-08	5.91E-07 na 5.91E-07	7.05E-07 na 7.05E-07	5.12E-10 na 5.12E-10	1.68E-09 na 1.68E-09	1.13E-08 na 1.13E-08	1.35E-08 na 1.35E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC _{rad} (mole/kg-d)	HGR from thermolysis, RC _{therm} (mole/kg-d)	HGR from corrosion, RC _{corr} (mole/kg-d)	Total HGR from model, RC _{tot} (mole/kg-d)	HGR from radiolysis, RC _{rad} (mole/m ³ -s)	HGR from thermolysis, RC _{therm} (mole/m ³ -s)	HGR from corrosion, RC _{corr} (mole/m ³ -s)	Total HGR from model, RC _{tot} (mole/m ³ -s)
241-S-111 Supernatant	7.63E-08	4.28E-08	6.70E-07	7.89E-07	1.36E-09	7.62E-10	1.19E-08	1.40E-08
Solid Layer	na	na	na	na	na	na	na	na
241-S-112 Supernatant	7.63E-08	4.28E-08	6.70E-07	7.89E-07	1.36E-09	7.62E-10	1.19E-08	1.40E-08
Solid Layer	7.99E-09	8.80E-09	4.56E-07	4.73E-07	1.54E-10	1.69E-10	8.78E-09	9.11E-09
241-SX-101 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	7.99E-09	8.80E-09	4.56E-07	4.73E-07	1.54E-10	1.69E-10	8.78E-09	9.11E-09
241-SX-101 Supernatant	9.64E-08	5.36E-07	5.65E-07	1.20E-06	1.86E-09	1.04E-08	1.09E-08	2.32E-08
Solid Layer	na	na	na	na	na	na	na	na
241-SX-102 Supernatant	9.64E-08	5.36E-07	5.65E-07	1.20E-06	1.86E-09	1.04E-08	1.09E-08	2.32E-08
Solid Layer	1.17E-07	5.87E-07	5.42E-07	1.25E-06	2.29E-09	1.16E-08	1.07E-08	2.45E-08
241-SX-102 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.17E-07	5.87E-07	5.42E-07	1.25E-06	2.29E-09	1.16E-08	1.07E-08	2.45E-08
241-SX-103 Supernatant	3.52E-07	3.27E-06	4.94E-07	4.11E-06	7.04E-09	6.54E-08	9.89E-09	8.23E-08
Solid Layer	7.18E-07	9.73E-06	2.57E-07	1.07E-05	1.22E-08	1.66E-07	4.37E-09	1.82E-07
241-SX-104 Supernatant	3.52E-07	3.27E-06	4.94E-07	4.11E-06	7.04E-09	6.54E-08	9.89E-09	8.23E-08
Solid Layer	1.55E-07	5.17E-07	5.40E-07	1.21E-06	2.99E-09	1.00E-08	1.04E-08	2.34E-08
241-SX-104 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.55E-07	5.17E-07	5.40E-07	1.21E-06	2.99E-09	1.00E-08	1.04E-08	2.34E-08
241-SX-105 Supernatant	2.37E-07	2.29E-06	6.14E-07	3.14E-06	4.48E-09	4.32E-08	1.16E-08	5.93E-08
Solid Layer	na	na	na	na	na	na	na	na
241-SX-106 Supernatant	2.37E-07	2.29E-06	6.14E-07	3.14E-06	4.48E-09	4.32E-08	1.16E-08	5.93E-08
Solid Layer	6.25E-08	1.75E-07	6.13E-07	8.51E-07	1.14E-09	3.19E-09	1.12E-08	1.55E-08
241-SX-106 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	6.25E-08	1.75E-07	6.13E-07	8.51E-07	1.14E-09	3.19E-09	1.12E-08	1.55E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-SX-107 Supernatant	1.01E-07	2.11E-07	1.65E-06	1.96E-06	2.02E-09	4.23E-09	3.31E-08	3.94E-08
Solid Layer	na	na	na	na	na	na	na	na
241-SX-108 Supernatant	1.01E-07	2.11E-07	1.65E-06	1.96E-06	2.02E-09	4.23E-09	3.31E-08	3.94E-08
Solid Layer	3.45E-07	3.08E-07	2.05E-06	2.70E-06	6.98E-09	6.23E-09	4.15E-08	5.47E-08
241-SX-109 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	3.45E-07	3.08E-07	2.05E-06	2.70E-06	6.98E-09	6.23E-09	4.15E-08	5.47E-08
241-SX-110 Supernatant	2.26E-07	1.06E-06	7.81E-07	2.06E-06	4.51E-09	2.11E-08	1.56E-08	4.12E-08
Solid Layer	na	na	na	na	na	na	na	na
241-SX-110 Supernatant	2.26E-07	1.06E-06	7.81E-07	2.06E-06	4.51E-09	2.11E-08	1.56E-08	4.12E-08
Solid Layer	2.08E-07	2.96E-07	2.63E-06	3.13E-06	4.17E-09	5.94E-09	5.28E-08	6.29E-08
241-SX-111 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.08E-07	2.96E-07	2.63E-06	3.13E-06	4.17E-09	5.94E-09	5.28E-08	6.29E-08
241-SX-111 Supernatant	9.87E-08	3.19E-07	1.40E-06	1.82E-06	1.96E-09	6.33E-09	2.79E-08	3.62E-08
Solid Layer	na	na	na	na	na	na	na	na
241-SX-112 Supernatant	9.87E-08	3.19E-07	1.40E-06	1.82E-06	1.96E-09	6.33E-09	2.79E-08	3.62E-08
Solid Layer	8.86E-08	8.26E-08	2.03E-06	2.21E-06	1.77E-09	1.65E-09	4.06E-08	4.40E-08
241-SX-113 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	8.86E-08	8.26E-08	2.03E-06	2.21E-06	1.77E-09	1.65E-09	4.06E-08	4.40E-08
241-SX-113 Supernatant	4.47E-08	3.66E-08	1.21E-05	1.22E-05	5.48E-10	4.49E-10	1.49E-07	1.50E-07
Solid Layer	na	na	na	na	na	na	na	na
241-SX-114 Supernatant	4.47E-08	3.66E-08	1.21E-05	1.22E-05	5.48E-10	4.49E-10	1.49E-07	1.50E-07
Solid Layer	7.29E-08	2.67E-07	1.12E-06	1.46E-06	1.42E-09	5.20E-09	2.18E-08	2.84E-08
241-SX-114 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	7.29E-08	2.67E-07	1.12E-06	1.46E-06	1.42E-09	5.20E-09	2.18E-08	2.84E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-SX-115 Supernatant	1.13E-06 na	6.16E-09 na	3.64E-05 na	3.75E-05 na	2.29E-08 na	1.25E-10 na	7.37E-07 na	7.60E-07 na
241-SX-115 Solid Layer	1.13E-06	6.16E-09	3.64E-05	3.75E-05	2.29E-08	1.25E-10	7.37E-07	7.60E-07
241-T-101 Supernatant	3.64E-08 na	9.58E-08 na	1.69E-06 na	1.82E-06 na	6.82E-10 na	1.80E-09 na	3.17E-08 na	3.41E-08 na
241-T-101 Solid Layer	3.64E-08	9.58E-08	1.69E-06	1.82E-06	6.82E-10	1.80E-09	3.17E-08	3.41E-08
241-T-102 Supernatant	1.91E-08 1.14E-08	1.87E-09 3.44E-09	5.04E-06 3.31E-07	5.06E-06 3.46E-07	3.38E-10 1.51E-10	3.30E-11 4.54E-11	8.91E-08 4.37E-09	8.95E-08 4.57E-09
241-T-102 Solid Layer	2.25E-08	1.19E-09	7.09E-06	7.12E-06	4.65E-10	2.45E-11	1.47E-07	1.47E-07
241-T-103 Supernatant	9.81E-08 2.04E-08	2.29E-12 6.33E-12	5.70E-06 3.78E-07	5.79E-06 3.98E-07	1.81E-09 2.36E-10	4.22E-14 7.33E-14	1.05E-07 4.37E-09	1.07E-07 4.61E-09
241-T-103 Solid Layer	1.06E-07	1.88E-12	6.24E-06	6.34E-06	2.08E-09	3.69E-14	1.22E-07	1.24E-07
241-T-104 Supernatant	9.21E-10 na	1.66E-08 na	8.66E-07 na	8.83E-07 na	1.38E-11 na	2.47E-10 na	1.29E-08 na	1.32E-08 na
241-T-104 Solid Layer	9.21E-10	1.66E-08	8.66E-07	8.83E-07	1.38E-11	2.47E-10	1.29E-08	1.32E-08
241-T-105 Supernatant	3.72E-08 na	3.71E-09 na	1.90E-06 na	1.94E-06 na	6.29E-10 na	6.26E-11 na	3.20E-08 na	3.27E-08 na
241-T-105 Solid Layer	3.72E-08	3.71E-09	1.90E-06	1.94E-06	6.29E-10	6.26E-11	3.20E-08	3.27E-08
241-T-106 Supernatant	4.40E-09 na	5.01E-09 na	7.93E-06 na	7.94E-06 na	7.18E-11 na	8.17E-11 na	1.29E-07 na	1.30E-07 na
241-T-106 Solid Layer	4.40E-09	5.01E-09	7.93E-06	7.94E-06	7.18E-11	8.17E-11	1.29E-07	1.30E-07
241-T-107 Supernatant	2.68E-08 na	1.04E-08 na	1.11E-06 na	1.15E-06 na	4.84E-10 na	1.87E-10 na	2.00E-08 na	2.07E-08 na
241-T-107 Solid Layer	2.68E-08	1.04E-08	1.11E-06	1.15E-06	4.84E-10	1.87E-10	2.00E-08	2.07E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC _{rad} (mole/kg-d)	HGR from thermolysis, RC _{therm} (mole/kg-d)	HGR from corrosion, RC _{corr} (mole/kg-d)	Total HGR from model, RC _{tot} (mole/kg-d)	HGR from radiolysis, RC _{rad} (mole/m ³ -s)	HGR from thermolysis, RC _{therm} (mole/m ³ -s)	HGR from corrosion, RC _{corr} (mole/m ³ -s)	Total HGR from model, RC _{tot} (mole/m ³ -s)
241-T-108 Supernatant	1.64E-09 na	4.40E-16 na	1.05E-05 na	1.05E-05 na	2.73E-11 na	7.35E-18 na	1.75E-07 na	1.75E-07 na
Solid Layer	1.64E-09	4.40E-16	1.05E-05	1.05E-05	2.73E-11	7.35E-18	1.75E-07	1.75E-07
241-T-109 Supernatant	1.33E-09 na	9.06E-16 na	2.85E-06 na	2.85E-06 na	2.24E-11 na	1.53E-17 na	4.80E-08 na	4.80E-08 na
Solid Layer	1.33E-09	9.06E-16	2.85E-06	2.85E-06	2.24E-11	1.53E-17	4.80E-08	4.80E-08
241-T-110 Supernatant	6.00E-08 4.69E-12	0.00E+00 0.00E+00	8.10E-07 3.60E-07	8.70E-07 3.60E-07	8.69E-10 5.70E-14	0.00E+00 0.00E+00	1.17E-08 4.37E-09	1.26E-08 4.37E-09
Solid Layer	6.00E-08	0.00E+00	8.10E-07	8.70E-07	8.69E-10	0.00E+00	1.17E-08	1.26E-08
241-T-111 Supernatant	1.57E-09 na	1.53E-08 na	7.27E-07 na	7.44E-07 na	2.25E-11 na	2.20E-10 na	1.04E-08 na	1.07E-08 na
Solid Layer	1.57E-09	1.53E-08	7.27E-07	7.44E-07	2.25E-11	2.20E-10	1.04E-08	1.07E-08
241-T-112 Supernatant	6.81E-09 1.08E-09	0.00E+00 0.00E+00	3.36E-06 3.43E-07	3.37E-06 3.45E-07	1.01E-10 1.38E-11	0.00E+00 0.00E+00	4.98E-08 4.37E-09	4.99E-08 4.39E-09
Solid Layer	6.81E-09	0.00E+00	3.36E-06	3.37E-06	1.01E-10	0.00E+00	4.98E-08	4.99E-08
241-T-201 Supernatant	1.97E-11 5.51E-11	0.00E+00 0.00E+00	1.51E-06 1.34E-06	1.51E-06 1.34E-06	2.99E-13 6.74E-13	0.00E+00 0.00E+00	2.30E-08 1.64E-08	2.30E-08 1.64E-08
Solid Layer	1.97E-11	0.00E+00	1.51E-06	1.51E-06	2.99E-13	0.00E+00	2.30E-08	2.30E-08
241-T-202 Supernatant	1.01E-11 na	1.68E-08 na	1.86E-06 na	1.88E-06 na	1.38E-13 na	2.30E-10 na	2.54E-08 na	2.56E-08 na
Solid Layer	1.01E-11	1.68E-08	1.86E-06	1.88E-06	1.38E-13	2.30E-10	2.54E-08	2.56E-08
241-T-203 Supernatant	5.91E-12 na	1.55E-08 na	1.53E-06 na	1.54E-06 na	8.35E-14 na	2.19E-10 na	2.16E-08 na	2.18E-08 na
Solid Layer	5.91E-12	1.55E-08	1.53E-06	1.54E-06	8.35E-14	2.19E-10	2.16E-08	2.18E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-T-204	4.43E-12	1.76E-08	1.58E-06	1.60E-06	6.05E-14	2.41E-10	2.16E-08	2.18E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	4.43E-12	1.76E-08	1.58E-06	1.60E-06	6.05E-14	2.41E-10	2.16E-08	2.18E-08
241-TX-101	1.75E-07	9.31E-08	1.71E-06	1.98E-06	3.50E-09	1.86E-09	3.42E-08	3.93E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.75E-07	9.31E-08	1.71E-06	1.98E-06	3.50E-09	1.86E-09	3.42E-08	3.95E-08
241-TX-102	2.00E-08	6.70E-08	8.88E-07	9.75E-07	3.81E-10	1.27E-09	1.69E-08	1.85E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.00E-08	6.70E-08	8.88E-07	9.75E-07	3.81E-10	1.27E-09	1.69E-08	1.85E-08
241-TX-103	2.22E-08	5.15E-08	1.22E-06	1.29E-06	4.21E-10	9.78E-10	2.31E-08	2.45E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.22E-08	5.15E-08	1.22E-06	1.29E-06	4.21E-10	9.78E-10	2.31E-08	2.45E-08
241-TX-104	8.99E-08	6.39E-09	2.23E-06	2.33E-06	1.81E-09	1.28E-10	4.49E-08	4.68E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	8.99E-08	6.39E-09	2.23E-06	2.33E-06	1.81E-09	1.28E-10	4.49E-08	4.68E-08
241-TX-105	8.20E-09	5.24E-08	4.72E-07	5.32E-07	1.58E-10	1.01E-09	9.08E-09	1.02E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	8.20E-09	5.24E-08	4.72E-07	5.32E-07	1.58E-10	1.01E-09	9.08E-09	1.02E-08
241-TX-106	2.61E-08	7.85E-08	6.37E-07	7.42E-07	4.98E-10	1.50E-09	1.22E-08	1.42E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.61E-08	7.85E-08	6.37E-07	7.42E-07	4.98E-10	1.50E-09	1.22E-08	1.42E-08
241-TX-107	5.38E-08	7.78E-08	4.67E-06	4.80E-06	1.11E-09	1.60E-09	9.59E-08	9.87E-08
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	5.38E-08	7.78E-08	4.67E-06	4.80E-06	1.11E-09	1.60E-09	9.59E-08	9.87E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-TX-108 Supernatant	1.03E-08	1.99E-08	1.32E-06	1.35E-06	1.99E-10	3.82E-10	2.53E-08	2.59E-08
241-TX-108 Solid Layer	na	na	na	na	na	na	na	na
241-TX-109 Supernatant	1.03E-08	1.99E-08	1.32E-06	1.35E-06	1.99E-10	3.82E-10	2.53E-08	2.59E-08
241-TX-109 Solid Layer	9.35E-09	9.39E-08	7.25E-07	8.28E-07	1.53E-10	1.53E-09	1.18E-08	1.35E-08
241-TX-110 Supernatant	na	na	na	na	na	na	na	na
241-TX-110 Solid Layer	9.35E-09	9.39E-08	7.25E-07	8.28E-07	1.53E-10	1.53E-09	1.18E-08	1.35E-08
241-TX-111 Supernatant	7.63E-09	3.08E-08	5.34E-07	5.73E-07	1.45E-10	5.87E-10	1.02E-08	1.09E-08
241-TX-111 Solid Layer	na	na	na	na	na	na	na	na
241-TX-112 Supernatant	7.63E-09	3.08E-08	5.34E-07	5.73E-07	1.45E-10	5.87E-10	1.02E-08	1.09E-08
241-TX-112 Solid Layer	7.70E-09	2.67E-08	6.22E-07	6.56E-07	1.46E-10	5.07E-10	1.18E-08	1.24E-08
241-TX-113 Supernatant	na	na	na	na	na	na	na	na
241-TX-113 Solid Layer	7.70E-09	2.67E-08	6.22E-07	6.56E-07	1.46E-10	5.07E-10	1.18E-08	1.24E-08
241-TX-114 Supernatant	8.32E-09	1.91E-08	4.51E-07	4.79E-07	1.59E-10	3.67E-10	8.65E-09	9.18E-09
241-TX-114 Solid Layer	na	na	na	na	na	na	na	na
241-TX-115 Supernatant	8.32E-09	1.91E-08	4.51E-07	4.79E-07	1.59E-10	3.67E-10	8.65E-09	9.18E-09
241-TX-115 Solid Layer	3.76E-10	9.73E-09	4.57E-07	4.67E-07	7.10E-12	1.84E-10	8.62E-09	8.81E-09
241-TX-116 Supernatant	na	na	na	na	na	na	na	na
241-TX-116 Solid Layer	3.76E-10	9.73E-09	4.57E-07	4.67E-07	7.10E-12	1.84E-10	8.62E-09	8.81E-09
241-TX-117 Supernatant	2.72E-09	3.40E-09	4.97E-07	5.03E-07	5.17E-11	6.47E-11	9.46E-09	9.58E-09
241-TX-117 Solid Layer	na	na	na	na	na	na	na	na
241-TX-118 Supernatant	2.72E-09	3.40E-09	4.97E-07	5.03E-07	5.17E-11	6.47E-11	9.46E-09	9.58E-09
241-TX-118 Solid Layer	5.70E-09	1.29E-08	4.83E-07	5.02E-07	1.09E-10	2.48E-10	9.27E-09	9.62E-09
241-TX-119 Supernatant	na	na	na	na	na	na	na	na
241-TX-119 Solid Layer	5.70E-09	1.29E-08	4.83E-07	5.02E-07	1.09E-10	2.48E-10	9.27E-09	9.62E-09

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-TX-116 Supernatant	6.00E-10	1.52E-11	4.82E-07	4.83E-07	1.11E-11	2.80E-13	8.90E-09	8.91E-09
241-TX-116 Solid Layer	na	na	na	na	na	na	na	na
241-TX-117 Supernatant	6.00E-10	1.52E-11	4.82E-07	4.83E-07	1.11E-11	2.80E-13	8.90E-09	8.91E-09
241-TX-117 Solid Layer	7.16E-10	7.57E-17	5.61E-07	5.61E-07	1.28E-11	1.35E-18	1.00E-08	1.00E-08
241-TX-118 Supernatant	na	na	na	na	na	na	na	na
241-TX-118 Solid Layer	7.16E-10	7.57E-17	5.61E-07	5.61E-07	1.28E-11	1.35E-18	1.00E-08	1.00E-08
241-TX-118 Supernatant	4.35E-08	7.15E-08	7.67E-07	8.82E-07	8.49E-10	1.40E-09	1.50E-08	1.72E-08
241-TX-118 Solid Layer	na	na	na	na	na	na	na	na
241-TY-101 Supernatant	4.35E-08	7.15E-08	7.67E-07	8.82E-07	8.49E-10	1.40E-09	1.50E-08	1.72E-08
241-TY-101 Solid Layer	3.73E-10	1.73E-16	1.44E-06	1.44E-06	7.06E-12	3.28E-18	2.73E-08	2.73E-08
241-TY-102 Supernatant	na	na	na	na	na	na	na	na
241-TY-102 Solid Layer	3.73E-10	1.73E-16	1.44E-06	1.44E-06	7.06E-12	3.28E-18	2.73E-08	2.73E-08
241-TY-102 Supernatant	6.64E-09	2.26E-08	2.16E-06	2.19E-06	1.35E-10	4.58E-10	4.37E-08	4.43E-08
241-TY-102 Solid Layer	na	na	na	na	na	na	na	na
241-TY-103 Supernatant	6.64E-09	2.26E-08	2.16E-06	2.19E-06	1.35E-10	4.58E-10	4.37E-08	4.43E-08
241-TY-103 Solid Layer	7.15E-08	1.41E-07	1.12E-06	1.33E-06	1.40E-09	2.75E-09	2.18E-08	2.60E-08
241-TY-103 Supernatant	na	na	na	na	na	na	na	na
241-TY-103 Solid Layer	7.15E-08	1.41E-07	1.12E-06	1.33E-06	1.40E-09	2.75E-09	2.18E-08	2.60E-08
241-TY-104 Supernatant	3.24E-08	4.42E-09	3.39E-06	3.42E-06	6.28E-10	8.58E-11	6.58E-08	6.65E-08
241-TY-104 Solid Layer	3.20E-09	6.79E-09	3.20E-07	3.30E-07	4.37E-11	9.28E-11	4.37E-09	4.51E-09
241-TY-105 Supernatant	3.29E-08	4.38E-09	3.44E-06	3.48E-06	6.43E-10	8.56E-11	6.73E-08	6.80E-08
241-TY-105 Solid Layer	2.72E-08	1.36E-08	9.10E-07	9.50E-07	4.81E-10	2.41E-10	1.61E-08	1.68E-08
241-TY-105 Supernatant	na	na	na	na	na	na	na	na
241-TY-105 Solid Layer	2.72E-08	1.36E-08	9.10E-07	9.50E-07	4.81E-10	2.41E-10	1.61E-08	1.68E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-TY-106 Supernatant	3.94E-08	7.26E-09	1.05E-05	1.05E-05	6.38E-10	1.18E-10	1.70E-07	1.71E-07
241-TY-106 Solid Layer	na	na	na	na	na	na	na	na
241-U-101 Supernatant	3.94E-08	7.26E-09	1.05E-05	1.05E-05	6.38E-10	1.18E-10	1.70E-07	1.71E-07
241-U-101 Solid Layer	1.10E-07	1.19E-08	5.91E-06	6.03E-06	2.23E-09	2.40E-10	1.20E-07	1.22E-07
241-U-101 Supernatant	na	na	na	na	na	na	na	na
241-U-101 Solid Layer	1.10E-07	1.19E-08	5.91E-06	6.03E-06	2.23E-09	2.40E-10	1.20E-07	1.22E-07
241-U-102 Supernatant	1.85E-07	2.61E-07	6.56E-07	1.10E-06	3.58E-09	5.04E-09	1.27E-08	2.13E-08
241-U-102 Solid Layer	2.70E-07	3.07E-07	2.55E-07	8.32E-07	4.62E-09	5.26E-09	4.37E-09	1.43E-08
241-U-102 Supernatant	1.85E-07	2.61E-07	6.56E-07	1.10E-06	3.58E-09	5.04E-09	1.27E-08	2.13E-08
241-U-102 Solid Layer	1.19E-07	3.51E-07	6.18E-07	1.09E-06	2.34E-09	6.91E-09	1.22E-08	2.14E-08
241-U-103 Supernatant	3.71E-07	6.38E-07	2.62E-07	1.27E-06	6.19E-09	1.06E-08	4.37E-09	2.12E-08
241-U-103 Solid Layer	1.19E-07	3.51E-07	6.18E-07	1.09E-06	2.34E-09	6.91E-09	1.22E-08	2.14E-08
241-U-104 Supernatant	1.93E-07	2.53E-07	1.53E-06	1.98E-06	3.34E-09	4.39E-09	2.66E-08	3.43E-08
241-U-104 Solid Layer	na	na	na	na	na	na	na	na
241-U-105 Supernatant	1.93E-07	2.53E-07	1.53E-06	1.98E-06	3.34E-09	4.39E-09	2.66E-08	3.43E-08
241-U-105 Solid Layer	1.15E-07	3.40E-07	6.23E-07	1.08E-06	2.23E-09	6.58E-09	1.20E-08	2.09E-08
241-U-105 Supernatant	na	na	na	na	na	na	na	na
241-U-105 Solid Layer	1.15E-07	3.40E-07	6.23E-07	1.08E-06	2.23E-09	6.58E-09	1.20E-08	2.09E-08
241-U-106 Supernatant	5.79E-07	7.67E-07	1.13E-06	2.48E-06	1.04E-08	1.37E-08	2.03E-08	4.44E-08
241-U-106 Solid Layer	7.88E-07	8.99E-07	2.82E-07	1.97E-06	1.22E-08	1.39E-08	4.37E-09	3.05E-08
241-U-106 Supernatant	5.77E-07	7.66E-07	1.14E-06	2.48E-06	1.04E-08	1.37E-08	2.04E-08	4.45E-08
241-U-107 Supernatant	2.83E-08	1.12E-07	6.53E-07	7.93E-07	5.70E-10	2.25E-09	1.31E-08	1.60E-08
241-U-107 Solid Layer	na	na	na	na	na	na	na	na
241-U-107 Supernatant	2.83E-08	1.12E-07	6.53E-07	7.93E-07	5.70E-10	2.25E-09	1.31E-08	1.60E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-U-108 Supernatant	7.69E-08 na	2.23E-07 na	5.71E-07 na	8.70E-07 na	1.49E-09 na	4.32E-09 na	1.11E-08 na	1.69E-08 na
241-U-108 Solid Layer	7.69E-08	2.23E-07	5.71E-07	8.70E-07	1.49E-09	4.32E-09	1.11E-08	1.69E-08
241-U-109 Supernatant	4.46E-08 na	1.17E-07 na	6.53E-07 na	8.16E-07 na	8.53E-10 na	2.25E-09 na	1.25E-08 na	1.56E-08 na
241-U-109 Solid Layer	4.46E-08	1.17E-07	6.53E-07	8.16E-07	8.53E-10	2.25E-09	1.25E-08	1.56E-08
241-U-110 Supernatant	4.52E-08 na	1.91E-08 na	1.03E-06 na	1.10E-06 na	8.69E-10 na	3.67E-10 na	1.98E-08 na	2.10E-08 na
241-U-110 Solid Layer	4.52E-08	1.91E-08	1.03E-06	1.10E-06	8.69E-10	3.67E-10	1.98E-08	2.10E-08
241-U-111 Supernatant	6.18E-08 na	1.10E-07 na	8.06E-07 na	9.77E-07 na	1.15E-09 na	2.04E-09 na	1.50E-08 na	1.82E-08 na
241-U-111 Solid Layer	6.18E-08	1.10E-07	8.06E-07	9.77E-07	1.15E-09	2.04E-09	1.50E-08	1.82E-08
241-U-112 Supernatant	5.60E-08 na	1.15E-08 na	3.18E-06 na	3.25E-06 na	1.13E-09 na	2.31E-10 na	6.40E-08 na	6.54E-08 na
241-U-112 Solid Layer	5.60E-08	1.15E-08	3.18E-06	3.25E-06	1.13E-09	2.31E-10	6.40E-08	6.54E-08
241-U-201 Supernatant	4.37E-10 4.92E-09	0.00E+00 0.00E+00	4.38E-06 1.12E-06	4.38E-06 1.13E-06	8.25E-12 7.18E-11	0.00E+00 0.00E+00	8.27E-08 1.64E-08	8.27E-08 1.65E-08
241-U-201 Solid Layer	4.37E-10	0.00E+00	4.38E-06	4.38E-06	8.25E-12	0.00E+00	8.27E-08	8.27E-08
241-U-202 Supernatant	3.95E-10 3.56E-09	1.03E-10 2.43E-10	5.11E-06 1.11E-06	5.11E-06 1.11E-06	6.90E-12 5.27E-11	1.80E-12 3.60E-12	8.93E-08 1.64E-08	8.93E-08 1.64E-08
241-U-202 Solid Layer	3.95E-10	1.03E-10	5.11E-06	5.11E-06	6.90E-12	1.80E-12	8.93E-08	8.93E-08
241-U-203 Supernatant	5.41E-10 3.26E-09	0.00E+00 0.00E+00	5.29E-06 1.11E-06	5.29E-06 1.11E-06	9.95E-12 4.82E-11	0.00E+00 0.00E+00	9.74E-08 1.64E-08	9.74E-08 1.64E-08
241-U-203 Solid Layer	5.41E-10	0.00E+00	5.29E-06	5.29E-06	9.95E-12	0.00E+00	9.74E-08	9.74E-08

Table B-3. Calculated Hydrogen Generation Rate as Mole Per Unit Waste Weight and Volume for 177 Tanks With Current Waste. (23 sheets)

Tank	HGR from radiolysis, RC_{rad} (mole/kg-d)	HGR from thermolysis, RC_{therm} (mole/kg-d)	HGR from corrosion, RC_{corr} (mole/kg-d)	Total HGR from model, RC_{tot} (mole/kg-d)	HGR from radiolysis, RC_{rad} (mole/m ³ -s)	HGR from thermolysis, RC_{therm} (mole/m ³ -s)	HGR from corrosion, RC_{corr} (mole/m ³ -s)	Total HGR from model, RC_{tot} (mole/m ³ -s)
241-U-204	7.24E-10	1.56E-11	7.09E-06	7.09E-06	1.23E-11	2.65E-13	1.21E-07	1.21E-07
Supernatant	1.42E-09	5.17E-11	1.28E-06	1.28E-06	1.82E-11	6.64E-13	1.64E-08	1.64E-08
Solid Layer	7.24E-10	1.56E-11	7.09E-06	7.09E-06	1.23E-11	2.65E-13	1.21E-07	1.21E-07

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-AN-101	2.13E-05	2.41E-05	3.69E-04	5%	6%	89%	4.15E-04	17
Supernatant	2.13E-05	2.41E-05	3.69E-04	5%	6%	89%	4.15E-04	17
Solid Layer	na	na	na	na	na	na	na	na
241-AN-102	3.92E-03	5.10E-03	7.37E-04	40%	52%	8%	9.76E-03	400
Supernatant	3.43E-03	4.59E-03	4.10E-04	41%	54%	5%	8.43E-03	345
Solid Layer	4.84E-04	5.16E-04	3.27E-04	36%	39%	25%	1.33E-03	54
241-AN-103	7.76E-04	1.39E-03	6.90E-04	27%	49%	24%	2.86E-03	117
Supernatant	5.82E-04	8.41E-04	2.18E-04	35%	51%	13%	1.64E-03	67
Solid Layer	1.95E-04	5.50E-04	4.72E-04	16%	45%	39%	1.22E-03	50
241-AN-104	9.45E-04	1.86E-03	7.32E-04	27%	53%	21%	3.54E-03	145
Supernatant	5.31E-04	9.09E-04	2.66E-04	31%	53%	16%	1.71E-03	70
Solid Layer	4.14E-04	9.51E-04	4.66E-04	23%	52%	25%	1.83E-03	75
241-AN-105	5.63E-04	1.32E-03	7.64E-04	21%	50%	29%	2.65E-03	109
Supernatant	2.55E-04	6.14E-04	2.58E-04	23%	54%	23%	1.13E-03	46
Solid Layer	3.08E-04	7.11E-04	5.06E-04	20%	47%	33%	1.52E-03	62
241-AN-106	1.64E-05	1.91E-05	3.33E-04	4%	5%	90%	3.69E-04	15
Supernatant	1.24E-05	1.80E-05	6.25E-05	13%	19%	67%	9.29E-05	4
Solid Layer	4.01E-06	1.19E-06	2.71E-04	1%	0%	98%	2.76E-04	11
241-AN-107	6.00E-03	3.20E-03	7.42E-04	60%	32%	7%	9.94E-03	407
Supernatant	4.38E-03	2.58E-03	3.70E-04	60%	35%	5%	7.33E-03	300
Solid Layer	1.62E-03	6.24E-04	3.72E-04	62%	24%	14%	2.61E-03	107
241-AP-101	1.34E-04	1.25E-04	7.38E-04	13%	12%	74%	9.97E-04	41
Supernatant	1.34E-04	1.25E-04	7.38E-04	13%	12%	74%	9.97E-04	41
Solid Layer	na	na	na	na	na	na	na	na

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, $(G_{rad})\%$	Percent of HGR from thermolysis, $(G_{therm})\%$	Percent of HGR from corrosion, $(G_{corr})\%$	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-AP-102	1.71E-05	5.82E-05	3.57E-04	12%	40%	49%	1.46E-04	6
Supernatant	1.71E-05	5.82E-05	7.11E-05	12%	40%	49%	1.46E-04	6
Solid Layer	na	na	na	na	na	na	na	na
241-AP-103	4.50E-04	7.14E-04	6.47E-04	25%	39%	36%	1.81E-03	74
Supernatant	4.50E-04	7.14E-04	6.47E-04	25%	39%	36%	1.81E-03	74
Solid Layer	na	na	na	na	na	na	na	na
241-AP-104	3.85E-04	5.79E-04	7.74E-04	22%	33%	45%	1.74E-03	71
Supernatant	3.85E-04	5.79E-04	7.74E-04	22%	33%	45%	1.74E-03	71
Solid Layer	na	na	na	na	na	na	na	na
241-AP-105	2.48E-04	3.23E-04	7.46E-04	19%	25%	57%	1.32E-03	54
Supernatant	2.28E-04	3.00E-04	4.44E-04	23%	31%	46%	9.73E-04	40
Solid Layer	1.95E-05	2.24E-05	3.02E-04	6%	7%	88%	3.44E-04	14
241-AP-106	2.70E-04	3.59E-04	7.52E-04	20%	26%	54%	1.38E-03	57
Supernatant	2.70E-04	3.59E-04	7.52E-04	20%	26%	54%	1.38E-03	57
Solid Layer	na	na	na	na	na	na	na	na
241-AP-107	5.16E-05	7.78E-05	3.70E-04	10%	16%	74%	5.00E-04	20
Supernatant	5.16E-05	7.78E-05	3.70E-04	10%	16%	74%	5.00E-04	20
Solid Layer	na	na	na	na	na	na	na	na
241-AP-108	4.32E-04	2.77E-03	7.50E-04	11%	70%	19%	3.95E-03	162
Supernatant	4.32E-04	2.77E-03	7.50E-04	11%	70%	19%	3.95E-03	162
Solid Layer	na	na	na	na	na	na	na	na
241-AW-101	8.72E-04	1.74E-03	7.61E-04	26%	52%	23%	3.37E-03	138
Supernatant	5.91E-04	1.17E-03	3.19E-04	28%	56%	15%	2.08E-03	85
Solid Layer	2.81E-04	5.71E-04	4.42E-04	22%	44%	34%	1.29E-03	53

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, $(G_{rad})\%$	Percent of HGR from thermolysis, $(G_{therm})\%$	Percent of HGR from corrosion, $(G_{corr})\%$	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-AW-102	1.49E-05	5.50E-06	3.05E-04	5%	2%	94%	3.25E-04	13
Supernatant	2.99E-06	3.61E-06	2.37E-05	10%	12%	78%	3.03E-05	1
Solid Layer	1.19E-05	1.89E-06	2.81E-04	4%	1%	95%	2.95E-04	12
241-AW-103	9.92E-05	1.52E-04	7.30E-04	10%	15%	74%	9.81E-04	40
Supernatant	8.65E-05	1.03E-04	3.35E-04	17%	20%	64%	5.24E-04	21
Solid Layer	1.27E-05	4.93E-05	3.95E-04	3%	11%	86%	4.57E-04	19
241-AW-104	8.55E-04	4.36E-03	7.61E-04	14%	73%	13%	5.98E-03	245
Supernatant	7.11E-04	3.92E-03	3.83E-04	14%	78%	8%	5.01E-03	205
Solid Layer	1.45E-04	4.48E-04	3.78E-04	15%	46%	39%	9.71E-04	40
241-AW-105	8.09E-06	1.07E-06	4.40E-04	2%	0%	98%	4.49E-04	18
Supernatant	1.09E-06	1.07E-06	6.81E-05	2%	2%	97%	7.02E-05	3
Solid Layer	6.99E-06	5.66E-11	3.72E-04	2%	0%	98%	3.79E-04	16
241-AW-106	6.70E-04	3.31E-03	7.30E-04	14%	70%	15%	4.71E-03	193
Supernatant	5.28E-04	2.49E-03	3.34E-04	16%	74%	10%	3.36E-03	138
Solid Layer	1.42E-04	8.18E-04	3.95E-04	10%	60%	29%	1.36E-03	56
241-AW-101	5.24E-04	6.77E-05	3.52E-04	56%	7%	37%	9.43E-04	39
Supernatant	4.99E-06	2.97E-05	3.71E-05	7%	41%	52%	7.18E-05	3
Solid Layer	5.19E-04	3.80E-05	3.14E-04	60%	4%	36%	8.71E-04	36
241-AW-102	5.51E-02	8.92E-04	6.08E-04	97%	2%	1%	5.66E-02	2318
Supernatant	2.66E-05	3.79E-04	2.48E-04	4%	58%	38%	6.54E-04	87
Solid Layer	5.50E-02	5.13E-04	3.60E-04	98%	1%	1%	5.59E-02	2291
241-AZ-101	3.91E-03	2.58E-03	7.85E-04	54%	35%	11%	7.27E-03	298
Supernatant	1.93E-03	2.36E-03	4.60E-04	41%	50%	10%	4.75E-03	195
Solid Layer	1.98E-03	2.22E-04	3.25E-04	78%	9%	13%	2.52E-03	103

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, $(G_{rad})\%$	Percent of HGR from thermolysis, $(G_{therm})\%$	Percent of HGR from corrosion, $(G_{corr})\%$	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-AZ-102	2.84E-03	4.69E-04	7.38E-04	70%	12%	18%	4.05E-03	166
Supernatant	1.44E-03	3.99E-04	4.06E-04	64%	18%	18%	2.25E-03	92
Solid Layer	1.40E-03	7.04E-05	3.32E-04	78%	4%	18%	1.80E-03	74
241-SY-101	4.92E-04	7.63E-04	7.58E-04	24%	38%	38%	2.01E-03	82
Supernatant	3.65E-04	5.62E-04	3.68E-04	28%	43%	28%	1.30E-03	53
Solid Layer	1.26E-04	2.01E-04	3.90E-04	18%	28%	54%	7.17E-04	29
241-SY-102	2.86E-04	6.10E-04	6.42E-04	19%	40%	42%	1.54E-03	63
Supernatant	2.13E-04	5.27E-04	3.07E-04	20%	50%	29%	1.05E-03	43
Solid Layer	7.26E-05	8.37E-05	3.35E-04	15%	17%	68%	4.91E-04	20
241-SY-103	7.27E-04	1.42E-03	5.93E-04	27%	52%	22%	2.74E-03	112
Supernatant	4.21E-04	7.26E-04	1.77E-04	32%	55%	13%	1.32E-03	54
Solid Layer	3.06E-04	6.94E-04	4.17E-04	22%	49%	29%	1.42E-03	58
241-A-101	3.47E-04	3.04E-03	9.31E-04	8%	70%	22%	4.31E-03	177
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	3.47E-04	3.04E-03	9.31E-04	8%	70%	22%	4.31E-03	177
241-A-102	1.76E-05	1.75E-10	5.80E-04	3%	0%	97%	5.98E-04	24
Supernatant	7.65E-07	1.38E-11	2.56E-06	23%	0%	77%	3.32E-06	0
Solid Layer	1.68E-05	1.61E-10	5.78E-04	3%	0%	97%	5.94E-04	24
241-A-103	3.05E-04	1.61E-03	8.72E-04	11%	58%	31%	2.78E-03	114
Supernatant	5.17E-06	5.74E-05	3.95E-06	8%	86%	6%	6.65E-05	3
Solid Layer	2.99E-04	1.55E-03	8.68E-04	11%	57%	32%	2.72E-03	111
241-A-104	3.11E-03	4.27E-04	5.72E-04	76%	10%	14%	4.11E-03	168
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	3.11E-03	4.27E-04	5.72E-04	76%	10%	14%	4.11E-03	168

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, $(G_{rad})\%$	Percent of HGR from thermolysis, $(G_{therm})\%$	Percent of HGR from corrosion, $(G_{corr})\%$	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-A-105 Supernatant Solid Layer	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA
241-A-106 Supernatant Solid Layer	7.61E-04 na 7.61E-04	4.87E-04 na 4.87E-04	6.28E-04 na 6.28E-04	41% na 41%	26% na 26%	33% na 33%	1.88E-03 na 1.88E-03	77 na 77
241-AX-101 Supernatant Solid Layer	2.29E-04 na 2.29E-04	9.08E-04 na 9.08E-04	8.28E-04 na 8.28E-04	12% na 12%	46% na 46%	42% na 42%	1.96E-03 na 1.96E-03	81 na 81
241-AX-102 Supernatant Solid Layer	2.47E-04 na 2.47E-04	4.41E-05 na 4.41E-05	5.57E-04 na 5.57E-04	29% na 29%	5% na 5%	66% na 66%	8.48E-04 na 8.48E-04	35 na 35
241-AX-103 Supernatant Solid Layer	1.20E-03 na 1.20E-03	1.01E-03 na 1.01E-03	6.41E-04 na 6.41E-04	42% na 42%	36% na 36%	22% na 22%	2.85E-03 na 2.85E-03	117 na 117
241-AX-104 Supernatant Solid Layer	1.03E-04 na 1.03E-04	3.25E-07 na 3.25E-07	5.49E-04 na 5.49E-04	16% na 16%	0% na 0%	84% na 84%	6.53E-04 na 6.53E-04	27 na 27
241-B-101 Supernatant Solid Layer	1.27E-04 na 1.27E-04	1.01E-11 na 1.01E-11	6.49E-04 na 6.49E-04	16% na 16%	0% na 0%	84% na 84%	7.77E-04 na 7.77E-04	32 na 32
241-B-102 Supernatant Solid Layer	2.47E-07 7.03E-08 1.76E-07	6.68E-14 1.37E-14 5.31E-14	5.50E-04 3.34E-06 5.46E-04	0% 2% 0%	0% 0% 0%	100% 98% 100%	5.50E-04 3.41E-06 5.46E-04	23 0 22

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, $(G_{rad})\%$	Percent of HGR from thermolysis, $(G_{therm})\%$	Percent of HGR from corrosion, $(G_{corr})\%$	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-B-103 Supernatant Solid Layer	6.59E-07 na 6.59E-07	1.70E-13 na 1.70E-13	5.76E-04 na 5.76E-04	0% na 0%	0% na 0%	100% na 100%	5.77E-04 na 5.77E-04	24 na 24
241-B-104 Supernatant Solid Layer	1.21E-05 na 1.21E-05	1.35E-12 na 1.35E-12	8.37E-04 na 8.37E-04	1% na 1%	0% na 0%	99% na 99%	8.49E-04 na 8.49E-04	35 na 35
241-B-105 Supernatant Solid Layer	3.10E-06 na 3.10E-06	1.69E-12 na 1.69E-12	7.64E-04 na 7.64E-04	0% na 0%	0% na 0%	100% na 100%	7.67E-04 na 7.67E-04	31 na 31
241-B-106 Supernatant Solid Layer	6.18E-06 na 6.18E-06	7.72E-13 na 7.72E-13	6.23E-04 na 6.23E-04	1% na 1%	0% na 0%	99% na 99%	6.29E-04 na 6.29E-04	26 na 26
241-B-107 Supernatant Solid Layer	1.59E-05 na 1.59E-05	1.20E-13 na 1.20E-13	6.56E-04 na 6.56E-04	2% na 2%	0% na 0%	98% na 98%	6.72E-04 na 6.72E-04	28 na 28
241-B-108 Supernatant Solid Layer	6.33E-07 na 6.33E-07	1.53E-13 na 1.53E-13	5.98E-04 na 5.98E-04	0% na 0%	0% na 0%	100% na 100%	5.99E-04 na 5.99E-04	25 na 25
241-B-109 Supernatant Solid Layer	4.09E-05 na 4.09E-05	4.22E-13 na 4.22E-13	6.24E-04 na 6.24E-04	6% na 6%	0% na 0%	94% na 94%	6.65E-04 na 6.65E-04	27 na 27
241-B-110 Supernatant Solid Layer	5.66E-05 0.00E+00 5.66E-05	0.00E+00 0.00E+00 0.00E+00	7.29E-04 8.91E-07 7.28E-04	7% 0% 7%	0% 0% 0%	93% 100% 93%	7.86E-04 8.91E-07 7.85E-04	32 0 32

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{total} (cfm)	Total HGR from model, G_{total} (L/day)
241-B-111	1.60E-04	0.00E+00	7.31E-04	18%	0%	82%	8.91E-04	37
Supernatant	0.00E+00	0.00E+00	8.97E-07	0%	0%	100%	8.97E-07	0
Solid Layer	1.60E-04	0.00E+00	7.30E-04	18%	0%	82%	8.90E-04	36
241-B-112	4.53E-06	7.51E-06	5.51E-04	1%	1%	98%	5.63E-04	23
Supernatant	0.00E+00	0.00E+00	2.44E-06	0%	0%	100%	2.44E-06	0
Solid Layer	4.53E-06	7.51E-06	5.48E-04	1%	1%	98%	5.60E-04	23
241-B-201	6.53E-08	1.22E-06	1.33E-04	0%	1%	99%	1.34E-04	5
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	6.53E-08	1.22E-06	1.33E-04	0%	1%	99%	1.34E-04	5
241-B-202	1.22E-07	2.04E-06	1.30E-04	0%	2%	98%	1.32E-04	5
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.22E-07	2.04E-06	1.30E-04	0%	2%	98%	1.32E-04	5
241-B-203	5.19E-08	0.00E+00	1.93E-04	0%	0%	100%	1.93E-04	8
Supernatant	8.14E-11	0.00E+00	1.62E-06	0%	0%	100%	1.62E-06	0
Solid Layer	5.19E-08	0.00E+00	1.93E-04	0%	0%	100%	1.93E-04	8
241-B-204	4.74E-08	0.00E+00	1.94E-04	0%	0%	100%	1.94E-04	8
Supernatant	9.91E-11	0.00E+00	2.49E-06	0%	0%	100%	2.49E-06	0
Solid Layer	4.74E-08	0.00E+00	1.94E-04	0%	0%	100%	1.94E-04	8
241-BX-101	4.89E-05	2.49E-06	5.67E-04	8%	0%	92%	6.19E-04	25
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	4.89E-05	2.49E-06	5.67E-04	8%	0%	92%	6.19E-04	25
241-BX-102	2.96E-05	1.58E-06	6.19E-04	5%	0%	95%	6.50E-04	27
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.96E-05	1.58E-06	6.19E-04	5%	0%	95%	6.50E-04	27

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, $(G_{rad})\%$	Percent of HGR from thermolysis, $(G_{therm})\%$	Percent of HGR from corrosion, $(G_{corr})\%$	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-BX-103	5.68E-05	1.34E-05	5.87E-04	9%	2%	89%	6.57E-04	27
Supernatant	7.15E-08	2.13E-06	9.40E-06	1%	18%	81%	1.16E-05	0
Solid Layer	5.68E-05	1.12E-05	5.78E-04	9%	2%	89%	6.46E-04	26
241-BX-104	2.75E-05	1.00E-05	6.16E-04	4%	2%	94%	6.54E-04	27
Supernatant	3.97E-07	4.77E-07	2.49E-06	12%	14%	74%	3.36E-06	0
Solid Layer	2.71E-05	9.53E-06	6.14E-04	4%	1%	94%	6.50E-04	27
241-BX-105	7.60E-06	4.76E-06	5.84E-04	1%	1%	98%	5.97E-04	24
Supernatant	8.99E-07	1.00E-06	4.02E-06	15%	17%	68%	5.92E-06	0
Solid Layer	6.70E-06	3.76E-06	5.80E-04	1%	1%	98%	5.91E-04	24
241-BX-106	6.43E-06	1.76E-06	5.55E-04	1%	0%	99%	5.63E-04	23
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	6.43E-06	1.76E-06	5.55E-04	1%	0%	99%	5.63E-04	23
241-BX-107	6.71E-06	1.73E-05	8.18E-04	1%	2%	97%	8.42E-04	34
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	6.71E-06	1.73E-05	8.18E-04	1%	2%	97%	8.42E-04	34
241-BX-108	2.12E-06	5.66E-07	5.49E-04	0%	0%	100%	5.52E-04	23
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.12E-06	5.66E-07	5.49E-04	0%	0%	100%	5.52E-04	23
241-BX-109	2.95E-05	1.39E-05	6.90E-04	4%	2%	94%	7.33E-04	30
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.95E-05	1.39E-05	6.90E-04	4%	2%	94%	7.33E-04	30
241-BX-110	2.25E-05	2.84E-05	6.97E-04	3%	4%	93%	7.48E-04	31
Supernatant	2.29E-07	2.18E-07	1.12E-06	15%	14%	71%	1.56E-06	0
Solid Layer	2.23E-05	2.82E-05	6.96E-04	3%	4%	93%	7.47E-04	31

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-BX-111 Supernatant Solid Layer	1.58E-06 na 1.58E-06	1.26E-06 na 1.26E-06	6.78E-04 na 6.78E-04	0% na 0%	0% na 0%	100% na 100%	6.80E-04 na 6.80E-04	28 na 28
241-BX-112 Supernatant Solid Layer	4.95E-06 4.81E-08 4.90E-06	0.00E+00 0.00E+00 0.00E+00	6.56E-04 1.11E-06 6.55E-04	1% 4% 1%	0% 0% 0%	99% 96% 99%	6.61E-04 1.15E-06 6.60E-04	27 0 27
241-BY-101 Supernatant Solid Layer	7.90E-05 na 7.90E-05	1.26E-04 na 1.26E-04	8.49E-04 na 8.49E-04	8% na 8%	12% na 12%	81% na 81%	1.05E-03 na 1.05E-03	43 na 43
241-BY-102 Supernatant Solid Layer	8.79E-06 na 8.79E-06	1.00E-05 na 1.00E-05	7.62E-04 na 7.62E-04	1% na 1%	1% na 1%	98% na 98%	7.81E-04 na 7.81E-04	32 na 32
241-BY-103 Supernatant Solid Layer	2.21E-05 na 2.21E-05	2.62E-05 na 2.62E-05	8.84E-04 na 8.84E-04	2% na 2%	3% na 3%	95% na 95%	9.33E-04 na 9.33E-04	38 na 38
241-BY-104 Supernatant Solid Layer	7.78E-05 na 7.78E-05	2.75E-04 na 2.75E-04	8.46E-04 na 8.46E-04	6% na 6%	23% na 23%	71% na 71%	1.20E-03 na 1.20E-03	49 na 49
241-BY-105 Supernatant Solid Layer	3.70E-05 na 3.70E-05	1.60E-04 na 1.60E-04	9.67E-04 na 9.67E-04	3% na 3%	14% na 14%	83% na 83%	1.16E-03 na 1.16E-03	48 na 48
241-BY-106 Supernatant Solid Layer	7.89E-05 na 7.89E-05	2.87E-04 na 2.87E-04	9.52E-04 na 9.52E-04	6% na 6%	22% na 22%	72% na 72%	1.32E-03 na 1.32E-03	54 na 54

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-BY-107 Supernatant Solid Layer	3.86E-05 na 3.86E-05	4.87E-04 na 4.87E-04	7.69E-04 na 7.69E-04	3% na 3%	38% na 38%	59% na 59%	1.29E-03 na 1.29E-03	53 na 53
241-BY-108 Supernatant Solid Layer	3.47E-05 na 3.47E-05	7.88E-05 na 7.88E-05	7.35E-04 na 7.35E-04	4% na 4%	9% na 9%	87% na 87%	8.48E-04 na 8.48E-04	35 na 35
241-BY-109 Supernatant Solid Layer	2.48E-05 na 2.48E-05	7.35E-06 na 7.35E-06	7.49E-04 na 7.49E-04	3% na 3%	1% na 1%	96% na 96%	7.81E-04 na 7.81E-04	32 na 32
241-BY-110 Supernatant Solid Layer	1.01E-04 na 1.01E-04	5.12E-04 na 5.12E-04	8.48E-04 na 8.48E-04	7% na 7%	35% na 35%	58% na 58%	1.46E-03 na 1.46E-03	60 na 60
241-BY-111 Supernatant Solid Layer	3.36E-06 na 3.36E-06	4.55E-06 na 4.55E-06	7.92E-04 na 7.92E-04	0% na 0%	1% na 1%	99% na 99%	8.00E-04 na 8.00E-04	33 na 33
241-BY-112 Supernatant Solid Layer	4.22E-06 na 4.22E-06	1.17E-05 na 1.17E-05	7.76E-04 na 7.76E-04	1% na 1%	1% na 1%	98% na 98%	7.92E-04 na 7.92E-04	32 na 32
241-C-101 Supernatant Solid Layer	4.36E-05 na 4.36E-05	1.33E-05 na 1.33E-05	6.23E-04 na 6.23E-04	6% na 6%	2% na 2%	92% na 92%	6.80E-04 na 6.80E-04	28 na 28
241-C-102 Supernatant Solid Layer	4.76E-05 na 4.76E-05	2.03E-05 na 2.03E-05	8.05E-04 na 8.05E-04	5% na 5%	2% na 2%	92% na 92%	8.72E-04 na 8.72E-04	36 na 36

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-C-103 Supernatant Solid Layer	1.65E-03 na 1.65E-03	1.48E-05 na 1.48E-05	6.35E-04 na 6.35E-04	72% na 72%	1% na 1%	28% na 28%	2.30E-03 na 2.30E-03	94 na 94
241-C-104 Supernatant Solid Layer	2.64E-04 na 2.64E-04	2.16E-04 na 2.16E-04	7.76E-04 na 7.76E-04	21% na 21%	17% na 17%	62% na 62%	1.26E-03 na 1.26E-03	51 na 51
241-C-105 Supernatant Solid Layer	1.56E-04 na 1.56E-04	8.54E-06 na 8.54E-06	6.85E-04 na 6.85E-04	18% na 18%	1% na 1%	81% na 81%	8.49E-04 na 8.49E-04	35 na 35
241-C-106 Supernatant Solid Layer	4.02E-04 1.61E-06 4.00E-04	1.47E-06 7.13E-07 7.61E-07	5.55E-04 4.16E-06 5.50E-04	42% 25% 42%	0% 11% 0%	58% 64% 58%	9.58E-04 6.49E-06 9.51E-04	39 0 39
241-C-107 Supernatant Solid Layer	4.55E-04 na 4.55E-04	1.23E-04 na 1.23E-04	7.91E-04 na 7.91E-04	33% na 33%	9% na 9%	58% na 58%	1.37E-03 na 1.37E-03	56 na 56
241-C-108 Supernatant Solid Layer	1.12E-05 na 1.12E-05	4.61E-06 na 4.61E-06	5.91E-04 na 5.91E-04	2% na 2%	1% na 1%	97% na 97%	6.07E-04 na 6.07E-04	25 na 25
241-C-109 Supernatant Solid Layer	6.81E-05 na 6.81E-05	5.55E-06 na 5.55E-06	5.87E-04 na 5.87E-04	10% na 10%	1% na 1%	89% na 89%	6.61E-04 na 6.61E-04	27 na 27
241-C-110 Supernatant Solid Layer	1.24E-06 2.32E-09 1.24E-06	4.40E-07 4.10E-09 4.36E-07	6.80E-04 9.01E-07 6.79E-04	0% 0% 0%	0% 0% 0%	100% 99% 100%	6.82E-04 9.08E-07 6.81E-04	28 0 28

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-C-111 Supernatant Solid Layer	1.50E-04 na 1.50E-04	4.03E-06 na 4.03E-06	5.81E-04 na 5.81E-04	20% na 20%	1% na 1%	79% na 79%	7.35E-04 na 7.35E-04	30 na 30
241-C-112 Supernatant Solid Layer	2.17E-04 na 2.17E-04	1.68E-05 na 1.68E-05	6.27E-04 na 6.27E-04	25% na 25%	2% na 2%	73% na 73%	8.61E-04 na 8.61E-04	35 na 35
241-C-201 Supernatant Solid Layer	2.11E-08 na 2.11E-08	5.66E-09 na 5.66E-09	4.05E-05 na 4.05E-05	0% na 0%	0% na 0%	100% na 100%	4.05E-05 na 4.05E-05	2 na 2
241-C-202 Supernatant Solid Layer	1.59E-08 na 1.59E-08	2.16E-09 na 2.16E-09	3.97E-05 na 3.97E-05	0% na 0%	0% na 0%	100% na 100%	3.97E-05 na 3.97E-05	2 na 2
241-C-203 Supernatant Solid Layer	7.76E-08 na 7.76E-08	6.83E-08 na 6.83E-08	4.55E-05 na 4.55E-05	0% na 0%	0% na 0%	100% na 100%	4.56E-05 na 4.56E-05	2 na 2
241-C-204 Supernatant Solid Layer	7.23E-08 na 7.23E-08	7.92E-08 na 7.92E-08	4.40E-05 na 4.40E-05	0% na 0%	0% na 0%	100% na 100%	4.41E-05 na 4.41E-05	2 na 2
241-S-101 Supernatant Solid Layer	2.62E-04 na 2.62E-04	3.56E-04 na 3.56E-04	8.93E-04 na 8.93E-04	17% na 17%	24% na 24%	59% na 59%	1.51E-03 na 1.51E-03	62 na 62
241-S-102 Supernatant Solid Layer	8.74E-05 na 8.74E-05	2.27E-04 na 2.27E-04	9.17E-04 na 9.17E-04	7% na 7%	18% na 18%	74% na 74%	1.23E-03 na 1.23E-03	50 na 50

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-S-103 Supernatant Solid Layer	5.69E-05 4.10E-07 5.65E-05	8.34E-05 5.41E-07 8.29E-05	7.35E-04 9.07E-07 7.35E-04	7% 22% 6%	10% 29% 9%	84% 49% 84%	8.76E-04 1.86E-06 8.74E-04	36 0 36
241-S-104 Supernatant Solid Layer	7.51E-05 na 7.51E-05	2.19E-05 na 2.19E-05	7.96E-04 na 7.96E-04	8% na 8%	2% na 2%	89% na 89%	8.93E-04 na 8.93E-04	37 na 37
241-S-105 Supernatant Solid Layer	2.30E-06 na 2.30E-06	2.38E-05 na 2.38E-05	8.77E-04 na 8.77E-04	0% na 0%	3% na 3%	97% na 97%	9.03E-04 na 9.03E-04	37 na 37
241-S-106 Supernatant Solid Layer	3.95E-05 na 3.95E-05	4.46E-05 na 4.46E-05	9.16E-04 na 9.16E-04	4% na 4%	4% na 4%	92% na 92%	1.00E-03 na 1.00E-03	41 na 41
241-S-107 Supernatant Solid Layer	6.48E-05 na 6.48E-05	5.31E-05 na 5.31E-05	8.18E-04 na 8.18E-04	7% na 7%	6% na 6%	87% na 87%	9.36E-04 na 9.36E-04	38 na 38
241-S-108 Supernatant Solid Layer	8.36E-06 na 8.36E-06	2.73E-05 na 2.73E-05	9.94E-04 na 9.94E-04	1% na 1%	3% na 3%	97% na 97%	1.03E-03 na 1.03E-03	42 na 42
241-S-109 Supernatant Solid Layer	4.44E-06 na 4.44E-06	1.57E-05 na 1.57E-05	9.87E-04 na 9.87E-04	0% na 0%	2% na 2%	98% na 98%	1.01E-03 na 1.01E-03	41 na 41
241-S-110 Supernatant Solid Layer	3.96E-05 na 3.96E-05	1.30E-04 na 1.30E-04	8.77E-04 na 8.77E-04	4% na 4%	12% na 12%	84% na 84%	1.05E-03 na 1.05E-03	43 na 43

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-S-111	1.05E-04	5.89E-05	9.21E-04	10%	5%	85%	1.09E-03	44
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.05E-04	5.89E-05	9.21E-04	10%	5%	85%	1.09E-03	44
241-S-112	1.85E-05	2.04E-05	1.06E-03	2%	2%	96%	1.10E-03	45
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.85E-05	2.04E-05	1.06E-03	2%	2%	96%	1.10E-03	45
241-SX-101	1.58E-04	8.78E-04	9.26E-04	8%	45%	47%	1.96E-03	80
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.58E-04	8.78E-04	9.26E-04	8%	45%	47%	1.96E-03	80
241-SX-102	2.01E-04	1.01E-03	9.37E-04	9%	47%	44%	2.15E-03	88
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.01E-04	1.01E-03	9.37E-04	9%	47%	44%	2.15E-03	88
241-SX-103	6.97E-04	6.48E-03	9.80E-04	9%	79%	12%	8.16E-03	334
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	6.97E-04	6.48E-03	9.80E-04	9%	79%	12%	8.16E-03	334
241-SX-104	2.71E-04	9.07E-04	9.47E-04	13%	43%	45%	2.12E-03	87
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.71E-04	9.07E-04	9.47E-04	13%	43%	45%	2.12E-03	87
241-SX-105	3.41E-04	3.29E-03	8.83E-04	8%	73%	20%	4.52E-03	185
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	3.41E-04	3.29E-03	8.83E-04	8%	73%	20%	4.52E-03	185
241-SX-106	9.03E-05	2.53E-04	8.87E-04	7%	21%	72%	1.23E-03	50
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	9.03E-05	2.53E-04	8.87E-04	7%	21%	72%	1.23E-03	50

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-SX-107 Supernatant Solid Layer	4.09E-05 na 4.09E-05	8.54E-05 na 8.54E-05	6.69E-04 na 6.69E-04	5% na 5%	11% na 11%	84% na 84%	7.95E-04 na 7.95E-04	33 na 33
241-SX-108 Supernatant Solid Layer	1.11E-04 na 1.11E-04	9.93E-05 na 9.93E-05	6.62E-04 na 6.62E-04	13% na 13%	11% na 11%	76% na 76%	8.72E-04 na 8.72E-04	36 na 36
241-SX-109 Supernatant Solid Layer	2.30E-04 na 2.30E-04	1.08E-03 na 1.08E-03	7.96E-04 na 7.96E-04	11% na 11%	51% na 51%	38% na 38%	2.10E-03 na 2.10E-03	86 na 86
241-SX-110 Supernatant Solid Layer	5.00E-05 na 5.00E-05	7.12E-05 na 7.12E-05	6.33E-04 na 6.33E-04	7% na 7%	9% na 9%	84% na 84%	7.54E-04 na 7.54E-04	31 na 31
241-SX-111 Supernatant Solid Layer	4.94E-05 na 4.94E-05	1.59E-04 na 1.59E-04	7.03E-04 na 7.03E-04	5% na 5%	17% na 17%	77% na 77%	9.12E-04 na 9.12E-04	37 na 37
241-SX-112 Supernatant Solid Layer	2.83E-05 na 2.83E-05	2.64E-05 na 2.64E-05	6.50E-04 na 6.50E-04	4% na 4%	4% na 4%	92% na 92%	7.05E-04 na 7.05E-04	29 na 29
241-SX-113 Supernatant Solid Layer	2.03E-06 na 2.03E-06	1.67E-06 na 1.67E-06	5.52E-04 na 5.52E-04	0% na 0%	0% na 0%	99% na 99%	5.56E-04 na 5.56E-04	23 na 23
241-SX-114 Supernatant Solid Layer	4.71E-05 na 4.71E-05	1.73E-04 na 1.73E-04	7.25E-04 na 7.25E-04	5% na 5%	18% na 18%	77% na 77%	9.45E-04 na 9.45E-04	39 na 39

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-SX-115	1.66E-05	9.06E-08	5.35E-04	3%	0%	97%	5.52E-04	23
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.66E-05	9.06E-08	5.35E-04	3%	0%	97%	5.52E-04	23
241-T-101	1.31E-05	3.46E-05	6.09E-04	2%	5%	93%	6.57E-04	27
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.31E-05	3.46E-05	6.09E-04	2%	5%	93%	6.57E-04	27
241-T-102	2.07E-06	2.02E-07	5.46E-04	0%	0%	100%	5.48E-04	22
Supernatant	3.75E-07	1.13E-07	1.08E-05	3%	1%	96%	1.13E-05	0
Solid Layer	1.70E-06	8.95E-08	5.35E-04	0%	0%	100%	5.37E-04	22
241-T-103	9.38E-06	2.19E-10	5.44E-04	2%	0%	98%	5.54E-04	23
Supernatant	1.80E-07	5.59E-11	3.34E-06	5%	0%	95%	3.52E-06	0
Solid Layer	9.20E-06	1.63E-10	5.41E-04	2%	0%	98%	5.50E-04	23
241-T-104	8.42E-07	1.51E-05	7.91E-04	0%	2%	98%	8.07E-04	33
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	8.42E-07	1.51E-05	7.91E-04	0%	2%	98%	8.07E-04	33
241-T-105	1.17E-05	1.17E-06	5.97E-04	2%	0%	98%	6.10E-04	25
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.17E-05	1.17E-06	5.97E-04	2%	0%	98%	6.10E-04	25
241-T-106	3.00E-07	3.42E-07	5.41E-04	0%	0%	100%	5.42E-04	22
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	3.00E-07	3.42E-07	5.41E-04	0%	0%	100%	5.42E-04	22
241-T-107	1.62E-05	6.27E-06	6.71E-04	2%	1%	97%	6.94E-04	28
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.62E-05	6.27E-06	6.71E-04	2%	1%	97%	6.94E-04	28

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-T-108 Supernatant	8.37E-08 na	2.25E-14 na	5.37E-04 na	0% na	0% na	100% na	5.37E-04 na	22 na
241-T-108 Solid Layer	8.37E-08	2.25E-14	5.37E-04	0%	0%	100%	5.37E-04	22
241-T-109 Supernatant	2.68E-07 na	1.83E-13 na	5.74E-04 na	0% na	0% na	100% na	5.75E-04 na	24 na
241-T-109 Solid Layer	2.68E-07	1.83E-13	5.74E-04	0%	0%	100%	5.75E-04	24
241-T-110 Supernatant	6.19E-05 8.73E-12	0.00E+00 0.00E+00	8.34E-04 6.69E-07	7% 0%	0% 0%	93% 100%	8.96E-04 6.69E-07	37 0
241-T-110 Solid Layer	6.19E-05	0.00E+00	8.34E-04	7%	0%	93%	8.96E-04	37
241-T-111 Supernatant	1.96E-06 na	1.91E-05 na	9.07E-04 na	0% na	2% na	98% na	9.28E-04 na	38 na
241-T-111 Solid Layer	1.96E-06	1.91E-05	9.07E-04	0%	2%	98%	9.28E-04	38
241-T-112 Supernatant	1.16E-06 1.82E-08	0.00E+00 0.00E+00	5.73E-04 5.79E-06	0% 0%	0% 0%	100% 100%	5.74E-04 5.81E-06	24 0
241-T-112 Solid Layer	1.16E-06	0.00E+00	5.73E-04	0%	0%	100%	5.74E-04	24
241-T-201 Supernatant	1.67E-09 2.74E-10	0.00E+00 0.00E+00	1.29E-04 6.67E-06	0% 0%	0% 0%	100% 100%	1.29E-04 6.67E-06	6 0
241-T-201 Solid Layer	1.67E-09	0.00E+00	1.29E-04	0%	0%	100%	1.29E-04	5
241-T-202 Supernatant	5.68E-10 na	9.46E-07 na	1.05E-04 na	0% na	1% na	99% na	1.05E-04 na	4 na
241-T-202 Solid Layer	5.68E-10	9.46E-07	1.05E-04	0%	1%	99%	1.05E-04	4
241-T-203 Supernatant	5.95E-10 na	1.56E-06 na	1.54E-04 na	0% na	1% na	99% na	1.55E-04 na	6 na
241-T-203 Solid Layer	5.95E-10	1.56E-06	1.54E-04	0%	1%	99%	1.55E-04	6

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-T-204 Supernatant Solid Layer	4.32E-10 na 4.32E-10	1.72E-06 na 1.72E-06	1.54E-04 na 1.54E-04	0% na 0%	1% na 1%	99% na 99%	1.56E-04 na 1.56E-04	6 na 6
241-TX-101 Supernatant Solid Layer	6.20E-05 na 6.20E-05	3.30E-05 na 3.30E-05	6.06E-04 na 6.06E-04	9% na 9%	5% na 5%	86% na 86%	7.01E-04 na 7.01E-04	29 na 29
241-TX-102 Supernatant Solid Layer	1.62E-05 na 1.62E-05	5.42E-05 na 5.42E-05	7.18E-04 na 7.18E-04	2% na 2%	7% na 7%	91% na 91%	7.88E-04 na 7.88E-04	32 na 32
241-TX-103 Supernatant Solid Layer	1.18E-05 na 1.18E-05	2.75E-05 na 2.75E-05	6.49E-04 na 6.49E-04	2% na 2%	4% na 4%	94% na 94%	6.88E-04 na 6.88E-04	28 na 28
241-TX-104 Supernatant Solid Layer	2.34E-05 na 2.34E-05	1.66E-06 na 1.66E-06	5.80E-04 na 5.80E-04	4% na 4%	0% na 0%	96% na 96%	6.05E-04 na 6.05E-04	25 na 25
241-TX-105 Supernatant Solid Layer	1.77E-05 na 1.77E-05	1.13E-04 na 1.13E-04	1.02E-03 na 1.02E-03	2% na 2%	10% na 10%	89% na 89%	1.15E-03 na 1.15E-03	47 na 47
241-TX-106 Supernatant Solid Layer	3.40E-05 na 3.40E-05	1.03E-04 na 1.03E-04	8.32E-04 na 8.32E-04	4% na 4%	11% na 11%	86% na 86%	9.68E-04 na 9.68E-04	40 na 40
241-TX-107 Supernatant Solid Layer	6.36E-06 na 6.36E-06	9.19E-06 na 9.19E-06	5.51E-04 na 5.51E-04	1% na 1%	2% na 2%	97% na 97%	5.67E-04 na 5.67E-04	23 na 23

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-TX-108	4.96E-06	9.53E-06	6.33E-04	1%	1%	98%	6.47E-04	27
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	4.96E-06	9.53E-06	6.33E-04	1%	1%	98%	6.47E-04	27
241-TX-109	1.16E-05	1.16E-04	8.99E-04	1%	11%	88%	1.03E-03	42
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.16E-05	1.16E-04	8.99E-04	1%	11%	88%	1.03E-03	42
241-TX-110	1.32E-05	5.32E-05	9.22E-04	1%	5%	93%	9.88E-04	40
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.32E-05	5.32E-05	9.22E-04	1%	5%	93%	9.88E-04	40
241-TX-111	1.04E-05	3.61E-05	8.39E-04	1%	4%	95%	8.86E-04	36
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.04E-05	3.61E-05	8.39E-04	1%	4%	95%	8.86E-04	36
241-TX-112	1.93E-05	4.50E-05	1.06E-03	2%	4%	94%	1.13E-03	46
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.93E-05	4.50E-05	1.06E-03	2%	4%	94%	1.13E-03	46
241-TX-113	8.81E-07	2.28E-05	1.07E-03	0%	2%	98%	1.09E-03	45
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	8.81E-07	2.28E-05	1.07E-03	0%	2%	98%	1.09E-03	45
241-TX-114	5.27E-06	6.59E-06	9.64E-04	1%	1%	99%	9.76E-04	40
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	5.27E-06	6.59E-06	9.64E-04	1%	1%	99%	9.76E-04	40
241-TX-115	1.17E-05	2.66E-05	9.94E-04	1%	3%	96%	1.03E-03	42
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.17E-05	2.66E-05	9.94E-04	1%	3%	96%	1.03E-03	42

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-TX-116 Supernatant	1.28E-06	3.22E-08	1.03E-03	0%	0%	100%	1.03E-03	42
Solid Layer	na	na	na	na	na	na	na	na
241-TX-117 Supernatant	1.28E-06	3.22E-08	1.03E-03	0%	0%	100%	1.03E-03	42
Solid Layer	1.18E-06	1.25E-13	9.26E-04	0%	0%	100%	9.27E-04	38
241-TX-118 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.18E-06	1.25E-13	9.26E-04	0%	0%	100%	9.27E-04	38
241-TX-118 Supernatant	4.24E-05	6.96E-05	7.46E-04	5%	8%	87%	8.58E-04	35
Solid Layer	na	na	na	na	na	na	na	na
241-TY-101 Supernatant	4.24E-05	6.96E-05	7.46E-04	5%	8%	87%	8.58E-04	35
Solid Layer	1.61E-07	7.47E-14	6.22E-04	0%	0%	100%	6.23E-04	26
241-TY-102 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.61E-07	7.47E-14	6.22E-04	0%	0%	100%	6.23E-04	26
241-TY-103 Supernatant	1.78E-06	6.08E-06	5.79E-04	0%	1%	99%	5.87E-04	24
Solid Layer	na	na	na	na	na	na	na	na
241-TY-104 Supernatant	1.78E-06	6.08E-06	5.79E-04	0%	1%	99%	5.87E-04	24
Solid Layer	4.19E-05	8.27E-05	6.56E-04	5%	11%	84%	7.80E-04	32
241-TY-105 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	4.19E-05	8.27E-05	6.56E-04	5%	11%	84%	7.80E-04	32
241-TY-104 Supernatant	5.34E-06	7.30E-07	5.59E-04	1%	0%	99%	5.65E-04	23
Solid Layer	8.90E-09	1.89E-08	1.42E-09	30%	65%	5%	2.92E-08	0
241-TY-105 Supernatant	5.33E-06	7.11E-07	5.59E-04	1%	0%	99%	5.65E-04	23
Solid Layer	2.16E-05	1.08E-05	7.25E-04	3%	1%	96%	7.57E-04	31
241-TY-105 Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.16E-05	1.08E-05	7.25E-04	3%	1%	96%	7.57E-04	31

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-TY-106	2.01E-06	3.71E-07	5.35E-04	0%	0%	100%	5.38E-04	22
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	2.01E-06	3.71E-07	5.35E-04	0%	0%	100%	5.38E-04	22
241-U-101	1.02E-05	1.10E-06	5.46E-04	2%	0%	98%	5.57E-04	23
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.02E-05	1.10E-06	5.46E-04	2%	0%	98%	5.57E-04	23
241-U-102	2.31E-04	3.25E-04	8.15E-04	17%	24%	59%	1.37E-03	56
Supernatant	9.62E-07	1.10E-06	1.16E-09	47%	53%	0%	2.06E-06	0
Solid Layer	2.30E-04	3.24E-04	8.15E-04	17%	24%	60%	1.37E-03	56
241-U-103	1.72E-04	5.07E-04	8.94E-04	11%	32%	57%	1.57E-03	64
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.72E-04	5.07E-04	8.94E-04	11%	32%	57%	1.57E-03	64
241-U-104	7.97E-05	1.05E-04	6.35E-04	10%	13%	77%	8.19E-04	34
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	7.97E-05	1.05E-04	6.35E-04	10%	13%	77%	8.19E-04	34
241-U-105	1.56E-04	4.61E-04	8.43E-04	11%	32%	58%	1.46E-03	60
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	1.56E-04	4.61E-04	8.43E-04	11%	32%	58%	1.46E-03	60
241-U-106	3.48E-04	4.61E-04	6.80E-04	23%	31%	46%	1.49E-03	61
Supernatant	3.82E-06	4.36E-06	1.92E-09	47%	53%	0%	8.18E-06	0
Solid Layer	3.44E-04	4.57E-04	6.80E-04	23%	31%	46%	1.48E-03	61
241-U-107	3.47E-05	1.37E-04	7.99E-04	4%	14%	82%	9.71E-04	40
Supernatant	na	na	na	na	na	na	na	na
Solid Layer	3.47E-05	1.37E-04	7.99E-04	4%	14%	82%	9.71E-04	40

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, (G_{rad})%	Percent of HGR from thermolysis, (G_{therm})%	Percent of HGR from corrosion, (G_{corr})%	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-U-108 Supernatant Solid Layer	1.19E-04 na 1.19E-04	3.46E-04 na 3.46E-04	8.85E-04 na 8.85E-04	9% na 9%	26% na 26%	66% na 66%	1.35E-03 na 1.35E-03	55 na 55
241-U-109 Supernatant Solid Layer	6.00E-05 na 6.00E-05	1.58E-04 na 1.58E-04	8.80E-04 na 8.80E-04	5% na 5%	14% na 14%	80% na 80%	1.10E-03 na 1.10E-03	45 na 45
241-U-110 Supernatant Solid Layer	3.00E-05 na 3.00E-05	1.27E-05 na 1.27E-05	6.83E-04 na 6.83E-04	4% na 4%	2% na 2%	94% na 94%	7.25E-04 na 7.25E-04	30 na 30
241-U-111 Supernatant Solid Layer	5.79E-05 na 5.79E-05	1.03E-04 na 1.03E-04	7.54E-04 na 7.54E-04	6% na 6%	11% na 11%	82% na 82%	9.15E-04 na 9.15E-04	37 na 37
241-U-112 Supernatant Solid Layer	9.92E-06 na 9.92E-06	2.03E-06 na 2.03E-06	5.63E-04 na 5.63E-04	2% na 2%	0% na 0%	98% na 98%	5.75E-04 na 5.75E-04	24 na 24
241-U-201 Supernatant Solid Layer	4.62E-09 1.46E-08 4.62E-09	0.00E+00 0.00E+00 0.00E+00	4.62E-05 3.33E-06 4.62E-05	0% 0% 0%	0% 0% 0%	100% 100% 100%	4.62E-05 3.35E-06 4.62E-05	2 0 2
241-U-202 Supernatant Solid Layer	3.50E-09 1.07E-08 3.50E-09	9.15E-10 7.31E-10 9.15E-10	4.54E-05 3.33E-06 4.54E-05	0% 0% 0%	0% 0% 0%	100% 100% 100%	4.54E-05 3.34E-06 4.54E-05	2 0 2
241-U-203 Supernatant Solid Layer	4.54E-09 9.78E-09 4.54E-09	0.00E+00 0.00E+00 0.00E+00	4.45E-05 3.32E-06 4.45E-05	0% 0% 0%	0% 0% 0%	100% 100% 100%	4.45E-05 3.33E-06 4.45E-05	2 0 2

Table B-4. Calculated Total Hydrogen Generation Rate for 177 Tanks. (23 sheets)

Tank	HGR from radiolysis, G_{rad} (cfm)	HGR from thermolysis, G_{therm} (cfm)	HGR from corrosion, G_{corr} (cfm)	Percent of HGR from radiolysis, $(G_{rad})\%$	Percent of HGR from thermolysis, $(G_{therm})\%$	Percent of HGR from corrosion, $(G_{corr})\%$	Total HGR from model, G_{mod} (cfm)	Total HGR from model, G_{mod} (L/day)
241-U-204	4.36E-09	9.41E-11	4.27E-05	0%	0%	100%	4.27E-05	2
Supernatant	3.68E-09	1.34E-10	3.32E-06	0%	0%	100%	3.32E-06	0
Solid Layer	4.36E-09	9.41E-11	4.27E-05	0%	0%	100%	4.27E-05	2

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-AN-101	1.38E+03	9.29E+04	1.13E+05	1.55E+04	4.32E-02	8.73E+01	1.28	1.29	994	0.6	0.6	21	22
Supernatant	1.38E+03	9.29E+04	1.13E+05	1.55E+04	4.32E-02	8.73E+01	1.28	1.29	994	0.6	0.6	21	22
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	na	0.00	0	na	na	24	22
241-AN-102	2.35E+04	9.35E+04	1.97E+05	1.78E+04	6.48E+01	2.71E+02	1.49	1.49	4,118	0.5	0.0	31	29
Supernatant	2.35E+04	9.33E+04	1.97E+05	1.78E+04	5.54E+01	2.72E+02	1.48	1.49	3,611	0.6	0.6	31	29
Solid Layer	2.38E+04	9.43E+04	1.99E+05	1.80E+04	1.29E+02	2.60E+02	1.57	1.49	507	0.4	na	31	29
241-AN-103	3.01E+03	1.29E+05	1.27E+05	2.96E+04	1.16E+00	3.40E+02	1.58	1.48	3,457	0.4	na	37	31
Supernatant	2.99E+03	1.28E+05	1.26E+05	2.94E+04	1.27E-02	4.51E+02	1.47	1.48	1,928	0.5	0.5	37	31
Solid Layer	3.05E+03	1.30E+05	1.29E+05	2.99E+04	2.39E+00	2.20E+02	1.72	1.48	1,529	0.3	na	37	31
241-AN-104	3.11E+03	1.18E+05	1.88E+05	3.86E+04	1.34E+01	3.50E+02	1.47	1.40	3,903	0.5	na	37	32
Supernatant	3.09E+03	1.17E+05	1.87E+05	3.83E+04	6.23E-02	3.72E+02	1.39	1.40	2,337	0.5	0.5	35	32
Solid Layer	3.14E+03	1.19E+05	1.90E+05	3.90E+04	3.09E+01	3.22E+02	1.59	1.40	1,566	0.5	na	39	32
241-AN-105	2.74E+03	1.17E+05	1.55E+05	4.13E+04	4.98E+00	2.42E+02	1.49	1.42	4,190	0.5	na	34	32
Supernatant	2.72E+03	1.17E+05	1.54E+05	4.10E+04	2.60E-02	2.18E+02	1.41	1.42	2,265	0.5	0.5	33	32
Solid Layer	2.76E+03	1.19E+05	1.56E+05	4.17E+04	1.02E+01	2.68E+02	1.57	1.42	1,925	0.4	na	35	32
241-AN-106	5.21E+03	1.68E+04	1.06E+04	5.30E+02	7.09E+00	5.30E+01	1.15	1.11	660	0.8	na	23	23
Supernatant	5.18E+03	1.67E+04	1.05E+04	5.26E+02	2.77E+00	3.80E+01	1.10	1.11	595	0.9	0.8	23	23
Solid Layer	5.53E+03	1.79E+04	1.12E+04	5.62E+02	3.47E+01	1.49E+02	1.58	1.11	65	0.4	na	22	23
241-AN-107	3.30E+04	6.79E+04	2.13E+05	1.15E+03	8.93E+01	2.31E+02	1.44	1.43	4,131	0.5	na	33	31
Supernatant	3.30E+04	6.78E+04	2.13E+05	1.14E+03	6.46E+01	2.27E+02	1.42	1.43	3,247	0.5	0.5	33	31
Solid Layer	3.33E+04	6.86E+04	2.15E+05	1.16E+03	1.77E+02	2.47E+02	1.48	1.43	884	0.4	na	33	31
241-AP-101	1.94E+03	4.16E+04	1.31E+05	6.89E+03	6.51E-02	1.07E+02	1.31	1.31	4,254	0.6	na	23	23
Supernatant	1.94E+03	4.16E+04	1.31E+05	6.89E+03	6.51E-02	1.07E+02	1.31	1.31	4,254	0.6	0.6	23	23
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.0	na	23	23

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] ($\mu\text{g/mL}$)	NO_2 in liquid [NO_2] ($\mu\text{g/mL}$)	NO_3 in liquid, [NO_3] ($\mu\text{g/mL}$)	Al in liquid, [Al] ($\mu\text{g/mL}$)	^{90}Sr in waste, [Sr] ($\mu\text{Ci/g}$)	^{137}Cs in waste, [Cs] ($\mu\text{Ci/g}$)	Bulk density, D (g/mL)	Liquid Density, D_L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H_2O] (wt%)	Liquid water, [H_2O] (wt%)	Waste temp., T_w ($^\circ\text{C}$)	Dome temp., T_d ($^\circ\text{C}$)
241-AP-102	1.16E+03	4.30E+04	6.29E+04	1.46E+04	1.58E-01	8.70E+01	1.21	1.15	732	0.7	na	32	36
Supernatant	1.15E+03	4.27E+04	6.24E+04	1.44E+04	1.08E-01	8.70E+01	1.14	1.15	644	0.8	0.8	33	36
Solid Layer	1.22E+03	4.54E+04	6.63E+04	1.53E+04	3.96E-01	8.70E+01	1.75	1.15	88	0.3	na	24	36
241-AP-103	7.18E+03	7.94E+04	1.47E+05	1.81E+04	1.90E+00	1.80E+02	1.35	1.35	3,427	0.6	0.0	25	24
Supernatant	7.18E+03	7.94E+04	1.47E+05	1.81E+04	1.90E+00	1.80E+02	1.35	1.35	3,427	0.6	0.6	25	24
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.0	na	24	24
241-AP-104	4.54E+03	7.16E+04	1.13E+05	1.44E+04	1.44E+00	1.65E+02	1.28	1.28	4,233	0.7	na	26	39
Supernatant	4.54E+03	7.16E+04	1.13E+05	1.44E+04	1.44E+00	1.65E+02	1.28	1.28	4,233	0.7	0.7	26	39
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.0	na	25	39
241-AP-105	2.86E+03	5.00E+04	1.21E+05	2.20E+04	4.75E+00	1.53E+02	1.32	1.30	4,320	0.6	na	23	24
Supernatant	2.86E+03	5.00E+04	1.21E+05	2.20E+04	2.11E+00	1.55E+02	1.30	1.30	3,983	0.6	0.6	24	24
Solid Layer	2.89E+03	5.04E+04	1.22E+05	2.22E+04	2.99E+01	1.28E+02	1.61	1.30	337	0.5	na	23	24
241-AP-106	3.43E+03	4.09E+04	6.99E+04	1.34E+04	1.05E+00	1.54E+02	1.21	1.21	4,350	0.7	na	24	24
Supernatant	3.43E+03	4.09E+04	6.99E+04	1.34E+04	1.05E+00	1.54E+02	1.21	1.21	4,350	0.7	0.7	24	24
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.0	na	24	24
241-AP-107	2.23E+03	8.47E+04	1.29E+05	2.53E+04	2.10E-01	1.58E+02	1.31	1.32	920	0.6	na	26	29
Supernatant	2.23E+03	8.47E+04	1.29E+05	2.53E+04	2.10E-01	1.58E+02	1.31	1.32	920	0.6	0.6	26	29
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	0.0	na	29	29
241-AP-108	2.44E+03	7.24E+04	1.11E+05	2.22E+04	5.99E-01	1.45E+02	1.25	1.25	4,351	0.7	na	43	23
Supernatant	2.44E+03	7.24E+04	1.11E+05	2.22E+04	5.99E-01	1.45E+02	1.25	1.25	4,351	0.7	0.7	43	23
Solid Layer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0	na	na	23	23
241-AW-101	3.97E+03	1.19E+05	1.69E+05	3.26E+04	1.41E+01	2.71E+02	1.51	1.47	4,209	0.5	na	34	30
Supernatant	3.96E+03	1.18E+05	1.68E+05	3.25E+04	2.70E-01	2.95E+02	1.46	1.47	2,806	0.5	0.5	34	30
Solid Layer	4.01E+03	1.20E+05	1.70E+05	3.29E+04	3.95E+01	2.28E+02	1.59	1.47	1,403	0.4	na	34	30

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-AW-102	7.47E+02	2.93E+04	4.49E+04	8.68E+03	1.98E+02	6.34E+01	1.23	1.13	358	0.7	na	25	28
Supernatant	7.07E+02	2.77E+04	4.25E+04	8.21E+03	5.63E-02	6.07E+01	1.11	1.13	245	0.9	0.8	24	28
Solid Layer	8.36E+02	3.28E+04	5.02E+04	9.71E+03	5.18E+02	6.77E+01	1.49	1.13	113	0.4	na	28	28
241-AW-103	2.11E+03	3.93E+04	1.23E+05	1.17E+04	2.48E+00	7.56E+01	1.31	1.24	4,208	0.6	na	22	22
Supernatant	2.10E+03	3.94E+04	1.22E+05	1.16E+04	1.05E-01	1.01E+02	1.24	1.24	3,024	0.6	0.6	22	22
Solid Layer	2.13E+03	3.99E+04	1.24E+05	1.18E+04	7.50E+00	2.30E+01	1.50	1.24	1,184	0.5	na	22	22
241-AW-104	4.89E+03	8.57E+04	1.35E+05	2.79E+04	1.94E+00	1.88E+02	1.35	1.32	4,105	0.5	na	40	40
Supernatant	4.26E+03	8.71E+04	1.39E+05	2.67E+04	1.32E+00	1.92E+02	1.32	1.32	3,262	0.6	0.6	43	40
Solid Layer	7.31E+03	8.04E+04	1.18E+05	3.29E+04	4.07E+00	1.74E+02	1.48	1.41	843	0.5	0.6	31	40
241-AW-105	3.55E+02	1.12E+04	4.32E+04	1.00E+03	1.73E+01	1.91E+01	1.24	1.06	1,649	0.7	0.0	19	20
Supernatant	9.00E+02	1.66E+03	2.37E+04	9.29E+01	2.07E-02	9.28E+00	1.06	1.06	650	0.9	0.9	19	20
Solid Layer	1.20E-02	1.73E+04	5.58E+04	1.60E+03	2.60E+01	2.41E+01	1.36	1.10	999	0.6	0.8	19	20
241-AW-106	3.47E+03	1.21E+05	1.88E+05	3.58E+04	9.39E+00	1.92E+02	1.47	1.44	3,690	0.5	na	42	48
Supernatant	3.46E+03	1.21E+05	1.87E+05	3.57E+04	3.28E-01	2.07E+02	1.43	1.44	2,786	0.5	0.5	41	48
Solid Layer	3.50E+03	1.22E+05	1.90E+05	3.62E+04	3.47E+01	1.49E+02	1.58	1.44	904	0.4	na	44	48
241-AY-101	1.30E+03	3.23E+04	4.44E+03	4.56E+03	2.02E+03	8.32E+01	1.43	1.19	723	0.6	na	39	33
Supernatant	1.22E+03	3.05E+04	4.19E+03	4.30E+03	7.74E-01	3.85E+01	1.17	1.19	358	0.8	0.8	36	33
Solid Layer	1.37E+03	3.41E+04	4.69E+03	4.81E+03	3.40E+03	1.14E+02	1.68	1.14	365	0.4	0.8	40	33
241-AY-102	1.27E+03	3.08E+04	3.46E+02	1.21E+03	1.57E+03	8.08E+01	1.25	1.17	2,749	0.7	na	55	44
Supernatant	1.07E+03	4.03E+04	4.52E+02	1.53E+03	1.36E+00	2.45E+01	1.17	1.17	2,104	0.8	0.8	49	44
Solid Layer	1.94E-03	0.00E+00	0.00E+00	1.70E+02	5.48E+03	2.22E+02	1.52	1.16	645	0.4	0.8	71	44
241-AZ-101	3.02E+02	6.07E+04	5.90E+04	7.13E+03	1.03E+03	1.24E+03	1.26	1.24	3,828	0.7	na	68	64
Supernatant	3.00E+02	6.03E+04	5.92E+04	7.11E+03	6.74E-01	1.26E+03	1.24	1.24	3,631	0.7	0.7	68	64
Solid Layer	3.35E+02	6.79E+04	5.46E+04	7.50E+03	1.54E+04	1.06E+03	1.63	1.24	197	0.4	0.7	75	64

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-AZ-102	1.03E+03	3.22E+04	1.68E+04	4.31E+02	6.92E+02	8.90E+02	1.14	1.11	3,788	0.8	na	51	46
Supernatant	1.03E+03	3.21E+04	1.68E+04	4.30E+02	1.86E+00	8.91E+02	1.11	1.11	3,392	0.8	0.8	49	46
Solid Layer	1.04E+03	3.25E+04	1.70E+04	4.35E+02	5.34E+03	8.81E+02	1.41	1.11	396	0.4	na	58	46
241-SY-101	5.58E+03	9.05E+04	1.27E+05	1.68E+04	1.23E+01	1.68E+02	1.38	1.34	4,218	0.6	0.0	26	31
Supernatant	5.57E+03	9.03E+04	1.27E+05	1.68E+04	2.31E+00	1.78E+02	1.34	1.34	3,234	0.6	0.6	26	31
Solid Layer	5.63E+03	9.14E+04	1.29E+05	1.70E+04	4.13E+01	1.42E+02	1.52	1.34	984	0.5	na	27	31
241-SY-102	3.46E+03	6.98E+04	1.06E+05	1.81E+04	1.63E+01	1.47E+02	1.32	1.28	3,239	0.6	na	31	32
Supernatant	3.21E+03	6.92E+04	1.00E+05	2.02E+04	8.36E-01	1.53E+02	1.28	1.28	2,689	0.6	0.6	31	32
Solid Layer	4.65E+03	7.31E+04	1.34E+05	7.58E+03	7.83E+01	1.21E+02	1.56	1.36	550	0.5	0.6	30	32
241-SY-103	6.07E+03	1.50E+05	1.66E+05	3.71E+04	1.72E+01	2.76E+02	1.52	1.47	2,794	0.4	0.0	32	29
Supernatant	6.01E+03	1.49E+05	1.64E+05	3.67E+04	1.90E+00	3.10E+02	1.46	1.47	1,581	0.4	0.4	31	29
Solid Layer	6.16E+03	1.52E+05	1.68E+05	3.76E+04	3.53E+01	2.36E+02	1.61	1.47	1,213	0.4	na	33	29
241-A-101	3.75E+03	1.65E+05	2.33E+05	5.17E+04	7.25E+01	1.88E+02	1.69	1.49	1,417	0.3	na	56	41
Supernatant	3.74E+03	1.65E+05	2.33E+05	5.18E+04	5.02E-02	2.51E+02	1.49	1.49	38	0.5	na	62	41
Solid Layer	3.75E+03	1.65E+05	2.33E+05	5.17E+04	7.43E+01	1.86E+02	1.69	1.49	1,379	0.3	0.5	56	41
241-A-102	9.99E-03	1.58E+03	1.03E+05	1.31E+05	3.04E+02	1.52E+02	1.53	1.57	188	0.5	0.0	34	33
Supernatant	2.80E-03	4.46E+02	2.91E+04	3.68E+04	2.39E-01	1.06E+02	1.13	1.57	49	0.8	0.5	33	33
Solid Layer	1.25E-02	1.98E+03	1.29E+05	1.64E+05	3.76E+02	1.63E+02	1.67	1.57	139	0.4	0.5	34	33
241-A-103	7.68E+03	9.31E+04	1.87E+05	5.67E+04	6.24E+01	1.57E+02	1.37	1.45	1,443	0.5	0.0	42	33
Supernatant	2.44E-03	2.97E+04	5.94E+04	1.80E+04	5.39E-01	7.47E+01	1.14	1.45	55	0.8	0.5	50	33
Solid Layer	7.88E-03	9.57E+04	1.92E+05	5.83E+04	6.45E+01	1.60E+02	1.37	1.45	1,388	0.4	0.5	42	33
241-A-104	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.43E+04	3.81E+02	1.52	1.17	144	0.5	na	74	34
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.43E+04	3.81E+02	1.17	1.17	38	0.8	0.8	76	34
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.43E+04	3.81E+02	1.64	1.17	106	0.4	na	74	34

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] ($\mu\text{g/mL}$)	NO_2 in liquid [NO_2] ($\mu\text{g/mL}$)	NO_3 in liquid, [NO_3] ($\mu\text{g/mL}$)	Al in liquid, [Al] ($\mu\text{g/mL}$)	^{90}Sr in waste, [Sr] ($\mu\text{Ci/g}$)	^{137}Cs in waste, [Cs] ($\mu\text{Ci/g}$)	Bulk density, D (g/mL)	Liquid Density, D_L (g/mL)	Non-RGS waste volume (mL)	Bulk water, [H_2O] (wt%)	Liquid water, [H_2O] (wt%)	Waste temp., T_w ($^{\circ}\text{C}$)	Dome temp., T_d ($^{\circ}\text{C}$)
241-A-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	NA	0	0.0	0.0	0	0
Supernatant	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00	NA	0	0.0	0.0	0	na
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.46E+04	5.37E+02	1.54	NA	139	0.0	0.0	0	na
241-A-106	1.10E+04	3.60E+04	7.96E+04	4.94E+03	1.04E+03	1.35E+02	1.64	1.17	337	0.4	na	52	39
Supernatant	1.10E+04	3.60E+04	7.96E+04	4.94E+03	1.04E+03	1.35E+02	1.17	1.17	38	0.8	0.8	54	39
Solid Layer	1.10E+04	3.60E+04	7.96E+04	4.94E+03	1.04E+03	1.35E+02	1.70	1.17	299	0.3	na	52	39
241-AX-101	3.98E+03	1.73E+05	2.72E+05	5.04E+04	8.01E+01	1.87E+02	1.70	1.53	1,258	0.3	na	44	32
Supernatant	3.98E+03	1.73E+05	2.72E+05	5.04E+04	8.01E+01	1.87E+02	1.53	1.53	38	0.5	0.5	35	32
Solid Layer	3.98E+03	1.73E+05	2.72E+05	5.04E+04	8.01E+01	1.87E+02	1.71	1.53	1,220	0.3	0.4	44	32
241-AX-102	2.30E+04	1.07E+05	1.76E+05	2.75E+04	1.27E+03	1.45E+02	1.67	1.39	151	0.4	na	24	25
Supernatant	2.30E+04	1.07E+05	1.76E+05	2.75E+04	1.27E+03	1.45E+02	1.39	1.39	38	0.5	0.5	24	25
Solid Layer	2.30E+04	1.07E+05	1.76E+05	2.75E+04	1.27E+03	1.45E+02	1.77	1.39	113	0.4	na	24	25
241-AX-103	2.36E+04	1.07E+05	1.36E+05	3.58E+04	7.43E+02	1.72E+02	1.58	1.46	448	0.4	na	39	33
Supernatant	2.36E+04	1.07E+05	1.36E+05	3.58E+04	7.43E+02	1.72E+02	1.46	1.46	38	0.5	0.5	43	33
Solid Layer	2.36E+04	1.07E+05	1.36E+05	3.58E+04	7.43E+02	1.72E+02	1.59	1.46	410	0.4	0.5	39	33
241-AX-104	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.38E+04	1.06E+03	1.44	1.17	66	0.4	na	32	31
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.38E+04	1.06E+03	1.17	1.17	38	0.8	0.8	32	31
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.38E+04	1.06E+03	1.80	1.17	28	0.1	na	32	31
241-B-101	9.72E-04	1.31E+05	3.56E+05	1.47E+03	1.56E+03	1.69E+01	1.49	1.53	449	0.4	na	41	37
Supernatant	9.72E-04	1.31E+05	3.56E+05	1.47E+03	1.56E+03	1.69E+01	1.53	1.53	38	0.5	0.5	39	37
Solid Layer	9.72E-04	1.31E+05	3.56E+05	1.47E+03	1.56E+03	1.69E+01	1.49	1.53	411	0.4	0.5	41	37
241-B-102	3.54E-04	1.39E+04	1.32E+05	5.36E+02	4.16E+00	1.20E+01	1.43	1.19	159	0.4	na	18	20
Supernatant	1.32E-04	5.17E+03	4.94E+04	1.99E+02	4.63E+00	3.55E+00	1.05	1.19	53	0.9	0.7	18	20
Solid Layer	4.65E-04	1.82E+04	1.74E+05	7.04E+02	4.00E+00	1.48E+01	1.61	1.19	106	0.3	0.7	18	20

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] ($\mu\text{g/mL}$)	NO_2 in liquid [NO_2] ($\mu\text{g/mL}$)	NO_3 in liquid, [NO_3] ($\mu\text{g/mL}$)	Al in liquid, [Al] ($\mu\text{g/mL}$)	^{90}Sr in waste, [Sr] ($\mu\text{Ci/g}$)	^{137}Cs in waste, [Cs] ($\mu\text{Ci/g}$)	Bulk density, D (g/mL)	Liquid Density, D_L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H_2O] (wt%)	Liquid water, [H_2O] (wt%)	Waste temp., T_w ($^{\circ}\text{C}$)	Dome temp., T_d ($^{\circ}\text{C}$)
241-B-103	4.65E-04	1.82E+04	1.74E+05	7.04E+02	4.00E+00	1.60E+01	1.55	1.19	249	0.5	na	17	23
Supernatant	4.65E-04	1.82E+04	1.74E+05	7.04E+02	4.00E+00	1.60E+01	1.19	1.19	38	0.5	0.5	17	23
Solid Layer	4.65E-04	1.82E+04	1.74E+05	7.04E+02	4.00E+00	1.60E+01	1.61	1.19	211	0.5	0.7	17	23
241-B-104	4.65E-04	1.82E+04	1.74E+05	7.03E+02	2.20E+01	4.23E+01	1.35	1.19	1,455	0.5	na	20	20
Supernatant	4.65E-04	1.82E+04	1.74E+05	7.03E+02	2.20E+01	4.23E+01	1.19	1.19	38	0.5	0.5	20	20
Solid Layer	4.65E-04	1.82E+04	1.74E+05	7.03E+02	2.20E+01	4.23E+01	1.36	1.19	1,417	0.5	0.7	20	20
241-B-105	4.65E-04	1.83E+04	1.75E+05	7.03E+02	3.58E+00	1.68E+01	1.66	1.19	1,136	0.4	na	23	19
Supernatant	4.65E-04	1.83E+04	1.75E+05	7.03E+02	3.58E+00	1.68E+01	1.19	1.19	38	0.5	0.5	18	19
Solid Layer	4.65E-04	1.83E+04	1.75E+05	7.03E+02	3.58E+00	1.68E+01	1.67	1.19	1,098	0.4	0.7	23	19
241-B-106	4.30E-04	1.68E+04	1.61E+05	6.50E+02	4.88E+01	1.54E+01	1.35	1.19	502	0.6	na	23	19
Supernatant	4.44E-05	1.74E+03	1.66E+04	6.71E+01	1.61E+00	1.24E+00	1.02	1.19	42	1.0	0.7	18	19
Solid Layer	4.65E-04	1.82E+04	1.74E+05	7.03E+02	5.19E+01	1.63E+01	1.38	1.19	460	0.6	na	23	19
241-B-107	7.17E-04	6.51E+03	3.31E+05	2.01E+01	1.23E+02	2.30E+01	1.61	1.34	649	0.4	na	16	19
Supernatant	7.17E-04	6.51E+03	3.31E+05	2.01E+01	1.23E+02	2.30E+01	1.34	1.34	38	0.6	0.6	16	19
Solid Layer	7.17E-04	6.51E+03	3.31E+05	2.01E+01	1.23E+02	2.30E+01	1.63	1.34	611	0.4	0.6	16	19
241-B-108	3.66E-04	5.38E+04	3.77E+05	8.98E+02	3.70E+00	1.34E+01	1.65	1.38	387	0.4	na	18	19
Supernatant	3.66E-04	5.38E+04	3.77E+05	8.98E+02	3.70E+00	1.34E+01	1.38	1.38	38	0.8	0.8	16	19
Solid Layer	3.66E-04	5.38E+04	3.77E+05	8.98E+02	3.70E+00	1.34E+01	1.67	1.38	349	0.4	0.8	18	19
241-B-109	4.65E-04	1.82E+04	1.75E+05	7.03E+02	4.59E+02	1.83E+01	1.73	1.19	511	0.4	na	19	18
Supernatant	4.65E-04	1.82E+04	1.75E+05	7.03E+02	4.59E+02	1.83E+01	1.19	1.19	38	0.6	0.6	18	18
Solid Layer	4.65E-04	1.82E+04	1.75E+05	7.03E+02	4.59E+02	1.83E+01	1.77	1.19	473	0.4	0.7	19	18
241-B-110	0.00E+00	1.07E+03	9.37E+03	0.00E+00	8.10E+01	1.13E+01	1.34	1.01	967	0.6	na	21	20
Supernatant	0.00E+00	1.06E+02	9.32E+02	0.00E+00	0.00E+00	0.00E+00	1.00	1.01	42	1.0	1.0	21	20
Solid Layer	0.00E+00	1.11E+03	9.75E+03	0.00E+00	8.37E+01	1.17E+01	1.36	1.01	925	0.6	na	21	20

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] ($\mu\text{g/mL}$)	NO_2 in liquid [NO_2] ($\mu\text{g/mL}$)	NO_3 in liquid, [NO_3] ($\mu\text{g/mL}$)	Al in liquid, [Al] ($\mu\text{g/mL}$)	^{90}Sr in waste, [Sr] ($\mu\text{Ci/g}$)	^{137}Cs in waste, [Cs] ($\mu\text{Ci/g}$)	Bulk density, D (g/mL)	Liquid Density, D_L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H_2O] (wt%)	Liquid water, [H_2O] (wt%)	Waste temp., T_w ($^{\circ}\text{C}$)	Dome temp., T_d ($^{\circ}\text{C}$)
241-B-111	0.00E+00	1.07E+03	9.36E+03	0.00E+00	1.99E+02	1.28E+02	1.18	1.01	952	0.6	na	22	22
Supernatant	0.00E+00	1.06E+02	9.32E+02	0.00E+00	0.00E+00	0.00E+00	1.00	1.01	42	1.0	1.0	24	22
Solid Layer	0.00E+00	1.11E+03	9.75E+03	0.00E+00	2.07E+02	1.33E+02	1.19	1.01	910	0.6	na	22	22
241-B-112	6.68E+03	7.09E+04	1.24E+05	3.08E+04	2.21E+01	5.34E+01	1.38	1.01	170	0.5	na	17	19
Supernatant	0.00E+00	2.50E+02	2.19E+03	0.00E+00	0.00E+00	0.00E+00	1.00	1.01	49	1.0	1.0	19	19
Solid Layer	9.38E+03	9.94E+04	1.74E+05	4.32E+04	2.79E+01	6.75E+01	1.53	1.46	121	0.4	0.5	17	19
241-B-201	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.84E+00	1.46E-01	1.26	1.17	119	0.6	na	17	19
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.84E+00	1.46E-01	1.17	1.17	4	0.8	0.8	16	19
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.84E+00	1.46E-01	1.26	1.17	115	0.6	na	17	19
241-B-202	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.23E+00	8.20E-02	1.22	1.17	115	0.8	na	21	21
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.23E+00	8.20E-02	1.17	1.17	4	0.8	0.8	21	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.23E+00	8.20E-02	1.22	1.17	111	0.8	na	21	21
241-B-203	9.42E+01	1.54E+03	5.54E+04	0.00E+00	1.46E+00	3.25E-02	1.18	1.05	199	0.8	na	18	12
Supernatant	3.32E+01	5.43E+02	1.95E+04	0.00E+00	4.37E-02	4.98E-02	1.02	1.05	6	1.0	0.9	18	12
Solid Layer	9.60E+01	1.57E+03	5.65E+04	0.00E+00	1.50E+00	3.20E-02	1.19	1.05	193	0.8	na	18	12
241-B-204	7.45E-03	1.34E+03	3.40E+04	0.00E+00	1.36E+00	2.88E-02	1.18	1.05	196	0.8	na	17	19
Supernatant	3.36E-03	6.03E+02	1.53E+04	0.00E+00	4.50E-02	5.13E-02	1.02	1.05	7	1.0	0.9	18	19
Solid Layer	7.60E-03	1.36E+03	3.47E+04	0.00E+00	1.40E+00	2.81E-02	1.19	1.05	189	0.8	na	17	19
241-BX-101	4.98E+03	6.43E+04	1.21E+05	5.17E+03	9.59E+02	2.13E+01	1.59	1.28	218	0.4	na	23	23
Supernatant	4.98E+03	6.43E+04	1.21E+05	5.17E+03	9.59E+02	2.13E+01	1.28	1.28	38	0.8	0.8	23	23
Solid Layer	4.98E+03	6.43E+04	1.21E+05	5.17E+03	9.59E+02	2.13E+01	1.66	1.28	180	0.3	na	23	23
241-BX-102	2.98E+03	3.60E+04	7.96E+04	4.94E+03	9.00E+02	1.87E+01	0.93	1.17	462	0.3	na	20	21
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	9.00E+02	1.87E+01	1.17	1.17	38	0.8	0.8	20	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	9.00E+02	1.87E+01	0.91	1.17	424	0.2	na	20	21

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-BX-103	3.81E+03	1.47E+04	4.69E+04	1.89E+04	5.12E+02	1.23E+01	1.49	1.11	315	0.6	na	21	21
Supernatant	2.28E+03	8.82E+03	2.81E+04	1.13E+04	1.28E+00	1.48E+00	1.06	1.11	80	0.9	0.8	21	21
Solid Layer	4.33E+03	1.68E+04	5.33E+04	2.14E+04	6.24E+02	1.47E+01	1.64	1.11	235	0.5	na	21	21
241-BX-104	2.90E+03	5.79E+04	1.22E+05	2.58E+03	1.93E+02	6.23E+01	1.61	1.28	417	0.3	na	30	25
Supernatant	7.18E+02	1.43E+04	3.01E+04	6.39E+02	3.87E-01	2.81E+01	1.06	1.28	49	0.9	0.6	30	25
Solid Layer	3.19E+03	6.37E+04	1.34E+05	2.84E+03	2.09E+02	6.52E+01	1.68	1.28	368	0.3	na	30	25
241-BX-105	8.29E+03	6.87E+04	1.03E+05	5.22E+03	1.04E+02	4.55E+01	1.59	1.29	309	0.2	na	20	21
Supernatant	3.04E+03	2.52E+04	3.78E+04	1.92E+03	2.39E+00	3.77E+01	1.09	1.29	56	0.9	0.7	20	21
Solid Layer	9.44E+03	7.83E+04	1.17E+05	5.94E+03	1.19E+02	4.66E+01	1.70	1.29	253	0.1	na	20	21
241-BX-106	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.43E+02	5.69E+01	1.54	1.17	180	0.4	na	20	21
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.43E+02	5.69E+01	1.17	1.17	38	0.8	0.8	20	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.43E+02	5.69E+01	1.64	1.17	142	0.4	na	20	21
241-BX-107	2.98E+03	3.60E+04	7.96E+04	4.94E+03	8.09E+00	1.44E+01	1.43	1.17	1,351	0.5	na	20	21
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	8.09E+00	1.44E+01	1.17	1.17	38	0.8	0.8	21	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	8.09E+00	1.44E+01	1.44	1.17	1,313	0.5	na	20	21
241-BX-108	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.64E+02	2.08E+01	1.43	1.17	157	0.3	na	20	20
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.64E+02	2.08E+01	1.17	1.17	38	0.8	0.8	20	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.64E+02	2.08E+01	1.51	1.17	119	0.2	na	20	20
241-BX-109	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.15E+02	1.15E+01	1.50	1.17	769	0.5	na	22	22
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.15E+02	1.15E+01	1.17	1.17	38	0.7	0.7	22	22
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.15E+02	1.15E+01	1.52	1.17	731	0.5	na	22	22
241-BX-110	8.78E+03	4.97E+04	3.93E+05	4.19E+03	1.18E+01	5.30E+01	1.70	1.44	814	0.4	na	20	21
Supernatant	1.07E+03	6.09E+03	4.81E+04	5.13E+02	3.13E+00	1.13E+01	1.05	1.44	43	0.9	0.5	20	21
Solid Layer	9.21E+03	5.21E+04	4.13E+05	4.40E+03	1.21E+01	5.44E+01	1.73	1.44	771	0.4	0.5	20	21

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] ($\mu\text{g/mL}$)	NO_2 in liquid [NO_2] ($\mu\text{g/mL}$)	NO_3 in liquid, [NO_3] ($\mu\text{g/mL}$)	Al in liquid, [Al] ($\mu\text{g/mL}$)	^{90}Sr in waste, [Sr] ($\mu\text{Ci/g}$)	^{137}Cs in waste, [Cs] ($\mu\text{Ci/g}$)	Bulk density, D (g/mL)	Liquid Density, D_L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H_2O] (wt%)	Liquid water, [H_2O] (wt%)	Waste temp., T_w ($^{\circ}\text{C}$)	Dome temp., T_d ($^{\circ}\text{C}$)
241-BX-111	1.69E+03	1.06E+05	1.85E+05	4.87E+04	1.54E+01	7.45E+01	1.44	1.45	752	0.3	na	19	18
Supernatant	1.69E+03	1.06E+05	1.85E+05	4.87E+04	1.54E+01	7.45E+01	1.45	1.45	38	0.5	0.5	19	18
Solid Layer	1.69E+03	1.06E+05	1.85E+05	4.87E+04	1.54E+01	7.45E+01	1.44	1.45	714	0.3	0.5	19	18
241-BX-112	0.00E+00	3.32E+04	9.29E+04	4.51E+01	6.12E+00	4.14E+01	1.29	1.18	660	0.6	na	18	18
Supernatant	0.00E+00	4.11E+03	1.15E+04	5.58E+00	3.47E+00	3.95E+00	1.02	1.18	43	1.0	0.7	18	18
Solid Layer	0.00E+00	3.52E+04	9.86E+04	4.78E+01	6.26E+00	4.34E+01	1.31	1.18	617	0.6	na	18	18
241-BY-101	9.39E+03	9.93E+04	1.75E+05	4.32E+04	1.05E+02	1.15E+02	1.80	1.46	1,438	0.2	na	27	25
Supernatant	9.39E+03	9.93E+04	1.75E+05	4.32E+04	1.05E+02	1.15E+02	1.46	1.46	38	0.5	0.5	27	25
Solid Layer	9.39E+03	9.93E+04	1.75E+05	4.32E+04	1.05E+02	1.15E+02	1.80	1.46	1,400	0.2	0.5	27	25
241-BY-102	1.55E+03	8.41E+04	1.48E+05	5.66E+04	1.55E+01	7.43E+01	1.57	1.44	1,086	0.3	na	22	22
Supernatant	1.55E+03	8.41E+04	1.48E+05	5.66E+04	1.55E+01	7.43E+01	1.44	1.44	38	0.5	0.5	22	22
Solid Layer	1.55E+03	8.41E+04	1.48E+05	5.66E+04	1.55E+01	7.43E+01	1.57	1.46	1,048	0.3	0.5	22	22
241-BY-103	1.91E+03	5.37E+04	1.69E+05	4.14E+04	4.09E+01	7.91E+01	1.63	1.29	1,613	0.3	na	24	24
Supernatant	1.91E+03	5.37E+04	1.69E+05	4.14E+04	4.09E+01	7.91E+01	1.29	1.29	38	0.6	0.6	26	24
Solid Layer	1.91E+03	5.37E+04	1.69E+05	4.14E+04	4.09E+01	7.91E+01	1.64	1.29	1,575	0.3	0.6	24	24
241-BY-104	2.37E+03	1.07E+05	1.88E+05	7.23E+04	1.57E+02	8.96E+01	1.69	1.46	1,394	0.3	na	43	27
Supernatant	2.37E+03	1.07E+05	1.88E+05	7.23E+04	1.57E+02	8.96E+01	1.46	1.46	38	0.5	0.5	50	27
Solid Layer	2.37E+03	1.07E+05	1.88E+05	7.23E+04	1.57E+02	8.96E+01	1.70	1.46	1,356	0.3	0.5	43	27
241-BY-105	2.43E+03	6.89E+04	1.99E+05	3.92E+04	4.82E+01	5.01E+01	1.80	1.44	1,859	0.2	na	36	32
Supernatant	2.43E+03	6.89E+04	1.99E+05	3.92E+04	4.82E+01	5.01E+01	1.44	1.44	38	0.5	0.5	43	32
Solid Layer	2.43E+03	6.89E+04	1.99E+05	3.92E+04	4.82E+01	5.01E+01	1.81	1.44	1,821	0.2	0.5	36	32
241-BY-106	2.67E+03	7.83E+04	1.10E+05	3.98E+04	4.80E+01	1.16E+02	1.65	1.31	1,895	0.3	na	38	25
Supernatant	2.67E+03	7.83E+04	1.10E+05	3.98E+04	4.80E+01	1.16E+02	1.31	1.31	38	0.6	0.6	49	25
Solid Layer	2.67E+03	7.83E+04	1.10E+05	3.98E+04	4.80E+01	1.16E+02	1.65	1.31	1,857	0.3	0.6	38	25

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/ml)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-BY-107	2.40E+03	1.17E+05	1.32E+05	5.11E+04	4.75E+01	1.21E+02	1.68	1.46	1,066	0.4	na	32	27
Supernatant	2.40E+03	1.17E+05	1.32E+05	5.11E+04	4.75E+01	1.21E+02	1.46	1.46	38	0.5	0.5	28	27
Solid Layer	2.40E+03	1.17E+05	1.32E+05	5.11E+04	4.75E+01	1.21E+02	1.69	1.46	1,028	0.4	0.5	32	27
241-BY-108	2.37E+03	7.85E+04	2.94E+05	3.63E+04	1.14E+02	4.13E+01	1.48	1.33	879	0.3	na	35	30
Supernatant	2.37E+03	7.85E+04	2.94E+05	3.63E+04	1.14E+02	4.13E+01	1.33	1.33	38	0.3	0.3	45	30
Solid Layer	2.37E+03	7.85E+04	2.94E+05	3.63E+04	1.14E+02	4.13E+01	1.48	1.33	841	0.3	0.3	35	30
241-BY-109	1.88E+03	8.29E+04	1.90E+05	3.88E+04	1.34E+02	5.75E+01	1.70	1.50	1,085	0.4	na	18	17
Supernatant	1.88E+03	8.29E+04	1.90E+05	3.88E+04	1.34E+02	5.75E+01	1.50	1.50	38	0.5	0.5	18	17
Solid Layer	1.88E+03	8.29E+04	1.90E+05	3.88E+04	1.34E+02	5.75E+01	1.71	1.50	1,047	0.4	0.5	18	17
241-BY-110	1.18E+04	1.24E+05	1.24E+05	6.57E+04	7.98E+01	9.18E+01	1.57	1.44	1,422	0.3	na	37	26
Supernatant	1.18E+04	1.24E+05	1.24E+05	6.57E+04	7.98E+01	9.18E+01	1.44	1.44	38	0.4	0.4	45	26
Solid Layer	1.18E+04	1.24E+05	1.24E+05	6.57E+04	7.98E+01	9.18E+01	1.57	1.44	1,384	0.3	0.4	37	26
241-BY-111	1.28E+03	3.29E+04	1.21E+05	2.57E+04	1.38E+01	6.84E+01	1.67	1.42	1,182	0.4	na	27	25
Supernatant	1.28E+03	3.29E+04	1.21E+05	2.57E+04	1.38E+01	6.84E+01	1.42	1.42	38	0.5	0.5	30	25
Solid Layer	1.28E+03	3.29E+04	1.21E+05	2.57E+04	1.38E+01	6.84E+01	1.68	1.42	1,144	0.3	0.5	27	25
241-BY-112	1.71E+03	1.40E+05	1.91E+05	5.54E+04	1.50E+01	7.39E+01	1.73	1.47	1,121	0.3	na	30	25
Supernatant	1.71E+03	1.40E+05	1.91E+05	5.54E+04	1.50E+01	7.39E+01	1.47	1.47	38	0.5	0.5	26	25
Solid Layer	1.71E+03	1.40E+05	1.91E+05	5.54E+04	1.50E+01	7.39E+01	1.74	1.47	1,083	0.3	0.5	30	25
241-C-101	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.82E+02	6.13E+01	1.72	1.17	371	0.3	na	33	33
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.82E+02	6.13E+01	1.17	1.17	38	0.7	0.7	32	33
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.82E+02	6.13E+01	1.78	1.17	333	0.2	na	33	33
241-C-102	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.99E+02	1.50E+01	1.65	1.17	1,234	0.3	na	31	26
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.99E+02	1.50E+01	1.17	1.17	38	0.8	0.8	27	26
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.99E+02	1.50E+01	1.66	1.17	1,196	0.3	na	31	26

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] ($\mu\text{g/mL}$)	NO_2 in liquid [NO_2] ($\mu\text{g/mL}$)	NO_3 in liquid, [NO_3] ($\mu\text{g/mL}$)	Al in liquid, [Al] ($\mu\text{g/mL}$)	^{90}Sr in waste, [Sr] ($\mu\text{Ci/g}$)	^{137}Cs in waste, [Cs] ($\mu\text{Ci/g}$)	Bulk density, D (g/mL)	Liquid Density, D_L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H_2O] (wt%)	Liquid water, [H_2O] (wt%)	Waste temp., T_w ($^\circ\text{C}$)	Dome temp., T_d ($^\circ\text{C}$)
241-C-103	6.63E+03	1.96E+04	1.96E+03	1.06E+01	3.61E+03	1.09E+02	1.49	1.11	373	0.6	na	43	39
Supernatant	6.63E+03	1.96E+04	1.96E+03	1.06E+01	5.32E+01	8.10E+01	1.11	1.11	38	0.9	0.9	46	39
Solid Layer	6.63E+03	1.96E+04	1.96E+03	1.06E+01	3.90E+03	1.12E+02	1.53	1.11	335	0.6	na	43	39
241-C-104	5.60E+03	3.60E+04	7.96E+04	4.94E+03	2.92E+02	5.76E+01	1.67	1.17	1,018	0.5	na	38	34
Supernatant	5.60E+03	3.60E+04	7.96E+04	4.94E+03	2.92E+02	5.76E+01	1.17	1.17	38	0.8	0.8	36	34
Solid Layer	5.60E+03	3.60E+04	7.96E+04	4.94E+03	2.92E+02	5.76E+01	1.69	1.17	980	0.5	na	38	34
241-C-105	2.87E+03	3.70E+04	3.43E+04	9.02E+00	6.14E+02	1.06E+02	1.53	1.23	538	0.3	na	49	44
Supernatant	2.87E+03	3.70E+04	3.43E+04	9.02E+00	6.14E+02	1.06E+02	1.23	1.23	38	0.7	0.7	44	44
Solid Layer	2.87E+03	3.70E+04	3.43E+04	9.02E+00	6.14E+02	1.06E+02	1.55	1.23	500	0.3	na	49	44
241-C-106	1.80E+03	7.27E+03	3.28E+02	1.15E+03	3.79E+03	1.61E+02	1.22	1.14	90	0.7	na	30	31
Supernatant	1.00E+03	4.05E+03	1.83E+02	6.41E+02	9.17E-01	1.65E+01	1.05	1.14	56	1.0	0.9	30	31
Solid Layer	3.11E+03	1.26E+04	5.67E+02	1.99E+03	8.07E+03	3.25E+02	1.52	1.14	34	0.4	na	30	31
241-C-107	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.54E+03	4.36E+01	1.54	1.17	978	0.5	na	46	44
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.54E+03	4.36E+01	1.17	1.17	38	0.8	0.8	48	44
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.54E+03	4.36E+01	1.55	1.17	940	0.5	na	46	44
241-C-108	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.33E+01	2.25E+02	1.41	1.17	288	0.4	na	25	26
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.33E+01	2.25E+02	1.17	1.17	38	0.8	0.8	27	26
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.33E+01	2.25E+02	1.45	1.17	250	0.4	na	25	26
241-C-109	2.98E+03	3.60E+04	7.96E+04	4.94E+03	7.26E+02	4.93E+02	1.41	1.17	278	0.4	na	26	26
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	7.26E+02	4.93E+02	1.17	1.17	38	0.8	0.8	26	26
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	7.26E+02	4.93E+02	1.44	1.17	240	0.4	na	26	26
241-C-110	5.49E+02	4.36E+03	5.70E+04	1.97E+02	3.96E+00	1.53E+01	1.32	1.10	712	0.6	na	22	23
Supernatant	5.54E+01	4.40E+02	5.76E+03	1.99E+01	2.16E-03	3.79E-01	1.01	1.10	42	1.0	0.8	21	23
Solid Layer	5.80E+02	4.60E+03	6.03E+04	2.09E+02	4.14E+00	1.60E+01	1.34	1.10	670	0.6	na	22	23

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-C-111	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.86E+03	6.30E+01	1.39	1.17	255	0.4	na	25	25
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.86E+03	6.30E+01	1.17	1.17	38	0.8	0.8	25	25
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.86E+03	6.30E+01	1.43	1.17	217	0.4	na	25	25
241-C-112	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.03E+03	4.53E+02	1.56	1.17	431	0.5	na	28	28
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.03E+03	4.53E+02	1.17	1.17	38	0.8	0.8	28	28
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.03E+03	4.53E+02	1.60	1.17	393	0.5	na	28	28
241-C-201	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.15E+02	7.27E+00	1.31	1.17	8	0.4	na	16	20
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.15E+02	7.27E+00	1.17	1.17	4	0.8	0.8	16	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.15E+02	7.27E+00	1.44	1.17	4	0.1	na	16	20
241-C-202	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.18E+02	1.14E+01	1.29	1.17	7	0.4	na	16	20
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.18E+02	1.14E+01	1.17	1.17	4	0.8	0.8	16	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.18E+02	1.14E+01	1.44	1.17	3	0.0	na	16	20
241-C-203	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.99E+01	4.57E+00	1.50	1.17	14	0.5	na	15	20
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.99E+01	4.57E+00	1.17	1.17	4	0.8	0.8	20	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.99E+01	4.57E+00	1.62	1.17	10	0.4	na	15	20
241-C-204	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.05E+01	4.66E+00	1.47	1.17	13	0.5	na	17	16
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.05E+01	4.66E+00	1.17	1.17	4	0.8	0.8	17	16
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.05E+01	4.66E+00	1.59	1.17	9	0.4	na	17	16
241-S-101	1.79E+03	1.13E+05	2.14E+05	3.00E+04	2.51E+02	1.27E+02	1.64	1.47	1,523	0.4	na	43	34
Supernatant	1.79E+03	1.13E+05	2.14E+05	3.00E+04	2.51E+02	1.27E+02	1.47	1.47	38	0.6	0.6	46	34
Solid Layer	1.79E+03	1.13E+05	2.14E+05	3.00E+04	2.51E+02	1.27E+02	1.64	1.47	1,485	0.4	0.5	43	34
241-S-102	3.76E+03	1.27E+05	1.55E+05	5.62E+04	4.56E+01	1.52E+02	1.59	1.46	1,262	0.3	na	33	28
Supernatant	3.76E+03	1.27E+05	1.55E+05	5.62E+04	4.56E+01	1.52E+02	1.46	1.46	38	0.5	0.5	38	28
Solid Layer	3.76E+03	1.27E+05	1.55E+05	5.62E+04	4.56E+01	1.52E+02	1.59	1.46	1,224	0.3	0.5	33	28

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid, [NO ₃] ($\mu\text{g/mL}$)	Al in liquid, [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste, [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste, [Cs] ($\mu\text{Ci/g}$)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-S-103	4.49E+03	1.41E+05	2.07E+05	3.07E+04	2.81E+01	1.49E+02	1.56	1.45	935	0.4	na	27	25
Supernatant	4.47E+02	1.40E+04	2.06E+04	3.06E+03	3.64E-02	3.18E+01	1.04	1.45	42	0.9	0.5	28	25
Solid Layer	4.68E+03	1.47E+05	2.16E+05	3.20E+04	2.90E+01	1.52E+02	1.59	1.45	893	0.4	0.5	27	25
241-S-104	3.96E+02	3.82E+04	2.69E+05	1.20E+04	2.37E+02	4.58E+01	1.65	1.37	1,128	0.4	na	37	32
Supernatant	3.96E+02	3.82E+04	2.69E+05	1.20E+04	2.37E+02	4.58E+01	1.37	1.37	38	0.6	0.6	40	32
Solid Layer	3.96E+02	3.82E+04	2.69E+05	1.20E+04	2.37E+02	4.58E+01	1.66	1.37	1,090	0.4	0.6	37	32
241-S-105	1.35E+04	9.75E+04	1.25E+05	4.19E+04	4.57E+00	2.97E+01	1.62	1.44	1,574	0.1	na	24	24
Supernatant	1.35E+04	9.75E+04	1.25E+05	4.19E+04	4.57E+00	2.97E+01	1.44	1.44	38	0.5	0.5	25	24
Solid Layer	1.35E+04	9.75E+04	1.25E+05	4.19E+04	4.57E+00	2.97E+01	1.63	1.44	1,536	0.1	0.5	24	24
241-S-106	1.98E+03	1.04E+05	2.36E+05	3.80E+04	1.32E+01	9.79E+01	1.72	1.43	1,761	0.3	na	23	23
Supernatant	1.98E+03	1.04E+05	2.36E+05	3.80E+04	1.32E+01	9.79E+01	1.43	1.43	38	0.5	0.5	24	23
Solid Layer	1.98E+03	1.04E+05	2.36E+05	3.80E+04	1.32E+01	9.79E+01	1.72	1.43	1,723	0.3	0.5	23	23
241-S-107	1.18E+03	7.11E+04	1.14E+05	1.07E+04	1.50E+02	7.27E+01	1.82	1.31	1,250	0.3	na	37	29
Supernatant	1.18E+03	7.11E+04	1.14E+05	1.07E+04	5.23E-02	9.46E+01	1.31	1.31	38	0.7	0.7	40	29
Solid Layer	1.18E+03	7.11E+04	1.14E+05	1.07E+04	1.54E+02	7.22E+01	1.84	1.31	1,212	0.3	0.6	37	29
241-S-108	1.35E+04	9.71E+04	1.25E+05	4.19E+04	1.86E+01	1.14E+02	1.65	1.44	2,120	0.3	na	27	22
Supernatant	1.35E+04	9.71E+04	1.25E+05	4.19E+04	1.86E+01	1.14E+02	1.44	1.44	38	0.5	0.5	28	22
Solid Layer	1.35E+04	9.71E+04	1.25E+05	4.19E+04	1.86E+01	1.14E+02	1.65	1.44	2,082	0.3	0.5	27	22
241-S-109	1.11E+03	8.49E+04	1.32E+05	4.59E+04	1.81E+01	1.43E+01	1.65	1.49	2,055	0.1	na	28	25
Supernatant	1.11E+03	8.49E+04	1.32E+05	4.59E+04	1.81E+01	1.43E+01	1.49	1.49	38	0.5	0.5	29	25
Solid Layer	1.11E+03	8.49E+04	1.32E+05	4.59E+04	1.81E+01	1.43E+01	1.66	1.49	2,017	0.1	0.5	28	25
241-S-110	2.28E+03	8.58E+04	2.17E+05	3.10E+04	1.01E+02	7.29E+01	1.65	1.43	1,511	0.2	na	42	29
Supernatant	2.28E+03	8.58E+04	2.17E+05	3.10E+04	1.01E+02	7.29E+01	1.43	1.43	38	0.5	0.5	44	29
Solid Layer	2.28E+03	8.58E+04	2.17E+05	3.10E+04	1.01E+02	7.29E+01	1.66	1.43	1,473	0.2	0.5	42	29

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid, [NO ₃] ($\mu\text{g/mL}$)	Al in liquid, [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste, [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste, [Cs] ($\mu\text{Ci/g}$)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] ($\text{wt}\%$)	Liquid water, [H ₂ O] ($\text{wt}\%$)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-S-111	1.49E+03	8.36E+04	1.92E+05	3.64E+04	1.91E+02	1.23E+02	1.54	1.45	1,521	0.3	na	31	27
Supernatant	1.49E+03	8.33E+04	1.92E+05	3.64E+04	8.39E-02	2.22E+02	1.45	1.45	38	0.5	0.5	32	27
Solid Layer	1.49E+03	8.36E+04	1.92E+05	3.64E+04	1.95E+02	1.21E+02	1.54	1.45	1,483	0.3	0.5	31	27
241-S-112	8.31E+02	6.21E+04	1.68E+05	3.69E+04	2.78E+01	5.63E+01	1.66	1.45	2,363	0.2	na	28	25
Supernatant	8.31E+02	6.21E+04	1.68E+05	3.69E+04	2.78E+01	5.63E+01	1.45	1.45	38	0.5	0.5	36	25
Solid Layer	8.31E+02	6.21E+04	1.68E+05	3.69E+04	2.78E+01	5.63E+01	1.66	1.45	2,325	0.2	0.5	28	25
241-SX-101	3.35E+02	7.48E+04	1.08E+05	8.01E+04	2.55E+02	1.14E+02	1.67	1.48	1,602	0.3	na	67	39
Supernatant	3.35E+02	7.48E+04	1.08E+05	8.01E+04	2.55E+02	1.14E+02	1.48	1.48	38	0.5	0.5	57	39
Solid Layer	3.35E+02	7.48E+04	1.08E+05	8.01E+04	2.55E+02	1.14E+02	1.67	1.48	1,564	0.3	0.5	67	39
241-SX-102	1.51E+03	1.51E+05	1.57E+05	4.56E+04	8.86E+01	1.47E+02	1.70	1.46	1,666	0.4	na	51	37
Supernatant	1.51E+03	1.51E+05	1.57E+05	4.56E+04	8.86E+01	1.47E+02	1.46	1.46	38	0.5	0.5	60	37
Solid Layer	1.51E+03	1.51E+05	1.57E+05	4.56E+04	8.86E+01	1.47E+02	1.70	1.46	1,628	0.4	0.5	51	37
241-SX-103	3.38E+03	1.58E+05	1.57E+05	4.44E+04	1.69E+02	1.32E+02	1.72	1.47	1,898	0.3	na	63	33
Supernatant	3.38E+03	1.58E+05	1.57E+05	4.44E+04	1.69E+02	1.32E+02	1.47	1.47	38	0.5	0.5	70	33
Solid Layer	3.38E+03	1.58E+05	1.57E+05	4.44E+04	1.69E+02	1.32E+02	1.73	1.47	1,860	0.3	0.5	63	33
241-SX-104	2.13E+03	1.17E+05	2.90E+05	3.56E+04	1.90E+02	1.04E+02	1.67	1.47	1,726	0.3	na	49	36
Supernatant	2.13E+03	1.17E+05	2.90E+05	3.56E+04	1.90E+02	1.04E+02	1.47	1.47	38	0.5	0.5	59	36
Solid Layer	2.13E+03	1.17E+05	2.90E+05	3.56E+04	1.90E+02	1.04E+02	1.67	1.47	1,688	0.3	0.5	49	36
241-SX-105	3.26E+03	1.43E+05	1.64E+05	4.41E+04	1.03E+02	1.13E+02	1.63	1.47	1,460	0.4	na	57	35
Supernatant	3.26E+03	1.43E+05	1.64E+05	4.41E+04	1.03E+02	1.13E+02	1.47	1.47	38	0.4	0.4	75	35
Solid Layer	3.26E+03	1.43E+05	1.64E+05	4.41E+04	1.03E+02	1.13E+02	1.63	1.47	1,422	0.4	0.4	57	35
241-SX-106	3.14E+03	1.49E+05	2.45E+05	2.26E+04	4.44E+00	1.45E+02	1.57	1.29	1,539	0.4	na	34	30
Supernatant	3.14E+03	1.49E+05	2.45E+05	2.26E+04	4.44E+00	1.45E+02	1.29	1.29	38	0.5	0.5	37	30
Solid Layer	3.14E+03	1.49E+05	2.45E+05	2.26E+04	4.44E+00	1.45E+02	1.58	1.29	1,501	0.4	0.5	34	30

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid, [NO ₃] ($\mu\text{g/mL}$)	Al in liquid, [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste, [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste, [Cs] ($\mu\text{Ci/g}$)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-SX-107	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.66E+02	8.47E+01	1.71	1.45	395	0.3	na	73	53
Supernatant	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.66E+02	8.47E+01	1.45	1.45	38	0.8	0.8	75	53
Solid Layer	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.66E+02	8.47E+01	1.73	1.45	357	0.3	0.5	73	53
241-SX-108	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.77E+03	1.77E+02	1.68	1.17	314	0.1	na	79	59
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.77E+03	1.77E+02	1.17	1.17	38	0.8	0.8	84	59
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.77E+03	1.77E+02	1.75	1.17	276	0.0	na	79	59
241-SX-109	9.20E+03	1.07E+05	1.76E+05	2.75E+04	2.50E+02	8.64E+01	1.71	1.39	951	0.3	na	54	48
Supernatant	9.20E+03	1.07E+05	1.76E+05	2.75E+04	2.50E+02	8.64E+01	1.39	1.39	38	0.5	0.5	57	48
Solid Layer	9.20E+03	1.07E+05	1.76E+05	2.75E+04	2.50E+02	8.64E+01	1.73	1.39	913	0.3	na	54	48
241-SX-110	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.52E+02	8.34E+01	1.65	1.17	250	0.3	na	51	53
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.52E+02	8.34E+01	1.17	1.17	38	0.8	0.8	59	53
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	3.52E+02	8.34E+01	1.74	1.17	212	0.3	na	51	53
241-SX-111	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.00E+02	9.07E+01	1.70	1.45	474	0.3	na	77	59
Supernatant	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.00E+02	9.07E+01	1.45	1.45	38	0.8	0.8	85	59
Solid Layer	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.00E+02	9.07E+01	1.72	1.45	436	0.3	0.5	77	59
241-SX-112	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.33E+02	8.77E+01	1.69	1.45	321	0.3	na	62	52
Supernatant	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.33E+02	8.77E+01	1.45	1.45	38	0.8	0.8	56	52
Solid Layer	1.15E+02	1.10E+05	1.74E+05	4.32E+04	4.33E+02	8.77E+01	1.73	1.45	283	0.3	0.5	62	52
241-SX-113	2.98E+03	3.60E+04	7.96E+04	4.94E+03	9.14E+01	4.18E+01	1.10	1.17	109	0.6	na	28	28
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	9.14E+01	4.18E+01	1.17	1.17	38	0.8	0.8	28	28
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	9.14E+01	4.18E+01	1.06	1.17	71	0.5	na	28	28
241-SX-114	1.15E+02	1.10E+05	1.74E+05	4.32E+04	2.41E+02	1.05E+02	1.67	1.45	626	0.3	na	73	52
Supernatant	1.15E+02	1.10E+05	1.74E+05	4.32E+04	2.41E+02	1.05E+02	1.45	1.45	38	0.8	0.8	57	52
Solid Layer	1.15E+02	1.10E+05	1.74E+05	4.32E+04	2.41E+02	1.05E+02	1.68	1.45	588	0.3	0.5	73	52

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] ($\mu\text{g/mL}$)	NO_2 in liquid [NO_2] ($\mu\text{g/mL}$)	NO_3 in liquid, [NO_3] ($\mu\text{g/mL}$)	Al in liquid, [Al] ($\mu\text{g/mL}$)	^{90}Sr in waste, [Sr] ($\mu\text{Ci/g}$)	^{137}Cs in waste, [Cs] ($\mu\text{Ci/g}$)	Bulk density, D (g/mL)	Liquid Density, D_L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H_2O] (wt%)	Liquid water, [H_2O] (wt%)	Waste temp., T_w ($^{\circ}\text{C}$)	Dome temp., T_d ($^{\circ}\text{C}$)
241-SX-115	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.48E+04	9.39E+01	1.33	1.17	52	0.5	na	25	25
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.48E+04	9.39E+01	1.17	1.17	38	0.8	0.8	25	25
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.48E+04	9.39E+01	1.75	1.17	14	0.1	na	25	25
241-T-101	1.08E+04	9.63E+04	1.66E+05	3.75E+04	1.72E+01	7.59E+01	1.61	1.47	414	0.3	na	22	21
Supernatant	1.08E+04	9.63E+04	1.66E+05	3.75E+04	1.72E+01	7.59E+01	1.47	1.47	38	0.6	0.6	22	21
Solid Layer	1.08E+04	9.63E+04	1.66E+05	3.75E+04	1.72E+01	7.59E+01	1.62	1.47	376	0.3	0.5	22	21
241-T-102	3.42E+02	1.76E+04	8.30E+04	6.34E+03	1.03E+02	3.08E+01	1.40	1.14	159	0.5	na	18	18
Supernatant	2.53E+02	1.30E+04	6.15E+04	4.70E+03	5.48E-01	2.89E+01	1.08	1.14	87	0.9	0.8	18	18
Solid Layer	4.49E+02	2.31E+04	1.09E+05	8.33E+03	1.78E+02	3.22E+01	1.79	1.14	72	0.3	na	18	18
241-T-103	3.78E-01	2.73E+04	5.75E+04	7.89E+03	6.65E+02	2.38E+01	1.43	1.00	140	0.4	na	19	20
Supernatant	1.47E-01	1.06E+04	2.24E+04	3.07E+03	1.43E+01	7.04E+00	1.00	1.00	53	0.9	0.7	19	20
Solid Layer	5.18E-01	3.75E+04	7.88E+04	1.08E+04	8.98E+02	2.98E+01	1.69	1.18	87	0.3	na	19	20
241-T-104	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.19E+00	1.66E-01	1.29	1.17	1,237	0.7	na	19	21
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.19E+00	1.66E-01	1.17	1.17	38	0.8	0.8	20	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.19E+00	1.66E-01	1.29	1.17	1,199	0.7	na	19	21
241-T-105	2.98E+03	5.42E+04	3.71E+04	3.62E+02	8.19E+01	5.23E+01	1.43	1.18	409	0.6	na	17	16
Supernatant	2.98E+03	5.42E+04	3.71E+04	3.62E+02	8.19E+01	5.23E+01	1.18	1.18	38	0.8	0.8	17	16
Solid Layer	2.98E+03	5.42E+04	3.71E+04	3.62E+02	8.19E+01	5.23E+01	1.46	1.18	371	0.6	na	17	16
241-T-106	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.11E+01	4.18E+01	1.33	1.17	120	0.3	na	20	20
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.11E+01	4.18E+01	1.17	1.17	38	0.8	0.8	20	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.11E+01	4.18E+01	1.41	1.17	82	0.2	na	20	20
241-T-107	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.08E+02	1.58E+01	1.54	1.17	693	0.5	na	20	21
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.08E+02	1.58E+01	1.17	1.17	38	0.8	0.8	20	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.08E+02	1.58E+01	1.56	1.17	655	0.5	na	20	21

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-T-108	4.45E-04	1.84E+04	1.74E+05	4.65E+02	3.81E+00	9.28E+00	1.34	1.18	98	0.4	na	16	21
Supernatant	4.45E-04	1.84E+04	1.74E+05	4.65E+02	3.81E+00	9.28E+00	1.18	1.18	38	0.6	0.6	16	21
Solid Layer	4.45E-04	1.84E+04	1.74E+05	4.65E+02	3.81E+00	9.28E+00	1.44	1.18	60	0.4	0.7	16	21
241-T-109	4.46E-04	1.85E+04	1.75E+05	4.64E+02	3.15E+00	3.82E+00	1.42	1.18	273	0.5	na	19	20
Supernatant	4.46E-04	1.85E+04	1.75E+05	4.64E+02	3.15E+00	3.82E+00	1.18	1.18	38	0.5	0.5	19	20
Solid Layer	4.46E-04	1.85E+04	1.75E+05	4.64E+02	3.15E+00	3.82E+00	1.46	1.18	235	0.5	0.7	19	20
241-T-110	4.38E+01	5.74E+01	1.78E+04	0.00E+00	1.72E+01	2.80E+01	1.24	1.05	1,438	0.8	na	18	20
Supernatant	3.30E+00	4.33E+00	1.34E+03	0.00E+00	3.54E-05	2.29E-04	1.00	1.05	41	1.0	0.9	19	20
Solid Layer	4.50E+01	5.90E+01	1.83E+04	0.00E+00	1.76E+01	2.86E+01	1.25	1.05	1,397	0.8	na	18	20
241-T-111	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.39E+00	1.09E-01	1.24	1.17	1,730	0.8	na	19	23
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.39E+00	1.09E-01	1.17	1.17	38	0.8	0.8	21	23
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.39E+00	1.09E-01	1.24	1.17	1,692	0.8	na	19	23
241-T-112	3.81E+02	3.38E+04	2.03E+04	0.00E+00	9.49E+00	1.45E+01	1.23	1.10	290	0.8	na	19	20
Supernatant	1.79E+02	1.58E+04	9.49E+03	0.00E+00	7.84E-01	9.00E-01	1.04	1.10	64	0.9	0.9	19	20
Solid Layer	4.38E+02	3.88E+04	2.33E+04	0.00E+00	1.15E+01	1.76E+01	1.28	1.10	226	0.7	na	19	20
241-T-201	7.62E-03	3.25E+02	4.47E+04	0.00E+00	7.19E-02	2.81E-02	1.29	1.06	122	0.7	na	18	20
Supernatant	5.34E-03	2.27E+02	3.13E+04	0.00E+00	7.03E-02	8.01E-02	1.04	1.06	12	0.9	0.9	19	20
Solid Layer	7.86E-03	3.35E+02	4.61E+04	0.00E+00	7.20E-02	2.37E-02	1.31	1.06	110	0.7	na	18	20
241-T-202	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.41E-03	2.73E-02	1.18	1.17	85	0.8	na	17	19
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.41E-03	2.73E-02	1.17	1.17	4	0.8	0.8	18	19
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.41E-03	2.73E-02	1.18	1.17	81	0.8	na	17	19
241-T-203	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.38E-03	1.68E-02	1.22	1.17	144	0.8	na	18	20
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.38E-03	1.68E-02	1.17	1.17	4	0.9	0.9	19	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.38E-03	1.68E-02	1.22	1.17	140	0.8	na	18	20

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-T-204	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.35E-03	7.32E-03	1.18	1.17	144	0.8	na	18	20
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.35E-03	7.32E-03	1.17	1.17	4	0.8	0.8	19	20
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.35E-03	7.32E-03	1.18	1.17	140	0.8	na	18	20
241-TX-101	1.08E+04	9.63E+04	1.66E+05	3.74E+04	4.16E+02	8.14E+01	1.70	1.47	382	0.3	na	25	23
Supernatant	1.08E+04	9.63E+04	1.66E+05	3.74E+04	4.16E+02	8.14E+01	1.47	1.47	38	0.8	0.8	25	23
Solid Layer	1.08E+04	9.63E+04	1.66E+05	3.74E+04	4.16E+02	8.14E+01	1.73	1.47	344	0.3	na	25	23
241-TX-102	1.08E+04	9.59E+04	1.66E+05	3.74E+04	2.19E+01	9.02E+01	1.63	1.47	859	0.3	na	27	25
Supernatant	1.08E+04	9.59E+04	1.66E+05	3.74E+04	2.19E+01	9.02E+01	1.47	1.47	38	0.5	0.5	27	25
Solid Layer	1.08E+04	9.59E+04	1.66E+05	3.74E+04	2.19E+01	9.02E+01	1.64	1.47	821	0.3	0.5	27	25
241-TX-103	1.03E+04	9.28E+04	1.67E+05	3.58E+04	2.18E+01	8.64E+01	1.63	1.46	586	0.3	na	22	22
Supernatant	1.03E+04	9.28E+04	1.67E+05	3.58E+04	2.18E+01	8.64E+01	1.46	1.46	38	0.5	0.5	22	22
Solid Layer	1.03E+04	9.28E+04	1.67E+05	3.58E+04	2.18E+01	8.64E+01	1.64	1.46	548	0.3	0.5	22	22
241-TX-104	1.19E+03	8.23E+04	3.10E+05	2.79E+03	2.03E+02	6.73E+01	1.63	1.44	300	0.5	na	21	21
Supernatant	2.60E+02	1.81E+04	6.81E+04	6.13E+02	4.64E+00	4.49E+01	1.08	1.44	47	0.9	0.5	21	21
Solid Layer	1.36E+03	9.42E+04	3.55E+05	3.19E+03	2.25E+02	6.99E+01	1.74	1.44	253	0.5	0.5	21	21
241-TX-105	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.22E+01	8.11E+01	1.66	1.47	2,219	0.3	na	35	23
Supernatant	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.22E+01	8.11E+01	1.47	1.47	38	0.5	0.5	36	23
Solid Layer	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.22E+01	8.11E+01	1.66	1.47	2,181	0.3	0.5	35	23
241-TX-106	1.08E+04	9.60E+04	1.66E+05	3.74E+04	2.87E+01	8.72E+01	1.64	1.47	1,356	0.3	na	26	26
Supernatant	1.08E+04	9.60E+04	1.66E+05	3.74E+04	2.87E+01	8.72E+01	1.47	1.47	38	0.5	0.5	27	26
Solid Layer	1.08E+04	9.60E+04	1.66E+05	3.74E+04	2.87E+01	8.72E+01	1.65	1.47	1,318	0.3	0.5	26	26
241-TX-107	7.75E+03	1.00E+05	1.68E+05	3.91E+04	5.03E+01	1.05E+02	1.70	1.46	150	0.3	na	22	22
Supernatant	7.75E+03	1.00E+05	1.68E+05	3.91E+04	5.03E+01	1.05E+02	1.46	1.46	38	0.5	0.5	22	22
Solid Layer	7.75E+03	1.00E+05	1.68E+05	3.91E+04	5.03E+01	1.05E+02	1.78	1.46	112	0.3	0.5	22	22

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-TX-108	1.08E+04	9.63E+04	1.66E+05	3.74E+04	2.69E+01	8.05E+01	1.64	1.47	527	0.3	na	20	21
Supernatant	1.08E+04	9.63E+04	1.66E+05	3.74E+04	2.69E+01	8.05E+01	1.47	1.47	38	0.5	0.5	19	21
Solid Layer	1.08E+04	9.63E+04	1.66E+05	3.74E+04	2.69E+01	8.05E+01	1.66	1.47	489	0.3	0.5	20	21
241-TX-109	2.98E+03	3.60E+04	7.96E+04	4.94E+03	5.15E+00	2.02E+01	1.40	1.17	1,413	0.6	na	36	45
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	5.15E+00	2.02E+01	1.17	1.17	38	0.8	0.8	39	45
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	5.15E+00	2.02E+01	1.41	1.17	1,375	0.6	na	36	45
241-TX-110	1.08E+04	9.61E+04	1.66E+05	3.73E+04	2.14E+01	7.45E+01	1.64	1.47	1,805	0.3	na	28	22
Supernatant	1.08E+04	9.61E+04	1.66E+05	3.73E+04	2.14E+01	7.45E+01	1.47	1.47	38	0.5	0.5	28	22
Solid Layer	1.08E+04	9.61E+04	1.66E+05	3.73E+04	2.14E+01	7.45E+01	1.65	1.47	1,767	0.3	0.5	28	22
241-TX-111	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.09E+01	7.20E+01	1.63	1.47	1,421	0.3	na	25	23
Supernatant	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.09E+01	7.20E+01	1.47	1.47	38	0.5	0.5	26	23
Solid Layer	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.09E+01	7.20E+01	1.64	1.47	1,383	0.3	0.5	25	23
241-TX-112	9.26E+03	8.54E+04	1.67E+05	3.23E+04	2.18E+01	7.78E+01	1.65	1.43	2,436	0.3	na	22	21
Supernatant	9.26E+03	8.54E+04	1.67E+05	3.23E+04	2.18E+01	7.78E+01	1.43	1.43	38	0.5	0.5	23	21
Solid Layer	9.26E+03	8.54E+04	1.67E+05	3.23E+04	2.18E+01	7.78E+01	1.66	1.43	2,398	0.3	0.5	22	21
241-TX-113	1.08E+04	9.62E+04	1.66E+05	3.74E+04	1.62E+00	8.58E+00	1.63	1.47	2,454	0.2	na	22	22
Supernatant	1.08E+04	9.62E+04	1.66E+05	3.74E+04	1.62E+00	8.58E+00	1.47	1.47	38	0.6	0.6	23	22
Solid Layer	1.08E+04	9.62E+04	1.66E+05	3.74E+04	1.62E+00	8.58E+00	1.63	1.47	2,416	0.2	0.5	22	22
241-TX-114	4.08E+03	4.78E+04	1.71E+05	1.45E+04	2.06E+01	7.07E+01	1.64	1.29	2,053	0.3	na	21	18
Supernatant	4.08E+03	4.78E+04	1.71E+05	1.45E+04	2.06E+01	7.07E+01	1.29	1.29	38	0.5	0.5	21	18
Solid Layer	4.08E+03	4.78E+04	1.71E+05	1.45E+04	2.06E+01	7.07E+01	1.64	1.29	2,015	0.3	0.6	21	18
241-TX-115	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.43E+01	8.04E+01	1.65	1.47	2,134	0.3	na	21	21
Supernatant	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.43E+01	8.04E+01	1.47	1.47	38	0.5	0.5	22	21
Solid Layer	1.08E+04	9.62E+04	1.66E+05	3.74E+04	2.43E+01	8.04E+01	1.66	1.47	2,096	0.3	0.5	21	21

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-TX-116	3.19E+02	1.05E+04	3.79E+05	8.79E+00	1.78E+00	2.92E+01	1.59	1.39	2,302	0.2	na	21	20
Supernatant	3.19E+02	1.05E+04	3.79E+05	8.79E+00	1.78E+00	2.92E+01	1.39	1.39	38	0.5	0.5	21	20
Solid Layer	3.19E+02	1.05E+04	3.79E+05	8.79E+00	1.78E+00	2.92E+01	1.60	1.39	2,264	0.2	0.5	21	20
241-TX-117	4.47E-04	1.84E+04	1.74E+05	4.67E+02	1.44E+01	4.90E+01	1.54	1.18	1,857	0.3	na	21	20
Supernatant	4.47E-04	1.84E+04	1.74E+05	4.67E+02	1.44E+01	4.90E+01	1.18	1.18	38	0.5	0.5	21	20
Solid Layer	4.47E-04	1.84E+04	1.74E+05	4.67E+02	1.44E+01	4.90E+01	1.54	1.18	1,819	0.3	0.7	21	20
241-TX-118	1.08E+04	9.64E+04	1.66E+05	3.74E+04	1.10E+02	4.26E+01	1.68	1.47	1,006	0.5	na	24	23
Supernatant	1.08E+04	9.64E+04	1.66E+05	3.74E+04	1.10E+02	4.26E+01	1.47	1.47	38	0.5	0.5	23	23
Solid Layer	1.08E+04	9.64E+04	1.66E+05	3.74E+04	1.10E+02	4.26E+01	1.69	1.47	968	0.5	0.5	24	23
241-TY-101	4.45E-04	1.84E+04	1.74E+05	4.65E+02	8.67E+00	2.41E-01	1.60	1.18	485	0.4	na	19	20
Supernatant	4.45E-04	1.84E+04	1.74E+05	4.65E+02	8.67E+00	2.41E-01	1.18	1.18	38	0.6	0.6	19	20
Solid Layer	4.45E-04	1.84E+04	1.74E+05	4.65E+02	8.67E+00	2.41E-01	1.64	1.18	447	0.4	0.7	19	20
241-TY-102	6.00E+03	6.17E+04	1.70E+05	2.10E+04	5.79E+00	2.29E+01	1.70	1.34	299	0.3	na	16	19
Supernatant	6.00E+03	6.17E+04	1.70E+05	2.10E+04	5.79E+00	2.29E+01	1.34	1.34	38	0.5	0.5	16	19
Solid Layer	6.00E+03	6.17E+04	1.70E+05	2.10E+04	5.79E+00	2.29E+01	1.75	1.34	261	0.3	0.6	16	19
241-TY-103	1.08E+04	9.63E+04	1.66E+05	3.74E+04	7.63E+01	2.24E+01	1.67	1.47	625	0.5	na	21	21
Supernatant	1.08E+04	9.63E+04	1.66E+05	3.74E+04	7.63E+01	2.24E+01	1.47	1.47	38	0.8	0.8	30	21
Solid Layer	1.08E+04	9.63E+04	1.66E+05	3.74E+04	7.63E+01	2.24E+01	1.69	1.47	587	0.5	0.5	21	21
241-TY-104	1.72E+03	9.21E+03	8.07E+04	4.65E+02	7.95E+01	2.78E+01	1.55	1.18	205	0.6	na	20	20
Supernatant	2.02E+02	1.08E+03	9.46E+03	5.45E+01	6.13E-03	1.15E+00	1.02	1.18	42	1.0	0.8	20	20
Solid Layer	2.11E+03	1.13E+04	9.90E+04	5.70E+02	9.18E+01	3.19E+01	1.69	1.18	163	0.5	na	20	20
241-TY-105	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.59E+02	6.69E+00	1.52	1.17	912	0.4	na	26	23
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.59E+02	6.69E+00	1.17	1.17	38	0.8	0.8	26	23
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.59E+02	6.69E+00	1.53	1.17	874	0.4	na	26	23

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-TY-106	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.30E+02	6.05E+01	1.31	1.17	100	0.5	na	16	19
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.30E+02	6.05E+01	1.17	1.17	38	0.8	0.8	16	19
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.30E+02	6.05E+01	1.40	1.17	62	0.4	na	16	19
241-U-101	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.93E+02	7.32E+01	1.58	1.17	127	0.4	na	22	22
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.93E+02	7.32E+01	1.17	1.17	38	0.8	0.8	19	22
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	4.93E+02	7.32E+01	1.75	1.17	89	0.3	na	22	22
241-U-102	1.09E+04	1.42E+05	1.92E+05	3.22E+04	1.01E+02	1.50E+02	1.65	1.48	1,276	0.4	na	28	26
Supernatant	1.07E+03	1.40E+04	1.89E+04	3.18E+03	6.62E-01	4.41E+01	1.05	1.48	42	0.9	0.5	27	26
Solid Layer	1.12E+04	1.46E+05	1.98E+05	3.32E+04	1.03E+02	1.52E+02	1.67	1.48	1,234	0.3	0.5	28	26
241-U-103	1.21E+04	1.33E+05	1.48E+05	3.99E+04	2.12E+01	1.27E+02	1.68	1.44	1,448	0.4	na	28	27
Supernatant	6.22E+02	6.88E+03	7.63E+03	2.05E+03	4.96E-01	2.34E+01	1.02	1.44	40	1.0	0.5	31	27
Solid Layer	1.24E+04	1.37E+05	1.52E+05	4.09E+04	2.16E+01	1.29E+02	1.70	1.44	1,408	0.4	0.5	28	27
241-U-104	9.58E+03	1.05E+05	2.07E+05	3.21E+04	1.83E+02	5.48E+01	1.49	1.40	500	0.4	na	28	24
Supernatant	9.58E+03	1.05E+05	2.07E+05	3.21E+04	1.83E+02	5.48E+01	1.40	1.40	38	0.6	0.6	28	24
Solid Layer	9.58E+03	1.05E+05	2.07E+05	3.21E+04	1.83E+02	5.48E+01	1.50	1.40	462	0.4	na	28	24
241-U-105	1.64E+04	1.08E+05	1.81E+05	2.98E+04	8.84E+00	1.47E+02	1.66	1.46	1,374	0.3	na	29	28
Supernatant	1.64E+04	1.08E+05	1.81E+05	2.98E+04	8.84E+00	1.47E+02	1.46	1.46	38	0.6	0.6	32	28
Solid Layer	1.64E+04	1.08E+05	1.81E+05	2.98E+04	8.84E+00	1.47E+02	1.67	1.46	1,336	0.3	0.5	29	28
241-U-106	4.04E+04	9.33E+04	2.35E+05	1.13E+04	6.13E+01	1.51E+02	1.52	1.34	682	0.4	na	27	27
Supernatant	5.86E+03	1.35E+04	3.40E+04	1.65E+03	7.74E+00	3.94E+01	1.05	1.34	44	0.9	0.5	27	27
Solid Layer	4.28E+04	9.88E+04	2.49E+05	1.20E+04	6.38E+01	1.56E+02	1.55	1.34	638	0.4	0.5	27	27
241-U-107	6.21E+03	1.27E+05	1.44E+05	4.06E+04	2.60E+00	8.06E+01	1.73	1.39	1,207	0.3	na	26	26
Supernatant	4.10E+03	1.16E+05	2.11E+05	2.79E+04	2.63E-01	1.95E+02	1.39	1.39	38	0.5	0.5	26	26
Solid Layer	6.28E+03	1.27E+05	1.42E+05	4.10E+04	2.66E+00	7.76E+01	1.74	1.43	1,169	0.3	0.5	26	26

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid, [NO ₃] (µg/mL)	Al in liquid, [Al] (µg/mL)	⁹⁰ Sr in waste, [Sr] (µCi/g)	¹³⁷ Cs in waste, [Cs] (µCi/g)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] (wt%)	Liquid water, [H ₂ O] (wt%)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-U-108	7.07E+03	1.34E+05	1.84E+05	3.05E+04	7.53E+00	1.39E+02	1.67	1.40	1,570	0.4	na	30	27
Supernatant	7.07E+03	1.34E+05	1.84E+05	3.05E+04	2.16E-01	2.61E+02	1.40	1.40	38	0.5	0.5	30	27
Solid Layer	7.07E+03	1.34E+05	1.84E+05	3.05E+04	7.68E+00	1.36E+02	1.68	1.40	1,532	0.4	0.5	30	27
241-U-109	6.53E+03	1.28E+05	1.85E+05	2.92E+04	7.48E+00	1.21E+02	1.65	1.47	1,389	0.3	na	28	27
Supernatant	6.53E+03	1.28E+05	1.85E+05	2.92E+04	7.48E+00	1.21E+02	1.47	1.47	38	0.5	0.5	27	27
Solid Layer	6.53E+03	1.28E+05	1.85E+05	2.92E+04	7.48E+00	1.21E+02	1.65	1.47	1,351	0.3	0.5	28	27
241-U-110	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.79E+02	1.98E+01	1.63	1.17	703	0.3	na	25	25
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.79E+02	1.98E+01	1.17	1.17	38	0.8	0.8	26	25
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	1.79E+02	1.98E+01	1.66	1.17	665	0.3	na	25	25
241-U-111	5.41E+03	1.20E+05	1.66E+05	3.66E+04	3.60E+01	1.29E+02	1.60	1.40	1,003	0.3	na	26	27
Supernatant	5.41E+03	1.20E+05	1.66E+05	3.66E+04	3.60E+01	1.29E+02	1.40	1.40	38	0.5	0.5	27	27
Solid Layer	5.41E+03	1.20E+05	1.66E+05	3.66E+04	3.60E+01	1.29E+02	1.61	1.40	965	0.3	na	26	27
241-U-112	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.20E+02	4.89E+01	1.63	1.17	210	0.4	na	21	21
Supernatant	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.20E+02	4.89E+01	1.17	1.17	38	0.8	0.8	21	21
Solid Layer	2.98E+03	3.60E+04	7.96E+04	4.94E+03	2.20E+02	4.89E+01	1.74	1.17	172	0.3	na	21	21
241-U-201	0.00E+00	1.65E+04	1.14E+05	1.13E+02	1.06E-01	7.76E+00	1.42	1.26	19	0.5	na	18	19
Supernatant	0.00E+00	1.06E+04	7.33E+04	7.26E-01	6.21E-03	1.33E+01	1.13	1.26	8	0.8	0.7	19	19
Solid Layer	0.00E+00	2.07E+04	1.43E+05	1.41E+02	1.55E-01	5.06E+00	1.63	1.22	11	0.3	na	18	19
241-U-202	1.11E+02	1.93E+04	1.19E+05	1.88E+02	4.18E-02	6.28E+00	1.35	1.28	18	0.5	na	18	19
Supernatant	7.24E+01	1.26E+04	7.80E+04	1.23E+02	2.99E-04	9.42E+00	1.14	1.28	8	0.8	0.7	18	19
Solid Layer	1.41E+02	2.45E+04	1.52E+05	2.39E+02	6.62E-02	4.42E+00	1.51	1.22	10	0.3	na	18	19
241-U-203	0.00E+00	1.50E+04	1.12E+05	1.45E+02	8.32E-02	5.96E+00	1.38	1.28	17	0.6	na	18	19
Supernatant	0.00E+00	9.94E+03	7.40E+04	9.63E-01	2.62E-04	8.84E+00	1.14	1.28	8	0.8	0.7	18	19
Solid Layer	0.00E+00	1.94E+04	1.44E+05	1.88E+02	1.35E-01	4.17E+00	1.59	1.28	9	0.4	na	18	19

Table B-5. Input Data for Hydrogen Generation Rate Model Calculations for 177 Tanks With Water Addition. (23 sheets)

Tank	TOC in liquid, [TOC] ($\mu\text{g/mL}$)	NO ₂ in liquid [NO ₂] ($\mu\text{g/mL}$)	NO ₃ in liquid, [NO ₃] ($\mu\text{g/mL}$)	Al in liquid, [Al] ($\mu\text{g/mL}$)	⁹⁰ Sr in waste, [Sr] ($\mu\text{Ci/g}$)	¹³⁷ Cs in waste, [Cs] ($\mu\text{Ci/g}$)	Bulk density, D (g/mL)	Liquid Density, D _L (g/mL)	Non-RGS waste volume (kL)	Bulk water, [H ₂ O] ($\text{wt}\%$)	Liquid water, [H ₂ O] ($\text{wt}\%$)	Waste temp., T _w (°C)	Dome temp., T _d (°C)
241-U-204	6.03E+01	5.23E+03	4.11E+04	1.09E+01	2.28E+00	4.54E+00	1.25	1.11	15	0.6	na	18	18
Supernatant	4.16E+01	3.61E+03	2.84E+04	7.51E+00	1.03E-04	3.55E+00	1.06	1.11	8	0.9	0.9	18	18
Solid Layer	8.10E+01	7.03E+03	5.53E+04	1.46E+01	4.10E+00	5.34E+00	1.47	1.11	7	0.3	na	18	18

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APPENDIX C

**CALCULATIONS OF THE HENRY'S LAW CONSTANTS AND THE
MASS TRANSPORT PRODUCTS OF h AND A**

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APPENDIX C

**CALCULATIONS OF THE HENRY'S LAW CONSTANTS AND THE
MASS TRANSPORT PRODUCTS OF h AND A**

Table C-1	Input Ion Concentration for NH ₃ Calculation.....	C-3
Table C-2	Calculations of Henry's Law Constant by Schumpe Model	C-6
Table C-3	Calculation of Mass Transport Properties for Off-Normal Ventilation Based on Normal Condition.....	C-9

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Table C-1. Input Ion Concentration for NH₃ Calculation. (3 sheets)

Tanks	Na ⁺ in liquid (µg/mL)	Al ³⁺ in liquid (µg/mL)	Fe ³⁺ in liquid (µg/mL)	Cr ³⁺ in liquid (µg/mL)	Ni ²⁺ in liquid (µg/mL)	K ⁺ in liquid (µg/mL)	OH ⁻ in liquid (µg/mL)	NO ₃ ⁻ in liquid (µg/mL)	NO ₂ ⁻ in liquid (µg/mL)	CO ₃ ²⁻ in liquid (µg/mL)	PO ₄ ³⁻ in liquid (µg/mL)	SO ₄ ²⁻ in liquid (µg/mL)	F ⁻ in liquid (µg/mL)	Cl ⁻ in liquid (µg/mL)
241-AN-101	9.29E+04	1.09E+04	6.32E+00	1.21E+02	3.61E+00	2.68E+03	3.08E+04	7.18E+04	4.07E+04	9.65E+03	1.59E+03	1.36E+03	2.89E+02	2.33E+03
241-AN-102	2.27E+05	1.54E+04	4.90E+01	2.97E+02	4.17E+02	2.88E+03	3.23E+03	2.36E+05	9.04E+04	7.00E+04	5.52E+03	1.53E+04	1.91E+03	4.11E+03
241-AN-103	2.85E+05	3.02E+04	3.01E+01	5.66E+02	1.20E+01	1.68E+04	9.93E+04	1.68E+05	1.65E+05	5.80E+03	1.65E+03	1.45E+03	6.60E+02	9.76E+03
241-AN-104	2.56E+05	3.86E+04	3.01E+01	3.36E+02	1.20E+01	6.69E+03	7.09E+04	1.70E+05	1.25E+05	1.07E+04	2.71E+03	3.54E+03	8.19E+01	8.09E+03
241-AN-105	2.46E+05	4.11E+04	2.47E+01	2.22E+02	9.95E+00	6.50E+03	5.86E+04	1.62E+05	1.21E+05	1.18E+04	1.22E+03	2.85E+03	3.06E+02	9.90E+03
241-AN-106	7.56E+04	3.22E+03	1.77E+00	9.91E+01	2.79E+02	5.96E+03	9.93E+04	6.58E+04	1.76E+04	2.18E+04	2.02E+03	5.50E+03	5.11E+03	9.60E+02
241-AN-107	2.03E+05	2.93E+02	1.67E+03	1.72E+02	5.51E+02	1.81E+03	9.93E+04	2.38E+05	6.59E+04	7.55E+04	2.94E+03	8.98E+03	4.18E+03	2.02E+03
241-AP-101	1.29E+05	6.94E+03	2.50E+00	1.43E+02	7.90E+00	3.12E+04	4.94E+04	1.32E+05	4.19E+04	3.23E+04	1.02E+03	4.03E+03	2.90E+03	1.98E+03
241-AP-102	1.02E+05	1.15E+04	3.82E+00	6.19E+02	2.66E+01	1.29E+03	9.09E+03	7.60E+04	3.59E+04	2.66E+04	1.16E+04	4.52E+03	1.68E+02	2.73E+03
241-AP-103	1.81E+05	8.43E+03	3.01E+01	3.72E+02	1.22E+02	1.33E+04	9.51E+03	1.35E+05	1.06E+05	7.55E+04	3.46E+03	4.50E+03	2.09E+03	2.82E+03
241-AP-104	1.36E+05	1.97E+04	1.04E+02	1.37E+03	7.85E+01	2.11E+03	2.26E+03	1.13E+05	6.74E+04	1.93E+04	3.86E+03	3.84E+03	4.15E+02	5.49E+03
241-AP-105	1.90E+05	2.07E+04	3.01E+01	5.13E+02	2.54E+01	1.23E+04	3.35E+04	2.32E+05	1.01E+05	1.12E+05	3.16E+03	6.78E+03	4.74E+03	5.45E+03
241-AP-106	1.22E+05	1.83E+04	1.13E+02	1.57E+03	7.56E+01	3.12E+03	9.01E+03	9.03E+04	6.14E+04	1.88E+04	2.76E+03	3.20E+03	6.71E+02	4.92E+03
241-AP-107	7.97E+04	8.69E+03	1.01E+01	6.55E+02	2.36E+00	1.58E+03	7.28E+03	9.56E+04	2.80E+04	4.55E+03	4.84E+03	2.41E+03	7.22E+02	2.29E+03
241-AP-108	9.03E+04	1.09E+04	1.01E+01	8.21E+02	4.02E+00	2.85E+03	1.39E+04	9.10E+04	3.27E+04	1.27E+04	3.40E+03	2.72E+03	9.70E+02	2.86E+03
241-AW-101	2.53E+05	3.07E+04	1.80E+01	1.12E+02	6.10E+00	4.12E+04	8.63E+04	1.70E+05	1.20E+05	9.20E+03	9.96E+02	1.26E+03	9.62E+02	7.30E+03
241-AW-102	5.68E+04	6.39E+03	6.95E+00	4.81E+02	1.90E+00	1.32E+03	7.45E+03	6.50E+04	2.01E+04	2.31E+03	6.22E+02	1.72E+03	5.42E+02	1.68E+03
241-AW-103	2.46E+04	6.46E+01	5.57E+00	2.53E+01	5.08E+00	1.43E+04	9.62E+03	4.22E+03	1.78E+03	4.70E+03	5.92E+01	6.72E+02	1.68E+04	1.38E+02
241-AW-104	1.74E+04	7.11E+02	1.86E+00	2.20E+00	7.40E-01	1.67E+03	3.55E+03	1.66E+04	5.33E+03	7.25E+03	2.93E+02	6.54E+02	1.32E+02	2.39E+02
241-AW-105	1.49E+04	4.34E+01	4.61E+00	2.12E+00	9.91E-01	1.99E+03	6.12E+03	2.70E+04	1.28E+03	1.62E+03	1.85E+02	3.01E+02	4.81E+02	2.45E+02
241-AW-106	1.77E+05	1.99E+04	2.18E+01	1.47E+03	8.39E+00	5.65E+03	9.80E+03	1.92E+05	6.35E+04	2.84E+04	1.47E+03	5.14E+03	1.23E+03	5.17E+03

Table C-1. Input Ion Concentration for NH₃ Calculation. (3 sheets)

Tanks	Na ⁺ in liquid (µg/mL)	Al ⁺³ in liquid (µg/mL)	Fe ⁺³ in liquid (µg/mL)	Cr ⁺³ in liquid (µg/mL)	Ni ⁺² in liquid (µg/mL)	K ⁺¹ in liquid (µg/mL)	OH ⁻¹ in liquid (µg/mL)	NO ₃ ⁻¹ in liquid (µg/mL)	NO ₂ ⁻¹ in liquid (µg/mL)	CO ₃ ⁻² in liquid (µg/mL)	PO ₄ ⁻³ in liquid (µg/mL)	SO ₄ ⁻² in liquid (µg/mL)	F ⁻¹ in liquid (µg/mL)	Cl ⁻¹ in liquid (µg/mL)
241-AY-101	5.19E+04	1.21E+01	1.20E+01	1.05E+02	5.90E+01	7.63E+02	2.29E+02	2.60E+04	3.53E+04	3.44E+04	1.15E+03	5.87E+03	1.74E+02	6.36E+02
241-AY-102	5.40E+04	1.97E+03	1.01E+01	2.91E+01	4.02E+00	3.88E+02	1.44E+03	4.86E+02	7.29E+03	4.87E+04	3.01E+03	2.32E+03	1.72E+02	1.60E+02
241-AZ-101	1.11E+05	8.56E+03	2.24E+01	7.23E+02	8.02E+00	4.76E+03	1.15E+04	7.12E+04	7.26E+04	3.42E+04	1.34E+03	1.50E+04	1.75E+03	1.51E+02
241-AZ-102	5.59E+04	6.68E+02	1.00E+00	7.37E+02	1.75E+00	3.20E+03	1.21E+03	1.85E+04	3.55E+04	3.50E+04	4.97E+02	1.86E+04	1.14E+03	7.66E+01
241-SY-101	1.63E+05	1.34E+04	3.97E+02	5.18E+03	2.02E+02	4.14E+03	2.63E+04	1.52E+05	9.56E+04	3.44E+04	4.94E+03	4.19E+03	5.50E+02	1.11E+04
241-SY-102	9.84E+04	1.44E+04	1.41E+01	2.41E+02	5.04E+01	1.53E+03	1.97E+04	9.20E+04	5.89E+04	1.31E+04	3.48E+03	2.91E+03	1.51E+02	4.64E+03
241-SY-103	2.12E+05	4.14E+04	2.10E+01	3.30E+01	4.90E+01	3.91E+03	2.89E+04	1.79E+05	1.43E+05	3.44E+04	3.12E+03	4.08E+03	3.51E+02	1.16E+04
241-A-101	2.78E+05	5.18E+04	4.29E+01	5.73E+01	1.85E+01	7.42E+03	4.48E+04	2.33E+05	1.65E+05	1.33E+04	5.89E+03	1.40E+03	2.17E+02	9.01E+03
241-A-103	2.20E+05	3.56E+04	1.81E+01	2.96E+02	9.46E+01	5.44E+03	4.48E+04	1.33E+05	1.65E+05	1.33E+04	3.67E+03	1.40E+03	2.17E+02	9.01E+03
241-AX-101	2.82E+05	5.03E+04	3.01E+01	1.75E+02	1.20E+01	7.42E+03	3.90E+04	2.72E+05	1.73E+05	1.10E+04	6.59E+03	1.54E+03	5.78E+01	8.82E+03
241-B-203	3.12E+04	1.00E+01	1.00E+01	1.62E+02	4.02E+00	5.44E+03	3.90E+04	5.67E+04	1.57E+03	1.09E+04	1.90E+03	5.62E+02	6.04E+03	6.77E+02
241-B-204	2.94E+04	8.35E+00	8.35E+00	1.52E+02	3.35E+00	6.42E+03	3.90E+04	4.82E+04	1.82E+03	1.09E+04	7.14E+02	8.24E+02	6.55E+03	6.22E+02
241-C-103	3.53E+04	1.16E+01	5.40E+00	7.86E+01	7.85E+01	3.10E+02	4.49E+04	4.30E+03	2.43E+04	2.94E+04	4.59E+03	3.22E+03	1.16E+03	4.05E+02
241-S-101	2.15E+05	2.45E+04	2.01E+01	8.13E+02	8.02E+00	2.36E+03	4.49E+04	1.81E+05	9.40E+04	5.30E+03	3.86E+03	5.65E+03	1.06E+02	7.45E+03
241-S-102	2.36E+05	4.19E+04	4.01E+01	1.08E+02	1.64E+01	3.25E+03	4.10E+04	1.59E+05	1.14E+05	2.01E+04	4.93E+03	4.63E+03	3.50E+02	1.04E+04
241-S-103	2.28E+05	3.20E+04	3.01E+01	2.69E+02	1.20E+01	3.90E+03	3.65E+04	2.16E+05	1.47E+05	2.21E+04	3.57E+03	5.10E+03	2.56E+02	1.33E+04
241-S-106	2.44E+05	3.85E+04	3.01E+01	9.41E+03	1.20E+01	1.84E+03	5.49E+04	2.40E+05	1.09E+05	1.58E+04	6.38E+03	5.73E+03	1.40E+02	1.11E+04
241-S-111	2.19E+05	2.91E+04	2.01E+01	4.06E+03	8.02E+00	1.64E+03	4.73E+04	1.90E+05	7.05E+04	1.28E+04	1.02E+04	4.32E+03	1.05E+02	6.39E+03
241-SX-101	2.42E+05	7.56E+04	3.56E+01	1.21E+04	3.44E+04	2.52E+03	4.87E+04	1.05E+05	7.80E+04	8.05E+03	5.18E+03	1.83E+03	7.14E+01	1.67E+04
241-SX-102	2.35E+05	4.56E+04	3.65E+01	2.77E+03	1.45E+01	3.55E+03	5.01E+04	1.58E+05	1.51E+05	8.80E+03	3.49E+03	3.33E+03	7.80E+01	1.02E+04
241-SX-103	2.37E+05	4.41E+04	3.01E+01	8.36E+01	2.05E+04	4.24E+03	4.15E+04	1.59E+05	1.58E+05	1.28E+04	3.33E+03	2.01E+03	1.01E+02	1.10E+04

Table C-1. Input Ion Concentration for NH_3 Calculation. (3 sheets)

Tanks	Na^+ in liquid ($\mu\text{g/mL}$)	Al^{+3} in liquid ($\mu\text{g/mL}$)	Fe^{+3} in liquid ($\mu\text{g/mL}$)	Cr^{+3} in liquid ($\mu\text{g/mL}$)	Ni^{+2} in liquid ($\mu\text{g/mL}$)	K^{+1} in liquid ($\mu\text{g/mL}$)	OH^{-1} in liquid ($\mu\text{g/mL}$)	NO_3^{-1} in liquid ($\mu\text{g/mL}$)	NO_2^{-1} in liquid ($\mu\text{g/mL}$)	CO_3^{-2} in liquid ($\mu\text{g/mL}$)	PO_4^{-3} in liquid ($\mu\text{g/mL}$)	SO_4^{-2} in liquid ($\mu\text{g/mL}$)	F^{-1} in liquid ($\mu\text{g/mL}$)	Cl^{-1} in liquid ($\mu\text{g/mL}$)
241-SX-104	2.50E+05	3.56E+04	3.38E+01	9.39E+02	1.35E+01	2.88E+03	3.42E+04	2.91E+05	1.17E+05	2.48E+04	1.27E+04	3.90E+03	1.87E+02	8.23E+03
241-SX-105	2.36E+05	4.41E+04	3.01E+01	3.38E+02	1.20E+01	3.38E+03	4.09E+04	1.65E+05	1.43E+05	1.41E+04	3.27E+03	4.20E+03	1.04E+02	9.01E+03
241-SX-106	2.45E+05	2.59E+04	3.01E+01	1.30E+02	1.20E+01	3.89E+03	3.31E+04	2.10E+05	1.32E+05	2.56E+04	3.52E+03	7.20E+03	3.11E+02	1.17E+04
241-SX-108	2.27E+05	1.54E+04	4.90E+01	2.97E+02	4.17E+02	2.88E+03	4.14E+04	2.36E+05	9.04E+04	7.00E+04	5.66E+03	1.53E+04	1.91E+03	4.11E+03
241-T-110	3.70E+04	5.00E+00	5.00E+00	3.46E+01	2.00E+00	3.27E+02	5.11E+03	1.83E+04	5.90E+01	7.00E+04	1.49E+03	4.36E+03	4.22E+03	9.58E+02
241-T-203	4.12E+04	5.05E+00	5.05E+00	4.26E+01	2.02E+00	8.39E+03	5.11E+03	7.37E+04	3.53E+02	7.00E+04	1.90E+03	4.69E+02	7.02E+03	7.07E+02
241-U-102	2.43E+05	1.80E+04	2.01E+01	2.79E+02	1.26E+02	3.77E+03	2.93E+04	2.45E+05	1.05E+05	4.68E+04	3.80E+03	9.84E+03	1.33E+02	8.82E+03
241-U-103	2.31E+05	4.09E+04	3.01E+01	1.08E+02	1.69E+02	4.83E+03	3.08E+04	1.52E+05	1.37E+05	1.56E+04	7.64E+02	2.68E+03	1.09E+03	1.14E+04
241-U-105	2.27E+05	2.98E+04	3.10E+01	2.01E+02	2.48E+02	3.98E+03	2.09E+04	1.81E+05	1.08E+05	2.78E+04	3.92E+03	8.01E+03	1.31E+03	8.92E+03
241-U-106	2.23E+05	1.20E+04	3.93E+01	4.96E+02	5.22E+02	1.89E+03	5.11E+03	2.52E+05	9.90E+04	4.73E+04	3.84E+03	8.64E+03	3.32E+02	5.46E+03
241-U-107	2.21E+05	2.64E+04	3.77E+01	5.75E+02	1.72E+01	3.27E+03	3.61E+04	2.27E+05	1.11E+05	2.65E+04	3.44E+03	6.63E+03	1.67E+02	8.99E+03
241-U-108	2.43E+05	3.29E+04	3.33E+01	1.28E+03	3.13E+01	4.01E+03	4.92E+04	1.81E+05	1.30E+05	2.20E+04	3.13E+03	4.23E+03	7.90E+02	8.94E+03
241-U-109	2.28E+05	2.92E+04	1.00E+02	2.61E+03	4.55E+01	3.33E+03	4.42E+04	1.85E+05	1.28E+05	1.87E+04	3.37E+03	5.17E+03	3.96E+02	8.69E+03

Table C-2. Calculations of Henry's Law Constant by Schumpe Model. (3 sheets)

Tanks	(NH ₃) _a in dome (ppm)	Liquid NH ₃ (µg/mL)	H ₂ O in liquid (wt%)	Spgr in liquid (g/mL)	Waste volume (kL)	Headspace temp. T _h (°C)	Waste temp. T _w (°C)	Sum C _i (mole/m ³)	Sum C _i *H _i (mole/m ³)	K _H ^o in water (mole/L-atm)	K _H in solns' correction factor	K _H in solns' in solns' (mole/L-atm)
241-AN-101	11	4.00E+01	70	1.15	606	18	18	8.64	0.82	86.11	1.25	41.96
241-AN-102	300	2.10E+02	48	1.43	4013	29	31	18.10	1.69	46.94	2.03	14.36
241-AN-103	7	3.45E+02	49	1.49	3627	28	38	26.53	2.54	34.01	2.30	4.25
241-AN-104	21	2.46E+02	51	1.40	3986	29	36	22.85	2.24	37.50	2.30	6.17
241-AN-105	15	2.10E+02	50	1.42	4263	28	34	21.62	2.15	40.39	2.26	7.15
241-AN-106	1	2.10E+02	76	1.20	148	18	17	11.59	1.04	88.51	1.38	40.30
241-AN-107	400	2.10E+02	50	1.37	3952	26	29	21.70	1.89	50.67	2.26	16.24
241-AP-101	125	4.39E+02	58	1.31	4221	19	19	13.43	1.22	81.52	1.41	30.97
241-AP-102	75	4.39E+02	75	1.20	4134	20	20	8.15	0.82	77.21	1.23	35.13
241-AP-103	1	2.50E+02	80	1.31	1079	16	16	15.11	1.46	96.18	1.40	24.73
241-AP-104	3	1.33E+02	97	1.29	91	15	15	10.73	1.06	98.90	1.33	37.70
241-AP-105	7	3.24E+02	62	1.35	2896	26	19	19.62	1.84	79.34	1.95	19.84
241-AP-106	5	6.75E+01	94	1.25	352	19	18	9.95	0.99	86.11	1.31	34.54
241-AP-107	5	1.06E+03	87	1.21	3695	17	14	6.67	0.60	101.71	1.17	61.92
241-AP-108	27	8.00E+02	81	1.25	1397	19	16	7.83	0.74	93.55	1.21	49.38
241-AW-101	5	1.00E+01	49	1.47	4263	16	34	24.06	2.31	40.39	2.26	6.46
241-AW-102	3	7.43E+01	88	1.15	303	26	21	4.81	0.44	75.16	1.10	51.68
241-AW-103	138	5.12E+02	93	1.02	1931	27	17	3.09	0.30	88.51	1.10	68.43
241-AW-104	6	1.69E+02	82	1.06	4236	25	21	1.56	0.15	73.16	1.10	68.40
241-AW-105	43	1.01E+03	93	1.02	1624	33	16	1.59	0.12	93.55	1.10	92.16
241-AW-106	28	3.55E+02	59	1.38	1791	33	32	14.42	1.34	44.63	1.60	16.10

Table C-2. Calculations of Henry's Law Constant by Schumpe Model. (3 sheets)

Tanks	(NH ₃) _{as} in dome (ppm)	Liquid NH ₃ (µg/mL)	H ₂ O in liquid (wt%)	Spg in liquid (g/mL)	Waste volume (kL)	Headspace temp. T _h (°C)	Waste temp. T _w (°C)	Sum C _i (mole/m ³)	Sum C _i *H _i (mole/m ³)	K _H ^o in water (mole/L-atm)	K _H in solns' correction factor	K _H in solns' in solns' (mole/L-atm)
241-AY-101	5	1.13E+02	84	1.09	583	30	38	4.15	0.42	34.01	1.00	20.48
241-AY-102	4	7.37E+01	92	1.12	2355	21	37	3.56	0.43	35.71	1.00	19.65
241-AZ-101	1	1.25E+02	72	1.22	3199	27	51	9.52	0.94	19.43	1.67	10.69
241-AZ-102	6	4.38E+02	84	1.14	3524	19	46	4.54	0.47	24.40	1.00	13.53
241-SY-101	400	1.04E+03	61	1.33	3685	30	32.0	14.89	1.37	43.96	1.63	15.79
241-SY-102	12	1.15E+03	75	1.23	2317	15	22	9.20	0.87	69.34	1.28	32.86
241-SY-103	59.43	1.29E+03	49	1.47	2817	16	31	19.55	1.93	45.77	2.25	10.57
241-A-101	394	5.31E+02	55	1.49	3608	36	60	24.74	2.42	13.69	3.28	2.61
241-A-103	261	5.31E+02	75	1.48	1404	36	58	19.95	1.98	14.96	3.28	4.70
241-AX-101	41	4.10E+03	48	1.49	2832	29	49	25.28	2.42	20.79	2.57	3.32
241-B-203	5	1.00E+02	89	1.17	193	12	12	5.28	0.44	115.89	1.00	76.38
241-B-204	5	1.00E+02	89	1.05	189	14	13	5.11	0.43	107.29	1.00	70.65
241-C-103	324	1.21E+03	86	1.08	750	38	43	5.43	0.53	27.01	1.17	16.99
241-S-101	765	1.21E+03	63	1.36	1616	31	43	18.34	1.73	26.82	2.27	8.66
241-S-102	588	1.70E+03	50	1.39	1946	27	39	20.10	2.03	32.41	2.31	6.54
241-S-103	149	1.41E+03	50	1.45	939	23	28	20.88	1.96	53.20	2.26	13.35
241-S-106	14	2.40E+02	51	1.46	1613	20	25	22.44	2.12	62.01	2.26	12.86
241-S-111	120	1.50E+03	52	1.40	2044	23	28	18.67	1.79	51.99	2.24	14.83
241-SX-101	4	1.32E+02	49	1.46	1696	38	52	21.14	2.37	19.00	2.57	2.14
241-SX-102	5	1.37E+03	48	1.45	1946	33	55	21.34	2.13	16.63	3.28	4.30
241-SX-103	31	1.80E+03	47	1.47	2400	31	62	21.45	2.17	12.84	3.28	3.10

Table C-2. Calculations of Henry's Law Constant by Schumpe Model. (3 sheets)

Tanks	(NH ₃) _s in dome (ppm)	Liquid NH ₃ (µg/mL)	H ₂ O in liquid (wt%)	Spg in liquid (g/mL)	Waste volume (kL)	Headspace temp. T _h (°C)	Waste temp. T _w (°C)	Sum C _i (mole/m ³)	Sum C _i *H _i (mole/m ³)	K _H ^o in water (mole/L-atm)	K _H in solns' correction factor	K _H in solns' in solns' (mole/L-atm)
241-SX-104	5	7.93E+02	51	1.39	1768	29	46	22.36	2.07	23.85	2.57	6.23
241-SX-105	27	1.21E+03	43	1.47	2411	34	63	20.74	2.07	12.06	3.28	3.31
241-SX-106	177	2.50E+03	46	1.42	1601	26	37	20.81	1.96	35.71	2.31	9.06
241-SX-108	5	1.30E+03	47.2	1.43	329	53	72	20.35	1.88	8.86	4.04	4.48
241-T-110	107	1.50E+03	87	1.17	1465	16	17	3.69	0.41	90.99	1.00	53.35
241-T-203	5	1.00E+02	85	1.17	132	15	17	5.08	0.47	89.83	1.00	53.34
241-U-102	651	7.45E+02	48	1.38	1420	24	28	20.47	1.88	53.34	2.26	15.39
241-U-103	722	1.40E+03	49	1.41	1772	25	28	19.59	1.97	51.99	2.26	11.13
241-U-105	1936	1.60E+03	69	1.46	1582	25	30	18.50	1.80	48.15	2.10	12.29
241-U-106	940	1.05E+03	49	1.36	856	24	26	17.81	1.60	57.66	2.01	21.04
241-U-107	448	4.03E+02	58	1.41	1545	23	24	19.69	1.82	62.37	2.00	16.58
241-U-108	684	1.05E+03	50	1.40	1772	24	28	21.29	2.06	51.99	2.26	10.70
241-U-109	5	1.10E+03	52	1.47	1760	23	26	20.17	1.93	57.66	2.26	14.45

Table C-3. Calculation of Mass Transport Properties for Off-Normal Ventilation Based on Normal Condition. (3 sheets)

Tanks	Normal vent Q (cfm)	Headspace volume V (ft ³)	Equiv (NH ₃) _{as} in liquid (mole/L)	hA from field data at normal condition (cfm)	Normal steady-state release rate (cfm)	Barometric breathing rate (cfm)	Off-normal constant k ₁ (min ⁻¹)	Off-normal constant k ₂ (mole/L-min)	(NH ₃) _{as} at off normal vent (atm)	(NH ₃) _{as} at off-normal vent (ppm)	Off-normal steady-state release rate (cfm)
241-AN-101	113	166,700	0.00047	2.85E-02	1.28E-03	0.52	1.74E-04	4.02E-10	5.50E-05	55	2.86E-05
241-AN-102	119	46,387	0.00431	1.80E-01	3.57E-02	0.14	1.38E-03	4.77E-08	8.57E-04	857	1.24E-04
241-AN-103	100	60,023	0.00003	1.33E-03	6.65E-04	0.19	5.46E-06	4.49E-10	2.03E-03	2034	3.82E-04
241-AN-104	100	47,323	0.00013	5.92E-03	2.10E-03	0.15	2.23E-05	1.81E-09	2.01E-03	2011	2.97E-04
241-AN-105	100	37,564	0.00011	5.02E-03	1.51E-03	0.12	2.67E-05	1.65E-09	1.52E-03	1523	1.79E-04
241-AN-106	117	182,875	0.00004	3.99E-04	1.17E-04	0.57	5.22E-06	2.69E-11	1.23E-04	123	7.02E-05
241-AN-107	129	48,526	0.00649	3.60E-01	5.16E-02	0.15	2.96E-03	9.15E-08	7.59E-04	759	1.15E-04
241-AP-101	108	39,035	0.00387	2.57E-02	1.35E-02	0.12	4.92E-04	1.70E-08	8.27E-04	827	1.01E-04
241-AP-102	135	42,109	0.00264	1.83E-02	1.02E-02	0.13	3.69E-04	1.12E-08	7.28E-04	728	9.57E-05
241-AP-103	200	149,990	0.00002	5.76E-04	2.00E-04	0.47	5.38E-06	5.64E-11	2.48E-04	248	1.16E-04
241-AP-104	71	184,881	0.00012	1.23E-03	2.23E-04	0.58	9.04E-06	5.19E-11	1.36E-04	136	7.83E-05
241-AP-105	176	85,823	0.00015	2.79E-03	1.29E-03	0.27	1.89E-05	6.18E-10	8.00E-04	800	2.15E-04
241-AP-106	111	175,657	0.00018	6.54E-03	5.92E-04	0.55	3.39E-05	1.48E-10	1.04E-04	104	5.72E-05
241-AP-107	342	57,616	0.00031	1.16E-03	1.71E-03	0.18	3.28E-05	1.25E-09	9.09E-04	909	1.64E-04
241-AP-108	129	138,761	0.00131	3.14E-03	3.43E-03	0.43	2.99E-05	1.06E-09	8.52E-04	852	3.69E-04
241-AW-101	100	37,564	0.00003	3.92E-02	5.15E-04	0.12	1.63E-04	6.13E-10	8.92E-05	89	1.05E-05
241-AW-102	292	177,394	0.00013	7.16E-03	7.44E-04	0.55	5.44E-05	1.76E-10	7.96E-05	80	4.41E-05
241-AW-103	134	119,912	0.00942	3.63E-02	1.85E-02	0.37	5.13E-04	9.10E-09	4.37E-04	437	1.64E-04
241-AW-104	141	38,500	0.00041	3.64E-03	8.46E-04	0.12	1.61E-04	9.37E-10	1.42E-04	142	1.71E-05
241-AW-105	194	130,740	0.00394	5.97E-03	8.30E-03	0.41	1.09E-04	2.71E-09	6.25E-04	625	2.55E-04
241-AW-106	158	124,858	0.00045	8.59E-03	4.40E-03	0.39	3.09E-05	1.43E-09	1.16E-03	1164	4.54E-04

Table C-3. Calculation of Mass Transport Properties for Off-Normal Ventilation Based on Normal Condition. (3 sheets)

Tanks	Normal vent Q (cfm)	Headspace volume V (ft ³)	Equiv (NH ₃) _g in liquid (mole/L)	hA from field data at normal condition (cfm)	Normal steady-state release rate (cfm)	Barometric breathing rate (cfm)	Off-normal constant k ₁ (min ⁻¹)	Off-normal constant k ₂ (mole/L-min)	(NH ₃) _g at off normal vent (atm)	(NH ₃) _g at off-normal vent (ppm)	Off-normal steady-state release rate (cfm)
241-AY-101	250	167,502	0.00010	7.69E-03	1.25E-03	0.52	2.65E-05	3.05E-10	2.86E-04	286	1.50E-04
241-AY-102	250	104,939	0.00008	1.05E-02	1.07E-03	0.33	5.04E-05	4.31E-10	2.07E-04	207	6.78E-05
241-AZ-101	150	75,129	0.00001	8.31E-04	1.50E-04	0.23	6.04E-06	8.12E-11	3.31E-04	331	7.77E-05
241-AZ-102	112	63,632	0.00007	1.01E-03	6.19E-04	0.20	8.26E-06	4.07E-10	1.18E-03	1181	2.35E-04
241-SY-101	486	57834	0.00632	1.42E-01	1.94E-01	0.18	9.68E-04	1.51E-07	3.87E-03	3870	6.99E-04
241-SY-102	363	106,276	0.00038	2.67E-03	4.24E-03	0.33	2.26E-05	1.70E-09	1.77E-03	1771	5.88E-04
241-SY-103	116	88,630	0.00063	3.88E-03	6.92E-03	0.28	1.41E-05	3.32E-09	5.58E-03	5581	1.55E-03
241-A-101	10	48,793	0.00103	5.17E-03	3.94E-03	0.15	1.01E-05	3.30E-09	8.25E-03	8253	1.26E-03
241-A-103	8	126,596	0.00122	2.61E-03	1.98E-03	0.40	5.58E-06	6.44E-10	2.92E-03	2922	1.16E-03
241-AX-101	10	80,208	0.00014	6.96E-05	4.15E-04	0.25	3.20E-06	2.09E-10	1.62E-03	1618	4.06E-04
241-B-203	0.28	1,069	0.00038	1.10E-05	1.41E-06	0.003	2.15E-05	6.03E-11	6.57E-05	66	2.20E-07
241-B-204	0.27	1,203	0.00035	1.05E-05	1.36E-06	0.004	1.76E-05	5.10E-11	6.83E-05	68	2.57E-07
241-C-103	10	87,026	0.00550	1.94E-03	3.24E-03	0.27	1.28E-05	1.58E-09	3.16E-03	3159	8.59E-04
241-S-101	6	83,283	0.00662	2.94E-03	4.72E-03	0.26	1.07E-05	2.51E-09	5.82E-03	5817	1.51E-03
241-S-102	2	71,653	0.00384	5.47E-04	1.29E-03	0.22	4.35E-06	7.62E-10	4.31E-03	4312	9.66E-04
241-S-103	15	107,212	0.00198	1.16E-03	2.28E-03	0.34	6.63E-06	8.95E-10	3.28E-03	3281	1.10E-03
241-S-106	9	83,417	0.00018	3.78E-04	1.27E-04	0.26	4.53E-06	6.38E-11	3.40E-04	340	8.85E-05
241-S-111	5	68,177	0.00178	3.09E-04	6.49E-04	0.21	4.76E-06	4.00E-10	2.04E-03	2041	4.35E-04
241-SX-101	40	113,228	0.00001	7.62E-04	1.51E-04	0.35	3.49E-06	5.22E-11	3.81E-04	381	1.35E-04
241-SX-102	40	104,405	0.00002	9.91E-05	2.00E-04	0.33	3.23E-06	7.63E-11	5.94E-04	594	1.94E-04
241-SX-103	53	88,363	0.00009	6.11E-04	1.61E-03	0.28	3.66E-06	7.30E-10	4.98E-03	4977	1.37E-03

Table C-3. Calculation of Mass Transport Properties for Off-Normal Ventilation Based on Normal Condition. (3 sheets)

Tanks	Normal vent Q (cfm)	Headspace volume V (ft ³)	Equiv (NH ₃) _{ss} in liquid (mole/L)	hA from field data at normal condition (cfm)	Normal steady-state release rate (cfm)	Barometric breathing rate (cfm)	Off-normal constant k ₁ (min ⁻¹)	Off-normal constant k ₂ (mole/L-min)	(NH ₃) _{ss} at off normal vent (atm)	(NH ₃) _{ss} at off-normal vent (ppm)	Off-normal steady-state release rate (cfm)
241-SX-104	30	110,688	0.00003	1.30E-04	1.50E-04	0.35	3.31E-06	5.48E-11	4.10E-04	410	1.42E-04
241-SX-105	40	87,962	0.00009	6.11E-04	1.09E-03	0.27	3.71E-06	4.94E-10	3.36E-03	3358	9.23E-04
241-SX-106	39	116,570	0.00160	1.93E-03	6.86E-03	0.36	6.80E-06	2.43E-09	8.75E-03	8752	3.19E-03
241-SX-108	455	161,486	0.00002	1.11E-03	2.28E-03	0.50	3.95E-06	5.27E-10	3.57E-03	3565	1.80E-03
241-T-110	7	61,761	0.00570	3.83E-04	7.48E-04	0.19	1.10E-05	5.47E-10	1.18E-03	1181	2.28E-04
241-T-203	6	3,208	0.00027	2.28E-04	3.02E-05	0.01	9.27E-05	4.18E-10	1.06E-04	106	1.07E-06
241-U-102	2	63,365	0.01002	1.66E-03	1.37E-03	0.20	1.30E-05	1.15E-09	2.16E-03	2157	4.27E-04
241-U-103	2	50,932	0.00804	9.56E-04	1.73E-03	0.16	8.24E-06	1.54E-09	4.58E-03	4582	7.29E-04
241-U-105	5	57,616	0.02379	5.64E-03	9.68E-03	0.18	3.26E-05	9.19E-09	6.91E-03	6909	1.24E-03
241-U-106	1	83,283	0.01977	1.20E-03	1.22E-03	0.26	1.05E-05	8.88E-10	2.06E-03	2058	5.36E-04
241-U-107	12	58,953	0.00743	1.34E-02	5.27E-03	0.18	9.45E-05	5.37E-09	1.38E-03	1380	2.54E-04
241-U-108	4	50,932	0.00732	1.87E-03	2.47E-03	0.16	1.27E-05	2.26E-09	4.34E-03	4345	6.92E-04
241-U-109	4	51,333	0.00007	1.37E-05	2.14E-05	0.16	3.22E-06	1.72E-11	1.30E-04	130	2.08E-05

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APPENDIX D

**CALCULATION RESULTS OF STEADY-STATE FLAMMABILITY EVALUATIONS
IN TANK DOME SPACES FOR 177 HANFORD TANKS**

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APPENDIX D

**CALCULATION RESULTS OF STEADY-STATE FLAMMABILITY EVALUATIONS
IN TANK DOME SPACES FOR 177 HANFORD TANKS**

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Table D-1. Steady-State Flammability Calculation Under Normal Ventilation Conditions for Current Waste. (8 sheets)

Tank	Ammonia headspace concentration [NH ₃] (%)	Methane headspace concentration [CH ₄] (%)	N ₂ O headspace concentration [N ₂ O] (%)	Waste volume V _w (kgal)	Headspace volume V _h (ft ³)	Normal ventilation rate (Vr) _{norm} (cfm)	Steady-state flammability at normal condition (% LFL)	Ammonia release rate Rr(NH ₃) (cfm)	N ₂ O release rate Rr(N ₂ O) (cfm)	Model hydrogen release rate Rr(H ₂) (cfm)	Methane release rate Rr(CH ₄) (cfm)
241-AN-101	0.0011	0.0002	0.0011	253	154,328	113.0	0.02%	1.28E-03	1.20E-03	4.15E-04	8.29E-05
241-AN-102	0.0300	0.0003	0.0053	1,078	44,011	119.0	0.41%	3.57E-02	6.31E-03	9.76E-03	3.19E-04
241-AN-103	0.0007	0.0002	0.0007	958	60,008	100.0	0.08%	6.65E-04	6.50E-04	2.86E-03	2.05E-04
241-AN-104	0.0021	0.0002	0.0007	1,052	47,401	100.0	0.11%	2.10E-03	7.09E-04	3.54E-03	1.95E-04
241-AN-105	0.0015	0.0002	0.0013	1,126	37,620	100.0	0.08%	1.51E-03	1.28E-03	2.65E-03	2.20E-04
241-AN-106	0.0000	0.0000	0.0002	164	166,122	117.0	0.01%	0.00E+00	2.32E-04	3.69E-04	1.17E-05
241-AN-107	0.0400	0.0005	0.0053	1,081	43,552	129.0	0.47%	5.16E-02	6.84E-03	9.94E-03	6.29E-04
241-AP-101	0.0125	0.0003	0.0061	1,114	39,209	108.0	0.11%	1.35E-02	6.63E-03	9.97E-04	1.99E-04
241-AP-102	0.0075	0.0002	0.0048	183	163,579	135.0	0.06%	1.02E-02	6.50E-03	1.46E-04	2.93E-05
241-AP-103	0.0000	0.0000	0.0008	895	68,412	200.0	0.02%	0.00E+00	1.70E-03	1.81E-03	8.58E-05
241-AP-104	0.0003	0.00001	0.0002	1,108	39,950	71.0	0.06%	2.23E-04	1.43E-04	1.74E-03	7.23E-06
241-AP-105	0.0007	0.0001	0.0026	1,131	36,878	176.0	0.03%	1.29E-03	4.55E-03	1.32E-03	2.30E-04
241-AP-106	0.0005	0.00003	0.0005	1,139	35,819	111.0	0.04%	5.92E-04	5.53E-04	1.38E-03	2.80E-05
241-AP-107	0.0005	0.0001	0.0017	233	156,941	342.0	0.01%	1.71E-03	5.81E-03	5.00E-04	9.99E-05
241-AP-108	0.0027	0.0000	0.0017	1,139	35,784	129.0	0.09%	3.43E-03	2.20E-03	3.95E-03	1.11E-05
241-AW-101	0.0005	0.0002	0.0007	1,127	37,443	100.0	0.09%	5.15E-04	7.29E-04	3.37E-03	1.56E-04
241-AW-102	0.0003	0.0000	0.0002	85	176,786	292.0	0.00%	7.44E-04	4.76E-04	3.25E-04	2.41E-05
241-AW-103	0.0138	0.0004	0.0009	1,102	40,833	134.0	0.12%	1.85E-02	1.23E-03	9.81E-04	1.96E-04
241-AW-104	0.0006	0.0007	0.0009	1,074	44,470	141.0	0.12%	8.46E-04	1.30E-03	5.98E-03	1.03E-03
241-AW-105	0.0043	0.0002	0.0009	426	131,198	194.0	0.04%	8.30E-03	1.78E-03	4.49E-04	8.98E-05
241-AW-106	0.0028	0.0001	0.0018	965	59,125	158.0	0.09%	4.40E-03	2.81E-03	4.71E-03	1.42E-04
241-AY-101	0.0005	0.0001	0.0009	181	163,897	250.0	0.01%	1.25E-03	2.21E-03	9.43E-04	1.42E-04
241-AY-102	0.0004	0.0001	0.0010	716	92,354	250.0	0.61%	1.07E-03	2.50E-03	5.66E-02	3.61E-04
241-AZ-101	0.0001	0.0005	0.0010	1,001	54,252	150.0	0.13%	1.88E-04	1.50E-03	7.27E-03	7.79E-04

Table D-1. Steady-State Flammability Calculation Under Normal Ventilation Conditions for Current Waste. (8 sheets)

Tank	Ammonia headspace concentration [NH ₃] (%)	Methane headspace concentration [CH ₄] (%)	N ₂ O headspace concentration [N ₂ O] (%)	Waste volume V _w (kgal)	Headspace volume V _h (ft ³)	Normal ventilation rate (Vr) _{norm} (cfm)	Steady-state flammability at normal condition (% LFL)	Ammonia release rate Rr(NH ₃) (cfm)	N ₂ O release rate Rr(N ₂ O) (cfm)	Model hydrogen release rate Rr(H ₂) (cfm)	Methane release rate Rr(CH ₄) (cfm)
241-AZ-102	0.0006	0.0008	0.0010	991	55,664	112.0	0.11%	6.19E-04	1.12E-03	4.05E-03	8.10E-04
241-SY-101	0.0200	0.0001	0.0005	1,119	38,467	461.0	0.15%	9.22E-02	2.46E-03	2.01E-03	3.58E-04
241-SY-102	0.0012	0.0004	0.0005	846	75,051	363.0	0.03%	4.24E-03	1.95E-03	1.54E-03	3.08E-04
241-SY-103	0.0059	0.0003	0.0016	750	87,869	116.4	0.10%	6.92E-03	1.87E-03	2.74E-03	3.15E-04
241-A-101*	0.0394	0.0006	0.0134	415	120,554	10.0	1.35%	3.94E-03	1.34E-03	4.31E-03	5.51E-05
241-A-102	0.0254	0.0002	0.0224	40	170,758	7.6	0.37%	1.93E-03	1.71E-03	5.98E-04	1.31E-05
241-A-103*	0.0261	0.0004	0.0220	371	126,441	10.0	0.88%	2.61E-03	2.20E-03	2.78E-03	3.92E-05
241-A-104	0.0005	0.0003	0.0040	28	172,312	10.0	1.04%	5.00E-05	4.02E-04	4.11E-03	2.58E-05
241-A-105	na	na	na	na	na	na	na	na	na	na	na
241-A-106	0.0275	0.0012	0.0198	79	165,497	10.0	0.68%	2.75E-03	1.98E-03	1.88E-03	1.15E-04
241-AX-101	0.0041	0.0002	0.0006	322	135,247	28.3	0.21%	1.17E-03	1.81E-04	1.96E-03	5.95E-05
241-AX-102	0.0034	0.0001	0.0050	30	174,337	16.5	0.15%	5.55E-04	8.23E-04	8.48E-04	9.04E-06
241-AX-103	0.0041	0.0002	0.0024	108	163,850	24.7	0.32%	1.02E-03	5.85E-04	2.85E-03	4.94E-05
241-AX-104	0.0007	0.0001	0.0016	7	177,339	7.0	0.24%	5.18E-05	1.15E-04	6.53E-04	7.37E-06
241-B-101	0.0013	0.0004	0.0086	109	99,114	7.8	0.26%	9.81E-05	6.72E-04	7.77E-04	3.40E-05
241-B-102	0.0005	0.0001	0.0063	32	109,354	7.0	0.20%	3.28E-05	4.40E-04	5.50E-04	9.64E-06
241-B-103	0.0008	0.0003	0.0061	56	106,176	7.0	0.22%	5.82E-05	4.26E-04	5.77E-04	1.78E-05
241-B-104	0.0005	0.0049	0.0076	374	63,589	7.0	0.40%	3.50E-05	5.31E-04	8.49E-04	1.70E-04
241-B-105	0.0012	0.0005	0.0092	290	74,854	7.0	0.29%	8.40E-05	6.45E-04	7.67E-04	3.27E-05
241-B-106	0.0005	0.0015	0.0240	123	97,242	7.0	0.26%	3.50E-05	1.68E-03	6.29E-04	1.08E-04
241-B-107	0.0021	0.0007	0.0017	161	92,051	7.0	0.27%	1.47E-04	1.19E-04	6.72E-04	4.95E-05
241-B-108	0.0034	0.0004	0.0087	92	101,303	7.0	0.25%	2.40E-04	6.08E-04	5.99E-04	3.00E-05
241-B-109	0.0042	0.0006	0.0117	125	96,924	7.0	0.28%	2.92E-04	8.21E-04	6.65E-04	4.05E-05
241-B-110	0.0050	0.0032	0.0050	245	80,822	7.0	0.38%	3.50E-04	3.49E-04	7.86E-04	1.57E-04

Table D-1. Steady-State Flammability Calculation Under Normal Ventilation Conditions for Current Waste. (8 sheets)

Tank	Ammonia headspace concentration [NH ₃] (%)	Methane headspace concentration [CH ₄] (%)	N ₂ O headspace concentration [N ₂ O] (%)	Waste volume V _w (kgal)	Headspace volume V _h (ft ³)	Normal ventilation rate (Vr) _{norm} (cfm)	Steady-state flammability at normal condition (% LFL)	Ammonia release rate Rr(NH ₃) (cfm)	N ₂ O release rate Rr(N ₂ O) (cfm)	Model hydrogen release rate Rr(H ₂) (cfm)	Methane release rate Rr(CH ₄) (cfm)
241-B-111	0.0025	0.0058	0.0090	241	81,352	3.5	0.77%	8.79E-05	3.15E-04	8.91E-04	1.78E-04
241-B-112	0.0031	0.0004	0.0068	35	108,966	7.0	0.23%	2.14E-04	4.74E-04	5.63E-04	3.04E-05
241-B-201	0.0005	0.0004	0.0006	30	3,880	7.0	0.06%	3.50E-05	4.16E-05	1.34E-04	2.67E-05
241-B-202	0.0003	0.0003	0.0017	29	4,021	7.2	0.05%	1.92E-05	1.23E-04	1.32E-04	2.49E-05
241-B-203	0.0005	0.0007	0.0105	52	1,055	0.3	1.73%	1.41E-06	2.95E-05	1.93E-04	1.89E-06
241-B-204	0.0005	0.0007	0.0103	51	1,161	0.3	1.80%	1.36E-06	2.79E-05	1.94E-04	1.79E-06
241-BX-101	0.0050	0.0006	0.0088	48	107,137	7.0	0.27%	3.50E-04	6.17E-04	6.19E-04	3.96E-05
241-BX-102	0.0003	0.0013	0.0017	112	98,521	7.0	0.26%	1.79E-05	1.19E-04	6.50E-04	8.85E-05
241-BX-103	0.0090	0.0009	0.0079	73	103,712	7.0	0.31%	6.27E-04	5.52E-04	6.57E-04	6.54E-05
241-BX-104	0.0212	0.0010	0.0130	100	100,110	8.7	0.35%	1.85E-03	1.14E-03	6.54E-04	9.12E-05
241-BX-105	0.0145	0.0006	0.0116	72	103,924	8.5	0.28%	1.23E-03	9.76E-04	5.97E-04	4.70E-05
241-BX-106	0.0047	0.0005	0.0043	38	108,479	7.0	0.24%	3.26E-04	3.02E-04	5.63E-04	3.50E-05
241-BX-107	0.0082	0.0004	0.0012	347	67,128	7.0	0.36%	5.74E-04	8.34E-05	8.42E-04	2.75E-05
241-BX-108	0.0024	0.0003	0.0053	31	109,291	7.0	0.22%	1.68E-04	3.73E-04	5.52E-04	2.40E-05
241-BX-109	0.0020	0.0025	0.0396	193	87,680	7.0	0.33%	1.40E-04	2.77E-03	7.33E-04	1.47E-04
241-BX-110	0.0063	0.0008	0.0017	205	86,091	7.0	0.33%	4.40E-04	1.19E-04	7.48E-04	5.57E-05
241-BX-111	0.0062	0.0002	0.0017	189	88,280	7.0	0.29%	4.35E-04	1.19E-04	6.80E-04	1.15E-05
241-BX-112	0.0122	0.0022	0.0339	164	91,529	7.0	0.36%	8.51E-04	2.37E-03	6.61E-04	1.32E-04
241-BY-101	0.0059	0.0010	0.0056	370	90,792	7.0	0.44%	4.15E-04	3.91E-04	1.05E-03	6.80E-05
241-BY-102	0.0173	0.0004	0.0017	276.8	103,222	7.0	0.40%	1.21E-03	1.22E-04	7.81E-04	2.75E-05
241-BY-103	0.0029	0.0002	0.0017	416	84,612	14.4	0.18%	4.12E-04	2.43E-04	9.33E-04	2.75E-05
241-BY-104	0.0259	0.0007	0.0250	358	92,346	7.6	0.58%	1.98E-03	1.92E-03	1.20E-03	5.41E-05
241-BY-105	0.0083	0.0004	0.0076	481	75,925	15.9	0.25%	1.32E-03	1.21E-03	1.16E-03	6.93E-05
241-BY-106	0.0079	0.0005	0.0132	491	74,654	5.9	0.62%	4.64E-04	7.75E-04	1.32E-03	2.89E-05

Table D-1. Steady-State Flammability Calculation Under Normal Ventilation Conditions for Current Waste. (8 sheets)

Tank	Ammonia headspace concentration [NH ₃] (%)	Methane headspace concentration [CH ₄] (%)	N ₂ O headspace concentration [N ₂ O] (%)	Waste volume V _w (kgal)	Headspace volume V _h (ft ³)	Normal ventilation rate (Vr) _{norm} (cfm)	Steady-state flammability at normal condition (% LFL)	Ammonia release rate Rr(NH ₃) (cfm)	N ₂ O release rate Rr(N ₂ O) (cfm)	Model hydrogen release rate Rr(H ₂) (cfm)	Methane release rate Rr(CH ₄) (cfm)
241-BY-107	0.0962	0.0010	0.0704	272	103,928	5.2	1.28%	5.03E-03	3.68E-03	1.29E-03	5.20E-05
241-BY-108	0.0870	0.0008	0.0553	222	110,531	6.8	0.91%	5.88E-03	3.74E-03	8.48E-04	5.16E-05
241-BY-109	0.0045	0.0002	0.0011	276.6	103,257	14.7	0.17%	6.57E-04	1.57E-04	7.81E-04	3.11E-05
241-BY-110	0.0397	0.0003	0.0102	366	91,357	13.3	0.54%	5.30E-03	1.37E-03	1.46E-03	4.36E-05
241-BY-111	0.0059	0.0003	0.0082	302	99,832	6.0	0.38%	3.51E-04	4.93E-04	8.00E-04	1.65E-05
241-BY-112	0.0063	0.0001	0.0039	286	101,986	13.6	0.19%	8.55E-04	5.34E-04	7.92E-04	1.72E-05
241-C-101	0.0098	0.0012	0.0636	88	101,868	3.6	0.56%	3.52E-04	2.29E-03	6.80E-04	4.30E-05
241-C-102	0.0187	0.0008	0.0141	316	71,393	11.8	0.33%	2.20E-03	1.66E-03	8.72E-04	9.81E-05
241-C-103*	0.0324	0.0016	0.0737	88	101,797	10.0	0.82%	3.24E-03	7.37E-03	2.30E-03	1.58E-04
241-C-104	0.0044	0.0004	0.0063	259	79,021	67.1	0.08%	2.96E-03	4.24E-03	1.26E-03	2.51E-04
241-C-105	0.0002	0.0000	0.0005	132	95,971	535.0	0.01%	1.29E-03	2.81E-03	8.49E-04	1.24E-04
241-C-106	0.0002	0.0001	0.0004	14	111,791	176.1	0.02%	4.38E-04	6.49E-04	9.58E-04	9.86E-05
241-C-107	0.0066	0.0010	0.0096	248	80,433	1.1	3.17%	7.24E-05	1.05E-04	1.37E-03	1.08E-05
241-C-108	0.0003	0.0000	0.0178	66	104,799	7.0	0.22%	1.84E-05	1.25E-03	6.07E-04	2.17E-06
241-C-109	0.0010	0.0001	0.0365	63	105,152	13.0	0.14%	1.30E-04	4.76E-03	6.61E-04	1.19E-05
241-C-110	0.0123	0.0031	0.0014	178	89,827	7.9	0.36%	9.69E-04	1.08E-04	6.82E-04	1.36E-04
241-C-111	0.0004	0.0001	0.0053	57	105,964	7.0	0.27%	2.74E-05	3.73E-04	7.35E-04	3.54E-06
241-C-112	0.0023	0.0001	0.0538	104	99,749	11.2	0.21%	2.52E-04	6.02E-03	8.61E-04	1.12E-05
241-C-201	0.0001	0.0000	0.0007	1	7,799	3.9	0.03%	4.02E-06	2.87E-05	4.05E-05	1.84E-06
241-C-202	0.0001	0.0000	0.0004	1	7,835	3.6	0.03%	2.48E-06	1.44E-05	3.97E-05	9.22E-07
241-C-203	0.0005	0.0001	0.0010	3	7,587	7.0	0.02%	3.23E-05	7.18E-05	4.56E-05	4.61E-06
241-C-204	0.0001	0.0001	0.0014	2	7,623	3.0	0.04%	2.18E-06	4.31E-05	4.41E-05	2.76E-06
241-S-101*	0.0765	0.0007	0.0197	392	87,924	6.2	1.14%	4.72E-03	1.21E-03	1.51E-03	4.36E-05
241-S-102*	0.0588	0.0008	0.0394	437	81,885	2.2	1.81%	1.29E-03	8.68E-04	1.23E-03	1.83E-05

Table D-1. Steady-State Flammability Calculation Under Normal Ventilation Conditions for Current Waste. (8 sheets)

Tank	Ammonia headspace concentration [NH ₃] (%)	Methane headspace concentration [CH ₄] (%)	N ₂ O headspace concentration [N ₂ O] (%)	Waste volume V _w (kgal)	Headspace volume V _h (ft ³)	Normal ventilation rate (Vr) _{norm} (cfm)	Steady-state flammability at normal condition (% LFL)	Ammonia release rate Rr(NH ₃) (cfm)	N ₂ O release rate Rr(N ₂ O) (cfm)	Model hydrogen release rate Rr(H ₂) (cfm)	Methane release rate Rr(CH ₄) (cfm)
241-S-103	0.0149	0.0005	0.0135	237	108,688	15.3	0.25%	2.28E-03	2.06E-03	8.76E-04	6.96E-05
241-S-104	0.0025	0.0047	0.0073	288	101,872	5.6	0.51%	1.40E-04	4.10E-04	8.93E-04	1.79E-04
241-S-105	0.0036	0.0002	0.0008	406	86,123	16.7	0.16%	6.00E-04	1.25E-04	9.03E-04	3.84E-05
241-S-106	0.0014	0.0016	0.0006	455	79,520	9.2	0.31%	1.27E-04	5.11E-05	1.00E-03	1.47E-04
241-S-107	0.0181	0.0010	0.0184	320	97,564	4.4	0.67%	7.93E-04	8.08E-04	9.36E-04	4.45E-05
241-S-108	0.0025	0.0001	0.0003	550	66,842	7.0	0.39%	1.77E-04	2.08E-05	1.03E-03	7.66E-06
241-S-109	0.0025	0.0196	0.0021	533	69,138	7.0	0.77%	1.74E-04	1.48E-04	1.01E-03	2.01E-04
241-S-110	0.0146	0.0005	0.0039	389	88,348	10.4	0.36%	1.52E-03	4.07E-04	1.05E-03	5.19E-05
241-S-111	0.0120	0.0003	0.0021	449	80,402	5.4	0.59%	6.49E-04	1.14E-04	1.09E-03	1.50E-05
241-S-112	0.0088	0.0003	0.0006	614	58,261	4.0	0.75%	3.52E-04	2.53E-05	1.10E-03	1.05E-05
241-SX-101	0.0004	0.0002	0.0007	413	118,153	40.0	0.13%	1.51E-04	2.74E-04	1.96E-03	6.57E-05
241-SX-102	0.0000	0.0002	0.0006	430	115,893	40.0	0.14%	0.00E+00	2.40E-04	2.15E-03	8.00E-05
241-SX-103*	0.0031	0.0005	0.0010	491	107,700	52.5	0.42%	1.61E-03	5.41E-04	8.16E-03	2.38E-04
241-SX-104	0.0005	0.0002	0.0007	446	113,774	30.0	0.18%	1.50E-04	2.00E-04	2.12E-03	6.53E-05
241-SX-105	0.0027	0.0002	0.0008	376	123,167	40.5	0.30%	1.09E-03	3.38E-04	4.52E-03	7.38E-05
241-SX-106	0.0177	0.0003	0.0023	397	120,378	38.8	0.20%	6.86E-03	9.10E-04	1.23E-03	1.07E-04
241-SX-107	0.0002	0.0000	0.0004	94	160,775	387.0	0.01%	6.73E-04	1.49E-03	7.95E-04	9.58E-05
241-SX-108	0.0001	0.0000	0.0003	73	163,635	455.0	0.01%	5.63E-04	1.25E-03	8.72E-04	8.02E-05
241-SX-109	0.0017	0.0001	0.0009	241	141,141	30.0	0.19%	5.05E-04	2.72E-04	2.10E-03	3.75E-05
241-SX-110	0.0001	0.0000	0.0003	56	165,895	293.0	0.01%	4.01E-04	8.90E-04	7.54E-04	5.71E-05
241-SX-111	0.0003	0.0000	0.0007	115	157,985	264.0	0.01%	7.89E-04	1.75E-03	9.12E-04	1.12E-04
241-SX-112	0.0003	0.0000	0.0007	75	163,388	225.0	0.01%	6.99E-04	1.55E-03	7.05E-04	9.95E-05
241-SX-113	0.0029	0.0004	0.0064	19	170,874	7.0	0.23%	2.01E-04	4.45E-04	5.56E-04	2.86E-05
241-SX-114	0.0004	0.0001	0.0008	155	152,618	325.0	0.01%	1.17E-03	2.60E-03	9.45E-04	1.67E-04

Table D-1. Steady-State Flammability Calculation Under Normal Ventilation Conditions for Current Waste. (8 sheets)

Tank	Ammonia headspace concentration [NH ₃] (%)	Methane headspace concentration [CH ₄] (%)	N ₂ O headspace concentration [N ₂ O] (%)	Waste volume V _w (kgal)	Headspace volume V _h (ft ³)	Normal ventilation rate (Vr) _{norm} (cfm)	Steady-state flammability at normal condition (% LFL)	Ammonia release rate Rr(NH ₃) (cfm)	N ₂ O release rate Rr(N ₂ O) (cfm)	Model hydrogen release rate Rr(H ₂) (cfm)	Methane release rate Rr(CH ₄) (cfm)
241-SX-115	0.0003	0.0002	0.0025	4	172,887	7.0	0.20%	1.75E-05	1.72E-04	5.52E-04	1.11E-05
241-T-101	0.0022	0.0004	0.0050	99	100,350	7.0	0.26%	1.52E-04	3.47E-04	6.57E-04	2.76E-05
241-T-102	0.0005	0.0004	0.0066	32	109,354	7.0	0.21%	3.50E-05	4.59E-04	5.48E-04	2.95E-05
241-T-103	0.0005	0.0004	0.0055	27	110,025	7.0	0.21%	3.50E-05	3.88E-04	5.54E-04	2.49E-05
241-T-104	0.0104	0.0004	0.0008	317	71,287	7.0	0.37%	7.30E-04	5.26E-05	8.07E-04	2.75E-05
241-T-105	0.0094	0.0013	0.0201	98	100,526	7.0	0.31%	6.60E-04	1.41E-03	6.10E-04	9.03E-05
241-T-106	0.0100	0.0003	0.0043	22	110,732	7.0	0.27%	7.00E-04	3.01E-04	5.42E-04	1.94E-05
241-T-107	0.0123	0.0023	0.0041	173	90,497	6.4	0.40%	7.85E-04	2.62E-04	6.94E-04	1.39E-04
241-T-108	0.0020	0.0002	0.0041	16	111,508	7.0	0.21%	1.40E-04	2.85E-04	5.37E-04	1.40E-05
241-T-109	0.0005	0.0002	0.0049	62	105,329	7.0	0.21%	3.50E-05	3.45E-04	5.75E-04	1.75E-05
241-T-110	0.0107	0.0002	0.0015	370	64,190	7.0	0.40%	7.48E-04	1.02E-04	8.96E-04	1.70E-05
241-T-111	0.0223	0.0058	0.0013	447	53,878	6.0	0.65%	1.35E-03	7.64E-05	9.28E-04	1.86E-04
241-T-112	0.0029	0.0009	0.0137	67	104,728	7.0	0.24%	2.01E-04	9.62E-04	5.74E-04	6.17E-05
241-T-201	0.0001	0.0004	0.0059	31	3,774	7.0	0.05%	7.00E-06	4.16E-04	1.29E-04	2.58E-05
241-T-202	0.0002	0.0003	0.0043	21	5,080	7.0	0.04%	1.60E-05	3.01E-04	1.05E-04	1.94E-05
241-T-203	0.0000	0.0085	0.1318	37	2,997	0.4	1.19%	0.00E+00	5.02E-04	1.55E-04	3.11E-05
241-T-204	0.0001	0.0005	0.0078	37	2,997	7.0	0.07%	8.75E-06	5.45E-04	1.56E-04	3.12E-05
241-TX-101	0.0014	0.0011	0.0050	91	128,082	7.0	0.28%	9.65E-05	3.47E-04	7.01E-04	8.02E-05
241-TX-102	0.0168	0.0002	0.0054	217	111,238	11.5	0.29%	1.93E-03	6.28E-04	7.88E-04	2.24E-05
241-TX-103	0.0107	0.0003	0.0086	145	120,878	7.0	0.32%	7.49E-04	6.05E-04	6.88E-04	2.20E-05
241-TX-104	0.0028	0.0006	0.0050	69	130,977	3.5	0.46%	9.83E-05	1.73E-04	6.05E-04	2.07E-05
241-TX-105	0.0020	0.0001	0.0013	576	63,213	14.4	0.22%	2.83E-04	1.82E-04	1.15E-03	1.98E-05
241-TX-106	0.0252	0.0007	0.0050	348	93,687	7.0	0.53%	1.77E-03	3.47E-04	9.68E-04	4.69E-05
241-TX-107	0.0204	0.0002	0.0031	30	136,274	7.0	0.34%	1.43E-03	2.14E-04	5.67E-04	1.08E-05

Table D-1. Steady-State Flammability Calculation Under Normal Ventilation Conditions for Current Waste. (8 sheets)

Tank	Ammonia headspace concentration [NH ₃] (%)	Methane headspace concentration [CH ₄] (%)	N ₂ O headspace concentration [N ₂ O] (%)	Waste volume V _w (kgal)	Headspace volume V _h (ft ³)	Normal ventilation rate (Vr) _{norm} (cfm)	Steady-state flammability at normal condition (% LFL)	Ammonia release rate Rr(NH ₃) (cfm)	N ₂ O release rate Rr(N ₂ O) (cfm)	Model hydrogen release rate Rr(H ₂) (cfm)	Methane release rate Rr(CH ₄) (cfm)
241-TX-108	0.0025	0.0001	0.0022	129	122,961	9.0	0.20%	2.21E-04	1.99E-04	6.47E-04	1.01E-05
241-TX-109	0.0400	0.0043	0.0668	363	91,675	7.0	0.72%	2.80E-03	4.68E-03	1.03E-03	2.05E-04
241-TX-110	0.0974	0.0003	0.0129	467	77,832	7.0	1.01%	6.82E-03	9.01E-04	9.88E-04	2.12E-05
241-TX-111	0.0605	0.0002	0.0175	365	91,392	9.7	0.64%	5.88E-03	1.70E-03	8.86E-04	1.87E-05
241-TX-112	0.0112	0.0007	0.0050	633	55,550	7.0	0.49%	7.84E-04	3.47E-04	1.13E-03	4.57E-05
241-TX-113	0.0021	0.0004	0.0050	638	54,914	9.3	0.31%	1.99E-04	4.61E-04	1.09E-03	3.46E-05
241-TX-114	0.0160	0.0002	0.0040	532	69,075	12.0	0.31%	1.93E-03	4.79E-04	9.76E-04	2.43E-05
241-TX-115	0.0014	0.0002	0.0046	554	66,214	10.0	0.27%	1.38E-04	4.58E-04	1.03E-03	2.32E-05
241-TX-116	0.0014	0.0012	0.0050	598	60,282	3.1	0.85%	4.34E-05	1.55E-04	1.03E-03	3.69E-05
241-TX-117	0.0014	0.0003	0.0050	481	75,996	6.5	0.37%	8.97E-05	3.22E-04	9.27E-04	1.87E-05
241-TX-118	0.0036	0.0022	0.0018	256	106,047	10.0	0.28%	3.57E-04	1.80E-04	8.58E-04	1.72E-04
241-TY-101	0.0016	0.0003	0.0097	118	124,578	3.2	0.49%	5.23E-05	3.15E-04	6.23E-04	8.38E-06
241-TY-102	0.0004	0.0003	0.0066	69	131,146	7.0	0.22%	2.84E-05	4.65E-04	5.87E-04	1.93E-05
241-TY-103	0.0045	0.0015	0.0198	155	119,635	8.2	0.30%	3.73E-04	1.63E-03	7.80E-04	1.23E-04
241-TY-104	0.0059	0.0003	0.0097	44	134,466	13.4	0.15%	7.87E-04	1.30E-03	5.65E-04	4.24E-05
241-TY-105	0.0003	0.0023	0.0051	231	109,500	7.0	0.32%	1.75E-05	3.54E-04	7.57E-04	1.51E-04
241-TY-106	0.0019	0.0003	0.0043	16	138,174	7.0	0.21%	1.36E-04	3.01E-04	5.38E-04	1.94E-05
241-U-101	0.0100	0.0003	0.0051	24	110,484	7.0	0.27%	7.00E-04	3.59E-04	5.57E-04	2.30E-05
241-U-102*	0.0651	0.0012	0.0805	327	69,910	2.1	2.09%	1.37E-03	1.69E-03	1.37E-03	2.47E-05
241-U-103*	0.0722	0.0014	0.0761	417	57,904	2.4	2.15%	1.73E-03	1.83E-03	1.57E-03	3.37E-05
241-U-104	0.0001	0.0006	0.0085	122	97,313	7.0	0.30%	4.88E-06	5.96E-04	8.19E-04	3.89E-05
241-U-105*	0.1936	0.0039	0.1324	353	66,450	5.0	2.10%	9.68E-03	6.62E-03	1.46E-03	1.96E-04
241-U-106	0.0940	0.0052	0.0554	170	90,886	1.3	3.59%	1.22E-03	7.20E-04	1.49E-03	6.81E-05
241-U-107*	0.0448	0.0010	0.0445	309	72,347	11.8	0.52%	5.27E-03	5.23E-03	9.71E-04	1.12E-04

Table D-1. Steady-State Flammability Calculation Under Normal Ventilation Conditions for Current Waste. (8 sheets)

Tank	Ammonia headspace concentration [NH ₃] (%)	Methane headspace concentration [CH ₄] (%)	N ₂ O headspace concentration [N ₂ O] (%)	Waste volume V _w (kgal)	Headspace volume V _h (ft ³)	Normal ventilation rate (Vr) _{norm} (cfm)	Steady-state flammability at normal condition (% LFL)	Ammonia release rate Rr(NH ₃) (cfm)	N ₂ O release rate Rr(N ₂ O) (cfm)	Model hydrogen release rate Rr(H ₂) (cfm)	Methane release rate Rr(CH ₄) (cfm)
241-U-108*	0.0684	0.0011	0.0485	405	59,528	3.6	1.41%	2.47E-03	1.75E-03	1.35E-03	3.94E-05
241-U-109	0.0005	0.0010	0.0499	401	60,058	4.3	0.67%	2.14E-05	2.14E-03	1.10E-03	4.45E-05
241-U-110	0.0225	0.0091	0.1418	176	90,144	1.9	1.30%	4.24E-04	2.67E-03	7.25E-04	1.45E-04
241-U-111	0.0669	0.0012	0.0324	255	79,551	1.9	1.67%	1.27E-03	6.15E-04	9.15E-04	2.27E-05
241-U-112	0.0301	0.0035	0.0203	45	107,553	1.3	1.40%	3.85E-04	2.60E-04	5.75E-04	4.52E-05
241-U-201	0.0005	0.0001	0.0010	4	7,411	7.0	0.02%	3.23E-05	7.18E-05	4.62E-05	4.61E-06
241-U-202	0.0005	0.0001	0.0010	4	7,446	7.0	0.02%	3.23E-05	7.18E-05	4.54E-05	4.61E-06
241-U-203	0.0001	0.0001	0.0021	3	7,481	2.1	0.06%	1.77E-06	4.31E-05	4.45E-05	2.76E-06
241-U-204	0.0000	0.0000	0.0004	3	7,552	10.2	0.01%	1.35E-06	4.31E-05	4.27E-05	2.76E-06

Note: For all DSTs and SSTs with "**", the ammonia was analyzed with equilibrium model.

Table D-2. Steady-State Flammability Calculations With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Off-normal ventilation rate (Vr_{bb}) (cfm)	Steady-state hydrogen concentration [H_2] (%)	Steady-state ammonia concentration [NH_3] (%)	Steady-state methane concentration [CH_4] (%)	Steady-state N_2O concentration [N_2O] (%)	Steady-state hydrogen flammability (% LFL)	Steady-state ammonia flammability (% LFL)	Steady-state methane flammability (% LFL)	Steady-state total flammability (% LFL)
241-AN-101	0.48	0.09	0.01	0.02	0.25	2.15	0.04	0.34	3
241-AN-102	0.14	7.094	0.09	0.23	4.59	177.35	0.58	4.64	183
241-AN-103	0.19	1.52	0.20	0.11	0.35	38.09	1.36	2.18	42
241-AN-104	0.15	2.39	0.20	0.13	0.48	59.68	1.34	2.63	64
241-AN-105	0.12	2.26	0.15	0.19	1.09	56.39	1.02	3.74	61
241-AN-106	0.52	0.07	0.01	0.00	0.04	1.77	0.08	0.05	2
241-AN-107	0.14	7.30	0.08	0.46	5.02	182.61	0.51	9.24	192
241-AP-101	0.12	0.81	0.08	0.16	5.42	20.34	0.55	3.25	24
241-AP-102	0.51	0.03	0.07	0.01	1.27	0.72	0.49	0.11	1
241-AP-103	0.21	0.85	0.02	0.04	0.79	21.17	0.17	0.80	22
241-AP-104	0.12	1.39	0.01	0.01	0.11	34.80	0.09	0.12	35
241-AP-105	0.12	1.14	0.08	0.20	3.95	28.57	0.53	4.00	33
241-AP-106	0.11	1.23	0.01	0.03	0.49	30.85	0.07	0.50	31
241-AP-107	0.49	0.10	0.09	0.02	1.18	2.55	0.61	0.41	4
241-AP-108	0.11	3.53	0.09	0.01	1.96	88.37	0.57	0.20	89
241-AW-101	0.12	2.88	0.01	0.13	0.62	72.09	0.06	2.66	75
241-AW-102	0.55	0.06	0.01	0.00	0.09	1.47	0.05	0.09	2
241-AW-103	0.13	0.77	0.04	0.15	0.97	19.22	0.29	3.08	23
241-AW-104	0.14	4.30	0.01	0.74	0.93	107.59	0.09	14.84	123
241-AW-105	0.41	0.11	0.06	0.02	0.44	2.74	0.42	0.44	4
241-AW-106	0.18	2.55	0.12	0.08	1.52	63.77	0.78	1.54	66
241-AY-101	0.51	0.18	0.03	0.03	0.43	4.60	0.19	0.55	5
241-AY-102	0.29	19.60	0.02	0.13	0.87	490	0.14	2.50	493
241-AZ-101	0.17	4.29	0.03	0.46	0.88	107.25	0.22	9.19	117

Table D-2. Steady-State Flammability Calculations With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Off-normal ventilation rate (Vr_{bb}) (cfm)	Steady-state hydrogen concentration [H_2] (%)	Steady-state ammonia concentration [NH_3] (%)	Steady-state methane concentration [CH_4] (%)	Steady-state N_2O concentration [N_2O] (%)	Steady-state hydrogen flammability (% LFL)	Steady-state ammonia flammability (% LFL)	Steady-state methane flammability (% LFL)	Steady-state total flammability (% LFL)
241-AZ-102	0.17	2.33	0.12	0.47	0.64	58.18	0.80	9.31	68
241-SY-101	0.12	1.67	0.39	0.30	2.05	41.86	2.58	5.96	50
241-SY-102	0.23	0.66	0.18	0.13	0.83	16.40	1.18	2.62	20
241-SY-103	0.27	1.00	0.56	0.11	0.68	24.96	3.72	2.29	31
241-A-101*	0.38	1.15	0.83	0.01	0.36	28.63	5.50	0.29	34
241-A-102	0.53	0.11	0.36	0.00	0.32	2.80	2.41	0.05	5
241-A-103*	0.40	0.70	0.29	0.01	0.56	17.60	1.95	0.20	20
241-A-104	0.54	0.76	0.01	0.00	0.07	19.07	0.06	0.10	19
241-A-105	na	na	na	na	na	na	na	na	na
241-A-106	0.52	0.36	0.53	0.02	0.38	9.07	3.54	0.45	13
241-AX-101*	0.42	0.46	0.16	0.01	0.04	11.62	1.08	0.28	13
241-AX-102	0.54	0.16	0.10	0.00	0.15	3.89	0.68	0.03	5
241-AX-103	0.51	0.56	0.20	0.01	0.11	13.94	1.33	0.19	15
241-AX-104	0.55	0.12	0.01	0.00	0.02	2.94	0.06	0.03	3
241-B-101	0.31	0.25	0.03	0.01	0.22	6.27	0.21	0.22	7
241-B-102	0.34	0.16	0.01	0.00	0.13	4.02	0.06	0.06	4
241-B-103	0.33	0.17	0.02	0.01	0.13	4.35	0.12	0.11	5
241-B-104	0.20	0.43	0.02	0.09	0.27	10.68	0.12	1.71	13
241-B-105	0.23	0.33	0.04	0.01	0.28	8.20	0.24	0.28	9
241-B-106	0.30	0.21	0.01	0.04	0.55	5.17	0.08	0.71	6
241-B-107	0.29	0.23	0.05	0.02	0.04	5.84	0.34	0.34	7
241-B-108	0.32	0.19	0.08	0.01	0.19	4.73	0.50	0.19	5
241-B-109	0.30	0.22	0.10	0.01	0.27	5.49	0.64	0.27	6
241-B-110	0.25	0.31	0.14	0.06	0.14	7.78	0.92	1.24	10

Table D-2. Steady-State Flammability Calculations With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Off-normal ventilation rate (Vr_{bb}) (cfm)	Steady-state hydrogen concentration [H ₂] (%)	Steady-state ammonia concentration [NH ₃] (%)	Steady-state methane concentration [CH ₄] (%)	Steady-state N ₂ O concentration [N ₂ O] (%)	Steady-state hydrogen flammability (% LFL)	Steady-state ammonia flammability (% LFL)	Steady-state methane flammability (% LFL)	Steady-state total flammability (% LFL)
241-B-111	0.25	0.35	0.03	0.07	0.12	8.76	0.23	1.40	10
241-B-112	0.34	0.17	0.06	0.01	0.14	4.13	0.42	0.18	5
241-B-201	0.01	1.10	0.29	0.22	0.34	27.61	1.92	4.41	34
241-B-202	0.01	1.05	0.15	0.20	0.98	26.34	1.02	3.96	31
241-B-203*	0.003	5.86	0.01	0.06	0.90	146.42	0.04	1.15	148
241-B-204*	0.004	5.35	0.01	0.05	0.77	133.72	0.05	0.99	135
241-BX-101	0.33	0.18	0.10	0.01	0.18	4.62	0.70	0.24	6
241-BX-102	0.31	0.21	0.01	0.03	0.04	5.28	0.04	0.57	6
241-BX-103	0.32	0.20	0.19	0.02	0.17	5.07	1.29	0.40	7
241-BX-104	0.31	0.21	0.59	0.03	0.36	5.22	3.94	0.58	10
241-BX-105	0.32	0.18	0.38	0.01	0.30	4.59	2.52	0.29	7
241-BX-106	0.34	0.17	0.10	0.01	0.09	4.16	0.64	0.21	5
241-BX-107	0.21	0.40	0.27	0.01	0.04	10.03	1.82	0.26	12
241-BX-108	0.34	0.16	0.05	0.01	0.11	4.04	0.33	0.14	5
241-BX-109	0.27	0.27	0.05	0.05	1.01	6.69	0.34	1.07	8
241-BX-110	0.27	0.28	0.16	0.02	0.04	6.95	1.09	0.41	8
241-BX-111	0.28	0.25	0.16	0.00	0.04	6.17	1.05	0.08	7
241-BX-112	0.29	0.23	0.30	0.05	0.83	5.78	1.98	0.92	9
241-BY-101	0.28	0.37	0.15	0.02	0.14	9.28	0.98	0.48	11
241-BY-102	0.32	0.24	0.38	0.01	0.04	6.05	2.51	0.17	9
241-BY-103	0.26	0.35	0.16	0.01	0.09	8.82	1.04	0.21	10
241-BY-104	0.29	0.42	0.69	0.02	0.66	10.38	4.57	0.37	15
241-BY-105	0.24	0.49	0.56	0.03	0.51	12.27	3.71	0.58	17
241-BY-106*	0.23	0.57	0.18	0.01	0.33	14.13	1.18	0.25	16

Table D-2. Steady-State Flammability Calculations With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Off-normal ventilation rate ($V_{r_{bb}}$) (cfm)	Steady-state hydrogen concentration $[H_2]$ (%)	Steady-state ammonia concentration $[NH_3]$ (%)	Steady-state methane concentration $[CH_4]$ (%)	Steady-state N_2O concentration $[N_2O]$ (%)	Steady-state hydrogen flammability (% LFL)	Steady-state ammonia flammability (% LFL)	Steady-state methane flammability (% LFL)	Steady-state total flammability (% LFL)
241-BY-107	0.32	0.40	1.00	0.02	1.13	9.96	6.67	0.32	17
241-BY-108	0.35	0.25	1.00	0.01	1.08	6.14	6.67	0.30	13
241-BY-109	0.32	0.24	0.20	0.01	0.05	6.05	1.36	0.19	8
241-BY-110	0.29	0.51	1.00	0.02	0.48	12.79	6.67	0.31	20
241-BY-111	0.31	0.26	0.11	0.01	0.16	6.41	0.75	0.11	7
241-BY-112	0.32	0.25	0.27	0.01	0.17	6.21	1.79	0.11	8
241-C-101	0.32	0.21	0.11	0.01	0.72	5.34	0.74	0.27	6
241-C-102	0.22	0.39	0.99	0.04	0.75	9.78	6.57	0.88	17
241-C-103*	0.32	0.72	0.32	0.05	2.32	18.07	2.11	0.99	21
241-C-104	0.25	0.51	1.00	0.10	1.72	12.72	6.67	2.03	21
241-C-105	0.30	0.28	0.43	0.04	0.94	7.08	2.87	0.83	11
241-C-106	0.35	0.27	0.13	0.03	0.19	6.85	0.84	0.56	8
241-C-107	0.25	0.54	0.03	0.00	0.04	13.61	0.19	0.09	14
241-C-108	0.33	0.19	0.01	0.00	0.38	4.63	0.04	0.01	5
241-C-109	0.33	0.20	0.04	0.00	1.45	5.03	0.26	0.07	5
241-C-110	0.28	0.24	0.35	0.05	0.04	6.07	2.30	0.97	9
241-C-111	0.33	0.22	0.01	0.00	0.11	5.55	0.06	0.02	6
241-C-112	0.31	0.28	0.08	0.00	1.93	6.90	0.54	0.07	8
241-C-201	0.02	0.17	0.02	0.01	0.12	4.16	0.11	0.15	4
241-C-202	0.02	0.16	0.01	0.00	0.06	4.05	0.07	0.08	4
241-C-203	0.02	0.19	0.14	0.02	0.30	4.81	0.91	0.39	6
241-C-204	0.02	0.19	0.01	0.01	0.18	4.63	0.06	0.23	5
241-S-101*	0.27	0.55	0.58	0.02	0.44	13.74	3.88	0.32	18
241-S-102*	0.26	0.48	0.43	0.01	0.34	12.03	2.87	0.14	15

Table D-2. Steady-State Flammability Calculations With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Off-normal ventilation rate (V_{rbb}) (cfm)	Steady-state hydrogen concentration [H_2] (%)	Steady-state ammonia concentration [NH_3] (%)	Steady-state methane concentration [CH_4] (%)	Steady-state N_2O concentration [N_2O] (%)	Steady-state hydrogen flammability (% LFL)	Steady-state ammonia flammability (% LFL)	Steady-state methane flammability (% LFL)	Steady-state total flammability (% LFL)
241-S-103*	0.34	0.26	0.33	0.02	0.61	6.45	2.19	0.41	9
241-S-104	0.32	0.28	0.04	0.06	0.13	7.01	0.29	1.12	8
241-S-105	0.27	0.34	0.22	0.01	0.05	8.39	1.49	0.29	10
241-S-106*	0.25	0.40	0.03	0.06	0.02	10.06	0.23	1.18	11
241-S-107	0.30	0.31	0.26	0.01	0.27	7.67	1.73	0.29	10
241-S-108	0.21	0.49	0.08	0.00	0.01	12.32	0.57	0.07	13
241-S-109	0.22	0.47	0.08	0.09	0.07	11.65	0.54	1.86	14
241-S-110	0.28	0.38	0.55	0.02	0.15	9.48	3.66	0.38	14
241-S-111*	0.25	0.43	0.20	0.01	0.05	10.80	1.36	0.12	12
241-S-112	0.18	0.60	0.19	0.01	0.01	15.05	1.29	0.12	16
241-SX-101*	0.37	0.53	0.04	0.02	0.07	13.28	0.25	0.36	14
241-SX-102*	0.36	0.59	0.06	0.02	0.07	14.86	0.40	0.44	16
241-SX-103*	0.34	2.42	0.50	0.07	0.16	60.59	3.32	1.41	65
241-SX-104*	0.36	0.60	0.04	0.02	0.06	14.94	0.27	0.37	16
241-SX-105*	0.38	1.17	0.34	0.02	0.09	29.35	2.24	0.38	32
241-SX-106*	0.38	0.33	0.88	0.03	0.24	8.17	5.83	0.57	15
241-SX-107	0.50	0.16	0.13	0.02	0.30	3.96	0.89	0.38	5
241-SX-108*	0.51	0.17	0.36	0.02	0.24	4.27	2.38	0.31	7
241-SX-109	0.44	0.48	0.11	0.01	0.06	11.92	0.76	0.17	13
241-SX-110	0.52	0.15	0.08	0.01	0.17	3.64	0.52	0.22	4
241-SX-111	0.49	0.18	0.16	0.02	0.35	4.62	1.07	0.46	6
241-SX-112	0.51	0.14	0.14	0.02	0.30	3.45	0.91	0.39	5
241-SX-113	0.53	0.10	0.04	0.01	0.08	2.60	0.25	0.11	3
241-SX-114	0.48	0.20	0.25	0.03	0.54	4.96	1.64	0.70	7

Table D-2. Steady-State Flammability Calculations With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Off-normal ventilation rate (Vr_{bb}) (cfm)	Steady-state hydrogen concentration [H_2] (%)	Steady-state ammonia concentration [NH_3] (%)	Steady-state methane concentration [CH_4] (%)	Steady-state N_2O concentration [N_2O] (%)	Steady-state hydrogen flammability (% LFL)	Steady-state ammonia flammability (% LFL)	Steady-state methane flammability (% LFL)	Steady-state total flammability (% LFL)
241-SX-115	0.54	0.10	0.00	0.00	0.03	2.55	0.02	0.04	3
241-T-101	0.31	0.21	0.05	0.01	0.11	5.24	0.32	0.18	6
241-T-102	0.34	0.16	0.01	0.01	0.13	4.01	0.07	0.17	4
241-T-103	0.34	0.16	0.01	0.01	0.11	4.03	0.07	0.14	4
241-T-104	0.22	0.36	0.33	0.01	0.02	9.06	2.18	0.25	11
241-T-105	0.31	0.19	0.21	0.03	0.45	4.85	1.40	0.57	7
241-T-106	0.35	0.16	0.20	0.01	0.09	3.92	1.35	0.11	5
241-T-107	0.28	0.25	0.28	0.05	0.09	6.13	1.85	0.98	9
241-T-108	0.35	0.15	0.04	0.00	0.08	3.85	0.27	0.08	4
241-T-109	0.33	0.17	0.01	0.01	0.10	4.36	0.07	0.11	5
241-T-110*	0.20	0.45	0.12	0.01	0.05	11.17	0.79	0.17	12
241-T-111	0.17	0.55	0.80	0.11	0.05	13.78	5.34	2.21	21
241-T-112	0.33	0.18	0.06	0.02	0.29	4.38	0.41	0.38	5
241-T-201	0.01	1.09	0.06	0.22	3.53	27.32	0.40	4.37	32
241-T-202	0.02	0.66	0.10	0.12	1.90	16.61	0.67	2.44	20
241-T-203*	0.01	1.66	0.01	0.33	5.36	41.51	0.07	6.64	48
241-T-204	0.01	1.66	0.09	0.33	5.82	41.58	0.62	6.65	49
241-TX-101	0.40	0.18	0.02	0.02	0.09	4.38	0.16	0.40	5
241-TX-102	0.35	0.23	0.56	0.01	0.18	5.67	3.71	0.13	10
241-TX-103	0.38	0.18	0.20	0.01	0.16	4.55	1.32	0.12	6
241-TX-104	0.41	0.15	0.02	0.01	0.04	3.70	0.16	0.10	4
241-TX-105	0.20	0.58	0.14	0.01	0.09	14.57	0.95	0.20	16
241-TX-106	0.29	0.33	0.60	0.02	0.12	8.27	4.02	0.32	13
241-TX-107	0.43	0.13	0.33	0.00	0.05	3.33	2.23	0.05	6

Table D-2. Steady-State Flammability Calculations With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Off-normal ventilation rate (Vr_{bb}) (cfm)	Steady-state hydrogen concentration $[H_2]$ (%)	Steady-state ammonia concentration $[NH_3]$ (%)	Steady-state methane concentration $[CH_4]$ (%)	Steady-state N_2O concentration $[N_2O]$ (%)	Steady-state hydrogen flammability (% LFL)	Steady-state ammonia flammability (% LFL)	Steady-state methane flammability (% LFL)	Steady-state total flammability (% LFL)
241-TX-108	0.38	0.17	0.06	0.00	0.05	4.21	0.38	0.05	5
241-TX-109	0.29	0.36	0.98	0.07	1.63	8.96	6.52	1.43	17
241-TX-110	0.24	0.41	1.00	0.01	0.37	10.16	6.67	0.17	17
241-TX-111	0.29	0.31	1.00	0.01	0.59	7.75	6.67	0.13	15
241-TX-112	0.17	0.65	0.45	0.03	0.20	16.20	3.01	0.53	20
241-TX-113	0.17	0.64	0.12	0.02	0.27	15.91	0.77	0.40	17
241-TX-114	0.22	0.45	0.89	0.01	0.22	11.30	5.95	0.22	17
241-TX-115	0.21	0.50	0.07	0.01	0.22	12.48	0.44	0.22	13
241-TX-116	0.19	0.54	0.02	0.02	0.08	13.62	0.15	0.39	14
241-TX-117	0.24	0.39	0.04	0.01	0.14	9.76	0.25	0.16	10
241-TX-118	0.33	0.26	0.11	0.05	0.05	6.48	0.72	1.04	8
241-TY-101	0.39	0.16	0.01	0.00	0.08	4.00	0.09	0.04	4
241-TY-102	0.41	0.14	0.01	0.00	0.11	3.58	0.05	0.09	4
241-TY-103	0.37	0.21	0.10	0.03	0.44	5.22	0.67	0.66	7
241-TY-104	0.42	0.13	0.19	0.01	0.31	3.36	1.25	0.20	5
241-TY-105	0.34	0.22	0.01	0.04	0.10	5.53	0.03	0.89	6
241-TY-106	0.43	0.12	0.03	0.00	0.07	3.11	0.21	0.09	3
241-U-101	0.35	0.16	0.20	0.01	0.10	4.03	1.35	0.13	6
241-U-102*	0.22	0.63	0.22	0.01	0.77	15.68	1.44	0.23	17
241-U-103*	0.18	0.87	0.46	0.02	1.01	21.72	3.05	0.37	25
241-U-104	0.30	0.27	0.00	0.01	0.20	6.74	0.01	0.26	7
241-U-105*	0.21	0.70	0.69	0.09	3.19	17.57	4.61	1.89	24
241-U-106*	0.28	0.52	0.21	0.02	0.25	13.10	1.37	0.48	15
241-U-107*	0.23	0.43	0.14	0.05	2.31	10.74	0.92	0.99	13

Table D-2. Steady-State Flammability Calculations With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Off-normal ventilation rate (Vr_{bb}) (cfm)	Steady-state hydrogen concentration [H_2] (%)	Steady-state ammonia concentration [NH_3] (%)	Steady-state methane concentration [CH_4] (%)	Steady-state N_2O concentration [N_2O] (%)	Steady-state hydrogen flammability (% LFL)	Steady-state ammonia flammability (% LFL)	Steady-state methane flammability (% LFL)	Steady-state total flammability (% LFL)
241-U-108*	0.19	0.73	0.43	0.02	0.94	18.15	2.90	0.42	21
241-U-109*	0.19	0.58	0.01	0.02	1.14	14.62	0.09	0.47	15
241-U-110	0.28	0.26	0.15	0.05	0.95	6.44	1.00	1.03	8
241-U-111	0.25	0.37	0.51	0.01	0.25	9.20	3.41	0.18	13
241-U-112	0.34	0.17	0.11	0.01	0.08	4.28	0.76	0.27	5
241-U-201	0.02	0.20	0.14	0.02	0.31	4.99	0.93	0.40	6
241-U-202	0.02	0.19	0.14	0.02	0.31	4.87	0.93	0.40	6
241-U-203	0.02	0.19	0.01	0.01	0.18	4.75	0.05	0.24	5
241-U-204	0.02	0.18	0.01	0.01	0.18	4.53	0.04	0.23	5

Table D-3. Time to Reach 25% LFL With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 25% LFL $t_{25\%}$ (day)	Minimum vent rate to prevent 25% LFL (cfm)	Hydrogen concentration at time $t_{25\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{25\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{25\%}$ $[CH_4](t)$ (%)	N_2O concentration at time $t_{25\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{25\%}$ (%)	Ammonia flammability at time $t_{25\%}$ (%)	Methane flammability at time $t_{25\%}$ (%)
241-AN-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-102	31	1.05	0.93	0.09	0.03	0.60	23.18	0.58	0.61
241-AN-103	199	0.32	0.91	0.16	0.06	0.21	22.63	1.08	1.30
241-AN-104	106	0.39	0.91	0.19	0.05	0.18	22.67	1.30	1.00
241-AN-105	112	0.30	0.90	0.15	0.07	0.43	22.40	1.00	1.48
241-AN-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-107	30	1.09	0.92	0.08	0.06	0.64	23.11	0.51	1.18
241-AP-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-104	277	0.18	0.99	0.01	0.00	0.08	24.80	0.09	0.08
241-AP-105	309	0.16	0.86	0.08	0.15	2.96	21.44	0.53	3.00
241-AP-106	352	0.14	0.98	0.01	0.02	0.39	24.53	0.07	0.40
241-AP-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-108	71	0.41	0.97	0.08	0.00	0.54	24.19	0.54	0.05
241-AW-101	89	0.36	0.96	0.01	0.04	0.21	23.98	0.06	0.88
241-AW-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-104	50	0.70	0.87	0.01	0.15	0.19	21.87	0.09	3.00
241-AW-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-106	102	0.51	0.94	0.12	0.03	0.56	23.49	0.77	0.57
241-AY-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AY-102	11	5.82	0.95	0.01	0.01	0.04	23.72	0.08	0.12
241-AZ-101	53	0.81	0.91	0.01	0.10	0.19	22.84	0.08	1.96

Table D-3. Time to Reach 25% LFL With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 25% LFL $t_{25\%}$ (day)	Minimum vent rate to prevent 25% LFL (cfm)	Hydrogen concentration at time $t_{25\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{25\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{25\%}$ $[CH_4](t)$ (%)	N ₂ O concentration at time $t_{25\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{25\%}$ (%)	Ammonia flammability at time $t_{25\%}$ (%)	Methane flammability at time $t_{25\%}$ (%)
241-AZ-102	99	0.49	0.84	0.08	0.17	0.23	21.05	0.55	3.36
241-SY-101	140	0.26	0.78	0.39	0.14	0.96	19.57	2.58	2.79
241-SY-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SY-103	336	0.36	0.78	0.56	0.09	0.53	19.49	3.72	1.79
241-A-101*	244	0.48	0.78	0.80	0.01	0.24	19.43	5.36	0.20
241-A-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-A-103*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-A-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-A-105	na	na	na	na	na	na	na	na	na
241-A-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AX-101*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AX-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AX-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AX-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-3. Time to Reach 25% LFL With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 25% LFL $t_{25\%}$ (day)	Minimum vent rate to prevent 25% LFL (cfm)	Hydrogen concentration at time $t_{25\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{25\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{25\%}$ $[CH_4](t)$ (%)	N_2O concentration at time $t_{25\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{25\%}$ (%)	Ammonia flammability at time $t_{25\%}$ (%)	Methane flammability at time $t_{25\%}$ (%)
241-B-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-201	296	0.02	0.81	0.21	0.16	0.25	20.34	1.42	3.26
241-B-202	355	0.02	0.84	0.12	0.16	0.78	21.03	0.81	3.17
241-B-203*	38	0.02	0.99	0.01	0.01	0.16	24.74	0.05	0.20
241-B-204*	42	0.02	0.99	0.01	0.01	0.15	24.76	0.05	0.19
241-BX-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-106*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-3. Time to Reach 25% LFL With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 25% LFL $t_{25\%}$ (day)	Minimum vent rate to prevent 25% LFL (cfm)	Hydrogen concentration at time $t_{25\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{25\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{25\%}$ $[CH_4](t)$ (%)	N_2O concentration at time $t_{25\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{25\%}$ (%)	Ammonia flammability at time $t_{25\%}$ (%)	Methane flammability at time $t_{25\%}$ (%)
241-BY-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-103*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-201	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-202	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-203	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-204	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-101*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-102*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-3. Time to Reach 25% LFL With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 25% LFL $t_{25\%}$ (day)	Minimum vent rate to prevent 25% LFL (cfm)	Hydrogen concentration at time $t_{25\%}$ [H ₂](t) (%)	Ammonia concentration at time $t_{25\%}$ [NH ₃](t) (%)	Methane concentration at time $t_{25\%}$ [CH ₄](t) (%)	N ₂ O concentration at time $t_{25\%}$ [N ₂ O](t) (%)	Hydrogen flammability at time $t_{25\%}$ (%)	Ammonia flammability at time $t_{25\%}$ (%)	Methane flammability at time $t_{25\%}$ (%)
241-S-103*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-106*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-111*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-101*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-102*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-103*	104	0.88	0.92	0.21	0.03	0.06	23.00	1.43	0.54
241-SX-104*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-105*	332	0.50	0.93	0.22	0.02	0.07	23.20	1.50	0.30
241-SX-106*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-108*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-113	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-114	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-3. Time to Reach 25% LFL With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 25% LFL $t_{25\%}$ (day)	Minimum vent rate to prevent 25% LFL (cfm)	Hydrogen concentration at time $t_{25\%}$ [H ₂](t) (%)	Ammonia concentration at time $t_{25\%}$ [NH ₃](t) (%)	Methane concentration at time $t_{25\%}$ [CH ₄](t) (%)	N ₂ O concentration at time $t_{25\%}$ [N ₂ O](t) (%)	Hydrogen flammability at time $t_{25\%}$ (%)	Ammonia flammability at time $t_{25\%}$ (%)	Methane flammability at time $t_{25\%}$ (%)
241-SX-115	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-110*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-201	335	0.02	0.85	0.05	0.17	2.75	21.29	0.31	3.42
241-T-202	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-203*	156	0.02	0.87	0.00	0.17	2.69	21.67	0.00	3.33
241-T-204	159	0.02	0.85	0.05	0.17	2.97	21.28	0.32	3.40
241-TX-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-3. Time to Reach 25% LFL With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 25% LFL $t_{25\%}$ (day)	Minimum vent rate to prevent 25% LFL (cfm)	Hydrogen concentration at time $t_{25\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{25\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{25\%}$ $[CH_4](t)$ (%)	N ₂ O concentration at time $t_{25\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{25\%}$ (%)	Ammonia flammability at time $t_{25\%}$ (%)	Methane flammability at time $t_{25\%}$ (%)
241-TX-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-113	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-114	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-115	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-116	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-117	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-118	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-102*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-103*	1089	0.18	0.86	0.46	0.02	1.00	21.57	3.05	0.37
241-U-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-105*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-106*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-107*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-3. Time to Reach 25% LFL With Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 25% LFL $t_{25\%}$ (day)	Minimum vent rate to prevent 25% LFL (cfm)	Hydrogen concentration at time $t_{25\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{25\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{25\%}$ $[CH_4](t)$ (%)	N_2O concentration at time $t_{25\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{25\%}$ (%)	Ammonia flammability at time $t_{25\%}$ (%)	Methane flammability at time $t_{25\%}$ (%)
241-U-108*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-109*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-201	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-202	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-203	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-204	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-4. Time to Reach 100% LFL Under Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 100% LFL $t_{100\%}$ (day)	Minimum vent rate to prevent 100% LFL (cfm)	Hydrogen concentration at time $t_{100\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{100\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{100\%}$ $[CH_4](t)$ (%)	N_2O concentration at time $t_{100\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{100\%}$ (%)	Ammonia flammability at time $t_{100\%}$ (%)	Methane flammability at time $t_{100\%}$ (%)
241-AN-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-102	175	0.25	3.87	0.09	0.13	2.50	96.71	0.58	2.53
241-AN-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-107	162	0.26	3.78	0.08	0.24	2.60	94.55	0.51	4.79
241-AP-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-104	376	0.17	3.51	0.01	0.60	0.76	87.73	0.09	12.10
241-AW-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AY-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AY-102	50	1.42	3.95	0.02	0.02	0.18	98.78	0.14	0.51
241-AZ-101	431	0.20	3.67	0.03	0.39	0.76	91.85	0.22	7.87

Table D-4. Time to Reach 100% LFL Under Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 100% LFL $t_{100\%}$ (day)	Minimum vent rate to prevent 100% LFL (cfm)	Hydrogen concentration at time $t_{100\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{100\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{100\%}$ $[CH_4](t)$ (%)	N ₂ O concentration at time $t_{100\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{100\%}$ (%)	Ammonia flammability at time $t_{100\%}$ (%)	Methane flammability at time $t_{100\%}$ (%)
241-AZ-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SY-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SY-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SY-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-A-101*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-A-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-A-103*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-A-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-A-105	na	na	na	na	na	na	na	na	na
241-A-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AX-101*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AX-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AX-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AX-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-4. Time to Reach 100% LFL Under Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 100% LFL $t_{100\%}$ (day)	Minimum vent rate to prevent 100% LFL (cfm)	Hydrogen concentration at time $t_{100\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{100\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{100\%}$ $[CH_4](t)$ (%)	N ₂ O concentration at time $t_{100\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{100\%}$ (%)	Ammonia flammability at time $t_{100\%}$ (%)	Methane flammability at time $t_{100\%}$ (%)
241-B-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-201	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-202	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-B-203*	248	0.005	3.96	0.03	0.04	0.61	99.02	0.19	0.81
241-B-204*	298	0.005	3.96	0.03	0.04	0.57	99.08	0.19	0.75
241-BX-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BX-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-106*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-4. Time to Reach 100% LFL Under Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 100% LFL $t_{100\%}$ (day)	Minimum vent rate to prevent 100% LFL (cfm)	Hydrogen concentration at time $t_{100\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{100\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{100\%}$ $[CH_4](t)$ (%)	N ₂ O concentration at time $t_{100\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{100\%}$ (%)	Ammonia flammability at time $t_{100\%}$ (%)	Methane flammability at time $t_{100\%}$ (%)
241-BY-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-BY-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-103*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-201	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-202	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-203	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-C-204	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-101*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-102*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-4. Time to Reach 100% LFL Under Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 100% LFL $t_{100\%}$ (day)	Minimum vent rate to prevent 100% LFL (cfm)	Hydrogen concentration at time $t_{100\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{100\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{100\%}$ $[CH_4](t)$ (%)	N_2O concentration at time $t_{100\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{100\%}$ (%)	Ammonia flammability at time $t_{100\%}$ (%)	Methane flammability at time $t_{100\%}$ (%)
241-S-103*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-106*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-111*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-S-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-101*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-102*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-103*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-104*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-105*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-106*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-108*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-113	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SX-114	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-4. Time to Reach 100% LFL Under Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 100% LFL $t_{100\%}$ (day)	Minimum vent rate to prevent 100% LFL (cfm)	Hydrogen concentration at time $t_{100\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{100\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{100\%}$ $[CH_4](t)$ (%)	N_2O concentration at time $t_{100\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{100\%}$ (%)	Ammonia flammability at time $t_{100\%}$ (%)	Methane flammability at time $t_{100\%}$ (%)
241-SX-115	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-110*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-201	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-202	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-203*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-T-204	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-4. Time to Reach 100% LFL Under Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 100% LFL $t_{100\%}$ (day)	Minimum vent rate to prevent 100% LFL (cfm)	Hydrogen concentration at time $t_{100\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{100\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{100\%}$ $[CH_4](t)$ (%)	N ₂ O concentration at time $t_{100\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{100\%}$ (%)	Ammonia flammability at time $t_{100\%}$ (%)	Methane flammability at time $t_{100\%}$ (%)
241-TX-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-109	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-113	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-114	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-115	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-116	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-117	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TX-118	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-TY-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-102*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-103*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-105*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-106*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-107*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table D-4. Time to Reach 100% LFL Under Barometric Breathing Rate for Current Waste. (8 sheets)

Tank	Time to reach 100% LFL $t_{100\%}$ (day)	Minimum vent rate to prevent 100% LFL (cfm)	Hydrogen concentration at time $t_{100\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{100\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{100\%}$ $[CH_4](t)$ (%)	N ₂ O concentration at time $t_{100\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{100\%}$ (%)	Ammonia flammability at time $t_{100\%}$ (%)	Methane flammability at time $t_{100\%}$ (%)
241-U-108*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-109*	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-110	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-111	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-112	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-201	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-202	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-203	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-U-204	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

APPENDIX E

**EQUATIONS TO CALCULATE THE MASS TRANSPORT COEFFICIENT h FOR
SOLUBLE GAS**

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APPENDIX E

EQUATIONS TO CALCULATE THE MASS TRANSPORT COEFFICIENT h FOR SOLUBLE GAS

As described in RPP-4941, *Methodology for Predicting Flammable Gas Mixtures in Double-Contained Receiver Tanks*, the overall mass transport coefficient for steady state can be written in terms of the mass transport coefficient in vapor phase h_g and in liquid h_l as:

$$h = \frac{1}{\frac{1}{h_l} + \frac{K_H RT}{h_g}}$$

with

$$h_g = 0.15 \cdot \frac{D_g}{L_c} \cdot (S_c \cdot G_r)^{1/3}$$

$$h_l = 0.15 \cdot D_L \cdot \left(\frac{\mu_L}{D_L \cdot \rho_L} \right)^{1/3} \cdot \left(\frac{g \cdot \beta_L \cdot \rho_L^2 \cdot \Delta T}{\mu_L^2} \right)^{1/3}$$

and

$$S_c = \frac{\mu_g}{D_g \cdot \rho_g} \quad G_r = \frac{g \cdot \beta_g \cdot \rho_g^2 \cdot L_c^3 \cdot \Delta T}{\mu_g^2}$$

where

ρ_g = Density of Gas	kg/m ³	1.17
D_g = Diffusion Coefficient in Gas Phase	m ² /s	2.50 E-05
μ_g = Viscosity of Gas	kg/m-s	2.0 E-05
S_c = Schmidt Number	(none)	6.84 E-01
G = Gravitational Constant	m/s ²	9.8
ΔT = Delta temperature between waste surface & gas	°K	1.00
β_g = Thermal expansion Coef. of Gas	(°K) ⁻¹	3.30 E-03
L_c = Characteristic length(1/4of Diameter)	m	5.7825
G_r = Grashoff Number	(none)	2.14 E+10
h_g = Vapor Film Coefficient.	m/s	0.001586
D_L = Diffusion Coefficient in Liquid Phase	m ² /s	2.8 E-09
ρ_L = Density of Liquid	kg/m ³	1300
μ_L = Viscosity of Liquid	kg/m-s	6.82 E-04
β_L = Thermal Expansion Coef. of Liquid	(°K) ⁻¹	3.02 E-04
h_L = Liquid Film Coefficient.	m/s	5.3047 E-06

The last column lists the typical values used in the calculation of h.

Reference

RPP-4941, 2000, *Methodology for Predicting Flammable Gas Mixtures in Double-Contained Receiver Tanks*, Rev 0B, CH2M HILL Hanford Group, Inc., Richland, Washington.

APPENDIX F

**WASTE ADDITION STUDIES: CALCULATION OF HYDROGEN GENERATION
RATE CALCULATION, AMMONIA MASS TRANSPORT PROPERTIES,
FLAMMABILITY LEVELS, AND TIME OF THE 25% AND 100% OF THE LOWER
FLAMMABILITY LIMITS (FROM REVISION 2)**

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APPENDIX F

**WASTE ADDITION STUDIES: CALCULATION OF HYDROGEN GENERATION
RATE CALCULATION, AMMONIA MASS TRANSPORT PROPERTIES,
FLAMMABILITY LEVELS, AND TIME OF THE 25% AND 100% OF THE LOWER
FLAMMABILITY LIMITS (FROM REVISION 2)**

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Table F-1. Water Addition Study: Input Data for Hydrogen Generation Rate Model Calculations for 28 DSTs. (4 sheets)

Tank	Water added (dilution factor) (kL)	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Aluminum in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Waste volume V (kL)	Bulk water [H ₂ O] (wt%)	Waste temp. Tw (°C)	Dome temp. Td (°C)
241-AY-102 AY-102 liquid AY-102 solid	436 (1.25)	1.50E+03 1.31E+03 2.12E+03	3.75E+03 4.788E+03 2.29E+02	3.21E+02 3.28E+02 2.95E+02	9.39E+02 1.19E+03 1.00E+02	1.26E+03 1.22E+00 5.85E+03	5.47E+01 2.20E+01 1.79E+02	1.18 1.12 1.40	2839 2193 646	76% 89% 38%	52 45 72	44 44 44
241-AN-101 AN-101 liquid AN-101 solid	3359 (4.51)	2.66E+02 2.66E+02 2.46E+02	9.52E+03 9.52E+03 8.48E+03	1.66E+04 1.66E+04 1.52E+04	2.57E+03 2.57E+03 2.24E+03	9.25E-03 9.25E-03 7.66E-03	1.88E+01 1.88E+01 1.71E+01	1.04 1.04 1.04	4315 4315 0	93% 93% 0%	24 24 0	25 25 0
241-AN-102 AN-102 liquid AN-102 solid	325 (1.09)	2.39E+04 2.37E+04 2.58E+04	8.73E+04 8.67E+04 9.44E+04	2.19E+05 2.17E+05 2.37E+05	1.48E+04 1.47E+04 1.60E+04	6.13E+01 5.48E+01 1.44E+02	2.01E+02 1.97E+02 2.78E+02	1.41 1.39 1.56	4315 3978 337	51% 52% 41%	33 33 33	31 31 31
241-AN-103 AN-103 liquid AN-103 solid	696 (1.37)	2.06E+03 1.76E+03 2.60E+03	1.30E+05 1.11E+05 1.64E+05	1.32E+05 1.13E+05 1.67E+05	2.37E+04 2.03E+04 3.00E+04	9.02E-01 7.43E-03 2.80E+00	2.55E+02 2.96E+02 2.58E+02	1.47 1.32 1.72	4315 2579 1533	49% 61% 32%	40 40 40	31 31 31
241-AN-104 AN-104 liquid AN-104 solid	333 (1.16)	2.78E+03 2.54E+03 3.14E+03	9.94E+04 9.07E+04 1.12E+05	1.52E+05 1.39E+05 1.72E+05	3.45E+04 3.15E+04 3.90E+04	1.15E+01 5.07E-02 3.09E+01	2.88E+02 3.05E+02 3.22E+02	1.43 1.32 1.59	4315 2416 1736	53% 58% 46%	41 41 41	33 33 33
241-AN-105 AN-105 liquid AN-105 solid	45 (1.02)	3.44E+03 3.37E+03 3.56E+03	1.17E+05 1.14E+05 1.21E+05	1.57E+05 1.53E+05 1.62E+05	3.98E+04 3.89E+04 4.11E+04	6.45E+00 2.49E-02 1.67E+01	2.03E+02 2.09E+02 2.27E+02	1.49 1.40 1.62	4315 2452 1772	49% 52% 44%	38 38 38	32 32 32
241-AN-106 AN-106 liquid AN-106 solid	4172 (53.81)	1.55E+02 8.70E+01 4.68E+03	6.29E+02 3.53E+02 1.90E+04	2.35E+03 1.32E+03 7.09E+04	1.15E+02 6.45E+01 3.47E+03	5.11E-01 5.54E-04 3.47E+01	3.29E+00 1.12E+00 1.49E+02	1.01 1.00 1.58	4315 4251 64	98% 99% 40%	22 22 22	23 23 23

Table F-1. Water Addition Study: Input Data for Hydrogen Generation Rate Model Calculations for 28 DSTs. (4 sheets)

Tank	Water added (dilution factor) (kL)	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Aluminum in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Waste volume V (kL)	Bulk water [H ₂ O] (wt%)	Waste temp. Tw (°C)	Dome temp. Td (°C)
241-AN-107 AN-107 liquid AN-107 solid	375 (1.12)	3.80E+04 3.70E+04 4.16E+04	6.05E+04 5.89E+04 6.62E+04	2.19E+05 2.13E+05 2.40E+05	2.69E+02 2.62E+02 2.95E+02	8.18E+01 6.43E+01 1.59E+02	2.18E+02 2.27E+02 2.23E+02	1.38 1.33 1.56	4315 3380 935	51% 54% 40%	32 32 32	29 29 29
241-AP-101 AP-101 liquid AP-101 solid	99 (1.02)	1.91E+03 1.91E+03 0	4.10E+04 4.10E+04 0	1.29E+05 1.29E+05 0	6.79E+03 6.79E+03 0	6.40E-02 6.40E-02 0	1.06E+02 1.06E+02 0	1.30 1.30 0	4315 4315 0	59% 59% 0	23 23 0	23 23 0
241-AP-102 AP-102 liquid AP-102 solid	193 (1.05)	3.27E+03 3.27E+03 0	3.64E+04 3.64E+04 0	7.48E+04 7.48E+04 0	1.10E+04 1.10E+04 0	9.58E-01 9.58E-01 0	1.52E+02 1.52E+02 0	1.19 1.19 0	4315 4315 0	76% 76% 0	24 24 0	24 24 0
241-AP-103 AP-103 liquid AP-103 solid	3248 (4.04)	9.59E+02 9.59E+02 0	2.66E+04 2.66E+04 0	3.38E+04 3.38E+04 0	2.11E+03 2.11E+03 0	1.01E-01 1.01E-01 0	4.62E+01 4.62E+01 0	1.08 1.08 0	4315 4315 0	99% 99% 0	24 24 0	24 24 0
241-AP-104 AP-104 liquid AP-104 solid	117 (1.03)	5.01E+03 5.01E+03 0	5.77E+04 5.77E+04 0	1.01E+05 1.01E+05 0	1.68E+04 1.68E+04 0	4.04E+00 4.04E+00 0	1.46E+02 1.46E+02 0	1.24 1.24 0	4315 4315 0	97% 97% 0	25 25 0	24 24 0
241-AP-105 AP-105 liquid AP-105 solid	19 (1.0)	2.87E+03 2.87E+03 2.88E+03	1.02E+05 1.02E+05 1.02E+05	2.38E+05 2.38E+05 2.39E+05	2.08E+04 2.08E+04 2.09E+04	4.25E+00 2.03E+00 3.12E+01	1.46E+02 1.49E+02 1.34E+02	1.37 1.35 1.58	4315 3978 337	61% 62% 45%	24 24 24	19 19 19
241-AP-106 AP-106 liquid AP-106 solid	1957 (1.83)	2.32E+03 2.32E+03 0	3.17E+04 3.17E+04 0	5.05E+04 5.05E+04 0	7.88E+03 7.88E+03 0	9.88E-01 9.88E-01 0	7.82E+01 7.82E+01 0	1.14 1.14 0	4315 4315 0	96% 96% 0	24 24 0	24 24 0

Table F-1. Water Addition Study: Input Data for Hydrogen Generation Rate Model Calculations for 28 DSTs. (4 sheets)

Tank	Water added (dilution factor) (kL)	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Aluminum in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Waste volume V (kL)	Bulk water [H ₂ O] (wt%)	Waste temp. T _w (°C)	Dome temp. T _d (°C)
241-AP-107 AP-107 liquid AP-107 solid	607 (1.16)	3.38E+03 3.38E+03 0	4.80E+04 4.80E+04 0	1.14E+05 1.14E+05 0	1.34E+04 1.34E+04 0	1.76E+00 1.76E+00 0	1.15E+02 1.15E+02 0	1.21 1.21 0	4315 4315 0	90% 90% 0	29 29 0	26 26 0
241-AP-108 AP-108 liquid AP-108 solid	4194 (35.66)	2.71E+01 2.71E+01 0	8.04E+02 8.04E+02 0	2.24E+03 2.24E+03 0	2.69E+02 2.69E+02 0	4.13E-03 4.13E-03 0	2.00E+00 2.00E+00 0	1.01 1.01 0	4315 4315 0	99% 99% 0	23 23 0	23 23 0
241-AW-101 AW-101 liquid AW-101 solid	49 (1.02)	3.87E+03 3.81E+03 4.00E+03	1.16E+05 1.14E+05 1.20E+05	1.64E+05 1.62E+05 1.70E+05	3.18E+04 3.13E+04 3.29E+04	1.24E+01 2.59E-01 3.95E+01	2.58E+02 2.84E+02 2.28E+02	1.49 1.45 1.59	4315 2847 1374	48% 51% 43%	38 38 38	30 30 30
241-AW-102 AW-102 liquid AW-102 solid	3993 (20.2)	1.78E+01 1.18E+01 2.38E+02	7.25E+01 4.81E+01 9.71E+02	3.42E+02 2.27E+02 4.58E+03	9.40E+00 6.24E+00 1.26E+02	1.35E+01 1.93E-04 5.18E+02	1.85E+00 9.00E-02 6.77E+01	1.01 1.00 1.49	4315 4201 114	97% 99% 40%	24 24 24	23 23 23
241-AW-103 AW-103 liquid AW-103 solid	145 (1.05)	2.06E+03 2.03E+03 2.13E+03	3.85E+04 3.80E+04 3.99E+04	1.20E+05 1.18E+05 1.24E+05	1.14E+04 1.12E+04 1.18E+04	2.01E+00 1.01E-01 7.50E+00	7.22E+01 9.68E+01 2.30E+01	1.30 1.23 1.50	4315 3131 1184	81% 93% 55%	24 24 24	26 26 26
241-AW-104 AW-104 liquid AW-104 solid	3120 (9.86)	1.71E+03 7.20E+01 8.47E+03	1.84E+04 2.23E+02 9.33E+04	2.73E+04 1.17E+03 1.35E+05	6.15E+03 1.38E+01 3.14E+04	7.47E-01 5.11E-04 4.18E+00	3.15E+01 4.04E-01 1.75E+02	1.10 1.01 1.49	4315 3472 843	86% 98% 53%	27 27 27	22 22 22
241-AW-105 AW-105 liquid AW-105 solid	2699 (5.15)	3.51E+02 1.82E+02 9.39E+02	8.92E+02 4.63E+02 2.38E+03	1.28E+04 6.66E+03 3.43E+04	8.57E+01 4.45E+01 2.29E+02	1.23E+01 4.13E-03 5.84E+01	7.62E+00 1.86E+00 2.98E+01	1.08 1.01 1.31	4315 3350 965	90% 98% 66%	20 20 20	21 21 21

Table F-1. Water Addition Study: Input Data for Hydrogen Generation Rate Model Calculations for 28 DSTs. (4 sheets)

Tank	Water added (dilution factor) (kL)	TOC in liquid [TOC] (µg/mL)	NO ₂ in liquid [NO ₂] (µg/mL)	NO ₃ in liquid [NO ₃] (µg/mL)	Aluminum in liquid [Al] (µg/mL)	⁹⁰ Sr in waste [Sr] (µCi/g)	¹³⁷ Cs in waste [Cs] (µCi/g)	Bulk density D (g/mL)	Waste volume V (kL)	Bulk water [H ₂ O] (wt%)	Waste temp. Tw (°C)	Dome temp. Td (°C)
241-AW-106 AW-106 liquid AW-106 solid	3184 (15.09)	6.74E+02 1.70E+02 2.57E+03	1.37E+04 3.46E+03 5.22E+04	4.27E+04 1.08E+04 1.63E+05	4.12E+03 1.04E+03 1.57E+04	6.53E+00 8.71E-03 3.47E+01	3.35E+01 7.69E+00 1.49E+02	1.14 1.02 1.58	4315 3410 905	85% 96% 55%	41 41 41	33 33 33
241-AY-101 AY-101 liquid AY-101 solid	3621 (12.01)	3.13E+02 1.11E+02 2.95E+03	7.08E+03 2.61E+03 6.53E+04	8.74E+02 4.25E+02 6.75E+03	2.23E+02 2.02E+02 5.29E+02	1.76E+02 5.42E-02 2.50E+03	9.87E+00 2.78E+00 1.05E+02	1.04 1.02 1.52	4315 3950 310	93% 98% 48%	43 43 43	41 41 41
241-AY-102 AY-102 liquid AY-102 solid	1912 (2.09)	9.85E+02 7.85E+02 2.12E+03	2.47E+03 2.86E+03 2.29E+02	2.11E+02 1.96E+02 2.95E+02	6.18E+02 7.09E+02 1.00E+02	8.38E+02 7.30E-01 5.85E+03	3.64E+01 1.31E+01 1.79E+02	1.12 1.07 1.40	4315 3669 646	83% 93% 38%	50 45 72	44 44 44
241-AZ-101 AZ-101 liquid AZ-101 solid	741 (1.22)	2.67E+02 2.65E+02 3.23E+02	5.37E+04 5.32E+04 6.49E+04	5.27E+04 5.22E+04 6.37E+04	6.33E+03 6.26E+03 7.64E+03	6.72E+02 5.93E-01 1.49E+04	1.09E+03 1.11E+03 1.13E+03	1.22 1.20 1.62	4315 4118 197	76% 77% 56%	65 64 75	64 64 64
241-AZ-102 AZ-102 liquid AZ-102 solid	541 (1.16)	9.17E+02 9.03E+02 1.05E+03	2.87E+04 2.83E+04 3.29E+04	1.50E+04 1.48E+04 1.72E+04	5.41E+02 5.33E+02 6.19E+02	3.57E+02 1.59E+00 3.94E+03	7.39E+02 7.63E+02 6.70E+02	1.14 1.12 1.38	4315 3918 397	83% 86% 56%	72 72 72	46 46 46
241-SY-101 SY-101 liquid SY-101 solid	648 (1.25)	5.16E+03 4.86E+03 6.17E+03	7.36E+04 6.93E+04 8.79E+04	1.18E+05 1.11E+05 1.41E+05	1.12E+04 1.06E+04 1.34E+04	1.06E+01 2.13E+00 4.13E+01	1.42E+02 1.50E+02 1.42E+02	1.34 1.28 1.51	4315 3275 984	64% 67% 53%	37 37 37	31 31 31
241-SY-102 SY-102 liquid SY-102 solid	401 (1.11)	1.17E+03 1.16E+03 1.29E+03	5.50E+04 5.46E+04 6.06E+04	8.76E+04 8.70E+04 9.66E+04	1.61E+04 1.60E+04 1.78E+04	9.22E+00 5.65E+00 6.45E+01	2.62E+02 2.75E+02 1.16E+02	1.24 1.23 1.44	4315 4046 269	85% 88% 51%	41 41 41	41 41 41
241-SY-103 SY-103 liquid SY-103 solid	1477 (1.96)	3.93E+03 3.06E+03 6.16E+03	9.73E+04 7.57E+04 1.52E+05	1.07E+05 8.35E+04 1.68E+05	2.40E+04 1.87E+04 3.76E+04	9.77E+00 9.58E-01 3.53E+01	1.65E+02 1.57E+02 2.36E+02	1.34 1.23 1.61	4315 3020 1213	57% 69% 34%	35 35 35	31 31 31

Table F-2. Water Addition Study: Derived Data for Hydrogen Generation Rate Model Calculations for 28 DSTs. (4 sheets)

Tank	Waste level D_w (inch)	Total mass M (kg)	Liquid in waste (wt%)	Wetted area A_{wet} (ft ²)	Heat load per kg H_L (watt/kg)	Tank heat load H_L (watt)	NO_3 in liquid [NO_3] _{lm} (mole/L)	NO_2 in liquid [NO_2] _{lm} (mole/L)	TOC in liquid [TOC] (wt%)	Aluminum in liquid [Al] (wt%)	G values for water G_{H_2O} (H_2 /100eV)	Total G values G_{TOT} (H_2 /100eV)
241-AY-102												
AY-102 liquid	272.3	3.36E+06	85%	9765	8.70E-03	2.92E+04	0.01	0.08	0.12	0.106	0.167	0.182
AY-102 solid	210.4	2.46E+06	100%	4131	1.12E-04	2.75E+02	0.005	0.104	0.12	0.106	0.150	0.161
241-AN-101												
AN-101 liquid	62.0	9.03E+05	43%	5635	4.00E-02	3.61E+04	0.005	0.005	0.12	0.106	0.282	0.322
AN-101 solid	413.9	4.48E+06	100%	12546	8.92E-05	3.99E+02	0.27	0.21	0.03	0.25	0.005	0.006
241-AN-102												
AN-102 liquid	413.9	4.48E+06	100%	8128	8.92E-05	3.99E+02	0.27	0.21	0.03	0.25	0.005	0.006
AN-102 solid	0.0	0.00E+00	0%	4418	8.10E-05	0.00E+00	0.24	0.18	0.03	0.25	0.005	0.005
241-AN-103												
AN-103 liquid	413.9	6.07E+06	98%	12546	1.36E-03	8.27E+03	3.53	1.90	1.70	1.06	0.005	0.086
AN-103 solid	381.6	5.55E+06	100%	7493	1.30E-03	7.20E+03	3.51	1.89	1.70	1.06	0.005	0.086
241-AN-104												
AN-104 liquid	32.3	5.26E+05	79%	5053	2.28E-03	1.20E+03	3.82	2.05	1.70	1.06	0.005	0.086
AN-104 solid	413.9	6.32E+06	80%	12546	1.21E-03	7.68E+03	2.14	2.82	0.13	1.53	0.005	0.014
241-AN-105												
AN-105 liquid	266.9	3.69E+06	100%	5240	1.40E-03	5.17E+03	1.83	2.41	0.13	1.53	0.005	0.014
AN-105 solid	147.1	2.64E+06	53%	7305	1.24E-03	3.26E+03	2.70	3.57	0.13	1.53	0.005	0.014
241-AN-106												
AN-106 liquid	413.9	6.17E+06	91%	12546	1.44E-03	8.80E+03	2.45	2.16	0.19	2.38	0.005	0.019
AN-106 solid	247.4	3.41E+06	100%	4858	1.44E-03	4.92E+03	2.24	1.97	0.19	2.38	0.005	0.019
241-AN-107												
AN-107 liquid	166.5	2.76E+06	79%	7688	1.73E-03	4.77E+03	2.77	2.44	0.19	2.38	0.005	0.019
AN-107 solid	413.9	6.42E+06	93%	12546	1.00E-03	6.46E+03	2.52	2.55	0.24	2.79	0.005	0.020
241-AN-108												
AN-108 liquid	244.0	3.55E+06	100%	4790	9.89E-04	3.52E+03	2.47	2.49	0.24	2.79	0.005	0.020
AN-108 solid	170.0	2.87E+06	85%	7755	1.19E-03	3.41E+03	2.61	2.63	0.24	2.79	0.005	0.020
241-AN-109												
AN-109 liquid	413.9	4.37E+06	99%	12546	1.90E-05	8.30E+01	0.04	0.01	0.01	0.01	0.159	0.159
AN-109 solid	407.8	4.27E+06	100%	8007	5.32E-06	2.27E+01	0.02	0.01	0.01	0.01	0.210	0.210
241-AN-110												
AN-110 liquid	6.1	1.01E+05	40%	4538	9.39E-04	9.49E+01	1.14	0.41	0.01	0.01	0.005	0.005

Table F-2. Water Addition Study: Derived Data for Hydrogen Generation Rate Model Calculations for 28 DSTs. (4 sheets)

Tank	Waste level D_w (inch)	Total mass M (kg)	Liquid in waste (wt%)	Wetted area A_{wet} (ft ²)	Heat load per kg H_L (watt/kg)	Tank heat load H_L (watt)	NO_3 in liquid $[NO_3]_M$ (mole/L)	NO_2 in liquid $[NO_2]_M$ (mole/L)	TOC in liquid [TOC] (wt%)	Aluminum in liquid [Al] (wt%)	G values for water G_{H_2O} (H ₂ /100eV)	Total G values G_{TOT} (H ₂ /100eV)
241-AN-107	413.9	5.95E+06	94%	12546	1.58E-03	9.38E+03	3.53	1.31	2.78	0.02	0.005	0.126
AN-107 liquid	324.3	4.49E+06	100%	6367	1.50E-03	6.75E+03	3.44	1.28	2.78	0.02	0.005	0.126
AN-107 solid	89.7	1.46E+06	74%	6179	2.12E-03	3.09E+03	3.86	1.44	2.78	0.02	0.005	0.126
241-AP-101	413.9	5.62E+06	100%	12546	5.00E-04	2.81E+03	2.08	0.89	0.15	0.52	0.005	0.009
AP-101 liquid	413.9	5.62E+06	100%	12546	5.00E-04	2.81E+03	2.08	0.89	0.15	0.52	0.005	0.009
AP-101 solid	0	0	0	0	0	0	0	0	0	0	0	0
241-AP-102	413.9	5.14E+06	100%	12546	7.23E-04	3.72E+03	1.21	0.79	0.27	0.93	0.005	0.013
AP-102 liquid	413.9	5.14E+06	100%	12546	7.23E-04	3.72E+03	1.21	0.79	0.27	0.93	0.005	0.013
AP-102 solid	0	0	0	0	0	0	0	0	0	0	0	0
241-AP-103	413.9	4.65E+06	100%	12546	2.19E-04	1.02E+03	0.55	0.58	0.09	0.20	0.005	0.007
AP-103 liquid	413.9	4.65E+06	100%	12546	2.19E-04	1.02E+03	0.55	0.58	0.09	0.20	0.005	0.007
AP-103 solid	0	0	0	0	0	0	0	0	0	0	0	0
241-AP-104	413.9	5.36E+06	100%	12546	7.16E-04	3.84E+03	1.63	1.25	0.40	1.35	0.005	0.017
AP-104 liquid	413.9	5.36E+06	100%	12546	7.16E-04	3.84E+03	1.63	1.25	0.40	1.35	0.005	0.017
AP-104 solid	0	0	0	0	0	0	0	0	0	0	0	0
241-AP-105	413.9	5.90E+06	98%	12546	7.20E-04	4.24E+03	3.84	2.21	0.21	1.54	0.005	0.011
AP-105 liquid	381.6	5.36E+06	100%	7493	7.20E-04	3.86E+03	3.84	2.21	0.21	1.54	0.005	0.011
AP-105 solid	32.3	5.32E+05	73%	5053	8.42E-04	4.48E+02	3.85	2.22	0.21	1.54	0.005	0.011
241-AP-106	413.9	4.93E+06	100%	12546	3.76E-04	1.85E+03	0.81	0.69	0.20	0.69	0.005	0.011
AP-106 liquid	413.9	4.93E+06	100%	12546	3.76E-04	1.85E+03	0.81	0.69	0.20	0.69	0.005	0.011
AP-106 solid	0	0	0	0	0	0	0	0	0	0	0	0

Table F-2. Water Addition Study: Derived Data for Hydrogen Generation Rate Model Calculations for 28 DSTs. (4 sheets)

Tank	Waste level D_w (inch)	Total mass M (kg)	Liquid in waste (wt%)	Wetted area A_{wet} (ft ²)	Heat load per kg H_L (watt/kg)	Tank heat load H_U (watt)	NO_3 in liquid $[NO_3]_M$ (mole/L)	NO_2 in liquid $[NO_2]_M$ (mole/L)	TOC in liquid [TOC] (wt%)	Aluminum in liquid [Al] (wt%)	G values for water G_{H_2O} (H ₂ /100eV)	Total G values G_{TOT} (H ₂ /100eV)
241-AP-107												
AP-107 liquid	413.9	5.24E+06	100%	12546	5.56E-04	2.92E+03	1.84	1.04	0.28	1.10	0.005	0.015
AP-107 solid	0	0	0	0	0	0	0	0	0	0	0	0
241-AP-108												
AP-108 liquid	413.9	4.35E+06	100%	12546	9.50E-06	4.13E+01	0.04	0.02	0.00	0.03	0.153	0.153
AP-108 solid	0	0	0	0	0	0	0	0	0	0	0	0
241-AW-101												
AW-101 liquid	413.9	6.44E+06	95%	12546	1.30E-03	8.40E+03	2.65	2.52	0.26	2.16	0.005	0.021
AW-101 solid	282.1	4.26E+06	100%	5540	1.35E-03	5.73E+03	2.61	2.48	0.26	2.16	0.005	0.021
241-AW-102												
AW-102 liquid	413.9	4.37E+06	98%	12546	9.92E-05	4.34E+02	0.01	0.00	0.00	0.00	0.301	0.301
AW-102 solid	403.0	4.20E+06	100%	7913	4.27E-07	1.80E+00	0.00	0.00	0.00	0.00	0.320	0.320
241-AW-103												
AW-103 liquid	10.9	1.70E+05	40%	4633	3.79E-03	6.43E+02	0.07	0.02	0.00	0.00	0.096	0.096
AW-103 solid	413.9	5.62E+06	87%	12546	3.55E-04	2.00E+03	1.93	0.84	0.17	0.91	0.005	0.010
241-AW-104												
AW-104 liquid	300.4	3.85E+06	100%	5898	4.59E-04	1.77E+03	1.91	0.83	0.17	0.91	0.005	0.010
AW-104 solid	113.6	1.77E+06	59%	6648	1.59E-04	2.82E+02	2.00	0.87	0.17	0.91	0.005	0.010
241-AW-105												
AW-105 liquid	413.9	4.75E+06	88%	12546	1.54E-04	7.32E+02	0.44	0.40	0.01	0.00	0.005	0.005
AW-105 solid	333.1	3.50E+06	100%	6540	1.91E-06	6.69E+00	0.02	0.00	0.01	0.00	0.228	0.228
241-AW-106												
AW-106 liquid	80.9	1.26E+06	54%	6006	8.54E-04	1.07E+03	2.18	2.03	0.01	0.00	0.005	0.005
AW-106 solid	413.9	4.66E+06	91%	12546	1.18E-04	5.50E+02	0.21	0.02	0.02	0.00	0.005	0.005
241-AW-107												
AW-107 liquid	321.4	3.40E+06	100%	6310	8.80E-06	2.99E+01	0.11	0.01	0.02	0.00	0.091	0.091
AW-107 solid	92.6	1.26E+06	67%	6235	5.32E-04	6.70E+02	0.55	0.05	0.02	0.00	0.005	0.005

Table F-2. Water Addition Study: Derived Data for Hydrogen Generation Rate Model Calculations for 28 DSTs. (4 sheets)

Tank	Waste level D_w (inch)	Total mass M (kg)	Liquid in waste (wt%)	Wetted area A_{wet} (ft ²)	Heat load per kg H_L (watt/kg)	Tank heat load H_L (watt)	NO ₃ in liquid [NO ₃] _{liq} (mole/L)	NO ₂ in liquid [NO ₂] _{liq} (mole/L)	TOC in liquid [TOC] (wt%)	Aluminum in liquid [Al] (wt%)	G values for water G_{H_2O} (H ₂ /100eV)	Total G values G_{TOT} (H ₂ /100eV)
241-AW-106	413.9	4.91E+06	88%	12546	2.02E-04	9.92E+02	0.69	0.30	0.02	0.10	0.005	0.006
AW-106 liquid	327.1	3.48E+06	100%	6423	3.64E-05	1.27E+02	0.17	0.08	0.02	0.10	0.005	0.006
AW-106 solid	86.8	1.43E+06	57%	6122	9.37E-04	1.34E+03	2.63	1.14	0.02	0.10	0.005	0.006
241-AY-101	413.9	4.49E+06	95%	12546	1.22E-03	5.49E+03	0.01	0.15	0.01	0.020	0.084	0.085
AY-101 liquid	378.9	4.02E+06	100%	7440	1.35E-05	5.44E+01	0.01	0.06	0.01	0.020	0.178	0.179
AY-101 solid	29.7	4.72E+05	49%	5002	1.72E-02	8.13E+03	0.11	1.42	0.01	0.020	0.005	0.006
241-AY-102	413.9	4.84E+06	89%	12546	5.78E-03	2.79E+04	0.00	0.05	0.07	0.066	0.204	0.212
AY-102 liquid	352.0	3.93E+06	100%	6911	6.70E-05	2.63E+02	0.00	0.06	0.07	0.066	0.197	0.204
AY-102 solid	62.0	9.03E+05	41%	5635	4.00E-02	3.61E+04	0.00	0.00	0.07	0.066	0.282	0.307
241-AZ-101	413.9	5.25E+06	98%	12546	9.65E-03	5.06E+04	0.85	1.17	0.02	0.52	0.005	0.010
AZ-101 liquid	395.0	4.93E+06	100%	7757	5.24E-03	2.58E+04	0.84	1.16	0.02	0.52	0.005	0.010
AZ-101 solid	18.9	3.19E+05	72%	4789	1.05E-01	3.36E+04	1.03	1.41	0.02	0.52	0.005	0.013
241-AZ-102	413.9	4.94E+06	96%	12546	5.88E-03	2.90E+04	0.24	0.62	0.08	0.05	0.005	0.032
AZ-102 liquid	375.9	4.39E+06	100%	7380	3.62E-03	1.59E+04	0.24	0.62	0.08	0.05	0.005	0.032
AZ-102 solid	38.1	5.48E+05	65%	5166	2.95E-02	1.62E+04	0.28	0.71	0.08	0.05	0.005	0.032
241-SY-101	413.9	5.76E+06	95%	12546	7.45E-04	4.29E+03	1.90	1.60	0.38	0.82	0.005	0.027
SY-101 liquid	319.6	4.28E+06	100%	6274	7.23E-04	3.09E+03	1.79	1.51	0.38	0.82	0.005	0.027
SY-101 solid	94.4	1.49E+06	79%	6271	9.48E-04	1.41E+03	2.27	1.91	0.38	0.82	0.005	0.027
241-SY-102	413.9	5.34E+06	97%	12546	1.30E-03	6.95E+03	1.41	1.20	0.09	1.31	0.005	0.012
SY-102 liquid	388.1	4.96E+06	100%	7621	1.34E-03	6.63E+03	1.40	1.19	0.09	1.31	0.005	0.012
SY-102 solid	25.8	3.87E+05	58%	4925	9.80E-04	3.80E+02	1.56	1.32	0.09	1.31	0.005	0.012
241-SY-103	413.9	5.78E+06	83%	12546	8.45E-04	4.88E+03	1.73	2.11	0.25	1.52	0.005	0.018
SY-103 liquid	297.6	3.83E+06	100%	5843	7.48E-04	2.86E+03	1.35	1.65	0.25	1.52	0.005	0.018
SY-103 solid	116.4	1.95E+06	49%	6703	1.35E-03	2.64E+03	2.71	3.31	0.25	1.52	0.005	0.018

Table F-3. Water Addition Study: Hydrogen Generation Rates as Mole Per Unit Waste in 28 DSTs. (4 sheets)

Tank	HGR from radiolysis RC _{rad} (mole/kg-d)	HGR from thermolysis RC _{therm} (mole/kg-d)	HGR from corrosion RC _{corr} (mole/kg-d)	Total HGR from model RC _{tot} (mole/kg-d)	HGR from radiolysis RC _{rad} (mole/m ³ -s)	HGR from thermolysis RC _{therm} (mole/m ³ -s)	HGR from corrosion RC _{corr} (mole/m ³ -s)	Total HGR from model RC _{tot} (mole/m ³ -s)
241-AY-102								
AY-102 liquid	1.20E-05	3.51E-07	2.93E-07	1.26E-05	1.64E-07	4.81E-09	4.01E-09	1.73E-07
AY-102 solid	1.61E-07	1.95E-07	1.69E-07	5.26E-07	2.09E-09	2.53E-09	2.19E-09	6.82E-09
	4.91E-05	1.17E-06	6.28E-07	5.09E-05	7.94E-07	1.89E-08	1.02E-08	8.23E-07
241-AN-101								
AN-101 liquid	4.58E-09	5.73E-09	2.82E-07	2.92E-07	5.50E-11	6.88E-11	3.39E-09	3.51E-09
AN-101 solid	4.58E-09	5.73E-09	1.83E-07	1.93E-07	5.50E-11	6.88E-11	2.19E-09	2.32E-09
	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
241-AN-102								
AN-102 liquid	1.02E-06	1.86E-06	2.08E-07	3.09E-06	1.67E-08	3.02E-08	3.39E-09	5.03E-08
AN-102 solid	9.94E-07	1.89E-06	1.36E-07	3.02E-06	1.61E-08	3.05E-08	2.19E-09	4.88E-08
	1.38E-06	1.50E-06	9.67E-07	3.85E-06	2.50E-08	2.71E-08	1.75E-08	6.95E-08
241-AN-103								
AN-103 liquid	1.27E-07	3.15E-07	2.00E-07	6.41E-07	2.15E-09	5.34E-09	3.39E-09	1.09E-08
AN-103 solid	1.82E-07	3.92E-07	1.43E-07	7.17E-07	2.79E-09	6.01E-09	2.19E-09	1.10E-08
	8.48E-08	2.07E-07	2.79E-07	5.71E-07	1.69E-09	4.12E-09	5.55E-09	1.14E-08
241-AN-104								
AN-104 liquid	2.24E-07	6.54E-07	2.05E-07	1.08E-06	3.70E-09	1.08E-08	3.39E-09	1.79E-08
AN-104 solid	2.47E-07	7.22E-07	1.43E-07	1.11E-06	3.79E-09	1.10E-08	2.19E-09	1.70E-08
	2.34E-07	5.70E-07	2.80E-07	1.08E-06	4.31E-09	1.05E-08	5.16E-09	1.99E-08
241-AN-105								
AN-105 liquid	1.71E-07	6.69E-07	1.97E-07	1.04E-06	2.94E-09	1.15E-08	3.39E-09	1.79E-08
AN-105 solid	1.80E-07	7.18E-07	1.36E-07	1.03E-06	2.92E-09	1.16E-08	2.19E-09	1.67E-08
	1.84E-07	6.09E-07	2.72E-07	1.07E-06	3.45E-09	1.14E-08	5.10E-09	2.00E-08
241-AN-106								
AN-106 liquid	2.67E-08	3.18E-10	2.89E-07	3.16E-07	3.13E-10	3.72E-12	3.39E-09	3.70E-09
AN-106 solid	1.00E-08	3.22E-10	1.89E-07	1.99E-07	1.16E-10	3.74E-12	2.19E-09	2.31E-09
	1.77E-08	1.30E-10	4.52E-06	4.54E-06	3.23E-10	2.37E-12	8.26E-08	8.29E-08

Table F-3. Water Addition Study: Hydrogen Generation Rates as Mole Per Unit Waste in 28 DSTs. (4 sheets)

Tank	HGR from radiolysis RC _{rad} (mole/kg-d)	HGR from thermolysis RC _{therm} (mole/kg-d)	HGR from corrosion RC _{corr} (mole/kg-d)	Total HGR from model RC _{tot} (mole/kg-d)	HGR from radiolysis RC _{rad} (mole/m ³ -s)	HGR from thermolysis RC _{therm} (mole/m ³ -s)	HGR from corrosion RC _{corr} (mole/m ³ -s)	Total HGR from model RC _{tot} (mole/m ³ -s)
241-AN-107								
AN-107 liquid	1.67E-06	4.96E-07	2.12E-07	2.38E-06	2.66E-08	7.92E-09	3.39E-09	3.79E-08
AN-107 solid	1.70E-06	5.30E-07	1.43E-07	2.37E-06	2.61E-08	8.15E-09	2.19E-09	3.64E-08
	1.77E-06	3.93E-07	4.26E-07	2.59E-06	3.20E-08	7.09E-09	7.70E-09	4.68E-08
241-AP-101								
AP-101 liquid	3.98E-08	3.81E-08	2.25E-07	3.03E-07	6.00E-10	5.75E-10	3.39E-09	4.56E-09
AP-101 solid	0	0	0	0	0	0	0	0
241-AP-102								
AP-102 liquid	8.27E-08	1.03E-07	2.46E-07	4.31E-07	1.14E-09	1.41E-09	3.39E-09	5.94E-09
AP-102 solid	8.27E-08	1.03E-07	2.46E-07	4.31E-07	1.14E-09	1.41E-09	3.39E-09	5.94E-09
	0	0	0	0	0	0	0	0
241-AP-103								
AP-103 liquid	1.46E-08	1.66E-08	2.72E-07	3.03E-07	1.82E-10	2.07E-10	3.39E-09	3.78E-09
AP-103 solid	1.46E-08	1.66E-08	2.72E-07	3.03E-07	1.82E-10	2.07E-10	3.39E-09	3.78E-09
	0	0	0	0	0	0	0	0
241-AP-104								
AP-104 liquid	1.09E-07	1.93E-07	2.35E-07	5.37E-07	1.56E-09	2.77E-09	3.39E-09	7.72E-09
AP-104 solid	1.09E-07	1.93E-07	2.35E-07	5.37E-07	1.56E-09	2.77E-09	3.39E-09	7.72E-09
	0	0	0	0	0	0	0	0
241-AP-105								
AP-105 liquid	6.98E-08	9.77E-08	2.14E-07	3.82E-07	1.10E-09	1.54E-09	3.39E-09	6.04E-09
AP-105 solid	7.16E-08	1.00E-07	1.41E-07	3.12E-07	1.12E-09	1.56E-09	2.19E-09	4.87E-09
	6.07E-08	7.27E-08	9.55E-07	1.09E-06	1.11E-09	1.33E-09	1.75E-08	1.99E-08
241-AP-106								
AP-106 liquid	3.65E-08	6.93E-08	2.56E-07	3.62E-07	4.82E-10	9.16E-10	3.39E-09	4.79E-09
AP-106 solid	3.65E-08	6.93E-08	2.56E-07	3.62E-07	4.82E-10	9.16E-10	3.39E-09	4.79E-09
	0	0	0	0	0	0	0	0

Table F-3. Water Addition Study: Hydrogen Generation Rates as Mole Per Unit Waste in 28 DSTs. (4 sheets)

Tank	HGR from radiolysis RC_{rad} (mole/kg-d)	HGR from thermolysis RC_{therm} (mole/kg-d)	HGR from corrosion RC_{corr} (mole/kg-d)	Total HGR from model RC_{tot} (mole/kg-d)	HGR from radiolysis RC_{rad} (mole/m ³ -s)	HGR from thermolysis RC_{therm} (mole/m ³ -s)	HGR from corrosion RC_{corr} (mole/m ³ -s)	Total HGR from model RC_{tot} (mole/m ³ -s)
241-AP-107 AP-107 liquid AP-107 solid	7.68E-08 7.68E-08 0	1.95E-07 1.95E-07 0	2.41E-07 2.41E-07 0	5.13E-07 5.13E-07 0	1.08E-09 1.08E-09 0	2.75E-09 2.75E-09 0	3.39E-09 3.39E-09 0	7.21E-09 7.21E-09 0
241-AP-108 AP-108 liquid AP-108 solid	1.31E-08 1.31E-08 0	2.09E-10 2.09E-10 0	2.91E-07 2.91E-07 0	3.04E-07 3.04E-07 0	1.52E-10 1.52E-10 0	2.43E-12 2.43E-12 0	3.39E-09 3.39E-09 0	3.54E-09 3.54E-09 0
241-AW-101 AW-101 liquid AW-101 solid	2.34E-07 2.54E-07 2.17E-07	6.17E-07 6.49E-07 5.55E-07	1.96E-07 1.31E-07 3.23E-07	1.05E-06 1.03E-06 1.09E-06	4.04E-09 4.25E-09 3.99E-09	1.07E-08 1.09E-08 1.02E-08	3.39E-09 2.19E-09 5.94E-09	1.81E-08 1.73E-08 2.01E-08
241-AW-102 AW-102 liquid AW-102 solid	2.61E-07 1.22E-09 1.31E-06	2.20E-11 2.25E-11 9.05E-12	2.89E-07 1.89E-07 2.75E-06	5.50E-07 1.91E-07 4.06E-06	3.06E-09 1.42E-11 2.26E-08	2.58E-13 2.60E-13 1.56E-13	3.39E-09 2.19E-09 4.73E-08	6.45E-09 2.21E-09 7.00E-08
241-AW-103 AW-103 liquid AW-103 solid	2.66E-08 3.95E-08 8.07E-09	5.21E-08 5.99E-08 3.53E-08	2.25E-07 1.54E-07 3.77E-07	3.03E-07 2.54E-07 4.21E-07	4.02E-10 5.62E-10 1.40E-10	7.86E-10 8.52E-10 6.12E-10	3.39E-09 2.19E-09 6.54E-09	4.57E-09 3.61E-09 7.29E-09
241-AW-104 AW-104 liquid AW-104 solid	6.35E-09 3.91E-09 2.17E-08	2.33E-10 2.65E-10 1.43E-10	2.66E-07 1.88E-07 4.81E-07	2.72E-07 1.92E-07 5.03E-07	8.09E-11 4.56E-11 3.74E-10	2.97E-12 3.09E-12 2.47E-12	3.39E-09 2.19E-09 8.30E-09	3.47E-09 2.24E-09 8.68E-09
241-AW-105 AW-105 liquid AW-105 solid	5.18E-09 7.21E-09 1.71E-08	4.10E-10 4.51E-10 3.00E-10	2.71E-07 1.87E-07 4.98E-07	2.77E-07 1.95E-07 5.15E-07	6.47E-11 8.46E-11 2.58E-10	5.12E-12 5.29E-12 4.54E-12	3.39E-09 2.19E-09 7.53E-09	3.46E-09 2.28E-09 7.79E-09

Table F-3. Water Addition Study: Hydrogen Generation Rates as Mole Per Unit Waste in 28 DSTs. (4 sheets)

Tank	HGR from radiolysis RC_{rad} (mole/kg-d)	HGR from thermolysis RC_{therm} (mole/kg-d)	HGR from corrosion RC_{corr} (mole/kg-d)	Total HGR from model RC_{tot} (mole/kg-d)	HGR from radiolysis RC_{rad} (mole/m ³ -s)	HGR from thermolysis RC_{therm} (mole/m ³ -s)	HGR from corrosion RC_{corr} (mole/m ³ -s)	Total HGR from model RC_{tot} (mole/m ³ -s)
241-AW-106	9.92E-09	1.63E-08	2.57E-07	2.83E-07	1.31E-10	2.14E-10	3.39E-09	3.73E-09
AW-106 liquid	2.04E-09	1.86E-08	1.86E-07	2.06E-07	2.41E-11	2.20E-10	2.19E-09	2.44E-09
AW-106 solid	3.01E-08	1.07E-08	4.31E-07	4.72E-07	5.51E-10	1.95E-10	7.88E-09	8.63E-09
241-AY-101	8.84E-07	7.09E-09	2.81E-07	1.17E-06	1.07E-08	8.54E-11	3.39E-09	1.41E-08
AY-101 liquid	2.17E-08	7.49E-09	1.86E-07	2.15E-07	2.56E-10	8.82E-11	2.19E-09	2.54E-09
AY-101 solid	4.48E-07	3.69E-09	1.07E-06	1.52E-06	7.89E-09	6.49E-11	1.88E-08	2.68E-08
241-AY-102	9.78E-06	1.52E-07	2.61E-07	1.02E-05	1.27E-07	1.98E-09	3.39E-09	1.32E-07
AY-102 liquid	1.22E-07	1.01E-07	1.77E-07	4.00E-07	1.52E-09	1.25E-09	2.19E-09	4.97E-09
AY-102 solid	4.48E-05	5.80E-07	6.28E-07	4.60E-05	7.25E-07	9.37E-09	1.02E-08	7.44E-07
241-AZ-101	8.81E-07	4.91E-07	2.41E-07	1.61E-06	1.24E-08	6.91E-09	3.39E-09	2.27E-08
AZ-101 liquid	4.79E-07	4.70E-07	1.58E-07	1.11E-06	6.63E-09	6.50E-09	2.19E-09	1.53E-08
AZ-101 solid	9.20E-06	9.08E-07	1.51E-06	1.16E-05	1.72E-07	1.70E-08	2.83E-08	2.18E-07
241-AZ-102	1.63E-06	1.29E-06	2.56E-07	3.18E-06	2.15E-08	1.71E-08	3.39E-09	4.21E-08
AZ-102 liquid	1.04E-06	1.35E-06	1.69E-07	2.56E-06	1.35E-08	1.75E-08	2.19E-09	3.32E-08
AZ-102 solid	5.52E-06	8.75E-07	9.49E-07	7.34E-06	8.81E-08	1.40E-08	1.52E-08	1.17E-07
241-SY-101	1.69E-07	5.36E-07	2.19E-07	9.24E-07	2.62E-09	8.28E-09	3.39E-09	1.43E-08
SY-101 liquid	1.74E-07	5.67E-07	1.48E-07	8.89E-07	2.58E-09	8.43E-09	2.19E-09	1.32E-08
SY-101 solid	1.79E-07	4.46E-07	4.25E-07	1.05E-06	3.14E-09	7.80E-09	7.43E-09	1.84E-08
241-SY-102	1.36E-07	2.76E-07	2.36E-07	6.48E-07	1.95E-09	3.95E-09	3.39E-09	9.29E-09
SY-102 liquid	1.44E-07	2.84E-07	1.55E-07	5.83E-07	2.05E-09	4.03E-09	2.19E-09	8.27E-09
SY-102 solid	6.14E-08	1.65E-07	1.28E-06	1.51E-06	1.02E-09	2.75E-09	2.13E-08	2.51E-08
241-SY-103	1.15E-07	3.43E-07	2.18E-07	6.77E-07	1.79E-09	5.32E-09	3.39E-09	1.05E-08
SY-103 liquid	1.23E-07	4.14E-07	1.54E-07	6.91E-07	1.76E-09	5.92E-09	2.19E-09	9.87E-09
SY-103 solid	1.09E-07	2.03E-07	3.45E-07	6.57E-07	2.03E-09	3.78E-09	6.44E-09	1.22E-08

Table F-4. Water Addition Study: Hydrogen Generation Rates in Dome Space for 28 DSTs. (4 sheets)

Tank	HGR from radiolysis G_{rad} (cfm)	HGR from thermolysis G_{therm} (cfm)	HGR from corrosion G_{corr} (cfm)	HGR from radiolysis percent (G_{rad})%	HGR from thermolysis percent (G_{therm})%	HGR from corrosion percent (G_{corr})%	Total HGR from model G_{mod} (cfm)	Total HGR from model G_{mod} (L/day)
241-AY-102								
AY-102 liquid	2.84E-02	9.791E-04	6.23E-04	94.7%	3.3%	2.1%	3.00E-02	1228
AY-102 solid	2.51E-04	3.06E-04	2.64E-04	30.6%	37.3%	32.1%	8.21E-04	34
	2.81E-02	6.73E-04	3.60E-04	96.5%	2.3%	1.2%	2.91E-02	1194
241-AN-101								
AN-101 liquid	1.22E-05	1.54E-05	4.88E-04	2.4%	3.0%	94.6%	5.16E-04	21
AN-101 solid	1.22E-05	1.54E-05	4.88E-04	2.4%	3.0%	94.6%	5.16E-04	21
	0.00E+00	0.00E+00	0.00E+00	0.0%	0.0%	0.0%	0.00E+00	0
241-AN-102								
AN-102 liquid	3.81E-03	6.91E-03	7.70E-04	33.2%	60.1%	6.7%	1.15E-02	471
AN-102 solid	3.36E-03	6.42E-03	4.60E-04	32.8%	62.7%	4.5%	1.02E-02	420
	4.44E-04	4.82E-04	3.10E-04	35.9%	39.0%	25.1%	1.24E-03	51
241-AN-103								
AN-103 liquid	5.45E-04	1.22E-03	7.70E-04	21.5%	48.1%	30.4%	2.61E-03	107
AN-103 solid	4.08E-04	8.85E-04	3.21E-04	25.3%	54.8%	19.9%	1.64E-03	67
	1.36E-04	3.35E-04	4.48E-04	14.8%	36.4%	48.8%	9.71E-04	40
241-AN-104								
AN-104 liquid	9.11E-04	2.48E-03	7.73E-04	21.9%	59.6%	18.6%	4.34E-03	178
AN-104 solid	5.16E-04	1.51E-03	2.99E-04	22.2%	65.0%	12.8%	2.37E-03	97
	3.95E-04	9.66E-04	4.73E-04	21.5%	52.7%	25.8%	1.97E-03	81
241-AN-105								
AN-105 liquid	7.12E-04	2.64E-03	7.70E-04	17.3%	64.0%	18.7%	4.22E-03	173
AN-105 solid	3.91E-04	1.56E-03	2.94E-04	17.4%	69.5%	13.1%	2.27E-03	93
	3.22E-04	1.07E-03	4.76E-04	17.2%	57.3%	25.5%	1.95E-03	80
241-AN-106								
AN-106 liquid	2.64E-05	8.26E-07	7.48E-04	3.4%	0.1%	96.5%	7.76E-04	32
AN-106 solid	2.53E-05	8.18E-07	4.78E-04	5.0%	0.2%	94.8%	5.04E-04	21
	1.06E-06	7.82E-09	2.71E-04	0.4%	0.0%	99.6%	2.72E-04	11

Table F-4. Water Addition Study: Hydrogen Generation Rates in Dome Space for 28 DSTs. (4 sheets)

Tank	HGR from radiolysis G_{rad} (cfm)	HGR from thermolysis G_{therm} (cfm)	HGR from corrosion G_{corr} (cfm)	HGR from radiolysis percent (G_{rad})%	HGR from thermolysis percent (G_{therm})%	HGR from corrosion percent (G_{corr})%	Total HGR from model G_{mod} (cfm)	Total HGR from model G_{mod} (L/day)
241-AN-107	6.16E-03	1.79E-03	7.63E-04	70.7%	20.6%	8.7%	8.72E-03	357
AN-107 liquid	4.60E-03	1.44E-03	3.87E-04	71.5%	22.4%	6.0%	6.43E-03	264
AN-107 solid	1.56E-03	3.48E-04	3.76E-04	68.3%	15.2%	16.4%	2.29E-03	94
241-AP-101	1.33E-04	1.28E-04	7.49E-04	13.2%	12.7%	74.2%	1.01E-03	41
AP-101 liquid	1.33E-04	1.28E-04	7.49E-04	13.2%	12.7%	74.2%	1.01E-03	41
AP-101 solid	0	0	0	0	0	0	0	0
241-AP-102	2.53E-04	3.16E-04	7.52E-04	19.2%	23.9%	56.9%	1.32E-03	54
AP-102 liquid	2.53E-04	3.16E-04	7.52E-04	19.2%	23.9%	56.9%	1.32E-03	54
AP-102 solid	0	0	0	0	0	0	0	0
241-AP-103	4.03E-05	4.62E-05	7.50E-04	4.8%	5.5%	89.7%	8.37E-04	34
AP-103 liquid	4.03E-05	4.62E-05	7.50E-04	4.8%	5.5%	89.7%	8.37E-04	34
AP-103 solid	0	0	0	0	0	0	0	0
241-AP-104	3.47E-04	6.19E-04	7.52E-04	20.2%	36.0%	43.8%	1.72E-03	70
AP-104 liquid	3.47E-04	6.19E-04	7.52E-04	20.2%	36.0%	43.8%	1.72E-03	70
AP-104 solid	0	0	0	0	0	0	0	0
241-AP-105	2.44E-04	3.39E-04	7.39E-04	18.4%	25.6%	55.9%	1.32E-03	54
AP-105 liquid	2.25E-04	3.16E-04	4.41E-04	22.9%	32.2%	44.9%	9.82E-04	40
AP-105 solid	1.89E-05	2.27E-05	2.98E-04	5.6%	6.7%	87.7%	3.39E-04	14
241-AP-106	1.07E-04	2.04E-04	7.52E-04	10.1%	19.2%	70.7%	1.06E-03	44
AP-106 liquid	1.07E-04	2.04E-04	7.52E-04	10.1%	19.2%	70.7%	1.06E-03	44
AP-106 solid	0	0	0	0	0	0	0	0

Table F-4. Water Addition Study: Hydrogen Generation Rates in Dome Space for 28 DSTs. (4 sheets)

Tank	HGR from radiolysis G_{rad} (cfm)	HGR from thermolysis G_{therm} (cfm)	HGR from corrosion G_{corr} (cfm)	HGR from radiolysis percent (G_{rad})%	HGR from thermolysis percent (G_{therm})%	HGR from corrosion percent (G_{corr})%	Total HGR from model G_{mod} (cfm)	Total HGR from model G_{mod} (L/day)
241-AP-107								
AP-107 liquid	2.41E-04	6.17E-04	7.57E-04	14.9%	38.2%	46.9%	1.61E-03	66
AP-107 solid	0	0	0	0	0	0	0	0
241-AP-108								
AP-108 liquid	3.37E-05	5.41E-07	7.50E-04	4.3%	0.1%	95.6%	7.84E-04	32
AP-108 solid	3.37E-05	5.41E-07	7.50E-04	4.3%	0.1%	95.6%	7.84E-04	32
241-AW-101								
AW-101 liquid	9.43E-04	2.42E-03	7.66E-04	22.8%	58.6%	18.5%	4.20E-03	172
AW-101 solid	6.56E-04	1.68E-03	3.38E-04	24.5%	62.9%	12.6%	2.70E-03	111
241-AW-102								
AW-102 liquid	2.87E-04	7.39E-04	4.28E-04	19.7%	50.8%	29.4%	1.51E-03	62
AW-102 solid	1.35E-04	5.72E-08	7.49E-04	15.3%	0.0%	84.7%	8.84E-04	36
241-AW-103								
AW-103 liquid	3.05E-06	5.63E-08	4.72E-04	0.6%	0.0%	99.3%	4.75E-04	19
AW-103 solid	1.32E-04	9.15E-10	2.76E-04	32.4%	0.0%	67.6%	4.09E-04	17
241-AW-104								
AW-104 liquid	9.96E-05	1.76E-04	7.56E-04	9.7%	17.1%	73.3%	1.03E-03	42
AW-104 solid	9.11E-05	1.39E-04	3.55E-04	15.6%	23.7%	60.7%	5.85E-04	24
241-AW-105								
AW-105 liquid	8.57E-06	3.76E-05	4.01E-04	1.9%	8.4%	89.7%	4.47E-04	18
AW-105 solid	2.42E-05	6.56E-07	7.46E-04	3.1%	0.1%	96.8%	7.71E-04	32
241-AW-106								
AW-106 liquid	8.07E-06	5.50E-07	3.89E-04	2.0%	0.1%	97.8%	3.97E-04	16
AW-106 solid	1.61E-05	1.07E-07	3.57E-04	4.3%	0.0%	95.7%	3.73E-04	15
241-AW-107								
AW-107 liquid	2.71E-05	1.13E-06	7.43E-04	3.5%	0.1%	96.3%	7.71E-04	32
AW-107 solid	1.44E-05	9.05E-07	3.74E-04	3.7%	0.2%	96.1%	3.89E-04	16
241-AW-108								
AW-108 liquid	1.27E-05	2.23E-07	3.69E-04	3.3%	0.1%	96.6%	3.82E-04	16

Table F-4. Water Addition Study: Hydrogen Generation Rates in Dome Space for 28 DSTs. (4 sheets)

Tank	HGR from radiolysis G_{rad} (cfm)	HGR from thermolysis G_{therm} (cfm)	HGR from corrosion G_{corr} (cfm)	HGR from radiolysis percent (G_{rad})%	HGR from thermolysis percent (G_{therm})%	HGR from corrosion percent (G_{corr})%	Total HGR from model G_{mod} (cfm)	Total HGR from model G_{mod} (L/day)
241-AW-106	3.08E-05	4.93E-05	7.75E-04	3.6%	5.8%	90.6%	8.55E-04	35
AW-106 liquid	4.36E-06	3.99E-05	3.97E-04	1.0%	9.0%	90.0%	4.41E-04	18
AW-106 solid	2.64E-05	9.40E-06	3.78E-04	6.4%	2.3%	91.3%	4.14E-04	17
241-AY-101	1.88E-04	2.014E-05	7.88E-04	18.9%	2.0%	79.1%	9.96E-04	41
AY-101 liquid	5.50E-05	1.90E-05	4.71E-04	10.1%	3.5%	86.4%	5.45E-04	22
AY-101 solid	1.33E-04	1.10E-06	3.17E-04	29.5%	0.2%	70.3%	4.51E-04	18
241-AY-102	2.60E-02	5.868E-04	8.01E-04	94.9%	2.1%	2.9%	2.73E-02	1120
AY-102 liquid	3.05E-04	2.53E-04	4.41E-04	30.5%	25.3%	44.1%	1.00E-03	41
AY-102 solid	2.57E-02	3.33E-04	3.60E-04	97.4%	1.3%	1.4%	2.63E-02	1079
241-AZ-101	3.57E-03	1.766E-03	8.53E-04	57.7%	28.5%	13.8%	6.19E-03	254
AZ-101 liquid	1.59E-03	1.57E-03	5.27E-04	43.2%	42.6%	14.3%	3.69E-03	151
AZ-101 solid	1.98E-03	1.97E-04	3.25E-04	79.1%	7.9%	13.0%	2.50E-03	103
241-AZ-102	4.85E-03	4.105E-03	8.07E-04	49.7%	42.0%	8.3%	9.76E-03	400
AZ-102 liquid	2.92E-03	3.80E-03	4.75E-04	40.6%	52.8%	6.6%	7.19E-03	295
AZ-102 solid	1.93E-03	3.08E-04	3.32E-04	75.1%	12.0%	12.9%	2.57E-03	105
241-SY-101	6.14E-04	1.886E-03	7.68E-04	18.8%	57.7%	23.5%	3.29E-03	135
SY-101 liquid	4.52E-04	1.48E-03	3.84E-04	19.5%	63.9%	16.6%	2.33E-03	95
SY-101 solid	1.62E-04	4.05E-04	3.84E-04	17.0%	42.6%	40.4%	9.64E-04	39
241-SY-102	4.64E-04	9.293E-04	7.93E-04	21.2%	42.5%	36.3%	2.19E-03	90
SY-102 liquid	4.49E-04	8.89E-04	4.82E-04	24.7%	48.8%	26.5%	1.82E-03	75
SY-102 solid	1.49E-05	4.04E-05	3.11E-04	4.1%	11.0%	84.9%	3.67E-04	15
241-SY-103	4.16E-04	1.211E-03	7.68E-04	17.4%	50.6%	32.1%	2.41E-03	99
SY-103 liquid	2.87E-04	9.69E-04	3.57E-04	17.8%	60.1%	22.2%	1.62E-03	66
SY-103 solid	1.29E-04	2.42E-04	4.10E-04	16.5%	31.0%	52.5%	7.95E-04	33

Table F-5. Waste Addition Study: Calculation of Henry's Law Constant by Schumpe Model. (3 sheets)

Tank	Original liquid NH_3 ($\mu\text{g/mL}$)	Original waste volume (kL)	Headspace temperature T_h ($^{\circ}\text{C}$)	Waste temperature T_w ($^{\circ}\text{C}$)	Sum C_i (mole/m^3)	Sum $C_i \cdot H_i$ (mole/m^3)	K_H° in water (mole/L-atm)	K_H in solns' correction factor	K_H in solns' (mole/L-atm)
Filled up with original waste									
241-AN-101	4.00E+01	606	18	18	8.64	0.82	86	1.25	42
241-AN-102	2.10E+02	4013	29	31	18.10	1.69	47	2.03	14
241-AN-103	3.45E+02	3627	28	38	26.53	2.54	34	2.30	4
241-AN-104	2.46E+02	3986	29	36	22.85	2.24	38	2.30	6
241-AN-105	2.10E+02	4263	28	34	21.62	2.15	40	2.26	7
241-AN-106	2.10E+02	148	18	17	11.59	1.04	89	1.38	40
241-AN-107	2.10E+02	3952	26	29	21.70	1.89	51	2.26	16
241-AP-101	4.39E+02	4221	19	19	13.43	1.22	82	1.41	31
241-AP-102	4.39E+02	4134	20	20	8.15	0.82	77	1.23	35
241-AP-103	2.50E+02	1079	16	16	15.11	1.46	96	1.40	25
241-AP-104	1.33E+02	91	15	15	10.73	1.06	99	1.33	38
241-AP-105	3.24E+02	2896	19	19	19.62	1.84	79	1.95	20
241-AP-106	6.75E+01	352	17	18	9.95	0.99	86	1.31	35
241-AP-107	1.06E+03	3695	15	14	6.67	0.60	102	1.17	62
241-AP-108	8.00E+02	1397	16	16	7.83	0.74	94	1.21	49
241-AW-101	1.00E+01	4263	26	34	24.06	2.31	40	2.26	6
241-AW-102	7.43E+01	303	19	20	4.81	0.44	77	1.10	53
241-AW-103	5.12E+02	1931	17	17	3.09	0.30	89	1.10	68
241-AW-104	1.69E+02	4236	19	21	1.56	0.15	73	1.10	68
241-AW-105	1.01E+03	1624	16	16	1.59	0.12	94	1.10	92
241-AW-106	3.55E+02	1791	26	31	14.42	1.34	46	1.60	17

Table F-5. Waste Addition Study: Calculation of Henry's Law Constant by Schumpe Model. (3 sheets)

Tank	Original liquid NH_3 ($\mu\text{g/mL}$)	Original waste volume (kL)	Headspace temperature T_h ($^{\circ}\text{C}$)	Waste temperature T_w ($^{\circ}\text{C}$)	Sum C_i (mole/m^3)	Sum $C_i \cdot H_i$ (mole/m^3)	K_H° in water (mole/L-atm)	K_H in solns' correction factor	K_H in solns' (mole/L-atm)
Filled up with original waste									
241-AY-101	1.13E+02	583	29	40	4.15	0.42	31	1.00	19
241-AY-102	7.37E+01	2419	33	37	3.56	0.43	36	1.00	20
241-AZ-101	1.25E+02	3199	41	51	9.52	0.94	19	1.67	11
241-AZ-102	4.38E+02	3524	44	42	4.54	0.47	28	1.00	16
241-SY-101	1.04E+03	3685	30	32	14.89	1.37	44	1.63	16
241-SY-102	1.15E+03	2317	21	22	9.20	0.87	69	1.28	33
241-SY-103	1.29E+03	2817	27	31	19.55	1.93	46	2.25	11
Filled up with water									
241-AN-101	4.00E+01	606	18	18	1.91	0.18	86	1.00	70
241-AN-102	2.10E+02	4013	29	31	16.62	1.55	47	1.70	14
241-AN-103	3.45E+02	3627	28	38	17.96	1.72	34	2.30	11
241-AN-104	2.46E+02	3986	29	36	18.45	1.81	38	2.30	10
241-AN-105	2.10E+02	4263	28	34	20.46	2.03	40	2.26	8
241-AN-106	2.10E+02	148	18	17	0.22	0.02	89	1.00	87
241-AN-107	2.10E+02	3952	26	29	19.29	1.68	51	2.26	20
241-AP-101	4.39E+02	4221	19	19	13.12	1.19	82	1.41	32
241-AP-102	4.39E+02	4134	20	20	7.78	0.79	77	1.23	37
241-AP-103	2.50E+02	1079	16	16	3.74	0.36	96	1.00	63
241-AP-104	1.33E+02	91	15	15	10.44	1.03	99	1.33	39
241-AP-105	3.24E+02	2896	19	19	19.53	1.83	79	1.95	20
241-AP-106	6.75E+01	352	17	18	5.44	0.54	86	1.11	50

Table F-5. Waste Addition Study: Calculation of Henry's Law Constant by Schumpe Model. (3 sheets)

Tank	Original liquid NH_3 ($\mu\text{g/mL}$)	Original waste volume (kL)	Headspace temperature T_h ($^{\circ}\text{C}$)	Waste temperature T_w ($^{\circ}\text{C}$)	Sum C_i (mole/m^3)	Sum $C_i \cdot H_i$ (mole/m^3)	K_H° in water (mole/L-atm)	K_H in solns' correction factor	K_H in solns' (mole/L-atm)
Filled up with water									
241-AP-107	1.06E+03	3695	16	16	5.74	0.52	94	1.10	59
241-AP-108	8.00E+02	1397	26	34	0.22	0.02	40	1.00	39
241-AW-101	1.00E+01	4263	19	20	22.88	2.19	77	2.26	14
241-AW-102	7.43E+01	303	17	17	0.24	0.02	89	1.00	86
241-AW-103	5.12E+02	1931	19	21	2.94	0.29	73	1.00	52
241-AW-104	1.69E+02	4236	16	16	0.16	0.01	94	1.00	92
241-AW-105	1.01E+03	1624	26	31	0.31	0.02	46	1.00	45
241-AW-106	3.55E+02	1791	33	32	0.96	0.09	45	1.00	40
241-AY-101	1.13E+02	583	29	40	0.35	0.03	31	1.00	30
241-AY-102	7.37E+01	2355	33	37	1.71	0.21	36	1.00	27
241-AZ-101	1.25E+02	3199	41	51	7.81	0.77	19	1.67	13
241-AZ-102	4.38E+02	3524	44	42	3.91	0.41	28	1.00	17
241-SY-101	1.04E+03	3685	30	32	11.74	1.08	44	1.63	22
241-SY-102	1.15E+03	2317	21	22	8.29	0.79	69	1.28	36
241-SY-103	1.29E+03	2817	27	31	9.72	0.96	46	1.50	22

Table F-6. Waste Addition Study: Calculation of Mass Transport Product of h and A. (3 sheets)

Tank	Liquid NH_3 concn. C_1 (mole/L)	Molar volume (L/mole)	Headspace volume V_h (ft ³)	KRT coeff.	Liquid film coeff. h_l (m/s)	Gas film coeff. h_g (m/s)	Calculated hA from h and A h_A (cfm)	Barometric vent rate Q (cfm)	Off-normal constant k_1 (min ⁻¹)	Off-normal constant k_2 (mole/L-min)	Off-normal (NH_3) _{ss} (atm)
Filled up with original waste											
241-AN-101	0.002	23.85	36,096	1001	5.087E-06	1.586E-03	1.05E+00	0.11	2.91E-02	6.84E-08	5.60E-05
241-AN-102	0.012	24.79	36,096	358	5.480E-06	1.586E-03	2.13E+00	0.11	2.10E-02	7.28E-07	8.58E-04
241-AN-103	0.020	24.69	36,096	108	5.551E-06	1.586E-03	3.50E+00	0.11	1.02E-02	1.96E-06	4.76E-03
241-AN-104	0.014	24.79	36,096	156	5.443E-06	1.586E-03	3.08E+00	0.11	1.31E-02	1.23E-06	2.34E-03
241-AN-105	0.012	24.66	36,096	180	5.463E-06	1.586E-03	2.93E+00	0.11	1.43E-02	1.00E-06	1.72E-03
241-AN-106	0.012	23.84	36,096	960	5.164E-06	1.586E-03	1.09E+00	0.11	2.90E-02	3.72E-07	3.06E-04
241-AN-107	0.012	24.55	36,096	402	5.398E-06	1.586E-03	1.98E+00	0.11	2.19E-02	6.77E-07	7.59E-04
241-AP-101	0.026	23.98	36,096	742	5.318E-06	1.586E-03	1.33E+00	0.11	2.73E-02	9.47E-07	8.32E-04
241-AP-102	0.026	24.02	36,096	844	5.165E-06	1.586E-03	1.20E+00	0.11	2.80E-02	8.55E-07	7.34E-04
241-AP-103	0.015	23.68	36,096	585	5.318E-06	1.586E-03	1.56E+00	0.11	2.53E-02	6.35E-07	5.94E-04
241-AP-104	0.008	23.64	36,096	891	5.291E-06	1.586E-03	1.16E+00	0.11	2.86E-02	2.51E-07	2.07E-04
241-AP-105	0.019	23.96	36,096	476	5.378E-06	1.586E-03	1.79E+00	0.11	2.36E-02	9.43E-07	9.59E-04
241-AP-106	0.004	23.79	36,096	824	5.230E-06	1.586E-03	1.22E+00	0.11	2.79E-02	1.34E-07	1.15E-04
241-AP-107	0.062	23.63	36,096	1460	5.175E-06	1.586E-03	7.81E-01	0.11	3.17E-02	1.35E-06	1.01E-03
241-AP-108	0.047	23.71	36,096	1171	5.236E-06	1.586E-03	9.36E-01	0.11	3.04E-02	1.22E-06	9.51E-04
241-AW-101	0.001	24.53	36,096	163	5.521E-06	1.586E-03	3.07E+00	0.11	1.35E-02	4.99E-08	9.09E-05
241-AW-102	0.004	23.96	36,096	1276	5.092E-06	1.586E-03	8.69E-01	0.11	3.12E-02	1.07E-07	8.22E-05
241-AW-103	0.030	23.79	36,096	1629	4.893E-06	1.586E-03	7.06E-01	0.11	3.19E-02	5.88E-07	4.39E-04
241-AW-104	0.010	23.96	36,096	1650	4.956E-06	1.586E-03	7.00E-01	0.11	3.18E-02	1.92E-07	1.45E-04
241-AW-105	0.059	23.71	36,096	2186	4.893E-06	1.586E-03	5.50E-01	0.11	3.33E-02	9.03E-07	6.43E-04
241-AW-106	0.021	24.53	36,096	414	5.411E-06	1.586E-03	1.95E+00	0.11	2.24E-02	1.15E-06	1.26E-03

Table F-6. Waste Addition Study: Calculation of Mass Transport Product of h and A. (3 sheets)

Tank	Liquid NH_3 concn. C_i (mole/L)	Molar volume (L/mole)	Headspace volume V_h (ft ³)	KRT coeff.	Liquid film coeff. h_i (m/s)	Gas film coeff. h_g (m/s)	Calculated hA from h and A hA (cfm)	Barometric vent rate Q (cfm)	Off-normal constant k_i (min ⁻¹)	Off-normal constant k_2 (mole/L-min)	Off-normal (NH_3) _{ss} (atm)
Filled up with original waste											
241-AY-101	0.007	24.78	36,096	478	5.005E-06	1.586E-03	1.74E+00	0.11	2.10E-02	3.02E-07	3.57E-04
241-AY-102	0.004	25.11	36,096	499	5.048E-06	1.586E-03	1.70E+00	0.11	2.32E-02	2.03E-07	2.20E-04
241-AZ-101	0.007	25.76	36,096	284	5.194E-06	1.586E-03	2.34E+00	0.11	1.79E-02	4.76E-07	6.86E-04
241-AZ-102	0.026	26.01	36,096	406	5.079E-06	1.586E-03	1.92E+00	0.11	2.35E-02	1.48E-06	1.64E-03
241-SY-101	0.061	24.86	36,096	395	5.345E-06	1.586E-03	1.99E+00	0.11	2.17E-02	3.39E-06	3.88E-03
241-SY-102	0.068	24.12	36,096	796	5.208E-06	1.586E-03	1.25E+00	0.11	2.75E-02	2.35E-06	2.05E-03
241-SY-103	0.076	24.61	36,096	264	5.527E-06	1.586E-03	2.51E+00	0.11	1.81E-02	5.26E-06	7.17E-03
Filled up with water											
241-AN-101	0.001	23.85	36,096	1667	4.913E-06	1.586E-03	6.93E-01	0.11	3.20E-02	9.99E-09	7.44E-06
241-AN-102	0.011	24.79	36,096	350	5.435E-06	1.586E-03	2.15E+00	0.11	2.07E-02	6.74E-07	8.06E-04
241-AN-103	0.014	24.69	36,096	278	5.347E-06	1.586E-03	2.40E+00	0.11	1.93E-02	9.83E-07	1.26E-03
241-AN-104	0.012	24.79	36,096	260	5.340E-06	1.586E-03	2.48E+00	0.11	1.89E-02	8.67E-07	1.14E-03
241-AN-105	0.012	24.66	36,096	206	5.434E-06	1.586E-03	2.77E+00	0.11	1.61E-02	9.28E-07	1.42E-03
241-AN-106	0.000	23.84	36,096	2065	4.866E-06	1.586E-03	5.77E-01	0.11	3.31E-02	3.66E-09	2.64E-06
241-AN-107	0.011	24.55	36,096	500	5.344E-06	1.586E-03	1.73E+00	0.11	2.37E-02	5.25E-07	5.43E-04
241-AP-101	0.025	23.98	36,096	764	5.309E-06	1.586E-03	1.30E+00	0.11	2.75E-02	9.05E-07	7.89E-04
241-AP-102	0.025	24.02	36,096	883	5.152E-06	1.586E-03	1.16E+00	0.11	2.83E-02	7.90E-07	6.70E-04
241-AP-103	0.004	23.68	36,096	1498	4.982E-06	1.586E-03	7.60E-01	0.11	3.15E-02	7.63E-08	5.74E-05
241-AP-104	0.008	23.64	36,096	922	5.280E-06	1.586E-03	1.13E+00	0.11	2.88E-02	2.37E-07	1.95E-04
241-AP-105	0.019	23.96	36,096	481	5.375E-06	1.586E-03	1.78E+00	0.11	2.36E-02	9.30E-07	9.44E-04
241-AP-106	0.002	23.79	36,096	1194	5.069E-06	1.586E-03	9.15E-01	0.11	3.02E-02	5.49E-08	4.33E-05

Table F-6. Waste Addition Study: Calculation of Mass Transport Product of h and A. (3 sheets)

Tank	Liquid NH_3 concn. C_1 (mole/L)	Molar volume (L/mole)	Headspace volume V_h (ft ³)	KRT coeff.	Liquid film coeff. h_l (m/s)	Gas film coeff. h_g (m/s)	Calculated hA from h and A hA (cfm)	Barometric vent rate Q (cfm)	Off-normal constant k_1 (min ⁻¹)	Off-normal constant k_2 (mole/L-min)	Off-normal (NH_3) _{ss} (atm)
Filled up with water											
241-AP-107	0.053	23.71	36,096	1392	5.133E-06	1.586E-03	8.11E-01	0.11	2.93E-02	1.13E-06	9.11E-04
241-AP-108	0.001	24.53	36,096	993	4.872E-06	1.586E-03	1.05E+00	0.11	1.49E-02	2.03E-08	3.34E-05
241-AW-101	0.001	23.96	36,096	338	5.492E-06	1.586E-03	2.20E+00	0.11	2.80E-02	4.65E-08	3.98E-05
241-AW-102	0.000	23.79	36,096	2059	4.872E-06	1.586E-03	5.78E-01	0.11	3.76E-02	3.94E-09	2.50E-06
241-AW-103	0.029	23.96	36,096	1261	4.891E-06	1.586E-03	8.70E-01	0.11	2.62E-02	5.99E-07	5.48E-04
241-AW-104	0.001	23.71	36,096	2183	4.870E-06	1.586E-03	5.50E-01	0.11	4.04E-02	1.86E-08	1.09E-05
241-AW-105	0.012	24.53	36,096	1123	4.867E-06	1.586E-03	9.52E-01	0.11	1.69E-02	1.76E-07	2.56E-04
241-AW-106	0.001	25.10	36,096	1011	4.901E-06	1.586E-03	1.03E+00	0.11	2.90E-02	3.95E-08	3.42E-05
241-AV-101	0.001	24.78	36,096	760	4.873E-06	1.586E-03	1.27E+00	0.11	2.42E-02	1.82E-08	1.87E-05
241-AV-102	0.002	25.11	36,096	681	4.952E-06	1.586E-03	1.38E+00	0.11	2.57E-02	7.90E-08	7.72E-05
241-AZ-101	0.006	25.76	36,096	347	5.137E-06	1.586E-03	2.10E+00	0.11	1.95E-02	3.49E-07	4.61E-04
241-AZ-102	0.022	26.01	36,096	441	5.050E-06	1.586E-03	1.83E+00	0.11	2.43E-02	1.21E-06	1.30E-03
241-SY-101	0.048	24.86	36,096	544	5.250E-06	1.586E-03	1.63E+00	0.11	2.48E-02	2.22E-06	2.22E-03
241-SY-102	0.061	24.12	36,096	878	5.175E-06	1.586E-03	1.16E+00	0.11	2.72E-02	1.89E-06	1.68E-03
241-SY-103	0.038	24.61	36,096	552	5.213E-06	1.586E-03	1.61E+00	0.11	2.38E-02	1.65E-06	1.70E-03

Table F-7. Waste Addition Study: Gas Conc., Release Rate and Flammability Level Under Normal Ventilation Conditions. (3 sheets)

Tank	Calculated hydrogen headspace conc., $[H_2](t_0)$ (%)	Ammonia headspace conc. $[NH_3](t_0)$ (%)	Methane headspace conc. $[CH_4](t_0)$ (%)	N ₂ O headspace conc. $[N_2O](t_0)$ (%)	Waste volume V_w (kgal)	Headspace volume V_h (ft ³)	Normal ventilation rate $(Vr)_{norm}$ (cfm)	Steady-state flammability at normal condition (% LFL)	Ammonia release rate $Rr(NH_3)$ (cfm)	Methane release rate $Rr(CH_4)$ (cfm)	N ₂ O release rate $Rr(N_2O)$ (cfm)	Model hydrogen release rate $Rr(H_2)$ (cfm)
Filled up with original waste												
241-AN-101	0.0009	0.0011	0.0008	0.0048	1,140	36,096	113	0.04%	1.28E-03	8.64E-04	5.42E-03	9.63E-04
241-AN-102	0.0109	0.0300	0.0003	0.0057	1,140	36,096	119	0.48%	3.57E-02	3.45E-04	6.82E-03	1.30E-02
241-AN-103	0.0036	0.0007	0.0002	0.0008	1,140	36,096	100	0.10%	6.65E-04	2.44E-04	7.75E-04	3.58E-03
241-AN-104	0.0052	0.0021	0.0002	0.0008	1,140	36,096	100	0.15%	2.10E-03	2.12E-04	7.69E-04	5.21E-03
241-AN-105	0.0043	0.0015	0.0002	0.0013	1,140	36,096	100	0.12%	1.51E-03	2.23E-04	1.30E-03	4.31E-03
241-AN-106	0.0010	0.0000	0.0003	0.0060	1,140	36,096	117	0.03%	0.00E+00	3.52E-04	6.96E-03	1.14E-03
241-AN-107	0.0082	0.0400	0.0005	0.0058	1,140	36,096	129	0.48%	5.16E-02	6.89E-04	7.49E-03	1.05E-02
241-AP-101	0.0009	0.0125	0.0003	0.0063	1,140	36,096	108	0.11%	1.35E-02	3.44E-04	6.80E-03	1.03E-03
241-AP-102	0.0010	0.0075	0.0003	0.0050	1,140	36,096	135	0.08%	1.02E-02	3.45E-04	6.81E-03	1.37E-03
241-AP-103	0.0007	0.0000	0.0002	0.0034	1,140	36,096	200	0.02%	0.00E+00	3.48E-04	6.88E-03	1.41E-03
241-AP-104	0.0025	0.0003	0.0000	0.0002	1,140	36,096	71	0.06%	2.23E-04	7.44E-06	1.47E-04	1.76E-03
241-AP-105	0.0008	0.0007	0.0001	0.0026	1,140	36,096	176	0.03%	1.29E-03	2.32E-04	4.58E-03	1.34E-03
241-AP-106	0.0014	0.0005	0.0000	0.0009	1,140	36,096	111	0.04%	5.92E-04	5.13E-05	1.01E-03	1.51E-03
241-AP-107	0.0005	0.0005	0.0001	0.0020	1,140	36,096	342	0.02%	1.71E-03	3.42E-04	6.75E-03	1.82E-03
241-AP-108	0.0007	0.0027	0.0003	0.0052	1,140	36,096	129	0.04%	3.43E-03	3.42E-04	6.77E-03	8.79E-04
241-AW-101	0.0051	0.0005	0.0002	0.0007	1,140	36,096	100	0.13%	5.15E-04	1.57E-04	7.38E-04	5.12E-03
241-AW-102	0.0009	0.0003	0.0001	0.0022	1,140	36,096	292	0.03%	7.44E-04	3.19E-04	6.31E-03	2.77E-03
241-AW-103	0.0008	0.0138	0.0004	0.0010	1,140	36,096	134	0.12%	1.85E-02	4.86E-04	1.28E-03	1.05E-03
241-AW-104	0.0006	0.0006	0.0026	0.0033	1,140	36,096	141	0.07%	8.46E-04	3.72E-03	4.68E-03	8.68E-04
241-AW-105	0.0004	0.0043	0.0005	0.0025	1,140	36,096	194	0.05%	8.30E-03	1.06E-03	4.78E-03	8.16E-04
241-AW-106	0.0023	0.0028	0.0003	0.0068	1,140	36,096	158	0.08%	4.40E-03	5.45E-04	1.08E-02	3.59E-03

Table F-7. Waste Addition Study: Gas Conc., Release Rate and Flammability Level Under Normal Ventilation Conditions. (3 sheets)

Tank	Calculated hydrogen headspace conc., [H ₂](t ₀) (%)	Ammonia headspace conc. [NH ₃](t ₀) (%)	Methane headspace conc. [CH ₄](t ₀) (%)	N ₂ O headspace conc. [N ₂ O](t ₀) (%)	Waste volume V _w (kgal)	Headspace volume V _h (ft ³)	Normal ventilation rate (V _T) _{norm} (cfm)	Steady-state flammability at normal condition (% LFL)	Ammonia release rate R _r (NH ₃) (cfm)	Methane release rate R _r (CH ₄) (cfm)	N ₂ O release rate R _r (N ₂ O) (cfm)	Model hydrogen release rate R _r (H ₂) (cfm)
Filled up with original waste												
241-AY-101	0.0014	0.0005	0.0004	0.0055	1,140	36,096	250	0.05%	1.25E-03	8.79E-04	1.37E-02	3.57E-03
241-AY-102	0.0225	0.0004	0.0003	0.0018	1,140	36,096	250	0.57%	1.07E-03	6.44E-04	4.46E-03	5.62E-02
241-AZ-101	0.0054	0.0001	0.0006	0.0012	1,140	36,096	150	0.15%	1.88E-04	9.48E-04	1.83E-03	8.13E-03
241-AZ-102	0.0108	0.0006	0.0009	0.0011	1,140	36,096	112	0.29%	6.19E-04	9.82E-04	1.28E-03	1.21E-02
241-SY-101	0.0009	0.0200	0.0001	0.0006	1,140	36,096	461	0.16%	9.22E-02	4.21E-04	2.89E-03	4.20E-03
241-SY-102	0.0007	0.0012	0.0005	0.0006	1,140	36,096	363	0.03%	4.24E-03	1.79E-03	2.26E-03	2.45E-03
241-SY-103	0.0042	0.0059	0.0004	0.0025	1,140	36,096	116	0.15%	6.92E-03	4.83E-04	2.88E-03	4.93E-03
Filled up with water												
241-AN-101	0.0005	0.0002	0.0000	0.0002	1,140	36,096	113	0.01%	2.82E-04	4.25E-05	2.67E-04	5.16E-04
241-AN-102	0.0096	0.0275	0.0002	0.0049	1,140	36,096	119	0.43%	3.28E-02	2.93E-04	5.79E-03	1.15E-02
241-AN-103	0.0025	0.0005	0.0001	0.0004	1,140	36,096	100	0.07%	4.50E-04	1.39E-04	4.40E-04	2.53E-03
241-AN-104	0.0042	0.0017	0.0002	0.0006	1,140	36,096	100	0.12%	1.70E-03	1.57E-04	5.73E-04	4.16E-03
241-AN-105	0.0041	0.0014	0.0002	0.0012	1,140	36,096	100	0.12%	1.43E-03	2.08E-04	1.21E-03	4.12E-03
241-AN-106	0.0007	0.0000	0.0000	0.0000	1,140	36,096	117	0.02%	0.00E+00	2.18E-07	4.31E-06	7.76E-04
241-AN-107	0.0068	0.0356	0.0004	0.0047	1,140	36,096	129	0.41%	4.59E-02	5.59E-04	6.08E-03	8.72E-03
241-AP-101	0.0009	0.0122	0.0003	0.0060	1,140	36,096	108	0.11%	1.32E-02	3.28E-04	6.48E-03	1.01E-03
241-AP-102	0.0010	0.0072	0.0002	0.0046	1,140	36,096	135	0.08%	9.70E-03	3.14E-04	6.21E-03	1.32E-03
241-AP-103	0.0004	0.0000	0.0000	0.0002	1,140	36,096	200	0.01%	0.00E+00	2.12E-05	4.19E-04	8.37E-04
241-AP-104	0.0024	0.0003	0.0000	0.0002	1,140	36,096	71	0.06%	2.17E-04	7.03E-06	1.39E-04	1.72E-03
241-AP-105	0.0008	0.0007	0.0001	0.0026	1,140	36,096	176	0.03%	1.28E-03	2.29E-04	4.53E-03	1.32E-03
241-AP-106	0.0010	0.0003	0.0000	0.0003	1,140	36,096	111	0.03%	3.23E-04	1.53E-05	3.02E-04	1.06E-03

Table F-7. Waste Addition Study: Gas Conc., Release Rate and Flammability Level Under Normal Ventilation Conditions. (3 sheets)

Tank	Calculated hydrogen headspace conc., [H ₂](t _a) (%)	Ammonia headspace conc. [NH ₃](t _a) (%)	Methane headspace conc. [CH ₄](t _a) (%)	N ₂ O headspace conc. [N ₂ O](t _a) (%)	Waste volume V _w (kgal)	Headspace volume V _h (ft ³)	Normal ventilation rate (Vr) _{norm} (cfm)	Steady-state flammability at normal condition (% LFL)	Ammonia release rate Rr(NH ₃) (cfm)	Methane release rate Rr(CH ₄) (cfm)	N ₂ O release rate Rr(N ₂ O) (cfm)	Model hydrogen release rate Rr(H ₂) (cfm)
Filled up with water												
241-AP-107	0.0005	0.0004	0.0001	0.0015	1,140	36,096	342	0.02%	1.47E-03	2.53E-04	4.99E-03	1.61E-03
241-AP-108	0.0006	0.0001	0.0000	0.0000	1,140	36,096	129	0.02%	9.62E-05	3.12E-07	6.16E-06	7.84E-04
241-AW-101	0.0041	0.0005	0.0001	0.0007	1,140	36,096	100	0.11%	4.90E-04	1.48E-04	6.93E-04	4.13E-03
241-AW-102	0.0003	0.0000	0.0000	0.0000	1,140	36,096	292	0.01%	3.68E-05	1.19E-06	2.36E-05	8.84E-04
241-AW-103	0.0008	0.0131	0.0003	0.0009	1,140	36,096	134	0.11%	1.76E-02	4.48E-04	1.18E-03	1.03E-03
241-AW-104	0.0005	0.0001	0.0001	0.0001	1,140	36,096	141	0.02%	8.58E-05	1.05E-04	1.31E-04	7.71E-04
241-AW-105	0.0004	0.0008	0.0000	0.0002	1,140	36,096	194	0.02%	1.61E-03	7.68E-05	3.47E-04	7.71E-04
241-AW-106	0.0005	0.0002	0.0000	0.0001	1,140	36,096	158	0.01%	2.92E-04	9.44E-06	1.87E-04	8.55E-04
241-AY-101	0.0004	0.0000	0.0000	0.0001	1,140	36,096	250	0.01%	1.04E-04	1.18E-05	1.84E-04	9.96E-04
241-AY-102	0.0109	0.0002	0.0001	0.0005	1,140	36,096	250	0.28%	5.13E-04	1.73E-04	1.20E-03	2.73E-02
241-AZ-101	0.0041	0.0001	0.0004	0.0008	1,140	36,096	150	0.11%	1.54E-04	6.39E-04	1.23E-03	6.19E-03
241-AZ-102	0.0087	0.0005	0.0007	0.0009	1,140	36,096	112	0.23%	5.33E-04	7.39E-04	9.65E-04	9.76E-03
241-SY-101	0.0007	0.0158	0.0001	0.0004	1,140	36,096	461	0.12%	7.27E-02	2.82E-04	1.94E-03	3.27E-03
241-SY-102	0.0006	0.0011	0.0004	0.0005	1,140	36,096	363	0.03%	3.81E-03	1.39E-03	1.76E-03	2.19E-03
241-SY-103	0.0021	0.0030	0.0001	0.0008	1,140	36,096	116	0.07%	3.44E-03	1.57E-04	9.32E-04	2.39E-03

Table F-8. Waste Addition Study: Steady-State Gas and Flammability Levels With Barometric Breathing Rate. (3 sheets)

Tank	Off-normal ventilation rate (Vr) _{bb} (cfm)	Steady-state hydrogen concentration [H ₂] (%)	Steady-state ammonia concentration [NH ₃] (%)	Steady-state methane concentration [CH ₄] (%)	Steady-state N ₂ O concentration [N ₂ O] (%)	Steady-state hydrogen flammability (% LFL)	Steady-state ammonia flammability (% LFL)	Steady-state methane flammability (% LFL)	Steady-state total flammability (% LFL)
Filled up with original waste									
241-AN-101	0.11	0.85	0.01	0.77	4.81	21	0.04	15.32	37
241-AN-102	0.11	11.49	0.09	0.31	6.05	287	0.57	6.12	294
241-AN-103	0.11	3.18	0.20	0.22	0.69	79	1.36	4.33	85
241-AN-104	0.11	4.62	0.20	0.19	0.68	116	1.34	3.75	121
241-AN-105	0.11	3.82	0.15	0.20	1.15	96	1.02	3.95	101
241-AN-106	0.11	1.01	0.01	0.31	6.17	25	0.08	6.25	32
241-AN-107	0.11	9.34	0.08	0.61	6.64	233	0.51	12.22	246
241-AP-101	0.11	0.91	0.08	0.30	6.02	23	0.55	6.10	29
241-AP-102	0.11	1.21	0.07	0.31	6.04	30	0.49	6.11	37
241-AP-103	0.11	1.25	0.02	0.31	6.10	31	0.17	6.17	38
241-AP-104	0.11	1.56	0.01	0.01	0.13	39	0.09	0.13	39
241-AP-105	0.11	1.19	0.08	0.21	4.06	30	0.53	4.11	34
241-AP-106	0.11	1.34	0.01	0.05	0.90	33	0.07	0.91	34
241-AP-107	0.11	1.62	0.09	0.30	5.98	40	0.61	6.06	47
241-AP-108	0.11	0.78	0.09	0.30	6.00	19	0.57	6.07	26
241-AW-101	0.11	4.54	0.01	0.14	0.65	113	0.06	2.79	116
241-AW-102	0.11	2.46	0.01	0.28	5.59	61	0.05	5.66	67
241-AW-103	0.11	0.93	0.04	0.43	1.13	23	0.29	8.62	32
241-AW-104	0.11	0.77	0.01	3.30	4.15	19	0.09	65.96	85
241-AW-105	0.11	0.72	0.06	0.94	4.23	18	0.42	18.76	37
241-AW-106	0.11	3.18	0.12	0.48	9.55	80	0.78	9.66	90

Table F-8. Waste Addition Study: Steady-State Gas and Flammability Levels With Barometric Breathing Rate. (3 sheets)

Tank	Off-normal ventilation rate (Vr) _{bs} (cfm)	Steady-state hydrogen concentration [H ₂] (%)	Steady-state ammonia concentration [NH ₃] (%)	Steady-state methane concentration [CH ₄] (%)	Steady-state N ₂ O concentration [N ₂ O] (%)	Steady-state hydrogen flammability (% LFL)	Steady-state ammonia flammability (% LFL)	Steady-state methane flammability (% LFL)	Steady-state total flammability (% LFL)
Filled up with original waste									
241-AY-101	0.11	3.16	0.03	0.78	12.14	79	0.19	15.59	95
241-AY-102	0.11	49.84	0.02	0.57	3.95	1246	0.14	11.42	1257
241-AZ-101	0.11	7.21	0.03	0.84	1.62	180	0.22	16.82	197
241-AZ-102	0.11	10.73	0.12	0.87	1.14	268	0.79	17.41	286
241-SY-101	0.11	3.72	0.39	0.37	2.56	93	2.58	7.46	103
241-SY-102	0.11	2.17	0.18	1.59	2.00	54	1.18	31.77	87
241-SY-103	0.11	4.37	0.56	0.43	2.55	109	3.72	8.57	122
Filled up with water									
241-AN-101	0.11	0.46	0.001	0.04	0.24	11	0.00	0.75	12
241-AN-102	0.11	10.18	0.08	0.26	5.13	254	0.54	5.20	260
241-AN-103	0.11	2.25	0.13	0.12	0.39	56	0.84	2.46	59
241-AN-104	0.11	3.69	0.11	0.14	0.51	92	0.76	2.79	96
241-AN-105	0.11	3.65	0.14	0.18	1.07	91	0.95	3.69	96
241-AN-106	0.11	0.69	0.0003	0.0002	0.004	17	0.00	0.00	17
241-AN-107	0.11	7.73	0.05	0.50	5.39	193	0.36	9.91	203
241-AP-101	0.11	0.89	0.08	0.29	5.75	22	0.53	5.82	29
241-AP-102	0.11	1.17	0.07	0.28	5.50	29	0.45	5.57	35
241-AP-103	0.11	0.74	0.01	0.02	0.37	19	0.04	0.38	19
241-AP-104	0.11	1.52	0.02	0.01	0.12	38	0.13	0.12	38
241-AP-105	0.11	1.17	0.09	0.20	4.02	29	0.63	4.07	34
241-AP-106	0.11	0.94	0.00	0.01	0.27	24	0.03	0.27	24

Table F-8. Waste Addition Study: Steady-State Gas and Flammability Levels With Barometric Breathing Rate. (3 sheets)

Tank	Off-normal ventilation rate (V_t) _{bs} (cfm)	Steady-state hydrogen concentration [H ₂] (%)	Steady-state ammonia concentration [NH ₃] (%)	Steady-state methane concentration [CH ₄] (%)	Steady-state N ₂ O concentration [N ₂ O] (%)	Steady-state hydrogen flammability (% LFL)	Steady-state ammonia flammability (% LFL)	Steady-state methane flammability (% LFL)	Steady-state total flammability (% LFL)
Filled up with water									
241-AP-107	0.11	1.43	0.09	0.22	4.42	36	0.61	4.48	41
241-AP-108	0.11	0.70	0.003	0.0003	0.01	17	0.02	0.01	17
241-AW-101	0.11	3.66	0.004	0.13	0.61	92	0.03	2.62	94
241-AW-102	0.11	0.78	0.0002	0.00	0.02	20	0.00	0.02	20
241-AW-103	0.11	0.91	0.05	0.40	1.04	23	0.37	7.95	31
241-AW-104	0.11	0.68	0.001	0.09	0.12	17	0.01	1.85	19
241-AW-105	0.11	0.68	0.03	0.07	0.31	17	0.17	1.36	19
241-AW-106	0.11	0.76	0.003	0.01	0.17	19	0.02	0.17	19
241-AY-101	0.11	0.88	0.002	0.01	0.16	22	0.01	0.21	22
241-AY-102	0.11	24.24	0.01	0.15	1.06	606	0.05	3.07	609
241-AZ-101	0.11	5.49	0.05	0.57	1.09	137	0.31	11.32	149
241-AZ-102	0.11	8.66	0.13	0.66	0.86	216	0.87	13.11	230
241-SY-101	0.11	2.90	0.22	0.25	1.72	72	1.48	5.01	79
241-SY-102	0.11	1.94	0.17	1.24	1.56	48	1.12	24.70	74
241-SY-103	0.11	2.12	0.17	0.14	0.83	53	1.14	2.78	57

Table F-9. Waste Addition Study: Time to Reach 25% LFL and Flammability With Barometric Breathing Rate. (3 sheets)

Tank	Time to reach 25% LFL $t_{25\%}$ (day)	Minimum vent rate to prevent 25% LFL (cfm)	Hydrogen concentration at time $t_{25\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{25\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{25\%}$ $[CH_4](t)$ (%)	N ₂ O concentration at time $t_{25\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{25\%}$ (%)	Ammonia flammability at time $t_{25\%}$ (%)	Methane flammability at time $t_{25\%}$ (%)
Filled up with original waste									
241-AN-101	253	0.17	0.58	0.01	0.52	3.27	14.51	0.04	10.42
241-AN-102	19	1.38	0.95	0.09	0.03	0.50	23.79	0.57	0.51
241-AN-103	66	0.44	0.82	0.48	0.06	0.18	20.47	3.17	1.12
241-AN-104	48	0.59	0.90	0.23	0.04	0.13	22.54	1.56	0.73
241-AN-105	60	0.48	0.91	0.17	0.05	0.27	22.70	1.15	0.94
241-AN-106	341	0.15	0.80	0.03	0.25	4.84	19.88	0.20	4.90
241-AN-107	23	1.15	0.93	0.08	0.06	0.66	23.14	0.51	1.21
241-AP-101	418	0.14	0.77	0.08	0.26	5.11	19.27	0.55	5.17
241-AP-102	248	0.17	0.81	0.07	0.21	4.06	20.36	0.49	4.11
241-AP-103	238	0.17	0.82	0.06	0.20	4.01	20.53	0.40	4.06
241-AP-104	223	0.18	0.99	0.02	0.00	0.08	24.78	0.14	0.08
241-AP-105	281	0.16	0.85	0.10	0.15	2.91	21.37	0.64	2.95
241-AP-106	287	0.16	0.97	0.01	0.03	0.65	24.25	0.08	0.66
241-AP-107	164	0.22	0.84	0.10	0.16	3.12	21.09	0.67	3.16
241-AP-108	682	0.12	0.74	0.10	0.29	5.72	18.57	0.63	5.79
241-AW-101	53	0.54	0.97	0.01	0.03	0.14	24.18	0.06	0.59
241-AW-102	103	0.31	0.91	0.01	0.11	2.08	22.80	0.05	2.10
241-AW-103	331	0.15	0.72	0.04	0.33	0.88	18.01	0.29	6.68
241-AW-104	76	0.39	0.22	0.01	0.96	1.20	5.58	0.10	19.14
241-AW-105	244	0.17	0.48	0.06	0.63	2.82	12.05	0.43	12.50
241-AW-106	70	0.43	0.86	0.13	0.13	2.58	21.53	0.84	2.62

Table F-9. Waste Addition Study: Time to Reach 25% LFL and Flammability With Barometric Breathing Rate. (3 sheets)

Tank	Time to reach 25% LFL $t_{25\%}$ (day)	Minimum vent rate to prevent 25% LFL (cfm)	Hydrogen concentration at time $t_{25\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{25\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{25\%}$ $[CH_4](t)$ (%)	N ₂ O concentration at time $t_{25\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{25\%}$ (%)	Ammonia flammability at time $t_{25\%}$ (%)	Methane flammability at time $t_{25\%}$ (%)
Filled up with original waste									
241-AY-101	67	0.44	0.82	0.04	0.20	3.16	20.61	0.24	4.06
241-AY-102	4	5.82	0.91	0.02	0.01	0.07	22.78	0.15	0.21
241-AZ-101	29	0.92	0.89	0.07	0.10	0.20	22.17	0.46	2.07
241-AZ-102	19	1.38	0.89	0.16	0.07	0.09	22.23	1.09	1.44
241-SY-101	55	0.52	0.82	0.39	0.08	0.56	20.43	2.59	1.64
241-SY-102	71	0.42	0.59	0.21	0.43	0.55	14.87	1.37	8.70
241-SY-103	41	0.67	0.74	0.72	0.07	0.43	18.51	4.78	1.45
Filled up with water									
241-AN-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-102	21	1.22	0.93	0.08	0.02	0.47	23.17	0.54	0.47
241-AN-103	111	0.29	0.91	0.16	0.05	0.17	22.75	1.06	1.04
241-AN-104	61	0.47	0.93	0.14	0.04	0.13	23.18	0.93	0.72
241-AN-105	62	0.47	0.91	0.16	0.05	0.27	22.83	1.08	0.94
241-AN-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-107	28	0.95	0.92	0.05	0.06	0.64	23.02	0.36	1.18
241-AP-101	450	0.13	0.78	0.08	0.25	4.99	19.42	0.53	5.05
241-AP-102	270	0.16	0.82	0.07	0.20	3.87	20.59	0.45	3.92
241-AP-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-104	233	0.18	0.99	0.02	0.00	0.08	24.76	0.13	0.08
241-AP-105	291	0.16	0.86	0.09	0.15	2.93	21.38	0.63	2.97
241-AP-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table F-9. Waste Addition Study: Time to Reach 25% LFL and Flammability With Barometric Breathing Rate. (3 sheets)

Tank	Time to reach 25% LFL $t_{25\%}$ (day)	Minimum vent rate to prevent 25% LFL (cfm)	Hydrogen concentration at time $t_{25\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{25\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{25\%}$ $[CH_4](t)$ (%)	N_2O concentration at time $t_{25\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{25\%}$ (%)	Ammonia flammability at time $t_{25\%}$ (%)	Methane flammability at time $t_{25\%}$ (%)
Filled up with water									
241-AP-107	206	0.19	0.86	0.09	0.14	2.67	21.62	0.61	2.71
241-AP-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-101	66	0.44	0.96	0.00	0.03	0.16	24.02	0.03	0.70
241-AW-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-103	356	0.14	0.73	0.05	0.32	0.83	18.27	0.37	6.35
241-AW-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AY-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AY-102	9	2.81	0.97	0.01	0.01	0.04	24.32	0.05	0.12
241-AZ-101	40	0.69	0.91	0.05	0.09	0.18	22.70	0.31	1.87
241-AZ-102	24	1.10	0.89	0.13	0.07	0.09	22.35	0.87	1.35
241-SY-101	79	0.38	0.87	0.23	0.08	0.52	21.82	1.54	1.52
241-SY-102	87	0.35	0.63	0.17	0.40	0.50	15.71	1.12	8.01
241-SY-103	121	0.27	0.90	0.18	0.06	0.36	22.48	1.20	1.20

Table F-10. Waste Addition Study: Time to Reach 100% LFL and Flammability With Barometric Breathing Rate. (3 sheets)

Tank	Time to reach 100% LFL $t_{100\%}$ (day)	Minimum vent rate to prevent 100% LFL (cfm)	Hydrogen concentration at time $t_{100\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{100\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{100\%}$ $[CH_4](t)$ (%)	N_2O concentration at time $t_{100\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{100\%}$ (% LFL)	Ammonia flammability at time $t_{100\%}$ (% LFL)	Methane flammability at time $t_{100\%}$ (% LFL)
Filled up with original waste									
241-AN-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-102	91	0.33	3.87	0.09	0.10	2.04	96.72	0.57	2.06
241-AN-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-104	387	0.14	3.81	0.23	0.15	0.56	95.28	1.56	3.09
241-AN-105	1109	0.11	3.80	0.17	0.20	1.14	94.93	1.15	3.92
241-AN-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-107	115	0.28	3.78	0.08	0.25	2.69	94.43	0.51	4.94
241-AP-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-101	436	0.13	3.90	0.01	0.12	0.56	97.53	0.06	2.40
241-AW-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table F-10. Waste Addition Study: Time to Reach 100% LFL and Flammability With Barometric Breathing Rate. (3 sheets)

Tank	Time to reach 100% LFL $t_{100\%}$ (day)	Minimum vent rate to prevent 100% LFL (cfm)	Hydrogen concentration at time $t_{100\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{100\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{100\%}$ $[CH_4](t)$ (%)	N_2O concentration at time $t_{100\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{100\%}$ (% LFL)	Ammonia flammability at time $t_{100\%}$ (% LFL)	Methane flammability at time $t_{100\%}$ (% LFL)
Filled up with original waste									
241-AY-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AY-102	18	1.42	3.90	0.02	0.04	0.31	97.46	0.15	0.89
241-AZ-101	156	0.22	3.64	0.07	0.42	0.82	90.99	0.46	8.49
241-AZ-102	94	0.33	3.71	0.16	0.30	0.39	92.72	1.09	6.02
241-SY-101	768	0.12	3.61	0.39	0.36	2.48	90.18	2.59	7.23
241-SY-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SY-103	366	0.14	3.53	0.72	0.35	2.06	88.30	4.78	6.92
Filled up with water									
241-AN-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-102	107	0.29	3.90	0.08	0.10	1.97	97.40	0.54	1.99
241-AN-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-104	1495	0.11	3.84	0.14	0.15	0.54	96.09	0.93	2.98
241-AN-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AN-107	149	0.23	3.78	0.05	0.24	2.63	94.48	0.36	4.85
241-AP-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

Table F-10. Waste Addition Study: Time to Reach 100% LFL and Flammability With Barometric Breathing Rate. (3 sheets)

Tank	Time to reach 100% LFL $t_{100\%}$ (day)	Minimum vent rate to prevent 100% LFL (cfm)	Hydrogen concentration at time $t_{100\%}$ $[H_2](t)$ (%)	Ammonia concentration at time $t_{100\%}$ $[NH_3](t)$ (%)	Methane concentration at time $t_{100\%}$ $[CH_4](t)$ (%)	N_2O concentration at time $t_{100\%}$ $[N_2O](t)$ (%)	Hydrogen flammability at time $t_{100\%}$ (% LFL)	Ammonia flammability at time $t_{100\%}$ (% LFL)	Methane flammability at time $t_{100\%}$ (% LFL)
Filled up with water									
241-AP-107	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AP-108	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-104	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-105	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AW-106	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AY-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-AY-102	39	0.69	3.91	0.01	0.02	0.17	97.78	0.05	0.49
241-AZ-101	246	0.17	3.68	0.05	0.38	0.73	91.92	0.31	7.58
241-AZ-102	125	0.26	3.73	0.13	0.28	0.37	93.23	0.87	5.65
241-SY-101	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SY-102	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur
241-SY-103	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur	not occur

APPENDIX G

**MATHCAD MODELS FOR THE STEADY-STATE FLAMMABLE GAS RELEASE
RATE CALCULATION AND LOWER FLAMMABILITY EVALUATION FOR
HANFORD TANK WASTE SINGLE-POINT MODEL AND
MONTE CARLO ANALYSIS (FROM REVISION 2)**

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G.0 PEER REVIEW SUMMARY

Appendix G consists of this summary section and 10 MathCAD Models. The first nine models are in groups of three.

The models

- *"RPP-5926 Rev. 2: 01 Calculation of Mass Transport Coefficient "h" for Soluble Gas",*
- *"RPP-5926 Rev. 2: 02 Decay Heat Generation Rate Based on Radionuclide Data", and*
- *"RPP-5926 Rev. 2: 03 Hydrogen Generation Rate Calculations Single-Point Calculation"*

are samples of the models used to check the calculations presented in Appendices B, C, and D.

The models

- *"RPP-5926 Rev. 2: 04 Calculation of Mass Transport Coefficient "h" for Soluble Gas",*
- *"RPP-5926 Rev. 2: 05 Decay Heat Generation Rate Based on Radionuclide Data", and*
- *"RPP-5926 Rev. 2: 06 Hydrogen Generation Rate Calculations Single-Point Calculation"*

are the same models except with the waste diluted with water as presented in Appendix F.

Finally, the models

- *"RPP-5926 Rev. 2: 07 Calculation of Mass Transport Coefficient "h" for Soluble Gas",*
- *"RPP-5926 Rev. 2: 08 Decay Heat Generation Rate Based on Radionuclide Data", and*
- *"RPP-5926 Rev. 2: 09 Hydrogen Generation Rate Calculations Single-Point Calculation"*

are the same models except with the waste diluted with additional supernatant liquids with the same properties as the supernatant originally present in the given tank as presented in Appendix F.

The model

- *"RPP-5926 Rev. 2: 10 Hydrogen Generation Rate Calculations"*

contains the Monte Carlo Calculation for Tank 241-AN-104 as presented in the report Section 4.6 "Uncertainty Analysis: Tank 241-AN-104 As An Example".

In order to make it easier on the reader, Table G-1 compares the results from the MathCad calculation to the results in the appropriate appendix, and where each of the corresponding values can be found in the report.

Table G-1. Comparison of Miscellaneous Results With Calculation Check (Tank 241-AY-102).

Variable Name	Units	Original Result	Location	MathCad Variable Name	MathCad Result	Location
Heat load (total)	Watt	3.64E+04	B-26	heat_load ₁	3.64E+04	G-21
Heat load (supernatant)	Watt	2.83E+02	B-26	heat_load ₃	2.82E+02	G-21
Heat load (solid layer)	Watt	3.61E+04	B-26	heat_load ₄	3.61E+04	G-21
G _{rad} (total)	cfm	3.00E-02	B-72	HGRradv ₁	3.00E-02	G-50
G _{rad} (supernatant)	cfm	2.26E-04	B-72	HGRradv ₃	2.26E-04	G-50
G _{rad} (solid layer)	cfm	2.98E-02	B-72	HGRradv ₄	3.00E-02	G-50
G _{therm} (total)	cfm	1.24E-03	B-72	HGRthermv ₁	1.31E-03	G-50
G _{therm} (supernatant)	cfm	3.31E-04	B-72	HGRthermv ₃	3.39E-04	G-50
G _{therm} (solid layer)	cfm	9.08E-04	B-72	HGRthermv ₄	9.66E-04	G-50
G _{corr} (total)	cfm	5.71E-04	B-72	HGRthermv ₁	5.71E-04	G-50
G _{corr} (supernatant)	cfm	2.11E-04	B-72	HGRthermv ₃	2.11E-04	G-50
G _{corr} (solid layer)	cfm	3.60E-04	B-72	HGRthermv ₄	3.59E-04	G-50
G _{mod} (total)	cfm	3.18E-02	B-72	HGR ₁	3.20E-02	G-50
G _{mod} (supernatant)	cfm	7.68E-04	B-72	HGR ₃	7.77E-04	G-50
G _{mod} (solid layer)	cfm	3.10E-02	B-72	HGR ₄	3.10E-02	G-50
k ₂	mol/(L x min)	4.31E-10	C-8	k ₂	4.32E-10	G-9
h _A	cfm	1.05E-02	C-8	h _A	1.05E-02	G-9
K _H	mol/(L x atm)	19.65	C-5	K _H	21.6	G-8
Steady-state hydrogen concentration (off normal)	(%)	9.86E+00	D-9	[H2 _{ss_bb}]	9.03E+00	G-40
Steady-state ammonia concentration (off normal)	(%)	0.02	D-9	[NH3 _{ss_bb}]	0.019	G-41
Steady-state methane concentration (off normal)	(%)	0.11	D-9	[CH4 _{ss_bb}]	0.11	G-41
Steady-state N ₂ O concentration (off normal)	(%)	0.77	D-9	[N2O _{ss_bb}]	0.77	G-41
Time to reach 25% LFL at loss of ventilation	day	23	D-17	time _{1_25%LFL}	23	G-51
Minimum vent rate to prevent 25% LFL	cfm	3.3	D-17	vent _{1_25%LFL}	3.2	G-51
Time to reach 100% LFL at loss of ventilation	day	114	D-25	time _{1_100%LFL}	116	G-51
Minimum vent rate to prevent 100% LFL	cfm	0.80	D-25	vent _{1_100%LFL}	0.78	G-51
Time to reach 25% LFL at loss of ventilation (water-fill case)	day	9	5-2, F-31	time _{1_25%LFL}	9	G-101
Time to reach 100% LFL at loss of ventilation (water-fill case)	day	39	5-2, F-34	time _{1_100%LFL}	41	G-101
Time to reach 25% LFL at loss of ventilation (waste-fill case)	day	4	5-2, F-30	time _{1_25%LFL}	4	G-151
Time to reach 100% LFL at loss of ventilation (waste-fill case)	day	18	5-2, F-33	time _{1_100%LFL}	18	G-151

Notes: atm = atmospheres.

cfm = cubic feet per minute.

HGR = hydrogen generation rate.

L = liter.

LFL = lower flammability limit.

**G.1 RPP-5926 REV. 2: 01 CALCULATION OF MASS TRANSPORT
COEFFICIENT "h" FOR SOLUBLE GAS -- 241-AY-102**

CH2MHILL
Hanford Group, Inc.

SA Barker

Calculation of Mass Transport Coefficient "h" for Soluble Gas

241-AY-102

References

Hu, T. A., S. A. Barker, D. C. Hedengren, M.A. Kufahl, 2001, "Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste", RPP-5926, Rev. 1, CH2MHILL Hanford Group, Inc., Richland, WA.

Input Data

Constants

$\rho_g = 1.17 \frac{\text{kg}}{\text{m}^3}$	Density of gas
$D_g = 2.50 \times 10^{-5} \frac{\text{m}^2}{\text{s}}$	Diffusion coefficient in gas phase
$\mu_g = 2.0 \cdot 10^{-5} \frac{\text{kg}}{\text{m} \cdot \text{s}}$	Viscosity of gas
$g = 9.807 \frac{\text{m}}{\text{s}^2}$	gravitational number
$\Delta T = 1 \cdot \text{K}$	Temperature difference between waste surface and gas
$\beta_g = 3.30 \cdot 10^{-3} \frac{1}{\text{K}}$	Thermal expansion coefficient of Gas
$L_c = 5.7825 \cdot \text{m}$	Characteristic Length (1/4 of Diameter)
$D_L = 2.8 \cdot 10^{-9} \frac{\text{m}^2}{\text{s}}$	Diffusion Coefficient in Liquid Phase
$\rho_L = 1300 \frac{\text{kg}}{\text{m}^3}$	Density of Liquid
	+

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$$\mu_L := 6.82 \cdot 10^{-4} \frac{\text{kg}}{\text{m} \cdot \text{s}}$$

Viscosity of Liquid

$$\beta_L := 3.02 \cdot 10^{-4} \frac{1}{\text{K}}$$

Thermal expansion coefficient of Liquid

$$\text{MW}_{\text{NH}_3} := 17.0307 \frac{\text{gm}}{\text{mol}}$$

Molecular Weight of Ammonia

$$h_{g_Schumpe_model} := -0.0481 \frac{\text{L}}{\text{mol}}$$

Schumpe Model Coefficient

Read Waste Information From "NH3CALInputData010829.xls"

IData :=

C:\NH3CALInputData010829.xls

Find Waste Properties

Tank_id := "241-AY-102"

TFI1 := search(Tank_id, "-", 1)

TFI1 = 3.000

TankFarm := substr(Tank_id, TFI1 + 1, 2)

TankFarm = "AY"

TankNames3 := stack(TankNames1, TankNames2)

j1 := 1..177

nal_j1 := j1

vent_rate := 350 cfm

From (Bingham 2000)

Find The Appropriate Tank Specific Information:

fil := FindIndex(TankNames6, Tank_id)

$$\text{fil} = \begin{pmatrix} 23.000 \\ 1.000 \end{pmatrix}$$

tank_idx := fil_1 + 1

tank_idx = 24.000

class_waste := if(fil_1 < 29, "dst", "sst")

class_waste = "dst"

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comp :=	"Na+"	IData _{tank_idx,2}		22.99		.1143	
	"AL+3"	IData _{tank_idx,3}		26.98		.2174	
	"Fe+3"	IData _{tank_idx,4}		55.85		.1161	
	"Cr+3"	IData _{tank_idx,5}		52		.0648	
	"Ni+2"	IData _{tank_idx,6}		58.71		.1654	
	"K+"	IData _{tank_idx,7}		39.09		.0922	
	"OH-"	IData _{tank_idx,8}		17.0074		.0839	
	"NO3-"	IData _{tank_idx,9}	$\frac{\mu\text{gm}}{\text{mL}}$	62.0049	$\frac{\text{gm}}{\text{mol}}$	.0128	$\frac{\text{Co}}{\frac{\mu\text{gm}}{\text{mL}}} =$
	"NO2-"	IData _{tank_idx,10}		46.0055		.0795	5.400-10 ⁴
	"CO3-2"	IData _{tank_idx,11}		60.0092		.1423	1.970-10 ³
	"PO4-3"	IData _{tank_idx,12}		94.9676		.2119	10.100
	"SO4-2"	IData _{tank_idx,13}		96.0576		.1117	29.100
	"F-"	IData _{tank_idx,14}		19		.092	4.020
	"Cl-"	IData _{tank_idx,15}		35.453		.0318	388.000
							1.439-10 ³
							486.000
							7.290-10 ³
							4.865-10 ⁴
							3.010-10 ³
							2.320-10 ³
							91.050
							197.343

Component Concentration Molecular Weight

$$[\text{NH}_3\text{SS}_{\text{dome}}] := \text{IData}_{\text{tank_idx},16} \text{ ppm} \quad [\text{NH}_3\text{SS}_{\text{dome}}] = 4.286 \text{ ppm}$$

$$[\text{NH}_3\text{L}] := \text{IData}_{\text{tank_idx},17} \frac{\mu\text{gm}}{\text{mL}} \quad [\text{NH}_3\text{L}] = 73.700 \frac{\mu\text{gm}}{\text{mL}}$$

$$[\text{H}_2\text{O}_{\text{wt}\%}] := \text{IData}_{\text{tank_idx},18} \% \quad [\text{H}_2\text{O}_{\text{wt}\%}] = 92.010 \%$$

$$\rho_{\text{liq}} := \text{IData}_{\text{tank_idx},19} \frac{\text{gm}}{\text{mL}} \quad \rho_{\text{liq}} = 1.120 \frac{\text{gm}}{\text{mL}}$$

$$\text{vol}_{\text{waste}} := \text{IData}_{\text{tank_idx},20} \text{ kilo-L} \quad \text{vol}_{\text{waste}} = 2.355 \times 10^3 \text{ kilo-L}$$

$$\text{vol}_{\text{waste}} = 1049.39 \text{ ft}^3 \quad \dots\dots\dots \text{AI}$$

$$Q_{\text{normal_vent}} := \text{vent_rate} \quad \dots\dots\dots \text{AH}$$

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$$T_{\text{headspace_c}} := \text{IData}_{\text{tank_dx}, 21} \cdot ^\circ\text{C}$$

$$T_{\text{headspace}} := (T_{\text{headspace_c}} + 273.15) \cdot \text{K} \quad T_{\text{headspace}} = 294.549 \text{ K}$$

$$T_{\text{waste_c}} := 36.666667 \cdot ^\circ\text{C}$$

$$T_{\text{waste}} := (T_{\text{waste_c}} + 273.15) \cdot \text{K} \quad T_{\text{waste}} = 309.817 \text{ K}$$

$$K_H_{\text{soln_corr_fact}} := \text{IData}_{\text{tank_dx}, 22}$$

AA

$$K_H_{\text{soln_corr_fact}} = 1.100$$

$$P := 1 \text{ atm}$$

$$t := 32 \text{ day}$$

time of interest

Calculations

Schmidt Number

$$S_c := \frac{\mu_g}{D_g \rho_g}$$

$$S_c = 0.683761$$

Grashoff Number

$$Gr := \frac{g \beta_g \rho_g^2 L_c^3 \Delta T}{\mu_g^2}$$

$$Gr = 2.141 \times 10^{10}$$

Film Coefficient - Vapor

$$h_g := 0.15 \frac{D_g}{L_c} (S_c Gr)^{\frac{1}{3}}$$

Vapor Film Coefficient

$$h_g = 1.587 \times 10^{-3} \frac{\text{m}}{\text{s}}$$

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Film Coefficient - Liquid

$$h_L = 0.15 \cdot D_L \cdot \left(\frac{\mu_L}{D_L \cdot \rho_L} \right)^{\frac{1}{3}} \cdot \left(\frac{g \cdot \beta_L \cdot \rho_L^2 \cdot \Delta T}{\mu_L^2} \right)^{\frac{1}{3}} \quad \text{Liquid Film Coefficient}$$

$$h_L = 5.306 \times 10^{-6} \frac{\text{m}}{\text{s}}$$

Sum C_i

$$C_{\text{sum}} = \frac{\sum_{i=1}^{13} \frac{C_{o,i}}{mw_i}}{1000}$$

$$C_{\text{sum}} = 3.555 \frac{\text{mol}}{\text{m}^3} \quad \dots\dots\dots X$$

Sum C_i x H_i

$$CH_{\text{sum}} = \frac{\sum_{i=1}^{13} \frac{C_{o,i}}{mw_i} \cdot H_i}{1000}$$

$$CH_{\text{sum}} = 0.430 \frac{\text{mol}}{\text{m}^3} \quad \dots\dots\dots Y$$

K_H^o In Water

$$= \text{EXP}(-8.0964 + 3917.5 / (273.15 + W3) - 0.00314 \cdot (273.15 + W3))$$

$$K_{H_o} = \exp \left(-8.0964 + \frac{3917.5 \cdot K}{T_{\text{waste}}} - 0.00314 \cdot \frac{T_{\text{waste}}}{K} \right)$$

$$K_{H_o} = 35.707 \quad \dots\dots\dots Z$$

K_H In Solution

$$= Z3 / \text{POWER}(10, Y3 + X3 * \$1\$60) * AA3$$

$$K_H = \frac{K_{H_o} \cdot K_{H_soln_corr_fact}}{10^{\left[\left[\frac{C_{\text{sum}}}{\left(\frac{\text{mol}}{\text{m}^3} \right)} \right] \cdot \left[\frac{h_{g_Schumpe_model}}{\left(\frac{\text{L}}{\text{mol}} \right)} \right] + \left[\frac{CH_{\text{sum}}}{\left(\frac{\text{mol}}{\text{m}^3} \right)} \right]} \right]} \cdot \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

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$$K_H = 21.617 \frac{\text{mol}}{\text{L} \cdot \text{atm}} \dots\dots\dots \text{AB}$$

Ammonia Concentration

$$\text{Output}_3 = \frac{K_H}{\frac{\text{mol}}{\text{L} \cdot \text{atm}}}$$

$$[\text{NH}_3\text{L}] = 0.074 \frac{\text{kg}}{\text{m}^3}$$

$$[\text{NH}_3\text{liq}] = \frac{[\text{NH}_3\text{L}]}{MW_{\text{NH}_3}}$$

$$[\text{NH}_3\text{liq}] = 4.327 \times 10^{-3} \frac{\text{mol}}{\text{L}} \dots\dots\dots \text{AD}$$

Ammonia Partial Pressure

$$\text{Output}_5 = \frac{[\text{NH}_3\text{liq}]}{\frac{\text{mol}}{\text{L}}}$$

$$P_{\text{NH}_3} = \frac{[\text{NH}_3\text{liq}]}{K_H}$$

$$P_{\text{NH}_3} = 2.002 \times 10^{-4} \text{ atm} \dots\dots\dots \text{AE}$$

Molar Volume

$$V_m = 22.4 \frac{\text{L}}{\text{mol}} \cdot \frac{T_{\text{headspace}}}{273.15 \cdot \text{K}}$$

$$\text{Output}_4 = \frac{V_m}{\frac{\text{L}}{\text{mol}}}$$

$$V_m = 24.154842 \frac{\text{L}}{\text{mol}} \dots\dots\dots \text{AG}$$

Steady-State Ammonia Concentration

$$[\text{NH}_3\text{ss}] = \frac{[\text{NH}_3\text{SS}_{\text{dome}}]}{V_m}$$

$$[\text{NH}_3\text{ss}] = 1.77427 \times 10^{-7} \frac{\text{mol}}{\text{L}} \dots\dots\dots \text{AF}$$

Equivalent Steady-State Ammonia Concentration In Liquid Phase

$$[\text{NH}_3\text{ss_liq_eq}] = K_H \cdot V_m \cdot [\text{NH}_3\text{ss}] \cdot P$$

$$[\text{NH}_3\text{ss_liq_eq}] = 9.264 \times 10^{-5} \frac{\text{mol}}{\text{L}} \dots\dots\dots \text{AJ}$$

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Mass Transport Properties

$$h_A := Q_{\text{normal_vent}} \left(\frac{[NH3_{ss}]}{[NH3_{liq}] - [NH3_{ss_liq_eq}]} \right)$$

$$h_A = 0.010474 \text{ cfm}$$

$$\text{Output}_2 := \frac{h_A}{\text{cfm}}$$

AK

Steady-State Release Rate At Normal Ventilation Conditions

$$v_{ss_norm} := h_A \cdot ([NH3_{liq}] - K_H \cdot [NH3_{ss_dome}] \cdot P) \cdot V_m$$

$$v_{ss_norm} = 1.071 \times 10^{-3} \text{ cfm}$$

AL

Off-Normal Barometric Vent Rate

$$Q_{\text{off_normal_vent}} := 45 \cdot \frac{\%}{\text{day}} \cdot \text{vol}_{\text{headspace}}$$

$$Q_{\text{off_normal_vent}} = 0.328 \text{ cfm}$$

AM

Off-Normal Constant, k_1 And k_2

$$k_1 := \frac{Q_{\text{off_normal_vent}} + (h_A \cdot K_H \cdot P \cdot V_m)}{\text{vol}_{\text{headspace}}}$$

$$k_1 = 5.524 \times 10^{-5} \frac{1}{\text{min}}$$

AN

$$k_2 := \frac{h_A \cdot [NH3_{liq}]}{\text{vol}_{\text{headspace}}}$$

$$k_2 = 4.319 \times 10^{-10} \frac{\text{mol}}{\text{L} \cdot \text{min}}$$

$$\text{Output}_1 := \frac{k_2}{\frac{\text{mol}}{\text{L} \cdot \text{min}}}$$

AO

Off-Normal Ammonia Partial Pressure

$$P_{NH3_on} := \frac{k_2}{k_1} \cdot V_m \cdot P$$

$$P_{NH3_on} = 1.88866 \times 10^{-4} \text{ atm}$$

AP

$$\frac{P_{NH3_on}}{\text{atm}} = 188.866 \text{ ppm}$$

AQ

Author: _____ Date: _____

Steady-State Release Rate At Normal Ventilation Conditions

$$v_{ss_off_norm} = h_A \left([NH3_{liq}] - K_H \frac{P_{NH3_on}}{atm} \cdot P \right) \cdot V_m$$

$$v_{ss_off_norm} = 6.194 \times 10^{-5} \text{ cfm} \dots\dots\dots AR$$

Ammonia Concentration At Time, t

$$[NH3_t] = \left[\frac{k_2}{k_1} + \left([NH3_{ss}] - \frac{k_2}{k_1} \right) \cdot \exp(-1 \cdot k_1 \cdot t) \right] \cdot V_m \cdot 10^6 \text{ ppm}$$

$$[NH3_t] = 177.463 \text{ ppm} \dots\dots\dots AU$$

Ammonia Diffusion Rate At Time, t

$$\delta_{NH3_t} = h_A \cdot ([NH3_{liq}] - K_H \cdot [NH3_t] \cdot P) \cdot V_m$$

$$\delta_{NH3_t} = 1.243 \times 10^{-4} \text{ cfm} \dots\dots\dots AV$$

KRT

$$KRT = T_{waste} \cdot K_H \cdot 0.082 \cdot \frac{(L \cdot atm)}{mol \cdot K}$$

$$KRT = 549.173 \dots\dots\dots AW$$

Film Coefficient - Liquid At Time t

$$h_{Lt} = 0.15 \cdot D_L \cdot \left(\frac{\mu_L}{D_L \cdot \rho_{liq}} \right)^{\frac{1}{3}} \cdot \left[\frac{g \beta_L (\rho_{liq})^2 \cdot \Delta T}{(\mu_L)^2} \right]^{\frac{1}{3}} \quad \text{Liquid Film Coefficient}$$

$$h_{Lt} = 5.049 \times 10^{-6} \frac{m}{s} \dots\dots\dots AX$$

Film Coefficient - Vapor At Time t

$$h_{gt} = 0.15 \cdot \frac{D_g}{L_c} \cdot (S_c \cdot G_r)^{\frac{1}{3}} \quad \text{Vapor Film Coefficient}$$

$$h_{gt} = 1.587 \times 10^{-3} \frac{m}{s} \dots\dots\dots AY$$

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Film Coefficient - Overall At Time t

Overall Film Coefficient

$$h = \frac{1}{\frac{1}{h_{Lt}} + \frac{KRT}{h_{gt}}}$$

$$h = 1.838 \times 10^{-6} \frac{\text{m}}{\text{s}}$$

.....AZ

Surface Area

$$\text{area} = \pi (37.5 \text{ ft})^2$$

$$\text{area} = 4.418 \times 10^3 \text{ ft}^2$$

.....BA

$$hx_A = h \cdot \text{area}$$

$$hx_A = 1.598 \text{ cfm}$$

.....BB

Effective Surface Area (percent)

$$\text{eff}_{SA} = \frac{h_A}{hx_A}$$

$$\text{eff}_{SA} = 0.655\%$$

.....BC

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Ammonia Concentrations As A Function Of Time

time :=

-30
-20
-10
.0001
.5
3
5
10
15
30
35
50
70
90
110
120
125
127
130
135
140
145

$$h_A = 0.010 \text{ cfm}$$

$$[\text{NH}_3]_{\text{liq}} = 4.327 \times 10^{-3} \frac{\text{mol}}{\text{L}}$$

$$K_H = 21.617 \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

$$V_m = 24.155 \frac{\text{L}}{\text{mol}}$$

$$i = 1..22$$

$$\text{NH}_3_i := \left[\frac{k_2}{k_1} + \left([\text{NH}_3]_{\text{ss}} - \frac{k_2}{k_1} \right) \exp \left(-1 \cdot \frac{k_1}{1 \text{ day}} \cdot \frac{\text{time}_i}{\text{day}} \right) \right] \cdot V_m$$

$$\text{RR}_{\text{NH}_3_1} = h_A \cdot ([\text{NH}_3]_{\text{liq}} - K_H \cdot P \cdot \text{NH}_3_1) \cdot V_m$$

$$\text{RR}_{\text{NH}_3_1} = h_A \quad \text{NH}_3_1 = [\text{NH}_3]_{\text{SS_dome}}$$

$$\text{RR}_{\text{NH}_3_2} = h_A \quad \text{NH}_3_2 = [\text{NH}_3]_{\text{SS_dome}}$$

$$\text{RR}_{\text{NH}_3_3} = h_A \quad \text{NH}_3_3 = [\text{NH}_3]_{\text{SS_dome}}$$

$$\text{RR}_{\text{NH}_3_4} = h_A$$

$$\text{RR}_{\text{NH}_3_4} = h_A$$

Author: _____ Date: _____

RPP-5926 REV 3

Output Results To Datafile "rpp5926_r2_01_NH3CALOutputData0020203.xls"

C:\Arpp5926_r2_01_NH3CALOutputData0020203.xls

Output

$$\text{Output} = \begin{pmatrix} 4.319 \times 10^{-10} \\ 0.010 \\ 21.617 \\ 24.155 \\ 4.327 \times 10^{-3} \end{pmatrix}$$

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RPP-5926 REV 3

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Author: _____ Date: _____

j := 0..61

na_j := j name := augment(na, me)

k := 0..3

kk := 0..3

excel :=

File Name is "FGS Input 020203.xls"

C:\FGS Input 020203.xls

excel =

	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0
2	0	1.166·10 ³	4.16·10 ⁴	7.305·10 ⁴	1.123·10 ⁴	0.04	82.911
3	0	1.166·10 ³	4.16·10 ⁴	7.305·10 ⁴	1.123·10 ⁴	0.04	82.911
4	0	0	0	0	0	0	0
5	0	2.581·10 ⁴	9.444·10 ⁴	2.368·10 ⁵	1.604·10 ⁴	67.467	220.193
6	0	2.581·10 ⁴	9.444·10 ⁴	2.368·10 ⁵	1.604·10 ⁴	59.727	214.404
7	0	2.581·10 ⁴	9.444·10 ⁴	2.368·10 ⁵	1.604·10 ⁴	144.373	277.714
8	0	2.597·10 ³	1.641·10 ⁵	1.673·10 ⁵	2.995·10 ⁴	1.371	351.899

Tank_id := "24L-AV-102"

...The following data is from Hu 2001b, except where noted

tank_idxT := 68

>>>> Compensate for Origin = 0 <<<<

tank_idxL := tank_idxT + 1

tank_idxS := tank_idxT + 2

$$[^{137}\text{Cs}] := \begin{bmatrix} \text{excel}_{\text{tank_idxT}, (7-1)} \\ 1 \cdot 10^{-12} \\ \text{excel}_{\text{tank_idxL}, (7-1)} \\ \text{excel}_{\text{tank_idxS}, (7-1)} \end{bmatrix} \cdot \frac{\mu\text{-Ci}}{\text{gm}}$$

$$[^{137}\text{Cs}] = \begin{pmatrix} 74.771 \\ 1 \times 10^{-12} \\ 27.904 \\ 175.68 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

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$$[90\text{Sr}] := \begin{bmatrix} \text{excel_tank_idxT}, (6-1) \\ 1 \cdot 10^{-12} \\ \text{excel_tank_idxL}, (6-1) \\ \text{excel_tank_idxS}, (6-1) \end{bmatrix} \frac{\mu \cdot \text{Ci}}{\text{gm}}$$

$$[90\text{Sr}] = \begin{pmatrix} 1.818 \times 10^3 \\ 1 \times 10^{-12} \\ 1.531 \\ 5.729 \times 10^3 \end{pmatrix} \frac{\mu \cdot \text{Ci}}{\text{gm}}$$

$$\rho_{\text{waste}} := \begin{bmatrix} \text{excel_tank_idxT}, (8-1) \\ \text{excel_tank_idxS}, (8-1) \\ \text{excel_tank_idxL}, (8-1) \\ \text{excel_tank_idxS}, (8-1) \end{bmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\rho_{\text{waste}} = \begin{pmatrix} 1.21 \\ 1.427 \\ 1.13 \\ 1.427 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{vol}_{\text{waste}} := \begin{bmatrix} \text{excel_tank_idxT}, (9-1) \\ 1 \cdot 10^{-9} \\ \text{excel_tank_idxL}, (9-1) \\ \text{excel_tank_idxS}, (9-1) \end{bmatrix} \text{kilo L}$$

$$\text{vol}_{\text{waste}} = \begin{pmatrix} 2403 \\ 0 \\ 1757 \\ 646 \end{pmatrix} \text{kilo L}$$

$$\text{name}_{\text{isotope}} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$[137\text{Ba}] = [137\text{Cs}] \cdot 0.946$$

$$[90\text{Y}] = [90\text{Sr}] \cdot 1.000$$

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Find the appropriate radio-isotope specific information:

```

FindIndex(M, key) :=
  r ← rows(M) - 1
  c ← cols(M) - 1
  i ← 0
  j ← 0
  while (j ≤ c) · (Mi,j ≠ key)
    i ← i + 1 if i < r
    otherwise
      i ← 1
      j ← j + 1
   $\begin{pmatrix} i \\ j \end{pmatrix}$  if j ≤ c
  0 otherwise

```

$$\text{name}_{\text{isotope}} = \begin{pmatrix} \text{"137Cs"} \\ \text{"137Ba"} \\ \text{"90Sr"} \\ \text{"90Y"} \end{pmatrix}$$

$$f_{kk} := \text{FindIndex}(\text{name}, \text{name}_{\text{isotope}_{kk}})$$

$$f_i = \begin{pmatrix} (2,1) \\ (2,1) \\ (2,1) \\ (2,1) \end{pmatrix}$$

$$\ddot{u} := \ddot{f}_i \quad \ddot{u}_0 = \begin{pmatrix} 31 \\ 1 \end{pmatrix} \quad \ddot{u}_1 = \begin{pmatrix} 32 \\ 1 \end{pmatrix} \quad \ddot{u}_2 = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \quad \ddot{u}_3 = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$$

$$m_{kk} := (m_{kk})_0$$

$$m = \begin{pmatrix} 31 \\ 32 \\ 4 \\ 5 \end{pmatrix}$$

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$$\text{half_life}_{kk} := M_{in_{kk},0} \cdot 10^{M_{in_{kk},1}} \cdot \text{day} \quad \text{half_life} = \begin{pmatrix} 30.171 \\ 4.795 \times 10^{-6} \\ 28.601 \\ 0.007 \end{pmatrix} \text{yr} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{wtatomic}_{kk} := M_{in_{kk},2} \frac{\text{gm}}{\text{g_mol}} \quad \text{wtatomic} = \begin{pmatrix} 137 \\ 137 \\ 90 \\ 90 \end{pmatrix} \frac{\text{gm}}{\text{g_mol}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{SA}_{kk} := M_{in_{kk},3} \cdot 10^{M_{in_{kk},4}} \frac{\text{dpm}}{\text{gm}} \quad \text{SA} = \begin{pmatrix} 1.92 \times 10^{14} \\ 1.21 \times 10^{21} \\ 3.08 \times 10^{14} \\ 1.21 \times 10^{18} \end{pmatrix} \frac{\text{dpm}}{\text{gm}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{SA} = \begin{pmatrix} 86.486 \\ 5.45 \times 10^8 \\ 138.739 \\ 5.45 \times 10^5 \end{pmatrix} \frac{\text{Ci}}{\text{gm}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{qisotope}_{kk} := M_{in_{kk},5} \cdot 10^{M_{in_{kk},6}} \frac{\text{watt}}{\text{Ci}} \quad \text{qisotope} = \begin{pmatrix} 1.01 \times 10^{-3} \\ 3.92 \times 10^{-3} \\ 1.16 \times 10^{-3} \\ 5.53 \times 10^{-3} \end{pmatrix} \frac{\text{watt}}{\text{Ci}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{qisotope} = \begin{pmatrix} 3.444 \times 10^{-3} \\ 0.013 \\ 3.955 \times 10^{-3} \\ 0.019 \end{pmatrix} \frac{\text{mBTU}}{\text{Ci} \cdot \text{hr}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{heat_load}_k := \text{vol_waste}_k \cdot \rho_{\text{waste}_k} \left[([137\text{Cs}])_k \cdot \text{qisotope}_0 + ([137\text{Ba}])_k \cdot \text{qisotope}_1 \dots \right. \\ \left. + ([90\text{Sr}])_k \cdot \text{qisotope}_2 + ([90\text{Y}])_k \cdot \text{qisotope}_3 \right]$$

$$\text{heat_load} = \begin{pmatrix} 3.639 \times 10^4 \\ 0 \\ 282 \\ 3.611 \times 10^4 \end{pmatrix} \text{watt}$$

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Check answer #1

$$z := 1$$

$$\text{heat_load2} := \text{volwaste}_z \cdot \rho_{\text{waste}_z} \cdot \left[([137\text{Cs}])_z \cdot q_{\text{isotope}_0} + ([137\text{Ba}])_z \cdot q_{\text{isotope}_1} \dots \right. \\ \left. + ([90\text{Sr}])_z \cdot q_{\text{isotope}_2} + ([90\text{Y}])_z \cdot q_{\text{isotope}_3} \right]$$

$$\text{heat_load2} = 0 \text{ watt}$$

Check answer #2 (alternate calculation)

$$[137\text{Cs}] = \begin{pmatrix} 74771 \\ 1 \times 10^{-12} \\ 27.904 \\ 175.68 \end{pmatrix} \frac{\mu\text{Ci}}{\text{gm}}$$

$$[90\text{Sr}] = \begin{pmatrix} 1.818 \times 10^3 \\ 1 \times 10^{-12} \\ 1.551 \\ 5.729 \times 10^3 \end{pmatrix} \frac{\mu\text{Ci}}{\text{gm}}$$

$$\text{volwaste} = \begin{pmatrix} 8.486 \times 10^4 \\ 3.531 \times 10^{-8} \\ 6.205 \times 10^4 \\ 2.281 \times 10^4 \end{pmatrix} \text{ft}^3$$

$$\rho_{\text{waste}} = \begin{pmatrix} 1.21 \\ 1.427 \\ 1.13 \\ 1.427 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$[137\text{Cs}137\text{Ba}] = [137\text{Cs}] \cdot 1.000 \quad [90\text{Sr}90\text{Y}] = [90\text{Sr}] \cdot 1.000$$

$$jk := 0..1$$

$$\text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$f2_{jk} := \text{FindIndex}(\text{name}, \text{nameisotope}_{jk})$$

$$f2 = \begin{pmatrix} 33 \\ 1 \\ 6 \\ 1 \end{pmatrix}$$

$$i1 := f2$$

$$i0 = \begin{pmatrix} 33 \\ 1 \end{pmatrix} \quad i1 = \begin{pmatrix} 6 \\ 1 \end{pmatrix}$$

$$\text{in2}_{jk} := (i1)_{jk}$$

$$\text{in2} = \begin{pmatrix} 33 \\ 6 \end{pmatrix}$$

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$$\text{half_life2}_{jk} := M_{\text{in2}_{jk},0} \cdot 10^{M_{\text{in2}_{jk},1}} \cdot \text{day} \quad \text{half_life2} = \begin{pmatrix} 11019.593 \\ 10446.150 \end{pmatrix} \text{day} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{wt2atomic}_{jk} := M_{\text{in2}_{jk},2} \frac{\text{gm}}{\text{g_mol}} \quad \text{wt2atomic} = \begin{pmatrix} 137 \\ 90 \end{pmatrix} \frac{\text{gm}}{\text{g_mol}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{SA2}_{jk} := M_{\text{in2}_{jk},3} \cdot 10^{M_{\text{in2}_{jk},4}} \frac{\text{dpm}}{\text{gm}} \quad \text{SA2} = \begin{pmatrix} 3.74 \times 10^{14} \\ 6.17 \times 10^{14} \end{pmatrix} \frac{\text{dpm}}{\text{gm}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{SA2} = \begin{pmatrix} 168.468 \\ 277.928 \end{pmatrix} \frac{\text{Ci}}{\text{gm}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{q2isotope}_{jk} := M_{\text{in2}_{jk},5} \cdot 10^{M_{\text{in2}_{jk},6}} \frac{\text{watt}}{\text{Ci}} \quad \text{q2isotope} = \begin{pmatrix} 4.72 \times 10^{-3} \\ 6.69 \times 10^{-3} \end{pmatrix} \frac{\text{watt}}{\text{Ci}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{q2isotope} = \begin{pmatrix} 0.016 \\ 0.023 \end{pmatrix} \frac{\text{mBTU}}{\text{Ci}\cdot\text{hr}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{heat_load2}_k := \text{volwaste}_k \cdot \rho_{\text{waste}_k} \left[([137\text{Cs}137\text{Ba}])_k \cdot \text{q2isotope}_0 + ([90\text{Sr}90\text{Y}])_k \cdot \text{q2isotope}_1 \right]$$

$$\text{heat_load2} = \begin{pmatrix} 3.639 \times 10^4 \\ 0 \\ 282.093 \\ 3.611 \times 10^4 \end{pmatrix} \text{watt} \quad \text{compares to} ==> \quad \text{heat_load} = \begin{pmatrix} 3.639 \times 10^4 \\ 0 \\ 282 \\ 3.611 \times 10^4 \end{pmatrix} \text{watt}$$

$$\text{heat_load2} = \begin{pmatrix} 1.242 \times 10^5 \\ 0 \\ 962.542 \\ 1.232 \times 10^5 \end{pmatrix} \frac{\text{BTU}}{\text{hr}} \quad \text{heat_load} = \begin{pmatrix} 1.241 \times 10^5 \\ 0 \\ 961.482 \\ 1.231 \times 10^5 \end{pmatrix} \frac{\text{mBTU}}{\text{hr}}$$

a1 :=

36388.25	
1.63E-23	
282.0001	
36106.24	

Write results to excel file
"rpp5926_r2_02_DecayHeatGRInput020203.xls"

$$\left(\frac{\text{heat_load}}{\text{watt}} \right)$$

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Author: _____ Date: _____

**G.3. RPP-5926 REV. 2: 03 HYDROGEN GENERATION RATE CALCULATIONS
SINGLE-POINT CALCULATION – CALCULATION NOTE RPP-5926, REVISION 2,
241-AY-102**

CH2MHILL
Hanford Group, Inc.

SA Barker

Hydrogen Generation Rate Calculations

Single-Point Calculation - Calculation Note
RPP-5926, Revision 2:

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Read Waste Information From "FGS Input 020203 .xls"

excel =

C:\FGS Input 020203 .xls

Datafile Name Is "FGS Input 020203 .xls"

excel =

1.000	2.000	3.000	4.000	5.000	6.000	7.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	1.166-10 ³	4.160-10 ⁴	7.305-10 ⁴	1.123-10 ⁴	0.040	82.911
0.000	1.166-10 ³	4.160-10 ⁴	7.305-10 ⁴	1.123-10 ⁴	0.040	82.911
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	2.581-10 ⁴	9.444-10 ⁴	2.368-10 ⁵	1.604-10 ⁴	67.467	220.193
0.000	2.581-10 ⁴	9.444-10 ⁴	2.368-10 ⁵	1.604-10 ⁴	59.727	214.404
0.000	2.581-10 ⁴	9.444-10 ⁴	2.368-10 ⁵	1.604-10 ⁴	144.373	277.714
0.000	2.597-10 ³	1.641-10 ⁵	1.673-10 ⁵	2.995-10 ⁴	1.371	351.899
0.000	2.597-10 ³	1.641-10 ⁵	1.673-10 ⁵	2.995-10 ⁴	0.011	434.834
0.000	2.597-10 ³	1.641-10 ⁵	1.673-10 ⁵	2.995-10 ⁴	2.845	262.084
0.000	3.140-10 ³	1.123-10 ⁵	1.719-10 ⁵	3.898-10 ⁴	15.096	351.079
0.000	3.140-10 ³	1.123-10 ⁵	1.719-10 ⁵	3.898-10 ⁴	0.062	374.528
0.000	3.140-10 ³	1.123-10 ⁵	1.719-10 ⁵	3.898-10 ⁴	31.297	325.809
0.000	3.556-10 ³	1.209-10 ⁵	1.616-10 ⁵	4.113-10 ⁴	7.631	223.898
0.000	3.556-10 ³	1.209-10 ⁵	1.616-10 ⁵	4.113-10 ⁴	0.026	220.893

Author: _____ Date: _____

Input Data

Waste Properties (Crust Layer Volume Is Included In Solids Layer In This Example)
(1 ==> Total Waste, 2 ==> Crust 3 ==> Liquid Waste, 4 ==> Solid Waste)

Tank_id = "241-AY-102" TFI1 := search(Tank_id, "-", 1) TFI1 = 3.000
 TankFarm := substr(Tank_id, TFI1 + 1, 2) TankFarm = "AY"
 TankNames3 := stack(TankNames1, TankNames2)
 j1 := 1..177
 nal_j1 := j1
 vent_rate = 250 cfm From (Bingham 2000)

Find The Appropriate Tank Specific Information:

fi1 := FindIndex(TankNames3, Tank_id)

$$fi1 = \begin{pmatrix} 23.000 \\ 1.000 \end{pmatrix}$$

$$\text{tank}_{idxT} := \left[(fi1_1 - 1) \cdot 3 \right] + 3 \quad \text{tank}_{idxT} = 69.000$$

$$\text{tank}_{idxL} := \text{tank}_{idxT} + 1$$

$$\text{tank}_{idxS} := \text{tank}_{idxT} + 2$$

$$\text{classwaste} := \text{if} \left[(fi1_1 < 29), "dst", "sst" \right]$$

$$\text{classwaste} = "dst"$$

...The Following Data Is From Hu 2001b, Except Where Noted

$$[TOC] = \begin{pmatrix} \text{excel}_{\text{tank}_{idxT}, 2} \\ \text{excel}_{\text{tank}_{idxS}, 2} \\ \text{excel}_{\text{tank}_{idxL}, 2} \\ \text{excel}_{\text{tank}_{idxS}, 2} \end{pmatrix} \frac{\mu\text{gm}}{\text{mL}} \quad [TOC] = \begin{pmatrix} 1.769 \times 10^3 \\ 2.124 \times 10^3 \\ 1.639 \times 10^3 \\ 2.124 \times 10^3 \end{pmatrix} \frac{\mu\text{gm}}{\text{mL}}$$

$$[NO_2] = \begin{pmatrix} \text{excel}_{\text{tank}_{idxT}, 3} \\ \text{excel}_{\text{tank}_{idxS}, 3} \\ \text{excel}_{\text{tank}_{idxL}, 3} \\ \text{excel}_{\text{tank}_{idxS}, 3} \end{pmatrix} \frac{\mu\text{gm}}{\text{mL}} \quad [NO_2] = \begin{pmatrix} 4.431 \times 10^3 \\ 228.866 \\ 5.976 \times 10^3 \\ 228.866 \end{pmatrix} \frac{\mu\text{gm}}{\text{mL}}$$

$Cl = 1.61 \cdot 10^{-2} \frac{\text{BTU}}{\text{hr}}$

Author: _____ Date: _____

$$[\text{NO}_3] = \begin{pmatrix} \text{excel_tank_idxT,4} \\ \text{excel_tank_idxS,4} \\ \text{excel_tank_idxL,4} \\ \text{excel_tank_idxS,4} \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_3] = \begin{pmatrix} 378.889 \\ 294.845 \\ 409.789 \\ 294.845 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{Al}] = \begin{pmatrix} \text{excel_tank_idxT,5} \\ \text{excel_tank_idxS,5} \\ \text{excel_tank_idxL,5} \\ \text{excel_tank_idxS,5} \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{Al}] = \begin{pmatrix} 1.109 \times 10^3 \\ 100.206 \\ 1.480 \times 10^3 \\ 100.206 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{90Sr}] = \begin{pmatrix} \text{excel_tank_idxT,6} \\ 1 \cdot 10^{-12} \\ \text{excel_tank_idxL,6} \\ \text{excel_tank_idxS,6} \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$[\text{90Sr}] = \begin{pmatrix} 1.818 \times 10^3 \\ 1.000 \times 10^{-12} \\ 1.551 \\ 5.729 \times 10^3 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$[\text{137Cs}] = \begin{pmatrix} \text{excel_tank_idxT,7} \\ 1 \cdot 10^{-12} \\ \text{excel_tank_idxL,7} \\ \text{excel_tank_idxS,7} \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$[\text{137Cs}] = \begin{pmatrix} 74.771 \\ 1.000 \times 10^{-12} \\ 27.904 \\ 175.680 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$\rho_{\text{waste}} = \begin{pmatrix} \text{excel_tank_idxT,8} \\ \text{excel_tank_idxS,8} \\ \text{excel_tank_idxL,8} \\ \text{excel_tank_idxS,8} \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\rho_{\text{waste}} = \begin{pmatrix} 1.210 \\ 1.427 \\ 1.130 \\ 1.427 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{vol}_{\text{waste}} = \begin{pmatrix} \text{excel_tank_idxT,9} \\ 1 \cdot 10^{-9} \\ \text{excel_tank_idxL,9} \\ \text{excel_tank_idxS,9} \end{pmatrix} \text{kilo-L}$$

$$\text{vol}_{\text{waste}} = \begin{pmatrix} 2403 \\ 0 \\ 1757 \\ 646 \end{pmatrix} \text{kilo-L}$$

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$$FH2O := \begin{pmatrix} excel_{tank_{idxT},10} \\ excel_{tank_{idxS},10} \\ excel_{tank_{idxL},10} \\ excel_{tank_{idxS},10} \end{pmatrix} \quad FH2O = \begin{pmatrix} 73.8 \\ 38.0 \\ 87.0 \\ 38.0 \end{pmatrix} \%$$

$$F_{liquid_2} := \left(\frac{FH2O_2}{FH2O_3} \right) \quad F_{liquid_3} := \left(\frac{FH2O_3}{FH2O_3} \right) \quad F_{liquid_4} := \left(\frac{FH2O_4}{FH2O_3} \right)$$

$$F_{liquid_1} := \left[\frac{F_{liquid_2} \cdot (vol_{waste_2} \cdot \rho_{waste_2}) + F_{liquid_3} \cdot (vol_{waste_3} \cdot \rho_{waste_3}) + F_{liquid_4} \cdot (vol_{waste_4} \cdot \rho_{waste_4})}{vol_{waste_4} \cdot \rho_{waste_4} + vol_{waste_3} \cdot \rho_{waste_3} + vol_{waste_2} \cdot \rho_{waste_2}} \right]$$

$$F_{liquid} = \begin{pmatrix} 82.137 \\ 43.678 \\ 100.000 \\ 43.678 \end{pmatrix} \%$$

$$Temp_{waste} := \begin{pmatrix} excel_{tank_{idxT},11} + 273.15 \\ excel_{tank_{idxS},11} + 273.15 \\ excel_{tank_{idxL},11} + 273.15 \\ excel_{tank_{idxS},11} + 273.15 \end{pmatrix} K \quad Temp_{waste} = \begin{pmatrix} 345.150 \\ 345.150 \\ 318.150 \\ 345.150 \end{pmatrix} K \quad \text{From (Bingham 2000)}$$

$$Temp_{vap} := (excel_{tank_{idxL},12} + 273.15) K \quad Temp_{vap} = 316.761 K \quad \text{From (Bingham 2000)}$$

Make Sure You Run The File "Decay Heat Generation Rate 011129 .MCD"

excel2 :=

C:\rpp5926_r2_02_DdecayHeatGRInput020203.xls

Read Results From Excel File

"rpp5926_r2_02_DdecayHeatGRInput020203.xls"

HeatLoad_{137Cs_90Sr} := excel2.watt

$$HeatLoad_{137Cs_90Sr} = \begin{pmatrix} 3.639 \times 10^4 \\ 1.628 \times 10^{-23} \\ 282.000 \\ 3.611 \times 10^4 \end{pmatrix} \text{ watt}$$

Calculated By Barker In
"Decay Heat Generation Rate .MCD"

Author: _____ Date: _____

TankInfo :=

C:\TankInfo_post-1999.xls

Read Waste properties From Excel File
"TankInfo_post-1999.xls"

j := 1..27

na_j := j name := augment(na, TankId)

TankFarm = "AY"

fi := FindIndex(name, TankFarm)

$$fi = \begin{pmatrix} 11.000 \\ 2.000 \end{pmatrix}$$

$$vol_{tank} := TankInfo_{fi,4} \cdot ft^3$$

$$vol_{tank} = 1407 \text{ kilo-gal}$$

$$vol_{tank} = 138089 \text{ ft}^3$$

$$vent_rate = 250.000 \text{ cfm}$$

$$vent_rate_{bb} := .0045 \cdot (vol_{tank} - vol_{waste_1}) \cdot \frac{1}{\text{day}}$$

$$vent_rate_{bb} = 0.323 \text{ cfm}$$

$$diam_{tank} := 2 \cdot TankInfo_{fi,2} \cdot ft$$

$$diam_{tank} = 75.000 \text{ ft}$$

$$ht_{tank} := \frac{vol_{waste}}{TankInfo_{fi,8} \cdot \frac{\text{gal}}{\text{in}}} \quad \text{estimation Of Waste Depth}$$

$$ht_{tank} = \begin{pmatrix} 230.504 \\ 9.592 \times 10^{-11} \\ 168.537 \\ 61.966 \end{pmatrix} \text{ in} \quad \text{estimation Of Waste Depth}$$

$$vol_{head} := vol_{tank} - vol_{waste_1} \quad vol_{head} = 1.032 \times 10^5 \text{ ft}^3$$

Dome-Space Methane Nitrous Oxide And Ammonia Concentrations (Bingham 2000)

$$[H_2] = .0022 \%$$

$$[CH_4] = 1.4445 \text{ ppm}$$

$$[N_2O] = .0010 \%$$

$$[NH_3] = 4.29 \text{ ppm}$$

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Ammonia Diffusion Information (see Rpp5926 R1 - Calculation Of Mass Transport Coefficient H For Soluble Gas AY-102 .mcd (from File "rpp5929_r2_01_NH3CALOutputData0020203.xls")

$$NH3In = \text{C:\rpp5926_r2_01_NH3CALOutputData0020203.xls}$$

+

$$k2_NH3 = NH3In_1 \cdot \frac{\text{mol}}{\text{L} \cdot \text{min}}$$

$$k2_NH3 = 4.319 \times 10^{-10} \frac{\text{mol}}{\text{L} \cdot \text{min}}$$

$$hA_NH3 = NH3In_2 \cdot \text{cfm}$$

$$hA_NH3 = 1.047 \times 10^{-2} \text{ cfm}$$

$$KH = NH3In_3 \cdot \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

$$KH = 21.617 \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

$$Vm = NH3In_4 \cdot \frac{\text{L}}{\text{mol}}$$

$$Vm = 24.155 \frac{\text{L}}{\text{mol}}$$

$$[NH3]_{liq} = NH3In_5 \cdot \frac{\text{mol}}{\text{L}}$$

$$[NH3]_{liq} = 4.327 \times 10^{-3} \frac{\text{mol}}{\text{L}}$$

$$P = 1 \text{ atm}$$

$$k1_NH3 = \frac{\text{vent_rate}_{ob} + (hA_NH3 \cdot KH \cdot P \cdot Vm)}{\text{vol}_{head}}$$

$$k1_NH3 = 5.611 \times 10^{-5} \text{ min}^{-1}$$

Gas Concentrations At LFL

$$LFL_{H2} = 4\%$$

$$\%LFL_{H2} = \frac{04}{100}$$

$$LFL_{NH3} = 15\%$$

$$\%LFL_{NH3} = \frac{15}{100}$$

$$LFL_{CH4} = 5\%$$

$$\%LFL_{CH4} = \frac{05}{100}$$

End Of Input Data

Calculations

$$i = 1..4$$

Hydrogen Generation Due To Thermolysis (Hu, 2000 - Eqn 4-8)

Define Constants (Based On Hu (2000) Eqn 4-8)

$$a_{thm} = 2.76 \cdot 10^9 \frac{\text{g} \cdot \text{mol}}{\text{kg} \cdot \text{day}}$$

Thermolysis pre-exponential Factor (Hu, 2000 - Eqn 4-8)

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$$E_{\text{thm}} = 89.33 \frac{\text{kilo-J}}{\text{g_mol}}$$

activation Energy (Hu, 2000 - Eqn 4-8)

$$R_{\text{const}} = 8.3144739 \frac{\text{J}}{\text{g_mol} \cdot \text{K}}$$

Gas Constant

$$r_f = \begin{cases} 0.4 & \text{if class_waste} = \text{"sst"} \\ 0.4 & \text{if class_waste} = \text{"SST"} \\ 0.7 & \text{otherwise} \end{cases}$$

Reactivity Coefficient (0.7 For DSTs, 0.4 For SSTs)
(Hu, 2000 - Eqn 4-8)

$$r_f = 0.700$$

Calculate The Weight Fraction Of Liquid In The Waste

$$WH_{2O_1} := \text{vol_waste}_1 \cdot \rho_{\text{waste}_1} \cdot FH_{2O_1}$$

$$WH_{2O} = \begin{pmatrix} 2.147 \times 10^6 \\ 5.424 \times 10^{-7} \\ 1.727 \times 10^6 \\ 3.504 \times 10^5 \end{pmatrix} \text{ kg}$$

Check Units On Input Data

$$[TOC] = \begin{pmatrix} 1.769 \times 10^3 \\ 2.124 \times 10^3 \\ 1.639 \times 10^3 \\ 2.124 \times 10^3 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$([TOC_{\text{wt}\%}]_1)_1 := \frac{([TOC]_3)}{\rho_{\text{waste}_3}} \cdot 100$$

$$[TOC_{\text{wt}\%}] = \begin{pmatrix} 0.145 \\ 0.145 \\ 0.145 \\ 0.145 \end{pmatrix}$$

$$[Al] = \begin{pmatrix} 1.109 \times 10^3 \\ 100.206 \times 10^0 \\ 1.480 \times 10^3 \\ 100.206 \times 10^0 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

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$$([Al_{wt\%}]_i) = \frac{([Al]_3)}{\rho_{waste_3}} \cdot 100$$

$$[Al_{wt\%}] = \begin{pmatrix} 0.131 \\ 0.131 \\ 0.131 \\ 0.131 \end{pmatrix}$$

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Calculate The Hydrogen Generation Rate Due To Thermolysis (HGR_{therm})

$$HGR_{therm_scf_i} := \frac{a_{thm}}{\left(\frac{g_mol}{kg \cdot day}\right)} \cdot r_f \left([TOC_{wt\%}]_i \right) \left([Al_{wt\%}]_i \right)^4 \cdot e^{-\left[\frac{\frac{E_{thm}}{\left(\frac{J}{g_mol}\right)}}{\left[\frac{R_{const}}{\left(\frac{J}{g_mol \cdot K}\right)} \right] \cdot \left(\frac{Temp_{waste_i}}{K} \right)} \right]} \cdot F_{liquid_i} \cdot \frac{g_mol}{kg \cdot day}$$

$$HGR_{therm_i} := HGR_{therm_scf_i}$$

$$HGR_{therm} = \begin{pmatrix} 3.091 \times 10^{-6} \\ 1.644 \times 10^{-6} \\ 2.681 \times 10^{-7} \\ 1.644 \times 10^{-6} \end{pmatrix} \frac{g_mol}{kg \cdot day}$$

$$HGR_{thermv_i} := HGR_{therm_i} \cdot (vol_{waste_i} \cdot \rho_{waste_i}) \cdot \frac{Temp_{vap}}{273.15 \cdot K}$$

$$HGR_{thermv_1} := \sum_{i=2}^4 HGR_{thermv_i}$$

$$HGR_{thermv} = \begin{pmatrix} 1.880 \\ 2.154 \times 10^{-12} \\ 0.489 \\ 1.391 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{thermv_scf_i} := HGR_{thermv_i} \cdot \frac{273.15 \cdot K}{Temp_{vap}}$$

$$HGR_{thermv} = \begin{pmatrix} 1.306 \times 10^{-3} \\ 1.496 \times 10^{-15} \\ 3.393 \times 10^{-4} \\ 9.662 \times 10^{-4} \end{pmatrix} cfm$$

$$HGR_{thermv_scf} = \begin{pmatrix} 1.621 \\ 1.857 \times 10^{-12} \\ 0.421 \\ 1.200 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{thermv_scf} = \begin{pmatrix} 1.126 \times 10^{-3} \\ 1.290 \times 10^{-15} \\ 2.926 \times 10^{-4} \\ 8.332 \times 10^{-4} \end{pmatrix} cfm$$

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Hydrogen Generation Due To Radiolysis (Hu, 2000 - Eqn 4-16)

Constant Definition (Based On Hu (2000) Eqn 4-16)

$$E_{\text{rad}} := 44.32 \cdot \frac{\text{kilo}\cdot\text{J}}{\text{g}\cdot\text{mol}}$$

Activation Energy Of G In Organic Radiolysis
(Hu, 2000 - Eqn 4-16)

$$a_{\text{rad}} := 2.49 \cdot 10^6 \cdot \frac{\text{molecules}}{100 \cdot \text{eV}}$$

pre-exponential Factor Of G In Organic
Radiolysis (Hu, 2000 - Eqn 4-16)

$$r_f := \begin{cases} 0.4 & \text{if classwaste} = \text{"sst"} \\ 0.4 & \text{if classwaste} = \text{"SST"} \\ 0.7 & \text{otherwise} \end{cases}$$

Reactivity Coefficient Of TOC (0.7 For DSTs,
0.4 For SSTs) (Hu, 2000 - Eqn 4-16)

$$r_f = 0.700$$

$$G_{\text{H}_2\text{O}_{\text{sat}}} := 0.005 \cdot \frac{\text{molecules}}{100 \cdot \text{eV}}$$

default Water Radiolysis G-value

Check Units On Input Data

$$\text{Tempwaste}_2 = 345.150 \text{ K}$$

$$\text{mwNO}_2 := (14.0067 + 2 \cdot 15.9994) \cdot \frac{\text{gm}}{\text{g}\cdot\text{mol}}$$

$$\text{mwNO}_3 := (14.0067 + 3 \cdot 15.9994) \cdot \frac{\text{gm}}{\text{g}\cdot\text{mol}}$$

$$[\text{NO}_3] = \begin{pmatrix} 378.889 \times 10^0 \\ 294.845 \times 10^0 \\ 409.789 \times 10^0 \\ 294.845 \times 10^0 \end{pmatrix} \cdot \frac{\mu\cdot\text{gm}}{\text{mL}}$$

$$[\text{NO}_3_{\text{molar}}] := \frac{[\text{NO}_3]}{\text{mwNO}_3}$$

$$[\text{NO}_3_{\text{molar}}] = \begin{pmatrix} 6.111 \times 10^{-3} \\ 4.755 \times 10^{-3} \\ 6.609 \times 10^{-3} \\ 4.755 \times 10^{-3} \end{pmatrix} \cdot \frac{\text{g}\cdot\text{mol}}{\text{liter}}$$

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$$[\text{NO}_2] = \begin{pmatrix} 4.431 \times 10^3 \\ 228.866 \times 10^0 \\ 5.976 \times 10^3 \\ 228.866 \times 10^0 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_2_{\text{molar}}] := \frac{[\text{NO}_2]}{\text{mwNO}_2}$$

$$[\text{NO}_2_{\text{molar}}] = \begin{pmatrix} 0.096 \\ 4.975 \times 10^{-3} \\ 0.130 \\ 4.975 \times 10^{-3} \end{pmatrix} \frac{\text{g_mol}}{\text{liter}}$$

$$\text{HeatLoad}_{137\text{Cs_90Sr}} = \begin{pmatrix} 7.712 \times 10^{12} \\ 3.451 \times 10^{-15} \\ 5.977 \times 10^{10} \\ 7.652 \times 10^{12} \end{pmatrix} \mu\text{-Ci}$$

$$\text{HeatLoad}_{137\text{Cs_90Sr}} = \begin{pmatrix} 1.242 \times 10^5 \\ 5.557 \times 10^{-23} \\ 962.224 \\ 1.232 \times 10^5 \end{pmatrix} \frac{\text{BTU}}{\text{hr}}$$

$$\text{HeatLoad}_{137\text{Cs_90Sr}} = \begin{pmatrix} 1.232 \times 10^5 \\ 3.639 \times 10^4 \\ 1.628 \times 10^{-23} \\ 282.000 \\ 3.611 \times 10^4 \end{pmatrix} \text{watt}$$

$$H_{\text{load}} := \frac{\text{HeatLoad}_{137\text{Cs_90Sr}}}{\text{vol}_{\text{waste}} \cdot \rho_{\text{waste}}}$$

$$H_{\text{load}} = \begin{pmatrix} 0.013 \\ 1.141 \times 10^{-17} \\ 1.420 \times 10^{-4} \\ 0.039 \end{pmatrix} \frac{\text{watt}}{\text{kg}}$$

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Calculate The Hydrogen Generation Rate Due To Radiolysis (HGR_{rad})

$$G_{org_i} = \frac{a_{rad}}{\left(\frac{\text{molecules}}{100 \cdot \text{eV}}\right)} \cdot e \left[\left[\frac{\left(\frac{E_{rad}}{\text{J}}\right)}{\left(\frac{\text{g}_{mol}}{\text{K}}\right)} \right] \cdot \left[\frac{R_{const}}{\left(\frac{\text{J}}{\text{g}_{mol} \cdot \text{K}}\right)} \cdot \frac{Temp_{waste_i}}{K} \right] \right] \cdot r_f \cdot ([TOC_{wt\%}]_i) \cdot \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$G_{org} = \begin{pmatrix} 0.050 \\ 0.050 \\ 0.013 \\ 0.050 \end{pmatrix} \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$G_{H_2O} = \left[0.45 - 0.56 \left[\frac{[NO_3_{molar}]}{\left(\frac{\text{g}_{mol}}{\text{liter}}\right)} \right]^{\frac{1}{3}} - 0.43 \left[\frac{[NO_2_{molar}]}{\left(\frac{\text{g}_{mol}}{\text{liter}}\right)} \right]^{\frac{1}{3}} \right] \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$G_{H_2O} = \begin{pmatrix} 0.151 \\ 0.282 \\ 0.127 \\ 0.282 \end{pmatrix} \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$G_{H_2O_i} = \begin{cases} G_{H_2O_i} & \text{if } G_{H_2O_i} > G_{H_2O_sat} \\ G_{H_2O_sat} & \text{otherwise} \end{cases}$$

$$G_{H_2O} = \begin{pmatrix} 0.151 \\ 0.282 \\ 0.127 \\ 0.282 \end{pmatrix} \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$HGR_{rad_i} = (G_{H_2O_i} + G_{org_i}) \cdot H_{load_i} \cdot F_{liquid_i} \cdot \frac{\text{g}_{mol}}{6.02 \cdot 10^{23} \cdot \text{molecules}}$$

$$HGR_{rad} = \begin{pmatrix} 1.459 \times 10^{-5} \\ 1.173 \times 10^{-20} \\ 1.415 \times 10^{-7} \\ 4.027 \times 10^{-5} \end{pmatrix} \frac{\text{ft}^3}{\text{kg} \cdot \text{day}} \quad HGR_{rad} = \begin{pmatrix} 1.843 \times 10^{-5} \\ 1.482 \times 10^{-20} \\ 1.788 \times 10^{-7} \\ 5.088 \times 10^{-5} \end{pmatrix} \frac{\text{g}_{mol}}{\text{kg} \cdot \text{day}}$$

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$$HGR_{radv} := \left[HGR_{rad} \cdot (vol_{waste} \cdot \rho_{waste}) \right] \cdot \frac{Temp_{vap}}{273.15 \cdot K}$$

$$HGR_{radv_1} := \sum_{i=2}^4 HGR_{radv_i}$$

$$HGR_{radv} = \begin{pmatrix} 43.3888 \\ 1.9422 \times 10^{-26} \\ 0.3259 \\ 43.0630 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{radv} = \begin{pmatrix} 0.030 \\ 1.349 \times 10^{-29} \\ 2.263 \times 10^{-4} \\ 0.030 \end{pmatrix} cfm$$

$$HGR_{radv_scf} := HGR_{radv} \cdot \frac{273.15 \cdot K}{Temp_{vap}}$$

$$HGR_{radv_scf} = \begin{pmatrix} 37.415 \\ 1.675 \times 10^{-26} \\ 0.281 \\ 37.134 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{radv_scf} = \begin{pmatrix} 0.026 \\ 1.163 \times 10^{-29} \\ 1.951 \times 10^{-4} \\ 0.026 \end{pmatrix} cfm$$

Hydrogen Generation Due To Corrosion (Hu, 2000 - Eqn 4-17)

Constant Definition (Based On Hu (2000) Eqn 4-17)

$$R_{corr} := \begin{cases} 3.6 \cdot 10^{-8} \cdot \frac{m^3}{m^2 \cdot min} & \text{if } class_{waste} = "sst" \\ 3.6 \cdot 10^{-8} \cdot \frac{m^3}{m^2 \cdot min} & \text{if } class_{waste} = "SST" \\ 1.83 \cdot 10^{-8} \cdot \frac{m^3}{m^2 \cdot min} & \text{otherwise} \end{cases}$$

Corrosion Coefficient (1.83E-08
For DSTs, 3.6E-08 For SSTs)
(m³/min/m²) Reference
Temperature Is 25°C
(Hu, 2001B - Eqn 2-1)

$$R_{corr} = 1.830 \times 10^{-8} \cdot \frac{m^3}{m^2 \cdot min}$$

Calculate The Wetted Area Of Steel (vertical Waste Storage Tank, Assuming A Flat Bottom)

$$\left[\pi \cdot \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank} \right] = \pi \cdot \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank}$$

$$Awet_1 := \pi \cdot \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank_1}$$

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$$Awet_2 := \pi \cdot diam_{tank} \cdot ht_{tank_2}$$

$$Awet_3 := \pi \cdot diam_{tank} \cdot ht_{tank_3}$$

$$Awet_4 := \pi \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank_4}$$

$$Awet = \begin{pmatrix} 8.944 \times 10^3 \\ 1.883 \times 10^{-9} \\ 3.309 \times 10^3 \\ 5.635 \times 10^3 \end{pmatrix} ft^2$$

Calculate Hydrogen Generation Due To Corrosion

$$HGR_{corr_mol} := \frac{R_{corr} \cdot Awet}{(vol_{waste} \cdot \rho_{waste})} \cdot \frac{273.15 \cdot K}{298.15 \cdot K}$$

$$HGR_{corr_mol} = \begin{pmatrix} 3.078 \times 10^{-7} \\ 1.320 \times 10^{-7} \\ 1.668 \times 10^{-7} \\ 6.114 \times 10^{-7} \end{pmatrix} \frac{g_mol}{kg_day}$$

$$HGR_{corr} := \left[HGR_{corr_mol} (vol_{waste} \cdot \rho_{waste}) \cdot \frac{Temp_{vap}}{273.15 \cdot K} \right]$$

$$HGR_{corr} = \begin{pmatrix} 5.705 \times 10^{-4} \\ 1.201 \times 10^{-16} \\ 2.111 \times 10^{-4} \\ 3.594 \times 10^{-4} \end{pmatrix} \frac{ft^3}{min}$$

$$HGR_{corr_scf} := HGR_{corr} \cdot \frac{273.15 \cdot K}{Temp_{vap}}$$

$$HGR_{corr_scf} = \begin{pmatrix} 4.920 \times 10^{-4} \\ 1.036 \times 10^{-16} \\ 1.820 \times 10^{-4} \\ 3.099 \times 10^{-4} \end{pmatrix} \frac{ft^3}{min}$$

$$HGR_{corr} = \begin{pmatrix} 0.822 \\ 1.730 \times 10^{-13} \\ 0.304 \\ 0.518 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{corr_scf} = \begin{pmatrix} 0.708 \\ 1.492 \times 10^{-13} \\ 0.262 \\ 0.446 \end{pmatrix} \frac{ft^3}{day}$$

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Total Hydrogen Generation Rate

$$\text{mass}_{\text{waste}} = \begin{pmatrix} 2.908 \times 10^6 \\ 1.427 \times 10^{-6} \\ 1.985 \times 10^6 \\ 9.221 \times 10^5 \end{pmatrix} \text{ kg}$$

$$\text{HGR}_{\text{thermv}} = \begin{pmatrix} 1.880 \\ 2.154 \times 10^{-12} \\ 0.489 \\ 1.391 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{radv}} = \begin{pmatrix} 43.389 \\ 1.942 \times 10^{-26} \\ 0.326 \\ 43.063 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{corr}} = \begin{pmatrix} 0.822 \\ 1.730 \times 10^{-13} \\ 0.304 \\ 0.518 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR} := (\text{HGR}_{\text{thermv}} + \text{HGR}_{\text{radv}} + \text{HGR}_{\text{corr}})$$

$$\text{HGR} = \begin{pmatrix} 0.03201 \\ 1.61582 \times 10^{-15} \\ 7.76677 \times 10^{-4} \\ 0.03123 \end{pmatrix} \text{ cfm}$$

$$\text{HGR} = \begin{pmatrix} 1.305 \times 10^3 \\ 6.589 \times 10^{-11} \\ 31.670 \\ 1.273 \times 10^3 \end{pmatrix} \frac{\text{L}}{\text{day}}$$

$$\text{HGR}_{\text{stp}} := \text{HGR} \cdot \frac{273.15 \cdot \text{K}}{\text{Temp}_{\text{vap}}}$$

} At Headspace Temp...

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$$\begin{array}{l}
 \text{HGR}_{\text{stp}} = \begin{pmatrix} 0.028 \\ 1.393 \times 10^{-15} \\ 6.697 \times 10^{-4} \\ 0.027 \end{pmatrix} \text{cfm} \\
 \text{HGR}_{\text{stp}} = \begin{pmatrix} 39.745 \\ 2.006 \times 10^{-12} \\ 0.964 \\ 38.780 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}
 \end{array}
 \left. \vphantom{\begin{array}{l} \text{HGR}_{\text{stp}} = \begin{pmatrix} 0.028 \\ 1.393 \times 10^{-15} \\ 6.697 \times 10^{-4} \\ 0.027 \end{pmatrix} \text{cfm} \\ \text{HGR}_{\text{stp}} = \begin{pmatrix} 39.745 \\ 2.006 \times 10^{-12} \\ 0.964 \\ 38.780 \end{pmatrix} \frac{\text{ft}^3}{\text{day}} \end{array}} \right\} \text{At Standard Conditions...}$$

Steady-State Hydrogen Concentration (Assuming Normal Ventilation Rate)

$$[\text{H2}_{\text{ss}}] := \frac{\text{HGR}_1}{\text{HGR}_1 + \text{vent_rate}}$$

$$[\text{H2}_{\text{ss}}] = 128.012 \text{ ppmv}$$

$$[\text{H2}_{\text{ss}}] = 0.013 \%$$

Steady-State Hydrogen Concentration (Assuming Barometric Breathing Ventilation Rate)

$$[\text{H2}_{\text{ss_bb}}] := \frac{\text{HGR}_1}{\text{HGR}_1 + \text{vent_rate}_{\text{bb}}}$$

$$[\text{H2}_{\text{ss_bb}}] = 9.026 \times 10^4 \text{ ppmv}$$

$$[\text{H2}_{\text{ss_bb}}] = 9.026 \%$$

$$[\text{H2}_{\text{ss_bb}}] = 225.661 \% \text{LFLH}_2$$

Gas Release Rate (Independent Of Ventilation Rate)

$$\text{rateH2_rel} := [\text{H2}_{\text{ss}}] \cdot \frac{\text{vent_rate}}{1 - [\text{H2}_{\text{ss}}]}$$

$$\text{rateH2_rel} = 0.0320 \text{ cfm}$$

$$\text{rateH2_rel_bb} := [\text{H2}_{\text{ss_bb}}] \cdot \frac{\text{vent_rate}_{\text{bb}}}{1 - [\text{H2}_{\text{ss_bb}}]}$$

$$\text{rateH2_rel_bb} = 0.032 \text{ cfm}$$

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Calculate Generation Rates Of Ammonia, Methane, And Nitrous Oxide (Assuming No Gas Retention)

$$GR_{NH3} := \frac{[NH_3] \cdot vent_rate}{1 - [NH_3]} \quad GR_{NH3} = 1.07250 \times 10^{-3} \text{ cfm}$$

$$GR_{CH4} := \frac{[CH_4] \cdot vent_rate}{1 - [CH_4]} \quad GR_{CH4} = 3.611 \times 10^{-4} \text{ cfm}$$

$$GR_{N2O} := \frac{[N_2O] \cdot vent_rate}{1 - [N_2O]} \quad GR_{N2O} = 2.500 \times 10^{-3} \text{ cfm}$$

Steady-State Ammonia, Methane, And Nitrous Oxide Concentration (Assuming Normal Ventilation Rate)(Just A Check Of Methodology)

$$[NH_{3ss}] := \frac{GR_{NH3}}{GR_{NH3} + vent_rate} \quad [NH_{3ss}] = 4.290 \times 10^{-4} \%$$

$$[CH_{4ss}] := \frac{GR_{CH4}}{GR_{CH4} + vent_rate} \quad [CH_{4ss}] = 1.444 \times 10^{-4} \%$$

$$[N_{2Oss}] := \frac{GR_{N2O}}{GR_{N2O} + vent_rate} \quad [N_{2Oss}] = 1.000 \times 10^{-3} \%$$

Steady-State Ammonia, Methane, And Nitrous Oxide Concentration (Assuming Barometric Breathing Ventilation Rate)

$$NH3_1000_day := \left[\frac{k_2_NH3}{k_1_NH3} + \left(\frac{[NH_{3ss}]}{v_m} - \frac{k_2_NH3}{k_1_NH3} \right) \exp \left(-1 \cdot \frac{k_1_NH3}{1} \cdot 1000 \right) \right] \cdot v_m$$

$$NH3_1000_day = 185.957 \text{ ppm}$$

$$[NH_{3ss_bb}] := NH3_1000_day \quad [NH_{3ss_bb}] = 0.019 \%$$

$$[NH_{3ss_bb}] = 0.124\% \text{ LFL}_{NH3}$$

$$[CH_{4ss_bb}] := \frac{GR_{CH4}}{GR_{CH4} + vent_rate_{bb}} \quad [CH_{4ss_bb}] = 0.112 \%$$

$$[CH_{4ss_bb}] = 2.236\% \text{ LFL}_{CH4}$$

$$[N_{2Oss_bb}] := \frac{GR_{N2O}}{GR_{N2O} + vent_rate_{bb}} \quad [N_{2Oss_bb}] = 0.769 \%$$

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Determine The Overall Steady-State Flammable Gas Concentration With Loss Of Ventilation

$$[\text{Conc_mix}_{ss_bb}] := \frac{[\text{H2}_{ss_bb}]}{\text{LFL}_{\text{H2}}} + \frac{[\text{NH3}_{ss_bb}]}{\text{LFL}_{\text{NH3}}} + \frac{[\text{CH4}_{ss_bb}]}{\text{LFL}_{\text{CH4}}}$$

$$[\text{Conc_mix}_{ss_bb}] = 228.022\% \text{LFL}$$

Set Variables Into Array, Where 1 => H2, 2 => NH3, 3 => CH4, And 4 => N2O

$$\text{GR} = \begin{pmatrix} \text{HGR}_1 \\ \text{GR}_{\text{NH3}} \\ \text{GR}_{\text{CH4}} \\ \text{GR}_{\text{N2O}} \end{pmatrix} \quad \text{GR} = \begin{pmatrix} 0.032 \\ 1.073 \times 10^{-3} \\ 3.611 \times 10^{-4} \\ 2.500 \times 10^{-3} \end{pmatrix} \text{cfm} \quad \begin{array}{l} \text{Generation} \\ \text{Rate} \end{array}$$

$$\text{Rate}_{\text{rel}} = \begin{pmatrix} \text{HGR}_1 \\ \text{GR}_{\text{NH3}} \\ \text{GR}_{\text{CH4}} \\ \text{GR}_{\text{N2O}} \end{pmatrix} \quad \text{Rate}_{\text{rel}} = \begin{pmatrix} 0.032 \\ 1.073 \times 10^{-3} \\ 3.611 \times 10^{-4} \\ 2.500 \times 10^{-3} \end{pmatrix} \text{cfm} \quad \begin{array}{l} \text{Release Rate} \\ \text{(Assume No Retention)} \end{array}$$

$$\text{Conc}_{\text{init}} = \begin{pmatrix} [\text{H2}_{ss}] \\ [\text{NH3}_{ss}] \\ [\text{CH4}_{ss}] \\ [\text{N2O}_{ss}] \end{pmatrix} \quad \text{Conc}_{\text{init}} = \begin{pmatrix} 0.013 \\ 4.290 \times 10^{-4} \\ 1.444 \times 10^{-4} \\ 1.000 \times 10^{-3} \end{pmatrix} \% \quad \begin{array}{l} \text{Initial Concentration Rate} \\ \text{(Assume At Steady-} \\ \text{State With Normal Ops)} \end{array}$$

Calculate The Composition Of All Components At Time 't'

Special Calculation For Ammonia (Soluble Gas)

$$\lambda_i := \frac{\text{vent_rate}_{bb} + \text{Rate}_{\text{rel}_i}}{\text{vol}_{\text{head}}}$$

$$\text{Conc}_{\text{in}_i} := \frac{\text{Rate}_{\text{rel}_i} \cdot 100\%}{\text{Rate}_{\text{rel}_i} + \text{vent_rate}_{bb}}$$

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$$\text{conc}(t,i) := \begin{cases} \text{Conc}_{in_i} [1 - e^{(-\lambda_i t)}] + \text{Conc}_{init_i} [e^{(-\lambda_i t)}] & \text{if } i < 2 \\ \text{Conc}_{in_i} [1 - e^{(-\lambda_i t)}] + \text{Conc}_{init_i} [e^{(-\lambda_i t)}] & \text{if } i > 2 \\ \left[\frac{k2_NH3}{k1_NH3} + \left(\frac{[NH3_{ss}]}{V_m} - \frac{k2_NH3}{k1_NH3} \right) \exp \left(-1 \cdot \frac{k1_NH3}{1} \cdot \frac{t}{\text{day}} \right) \right] \cdot V_m & \text{otherwise} \end{cases}$$

$\text{conc}(0\text{-sec},1) = 0.013\%$	$\text{conc}(1000\text{-day},1) = 8.962\%$	$\text{conc}(1000\text{-day},1) = 224.059\% \text{LFL}_{H2}$
$\text{conc}(0\text{-sec},2) = 4.290 \times 10^{-4}\%$	$\text{conc}(1000\text{-day},2) = 0.019\%$	$\text{conc}(1000\text{-day},2) = 0.124\% \text{LFL}_{NH3}$
$\text{conc}(0\text{-sec},3) = 1.444 \times 10^{-4}\%$	$\text{conc}(1000\text{-day},3) = 0.111\%$	$\text{conc}(1000\text{-day},3) = 2.212\% \text{LFL}_{CH4}$
$\text{conc}(0\text{-sec},4) = 1.000 \times 10^{-3}\%$	$\text{conc}(1000\text{-day},4) = 0.761\%$	

$$t := 0, 10 \dots 3000$$

Calculate Steady-State Flammable Gas Concentration At Normal Operating Conditions

$$\text{LFL}_{\text{mix}}(z) := \frac{1}{\frac{\text{conc}(z,1)}{\text{LFL}_{H2}} + \frac{\text{conc}(z,2)}{\text{LFL}_{NH3}} + \frac{\text{conc}(z,3)}{\text{LFL}_{CH4}}}$$

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$$\text{LFL}_{\text{mix}}(0 \cdot \text{day}) = 3.070 \times 10^4 \%$$

$$\text{LFL}_{\text{mix}}(100 \cdot \text{day}) = 112.122 \%$$

Calculate The Time To Reach Various Fractions Of The LFL

Time To Reach 25 %LFL

TOL := .00001

$$f(z, \text{tfl}) := \frac{\left(\frac{\text{conc}(z, 1)}{\text{LFL}_{\text{H}_2}} + \frac{\text{conc}(z, 2)}{\text{LFL}_{\text{NH}_3}} + \frac{\text{conc}(z, 3)}{\text{LFL}_{\text{CH}_4}} \right)}{\% \text{LFL}} - 11$$

$$\text{tfl} := 25$$

$$z := 10 \cdot \text{day} \quad \text{Initial Guess}$$

$$\text{temp}_{25} := -5 \cdot \text{day}$$

Initial Value In Case Solution
Cannot Be Found

$$\text{temp}_{25} := \text{Re}(\text{root}(f(z, \text{tfl}), z))$$

$$\text{temp}_{25} = 23.119 \text{ day}$$

$$\text{Time}_{1_25\% \text{LFL}} := \text{if}([\text{Conc}_{\text{mix}_{\text{ss_bb}}}] > 25\%, \text{if}(\text{temp}_{25} < 0 \cdot \text{day}, 0 \cdot \text{day}, \text{temp}_{25}), 10^9 \cdot \text{day})$$

$$\text{Time}_{1_25\% \text{LFL}} = 23.119 \text{ day}$$

Time To Reach 50 %LFL

$$\text{tfl} := 50$$

$$z := 10 \cdot \text{day} \quad \text{Initial Guess}$$

$$\text{temp}_{50} := -5 \cdot \text{day}$$

Initial Value In Case Solution
Cannot Be Found

$$\text{temp}_{50} := \text{Re}(\text{root}(f(z, \text{tfl}), z))$$

$$\text{temp}_{50} = 49.693 \text{ day}$$

$$\text{Time}_{1_50\% \text{LFL}} := \text{if}([\text{Conc}_{\text{mix}_{\text{ss_bb}}}] > 50\%, \text{if}(\text{temp}_{50} < 0 \cdot \text{day}, 0 \cdot \text{day}, \text{temp}_{50}), 10^9 \cdot \text{day})$$

$$\text{Time}_{1_50\% \text{LFL}} = 49.693 \text{ day}$$

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Time To Reach 75 %LFL

$$f(z) := \frac{\left(\frac{\text{conc}(z,1)}{\text{LFL}_{\text{H}_2}} + \frac{\text{conc}(z,2)}{\text{LFL}_{\text{NH}_3}} + \frac{\text{conc}(z,3)}{\text{LFL}_{\text{CH}_4}} \right)}{\% \text{LFL}} - 75$$

z := 10·day Initial Guess

temp75 := -5·day

Initial Value In Case Solution
Cannot Be Found

temp75 := Re(root(f(z), z))

temp75 = 80.310 day

Time1_75%LFL := if([Conc_mix_{ss_bb}] > 75%, if(temp75 < 0·day, 0·day, temp75), 10⁹·day)

Time1_75%LFL = 80.310 day

Time To Reach 100 %LFL

$$f(z) := \frac{\left(\frac{\text{conc}(z,1)}{\text{LFL}_{\text{H}_2}} + \frac{\text{conc}(z,2)}{\text{LFL}_{\text{NH}_3}} + \frac{\text{conc}(z,3)}{\text{LFL}_{\text{CH}_4}} \right)}{\% \text{LFL}} - 100$$

z := 10·day Initial Guess

temp100 := -5·day

Initial Value In Case Solution
Cannot Be Found

temp100 := Re(root(f(z), z))

temp100 = 116.405 day

Time1_100%LFL := if([Conc_mix_{ss_bb}] > 100%, if(temp100 < 0·day, 0·day, temp100), 10⁹·day)

Time1_100%LFL = 116.405 day

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Minimum Ventilation Rates Need To Prevent Headspace Concentrations From Reaching Various Levels

$$\text{Conc_vi}(V,i) := \begin{cases} \frac{\text{Rate_rel}_i \cdot 100\%}{\text{Rate_rel}_i + V} \left[1 - e^{-\left(\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day} \right)} \right] + \text{Conc_init}_i \left[e^{-\left(\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day} \right)} \right] & \text{if } i < 2 \\ \frac{\text{Rate_rel}_i \cdot 100\%}{\text{Rate_rel}_i + V} \left[1 - e^{-\left(\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day} \right)} \right] + \text{Conc_init}_i \left[e^{-\left(\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day} \right)} \right] & \text{if } i > 2 \\ \left[\frac{k2_NH3}{V + (h_{A_NH3} \cdot K_H \cdot P \cdot V_m)} + \left(\frac{[NH3]_{ss}}{V_m} - \frac{k2_NH3}{k1_NH3} \right) \exp \left[-1 \cdot \frac{V + (h_{A_NH3} \cdot K_H \cdot P \cdot V_m)}{\text{vol_head}} \cdot 10^9 \cdot \frac{1}{\text{day}} \right] \right] \cdot V_m & \text{otherwise} \end{cases}$$

Ventilation Rate To Keep Concentration Less Than 25 %LFL

$$f2_25(z) := \frac{\left(\frac{\text{Conc_vi}(z,1)}{\text{LFLH2}} + \frac{\text{Conc_vi}(z,2)}{\text{LFLNH3}} + \frac{\text{Conc_vi}(z,3)}{\text{LFLCH4}} \right)}{\%LFL} - 24.999$$

z := .001·cfm Initial Guess

temp25 := -5·cfm

Initial Value In Case Solution Cannot Be Found

temp25 := root(f2_25(z), z)

temp25 = 3.208734 cfm

vent_rate1_25%LFL := if(temp25 < 0·cfm, 0·cfm, temp25 + 0.001·cfm)

vent_rate1_25%LFL = 3.210 cfm

Ventilation Rate To Keep Concentration Less Than 50 %LFL

$$f2_50(z) := \frac{\left(\frac{\text{Conc_vi}(z,1)}{\text{LFLH2}} + \frac{\text{Conc_vi}(z,2)}{\text{LFLNH3}} + \frac{\text{Conc_vi}(z,3)}{\text{LFLCH4}} \right)}{\%LFL} - 49.999$$

z := .001·cfm Initial Guess

temp50 := -5·cfm

Initial Value In Case Solution Cannot Be Found

temp50 := root(f2_50(z), z)

temp50 = 1.586387 cfm

vent_rate1_50%LFL := if(temp50 < 0·cfm, 0·cfm, temp50 + 0.001·cfm)

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$$\text{vent_rate1_50\%LFL} = 1.587 \text{ cfm}$$

Ventilation Rate To Keep Concentration Less Than 75 %LFL

$$f2_75(z) := \frac{\left(\frac{\text{Conc_vr}(z,1)}{\text{LFL}_{\text{H}_2}} + \frac{\text{Conc_vr}(z,2)}{\text{LFL}_{\text{NH}_3}} + \frac{\text{Conc_vr}(z,3)}{\text{LFL}_{\text{CH}_4}} \right)}{\% \text{LFL}} - 74.999$$

$$z := .001 \cdot \text{cfm} \quad \text{Initial Guess}$$

$$\text{temp75} := -5 \cdot \text{cfm}$$

Initial Value In Case Solution
Cannot Be Found

$$\text{temp75} := \text{root}(f2_75(z), z)$$

$$\text{temp75} = 1.046417 \text{ cfm}$$

$$\text{vent_rate1_75\%LFL} := \text{if}(\text{temp75} < 0 \cdot \text{cfm}, 0 \cdot \text{cfm}, \text{temp75} + 0.001 \cdot \text{cfm})$$

$$\text{vent_rate1_75\%LFL} = 1.047 \text{ cfm}$$

Ventilation Rate To Keep Concentration Less Than 100 %LFL

$$f2_100(z) := \frac{\left(\frac{\text{Conc_vr}(z,1)}{\text{LFL}_{\text{H}_2}} + \frac{\text{Conc_vr}(z,2)}{\text{LFL}_{\text{NH}_3}} + \frac{\text{Conc_vr}(z,3)}{\text{LFL}_{\text{CH}_4}} \right)}{\% \text{LFL}} - 99.999$$

$$z := .001 \cdot \text{cfm} \quad \text{Initial Guess}$$

$$\text{temp100} := -5 \cdot \text{cfm}$$

Initial Value In Case Solution
Cannot Be Found

$$\text{temp100} := \text{root}(f2_100(z), z)$$

$$\text{temp100} = 0.776625 \text{ cfm}$$

$$\text{vent_rate1_100\%LFL} := \text{if}(\text{temp100} < 0 \cdot \text{cfm}, 0 \cdot \text{cfm}, \text{temp100} + 0.001 \cdot \text{cfm})$$

$$\text{vent_rate1_100\%LFL} = 0.778 \text{ cfm}$$

Additional Calculations -- Estimated Time To LFL With Zero Ventilation

Tank Headspace Hydrogen Concentration :

$$\text{vent_rate}_{\text{zh}} := 1 \cdot 10^{-6} \cdot \text{cfm}$$

$$\% \text{H}_{2\text{lim}} := 100 \cdot [\text{H}_{2\text{ss_bb}}]$$

$$\% \text{H}_{2\text{lim}} = 9.026$$

volume % Hydrogen

$$\% \text{LFL}_{\text{lim}} := 100 \cdot [\text{H}_{2\text{ss_bb}}] \cdot \frac{100}{4}$$

$$\% \text{LFL}_{\text{lim}} = 225.661$$

% LFL Based On Hydrogen

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Final H2 Concentration To Meet 25% (NH3 And CH4 Included) Estimate Gas Concentrations At Final Conditions:

$$H2_{25\%} := 0.0004 \left(25 - \frac{\text{conc}(23.2, \text{day}, 2)}{\%LFL_{NH3}} - \frac{\text{conc}(23.2, \text{day}, 3)}{\%LFL_{CH4}} \right) \quad H2_{25\%} = 0.987 \%$$

Final H2 Concentration To Meet 50% (NH3 And CH4 Included):

$$H2_{50\%} := 0.0004 \left(50 - \frac{\text{conc}(50, \text{day}, 2)}{\%LFL_{NH3}} - \frac{\text{conc}(50, \text{day}, 3)}{\%LFL_{CH4}} \right) \quad H2_{50\%} = 1.977 \%$$

Final H2 Concentration To Meet 100% (NH3 And CH4 Included):

$$H2_{100\%} := 0.0004 \left(100 - \frac{\text{conc}(117, \text{day}, 2)}{\%LFL_{NH3}} - \frac{\text{conc}(117, \text{day}, 3)}{\%LFL_{CH4}} \right) \quad H2_{100\%} = 3.958 \%$$

Maximum %LFL With Loss Of Ventilation (Assume Gas Conc. ~ Equal To Barometric Breathing At 100% LFL):

$$LFL_{\text{nat_breathing}} := \frac{HGR_1}{(HGR_1 + \text{vent_rate}_{bb}) \cdot 0.04} + \frac{[NH3_{ss_bb}]}{\%LFL_{NH3} \cdot 100} + \frac{[CH4_{ss_bb}]}{\%LFL_{CH4} \cdot 100} \quad LFL_{\text{nat_breathing}} = 228.022 \%$$

Time To Reach 25% LFL With Zero Ventilation:

$$\text{tempz}_{25} := \frac{-\text{vol}_{\text{head}}}{(HGR_1 + \text{vent_rate}_{zb})} \cdot \ln \left[\frac{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{25\%}}{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{\text{init}}} \right] \quad \text{tempz}_{25} = 23.118 \text{ day}$$

$$\text{Time_zb2_25\%LFL} := \text{if}(LFL_{\text{nat_breathing}} > 25\%, \text{if}(\text{tempz}_{25} < 0, \text{day}, 0, \text{day}, \text{tempz}_{25}), 999999999, \text{day})$$

$$\text{Time_zb2_25\%LFL} = 21.924 \text{ day}$$

Time To Reach 50% LFL With Zero Ventilation:

$$\text{tempz}_{50} := \frac{-\text{vol}_{\text{head}}}{(HGR_1 + \text{vent_rate}_{zb})} \cdot \ln \left[\frac{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{50\%}}{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{\text{init}}} \right] \quad \text{tempz}_{50} = 49.690 \text{ day}$$

$$\text{Time_zb2_50\%LFL} := \text{if}(LFL_{\text{nat_breathing}} > 50\%, \text{if}(\text{tempz}_{50} < 0, \text{day}, 0, \text{day}, \text{tempz}_{50}), 999999999, \text{day})$$

$$\text{Time_zb2_50\%LFL} = 44.435 \text{ day}$$

Time To Reach 100% LFL With Zero Ventilation:

$$\text{tempz}_{100} := \frac{-\text{vol}_{\text{head}}}{(HGR_1 + \text{vent_rate}_{zb})} \cdot \ln \left[\frac{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{100\%}}{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{\text{init}}} \right] \quad \text{tempz}_{100} = 116.399 \text{ day}$$

$$\text{Time_zb2_100\%LFL} := \text{if}(LFL_{\text{nat_breathing}} > 100\%, \text{if}(\text{tempz}_{100} < 0, \text{day}, 0, \text{day}, \text{tempz}_{100}), 999999999, \text{day})$$

$$\text{Time_zb2_100\%LFL} = 90.169 \text{ day}$$

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Summary Section**Input Data**

Waste Properties (1 ==> Total Waste, 2 ==> Liquid Waste, 3 ==> Solid Waste)

Tank_id = "241-AY-102"

classwaste = "dst"

$$[\text{TOC}] = \begin{pmatrix} 1.769 \times 10^3 \\ 2.124 \times 10^3 \\ 1.639 \times 10^3 \\ 2.124 \times 10^3 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_3] = \begin{pmatrix} 378.889 \\ 294.845 \\ 409.789 \\ 294.845 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_2] = \begin{pmatrix} 4.431 \times 10^3 \\ 228.866 \\ 5.976 \times 10^3 \\ 228.866 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{Al}] = \begin{pmatrix} 1.109 \times 10^3 \\ 100.206 \\ 1.480 \times 10^3 \\ 100.206 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[^{137}\text{Cs}] = \begin{pmatrix} 74.771 \\ 1.000 \times 10^{-12} \\ 27.904 \\ 175.680 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$[^{90}\text{Sr}] = \begin{pmatrix} 1.818 \times 10^3 \\ 1.000 \times 10^{-12} \\ 1.551 \\ 5.729 \times 10^3 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$\text{vol}_{\text{waste}} = \begin{pmatrix} 634.805 \\ 2.642 \times 10^{-10} \\ 464.150 \\ 170.655 \end{pmatrix} \text{kilo-gal}$$

$$\rho_{\text{waste}} = \begin{pmatrix} 1.210 \\ 1.427 \\ 1.130 \\ 1.427 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{Temp}_{\text{waste}} = \begin{pmatrix} 345.150 \\ 345.150 \\ 318.150 \\ 345.150 \end{pmatrix} \text{K}$$

$$\text{FH}_2\text{O} = \begin{pmatrix} 73.827 \\ 38.000 \\ 87.000 \\ 38.000 \end{pmatrix} \%$$

$$\text{HeatLoad}_{^{137}\text{Cs}_{90}\text{Sr}} = \begin{pmatrix} 3.639 \times 10^4 \\ 1.628 \times 10^{-23} \\ 282.000 \\ 3.611 \times 10^4 \end{pmatrix} \text{watt}$$

$$\text{Temp}_{\text{vap}} = 316.761 \text{ K}$$

$$\text{vol}_{\text{tank}} = 1.407 \times 10^3 \text{ kilo-gal}$$

$$\text{vent_rate} = 250.000 \text{ cfm}$$

$$\text{vent_rate}_{\text{bb}} = 0.323 \text{ cfm}$$

AN Tank Farm: Tank Da

$$\text{diam}_{\text{tank}} = 75.000 \text{ ft}$$

$$\text{ht}_{\text{tank}} = \begin{pmatrix} 230.504 \\ 9.592 \times 10^{-11} \\ 168.537 \\ 61.966 \end{pmatrix} \text{ in}$$

estimation Of Waste Depth

Dome-Space Compositions

$$[\text{CH}_4] = 1.444 \times 10^{-4} \%$$

$$[\text{N}_2\text{O}] = 1.000 \times 10^{-3} \%$$

$$[\text{NH}_3] = 4.290 \times 10^{-4} \%$$

End Of Input Data

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Output DataWaste Properties (1 ==> Total Waste, 2 ==> Crust 3 ==> Liquid Waste, 4 ==> Solid Waste)Hydrogen Generation Rate Due To Thermolysis, Radiolysis, And Corrosion...

$$HGR_{thermv} = \begin{pmatrix} 1.306 \times 10^{-3} \\ 1.496 \times 10^{-15} \\ 3.393 \times 10^{-4} \\ 9.662 \times 10^{-4} \end{pmatrix} \text{ cfm} \quad HGR_{radv} = \begin{pmatrix} 0.030 \\ 1.349 \times 10^{-29} \\ 2.263 \times 10^{-4} \\ 0.030 \end{pmatrix} \text{ cfm} \quad HGR_{corr} = \begin{pmatrix} 5.705 \times 10^{-4} \\ 1.201 \times 10^{-16} \\ 2.111 \times 10^{-4} \\ 3.594 \times 10^{-4} \end{pmatrix} \text{ cfm}$$

Overall Hydrogen Generation Rate...

at The Headspace Conditions...

$$HGR = \begin{pmatrix} 0.032 \\ 1.616 \times 10^{-15} \\ 7.767 \times 10^{-4} \\ 0.031 \end{pmatrix} \text{ cfm}$$

$$HGR = \begin{pmatrix} 46.090 \\ 2.327 \times 10^{-12} \\ 1.118 \\ 44.972 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

at Standard Conditions (273°K)...

$$HGR_{stp} = \begin{pmatrix} 0.028 \\ 1.393 \times 10^{-15} \\ 6.697 \times 10^{-4} \\ 0.027 \end{pmatrix} \text{ cfm}$$

$$HGR_{stp} = \begin{pmatrix} 39.745 \\ 2.006 \times 10^{-12} \\ 0.964 \\ 38.780 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

Steady-State Compositions

Hydrogen At Normal Ventilation Rate...

$$[H2_{ss}] = 0.320 \% \text{LFL}_{H2}$$

Ammonia At Normal Ventilation Rate...

$$[NH3_{ss}] = 2.860 \times 10^{-3} \% \text{LFL}_{NH3}$$

Methane At Normal Ventilation Rate...

$$[CH4_{ss}] = 2.889 \times 10^{-3} \% \text{LFL}_{CH4}$$

Nitrous Oxide At Normal Ventilation Rate...

$$[N2O_{ss}] = 1.000 \times 10^{-3} \%$$

At Barometric Breathing Ventilation Rate

$$[H2_{ss_bb}] = 225.661 \% \text{LFL}_{H2}$$

At Barometric Breathing Ventilation Rate

$$[NH3_{ss_bb}] = 0.124 \% \text{LFL}_{NH3}$$

At Barometric Breathing Ventilation Rate

$$[CH4_{ss_bb}] = 2.236 \% \text{LFL}_{CH4}$$

At Barometric Breathing Ventilation Rate

$$[N2O_{ss_bb}] = 0.769 \%$$

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Flammable Gas Concentrations After Loss Of Ventilation At Selected Time Periodsconc_{mix}(0 day) = 0.326 %LFLconc_{mix}(10 day) = 11.367 %LFLconc_{mix}(100 day) = 89.189 %LFLconc_{mix}(10⁹ day) = 228.022 %LFLTime To Reach Various LFL Levels At Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)Time_{1_25%}LFL = 23.119 dayTime_{1_75%}LFL = 80.310 dayTime_{1_50%}LFL = 49.693 dayTime_{1_100%}LFL = 116.405 dayTime To Reach Various LFL Levels At Zero Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)Time_{zb2_25%}LFL = 21.924 dayTime_{zb2_100%}LFL = 90.169 dayTime_{zb2_50%}LFL = 44.435 dayMinimum Ventilation Rates To Keep Headspace Composition Below Selected LFLsvent_rate_{1_25%}LFL = 3.210 cfmvent_rate_{1_75%}LFL = 1.047 cfmvent_rate_{1_50%}LFL = 1.587 cfmvent_rate_{1_100%}LFL = 0.778 cfmGas Concentrations At Time To Reach 25% LFL After Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)H2 [H2₂₅] = 0.987 %[H2₂₅] = 24.671 %LFL_{H2}NH3 [NH3₂₅] = 0.016 %[NH3₂₅] = 0.105 %LFL_{NH3}CH4 [CH4₂₅] = 0.011 %[CH4₂₅] = 0.224 %LFL_{CH4}Gas Concentrations At Time To Reach 50% LFL After Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)H2 [H2₅₀] = 1.977 %[H2₅₀] = 49.427 %LFL_{H2}NH3 [NH3₅₀] = 0.018 %[NH3₅₀] = 0.122 %LFL_{NH3}CH4 [CH4₅₀] = 0.023 %[CH4₅₀] = 0.451 %LFL_{CH4}Gas Concentrations At Time To Reach 100% LFL After Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)H2 [H2₁₀₀] = 3.958 %[H2₁₀₀] = 98.962 %LFL_{H2}NH3 [NH3₁₀₀] = 0.019 %[NH3₁₀₀] = 0.124 %LFL_{NH3}CH4 [CH4₁₀₀] = 0.046 %[CH4₁₀₀] = 0.914 %LFL_{CH4}

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G.4. RPP-5926 REV. 2: 04 CALCULATION OF MASS TRANSPORT COEFFICIENT "h" FOR SOLUBLE GAS -- 241-AY-102 FILLED WITH WATER

CH2MHILL
Hanford Group, Inc.

SA Barker

Calculation of Mass Transport Coefficient "h" for Soluble Gas

241-AY-102 Filled With Water

References

Hu, T. A., S. A. Barker, D. C. Hedengren, M.A. Kufahl, 2001, "Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste", RPP-5926, Rev. 1, CH2MHILL Hanford Group, Inc., Richland, WA.

Input Data

Constants

$\rho_g := 1.17 \cdot \frac{\text{kg}}{\text{m}^3}$	Density of gas
$D_g := 2.50 \times 10^{-5} \cdot \frac{\text{m}^2}{\text{s}}$	Diffusion coefficient in gas phase
$\mu_g := 2.0 \cdot 10^{-5} \cdot \frac{\text{kg}}{\text{m} \cdot \text{s}}$	Viscosity of gas
$g = 9.807 \cdot \frac{\text{m}}{\text{s}^2}$	gravitational number
$\Delta T := 1 \cdot \text{K}$	Temperature difference between waste surface and gas
$\beta_g := 3.30 \cdot 10^{-3} \cdot \frac{1}{\text{K}}$	Thermal expansion coefficient of Gas
$L_c := 5.7825 \cdot \text{m}$	Characteristic Length (1/4 of Diameter)
$D_L := 2.8 \cdot 10^{-9} \cdot \frac{\text{m}^2}{\text{s}}$	Diffusion Coefficient in Liquid Phase
$\rho_L := 1300 \cdot \frac{\text{kg}}{\text{m}^3}$	Density of Liquid

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$$\mu_L := 6.82 \cdot 10^{-4} \cdot \frac{\text{kg}}{\text{m} \cdot \text{s}}$$

Viscosity of Liquid

$$\beta_L := 3.02 \cdot 10^{-4} \cdot \frac{1}{\text{K}}$$

Thermal expansion coefficient of Liquid

$$\text{MW}_{\text{NH}_3} := 17.0307 \cdot \frac{\text{gm}}{\text{mol}}$$

Molecular Weight of Ammonia

$$h_{g_Schumpe_model} := -0.0481 \cdot \frac{\text{L}}{\text{mol}}$$

Schumpe Model Coefficient

Read Waste Information From "NH3CALInputData010829-04.xls"

IData :=

C:\NH3CALInputData010829-04.xls

Read Tank Information From "TankInfo.xls"

TData :=

C:\TankInfo.xls

Find Waste Properties

Tank_id := "241-AY-102"

TFI1 := search(Tank_id, "-", 1)

TFI1 = 3.000

j1 := 1..177

TankFarm := substr(Tank_id, TFI1 + 1, 2)

TankFarm = "AY"

TankNames3 := stack(TankNames1, TankNames2)

nal_j1 := j1

vent_rate := 250 cfm

From (Bingham 2000)

Find The Appropriate Tank Specific Information:

fi1 := FindIndex(TankNames6, Tank_id)

fi2 := FindIndex(Farms, TankFarm)

$$fi1 = \begin{pmatrix} 23.000 \\ 1.000 \end{pmatrix}$$

$$fi2 = \begin{pmatrix} 6.000 \\ 1.000 \end{pmatrix}$$

tank_idx := fi1 + 1

tank_idx = 24.000

farm_idx := fi2 + 5

farm_idx = 11.000

class_waste := if(fi1 < 29, "dst", "sst")

vol_tank := TData_farm_idx, 4 ft³

class_waste = "dst"

vol_tank = 1.881 × 10⁵ ft³

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comp :=	"Na+"	IData _{tank_idx, 2}	$\frac{\mu\text{-gm}}{\text{mL}}$	mw :=	$\frac{\text{gm}}{\text{mol}}$	H :=	$\frac{\text{Co}}{\frac{\mu\text{-gm}}{\text{mL}}} =$		1		
	"AL+3"	IData _{tank_idx, 3}						22.99	1143	1	5.400·10 ⁴
	"Fe+3"	IData _{tank_idx, 4}						26.98	2174	2	1.970·10 ³
	"Cr+3"	IData _{tank_idx, 5}						55.85	1161	3	10.100
	"Ni+2"	IData _{tank_idx, 6}						52	0648	4	29.100
	"K+"	IData _{tank_idx, 7}						58.71	1654	5	4.020
	"OH-"	IData _{tank_idx, 8}						39.09	0922	6	388.000
	"NO3-"	IData _{tank_idx, 9}						17.0074	0839	7	1.439·10 ³
	"NO2-"	IData _{tank_idx, 10}						62.0049	0128	8	486.000
	"CO3-2"	IData _{tank_idx, 11}						46.0055	0795	9	7.290·10 ³
	"PO4-3"	IData _{tank_idx, 12}						60.0092	1423	10	4.865·10 ⁴
	"SO4-2"	IData _{tank_idx, 13}						94.9676	2119	11	3.010·10 ³
	"F-"	IData _{tank_idx, 14}						96.0576	1117	12	2.320·10 ³
	"Cl-"	IData _{tank_idx, 15}						19	092	13	91.050
								35.453	0318	14	197.343
				15							
				16							

Component	Concentration	Molecular Weight
[NH ₃ _SS_dome]	= IData_tank1x_16 ppm	[NH ₃ _SS_dome] = 4.286 ppm

$$[\text{NH}_3\text{L}] = \text{IDat}_{\text{tank}_{\text{id}_x}, 17} \cdot \frac{\mu \cdot \text{gm}}{\text{mL}} \quad [\text{NH}_3\text{L}] = 35\,293 \frac{\mu \cdot \text{gm}}{\text{mL}}$$

$$[H_2O_{wt\%}] := \text{IData}_{\text{tankid}, 18} \% \quad [H_2O_{wt\%}] = 93.775 \%$$

$$\rho_{\text{liq}} = \text{IData}_{\text{tank}_{\text{idx}}, 19} \frac{\text{gm}}{\text{mL}} \quad \rho_{\text{liq}} = 1.070 \frac{\text{gm}}{\text{mL}}$$

$$\text{vol}_{\text{waste}} := \text{IData}_{\text{tank_idx}, 20} \cdot \text{kilo} \cdot \text{L} \quad \text{vol}_{\text{waste}} = 4.315 \times 10^3 \text{ kilo} \cdot \text{L}$$

$$\text{vol}_{\text{headspace}} := \text{vol}_{\text{tank}} - \text{vol}_{\text{waste}}$$

$$\text{vol}_{\text{headspace}} = 35693 \text{ ft}^3$$

$Q_{\text{normal vent}} := \text{vent_rate}$ AH

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$$\begin{aligned}
 T_{\text{headspace_c}} &:= \text{IData}_{\text{tank_idx}, 21} \cdot ^\circ\text{C} & T_{\text{headspace}} &:= (T_{\text{headspace_c}} + 273.15) \cdot \text{K} & T_{\text{headspace}} &= 294.549 \text{ K} \\
 T_{\text{waste_c}} &:= \text{IData}_{\text{tank_idx}, 22} \cdot ^\circ\text{C} & T_{\text{waste}} &:= (T_{\text{waste_c}} + 273.15) \cdot \text{K} & T_{\text{waste}} &= 309.817 \text{ K} \\
 K_{\text{H_soln_corr_fact}} &:= \text{IData}_{\text{tank_idx}, 23} & & & & \text{AA} \\
 K_{\text{H_soln_corr_fact}} &= 1.100 \\
 P &:= 1 \cdot \text{atm} \\
 t &:= 35 \cdot \text{day} & \text{time of interest}
 \end{aligned}$$

Calculations

Schmidt Number

$$S_c := \frac{\mu_g}{D_g \rho_g}$$

$$S_c = 0.683761$$

Grashoff Number

$$G_r := \frac{g \beta_g \rho_g^2 L_c^3 \Delta T}{\mu_g^2}$$

$$G_r = 2.141 \times 10^{10}$$

Film Coefficient - Vapor

$$h_g := 0.15 \frac{D_g}{L_c} (S_c G_r)^{\frac{1}{3}} \quad \text{Vapor Film Coefficient}$$

$$h_g = 1.587 \times 10^{-3} \frac{\text{m}}{\text{s}}$$

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Film Coefficient - Liquid

$$h_L := 0.15 \cdot D_L \cdot \left(\frac{\mu_L}{D_L \cdot \rho_L} \right)^{\frac{1}{3}} \cdot \left(\frac{g \cdot \beta_L \cdot \rho_L^2 \cdot \Delta T}{\mu_L^2} \right)^{\frac{1}{3}} \quad \text{Liquid Film Coefficient}$$

$$h_L = 5.306 \times 10^{-6} \frac{\text{m}}{\text{s}}$$

Sum C_i

$$C_{\text{sum}} := \frac{\sum_{i=1}^{13} \frac{C_{o,i}}{mw_i}}{1000}$$

$$C_{\text{sum}} = 3.555 \frac{\text{mol}}{\text{m}^3} \quad \dots\dots\dots X$$

Sum C_i x H_i

$$CH_{\text{sum}} := \frac{\sum_{i=1}^{13} \frac{C_{o,i}}{mw_i} \cdot H_i}{1000}$$

$$CH_{\text{sum}} = 0.430 \frac{\text{mol}}{\text{m}^3} \quad \dots\dots\dots Y$$

K_H^o In Water

$$= \text{EXP}(-8.0964 + \frac{3917.5}{273.15 + W3} - 0.00314 \cdot (273.15 + W3))$$

$$K_{H_o} := \exp \left(-8.0964 + \frac{3917.5 \cdot K}{T_{\text{waste}}} - 0.00314 \cdot \frac{T_{\text{waste}}}{K} \right)$$

$$K_{H_o} = 35.707 \quad \dots\dots\dots Z$$

K_Ho In Solution

$$= Z3 / \text{POWER}(10, Y3 + X3 * \$1\$60) * AA3$$

$$K_H := \frac{K_{H_o} \cdot K_{H_{\text{soln_corr_fact}}}}{10^{\left[\left[\frac{C_{\text{sum}}}{\left(\frac{\text{mol}}{\text{m}^3} \right)} \right] \left[\frac{h_{g_Schumpe_model}}{\left(\frac{\text{L}}{\text{mol}} \right)} \right] + \left[\frac{CH_{\text{sum}}}{\left(\frac{\text{mol}}{\text{m}^3} \right)} \right]} \right]} \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

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$$K_H = 21.617 \frac{\text{mol}}{\text{L} \cdot \text{atm}} \dots\dots\dots \text{AB}$$

Ammonia Concentration

$$\text{Output}_3 := \frac{K_H}{\frac{\text{mol}}{\text{L} \cdot \text{atm}}}$$

$$[\text{NH}_3]_L = 0.035 \frac{\text{kg}}{\text{m}^3}$$

$$[\text{NH}_3]_{\text{liq}} := \frac{[\text{NH}_3]_L}{\text{MW}_{\text{NH}_3}}$$

$$[\text{NH}_3]_{\text{liq}} = 2.072 \times 10^{-3} \frac{\text{mol}}{\text{L}} \dots\dots\dots \text{AD}$$

Ammonia Partial Pressure

$$\text{Output}_5 := \frac{[\text{NH}_3]_{\text{liq}}}{\frac{\text{mol}}{\text{L}}}$$

$$P_{\text{NH}_3} := \frac{[\text{NH}_3]_{\text{liq}}}{K_H}$$

$$P_{\text{NH}_3} = 9.587 \times 10^{-5} \text{ atm} \dots\dots\dots \text{AE}$$

Molar Volume

$$V_m = 22.4 \frac{\text{L}}{\text{mol}} \cdot \frac{T_{\text{headspace}}}{273.15 \cdot \text{K}}$$

$$\text{Output}_4 := \frac{V_m}{\frac{\text{L}}{\text{mol}}}$$

$$V_m = 24.154842 \frac{\text{L}}{\text{mol}} \dots\dots\dots \text{AG}$$

Steady-State Ammonia Concentration

$$[\text{NH}_3]_{ss} := \frac{[\text{NH}_3]_{ss_dome}}{V_m}$$

$$[\text{NH}_3]_{ss} = 1.77427 \times 10^{-7} \frac{\text{mol}}{\text{L}} \dots\dots\dots \text{AF}$$

Equivalent Steady-State Ammonia Concentration In Liquid Phase

$$[\text{NH}_3]_{ss_liq_eq} := K_H \cdot V_m \cdot [\text{NH}_3]_{ss} \cdot P$$

$$[\text{NH}_3]_{ss_liq_eq} = 9.264 \times 10^{-5} \frac{\text{mol}}{\text{L}} \dots\dots\dots \text{AJ}$$

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Mass Transport Properties

$$h_A := Q_{\text{normal_vent}} \cdot \left(\frac{[\text{NH}_3]_{\text{ss}}}{[\text{NH}_3]_{\text{liq}} - [\text{NH}_3]_{\text{ss_liq_eq}}} \right)$$

$$h_A = 0.022406 \text{ cfm}$$

$$\text{Output}_2 := \frac{h_A}{\text{cfm}}$$

AK

Steady-State Release Rate At Normal Ventilation Conditions

$$vr_{\text{ss_norm}} := h_A \cdot ([\text{NH}_3]_{\text{liq}} - K_H [\text{NH}_3]_{\text{ss_dome}} \cdot P) \cdot V_m$$

$$vr_{\text{ss_norm}} = 1.071 \times 10^{-3} \text{ cfm} \dots\dots\dots \text{AL}$$

Off-Normal Barometric Vent Rate

$$Q_{\text{off_normal_vent}} := .45 \cdot \frac{\%}{\text{day}} \cdot \text{vol}_{\text{headspace}}$$

$$Q_{\text{off_normal_vent}} = 0.112 \text{ cfm} \dots\dots\dots \text{AM}$$

Off-Normal Constant, k_1 And k_2

$$k_1 := \frac{Q_{\text{off_normal_vent}} + (h_A \cdot K_H \cdot P \cdot V_m)}{\text{vol}_{\text{headspace}}}$$

$$k_1 = 3.309 \times 10^{-4} \frac{1}{\text{min}} \dots\dots\dots \text{AN}$$

$$k_2 := \frac{h_A \cdot [\text{NH}_3]_{\text{liq}}}{\text{vol}_{\text{headspace}}}$$

$$\text{Output}_1 := \frac{k_2}{\frac{\text{mol}}{\text{L} \cdot \text{min}}}$$

$$k_2 = 1.301 \times 10^{-9} \frac{\text{mol}}{\text{L} \cdot \text{min}} \dots\dots\dots \text{AO}$$

Off-Normal Ammonia Partial Pressure

$$P_{\text{NH}_3\text{_on}} := \frac{k_2}{k_1} \cdot V_m \cdot P$$

$$P_{\text{NH}_3\text{_on}} = 9.49615 \times 10^{-5} \text{ atm} \dots\dots\dots \text{AP}$$

$$\frac{P_{\text{NH}_3\text{_on}}}{\text{atm}} = 94.962 \text{ ppm} \dots\dots\dots \text{AQ}$$

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Steady-State Release Rate At Normal Ventilation Conditions

$$vr_{ss_off_norm} := h_A \cdot \left([NH3_{liq}] - K_H \cdot \frac{P_{NH3_on}}{atm} \cdot P \right) \cdot V_m$$

$$vr_{ss_off_norm} = 1.059 \times 10^{-5} \text{ cfm} \quad \dots\dots\dots AR$$

Ammonia Concentration At Time, t

$$[NH3_t] := \left[\frac{k_2}{k_1} + \left([NH3_{ss}] - \frac{k_2}{k_1} \right) \cdot \exp(-1 \cdot k_1 \cdot t) \right] \cdot V_m \cdot 10^6 \text{ ppm}$$

$$[NH3_t] = 94.962 \text{ ppm} \quad \dots\dots\dots AU$$

Ammonia Diffusion Rate At Time, t

$$\delta_{NH3_t} := h_A \cdot ([NH3_{liq}] - K_H \cdot [NH3_t] \cdot P) \cdot V_m$$

$$\delta_{NH3_t} = 1.059 \times 10^{-5} \text{ cfm} \quad \dots\dots\dots AV$$

KRT

$$KRT := T_{waste} \cdot K_H \cdot 0.082 \cdot \frac{(L \cdot atm)}{mol \cdot K}$$

$$KRT = 549.173 \quad \dots\dots\dots AW$$

Film Coefficient - Liquid At Time t

$$h_{Lt} = 0.15 \cdot D_L \cdot \left(\frac{\mu_L}{D_L \cdot \rho_{liq}} \right)^{\frac{1}{3}} \cdot \left[\frac{g \cdot \beta_L \cdot (\rho_{liq})^2 \cdot \Delta T}{(\mu_L)^2} \right]^{\frac{1}{3}} \quad \text{Liquid Film Coefficient}$$

$$h_{Lt} = 4.972 \times 10^{-6} \frac{m}{s} \quad \dots\dots\dots AX$$

Film Coefficient - Vapor At Time t

$$h_{gt} = 0.15 \cdot \frac{D_g}{L_c} \cdot (S_c \cdot G_t)^{\frac{1}{3}} \quad \text{Vapor Film Coefficient}$$

$$h_{gt} = 1.587 \times 10^{-3} \frac{m}{s} \quad \dots\dots\dots AY$$

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Film Coefficient - Overall At Time t

Overall Film Coefficient

$$h := \frac{1}{\frac{1}{h_{Lt}} + \frac{KRT}{h_{gt}}}$$

$$h = 1.827 \times 10^{-6} \frac{\text{m}}{\text{s}} \quad \text{.....AZ}$$

Surface Area

$$\text{area} := \pi \cdot (37.5 \cdot \text{ft})^2$$

$$\text{area} = 4.418 \times 10^3 \text{ ft}^2 \quad \text{.....BA}$$

$$hx_A := h \cdot \text{area}$$

$$hx_A = 1.589 \text{ cfm} \quad \text{.....BB}$$

Effective Surface Area (percent)

$$\text{eff}_{SA} := \frac{h_A}{hx_A}$$

$$\text{eff}_{SA} = 1.410 \% \quad \text{.....BC}$$

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Ammonia Concentrations As A Function Of Time

time :=

-30
-20
-10
.0001
.5
3
5
10
15
30
35
50
70
90
110
120
125
127
130
135
140
145

day

i := 1..22

$$NH3_i := \left[\frac{k_2}{k_1} + \left([NH3_{ss}] - \frac{k_2}{k_1} \right) \exp \left(-1 \cdot \frac{k_1}{1} \cdot \frac{time_i}{day} \right) \right] \cdot V_m$$

$$RR_{NH3_1} := h_A \cdot ([NH3_{liq}] - K_H \cdot P \cdot NH3_1) \cdot V_m$$

$$RR_{NH3_1} := h_A \quad NH3_1 := [NH3_{SS_dome}]$$

$$RR_{NH3_2} := h_A \quad NH3_2 := [NH3_{SS_dome}]$$

$$RR_{NH3_3} := h_A \quad NH3_3 := [NH3_{SS_dome}]$$

$$RR_{NH3_4} := h_A$$

$$h_A = 0.022 \text{ cfm}$$

$$[NH3_{liq}] = 2.072 \times 10^{-3} \frac{\text{mol}}{\text{L}}$$

$$K_H = 21.617 \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

$$V_m = 24.155 \frac{\text{L}}{\text{mol}}$$

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$\frac{\text{time}_1}{\text{day}} =$	$\frac{\text{NH}_3}{\text{ppm}} =$	$\frac{\text{RRNH}_3}{\text{cfm}} =$
-30	4.286	0.022
-20	4.286	0.022
-10	4.286	0.022
1-10-4	4.290	0.022
1	23.508	8.465-10-4
3	73.251	2.646-10-4
5	86.590	1.085-10-4
10	94.189	1.963-10-5
15	94.890	1.143-10-5
30	94.961	1.059-10-5
35	94.962	1.059-10-5
50	94.962	1.059-10-5
70	94.962	1.059-10-5
90	94.962	1.059-10-5
110	94.962	1.059-10-5
120	94.962	1.059-10-5
125	94.962	1.059-10-5
127	94.962	1.059-10-5
130	94.962	1.059-10-5
135	94.962	1.059-10-5
140	94.962	1.059-10-5
145	94.962	1.059-10-5

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Output Results To Datafile "rpp5926_r2_04_NH3CALOutputData0020203.xls"

C:\rpp5926_r2_04_NH3CALOutputData0020203.xls

Output

$$\text{Output} = \begin{pmatrix} 1.301 \times 10^{-9} \\ 0.022 \\ 21.617 \\ 24.155 \\ 2.072 \times 10^{-3} \end{pmatrix}$$

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j := 0,1..61

na_j := j name := augment(na,me)

k := 0..3

kk := 0..3

excel :=

File Name is "FGS Input 020203.xls"

C:\FGS Input 020203.xls

excel =

	0	1	2	3	4	5	6
0	1	2	3	4	5	6	7
1	0	0	0	0	0	0	0
2	0	1.166·10 ³	4.16·10 ⁴	7.305·10 ⁴	1.123·10 ⁴	0.04	82.911
3	0	1.166·10 ³	4.16·10 ⁴	7.305·10 ⁴	1.123·10 ⁴	0.04	82.911
4	0	0	0	0	0	0	0
5	0	2.581·10 ⁴	9.444·10 ⁴	2.368·10 ⁵	1.604·10 ⁴	87.467	220.193
6	0	2.581·10 ⁴	9.444·10 ⁴	2.368·10 ⁵	1.604·10 ⁴	59.727	214.404
7	0	2.581·10 ⁴	9.444·10 ⁴	2.368·10 ⁵	1.604·10 ⁴	144.373	277.714
8	0	2.597·10 ³	1.641·10 ⁵	1.673·10 ⁵	2.995·10 ⁴	1.371	351.899

Tank_id := "241-AY-102"

...The following data is from Hu 2001b, except where noted

tank_{idx}T := 68

>>>> Compensate for Origin = 0 <<<<

tank_{idx}L := tank_{idx}T + 1

tank_{idx}S := tank_{idx}T + 2 idcol := 20 - 1

$$[137Cs] := \begin{pmatrix} \text{excel}_{\text{tank}_{idx}T, idcol} \\ 1 \cdot 10^{-12} \\ \text{excel}_{\text{tank}_{idx}L, idcol} \\ \text{excel}_{\text{tank}_{idx}S, idcol} \end{pmatrix} \cdot \frac{\mu \cdot Ci}{gm}$$

$$[137Cs] = \begin{pmatrix} 33.506 \\ 1 \times 10^{-12} \\ 6.354 \times 10^{-3} \\ 179.452 \end{pmatrix} \cdot \frac{\mu \cdot Ci}{gm}$$

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$$[90\text{Sr}] := \begin{bmatrix} \text{excel_tank_idxT}, (\text{idcol}-1) \\ 1 \cdot 10^{-12} \\ \text{excel_tank_idxL}, (\text{idcol}-1) \\ \text{excel_tank_idxS}, (\text{idcol}-1) \end{bmatrix} \frac{\mu\text{-Ci}}{\text{gm}} \quad [90\text{Sr}] = \begin{pmatrix} 1.093 \times 10^3 \\ 1 \times 10^{-12} \\ 0.676 \\ 5.85 \times 10^3 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$\rho_{\text{waste}} := \begin{bmatrix} \text{excel_tank_idxT}, (\text{idcol}+1) \\ \text{excel_tank_idxS}, (\text{idcol}+1) \\ \text{excel_tank_idxL}, (\text{idcol}+1) \\ \text{excel_tank_idxS}, (\text{idcol}+1) \end{bmatrix} \frac{\text{gm}}{\text{mL}} \quad \rho_{\text{waste}} = \begin{pmatrix} 1.121 \\ 1.397 \\ 1.072 \\ 1.397 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{volwaste} := \begin{bmatrix} \text{excel_tank_idxT}, (\text{idcol}+2) \\ 1 \cdot 10^{-9} \\ \text{excel_tank_idxL}, (\text{idcol}+2) \\ \text{excel_tank_idxS}, (\text{idcol}+2) \end{bmatrix} \cdot \text{kilo-L} \quad \text{volwaste} = \begin{pmatrix} 4315 \\ 0 \\ 3669 \\ 646 \end{pmatrix} \text{kilo-L}$$

$$\text{nameisotope} := \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$[137\text{Ba}] := [137\text{Cs}] \cdot 0.946 \quad [90\text{Y}] := [90\text{Sr}] \cdot 1.000$$

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Find the appropriate radio-isotope specific information:

$$\text{FindIndex}(M, \text{key}) := \begin{array}{l} r \leftarrow \text{rows}(M) - 1 \\ c \leftarrow \text{cols}(M) - 1 \\ i \leftarrow 0 \\ j \leftarrow 0 \\ \text{while } (j \leq c) \cdot (M_{i,j} \neq \text{key}) \\ \quad \left| \begin{array}{l} i \leftarrow i + 1 \text{ if } i < r \\ \text{otherwise} \\ \quad \left| \begin{array}{l} i \leftarrow 1 \\ j \leftarrow j + 1 \end{array} \right. \end{array} \right. \\ \quad \begin{pmatrix} i \\ j \end{pmatrix} \text{ if } j \leq c \\ 0 \text{ otherwise} \end{array}$$

$$\text{name}_{\text{isotope}} = \begin{pmatrix} \text{"137Cs"} \\ \text{"137Ba"} \\ \text{"90Sr"} \\ \text{"90Y"} \end{pmatrix}$$

$$f_{kk} := \text{FindIndex}(\text{name}, \text{name}_{\text{isotope}_{kk}})$$

$$f_i = \begin{pmatrix} (2,1) \\ (2,1) \\ (2,1) \\ (2,1) \end{pmatrix}$$

$$\vec{u} := \vec{f}_i \quad \vec{u}_0 = \begin{pmatrix} 31 \\ 1 \end{pmatrix} \quad \vec{u}_1 = \begin{pmatrix} 32 \\ 1 \end{pmatrix} \quad \vec{u}_2 = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \quad \vec{u}_3 = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$$

$$\text{in}_{kk} := (\vec{u}_{kk})_0$$

$$\text{in} = \begin{pmatrix} 31 \\ 32 \\ 4 \\ 5 \end{pmatrix}$$

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$$\text{half_life}_{kk} := M_{in_{kk},0} \cdot 10^{M_{in_{kk},1}} \cdot \text{day} \quad \text{half_life} = \begin{pmatrix} 30.171 \\ 4.795 \times 10^{-6} \\ 28.601 \\ 0.007 \end{pmatrix} \text{yr} \quad \text{name_isotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{wtatomic}_{kk} := M_{in_{kk},2} \cdot \frac{\text{gm}}{\text{g_mol}} \quad \text{wtatomic} = \begin{pmatrix} 137 \\ 137 \\ 90 \\ 90 \end{pmatrix} \frac{\text{gm}}{\text{g_mol}} \quad \text{name_isotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{SA}_{kk} := M_{in_{kk},3} \cdot 10^{M_{in_{kk},4}} \cdot \frac{\text{dpm}}{\text{gm}} \quad \text{SA} = \begin{pmatrix} 1.92 \times 10^{14} \\ 1.21 \times 10^{21} \\ 3.08 \times 10^{14} \\ 1.21 \times 10^{18} \end{pmatrix} \frac{\text{dpm}}{\text{gm}} \quad \text{name_isotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{SA} = \begin{pmatrix} 86.486 \\ 5.45 \times 10^8 \\ 138.739 \\ 5.45 \times 10^5 \end{pmatrix} \frac{\text{Ci}}{\text{gm}} \quad \text{name_isotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$q_{\text{isotope}_{kk}} := M_{in_{kk},5} \cdot 10^{M_{in_{kk},6}} \cdot \frac{\text{watt}}{\text{Ci}} \quad q_{\text{isotope}} = \begin{pmatrix} 1.01 \times 10^{-3} \\ 3.92 \times 10^{-3} \\ 1.16 \times 10^{-3} \\ 5.53 \times 10^{-3} \end{pmatrix} \frac{\text{watt}}{\text{Ci}} \quad \text{name_isotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$q_{\text{isotope}} = \begin{pmatrix} 3.444 \times 10^{-3} \\ 0.013 \\ 3.955 \times 10^{-3} \\ 0.019 \end{pmatrix} \frac{\text{mBTU}}{\text{Ci} \cdot \text{hr}} \quad \text{name_isotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{heat_load}_k := \text{volwaste}_k \cdot \rho_{\text{waste}_k} \cdot \left[([137\text{Cs}])_k \cdot q_{\text{isotope}_0} + ([137\text{Ba}])_k \cdot q_{\text{isotope}_1} \dots \right. \\ \left. + ([90\text{Sr}])_k \cdot q_{\text{isotope}_2} + ([90\text{Y}])_k \cdot q_{\text{isotope}_3} \right]$$

$$\text{heat_load} = \begin{pmatrix} 3.611 \times 10^4 \\ 0 \\ 17.892 \\ 3.61 \times 10^4 \end{pmatrix} \text{watt}$$

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Check answer #1

$$z := 1$$

$$\text{heat_load2} := \text{volwaste}_z \cdot \rho_{\text{waste}_z} \cdot \left[\begin{aligned} &([137\text{Cs}])_z \cdot \text{qisotope}_0 + ([137\text{Ba}])_z \cdot \text{qisotope}_1 \dots \\ &+ ([90\text{Sr}])_z \cdot \text{qisotope}_2 + ([90\text{Y}])_z \cdot \text{qisotope}_3 \end{aligned} \right]$$

$$\text{heat_load2} = 0 \text{ watt}$$

Check answer #2 (alternate calculation)

$$\begin{aligned} [137\text{Cs}] &= \begin{pmatrix} 33.506 \\ 1 \times 10^{-12} \\ 6.354 \times 10^{-3} \\ 179.452 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} & [90\text{Sr}] &= \begin{pmatrix} 1.093 \times 10^3 \\ 1 \times 10^{-12} \\ 0.676 \\ 5.85 \times 10^3 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} \\ \text{volwaste} &= \begin{pmatrix} 1.524 \times 10^5 \\ 3.531 \times 10^{-8} \\ 1.296 \times 10^5 \\ 2.281 \times 10^4 \end{pmatrix} \text{ft}^3 & \rho_{\text{waste}} &= \begin{pmatrix} 1.121 \\ 1.397 \\ 1.072 \\ 1.397 \end{pmatrix} \frac{\text{gm}}{\text{mL}} \end{aligned}$$

$$\text{nameisotope} := \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$[137\text{Cs}137\text{Ba}] := [137\text{Cs}] \cdot 1.000 \quad [90\text{Sr}90\text{Y}] := [90\text{Sr}] \cdot 1.000$$

$$jk := 0..1$$

$$\text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{fi2}_{jk} := \text{FindIndex}(\text{name}, \text{nameisotope}_{jk})$$

$$\text{fi2} = \begin{bmatrix} \begin{pmatrix} 33 \\ 1 \end{pmatrix} \\ \begin{pmatrix} 6 \\ 1 \end{pmatrix} \end{bmatrix}$$

$$\vec{u} := \text{fi2} \quad \vec{u}_0 = \begin{pmatrix} 33 \\ 1 \end{pmatrix} \quad \vec{u}_1 = \begin{pmatrix} 6 \\ 1 \end{pmatrix}$$

$$\text{in2}_{jk} := (\vec{u}_{jk})_0$$

$$\text{in2} = \begin{pmatrix} 33 \\ 6 \end{pmatrix}$$

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$$\text{half_life2}_{jk} := M_{\text{in2}_{jk},0} \cdot 10^{\frac{M_{\text{in2}_{jk},1}}{M_{\text{in2}_{jk},0}}} \cdot \text{day} \quad \text{half_life2} = \left(\frac{11019.593}{10446.150} \right) \text{day} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{wt2atomic}_{jk} := M_{\text{in2}_{jk},2} \frac{\text{gm}}{\text{g_mol}} \quad \text{wt2atomic} = \left(\frac{137}{90} \right) \frac{\text{gm}}{\text{g_mol}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{SA2}_{jk} := M_{\text{in2}_{jk},3} \cdot 10^{\frac{M_{\text{in2}_{jk},4}}{M_{\text{in2}_{jk},3}}} \frac{\text{dpm}}{\text{gm}} \quad \text{SA2} = \left(\frac{3.74 \times 10^{14}}{6.17 \times 10^{14}} \right) \frac{\text{dpm}}{\text{gm}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{SA2} = \left(\frac{168.468}{277.928} \right) \frac{\text{Ci}}{\text{gm}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{q2isotope}_{jk} := M_{\text{in2}_{jk},5} \cdot 10^{\frac{M_{\text{in2}_{jk},6}}{M_{\text{in2}_{jk},5}}} \frac{\text{watt}}{\text{Ci}} \quad \text{q2isotope} = \left(\frac{4.72 \times 10^{-3}}{6.69 \times 10^{-3}} \right) \frac{\text{watt}}{\text{Ci}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{q2isotope} = \left(\frac{0.016}{0.023} \right) \frac{\text{mBTU}}{\text{Ci} \cdot \text{hr}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{heat_load2}_k := \text{volwaste}_k \cdot \rho_{\text{waste}_k} \cdot \left[([137\text{Cs}137\text{Ba}])_k \cdot \text{q2isotope}_0 + ([90\text{Sr}90\text{Y}])_k \cdot \text{q2isotope}_1 \right]$$

$$\text{heat_load2} = \begin{pmatrix} 3.611 \times 10^4 \\ 0 \\ 17.892 \\ 3.61 \times 10^4 \end{pmatrix} \text{watt} \quad \text{compares to} ==> \quad \text{heat_load} = \begin{pmatrix} 3.611 \times 10^4 \\ 0 \\ 17.892 \\ 3.61 \times 10^4 \end{pmatrix} \text{watt}$$

$$\text{heat_load2} = \begin{pmatrix} 1.232 \times 10^5 \\ 0 \\ 61.049 \\ 1.232 \times 10^5 \end{pmatrix} \frac{\text{BTU}}{\text{hr}} \quad \text{heat_load} = \begin{pmatrix} 1.231 \times 10^5 \\ 0 \\ 61.001 \\ 1.231 \times 10^5 \end{pmatrix} \frac{\text{mBTU}}{\text{hr}}$$

a1 :=

36113.42
1.59E-23
17.89153
36095.53

Write results to excel file
 "rpp5926_r2_05_DecayHeatGRInput020203.xls"

$$\left(\frac{\text{heat_load}}{\text{watt}} \right)$$

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**G.6. RPP-5926 REV. 2: 06 HYDROGEN GENERATION RATE CALCULATIONS --
SINGLE-POINT CALCULATION - CALCULATION NOTE RPP-5926, REV 2 - TANK
241-AY-102 WITH WATER FILL**

CH2MHILL

Hanford Group, Inc.

SA Barker

Hydrogen Generation Rate Calculations

Single-Point Calculation - Calculation Note RPP-5926, Rev 2 --
Tank 241-AY-102 with Water Fill:

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RPP-5926 REV 3

Read Waste Information From "FGS Input 020203 .xls"

excel :=

C:\FGS Input 020203 .xls

Datafile Name Is "FGS Input 020203 .xls"

excel =

	1	2	3	4	5	6	7
1	1.000	2.000	3.000	4.000	5.000	6.000	7.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	1.166-10 ³	4.160-10 ⁴	7.305-10 ⁴	1.123-10 ⁴	0.040	82.911
4	0.000	1.166-10 ³	4.160-10 ⁴	7.305-10 ⁴	1.123-10 ⁴	0.040	82.911
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	2.581-10 ⁴	9.444-10 ⁴	2.368-10 ⁵	1.604-10 ⁴	67.467	220.193
7	0.000	2.581-10 ⁴	9.444-10 ⁴	2.368-10 ⁵	1.604-10 ⁴	59.727	214.404
8	0.000	2.581-10 ⁴	9.444-10 ⁴	2.368-10 ⁵	1.604-10 ⁴	144.373	277.714
9	0.000	2.597-10 ³	1.641-10 ⁵	1.673-10 ⁵	2.995-10 ⁴	1.371	351.899
10	0.000	2.597-10 ³	1.641-10 ⁵	1.673-10 ⁵	2.995-10 ⁴	0.011	434.834
11	0.000	2.597-10 ³	1.641-10 ⁵	1.673-10 ⁵	2.995-10 ⁴	2.845	262.084
12	0.000	3.140-10 ³	1.123-10 ⁵	1.719-10 ⁵	3.898-10 ⁴	15.098	351.079
13	0.000	3.140-10 ³	1.123-10 ⁵	1.719-10 ⁵	3.898-10 ⁴	0.062	374.528
14	0.000	3.140-10 ³	1.123-10 ⁵	1.719-10 ⁵	3.898-10 ⁴	31.297	325.809
15	0.000	3.556-10 ³	1.209-10 ⁵	1.616-10 ⁵	4.113-10 ⁴	7.631	223.898
16	0.000	3.556-10 ³	1.209-10 ⁵	1.616-10 ⁵	4.113-10 ⁴	0.026	220.893

Author: _____ Date: _____

Input Data

Waste Properties (Crust Layer Volume Is Included In Solids Layer In This Example)
(1 ==> Total Waste, 2 ==> Crust 3 ==> Liquid Waste, 4 ==> Solid Waste)

```
Tank_id := "241-AY-102"      TFI1 := search(Tank_id, "-", 1)      TFI1 = 3.000
                              TankFarm := substr(Tank_id, TFI1 + 1, 2)      TankFarm = "AY"
TankNames3 := stack(TankNames1, TankNames2)
j1 := 1..177
nal_j1 := j1
vent_rate := 250 cfm          From (Bingham 2000)
```

Find The Appropriate Tank Specific Information:

```
fi1 := FindIndex(TankNames3, Tank_id)
fi1 =  $\begin{pmatrix} 23.000 \\ 1.000 \end{pmatrix}$ 
tank_idxT :=  $\left[ (fi1_1 - 1) \cdot 3 \right] + 3$       tank_idxT = 69.000      Col_idx := 15
tank_idxL := tank_idxT + 1
tank_idxS := tank_idxT + 2
class_waste := if  $\left[ (fi1_1 < 29) \right]$ , "dst", "sst"
class_waste = "dst"
```

...The Following Data Is From Hu 2001b, Except Where Noted

$$[TOC] := \begin{pmatrix} excel_{tank_idxT, Col_idx} \\ excel_{tank_idxS, Col_idx} \\ excel_{tank_idxL, Col_idx} \\ excel_{tank_idxS, Col_idx} \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}} \quad [TOC] = \begin{pmatrix} 6.674 \times 10^2 \\ 2.124 \times 10^3 \\ 6.674 \times 10^2 \\ 2.124 \times 10^3 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}} \quad Ci = 1.61 \cdot 10^{-2} \frac{\text{BTU}}{\text{hr}}$$

$$[NO_2] := \begin{pmatrix} excel_{tank_idxT, Col_idx+1} \\ excel_{tank_idxS, Col_idx+1} \\ excel_{tank_idxL, Col_idx+1} \\ excel_{tank_idxS, Col_idx+1} \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}} \quad [NO_2] = \begin{pmatrix} 1.205 \\ 228.866 \\ 1.205 \\ 228.866 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

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$$[\text{NO}_3] = \begin{pmatrix} \text{excel_tank}_{idxT}, \text{Col}_{idx}+2 \\ \text{excel_tank}_{idxS}, \text{Col}_{idx}+2 \\ \text{excel_tank}_{idxL}, \text{Col}_{idx}+2 \\ \text{excel_tank}_{idxS}, \text{Col}_{idx}+2 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}} \quad [\text{NO}_3] = \begin{pmatrix} 4.273 \\ 294.845 \\ 4.273 \\ 294.845 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{Al}] = \begin{pmatrix} \text{excel_tank}_{idxT}, \text{Col}_{idx}+3 \\ \text{excel_tank}_{idxS}, \text{Col}_{idx}+3 \\ \text{excel_tank}_{idxL}, \text{Col}_{idx}+3 \\ \text{excel_tank}_{idxS}, \text{Col}_{idx}+3 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}} \quad [\text{Al}] = \begin{pmatrix} 14.955 \\ 100.206 \\ 14.955 \\ 100.206 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{90Sr}] = \begin{pmatrix} \text{excel_tank}_{idxT}, \text{Col}_{idx}+4 \\ 1 \cdot 10^{-12} \\ \text{excel_tank}_{idxL}, \text{Col}_{idx}+4 \\ \text{excel_tank}_{idxS}, \text{Col}_{idx}+4 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} \quad [\text{90Sr}] = \begin{pmatrix} 1.097 \times 10^3 \\ 1.000 \times 10^{-12} \\ 0.687 \\ 5.729 \times 10^3 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$[\text{137Cs}] = \begin{pmatrix} \text{excel_tank}_{idxT}, \text{Col}_{idx}+5 \\ 1 \cdot 10^{-12} \\ \text{excel_tank}_{idxL}, \text{Col}_{idx}+5 \\ \text{excel_tank}_{idxS}, \text{Col}_{idx}+5 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} \quad [\text{137Cs}] = \begin{pmatrix} 33.616 \\ 1.000 \times 10^{-12} \\ 6.466 \times 10^{-3} \\ 175.680 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$\rho_{\text{waste}} = \begin{pmatrix} \text{excel_tank}_{idxT}, \text{Col}_{idx}+6 \\ \text{excel_tank}_{idxS}, \text{Col}_{idx}+6 \\ \text{excel_tank}_{idxL}, \text{Col}_{idx}+6 \\ \text{excel_tank}_{idxS}, \text{Col}_{idx}+6 \end{pmatrix} \frac{\text{gm}}{\text{mL}} \quad \rho_{\text{waste}} = \begin{pmatrix} 1.117 \\ 1.427 \\ 1.062 \\ 1.427 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{vol}_{\text{waste}} = \begin{pmatrix} \text{excel_tank}_{idxT}, \text{Col}_{idx}+7 \\ 1 \cdot 10^{-9} \\ \text{excel_tank}_{idxL}, \text{Col}_{idx}+7 \\ \text{excel_tank}_{idxS}, \text{Col}_{idx}+7 \end{pmatrix} \text{kilo-L} \quad \text{vol}_{\text{waste}} = \begin{pmatrix} 4315 \\ 0 \\ 3669 \\ 646 \end{pmatrix} \text{kilo-L}$$

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$$FH2O := \begin{pmatrix} excel_{tank_{idx}T, Col_{idx}+8} \\ excel_{tank_{idx}S, Col_{idx}+8} \\ excel_{tank_{idx}L, Col_{idx}+8} \\ excel_{tank_{idx}S, Col_{idx}+8} \end{pmatrix} \quad FH2O = \begin{pmatrix} 85.4 \\ 38.0 \\ 93.8 \\ 38.0 \end{pmatrix} \%$$

$$F_{liquid_2} := \left(\frac{FH2O_2}{FH2O_3} \right) \quad F_{liquid_3} := \left(\frac{FH2O_3}{FH2O_3} \right) \quad F_{liquid_4} := \left(\frac{FH2O_4}{FH2O_3} \right)$$

$$F_{liquid_1} := \frac{F_{liquid_2} \cdot \{volwaste_2 \cdot \rho_{waste_2}\} + F_{liquid_3} \cdot \{volwaste_3 \cdot \rho_{waste_3}\} + F_{liquid_4} \cdot \{volwaste_4 \cdot \rho_{waste_4}\}}{volwaste_4 \cdot \rho_{waste_4} + volwaste_3 \cdot \rho_{waste_3} + volwaste_2 \cdot \rho_{waste_2}}$$

$$F_{liquid} = \begin{pmatrix} 88.621 \\ 40.522 \\ 100.000 \\ 40.522 \end{pmatrix} \%$$

$$Temp_{waste} := \begin{pmatrix} excel_{tank_{idx}T, Col_{idx}+9 + 273.15} \\ excel_{tank_{idx}S, Col_{idx}+9 + 273.15} \\ excel_{tank_{idx}L, Col_{idx}+9 + 273.15} \\ excel_{tank_{idx}S, Col_{idx}+9 + 273.15} \end{pmatrix} \cdot K \quad Temp_{waste} = \begin{pmatrix} 345.150 \\ 345.150 \\ 318.150 \\ 345.150 \end{pmatrix} K \quad \text{From (Bingham 2000)}$$

$$Temp_{vap} := (excel_{tank_{idx}L, Col_{idx}+10 + 273.15) \cdot K \quad Temp_{vap} = 316.761 K \quad \text{From (Bingham 2000)}$$

Make Sure You Run The File "Decay Heat Generation Rate 011129 .MCD"

excel2 :=

C:\rpp5926_r2_05_DdecayHeatGRInput020203.xls

HeatLoad_{137Cs_90Sr} := excel2.watt

Calculated By Barker In
"Decay Heat Generation Rate .MCD"

Read Results From Excel File

"rpp5926_r2_05_DdecayHeatGRInput020203.xls"

$$HeatLoad_{137Cs_90Sr} = \begin{pmatrix} 3.611 \times 10^4 \\ 1.594 \times 10^{-23} \\ 17.892 \\ 3.610 \times 10^4 \end{pmatrix} \text{ watt}$$

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TankInfo :=

C:\TankInfo_post-1999.xls

Read Waste properties From Excel File
"TankInfo_post-1999.xls"

j := 1..27

na_j := j name := augment(na, TankId)

TankFarm = "AY"

fi := FindIndex(name, TankFarm)

fi = $\begin{pmatrix} 11.000 \\ 2.000 \end{pmatrix}$

vol_tank := TankInfo_{fi,4} · ft³

vol_tank = 1407 kilo-gal vol_tank = 188089 ft³

vent_rate = 250.000 cfm

vent_rate_{bb} := .0045 · (vol_tank - vol_waste₁) · $\frac{1}{\text{day}}$

vent_rate_{bb} = 0.112 cfm

diam_tank := 2 · TankInfo_(fi,2) · ft diam_tank = 75.000 ft

ht_tank := $\frac{\text{vol}_{\text{waste}}}{\text{TankInfo}_{(fi,8)} \cdot \frac{\text{gal}}{\text{in}}}$ estimation Of Waste Depth

ht_tank = $\begin{pmatrix} 413.944 \\ 9.592 \times 10^{-11} \\ 351.978 \\ 61.966 \end{pmatrix}$ in estimation Of Waste Depth

vol_head := vol_tank - vol_waste₁ vol_head = 3.569×10^4 ft³

Dome-Space Methane Nitrous Oxide And Ammonia Concentrations (Bingham 2000)

[H₂] := .0022 % [CH₄] := 1.4445 ppm [N₂O] := .0010 % [NH₃] := 4.29 ppm

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Ammonia Diffusion Information (see Rpp5926 R1 - Calculation Of Mass Transport Coefficient H For Soluble Gas AY-102 .mcd (from File "rpp5929_r2_04_NH3CALOutputData0020203.xls"

NH3In :=

C:\rpp5926_r2_04_NH3CALOutputData0020203.xls

$$k_2_NH3 := NH3In_1 \cdot \frac{\text{mol}}{\text{L} \cdot \text{min}}$$

$$k_2_NH3 = 1.301 \times 10^{-9} \frac{\text{mol}}{\text{L} \cdot \text{min}}$$

$$hA_NH3 := NH3In_2 \cdot \text{cfm}$$

$$hA_NH3 = 2.241 \times 10^{-2} \text{ cfm}$$

$$KH := NH3In_3 \cdot \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

$$KH = 21.617 \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

$$V_m := NH3In_4 \cdot \frac{\text{L}}{\text{mol}}$$

$$V_m = 24.155 \frac{\text{L}}{\text{mol}}$$

$$[NH3]_{liq} := NH3In_5 \cdot \frac{\text{mol}}{\text{L}}$$

$$[NH3]_{liq} = 2.072 \times 10^{-3} \frac{\text{mol}}{\text{L}}$$

$$P := 1 \cdot \text{atm}$$

$$k_1_NH3 := \frac{\text{vent_rate}_{bb} + (hA_NH3 \cdot KH \cdot P \cdot V_m)}{\text{vol}_{head}}$$

$$k_1_NH3 = 3.309 \times 10^{-4} \text{ min}^{-1}$$

Gas Concentrations At LFL

$$LFL_{H2} := 4\%$$

$$\%LFL_{H2} := \frac{.04}{100}$$

$$LFL_{NH3} := 15\%$$

$$\%LFL_{NH3} := \frac{.15}{100}$$

$$LFL_{CH4} := 5\%$$

$$\%LFL_{CH4} := \frac{.05}{100}$$

End Of Input Data

Calculations

$$i := 1..4$$

Hydrogen Generation Due To Thermolysis (Hu, 2000 - Eqn 4-8)

Define Constants (Based On Hu (2000) Eqn 4-8)

$$a_{thm} := 2.76 \cdot 10^9 \frac{\text{g} \cdot \text{mol}}{\text{kg} \cdot \text{day}}$$

Thermolysis pre-exponential Factor (Hu, 2000 - Eqn 4-8)

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$$E_{\text{thm}} := 89.33 \frac{\text{kilo-J}}{\text{g_mol}} \quad \text{activation Energy (Hu, 2000 - Eqn 4-8)}$$

$$R_{\text{const}} = 8.3144739 \frac{\text{J}}{\text{g_mol-K}} \quad \text{Gas Constant}$$

$$r_f := \begin{cases} 0.4 & \text{if class}_{\text{waste}} = \text{"sst"} \\ 0.4 & \text{if class}_{\text{waste}} = \text{"SST"} \\ 0.7 & \text{otherwise} \end{cases} \quad \begin{array}{l} \text{Reactivity Coefficient (0.7 For DSTs, 0.4 For SSTs)} \\ \text{(Hu, 2000 - Eqn 4-8)} \end{array}$$

$$r_f = 0.700$$

Calculate The Weight Fraction Of Liquid In The Waste

$$W_{\text{H}_2\text{O}_i} := \text{vol}_{\text{waste}_i} \cdot \rho_{\text{waste}_i} \cdot F_{\text{H}_2\text{O}_i}$$

$$W_{\text{H}_2\text{O}} = \begin{pmatrix} 4.117 \times 10^6 \\ 5.424 \times 10^{-7} \\ 3.655 \times 10^6 \\ 3.504 \times 10^5 \end{pmatrix} \text{ kg}$$

Check Units On Input Data

$$[\text{TOC}] = \begin{pmatrix} 667.382 \\ 2.124 \times 10^3 \\ 667.382 \\ 2.124 \times 10^3 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$([\text{TOC}_{\text{wt}\%}]_i := \frac{([\text{TOC}]_3)}{\rho_{\text{waste}_3}} \cdot 100$$

$$[\text{TOC}_{\text{wt}\%}] = \begin{pmatrix} 0.063 \\ 0.063 \\ 0.063 \\ 0.063 \end{pmatrix}$$

$$[\text{A1}] = \begin{pmatrix} 14.955 \times 10^0 \\ 100.206 \times 10^0 \\ 14.955 \times 10^0 \\ 100.206 \times 10^0 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

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$$([Al_{wt\%}]_i) = \frac{([Al]_3)}{P_{waste_3}} \cdot 100$$

$$[Al_{wt\%}] = \begin{pmatrix} 1.408 \times 10^{-3} \\ 1.408 \times 10^{-3} \\ 1.408 \times 10^{-3} \\ 1.408 \times 10^{-3} \end{pmatrix}$$

+

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Calculate The Hydrogen Generation Rate Due To Thermolysis (HGR_{therm})

$$HGR_{therm_scf_i} = \frac{a_{thm}}{\left(\frac{g_mol}{kg_day}\right)} \cdot \left(\left([TOC_{wt\%}]_i \right) \left([Al_{wt\%}]_i \right)^4 \right) \cdot \left[\frac{\left(\frac{E_{thm}}{J} \right)}{\left(\frac{R_{const}}{\left(\frac{J}{g_mol \cdot K} \right)} \right) \left(\frac{Temp_{waste_i}}{K} \right)} \right] \cdot F_{liquid_i} \cdot \frac{g_mol}{kg_day}$$

$$HGR_{therm_i} = HGR_{therm_scf_i}$$

$$HGR_{therm} = \begin{pmatrix} 2.357 \times 10^{-7} \\ 1.078 \times 10^{-7} \\ 1.894 \times 10^{-8} \\ 1.078 \times 10^{-7} \end{pmatrix} \frac{g_mol}{kg_day}$$

$$HGR_{thermv_i} = HGR_{therm_i} \left(vol_{waste_i} \cdot \rho_{waste_i} \right) \frac{Temp_{vap}}{273.15 \cdot K}$$

$$HGR_{thermv_i} = \sum_{i=2}^4 HGR_{thermv_i}$$

$$HGR_{thermv} = \begin{pmatrix} 0.159 \\ 1.412 \times 10^{-13} \\ 0.068 \\ 0.091 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{thermv_scf_i} = HGR_{thermv_i} \frac{273.15 \cdot K}{Temp_{vap}}$$

$$HGR_{thermv} = \begin{pmatrix} 1.104 \times 10^{-4} \\ 9.805 \times 10^{-17} \\ 4.707 \times 10^{-5} \\ 6.334 \times 10^{-5} \end{pmatrix} cfm$$

$$HGR_{thermv_scf} = \begin{pmatrix} 0.137 \\ 1.218 \times 10^{-13} \\ 0.058 \\ 0.079 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{thermv_scf} = \begin{pmatrix} 9.521 \times 10^{-5} \\ 8.455 \times 10^{-17} \\ 4.059 \times 10^{-5} \\ 5.462 \times 10^{-5} \end{pmatrix} cfm$$

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Hydrogen Generation Due To Radiolysis (Hu, 2000 - Eqn 4-16)

Constant Definition (Based On Hu (2000) Eqn 4-16)

$$E_{\text{rad}} := 44.32 \cdot \frac{\text{kilo-J}}{\text{g_mol}}$$

Activation Energy Of G In Organic Radiolysis
(Hu, 2000 - Eqn 4-16)

$$a_{\text{rad}} := 2.49 \cdot 10^6 \cdot \frac{\text{molecules}}{100 \cdot \text{eV}}$$

pre-exponential Factor Of G In Organic
Radiolysis (Hu, 2000 - Eqn 4-16)

$$r_f := \begin{cases} 0.4 & \text{if classwaste} = \text{"sst"} \\ 0.4 & \text{if classwaste} = \text{"SST"} \\ 0.7 & \text{otherwise} \end{cases}$$

Reactivity Coefficient Of TOC (0.7 For DSTs,
0.4 For SSTs) (Hu, 2000 - Eqn 4-16)

$$r_f = 0.700$$

$$G_{\text{H}_2\text{O_sat}} := 0.005 \cdot \frac{\text{molecules}}{100 \cdot \text{eV}}$$

default Water Radiolysis G-value

Check Units On Input Data

$$\text{Temp}_{\text{waste}_2} = 345.150 \text{ K}$$

$$\text{mwNO}_2 := (14.0067 + 2 \cdot 15.9994) \cdot \frac{\text{gm}}{\text{g_mol}}$$

$$\text{mwNO}_3 := (14.0067 + 3 \cdot 15.9994) \cdot \frac{\text{gm}}{\text{g_mol}}$$

$$[\text{NO}_3] = \begin{pmatrix} 4.273 \times 10^0 \\ 294.845 \times 10^0 \\ 4.273 \times 10^0 \\ 294.845 \times 10^0 \end{pmatrix} \frac{\mu \cdot \text{gm}}{\text{mL}}$$

$$[\text{NO}_3_{\text{molar}}] := \frac{[\text{NO}_3]}{\text{mwNO}_3}$$

$$[\text{NO}_3_{\text{molar}}] = \begin{pmatrix} 6.892 \times 10^{-5} \\ 4.755 \times 10^{-3} \\ 6.892 \times 10^{-5} \\ 4.755 \times 10^{-3} \end{pmatrix} \frac{\text{g_mol}}{\text{liter}}$$

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$$[\text{NO}_2] = \begin{pmatrix} 1.205 \times 10^0 \\ 228.866 \times 10^0 \\ 1.205 \times 10^0 \\ 228.866 \times 10^0 \end{pmatrix} \frac{\mu\text{gm}}{\text{mL}}$$

$$[\text{NO}_2_{\text{molar}}] := \frac{[\text{NO}_2]}{\text{mw}_{\text{NO}_2}}$$

$$[\text{NO}_2_{\text{molar}}] = \begin{pmatrix} 2.619 \times 10^{-5} \\ 4.975 \times 10^{-3} \\ 2.619 \times 10^{-5} \\ \dots -3 \end{pmatrix} \frac{\text{g_mol}}{\text{liter}}$$

$$\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}} = \begin{pmatrix} 7.654 \times 10^{12} \\ 3.379 \times 10^{-15} \\ 3.792 \times 10^9 \\ 7.650 \times 10^{12} \end{pmatrix} \mu\text{Ci}$$

$$\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}} = \begin{pmatrix} 1.232 \times 10^5 \\ 5.440 \times 10^{-23} \\ 61.048 \\ 1.232 \times 10^5 \end{pmatrix} \frac{\text{BTU}}{\text{hr}}$$

$$\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}} = \begin{pmatrix} 3.611 \times 10^4 \\ 1.594 \times 10^{-23} \\ 17.892 \\ 3.610 \times 10^4 \end{pmatrix} \text{watt}$$

$$H_{\text{load}} := \left(\frac{\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}}}{\text{vol}_{\text{waste}} \cdot \rho_{\text{waste}}} \right)$$

$$H_{\text{load}} = \begin{pmatrix} 7.493 \times 10^{-3} \\ 1.117 \times 10^{-17} \\ 4.590 \times 10^{-6} \\ 0.039 \end{pmatrix} \frac{\text{watt}}{\text{kg}}$$

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Calculate The Hydrogen Generation Rate Due To Radiolysis (HGR_{rad})

$$G_{org_i} = \frac{e_{rad}}{\left(\frac{\text{molecules}}{100 \cdot eV} \right)} \cdot \left[\frac{\left(\frac{E_{rad}}{\frac{J}{g_mol}} \right)}{\left(\frac{R_{const}}{\left(\frac{J}{g_mol \cdot K} \right)} \cdot \frac{Temp_{waste_i}}{K} \right)} \right] \cdot \left([TOC_{wt\%}]_i \right) \cdot \frac{\text{molecules}}{100 \cdot eV}$$

$$G_{org} = \begin{pmatrix} 0.021 \\ 0.021 \\ 5.795 \times 10^{-3} \\ 0.021 \end{pmatrix} \frac{\text{molecules}}{100 \cdot eV}$$

$$G_{H_2O} = \left[0.45 - 0.56 \cdot \left[\frac{[NO_3_molar]}{\left(\frac{g_mol}{liter} \right)} \right]^{\frac{1}{3}} - 0.43 \cdot \left[\frac{[NO_2_molar]}{\left(\frac{g_mol}{liter} \right)} \right]^{\frac{1}{3}} \right] \cdot \frac{\text{molecules}}{100 \cdot eV}$$

$$G_{H_2O} = \begin{pmatrix} 0.414 \\ 0.282 \\ 0.414 \\ 0.282 \end{pmatrix} \frac{\text{molecules}}{100 \cdot eV}$$

$$G_{H_2O_i} = \begin{cases} G_{H_2O_i} & \text{if } G_{H_2O_i} > G_{H_2O_sat} \\ G_{H_2O_sat} & \text{otherwise} \end{cases}$$

$$G_{H_2O} = \begin{pmatrix} 0.414 \\ 0.282 \\ 0.414 \\ 0.282 \end{pmatrix} \frac{\text{molecules}}{100 \cdot eV}$$

$$HGR_{rad_i} = (G_{H_2O_i} + G_{org_i}) \cdot H_{load_i} \cdot F_{liquid_i} \cdot \frac{g_mol}{6.02 \cdot 10^{23} \cdot \text{molecules}}$$

$$HGR_{rad} = \begin{pmatrix} 2.052 \times 10^{-5} \\ 9.754 \times 10^{-21} \\ 1.367 \times 10^{-8} \\ 3.419 \times 10^{-5} \end{pmatrix} \frac{ft^3}{kg \cdot day}$$

$$HGR_{rad} = \begin{pmatrix} 2.592 \times 10^{-5} \\ 1.232 \times 10^{-20} \\ 1.727 \times 10^{-8} \\ 4.319 \times 10^{-5} \end{pmatrix} \frac{g_mol}{kg \cdot day}$$

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$$HGR_{radv} := \left[HGR_{rad} \cdot (vol_{waste} \cdot \rho_{waste}) \right] \cdot \frac{Temp_{vap}}{273.15 \cdot K}$$

$$HGR_{radv_1} := \sum_{i=2}^4 HGR_{radv_i}$$

$$HGR_{radv} = \begin{pmatrix} 36.6183 \\ 1.6146 \times 10^{-26} \\ 0.0618 \\ 36.5565 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{radv} = \begin{pmatrix} 0.025 \\ 1.121 \times 10^{-29} \\ 4.292 \times 10^{-5} \\ 0.025 \end{pmatrix} cfm$$

$$HGR_{radv_scf} := HGR_{radv} \cdot \frac{273.15 \cdot K}{Temp_{vap}}$$

$$HGR_{radv_scf} = \begin{pmatrix} 31.577 \\ 1.392 \times 10^{-26} \\ 0.053 \\ 31.523 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{radv_scf} = \begin{pmatrix} 0.022 \\ 9.669 \times 10^{-30} \\ 3.701 \times 10^{-5} \\ 0.022 \end{pmatrix} cfm$$

Hydrogen Generation Due To Corrosion (Hu, 2000 - Eqn 4-17)

Constant Definition (Based On Hu (2000) Eqn 4-17)

$$R_{corr} := \begin{cases} 3.6 \cdot 10^{-8} \cdot \frac{m^3}{m^2 \cdot min} & \text{if } class_{waste} = "sst" \\ 3.6 \cdot 10^{-8} \cdot \frac{m^3}{m^2 \cdot min} & \text{if } class_{waste} = "SST" \\ 1.83 \cdot 10^{-8} \cdot \frac{m^3}{m^2 \cdot min} & \text{otherwise} \end{cases}$$

Corrosion Coefficient (1.83E-08
For DSTs, 3.6E-08 For SSTs)
(m³/min/m²) Reference
Temperature Is 25°C
(Hu, 2001B - Eqn 2-1)

$$R_{corr} = 1.830 \times 10^{-8} \frac{m^3}{m^2 \cdot min}$$

Calculate The Wetted Area Of Steel (vertical Waste Storage Tank, Assuming A Flat Bottom)

$$\left[\pi \cdot \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank} \right] = \pi \cdot \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank}$$

$$Awet_1 := \pi \cdot \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank_1}$$

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$$Awet_2 := \pi \cdot diam_{tank} \cdot ht_{tank_2}$$

$$Awet_3 := \pi \cdot diam_{tank} \cdot ht_{tank_3}$$

$$Awet_4 := \pi \cdot \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank_4}$$

$$Awet = \begin{pmatrix} 1.255 \times 10^4 \\ 1.883 \times 10^{-9} \\ 6.911 \times 10^3 \\ 5.635 \times 10^3 \end{pmatrix} ft^2$$

Calculate Hydrogen Generation Due To Corrosion

$$HGR_{corr_mol} = \frac{R_{corr} \cdot Awet}{(vol_{waste} \cdot \rho_{waste})} \cdot \frac{273.15 \cdot K}{298.15 \cdot K}$$

$$HGR_{corr_mol_1} = \begin{pmatrix} 2.605 \times 10^{-7} \\ 1.320 \times 10^{-7} \\ 1.774 \times 10^{-7} \\ 6.114 \times 10^{-7} \end{pmatrix} \frac{g_mol}{kg_day}$$

$$HGR_{corr} = \frac{HGR_{corr_mol} (vol_{waste} \cdot \rho_{waste}) \cdot \frac{Temp_{vap}}{273.15 \cdot K}}{1}$$

$$HGR_{corr} = \begin{pmatrix} 8.003 \times 10^{-4} \\ 1.201 \times 10^{-16} \\ 4.408 \times 10^{-4} \\ 3.594 \times 10^{-4} \end{pmatrix} \frac{ft^3}{min}$$

$$HGR_{corr} = \begin{pmatrix} 1.152 \\ 1.730 \times 10^{-13} \\ 0.635 \\ 0.518 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{corr_scf} = HGR_{corr} \cdot \frac{273.15 \cdot K}{Temp_{vap}}$$

$$HGR_{corr_scf} = \begin{pmatrix} 6.901 \times 10^{-4} \\ 1.036 \times 10^{-16} \\ 3.801 \times 10^{-4} \\ 3.099 \times 10^{-4} \end{pmatrix} \frac{ft^3}{min}$$

$$HGR_{corr_scf} = \begin{pmatrix} 0.994 \\ 1.492 \times 10^{-13} \\ 0.547 \\ 0.446 \end{pmatrix} \frac{ft^3}{day}$$

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Total Hydrogen Generation Rate

+

$$\text{mass}_{\text{waste}} = \begin{pmatrix} 4.820 \times 10^6 \\ 1.427 \times 10^{-6} \\ 3.898 \times 10^6 \\ 9.221 \times 10^5 \end{pmatrix} \text{ kg}$$

$$\text{HGR}_{\text{thermv}} = \begin{pmatrix} 0.159 \\ 1.412 \times 10^{-13} \\ 0.068 \\ 0.091 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{radv}} = \begin{pmatrix} 36.618 \\ 1.615 \times 10^{-26} \\ 0.062 \\ 36.557 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{corr}} = \begin{pmatrix} 1.152 \\ 1.730 \times 10^{-13} \\ 0.635 \\ 0.518 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR} = (\text{HGR}_{\text{thermv}} + \text{HGR}_{\text{radv}} + \text{HGR}_{\text{corr}})$$

$$\text{HGR} = \begin{pmatrix} 0.02634 \\ 2.18190 \times 10^{-16} \\ 5.30826 \times 10^{-4} \\ 0.02581 \end{pmatrix} \text{ cfm}$$

$$\text{HGR} = \begin{pmatrix} 1.074 \times 10^3 \\ 8.897 \times 10^{-12} \\ 21.645 \\ 1.052 \times 10^3 \end{pmatrix} \frac{\text{L}}{\text{day}}$$

$$\text{HGR}_{\text{stp}} = \text{HGR} \cdot \frac{273.15 \cdot \text{K}}{\text{Temp}_{\text{vap}}}$$

At Headspace Temp...

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$$\begin{aligned}
 \text{HGR}_{\text{stp}} &= \begin{pmatrix} 0.023 \\ 1.882 \times 10^{-16} \\ 4.577 \times 10^{-4} \\ 0.022 \end{pmatrix} \text{cfm} \\
 \text{HGR}_{\text{stp}} &= \begin{pmatrix} 32.708 \\ 2.709 \times 10^{-13} \\ 0.659 \\ 32.048 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}
 \end{aligned}
 \left. \vphantom{\begin{aligned} \text{HGR}_{\text{stp}} &= \begin{pmatrix} 0.023 \\ 1.882 \times 10^{-16} \\ 4.577 \times 10^{-4} \\ 0.022 \end{pmatrix} \text{cfm} \\ \text{HGR}_{\text{stp}} &= \begin{pmatrix} 32.708 \\ 2.709 \times 10^{-13} \\ 0.659 \\ 32.048 \end{pmatrix} \frac{\text{ft}^3}{\text{day}} \end{aligned}} \right\} \text{At Standard Conditions...}$$

Steady-State Hydrogen Concentration (Assuming Normal Ventilation Rate)

$$[\text{H2}_{\text{ss}}] := \frac{\text{HGR}_1}{\text{HGR}_1 + \text{vent_rate}}$$

$$[\text{H2}_{\text{ss}}] = 105.349 \text{ ppmv}$$

$$[\text{H2}_{\text{ss}}] = 0.011 \%$$

Steady-State Hydrogen Concentration (Assuming Barometric Breathing Ventilation Rate)

$$[\text{H2}_{\text{ss_bb}}] := \frac{\text{HGR}_1}{\text{HGR}_1 + \text{vent_rate}_{\text{bb}}}$$

$$[\text{H2}_{\text{ss_bb}}] = 1.910 \times 10^5 \text{ ppmv}$$

$$[\text{H2}_{\text{ss_bb}}] = 19.104 \%$$

$$[\text{H2}_{\text{ss_bb}}] = 477.591 \% \text{LFL}_{\text{H2}}$$

Gas Release Rate (Independent Of Ventilation Rate)

$$\text{rateH2_rel} := [\text{H2}_{\text{ss}}] \cdot \frac{\text{vent_rate}}{1 - [\text{H2}_{\text{ss}}]}$$

$$\text{rateH2_rel} = 0.0263 \text{ cfm}$$

$$\text{rateH2_rel_bb} := [\text{H2}_{\text{ss_bb}}] \cdot \frac{\text{vent_rate}_{\text{bb}}}{1 - [\text{H2}_{\text{ss_bb}}]}$$

$$\text{rateH2_rel_bb} = 0.026 \text{ cfm}$$

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Calculate Generation Rates Of Ammonia, Methane, And Nitrous Oxide (Assuming No Gas Retention)

$$GR_{NH3} := \frac{[NH_3] \cdot vent_rate}{1 - [NH_3]} \quad GR_{NH3} = 1.07250 \times 10^{-3} \text{ cfm}$$

$$GR_{CH4} := \frac{[CH_4] \cdot vent_rate}{1 - [CH_4]} \quad GR_{CH4} = 3.611 \times 10^{-4} \text{ cfm}$$

$$GR_{N2O} := \frac{[N_2O] \cdot vent_rate}{1 - [N_2O]} \quad GR_{N2O} = 2.500 \times 10^{-3} \text{ cfm}$$

Steady-State Ammonia, Methane, And Nitrous Oxide Concentration (Assuming Normal Ventilation Rate)(Just A Check Of Methodology)

$$[NH3_{ss}] := \frac{GR_{NH3}}{GR_{NH3} + vent_rate} \quad [NH3_{ss}] = 4.290 \times 10^{-4} \%$$

$$[CH4_{ss}] := \frac{GR_{CH4}}{GR_{CH4} + vent_rate} \quad [CH4_{ss}] = 1.444 \times 10^{-4} \%$$

$$[N2O_{ss}] := \frac{GR_{N2O}}{GR_{N2O} + vent_rate} \quad [N2O_{ss}] = 1.000 \times 10^{-3} \%$$

Steady-State Ammonia, Methane, And Nitrous Oxide Concentration (Assuming Barometric Breathing Ventilation Rate)

$$NH3_1000_day := \left[\frac{k_2_NH3}{k_1_NH3} + \left(\frac{[NH3_{ss}]}{V_m} - \frac{k_2_NH3}{k_1_NH3} \right) \exp \left(-1 \cdot \frac{k_1_NH3}{1} \cdot 1000 \right) \right] \cdot V_m$$

$$NH3_1000_day = 94.962 \text{ ppm}$$

$$[NH3_{ss_bb}] := NH3_1000_day \quad [NH3_{ss_bb}] = 9.496 \times 10^{-3} \%$$

$$[NH3_{ss_bb}] = 0.063 \% LFL_{NH3}$$

$$[CH4_{ss_bb}] := \frac{GR_{CH4}}{GR_{CH4} + vent_rate_{bb}} \quad [CH4_{ss_bb}] = 0.323 \%$$

$$[CH4_{ss_bb}] = 6.454 \% LFL_{CH4}$$

$$[N2O_{ss_bb}] := \frac{GR_{N2O}}{GR_{N2O} + vent_rate_{bb}} \quad [N2O_{ss_bb}] = 2.192 \%$$

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Determine The Overall Steady-State Flammable Gas Concentration With Loss Of Ventilation

$$[\text{Conc_mix}_{ss_bb}] = \frac{[\text{H2}_{ss_bb}]}{\text{LFL}_{\text{H2}}} + \frac{[\text{NH3}_{ss_bb}]}{\text{LFL}_{\text{NH3}}} + \frac{[\text{CH4}_{ss_bb}]}{\text{LFL}_{\text{CH4}}}$$

$$[\text{Conc_mix}_{ss_bb}] = 484.109\% \text{LFL}$$

Set Variables Into Array, Where 1 => H2, 2 => NH3, 3 => CH4, And 4 => N2O

$$\text{GR} = \begin{pmatrix} \text{HGR}_1 \\ \text{GR}_{\text{NH3}} \\ \text{GR}_{\text{CH4}} \\ \text{GR}_{\text{N2O}} \end{pmatrix} \quad \text{GR} = \begin{pmatrix} 0.026 \\ 1.073 \times 10^{-3} \\ 3.611 \times 10^{-4} \\ 2.500 \times 10^{-3} \end{pmatrix} \text{ cfm} \quad \text{Generation Rate}$$

$$\text{Rate}_{\text{rel}} = \begin{pmatrix} \text{HGR}_1 \\ \text{GR}_{\text{NH3}} \\ \text{GR}_{\text{CH4}} \\ \text{GR}_{\text{N2O}} \end{pmatrix} \quad \text{Rate}_{\text{rel}} = \begin{pmatrix} 0.026 \\ 1.073 \times 10^{-3} \\ 3.611 \times 10^{-4} \\ 2.500 \times 10^{-3} \end{pmatrix} \text{ cfm} \quad \text{Release Rate (Assume No Retention)}$$

$$\text{Conc}_{\text{init}} = \begin{pmatrix} [\text{H2}_{ss}] \\ [\text{NH3}_{ss}] \\ [\text{CH4}_{ss}] \\ [\text{N2O}_{ss}] \end{pmatrix} \quad \text{Conc}_{\text{init}} = \begin{pmatrix} 0.011 \\ 4.290 \times 10^{-4} \\ 1.444 \times 10^{-4} \\ 1.000 \times 10^{-3} \end{pmatrix} \% \quad \text{Initial Concentration Rate (Assume At Steady-State With Normal Ops)}$$

Calculate The Composition Of All Components At Time 't'

Special Calculation For Ammonia (Soluble Gas)

$$\lambda_i = \frac{\text{vent_rate}_{bb} + \text{Rate}_{\text{rel}_i}}{\text{vol}_{\text{head}}}$$

$$\text{Conc}_{\text{in}_i} = \frac{\text{Rate}_{\text{rel}_i} \cdot 100\%}{\text{Rate}_{\text{rel}_i} + \text{vent_rate}_{bb}}$$

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$$\text{conc}(t,i) := \begin{cases} \text{Conc}_{in_i} \left[1 - e^{(-\lambda_i t)} \right] + \text{Conc}_{init_i} \left[e^{(-\lambda_i t)} \right] & \text{if } i < 2 \\ \text{Conc}_{in_i} \left[1 - e^{(-\lambda_i t)} \right] + \text{Conc}_{init_i} \left[e^{(-\lambda_i t)} \right] & \text{if } i > 2 \\ \left[\frac{k_2_{\text{NH}_3}}{k_1_{\text{NH}_3}} + \left(\frac{[\text{NH}_3]_{ss}}{V_m} - \frac{k_2_{\text{NH}_3}}{k_1_{\text{NH}_3}} \right) \exp \left(-1 \cdot \frac{k_1_{\text{NH}_3}}{1} \cdot \frac{t}{\text{day}} \right) \right] \cdot V_m & \text{otherwise} \end{cases}$$

$$\text{conc}(0\text{-sec},1) = 0.011\%$$

$$\text{conc}(1000\text{-day},1) = 19.030\%$$

$$\text{conc}(1000\text{-day},1) = 475.759\% \text{LFL}_{\text{H}_2}$$

$$\text{conc}(0\text{-sec},2) = 4.290 \times 10^{-4}\%$$

$$\text{conc}(1000\text{-day},2) = 9.496 \times 10^{-3}\%$$

$$\text{conc}(1000\text{-day},2) = 0.063\% \text{LFL}_{\text{NH}_3}$$

$$\text{conc}(0\text{-sec},3) = 1.444 \times 10^{-4}\%$$

$$\text{conc}(1000\text{-day},3) = 0.319\%$$

$$\text{conc}(1000\text{-day},3) = 6.384\% \text{LFL}_{\text{CH}_4}$$

$$\text{conc}(0\text{-sec},4) = 1.000 \times 10^{-3}\%$$

$$\text{conc}(1000\text{-day},4) = 2.170\%$$

$$t := 0, 10 \dots 3000$$

Calculate Steady-State Flammable Gas Concentration At Normal Operating Conditions

$$\text{LFL}_{\text{mix}}(z) := \frac{1}{\frac{\text{conc}(z,1)}{\text{LFL}_{\text{H}_2}} + \frac{\text{conc}(z,2)}{\text{LFL}_{\text{NH}_3}} + \frac{\text{conc}(z,3)}{\text{LFL}_{\text{CH}_4}}}$$

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$$\text{LFL}_{\text{mix}}(0 \cdot \text{day}) = 3.716 \times 10^4 \%$$

$$\text{LFL}_{\text{mix}}(100 \cdot \text{day}) = 48.467 \%$$

Calculate The Time To Reach Various Fractions Of The LFL

Time To Reach 25 %LFL

TOL := .00001

$$f(z, t) := \frac{\left(\frac{\text{conc}(z, 1)}{\text{LFL}_{\text{H2}}} + \frac{\text{conc}(z, 2)}{\text{LFL}_{\text{NH3}}} + \frac{\text{conc}(z, 3)}{\text{LFL}_{\text{CH4}}} \right)}{\% \text{LFL}} - 11$$

$$t_{\text{fl}} := 25$$

$$z := 10 \cdot \text{day} \quad \text{Initial Guess}$$

$$\text{temp}_{25} := -5 \cdot \text{day}$$

Initial Value In Case Solution
Cannot Be Found

$$\text{temp}_{25} := \text{Re}(\text{root}(f(z, t_{\text{fl}}), z))$$

$$\text{temp}_{25} = 9.433 \text{ day}$$

$$\text{Time}_{1_25\% \text{LFL}} := \text{if}([\text{Conc}_{\text{mix}_{\text{ss_bb}}] > 25\%, \text{if}(\text{temp}_{25} < 0 \cdot \text{day}, 0 \cdot \text{day}, \text{temp}_{25}), 10^9 \cdot \text{day})$$

$$\text{Time}_{1_25\% \text{LFL}} = 9.433 \text{ day}$$

Time To Reach 50 %LFL

$$t_{\text{fl}} := 50$$

$$z := 10 \cdot \text{day} \quad \text{Initial Guess}$$

$$\text{temp}_{50} := -5 \cdot \text{day}$$

Initial Value In Case Solution
Cannot Be Found

$$\text{temp}_{50} := \text{Re}(\text{root}(f(z, t_{\text{fl}}), z))$$

$$\text{temp}_{50} = 19.525 \text{ day}$$

$$\text{Time}_{1_50\% \text{LFL}} := \text{if}([\text{Conc}_{\text{mix}_{\text{ss_bb}}] > 50\%, \text{if}(\text{temp}_{50} < 0 \cdot \text{day}, 0 \cdot \text{day}, \text{temp}_{50}), 10^9 \cdot \text{day})$$

$$\text{Time}_{1_50\% \text{LFL}} = 19.525 \text{ day}$$

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Time To Reach 75 %LFL

$$f(z) := \frac{\left(\frac{\text{conc}(z,1)}{\text{LFL}_{\text{H}_2}} + \frac{\text{conc}(z,2)}{\text{LFL}_{\text{NH}_3}} + \frac{\text{conc}(z,3)}{\text{LFL}_{\text{CH}_4}} \right)}{\% \text{LFL}} - 75$$

z := 10·day Initial Guess

temp75 := -5·day

Initial Value In Case Solution
Cannot Be Found

temp75 := Re(root(f(z), z))

temp75 = 30.215 day

Time1_75%LFL := if([Conc_mixes_bb] > 75%, if(temp75 < 0·day, 0·day, temp75), 10⁹·day)

Time1_75%LFL = 30.215 day

Time To Reach 100 %LFL

$$f(z) := \frac{\left(\frac{\text{conc}(z,1)}{\text{LFL}_{\text{H}_2}} + \frac{\text{conc}(z,2)}{\text{LFL}_{\text{NH}_3}} + \frac{\text{conc}(z,3)}{\text{LFL}_{\text{CH}_4}} \right)}{\% \text{LFL}} - 100$$

z := 10·day Initial Guess

temp100 := -5·day

Initial Value In Case Solution
Cannot Be Found

temp100 := Re(root(f(z), z))

temp100 = 41.580 day

Time1_100%LFL := if([Conc_mixes_bb] > 100%, if(temp100 < 0·day, 0·day, temp100), 10⁹·day)

Time1_100%LFL = 41.580 day

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Minimum Ventilation Rates Need To Prevent Headspace Concentrations From Reaching Various Levels

$$\text{Conc_vr}(V,i) := \begin{cases} \frac{\text{Rate_rel}_i \cdot 100\%}{\text{Rate_rel}_i + V} \left[1 - e^{-\left(\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day} \right)} \right] + \text{Conc_init}_i \left[e^{-\left(\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day} \right)} \right] & \text{if } i < 2 \\ \frac{\text{Rate_rel}_i \cdot 100\%}{\text{Rate_rel}_i + V} \left[1 - e^{-\left(\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day} \right)} \right] + \text{Conc_init}_i \left[e^{-\left(\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day} \right)} \right] & \text{if } i > 2 \\ \left[\frac{k2_NH3}{V + (h_{A_NH3} \cdot K_H \cdot P \cdot V_m)} + \left(\frac{[NH3]_{ss}}{V_m} - \frac{k2_NH3}{k1_NH3} \right) \exp \left[-1 \cdot \frac{V + (h_{A_NH3} \cdot K_H \cdot P \cdot V_m)}{\text{vol_head}} \cdot 10^9 \cdot \frac{1}{\text{day}} \right] \right] V_m & \text{otherwise} \end{cases}$$

Ventilation Rate To Keep Concentration Less Than 25 %LFL

$$f2_25(z) := \frac{\left(\frac{\text{Conc_vr}(z,1)}{\text{LFLH2}} + \frac{\text{Conc_vr}(z,2)}{\text{LFLNH3}} + \frac{\text{Conc_vr}(z,3)}{\text{LFLCH4}} \right)}{\%LFL} - 24.999$$

z := .001 cfm Initial Guess

temp25 := -5 cfm

Initial Value In Case Solution Cannot Be Found

temp25 := root(f2_25(z), z)

temp25 = 2.642510 cfm

vent_rate1_25%LFL := if(temp25 < 0 cfm, 0 cfm, temp25 + 0.001 cfm)

vent_rate1_25%LFL = 2.644 cfm

Ventilation Rate To Keep Concentration Less Than 50 %LFL

$$f2_50(z) := \frac{\left(\frac{\text{Conc_vr}(z,1)}{\text{LFLH2}} + \frac{\text{Conc_vr}(z,2)}{\text{LFLNH3}} + \frac{\text{Conc_vr}(z,3)}{\text{LFLCH4}} \right)}{\%LFL} - 49.999$$

z := .001 cfm Initial Guess

temp50 := -5 cfm

Initial Value In Case Solution Cannot Be Found

temp50 := root(f2_50(z), z)

temp50 = 1.306943 cfm

vent_rate1_50%LFL := if(temp50 < 0 cfm, 0 cfm, temp50 + 0.001 cfm)

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vent_rate1_50%LFL = 1.308 cfm

Ventilation Rate To Keep Concentration Less Than 75 %LFL

$$f2_75(z) := \frac{\left(\frac{\text{Conc_vr}(z,1)}{\text{LFL}_{\text{H2}}} + \frac{\text{Conc_vr}(z,2)}{\text{LFL}_{\text{NH3}}} + \frac{\text{Conc_vr}(z,3)}{\text{LFL}_{\text{CH4}}} \right)}{\% \text{LFL}} - 74.999$$

z := .001 cfm Initial Guess

temp75 := -5 cfm

Initial Value In Case Solution
Cannot Be Found

temp75 := root(f2_75(z), z)

temp75 = 0.862298 cfm

vent_rate1_75%LFL := if(temp75 < 0 cfm, 0 cfm, temp75 + 0.001 cfm)

vent_rate1_75%LFL = 0.863 cfm

Ventilation Rate To Keep Concentration Less Than 100 %LFL

$$f2_100(z) := \frac{\left(\frac{\text{Conc_vr}(z,1)}{\text{LFL}_{\text{H2}}} + \frac{\text{Conc_vr}(z,2)}{\text{LFL}_{\text{NH3}}} + \frac{\text{Conc_vr}(z,3)}{\text{LFL}_{\text{CH4}}} \right)}{\% \text{LFL}} - 99.999$$

z := .001 cfm Initial Guess

temp100 := -5 cfm

Initial Value In Case Solution
Cannot Be Found

temp100 := root(f2_100(z), z)

temp100 = 0.640087 cfm

vent_rate1_100%LFL := if(temp100 < 0 cfm, 0 cfm, temp100 + 0.001 cfm)

vent_rate1_100%LFL = 0.641 cfm

Additional Calculations -- Estimated Time To LFL With Zero Ventilation

Tank Headspace Hydrogen Concentration :

vent_ratezb := 1 · 10⁻⁶ cfm

%H2lim := 100 · [H2_{ss_bb}]

%H2lim = 19.104

volume % Hydrogen

%LFLlim := 100 · [H2_{ss_bb}] · $\frac{100}{4}$

%LFLlim = 477.591

% LFL Based On Hydrogen

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Final H2 Concentration To Meet 25% (NH3 And CH4 Included) Estimate Gas Concentrations At Final Conditions:

$$H2_{25\%} := 0.0004 \left(25 - \frac{\text{conc}(23.2, \text{day}, 2)}{\%LFL_{NH3}} - \frac{\text{conc}(23.2, \text{day}, 3)}{\%LFL_{CH4}} \right) \quad H2_{25\%} = 0.972\%$$

Final H2 Concentration To Meet 50% (NH3 And CH4 Included):

$$H2_{50\%} := 0.0004 \left(50 - \frac{\text{conc}(50, \text{day}, 2)}{\%LFL_{NH3}} - \frac{\text{conc}(50, \text{day}, 3)}{\%LFL_{CH4}} \right) \quad H2_{50\%} = 1.945\%$$

Final H2 Concentration To Meet 100% (NH3 And CH4 Included):

$$H2_{100\%} := 0.0004 \left(100 - \frac{\text{conc}(117, \text{day}, 2)}{\%LFL_{NH3}} - \frac{\text{conc}(117, \text{day}, 3)}{\%LFL_{CH4}} \right) \quad H2_{100\%} = 3.891\%$$

Maximum %LFL With Loss Of Ventilation (Assume Gas Conc. ~ Equal To Barometric Breathing At 100% LFL):

$$LFL_{nat_breathing} := \frac{HGR_1}{(HGR_1 + \text{vent_rate}_{bb}) \cdot 0.4} + \frac{[NH3_{ss_bb}]}{\%LFL_{NH3} \cdot 100} + \frac{[CH4_{ss_bb}]}{\%LFL_{CH4} \cdot 100} \quad LFL_{nat_breathing} = 484.109\%$$

Time To Reach 25% LFL With Zero Ventilation:

$$\text{tempz}_{25} := \frac{-\text{vol}_{head}}{(HGR_1 + \text{vent_rate}_{zb})} \cdot \ln \left[\frac{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{25\%}}{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{init}} \right] \quad \text{tempz}_{25} = 9.285 \text{ day}$$

$$\text{Time_zb2_25\%LFL} := \text{if}(LFL_{nat_breathing} > 25\%, \text{if}(\text{tempz}_{25} < 0, \text{day}, 0, \text{day}, \text{tempz}_{25}), 999999999, \text{day})$$

$$\text{Time_zb2_25\%LFL} = 9.089 \text{ day}$$

Time To Reach 50% LFL With Zero Ventilation:

$$\text{tempz}_{50} := \frac{-\text{vol}_{head}}{(HGR_1 + \text{vent_rate}_{zb})} \cdot \ln \left[\frac{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{50\%}}{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{init}} \right] \quad \text{tempz}_{50} = 19.206 \text{ day}$$

$$\text{Time_zb2_50\%LFL} := \text{if}(LFL_{nat_breathing} > 50\%, \text{if}(\text{tempz}_{50} < 0, \text{day}, 0, \text{day}, \text{tempz}_{50}), 999999999, \text{day})$$

$$\text{Time_zb2_50\%LFL} = 18.386 \text{ day}$$

Time To Reach 100% LFL With Zero Ventilation:

$$\text{tempz}_{100} := \frac{-\text{vol}_{head}}{(HGR_1 + \text{vent_rate}_{zb})} \cdot \ln \left[\frac{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{100\%}}{HGR_1 - (HGR_1 + \text{vent_rate}_{zb}) \cdot H2_{init}} \right] \quad \text{tempz}_{100} = 40.849 \text{ day}$$

$$\text{Time_zb2_100\%LFL} := \text{if}(LFL_{nat_breathing} > 100\%, \text{if}(\text{tempz}_{100} < 0, \text{day}, 0, \text{day}, \text{tempz}_{100}), 999999999, \text{day})$$

$$\text{Time_zb2_100\%LFL} = 37.252 \text{ day}$$

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Summary Section**Input Data**Waste Properties (1 ==> Total Waste, 2 ==> Liquid Waste, 3 ==> Solid Waste)

Tank_id = "241-AY-102"

classwaste = "dst"

$$[\text{TOC}] = \begin{pmatrix} 667.382 \\ 2.124 \times 10^3 \\ 667.382 \\ 2.124 \times 10^3 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_3] = \begin{pmatrix} 4.273 \\ 294.845 \\ 4.273 \\ 294.845 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_2] = \begin{pmatrix} 1.205 \\ 228.866 \\ 1.205 \\ 228.866 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{Al}] = \begin{pmatrix} 14.955 \\ 100.206 \\ 14.955 \\ 100.206 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{137Cs}] = \begin{pmatrix} 33.616 \\ 1.000 \times 10^{-12} \\ 6.466 \times 10^{-3} \\ 175.680 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$[\text{90Sr}] = \begin{pmatrix} 1.097 \times 10^3 \\ 1.000 \times 10^{-12} \\ 0.687 \\ 5.729 \times 10^3 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$\text{vol}_{\text{waste}} = \begin{pmatrix} 1.140 \times 10^3 \\ 2.642 \times 10^{-10} \\ 969.345 \\ 170.655 \end{pmatrix} \text{kilo-gal}$$

$$\rho_{\text{waste}} = \begin{pmatrix} 1.117 \\ 1.427 \\ 1.062 \\ 1.427 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{Temp}_{\text{waste}} = \begin{pmatrix} 345.150 \\ 345.150 \\ 318.150 \\ 345.150 \end{pmatrix} \text{K}$$

$$\text{FH}_2\text{O} = \begin{pmatrix} 85.426 \\ 38.000 \\ 93.775 \\ 38.000 \end{pmatrix} \%$$

$$\text{HeatLoad}_{137\text{Cs}_90\text{Sr}} = \begin{pmatrix} 3.611 \times 10^4 \\ 1.594 \times 10^{-23} \\ 17.892 \\ 3.610 \times 10^4 \end{pmatrix} \text{watt}$$

$$\text{Temp}_{\text{vap}} = 316.761 \text{ K}$$

$$\text{vol}_{\text{tank}} = 1.407 \times 10^3 \text{ kilo-gal}$$

$$\text{vent_rate} = 250.000 \text{ cfm}$$

$$\text{vent_rate}_{\text{bb}} = 0.112 \text{ cfm}$$

AN Tank Farm: Tank Data

$$\text{diam}_{\text{tank}} = 75.000 \text{ ft}$$

$$\text{ht}_{\text{tank}} = \begin{pmatrix} 413.944 \\ 9.592 \times 10^{-11} \\ 351.978 \\ 61.966 \end{pmatrix} \text{ in}$$

estimation Of Waste Depth

Dome Space Compositions

$$[\text{CH}_4] = 1.444 \times 10^{-4} \%$$

$$[\text{N}_2\text{O}] = 1.000 \times 10^{-3} \%$$

$$[\text{NH}_3] = 4.290 \times 10^{-4} \%$$

+

End Of Input Data

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Output DataWaste Properties (1 ==> Total Waste, 2 ==> Crust 3 ==> Liquid Waste, 4 ==> Solid Waste)Hydrogen Generation Rate Due To Thermolysis, Radiolysis, And Corrosion...

$$\begin{aligned}
 \text{HGR}_{\text{therm}} &= \begin{pmatrix} 1.104 \times 10^{-4} \\ 9.805 \times 10^{-17} \\ 4.707 \times 10^{-5} \\ 6.334 \times 10^{-5} \end{pmatrix} \text{ cfm} &
 \text{HGR}_{\text{radv}} &= \begin{pmatrix} 0.025 \\ 1.121 \times 10^{-29} \\ 4.292 \times 10^{-5} \\ 0.025 \end{pmatrix} \text{ cfm} &
 \text{HGR}_{\text{corr}} &= \begin{pmatrix} 8.003 \times 10^{-4} \\ 1.201 \times 10^{-16} \\ 4.408 \times 10^{-4} \\ 3.594 \times 10^{-4} \end{pmatrix} \text{ cfm}
 \end{aligned}$$

Overall Hydrogen Generation Rate...

at The Headspace Conditions...

$$\text{HGR} = \begin{pmatrix} 0.026 \\ 2.182 \times 10^{-16} \\ 5.308 \times 10^{-4} \\ 0.026 \end{pmatrix} \text{ cfm}$$

$$\text{HGR} = \begin{pmatrix} 37.930 \\ 3.142 \times 10^{-13} \\ 0.764 \\ 37.165 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

at Standard Conditions (273°K)...

$$\text{HGR}_{\text{stp}} = \begin{pmatrix} 0.023 \\ 1.882 \times 10^{-16} \\ 4.577 \times 10^{-4} \\ 0.022 \end{pmatrix} \text{ cfm}$$

$$\text{HGR}_{\text{stp}} = \begin{pmatrix} 32.708 \\ 2.709 \times 10^{-13} \\ 0.659 \\ 32.048 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

Steady-State Compositions

Hydrogen At Normal Ventilation Rate...

$$[\text{H2}_{\text{ss}}] = 0.263\% \text{LFL}_{\text{H2}}$$

Ammonia At Normal Ventilation Rate...

$$[\text{NH3}_{\text{ss}}] = 2.860 \times 10^{-3}\% \text{LFL}_{\text{NH3}}$$

Methane At Normal Ventilation Rate...

$$[\text{CH4}_{\text{ss}}] = 2.889 \times 10^{-3}\% \text{LFL}_{\text{CH4}}$$

Nitrous Oxide At Normal Ventilation Rate...

$$[\text{N2O}_{\text{ss}}] = 1.000 \times 10^{-3}\%$$

At Barometric Breathing Ventilation Rate

$$[\text{H2}_{\text{ss_bb}}] = 477.591\% \text{LFL}_{\text{H2}}$$

At Barometric Breathing Ventilation Rate

$$[\text{NH3}_{\text{ss_bb}}] = 0.063\% \text{LFL}_{\text{NH3}}$$

At Barometric Breathing Ventilation Rate

$$[\text{CH4}_{\text{ss_bb}}] = 6.454\% \text{LFL}_{\text{CH4}}$$

At Barometric Breathing Ventilation Rate

$$[\text{N2O}_{\text{ss_bb}}] = 2.192\%$$

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Flammable Gas Concentrations After Loss Of Ventilation At Selected Time Periods

$$\text{conc}_{\text{mix}}(0 \cdot \text{day}) = 0.269 \% \text{LFL}$$

$$\text{conc}_{\text{mix}}(10 \cdot \text{day}) = 26.441 \% \text{LFL}$$

$$\text{conc}_{\text{mix}}(100 \cdot \text{day}) = 206.328 \% \text{LFL}$$

$$\text{conc}_{\text{mix}}(10^9 \cdot \text{day}) = 434.109 \% \text{LFL}$$

Time To Reach Various LFL Levels At Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)

$$\text{Time}_{1_25\% \text{LFL}} = 9.433 \text{ day}$$

$$\text{Time}_{1_75\% \text{LFL}} = 30.215 \text{ day}$$

$$\text{Time}_{1_50\% \text{LFL}} = 19.525 \text{ day}$$

$$\text{Time}_{1_100\% \text{LFL}} = 41.580 \text{ day}$$

Time To Reach Various LFL Levels At Zero Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)

$$\text{Time}_{\text{zb2_}25\% \text{LFL}} = 9.089 \text{ day}$$

$$\text{Time}_{\text{zb2_}50\% \text{LFL}} = 18.386 \text{ day}$$

$$\text{Time}_{\text{zb2_}100\% \text{LFL}} = 37.252 \text{ day}$$

Minimum Ventilation Rates To Keep Headspace Composition Below Selected LFLs

$$\text{vent_rate}_{1_25\% \text{LFL}} = 2.644 \text{ cfm}$$

$$\text{vent_rate}_{1_75\% \text{LFL}} = 0.863 \text{ cfm}$$

$$\text{vent_rate}_{1_50\% \text{LFL}} = 1.308 \text{ cfm}$$

$$\text{vent_rate}_{1_100\% \text{LFL}} = 0.641 \text{ cfm}$$

Gas Concentrations At Time To Reach 25% LFL After Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)

$$\text{H}_2 \quad [\text{H}_2]_{25} = 0.987 \%$$

$$[\text{H}_2]_{25} = 24.665 \% \text{LFL}_{\text{H}_2}$$

$$\text{NH}_3 \quad [\text{NH}_3]_{25} = 9.395 \times 10^{-3} \%$$

$$[\text{NH}_3]_{25} = 0.063 \% \text{LFL}_{\text{NH}_3}$$

$$\text{CH}_4 \quad [\text{CH}_4]_{25} = 0.014 \%$$

$$[\text{CH}_4]_{25} = 0.272 \% \text{LFL}_{\text{CH}_4}$$

Gas Concentrations At Time To Reach 50% LFL After Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)

$$\text{H}_2 \quad [\text{H}_2]_{50} = 1.976 \%$$

$$[\text{H}_2]_{50} = 49.389 \% \text{LFL}_{\text{H}_2}$$

$$\text{NH}_3 \quad [\text{NH}_3]_{50} = 9.495 \times 10^{-3} \%$$

$$[\text{NH}_3]_{50} = 0.063 \% \text{LFL}_{\text{NH}_3}$$

$$\text{CH}_4 \quad [\text{CH}_4]_{50} = 0.027 \%$$

$$[\text{CH}_4]_{50} = 0.547 \% \text{LFL}_{\text{CH}_4}$$

Gas Concentrations At Time To Reach 100% LFL After Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)

$$\text{H}_2 \quad [\text{H}_2]_{100} = 3.953 \%$$

$$[\text{H}_2]_{100} = 98.830 \% \text{LFL}_{\text{H}_2}$$

$$\text{NH}_3 \quad [\text{NH}_3]_{100} = 9.496 \times 10^{-3} \%$$

$$[\text{NH}_3]_{100} = 0.063 \% \text{LFL}_{\text{NH}_3}$$

$$\text{CH}_4 \quad [\text{CH}_4]_{100} = 0.055 \%$$

$$[\text{CH}_4]_{100} = 1.107 \% \text{LFL}_{\text{CH}_4}$$

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**G.7. RPP-5926 REV. 2: 07 CALCULATION OF MASS TRANSPORT COEFFICIENT
"h" FOR SOLUBLE GAS -- 241-AY-102 FILLED WITH WASTE**

CH2MHILL
Hanford Group, Inc.

SA Barker

Calculation of Mass Transport Coefficient "h" for Soluble Gas

241-AY-102 Filled With Waste +

References

Hu, T. A., S. A. Barker, D. C. Hedengren, M.A. Kufahl, 2001, "Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste", RPP-5926, Rev. 1, CH2MHILL Hanford Group, Inc., Richland, WA.

Input Data

Constants

$\rho_g := 1.17 \cdot \frac{\text{kg}}{\text{m}^3}$	Density of gas
$D_g := 2.50 \times 10^{-5} \cdot \frac{\text{m}^2}{\text{s}}$	Diffusion coefficient in gas phase
$\mu_g := 2.0 \cdot 10^{-5} \cdot \frac{\text{kg}}{\text{m} \cdot \text{s}}$	Viscosity of gas
$g = 9.807 \cdot \frac{\text{m}}{\text{s}^2}$	gravitational number
$\Delta T := 1 \cdot \text{K}$	Temperature difference between waste surface and gas
$\beta_g := 3.30 \cdot 10^{-3} \cdot \frac{1}{\text{K}}$	Thermal expansion coefficient of Gas
$L_c := 5.7825 \cdot \text{m}$	Characteristic Length (1/4 of Diameter)
$D_L := 2.8 \cdot 10^{-9} \cdot \frac{\text{m}^2}{\text{s}}$	Diffusion Coefficient in Liquid Phase
$\rho_L := 1300 \cdot \frac{\text{kg}}{\text{m}^3}$	Density of Liquid

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$$\mu_L := 6.82 \cdot 10^{-4} \frac{\text{kg}}{\text{m} \cdot \text{s}}$$

Viscosity of Liquid

$$\beta_L := 3.02 \cdot 10^{-4} \frac{1}{\text{K}}$$

Thermal expansion coefficient of Liquid

$$MW_{\text{NH}_3} := 17.0307 \frac{\text{gm}}{\text{mol}}$$

Molecular Weight of Ammonia

$$h_{g_Schumpe_model} := -0.0481 \frac{\text{L}}{\text{mol}}$$

Schumpe Model Coefficient

Read Waste Information From "NH3CALInputData010829-07.xls"

IData :=

C:\NH3CALInputData010829-07.xls

Read Tank Information From "TankInfo.xls"

TData :=

C:\TankInfo.xls

Find Waste Properties

Tank_id := "241-AY-102"

TFI1 := search(Tank_id, "-", 1)

TFI1 = 3.000

j1 := 1..177

TankFarm := substr(Tank_id, TFI1 + 1, 2)

TankFarm = "AY"

TankNames3 := stack(TankNames1, TankNames2)

nal_j1 := j1

vent_rate := 250 cfm

From (Bingham 2000)

Find The Appropriate Tank Specific Information:

fi1 := FindIndex(TankNames6, Tank_id)

fi2 := FindIndex(Farms, TankFarm)

$$fi1 = \begin{pmatrix} 23.000 \\ 1.000 \end{pmatrix}$$

$$fi2 = \begin{pmatrix} 6.000 \\ 1.000 \end{pmatrix}$$

tank_idx := fi1 + 1

tank_idx = 24.000

farm_idx := fi2 + 5 farm_idx = 11.000

classwaste := if([fi1 < 29], "dst", "sst")

vol_tank := TData_farm_idx, 4 ft³

classwaste = "dst"

vol_tank = 1.881 × 10⁵ ft³

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comp :=	Co :=	IData _{tank_idx, 2}	$\frac{\mu\text{-gm}}{\text{mL}}$	mw =	$\frac{\text{gm}}{\text{mol}}$	H :=	$\frac{\text{Co}}{\frac{\mu\text{-gm}}{\text{mL}}} =$
"Na+"	IData _{tank_idx, 3}	22.99	.1143				1
"AL+3"	IData _{tank_idx, 4}	26.98	.2174				1
"Fe+3"	IData _{tank_idx, 5}	55.85	.1161				1
"Cr+3"	IData _{tank_idx, 6}	52	.0648				1
"Ni+2"	IData _{tank_idx, 7}	58.71	.1654				1
"K+"	IData _{tank_idx, 8}	39.09	.0922				1
"OH."	IData _{tank_idx, 9}	17.0074	.0839				1
"NO3."	IData _{tank_idx, 10}	62.0049	.0128				1
"NO2."	IData _{tank_idx, 11}	46.0055	.0795				1
"CO3-2"	IData _{tank_idx, 12}	60.0092	.1423				1
"PO4-3"	IData _{tank_idx, 13}	94.9676	.2119				1
"SO4-2"	IData _{tank_idx, 14}	96.0576	.1117				1
"F."	IData _{tank_idx, 15}	19	.092				1
"Cl."		35.453	.0318				1

Component	Concentration	Molecular Weight
[NH3_SS_dome]	$\text{:= IData}_{\text{tank}_{idx},16} \cdot \text{ppm}$	[NH3_SS_dome] = 4.286 ppm
[NH3_L]	$\text{:= IData}_{\text{tank}_{idx},17} \cdot \frac{\mu \cdot \text{gm}}{\text{mL}}$	[NH3_L] = 35.293 $\frac{\mu \cdot \text{gm}}{\text{mL}}$
[H2O_wt%]	$\text{:= IData}_{\text{tank}_{idx},18} \cdot \%$	[H2O_wt%] = 87.000 %
ρ_{liq}	$\text{:= IData}_{\text{tank}_{idx},19} \cdot \frac{\text{gm}}{\text{mL}}$	$\rho_{\text{liq}} = 1.150 \frac{\text{gm}}{\text{mL}}$
vol_waste	$\text{:= IData}_{\text{tank}_{idx},20} \cdot \text{kilo-L}$	vol_waste = 4.315×10^3 kilo-L
vol_headspace	$\text{:= vol}_{\text{tank}} - \text{vol}_{\text{waste}}$	
vol_headspace	$= 35693 \text{ ft}^3$	AI
Q_normal_vent	:= vent_rate	AH

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$$\begin{aligned}
 T_{\text{headspace_c}} &:= \text{IDat}_{\text{tank_idx}, 21} \cdot ^\circ\text{C} & T_{\text{headspace}} &:= (T_{\text{headspace_c}} + 273.15) \cdot \text{K} & T_{\text{headspace}} &= 316.761 \text{ K} \\
 T_{\text{waste_c}} &:= \text{IDat}_{\text{tank_idx}, 22} \cdot ^\circ\text{C} & T_{\text{waste}} &:= (T_{\text{waste_c}} + 273.15) \cdot \text{K} & T_{\text{waste}} &= 325.150 \text{ K} \\
 \text{KH_soln_corr_fact} &:= \text{IDat}_{\text{tank_idx}, 23} & & & & \text{AA} \\
 \text{KH_soln_corr_fact} &= 1.100 \\
 P &:= 1 \cdot \text{atm} \\
 t &:= 35 \cdot \text{day} & \text{time of interest}
 \end{aligned}$$

Calculations

Schmidt Number

$$S_c := \frac{\mu_g}{D_g \cdot \rho_g}$$

$$S_c = 0.683761$$

Grashoff Number

$$G_r := \frac{g \cdot \beta_g \cdot \rho_g^2 \cdot L_c^3 \cdot \Delta T}{\mu_g^2}$$

$$G_r = 2.141 \times 10^{10}$$

Film Coefficient - Vapor

$$h_g := 0.15 \cdot \frac{D_g}{L_c} \cdot (S_c \cdot G_r)^{\frac{1}{3}} \quad \text{Vapor Film Coefficient}$$

$$h_g = 1.587 \times 10^{-3} \frac{\text{m}}{\text{s}}$$

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Film Coefficient - Liquid

$$h_L := 0.15 \cdot D_L \left(\frac{\mu_L}{D_L \cdot \rho_L} \right)^{\frac{1}{3}} \left(\frac{g \cdot \beta_L \cdot \rho_L^2 \cdot \Delta T}{\mu_L^2} \right)^{\frac{1}{3}} \quad \text{Liquid Film Coefficient}$$

$$h_L = 5.306 \times 10^{-6} \frac{\text{m}}{\text{s}}$$

Sum C_i

$$C_{\text{sum}} := \frac{\sum_{i=1}^{13} \frac{C_{o_i}}{mw_i}}{1000}$$

$$C_{\text{sum}} = 3.555 \frac{\text{mol}}{\text{m}^3} \quad \dots\dots\dots X$$

Sum C_i x H_i

$$CH_{\text{sum}} := \frac{\sum_{i=1}^{13} \frac{C_{o_i}}{mw_i} H_i}{1000}$$

$$CH_{\text{sum}} = 0.430 \frac{\text{mol}}{\text{m}^3} \quad \dots\dots\dots Y$$

K_H^o In Water

$$= \text{EXP}(-8.0964 + 3917.5/(273.15 + W3) - 0.00314 \cdot (273.15 + W3))$$

$$K_{H_o} := \exp \left(-8.0964 + \frac{3917.5 \cdot K}{T_{\text{waste}}} - 0.00314 \cdot \frac{T_{\text{waste}}}{K} \right)$$

$$K_{H_o} = 18.745 \quad \dots\dots\dots Z$$

K_H In Solution

$$= Z3 / \text{POWER}(10, Y3 + X3 * \$1\$60) * AA3$$

$$K_H = \frac{K_{H_o} \cdot K_{H_soln_corr_fact}}{10^{\left[\left[\frac{C_{\text{sum}}}{\left(\frac{\text{mol}}{\text{m}^3} \right)} \right] \left[\frac{h_{g_Schampet_model}}{\left(\frac{\text{L}}{\text{mol}} \right)} \right] + \left[\frac{CH_{\text{sum}}}{\left(\frac{\text{mol}}{\text{m}^3} \right)} \right] \right]} \cdot \frac{\text{mol}}{\text{L} \cdot \text{atm}}}$$

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$$K_H = 11.348 \frac{\text{mol}}{\text{L} \cdot \text{atm}} \dots\dots\dots \text{AB}$$

Ammonia Concentration

$$\text{Output}_3 = \frac{K_H}{\frac{\text{mol}}{\text{L} \cdot \text{atm}}}$$

$$[\text{NH}_3] = 0.035 \frac{\text{kg}}{\text{m}^3}$$

$$[\text{NH}_3]_{\text{liq}} := \frac{[\text{NH}_3]_{\text{L}}}{\text{MW}_{\text{NH}_3}}$$

$$[\text{NH}_3]_{\text{liq}} = 2.072 \times 10^{-3} \frac{\text{mol}}{\text{L}} \dots\dots\dots \text{AD}$$

Ammonia Partial Pressure

$$\text{Output}_5 = \frac{[\text{NH}_3]_{\text{liq}}}{\frac{\text{mol}}{\text{L}}}$$

$$P_{\text{NH}_3} = \frac{[\text{NH}_3]_{\text{liq}}}{K_H}$$

$$P_{\text{NH}_3} = 1.826 \times 10^{-4} \text{ atm} \dots\dots\dots \text{AE}$$

Molar Volume

$$V_m = 22.4 \frac{\text{L}}{\text{mol}} \cdot \frac{T_{\text{headspace}}}{273.15 \cdot \text{K}}$$

$$\text{Output}_4 = \frac{V_m}{\frac{\text{L}}{\text{mol}}}$$

$$V_m = 25.976383 \frac{\text{L}}{\text{mol}} \dots\dots\dots \text{AG}$$

Steady-State Ammonia Concentration

$$[\text{NH}_3]_{\text{ss}} := \frac{[\text{NH}_3]_{\text{SS_dome}}}{V_m}$$

$$[\text{NH}_3]_{\text{ss}} = 1.64985 \times 10^{-7} \frac{\text{mol}}{\text{L}} \dots\dots\dots \text{AF}$$

Equivalent Steady-State Ammonia Concentration In Liquid Phase

$$[\text{NH}_3]_{\text{ss_liq_eq}} := K_H \cdot V_m \cdot [\text{NH}_3]_{\text{ss}} \cdot P$$

$$[\text{NH}_3]_{\text{ss_liq_eq}} = 4.863 \times 10^{-5} \frac{\text{mol}}{\text{L}} \dots\dots\dots \text{AJ}$$

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Mass Transport Properties

$$h_A := Q_{\text{normal_vent}} \cdot \left(\frac{[\text{NH}_3]_{ss}}{[\text{NH}_3]_{\text{liq}} - [\text{NH}_3]_{ss_liq_eq}} \right)$$

$$\text{Output}_2 := \frac{h_A}{\text{cfm}}$$

$$h_A = 0.020382 \text{ cfm} \dots\dots\dots \text{AK}$$

Steady-State Release Rate At Normal Ventilation Conditions

$$v_{ss_norm} := h_A \cdot ([\text{NH}_3]_{\text{liq}} - K_H \cdot [\text{NH}_3]_{ss_dome}) \cdot P \cdot V_m$$

$$v_{ss_norm} = 1.071 \times 10^{-3} \text{ cfm} \dots\dots\dots \text{AL}$$

Off-Normal Barometric Vent Rate

$$Q_{\text{off_normal_vent}} := .45 \cdot \frac{\%}{\text{day}} \cdot \text{vol}_{\text{headspace}}$$

$$Q_{\text{off_normal_vent}} = 0.112 \text{ cfm} \dots\dots\dots \text{AM}$$

Off-Normal Constant, k_1 And k_2

$$k_1 := \frac{Q_{\text{off_normal_vent}} + (h_A \cdot K_H \cdot P \cdot V_m)}{\text{vol}_{\text{headspace}}}$$

$$k_1 = 1.715 \times 10^{-4} \frac{1}{\text{min}} \dots\dots\dots \text{AN}$$

$$k_2 := \frac{h_A \cdot [\text{NH}_3]_{\text{liq}}}{\text{vol}_{\text{headspace}}}$$

$$\text{Output}_1 := \frac{k_2}{\frac{\text{mol}}{\text{L} \cdot \text{min}}}$$

$$k_2 = 1.183 \times 10^{-9} \frac{\text{mol}}{\text{L} \cdot \text{min}} \dots\dots\dots \text{AO}$$

Off-Normal Ammonia Partial Pressure

$$P_{\text{NH}_3_on} := \frac{k_2}{k_1} \cdot V_m \cdot P$$

$$P_{\text{NH}_3_on} = 1.79289 \times 10^{-4} \text{ atm} \dots\dots\dots \text{AP}$$

$$\frac{P_{\text{NH}_3_on}}{\text{atm}} = 179.289 \text{ ppm} \dots\dots\dots \text{AQ}$$

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Steady-State Release Rate At Normal Ventilation Conditions

$$v_{ss_off_norm} := h_A \cdot \left([NH3_{liq}] - K_H \cdot \frac{P_{NH3_on}}{atm} \cdot P \right) \cdot V_m$$

$$v_{ss_off_norm} = 2.000 \times 10^{-5} \text{ cfm} \quad \dots \text{AR}$$

Ammonia Concentration At Time, t

$$[NH3_t] := \left[\frac{k_2}{k_1} + \left([NH3_{ss}] - \frac{k_2}{k_1} \right) \cdot \exp(-1 \cdot k_1 \cdot t) \right] \cdot V_m \cdot 10^6 \cdot \text{ppm}$$

$$[NH3_t] = 179.259 \text{ ppm} \quad \dots \text{AU}$$

Ammonia Diffusion Rate At Time, t

$$\delta_{NH3_t} := h_A \cdot ([NH3_{liq}] - K_H \cdot [NH3_t] \cdot P) \cdot V_m$$

$$\delta_{NH3_t} = 2.018 \times 10^{-5} \text{ cfm} \quad \dots \text{AV}$$

KRT

$$KRT := T_{waste} \cdot K_H \cdot 0.082 \cdot \frac{(L \cdot atm)}{mol \cdot K}$$

$$KRT = 302.561 \quad \dots \text{AW}$$

Film Coefficient - Liquid At Time t

$$h_{Lt} := 0.15 \cdot D_L \cdot \left(\frac{\mu_L}{D_L \cdot \rho_{liq}} \right)^{\frac{1}{3}} \cdot \left[\frac{g \cdot \beta_L \cdot (\rho_{liq})^2 \cdot \Delta T}{(\mu_L)^2} \right]^{\frac{1}{3}} \quad \text{Liquid Film Coefficient}$$

$$h_{Lt} = 5.093 \times 10^{-6} \frac{m}{s} \quad \dots \text{AX}$$

Film Coefficient - Vapor At Time t

$$h_{gt} := 0.15 \cdot \frac{D_g}{L_c} \cdot (S_c \cdot G_T)^{\frac{1}{3}} \quad \text{Vapor Film Coefficient}$$

$$h_{gt} = 1.587 \times 10^{-3} \frac{m}{s} \quad \dots \text{AY}$$

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Film Coefficient - Overall At Time t

Overall Film Coefficient

$$h := \frac{1}{\frac{1}{h_{Lt}} + \frac{KRT}{h_{gt}}}$$

$$h = 2.584 \times 10^{-6} \frac{\text{m}}{\text{s}} \dots\dots\dots \text{AZ}$$

Surface Area

$$\text{area} := \pi \cdot (37.5 \cdot \text{ft})^2$$

$$\text{area} = 4.418 \times 10^3 \text{ ft}^2 \dots\dots\dots \text{BA}$$

$$hxA := h \cdot \text{area}$$

$$hxA = 2.247 \text{ cfm} \dots\dots\dots \text{BB}$$

Effective Surface Area (Percent)

$$\text{eff}_{SA} := \frac{h_A}{hxA}$$

$$\text{eff}_{SA} = 0.907 \% \dots\dots\dots \text{BC}$$

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Ammonia Concentrations As A Function Of Time

i := 1..22

$$NH3_i := \left[\frac{k_2}{k_1} + \left([NH3_{ss}] - \frac{k_2}{k_1} \right) \exp \left(-1 \cdot \frac{k_1}{1} \cdot \frac{time_i}{day} \right) \right] \cdot V_m$$

$$RR_{NH3_1} := h_A \cdot ([NH3_{liq}] - K_H \cdot P \cdot NH3_1) \cdot V_m$$

$$RR_{NH3_1} := h_A \quad NH3_1 := [NH3_{SS_dome}]$$

$$RR_{NH3_2} := h_A \quad NH3_2 := [NH3_{SS_dome}]$$

$$RR_{NH3_3} := h_A \quad NH3_3 := [NH3_{SS_dome}]$$

$$RR_{NH3_4} := h_A$$

$$RR_{NH3_4} := h_A$$

time := $\begin{pmatrix} -30 \\ -20 \\ -10 \\ .0001 \\ .5 \\ 3 \\ 5 \\ 10 \\ 15 \\ 30 \\ 35 \\ 50 \\ 70 \\ 90 \\ 110 \\ 120 \\ 125 \\ 127 \\ 130 \\ 135 \\ 140 \\ 145 \end{pmatrix}$ day

$$h_A = 0.020 \text{ cfm}$$

$$[NH3_{liq}] = 2.072 \times 10^{-3} \frac{\text{mol}}{\text{L}}$$

$$K_H = 11.348 \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

$$V_m = 25.976 \frac{\text{L}}{\text{mol}}$$

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$\frac{\text{time}_i}{\text{day}} =$	$\frac{\text{NH}_3_i}{\text{ppm}} =$	$\frac{\text{RR}_{\text{NH}_3_i}}{\text{cfm}} =$
-30	4.286	0.020
-20	4.286	0.020
-10	4.286	0.020
1-10 ⁻⁴	4.290	0.020
1	24.609	9.493-10 ⁻⁴
3	95.849	5.213-10 ⁻⁴
5	128.365	3.260-10 ⁻⁴
10	164.471	1.090-10 ⁻⁴
15	174.977	4.591-10 ⁻⁵
30	179.183	2.064-10 ⁻⁵
35	179.259	2.018-10 ⁻⁵
50	179.289	2.000-10 ⁻⁵
70	179.289	2.000-10 ⁻⁵
90	179.289	2.000-10 ⁻⁵
110	179.289	2.000-10 ⁻⁵
120	179.289	2.000-10 ⁻⁵
125	179.289	2.000-10 ⁻⁵
127	179.289	2.000-10 ⁻⁵
130	179.289	2.000-10 ⁻⁵
135	179.289	2.000-10 ⁻⁵
140	179.289	2.000-10 ⁻⁵
145	179.289	2.000-10 ⁻⁵

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Output Results To Datafile "rpp5926_r2_07_NH3CALOutputData0020203.xls"

C:\rpp5926_r2_07_NH3CALOutputData0020203.xls

Output

Output = $\begin{pmatrix} 1.183 \times 10^{-9} \\ 0.020 \\ 11.348 \\ 25.976 \\ 2.072 \times 10^{-3} \end{pmatrix}$

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j := 0..61

na_j := j name := augment(na, me)

k := 0..3

kk := 0..3

excel :=

File Name is "FGS Input 020203.xls"

C:\FGS Input 020203.xls

excel =

	10	1	2	3	4	5	6
0	1	2	3	4	5	6	7
1	0	0	0	0	0	0	0
2	0	$1.166 \cdot 10^3$	$4.16 \cdot 10^4$	$7.305 \cdot 10^4$	$1.123 \cdot 10^4$	0.04	82.911
3	0	$1.166 \cdot 10^3$	$4.16 \cdot 10^4$	$7.305 \cdot 10^4$	$1.123 \cdot 10^4$	0.04	82.911
4	0	0	0	0	0	0	0
5	0	$2.581 \cdot 10^4$	$9.444 \cdot 10^4$	$2.368 \cdot 10^5$	$1.604 \cdot 10^4$	87.467	220.193
6	0	$2.581 \cdot 10^4$	$9.444 \cdot 10^4$	$2.368 \cdot 10^5$	$1.604 \cdot 10^4$	59.727	214.404
7	0	$2.581 \cdot 10^4$	$9.444 \cdot 10^4$	$2.368 \cdot 10^5$	$1.604 \cdot 10^4$	144.373	277.714
8	0	$2.597 \cdot 10^3$	$1.641 \cdot 10^5$	$1.673 \cdot 10^5$	$2.995 \cdot 10^4$	1.371	351.899

Tank_id := "241-AY-102"

... The following data is from Hu 2001b, except where noted

tank_idxT := 68

>>>> Compensate for Origin = 0 <<<<

tank_idxL := tank_idxT + 1

tank_idxS := tank_idxT + 2 idcol := 33 - 1

$$[137Cs] := \begin{pmatrix} \text{excel}_{\text{tank_idxT}, \text{idcol}} \\ 1 \cdot 10^{-12} \\ \text{excel}_{\text{tank_idxL}, \text{idcol}} \\ \text{excel}_{\text{tank_idxS}, \text{idcol}} \end{pmatrix} \cdot \frac{\mu \cdot Ci}{gm}$$

$$[137Cs] = \begin{pmatrix} 74.368 \\ 1 \times 10^{-12} \\ 27.418 \\ 179.452 \end{pmatrix} \cdot \frac{\mu \cdot Ci}{gm}$$

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$$[90\text{Sr}] := \begin{bmatrix} \text{excel}_{\text{tank}_{\text{dxT}},(\text{idcol}-1)} \\ 1 \cdot 10^{-12} \\ \text{excel}_{\text{tank}_{\text{dxL}},(\text{idcol}-1)} \\ \text{excel}_{\text{tank}_{\text{dxS}},(\text{idcol}-1)} \end{bmatrix} \frac{\mu\text{-Ci}}{\text{gm}} \quad [90\text{Sr}] = \begin{pmatrix} 1.808 \times 10^3 \\ 1 \times 10^{-12} \\ 1.524 \\ 5.85 \times 10^3 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$\rho_{\text{waste}} := \begin{bmatrix} \text{excel}_{\text{tank}_{\text{dxT}},(\text{idcol}+1)} \\ \text{excel}_{\text{tank}_{\text{dxS}},(\text{idcol}+1)} \\ \text{excel}_{\text{tank}_{\text{dxL}},(\text{idcol}+1)} \\ \text{excel}_{\text{tank}_{\text{dxS}},(\text{idcol}+1)} \end{bmatrix} \frac{\text{gm}}{\text{mL}} \quad \rho_{\text{waste}} = \begin{pmatrix} 1.217 \\ 1.397 \\ 1.15 \\ 1.397 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{vol}_{\text{waste}} := \begin{bmatrix} \text{excel}_{\text{tank}_{\text{dxT}},(\text{idcol}+2)} \\ 1 \cdot 10^{-9} \\ \text{excel}_{\text{tank}_{\text{dxL}},(\text{idcol}+2)} \\ \text{excel}_{\text{tank}_{\text{dxS}},(\text{idcol}+2)} \end{bmatrix} \text{kilo-L} \quad \text{vol}_{\text{waste}} = \begin{pmatrix} 4177 \\ 0 \\ 3155 \\ 1022 \end{pmatrix} \text{kilo-L}$$

$$\text{name}_{\text{isotope}} := \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$[137\text{Ba}] := [137\text{Cs}] \cdot 0.946 \quad [90\text{Y}] := [90\text{Sr}] \cdot 1.000$$

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Find the appropriate radio-isotope specific information:

$\text{FindIndex}(M, \text{key}) :=$

$$\begin{array}{l}
 r \leftarrow \text{rows}(M) - 1 \\
 c \leftarrow \text{cols}(M) - 1 \\
 i \leftarrow 0 \\
 j \leftarrow 0 \\
 \text{while } (j \leq c) \cdot (M_{i,j} \neq \text{key}) \\
 \quad \left| \begin{array}{l} i \leftarrow i + 1 \text{ if } i < r \\ \text{otherwise} \\ \quad \left| \begin{array}{l} i \leftarrow 1 \\ j \leftarrow j + 1 \end{array} \right. \end{array} \right. \\
 \quad \left(\begin{array}{c} i \\ j \end{array} \right) \text{ if } j \leq c \\
 0 \text{ otherwise}
 \end{array}$$

$\text{name}_{\text{isotope}} =$

$$\begin{pmatrix}
 \text{"137Cs"} \\
 \text{"137Ba"} \\
 \text{"90Sr"} \\
 \text{"90Y"}
 \end{pmatrix}$$

$\text{fi}_{kk} := \text{FindIndex}(\text{name}, \text{name}_{\text{isotope}_{kk}})$

$\text{fi} =$

$$\begin{pmatrix}
 (2,1) \\
 (2,1) \\
 (2,1) \\
 (2,1)
 \end{pmatrix}$$

$\ddot{u} := \overset{\rightarrow}{\text{fi}} \quad \ddot{u}_0 = \begin{pmatrix} 31 \\ 1 \end{pmatrix} \quad \ddot{u}_1 = \begin{pmatrix} 32 \\ 1 \end{pmatrix} \quad \ddot{u}_2 = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \quad \ddot{u}_3 = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$

$\text{in}_{kk} := (\ddot{u}_{kk})_0$

$\text{in} =$

$$\begin{pmatrix}
 31 \\
 32 \\
 4 \\
 5
 \end{pmatrix}$$

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$$\text{half_life}_{kk} := M_{in_{kk},0} \cdot 10^{M_{in_{kk},1}} \cdot \text{day} \quad \text{half_life} = \begin{pmatrix} 30.171 \\ 4.795 \times 10^{-6} \\ 28.601 \\ 0.007 \end{pmatrix} \text{yr} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{wtatomic}_{kk} := M_{in_{kk},2} \cdot \frac{\text{gm}}{\text{g_mol}} \quad \text{wtatomic} = \begin{pmatrix} 137 \\ 137 \\ 90 \\ 90 \end{pmatrix} \frac{\text{gm}}{\text{g_mol}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{SA}_{kk} := M_{in_{kk},3} \cdot 10^{M_{in_{kk},4}} \cdot \frac{\text{dpm}}{\text{gm}} \quad \text{SA} = \begin{pmatrix} 1.92 \times 10^{14} \\ 1.21 \times 10^{21} \\ 3.08 \times 10^{14} \\ 1.21 \times 10^{18} \end{pmatrix} \frac{\text{dpm}}{\text{gm}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{SA} = \begin{pmatrix} 86.486 \\ 5.45 \times 10^8 \\ 138.739 \\ 5.45 \times 10^5 \end{pmatrix} \frac{\text{Ci}}{\text{gm}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{qisotope}_{kk} := M_{in_{kk},5} \cdot 10^{M_{in_{kk},6}} \cdot \frac{\text{watt}}{\text{Ci}} \quad \text{qisotope} = \begin{pmatrix} 1.01 \times 10^{-3} \\ 3.92 \times 10^{-3} \\ 1.16 \times 10^{-3} \\ 5.53 \times 10^{-3} \end{pmatrix} \frac{\text{watt}}{\text{Ci}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{qisotope} = \begin{pmatrix} 3.444 \times 10^{-3} \\ 0.013 \\ 3.955 \times 10^{-3} \\ 0.019 \end{pmatrix} \frac{\text{mBTU}}{\text{Ci} \cdot \text{hr}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}" \\ "137\text{Ba}" \\ "90\text{Sr}" \\ "90\text{Y}" \end{pmatrix}$$

$$\text{heat_load}_k := \text{volwaste}_k \cdot \rho_{\text{waste}_k} \cdot \left[([137\text{Cs}])_k \cdot \text{qisotope}_0 + ([137\text{Ba}])_k \cdot \text{qisotope}_1 \dots \right. \\ \left. + ([90\text{Sr}])_k \cdot \text{qisotope}_2 + ([90\text{Y}])_k \cdot \text{qisotope}_3 \right]$$

$$\text{heat_load} = \begin{pmatrix} 6.324 \times 10^4 \\ 0 \\ 506.423 \\ 5.71 \times 10^4 \end{pmatrix} \text{watt}$$

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Check answer #1

$$z := 1$$

$$\text{heat_load2} := \text{vol_waste}_z \cdot \rho_{\text{waste}}_z \cdot \left[([137\text{Cs}])_z \cdot \text{qisotope}_0 + ([137\text{Ba}])_z \cdot \text{qisotope}_1 \dots \right. \\ \left. + ([90\text{Sr}])_z \cdot \text{qisotope}_2 + ([90\text{Y}])_z \cdot \text{qisotope}_3 \right]$$

$$\text{heat_load2} = 0 \text{ watt}$$

Check answer #2 (alternate calculation)

$$[137\text{Cs}] = \begin{pmatrix} 74.368 \\ 1 \times 10^{-12} \\ 27.418 \\ 179.452 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} \quad [90\text{Sr}] = \begin{pmatrix} 1.808 \times 10^3 \\ 1 \times 10^{-12} \\ 1.524 \\ 5.85 \times 10^3 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$\text{vol_waste} = \begin{pmatrix} 1.475 \times 10^5 \\ 3.531 \times 10^{-8} \\ 1.114 \times 10^5 \\ 3.609 \times 10^4 \end{pmatrix} \text{ft}^3 \quad \rho_{\text{waste}} = \begin{pmatrix} 1.217 \\ 1.397 \\ 1.15 \\ 1.397 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{name_isotope} := \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$[137\text{Cs}137\text{Ba}] := [137\text{Cs}] \cdot 1.000 \quad [90\text{Sr}90\text{Y}] := [90\text{Sr}] \cdot 1.000$$

$$jk := 0..1$$

$$\text{name_isotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$i2_{jk} := \text{FindIndex}(\text{name}, \text{name_isotope}_{jk})$$

$$i2 = \begin{bmatrix} \begin{pmatrix} 33 \\ 1 \end{pmatrix} \\ \begin{pmatrix} 6 \\ 1 \end{pmatrix} \end{bmatrix}$$

$$i := i2 \quad i_0 = \begin{pmatrix} 33 \\ 1 \end{pmatrix} \quad i_1 = \begin{pmatrix} 6 \\ 1 \end{pmatrix}$$

$$in2_{jk} := (i_{jk})_0$$

$$in2 = \begin{pmatrix} 33 \\ 6 \end{pmatrix}$$

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$$\text{half_life2}_{jk} := M_{in2jk,0} \cdot 10^{M_{in2jk,1}} \cdot \text{day} \quad \text{half_life2} = \left(\frac{11019.593}{10446.150} \right) \text{day} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{wt2atomic}_{jk} := M_{in2jk,2} \frac{\text{gm}}{\text{g_mol}} \quad \text{wt2atomic} = \begin{pmatrix} 137 \\ 90 \end{pmatrix} \frac{\text{gm}}{\text{g_mol}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{SA2}_{jk} := M_{in2jk,3} \cdot 10^{M_{in2jk,4}} \frac{\text{dpm}}{\text{gm}} \quad \text{SA2} = \begin{pmatrix} 3.74 \times 10^{14} \\ 6.17 \times 10^{14} \end{pmatrix} \frac{\text{dpm}}{\text{gm}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{SA2} = \begin{pmatrix} 168.468 \\ 277.928 \end{pmatrix} \frac{\text{Ci}}{\text{gm}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{q2isotope}_{jk} := M_{in2jk,5} \cdot 10^{M_{in2jk,6}} \frac{\text{watt}}{\text{Ci}} \quad \text{q2isotope} = \begin{pmatrix} 4.72 \times 10^{-3} \\ 6.69 \times 10^{-3} \end{pmatrix} \frac{\text{watt}}{\text{Ci}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{q2isotope} = \begin{pmatrix} 0.016 \\ 0.023 \end{pmatrix} \frac{\text{mBTU}}{\text{Ci} \cdot \text{hr}} \quad \text{nameisotope} = \begin{pmatrix} "137\text{Cs}137\text{Ba}" \\ "90\text{Sr}90\text{Y}" \end{pmatrix}$$

$$\text{heat_load2}_k := \text{volwaste}_k \cdot \rho_{\text{waste}_k} \cdot \left[([137\text{Cs}137\text{Ba}])_k \cdot \text{q2isotope}_0 + ([90\text{Sr}90\text{Y}])_k \cdot \text{q2isotope}_1 \right]$$

$$\text{heat_load2} = \begin{pmatrix} 6.324 \times 10^4 \\ 0 \\ 506.59 \\ 5.71 \times 10^4 \end{pmatrix} \text{watt} \quad \text{compares to} ==> \quad \text{heat_load} = \begin{pmatrix} 6.324 \times 10^4 \\ 0 \\ 506.423 \\ 5.71 \times 10^4 \end{pmatrix} \text{watt}$$

$$\text{heat_load2} = \begin{pmatrix} 2.158 \times 10^5 \\ 0 \\ 1.729 \times 10^3 \\ 1.948 \times 10^5 \end{pmatrix} \frac{\text{BTU}}{\text{hr}} \quad \text{heat_load} = \begin{pmatrix} 2.156 \times 10^5 \\ 0 \\ 1.727 \times 10^3 \\ 1.947 \times 10^5 \end{pmatrix} \frac{\text{mBTU}}{\text{hr}}$$

a1 :=

63235.48
1.59E-23
506.4231
57098.92

Write results to excel file
 "rpp5926_r2_08_DecayHeatGRInput020203.xls"

$$\left(\frac{\text{heat_load}}{\text{watt}} \right)$$

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**G.9. RPP-5926 REV. 2: 09 HYDROGEN GENERATION RATE CALCULATIONS --
SINGLE-POINT CALCULATION -- CALC. NOTE RPP-5926, REV. 2: FILL TANK TO
1,140 KGAL WITH SAME WASTE ADDITION, 241-AY-102**

+

CH2MHILL
Hanford Group, Inc.

SA Barker

Hydrogen Generation Rate Calculations

Single-Point Calculation - Calculation Note RPP-5926, Rev 2 --
Tank 241-AY-102 with Water Fill:

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RPP-5926 REV 3

Read Waste Information From "FGS Input 020203.xls"

excel :=

C:\FGS Input 020203.xls

Datafile Name Is "FGS Input 020203.xls"

excel =

	1	2	3	4	5	6	7
1	1.000	2.000	3.000	4.000	5.000	6.000	7.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	$1.166 \cdot 10^3$	$4.160 \cdot 10^4$	$7.305 \cdot 10^4$	$1.123 \cdot 10^4$	0.040	82.911
4	0.000	$1.166 \cdot 10^3$	$4.160 \cdot 10^4$	$7.305 \cdot 10^4$	$1.123 \cdot 10^4$	0.040	82.911
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	$2.581 \cdot 10^4$	$9.444 \cdot 10^4$	$2.368 \cdot 10^5$	$1.604 \cdot 10^4$	67.467	220.193
7	0.000	$2.581 \cdot 10^4$	$9.444 \cdot 10^4$	$2.368 \cdot 10^5$	$1.604 \cdot 10^4$	59.727	214.404
8	0.000	$2.581 \cdot 10^4$	$9.444 \cdot 10^4$	$2.368 \cdot 10^5$	$1.604 \cdot 10^4$	144.373	277.714
9	0.000	$2.597 \cdot 10^3$	$1.641 \cdot 10^5$	$1.673 \cdot 10^5$	$2.995 \cdot 10^4$	1.371	351.899
10	0.000	$2.597 \cdot 10^3$	$1.641 \cdot 10^5$	$1.673 \cdot 10^5$	$2.995 \cdot 10^4$	0.011	434.834
11	0.000	$2.597 \cdot 10^3$	$1.641 \cdot 10^5$	$1.673 \cdot 10^5$	$2.995 \cdot 10^4$	2.845	262.084
12	0.000	$3.140 \cdot 10^3$	$1.123 \cdot 10^5$	$1.719 \cdot 10^5$	$3.898 \cdot 10^4$	15.096	351.079
13	0.000	$3.140 \cdot 10^3$	$1.123 \cdot 10^5$	$1.719 \cdot 10^5$	$3.898 \cdot 10^4$	0.062	374.528
14	0.000	$3.140 \cdot 10^3$	$1.123 \cdot 10^5$	$1.719 \cdot 10^5$	$3.898 \cdot 10^4$	31.297	325.809
15	0.000	$3.556 \cdot 10^3$	$1.209 \cdot 10^5$	$1.616 \cdot 10^5$	$4.113 \cdot 10^4$	7.631	223.898
16	0.000	$3.556 \cdot 10^3$	$1.209 \cdot 10^5$	$1.616 \cdot 10^5$	$4.113 \cdot 10^4$	0.026	220.893

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Input Data

Waste Properties (Crust Layer Volume Is Included In Solids Layer In This Example)
(1 ==> Total Waste, 2 ==> Crust 3 ==> Liquid Waste, 4 ==> Solid Waste)

Tank_id := "241-AY-102" TFI1 := search(Tank_id, "-", 1) TFI1 = 3.000
 TankFarm := substr(Tank_id, TFI1 + 1, 2) TankFarm = "AY"
 TankNames3 := stack(TankNames1, TankNames2)
 j1 := 1..177
 nal_j1 := j1
 vent_rate := 250-cfm From (Bingham 2000)

Find The Appropriate Tank Specific Information:

fi1 := FindIndex(TankNames3, Tank_id)

$$fi1 = \begin{pmatrix} 23.000 \\ 1.000 \end{pmatrix}$$

$$tank_{idxT} := \left[(fi1_1 - 1) \cdot 3 \right] + 3 \quad tank_{idxT} = 69.000 \quad Col_{idx} := 28$$

$$tank_{idxL} := tank_{idxT} + 1$$

$$tank_{idxS} := tank_{idxT} + 2$$

$$classwaste := \text{if} \left[(fi1_1 < 29), "dst", "sst" \right]$$

$$classwaste = "dst"$$

...The Following Data Is From Hu 2001b, Except Where Noted

$$[TOC] := \begin{pmatrix} excel_{tank_{idxT}, Col_{idx}} \\ excel_{tank_{idxS}, Col_{idx}} \\ excel_{tank_{idxL}, Col_{idx}} \\ excel_{tank_{idxS}, Col_{idx}} \end{pmatrix} \cdot \frac{\mu \cdot gm}{mL} \quad [TOC] = \begin{pmatrix} 1.769 \times 10^3 \\ 2.124 \times 10^3 \\ 1.639 \times 10^3 \\ 2.124 \times 10^3 \end{pmatrix} \frac{\mu \cdot gm}{mL} \quad Ci := 1.61 \cdot 10^{-2} \frac{BTU}{hr}$$

$$[NO_2] := \begin{pmatrix} excel_{tank_{idxT}, Col_{idx}+1} \\ excel_{tank_{idxS}, Col_{idx}+1} \\ excel_{tank_{idxL}, Col_{idx}+1} \\ excel_{tank_{idxS}, Col_{idx}+1} \end{pmatrix} \cdot \frac{\mu \cdot gm}{mL} \quad [NO_2] = \begin{pmatrix} 4.431 \times 10^3 \\ 228.866 \\ 5.976 \times 10^3 \\ 228.866 \end{pmatrix} \frac{\mu \cdot gm}{mL}$$

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$$[\text{NO}_3] := \begin{pmatrix} \text{excel_tank_idxT, Col_idx+2} \\ \text{excel_tank_idxS, Col_idx+2} \\ \text{excel_tank_idxL, Col_idx+2} \\ \text{excel_tank_idxS, Col_idx+2} \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}} \quad [\text{NO}_3] = \begin{pmatrix} 378.889 \\ 294.845 \\ 409.789 \\ 294.845 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{Al}] := \begin{pmatrix} \text{excel_tank_idxT, Col_idx+3} \\ \text{excel_tank_idxS, Col_idx+3} \\ \text{excel_tank_idxL, Col_idx+3} \\ \text{excel_tank_idxS, Col_idx+3} \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}} \quad [\text{Al}] = \begin{pmatrix} 1.109 \times 10^3 \\ 100.206 \\ 1.480 \times 10^3 \\ 100.206 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{90Sr}] := \begin{pmatrix} \text{excel_tank_idxT, Col_idx+4} \\ 1 \cdot 10^{-12} \\ \text{excel_tank_idxL, Col_idx+4} \\ \text{excel_tank_idxS, Col_idx+4} \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} \quad [\text{90Sr}] = \begin{pmatrix} 1.818 \times 10^3 \\ 1.000 \times 10^{-12} \\ 1.551 \\ 5.729 \times 10^3 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$[\text{137Cs}] := \begin{pmatrix} \text{excel_tank_idxT, Col_idx+5} \\ 1 \cdot 10^{-12} \\ \text{excel_tank_idxL, Col_idx+5} \\ \text{excel_tank_idxS, Col_idx+5} \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} \quad [\text{137Cs}] = \begin{pmatrix} 74.771 \\ 1.000 \times 10^{-12} \\ 27.904 \\ 175.680 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$\text{Pwaste} := \begin{pmatrix} \text{excel_tank_idxT, Col_idx+6} \\ \text{excel_tank_idxS, Col_idx+6} \\ \text{excel_tank_idxL, Col_idx+6} \\ \text{excel_tank_idxS, Col_idx+6} \end{pmatrix} \frac{\text{gm}}{\text{mL}} \quad \text{Pwaste} = \begin{pmatrix} 1.210 \\ 1.427 \\ 1.130 \\ 1.427 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{vol_waste} := \begin{pmatrix} \text{excel_tank_idxT, Col_idx+7} \\ 1 \cdot 10^{-9} \\ \text{excel_tank_idxL, Col_idx+7} \\ \text{excel_tank_idxS, Col_idx+7} \end{pmatrix} \cdot \text{kilo-L} \quad \text{vol_waste} = \begin{pmatrix} 4315 \\ 0 \\ 3669 \\ 646 \end{pmatrix} \text{kilo-L}$$

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$$FH2O := \begin{pmatrix} \text{excel}_{\text{tank}_{idx}T, Col_{idx}+8} \\ \text{excel}_{\text{tank}_{idx}S, Col_{idx}+8} \\ \text{excel}_{\text{tank}_{idx}L, Col_{idx}+8} \\ \text{excel}_{\text{tank}_{idx}S, Col_{idx}+8} \end{pmatrix} \quad FH2O = \begin{pmatrix} 79.7 \\ 38.0 \\ 87.0 \\ 38.0 \end{pmatrix} \%$$

$$F_{liquid_2} := \left(\frac{FH2O_2}{FH2O_3} \right) \quad F_{liquid_3} := \left(\frac{FH2O_3}{FH2O_3} \right) \quad F_{liquid_4} := \left(\frac{FH2O_4}{FH2O_3} \right)$$

$$F_{liquid_1} := \left[\frac{F_{liquid_2} \cdot \{vol_{waste_2} \cdot \rho_{waste_2}\} + F_{liquid_3} \cdot \{vol_{waste_3} \cdot \rho_{waste_3}\} + F_{liquid_4} \cdot \{vol_{waste_4} \cdot \rho_{waste_4}\}}{vol_{waste_4} \cdot \rho_{waste_4} + vol_{waste_3} \cdot \rho_{waste_3} + vol_{waste_2} \cdot \rho_{waste_2}} \right]$$

$$F_{liquid} = \begin{pmatrix} 89.753 \\ 43.678 \\ 100.000 \\ 43.678 \end{pmatrix} \%$$

$$Temp_{waste} := \begin{pmatrix} \text{excel}_{\text{tank}_{idx}T, Col_{idx}+9} + 273.15 \\ \text{excel}_{\text{tank}_{idx}S, Col_{idx}+9} + 273.15 \\ \text{excel}_{\text{tank}_{idx}L, Col_{idx}+9} + 273.15 \\ \text{excel}_{\text{tank}_{idx}S, Col_{idx}+9} + 273.15 \end{pmatrix} \cdot K \quad Temp_{waste} = \begin{pmatrix} 345.150 \\ 345.150 \\ 318.150 \\ 345.150 \end{pmatrix} K \quad \text{From (Bingham 2000)}$$

$$Temp_{vap} := \left\{ \text{excel}_{\text{tank}_{idx}L, Col_{idx}+10} + 273.15 \right\} \cdot K \quad Temp_{vap} = 316.761 K \quad \text{From (Bingham 2000)}$$

Make Sure You Run The File "Decay Heat Generation Rate 011129 .MCD"

excel2 :=

C:\rpp5926_r2_08_DdecayHeatGRInput020203.xls

HeatLoad_{137Cs_90Sr} := excel2.watt

Calculated By Barker In
"Decay Heat Generation Rate .MCD"

Read Results From Excel File

"rpp5926_r2_08_DdecayHeatGRInput020203 .xls"

$$HeatLoad_{137Cs_90Sr} = \begin{pmatrix} 6.533 \times 10^4 \\ 1.594 \times 10^{-23} \\ 506.423 \\ 6.482 \times 10^4 \end{pmatrix} \text{ watt}$$

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RPP-5926 REV 3

TankInfo :=

C:\TankInfo_post-1999.xls

Read Waste properties From Excel File
"TankInfo_post-1999.xls"

j := 1..27

na_j := j name := augment(na, TankId)

TankFarm = "AY"

fi := FindIndex(name, TankFarm)

fi = $\begin{pmatrix} 11.000 \\ 2.000 \end{pmatrix}$

vol_{tank} := TankInfo_{fi,4} · ft³

vol_{tank} = 1407 kilo·gal vol_{tank} = 188089 ft³

vent_rate = 250.000 cfm

vent_rate_{bb} := .0045 · (vol_{tank} - vol_{waste,1}) · $\frac{1}{\text{day}}$

vent_rate_{bb} = 0.112 cfm

diam_{tank} := 2 · TankInfo_(fi,2) · ft diam_{tank} = 75.000 ft

ht_{tank} := $\frac{\text{vol}_{\text{waste}}}{\text{TankInfo}_{(fi,8)} \cdot \frac{\text{gal}}{\text{in}}}$ estimation Of Waste Depth

ht_{tank} = $\begin{pmatrix} 413.944 \\ 9.592 \times 10^{-11} \\ 351.978 \\ 61.966 \end{pmatrix}$ in estimation Of Waste Depth

vol_{head} := vol_{tank} - vol_{waste,1} vol_{head} = 3.569 × 10⁴ ft³

Dome-Space Methane Nitrous Oxide And Ammonia Concentrations (Bingham 2000)

[H₂] := .0022·% [CH₄] := 1.4445·ppm [N₂O] := .0010·% [NH₃] := 4.29·ppm

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Ammonia Diffusion Information (see Rpp5926 R1 - Calculation Of Mass Transport Coefficient H For Soluble Gas AY-102 .mcd (from File "rpp5929_r2_04_NH3CALOutputData0020203.xls")

NH3In :=

C:\rpp5926_r2_07_NH3CALOutputData0020203.xls

$$k2_NH3 := NH3In_1 \cdot \frac{\text{mol}}{\text{L} \cdot \text{min}}$$

$$k2_NH3 = 1.183 \times 10^{-9} \frac{\text{mol}}{\text{L} \cdot \text{min}}$$

$$hA_NH3 := NH3In_2 \cdot \text{cfm}$$

$$hA_NH3 = 2.038 \times 10^{-2} \text{ cfm}$$

$$KH := NH3In_3 \cdot \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

$$KH = 11.348 \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

$$V_m := NH3In_4 \cdot \frac{\text{L}}{\text{mol}}$$

$$V_m = 25.976 \frac{\text{L}}{\text{mol}}$$

$$[NH3_{liq}] := NH3In_5 \cdot \frac{\text{mol}}{\text{L}}$$

$$[NH3_{liq}] = 2.072 \times 10^{-3} \frac{\text{mol}}{\text{L}}$$

$$P := 1 \cdot \text{atm}$$

$$k1_NH3 := \frac{\text{vent_rate}_{bb} + (hA_NH3 \cdot KH \cdot P \cdot V_m)}{\text{vol}_{head}}$$

$$k1_NH3 = 1.715 \times 10^{-4} \text{ min}^{-1}$$

Gas Concentrations At LFL

$$LFL_{H2} := 4\%$$

$$\%LFL_{H2} := \frac{.04}{100}$$

$$LFL_{NH3} := 15\%$$

$$\%LFL_{NH3} := \frac{.15}{100}$$

$$LFL_{CH4} := 5\%$$

$$\%LFL_{CH4} := \frac{.05}{100}$$

End Of Input Data

Calculations

$$i := 1..4$$

Hydrogen Generation Due To Thermolysis (Hu, 2000 - Eqn 4-8)

Define Constants (Based On Hu (2000) Eqn 4-8)

$$a_{thm} := 2.76 \cdot 10^9 \frac{\text{g} \cdot \text{mol}}{\text{kg} \cdot \text{day}}$$

Thermolysis pre-exponential Factor (Hu, 2000 - Eqn 4-8)

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$$E_{\text{thm}} = 89.33 \frac{\text{kilo-J}}{\text{g_mol}} \quad \text{activation Energy (Hu, 2000 - Eqn 4-8)}$$

$$R_{\text{const}} = 8.3144739 \frac{\text{J}}{\text{g_mol} \cdot \text{K}} \quad \text{Gas Constant}$$

$$r_f = \begin{cases} 0.4 & \text{if class}_{\text{waste}} = \text{"sst"} \\ 0.4 & \text{if class}_{\text{waste}} = \text{"SST"} \\ 0.7 & \text{otherwise} \end{cases} \quad \begin{array}{l} \text{Reactivity Coefficient (0.7 For DSTs, 0.4 For SSTs)} \\ \text{(Hu, 2000 - Eqn 4-8)} \end{array}$$

$$r_f = 0.700$$

Calculate The Weight Fraction Of Liquid In The Waste

$$W_{\text{H}_2\text{O}_i} = \text{vol}_{\text{waste}_i} \cdot \rho_{\text{waste}_i} \cdot F_{\text{H}_2\text{O}_i}$$

$$W_{\text{H}_2\text{O}} = \begin{pmatrix} 4.160 \times 10^6 \\ 5.424 \times 10^{-7} \\ 3.607 \times 10^6 \\ 3.504 \times 10^5 \end{pmatrix} \text{ kg}$$

Check Units On Input Data

$$[\text{TOC}] = \begin{pmatrix} 1.769 \times 10^3 \\ 2.124 \times 10^3 \\ 1.639 \times 10^3 \\ 2.124 \times 10^3 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$([\text{TOC}_{\text{wt}\%}]_i) = \frac{([\text{TOC}]_3)}{\rho_{\text{waste}_3}} \cdot 100$$

$$[\text{TOC}_{\text{wt}\%}] = \begin{pmatrix} 0.145 \\ 0.145 \\ 0.145 \\ 0.145 \end{pmatrix}$$

$$[\text{Al}] = \begin{pmatrix} 1.109 \times 10^3 \\ 100.206 \times 10^0 \\ 1.480 \times 10^3 \\ 100.206 \times 10^0 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

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$$([Al_{wt\%}]_i) = \frac{([Al]_3)}{\rho_{waste_3}} \cdot 100$$

$$[Al_{wt\%}] = \begin{pmatrix} 0.131 \\ 0.131 \\ 0.131 \\ 0.131 \end{pmatrix}$$

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Calculate The Hydrogen Generation Rate Due To Thermolysis (HGR_{therm})

$$HGR_{therm_scf_i} = \frac{a_{thm}}{\left(\frac{g_mol}{kg \cdot day}\right)} \cdot rf \cdot ([TOC_{wt\%}]_i) \cdot ([Al_{wt\%}]_i)^4 \cdot e^{\left[\frac{\left(\frac{E_{thm}}{\left(\frac{J}{g_mol}\right)}\right)}{\left[\frac{R_{const}}{\left(\frac{J}{g_mol \cdot K}\right)}\right] \cdot \left(\frac{Temp_{waste_i}}{K}\right)}\right]} \cdot F_{liquid_i} \frac{g_mol}{kg \cdot day}$$

$$HGR_{therm_1} = HGR_{therm_scf_1}$$

$$HGR_{therm} = \begin{pmatrix} 3.378 \times 10^{-6} \\ 1.644 \times 10^{-6} \\ 2.681 \times 10^{-7} \\ 1.644 \times 10^{-6} \end{pmatrix} \frac{g_mol}{kg \cdot day}$$

$$HGR_{thermv_i} = HGR_{therm_i} \cdot (vol_{waste_i} \cdot \rho_{waste_i}) \cdot \frac{Temp_{vap}}{273.15 \cdot K}$$

$$HGR_{thermv_1} = \sum_{i=2}^4 HGR_{thermv_i}$$

$$HGR_{thermv} = \begin{pmatrix} 2.412 \\ 2.154 \times 10^{-12} \\ 1.020 \\ 1.391 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{thermv_scf_i} = HGR_{thermv_i} \cdot \frac{273.15 \cdot K}{Temp_{vap}}$$

$$HGR_{thermv} = \begin{pmatrix} 1.675 \times 10^{-3} \\ 1.496 \times 10^{-15} \\ 7.086 \times 10^{-4} \\ 9.662 \times 10^{-4} \end{pmatrix} cfm$$

$$HGR_{thermv_scf} = \begin{pmatrix} 2.080 \\ 1.857 \times 10^{-12} \\ 0.880 \\ 1.200 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{thermv_scf} = \begin{pmatrix} 1.444 \times 10^{-3} \\ 1.290 \times 10^{-15} \\ 6.110 \times 10^{-4} \\ 8.332 \times 10^{-4} \end{pmatrix} cfm$$

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Hydrogen Generation Due To Radiolysis (Hu, 2000 - Eqn 4-16)

Constant Definition (Based On Hu (2000) Eqn 4-16)

$$E_{\text{rad}} := 44.32 \frac{\text{kilo-J}}{\text{g_mol}}$$

Activation Energy Of G In Organic Radiolysis
(Hu, 2000 - Eqn 4-16)

$$a_{\text{rad}} := 2.49 \cdot 10^6 \frac{\text{molecules}}{100 \cdot \text{eV}}$$

pre-exponential Factor Of G In Organic
Radiolysis (Hu, 2000 - Eqn 4-16)

$$r_f := \begin{cases} 0.4 & \text{if class}_{\text{waste}} = \text{"sst"} \\ 0.4 & \text{if class}_{\text{waste}} = \text{"SST"} \\ 0.7 & \text{otherwise} \end{cases}$$

Reactivity Coefficient Of TOC (0.7 For DSTs,
0.4 For SSTs) (Hu, 2000 - Eqn 4-16)

$$r_f = 0.700$$

$$\text{GH}_2\text{O}_{\text{sat}} := 0.005 \frac{\text{molecules}}{100 \cdot \text{eV}}$$

default Water Radiolysis G-value

Check Units On Input Data

$$\text{Temp}_{\text{waste}_2} = 345.150 \text{ K}$$

$$\text{mwNO}_2 := (14.0067 + 2 \cdot 15.9994) \frac{\text{gm}}{\text{g_mol}}$$

$$\text{mwNO}_3 := (14.0067 + 3 \cdot 15.9994) \frac{\text{gm}}{\text{g_mol}}$$

$$[\text{NO}_3] = \begin{pmatrix} 378.889 \times 10^0 \\ 294.845 \times 10^0 \\ 409.789 \times 10^0 \\ 294.845 \times 10^0 \end{pmatrix} \frac{\mu \cdot \text{gm}}{\text{mL}}$$

$$[\text{NO}_3]_{\text{molar}} := \frac{[\text{NO}_3]}{\text{mwNO}_3}$$

$$[\text{NO}_3]_{\text{molar}} = \begin{pmatrix} 6.111 \times 10^{-3} \\ 4.755 \times 10^{-3} \\ 6.609 \times 10^{-3} \\ 4.755 \times 10^{-3} \end{pmatrix} \frac{\text{g_mol}}{\text{liter}}$$

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$$[\text{NO}_2] = \begin{pmatrix} 4.431 \times 10^3 \\ 228.866 \times 10^0 \\ 5.976 \times 10^3 \\ 228.866 \times 10^0 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_2_{\text{molar}}] = \frac{[\text{NO}_2]}{\text{mwNO}_2}$$

$$[\text{NO}_2_{\text{molar}}] = \begin{pmatrix} 0.096 \\ 4.975 \times 10^{-3} \\ 0.130 \\ 4.975 \times 10^{-3} \end{pmatrix} \frac{\text{g_mol}}{\text{liter}}$$

$$\text{HeatLoad}_{137\text{Cs_90Sr}} = \begin{pmatrix} 1.385 \times 10^{13} \\ 3.379 \times 10^{-15} \\ 1.073 \times 10^{11} \\ 1.374 \times 10^{13} \end{pmatrix} \mu\text{-Ci}$$

$$\text{HeatLoad}_{137\text{Cs_90Sr}} = \begin{pmatrix} 2.229 \times 10^5 \\ 5.440 \times 10^{-23} \\ 1.728 \times 10^3 \\ 2.212 \times 10^5 \end{pmatrix} \frac{\text{BTU}}{\text{hr}}$$

$$\text{HeatLoad}_{137\text{Cs_90Sr}} = \begin{pmatrix} 6.533 \times 10^4 \\ 1.594 \times 10^{-23} \\ 506.423 \\ 6.482 \times 10^4 \end{pmatrix} \text{watt}$$

$$H_{\text{load}} = \frac{\text{HeatLoad}_{137\text{Cs_90Sr}}}{\text{vol}_{\text{waste}} \cdot \rho_{\text{waste}}}$$

$$H_{\text{load}} = \begin{pmatrix} 0.013 \\ 1.117 \times 10^{-17} \\ 1.221 \times 10^{-4} \\ 0.070 \end{pmatrix} \frac{\text{watt}}{\text{kg}}$$

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Calculate The Hydrogen Generation Rate Due To Radiolysis (HGR_{rad})

$$G_{org_i} = \frac{e_{rad}}{\left(\frac{\text{molecules}}{100 \cdot \text{eV}}\right)} \cdot e^{-\left[\frac{\left(\frac{E_{rad}}{\left(\frac{J}{\text{g}_{mol}}\right)}\right)}{\left[\frac{R_{const}}{\left(\frac{J}{\text{g}_{mol} \cdot K}\right)} \cdot \frac{\text{Temp}_{waste_i}}{K}\right]}\right]} \cdot rf_i \left(\left[TOC_{wt\%}\right]\right)_i \cdot \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$G_{org} = \begin{pmatrix} 0.050 \\ 0.050 \\ 0.013 \\ 0.050 \end{pmatrix} \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$G_{H_2O} = \left[0.45 - 0.56 \cdot \left[\frac{[NO_3]_{molar}}{\left(\frac{\text{g}_{mol}}{\text{liter}}\right)} \right]^{\frac{1}{3}} - 0.43 \cdot \left[\frac{[NO_2]_{molar}}{\left(\frac{\text{g}_{mol}}{\text{liter}}\right)} \right]^{\frac{1}{3}} \right] \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$G_{H_2O} = \begin{pmatrix} 0.151 \\ 0.282 \\ 0.127 \\ 0.282 \end{pmatrix} \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$G_{H_2O_i} = \begin{cases} G_{H_2O_i} & \text{if } G_{H_2O_i} > G_{H_2O_sat} \\ G_{H_2O_sat} & \text{otherwise} \end{cases}$$

$$G_{H_2O} = \begin{pmatrix} 0.151 \\ 0.282 \\ 0.127 \\ 0.282 \end{pmatrix} \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$HGR_{rad_i} = (G_{H_2O_i} + G_{org_i}) \cdot H_{load_i} \cdot F_{liquid_i} \cdot \frac{\text{g}_{mol}}{6.02 \cdot 10^{23} \cdot \text{molecules}}$$

$$HGR_{rad} = \begin{pmatrix} 1.594 \times 10^{-5} \\ 1.149 \times 10^{-20} \\ 1.217 \times 10^{-7} \\ 7.230 \times 10^{-5} \end{pmatrix} \frac{\text{ft}^3}{\text{kg} \cdot \text{day}} \quad HGR_{rad} = \begin{pmatrix} 2.013 \times 10^{-5} \\ 1.451 \times 10^{-20} \\ 1.538 \times 10^{-7} \\ 9.134 \times 10^{-5} \end{pmatrix} \frac{\text{g}_{mol}}{\text{kg} \cdot \text{day}}$$

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$$HGR_{radv} := \left[HGR_{rad} \cdot (vol_{waste} \cdot \rho_{waste}) \right] \cdot \frac{Temp_{vap}}{273.15 \cdot K}$$

$$HGR_{radv_i} := \sum_{i=2}^4 HGR_{radv_i}$$

$$HGR_{radv} = \begin{pmatrix} 77.8958 \\ 1.9014 \times 10^{-26} \\ 0.5852 \\ 77.3106 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{radv} = \begin{pmatrix} 0.054 \\ 1.320 \times 10^{-29} \\ 4.064 \times 10^{-4} \\ 0.054 \end{pmatrix} cfm$$

$$HGR_{radv_scf} := HGR_{radv} \cdot \frac{273.15 \cdot K}{Temp_{vap}}$$

$$HGR_{radv_scf} = \begin{pmatrix} 67.171 \\ 1.640 \times 10^{-26} \\ 0.505 \\ 66.667 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{radv_scf} = \begin{pmatrix} 0.047 \\ 1.139 \times 10^{-29} \\ 3.504 \times 10^{-4} \\ 0.046 \end{pmatrix} cfm$$

Hydrogen Generation Due To Corrosion (Hu, 2000 - Eqn 4-17)

Constant Definition (Based On Hu (2000) Eqn 4-17)

$$R_{corr} := \begin{cases} 3.6 \cdot 10^{-8} \cdot \frac{m^3}{m^2 \cdot min} & \text{if } class_{waste} = "sst" \\ 3.6 \cdot 10^{-8} \cdot \frac{m^3}{m^2 \cdot min} & \text{if } class_{waste} = "SST" \\ 1.83 \cdot 10^{-8} \cdot \frac{m^3}{m^2 \cdot min} & \text{otherwise} \end{cases}$$

Corrosion Coefficient (1.83E-08
For DSTs, 3.6E-08 For SSTs)
(m³/min/m²) Reference
Temperature Is 25°C
(Hu, 2001B - Eqn 2-1)

$$R_{corr} = 1.830 \times 10^{-8} \cdot \frac{m^3}{m^2 \cdot min}$$

Calculate The Wetted Area Of Steel (vertical Waste Storage Tank, Assuming A Flat Bottom)

$$\left[\pi \cdot \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank} \right] = \pi \cdot \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank}$$

$$A_{wet_1} := \pi \cdot \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank_1}$$

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$$Awet_2 := \pi \cdot diam_{tank} \cdot ht_{tank_2}$$

$$Awet_3 := \pi \cdot diam_{tank} \cdot ht_{tank_3}$$

$$Awet_4 := \pi \cdot \left(\frac{diam_{tank}}{2} \right)^2 + \pi \cdot diam_{tank} \cdot ht_{tank_4}$$

$$Awet = \begin{pmatrix} 1.255 \times 10^4 \\ 1.883 \times 10^{-9} \\ 6.911 \times 10^3 \\ 5.635 \times 10^3 \end{pmatrix} ft^2$$

Calculate Hydrogen Generation Due To Corrosion

$$HGR_{corr_mol} := \frac{R_{corr} \cdot Awet}{(vol_{waste} \cdot \rho_{waste})} \cdot \frac{273.15 \cdot K}{298.15 \cdot K}$$

$$HGR_{corr_mol} = \begin{pmatrix} 2.404 \times 10^{-7} \\ 1.320 \times 10^{-7} \\ 1.668 \times 10^{-7} \\ 6.114 \times 10^{-7} \end{pmatrix} \frac{g_mol}{kg \cdot day}$$

$$HGR_{corr} = \left[HGR_{corr_mol} (vol_{waste} \cdot \rho_{waste}) \cdot \frac{Temp_{vap}}{273.15 \cdot K} \right]$$

$$HGR_{corr} = \begin{pmatrix} 8.003 \times 10^{-4} \\ 1.201 \times 10^{-16} \\ 4.408 \times 10^{-4} \\ 3.594 \times 10^{-4} \end{pmatrix} \frac{ft^3}{min}$$

$$HGR_{corr_scf} := HGR_{corr} \cdot \frac{273.15 \cdot K}{Temp_{vap}}$$

$$HGR_{corr_scf} = \begin{pmatrix} 6.901 \times 10^{-4} \\ 1.036 \times 10^{-16} \\ 3.801 \times 10^{-4} \\ 3.099 \times 10^{-4} \end{pmatrix} \frac{ft^3}{min}$$

$$HGR_{corr} = \begin{pmatrix} 1.152 \\ 1.730 \times 10^{-13} \\ 0.635 \\ 0.518 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{corr_scf} = \begin{pmatrix} 0.994 \\ 1.492 \times 10^{-13} \\ 0.547 \\ 0.446 \end{pmatrix} \frac{ft^3}{day}$$

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Total Hydrogen Generation Rate

$$\text{mass}_{\text{waste}} = \begin{pmatrix} 5.221 \times 10^6 \\ 1.427 \times 10^{-6} \\ 4.146 \times 10^6 \\ 9.221 \times 10^5 \end{pmatrix} \text{ kg}$$

$$\text{HGR}_{\text{thermv}} = \begin{pmatrix} 2.412 \\ 2.154 \times 10^{-12} \\ 1.020 \\ 1.391 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{radv}} = \begin{pmatrix} 77.896 \\ 1.901 \times 10^{-26} \\ 0.585 \\ 77.311 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{corr}} = \begin{pmatrix} 1.152 \\ 1.730 \times 10^{-13} \\ 0.635 \\ 0.518 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR} := \left(\text{HGR}_{\text{thermv}} + \text{HGR}_{\text{radv}} + \text{HGR}_{\text{corr}} \right)$$

$$\text{HGR} = \begin{pmatrix} 0.05657 \\ 1.61582 \times 10^{-15} \\ 1.55582 \times 10^{-3} \\ 0.05501 \end{pmatrix} \text{ cfm}$$

$$\text{HGR} = \begin{pmatrix} 2.307 \times 10^3 \\ 6.589 \times 10^{-11} \\ 63.441 \\ 2.243 \times 10^3 \end{pmatrix} \frac{\text{L}}{\text{day}}$$

$$\text{HGR}_{\text{stp}} := \text{HGR} \cdot \frac{273.15 \cdot \text{K}}{\text{Temp}_{\text{vap}}}$$

} At Headspace Temp...

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$$\begin{aligned}
 \text{HGR}_{\text{stp}} &= \begin{pmatrix} 0.049 \\ 1.393 \times 10^{-15} \\ 1.342 \times 10^{-3} \\ 0.047 \end{pmatrix} \text{cfm} \\
 \text{HGR}_{\text{stp}} &= \begin{pmatrix} 70.245 \\ 2.006 \times 10^{-12} \\ 1.932 \\ 68.313 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}
 \end{aligned}
 \left. \vphantom{\begin{aligned} \text{HGR}_{\text{stp}} &= \begin{pmatrix} 0.049 \\ 1.393 \times 10^{-15} \\ 1.342 \times 10^{-3} \\ 0.047 \end{pmatrix} \text{cfm} \\ \text{HGR}_{\text{stp}} &= \begin{pmatrix} 70.245 \\ 2.006 \times 10^{-12} \\ 1.932 \\ 68.313 \end{pmatrix} \frac{\text{ft}^3}{\text{day}} \end{pmatrix} \right\} \text{At Standard Conditions...}$$

Steady-State Hydrogen Concentration (Assuming Normal Ventilation Rate)

$$[\text{H2}_{\text{ss}}] := \frac{\text{HGR}_1}{\text{HGR}_1 + \text{vent_rate}}$$

$$[\text{H2}_{\text{ss}}] = 226.226 \text{ ppmv}$$

$$[\text{H2}_{\text{ss}}] = 0.023 \%$$

Steady-State Hydrogen Concentration (Assuming Barometric Breathing Ventilation Rate)

$$[\text{H2}_{\text{ss_bb}}] := \frac{\text{HGR}_1}{\text{HGR}_1 + \text{vent_rate}_{\text{bb}}}$$

$$[\text{H2}_{\text{ss_bb}}] = 3.365 \times 10^5 \text{ ppmv}$$

$$[\text{H2}_{\text{ss_bb}}] = 33.650 \%$$

$$[\text{H2}_{\text{ss_bb}}] = 841.260 \% \text{ LFL}_{\text{H2}}$$

Gas Release Rate (Independent Of Ventilation Rate)

$$\text{rateH2_rel} := [\text{H2}_{\text{ss}}] \cdot \frac{\text{vent_rate}}{1 - [\text{H2}_{\text{ss}}]}$$

$$\text{rateH2_rel} = 0.0566 \text{ cfm}$$

$$\text{rateH2_rel_bb} := [\text{H2}_{\text{ss_bb}}] \cdot \frac{\text{vent_rate}_{\text{bb}}}{1 - [\text{H2}_{\text{ss_bb}}]}$$

$$\text{rateH2_rel_bb} = 0.057 \text{ cfm}$$

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Calculate Generation Rates Of Ammonia, Methane, And Nitrous Oxide (Assuming No Gas Retention)

$$GR_{NH3} := \frac{[NH3] \cdot vent_rate}{1 - [NH3]} \quad GR_{NH3} = 1.07250 \times 10^{-3} \text{ cfm}$$

$$GR_{CH4} := \frac{[CH4] \cdot vent_rate}{1 - [CH4]} \quad GR_{CH4} = 3.611 \times 10^{-4} \text{ cfm}$$

$$GR_{N2O} := \frac{[N2O] \cdot vent_rate}{1 - [N2O]} \quad GR_{N2O} = 2.500 \times 10^{-3} \text{ cfm}$$

Steady-State Ammonia, Methane, And Nitrous Oxide Concentration (Assuming Normal Ventilation Rate)(Just A Check Of Methodology)

$$[NH3_{ss}] := \frac{GR_{NH3}}{GR_{NH3} + vent_rate} \quad [NH3_{ss}] = 4.290 \times 10^{-4} \%$$

$$[CH4_{ss}] := \frac{GR_{CH4}}{GR_{CH4} + vent_rate} \quad [CH4_{ss}] = 1.444 \times 10^{-4} \%$$

$$[N2O_{ss}] := \frac{GR_{N2O}}{GR_{N2O} + vent_rate} \quad [N2O_{ss}] = 1.000 \times 10^{-3} \%$$

Steady-State Ammonia, Methane, And Nitrous Oxide Concentration (Assuming Barometric Breathing Ventilation Rate)

$$NH3_1000_day := \left[\frac{k2_NH3}{k1_NH3} + \left(\frac{[NH3_{ss}]}{V_m} - \frac{k2_NH3}{k1_NH3} \right) \exp \left(-1 \cdot \frac{k1_NH3}{1} \cdot 1000 \right) \right] \cdot V_m$$

$$NH3_1000_day = 179.289 \text{ ppm}$$

$$[NH3_{ss_bb}] := NH3_1000_day \quad [NH3_{ss_bb}] = 0.018 \%$$

$$[NH3_{ss_bb}] = 0.120 \% LFL_{NH3}$$

$$[CH4_{ss_bb}] := \frac{GR_{CH4}}{GR_{CH4} + vent_rate_{bb}} \quad [CH4_{ss_bb}] = 0.323 \%$$

$$[CH4_{ss_bb}] = 6.454 \% LFL_{CH4}$$

$$[N2O_{ss_bb}] := \frac{GR_{N2O}}{GR_{N2O} + vent_rate_{bb}} \quad [N2O_{ss_bb}] = 2.192 \%$$

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Determine The Overall Steady-State Flammable Gas Concentration With Loss Of Ventilation

$$[\text{Conc_mix}_{ss_bb}] := \frac{[\text{H2}_{ss_bb}]}{\text{LFL}_{\text{H2}}} + \frac{[\text{NH3}_{ss_bb}]}{\text{LFL}_{\text{NH3}}} + \frac{[\text{CH4}_{ss_bb}]}{\text{LFL}_{\text{CH4}}}$$

$$[\text{Conc_mix}_{ss_bb}] = 847.834\% \text{LFL}$$

Set Variables Into Array, Where 1 => H2, 2 => NH3, 3 => CH4, And 4 => N2O

$$\text{GR} := \begin{pmatrix} \text{HGR}_1 \\ \text{GR}_{\text{NH3}} \\ \text{GR}_{\text{CH4}} \\ \text{GR}_{\text{N2O}} \end{pmatrix} \quad \text{GR} = \begin{pmatrix} 0.057 \\ 1.073 \times 10^{-3} \\ 3.611 \times 10^{-4} \\ 2.500 \times 10^{-3} \end{pmatrix} \text{ cfm} \quad \begin{array}{l} \text{Generation} \\ \text{Rate} \end{array}$$

$$\text{Rate}_{\text{rel}} := \begin{pmatrix} \text{HGR}_1 \\ \text{GR}_{\text{NH3}} \\ \text{GR}_{\text{CH4}} \\ \text{GR}_{\text{N2O}} \end{pmatrix} \quad \text{Rate}_{\text{rel}} = \begin{pmatrix} 0.057 \\ 1.073 \times 10^{-3} \\ 3.611 \times 10^{-4} \\ 2.500 \times 10^{-3} \end{pmatrix} \text{ cfm} \quad \begin{array}{l} \text{Release Rate} \\ \text{(Assume No Retention)} \end{array}$$

$$\text{Conc}_{\text{init}} := \begin{pmatrix} [\text{H2}_{ss}] \\ [\text{NH3}_{ss}] \\ [\text{CH4}_{ss}] \\ [\text{N2O}_{ss}] \end{pmatrix} \quad \text{Conc}_{\text{init}} = \begin{pmatrix} 0.023 \\ 4.290 \times 10^{-4} \\ 1.444 \times 10^{-4} \\ 1.000 \times 10^{-3} \end{pmatrix} \% \quad \begin{array}{l} \text{Initial Concentration Rate} \\ \text{(Assume At Steady-} \\ \text{State With Normal Ops)} \end{array}$$

Calculate The Composition Of All Components At Time 't'

Special Calculation For Ammonia (Soluble Gas)

$$\lambda_i := \frac{\text{vent_rate}_{bb} + \text{Rate}_{\text{rel}_i}}{\text{vol}_{\text{head}}}$$

$$\text{Conc}_{\text{in}_i} := \frac{\text{Rate}_{\text{rel}_i} \cdot 100\%}{\text{Rate}_{\text{rel}_i} + \text{vent_rate}_{bb}}$$

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$$\text{conc}(t,i) = \begin{cases} \text{Conc}_{in_i} [1 - e^{(-\lambda_i t)}] + \text{Conc}_{init_i} [e^{(-\lambda_i t)}] & \text{if } i < 2 \\ \text{Conc}_{in_i} [1 - e^{(-\lambda_i t)}] + \text{Conc}_{init_i} [e^{(-\lambda_i t)}] & \text{if } i > 2 \\ \left[\frac{k_2_NH3}{k_1_NH3} + \left(\frac{[NH3]_{ss}}{V_m} - \frac{k_2_NH3}{k_1_NH3} \right) \exp \left(-1 \cdot \frac{k_1_NH3}{1} \cdot \frac{t}{\text{day}} \right) \right] \cdot V_m & \text{otherwise} \end{cases}$$

$$\text{conc}(0\text{-sec},1) = 0.023\%$$

$$\text{conc}(1000\text{-day},1) = 33.612\%$$

$$\text{conc}(1000\text{-day},1) = 840.307\% \text{LFL}_{H2}$$

$$\text{conc}(0\text{-sec},2) = 4.290 \times 10^{-4}\%$$

$$\text{conc}(1000\text{-day},2) = 0.018\%$$

$$\text{conc}(1000\text{-day},2) = 0.120\% \text{LFL}_{NH3}$$

$$\text{conc}(0\text{-sec},3) = 1.444 \times 10^{-4}\%$$

$$\text{conc}(1000\text{-day},3) = 0.319\%$$

$$\text{conc}(1000\text{-day},3) = 6.384\% \text{LFL}_{CH4}$$

$$\text{conc}(0\text{-sec},4) = 1.000 \times 10^{-3}\%$$

$$\text{conc}(1000\text{-day},4) = 2.170\%$$

$$t = 0, 10, \dots, 3000$$

Calculate Steady-State Flammable Gas Concentration At Normal Operating Conditions

$$\text{LFL}_{\text{mix}}(z) = \frac{1}{\frac{\text{conc}(z,1)}{\text{LFL}_{H2}} + \frac{\text{conc}(z,2)}{\text{LFL}_{NH3}} + \frac{\text{conc}(z,3)}{\text{LFL}_{CH4}}}$$

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$$\text{LFL}_{\text{mix}}(0\text{-day}) = 1.750 \times 10^4 \%$$

$$\text{LFL}_{\text{mix}}(100\text{-day}) = 23.977 \%$$

Calculate The Time To Reach Various Fractions Of The LFL

Time To Reach 25 %LFL

TOL := .00001

$$f(z, t) := \frac{\left(\frac{\text{conc}(z, 1)}{\text{LFL}_{\text{H2}}} + \frac{\text{conc}(z, 2)}{\text{LFL}_{\text{NH3}}} + \frac{\text{conc}(z, 3)}{\text{LFL}_{\text{CH4}}} \right)}{\% \text{LFL}} - 1$$

$$t_{\text{fl}} := 25$$

$$z := 10\text{-day} \quad \text{Initial Guess}$$

$$\text{temp}_{25} := -5\text{-day}$$

Initial Value In Case Solution
Cannot Be Found

$$\text{temp}_{25} := \text{Re}(\text{root}(f(z, t_{\text{fl}}), z))$$

$$\text{temp}_{25} = 4.312\text{ day}$$

$$\text{Time}_{1_25\% \text{LFL}} := \text{if}([\text{Conc_mix}_{\text{ss_bb}}] > 25\%, \text{if}(\text{temp}_{25} < 0\text{-day}, 0\text{-day}, \text{temp}_{25}), 10^9\text{-day})$$

$$\text{Time}_{1_25\% \text{LFL}} = 4.312\text{ day}$$

Time To Reach 50 %LFL

$$t_{\text{fl}} := 50$$

$$z := 10\text{-day} \quad \text{Initial Guess}$$

$$\text{temp}_{50} := -5\text{-day}$$

Initial Value In Case Solution
Cannot Be Found

$$\text{temp}_{50} := \text{Re}(\text{root}(f(z, t_{\text{fl}}), z))$$

$$\text{temp}_{50} = 8.868\text{ day}$$

$$\text{Time}_{1_50\% \text{LFL}} := \text{if}([\text{Conc_mix}_{\text{ss_bb}}] > 50\%, \text{if}(\text{temp}_{50} < 0\text{-day}, 0\text{-day}, \text{temp}_{50}), 10^9\text{-day})$$

$$\text{Time}_{1_50\% \text{LFL}} = 8.868\text{ day}$$

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Time To Reach 75 %LFL

$$f(z) := \frac{\left(\frac{\text{conc}(z,1)}{\text{LFLH2}} + \frac{\text{conc}(z,2)}{\text{LFLNH3}} + \frac{\text{conc}(z,3)}{\text{LFLCH4}} \right)}{\% \text{LFL}} - 75$$

z := 10·day Initial Guess

temp75 := -5·day

Initial Value In Case Solution
Cannot Be Found

temp75 := Re(root(f(z),z))

temp75 = 13.572 day

Time1_75%LFL := if([Conc_mixss_bb] > 75%, if(temp75 < 0·day, 0·day, temp75), 10⁹·day)

Time1_75%LFL = 13.572 day

Time To Reach 100 %LFL

$$f(z) := \frac{\left(\frac{\text{conc}(z,1)}{\text{LFLH2}} + \frac{\text{conc}(z,2)}{\text{LFLNH3}} + \frac{\text{conc}(z,3)}{\text{LFLCH4}} \right)}{\% \text{LFL}} - 100$$

z := 10·day Initial Guess

temp100 := -5·day

Initial Value In Case Solution
Cannot Be Found

temp100 := Re(root(f(z),z))

temp100 = 18.433 day

Time1_100%LFL := if([Conc_mixss_bb] > 100%, if(temp100 < 0·day, 0·day, temp100), 10⁹·day)

Time1_100%LFL = 18.433 day

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Minimum Ventilation Rates Need To Prevent Headspace Concentrations From Reaching Various Levels

$$\text{Conc_vr}(V,i) := \begin{cases} \frac{\text{Rate_rel}_i \cdot 100\%}{\text{Rate_rel}_i + V} \left[1 - e^{-\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day}} \right] + \text{Conc_init}_i \cdot e^{-\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day}} & \text{if } i < 2 \\ \frac{\text{Rate_rel}_i \cdot 100\%}{\text{Rate_rel}_i + V} \left[1 - e^{-\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day}} \right] + \text{Conc_init}_i \cdot e^{-\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day}} & \text{if } i > 2 \\ \left[\frac{k_2_NH3}{V + (h_{A_NH3} \cdot K_H \cdot P \cdot V_m)} + \left(\frac{[NH3]_{ss}}{V_m} - \frac{k_2_NH3}{k_1_NH3} \right) \exp \left[-1 \cdot \frac{V + (h_{A_NH3} \cdot K_H \cdot P \cdot V_m)}{\text{vol_head}} \cdot 10^9 \cdot \frac{1}{\text{day}} \right] \right] \cdot V_m & \text{otherwise} \end{cases}$$

Ventilation Rate To Keep Concentration Less Than 25 %LFL

$$f2_25(z) := \frac{\left(\frac{\text{Conc_vr}(z,1)}{\text{LFLH2}} + \frac{\text{Conc_vr}(z,2)}{\text{LFLNH3}} + \frac{\text{Conc_vr}(z,3)}{\text{LFLCH4}} \right)}{\%LFL} - 24.999$$

z := .001 cfm Initial Guess

temp25 := -5 cfm

Initial Value In Case Solution Cannot Be Found

temp25 := root(f2_25(z), z)

temp25 = 5.644076 cfm

vent_rate1_25%LFL := if(temp25 < 0 cfm, 0 cfm, temp25 + 0.001 cfm)

vent_rate1_25%LFL = 5.645 cfm

Ventilation Rate To Keep Concentration Less Than 50 %LFL

$$f2_50(z) := \frac{\left(\frac{\text{Conc_vr}(z,1)}{\text{LFLH2}} + \frac{\text{Conc_vr}(z,2)}{\text{LFLNH3}} + \frac{\text{Conc_vr}(z,3)}{\text{LFLCH4}} \right)}{\%LFL} - 49.999$$

z := .001 cfm Initial Guess

temp50 := -5 cfm

Initial Value In Case Solution Cannot Be Found

temp50 := root(f2_50(z), z)

temp50 = 2.791426 cfm

vent_rate1_50%LFL := if(temp50 < 0 cfm, 0 cfm, temp50 + 0.001 cfm)

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$$\text{vent_rate1}_{50\%LFL} = 2.792 \text{ cfm}$$

Ventilation Rate To Keep Concentration Less Than 75 %LFL

$$f2_{75}(z) := \frac{\left(\frac{\text{Conc_vr}(z,1)}{LFL_{H2}} + \frac{\text{Conc_vr}(z,2)}{LFL_{NH3}} + \frac{\text{Conc_vr}(z,3)}{LFL_{CH4}} \right)}{\%LFL} - 74.999$$

$$z := .001 \cdot \text{cfm} \quad \text{Initial Guess}$$

$$\text{temp75} := -5 \cdot \text{cfm} \quad \text{Initial Value In Case Solution Cannot Be Found}$$

$$\text{temp75} := \text{root}(f2_{75}(z), z)$$

$$\text{temp75} = 1.841383 \text{ cfm}$$

$$\text{vent_rate1}_{75\%LFL} := \text{if}(\text{temp75} < 0 \cdot \text{cfm}, 0 \cdot \text{cfm}, \text{temp75} + 0.001 \cdot \text{cfm})$$

$$\text{vent_rate1}_{75\%LFL} = 1.842 \text{ cfm}$$

Ventilation Rate To Keep Concentration Less Than 100 %LFL

$$f2_{100}(z) := \frac{\left(\frac{\text{Conc_vr}(z,1)}{LFL_{H2}} + \frac{\text{Conc_vr}(z,2)}{LFL_{NH3}} + \frac{\text{Conc_vr}(z,3)}{LFL_{CH4}} \right)}{\%LFL} - 99.999$$

$$z := .001 \cdot \text{cfm} \quad \text{Initial Guess}$$

$$\text{temp100} := -5 \cdot \text{cfm} \quad \text{Initial Value In Case Solution Cannot Be Found}$$

$$\text{temp100} := \text{root}(f2_{100}(z), z)$$

$$\text{temp100} = 1.366605 \text{ cfm}$$

$$\text{vent_rate1}_{100\%LFL} := \text{if}(\text{temp100} < 0 \cdot \text{cfm}, 0 \cdot \text{cfm}, \text{temp100} + 0.001 \cdot \text{cfm})$$

$$\text{vent_rate1}_{100\%LFL} = 1.368 \text{ cfm}$$

Additional Calculations -- Estimated Time To LFL With Zero Ventilation

Tank Headspace Hydrogen Concentration :

$$\text{vent_rate}_{zb} := 1 \cdot 10^{-6} \cdot \text{cfm}$$

$$\%H_{2lim} := 100 \cdot [H_{2ss_bb}]$$

$$\%H_{2lim} = 33.650$$

volume % Hydrogen

$$\%LFL_{lim} := 100 \cdot [H_{2ss_bb}] \cdot \frac{100}{4}$$

$$\%LFL_{lim} = 841.260$$

% LFL Based On Hydrogen

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Final H2 Concentration To Meet 25% (NH3 And CH4 Included) Estimate Gas Concentrations At Final Conditions:

$$H2_{25\%} = 0.0004 \left(25 - \frac{\text{conc}(23.2\text{-day}, 2)}{\%LFL_{NH3}} - \frac{\text{conc}(23.2\text{-day}, 3)}{\%LFL_{CH4}} \right) \quad H2_{25\%} = 0.969\%$$

Final H2 Concentration To Meet 50% (NH3 And CH4 Included):

$$H2_{50\%} = 0.0004 \left(50 - \frac{\text{conc}(50\text{-day}, 2)}{\%LFL_{NH3}} - \frac{\text{conc}(50\text{-day}, 3)}{\%LFL_{CH4}} \right) \quad H2_{50\%} = 1.943\%$$

Final H2 Concentration To Meet 100% (NH3 And CH4 Included):

$$H2_{100\%} = 0.0004 \left(100 - \frac{\text{conc}(117\text{-day}, 2)}{\%LFL_{NH3}} - \frac{\text{conc}(117\text{-day}, 3)}{\%LFL_{CH4}} \right) \quad H2_{100\%} = 3.889\%$$

Maximum %LFL With Loss Of Ventilation (Assume Gas Conc. ~ Equal To Barometric Breathing At 100% LFL):

$$LFL_{nat_breathing} = \frac{HGR_1}{(HGR_1 + vent_rate_{bb}) \cdot 0.04} + \frac{[NH3_{ss_bb}]}{\%LFL_{NH3} \cdot 100} + \frac{[CH4_{ss_bb}]}{\%LFL_{CH4} \cdot 100} \quad LFL_{nat_breathing} = 847.834\%$$

Time To Reach 25% LFL With Zero Ventilation:

$$tempz25 = \frac{-vol_{head}}{(HGR_1 + vent_rate_{zb})} \cdot \ln \left[\frac{HGR_1 - (HGR_1 + vent_rate_{zb}) \cdot H2_{25\%}}{HGR_1 - (HGR_1 + vent_rate_{zb}) \cdot H2_{init}} \right] \quad tempz25 = 4.211 \text{ day}$$

$$Time_zb2_25\%LFL := \text{if}(LFL_{nat_breathing} > 25\%, \text{if}(tempz25 < 0\text{-day}, 0\text{-day}, tempz25), 999999999\text{-day})$$

$$Time_zb2_25\%LFL = 4.169 \text{ day}$$

Time To Reach 50% LFL With Zero Ventilation:

$$tempz50 = \frac{-vol_{head}}{(HGR_1 + vent_rate_{zb})} \cdot \ln \left[\frac{HGR_1 - (HGR_1 + vent_rate_{zb}) \cdot H2_{50\%}}{HGR_1 - (HGR_1 + vent_rate_{zb}) \cdot H2_{init}} \right] \quad tempz50 = 8.670 \text{ day}$$

$$Time_zb2_50\%LFL := \text{if}(LFL_{nat_breathing} > 50\%, \text{if}(tempz50 < 0\text{-day}, 0\text{-day}, tempz50), 999999999\text{-day})$$

$$Time_zb2_50\%LFL = 8.498 \text{ day}$$

Time To Reach 100% LFL With Zero Ventilation:

$$tempz100 = \frac{-vol_{head}}{(HGR_1 + vent_rate_{zb})} \cdot \ln \left[\frac{HGR_1 - (HGR_1 + vent_rate_{zb}) \cdot H2_{100\%}}{HGR_1 - (HGR_1 + vent_rate_{zb}) \cdot H2_{init}} \right] \quad tempz100 = 18.010 \text{ day}$$

$$Time_zb2_100\%LFL := \text{if}(LFL_{nat_breathing} > 100\%, \text{if}(tempz100 < 0\text{-day}, 0\text{-day}, tempz100), 999999999\text{-day})$$

$$Time_zb2_100\%LFL = 17.282 \text{ day}$$

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Summary Section**Input Data**Waste Properties (1 ==> Total Waste, 2 ==> Liquid Waste, 3 ==> Solid Waste)

Tank_id = "241-AY-102"

classwaste = "dst"

$$[\text{TOC}] = \begin{pmatrix} 1.769 \times 10^3 \\ 2.124 \times 10^3 \\ 1.639 \times 10^3 \\ 2.124 \times 10^3 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_3] = \begin{pmatrix} 378.889 \\ 294.845 \\ 409.789 \\ 294.845 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_2] = \begin{pmatrix} 4.431 \times 10^3 \\ 228.866 \\ 5.976 \times 10^3 \\ 228.866 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{Al}] = \begin{pmatrix} 1.109 \times 10^3 \\ 100.206 \\ 1.480 \times 10^3 \\ 100.206 \end{pmatrix} \frac{\mu\text{-gm}}{\text{mL}}$$

$$[^{137}\text{Cs}] = \begin{pmatrix} 74.771 \\ 1.000 \times 10^{-12} \\ 27.904 \\ 175.680 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$[^{90}\text{Sr}] = \begin{pmatrix} 1.818 \times 10^3 \\ 1.000 \times 10^{-12} \\ 1.551 \\ 5.729 \times 10^3 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$\text{vol}_{\text{waste}} = \begin{pmatrix} 1.140 \times 10^3 \\ 2.642 \times 10^{-10} \\ 969.345 \\ 170.655 \end{pmatrix} \text{kilo-gal}$$

$$\rho_{\text{waste}} = \begin{pmatrix} 1.210 \\ 1.427 \\ 1.130 \\ 1.427 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{Temp}_{\text{waste}} = \begin{pmatrix} 345.150 \\ 345.150 \\ 318.150 \\ 345.150 \end{pmatrix} \text{K}$$

$$\text{FH}_2\text{O} = \begin{pmatrix} 79.665 \\ 38.000 \\ 87.000 \\ 38.000 \end{pmatrix} \%$$

$$\text{HeatLoad}_{^{137}\text{Cs}_{-}^{90}\text{Sr}} = \begin{pmatrix} 6.533 \times 10^4 \\ 1.594 \times 10^{-23} \\ 506.423 \\ 6.482 \times 10^4 \end{pmatrix} \text{watt}$$

$$\text{Temp}_{\text{vap}} = 316.761 \text{ K}$$

$$\text{vol}_{\text{tank}} = 1.407 \times 10^3 \text{ kilo-gal}$$

$$\text{vent_rate} = 250.000 \text{ cfm}$$

$$\text{vent_rate}_{\text{pb}} = 0.112 \text{ cfm}$$

AN Tank Farm: Tank Data

$$\text{diam}_{\text{tank}} = 75.000 \text{ ft}$$

$$h_{\text{tank}} = \begin{pmatrix} 413.944 \\ 9.592 \times 10^{-11} \\ 351.978 \\ 61.966 \end{pmatrix} \text{ in}$$

estimation Of Waste Depth

Dome-Space Compositions

$$[\text{CH}_4] = 1.444 \times 10^{-4} \%$$

$$[\text{N}_2\text{O}] = 1.000 \times 10^{-3} \%$$

$$[\text{NH}_3] = 4.290 \times 10^{-4} \%$$

End Of Input Data

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Output Data

Waste Properties (1 ==> Total Waste, 2 ==> Crust 3 ==> Liquid Waste, 4 ==> Solid Waste)

Hydrogen Generation Rate Due To Thermolysis, Radiolysis, And Corrosion...

$$\begin{aligned}
 \text{HGR}_{\text{thermv}} &= \begin{pmatrix} 1.675 \times 10^{-3} \\ 1.496 \times 10^{-15} \\ 7.086 \times 10^{-4} \\ 9.662 \times 10^{-4} \end{pmatrix} \text{ cfm} &
 \text{HGR}_{\text{radv}} &= \begin{pmatrix} 0.054 \\ 1.320 \times 10^{-29} \\ 4.064 \times 10^{-4} \\ 0.054 \end{pmatrix} \text{ cfm} &
 \text{HGR}_{\text{corr}} &= \begin{pmatrix} 8.003 \times 10^{-4} \\ 1.201 \times 10^{-16} \\ 4.408 \times 10^{-4} \\ 3.594 \times 10^{-4} \end{pmatrix} \text{ cfm}
 \end{aligned}$$

Overall Hydrogen Generation Rate...

at The Headspace Conditions...

$$\begin{aligned}
 \text{HGR} &= \begin{pmatrix} 0.057 \\ 1.616 \times 10^{-15} \\ 1.556 \times 10^{-3} \\ 0.055 \end{pmatrix} \text{ cfm} \\
 \text{HGR} &= \begin{pmatrix} 81.460 \\ 2.327 \times 10^{-12} \\ 2.240 \\ 79.220 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}
 \end{aligned}$$

at Standard Conditions (273°K)...

$$\begin{aligned}
 \text{HGR}_{\text{stp}} &= \begin{pmatrix} 0.049 \\ 1.393 \times 10^{-15} \\ 1.342 \times 10^{-3} \\ 0.047 \end{pmatrix} \text{ cfm} \\
 \text{HGR}_{\text{stp}} &= \begin{pmatrix} 70.245 \\ 2.006 \times 10^{-12} \\ 1.932 \\ 68.313 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}
 \end{aligned}$$

Steady-State Compositions

Hydrogen At Normal Ventilation Rate...

$$[\text{H}_{2\text{ss}}] = 0.566\% \text{LFLH}_2$$

Ammonia At Normal Ventilation Rate...

$$[\text{NH}_{3\text{ss}}] = 2.860 \times 10^{-3}\% \text{LFLNH}_3$$

Methane At Normal Ventilation Rate...

$$[\text{CH}_{4\text{ss}}] = 2.889 \times 10^{-3}\% \text{LFLCH}_4$$

Nitrous Oxide At Normal Ventilation Rate...

$$[\text{N}_2\text{O}_{\text{ss}}] = 1.000 \times 10^{-3}\%$$

At Barometric Breathing Ventilation Rate

$$[\text{H}_{2\text{ss_bb}}] = 841.260\% \text{LFLH}_2$$

At Barometric Breathing Ventilation Rate

$$[\text{NH}_{3\text{ss_bb}}] = 0.120\% \text{LFLNH}_3$$

At Barometric Breathing Ventilation Rate

$$[\text{CH}_{4\text{ss_bb}}] = 6.454\% \text{LFLCH}_4$$

At Barometric Breathing Ventilation Rate

$$[\text{N}_2\text{O}_{\text{ss_bb}}] = 2.192\%$$

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Flammable Gas Concentrations After Loss Of Ventilation At Selected Time Periods

$$\text{conc}_{\text{mix}}(0 \cdot \text{day}) = 0.571 \% \text{LFL}$$

$$\text{conc}_{\text{mix}}(10 \cdot \text{day}) = 56.090 \% \text{LFL}$$

$$\text{conc}_{\text{mix}}(100 \cdot \text{day}) = 417.060 \% \text{LFL}$$

$$\text{conc}_{\text{mix}}(10^9 \cdot \text{day}) = 847.834 \% \text{LFL}$$

Time To Reach Various LFL Levels At Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)

$$\text{Time}_1_{25\% \text{LFL}} = 4.312 \text{ day}$$

$$\text{Time}_1_{75\% \text{LFL}} = 13.572 \text{ day}$$

$$\text{Time}_1_{50\% \text{LFL}} = 8.868 \text{ day}$$

$$\text{Time}_1_{100\% \text{LFL}} = 18.433 \text{ day}$$

Time To Reach Various LFL Levels At Zero Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)

$$\text{Time}_{\text{zb}2}_{25\% \text{LFL}} = 4.169 \text{ day}$$

$$\text{Time}_{\text{zb}2}_{50\% \text{LFL}} = 8.498 \text{ day}$$

$$\text{Time}_{\text{zb}2}_{100\% \text{LFL}} = 17.282 \text{ day}$$

Minimum Ventilation Rates To Keep Headspace Composition Below Selected LFLs

$$\text{vent_rate}_1_{25\% \text{LFL}} = 5.645 \text{ cfm}$$

$$\text{vent_rate}_1_{75\% \text{LFL}} = 1.842 \text{ cfm}$$

$$\text{vent_rate}_1_{50\% \text{LFL}} = 2.792 \text{ cfm}$$

$$\text{vent_rate}_1_{100\% \text{LFL}} = 1.368 \text{ cfm}$$

Gas Concentrations At Time To Reach 25% LFL After Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)

$$\text{H}_2 \quad [\text{H}_2]_{25} = 0.992 \%$$

$$[\text{H}_2]_{25} = 24.793 \% \text{LFLH}_2$$

$$\text{NH}_3 \quad [\text{NH}_3]_{25} = 0.012 \%$$

$$[\text{NH}_3]_{25} = 0.079 \% \text{LFLNH}_3$$

$$\text{CH}_4 \quad [\text{CH}_4]_{25} = 6.363 \times 10^{-3} \%$$

$$[\text{CH}_4]_{25} = 0.127 \% \text{LFLCH}_4$$

Gas Concentrations At Time To Reach 50% LFL After Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)

$$\text{H}_2 \quad [\text{H}_2]_{50} = 1.985 \%$$

$$[\text{H}_2]_{50} = 49.637 \% \text{LFLH}_2$$

$$\text{NH}_3 \quad [\text{NH}_3]_{50} = 0.016 \%$$

$$[\text{NH}_3]_{50} = 0.106 \% \text{LFLNH}_3$$

$$\text{CH}_4 \quad [\text{CH}_4]_{50} = 0.013 \%$$

$$[\text{CH}_4]_{50} = 0.256 \% \text{LFLCH}_4$$

Gas Concentrations At Time To Reach 100% LFL After Loss Of Ventilation (Values = 1.000x10² Indicates Condition Does Not Occur)

$$\text{H}_2 \quad [\text{H}_2]_{100} = 3.975 \%$$

$$[\text{H}_2]_{100} = 99.364 \% \text{LFLH}_2$$

$$\text{NH}_3 \quad [\text{NH}_3]_{100} = 0.018 \%$$

$$[\text{NH}_3]_{100} = 0.118 \% \text{LFLNH}_3$$

$$\text{CH}_4 \quad [\text{CH}_4]_{100} = 0.026 \%$$

$$[\text{CH}_4]_{100} = 0.518 \% \text{LFLCH}_4$$

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Author: _____ Date: _____

**G.10. RPP-5926 REV. 2: 10 HYDROGEN GENERATION RATE CALCULATIONS –
MONTE CARLO CALCULATION – CALCULATION NOTE RPP-5926, REVISION 2
TANK 241-AN-104**

CH2MHILL
Hanford Group, Inc.

SA Barker

Hydrogen Generation Rate Calculations

Monte Carlo Analysis - 241-AN-104

This Calculation Allows The User To Assign Uncertainty Information And Perform A Monte Carlo Analysis To Determine Uncertainty Bound For An Answer.

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Read Waste Information From "FGS Input 020203.xls"

excel :=

C:\FGS Input 020203 mc.xls

Datafile Name Is "FGS Input 020203 mc.xls"

excel =

	1	2	3	4	5	6	7
1	1.000	2.000	3.000	4.000	5.000	6.000	7.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	$1.166 \cdot 10^3$	116.578	$4.160 \cdot 10^4$	$4.160 \cdot 10^3$	$7.305 \cdot 10^4$	$7.305 \cdot 10^3$
4	0.000	$1.166 \cdot 10^3$	116.578	$4.160 \cdot 10^4$	$4.160 \cdot 10^3$	$7.305 \cdot 10^4$	$7.305 \cdot 10^3$
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	$2.581 \cdot 10^4$	$2.581 \cdot 10^3$	$9.444 \cdot 10^4$	$9.444 \cdot 10^3$	$2.368 \cdot 10^5$	$2.368 \cdot 10^4$
7	0.000	$2.581 \cdot 10^4$	$2.581 \cdot 10^3$	$9.444 \cdot 10^4$	$9.444 \cdot 10^3$	$2.368 \cdot 10^5$	$2.368 \cdot 10^4$
8	0.000	$2.581 \cdot 10^4$	$2.581 \cdot 10^3$	$9.444 \cdot 10^4$	$9.444 \cdot 10^3$	$2.368 \cdot 10^5$	$2.368 \cdot 10^4$
9	0.000	$2.597 \cdot 10^3$	259.692	$1.641 \cdot 10^5$	$1.641 \cdot 10^4$	$1.673 \cdot 10^5$	$1.673 \cdot 10^4$
10	0.000	$2.597 \cdot 10^3$	259.692	$1.641 \cdot 10^5$	$1.641 \cdot 10^4$	$1.673 \cdot 10^5$	$1.673 \cdot 10^4$
11	0.000	$2.597 \cdot 10^3$	259.692	$1.641 \cdot 10^5$	$1.641 \cdot 10^4$	$1.673 \cdot 10^5$	$1.673 \cdot 10^4$
12	0.000	$3.140 \cdot 10^3$	313.970	$1.123 \cdot 10^5$	$1.123 \cdot 10^4$	$1.719 \cdot 10^5$	$1.719 \cdot 10^4$
13	0.000	$3.140 \cdot 10^3$	313.970	$1.123 \cdot 10^5$	$1.123 \cdot 10^4$	$1.719 \cdot 10^5$	$1.719 \cdot 10^4$
14	0.000	$3.140 \cdot 10^3$	313.970	$1.123 \cdot 10^5$	$1.123 \cdot 10^4$	$1.719 \cdot 10^5$	$1.719 \cdot 10^4$
15	0.000	$3.556 \cdot 10^3$	355.629	$1.209 \cdot 10^5$	$1.209 \cdot 10^4$	$1.616 \cdot 10^5$	$1.616 \cdot 10^4$
16	0.000	$3.556 \cdot 10^3$	355.629	$1.209 \cdot 10^5$	$1.209 \cdot 10^4$	$1.616 \cdot 10^5$	$1.616 \cdot 10^4$

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Input Data**Waste Properties****(1 ==> Total Waste, 2 ==> Crust 3 ==> Liquid Waste, 4 ==> Solid Waste)**

Tank_id := "241-AN-104" TFI1 := search(Tank_id, "-", 1) TFI1 = 3.000
 TankFarm := substr(Tank_id, TFI1 + 1, 2) TankFarm = "AN"
 TankNames3 := stack(TankNames1, TankNames2)
 j1 := 1..177
 nal_j1 := j1
 vent_rate := 100 cfm From (Bingham 2000)

Set Monte Carlo Sampling Parameters:

NSamples := 500 number Of Individual Samples To Collect
 SSize := 100 number Of Data Points In Each Sample

Find The Appropriate Tank Specific Information:

fil := FindIndex(TankNames3, Tank_id)

$$fil = \begin{pmatrix} 4.000 \\ 1.000 \end{pmatrix}$$

$$tank_{idxT} := [(fil_1 - 1) \cdot 3] + 3 \quad tank_{idxT} = 12.000$$

$$tank_{idxL} := tank_{idxT} + 1$$

$$tank_{idxS} := tank_{idxT} + 2$$

$$class_{waste} := \text{if}[(fil_1 < 29), "dst", "sst"]$$

$$class_{waste} = "dst"$$

$$Ci := 1.61 \cdot 10^{-2} \frac{\text{BTU}}{\text{hr}}$$

...The Following Data Is From Hu 2002, Except Where Noted

For The Following Parameters Use Liquid Data Only...

$$[TOC_m] := \text{excel}_{tank_{idxL}, 2} \frac{\mu\text{-gm}}{\text{mL}} \quad [TOC_m] = 3.140 \times 10^3 \frac{\mu\text{-gm}}{\text{mL}}$$

$$[TOC_{sd}] := \text{excel}_{tank_{idxL}, 3} \frac{\mu\text{-gm}}{\text{mL}} \quad [TOC_{sd}] = 3.140 \times 10^2 \frac{\mu\text{-gm}}{\text{mL}}$$

$$[NO_2_m] := \text{excel}_{tank_{idxL}, 4} \frac{\mu\text{-gm}}{\text{mL}} \quad [NO_2_m] = 1.123 \times 10^5 \frac{\mu\text{-gm}}{\text{mL}}$$

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$$\begin{aligned}
 [\text{NO}_2\text{sd}] &:= \text{excel}_{\text{tankidxL},5} \frac{\mu\text{-gm}}{\text{mL}} & [\text{NO}_2\text{sd}] &= 1.123 \times 10^4 \frac{\mu\text{-gm}}{\text{mL}} \\
 [\text{NO}_3\text{m}] &:= \text{excel}_{\text{tankidxL},6} \frac{\mu\text{-gm}}{\text{mL}} & [\text{NO}_3\text{m}] &= 1.719 \times 10^5 \frac{\mu\text{-gm}}{\text{mL}} \\
 [\text{NO}_3\text{sd}] &:= \text{excel}_{\text{tankidxL},7} \frac{\mu\text{-gm}}{\text{mL}} & [\text{NO}_3\text{sd}] &= 1.719 \times 10^4 \frac{\mu\text{-gm}}{\text{mL}} \\
 [\text{Alm}] &:= \text{excel}_{\text{tankidxL},8} \frac{\mu\text{-gm}}{\text{mL}} & [\text{Alm}] &= 3.898 \times 10^4 \frac{\mu\text{-gm}}{\text{mL}} \\
 [\text{Als}] &:= \text{excel}_{\text{tankidxL},9} \frac{\mu\text{-gm}}{\text{mL}} & [\text{Als}] &= 3.898 \times 10^3 \frac{\mu\text{-gm}}{\text{mL}}
 \end{aligned}$$

For The Following Parameters Use Layer Specific Data...

$$\begin{aligned}
 [90\text{Sr}_\text{m}] &:= \begin{pmatrix} \text{excel}_{\text{tankidxT},10} \\ 1 \cdot 10^{-12} \\ \text{excel}_{\text{tankidxL},10} \\ \text{excel}_{\text{tankidxS},10} \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} & [90\text{Sr}_\text{m}] &= \begin{pmatrix} 15.096 \\ 1.000 \times 10^{-12} \\ 0.062 \\ 31.297 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} \\
 [90\text{Sr}_\text{sd}] &:= \begin{pmatrix} \text{excel}_{\text{tankidxT},11} \\ 1 \cdot 10^{-12} \\ \text{excel}_{\text{tankidxL},11} \\ \text{excel}_{\text{tankidxS},11} \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} & [90\text{Sr}_\text{sd}] &= \begin{pmatrix} 1.510 \\ 1.000 \times 10^{-12} \\ 6.231 \times 10^{-3} \\ 3.130 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} \\
 [137\text{Cs}_\text{m}] &:= \begin{pmatrix} \text{excel}_{\text{tankidxT},12} \\ 1 \cdot 10^{-12} \\ \text{excel}_{\text{tankidxL},12} \\ \text{excel}_{\text{tankidxS},12} \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} & [137\text{Cs}_\text{m}] &= \begin{pmatrix} 351.079 \\ 1.000 \times 10^{-12} \\ 374.528 \\ 325.809 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} \\
 [137\text{Cs}_\text{sd}] &:= \begin{pmatrix} \text{excel}_{\text{tankidxT},13} \\ 1 \cdot 10^{-12} \\ \text{excel}_{\text{tankidxL},13} \\ \text{excel}_{\text{tankidxS},13} \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}} & [137\text{Cs}_\text{sd}] &= \begin{pmatrix} 35.108 \\ 1.000 \times 10^{-12} \\ 37.453 \\ 32.581 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}
 \end{aligned}$$

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$$P_{waste_m} = \begin{pmatrix} excel_{tank_{idxT},14} \\ excel_{tank_{idxL},14} \cdot 0.95 \\ excel_{tank_{idxL},14} \\ excel_{tank_{idxS},14} \end{pmatrix} \cdot \frac{gm}{mL} \quad P_{waste_m} = \begin{pmatrix} 1.483 \\ 1.339 \\ 1.410 \\ 1.579 \end{pmatrix} \frac{gm}{mL}$$

$$P_{waste_sd} = \begin{pmatrix} excel_{tank_{idxT},15} \\ excel_{tank_{idxS},15} \\ excel_{tank_{idxL},15} \\ excel_{tank_{idxS},15} \end{pmatrix} \cdot \frac{gm}{mL} \quad P_{waste_sd} = \begin{pmatrix} 0.050 \\ 0.050 \\ 0.054 \\ 0.050 \end{pmatrix} \frac{gm}{mL}$$

$$vol_{waste_m} = \begin{pmatrix} excel_{tank_{idxT},16} \\ 1 \cdot 10^{-9} \\ excel_{tank_{idxL},16} \\ excel_{tank_{idxS},16} \end{pmatrix} \cdot kilo \cdot L \quad vol_{waste_m} = \begin{pmatrix} 3819 \\ 0 \\ 2083 \\ 1736 \end{pmatrix} kilo \cdot L$$

$$vol_{waste_sd} = \begin{pmatrix} excel_{tank_{idxT},17} \\ 1 \cdot 10^{-10} \\ excel_{tank_{idxL},17} \\ excel_{tank_{idxS},17} \end{pmatrix} \cdot kilo \cdot L \quad vol_{waste_sd} = \begin{pmatrix} 161 \\ 0 \\ 162 \\ 171 \end{pmatrix} kilo \cdot L$$

$$FH2O_m = \begin{pmatrix} excel_{tank_{idxT},18} \\ excel_{tank_{idxS},18} \\ excel_{tank_{idxL},18} \\ excel_{tank_{idxS},18} \end{pmatrix} \quad FH2O_m = \begin{pmatrix} 48.6 \\ 45.8 \\ 50.9 \\ 45.8 \end{pmatrix} \%$$

$$FH2O_sd = \begin{pmatrix} excel_{tank_{idxT},19} \\ excel_{tank_{idxS},19} \\ excel_{tank_{idxL},19} \\ excel_{tank_{idxS},19} \end{pmatrix} \quad FH2O_sd = \begin{pmatrix} 4.9 \\ 4.6 \\ 5.1 \\ 4.6 \end{pmatrix} \%$$

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$$F_{liquid_m_2} = \left(\frac{FH2O_m_2}{FH2O_m_3} \right)$$

$$F_{liquid_m_3} = \left(\frac{FH2O_m_3}{FH2O_m_3} \right)$$

$$F_{liquid_m_4} = \left(\frac{FH2O_m_4}{FH2O_m_3} \right)$$

$$F_{liquid_m_1} = \left[\frac{F_{liquid_m_2} \cdot (volwaste_m_2 \cdot \rho_{waste_m_2}) + F_{liquid_m_3} \cdot (volwaste_m_3 \cdot \rho_{waste_m_3}) + F_{liquid_m_4} \cdot (volwaste_m_4 \cdot \rho_{waste_m_4})}{volwaste_m_4 \cdot \rho_{waste_m_4} + volwaste_m_3 \cdot \rho_{waste_m_3} + volwaste_m_2 \cdot \rho_{waste_m_2}} \right]$$

$$F_{liquid_m} = \begin{pmatrix} 95.174 \\ 90.002 \\ 100.000 \\ 90.002 \end{pmatrix} \%$$

$$F_{liquid_sd} = F_{liquid_m} \cdot 1$$

$$F_{liquid_sd} = \begin{pmatrix} 9.517 \\ 9.000 \\ 10.000 \\ 9.000 \end{pmatrix} \%$$

$$Temp_{vap_m} = (excel_{tank_idxS,22} + 273.15) \cdot K \quad Temp_{vap_sd} = excel_{tank_idxS,23} \cdot K$$

$$Temp_{vap_m} = 307.650 K$$

$$Temp_{vap_sd} = 4 K$$

$$Temp_{waste_m} = \begin{pmatrix} excel_{tank_idxT,20} + 273.15 \\ excel_{tank_idxS,20} + 273.15 \\ excel_{tank_idxL,20} + 273.15 \\ excel_{tank_idxS,20} + 273.15 \end{pmatrix} K \quad Temp_{waste_sd} = \begin{pmatrix} excel_{tank_idxT,21} \\ excel_{tank_idxS,21} \\ excel_{tank_idxT,21} \\ excel_{tank_idxT,21} \end{pmatrix} K$$

$$Temp_{waste_m} = \begin{pmatrix} 314.150 \\ 314.150 \\ 314.150 \\ 314.150 \end{pmatrix} K$$

$$Temp_{waste_sd} = \begin{pmatrix} 5 \\ 5 \\ 5 \\ 5 \end{pmatrix} K$$

$$class_{waste} = "dst"$$

Heat Load Calculated By Barker In
"Decay Heat Generation Rate AN-104.MCD"

Make Sure You Run The File "Decay Heat Generation Rate 011129 .MCD"

Read Results From Excel File "rpp5926_r2_01_NH3CALOutputData0020203_AN-102.xls"

excel2 :=

C:\rpp5926_r2_02_DdecayHeatGRIinput020203_AN-104.xls

HeatLoad137Cs_90Sr_m := excel2.watt

Calculated By Barker In
"Decay Heat Generation Rate .MCD"

$$HeatLoad137Cs_90Sr_m = \begin{pmatrix} 9.952 \times 10^3 \\ 1.791 \times 10^{-23} \\ 5.191 \times 10^3 \\ 4.761 \times 10^3 \end{pmatrix} \text{ watt}$$

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$$\text{HeatLoad}_{137\text{Cs}_{90\text{Sr}}_{\text{sd}}} := \text{HeatLoad}_{137\text{Cs}_{90\text{Sr}}_{\text{m}}} \cdot 0.1$$

TankInfo :=

C:\TankInfo.xls

Read Waste Properties From Excel File
"TankInfo.xls"

$$j := 1..27$$

$$na_j := j \quad \text{name} := \text{augment}(na, \text{TankId})$$

$$\text{TankFarm} = "AN"$$

$$fi := \text{FindIndex}(\text{name}, \text{TankFarm})$$

$$fi = \begin{pmatrix} 7.000 \\ 2.000 \end{pmatrix}$$

$$\text{vol}_{\text{tank}} := \text{TankInfo}_{fi,4} \cdot \text{ft}^3$$

$$\text{vol}_{\text{tank}} = 1407 \text{ kilo} \cdot \text{gal} \quad \text{vol}_{\text{tank}} = 188089 \text{ ft}^3$$

$$\text{vent_rate} = 100.000 \text{ cfm}$$

$$\text{vent_rate}_{\text{nb}} := 0.045 \cdot \left(\text{vol}_{\text{tank}} - \text{vol}_{\text{waste}_1} \right) \cdot \frac{1}{\text{day}}$$

$$\text{vent_rate}_{\text{nb}} = 0.166 \text{ cfm}$$

$$\text{diam}_{\text{tank}} := 2 \cdot \text{TankInfo}_{(fi,2)} \cdot \text{ft} \quad \text{diam}_{\text{tank}} = 75.000 \text{ ft}$$

$$\text{ht}_{\text{tank}} := \frac{\text{vol}_{\text{waste}_m}}{\text{TankInfo}_{(fi,8)} \cdot \frac{\text{gal}}{\text{in}}} \quad \text{estimation Of Waste Depth}$$

$$\text{ht}_{\text{tank}} = \begin{pmatrix} 366.331 \\ 9.592 \times 10^{-11} \\ 199.808 \\ 166.523 \end{pmatrix} \text{ in}$$

estimation Of Waste Depth

$$\text{vol}_{\text{head}} := \text{vol}_{\text{tank}} - \text{vol}_{\text{waste}_m}$$

$$\text{vol}_{\text{head}} = 5.322 \times 10^4 \text{ ft}^3$$

$$i := 1..4 \quad k := 1..NSamples$$

$$\text{vol}_{\text{waste}_i} := \left(\text{norm} \left(NSamples, \frac{\text{vol}_{\text{waste}_m}}{\text{kilo} \cdot \text{gal}}, \frac{\text{vol}_{\text{waste}_{\text{sd}_i}}}{\text{kilo} \cdot \text{gal}} \right) \right) \cdot \text{kilo} \cdot \text{gal}$$

$$\text{vol}_{\text{head}} := \text{vol}_{\text{tank}} - \text{vol}_{\text{waste}_1}$$

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$$\text{volhead_m} := \text{mean}(\text{volhead})$$

$$\text{volhead_sd} := \text{Stdev}(\text{volhead})$$

$$\text{volhead_m} = 5.387 \times 10^4 \text{ ft}^3$$

$$\text{volhead_sd} = 5.654 \times 10^3 \text{ ft}^3$$

$$\rho_{\text{waste}_i} := \left(\text{norm} \left(\text{NSamples}, \frac{\rho_{\text{waste_m}_i}}{\frac{\text{gm}}{\text{mL}}}, \frac{\rho_{\text{waste_sd}_i}}{\frac{\text{gm}}{\text{mL}}} \right) \right) \frac{\text{gm}}{\text{mL}}$$

$$\text{masswaste}_i := \left(\text{volwaste}_i \cdot \rho_{\text{waste}_i} \right)$$

$$\text{masswaste_m}_i := \text{mean}(\text{masswaste}_i)$$

$$\text{masswaste_sd}_i := \text{Stdev}(\text{masswaste}_i)$$

$$\text{masswaste_m}_i = \begin{pmatrix} 5.646 \times 10^6 \\ 1.340 \times 10^{-6} \\ 2.949 \times 10^6 \\ 2.749 \times 10^6 \end{pmatrix} \text{ kg}$$

$$\text{masswaste_sd}_i = \begin{pmatrix} 3.027 \times 10^5 \\ 1.424 \times 10^{-7} \\ 2.440 \times 10^5 \\ 2.835 \times 10^5 \end{pmatrix} \text{ kg}$$

Dome-Space Methane Nitrous Oxide And Ammonia Concentrations (Bingham 2000)

$$[\text{H}_2\text{m}] := .0021\% \quad [\text{CH}_4\text{m}] := .0002\% \quad [\text{N}_2\text{O}_m] := .0007\% \quad [\text{NH}_3\text{m}] := .0021\%$$

$$[\text{H}_2\text{sd}] := .00021\% \quad [\text{CH}_4\text{sd}] := .00002\% \quad [\text{N}_2\text{Osd}] := .00007\% \quad [\text{NH}_3\text{sd}] := .00021\%$$

Ammonia Diffusion Information (see Rpp5926 R1 - Calculation Of Mass Transport Coefficient H For Soluble Gas AY-102 .mcd (from File "rpp5929_r2_01_NH3CALOutputData0020203.xls")

$$\text{NH3In} :=$$

$$\text{C:\rpp5926_r2_01_NH3CALOutputData0020203_AN-104.xls}$$

$$k_{2_NH3} := \text{NH3In}_1 \cdot \frac{\text{mol}}{\text{L} \cdot \text{min}}$$

$$k_{2_NH3} = 1.806 \times 10^{-9} \frac{\text{mol}}{\text{L} \cdot \text{min}}$$

$$h_{A_NH3} := \text{NH3In}_2 \cdot \text{cfm}$$

$$h_{A_NH3} = 5.916 \times 10^{-3} \text{ cfm}$$

$$K_H := \text{NH3In}_3 \cdot \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

$$K_H = 6.123 \frac{\text{mol}}{\text{L} \cdot \text{atm}}$$

$$V_m := \text{NH3In}_4 \cdot \frac{\text{L}}{\text{mol}}$$

$$V_m = 24.794 \frac{\text{L}}{\text{mol}}$$

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$$[\text{NH3}_{\text{liq}}] := \text{NH3}_{\text{in}} \frac{\text{mol}}{\text{L}}$$

$$[\text{NH3}_{\text{liq}}] = 0.014 \frac{\text{mol}}{\text{L}}$$

$$P := 1 \cdot \text{atm}$$

$$k_1_{\text{NH3}} := \frac{\text{vent_rate}_{\text{rb}} + (h_A_{\text{NH3}} K_H \cdot P \cdot V_m)}{\text{vol}_{\text{head}}}$$

$$k_1_{\text{NH3_m}} := \text{mean}(k_1_{\text{NH3}})$$

$$k_1_{\text{NH3_m}} = 1.998 \times 10^{-5} \text{ min}^{-1}$$

$$k_1_{\text{NH3_med}} := \text{median}(k_1_{\text{NH3}})$$

$$k_1_{\text{NH3_sd}} := \text{Stdev}(k_1_{\text{NH3}})$$

$$k_1_{\text{NH3_med}} = 1.983 \times 10^{-5} \text{ min}^{-1}$$

$$k_1_{\text{NH3_sd}} = 2.141 \times 10^{-6} \text{ min}^{-1}$$

Gas Concentrations At LFL

$$\text{LFL}_{\text{H2}} := 4\%$$

$$\% \text{LFL}_{\text{H2}} := \frac{.04}{100}$$

$$\text{LFL}_{\text{NH3}} := 15\%$$

$$\% \text{LFL}_{\text{NH3}} := \frac{.15}{100}$$

$$\text{LFL}_{\text{CH4}} := 5\%$$

$$\% \text{LFL}_{\text{CH4}} := \frac{.05}{100}$$

End Of Input Data

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CalculationsHydrogen Generation Due To Thermolysis (Hu, 2000 - Eqn 4-8)

Define Constants (Based On Hu (2000) Eqn 4-8)

$$a_{thm} := 2.76 \cdot 10^9 \frac{\text{g} \cdot \text{mol}}{\text{kg} \cdot \text{day}} \quad \text{Thermolysis Pre-exponential Factor (Hu, 2000 - Eqn 4-8)}$$

$$E_{thm} := 89.33 \frac{\text{kilo-J}}{\text{g} \cdot \text{mol}} \quad \text{activation Energy (Hu, 2000 - Eqn 4-8)}$$

$$R_{const} = 8.3144739 \frac{\text{J}}{\text{g} \cdot \text{mol} \cdot \text{K}} \quad \text{Gas Constant}$$

$$r_f := \begin{cases} 0.4 & \text{if classwaste} = \text{"sst"} \\ 0.4 & \text{if classwaste} = \text{"SST"} \\ 0.7 & \text{otherwise} \end{cases} \quad \begin{array}{l} \text{Reactivity Coefficient (0.7 For DSTs, 0.4 For SSTs)} \\ \text{(Hu, 2000 - Eqn 4-8)} \end{array}$$

$$r_f = 0.700$$

Calculate The Weight Fraction Of Liquid In The Waste

$$FH2O_i := \left(\text{norm} \left(\text{NSamples}, FH2O_m_i, FH2O_sd_i \right) \right)$$

$$WH2O_i := \overline{\text{masswaste}_i \cdot FH2O_i}$$

$$WH2O_m_i := \text{mean}(WH2O_i)$$

$$WH2O_sd_i := \text{Stdev}(WH2O_i)$$

$$WH2O_m_i = \begin{pmatrix} 1.379 \times 10^9 \\ 3.068 \times 10^{-4} \\ 7.532 \times 10^8 \\ 6.338 \times 10^8 \end{pmatrix} \text{kg}$$

$$WH2O_sd_i = \begin{pmatrix} 1.346 \times 10^8 \\ 3.070 \times 10^{-5} \\ 7.293 \times 10^7 \\ 6.017 \times 10^7 \end{pmatrix} \text{kg}$$

Check Units On Input Data

$$[TOC] := \left(\text{norm} \left(\text{NSamples}, \frac{[TOC_m]}{\frac{\mu \cdot \text{gm}}{\text{mL}}}, \frac{[TOC_sd]}{\frac{\mu \cdot \text{gm}}{\text{mL}}} \right) \right) \cdot \frac{\mu \cdot \text{gm}}{\text{mL}}$$

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$$[\text{TOC}_{\text{wt}\%}] := \frac{\overrightarrow{[\text{TOC}]}}{\rho_{\text{waste}_3}} \cdot 100$$

$$[\text{TOC}_{\text{wt}\%}_m] := \text{mean}([\text{TOC}_{\text{wt}\%}])$$

$$[\text{TOC}_{\text{wt}\%}_m] = 0.221$$

$$[\text{TOC}_{\text{wt}\%}_{sd}] := \text{Stdev}([\text{TOC}_{\text{wt}\%}])$$

$$[\text{TOC}_{\text{wt}\%}_{sd}] = 0.023$$

$$[\text{Al}] := \left(\text{norm} \left(\text{NSamples}, \frac{[\text{Al}_m]}{\frac{\mu\text{-gm}}{\text{mL}}}, \frac{[\text{Al}_{sd}]}{\frac{\mu\text{-gm}}{\text{mL}}} \right) \right) \cdot \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{Al}_{\text{wt}\%}] := \frac{\overrightarrow{[\text{Al}]}}{\rho_{\text{waste}_3}} \cdot 100$$

$$[\text{Al}_{\text{wt}\%}_m] := \text{mean}([\text{Al}_{\text{wt}\%}])$$

$$[\text{Al}_{\text{wt}\%}_m] = 2.755$$

$$[\text{Al}_{\text{wt}\%}_{sd}] := \text{Stdev}([\text{Al}_{\text{wt}\%}])$$

$$[\text{Al}_{\text{wt}\%}_{sd}] = 0.278$$

Calculate The Hydrogen Generation Rate Due To Thermolysis ($\text{HGR}_{\text{therm}}$)

$$\text{Tempwaste}_i := \left(\text{norm} \left(\text{NSamples}, \frac{\text{Tempwaste}_{m_i}}{K}, \frac{\text{Tempwaste}_{sd_i}}{K} \right) \right) \cdot K$$

$$\text{Fliquid1} := \left(\text{norm}(\text{NSamples}, \text{Fliquid}_{m_1}, \text{Fliquid}_{sd_1}) \right)$$

$$\text{Fliquid1}_k := \begin{cases} \text{Fliquid1}_k & \text{if } \text{Fliquid1}_k \leq 1.0 \\ 1 & \text{otherwise} \end{cases}$$

$$\text{Fliquid2} := \left(\text{norm}(\text{NSamples}, \text{Fliquid}_{m_2}, \text{Fliquid}_{sd_2}) \right)$$

$$\text{Fliquid2}_k := \begin{cases} \text{Fliquid2}_k & \text{if } \text{Fliquid2}_k \leq 1.0 \\ 1 & \text{otherwise} \end{cases}$$

$$\text{Fliquid3} := \left(\text{norm}(\text{NSamples}, \text{Fliquid}_{m_3}, \text{Fliquid}_{sd_3}) \right)$$

$$\text{Fliquid3}_k := \begin{cases} \text{Fliquid3}_k & \text{if } \text{Fliquid3}_k \leq 1.0 \\ 1 & \text{otherwise} \end{cases}$$

$$\text{Fliquid4} := \left(\text{norm}(\text{NSamples}, \text{Fliquid}_{m_4}, \text{Fliquid}_{sd_4}) \right)$$

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$$F_{\text{liquid}4_k} := \begin{cases} F_{\text{liquid}4_k} & \text{if } F_{\text{liquid}4_k} \leq 1.0 \\ 1 & \text{otherwise} \end{cases}$$

$$F_{\text{liquid}1} := F_{\text{liquid}1}$$

$$F_{\text{liquid}2} := F_{\text{liquid}2}$$

$$F_{\text{liquid}3} := F_{\text{liquid}3}$$

$$F_{\text{liquid}4} := F_{\text{liquid}4}$$

$$i := 1..4$$

$$HGR_{\text{therm_scf}_i} := \frac{a_{\text{thm}}}{\left(\frac{\text{g_mol}}{\text{kg_day}}\right)} \cdot \text{rf} \left[\text{TOC}_{\text{wt}\%} \cdot ([A1_{\text{wt}\%}])^{.4} \cdot e^{-\left[\frac{\left(\frac{E_{\text{thm}}}{\left(\frac{\text{J}}{\text{g_mol}}\right)}\right)}{\left[\frac{R_{\text{const}}}{\left(\frac{\text{J}}{\text{g_mol}\cdot\text{K}}\right)}\right] \left(\frac{\text{Temp}_{\text{waste}_i}}{\text{K}}\right)} \right]} \cdot F_{\text{liquid}_i} \right] \cdot \frac{\text{g_mol}}{\text{kg_day}}$$

$$HGR_{\text{therm}_i} := HGR_{\text{therm_scf}_i}$$

$$HGR_{\text{therm_m}_1} := \text{mean}(HGR_{\text{therm}_i})$$

$$HGR_{\text{therm_sd}_1} := \text{Stdev}(HGR_{\text{therm}_i})$$

$$HGR_{\text{therm_m}} = \begin{pmatrix} 9.600 \times 10^{-7} \\ 9.144 \times 10^{-7} \\ 9.928 \times 10^{-7} \\ 9.403 \times 10^{-7} \end{pmatrix} \frac{\text{g_mol}}{\text{kg_day}}$$

$$HGR_{\text{therm_sd}} = \begin{pmatrix} 5.768 \times 10^{-7} \\ 5.205 \times 10^{-7} \\ 5.825 \times 10^{-7} \\ 6.229 \times 10^{-7} \end{pmatrix} \frac{\text{g_mol}}{\text{kg_day}}$$

$$HGR_{\text{thermv}_i} := \left[HGR_{\text{therm}_i} \cdot (\text{vol}_{\text{waste}_i} \cdot \rho_{\text{waste}_i}) \right] \cdot \frac{\text{Temp}_{\text{vap_m}}}{273.15 \cdot \text{K}}$$

$$HGR_{\text{thermv}_1} := \sum_{i=2}^4 HGR_{\text{thermv}_i}$$

$$HGR_{\text{thermv_median}_1} := \text{median}(HGR_{\text{thermv}_i})$$

$$HGR_{\text{thermv_m}_1} := \text{mean}(HGR_{\text{thermv}_i})$$

$$HGR_{\text{thermv_sd}_1} := \text{Stdev}(HGR_{\text{thermv}_i})$$

$$HGR_{\text{thermv_m}} = \begin{pmatrix} 4.925 \\ 1.097 \times 10^{-12} \\ 2.618 \\ 2.307 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$HGR_{\text{thermv_scf}_1} := HGR_{\text{thermv_m}_1} \cdot \frac{273.15 \cdot \text{K}}{\text{Temp}_{\text{vap_m}}}$$

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$$\begin{aligned}
 \text{HGR}_{\text{thermv_m}} &= \begin{pmatrix} 3.420 \times 10^{-3} \\ 7.617 \times 10^{-16} \\ 1.818 \times 10^{-3} \\ 1.602 \times 10^{-3} \end{pmatrix} \text{ cfm} & \text{HGR}_{\text{thermv_scf}} &= \begin{pmatrix} 4.372 \\ 9.738 \times 10^{-13} \\ 2.324 \\ 2.048 \end{pmatrix} \frac{\text{ft}^3}{\text{day}} \\
 \text{HGR}_{\text{thermv_median}} &= \begin{pmatrix} 3.064 \times 10^{-3} \\ 6.742 \times 10^{-16} \\ 1.584 \times 10^{-3} \\ 1.296 \times 10^{-3} \end{pmatrix} \text{ cfm} & \text{HGR}_{\text{thermv_scf}} &= \begin{pmatrix} 3.036 \times 10^{-3} \\ 6.762 \times 10^{-16} \\ 1.614 \times 10^{-3} \\ 1.422 \times 10^{-3} \end{pmatrix} \text{ cfm}
 \end{aligned}$$

Hydrogen Generation Due To Radiolysis (Hu, 2000 - Eqn 4-16)

Constant Definition (Based On Hu (2000) Eqn 4-16)

$$E_{\text{rad}} := 44.32 \frac{\text{kilo-J}}{\text{g_mol}} \quad \text{Activation Energy Of G In Organic Radiolysis (Hu, 2000 - Eqn 4-16)}$$

$$a_{\text{rad}} := 2.49 \cdot 10^6 \frac{\text{molecules}}{100 \cdot \text{eV}} \quad \text{pre-exponential Factor Of G In Organic Radiolysis (Hu, 2000 - Eqn 4-16)}$$

$$r_f := \begin{cases} 0.4 & \text{if classwaste} = \text{"sst"} \\ 0.4 & \text{if classwaste} = \text{"SST"} \\ 0.7 & \text{otherwise} \end{cases} \quad \text{Reactivity Coefficient Of TOC (0.7 For DSTs, 0.4 For SSTs) (Hu, 2000 - Eqn 4-16)}$$

$$r_f = 0.700$$

$$\text{GH}_2\text{O}_{\text{sat}} := 0.005 \frac{\text{molecules}}{100 \cdot \text{eV}} \quad \text{default Water Radiolysis G-value}$$

Check Units On Input Data

$$\text{Tempwaste}_{m_2} = 314.127 \text{ K}$$

$$\text{mwNO}_2 := (14.0067 + 2 \cdot 15.9994) \frac{\text{gm}}{\text{g_mol}}$$

$$\text{mwNO}_3 := (14.0067 + 3 \cdot 15.9994) \frac{\text{gm}}{\text{g_mol}}$$

$$[\text{NO}_3]_m = 171.867 \times 10^3 \frac{\mu\text{g}}{\text{mL}}$$

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$$[\text{NO}_3] := \left(\text{norm} \left(\text{NSamples}, \frac{[\text{NO}_3_m]}{\frac{\mu\text{-gm}}{\text{mL}}}, \frac{[\text{NO}_3_sd]}{\frac{\mu\text{-gm}}{\text{mL}}} \right) \right) \cdot \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_3_molar] := \frac{[\text{NO}_3]}{\text{mwNO}_3}$$

$$[\text{NO}_3_molar_m] := \text{mean}([\text{NO}_3_molar]) \quad [\text{NO}_3_molar_sd] := \text{Stdev}([\text{NO}_3_molar])$$

$$[\text{NO}_3_molar_m] = 2.770 \frac{\text{g_mol}}{\text{L}} \quad [\text{NO}_3_molar_sd] = 0.282 \frac{\text{g_mol}}{\text{L}}$$

$$[\text{NO}_2_m] = 112.338 \times 10^3 \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_2] := \left(\text{norm} \left(\text{NSamples}, \frac{[\text{NO}_2_m]}{\frac{\mu\text{-gm}}{\text{mL}}}, \frac{[\text{NO}_2_sd]}{\frac{\mu\text{-gm}}{\text{mL}}} \right) \right) \cdot \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_2_molar] := \frac{[\text{NO}_2]}{\text{mwNO}_2}$$

$$[\text{NO}_2_molar_m] := \text{mean}([\text{NO}_2_molar]) \quad [\text{NO}_2_molar_sd] := \text{Stdev}([\text{NO}_2_molar])$$

$$[\text{NO}_2_molar_m] = 2.428 \frac{\text{g_mol}}{\text{L}} \quad [\text{NO}_2_molar_sd] = 0.244 \frac{\text{g_mol}}{\text{L}}$$

$$\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}_1} := \left[\text{norm} \left[\text{NSamples}, \frac{\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}_1_m}}{\mu\text{-Ci}}, \frac{\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}_1_sd}}{(\mu\text{-Ci})} \right] \right] \cdot \mu\text{-Ci}$$

$$\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}_1_md} := \text{mean}(\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}_1})$$

$$\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}_1_md} = \begin{pmatrix} 2.105 \times 10^{12} \\ 3.784 \times 10^{-15} \\ 1.101 \times 10^{12} \\ 1.002 \times 10^{12} \end{pmatrix} \mu\text{-Ci}$$

$$\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}_1_sdd} := \text{Stdev}(\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}_1})$$

$$\text{HeatLoad}_{137\text{Cs}_{90}\text{Sr}_1_sdd} = \begin{pmatrix} 2.044 \times 10^{11} \\ 0.000 \\ 1.139 \times 10^{11} \\ 9.512 \times 10^{10} \end{pmatrix} \mu\text{-Ci}$$

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$$H_{load} := \frac{\text{HeatLoad}_{137Cs_90Sr}}{\text{vol}_{waste} \cdot \rho_{waste}}$$

$$\text{HeatLoad}_{m_1} := \text{mean}(H_{load_i})$$

$$\text{HeatLoad}_{m_1} = \begin{pmatrix} 3.519 \times 10^{-6} \\ 2.665 \times 10^{-20} \\ 3.522 \times 10^{-6} \\ 3.440 \times 10^{-6} \end{pmatrix} \frac{\text{watt}}{\text{kg}}$$

Calculate The Hydrogen Generation Rate Due To Radiolysis (HGR_{rad})

$$G_{org_i} := \frac{a_{rad}}{\left(\frac{\text{molecules}}{100 \cdot \text{eV}} \right)} \cdot e^{-\left[\frac{\frac{\frac{E_{rad}}{\left(\frac{\text{J}}{\text{g_mol}} \right)}}{\frac{R_{const}}{\left(\frac{\text{J}}{\text{g_mol} \cdot \text{K}} \right)} \cdot \text{Temp}_{waste_i}}}{K}} \right]} \cdot [\text{TOC}_{wt\%}] \cdot r_f \cdot \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$G_{org_m_1} := \text{mean}(G_{org_i})$$

$$G_{org_sd_1} := \text{Stdev}(G_{org_i})$$

$$G_{org_m_1} = \begin{pmatrix} 0.017 \\ 0.017 \\ 0.017 \\ 0.017 \end{pmatrix} \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$G_{org_sd_1} = \begin{pmatrix} 4.912 \times 10^{-3} \\ 4.762 \times 10^{-3} \\ 4.942 \times 10^{-3} \\ 5.506 \times 10^{-3} \end{pmatrix} \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$GH_{2O} := \left[0.45 - 0.56 \cdot \left[\frac{[\text{NO}_3_molar]}{\left(\frac{\text{g_mol}}{\text{liter}} \right)} \right]^{\frac{1}{3}} - 0.43 \cdot \left[\frac{[\text{NO}_2_molar]}{\left(\frac{\text{g_mol}}{\text{liter}} \right)} \right]^{\frac{1}{3}} \right] \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$GH_{2O}_k := \begin{cases} GH_{2O}_k & \text{if } GH_{2O}_k > GH_{2O_sat} \\ GH_{2O_sat} & \text{otherwise} \end{cases}$$

$$GH_{2O_m} := \text{mean}(GH_{2O})$$

$$GH_{2O_sd} := \text{Stdev}(GH_{2O})$$

$$GH_{2O_m} = 5.000 \times 10^{-3} \frac{\text{molecules}}{100 \cdot \text{eV}}$$

$$GH_{2O_sd} = 0.000 \frac{\text{molecules}}{100 \cdot \text{eV}}$$

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$$HGR_{rad_i} := (GH_{2O_i} + G_{org_i}) \cdot H_{load_i} \cdot F_{liquid_i} \cdot \frac{g_{mol}}{6.02 \cdot 10^{23} \cdot molecules}$$

$$HGR_{rad_m_i} := \text{mean}(HGR_{rad_i})$$

$$HGR_{rad_sd_i} := \text{Stdev}(HGR_{rad_i})$$

$$HGR_{rad_m} = \begin{pmatrix} 2.562 \times 10^{-7} \\ 1.854 \times 10^{-21} \\ 2.632 \times 10^{-7} \\ 2.399 \times 10^{-7} \end{pmatrix} \frac{ft^3}{kg \cdot day}$$

$$HGR_{rad_sd} = \begin{pmatrix} 2.535 \times 10^{-8} \\ 0.000 \\ 2.098 \times 10^{-8} \\ 2.832 \times 10^{-8} \end{pmatrix} \frac{g_{mol}}{kg \cdot day}$$

$$HGR_{radv_i} := \left[HGR_{rad_i} (vol_{waste_i} \cdot \rho_{waste_i}) \right] \frac{Temp_{vap_m}}{273.15 \cdot K}$$

$$HGR_{radv_median_i} := \text{median}(HGR_{radv_i})$$

$$HGR_{radv_m_i} := \text{mean}(HGR_{radv_i})$$

$$HGR_{radv_sd_i} := \text{Stdev}(HGR_{radv_i})$$

$$HGR_{radv_m} = \begin{pmatrix} 1.6286 \\ 2.7979 \times 10^{-27} \\ 0.8744 \\ 0.7428 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{radv_sd} = \begin{pmatrix} 0.1493 \\ 0.0000 \\ 0.0925 \\ 0.1034 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{radv_m} = \begin{pmatrix} 1.131 \times 10^{-3} \\ 1.943 \times 10^{-30} \\ 6.072 \times 10^{-4} \\ 5.158 \times 10^{-4} \end{pmatrix} cfm$$

$$HGR_{radv_median} = \begin{pmatrix} 1.146 \times 10^{-3} \\ 1.934 \times 10^{-30} \\ 6.124 \times 10^{-4} \\ 5.149 \times 10^{-4} \end{pmatrix} cfm$$

$$HGR_{radv_scf_i} := HGR_{radv_i} \cdot \frac{273.15 \cdot K}{Temp_{vap_m}}$$

$$HGR_{radv_scf_median_i} := \text{median}(HGR_{radv_scf_i})$$

$$HGR_{radv_scf_m_i} := \text{mean}(HGR_{radv_scf_i})$$

$$HGR_{radv_scf_sd_i} := \text{Stdev}(HGR_{radv_scf_i})$$

$$HGR_{radv_scf_m} = \begin{pmatrix} 1.446 \\ 2.484 \times 10^{-27} \\ 0.776 \\ 0.659 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{radv_scf_sd} = \begin{pmatrix} 0.133 \\ 0.000 \\ 0.082 \\ 0.092 \end{pmatrix} \frac{ft^3}{day}$$

$$HGR_{radv_scf_m} = \begin{pmatrix} 1.004 \times 10^{-3} \\ 1.725 \times 10^{-30} \\ 5.391 \times 10^{-4} \\ 4.580 \times 10^{-4} \end{pmatrix} cfm$$

$$HGR_{radv_scf_median} = \begin{pmatrix} 1.017 \times 10^{-3} \\ 1.717 \times 10^{-30} \\ 5.437 \times 10^{-4} \\ 4.572 \times 10^{-4} \end{pmatrix} cfm$$

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Hydrogen Generation Due To Corrosion (Hu, 2000 - Eqn 4-17)

Constant Definition (Based On Hu (2000) Eqn 4-17)

$$R_{\text{corr}} := \begin{cases} 1.2 \cdot 10^{-7} \cdot \frac{\text{ft}^3}{\text{ft}^2 \cdot \text{min}} & \text{if class}_{\text{waste}} = \text{"sst"} \\ 1.2 \cdot 10^{-7} \cdot \frac{\text{ft}^3}{\text{ft}^2 \cdot \text{min}} & \text{if class}_{\text{waste}} = \text{"SST"} \\ 6.0 \cdot 10^{-8} \cdot \frac{\text{ft}^3}{\text{ft}^2 \cdot \text{min}} & \text{otherwise} \end{cases}$$

Corrosion Coefficient (6.0E-08 For DSTs, 1.2E-07 For SSTs) (ft³/min/ft²) (Hu, 2000 - Eqn 4-xx)

$$R_{\text{corr}} = 6.000 \times 10^{-8} \frac{\text{ft}^3}{\text{ft}^2 \cdot \text{min}}$$

Calculate The Wetted Area Of Steel (Vertical Waste Storage Tank, Assuming A Flat Bottom)

$$\left[\pi \cdot \left(\frac{\text{diam}_{\text{tank}}}{2} \right)^2 + \pi \cdot \text{diam}_{\text{tank}} \cdot \text{ht}_{\text{tank}} \right] = \pi \cdot \left(\frac{\text{diam}_{\text{tank}}}{2} \right)^2 + \pi \cdot \text{diam}_{\text{tank}} \cdot \text{ht}_{\text{tank}}$$

$$\text{Awet}_1 := \pi \cdot \left(\frac{\text{diam}_{\text{tank}}}{2} \right)^2 + \pi \cdot \text{diam}_{\text{tank}} \cdot \text{ht}_{\text{tank}_1}$$

$$\text{Awet}_2 := \pi \cdot \text{diam}_{\text{tank}} \cdot \text{ht}_{\text{tank}_2}$$

$$\text{Awet}_3 := \pi \cdot \text{diam}_{\text{tank}} \cdot \text{ht}_{\text{tank}_3}$$

$$\text{Awet}_4 := \pi \cdot \left(\frac{\text{diam}_{\text{tank}}}{2} \right)^2 + \pi \cdot \text{diam}_{\text{tank}} \cdot \text{ht}_{\text{tank}_4}$$

$$\text{Awet} = \begin{pmatrix} 1.161 \times 10^4 \\ 1.883 \times 10^{-9} \\ 3.923 \times 10^3 \\ 7.688 \times 10^3 \end{pmatrix} \text{ft}^2$$

Calculate Hydrogen Generation Due To Corrosion

$$\text{HGR}_{\text{corr}_1} := R_{\text{corr}} \cdot \text{Awet}_1 \cdot \frac{\text{Temp}_{\text{waste}_1}}{273.15 \cdot \text{K}}$$

$$\text{HGR}_{\text{corr_median}_1} := \text{median}\{\text{HGR}_{\text{corr}_i}\}$$

$$\text{HGR}_{\text{corr_m}_1} := \text{mean}\{\text{HGR}_{\text{corr}_i}\}$$

$$\text{HGR}_{\text{corr_sd}_1} := \text{Stdev}\{\text{HGR}_{\text{corr}_i}\}$$

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$$\text{HGR}_{\text{corr_m}} = \begin{pmatrix} 1.1535 \\ 1.8714 \times 10^{-13} \\ 0.3899 \\ 0.7640 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{corr_m}} = \begin{pmatrix} 8.011 \times 10^{-4} \\ 1.300 \times 10^{-16} \\ 2.708 \times 10^{-4} \\ 5.306 \times 10^{-4} \end{pmatrix} \text{cfm}$$

$$\text{HGR}_{\text{corr_scf}_1} := \text{HGR}_{\text{corr}_1} \frac{273.15 \text{ K}}{\text{Tempvap_m}}$$

$$\text{HGR}_{\text{corr_scf_m}_1} := \text{mean}(\text{HGR}_{\text{corr_scf}_1})$$

$$\text{HGR}_{\text{corr_scf_m}} = \begin{pmatrix} 1.024 \\ 1.662 \times 10^{-13} \\ 0.346 \\ 0.678 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{corr_scf_m}} = \begin{pmatrix} 7.112 \times 10^{-4} \\ 1.154 \times 10^{-16} \\ 2.404 \times 10^{-4} \\ 4.711 \times 10^{-4} \end{pmatrix} \text{cfm}$$

$$\text{HGR}_{\text{corr_sd}} = \begin{pmatrix} 0.0186 \\ 0.0000 \\ 6.3391 \times 10^{-3} \\ 0.0128 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{corr_median}} = \begin{pmatrix} 8.011 \times 10^{-4} \\ 1.300 \times 10^{-16} \\ 2.708 \times 10^{-4} \\ 5.305 \times 10^{-4} \end{pmatrix} \text{cfm}$$

$$\text{HGR}_{\text{corr_scf_median}_1} := \text{median}(\text{HGR}_{\text{corr_scf}_1})$$

$$\text{HGR}_{\text{corr_scf_sd}_1} := \text{Stddev}(\text{HGR}_{\text{corr_scf}_1})$$

$$\text{HGR}_{\text{corr_scf_sd}} = \begin{pmatrix} 0.017 \\ 0.000 \\ 5.628 \times 10^{-3} \\ 0.011 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{corr_scf_median}} = \begin{pmatrix} 7.112 \times 10^{-4} \\ 1.154 \times 10^{-16} \\ 2.404 \times 10^{-4} \\ 4.710 \times 10^{-4} \end{pmatrix} \text{cfm}$$

Total Hydrogen Generation Rate

$$\text{mass}_{\text{waste_m}} = \begin{pmatrix} 5.646 \times 10^6 \\ 1.340 \times 10^{-6} \\ 2.949 \times 10^6 \\ 2.749 \times 10^6 \end{pmatrix} \text{kg}$$

$$\text{HGR}_{\text{thermv_m}} = \begin{pmatrix} 4.925 \\ 1.097 \times 10^{-12} \\ 2.618 \\ 2.307 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{thermv_median}} = \begin{pmatrix} 4.413 \\ 9.709 \times 10^{-13} \\ 2.282 \\ 1.866 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

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$$\text{HGR}_{\text{radv_m}} = \begin{pmatrix} 1.629 \\ 2.798 \times 10^{-27} \\ 0.874 \\ 0.743 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{corr_m}} = \begin{pmatrix} 1.154 \\ 1.871 \times 10^{-13} \\ 0.390 \\ 0.764 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{radv_median}} = \begin{pmatrix} 1.650 \\ 2.785 \times 10^{-27} \\ 0.882 \\ 0.742 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_{\text{corr_median}} = \begin{pmatrix} 1.154 \\ 1.872 \times 10^{-13} \\ 0.390 \\ 0.764 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}$$

$$\text{HGR}_i = \text{HGR}_{\text{thermv}_i} + \text{HGR}_{\text{radv}_i} + \text{HGR}_{\text{corr}_i}$$

$$\text{HGR}_{\text{median}_i} = \text{median}(\text{HGR}_i)$$

$$\text{HGR}_{\text{m}_i} = \text{mean}(\text{HGR}_i)$$

$$\text{HGR}_{\text{sd}_i} = \text{Stdev}(\text{HGR}_i)$$

$$\text{HGR}_{\text{m}} = \begin{pmatrix} 5.352 \times 10^{-3} \\ 8.916 \times 10^{-16} \\ 2.696 \times 10^{-3} \\ 2.648 \times 10^{-3} \\ 218.230 \\ 3.636 \times 10^{-11} \\ 109.935 \\ 107.985 \end{pmatrix} \left. \begin{matrix} \text{cfm} \\ \\ \\ \\ \\ \frac{\text{L}}{\text{day}} \end{matrix} \right\} \text{At Headspace Temp...}$$

$$\text{HGR}_{\text{sd}} = \begin{pmatrix} 1.590 \times 10^{-3} \\ 0.000 \\ 1.112 \times 10^{-3} \\ 1.098 \times 10^{-3} \end{pmatrix} \text{cfm}$$

$$\text{HGR}_{\text{median}} = \begin{pmatrix} 5.010 \times 10^{-3} \\ 8.045 \times 10^{-16} \\ 2.463 \times 10^{-3} \\ 2.336 \times 10^{-3} \end{pmatrix} \text{cfm}$$

$$\text{HGR}_{\text{stp}_i} = \text{HGR}_i \frac{273.15 \text{ K}}{\text{Temp}_{\text{vap_m}}}$$

$$\text{HGR}_{\text{stp_median}_i} = \text{median}(\text{HGR}_{\text{stp}_i})$$

$$\text{HGR}_{\text{stp_m}_i} = \text{mean}(\text{HGR}_{\text{stp}_i})$$

$$\text{HGR}_{\text{stp_sd}_i} = \text{Stdev}(\text{HGR}_{\text{stp}_i})$$

$$\text{HGR}_{\text{stp_m}} = \begin{pmatrix} 4.752 \times 10^{-3} \\ 7.916 \times 10^{-16} \\ 2.394 \times 10^{-3} \\ 2.351 \times 10^{-3} \\ 6.842 \\ 1.140 \times 10^{-12} \\ 3.447 \\ 3.386 \end{pmatrix} \left. \begin{matrix} \text{cfm} \\ \\ \\ \\ \\ \frac{\text{ft}^3}{\text{day}} \end{matrix} \right\} \text{At Standard Conditions...}$$

$$\text{HGR}_{\text{stp_sd}} = \begin{pmatrix} 1.412 \times 10^{-3} \\ 0.000 \\ 9.875 \times 10^{-4} \\ 9.751 \times 10^{-4} \end{pmatrix} \text{cfm}$$

$$\text{HGR}_{\text{stp_median}} = \begin{pmatrix} 4.448 \times 10^{-3} \\ 7.143 \times 10^{-16} \\ 2.187 \times 10^{-3} \\ 2.074 \times 10^{-3} \end{pmatrix} \text{cfm}$$

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Steady-State Hydrogen Concentration (Assuming Normal Ventilation Rate)

$$[H2_{ss}] := \frac{\overrightarrow{HGR_1}}{HGR_1 + vent_rate}$$

$$[H2_{ss_m}] := \text{mean}([H2_{ss}])$$

$$[H2_{ss_sd}] := \text{Stdev}([H2_{ss}])$$

$$[H2_{ss_m}] = 5.352 \times 10^{-3} \%$$

$$[H2_{ss_sd}] = 1.590 \times 10^{-3} \%$$

$$[H2_{ss_m}] = 0.134\% \text{LFLH}_2$$

$$[H2_{ss_sd}] = 0.040\% \text{LFLH}_2$$

Steady-State Hydrogen Concentration (Assuming Natural Breathing Ventilation Rate)

$$[H2_{ss_nb}] := \frac{\overrightarrow{HGR_1}}{HGR_1 + vent_rate_{nb}}$$

$$[H2_{ss_nb_median}] := \text{median}([H2_{ss_nb}])$$

$$[H2_{ss_nb_m}] := \text{mean}([H2_{ss_nb}])$$

$$[H2_{ss_nb_sd}] := \text{Stdev}([H2_{ss_nb}])$$

$$[H2_{ss_nb_m}] = 3.109 \%$$

$$[H2_{ss_nb_sd}] = 0.887 \%$$

$$[H2_{ss_nb_m}] = 77.734\% \text{LFLH}_2$$

$$[H2_{ss_nb_sd}] = 22.168\% \text{LFLH}_2$$

$$[H2_{ss_nb_median}] = 73.098\% \text{LFLH}_2$$

Gas Release Rate (Independent Of Ventilation Rate)

$$rateH2_rel := [H2_{ss_m}] \cdot \frac{vent_rate}{1 - [H2_{ss_m}]}$$

$$rateH2_rel_nb := [H2_{ss_nb_median}] \cdot \frac{vent_rate_{nb}}{1 - [H2_{ss_nb_median}]}$$

$$rateH2_rel = 5.352 \times 10^{-3} \text{ cfm}$$

$$rateH2_rel_nb = 5.010 \times 10^{-3} \text{ cfm}$$

Calculate Release Rates Of Ammonia, Methane, And Nitrous Oxide (Assuming No Gas Retention)

$$[NH_3] := (\text{morm}(\text{NSamples}, [NH_3_m], [NH_3_sd]))$$

$$RR_{NH_3} := \left(\frac{[NH_3] \cdot vent_rate}{1 - [NH_3]} \right)$$

$$RR_{NH_3_m} := \text{mean}(RR_{NH_3})$$

$$RR_{NH_3_sd} := \text{Stdev}(RR_{NH_3})$$

$$RR_{NH_3_m} = 2.097 \times 10^{-3} \text{ cfm}$$

$$RR_{NH_3_sd} = 2.073 \times 10^{-4} \text{ cfm}$$

$$[CH_4] := (\text{morm}(\text{NSamples}, [CH_4_m], [CH_4_sd]))$$

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$$RRCH4 := \frac{[CH4] \cdot vent_rate}{1 - [CH4]}$$

$$RRCH4_m := \text{mean}(RRCH4)$$

$$RRCH4_sd := \text{Stdev}(RRCH4)$$

$$RRCH4_m = 2.007 \times 10^{-4} \text{ cfm}$$

$$RRCH4_sd = 1.956 \times 10^{-5} \text{ cfm}$$

$$[N2O] := (\text{norm}(\text{NSamples}, [N2O_m], [N2O_sd]))$$

$$RRN2O := \frac{[N2O] \cdot vent_rate}{1 - [N2O]}$$

$$RRN2O_m := \text{mean}(RRN2O)$$

$$RRN2O_sd := \text{Stdev}(RRN2O)$$

$$RRN2O_m = 7.022 \times 10^{-4} \text{ cfm}$$

$$RRN2O_sd = 7.151 \times 10^{-5} \text{ cfm}$$

Steady-State Ammonia, Methane, And Nitrous Oxide Concentration (Assuming Normal Ventilation Rate)(just A Check Of Methodology)

$$[NH3_{ss_m}] := \frac{RRNH3_m}{RRNH3_m + vent_rate}$$

$$[NH3_{ss_m}] = 2.097 \times 10^{-3} \%$$

$$[NH3_{ss}] := \frac{RRNH3}{RRNH3 + vent_rate}$$

$$[NH3_{ss_m}] = 0.014\% \text{LFL}_{NH3}$$

$$[CH4_{ss_m}] := \frac{RRCH4_m}{RRCH4_m + vent_rate}$$

$$[CH4_{ss_m}] = 2.007 \times 10^{-4} \%$$

$$[CH4_{ss_m}] = 4.014 \times 10^{-3} \% \text{LFL}_{CH4}$$

$$[N2O_{ss_m}] := \frac{RRN2O_m}{RRN2O_m + vent_rate}$$

$$[N2O_{ss_m}] = 7.022 \times 10^{-4} \%$$

Steady-State Ammonia, Methane, And Nitrous Oxide Concentration (Assuming Natural Breathing Ventilation Rate)

$$NH3_1000_day := \left[\frac{k2_NH3}{k1_NH3} + \left(\frac{[NH3_{ss}]}{V_m} - \frac{k2_NH3}{k1_NH3} \right) \exp \left(-1 \cdot \frac{k1_NH3}{1} \cdot 1000 \right) \right] V_m$$

$$[NH3_{ss_nb}] := NH3_1000_day$$

$$[NH3_{ss_nb_m}] := \text{mean}([NH3_{ss_nb}])$$

$$[NH3_{ss_nb_median}] := \text{median}([NH3_{ss_nb}])$$

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$$[NH3_{ss_nb_m}] = 0.227\%$$

$$[NH3_{ss_nb_sd}] := \text{Stdev}([NH3_{ss_nb}])$$

$$[NH3_{ss_nb_m}] = 1.511\%LFL_{NH3}$$

$$[NH3_{ss_nb_sd}] = 0.024\%$$

$$[NH3_{ss_nb_median}] = 0.226\%$$

$$[NH3_{ss_nb_sd}] = 0.159\%LFL_{NH3}$$

$$[NH3_{ss_nb_median}] = 1.506\%LFL_{NH3}$$

$$[CH4_{ss_nb}] := \frac{RR_{CH4}}{RR_{CH4} + \text{vent_rate}_{nb}} \quad [CH4_{ss_nb_median}] := \text{median}([CH4_{ss_nb}])$$

$$[CH4_{ss_nb_m}] := \text{mean}([CH4_{ss_nb}])$$

$$[CH4_{ss_nb_sd}] := \text{Stdev}([CH4_{ss_nb}])$$

$$[CH4_{ss_nb_m}] = 0.121\%$$

$$[CH4_{ss_nb_sd}] = 0.012\%$$

$$[CH4_{ss_nb_m}] = 2.410\%LFL_{CH4}$$

$$[CH4_{ss_nb_median}] = 0.121\%$$

$$[N2O_{ss_nb}] := \frac{RR_{N2O}}{RR_{N2O} + \text{vent_rate}_{nb}} \quad [N2O_{ss_nb_median}] := \text{median}([N2O_{ss_nb}])$$

$$[N2O_{ss_nb_m}] := \text{mean}([N2O_{ss_nb}])$$

$$[N2O_{ss_nb_sd}] := \text{Stdev}([N2O_{ss_nb}])$$

$$[N2O_{ss_nb_m}] = 0.420\%$$

$$[N2O_{ss_nb_sd}] = 0.043\%$$

$$[N2O_{ss_nb_median}] = 0.422\%$$

$$[N2O_{ss_nb_sd}] = 0.853\%LFL_{CH4}$$

Determine The Overall Steady-State Flammable Gas Concentration With Loss Of Ventilation

$$[Conc_mix_{ss_nb}] := \frac{[H2_{ss_nb}]}{LFL_{H2}} + \frac{[NH3_{ss_nb}]}{LFL_{NH3}} + \frac{[CH4_{ss_nb}]}{LFL_{CH4}}$$

$$[Conc_mix_{ss_nb_m}] := \text{mean}([Conc_mix_{ss_nb}])$$

$$[Conc_mix_{ss_nb_m}] = 81.655\%LFL$$

$$[Conc_mix_{ss_nb_sd}] := \text{Stdev}([Conc_mix_{ss_nb}])$$

$$[Conc_mix_{ss_nb_sd}] = 22.186\%LFL$$

$$[Conc_mix_{ss_nb_median}] := \text{median}([Conc_mix_{ss_nb}])$$

$$[Conc_mix_{ss_nb_median}] = 77.013\%LFL$$

Set Variables Into Array, Where 1 => H2, 2 => NH3, 3 => CH4, And 4 => N2O

$$GR := \begin{pmatrix} HGR_1 \\ RR_{NH3} \\ RR_{CH4} \\ RR_{N2O} \end{pmatrix} \quad GR = \begin{pmatrix} \{500,1\} \\ \{500,1\} \\ \{500,1\} \\ \{500,1\} \end{pmatrix} \text{ cfm} \quad \begin{matrix} \text{Generation} \\ \text{Rate} \end{matrix}$$

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$$GR_m := \begin{pmatrix} HGR_m \\ RR_{NH3}_m \\ RR_{CH4}_m \\ RR_{N2O}_m \end{pmatrix} \quad GR_m = \begin{pmatrix} 5.352 \times 10^{-3} \\ 2.097 \times 10^{-3} \\ 2.007 \times 10^{-4} \\ 7.022 \times 10^{-4} \end{pmatrix} \text{ cfm}$$

$$Rate_{rel} := \begin{pmatrix} HGR_1 \\ RR_{NH3} \\ RR_{CH4} \\ RR_{N2O} \end{pmatrix} \quad Rate_{rel} = \begin{pmatrix} \{500,1\} \\ \{500,1\} \\ \{500,1\} \\ \{500,1\} \end{pmatrix} \text{ cfm}$$

Release Rate
(Assume No Retention)

$$Conc_{init} := \begin{pmatrix} [H2_{ss}_m] \\ [NH3_{ss}_m] \\ [CH4_{ss}_m] \\ [N2O_{ss}_m] \end{pmatrix} \quad Conc_{init} = \begin{pmatrix} 5.352 \times 10^{-3} \\ 2.097 \times 10^{-3} \\ 2.007 \times 10^{-4} \\ 7.022 \times 10^{-4} \end{pmatrix} \%$$

Initial Concentration Rate
(Assume At Steady-State With Normal Ops)

Calculate The Composition Of All Components At Time 't'

$$\lambda_i := \frac{\text{vent_rate}_{nb} + Rate_{rel_i}}{\text{volhead}}$$

$$Conc_{in_i} := \frac{Rate_{rel_i} \cdot 100\%}{Rate_{rel_i} + \text{vent_rate}_{nb}}$$

$$conc(t,i) := \left[Conc_{in_i} \cdot [1 - e^{(-\lambda_i t)}] + Conc_{init_i} \cdot [e^{(-\lambda_i t)}] \right]$$

$$conc_m(t,i) := \text{mean} \left[Conc_{in_i} \cdot [1 - e^{(-\lambda_i t)}] + Conc_{init_i} \cdot [e^{(-\lambda_i t)}] \right]$$

$$conc_m(t,i) := \text{mean}(conc(t,i)) \quad concmed(t,i) := \text{median}(conc(t,i))$$

$$conc_median(t,i) := \text{median} \left[Conc_{in_i} \cdot [1 - e^{(-\lambda_i t)}] + Conc_{init_i} \cdot [e^{(-\lambda_i t)}] \right]$$

$conc_m(0\text{-sec},1) = 5.352 \times 10^{-3} \%$	$conc_m(1000\text{-day},1) = 3.076 \%$	$conc_m(1000\text{-day},1) = 76.902 \%$ LFL _{H2}
$conc_m(0\text{-sec},2) = 2.097 \times 10^{-3} \%$	$conc_m(1000\text{-day},2) = 1.231 \%$	$conc_m(1000\text{-day},2) = 8.204 \%$ LFL _{NH3}
$conc_m(0\text{-sec},3) = 2.007 \times 10^{-4} \%$	$conc_m(1000\text{-day},3) = 0.119 \%$	$conc_m(1000\text{-day},3) = 2.381 \%$ LFL _{CH4}
$conc_m(0\text{-sec},4) = 7.022 \times 10^{-4} \%$	$conc_m(1000\text{-day},4) = 0.415 \%$	

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$t := 0, 30 \dots 3000$

Calculate Steady-State Flammable Gas Concentration At Normal Operating Conditions

$$LFL_{mix}(z) := \frac{1}{\frac{conc(z,1)}{LFL_{H2}} + \frac{conc(z,2)}{LFL_{NH3}} + \frac{conc(z,3)}{LFL_{CH4}}}$$

$$LFL_{mix_m}(z) := \text{mean}(LFL_{mix}(z))$$

$$LFL_{mix_sd}(z) := \text{Stdev}(LFL_{mix}(z))$$

$$LFL_{mix_m}(0\text{-day}) = 6.588 \times 10^{-4} \%$$

$$LFL_{mix_sd}(0\text{-day}) = 0.000 \%$$

$$LFL_{mix_m}(1000000\text{-day}) = 119.344 \%$$

$$LFL_{mix_sd}(1000000\text{-day}) = 26.362 \%$$

$$LFL_{mix_median}(z) := \text{median}(LFL_{mix}(z))$$

$$LFL_{mix_median}(1000000\text{-day}) = 119.656 \%$$

Calculate The Time To Reach Various Fractions Of The LFL

Time To Reach 25 %LFL

$$f_m(z,1) := \frac{\left(\frac{1}{LFL_{mix_m}(z)} \right)}{\%LFL} - 11$$

$$f_{md}(z,1) := \frac{\left(\frac{1}{LFL_{mix_median}(z)} \right)}{\%LFL} - 11 \quad \text{TOL} := .00001$$

$$f(z,1) := \text{mean} \left(\frac{\left(\frac{conc(z,1)}{LFL_{H2}} + \frac{conc(z,2)}{LFL_{NH3}} + \frac{conc(z,3)}{LFL_{CH4}} \right)}{\%LFL} - 11 \right)$$

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$$f_sd(z, t) := \text{Stdev} \left(\frac{\left(\frac{\text{conc}(z, 1)}{\text{LFLH2}} + \frac{\text{conc}(z, 2)}{\text{LFLNH3}} + \frac{\text{conc}(z, 3)}{\text{LFLCH4}} \right)}{\% \text{LFL}} - 1 \right) \cdot \%$$

$$f_md(z, t) := \text{median} \left(\frac{\left(\frac{\text{conc}(z, 1)}{\text{LFLH2}} + \frac{\text{conc}(z, 2)}{\text{LFLNH3}} + \frac{\text{conc}(z, 3)}{\text{LFLCH4}} \right)}{\% \text{LFL}} - 1 \right)$$

tlf1 := 25

z := 10-day Initial Guess

temp25 := -5-day

Initial Value In Case Solution
Cannot Be Found

temp25 := Re(root(f(z, tlf1), z))

The "Re" Function Will Keep The Real Portion Of A Complex Number.
This Function Is Used To Allow The "IF" Statements Below To
Function Properly. Caution, The Answer Given May Be Complex.
Without The "IF" Statement The User May Be Unaware Of This!

temp25 = 71.437 day

zm := 10-day Initial Guess

temp25_m := -5-day

Initial Value In Case Solution
Cannot Be Found

temp25_m := Re(root(fm(zm, tlf1), zm))

temp25_m = 77.092 day

zm := 10-day Initial Guess

temp25_md := -5-day

Initial Value In Case Solution
Cannot Be Found

temp25_md := Re(root(f_md(zm, tlf1), zm))

temp25_md = 76.942 day

Time1_25%LFL_m := if([Conc_mixss_nb_m] > 25%, if(temp25_m < 0-day, 0-day, temp25_m), 10⁹·day)

Time1_25%LFL_m = 77.092 day

Time1_25%LFL_sd := if([Conc_mixss_nb_m] > 25%, if(temp25 < 0-day, 0-day, f_sd(temp25, tlf1)·temp25), 10⁹·day)

Time1_25%LFL_sd = 4.851 day

Time1_25%LFL_md := if([Conc_mixss_nb_m] > 25%, if(temp25_md < 0-day, 0-day, temp25_md), 10⁹·day)

Time1_25%LFL_md = 76.942 day

Time To Reach 50 %LFL

tlf1 := 50

z := 10-day Initial Guess

temp50 := -5-day

Initial Value In Case Solution
Cannot Be Found

temp50 := Re(root(f(z, tlf1), z))

The "Re" Function Will Keep The Real Portion Of A Complex Number.
This Function Is Used To Allow The "IF" Statements Below To
Function Properly. Caution, The Answer Given May Be Complex.
Without The "IF" Statement The User May Be Unaware Of This!

temp50 = 180.222 day

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zm := 10·day Initial Guess temp50_m := -5·day Initial Value In Case Solution
Cannot Be Found

temp50_m := Re(root(fm(zm, tlf), zm))

temp50_m = 198.368 day

zm := 10·day Initial Guess temp50_md := -5·day Initial Value In Case Solution
Cannot Be Found

temp50_md := Re(root(f_md(zm, tlf), zm))

temp50_md = 199.583 day

Time1_50%LFL_m := if([Conc_mixss_nb_m] > 50%, if(temp50_m < 0·day, 0·day, temp50_m), 10⁹·day)

Time1_50%LFL_m = 198.368 day

Time1_50%LFL_sd := if([Conc_mixss_nb_m] > 50%, if(temp50 < 0·day, 0·day, f_sd(temp50, tlf)·temp50), 10⁹·day)

Time1_50%LFL_sd = 23.838 day

Time1_50%LFL_md := if([Conc_mixss_nb_m] > 50%, if(temp50_md < 0·day, 0·day, temp50_md), 10⁹·day)

Time1_50%LFL_md = 199.583 day

Time To Reach 75 %LFL

tlf = 75

z := 10·day Initial Guess temp75 := -5·day Initial Value In Case Solution
Cannot Be Found

temp75 := Re(root(f(z, tlf), z))

The "Re" Function Will Keep The Real Portion Of A Complex Number.
This Function Is Used To Allow The "IF" Statements Below To
Function Properly. Caution, The Answer Given May Be Complex.
Without The "IF" Statement The User May Be Unaware Of This!

temp75 = 410.319 day

zm := 10·day Initial Guess temp75_m := -5·day Initial Value In Case Solution
Cannot Be Found

temp75_m := Re(root(fm(zm, tlf), zm))

temp75_m = 494.911 day

zm := 10·day Initial Guess temp75_md := -5·day Initial Value In Case Solution
Cannot Be Found

temp75_md := Re(root(f_md(zm, tlf), zm))

temp75_md = 486.845 day

Time1_75%LFL_m := if([Conc_mixss_nb_m] > 75%, if(temp75_m < 0·day, 0·day, temp75_m), 10⁹·day)

Time1_75%LFL_m = 494.911 day

Time1_75%LFL_sd := if([Conc_mixss_nb_m] > 75%, if(temp75 < 0·day, 0·day, f_sd(temp75, tlf)·temp75), 10⁹·day)

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Time1_75%LFL_sd = 78.812 day

Time1_75%LFL_md := if([Conc_mixss_nb_m] > 75%, if(temp75_md < 0·day, 0·day, temp75_md), 10⁹·day)

Time1_75%LFL_md = 486.845 day

Time To Reach 100 %LFL

tlfl := 100

z := 10·day

Initial Guess

temp100 := -5·day

Initial Value In Case Solution
Cannot Be Found

temp100 := Re(root(f(z, tlfl), z))

The "Re" Function Will Keep The Real Portion Of A Complex Number.
This Function Is Used To Allow The "IF" Statements Below To
Function Properly. Caution, The Answer Given May Be Complex.
Without The "IF" Statement The User May Be Unaware Of This!

temp100 = 432.160 day

zm := 10·day

Initial Guess

temp100_m := -5·day

Initial Value In Case Solution
Cannot Be Found

temp100_m := Re(root(fm(zm, tlfl), zm))

temp100_m = 348.779 day

zm := 10·day

Initial Guess

temp100_md := -5·day

Initial Value In Case Solution
Cannot Be Found

temp100_md := Re(root(f_md(zm, tlfl), zm))

temp100_md = -5.000 day

Time1_100%LFL_m := if([Conc_mixss_nb_m] > 100%, if(temp100_m < 0·day, 0·day, temp100_m), 10⁹·day)

Time1_100%LFL_m = 1.000 × 10⁹ day

Time1_100%LFL_sd := if([Conc_mixss_nb_m] > 100%, if(temp100 < 0·day, 0·day, f_sd(temp100, tlfl)·(temp100)), 10⁹·day)

Time1_100%LFL_sd = 1.000 × 10⁹ day

Time1_100%LFL_md := if([Conc_mixss_nb_m] > 100%, if(temp100_md < 0·day, 0·day, temp100_md), 10⁹·day)

Time1_100%LFL_md = 1.000 × 10⁹ day

Minimum Ventilation Rates Needed To Prevent Headspace Concentrations From Reaching Various Levels

$$\text{Conc_vr}(V, i) := \frac{\text{Rate}_{\text{rel}_i} \cdot 100\%}{\text{Rate}_{\text{rel}_i} + V} \left[1 - e^{\left(-\frac{V + \text{Rate}_{\text{rel}_i}}{\text{vol}_{\text{head}}} \cdot 10^9 \cdot \text{day} \right)} \right] + \text{Conc}_{\text{init}_i} \cdot e^{\left(-\frac{V + \text{Rate}_{\text{rel}_i}}{\text{vol}_{\text{head}}} \cdot 10^9 \cdot \text{day} \right)}$$

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$$\text{Conc_vr_m}(V, t) := \text{mean} \left(\left[\frac{\text{Rate_rel}_i \cdot 100\%}{\text{Rate_rel}_i + V} \cdot \left[1 - e^{\left(-\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day} \right)} \right] + \text{Conc_init}_i \cdot e^{\left(-\frac{V + \text{Rate_rel}_i}{\text{vol_head}} \cdot 10^9 \cdot \text{day} \right)} \right] \right)$$

Calculate Steady-State Flammable Gas Concentration At Normal Operating Conditions

$$\text{LFL_mix_vr}(v) := \frac{1}{\frac{\text{Conc_vr}(v, 1)}{\text{LFLH2}} + \frac{\text{Conc_vr}(v, 2)}{\text{LFLNH3}} + \frac{\text{Conc_vr}(v, 3)}{\text{LFLCH4}}}$$

$$\text{LFL_mix_vr_m}(z) := \text{mean}(\text{LFL_mix_vr}(z))$$

$$\text{LFL_mix_vr_sd}(z) := \text{Stdev}(\text{LFL_mix_vr}(z))$$

$$\text{LFL_mix_vr_m}(0.148 \cdot \text{cfm}) = 106.553\%$$

$$\text{LFL_mix_vr_sd}(0.148 \cdot \text{cfm}) = 23.445\%$$

$$\text{LFL_mix_vr_m}(1 \cdot \text{cfm}) = 701.470\%$$

$$\text{LFL_mix_vr_sd}(1 \cdot \text{cfm}) = 159.148\%$$

Ventilation Rate To Keep Concentration Less Than 25 %LFL

$$f2m(z, 1) := \frac{\left(\frac{1}{\text{LFL_mix_vr_m}(z)} \right)}{\% \text{LFL}} - 11$$

$$f2(z, 1) := \text{mean} \left(\frac{\left(\frac{\text{Conc_vr}(z, 1)}{\text{LFLH2}} + \frac{\text{Conc_vr}(z, 2)}{\text{LFLNH3}} + \frac{\text{Conc_vr}(z, 3)}{\text{LFLCH4}} \right)}{\% \text{LFL}} - 11 \right)$$

$$f2_sd(z, 1) := \text{Stdev} \left(\frac{\left(\frac{\text{Conc_vr}(z, 1)}{\text{LFLH2}} + \frac{\text{Conc_vr}(z, 2)}{\text{LFLNH3}} + \frac{\text{Conc_vr}(z, 3)}{\text{LFLCH4}} \right)}{\% \text{LFL}} - 11 \right) \cdot \%$$

$$f2_md(z, 1) := \text{median} \left(\frac{\left(\frac{\text{Conc_vr}(z, 1)}{\text{LFLH2}} + \frac{\text{Conc_vr}(z, 2)}{\text{LFLNH3}} + \frac{\text{Conc_vr}(z, 3)}{\text{LFLCH4}} \right)}{\% \text{LFL}} - 11 \right)$$

$$t1f1 := 24.999$$

$$z := 0.01 \cdot \text{cfm}$$

Initial Guess

$$\text{temp25} := -5 \cdot \text{cfm}$$

Initial Value In Case Solution
Cannot Be Found

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temp25 := root(f2(z, tlf), z)

temp25 = 0.601875 cfm

zm := .001 cfm Initial Guess

temp25_m := -5 cfm

Initial Value In Case Solution
Cannot Be Found

temp25_m := root(f2(zm, tlf), zm)

temp25_m = 0.601875 cfm

zm := .001 cfm Initial Guess

temp25_md := -5 cfm

Initial Value In Case Solution
Cannot Be Found

temp25_md := root(f2_md(zm, tlf), zm)

temp25_md = 0.566662 cfm

vent_rate1_25%LFL_m := if(temp25_m < 0 cfm, 0 cfm, temp25_m + 0.001 cfm)

vent_rate1_25%LFL_m = 0.603 cfm

vent_rate1_25%LFL_sd := if(temp25 < 0 cfm, 0 cfm, f2_sd(temp25, tlf) * temp25)

vent_rate1_25%LFL_sd = 0.039 cfm

vent_rate1_25%LFL_md := if(temp25_md < 0 cfm, 0 cfm, temp25_md + 0.001 cfm)

vent_rate1_25%LFL_md = 0.568 cfm

Ventilation Rate To Keep Concentration Less Than 50 %LFL

tlf := 50 - .001

z := .001 cfm Initial Guess

temp50 := -5 cfm

Initial Value In Case Solution
Cannot Be Found

temp50 := root(f2(z, tlf), z)

temp50 = 0.298278 cfm

zm := .001 cfm Initial Guess

temp50_m := -5 cfm

Initial Value In Case Solution
Cannot Be Found

temp50_m := root(f2m(zm, tlf), zm)

temp50_m = 0.281831 cfm

zm := .001 cfm Initial Guess

temp50_md := -5 cfm

Initial Value In Case Solution
Cannot Be Found

temp50_md := root(f2_md(zm, tlf), zm)

temp50_md = 0.281052 cfm

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$\text{vent_rate1_50\%LFL_m} := \text{if}(\text{temp50} < 0 \cdot \text{cfm}, 0 \cdot \text{cfm}, \text{temp50_m} + 0.001 \cdot \text{cfm})$
 $\text{vent_rate1_50\%LFL_m} = 0.283 \text{ cfm}$
 $\text{vent_rate1_50\%LFL_sd} := \text{if}(\text{temp50} < 0 \cdot \text{cfm}, 0 \cdot \text{cfm}, f2_sd(\text{temp50}, \text{tlf}) \cdot \text{temp50})$
 $\text{vent_rate1_50\%LFL_sd} = 0.038 \text{ cfm}$
 $\text{vent_rate1_50\%LFL_md} := \text{if}(\text{temp50} < 0 \cdot \text{cfm}, 0 \cdot \text{cfm}, \text{temp50_md} + 0.001 \cdot \text{cfm})$
 $\text{vent_rate1_50\%LFL_md} = 0.282 \text{ cfm}$

Ventilation Rate To Keep Concentration Less Than 75 %LFL

$\text{tlf} := 75 - .001$
 $z := .001 \cdot \text{cfm}$ Initial Guess $\text{temp75} := -5 \cdot \text{cfm}$ Initial Value In Case Solution Cannot Be Found
 $\text{temp75} := \text{root}(f2(z, \text{tlf}), z)$
 $\text{temp75} = 0.197086 \text{ cfm}$
 $zm := .001 \cdot \text{cfm}$ Initial Guess $\text{temp75_m} := -5 \cdot \text{day}$ Initial Value In Case Solution Cannot Be Found
 $\text{temp75_m} := \text{root}(f2m(zm, \text{tlf}), zm)$
 $\text{temp75_m} = 0.186354 \text{ cfm}$
 $zm := .001 \cdot \text{cfm}$ Initial Guess $\text{temp75_md} := -5 \cdot \text{day}$ Initial Value In Case Solution Cannot Be Found
 $\text{temp75_md} := \text{root}(f2_md(zm, \text{tlf}), zm)$
 $\text{temp75_md} = 0.185852 \text{ cfm}$
 $\text{vent_rate1_75\%LFL_m} := \text{if}(\text{temp75} < 0 \cdot \text{cfm}, 0 \cdot \text{cfm}, \text{temp75_m} + 0.001 \cdot \text{cfm})$
 $\text{vent_rate1_75\%LFL_m} = 0.187 \text{ cfm}$
 $\text{vent_rate1_75\%LFL_sd} := \text{if}(\text{temp75} < 0 \cdot \text{cfm}, 0 \cdot \text{cfm}, f2_sd(\text{temp75}, \text{tlf}) \cdot \text{temp75})$
 $\text{vent_rate1_75\%LFL_sd} = 0.037 \text{ cfm}$
 $\text{vent_rate1_75\%LFL_md} := \text{if}(\text{temp75} < 0 \cdot \text{cfm}, 0 \cdot \text{cfm}, \text{temp75_md} + 0.001 \cdot \text{cfm})$
 $\text{vent_rate1_75\%LFL_md} = 0.187 \text{ cfm}$

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Ventilation Rate To Keep Concentration Less Than 100 %LFL

tlfi := 100 - .001

z := .001·cfm Initial Guess

temp100 := -5·cfm

Initial Value In Case Solution
Cannot Be Found

temp100 := root(f2(z, tlfi), z)

temp100 = 0.146493 cfm

zm := .001·cfm Initial Guess

temp100_m := -5·day

Initial Value In Case Solution
Cannot Be Found

temp100_m := root(f2m(zm, tlfi), zm)

temp100_m = 0.138616 cfm

zm := .001·cfm Initial Guess

temp100_md := -5·day

Initial Value In Case Solution
Cannot Be Found

temp100_md := root(f2_md(zm, tlfi), zm)

temp100_md = 0.138249 cfm

vent_rate1_100%LFL_m := if(temp100 < 0·cfm, 0·cfm, temp100_m + 0.001·cfm)

vent_rate1_100%LFL_m = 0.140 cfm

vent_rate1_100%LFL_sd := if(temp100 < 0·cfm, 0·cfm, f2_sd(temp100, tlfi)·temp100)

vent_rate1_100%LFL_sd = 0.037 cfm

vent_rate1_100%LFL_md := if(temp100 < 0·cfm, 0·cfm, temp100_md + 0.001·cfm)

vent_rate1_100%LFL_md = 0.139 cfm

Author: _____ Date: _____

Summary SectionInput DataWaste Properties (1 ==> Total Waste, 2 ==> Liquid Waste, 3 ==> Solid Waste)

Tank_id = "241-AN-104"

class_waste = "dst"

$$[\text{TOC}_m] = 3.140 \times 10^3 \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_3_m] = 1.719 \times 10^5 \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{NO}_2_m] = 1.123 \times 10^5 \frac{\mu\text{-gm}}{\text{mL}}$$

$$[\text{Al}_m] = 3.898 \times 10^4 \frac{\mu\text{-gm}}{\text{mL}}$$

$$[^{137}\text{Cs}_m] = \begin{pmatrix} 351.079 \\ 1.000 \times 10^{-12} \\ 374.528 \\ 325.809 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$[^{90}\text{Sr}_m] = \begin{pmatrix} 15.096 \\ 1.000 \times 10^{-12} \\ 0.062 \\ 31.297 \end{pmatrix} \frac{\mu\text{-Ci}}{\text{gm}}$$

$$\text{vol}_{\text{waste}_m} = \begin{pmatrix} 1.349 \times 10^5 \\ 3.531 \times 10^{-8} \\ 7.356 \times 10^4 \\ 6.131 \times 10^4 \end{pmatrix} \text{ft}^3$$

$$\text{P}_{\text{waste}_m} = \begin{pmatrix} 1.483 \\ 1.339 \\ 1.410 \\ 1.579 \end{pmatrix} \frac{\text{gm}}{\text{mL}}$$

$$\text{Temp}_{\text{waste}_m} = \begin{pmatrix} 314.088 \\ 314.127 \\ 314.208 \\ 314.209 \end{pmatrix} \text{K}$$

$$\text{FH}_2\text{O}_m = \begin{pmatrix} 48.589 \\ 45.813 \\ 50.902 \\ 45.813 \end{pmatrix} \%$$

$$\text{HeatLoad}_{^{137}\text{Cs}_{90}\text{Sr}_m} = \begin{pmatrix} 9.952 \times 10^3 \\ 1.791 \times 10^{-23} \\ 5.191 \times 10^3 \\ 4.761 \times 10^3 \end{pmatrix} \text{watt}$$

$$\text{Temp}_{\text{vap}_m} = 307.650 \text{K}$$

$$\text{vol}_{\text{tank}} = 1.407 \times 10^3 \text{ kilo-gal}$$

$$\text{vent_rate} = 100.000 \text{ cfm}$$

$$\text{vent_rate}_{\text{nb}} = 0.166 \text{ cfm}$$

AN Tank Farm: Tank Data

$$\text{diam}_{\text{tank}} = 75.000 \text{ ft}$$

$$\text{ht}_{\text{tank}} = \begin{pmatrix} 366.331 \\ 9.592 \times 10^{-11} \\ 199.808 \\ 166.523 \end{pmatrix} \text{in}$$

estimation Of Waste Depth

Dome-Space Compositions

$$[\text{CH}_4_m] = 2.000 \times 10^{-4} \%$$

$$[\text{N}_2\text{O}_m] = 7.000 \times 10^{-4} \%$$

$$[\text{NH}_3_m] = 2.100 \times 10^{-3} \%$$

End Of Input Data

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Output DataWaste Properties (1 ==> Total Waste, 2 ==> Liquid Waste, 3 ==> Solid Waste)Hydrogen Generation Rate Due To Thermolysis, Radiolysis, And Corrosion...

$$\begin{aligned}
 \text{HGR}_{\text{thermv_m}} &= \begin{pmatrix} 3.420 \times 10^{-3} \\ 7.617 \times 10^{-16} \\ 1.818 \times 10^{-3} \\ 1.602 \times 10^{-3} \end{pmatrix} \text{ cfm} & \text{HGR}_{\text{thermv_median}} &= \begin{pmatrix} 3.064 \times 10^{-3} \\ 6.742 \times 10^{-16} \\ 1.584 \times 10^{-3} \\ 1.296 \times 10^{-3} \end{pmatrix} \text{ cfm} & \text{HGR}_{\text{thermv_sd}} &= \begin{pmatrix} 1.581 \times 10^{-3} \\ 0.000 \\ 1.092 \times 10^{-3} \\ 1.074 \times 10^{-3} \end{pmatrix} \text{ cfm} \\
 \text{HGR}_{\text{radv_m}} &= \begin{pmatrix} 1.131 \times 10^{-3} \\ 1.943 \times 10^{-30} \\ 6.072 \times 10^{-4} \\ 5.158 \times 10^{-4} \end{pmatrix} \text{ cfm} & \text{HGR}_{\text{radv_median}} &= \begin{pmatrix} 1.146 \times 10^{-3} \\ 1.934 \times 10^{-30} \\ 6.124 \times 10^{-4} \\ 5.149 \times 10^{-4} \end{pmatrix} \text{ cfm} & \text{HGR}_{\text{radv_sd}} &= \begin{pmatrix} 1.037 \times 10^{-4} \\ 0.000 \\ 6.423 \times 10^{-5} \\ 7.182 \times 10^{-5} \end{pmatrix} \text{ cfm} \\
 \text{HGR}_{\text{corr_m}} &= \begin{pmatrix} 8.011 \times 10^{-4} \\ 1.300 \times 10^{-16} \\ 2.708 \times 10^{-4} \\ 5.306 \times 10^{-4} \end{pmatrix} \text{ cfm} & \text{HGR}_{\text{corr_median}} &= \begin{pmatrix} 8.011 \times 10^{-4} \\ 1.300 \times 10^{-16} \\ 2.708 \times 10^{-4} \\ 5.305 \times 10^{-4} \end{pmatrix} \text{ cfm} & \text{HGR}_{\text{corr_sd}} &= \begin{pmatrix} 1.293 \times 10^{-5} \\ 0.000 \\ 4.402 \times 10^{-6} \\ 8.871 \times 10^{-6} \end{pmatrix} \text{ cfm}
 \end{aligned}$$

Overall Hydrogen Generation Rate...

At The Headspace Conditions...

At Standard Conditions (273.15°K)...

$$\begin{aligned}
 \text{HGR}_m &= \begin{pmatrix} 5.352 \times 10^{-3} \\ 8.916 \times 10^{-16} \\ 2.696 \times 10^{-3} \\ 2.648 \times 10^{-3} \end{pmatrix} \text{ cfm} & \text{HGR}_{\text{stp_m}} &= \begin{pmatrix} 4.752 \times 10^{-3} \\ 7.916 \times 10^{-16} \\ 2.394 \times 10^{-3} \\ 2.351 \times 10^{-3} \end{pmatrix} \text{ cfm} & \text{HGR}_{\text{stp_median}} &= \begin{pmatrix} 4.448 \times 10^{-3} \\ 7.143 \times 10^{-16} \\ 2.187 \times 10^{-3} \\ 2.074 \times 10^{-3} \end{pmatrix} \text{ cfm} \\
 \text{HGR}_m &= \begin{pmatrix} 7.707 \\ 1.284 \times 10^{-12} \\ 3.882 \\ 3.813 \end{pmatrix} \frac{\text{ft}^3}{\text{day}} & \text{HGR}_{\text{stp_m}} &= \begin{pmatrix} 6.842 \\ 1.140 \times 10^{-12} \\ 3.447 \\ 3.386 \end{pmatrix} \frac{\text{ft}^3}{\text{day}} & \text{HGR}_{\text{stp_median}} &= \begin{pmatrix} 6.405 \\ 1.029 \times 10^{-12} \\ 3.149 \\ 2.987 \end{pmatrix} \frac{\text{ft}^3}{\text{day}}
 \end{aligned}$$

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Steady-State Compositions

Hydrogen At Normal Ventilation Rate...

$$[H2_{ss_m}] = 0.134\%LFL_{H2}$$

Ammonia At Normal Ventilation Rate...

$$[NH3_{ss_m}] = 0.014\%LFL_{NH3}$$

Methane At Normal Ventilation Rate...

$$[CH4_{ss_m}] = 4.014 \times 10^{-3}\%LFL_{CH4}$$

Nitrous Oxide At Normal Ventilation Rate...

$$[N2O_{ss_m}] = 7.022 \times 10^{-4}\%$$

At Natural Breathing Ventilation Rate

$$[H2_{ss_nb_m}] = 77.734\%LFL_{H2}$$

At Natural Breathing Ventilation Rate

$$[NH3_{ss_nb_m}] = 1.511\%LFL_{NH3}$$

At Natural Breathing Ventilation Rate

$$[CH4_{ss_nb_m}] = 2.410\%LFL_{CH4}$$

At Natural Breathing Ventilation Rate

$$[N2O_{ss_nb_m}] = 0.420\%$$

Flammable Gas Concentrations After Loss Of Ventilation At Selected Time Periods (Mean Values)

$$conc_{mix_m}(0\text{-day}) = 0.152\%LFL$$

$$conc_{mix_m}(100\text{-day}) = 30.843\%LFL$$

$$conc_{mix_m}(10^9\text{-day}) = 83.791\%LFL$$

$$conc_{mix_m}(10\text{-day}) = 3.898\%LFL$$

$$conc_{mix_m}(489.445\text{-day}) = 74.780\%LFL$$

Flammable Gas Concentrations After Loss Of Ventilation At Selected Time Periods (Median Values)

$$conc_{mix_median}(0\text{-day}) = 0.152\%LFL$$

$$conc_{mix_median}(100\text{-day}) = 30.843\%LFL$$

$$conc_{mix_median}(10^9\text{-day}) = 83.791\%LFL$$

$$conc_{mix_median}(10\text{-day}) = 3.898\%LFL$$

$$conc_{mix_median}(489.445\text{-day}) = 74.780\%LFL$$

Time To Reach Various LFL Levels (Mean)

$$Time1_{.25\%LFL_m} = 77.092\text{ day}$$

$$Time1_{.50\%LFL_m} = 198.368\text{ day}$$

$$Time1_{.75\%LFL_m} = 494.911\text{ day}$$

$$Time1_{.100\%LFL_m} = 1.000 \times 10^9\text{ day}$$

Time To Reach Various LFL Levels (Median)

$$Time1_{.25\%LFL_md} = 76.942\text{ day}$$

$$Time1_{.50\%LFL_md} = 199.583\text{ day}$$

$$Time1_{.75\%LFL_md} = 486.845\text{ day}$$

$$Time1_{.100\%LFL_md} = 1.000 \times 10^9\text{ day}$$

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Minimum Ventilation Rates To Keep Headspace Composition Below Selected LFLs (Mean)

vent_rate1_25%LFL_m = 0.603 cfm

vent_rate1_75%LFL_m = 0.187 cfm

vent_rate1_50%LFL_m = 0.283 cfm

vent_rate1_100%LFL_m = 0.140 cfm

Minimum Ventilation Rates To Keep Headspace Composition Below Selected LFLs (Median)

vent_rate1_25%LFL_md = 0.568 cfm

vent_rate1_75%LFL_md = 0.187 cfm

vent_rate1_50%LFL_md = 0.282 cfm

vent_rate1_100%LFL_md = 0.139 cfm

Author: _____ Date: _____

APPENDIX H

**FLAMMABILITY EVALUATIONS ON THE SENSITIVITY OF WASTE
TEMPERATURE AND WATER ADDITION UNDER ZERO VENTILATION
CONDITION FOR TOP FLAMMABILITY LEVEL AND AGING WASTE DOUBLE-
SHELL TANKS 241-AY-102, 241-AZ-102, 241-AZ-101, 241-AY-101, 241-AN-102, AND
241-AN-107**

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LIST OF TERMS

DST	double-shell tank
HGR	hydrogen generation rate
LFL	lower flammability limit

H1.0 OBJECTIVE

This study focuses on the sensitivity of waste temperature and water addition in the flammability evaluation under zero ventilation for double-shell tanks (DST). Six DSTs (241-AY-101, 241-AY-102, 241-AN-102, 241-AZ-102, 241-AN-107, and 241-AZ-101) were selected for this sensitivity calculation. These tanks either in the category of aging waste tank or have the least margin to flammable conditions among 28 tanks according to the study results provided in the main text of this document (Chapter 4.0, Table 4-3). Time to 25% and 100% of the lower flammability limit (LFL) in the tank dome space are calculated for the five tanks under the following conditions:

- 10 kgal of water mixed with the existing supernatant layer
- Zero dome space ventilation
- A waste temperature increase calculated from these conditions at the initial temperatures of baseline temperature, and baseline temperature plus 5, 10, and 20 °C.

The baseline temperature of each tank is documented in Appendix B, Table B-1.

H2.0 BACKGROUND

This sensitivity study addresses several flammability safety issues encountered in tank farm operations. First, it is quite common to pour a small amount (10 to 30 gal) of flush water into the tank. This study assumes a total of 10 kgal of water is added to the current waste over a period of time and that the water is well mixed with supernatant; this keeps the solid waste layer unchanged. The DST flammability under barometric breathing rate has been evaluated for the off-normal ventilation condition (Chapter 4.0 in the main text).

Second is the effect of zero ventilation for the dome space during the off-normal ventilation condition. Because the validation of barometric breathing rate under off-normal condition requires extensive effort, it is important to know how long it would take to reach 25% and 100% of the LFL with zero ventilation rate during the off-normal condition.

Third, the effect of different temperatures is evaluated. In the previous flammability evaluation for the off-normal condition, the tank waste temperature was a fixed value in the calculations using the temperature obtained under the normal operating condition. This assumption is probably true for the majority of tanks because the heatup rate is very slow, and the impact of temperature change on gas generation and flammability is insignificant within the time to 100% of the LFL. However, the temperature could be raised significantly for higher heat load, aging waste tanks (AY/AZ) when they lose both dome space and annulus ventilation. For example, the temperature of DST 241-AY-102 increased 13 °F in 1 month when it lost the annulus cooling in August 2001. As described in the hydrogen generation rate model (RPP-3851, *Empirical Rate*

Equation Model and Rate Calculations of Hydrogen Generation for Hanford Tank Waste), both radiolysis and thermolysis rates are an exponential function of temperature. The increase of temperature will increase gas concentration.

This report addresses the initial temperature that should be applied when a tank operates under off-normal conditions. For this study, a zero ventilation condition is assumed. The tank waste temperature or dome space temperature could be higher than the current recorded temperature under normal operation because of the uncertainty of temperature measurement (possibly 5 °C) or under alternate operating conditions. In this study, the gas concentration and flammability will be investigated by considering a temperature increase rate under the zero ventilation condition. The initial temperatures that will be used are the baseline temperature, and the baseline temperature plus 5, 10, and 20 °C. The baseline temperature of tank waste and dome space is documented in Appendix B, Table B-1, and summarized in Table H-1.

H3.0 METHODOLOGY

The methodology of flammability evaluations (Chapter 3.0 in the main text) for off-normal condition was developed to calculate the gas release rate, gas concentration, flammability level, and time to 25% and 100% of the LFL for a given ventilation rate using a fixed temperature obtained in the normal operating condition. In this study, considering a closed system (i.e., zero ventilation), the tank waste temperature, as well as the gas generation rate and gas concentration, will change with time, and thus the flammability will change non-linearly with time. Since the gas generation rate is a function of temperature and gas concentration is a function of the gas generation rate, flammability becomes very complex as a function of time when temperature starts to vary with time. Thus, no exact solution can be formulated to calculate the time to 25% and 100% of the LFL. In this calculation, an analytical method was used to calculate the accumulated flammability using the time step of 1 day. In other words, the gas generation rates and gas concentrations are calculated daily based on the temperature calculated using the temperature increase rate. Then, the flammabilities from each gas concentration are added up for a single day, and the time to 25% and 100% of the LFL are identified. The equation for flammability is described in Chapter 3.0, Equation 3-18 in the main text, and is given in Equation H-1:

$$LFL_m(t) = \left(\frac{[H_2](t)}{LFL_{H_2}} + \frac{[NH_3](t)}{LFL_{NH_3}} + \frac{[CH_4](t)}{LFL_{CH_4}} \right) \times 100\% \quad (H-1)$$

where:

$[H_2](t)$	=	hydrogen concentration (volume percent) at time t
$[NH_3](t)$	=	ammonia concentration (volume percent) at time t
$[CH_4](t)$	=	methane concentration (volume percent) at time t
LFL_{H_2}	=	volume percent of hydrogen at its LFL in air alone

LFL_{NH3} = volume percent of ammonia at its LFL in air alone
 LFL_{CH4} = volume percent of methane at its LFL in air alone.

The volume percent of the LFLs, LFL_{H2} , LFL_{NH3} , and LFL_{CH4} , are 4, 15, 5%, respectively, for a fuel-air mixture.

In the calculations, the waste condition documented in Appendices B, C, and D is used as a starting point or as a current condition. The waste conditions are then modified by a dilution factor when the 10 kgal of water are added to the current waste. The methodology to calculate the gas generation rate and gas concentration is the same as Chapter 4.0 in the main text, except gas concentration equations are modified under the zero ventilation condition. Details of the equation's modification are given in Section H3.1. The methodology to calculate the temperature increase adopted the heat transfer model documented in RPP-6213, *Hanford Waste Tank Bump Accident and Consequence Analysis*. The model was developed by Fauske & Associates, Inc. to study the safety issue of tank steam bump when the tank waste temperature increases under the zero ventilation condition. Details of the methodology of the temperature increase rate are summarized in Section H3.2.

H3.1 TIME-DEPENDENT GAS CONCENTRATION UNDER ZERO VENTILATION CONDITION

Time-dependent gas concentration for a given ventilation rate is documented in Chapter 3.0, Section 3.3 in the main text. For insoluble gas, under zero ventilation, the mass balance equation in Chapter 3.0, Equation 3-5 in the main text can be rewritten as Equation H-2:

$$Vol \frac{\partial [C_g]}{\partial t} = R_g \quad (H-2)$$

where:

$[C_g]$ = gas concentration (volume percent)
 Vol = volume of the tank dome space (volume)
 R_g = gas release rate from the waste surface (volume/time).

By solving the differential Equation H-2, a time-dependent gas concentration at time t , $[C_g]_{\%}(t)$, in the unit of volume percent is given in Equation H-3:

$$[C_g]_{\%}(t) = [C_g]_{\%}(t_0) + \left[\frac{R_g}{Vol} \cdot t \right]_{\%} \quad (H-3)$$

where:

R_g = gas release rate from the waste surface (volume/time)
 $[C_g]_{\%}(t_0)$ = initial gas concentration at time t (volume percent)
 Vol = volume of the tank dome space (volume).

In Equation H-3, the first term on the right side of the equation represents initial gas concentration and the second term represents how the gas level builds up in the form of $[R_g t / Vol]_{\%}$ as time goes on. In the real calculation in Chapter H4.0, instead of Equation H-3, the gas concentration was calculated analytically as shown in Equation H-4 because the hydrogen release rate is a variable as time rather than a fixed value due to tank waste heatup under the zero ventilation condition.

$$[C_g]_{\%}(t) = [C_g]_{\%}(t_0) + \sum_{t=0}^t \left[\frac{R_g(t)}{Vol} \cdot t \right]_{\%} \quad (H-4)$$

The summation of gas concentration in the second term on the right side of Equation H-4 is calculated in the time step of 1 day. As shown in Chapter H4.0, the time step of 1 day is a reasonable choice considering the change of hydrogen generation rate for the temperature increase rates used.

For a highly soluble gas such as ammonia, the mass balance in Chapter 3.0, Equation 3-10 in the main text can be rewritten for the zero ventilation condition as shown in Equation H-5:

$$Vol \frac{\partial [C_g]}{\partial t} = h \cdot A \cdot (C_l - K_H \cdot P \cdot v \cdot C_g) \quad (H-5)$$

where:

- h = overall mass transport coefficient from liquid to vapor (m/sec)
- A = effective area for the transport ($1000 \times m^2$)
- C_l = current ammonia concentration in liquid (g-mole/L)
- P = dome space total pressure (atm)
- v = specific molar volume of gas in the dome space (L/mole)
- C_g = current ammonia concentration in the dome space (g-mole/L)
- K_H = Henry's Law constant (mole/L-atm).

Dividing by Vol and rearranging the terms, Equation H-5 becomes Equation H-6:

$$\frac{\partial [C_g]}{\partial t} = g_2 - g_1 \cdot [C_g] \quad (H-6)$$

with

$$g_1 = \frac{[h \cdot A \cdot K_H \cdot P \cdot v]}{Vol}$$

and

$$g_2 = \frac{[h \cdot A \cdot C_l]}{Vol}$$

The solution of Equation H-6 is given as Equation H-7:

$$[C_g](t) = [C_g](t_0) \exp(-g_1 \cdot t) + \left[\frac{g_2}{g_1} \right] [1 - \exp(-g_1 \cdot t)] \quad (\text{H-7})$$

In some cases, particularly when hA is large, the $g_1 t$ is much greater than one in a few days. So the decay rate $\exp(-g_1 t)$ goes to zero in a few days, thus the vapor concentration is simply the vapor equilibrium concentration C_{eq} with liquid phase as shown in Equation H-8:

$$C_{eq} = \frac{C_l}{K_H \cdot P \cdot v} \quad (\text{H-8})$$

H3.2 TANK WASTE TEMPERATURE INCREASE RATE

Under normal operation, tank waste temperature ranged from an ambient temperature as low as 15 °C up to 78 °C. This tank waste temperature range reflected the seasonal effect on the temperature, which oscillates up and down throughout the year. During the off-normal operation, however, the tank waste temperature could increase due to the loss of active or passive ventilation. For DSTs, the tank waste temperature could increase even more if the ventilation of the annulus is shut down. For example, the tank waste temperature of DST 241-AY-102 increased 13 °F in 1 month while the annulus ventilation was shut down. It is known that the flammable gas generation rate is a function of temperature. In the hydrogen generation rate model (HNF-3851), the thermolysis rate and the organic G value of the radiolysis rate are an exponential function of temperature. In this section, a simple and conservative heat transfer model (RPP-6213), used in evaluation of the steam bump hazard, is used for tank waste temperature increase analysis in the gas generation rate calculations and is described below.

With the tank under the zero ventilation condition, the temperature change with time can be estimated using a lumped capacitance solution for the transient waste temperature as shown in Equation H-9:

$$(\rho_{ncl} \cdot V_{ncl} \cdot c_{ncl} + \rho_{cl} \cdot V_{cl} \cdot c_{cl}) \frac{\partial T}{\partial t} = Q - \frac{k_s \cdot A \cdot (T - T_{\infty,s})}{R} - \frac{k_s \cdot A \cdot (T - T_{\infty,a})}{\delta} \quad (\text{H-9})$$

where:

- V_{ncl} = volume of the non-convective layer (m^3)
- ρ_{ncl} = density of the non-convective layer (kg/m^3)
- c_{ncl} = specific heat of the non-convective layer ($\text{J}/\text{kg}\cdot\text{K}$)
- V_{cl} = volume of the convective layer (m^3)
- ρ_{cl} = density of the convective layer (kg/m^3)
- c_{cl} = specific heat of the convective layer ($\text{J}/\text{kg}\cdot\text{K}$)
- Q = tank waste heat load (Watt)
- k_s = soil thermal conductivity ($\text{W}/\text{m}\cdot\text{K}$)

- A = tank heat transfer area (m^2)
 T = waste average temperature ($^{\circ}\text{K}$)
 $T_{\infty,s}$ = average ambient soil temperature ($^{\circ}\text{K}$)
 $T_{\infty,a}$ = average ambient air temperature ($^{\circ}\text{K}$)
 δ = soil thickness (m)
 R = tank radius (m).

The right side of Equation H-9 represents the net heat generation rate, which is the total heat source generation rate Q from tank waste minus the upward (2nd term) and downward (3rd term) heat transfer rates. For a given tank waste temperature T along with other waste conditions, the temperature increase rate $\partial T/\partial t$ can simply be calculated by dividing the net heat generation rate by the product of mass of waste and waste specific heat using Equation H-9. The following parameter values were taken from RPP-6213 and apply to all tanks:

- Heat capacity 3300 J/kg-k
- Air temperature 285 $^{\circ}\text{K}$
- Soil temperature 287 $^{\circ}\text{K}$
- Heat exchange area 411 m^2
- Soil thermal conductivity 1 W/m-K
- Soil overburden thickness 4 m
- Tank radius 11 m.

Note that Equation H-9 can be used for tanks having similar waste temperatures for convective and non-convective layers. For tanks having distinct temperatures between layers, i.e., aging tank waste (AY/AZ), the energy balance equation should be written for each layer as shown in Equations H-10 and H-11:

$$\rho_{cl} \cdot V_{cl} \cdot c_{cl} \frac{\partial T_{cl}}{\partial t} = Q_{cl} - \frac{k_s \cdot A}{\delta} (T_{cl} - T_{\infty,a}) + h_{ex} \cdot A \cdot (T_{ncl} - T_{cl}) \quad (\text{H-10})$$

$$\rho_{ncl} \cdot V_{ncl} \cdot c_{ncl} \frac{\partial T_{ncl}}{\partial t} = Q_{ncl} - \frac{k_s \cdot A}{R} (T_{ncl} - T_{\infty,s}) - h_{ex} \cdot A \cdot (T_{ncl} - T_{cl}) \quad (\text{H-11})$$

where:

- T_{cl} = waste temperature of the convective layer ($^{\circ}\text{K}$)
 Q_{cl} = tank waste heat load of the convective layer (Watt)
 T_{ncl} = waste temperature of the non-convective layer ($^{\circ}\text{K}$)
 Q_{ncl} = tank waste heat load of the non-convective layer (Watt)
 h_{ex} = heat transfer coefficient for heat exchange between two layers ($\text{W}/\text{m}^2/\text{K}$).

Symbols that are not defined in Equations H-10 and H-11 are defined in Equation H-9. As described in RPP-6213, the heat exchange coefficient was adjusted to meet the quasi-steady approximation in Equation H-12:

$$\frac{\partial T_{cl}}{\partial t} = \frac{\partial T_{ncl}}{\partial t} \quad (\text{H-12})$$

For the given waste temperatures and other waste conditions, once h_{ex} is determined, the temperature increase rate $\partial T_{ncl}/\partial t$ or $\partial T_{cl}/\partial t$ can be calculated.

As shown in Equations H-9 to H-11, this heat transfer model is relatively conservative in terms of overestimating the heatup rate because it considers only the upward and downward heat transfer but neglects the heat transfer from the sides. Additionally, the temperature increase rates for the convective and non-convective layers may be different throughout the heatup process while Equation H-12 assumes they are the same. For example, while DST 241-AY-102 lost annulus cooling in August 2001, it was observed that the temperature increase rate for the convective layer was slower than the temperature increase rate for the non-convective layer in the first few weeks; in time, the two temperature increase rates got closer. The calculated temperature increase rate (0.27 °C/day from Table H-2) using Equation H-12 is comparable, but larger than the rate observed (0.24 °C/day estimated from the temperature data on personal computer interface for Surveillance Analysis Computer System) in August 2001. Overall, the temperature data of DST 241-AY-102 validates that the assumption of Equation H-12 is reasonable and conservative.

H4.0 CALCULATIONS AND RESULTS

The calculations and results of the time to 25% and 100% of the LFL in the dome space under the zero ventilation condition for DSTs 241-AY-101, 241-AY-102, 241-AZ-102, 241-AZ-101, 241-AN-102, and 241-AN-107 are described in this chapter. The input data about the tank waste condition for the calculations were taken from Appendices B, C, and D. Details of the input data are described in Section H4.1. The temperature increase rate calculations are discussed in Section H4.2. Details of the gas concentrations, flammability, and time to 25% and 100% of the LFL are given in Section H4.3.

H4.1 INITIAL TANK WASTE CONDITIONS WITH 10-KGAL WATER ADDITIONS

For the hydrogen generation rate calculation, the required input data listed in Appendix B, Table B-1, is used as the starting point before adding 10 kgal of water. The input data for the hydrogen generation rate calculation is provided in Table H-1. For the 10-kgal water additions, it is assumed that the water is well mixed with supernatant, and that the concentration, density, and the weight percent of water of the supernatant are adjusted accordingly by a simple dilution factor. The dilution factor is the ratio between current waste volume and current waste volume plus the volume of 10 kgal of water.

Table H-1. Input Data of Tank Waste Adding 10 Kgal Water for Hydrogen Generation Rate Calculation.

Tank Identification	Dilution factor from 10 kgal water addition	TOC in Liquid (ug/ml)	NO ₂ in Liquid (ug/ml)	NO ₃ in Liquid (ug/ml)	Aluminum in Liquid (ug/ml)	⁹⁰ Sr in Waste (uCi/g)	¹³⁷ Cs in Waste (uCi/g)	DB (g/ml) Bulk Density	DL (g/ml) Liquid Density	V (kL) Non-RGS Waste Volume	[H ₂ O] (wt%) Bulk Water	[H ₂ O] (wt%) Liquid Water	Waste Temp., Tw (°C)	Dome Temp., Td (°C)
AN-102 liquid	1.011	2.35E+04	9.33E+04	1.97E+05	1.78E+04	5.54E+01	2.72E+02	1.48	1.49	3611	56.7%	56.4%	31	29
AN-102 solid		2.38E+04	9.43E+04	1.99E+05	1.80E+04	1.29E+02	2.60E+02	1.57	1.49	507	42.8%	na	31	29
AN-107 liquid	1.012	3.30E+04	6.78E+04	2.13E+05	1.14E+03	6.46E+01	2.27E+02	1.42	1.43	3247	51.9%	51.5%	33	31
AN-107 solid		3.33E+04	6.86E+04	2.15E+05	1.16E+03	1.77E+02	2.47E+02	1.48	1.43	884	42.5%	na	33	31
AY-102 liquid	1.018	1.49E+03	4.43E+04	1.77E+02	1.40E+03	1.36E+00	2.45E+01	1.17	1.17	2104	82.3%	82.1%	49	44
AY-102 solid		2.12E+03	0.00E+00	0.00E+00	1.23E+03	5.48E+03	2.22E+02	1.41	1.16	645	50.1%	85.7%	71	44
AZ-101 liquid	1.011	3.00E+02	6.03E+04	5.92E+04	7.11E+03	6.74E-01	1.26E+03	1.24	1.24	3631	71.5%	71.3%	68	64
AZ-101 solid		3.35E+02	6.79E+04	5.46E+04	7.50E+03	1.54E+04	1.06E+03	1.63	1.24	197	43.0%	71.3%	75	64
AY-101 liquid	1.118	1.22E+03	3.05E+04	4.19E+03	4.30E+03	7.74E-01	3.85E+01	1.17	1.19	358	81.1%	79.3%	36	33
AY-101 solid		1.37E+03	3.41E+04	4.69E+03	4.81E+03	3.40E+03	1.14E+02	1.68	1.14	365	39.8%	81.4%	40	33
AZ-102 liquid	1.011	1.03E+03	3.21E+04	1.68E+04	4.30E+02	1.86E+00	8.91E+02	1.11	1.11	3392	83.4%	83.2%	49	46
AZ-102 solid		1.04E+03	3.25E+04	1.70E+04	4.35E+02	5.34E+03	8.81E+02	1.41	1.11	396	42.9%	na	58	46

Notes:

All the data are taken from Appendix B, Table B-5.

RGS = retained gas sampling.

TOC = total organic carbon.

V = volume.

The gas generation rate for methane is derived from the vapor concentration and ventilation rate at normal operating conditions (Appendix D, Table D-1). The release rate for soluble gas ammonia is governed by the concentration gradient between the vapor and liquid phases. Time-dependent ammonia concentration can be calculated using Equation H-7. For all five tanks studied, it is concluded that the time to reach the equilibrium concentration is much shorter than the time to reach 100% of the LFL. Thus in the flammability calculations, the equilibrium ammonia concentration in the dome space is used. The equilibrium ammonia vapor concentration can be calculated using the liquid ammonia concentration and Henry's Law constant. The dilution effect on methane and ammonia are not addressed in this calculation because they contribute very little to the total flammability.

H4.2 TEMPERATURE INCREASE RATE UNDER ZERO VENTILATION

Equation H-9 is used to calculate the temperature increase rates for DSTs 241-AN-102, 241-AZ-102, and 241-AN-107. Because the temperatures are the same for convective and non-convective layers, the equation can be used for the whole tank. For aging waste tanks, DSTs 241-AY-102, 241-AY-101, 241-AZ-102 and 241-AZ-101, the convective layer and non-convective layer have different temperatures; Equations H-10 and H-11 are used to address each layer separately, including the heat exchange between these two layers. The required input data for the calculation for each layer and for each tank include density, volume, heat load, and waste temperature (Table H-2). Other input parameters commonly used in the calculations for all tanks are: heat capacity 3,300 J/kg, air temperature = 285 °K, soil temperature = 287 °K, heat exchange area 411 m², soil thermal conductivity = 1 W/m-K, soil overburden thickness = 4 m, tank radius = 11 m. (Values are taken from RPP-6213)

For tanks treated as a whole, the temperature increase rate is the net heat rate, which is the tank heat load minus upward and downward heat lost, divided by the product of mass and heat capacity. For tanks with distinct temperatures between layers, the heat transfer coefficients are adjusted and determined until the calculated temperature increase rates are equal for convective and non-convective layers. Once the heat transfer coefficients are determined, the heatup rates are finalized. The heatup rates, along with other calculated heat transfer properties at the baseline temperature, and baseline temperature plus 5, 10, and 20 °C are given in Table H-2.

Table H-2. Temperature Increase Rate Calculations Under Zero Ventilation.

Tank	Heat Transfer Coefficient, h (W/m ² /K)	Upward Loss (W)	Heat Transfer, QEX (Watt)	Downward Loss (W)	Heatup rate (°C/Day)
Case of baseline temperature + 0 °C					
AN-102	2.1989	1911	0	620	0.034
AN-107	6.2540	2175	0	716	0.032
AY-102	2.6836	3758	24460	2120	0.224
AZ-101	9.6787	5745	28818	2285	0.290
AY-101	4.3708	2498	6843	976	0.277
AZ-102	4.8672	3847	16408	1631	0.198
Case of baseline temperature + 5 °C					
AN-102	2.1989	2425	0	807	0.031
AN-107	6.2540	2689	0	903	0.028
AY-102	2.6839	4271	24463	2307	0.219
AZ-101	9.6316	6259	28678	2472	0.286
AY-101	4.5176	3012	7073	1163	0.259
AZ-102	4.8386	4361	16312	1818	0.194
Case of baseline temperature + 10 °C					
AN-102	2.1989	2939	0	994	0.028
AN-107	6.2540	3202	0	1090	0.025
AY-102	2.6842	4785	24466	2494	0.213
AZ-101	9.5845	6773	28538	2659	0.283
AY-101	4.6645	3525	7303	1350	0.241
AZ-102	4.8101	4875	16216	2004	0.190
Case of baseline temperature + 20 °C					
AN-102	2.1989	3966	0	1368	0.022
AN-107	6.2540	4230	0	1463	0.019
AY-102	2.6848	5813	24471	2868	0.202
AZ-101	9.4903	7800	28257	3032	0.275
AY-101	4.9581	4553	7763	1723	0.206
AZ-102	4.7530	5902	16023	2378	0.181

Note:

*Input data taken from Table H-1.

QEX = heat transfer.

W = Watt.

H4.3 TIME TO 25% AND 100% OF THE LOWER FLAMMABILITY LIMIT

Time to 25% and 100% of the LFL in the tank dome space under zero ventilation can be identified when the total flammability calculated with Equation H-1 reaches 25% and 100% of the LFL. The flammability and time to LFL are calculated at four initial temperatures, which are baseline temperature, and baseline temperature plus 5, 10, and 20 °C. At the given initial tank waste temperature, and considering the temperature increase in the time step of 1 day, the accumulated flammability on the dome space is calculated daily.

At the given initial temperature along with temperature increase rate, the gas concentrations for hydrogen and methane are calculated as the temperature changes in the time step of 1 day. The accumulated gas concentrations are calculated daily using Equation H-4, since the day of losing the normal ventilation condition. The initial concentration condition in Equation H-4 is a steady-state concentration at the normal ventilation condition. The hydrogen release rate, which is assumed to be the same as the hydrogen generation rate, is calculated daily using the rate equation model documented in RPP-3851, or summarized in Chapter 2.0 in the main text, based on the calculated temperature of each day.

Because methane does not have a rate equation model available, its daily gas release rate is calculated with the initial release rate at the given initial tank waste temperature, plus the daily increase rate due to tank waste heatup under the zero ventilation condition. The daily increase rate of methane uses the same daily increase rate of hydrogen gas generation, which is the ratio between the hydrogen generation rates of the current and previous days. The initial methane rates at baseline temperature are taken from Appendix D, Table D-1. The initial methane release rate at baseline temperature plus 5, 10, and 20 °C is calculated in the same ratio as the hydrogen release rate increases as shown in Equation H-13:

$$MGR_{baseline+T}^i = MGR_{baseline}^i \cdot \frac{HGR_{baseline+T}^i}{HGR_{baseline}^i} \quad (H-13)$$

where:

$MGR_{baseline+T}^i$	=	methane initial release rate at baseline temperature plus T (cfm)
$MGR_{baseline}^i$	=	methane initial release rate at baseline temperature (cfm)
$HGR_{baseline+T}^i$	=	hydrogen initial release rate at baseline temperature plus T (cfm)
$HGR_{baseline}^i$	=	hydrogen initial release rate at baseline temperature (cfm).

The calculated initial hydrogen and methane release rates, at several initial tank waste temperatures, are given in Table H-3. These rates are used in the flammability calculations. Although part of the corrosion rate in the hydrogen generation rate should be excluded in the rate increase ratio calculation for methane, the corrosion rates for the five DSTs studied are so small that the conservatism introduced can be ignored.

Ammonia concentrations are calculated using Equation H-7. Due to the low liquid ammonia concentration, the ammonia contributions range between 0.14% and 0.80% of the LFL (Appendix D, Table D-1) at the baseline temperature for the five tanks studied here. Although

ammonia concentration is also a function of temperature, to simplify the flammability evaluation the intention was to obtain one set of ammonia transport properties at the highest temperature for each tank and use it throughout the whole calculation. As shown in Table H-5, the highest temperatures are 112, 106, 98, 92, 54, and 51°C for DSTs 241-AY-101, 241-AN-102, 241-AN-107, 241-AY-102, 241-AZ-101, and 241-AZ-102, respectively. Calculations show that the equilibrium ammonia vapor concentration at these highest temperatures contributes to flammability is not too far from the contributions calculated at baseline temperature. The transport coefficient g_1 for DSTs 241-AY-102, 241-AZ-101, and 241-AZ-102 is such that the times to reach 100% of the LFL are much shorter than the times to reach the equilibrium for ammonia. In other words, for these tanks the ammonia contributes even less flammability than calculated above when the system is at 100% of the LFL. So overall, it is a simple and slightly conservative approach. In this calculation, the ammonia transport coefficients g_1 and g_2 derived at the highest temperatures (as mentioned above) for each tank are used for the flammability calculations and are listed in Table H-3. In addition, the vapor molar volume at these maximum temperatures, the tank headspace volume, and the percent LFL at normal vent condition (used as initial condition) are also given in Table H-3.

Table H-3. Gas Generation Rates and Ammonia Transport Constants for Flammability Calculations.

Tank	H ₂ rate at initial temp. (cfm)	CH ₄ rate at initial temp. (cfm)	H ₂ rate at initial temp. (cfm)	CH ₄ rate at initial temp. (cfm)	H ₂ rate at initial temp. (cfm)	CH ₄ rate at initial temp. (cfm)	Vapor molar volume (L/mole)	NH ₃ const. g ₁ (min ⁻¹)	NH ₃ const. g ₂ (mole/L-min)	Head space volume (ft ³)	% of LFL at normal vent condition
	Baseline temp. + 0 °C			Baseline temp. + 5 °C			Baseline temp. + 10 °C			At maximum temp*	
AN-102	9.69E-03	3.19E-04	1.50E-02	4.96E-04	2.37E-02	7.83E-04	26.75	4.00E-04	3.32E-08	42675	0.41%
AN-107	9.86E-03	6.29E-04	1.43E-02	9.14E-04	2.12E-02	1.35E-03	26.66	6.46E-04	4.95E-08	42216	0.47%
AY-102	5.66E-02	3.61E-04	5.66E-02	3.61E-04	5.95E-02	3.80E-04	28.63	7.06E-06	3.57E-10	91017	0.57%
AZ-101	7.25E-03	7.79E-04	9.47E-03	1.02E-03	1.27E-02	1.36E-03	30.44	3.51E-06	6.56E-11	54252	0.13%
AY-101	9.45E-04	1.42E-04	1.11E-03	1.67E-04	1.34E-03	2.02E-04	33.89	4.10E-06	2.20E-10	162561	0.01%
AZ-102	4.04E-03	8.58E-04	4.99E-03	1.06E-03	6.30E-03	1.34E-03	28.14	3.94E-06	3.46E-10	54328	0.11%

Notes:

*As discussed in Section H4.3, the maximum temperature refers to the highest possible temperatures in the whole calculations.

cfm = cubic feet per minute.

LFL = lower flammability limit.

For the given input data and initial conditions, the accumulated flammability of the headspace can be calculated daily. Using DST 241-AN-107 as an example, this example is carried out from Revision 2A and has not been updated in this revision, Table H-4 presents the flammability calculation at the baseline tank waste temperature for each day from day 0, until 25% and 100% of the LFL is reached. The input data for hydrogen generation rate of radiolysis, thermolysis, and corrosion calculations are given for convective and non-convective layers. The total hydrogen and methane release rates, along with ammonia transport coefficients, the headspace volume, initial flammability condition, and temperature increase rates, are also given in the input data and initial condition section of Table H-4.

Table H-4. Flammability Calculations for AN-107 Under Zero Ventilation at Baseline Waste Temperature (from Revision 2A). (5 sheets)

Input Data for Gas Concentration, and Release Rate Calculations								
Tank	TOC in liquid [TOC] ($\mu\text{g/mL}$)	NO_2 in liquid [NO_2] ($\mu\text{g/mL}$)	NO_3 in liquid [NO_3] ($\mu\text{g/mL}$)	Al in liquid [Al] ($\mu\text{g/mL}$)	^{90}Sr in waste [Sr] ($\mu\text{Ci/g}$)	^{137}Cs in waste [Cs] ($\mu\text{Ci/g}$)	Bulk density D (g/mL)	Waste volume V (kL)
AN-107 CL	4.11E+04	6.54E+04	2.37E+05	2.91E+02	7.15E+01	2.52E+02	1.37	3043
AN-107 NC	4.16E+04	6.62E+04	2.40E+05	2.95E+02	1.59E+02	2.23E+02	1.56	935
Tank	Bulk water [H_2O] (wt%)	Waste temp. T_w ($^{\circ}\text{C}$)	Dome temp. T_d ($^{\circ}\text{C}$)	G values for water $G_{\text{H}_2\text{O}}$ ($\text{H}_2/100\text{eV}$)	Total G values G_{TOT} ($\text{H}_2/100\text{eV}$)	HGR from radiolysi s RC_{rad} (cfm)	HGR from thermolysis RC_{therm} (cfm)	HGR from corrosion RC_{corr} (cfm)
AN-107 CL	51%	31.5	28.6	0.005	0.136	5.12E-03	1.49E-03	3.48E-04
AN-107 NC	40%	31.5	28.6	0.005	0.137	1.85E-03	4.26E-04	3.76E-04
Tank	Hydrogen release rate $\text{Rr}(\text{H}_2)$ (cfm)	Methane release rate $\text{Rr}(\text{CH}_4)$ cfm	Molar volume v at 53 $^{\circ}\text{C}$ L/mole	Ammonia g_1 at 53 $^{\circ}\text{C}$ (min-1)	Ammonia g_2 at 53 $^{\circ}\text{C}$ mole/L-min	Head Space Volume (ft^3)	LFL at Normal Vent Condition	Temp Incre. Rate ($^{\circ}\text{C}$)
AN-107	9.617E-03	5.521E-04	26.66	6.46E-04	4.95E-08	48,015	0.43%	0.034

Table H-4. Flammability Calculations for AN-107 Under Zero Ventilation at Baseline Waste Temperature from Revision 2A. (5 sheets)

Flammability and Time to LFL Calculation Results								
Days	Waste temp. T_w (°C)	Dome temp. T_d (°C)	Hydrogen release rate $R_r(H_2)$ (cfm)	Methane release rate $R_r(CH_4)$ (cfm)	LFL from $H_2(t)$	LFL from $CH_4(t)$	LFL from $NH_3(t)$	Total LFL
0	31.500	28.600	9.617E-03	5.521E-04				0.43%
1	31.534	28.634	9.639E-03	5.533E-04	0.723%	0.03%	0.83%	2.04%
2	31.568	28.668	9.661E-03	5.546E-04	1.447%	0.07%	1.15%	3.12%
3	31.602	28.702	9.683E-03	5.559E-04	2.173%	0.10%	1.28%	4.01%
4	31.636	28.736	9.705E-03	5.571E-04	2.901%	0.13%	1.33%	4.82%
5	31.670	28.770	9.727E-03	5.584E-04	3.630%	0.17%	1.35%	5.61%
6	31.704	28.804	9.749E-03	5.596E-04	4.361%	0.20%	1.36%	6.38%
7	31.738	28.838	9.771E-03	5.609E-04	5.093%	0.23%	1.36%	7.15%
8	31.772	28.872	9.793E-03	5.622E-04	5.828%	0.27%	1.36%	7.92%
9	31.806	28.906	9.815E-03	5.635E-04	6.564%	0.30%	1.36%	8.69%
10	31.840	28.940	9.838E-03	5.648E-04	7.301%	0.34%	1.36%	9.46%
11	31.874	28.974	9.860E-03	5.660E-04	8.040%	0.37%	1.36%	10.23%
12	31.908	29.008	9.882E-03	5.673E-04	8.781%	0.40%	1.36%	11.01%
13	31.942	29.042	9.905E-03	5.686E-04	9.524%	0.44%	1.36%	11.78%
14	31.976	29.076	9.927E-03	5.699E-04	10.268%	0.47%	1.36%	12.56%
15	32.010	29.110	9.950E-03	5.712E-04	11.014%	0.51%	1.36%	13.34%
16	32.044	29.144	9.973E-03	5.725E-04	11.76%	0.54%	1.36%	14.12%
17	32.078	29.178	9.995E-03	5.738E-04	12.51%	0.57%	1.36%	14.91%
18	32.112	29.212	1.002E-02	5.751E-04	13.26%	0.61%	1.36%	15.69%
19	32.146	29.246	1.004E-02	5.764E-04	14.02%	0.64%	1.36%	16.48%
20	32.180	29.280	1.006E-02	5.777E-04	14.77%	0.68%	1.36%	17.27%
21	32.214	29.314	1.009E-02	5.791E-04	15.53%	0.71%	1.36%	18.06%
22	32.248	29.348	1.011E-02	5.804E-04	16.28%	0.75%	1.36%	18.85%
23	32.282	29.382	1.013E-02	5.817E-04	17.04%	0.78%	1.36%	19.65%
24	32.316	29.416	1.016E-02	5.830E-04	17.81%	0.82%	1.36%	20.45%
25	32.350	29.450	1.018E-02	5.844E-04	18.57%	0.85%	1.36%	21.24%
26	32.384	29.484	1.020E-02	5.857E-04	19.33%	0.89%	1.36%	22.04%
27	32.418	29.518	1.023E-02	5.870E-04	20.10%	0.92%	1.36%	22.85%
28	32.452	29.552	1.025E-02	5.884E-04	20.87%	0.96%	1.36%	23.65%
29	32.486	29.586	1.027E-02	5.897E-04	21.64%	0.99%	1.36%	24.45%
30	32.520	29.620	1.030E-02	5.911E-04	22.41%	1.03%	1.36%	25.26%
31	32.554	29.654	1.030E-02	5.912E-04	23.18%	1.06%	1.36%	26.07%

Table H-4. Flammability Calculations for AN-107 Under Zero Ventilation at Baseline Waste Temperature from Revision 2A. (5 sheets)

Flammability and Time to LFL Calculation Results								
32	32.588	29.688	1.032E-02	5.925E-04	23.96%	1.10%	1.36%	26.88%
33	32.622	29.722	1.034E-02	5.939E-04	24.73%	1.14%	1.36%	27.69%
34	32.656	29.756	1.037E-02	5.952E-04	25.51%	1.17%	1.36%	28.50%
35	32.690	29.790	1.039E-02	5.966E-04	26.29%	1.21%	1.36%	29.32%
36	32.724	29.824	1.042E-02	5.979E-04	27.07%	1.24%	1.36%	30.14%
37	32.758	29.858	1.044E-02	5.993E-04	27.85%	1.28%	1.36%	30.95%
38	32.792	29.892	1.046E-02	6.007E-04	28.64%	1.32%	1.36%	31.77%
39	32.826	29.926	1.049E-02	6.021E-04	29.42%	1.35%	1.36%	32.60%
40	32.860	29.960	1.051E-02	6.034E-04	30.21%	1.39%	1.36%	33.42%
41	32.894	29.994	1.054E-02	6.048E-04	31.00%	1.42%	1.36%	34.25%
42	32.928	30.028	1.056E-02	6.062E-04	31.79%	1.46%	1.36%	35.08%
43	32.962	30.062	1.058E-02	6.076E-04	32.59%	1.50%	1.36%	35.91%
44	32.996	30.096	1.061E-02	6.090E-04	33.38%	1.53%	1.36%	36.74%
45	33.030	30.130	1.063E-02	6.104E-04	34.18%	1.57%	1.36%	37.57%
46	33.064	30.164	1.066E-02	6.118E-04	34.98%	1.61%	1.36%	38.41%
47	33.098	30.198	1.068E-02	6.132E-04	35.78%	1.64%	1.36%	39.24%
48	33.132	30.232	1.071E-02	6.146E-04	36.58%	1.68%	1.36%	40.08%
49	33.166	30.266	1.073E-02	6.160E-04	37.39%	1.72%	1.36%	40.93%
50	33.200	30.300	1.076E-02	6.174E-04	38.19%	1.75%	1.36%	41.77%
51	33.234	30.334	1.078E-02	6.189E-04	39.00%	1.79%	1.36%	42.61%
52	33.268	30.368	1.080E-02	6.203E-04	39.81%	1.83%	1.36%	43.46%
53	33.302	30.402	1.083E-02	6.217E-04	40.62%	1.87%	1.36%	44.31%
54	33.336	30.436	1.085E-02	6.231E-04	41.44%	1.90%	1.36%	45.16%
55	33.370	30.470	1.088E-02	6.246E-04	42.25%	1.94%	1.36%	46.02%
56	33.404	30.504	1.090E-02	6.260E-04	43.07%	1.98%	1.36%	46.87%
57	33.438	30.538	1.093E-02	6.274E-04	43.89%	2.02%	1.36%	47.73%
58	33.472	30.572	1.095E-02	6.289E-04	44.71%	2.05%	1.36%	48.59%
59	33.506	30.606	1.098E-02	6.303E-04	45.53%	2.09%	1.36%	49.45%
60	33.540	30.640	1.101E-02	6.318E-04	46.36%	2.13%	1.36%	50.31%
61	33.574	30.674	1.103E-02	6.332E-04	47.19%	2.17%	1.36%	51.18%
62	33.608	30.708	1.106E-02	6.347E-04	48.02%	2.21%	1.36%	52.04%
63	33.642	30.742	1.108E-02	6.362E-04	48.85%	2.24%	1.36%	52.91%
64	33.676	30.776	1.111E-02	6.376E-04	49.68%	2.28%	1.36%	53.78%
65	33.710	30.810	1.113E-02	6.391E-04	50.51%	2.32%	1.36%	54.66%
66	33.744	30.844	1.116E-02	6.406E-04	51.35%	2.36%	1.36%	55.53%
67	33.778	30.878	1.118E-02	6.421E-04	52.19%	2.40%	1.36%	56.41%
68	33.812	30.912	1.121E-02	6.435E-04	53.03%	2.44%	1.36%	57.29%

Table H-4. Flammability Calculations for AN-107 Under Zero Ventilation at Baseline Waste Temperature from Revision 2A. (5 sheets)

Flammability and Time to LFL Calculation Results								
69	33.846	30.946	1.124E-02	6.450E-04	53.87%	2.47%	1.36%	58.17%
70	33.880	30.980	1.126E-02	6.465E-04	54.72%	2.51%	1.36%	59.05%
71	33.914	31.014	1.129E-02	6.480E-04	55.56%	2.55%	1.36%	59.94%
72	33.948	31.048	1.131E-02	6.495E-04	56.41%	2.59%	1.36%	60.82%
73	33.982	31.082	1.134E-02	6.510E-04	57.26%	2.63%	1.36%	61.71%
74	34.016	31.116	1.137E-02	6.525E-04	58.11%	2.67%	1.36%	62.60%
75	34.050	31.150	1.139E-02	6.540E-04	58.97%	2.71%	1.36%	63.50%
76	34.084	31.184	1.142E-02	6.555E-04	59.82%	2.75%	1.36%	64.39%
77	34.118	31.218	1.145E-02	6.571E-04	60.68%	2.79%	1.36%	65.29%
78	34.152	31.252	1.147E-02	6.586E-04	61.54%	2.83%	1.36%	66.19%
79	34.186	31.286	1.150E-02	6.601E-04	62.40%	2.87%	1.36%	67.09%
80	34.220	31.320	1.153E-02	6.616E-04	63.27%	2.91%	1.36%	68.00%
81	34.254	31.354	1.155E-02	6.632E-04	64.14%	2.95%	1.36%	68.90%
82	34.288	31.388	1.158E-02	6.647E-04	65.00%	2.99%	1.36%	69.81%
83	34.322	31.422	1.161E-02	6.662E-04	65.87%	3.03%	1.36%	70.72%
84	34.356	31.456	1.163E-02	6.678E-04	66.75%	3.07%	1.36%	71.63%
85	34.390	31.490	1.166E-02	6.693E-04	67.62%	3.11%	1.36%	72.55%
86	34.424	31.524	1.169E-02	6.709E-04	68.50%	3.15%	1.36%	73.46%
87	34.458	31.558	1.171E-02	6.724E-04	69.37%	3.19%	1.36%	74.38%
88	34.492	31.592	1.174E-02	6.740E-04	70.25%	3.23%	1.36%	75.30%
89	34.526	31.626	1.177E-02	6.756E-04	71.14%	3.27%	1.36%	76.23%
90	34.560	31.660	1.180E-02	6.771E-04	72.02%	3.31%	1.36%	77.15%
91	34.594	31.694	1.182E-02	6.787E-04	72.91%	3.35%	1.36%	78.08%
92	34.628	31.728	1.185E-02	6.803E-04	73.80%	3.39%	1.36%	79.01%
93	34.662	31.762	1.188E-02	6.819E-04	74.69%	3.43%	1.36%	79.94%
94	34.696	31.796	1.191E-02	6.835E-04	75.58%	3.47%	1.36%	80.87%
95	34.730	31.830	1.193E-02	6.850E-04	76.47%	3.51%	1.36%	81.81%
96	34.764	31.864	1.196E-02	6.866E-04	77.37%	3.55%	1.36%	82.75%
97	34.798	31.898	1.199E-02	6.882E-04	78.27%	3.59%	1.36%	83.69%
98	34.832	31.932	1.202E-02	6.898E-04	79.17%	3.64%	1.36%	84.63%
99	34.866	31.966	1.204E-02	6.914E-04	80.07%	3.68%	1.36%	85.57%
100	34.900	32.000	1.207E-02	6.931E-04	80.98%	3.72%	1.36%	86.52%
101	34.934	32.034	1.210E-02	6.947E-04	81.89%	3.76%	1.36%	87.47%
102	34.968	32.068	1.213E-02	6.963E-04	82.80%	3.80%	1.36%	88.42%
103	35.002	32.102	1.216E-02	6.979E-04	83.71%	3.84%	1.36%	89.37%
104	35.036	32.136	1.219E-02	6.995E-04	84.62%	3.89%	1.36%	90.33%
105	35.070	32.170	1.221E-02	7.012E-04	85.54%	3.93%	1.36%	91.29%

Table H-4. Flammability Calculations for AN-107 Under Zero Ventilation at Baseline Waste Temperature from Revision 2A. (5 sheets)

Flammability and Time to LFL Calculation Results								
106	35.104	32.204	1.224E-02	7.028E-04	86.45%	3.97%	1.36%	92.25%
107	35.138	32.238	1.227E-02	7.044E-04	87.37%	4.01%	1.36%	93.21%
108	35.172	32.272	1.230E-02	7.061E-04	88.30%	4.06%	1.36%	94.17%
109	35.206	32.306	1.233E-02	7.077E-04	89.22%	4.10%	1.36%	95.14%
110	35.240	32.340	1.236E-02	7.094E-04	90.15%	4.14%	1.36%	96.11%
111	35.274	32.374	1.239E-02	7.110E-04	91.08%	4.18%	1.36%	97.08%
112	35.308	32.408	1.241E-02	7.127E-04	92.01%	4.23%	1.36%	98.05%
113	35.342	32.442	1.244E-02	7.144E-04	92.94%	4.27%	1.36%	99.03%
114	35.376	32.476	1.247E-02	7.160E-04	93.88%	4.31%	1.36%	100.01%

In the flammability and time to LFL calculations results section of Table H-4, it gives waste temperatures, headspace temperatures, hydrogen and methane release rates; the percent LFL from hydrogen, methane, ammonia; and the total percent of LFL for each single day. For day 0, it would be the initial conditions, which represent the condition under normal ventilation operation. In day 1, the temperature goes up 0.034 °C for both tank waste and headspace, thus the hydrogen and methane release rate, and total percent LFL are all increased because of the temperature increase. Note that ammonia has gone up to 0.83% of the LFL in day 1, which is more than 50% of the equilibrium value of 1.36% of the LFL occurring on day 6. So ammonia for this case reaches its equilibrium much faster than the time to reach 25% and 100% of the LFL, which are 30 and 114 days, respectively. Another observation is that the temperature increase rate is so low that the temperatures only go up 1 and 3.8 °C on the days reaching 25% and 100% of the LFL, respectively. Therefore, the times to 25% and 100% of the LFL are close to those times that do not consider a temperature increase (31 and 130 days, respectively).

The final flammability and time to LFL results under zero ventilation for all five tanks are given in Table H-5. The table also lists the initial tank waste temperature of non-convective layer, the temperature increase rate, and the non-convective layer temperatures when it reaches 25% and 100% of the LFL. This gives an understanding of what temperature the tank will reach at the time to 25% and 100% of the LFL. The maximum temperature increase rates are 0.28, 0.29, 0.24, 0.20, 0.03, and 0.03 °C for DSTs 241-AY-101, 241-AZ-101, 241-AY-102, 241-AZ-102, 241-AN-107, and 241-AN-102, respectively, and occur at the initial temperature of baseline temperature. The temperature increase rate decreases slightly for each tank as the initial temperature rises, and the minimum temperature increase rates occur at the initial temperature of baseline temperature plus 20 °C. The highest temperatures the tanks can reach are 112, 106, 98, 92, 54, and 51 °C for DSTs 241-AY-101, 241-AZ-101, 241-AY-102, 241-AZ-102, 241-AN-102, and 241-AN-107, respectively, and occur at the case of baseline temperature plus 20 °C when the tank reaches 100% of the LFL.

For DST 241-AY-102, the times to reach 25% and 100% of the LFL under zero ventilation at the initial temperature of baseline temperature are 10 and 42 days, respectively. These times are shorter in comparison to 11 and 50 days, respectively, which considers no temperature increase under barometric breathing ventilation (Chapter 4.0 in the main text). The time to 25% and

100% of LFL becomes shorter for each tank when the initial temperature increases. The time to 25% and 100% of the LFL under zero ventilation at the initial temperature of baseline temperature plus 20 °C are 4 and 18 days, respectively, for DST 241-AN-102; 5 and 23 days, respectively, for DST 241-AN-107; 28 and 82 days, respectively, for DST 241-AZ-102; 158 and 251 days, respectively, for DST 241-AY-101; 8 and 31 days, respectively, for DST 241-AY-102; and 13 and 40 days, respectively, for DST 241-AZ-101. Note that for DSTs 241-AN-102 and 241-AN-107 to reach 51 and 53 °C, respectively, from the initial temperature of 33 and 32 °C, respectively, takes more than 600 days. The tank will reach 25% and 100% of the LFL ahead of the time needed to increase the temperature by 20 °C naturally, or even by 5 or 10 °C naturally.

Table H-5. Temperature and Time to Reach 25% and 100% LFL for Adding 10-kgal Water. (2 sheets)

Tank	NCL Initial Temperature (°C)	Time to 25% LFL (days)	Time to 100% LFL (days)	Minimum Vent To Prevent Reaching 25% LFL (cfm)	Minimum Vent To Prevent Reaching 100% LFL (cfm)	Temperature Heat-up Rate (°C/day)	NCL Temperature at 25% LFL (°C)	NCL Temperature at 100% LFL (°C)
Case of baseline temperature + 0 °C								
AN-102	31	27	101	1.02	0.25	0.03	31	34
AN-107	33	26	100	1.06	0.26	0.03	34	36
AY-102	71	10	42	5.72	1.42	0.24	73	81
AZ-101	75	35	84	0.79	0.20	0.29	85	100
AY-101	40	196	269	0.11	0.03	0.28	94	115
AZ-102	58	60	145	0.48	0.12	0.20	70	86
Case of baseline temperature + 5 °C								
AN-102	36	18	69	1.56	0.38	0.03	36	38
AN-107	38	18	72	1.51	0.37	0.03	39	40
AY-102	76	10	39	6.02	1.50	0.23	78	85
AZ-101	80	28	72	1.02	0.25	0.29	88	101
AY-101	45	188	266	0.12	0.03	0.26	94	114
AZ-102	63	51	129	0.59	0.14	0.19	73	88
Case of baseline temperature + 10 °C								
AN-102	41	11	46	2.45	0.60	0.03	41	42
AN-107	43	12	51	2.21	0.54	0.03	43	44
AY-102	81	9	37	6.37	1.59	0.23	83	89
AZ-101	85	22	61	1.34	0.33	0.28	91	102
AY-101	50	180	262	0.15	0.04	0.24	94	113
AZ-102	68	42	113	0.72	0.18	0.19	76	89

Table H-5. Temperature and Time to Reach 25% and 100% LFL for Adding 10-kgal Water. (2 sheets)

Tank	NCL Initial Temperature (°C)	Time to 25% LFL (days)	Time to 100% LFL (days)	Minimum Vent To Prevent Reaching 25% LFL (cfm)	Minimum Vent To Prevent Reaching 100% LFL (cfm)	Temperature Heat-up Rate (°C/day)	NCL Temperature at 25% LFL (°C)	NCL Temperature at 100% LFL (°C)
Case of baseline temperature + 20 °C								
AN-102	51	4	18	6.22	1.53	0.02	51	51
AN-107	53	5	23	4.93	1.22	0.02	53	54
AY-102	91	8	31	7.41	1.82	0.22	92	98
AZ-101	95	13	40	2.48	0.61	0.28	99	106
AY-101	60	158	251	0.23	0.06	0.21	93	112
AZ-102	78	28	82	1.16	0.28	0.18	83	92

Notes:

¹The heatup rate based on the heat transfer model documented on RPP-6213, 2001, Hanford Waste Tank Bump Accident and Consequence Analysis, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

²Note that the temperature increase to 5 °C internally under losing ventilation condition can take minimum of 250 days, which is much longer than the time to 25% LFL and 100% LFL with baseline temperature.

°C = degrees Celsius

LFL = lower flammability limit.

NCL = non-connective layer.

H5.0 SUMMARY

This sensitivity study on the flammability and time to LFL for DSTs is to address (1) the routine small amount water addition issue, (2) the tank heatup issue during the lost of normal ventilation, and (3) possible zero ventilation condition.

Under the zero ventilation condition, the time to 25% and 100% of the LFL on the tank headspace are calculated for six DSTs: 241-AN-102, 241-AN-107, 241-AY-101, 241-AY-102, 241-AZ-101, and 241-AZ-102. This calculation considers (1) 10 kgal of water added to the current waste and the water is well mixed with the convective layer; (2) temperature increase and its impact to gas generation rate, gas concentration, total flammability, and time to LFL; and (3) several initial tank waste temperatures scenarios as baseline temperature, and baseline temperature plus 5, 10, and 20 °C.

In the calculations, simple dilution effects are used to recalculate the waste concentration, density, and weight percent water. A new set of equations for time-dependent gas concentrations under zero ventilation condition are derived. The temperature increase rate calculations under zero ventilation condition adopt a simple and conservative heat transfer model used in the tank steam bump study (RPP-6213). The initial hydrogen generation rate, methane release rate, and ammonia transport coefficient are prepared at several initial tank waste temperature scenarios based on the current waste data documented in Appendix B.

The final temperature increase rates and time to LFL under zero ventilation for six DSTs are given in Table H-5. The calculation shows that the maximum temperature increase rates occur at the initial temperature of baseline temperature, which are 0.03, 0.03, 0.29, 0.24, 0.28, and 0.20 °C/day for DSTs 241-AN-102, 241-AN-107, 241-AZ-101, 241-AY-102, 241-AY-101, and 241-AZ-102, respectively. Under the zero ventilation condition, the shortest time to 25% and 100% of the LFL are 10 and 42 days, respectively, for DST 241-AY-102 at the initial temperature of baseline temperature. The comparable times are 10 and 39 days, respectively, for DST 241-AY-102 at the initial temperature of baseline temperature plus 5 °C.

H6.0 REFERENCES

- HNF-3851, 2000, *Empirical Rate Equation Model and Rate Calculations of Hydrogen Generation for Hanford Tank Waste*, Rev. 0B, CH2M HILL Hanford Group, Inc., Richland, Washington.
- RPP-6213, 2001, *Hanford Waste Tank Bump Accident and Consequence Analysis*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

APPENDIX I

PEER REVIEW CHECKLIST

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APPENDIX I

PEER REVIEW CHECKLIST

CHECKLIST FOR TECHNICAL PEER REVIEW

Document Reviewed:

RPP-5926, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 3

Scope of Review (e.g., document section or portion of calculation):

Changes to RPP-5926, Rev. 2 and 2A, which will become RPP-5926, Rev. 3. This review includes changes to the document main text, Appendices B, D, and H.

Yes No NA*

☒	☐	☐	☐	1. Previous reviews are complete and cover the analysis, up to the scope of this review, with no gaps. <i>This review covered only the changes in the text and three appendices of the document. Appendix A was reviewed by another individual and a peer review sheet will be provided. There were no changes to Appendices C, E, F, and G.</i>
☒	☐	☐	☐	2. Problem is completely defined.
☐	☐	☐	☒	3. Accident scenarios are developed in a clear and logical manner. <i>There are no accident scenarios in the document. It documents calculations.</i>
☒	☐	☐	☐	4. Analytical and technical approaches and results are reasonable and appropriate. (ORP QAPP criterion 2.8)
☒	☐	☐	☐	5. Necessary assumptions are reasonable, explicitly stated, and supported. (ORP QAPP criterion 2.2)
☐	☐	☐	☒	6. Computer codes and data files are documented. <i>No software used other than Excel spread sheet.</i>
☒	☐	☐	☐	7. Data used in calculations are explicitly stated.
☒	☐	☐	☐	8. Bases for calculations, including assumptions and data, are consistent with the supported safety basis document (e.g., the Tank Farms Final Safety Analysis Report). <i>Technical Basis Document is written to support the Documented Safety Analysis.</i>
☒	☐	☐	☐	9. Data were checked for consistency with original source information as applicable. (ORP QAPP criterion 2.9) <i>This was done primarily in Appendix A by another individual. Data within the scope of this review were checked.</i>
☒	☐	☐	☐	10. For both qualitative and quantitative data, uncertainties are recognized and discussed, as appropriate. (ORP QAPP criterion 2.17)
☐	☐	☐	☒	11. Mathematical derivations were checked including dimensional consistency of results. (ORP QAPP criterion 2.16) <i>No new derivations were incorporated in the revision.</i>
☒	☐	☐	☐	12. Models are appropriate and were used within their established range of validity or adequate justification was provided for use outside their established range of validity.
☒	☐	☐	☐	13. Spreadsheet results and all hand calculations were verified. <i>Appendices B, D, and H.</i>
☒	☐	☐	☐	14. Calculations are sufficiently detailed such that a technically qualified person can understand the analysis without requiring outside information. (ORP QAPP criterion 2.5)
☒	☐	☐	☐	15. Software input is correct and consistent with the document reviewed. <i>The scope of this review is limited to Appendices B, D, and H.</i>
☒	☐	☐	☐	16. Software output is consistent with the input and with the results reported in the document reviewed. <i>The scope of this review is limited to Appendices B, D, and H.</i>
☐	☐	☐	☒	17. Software verification and validation are addressed adequately. (ORP QAPP criterion 2.6) <i>Software verification and validation was done in previous revisions and the same software is being used.</i>
☒	☐	☐	☐	18. Limits/criteria/guidelines applied to the analysis results are appropriate and referenced. Limits/criteria/guidelines were checked against references. (ORP QAPP criterion 2.9)

Reviewer's Initials

- ☒ ☐ ☐ ☐ 19. Safety margins are consistent with good engineering practices.
☒ ☐ ☐ ☐ 20. Conclusions are consistent with analytical results and applicable limits.
☒ ☐ ☐ ☐ 21. Results and conclusions address all points in the purpose. (ORP QAPP criterion 2.3)
☐ ☐ ☐ ☐ 22. All references cited in the text, figures, and tables are contained in the reference list.
☐ ☐ ☐ ☐ 23. Reference citations (e.g., title and number) are consistent between the text callout and the reference list.
☐ ☐ ☐ ☐ 24. Only released (i.e., not draft) references are cited. (ORP QAPP criterion 2.1)
☐ ☐ ☐ ☐ 25. Referenced documents are retrievable or otherwise available.
☐ ☐ ☐ ☐ 26. The most recent version of each reference is cited, as appropriate. (ORP QAPP criterion 2.1)
☐ ☐ ☐ ☐ 27. There are no duplicate citations in the reference list.
☐ ☐ ☐ ☐ 28. Referenced documents are spelled out (title and number) the first time they are cited.
☐ ☐ ☐ ☐ 29. All acronyms are spelled out the first time they are used.
☐ ☐ ☐ ☐ 30. The Table of Contents is correct.
☐ ☐ ☐ ☐ 31. All figure, table, and section callouts are correct.
☐ ☐ ☐ ☐ 32. Unit conversions are correct and consistent.
☐ ☐ ☐ ☐ 33. The number of significant digits is appropriate and consistent.
☐ ☐ ☐ ☒ 34. Chemical reactions are correct and balanced. *No chemical reactions are included.*
☐ ☐ ☐ ☐ 35. All tables are formatted consistently and are free of blank cells.
☐ ☐ ☐ ☐ 36. The document is complete (pages, attachments, and appendices) and in the proper order.
☐ ☐ ☐ ☐ 37. The document is free of typographical errors.
☐ ☐ ☐ ☐ 38. The tables are internally consistent.
☐ ☐ ☐ ☐ 39. The document was prepared in accordance with HNF-2353, Section 4.3, Attachment B, "Calculation Note Format and Preparation Instructions."
☒ ☐ ☐ ☐ **Concurrence**

Comments:

Document reviewed: RPP-5926, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 3

Judith Cuta

Reviewer (Printed Name and Signature)

September 16, 2003

Date

- If No or NA is chosen, an explanation must be provided on this form.

1. Tech editing is not in the scope of this review.

SPREADSHEET VERIFICATION FORM

A. Name of Spreadsheet Owner: T. A. Hu

B. Spreadsheet File Number: 032Hu

C. File Name of Spreadsheet: RPP-5926-8050-R3-LFL-CAL-T2-092203.xls

D. Location of Spreadsheet (share drive, personal computer, data system):
U:\FlamGas\RPP-5926 Rev 3\Calculations

E. Brief Description of Function and Purpose of Spreadsheet:

This spreadsheet is used to calculate the flammable gas concentration in the headspace of 177 storage tanks.

F. Assumptions Important to Spreadsheet Function if Applicable:

All assumptions and methodologies are documented in the RPP-5926 Rev. 3.

G. Method Used to Perform Verification and Verification Documentation:

The revised parts of the flammability spreadsheet for RPP-5926 Rev. 3 were verified by independent calculation performed by knowledgeable PNNL staff, Judith Cuta. (See her peer review sheet in this appendix.)

H. Approvals:

Owner: T. A. Hu

aut Hu 9/29/03

Verifier: PNNL Staff Judith Cuta (See her peer review sheets for signature.)

Owner's Manager: N. W. Kirch

NWK 9/29/03

Title: Best-Basis Inventory Data Input for Revision of Flammable Gas Generation

Identifier: RPP-5926 Rev: 3 Draft

Originator: Albert Hu Date: _____

Checker: David E. Place *David E. Place* Date: 8/20/03

Objective/Purpose: Verify that the waste volume, density, wt% water and concentration data input for revision of the flammable gas calculations are consistent with the Best-Basis Inventory (BBI).

Open Items: None

Methods of Analysis: The input BBI data for the flammable gas calculations will be verified by independently calculating the required Al, NO₂, NO₃, TOC, ⁹⁰Sr and ¹³⁷Cs concentrations and the associated phase densities and wt% water from an electronic download of the July 17, 2003 Best-Basis Inventory Calculation Detail Report using traditional spreadsheet functions (VLOOKUP, SUMIF, etc.). The original input data was compiled with a Visual Basic program in an Excel spreadsheet. The results will then be compared as ratios. Ratios indicating even small discrepancies (six decimal places) will be identified and resolved. All BBI derived values will be verified (100% check).

Input Data:

BBI Calculation Detail Report, Tank Waste Information Network System (TWINS), Queried 7/17/03 [all tanks, Intranet at <http://twins.pnl.gov/twins.htm>, CH2M HILL Hanford Group, Inc., Richland, Washington.

The newly developed BBI density and wt% water for each BBI waste layer (Internal Memo 7G410-03-KMB-001).

Spreadsheets: H2INPUT for Review081103.xls and H2INPUT for Review0813103.xls

Results:

Initially, several discrepancies were noted. These discrepancies were primarily associated with solids and liquids in non-convective (NC) layer.

- AN-102: Calculation of NC layer density slightly off (should be closer to 1.56 g/mL than 1.57). May have impacted ⁹⁰Sr and ¹³⁷Cs. Bulk NC wt% water also slightly off.
- AW-104: NC layer liquid density of 1.32 g/mL should be 1.41.
- AW-105: NC layer liquid density of 1.06 g/mL should be 1.10.
- AY-101: NC liquid density of 1.19 should be 1.14. Interstitial liquid composition should be used for TOC, NO₂, NO₃ and Al.
- AY-102: NC liquid density of 1.17 g/mL should be 1.16.
- SY-102: NC liquid density of 1.28 g/mL should be 1.36. Very minor discrepancies in TOC, NO₂, NO₃ and Al concentrations.
- B-112: NC liquid density of 1.01 g/mL should be 1.46.
- S-107: Very minor discrepancies in TOC, NO₂, NO₃ and Al concentrations.

Title: Best-Basis Inventory Data Input for Revision of Flammable Gas Generation

Identifier: RPP-5926 Rev: 3 Draft

Originator: Albert Hu Date: _____

Checker: David E. Place *David E. Place* Date: 8/20/03

- TX-108: NC bulk density of 1.66 g/mL should be 1.65. May have impacted ⁹⁰Sr and ¹³⁷Cs.

The Visual Basic code was corrected and the new results (8/13/03) were compared to the check spreadsheet. All values were identical to six decimal places.

Conclusions: The input data for the flammable gas calculations are in complete agreement with the Best-Basis Inventory.

Figure 1. Calculation Review Checklist.

Calculation Reviewed: H2INPUT for Review081103.xlsScope of Review: Review Limited to BBI Data Input
(e.g., document section or portion of calculation)Engineer/Analyst: David E. Place *David E. Place* Date: 8/20/03Organizational Mgr: N. W. Kirch Date: _____

This document consists of 1 page and no attachments:

Yes	No	NA*	
☒	☐	☐	1. Analytical and technical approaches and results are reasonable and appropriate.
☐	☐	☒	2. Necessary assumptions are reasonable, explicitly stated, and supported.
☒	☐	☐	3. Ensure calculations that use software include a paper printout, microfiche, CD ROM, or other electronic file of the input data and identification to the computer codes and versions used, or provide alternate documentation to uniquely and clearly identify the exact coding and execution process.
☒	☐	☐	4. Input data were checked for consistency with original source information.
☐	☐	☒	5. For both qualitative and quantitative data, uncertainties are recognized and discussed.
☐	☐	☒	6. Mathematical derivations were checked including dimensional consistency of results.
☒	☐	☐	7. Calculations are sufficiently detailed such that a technically qualified person can understand the analysis without requiring outside information.
☐	☐	☒	8. Software verification and validation are addressed adequately.
☐	☐	☒	9. Limits/criteria/guidelines applied to the analysis results are appropriate and referenced. Limits/criteria/guidelines were checked against references.
☐	☐	☒	10. Conclusions are consistent with analytical results and applicable limits.
☐	☐	☒	11. Results and conclusions address all points in the purpose.
☒	☐	☐	12. Referenced documents are retrievable or otherwise available.
☒	☐	☐	13. The version or revision of each reference is cited.
☐	☐	☒	14. The document was prepared in accordance with Attachment A, "Calculation Format and Preparation Instructions."
☒	☐	☐	15. All checker comments have been dispositioned and the design media matches the calculations.

David E. Place

Checker (Printed Name and Signature)

8/20/03

Date

• If No or NA is chosen, an explanation must be provided on or attached to this form.

NA Items 2, 5, 6, 9, 10, 11 and 14: The review was limited to verification of the input data generated from a Best Basis Inventory Calculation Detail Report. The document and methodology reviews will be performed by others.

NA Item 8: Calculations performed in an Excel spreadsheet. No new software was developed or used.

DISTRIBUTION SHEET

[illegible]