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RESOLVE! Version 2.5: Flammable Gas Accident Analysis Tool Acceptance Test Plan and Test Results

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Richland, Washington

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RESOLVE! VERSION 2.5: FLAMMABLE GAS ACCIDENT ANALYSIS TOOL ACCEPTANCE TEST PLAN AND TEST RESULTS

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EXECUTIVE SUMMARY

To assist in quantifying the potential risk of flammable gas accidents in the Hanford waste tanks an Analysis Tool (AT) has been developed using commercially available software and tank characterization data. The AT is a computer code called RESOLVE!. The AT is designed to quantify the risk and uncertainty of combustion accidents in actual or representative tanks and the change in risk that would result from using different control strategies. RESOLVE! is used to help identify optimal controls for each tank and analyze the implementation of the controls prior to actual implementation in the field.

The acceptance and validation testing of a developmental version, *RESOLVE! Version 2.13 Acceptance Testing: Test Plan and Test Results* is documented in Attachment 1. Following independent reviews of the AT Version 2.13 additional changes were identified and have been incorporated. The new revision, RESOLVE! Version 2.5 has been issued. The changes incorporated include revised waste classifications based on the characteristics of the waste, incorporation of empirical or observed tank waste behavior data, and graphical user interface upgrades.

Each Acceptance Test Plan is divided into three primary areas. The three areas are: "Features Testing," "Characteristics Testing," and "Trend Testing." The purpose of the "Features Testing" is to ensure that all of the options and features of the computer code run. The purpose of the "Characteristics Testing" is to verify that the calculated results are consistent with each other and that the results are repeatable and to quantify the baseline stability or behavior of the computer code. "Trend Testing" is performed to evaluate the effects of the changes to the parameter values on the frequency and consequence trends (i.e. increase, decrease or no change) associated with flammable gas deflagrations or detonations.

The results of the Acceptance Testing indicate that the majority of the parameters modified for both double-shell tanks (DSTs) and single-shell tanks (SSTs) did not significantly affect the benchmark results. This is the same conclusion reached during acceptance testing of Resolve Version 2.13. The parameter modifications that did significantly impact the results

include waste volume reduction, an increase or decrease in ventilation flow rate and changes in the waste and waste gas generation characteristics (for DSTs only). In each of these cases the results trend as expected.

As a result of testing there were two limitations identified. One resulted from "Characteristics Testing" and determined that the calculated mean toxicological sum of fractions exceeded the acceptance relative standard deviation criteria. It is recommended that prior to reporting toxicological consequences, multiple runs should be performed using different statistical sampling parameters and the results evaluated for appropriateness. The other limitation associated with "Waste Intrusive Equipment" is based on a lack of actual or observed data to validate the results.

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1.0 INTRODUCTION

1.1 BACKGROUND

To assist in quantifying the potential risk of flammable gas accidents in the Hanford waste tanks, an Analysis Tool (AT) has been developed using commercially available software and tank characterization data. In addition to using available data and analysis results, the process also uses formal systematic expert elicitation on flammable gas technical parameters for which no data exists. The AT is a computer code called RESOLVE!. The AT is designed to quantify the risk and uncertainty of combustion accidents in actual or representative tanks and the change in risk that would result from using different control strategies. RESOLVE! is used to help identify optimal controls for each tank and analyze the implementation of the controls prior to actual implementation in the field.

The acceptance and validation testing of the developmental versions, RESOLVE! Version 1.51, is documented in RESOLVE! Version 1.51 Acceptance Testing: Test Plan and Test Results (Lavender et al. 1998) and RESOLVE! Version 2.13 Acceptance Testing: Test Plan and Test Results (see Attachment 1). RESOLVE! Version 1.51 was modified primarily to include the analysis and evaluation of Double-Shell Tanks (DSTs). Additional changes to the refined safety AT (Version 1.51) included a buoyant displacement model, revised mass balance, waste intrusive equipment burns, mixer pump, waste transfer and the graphical user interface (GUI). The modified version was identified as RESOLVE! Version 2.13. The impacts associated with these changes have been previously determined and are documented (Slezak et al. 1999, Slezak and Bratzel 1997). The acceptability of RESOLVE! Version 2.13 is documented in Attachment 1.

Following independent reviews of the AT Version 2.13 additional changes were identified and have been incorporated. The new revision, RESOLVE! Version 2.5 has been issued. The changes incorporated include revised waste classifications based on the characteristics of the waste, incorporation of empirical or observed tank waste behavior data, and the graphical user interface (GUI) upgrades. The impacts associated with these changes have been previously determined and are documented (Slezak et al. 2000). This report documents the acceptance testing performed on Version 2.5.

1.2 PURPOSE

The acceptance test is part of the software certification process for RESOLVE! Version 2.5. This testing has been performed to enhance the understanding of the analysis framework (AF) and implication of the AT results. The results of acceptance testing are used to do the following:

Confirm that the results of RESOLVE! Version 2.5 trend logically

- Ensure that RESOLVE! Version 2.5 performs within the predefined parameters

- Determine the status of previously identified AT user interface issues and calculational errors
- Identify any limitations for application of Version 2.5.

Whenever an area of acceptance testing raises an issue, two approaches are used to evaluate the condition. Unless it is evident that an error (e.g., computational or GUI) exists, the code developers and the Tank Farm Contractor team convene to determine if the suspected error is correct (i.e., whether the tool behaved as expected based on the parameter modified and the correct calculational formulae) or whether a deficiency exists (i.e., results are unexpected based on parameter modification and the calculational formulae). If a deficiency has been noted, a code limitation (see Section 4.0) is described. Section 2.0 identifies the tests performed, Section 3.0 summarizes testing results, Section 5.0 lists references and Appendix A and B provide detailed trend test analysis results.

2.0 ACCEPTANCE TEST PLAN

The acceptance testing performed using Version 2.13 is documented in Attachment 1. This was an extensive test of all features of the AT and GUI and trended the calculated results for each change in control strategy, operation, and waste modification using multiple single-shell tanks (SSTs) and double-shell tanks (DSTs). The acceptance test plan for Version 2.5 is designed to evaluate the same changes in control strategies, operations, and waste modifications to corroborate the results reached during acceptance testing of Version 2.13. That is, the results are not trended at the conclusion of Version 2.5 acceptance testing.

Two acceptance test plans (ATPs) have been developed, one addresses the SSTs and the other addresses the DSTs. To provide a better understanding of the behavior of the AT the two test plans evaluate the same parameter changes. Where appropriate additional tests have been identified based on the characteristics of the waste contained in the tanks. For example, buoyant displacement gaseous release events are only evaluated with DSTs. Tables 1 and 2 identify the tests and input parameters, and variables modified for each test that will be performed, for SSTs and DSTs, respectively.

Each ATP is divided into three primary areas. The three areas are: "Features Testing," "Characteristics Testing," and "Trend Testing." The purpose of the "Features Testing" (see Section 2.1) is to ensure that all of the options and features of the computer code run. The purpose of the "Characteristics Testing" (see Section 2.2) is to verify that the calculated results are consistent with each other and repeatable and to quantify the baseline stability or behavior of the computer code. "Trend Testing" (see Section 2.3) is performed to evaluate the effects of the changes to the parameter values on the frequency and consequence trends (i.e. increase, decrease or no change) associated with gas deflagrations or detonations.

Code limitations and issues identified during testing are discussed and summarized in Section 4.0.

2.1 FEATURES TESTING

Testing the features of RESOLVE! 2.5 ensures that it runs correctly and produces the proper outputs when various available options are selected. An extensive test of the AT and GUI features is discussed in Attachment 1. The "Features Testing" performed in this ATP is limited to the options selected during characteristics and trend testing. This limited set of features tests based on the parameter modifications, will also verify that the code and data libraries are consistent with the changes in the baseline documentation.

As shown in Table 2 and Attachment 1, additional features tests are identified for DSTs. The additional DST features test include turning on the mixer pump (normally off) and creating buoyant displacement gaseous release events (GREs) in non-buoyant tanks by modifying the characteristics of the waste.

Table 1. Single-Shell Tanks: Acceptance Tests and Input Variables and Parameters. (4 sheets)

Test Title[a]	Test Description	Input variable and parameter
FEATURES TESTING OF SSTs (see Section 2.1.1)		
Features testing	All parameters for Tank 241-SX-103	See Acceptance Test Procedures for variable values
CHARACTERISTICS TESTING OF SSTs (see Section 2.2.1)		
Sample Count Stability (see Section 2.2.1)	This test is used to establish the statistical stability of RESOLVE! Version 2.5	Tank: S-102 Analysis type: Sensitivity Sample count: 200 to 1000 in increments of 50 Sample seed: 90,000,000
Sample Seed Stability (see Section 2.2.2)	This test is used to establish the statistical stability of RESOLVE! Version 2.5	Tank: S-102 Analysis type: Sensitivity Sample count: 500 Sample seed: 10,000,000 to 97,000,000 in increments of 30,000,000
TREND TESTING OF SSTs (see Section 2.3.1)		
Initial Trend Test Case (see Section 2.3)	Establish benchmarks for low, medium, and high fill factor tanks	Tanks: 241-A-102 241-B-111 241-S-102 241-T-203 Analysis type: Benchmark Sample count: 1000 Sample seed: 90,000,000
Saltwell pumping (see Section 2.3.1)	Trend test cases are run to explore the effect of saltwell pumping on risk	Tanks tested: 241-A-102 Parameter modified: Pump status Benchmark / Trend case never pumped / previously pumped
Waste Volume Reduction (see Section 2.3.2)	Trend test cases are run to explore the effect of changing the waste volume on risk	Tanks tested: 241-B-111 Parameter modified: Waste volume Tank / Benchmark / Trend case 241-B-111 / 327 / 166

Table 1. Single-Shell Tanks: Acceptance Tests and Input Variables and Parameters. (4 sheets)

Test Title[a]	Test Description	Input variable and parameter
Number of Intrusive Operations (see Section 2.3.3)	Trend test cases are run to explore the effect of increasing the number of equipment insertions and/or removal operations on risk	Tanks tested: 241-S-102 Parameter modified: In-Tank: All waste disturbing; Intrusive operations Variable / Benchmark / Trend case Non waste disturbing: Triangular(0,1.5,11) / Triangular(5,7.5,55) Locally waste disturbing: Triangular(0,0.32,3) / Triangular(0,1.6,15) Globally waste disturbing: Triangular(0,0.07,4) / Triangular(0,0.35,20)
		Tanks tested: 241-S-102 Parameter modified: In-Tank: Non waste disturbing; Intrusive operations Variable / Benchmark / Trend case Non waste disturbing: Triangular(0,1.5,11) / Triangular(5,7.5,55)
Number of Intrusive Operations (see Section 2.3.3) Continued		Tanks tested: 241-S-102 Parameter modified: In-Tank: Locally waste disturbing; Intrusive operations Variable / Benchmark / Trend case Locally waste disturbing: Triangular(0,0.32,3) / Triangular(0,1.6,15)
		Tanks tested: 241-S-102 Parameter modified: In-Tank: Globally waste disturbing; Intrusive operations Variable / Benchmark / Trend case Globally waste disturbing: Triangular(0,0.07,4) / Triangular(0,0.35,20)
		Tanks tested: 241-S-102Parameter modified: Ex-Tank: All waste disturbing; Intrusive operations Ex-Tank Variable / Benchmark / Trend case Waste disturbing: Triangular(3,12,55) / Triangular(15,60,275)
		Tanks tested: 241-S-102 Parameter modified: In-/Ex-Tank: All waste disturbing; Intrusive operations In-Tank Variable / Benchmark / Trend case Non waste disturbing: Triangular(0,1.5,11) / Triangular(5,7.5,55) Locally waste disturbing: Triangular(0,0.32,3) / Triangular(0,1.6,15) Globally waste disturbing: Triangular(0,0.07,4) / Triangular(0,0.35,20) Ex-Tank Variable / Benchmark / Trend case Waste disturbing: Triangular(3,12,55) / Triangular(15,60,275)

Table 1. Single-Shell Tanks: Acceptance Tests and Input Variables and Parameters. (4 sheets)

Test Title[a]	Test Description	Input variable and parameter
Ignition Control Set (see Section 2.3.4)	Trend test cases are run to explore the effect of changing the ignition controls on risk	Tanks tested: 241-A-102 Parameter modified: Ignition control, in-tank all waste disturbing activities Benchmark: Control Set II; Trend case: past practices
		Tanks tested: 241-A-102 Parameter modified: Ignition control, in/ex-tank all waste disturbing activities Benchmark: Control Set II; Trend case: past practices
Ventilation rate (see Section 2.3.5)	Trend test cases are run to explore the effect of changing the ventilation rate on risk	Tanks tested: 241-B-111 Parameter modified: Ventilation flow rate, reduction Tank: 241-B-111; Benchmark: 0.2566; Trend case: 0.0257
		Tanks effected: 241-B-111 Parameter modified: Ventilation flow rate, increase Tank: 241-B-111; Benchmark: 0.2566; Trend case: 2.57
Inerting Tank Headspace (see Section 2.3.6)	Trend test cases are run to explore the effect of inerting the tank headspace on risk	Tanks tested: 241-T-203 Parameter modified: Headspace atmosphere; Residual oxygen Headspace atmosphere: Benchmark: Normal; Trend case: nitrogen Residual oxygen (inerting efficiency) Benchmark: 21%; Trend case: 5%
		Tanks tested: 241-T-203 Parameter modified: Headspace atmosphere; Residual oxygen Headspace atmosphere: Benchmark: Normal; Trend case: nitrogen Residual oxygen (inerting efficiency) Benchmark: 21%; Trend case: 10%

Table 1. Single-Shell Tanks: Acceptance Tests and Input Variables and Parameters. (4 sheets)

Test Title[a]	Test Description	Input variable and parameter
Tank Failure (cracking) Pressure (see Section 2.3.7)	Trend test cases are run to determine the effect of changing the tank cracking pressure on risk	Tanks tested: 241-B-111 Parameter modified: Tank dome cracking pressure, reduction Tank / Benchmark / Trend case 241-B-111 / 15 / 7.5
		Tanks tested: 241-B-111 Parameter modified: Tank dome cracking pressure, increase Tank / Benchmark / Trend case 241-B-111 / 15 / 30
Tank Failure (collapse) Pressure (see Section 2.3.8)	Trend test cases are run to determine the effect of changing the tank collapse pressure on risk	Tanks tested: 241-B-111 Parameter modified: Tank dome collapse pressure Benchmark / Trend case Triangular(22,44,88) / Triangular(11,22,44)
Waste Intrusive Equipment Burns (see Section 2.3.9)	Trend test cases are run to determine the effects of changing individual parameters characterizing waste intrusive equipment characteristics and operations	Tanks tested: 241-A-102 Parameter modified: Waste intrusive equipment number of operations per year Benchmark / Trend case 0 / 5
		Tanks tested: 241-A-102 Parameter modified: Waste intrusive equipment ignition control (5 operations per year) Benchmark / Trend case NFPA purge / No purge
		Tanks effected: 241-A-102Parameter modified: Waste intrusive equipment; equipment diameter (5 operations per year) Benchmark / Trend case 3 / 6
		Tanks tested: 241-A-102 Parameter modified: Waste intrusive equipment; equipment length (5 operations per year) Benchmark / Trend case 54 / 108

(a) Sections identified provide detailed discussion of test performed.

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters. (6 sheets)

Test Title[(a)]	Test Description	Input parameter and variable values
FEATURES TESTING OF DSTs (see Section 2.1.2)		
Features testing	All parameters for Tank 241-SY-103	See Acceptance Test Procedures for variable values
Buoyant displacement go/no-go	Average density criteria. BD's occur at average densities >1.41kg/L	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000
	Sodium concentration criteria. BD's occur at sodium concentrations >10 molar and TOC > ~0.3wt%.	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000
	Nitrite concentration. BD's occur at nitrite concentrations > 2 molar and TOC > ~0.3wt%.	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000
	Aluminate concentration. BD's occur at aluminate concentrations > 0.9 molar and TOC > ~0.3wt%.	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000
	Layer levels and densities. Layer characteristics are an important factor to control the density criteria and the Energy Equation (BD's occur at $ER_{min} > 1$)	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000
Mixer pump	Test to determine if the Mixer Pumps can be turned on and if they have an impact on consequences.	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000 Benchmark: mixer pump off Sensitivity: mixer pump on
Waste intrusive equipment burns	Test to determine In-tank equipment burns can be turned on. Results, both % LFL and Consequences, will need to be compared for WIE burns (TDS).	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000 Benchmark: equipment frequency = 0 Sensitivity: equipment frequency = 5

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters. (6 sheets)

Test Title[a]	Test Description	Input parameter and variable values
CHARACTERISTICS TESTING OF DSTs (see Section 2.2.2)		
Sample Count Stability (see Section 2.2.1)	This test is used to establish the statistical stability of RESOLVE! Version 2.5	Tank: AW-102 Analysis type: Benchmark Sample count: 200 to 1000 in increments of 50 (e.g., 200, 250, 300, ...) Seed: 90,000,000
Sample Seed Stability (see Section 2.2.2)	This test is used to establish the statistical stability of RESOLVE! Version 2.5	Tank: AW-102 Analysis type: Benchmark Sample count: 1000 Seed: 10,000,000 to 97,000,000 in increments of 3,000,000 (e.g., 10,000,000, 13,000,000, 16,000,000, ...)
TREND TESTING OF DSTs (see Section 2.3.2)		
Initial Trend Test Case (see Section 2.3)	Establish benchmarks for low, medium and high fill factor tanks	Tanks: 241-AN-107 241-AW-106 241-AY-101 Analysis type: Benchmark Sample count: 1000 Seed: 90,000,000
Waste Volume Reduction (see Section 2.3.2)	Trend test cases are run to explore the effect of changing the waste volume on risk. Test evaluates reducing the total waste volume 5% by reducing the volume of liquids in the tank.	Tank tested: 241-AN-107 Parameter modified: Liquid volume (cu.ft.), Tank average specific gravity, Liquid thickness (ft.), Total waste volume (gal.). Tank / Benchmark cuft / Trend case: Liquid vol. / Avg sPg / Liq Thick. / Waste Volume 241-AN-107 / 107,470 / 79,368 / 1.47 / 18.0 / 840,720
Number of Intrusive Operations (see Section 2.3.3)	Trend test cases are run to explore the effect of decreasing/increasing the number of equipment insertions and/or removal operations on risk	Tank tested: 241-AW-106 Parameter modified: In-Tank: All waste disturbing; Intrusive operations Benchmark / Trend case Non-waste disturbing: Triangular(0,1.3,6) / Triangular(0,2.6,12) Locally waste disturbing: Triangular(0,1.7,39) / Triangular(0,3.4,78) Globally waste disturbing: Triangular(0,2.6,23) / Triangular(0,5.2,46)
		Tank tested: 241-AW-106 Parameter modified: In-Tank: Non waste disturbing; Intrusive operations Benchmark / Trend case Non-waste disturbing: Triangular(0,1.3,6) / Triangular(0,2.6,12)

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters. (6 sheets)

Test Title[a]	Test Description	Input parameter and variable values
Number of Intrusive Operations (see Section 2.3.3) (continued)	Trend test cases are run to explore the effect of decreasing/increasing the number of equipment insertions and/or removal operations on risk (continued)	Tank tested: 241-AW-106 Parameter modified: In-Tank: Locally waste disturbing; Intrusive operations Benchmark / Trend case Locally waste disturbing Triangular(0,1.7,39) Triangular(0,3.4,78)
Number of Intrusive Operations (see Section 2.3.3) Continued		Tank tested: 241-AW-106 Parameter modified: In-Tank: Globally waste disturbing; Intrusive operations Benchmark / Trend case Globally waste disturbing Triangular(0,2.6,23) Triangular(0,5.2,46)
		Tank tested: 241-AW-106 Parameter modified: Ex-Tank: Waste disturbing; Intrusive operations Benchmark / Trend case Waste disturbing Triangular(60,110,298) Triangular(120,220,596)
		Tank tested: 241-AW-106 Parameter modified: In-Tank: All waste disturbing; Intrusive operations Benchmark / Trend case Non-waste disturbing Triangular(0,1.3,6) Triangular(0,2.6,12) Locally waste disturbing Triangular(0,1.7,39) Triangular(0,3.4,78) Globally waste disturbing Triangular(0,2.6,23) Triangular(0,5.2,46) Parameter modified: Ex-Tank: Waste disturbing; Intrusive operations Benchmark / Trend case Waste disturbing Triangular(60,110,298) Triangular(120,220,596)
In-Tank Ignition Control Set (see Section 2.3.4)	Trend test cases are run to explore the effect of changing the In-Tank ignition controls on risk	Tank tested: 241-AY-101 Parameter modified: Ignition control set All waste disturbing options Benchmark / Trend case Control set II Past practices
Ex-Tank Ignition Control Set (see Section 2.3.4)	Trend test cases are run to explore the effect of changing the Ex-Tank ignition controls on risk	Tank tested: 241-AY-101 Parameter modified: Ignition control set Operations Benchmark / Trend case 241-AY-101 Control set II Past practices

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters. (6 sheets)

Test Title[a]	Test Description	Input parameter and variable values
In- and Ex-Tank Ignition Control Set (see Section 2.3.4)	Trend test cases are run to explore the effect of changing the Ex-Tank ignition controls on risk	Tank tested: 241-AY-101 Parameter modified: Ignition control set In-Tank: All waste disturbing options Benchmark — Trend case Control set II — Past practices Ex-Tank: Operations Benchmark — DTT5c 241-AY-101 Control set II — Past practices
Ventilation rate (see Section 2.3.5)	Trend test cases are run to explore the effect of changing the ventilation rate on risk	Tank tested: 241-AW-106 Parameter modified: Ventilation flow rate Tank — Benchmark — Trend case 241-AW-106 — 151 — 15.1
		Tank tested: 241-AW-106 Parameter modified: Ventilation flow rate Tank — Benchmark — Trend case 241-AW-106 — 151 — 1510
Inerting Tank Headspace (see Section 2.3.6)	Trend test cases are run to explore the effect of inerting the tank headspace on risk	Tank tested: 241-AN-107 Parameter modified: Headspace atmosphere; Residual oxygen Headspace atmosphere: Benchmark — Trend case Normal — nitrogen Residual oxygen (inerting efficiency) Benchmark — Trend case 21% — 5%
		Tank tested: 241-AN-107 Parameter modified: Headspace atmosphere; Residual oxygen Headspace atmosphere: Benchmark — Trend case Normal — nitrogen Residual oxygen (inerting efficiency) Benchmark — Trend case 21% — 10%

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters. (6 sheets)

Test Title[(a)]	Test Description	Input parameter and variable values
Tank Failure (collapse) Pressure (see Section 2.3.8)	Trend test cases are run to determine the effect of changing the tank collapse pressure on risk	Tank tested: 241-AN-107 Parameter modified: Tank dome collapse pressure (psig) Benchmark: Uniform(55,60) — Trend case: Uniform(27.5,30)
Waste Intrusive Equipment Burns (see Section 2.3.9)	Trend test cases are run to determine the effects of changing individual parameters characterizing waste intrusive equipment characteristics and operations	Tank tested: 241-AY-101 Parameter modified: Waste intrusive equipment number of operations per year Benchmark: 0 — Trend case: 5
		Tank tested: 241-AY-101 Ignition Control Strategy (Operations at 5 times per year) Benchmark: Purged — Trend case: Not purged
Waste Intrusive Equipment Burns (see Section 2.3.9) (continued)		Tank tested: 241-AY-101 Parameter modified: Waste intrusive equipment design Equipment diameter (Operations at 5 times per year) Benchmark: 3 — Trend case: 6
		Tank tested: 241-AY-101 Parameter modified: Waste intrusive equipment design Equipment length (Operations at 5 times per year) Benchmark: 55 — Trend case: 65
Density ratio of liquids to solids (see Section 2.3.2.10)	Trend test cases are run to explore the effects of increasing the settled and immobile solids bulk density (layer thickness and liquid layer characteristics are not changed) Note: 241-SY-101 has no immobile solids and is not analyzed	Tank tested: 241-AN-107 Benchmark Tank: 241-AN-107 — Liquids: 91.77 — Settled solids: 98.01 — Immobile solids: 98.01 Parameter modified: Settled solids bulk density Tank: 241-AN-107 — Trend case: 147.02

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters. (6 sheets)

Test Title[(a)]	Test Description	Input parameter and variable values
Density ratio of liquids to solids (see Section 2.3.2.10) (continued)		Tank tested: 241-AN-107 Benchmark Tank / Liquids / Settled solids / Immobile solids 241-AN-107 / 91.77 / 98.01 / 98.01 Parameter modified: Immobile solids bulk density Tank / Trend case 241-AN-10 / 147.02
Waste gas generation rate (see Section 2.3.11)	Trend test cases are run to explore the effects of increasing the settled and immobile solids waste gas generation rates (liquid gas generation rates are not changed)	Tank tested: 241-AN-107 Benchmark Tank / Liquids / Settled solids / Immobile solids 241-AN-107 / 1.27E-07 / 1.67E-07 / 3.16E-08 Parameter modified: Settled solids gas generation rate Tank / Trend case 241-AN-107 / 1.67E-06
Waste gas generation rate (see Section 2.3.11) (continued)		Tank tested: 241-AN-107 Benchmark Tank / Liquids / Settled solids / Immobile solids 241-AN-107 / 1.27E-07 / 1.67E-07 / 3.16E-08 Parameter modified: Immobile solids gas generation rate Tank / Trend case 241-AN-107 / 3.16E-07

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters. (6 sheets)

Test Title[a]	Test Description	Input parameter and variable values
Buoyant Displacement	Trend test cases are run to explore the effects of different parameters on whether or not BD GREs occur.	Tank tested: 241-SY-101

Tank SY-103	Bench Mark	Parameter Minium	Parameter Maxium
Tot Vol	749500	457000	1155000
Ave Den	1.52	1.24	1.74
Crust Thick	0.66	0.66	0.66
Crust Den	90	61	90
Liq Thick	11	3	23
Liq Den	92	62	92
SS Thick	7.6	2	7.6
SS Den	98	77	135
IS Thick	3.4	3.4	5
IS Den	98	81	135
Al	0.96	0.80	0.96
NO2	2.89	1.89	2.89
Na	11	9	11
TOC	0.88	0.2	0.88

(a) Sections identified provide detailed discussion of test performed

Acceptable behavior is that all features perform the function intended by the programmers and that no feature causes the program to "crash" or result in an error message. The baseline code and the data libraries must also be consistent with the documentation. Results of "Feature Testing" are summarized in Section 3.1. Any code limitations generated as a result of this testing are presented in Section 4.0.

2.2 CHARACTERISTIC TESTING

Characteristic Testing is performed following the successful completion of the "Features Testing." The purpose of the "Characteristic Testing" is to verify that the calculated results are stable and repeatable and to determine the number of trials (or samples) required to achieve stable and repeatable results. These tests are performed at different workstations using the identical statistical analysis parameters. Characteristics Testing is also used to establish system baseline stability or behavior due to changes in statistical analysis parameters. Typically, it would be necessary to test the AT as an integrated tool; however, DSTs, are analyzed using a different set of algorithms. Therefore, it is necessary to test both the SST and DST stability. The following subsections describe the characteristics testing, which is common to both SSTs and DSTs and the expected changes to the results caused by the testing. Results of Characteristic Testing are summarized in Section 3.2.

To test system stability, the variance, standard deviation and the relative standard deviation values are calculated. The relative standard deviation is calculated using two methods: 1) dividing the square root of the variance by the average and 2) dividing the standard deviation by the average. Simply stated, the standard deviation equals the square root of the variance. In order to comply, the values must not vary by more than a factor or two. Translated to the percentile notation common with relative standard deviations, the values cannot be over 200%.

2.2.1 Sample Count Stability

This test is used to establish the stability of RESOLVE! 2.5. That is, changing the number of samples analyzed will impact the statistical analysis and the reported results. It is expected that the reported results for each case based on the number of samples analyzed will vary; however, the variance should not be significant. An analyst performs benchmark runs using a single tank and the same sample seed value. For each run, the sample count is iterated from 200 to 1000 in increments of 50.

The mean of the onsite radiological and toxicological results, as shown on the GUI, are compared, for the benchmark runs. The relative standard deviation should be less than 200%. See Tables 1 and 2 for a description of the tests performed.

2.2.2 Sample Seed Stability

Similar to the Sample Count Sensitivity test discussed above, changing the seed value will impact the statistical analysis and the reported results. It is expected that the reported results for each sample seed value analyzed will vary; however, the variance should not be significant. An analyst performs benchmark runs using a single tank and the same sample count. For each run, the sample seed is increased from 10,000,000 to 61,000,000 in increments of 300,000.

The mean of the onsite radiological and toxicological results as shown on the GUI for all runs are compared. The relative standard deviation should be less than 200%. See Tables 1 and 2 for a description of the tests performed.

2.3 TREND TESTING

Trend testing is performed to evaluate the effects of changes in the pedigreed data values and the predefined controls on the frequency and consequences of a flammable gaseous release. The trend testing is performed by comparing the Benchmark case to the modified (i.e., changed, pedigreed data values and predefined controls) case. As discussed previously in Section 1.1, the *major improvement of the refined safety AT is revision of the tank waste characteristics.* Four representative SSTs and three DTSs were selected for trend analysis. Tables 3 and 4 for SSTs and DSTs, respectively, identify the tanks and the parameters selected for trend testing.

For this test a series of tanks was selected based on the classification of the waste. That is, prior versions of RESOLVE! have classified tanks using Facility Groups (HNF 1999). The waste characteristics; i.e., composition and GRE behavior, have been revised in the relational database (Barker et al. 2000) to reflect actual waste conditions. The four SSTs and three DSTs selected for testing have different waste characteristics, thus the results due to changes in the waste parameters, tank operations, and controls are reviewed to determine if the results are as expected.

The general approach followed in trend testing is to develop a Benchmark case for each tank maximizing the sensitivity of the program and to perform multiple analyses or sensitivity case runs for each tank changing only one parameter (i.e., relational database data value or predefined control) per analysis. The output from each run or analysis (e.g., frequency and/or consequences) are tabulated and compared. This approach will test the effects of significantly increasing or decreasing a parameter.

Tables 1 and 2 for SSTs and DSTs, respectively, provide a listing of the input parameters and values that are changed for each test. Each trend test uses the Benchmark Case as a template. That is, the Benchmark Case file is "opened" and modified. For all trend tests the Analysis Type is changed from "Benchmark" to "Sensitivity" and the appropriate input parameters and values are changed to the values specified for each test.

The following subsections describe the trend testing. The expected results due to the parameter changes are shown in Tables 5 and 6 for SSTs and DSTs, respectively. Based on the expected,

Table 3. Summary of Single Shell Tanks Used in Trend Testing.

Tank	Tank Volume (a)	Waste Volume (a)	Waste Classification (b)	Fill Factor	Saltwell Pump Status	Ventilation Flow Rate (cfm)	GRE Behavior (c)
B-111	530,000	237,000	SL-NL	0.3 (medium)	never pumped	0.3	NBD
S-102	758,000	549,000	SC/SS-NL	0.5 (medium)	never pumped	0.2	NBD
U-111	530,000	329,000	MIX-NL	0.4 (medium)	never pumped	0.2	NBD
T-203	38,000	35,000	SL-NL	0.9 (high)	never pumped	0.4	NBD

(a) Volumes shown are approximate.
(b) Taken from RESOLVE! Version 2.5 database (Barton et al. 1998).
(c) SL - slurry
NL - no liquid
SC - salt cake
SS - salt sludge
(d) GRE - Gas release event
NBD - Non-buoyant displacement

Table 4. Summary of Double Shell Tanks Used in Trend Testing.

Tank	Waste Volume[a]	Waste Classification[b]	Waste Characteristics[c]			Ventilation Flow Rate (cfm)	GRE Behavior[c]
			Volume (ft^3)	Gas Generation Rate (moles/m^3 sec)	Bulk Density (lbm/ft^3)		
AW-106	579,300	SC/SS-NL	C-0	C-NA	C-NA	151	NBD
			L-46,960	L-3.17E-09	L-69.3		
			SS-30,480	SS-1.13E-8	SS-98.01		
			IS-0	IS-NA	IS-NA		
AN-107	1,050,900	SC/SL-LIQ	C-0	C-NA	C-NA	126	NBD
			L-107,490	L-1.27E-07	L-86.77		
			SS-33,000	SS-1.67E-07	SS-91.77		
			IS-0	IS-NA	IS-NA		
AY-101	1,107,110	SL-NL	C-14,710	C-8.78E-08	C-84.3	485	BD
			L-76,560	L-1.36E-07	L-98.01		
			SS-56,680	SS-1.49E-07	SS-106.13		
			IS-0	IS-NA	IS-NA		

NA – Not applicable

(a)Volumes shown are approximate.

(b)Taken from RESOLVE! Version 2.5 database (Barton et al. 1998)

SL - slurry
NL - no liquid
SC - salt cake
SS - salt sludge
LIQ - liquid

(c) Volumes shown are approximate. lbm/cuft = pound moles per cubic foot

C - crust layer
L - liquid layer
SS - settled solids layer
IS - immobile solids layer

(d)GRE - Gas release event

BD - Buoyant displacement
NBD - Non-buoyant displacement

Table 5. Single-Shell Tanks: Expected Results from Acceptance Testing. (4 sheets)

Test Title[a]	Test Description	Expected Test Results[b]
FEATURES TESTING OF SSTs (see Section 2.1.1)		
Features testing	All parameters for Tank 241-SX-103	See Acceptance Test Procedures for expected testing results
CHARACTERISTICS TESTING OF SSTs (see Section 2.2.1)		
Sample Count Stability (see Section 2.2.1)	This test is used to establish the statistical stability of RESOLVE! Version 2.5	Relative standard deviation is less than 200% (i.e., 2)
Sample Seed Stability (see Section 2.2.2)	This test is used to establish the statistical stability of RESOLVE! Version 2.5	Relative standard deviation is less than 200% (i.e., 2)
TREND TESTING OF SSTs (see Section 2.3.1)		
Initial Trend Test Case (see Section 2.3.1)	Establish benchmarks for low, medium and high fill factor tanks	Not Applicable
Saltwell pumping (see Section 2.3.2)	Trend test cases are run to explore the effect of saltwell pumping on risk	Never to previously pumped: All tanks Frequency: Decrease Consequences: Decrease Expected risk: Decrease
Waste Volume Reduction (see Section 2.3.3)	Trend test cases are run to explore the effect of changing the waste volume on risk	Waste volume reduced 30% in all tanks: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Number of Intrusive Operations (see Section 2.3.4)	Trend test cases are run to explore the effect of increasing the number of equipment insertions and/or removal operations on risk	Increase number of intrusive operations for all activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Increase number of intrusive operations for non waste disturbing activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Increase number of intrusive operations for locally waste disturbing activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase

Table 5. Single-Shell Tanks: Expected Results from Acceptance Testing. (4 sheets)

Test Title[a]	Test Description	Expected Test Results[b]
Number of Intrusive Operations (see Section 2.3.4) Continued		Increase number of intrusive operations for globally waste disturbing activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Increase number of intrusive operations Ex-Tank activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
Ignition Control Set (see Section 2.3.5)	Trend test cases are run to explore the effect of changing the ignition controls on risk	In-tank ignition control set changed from control set II to past practices: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Ex-tank ignition control set changed from past practices to control set II: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
Ventilation rate (see Section 2.3.6)	Trend test cases are run to explore the effect of changing the ventilation rate on risk	Reduce ventilation flow rate: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Increase ventilation flow rate: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease

Table 5. Single-Shell Tanks: Expected Results from Acceptance Testing. (4 sheets)

Test Title[a]	Test Description	Expected Test Results[b]
Inerting Tank Headspace (see Section 2.3.7)	Trend test cases are run to explore the effect of inerting the tank headspace on risk	Inerting tank headspace with nitrogen 5% residual oxygen: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
		Inerting tank headspace with nitrogen 10% residual oxygen: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Tank Failure (cracking) Pressure (see Section 2.3.8)	Trend test cases are run to determine the effect of changing the tank cracking pressure on risk	Reduce tank failure (cracking) pressure: All tanks Frequency: No change Consequences: No change Expected risk: No change
		Increase tank failure (cracking) pressure: All tanks Frequency: No change Consequences: Increase Expected risk: Increase
Tank Failure (collapse) Pressure (see Section 2.3.9)	Trend test cases are run to determine the effect of changing the tank collapse pressure on risk	Reduce tank failure (collapse) pressure: All tanks Frequency: No change Consequences: Increase Expected risk: Increase
Waste Intrusive Equipment Burns (see Section 2.3.10)	Trend test cases are run to determine the effects of changing individual parameters characterizing waste intrusive equipment characteristics and operations	Increase the number of operations to 5 per year: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Change ignition control to no inerting (5 operations per year): All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Increase the diameter of the equipment (5 operations per year): All tanks Frequency: Decrease Consequences: Increase Expected risk: Increase

Table 5. Single-Shell Tanks: Expected Results from Acceptance Testing. (4 sheets)

Test Title[a]	Test Description	Expected Test Results[b]
Waste Intrusive Equipment Burns (see Section 2.3.10) (Continued)		Increase the length of the equipment (5 operations per year): All tanks: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase

(a) Sections identified provide detailed discussion of test performed. See also Table 1.
(b) Expected analysis results based on parameter modified and anticipated effects associated with the modification.

Table 5. Single-Shell Tanks: Expected Results from Acceptance Testing. (4 sheets)

Test Title[a]	Test Description	Expected Test Results[b]
Inerting Tank Headspace (see Section 2.3.7)	Trend test cases are run to explore the effect of inerting the tank headspace on risk	Inerting tank headspace with nitrogen 5% residual oxygen: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
		Inerting tank headspace with nitrogen 10% residual oxygen: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Tank Failure (cracking) Pressure (see Section 2.3.8)	Trend test cases are run to determine the effect of changing the tank cracking pressure on risk	Reduce tank failure (cracking) pressure: All tanks Frequency: No change Consequences: No change Expected risk: No change
		Increase tank failure (cracking) pressure: All tanks Frequency: No change Consequences: Increase Expected risk: Increase
Tank Failure (collapse) Pressure (see Section 2.3.9)	Trend test cases are run to determine the effect of changing the tank collapse pressure on risk	Reduce tank failure (collapse) pressure: All tanks Frequency: No change Consequences: Increase Expected risk: Increase
Waste Intrusive Equipment Burns (see Section 2.3.10)	Trend test cases are run to determine the effects of changing individual parameters characterizing waste intrusive equipment characteristics and operations	Increase the number of operations to 5 per year: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Change ignition control to no inerting (5 operations per year): All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Increase the diameter of the equipment (5 operations per year): All tanks Frequency: Decrease Consequences: Increase Expected risk: Increase

Table 5. Single-Shell Tanks: Expected Results from Acceptance Testing. (4 sheets)

Test Title[a]	Test Description	Expected Test Results[b]
Waste Intrusive Equipment Burns (see Section 2.3.10) (Continued)		Increase the length of the equipment (5 operations per year): All tanks: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase

(a) Sections identified provide detailed discussion of test performed. See also Table 1.
(b) Expected analysis results based on parameter modified and anticipated effects associated with the modification.

Table 6. Double-Shell Tanks: Expected Results from Acceptance Testing. (4 sheets)

Test Title[a]	Test Description	Expected Test Results[b]
FEATURES TESTING OF DSTs (see Section 2.1.1)		
Features testing	All parameters for Tank 241-SY-103	See Acceptance Test Procedures for expected testing results
	Buoyant displacement	Buoyant displacement GREs can be turned off or on as a function of tank conditions. Check of Average Tank Density, Sodium Concentration, Nitrite Concentration, Aluminate Concentration, and Energy Criteria.
	Mixer pump	Mixer pump turned on reducing the frequency of buoyant displacement GREs and is sensitive to pump operating parameters; pump status, time since last GRE, pump circulation rate, pump circulation rate, settled-solids disturbance rate, mixer pump operations duration, mixer pump operations frequency, mixer pump radius of influence, and post mixer pump operations void fraction.
CHARACTERISTICS TESTING OF DSTs (see Section 2.2.1)		
Sample Count Stability (see Section 2.2.1)	This test is used to establish the statistical stability of RESOLVE! Version 2.5	Relative standard deviation is less than 200% (i.e., 2)
Sample Seed Stability (see Section 2.2.2)	This test is used to establish the statistical stability of RESOLVE! Version 2.5	Relative standard deviation is less than 200% (i.e., 2)
TREND TESTING OF DSTs (see Section 2.3.1)		
Initial Trend Test Case (see Section 2.3)	Establish benchmarks for low, medium and high fill factor tanks	Not Applicable
Waste Volume Reduction (see Section 2.3.2)	Trend test cases are run to explore the effect of changing the waste volume on risk	Waste volume reduced 30% in all tanks: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Number of Intrusive Operations (see Section 2.3.3)	Trend test cases are run to explore the effect of increasing the number of equipment insertions and/or removal operations on risk	Increase number of intrusive operations for all activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase

Table 6. Double-Shell Tanks: Expected Results from Acceptance Testing. (4 sheets)

Test Title[a]	Test Description	Expected Test Results[b]
		Increase number of intrusive operations for non waste disturbing activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
Number of Intrusive Operations (see Section 2.3.3) Continued		Increase number of intrusive operations for locally waste disturbing activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Increase number of intrusive operations for globally waste disturbing activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Increase number of intrusive operations Ex-Tank activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
Ignition Control Set (see Section 2.3.4)	Trend test cases are run to explore the effect of changing the ignition controls on risk	In-tank ignition control set changed from control set II to past practices: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Ex-tank ignition control set changed from past practices to control set II: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
Ventilation rate (see Section 2.3.5)	Trend test cases are run to explore the effect of changing the ventilation rate on risk	Reduce ventilation flow rate: All tanks Frequency: Increase Consequences: No change Expected risk: Increase

Table 6. Double-Shell Tanks: Expected Results from Acceptance Testing. (4 sheets)

Test Title[a]	Test Description	Expected Test Results[b]
		Increase ventilation flow rate: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Inerting Tank Headspace (see Section 2.3.6)	Trend test cases are run to explore the effect of inerting the tank headspace on risk	Inerting tank headspace with nitrogen 5% residual oxygen: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Inerting Tank Headspace (see Section 2.3.6) Continued		Inerting tank headspace with nitrogen 10% residual oxygen: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Tank Failure (collapse) Pressure (see Section 2.3.8)	Trend test cases are run to determine the effect of changing the tank collapse pressure on risk	Reduce tank failure (collapse) pressure: All tanks Frequency: No change Consequences: Increase Expected risk: Increase
Waste Intrusive Equipment Burns (see Section 2.3.9)	Trend test cases are run to determine the effects of changing individual parameters characterizing waste intrusive equipment characteristics and operations	Increase the number of operations to 5 per year: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Change ignition control to no inerting (5 operations per year): All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Increase the diameter of the equipment (5 operations per year): All tanks Frequency: Decrease Consequences: Increase Expected risk: Increase

Table 6. Double-Shell Tanks: Expected Results from Acceptance Testing. (4 sheets)

Test Title[a]	Test Description	Expected Test Results[b]
		Increase the length of the equipment (5 operations per year): All tanks: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
Density ratio of solids to liquids (see Section 2.3.2.10)	Trend test cases are run to explore the effects of increasing the settled and immobile solids bulk density (layer thickness and liquid layer characteristics are not changed) Note: 241-SY-101 has no immobile solids and is not analyzed	Increase the settled solids bulk density: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Increase the immobile solids bulk density: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
Waste gas generation rate (see Section 2.3.11)	Trend test cases are run to explore the effects of increasing the settled and immobile solids waste gas generation rates (liquid gas generation rates are not changed)	Increase the settled solids gas generation rate: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Increase the immobile solids gas generation rate: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase

(a) Sections identified provide detailed discussion of test performed. See also Table 2.
(b) Expected analysis results based on parameter modified and anticipated effects associated with the modification.

results specific results (e.g., frequency, deflagrations, detonations) are compared for each trend test to the benchmark case results.

2.3.1 Saltwell Pumping

This test applies to SSTs only, since only SSTs are saltwell pumped. Trend testing cases are run to explore the effect of saltwell pumping on risk. Only the saltwell pumping status is varied. The waste volume, which would change if a tank were actually saltwell pumped, is left unchanged. The influence of saltwell pumping on gas retention characteristics is an elicited parameter (Slezak and Bratzel 1997). Tanks identified as "never pumped" are changed to "previously pumped" and vice versa. Changing the saltwell pumping status from "never pumped" to "previously pumped" is expected to decrease risk. Changing the status to "previously pumped" changes the waste void fraction and GRE frequency elicitation. The end result should be a reduction in the number of flammable events, frequency, and magnitude of radiological and toxicological consequences. Table 1 provides a listing of the input parameters and values that are changed for each test.

2.3.2 Waste Volume

This test applies to SSTs and DSTs. Trend testing cases were run to explore the effect of changing the waste volume on risk. The waste volume is changed significantly. A reduction in the waste volume will increase the headspace volume. This effect may impact the ability of the headspace gases to reach the lower flammability limit. To test the effect of reducing waste volume, 30 percent of the existing waste was removed. Reducing the waste volume decreases the retained gas volume by providing less waste in which the gas can be stored. In addition, reducing the waste volume increases the headspace volume in which to dilute the GRE gases. Therefore, the size of the GREs and the fraction of the GREs that produce flammable conditions would decrease which would result in a decrease in the number of events. Due to the properties of the waste the impacts on the frequency and consequences are indeterminate. See Tables 1 and 2 for SSTs and DSTs respectively, for test input parameters. The total DST volume is reduced but the reduction is reflected in liquids only.

2.3.3 Number of Intrusive Operations

This test applies to SSTs and DSTs. Trend testing cases are run to explore the effect of increasing the number of equipment insertion and/or removal operations on risk. The number of operations is increased by a factor of five over the default value. It is expected that the increase in the number of operations increases the risk by increasing the frequency of induced GREs and the frequency of ignition sources. Only the frequency is expected to increase. There should be no change in the number of flammable events and the radiological and toxicological consequences. See Tables 1 and 2 for SSTs and DSTs, respectively, for test input parameters.

2.3.4 Ignition Control Set

This test applies to SSTs and DSTs. Trend testing cases were run to explore the effect of changing the ignition controls on risk. It is expected that frequency increases as the level of ignition control is decreased from "Control Set 1" or "Control Set 2" (HNF-1999) to "Past Practices" (i.e., no controls). The ignition control sets, "Control Set 1", "Control Set 2" and "Past Practices" are described in Appendix B of Slezak and Bratzel (1997). Because the controls do affect the GREs, the controls are expected to affect the frequency but have little effect on the radiological and toxicological consequences. It is expected that changing controls from Ignition Control Set 2 to Past Practices should not change the number of flammable events or consequences; however, the frequency should increase. See Tables 1 and 2 for SST and DST, respectively, for test input parameters.

2.3.5 Ventilation Rate

This test applies to SSTs and DSTs. Trend testing cases were run to explore the effect on risk due to changes the ventilation flow rate (i.e., increasing or decreasing). This test involves reducing or increasing the default ventilation flow rate by a factor of 10. It is expected that actively ventilating a tank, compared to passive ventilation could reduce the time at risk and the computed burn pressures, and perhaps even eliminate flammable conditions (Slezak and Bratzel 1997). Conversely reducing the flow rate could increase the time at risk and the computed burn pressure. Therefore, the expected result of increasing the ventilation rate is a decrease in risk, and decreasing the ventilation rate is an increase in risk. As the ventilation flow rate is modified, gases may be swept out of the tank (increased flow rate) or allowed to accumulate in the headspace (decreased flow rate). See Tables 1 and 2 for SSTs and DSTs, respectively, for test input parameters

2.3.6 Inerting the Tank Headspace with Nitrogen

This test applies to SSTs and DSTs. Trend testing cases were run to determine the impact of inerting the headspace. Sufficient inerting of the headspace will increase the size of GREs needed to reach flammability and can prevent combustion of mixtures that are flammable before release (Slezak and Bratzel 1997). Inerting the headspace reduces the oxidizer for the burn typically furnished by air. Inerting the tank headspace should reduce GRE flammable event frequencies and should result in less damage to the tank as well as reducing the dose consequences. Risk is expected to decrease as inerting is applied. The number of hits, as well as the frequency of burns, should decrease with a small reduction in the consequences. See Tables 1 and 2 for SSTs and DSTs, respectively, for test input parameters.

2.3.7 Tank Failure (Cracking) Pressure

This test applies to SSTs only. Trend testing cases were run to explore the effect on risk of decreasing or increasing the dome cracking pressure. For this test, the dome cracking pressure is decreased or increased by 50%. Structural capacity and failure evaluations are discussed in Slezak and Bratzel 1997. It is expected that risk will increase as failure pressure is reduced, and conversely decrease as failure pressure is increased. A decrease or increase in the cracking pressure from the default value should, respectively, increase or decrease the consequences but should not affect the frequency. Additionally, the number of flammable events for an increase or decrease in the cracking pressure should not change. For a decrease in the cracking pressure, more material would be released to the environment for lower combustion pressures. Conversely for the same combustion pressures, less material would be released to the environment, thus resulting in lower consequences. See Table 1 for test input parameters.

2.3.8 Tank Failure (Collapse) Pressure

This test applies to SSTs and DSTs. Trend testing cases were run to explore the effect on risk of decreasing the dome collapse pressure. The dome collapse pressure is reduced to one-half of the default value. Structural capacities and failure evaluations are discussed in Slezak and Bratzel 1997. It is expected that risk will increase as failure pressure is reduced. Reducing the dome collapse pressure should result in the same conclusions reached in the Tank Failure (Cracking) pressure test (see Section 2.3.7); i.e., the consequences should increase but the frequency should not be affected. Additionally, the number of flammable events for an increase or decrease in the cracking pressure should not change. The risk would therefore increase somewhat. More material would be released to the environment for lower combustion pressures. See Tables 1 and 2 for SSTs and DSTs, respectively, for test input parameters.

2.3.9 Waste Intrusive Equipment

This test applies to SSTs and DSTs. Trend testing cases were run to explore the effect on risk of waste intrusive equipment flammable events. A series of four tests are performed: 1) increase the number of operations per year; 2) change the ignition control from purged to not purged; 3) increase the diameter of the equipment; and 4) increase the length of the equipment. There are no waste intrusive operations in the benchmark case or initial condition. Thus increasing the number of operations will increase risk. The current ignition control requires purging waste intrusive equipment in accordance with the National Fire Prevention Association (NFPA); therefore, not purging the equipment (maintaining operations at five per year) will increase the risk over benchmark conditions and Test 1 in this series. Tests 3 and 4 of the series should affect the detonation cell size, thus an impact is expected on the number of flammable events. However, realistic changes in the equipment design (e.g., diameter and length) may be insufficient to impact the results of Test 1 in this series. Therefore the expected changes at this time are indeterminate.

2.3.10 Increase in Bulk Density Ratio of Solids to Liquids

This test applies to DSTs only. Two tests are performed to determine the relative impacts of increasing the bulk density of the settled solids and immobile solids with respect to GRE behavior. These tests, unlike the previous tests, do not model operations or potential controls that would be implemented in the tank farms. However, based on the behavior of the waste it is anticipated that GRE behavior will be affected. That is, the higher the densities the more gas that will be retained in the waste and released spontaneously or due to some initiating event such as a seismic event or intrusive operation. Thus it is anticipated that the risk will increase.

2.3.11 Increase in Waste Gas Generation Rate

This test applies to DSTs only. Two tests are performed to determine the relative impacts of increasing the gas generation rate in the settled solids and immobile solids with respect to GRE behavior. These tests, unlike the previous tests, do not model operations or potential controls that would be implemented in the tank farms. It is anticipated that the risk will increase relatively proportional to the increased rates.

2.3.12 Mixer Pump

This test applies to DSTs only. The tests, in addition to the Features Tests, were performed to determine the impacts of a mixer pump on consequences. Based on operational experience it is well understood that the mixer pump will reduce the efficiency of the GREs, thus the consequences should decrease. Similarly, the frequency of buoyant displacement GREs will also decrease.

2.3.13 Waste Transfers

This test was performed to evaluate the AT's ability to characterize the risk associated with waste transfer operations. Both cases studied were SST to DST waste transfers. The first case modeled was a direct liquid waste transfer while the second was a water-diluted solid waste transfer. For this testing it is assumed that blending is complete and values for the layers are uniform throughout the layers, all liquids are saturated and the dilution water has no contribution to the waste compositions. Table 7 lists the waste transfer input parameters that were tested.

Table 7. Waste Transfer Input Parameters.

	Case 1				Case 2			
	Sending Tank A-101		Receiving Tank AN-101		Sending Tank A-101		Receiving Tank AY-101	
	gal	(ft^3)	gal	(ft^3)	gal	(ft^3)	gal	(ft^3)
Total volume initial	953,133	(127,415)	160,088	(21,401)	295,080	(39,446)	154,012	(20,588)
Crust Volume Transferred	-	-	-	-	-	-	-	-
Liquid Volume Transferred	200,000	(26,736)	200,000	(26,736)	-	-	-	-
Solids Volume Transferred	-	-	-	-	270,000	(36,094)	270,000	(36,094)
Immobile Solids Volume Transferred	-	-	-	-	-	-	-	-
Dilution Volume	-	-	-	-	-	-	270,000	(36,094)
Total volume final	753,133	(100,679)	360,088	(48,137)	25,080	(3,353)	694,012	(92,776)
Pumping Rate (per min)	72.94	(9.75)	72.94	(9.75)	72.94	(9.75)	72.94	(9.75)

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3.0 SUMMARY OF TEST RESULTS

The results and conclusions reached regarding the acceptability of RESOLVE! Version 2.5 and the insights gained during testing are summarized in the following Sections. Appendices A and B provide the detailed results. Section 4.0 discusses any limitations identified during testing.

3.1 FEATURES TESTING

As discussed in Section 2.1, an extensive test of the AT and GUI features is discussed in Attachment 1. The features testing performed in this acceptance test was limited to the options selected during characteristics and trend testing. This limited set of features tests, based on the parameter modifications, will also verify that the code and data libraries are consistent with the changes in the baseline documentation due to comment incorporation from the independent review.

Additional Features Tests were performed for the DSTs, including turning on and off the mixer pump, buoyant displacement GRE go/no-go tests, waste transfers, and waste intrusive equipment impacts. As stated previously stated, significant developmental testing was performed. As a result of this testing all features performed as expected.

3.2 CHARACTERISTICS TESTS

The following table (Table 8) summarizes the results of the Characteristics Tests performed. As can be seen, with the exception of the DST sample count test, all results meet the established criteria discussed in Section 2.2.

The calculated mean toxicological sum of fractions for a sample count of 950 was approximately eight times the highest calculated sum of fractions for the other tests (i.e., 247 vs 31). All other calculated values, as well as the 95th percentile value for sample count equal to 950, are within the minimum and maximum values. Therefore, prior to reporting toxicological consequences multiple runs should be performed using different seeds and sample sizes (or counts) and evaluated for appropriateness.

3.3 SUMMARY OF TREND TESTING RESULTS

Figures 1 through 32 provide a summary of the trend testing results by tank for each of the parameters modified. Appendices A and B provide the detailed data and quantitative comparisons of the calculated results for the parameter modifications to the benchmark case. Consequences were not calculated for tank Tank 241-T-203, thus no graphical representations are provided for the inerting cases.

Table 8. Summary of the Results of the Characteristics Tests Performed.

Characteristic Test	Test Results – Relative Standard Deviation (%)				
	Number of Events Modeled	Accident Frequency	Radiological Consequences	Toxicological Consequences	Expected Risk
SSTs – 241-S-102					
Sample Count Sensitivity	43.49	6.5	59.78	19.99	96.63
Sample Seed Sensitivity	4.98	7.26	44.94	19.03	51.68
DST – 241-AW-102 (Non-BD)					
Sample Count Sensitivity	42.12	62.76	102.24	251.55	161.43
Sample Seed Sensitivity	0.18	70.57	127.30	96.02	143.39
DST – 241-AN-103 (BD)					
Sample Count Sensitivity	42.24	27.55	103.43	68.31	158.89
Sample Sed Sensitivity	1.39	20.55	99.37	68.55	126.62

BD – Buoyant displacement

As can be seen from the figures the majority of the parameters modified for both DSTs and SSTs did not significantly affect the benchmark results. This is the same conclusion reached during acceptance testing of Version 2.13 (see Attachment 1). The parameter modifications that did significantly impact the results include waste volume reduction, an increase or decrease in ventilation flow rate, and changes in the waste and waste gas generation characteristics (DST only). In each of these cases the results trend as expected.

With respect to waste intrusive equipment, as expected for both DSTs and SSTs, increasing the number of waste intrusive activities increased the number of potential deflagrations and detonations when compared to the benchmark case. Additionally as expected, removing the purge from the waste intrusive equipment significantly increased the number of potential deflagrations and detonations when compared to the base case or five operations per year. Increasing the equipment diameter or length had no impact on the base case results. Because there are no or limited observed data regarding waste intrusive equipment, the results cannot be evaluated for appropriateness.

Figure 18 graphically shows the results obtained due to modifications in the characteristics of the settled solids and the immobile solids (hard pan) in Tank 241-AN-107. This represents the greatest change form benchmark conditions for all tests performed. As can be seen increasing the ratio of the settled solids to the liquids increased the number of deflagrations in Tank 241-AN-107. Additionally, the change in waste characteristics increased the BD GRE frequency in Tank 241-AN-107.

Not shown graphically are the results obtained from buoyant displacement, mixer pump, and waste transfers testing. As expected changes in the five criteria identified in Table 6 (DST Features Testing) created buoyant displacement GREs in non-buoyant displacement tanks and vice versa. Similarly as expected, the calculated results from turning on the mixer pump and changing selected parameters to model existing conditions in Tank 241-SY-101 were validated to current conditions or observed GRE behavior in the tank. The waste transfer test described in Section 2.1.13 performed as expected;s, post transfer sending and receiving tank analysis results were comparable to tank analyses.

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4.0 LIMITATIONS

This section discusses the limitations identified as a result of acceptance testing. There were two limitations identified. One resulted from "Characteristics Testing" and the other, "Waste Intrusive Equipment" was identified based on a lack of actual or observed data to validate the results. Each of the limitations is discussed in the following.

4.1 CHARACTERISTICS TESTING

As discussed in Section 3.2, with the exception of the DST sample count test, all results met the established criteria discussed in Section 2.2. The calculated mean toxicological sum of fractions exceeded the acceptance relative standard deviation criteria. The calculated sum of fractions for one sample count, 950, was approximately 8 times the highest calculated sum of fractions for the other tests (i.e., 247 vs 31). All other calculated values, as well as the 95th percentile value for sample count equal to 950, are within the minimum and maximum values. Therefore, prior to reporting toxicological consequences multiple runs should be performed using different seeds and sample sizes (or counts) and evaluated for appropriatness.

4.2 WASTE INTRUSIVE EQUIPMENT

Based on a lack of actual or observed data, the results from testing parameter modifications in the operations of waste intrusive equipment and equipment design could not be validated. However, the results from the modifications trended as expected (see Section 3.3). This limitation was also identified during verification and validation testing of Version 2.5 (Cheng et al. 2000). Therefore, when reporting the results associated with waste intrusive equipment, it should be noted that the results cannot be validated and should be used for comparison purposes only.

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5.0 REFRENCES

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APPENDIX A

SST ACCEPTANCE TEST RESULTS

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APPENDIX A

This Appendix provides the results of the SST acceptance testing. A strict comparison of the benchmark results to the trend analysis results does not consider the magnitude of the difference. For example, if the benchmark mean consequence value is 4.567E-05 Sv and the mean trend test analysis result is 4.566E-05 Sv, a comparison of this type would indicate that by modifying a specific parameter, the consequences decreased; however, based on the conservatisms and uncertainties incorporated in the Analysis Tool, a better conclusion would be that there is no change.

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Table A-1. SST Acceptance Test Results: GRE Behavior. (Seed: 90,000,000, Sample Count: 1000)

Tank	GRE Behavior	Number of Events		Number of Deflagrations		Number of Detonations		%LFL Mean Frequency		%LFL Mean Concentration		Mean Number of Events/year	
BENCHMARK													
A-102	all sizes	11962		272		0		9.28E-03		18.70		7.91E-02	
	small	3986		0		0		2.21E-02		0.07		6.68E-02	
	medium	3988		272		0		4.42E-03		54.40		9.37E-03	
	large	3988		0		0		1.31E-03		1.72		2.69E-03	
B-111	all sizes	11828		116		0		6.44E-02		10.80		5.93E-01	
	small	3940		0		0		1.62E-01		0.12		5.22E-01	
	medium	3944		116		0		2.44E-02		29.20		5.44E-02	
	large	3944		0		0		7.08E-03		3.08		1.50E-02	
S-102	all sizes	12945		1752		0		6.50E-03		154.00		5.53E-02	
	small	4313		0		0		1.52E-02		2.52		4.60E-02	
	medium	4316		1386		0		3.13E-03		397.00		6.80E-03	
	large	4316		366		0		1.18E-03		61.70		2.40E-03	
T-203	all sizes	11628		110		0		8.95E-03		8.22		7.71E-02	
	small	3876		0		0		2.15E-02		0.66		6.55E-02	
	medium	3876		22		0		4.07E-03		7.02		8.69E-03	
	large	3876		88		0		1.32E-03		17.00		2.74E-03	
SALT WELL PUMPING													
A-102	all sizes	11887	<	264	<	0	=	9.56E-03	>	17.80	<	8.24E-02	>
WASTE VOLUME REDUCTION													
B-111	all sizes	11888	>	76	<	0	=	6.65E-02	>	6.53	<	6.14E-01	>
INTRUSIVE OPERATIONS INCREASE ALL													
S-102	all sizes	12129	<	1672	<	0	=	6.64E-03	>	156.00	>	4.83E-02	<
	small	4041	<	2	>	0	=	1.46E-02	<	3.13	>	3.73E-02	<
	medium	4044	<	1320	<	0	=	4.21E-03	>	403.00	>	8.74E-03	>
	large	4044	<	350	<	0	=	1.08E-03	<	60.70	<	2.18E-03	<
INTRUSIVE OPERATIONS INCREASE NON WASTE DISTURBING													
S-102	all sizes	12945	=	1752	=	0	=	6.50E-03	=	154.00	=	5.53E-02	=
	small	4313	=	0	=	0	=	1.52E-02	=	2.52	=	4.60E-02	=
	medium	4316	=	1386	=	0	=	3.13E-03	=	397.00	=	6.80E-03	=
	large	4316	=	366	=	0	=	1.18E-03	=	61.70	=	2.40E-03	=
INTRUSIVE OPERATIONS INCREASE LOCALLY WASTE DISTURBING													
S-102	all sizes	12213	<	1710	<	0	=	8.15E-03	>	156.00	>	6.49E-02	>
	small	4069	<	0	=	0	=	1.99E-02	>	2.55	>	5.51E-02	>
	medium	4072	<	1338	<	0	=	3.64E-03	>	406.00	>	7.97E-03	>
	large	4072	<	372	>	0	=	8.70E-04	<	61.10	<	1.79E-03	<
INTRUSIVE OPERATIONS INCREASE GLOBALLY WASTE DISTURBING													
S-102	all sizes	11938	<	1648	<	0	=	7.31E-03	>	153.00	<	5.31E-02	<
	small	3978	<	4	>	0	=	1.68E-02	>	3.78	>	4.23E-02	<
	medium	3980	<	1270	<	0	=	4.28E-03	>	394.00	<	8.96E-03	>
	large	3980	<	374	>	0	=	8.73E-04	<	60.90	<	1.77E-03	<
INTRUSIVE OPERATIONS INCREASE EX-TANK													
S-102	all sizes	12945	=	1752	=	0	=	6.50E-03	=	154.00	=	5.53E-02	=
	small	4313	=	0	=	0	=	1.52E-02	=	2.52	=	4.60E-02	=
	medium	4316	=	1386	=	0	=	3.13E-03	=	397.00	=	6.80E-03	=
	large	4316	=	366	=	0	=	1.18E-03	=	61.70	=	2.40E-03	=
INTRUSIVE OPERATIONS INCREASE IN/EX-TANK													
S-102	all sizes	12129	<	1672	<	0	=	6.64E-03	>	156.00	>	4.83E-02	<
	small	4041	<	2	>	0	=	1.46E-02	<	3.13	>	3.73E-02	<
	medium	4044	<	1320	<	0	=	4.21E-03	>	403.00	>	8.74E-03	>
	large	4044	<	350	<	0	=	1.08E-03	<	60.70	<	2.18E-03	<
IGNITION CONTROL SET IN-TANK													
A-102	all sizes	11962	=	272	<	0	=	9.28E-03	>	18.70	<	7.91E-02	>

Table A-1. SST Acceptance Test Results: GRE Behavior. (Seed: 90,000,000, Sample Count: 1000)

Tank	GRE Behavior	Number of Events		Number of Deflagrations		Number of Detonations		%LFL Mean Frequency		%LFL Mean Concentration		Mean Number of Events/year	
IGNITION CONTROL SET IN/EX-TANK													
A-102	all sizes	11962	=	272	<	0	=	9.28E-03	>	18.70	<	7.91E-02	>
VENTILATION FLOW RATE REDUCTION													
B-111	all sizes	11828	=	116	=	0	=	6.44E-02	=	10.80	=	5.93E-01	=
	small	3940	=	0	=	0	=	1.62E-01	=	0.14	>	5.22E-01	=
	medium	3944	=	116	=	0	=	2.44E-02	=	29.20	=	5.44E-02	=
	large	3944	=	0	=	0	=	7.08E-03	=	3.14	>	1.50E-02	=
VENTILATION FLOW RATE INCREASE													
B-111	all sizes	11828	=	116	=	0	=	6.44E-02	=	10.70	<	5.93E-01	=
	small	3940	=	0	=	0	=	1.62E-01	=	0.10	<	5.22E-01	=
	medium	3944	=	116	=	0	=	2.44E-02	=	29.10	<	5.44E-02	=
	large	3944	=	0	=	0	=	7.08E-03	=	2.75	<	1.50E-02	=
INERTING NITROGEN 5% OXYGEN													
T-203	all sizes	11628	=	0	<	0	=	8.95E-03	=	6.17	<	7.71E-02	=
INERTING NITROGEN 10% OXYGEN													
T-203	all sizes	11628	=	0	<	0	=	8.95E-03	=	6.17	<	7.71E-02	=
TANK CRACKING PRESSURE REDUCTION													
B-111	all sizes	11828	=	116	=	0	=	6.44E-02	=	10.80	=	5.93E-01	=
TANK CRACKING PRESSURE INCREASE													
B-111	all sizes	11828	=	116	=	0	=	6.44E-02	=	10.80	=	5.93E-01	=
TANK COLLAPSE PRESSURE REDUCTION													
B-111	all sizes	11828	=	116	=	0	=	6.44E-02	=	10.80	=	5.93E-01	=
WASTE INTRUSIVE EQUIPMENT - INCREASE OPERATIONS													
A-102	all sizes	11963	>	272	>	1	>	9.63E-03	>	18.80	>	7.91E-02	>
	WIE all sizes	1	>	0	=	1	>	1.00E+00	>	667.00	>	1.00E+00	>
WASTE INTRUSIVE EQUIPMENT - INCREASE OPERATIONS - NO PURGE													
A-102	all sizes	12670	>	584	>	396	>	6.46E-02	>	43.80	>	7.91E-02	=
	WIE all sizes	708	>	312	>	396	>	1.00E+00	=	467.00	<	1.00E+00	=
WASTE INTRUSIVE EQUIPMENT - INCREASE OPERATIONS - IINCREASE EQUIPMENT DIAMETER													
A-102	all sizes	11963	=	272	=	1	=	9.63E-03	=	18.80	=	7.91E-02	=
	WIE all sizes	1	=	0	=	1	=	1.00E+00	=	667.00	=	1.00E+00	=
WASTE INTRUSIVE EQUIPMENT - INCREASE OPERATIONS - IINCREASE EQUIPMENT LENGTH													
A-102	all sizes	11963	=	272	=	1	=	9.63E-03	=	18.80	=	7.91E-02	=
	WIE all sizes	1	=	0	=	1	=	1.00E+00	=	667.00	=	1.00E+00	=

APPENDIX B

DST ACCEPTANCE TEST RESULTS

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APPENDIX B

This Appendix provides the results of the DST acceptance testing. A strict comparison of the benchmark results to the trend analysis results does not consider the magnitude of the difference. For example, if the benchmark mean consequence value is 4.567E-05 Sv and the mean trend test analysis result is 4.566E-05 Sv, a comparison of this type would indicate that by modifying a specific parameter, the consequences decreased; however, based on the conservatisms and uncertainties incorporated in the Analysis Tool, a better conclusion would be that there is no change.

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Table B-1. DST Acceptance Test Results: GRE Behavior. (Seed: 90,000,000, Sample Count: 1000)

Tank	GRE Behavior	Number of Events		Number of Deflagrations		Number of Detonations		%LFL				Mean Number of Events/year	
								Mean Frequency		Mean Concentration			
BENCHMARK													
AN-107	all sizes	4235		505		0		7.07E+00		1.26E+02		3.33E+01	
	small	1221		0		0		5.31E+00		1.81E+00		N/A	
	medium	2014		492		0		1.16E+01		2.47E+02		N/A	
	large	1000		13		0		2.43E-03		3.54E+01		2.43E-03	
	BD	1241		0		0		2.41E+01		6.79E+00		3.33E+01	
	Non-BD	2994		505		0		2.91E-03		1.76E+02		8.73E-03	
AW-106	all sizes	12017		936		0		1.95E-01		6.08E+01		1.28E+00	
	small	4001		0		0		4.42E-01		5.83E-01		9.86E-01	
	medium	4008		930		0		1.18E-01		1.65E+02		2.39E-01	
	large	4008		6		0		2.42E-02		1.71E+01		4.90E-02	
	BD	0		0		0		0.00E+00		0.00E+00		0.00E+00	
	Non-BD	12017		936		0		1.95E-01		6.08E+01		1.27E+00	
AY-101	all sizes	11997		80		0		8.03E-01		7.66E+00		5.56E+00	
	small	3997		0		0		1.52E+00		2.61E-01		3.76E+00	
	medium	4000		80		0		4.75E-01		2.18E+01		9.73E-01	
	large	4000		0		0		4.11E-01		9.33E-01		8.24E-01	
	BD	0		0		0		0.00E+00		0.00E+00		0.00E+00	
	Non-BD	11997		80		0		8.03E-01		7.66E+00		5.56E+00	
INERTING NITROGEN 5% OXYGEN													
AN-107	all sizes	4235	=	133	<	0	=	7.07E+00	=	5.48E+01	<	3.33E+01	=
INERTING NITROGEN 10% OXYGEN													
AN-107	all sizes	4235	=	133	<	0	=	7.07E+00	=	5.48E+01	<	3.33E+01	=
WASTE VOLUME REDUCTION													
AN-107	all sizes	4355	>	463	<	0	=	8.88E+00	>	1.01E+02	<	1.01E+02	>
	BD	1361	>	0	=	0	=	2.84E+01	>	3.66E+00	<	3.66E+00	<
	Non-BD	2994	=	463	<	0	=	2.91E-03	=	1.46E+02	<	1.46E+02	>
VENTILATION FLOW RATE REDUCTION													
AW-106	all sizes	12017	=	940	>	0	=	1.95E-01	=	6.26E+01	>	1.28E+00	=
	small	4001	=	0	=	0	=	4.42E-01	=	8.74E-01	>	9.86E-01	=
	medium	4008	=	932	>	0	=	1.18E-01	=	1.65E+02	=	2.39E-01	=
	large	4008	=	8	>	0	=	2.42E-02	=	2.16E+01	>	4.90E-02	=
	BD	0	=	0	=	0	=	0.00E+00	=	0.00E+00	=	0.00E+00	=
	Non-BD	12017	=	940	>	0	=	1.95E-01	=	6.26E+01	>	1.27E+00	=
VENTILATION FLOW RATE INCREASE													
AW-106	all sizes	12017	=	932	<	0	=	1.95E-01	=	5.85E+01	<	1.28E+00	=
	small	4001	=	0	=	0	=	4.42E-01	=	3.80E-01	<	9.86E-01	=
	medium	4008	=	930	=	0	=	1.18E-01	=	1.64E+02	<	2.39E-01	=
	large	4008	=	2	<	0	=	2.42E-02	=	1.13E+01	<	4.90E-02	=
	BD	0	=	0	=	0	=	0.00E+00	=	0.00E+00	=	0.00E+00	=
	Non-BD	12017	=	932	<	0	=	1.95E-01	=	5.85E+01	<	1.27E+00	=
INTRUSIVE OPERATIONS INCREASE ALL													
AW-106	all sizes	12017	=	936	=	0	=	1.95E-01	=	6.08E+01	=	1.28E+00	=
	small	4001	=	0	=	0	=	4.42E-01	=	5.83E-01	=	9.86E-01	=

Table B-1. DST Acceptance Test Results: GRE Behavior. (Seed: 90,000,000, Sample Count: 1000)

Tank	GRE Behavior	Number of Events		Number of Deflagrations		Number of Detonations		%LFL Mean Frequency		%LFL Mean Concentration		Mean Number of Events/year	
	medium	4008	=	930	=	0	=	1.18E-01	=	1.65E+02	=	2.39E-01	=
	large	4008	=	6	=	0	=	2.42E-02	=	1.71E+01	=	4.90E-02	=
	BD	0	=	0	=	0	=	0.00E+00	=	0.00E+00	=	0.00E+00	=
	Non-BD	12017	=	936	=	0	=	1.95E-01	=	6.08E+01	=	1.27E+00	=
INTRUSIVE OPERATIONS INCREASE NON WASTE DISTURBING													
AW-106	all sizes	12017	=	936	=	0	=	1.95E-01	=	6.08E+01	=	1.28E+00	=
	small	4001	=	0	=	0	=	4.42E-01	=	5.83E-01	=	9.86E-01	=
	medium	4008	=	930	=	0	=	1.18E-01	=	1.65E+02	=	2.39E-01	=
	large	4008	=	6	=	0	=	2.42E-02	=	1.71E+01	=	4.90E-02	=
	BD	0	=	0	=	0	=	0.00E+00	=	0.00E+00	=	0.00E+00	=
	Non-BD	12017	=	936	=	0	=	1.95E-01	=	6.08E+01	=	1.27E+00	=
INTRUSIVE OPERATIONS INCREASE LOCALLY WASTE DISTURBING													
AW-106	all sizes	12147	>	954	>	0	=	1.85E-01	<	6.18E+01	>	1.22E+00	<
	small	4043	>	0	=	0	=	4.10E-01	<	5.84E-01	>	9.24E-01	<
	medium	4052	>	952	>	0	=	1.22E-01	>	1.68E+02	>	2.46E-01	>
	large	4052	>	2	<	0	=	2.53E-02	>	1.71E+01	=	5.12E-02	>
	BD	0	=	0	=	0	=	0.00E+00	=	0.00E+00	=	0.00E+00	=
	Non-BD	12147	>	954	>	0	=	1.85E-01	<	6.18E+01	>	1.22E+00	<
INTRUSIVE OPERATIONS INCREASE GLOBALLY WASTE DISTURBING													
AW-106	all sizes	12125	>	936	=	0	=	2.09E-01	>	6.09E+01	>	1.36E+00	>
	small	4037	>	0	=	0	=	4.82E-01	>	5.80E-01	<	1.06E+00	>
	medium	4044	>	930	=	0	=	1.22E-01	>	1.65E+02	=	2.46E-01	>
	large	4044	>	6	=	0	=	2.41E-02	<	1.71E+01	=	4.88E-02	<
	BD	0	=	0	=	0	=	0.00E+00	=	0.00E+00	=	0.00E+00	=
	Non-BD	12125	>	936	=	0	=	2.09E-01	>	6.09E+01	>	1.35E+00	>
INTRUSIVE OPERATIONS INCREASE EX-TANK													
AW-106	all sizes	12039	>	936	=	0	=	1.83E-01	<	5.78E+01	<	1.23E+00	<
	small	4007	>	0	=	0	=	4.19E-01	<	5.92E-01	>	9.62E-01	<
	medium	4016	>	936	>	0	=	1.08E-01	<	1.55E+02	<	2.19E-01	<
	large	4016	>	0	<	0	=	2.33E-02	<	1.72E+01	>	4.74E-02	<
	BD	0	=	0	=	0	=	0.00E+00	=	0.00E+00	=	0.00E+00	=
	Non-BD	12039	>	936	=	0	=	1.83E-01	<	5.78E+01	<	1.23E+00	<
INTRUSIVE OPERATIONS INCREASE IN/EX-TANK													
AW-106	all sizes	12063	>	918	<	0	=	2.01E-01	>	5.97E+01	<	1.29E+00	>
	small	4015	>	0	=	0	=	4.51E-01	>	5.88E-01	>	9.81E-01	<
	medium	4024	>	914	<	0	=	1.26E-01	>	1.61E+02	<	2.53E-01	>
	large	4024	>	4	<	0	=	2.51E-02	>	1.71E+01	=	5.07E-02	>
	BD	0	=	0	=	0	=	0.00E+00	=	0.00E+00	=	0.00E+00	=
	Non-BD	12063	>	918	<	0	=	2.01E-01	>	5.97E+01	<	1.29E+00	>
IGNITION CONTROL SET IN-TANK													
AY-101	all sizes	11997	=	80	=	0	=	8.03E-01	=	7.66E+00	=	5.56E+00	=
IGNITION CONTROL SET EX-TANK													
AY-101	all sizes	11997	=	80	=	0	=	8.03E-01	=	7.66E+00	=	5.56E+00	=
IGNITION CONTROL SET IN/EX-TANK													
AY-101	all sizes	11997	=	80	=	0	=	8.03E-01	=	7.66E+00	=	5.56E+00	=
DENSITY RATIO LIQUIDS TO SETTLED SOLIDS													

Table B-1. DST Acceptance Test Results: GRE Behavior. (Seed: 90,000,000, Sample Count: 1000)

Tank	GRE Behavior	Number of Events		Number of Deflagrations		Number of Detonations		%LFL Mean Frequency		%LFL Mean Concentration		Mean Number of Events/year	
AN-107	all sizes	4230	<	1781	>	45	>	8.94E-01	<	2.42E+02	>	5.94E+00	<
	BD	1253	>	124	>	0	=	3.01E+00	<	5.67E+01	>	5.92E+00	<
	Non-BD	2977	<	1657	>	45	>	2.92E-03	>	3.21E+02	>	8.77E-03	>
DENSITY RATIO LIQUIDS TO IMMOBILE SOLIDS													
AN-107	all sizes	4235	=	505	=	0	=	7.07E+00	=	1.26E+02	=	3.33E+01	=
	BD	1241	=	0	=	0	=	2.41E+01	=	6.79E+00	=	3.33E+01	=
	Non-BD	2994	=	505	=	0	=	2.91E-03	=	1.76E+02	=	8.73E-03	=
GAS GENERATION RATE INCREASE SETTLED SOLIDS													
AN-107	all sizes	4235	=	505	=	0	=	7.06E+01	>	1.26E+02	=	3.02E+02	>
	small	1221	=	0	=	0	=	5.23E+01	>	1.81E+00	=	N/A	=
	medium	2014	=	492	=	0	=	1.17E+02	>	2.47E+02	=	N/A	=
	large	1000	=	13	=	0	=	2.43E-03	=	3.54E+01	=	2.43E-03	=
	BD	1241	=	0	=	0	=	2.41E+02	>	6.79E+00	=	3.02E+02	>
	Non-BD	2994	=	505	=	0	=	2.91E-03	=	1.76E+02	=	8.73E-03	=
GAS GENERATION RATE INCREASE IMMOBILE SOLIDS													
AN-107	all sizes	4235	=	505	=	0	=	2.25E-05	<	4.11E-04	<	3.65E-04	<
	small	1221	=	0	=	0	=	2.92E-05	<	7.48E-04	<	2.92E-05	<
	medium	2014	=	492	=	0	=	0.00E+00	<	0.00E+00	<	0.00E+00	<
	large	1000	=	13	=	0	=	3.37E-05	<	1.77E+01	<	1.50E-03	<
	BD	1241	=	0	=	0	=	4.77E-05	<	7.27E-04	<	5.80E-04	<
	Non-BD	2994	=	505	=	0	=	2.25E-05	<	4.63E+00	<	3.65E-04	<
TANK FAILURE PRESSURE REDUCTION													
AN-107	all sizes	4235	=	505	=	505	>	0.00E+00	<	1.26E+02	=	3.33E+01	=
WASTE INTRUSIVE EQUIPMENT - INCREASE OPERATIONS													
AY-101	all sizes	11998	>	80	=	1	>	8.03E-01	=	7.79E+00	>	5.56E+00	=
	WIE all sizes	1	>	0	>	1	>	1.00E+00	>	1.55E+03	>	1.00E+00	>
WASTE INTRUSIVE EQUIPMENT - INCREASE OPERATIONS - NO PURGE													
AY-101	all sizes	12678	>	380	>	381	>	8.14E-01	>	3.29E+01	>	5.56E+00	=
	WIE all sizes	681	>	300	>	381	>	1.00E+00	=	4.78E+02	<	1.00E+00	=
WASTE INTRUSIVE EQUIPMENT - INCREASE OPERATIONS - INCREASE EQUIPMENT DIAMETER													
AY-101	all sizes	11998	=	80	=	80	>	1.00E+00	>	7.79E+00	=	5.56E+00	=
	WIE all sizes	1	=	0	=	0	<	1.00E+00	=	1.55E+03	=	1.00E+00	=
WASTE INTRUSIVE EQUIPMENT - INCREASE OPERATIONS - INCREASE EQUIPMENT LENGTH													
AY-101	all sizes	11998	=	80	=	80	>	1.00E+00	>	7.79E+00	=	5.56E+00	=
	WIE all sizes	1	=	0	=	0	<	1.00E+00	=	1.55E+03	=	1.00E+00	=

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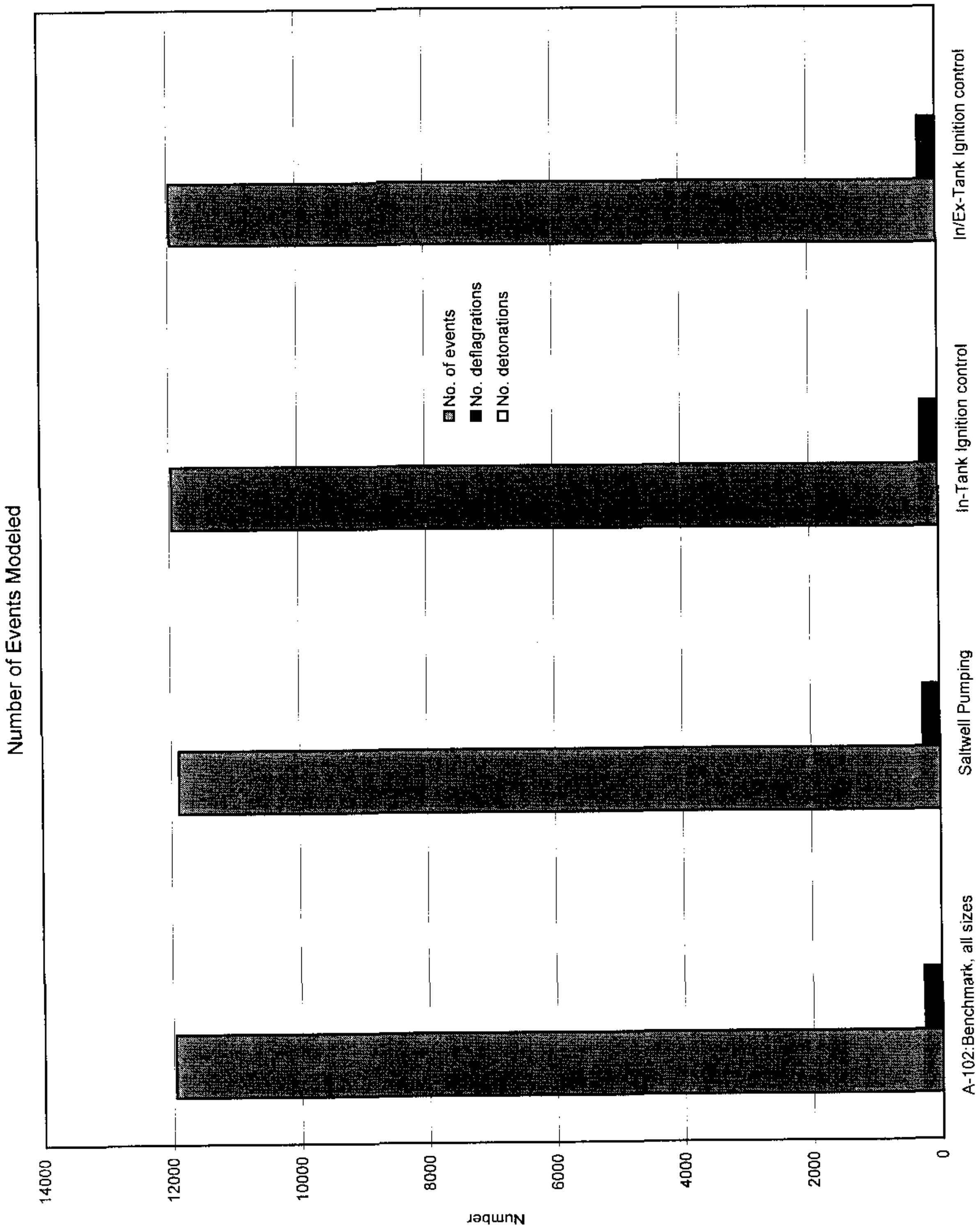

Figure 1. Comparison of Tank 241-A-102 Benchmark Events, Deflagrations, and Detonations to Modified Conditions.

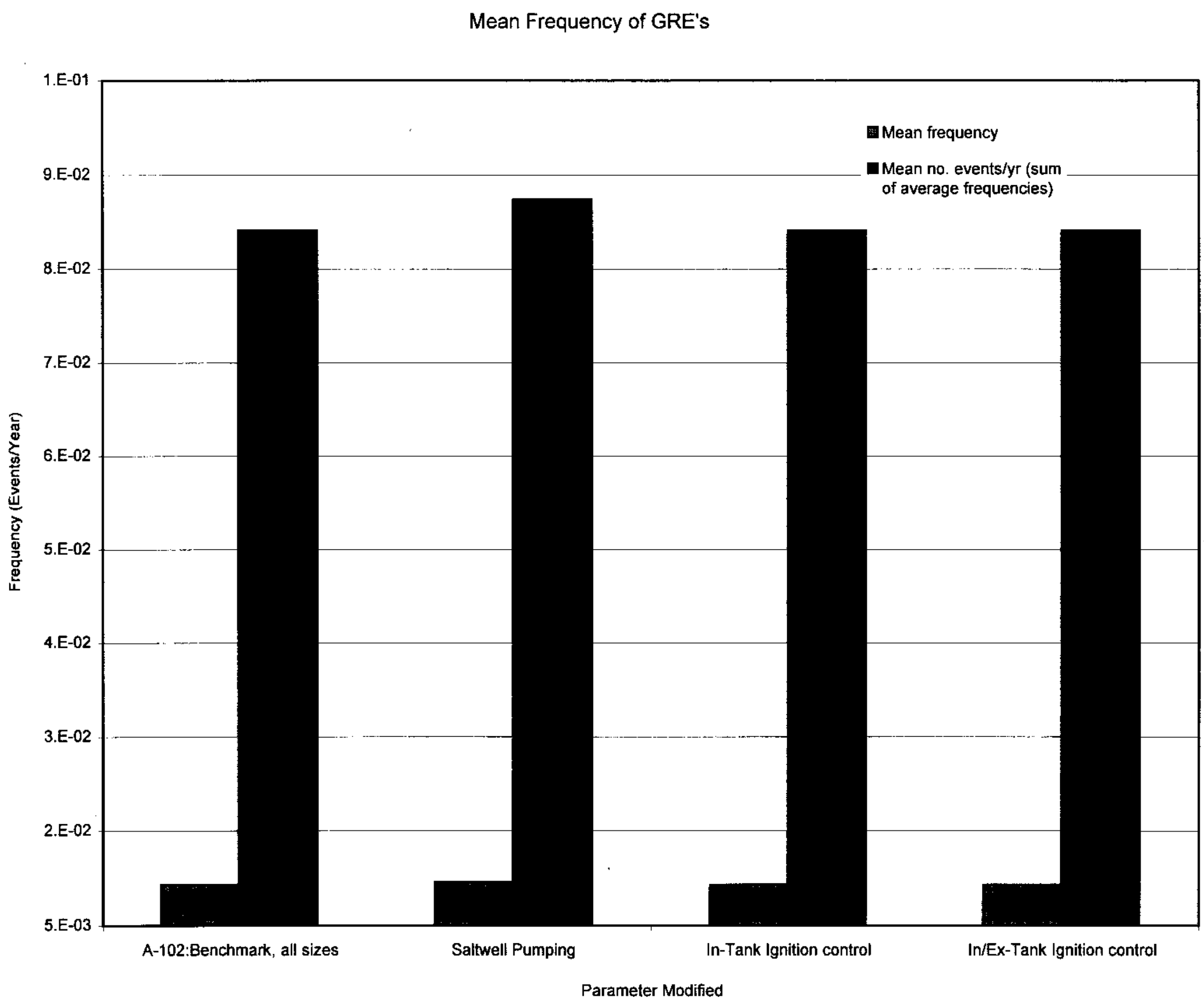

Figure 2. Comparison of Tank 241-A-102 Benchmark GRE Frequency (events/year) to Modified Conditions.

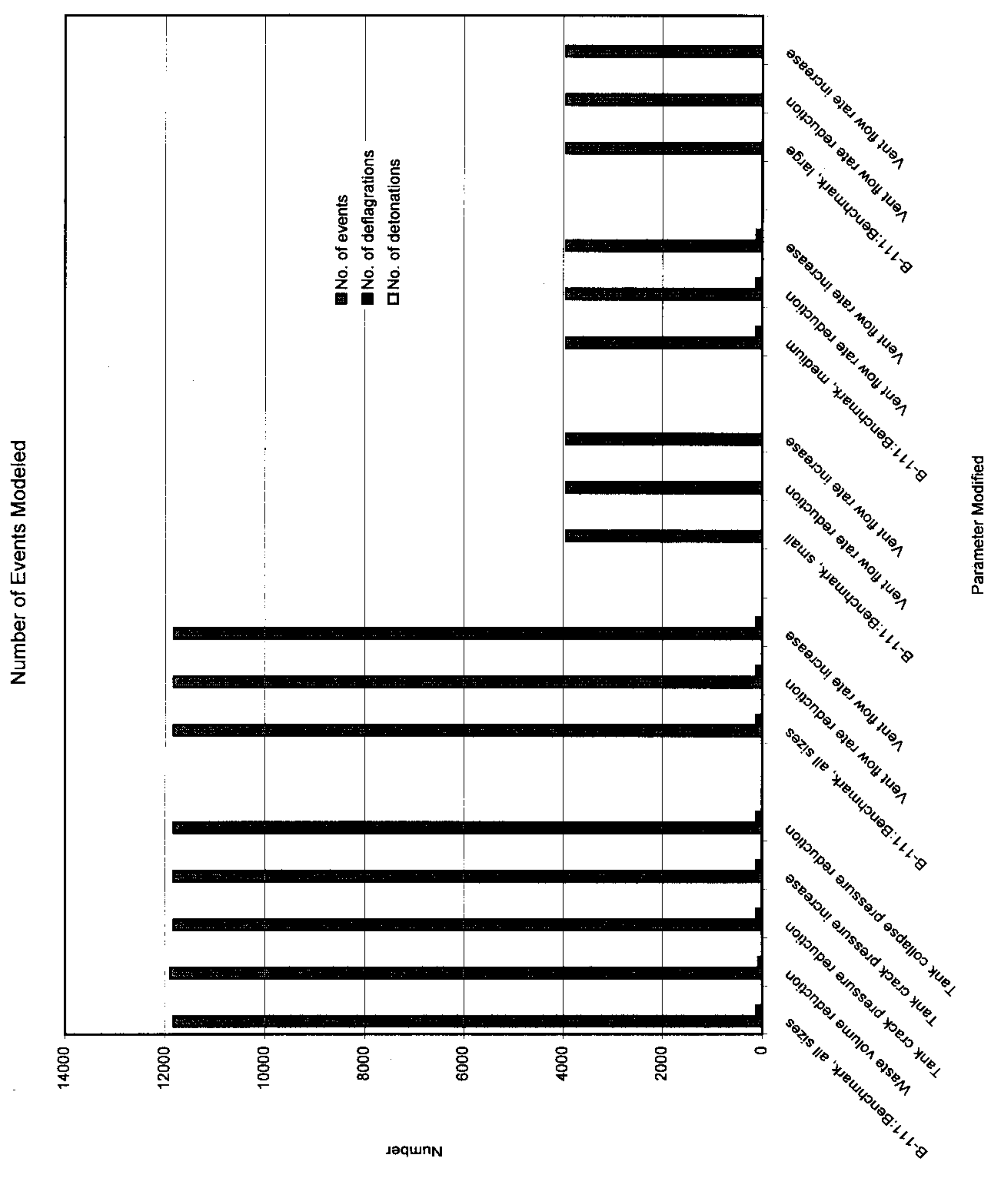

Figure 3. Comparison of Tank 241-B-111 Benchmark Events, Deflagrations, and Detonations to Modified Conditions.

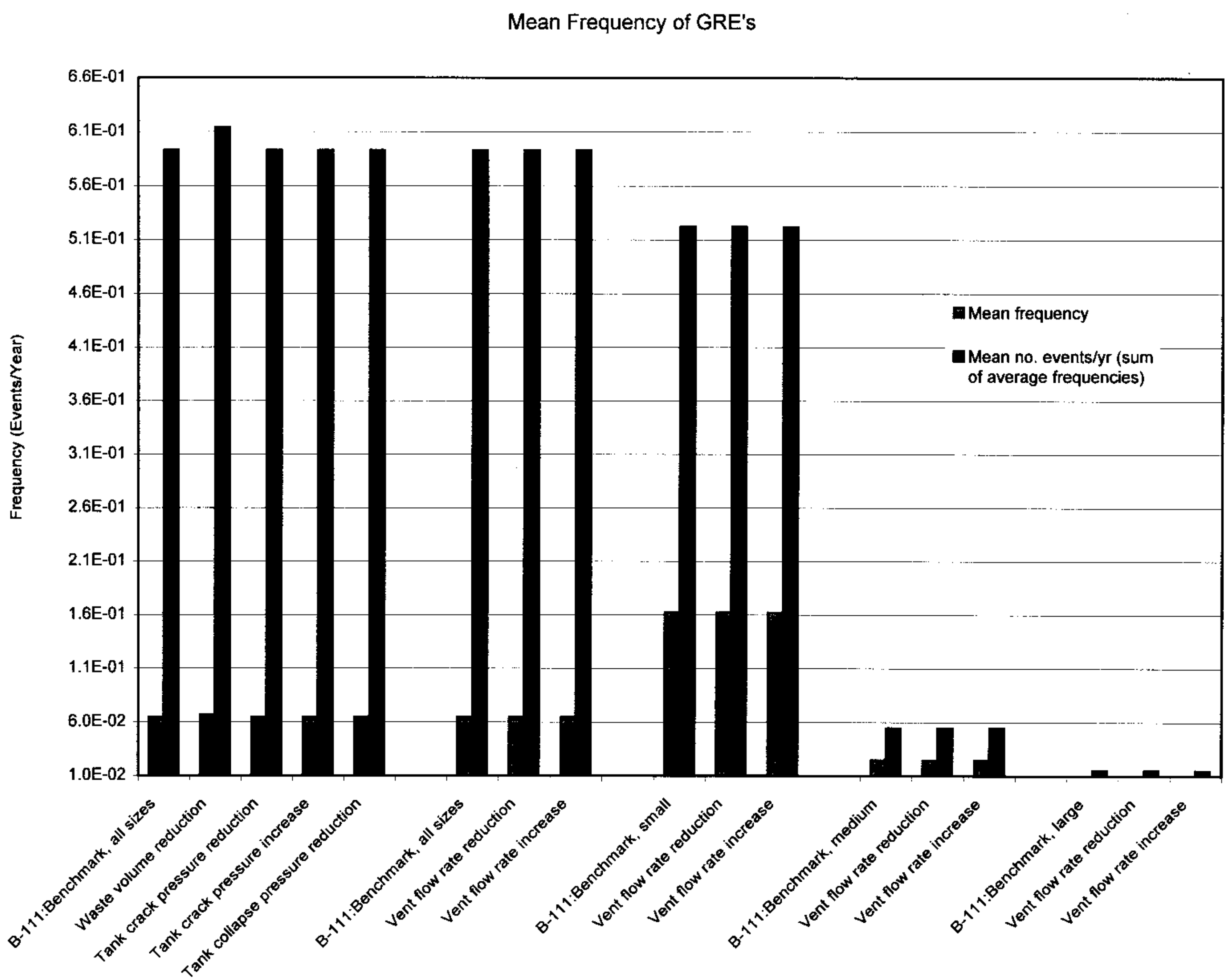

Figure 4. Comparison of Tank 241-B-111 Benchmark GRE Frequency (events/year) to Modified Conditions.

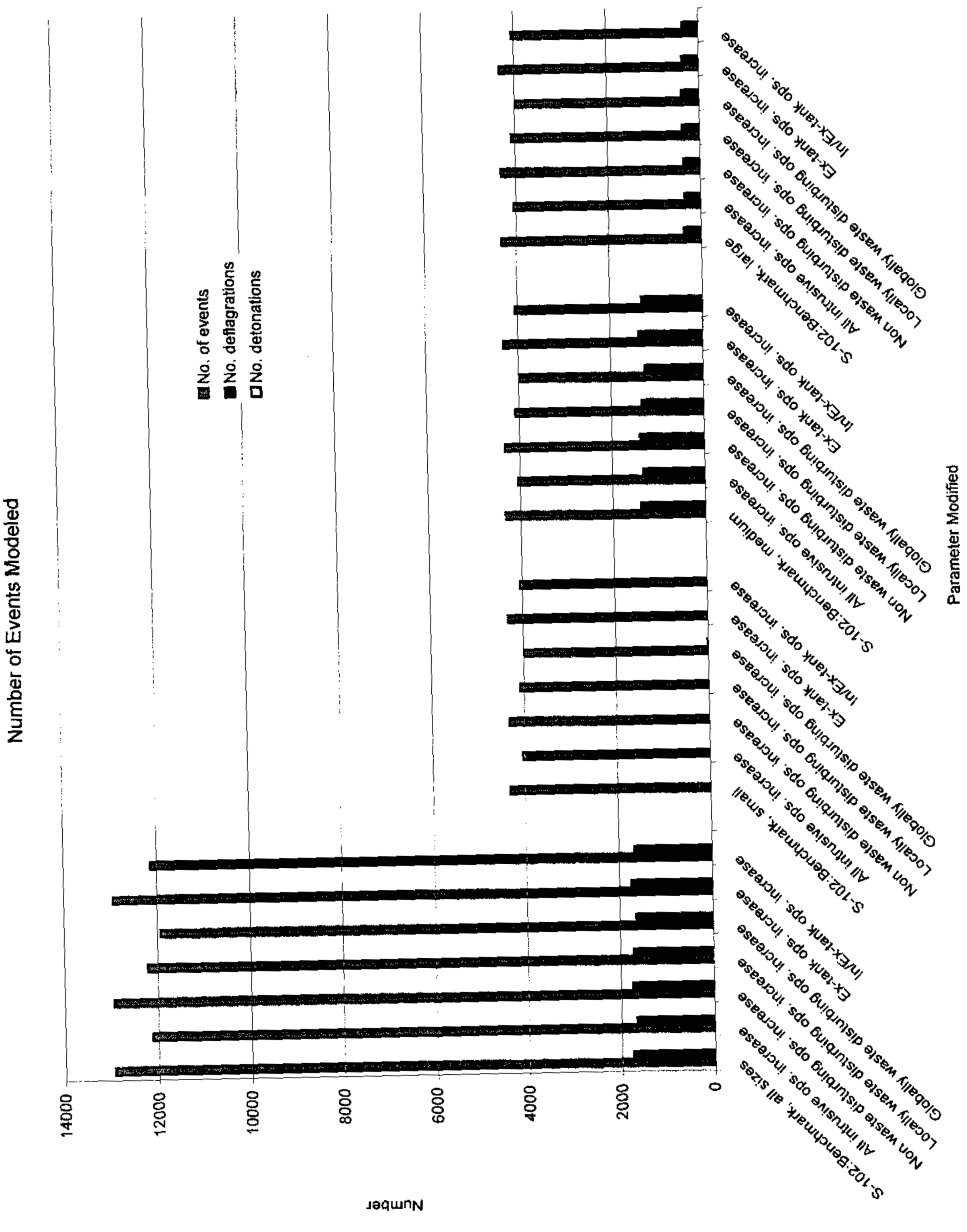

Figure 5. Comparison of Tank 241-S-102 Benchmark Events, Deflagrations, and Detonations to Modified Conditions.

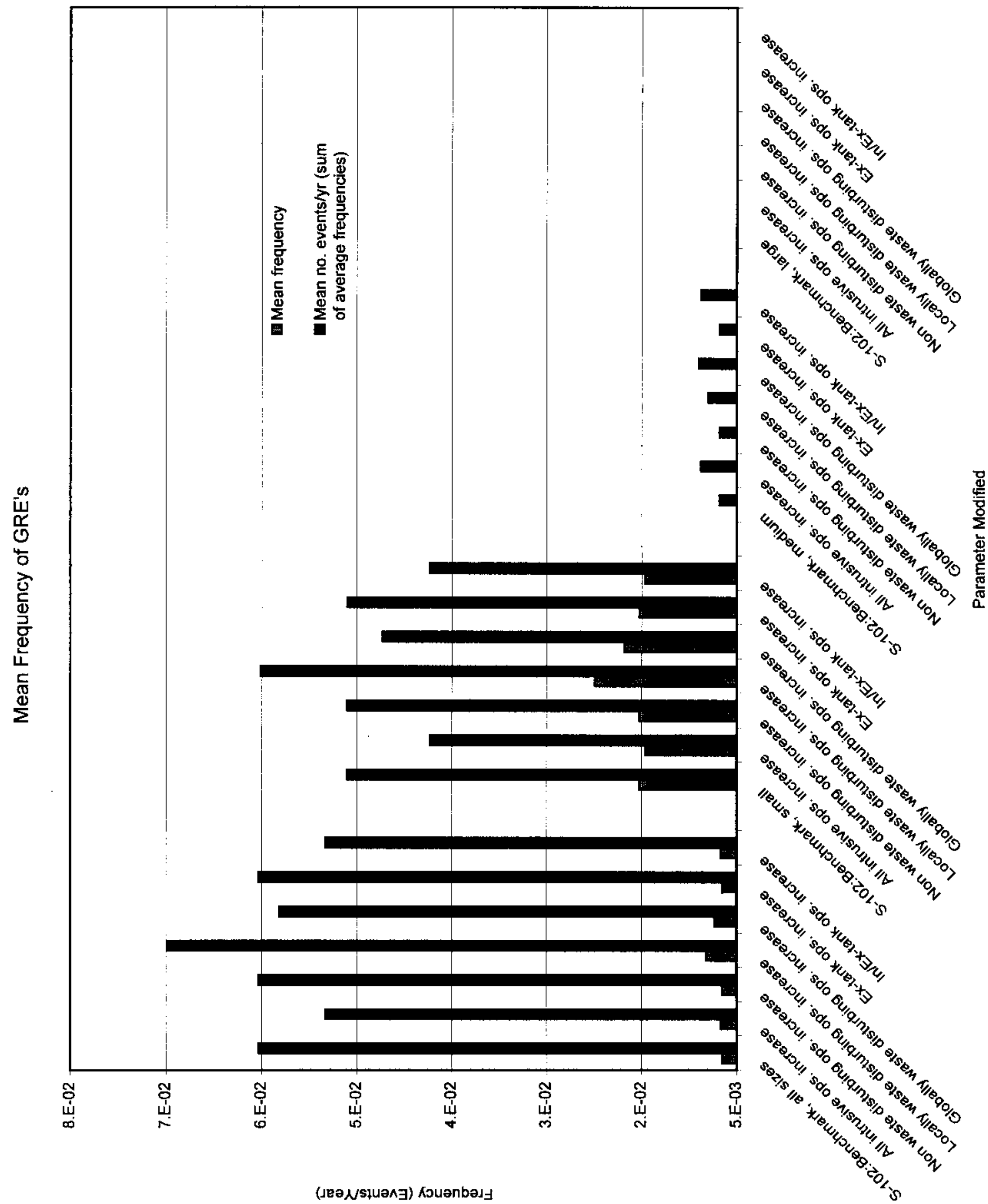

Figure 6. Comparison of Tank 241-S-102 Benchmark GRE Frequency (events/year) to Modified Conditions.

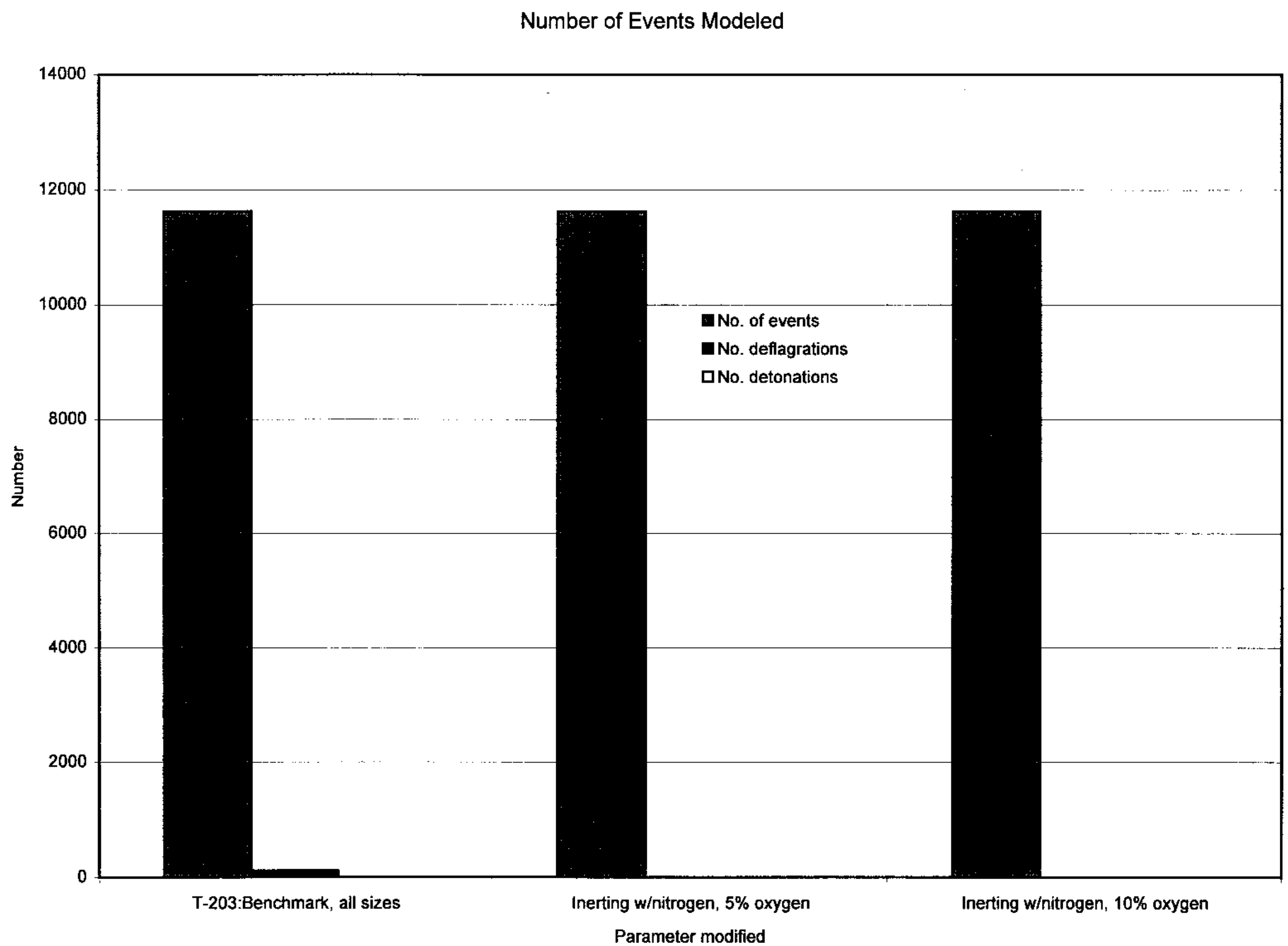

Figure 7. Comparison of Tank 241-T-203 Benchmark Events, Deflagrations, and Detonations to Modified Conditions.

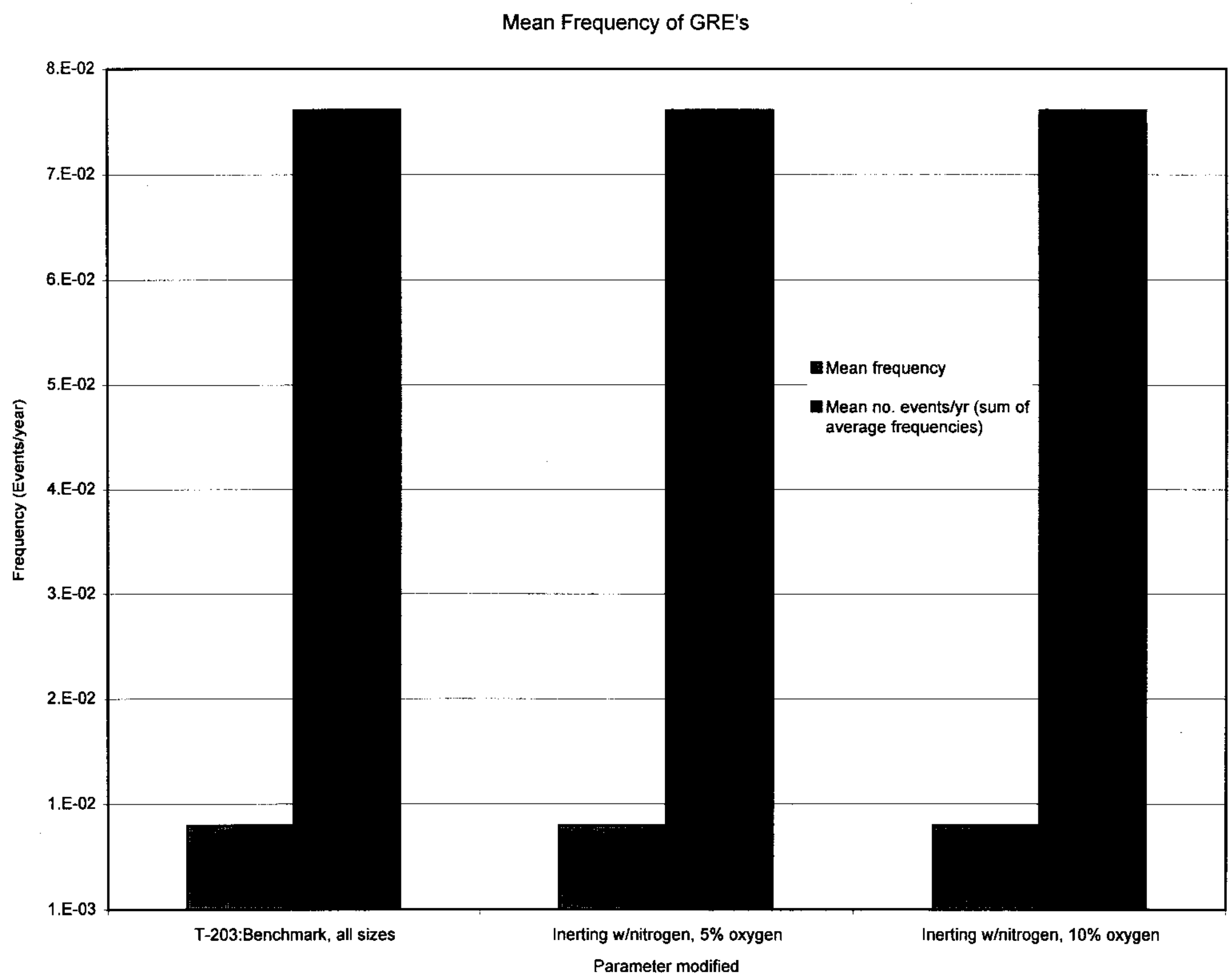

Figure 8. Comparison of Tank 241-T-203 Benchmark GRE Frequency (events/year) to Modified Conditions.

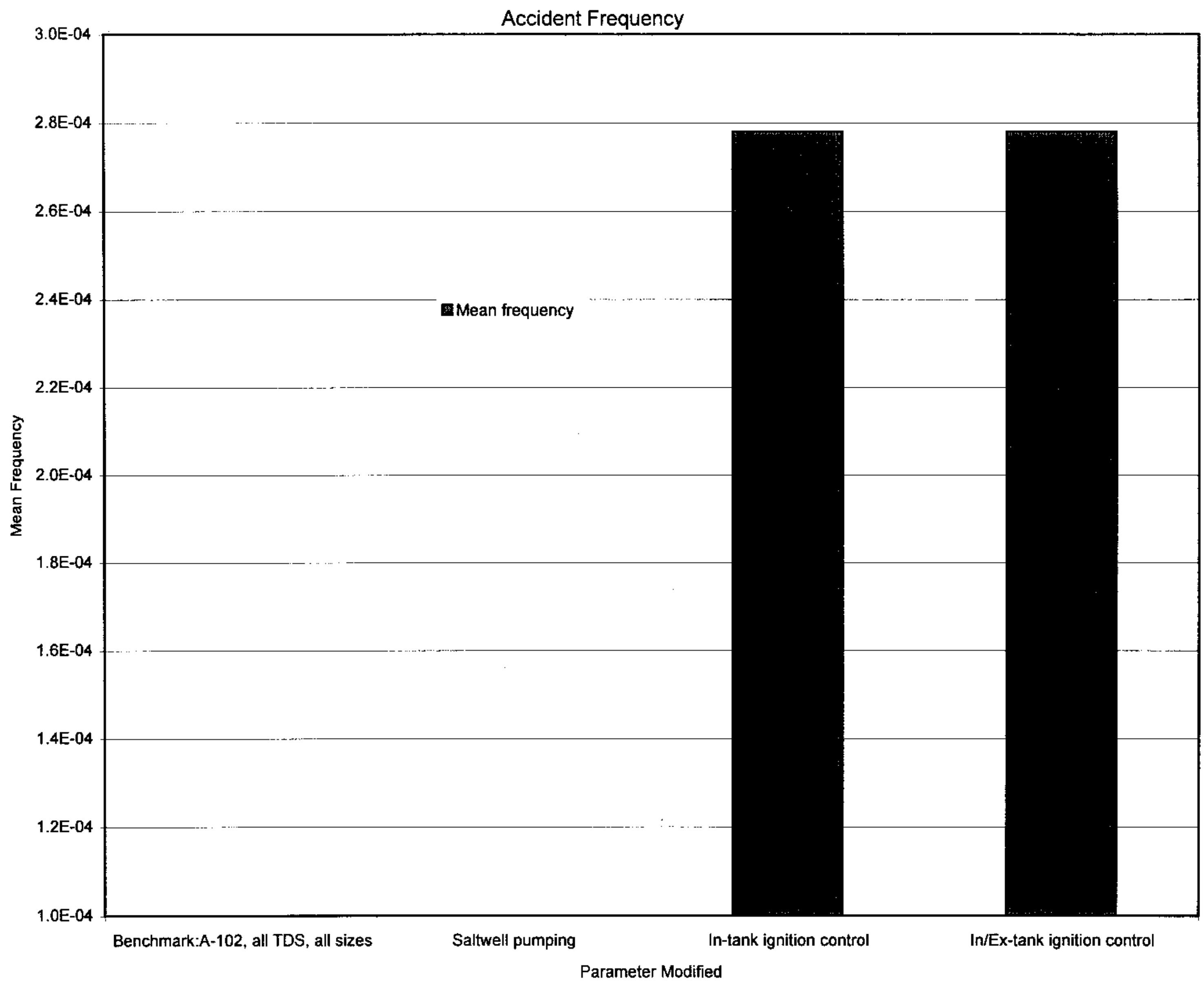

Figure 9. Comparison of Tank 241-A-102 Benchmark Accident Mean Frequency to Modified Conditions.

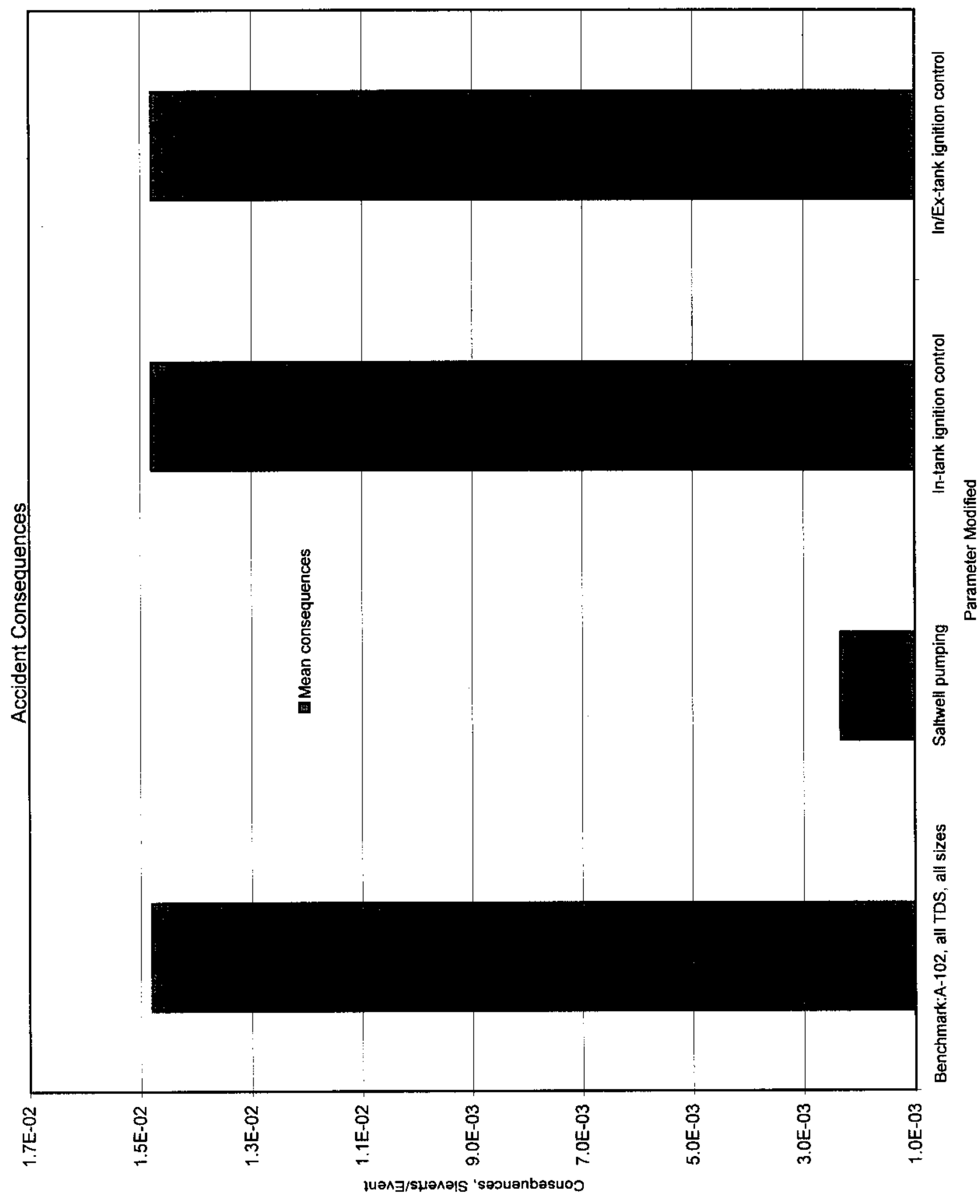

Figure 10. Comparison of Tank 241-A-102 Benchmark Accident Onsite Consequences to Modified Conditions.

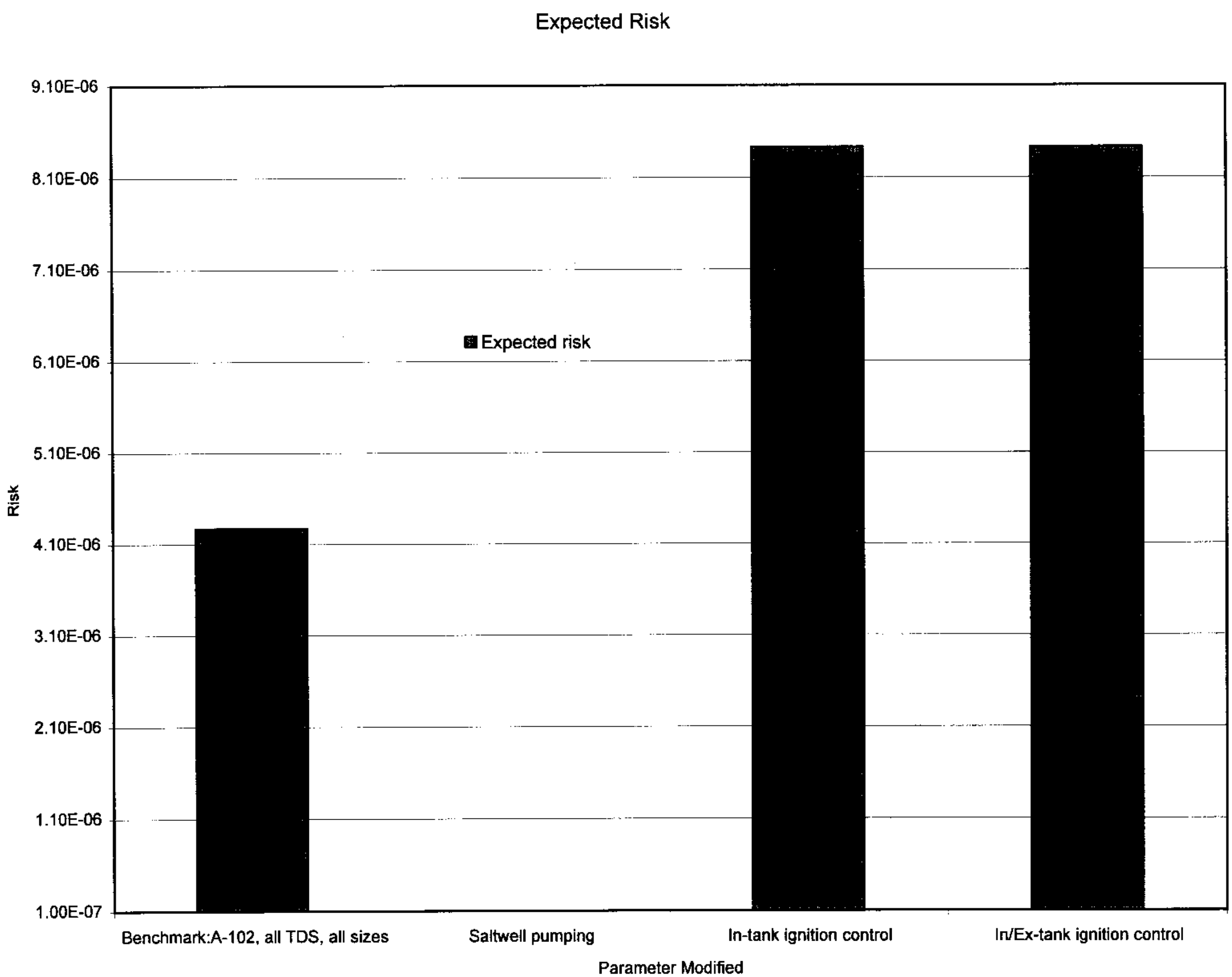

Figure 11. Comparison of Tank 241-A-102 Benchmark Accident Expected Risk to Modified Conditions.

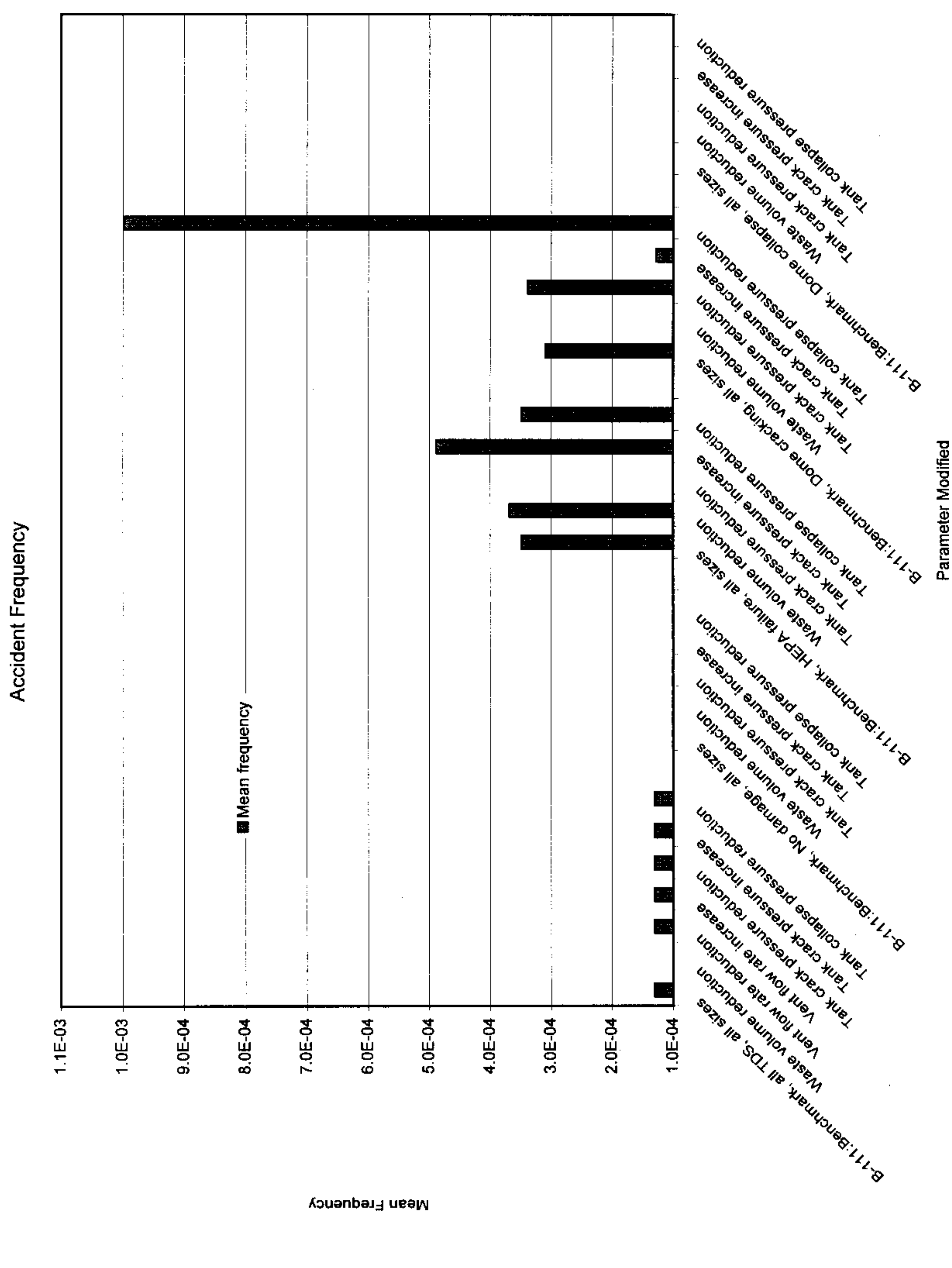

Figure 12. Comparison of Tank 241-B-111 Benchmark Accident Mean Frequency to Modified Conditions.

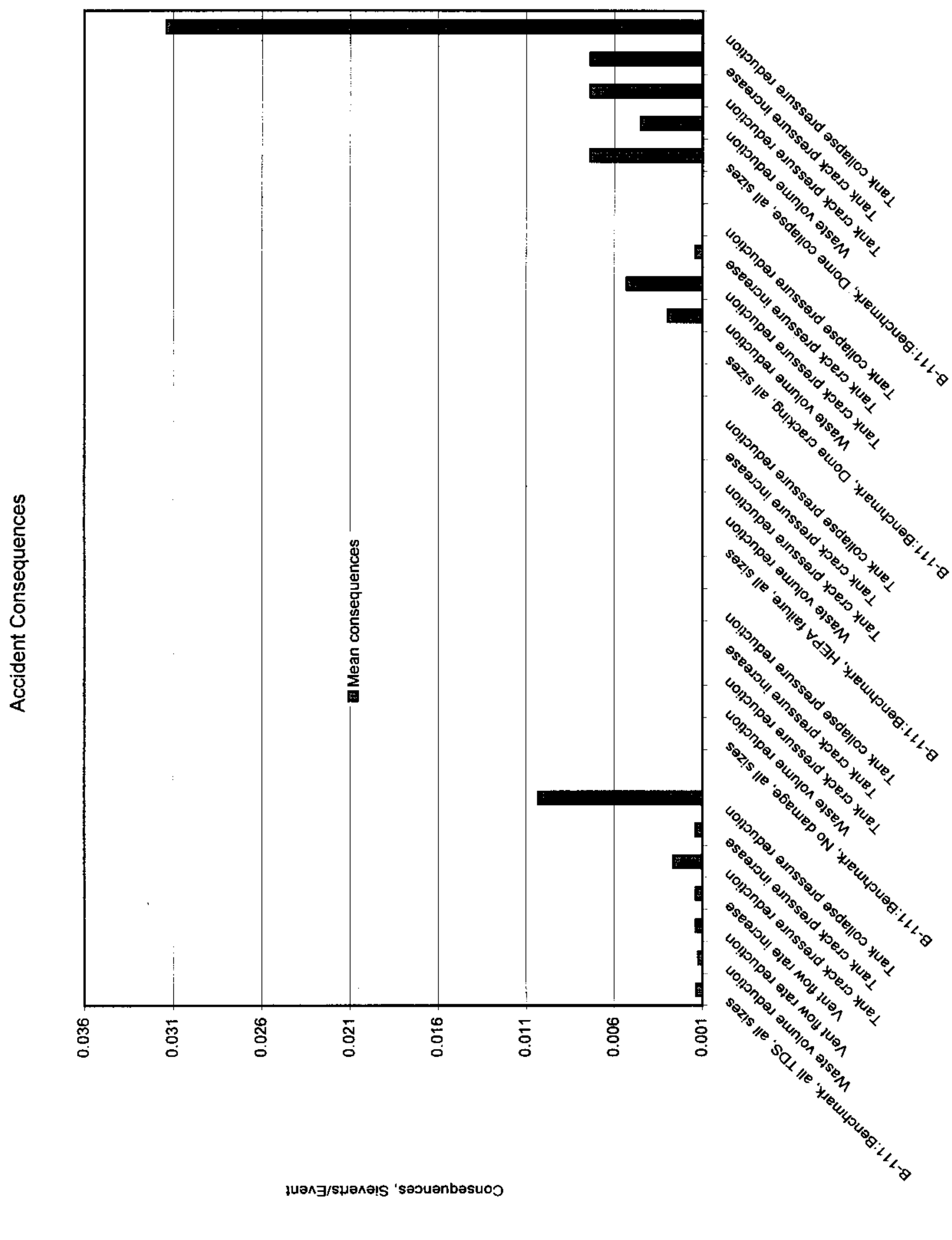

Figure 13. Comparison of Tank 241-B-111 Benchmark Accident Onsite Consequences to Modified Conditions.

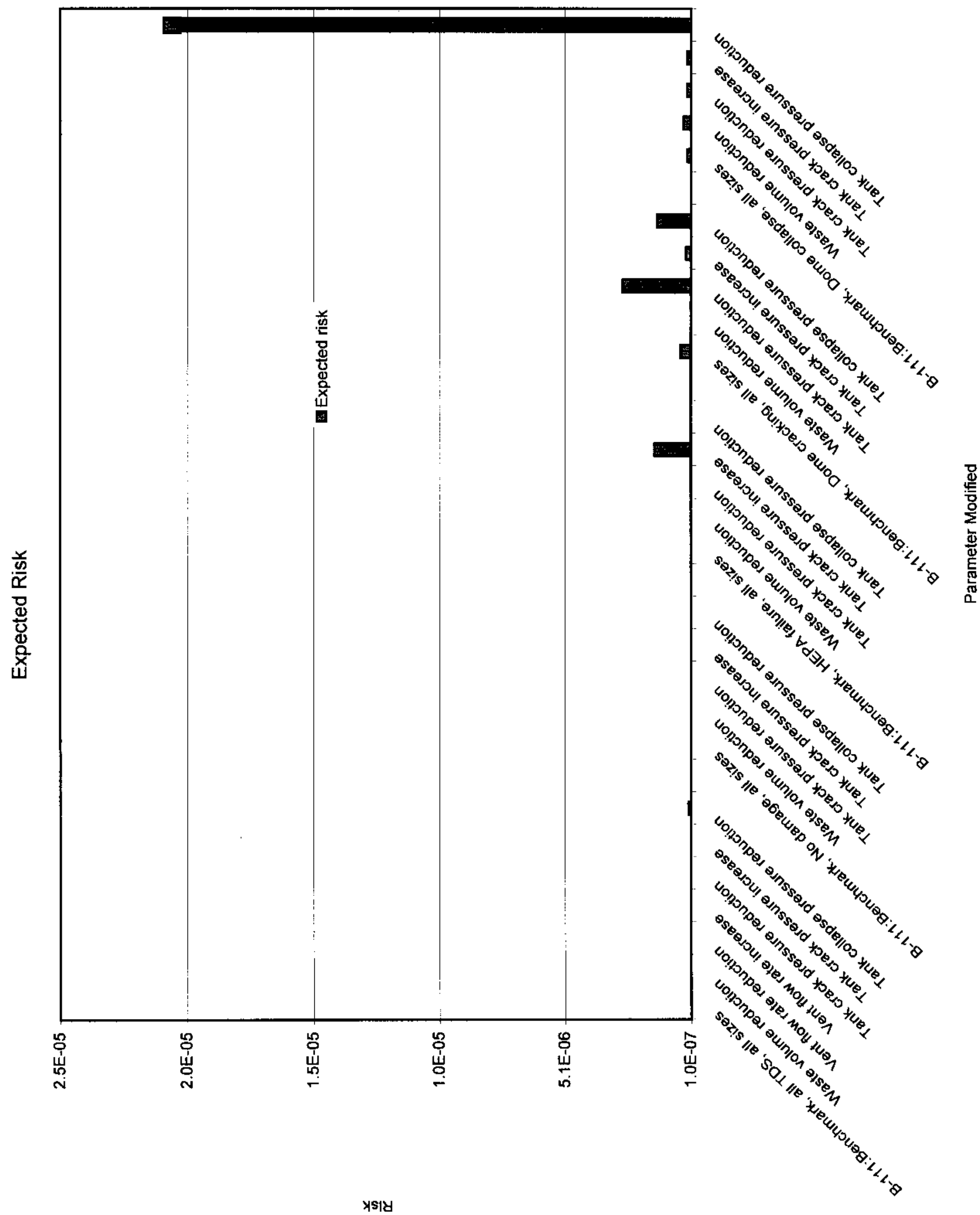

Figure 14. Comparison of Tank 241-B-111 Benchmark Accident Expected Risk to Modified Conditions.

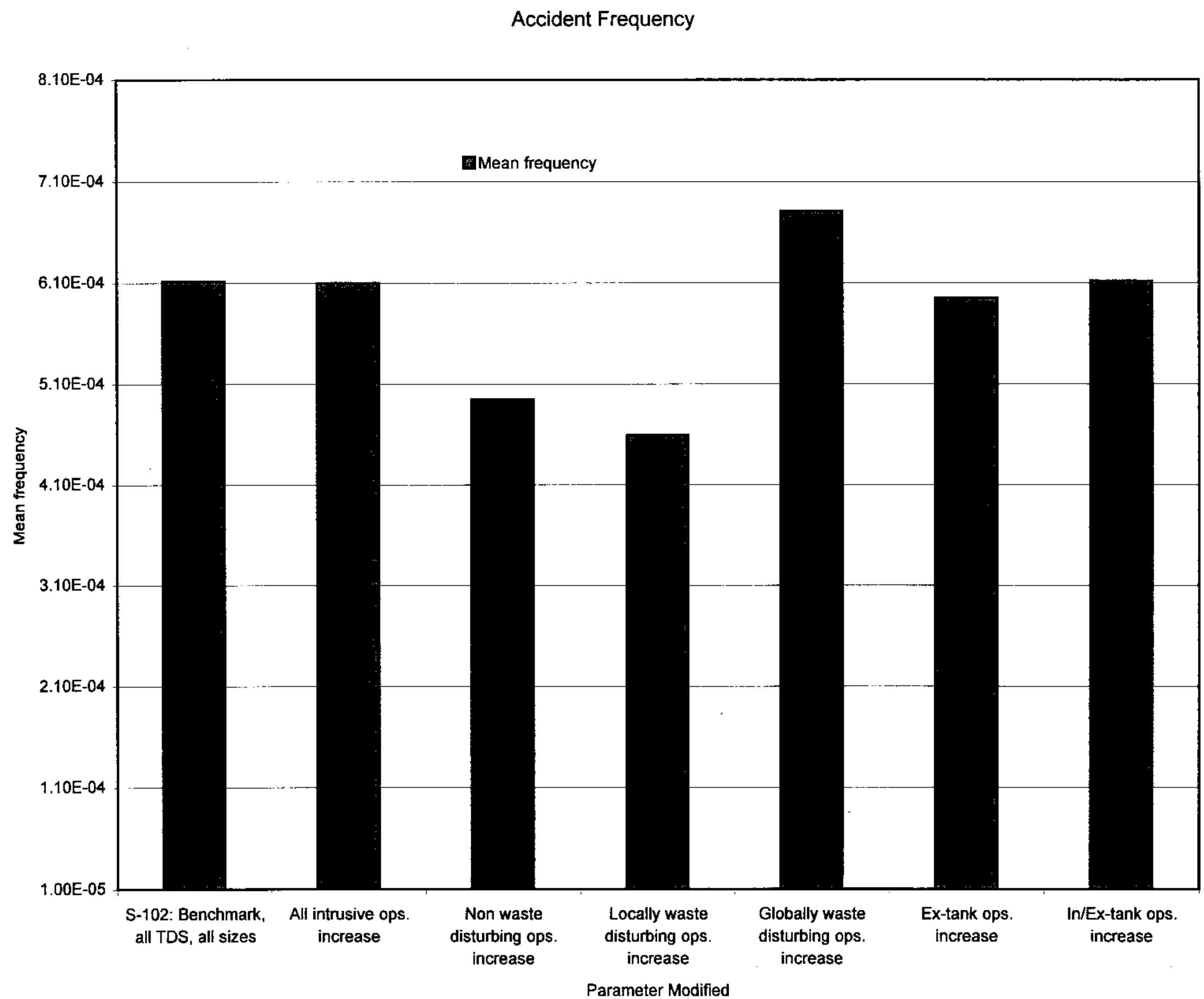

Figure 15. Comparison of Tank 241-S-102 Benchmark Accident Mean Frequency to Modified Conditions.

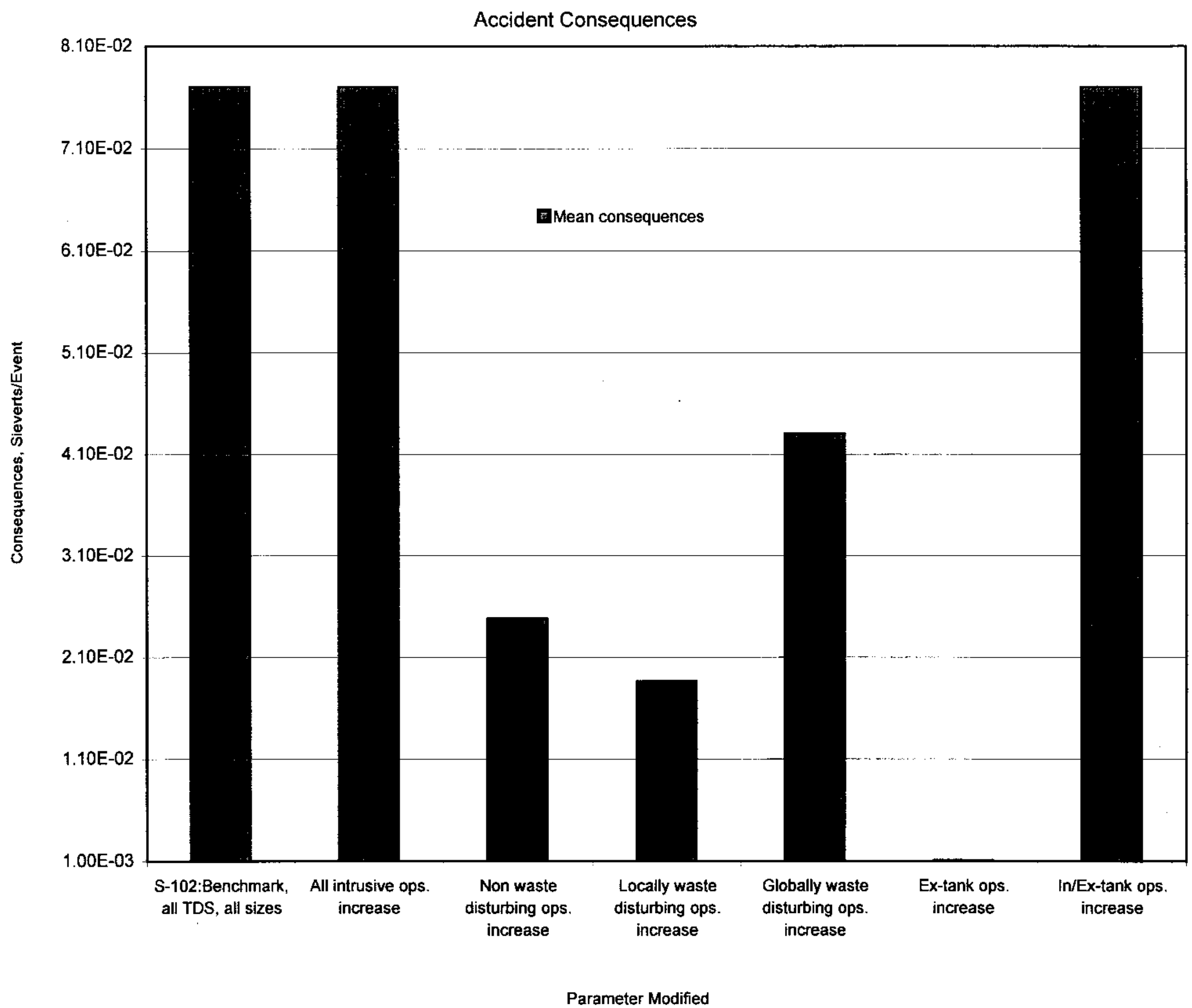

Figure 16. Comparison of Tank 241-S-102 Benchmark Accident Onsite Consequences to Modified Conditions.

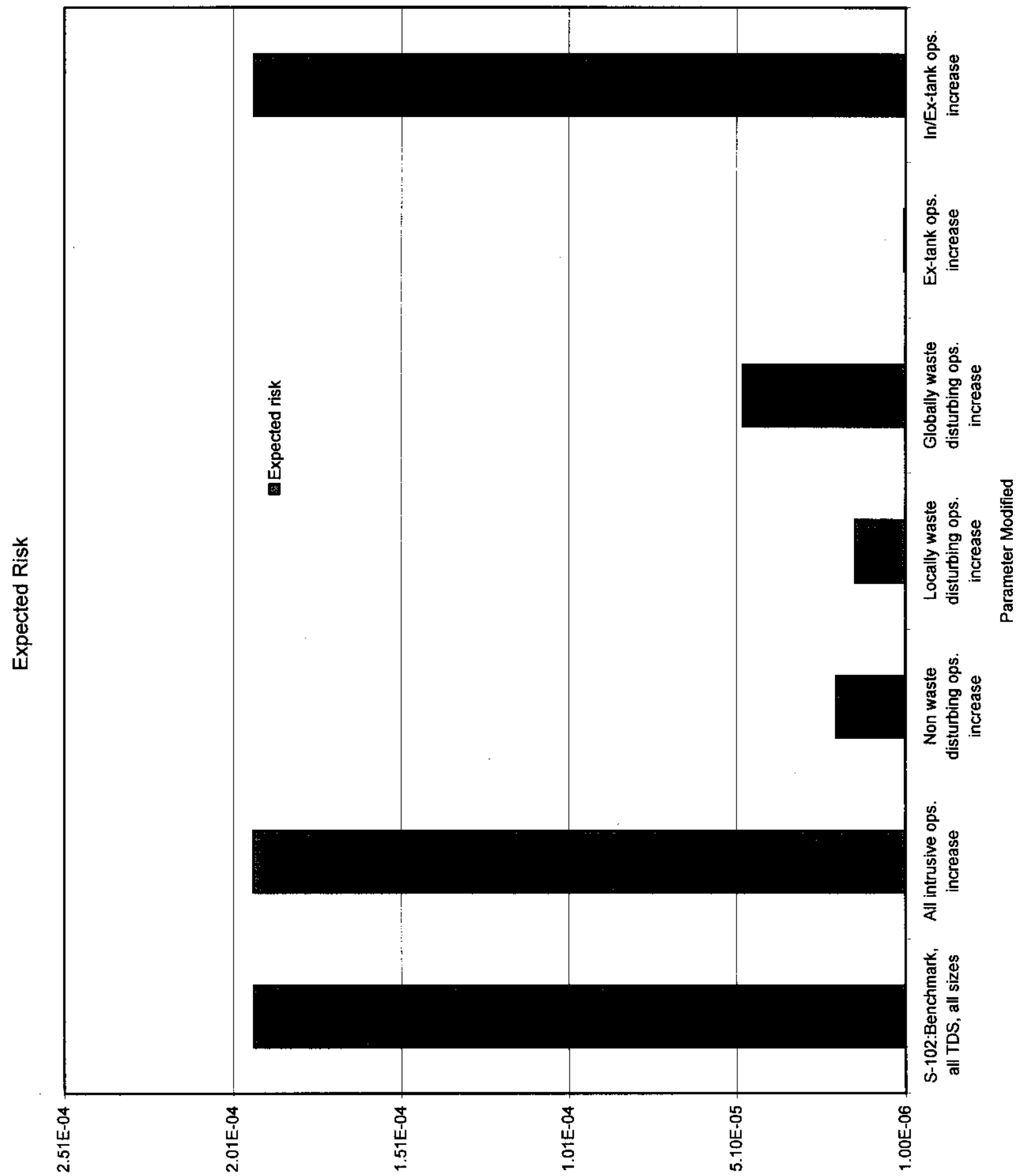

Figure 17. Comparison of Tank 241-B-111 Benchmark Accident Expected Risk to Modified Conditions.

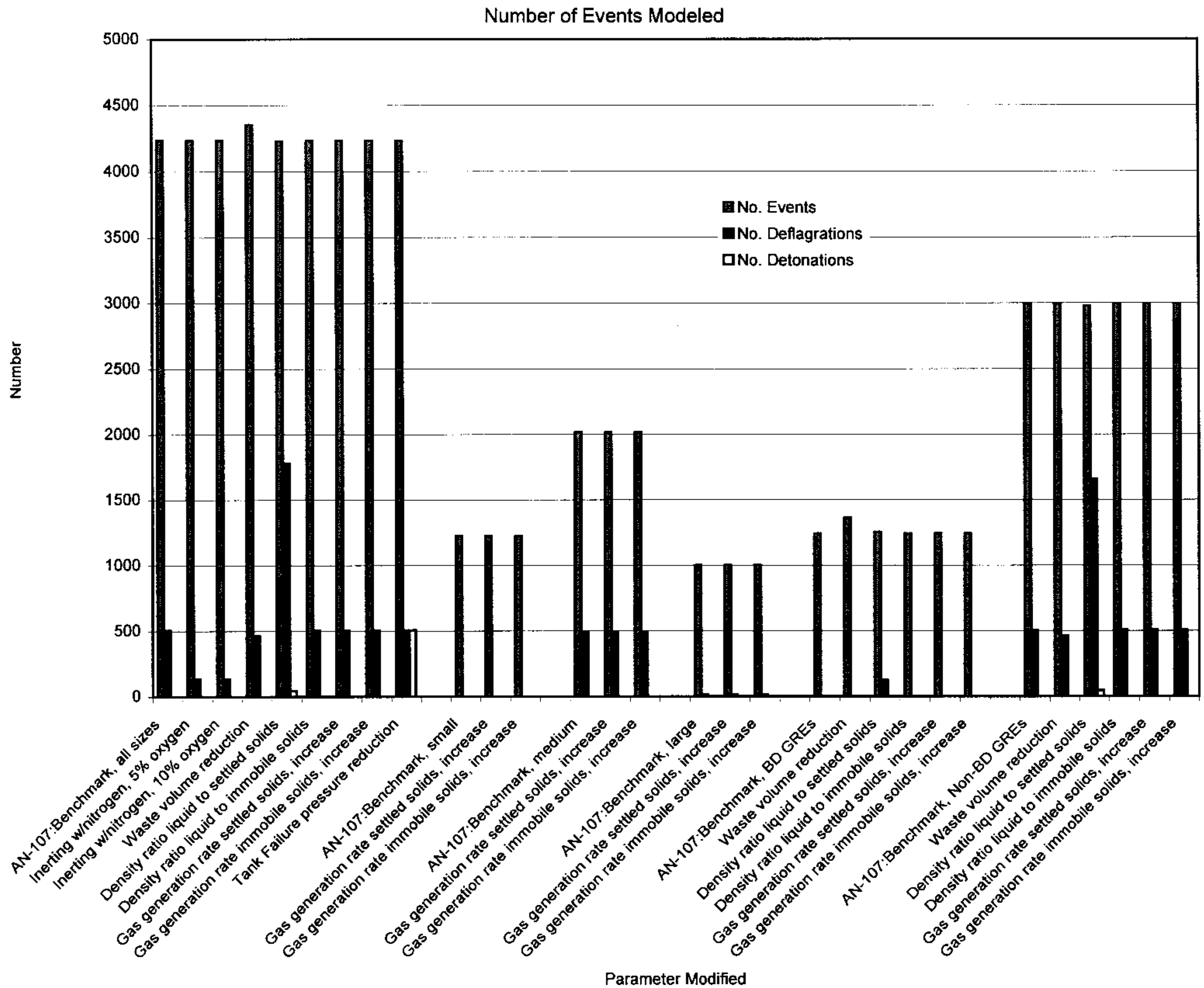

Figure 18. Comparison of Tank 241-AN-107 Benchmark Events, Deflagrations, and Detonations to Modified Conditions.

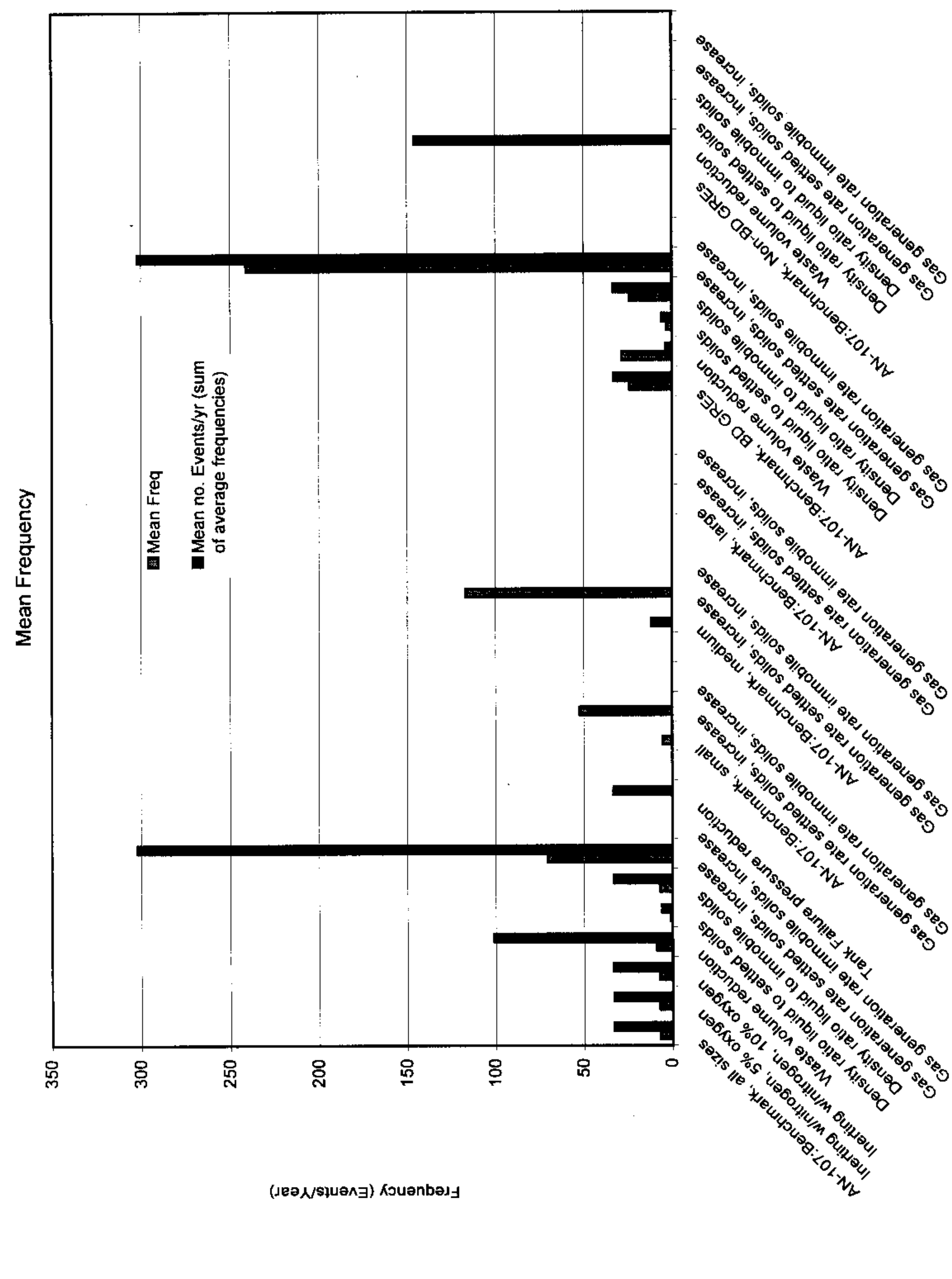

Figure 19. Comparison of Tank 241-AN-107 Benchmark GRE Frequency (events/year) to Modified Conditions.

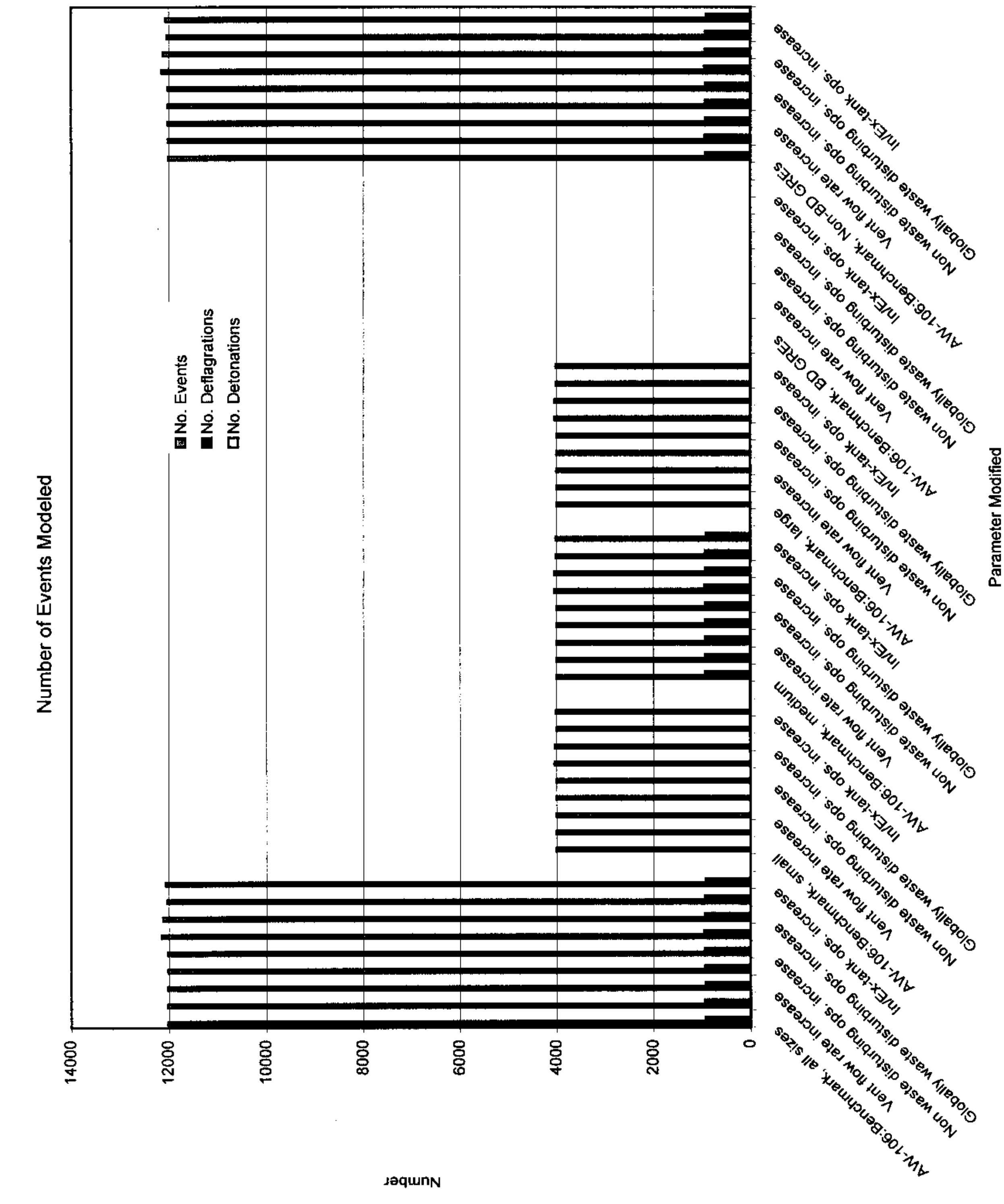

Figure 20. Comparison of Tank 241-AW-106 Benchmark Events, Deflagrations, and Detonations to Modified Conditions.

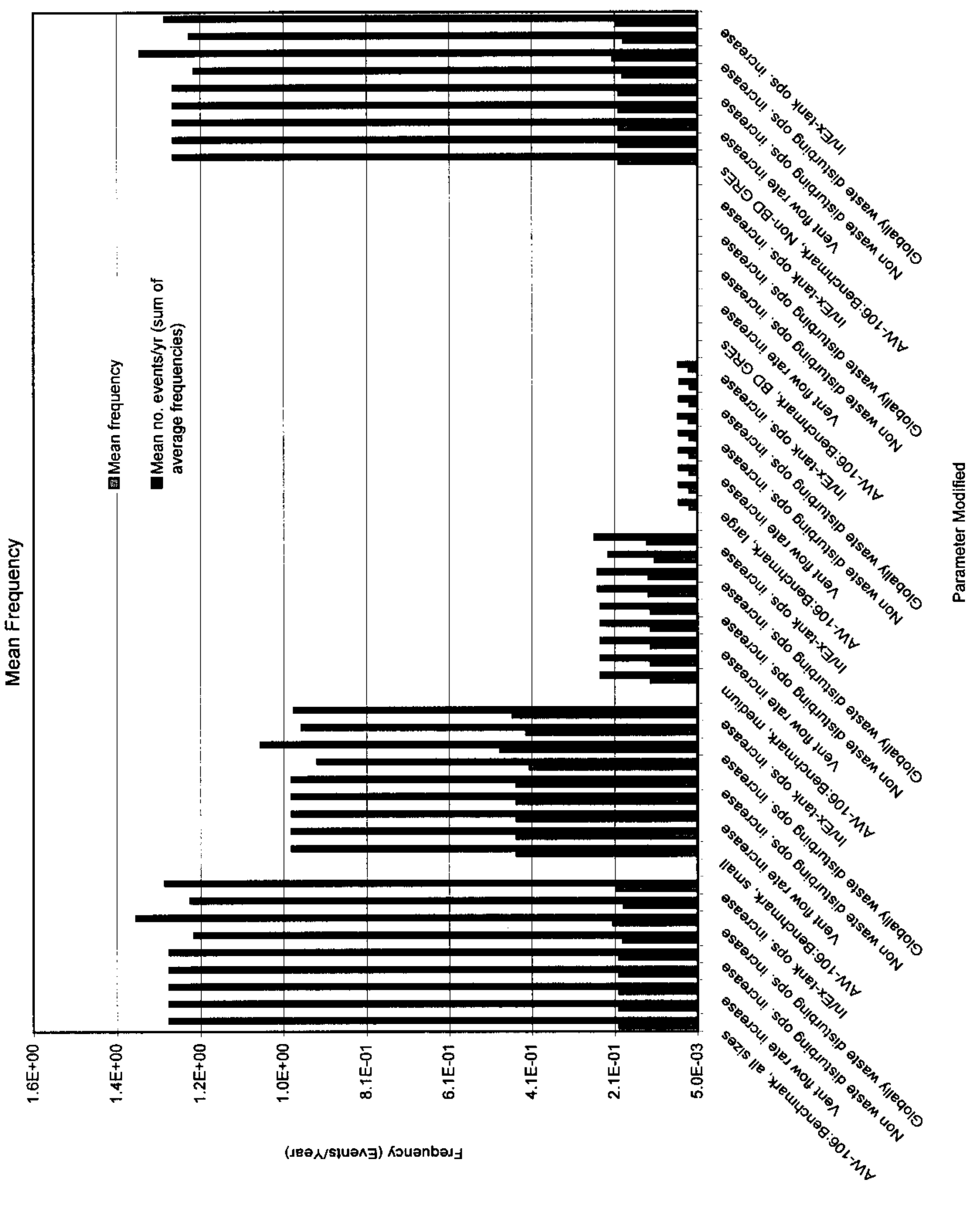

Figure 21. Comparison of Tank 241-AW-106 Benchmark GRE Frequency (events/year) to Modified Conditions.

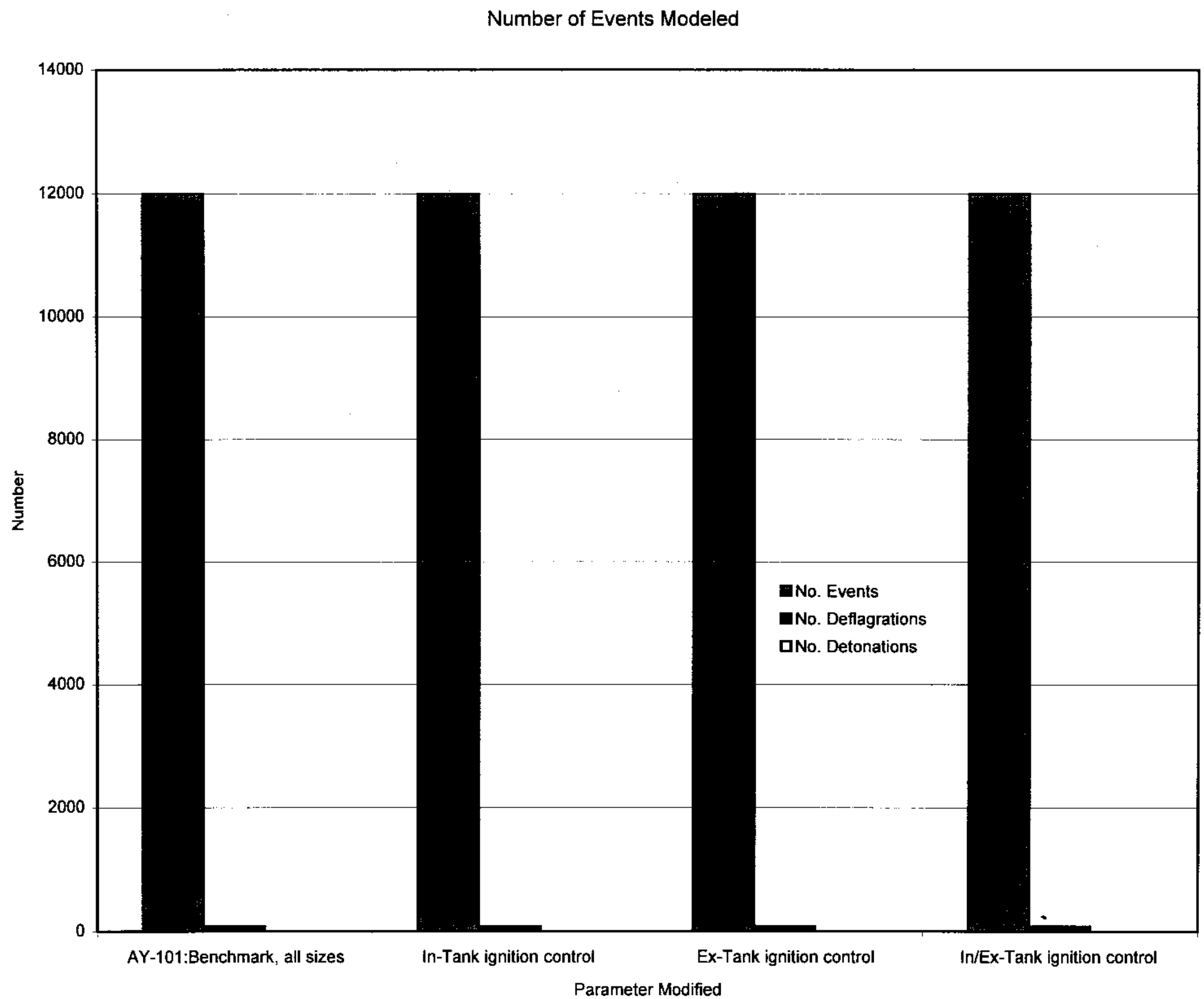

Figure 22. Comparison of Tank 241-AY-101 Benchmark Events, Deflagrations, and Detonations to Modified Conditions.

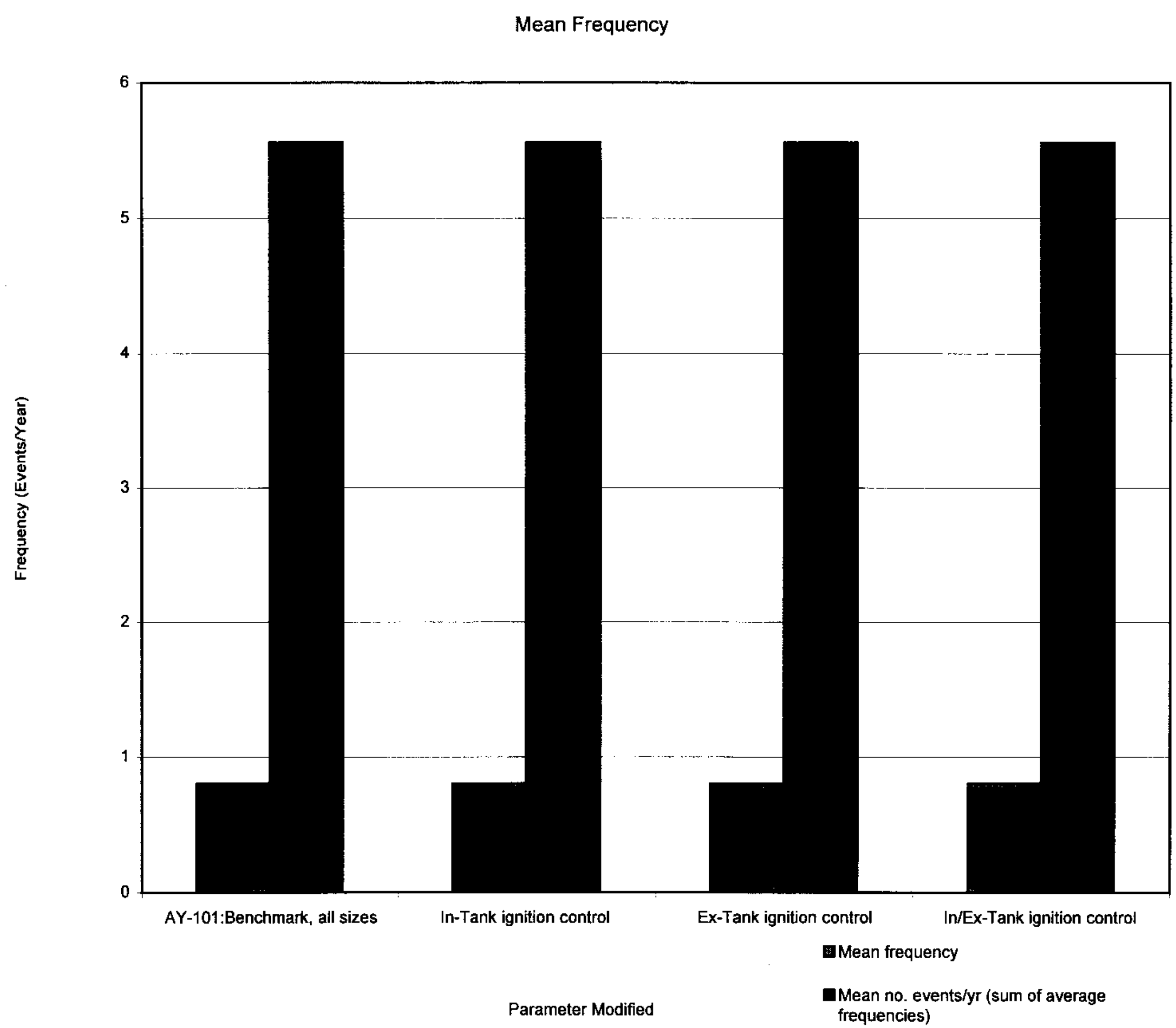

Figure 23. Comparison of Tank 241-AY-101 Benchmark GRE Frequency (events/year) to Modified Conditions.

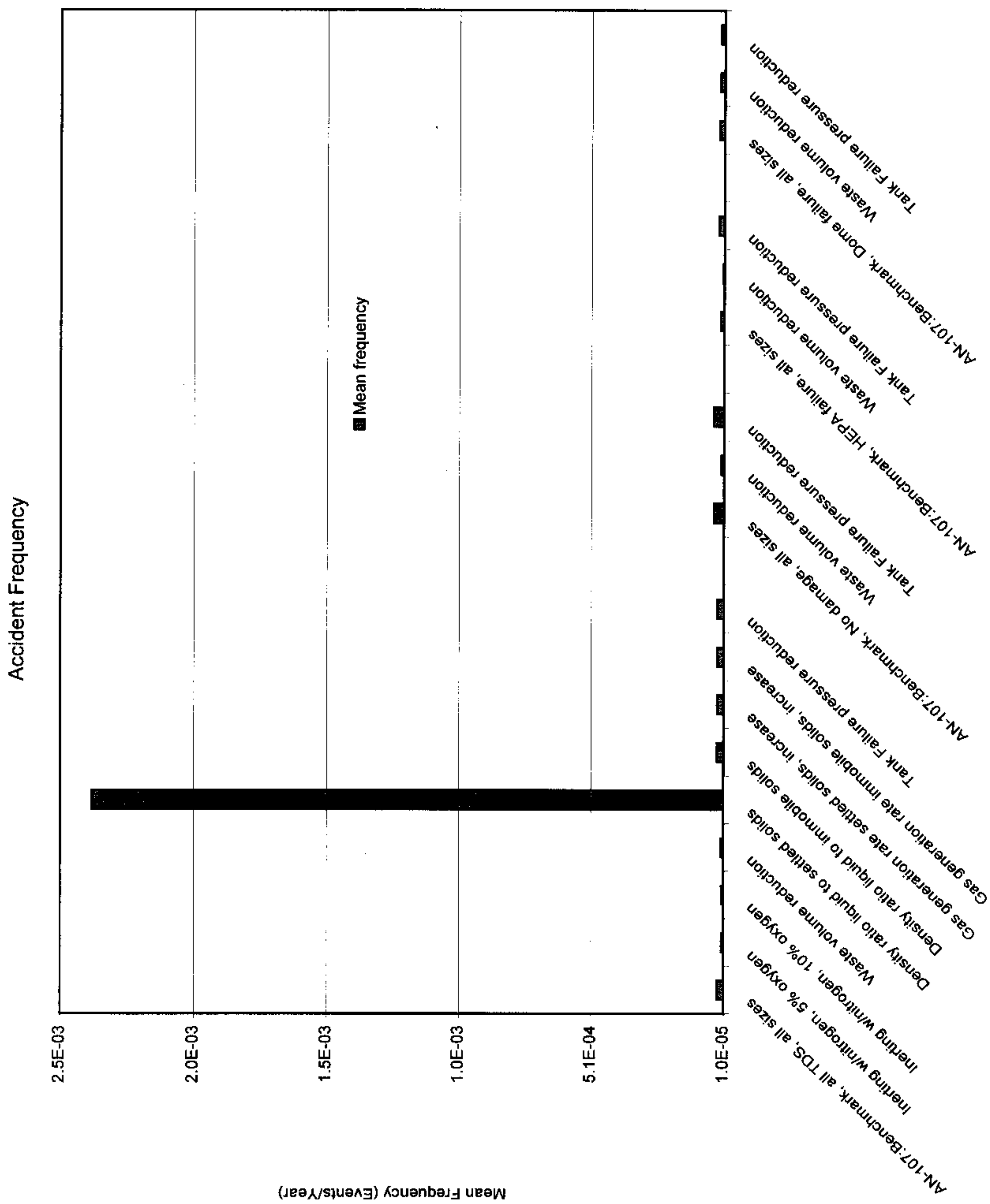

Figure 24. Comparison of Tank 241-AN-107 Benchmark Accident Mean Frequency to Modified Conditions.

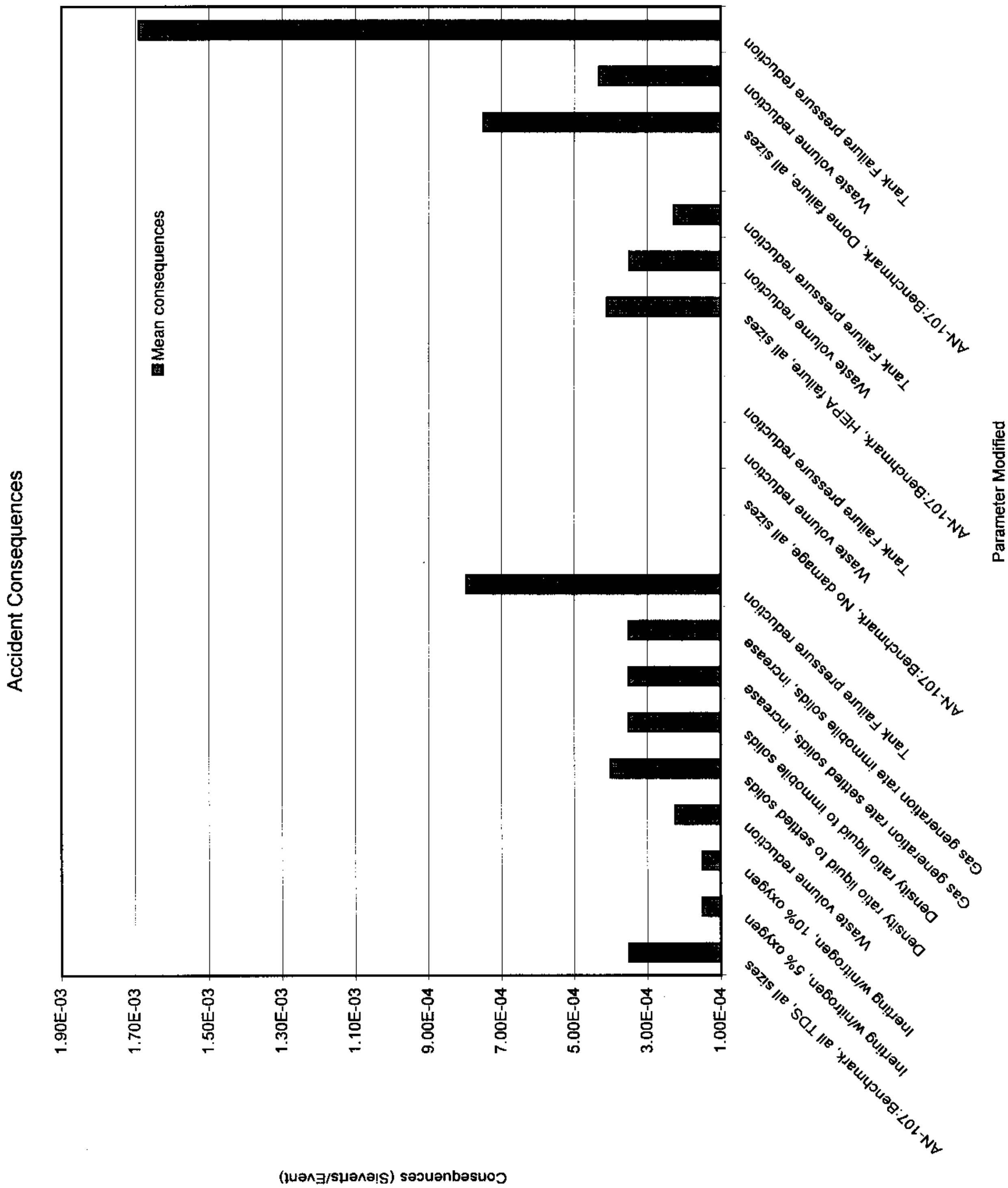

Figure 25. Comparison of Tank 241-AN-107 Benchmark Accident Onsite Consequences to Modified Conditions.

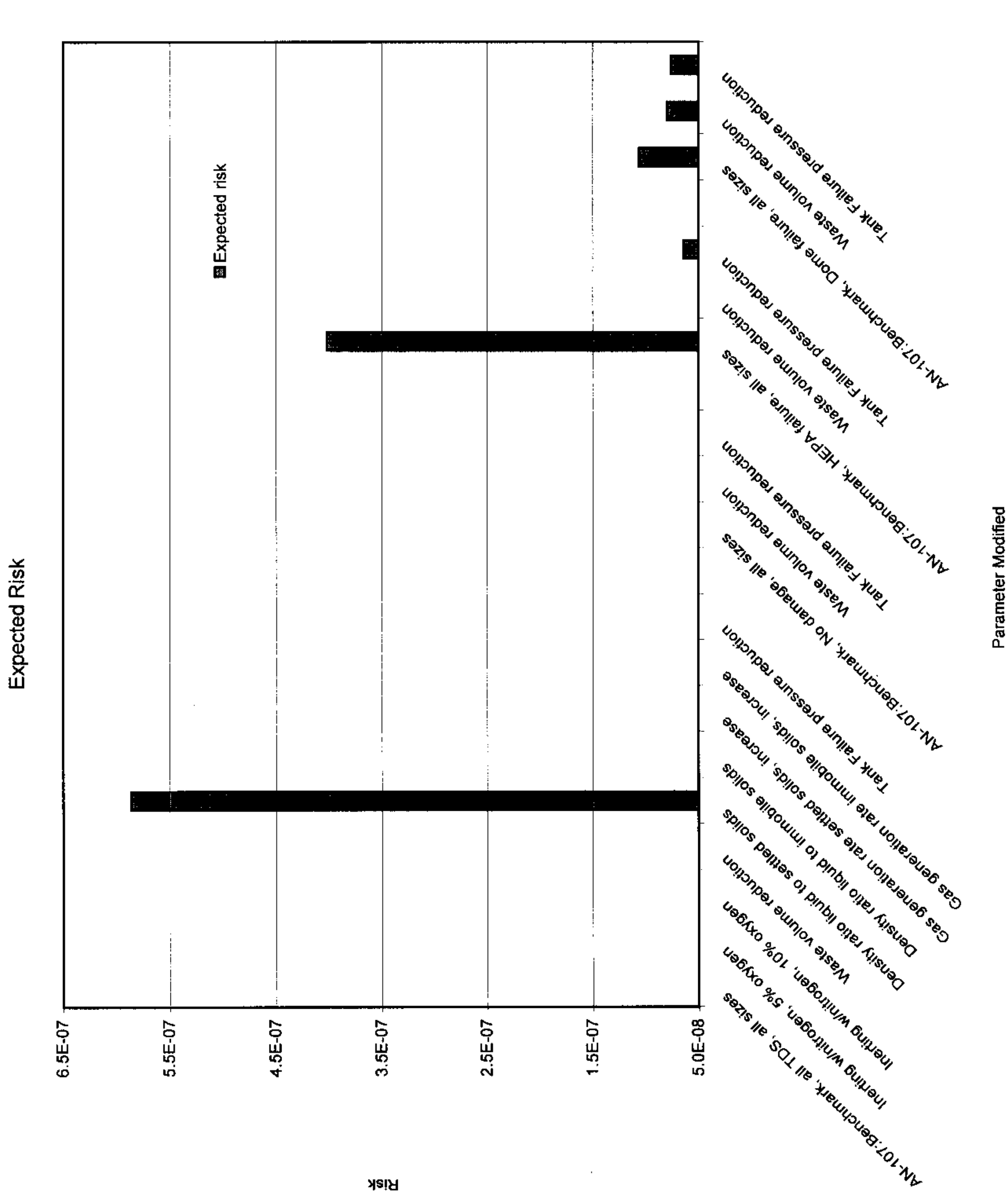

Figure 26. Comparison of Tank 241-AN-107 Benchmark Accident Expected Risk to Modified Conditions.

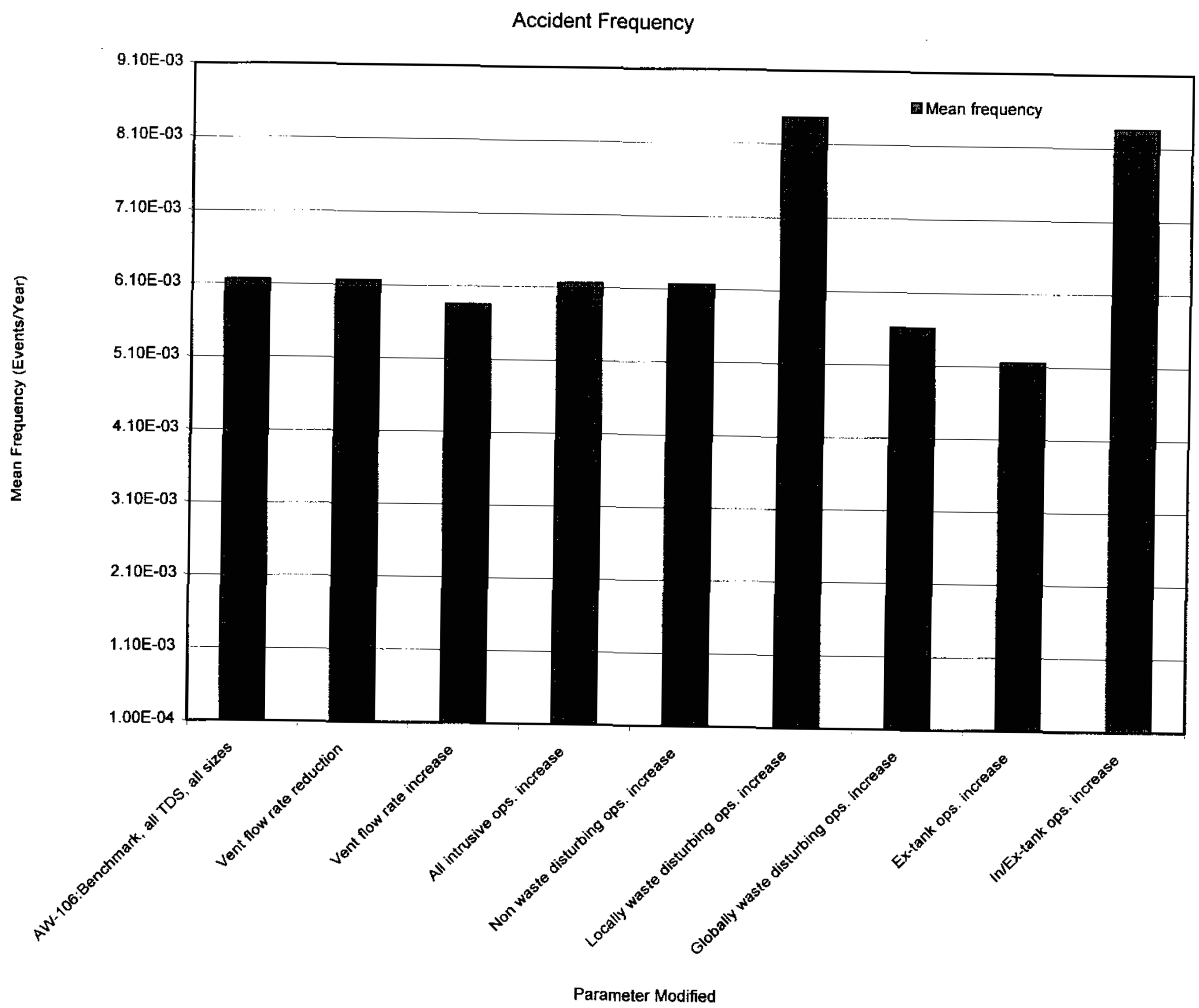

Figure 27. Comparison of Tank 241-AW-106 Benchmark Accident Mean Frequency to Modified Conditions.

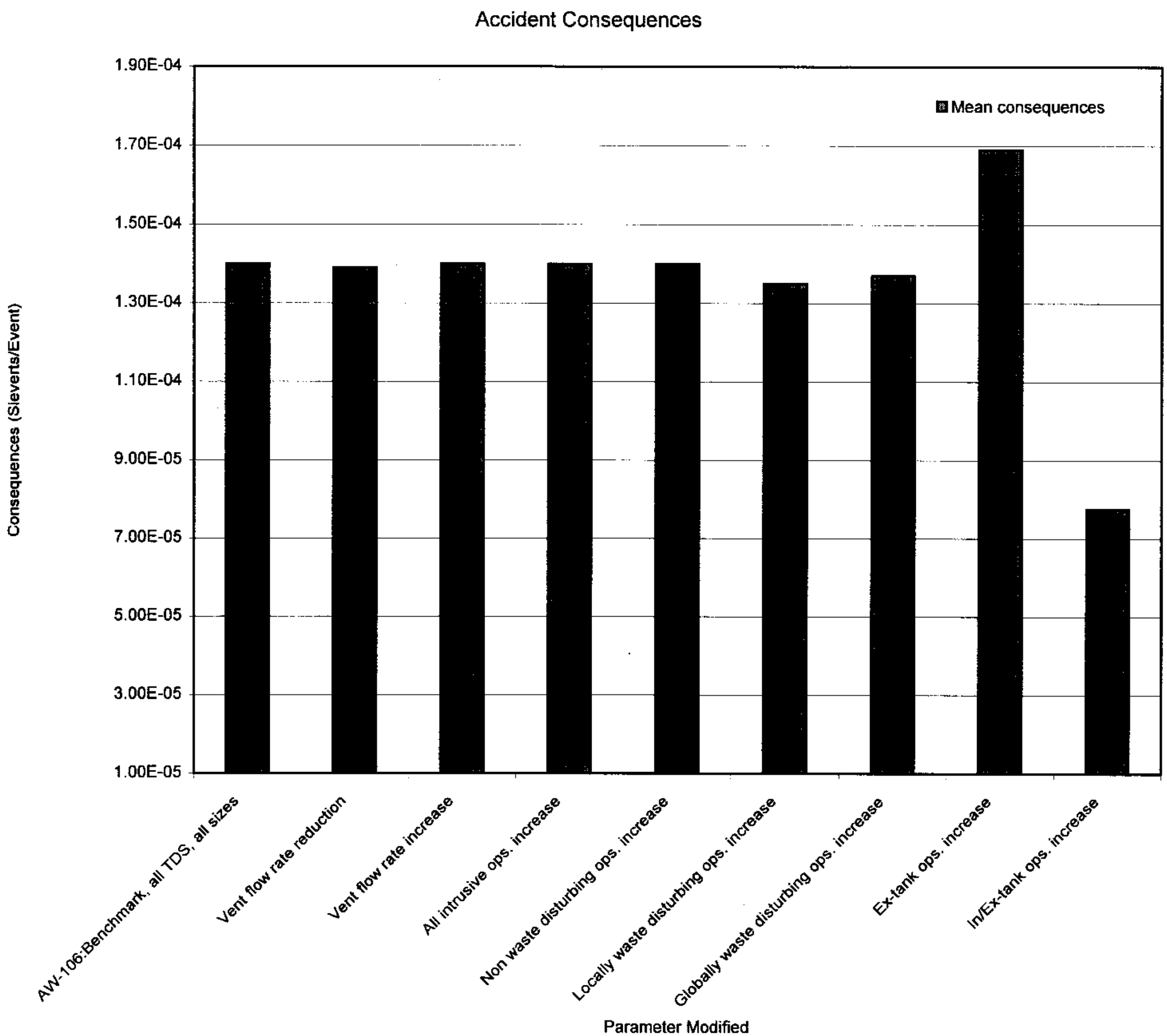

Figure 28. Comparison of Tank 241-AW-106 Benchmark Accident Onsite Consequences to Modified Conditions.

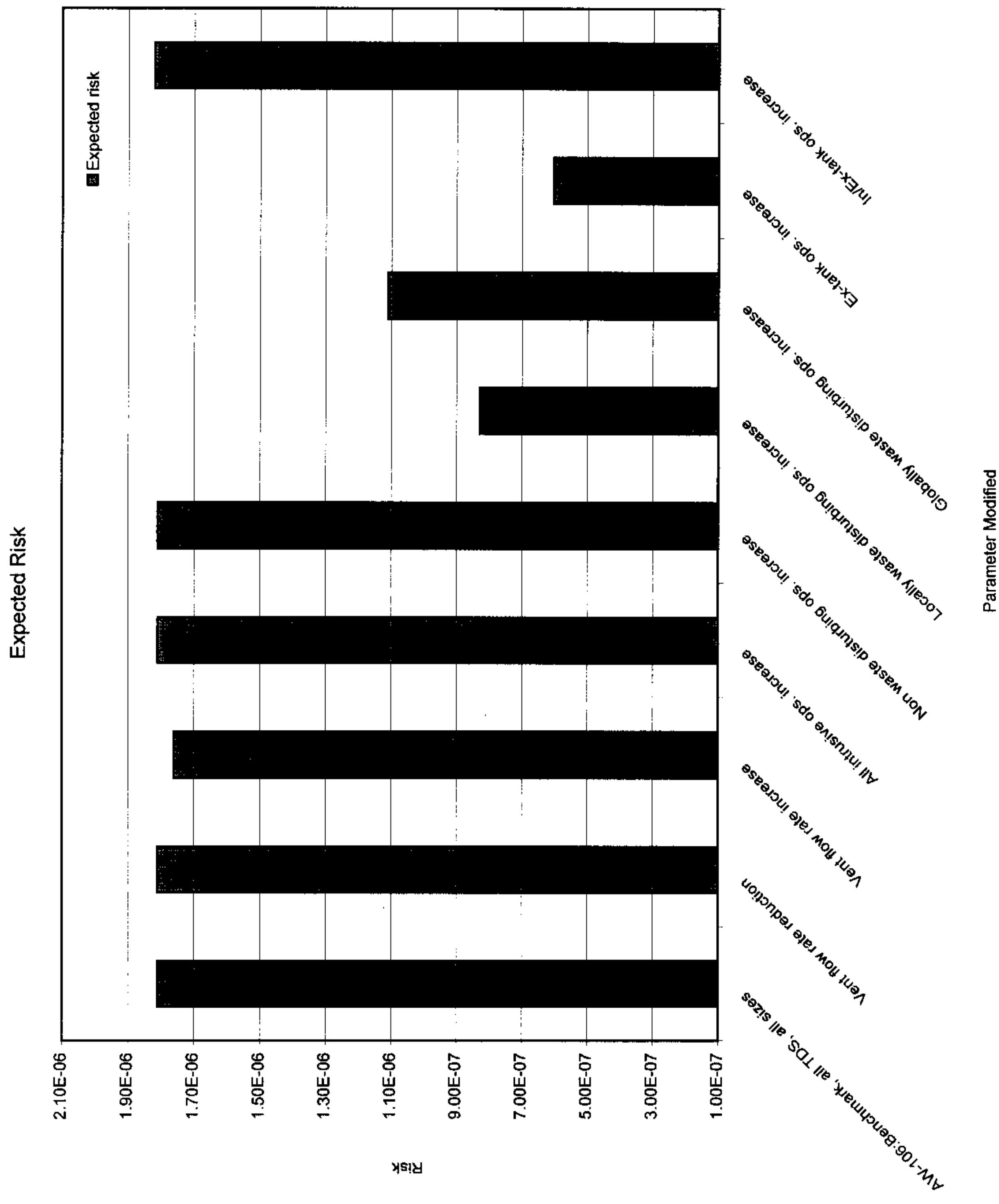

Figure 29. Comparison of Tank 241-AW-106 Benchmark Accident Expected Risk to Modified Conditions.

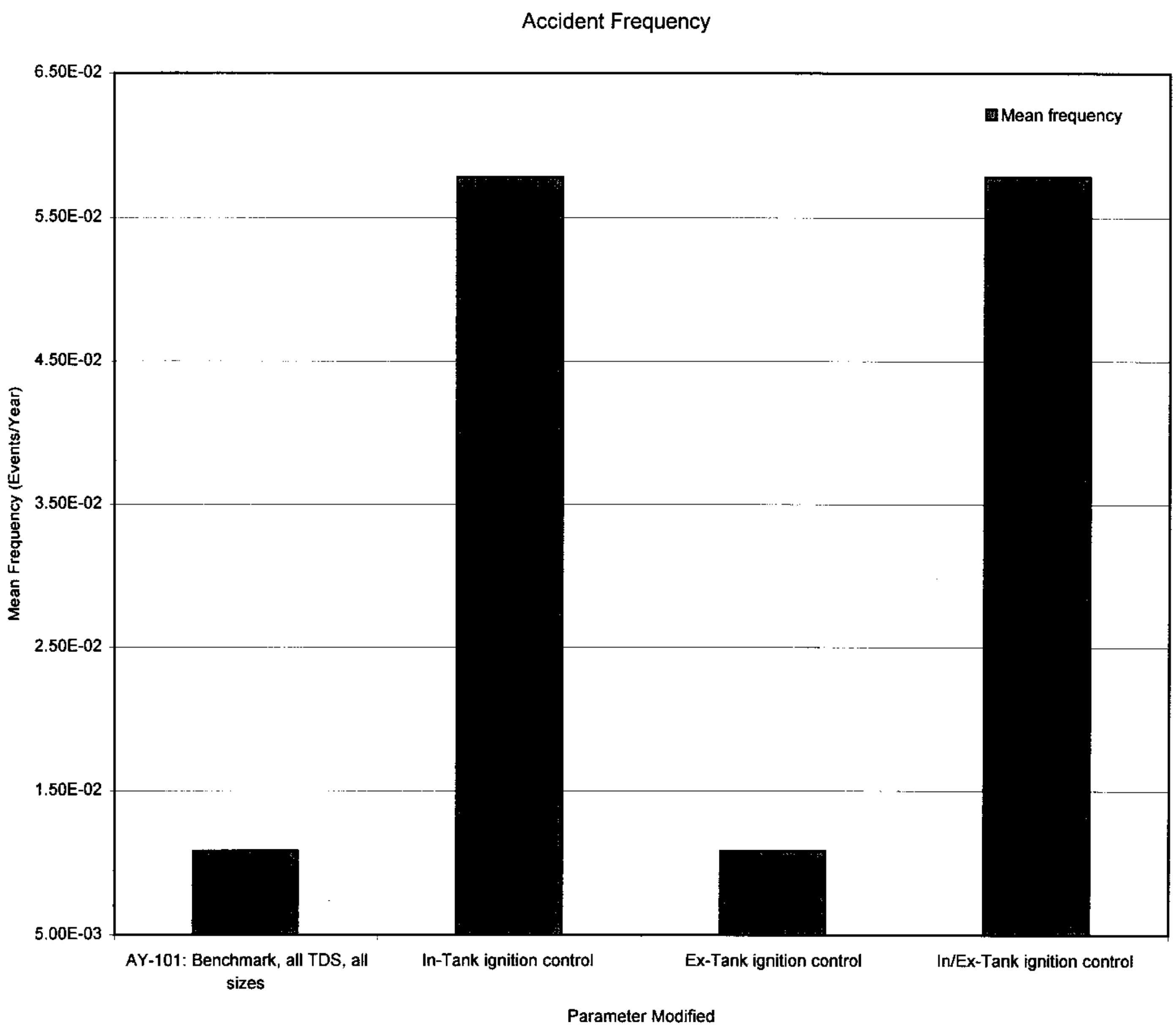

Figure 30. Comparison of Tank 241-AY-101 Benchmark Accident Mean Frequency to Modified Conditions.

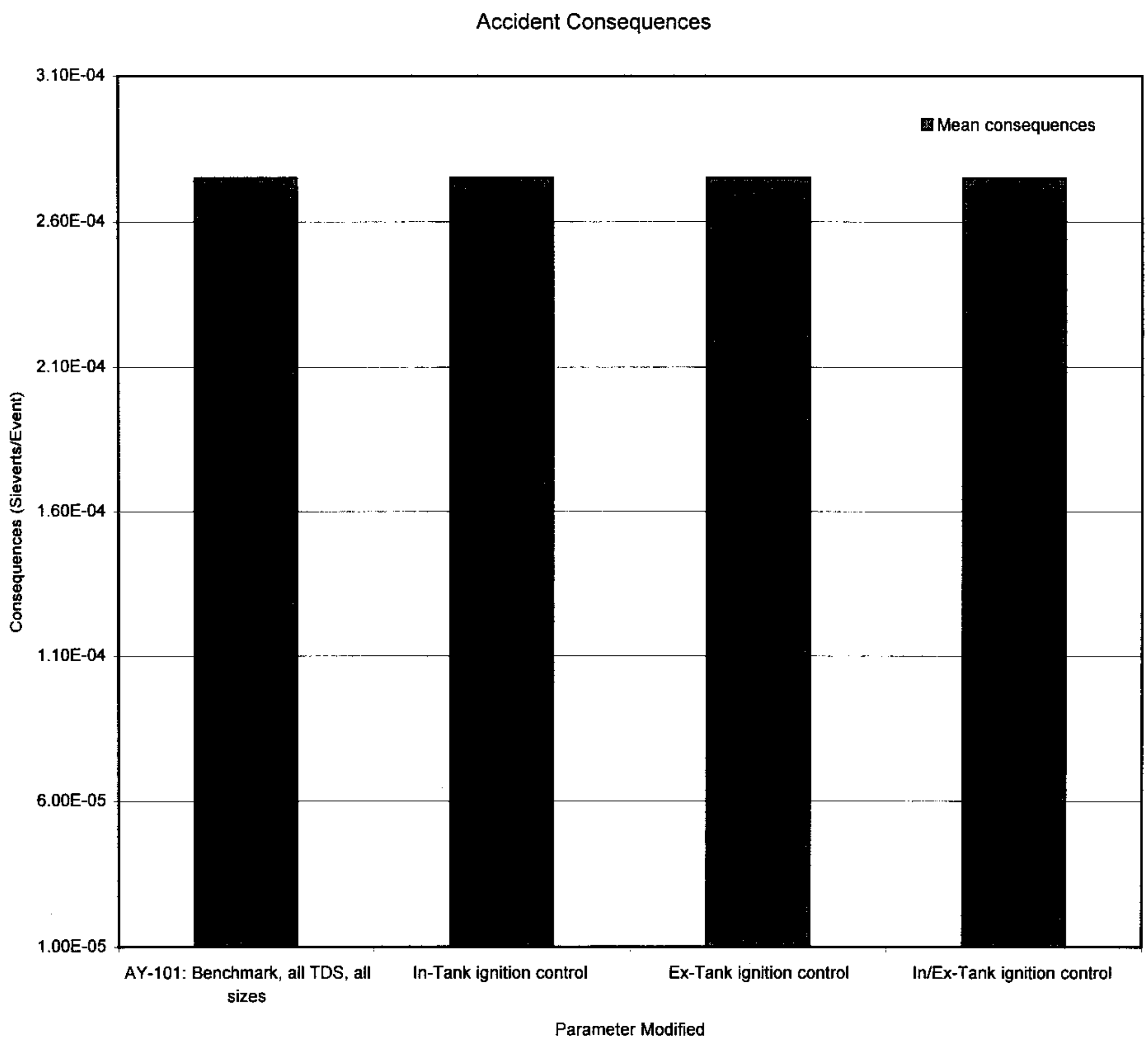

Figure 31. Comparison of Tank 241-AY-101 Benchmark Accident Onsite Consequences to Modified Conditions.

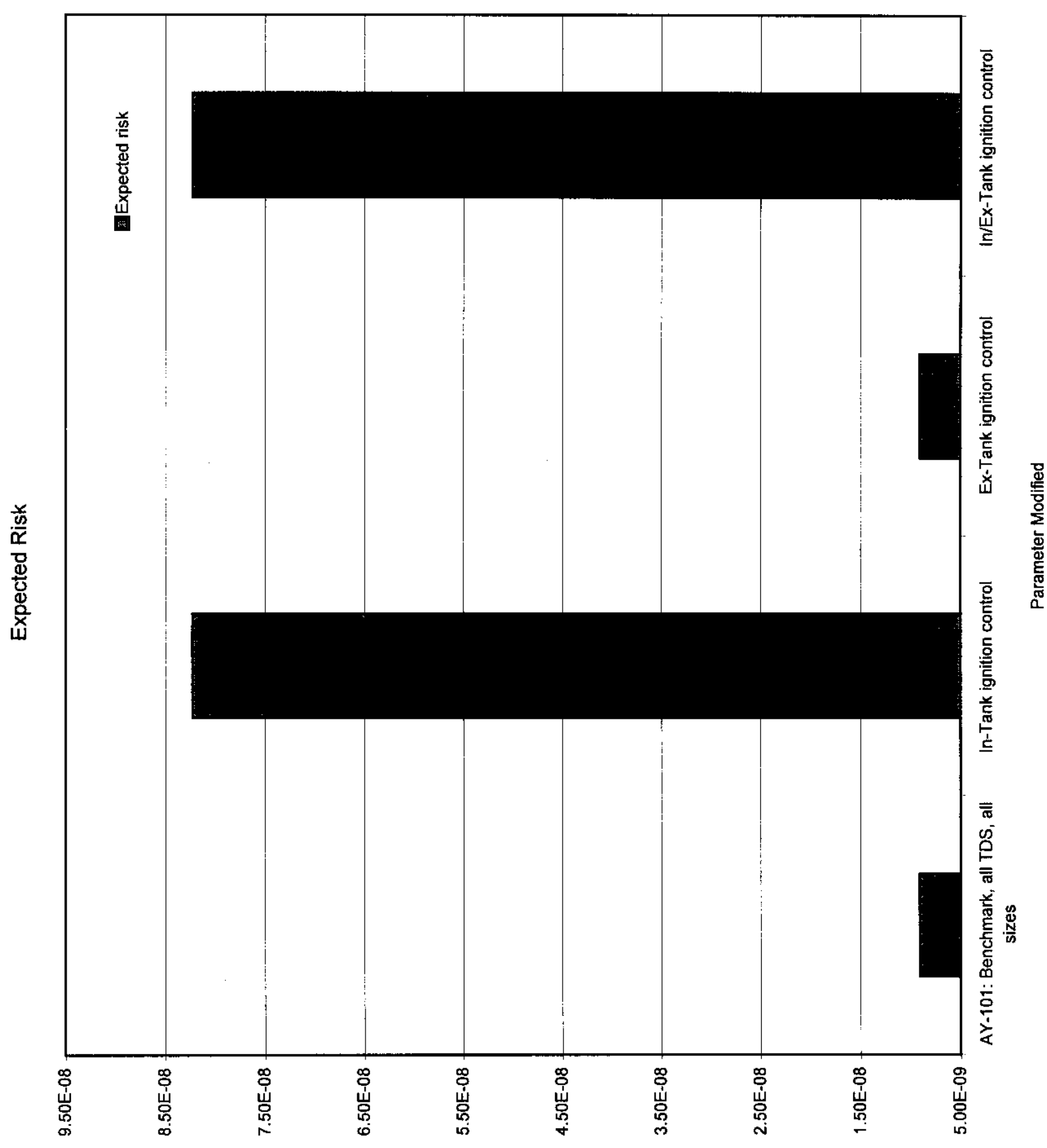

Figure 32. Comparison of Tank 241-AY-101 Benchmark Accident Expected Risk to Modified Conditions.

ATTACHMENT 1

RESOLVE VERSION 2.13
ACCEPTANCE TESTING: TEST PLAN AND TEST RESULTS

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1.0 INTRODUCTION

1.1 BACKGROUND

To assist in quantifying the risk of the Flammable Gas Safety Issue, an accident Analysis Tool has been developed using commercially available software and tank characterization data. In addition to using available data and analysis results, the process also uses formal systematic expert elicitation on flammable gas technical parameters for which no data exists. The Analysis Tool is a computer code called Resolve!. The Analysis Tool is designed to quantify the risk and uncertainty of combustion accidents in actual or representative tanks and the change in risk that would result from using different control strategies. Resolve! is used to help identify optimal controls for each tank and analyze the implementation of the controls prior to actual implementation in the field. This supports the actions needed to update the Authorization Basis.

The acceptance and validation testing of the precursor version, RESOLVE! Version 1.51, is documented in *RESOLVE Version 1.51 Acceptance Testing: Test Plan and Test Results*. The major improvement of the refined safety analysis tool is the ability to analysis and evaluate Double-Shell Tanks (DSTs). Additional changes to the refined safety analysis tool include, buoyant displacement model, revised mass balance, waste intrusive equipment burns, mixer pump, waste transfer and the graphical user interface (GUI). The revised version is identified as Resolve! Version 2.13. This Attachment documents the acceptance testing performed on Version 2.13.

1.2 PURPOSE

The acceptance test is the primary method used by the Tank Farm Contractor (TFC) Team to accept the Analysis Tool, Resolve! Version 2.13. This version of the Analysis Tool (Resolve! Version 2.13) is not intended to be used to identify, analyze, and select safety related controls; therefore, the acceptance test and results are documented in this Attachment 1. This testing has been performed to enhance the TFC Team understanding of the Analysis Framework and implication of the Analysis Tool results.

This Attachment 1 provides the results of acceptance testing of Resolve, Version 2.13. The results of acceptance testing are used to do the following:

Confirm that the results of Resolve! Version 2.13, trends logically

- Ensure that Resolve! Version 2.13, performs within the predefined parameters
- Determine the status of previously identified Analysis Tool user interface issues and calculational errors.
- Identify any deficiencies and limitations for application of Version 2.13

Whenever an area of acceptance testing is unsuccessful, two approaches are used to evaluate the condition. Unless it is evident that an error (e.g., computational or GUI) exists, the code developers and the TFC Team convene to determine if the suspected error is correct (i.e., whether the tank behaved as expected based on the parameter modified and the correct calculational formulae) or whether a deficiency exists (i.e., results are unexpected based on parameter modification and the calculational formulae). If the error is obvious or a deficiency was noted, a discrepancy report is submitted. The code developers use the discrepancy report to correct and improve the functionality of the refined safety analysis tool. Section 2.0 identifies the tests performed, Section 3.0 summarizes testing results, Section 4.0, lists references and Appendix A provides a listing of Discrepancy Reports and report status, and Appendices B and C provide detailed trend test analysis results.

2.0 ACCEPTANCE TEST PLAN

RESOLVE! Version 1.51 was improved to include the analysis and evaluation of Double-Shell Tanks (DSTs). Additional changes to the refined safety Analysis Tool include the buoyant displacement model, the revised mass balance, waste intrusive equipment burns, the mixer pump, waste transfer and the graphical user interface (GUI). The impacts associated with these changes have been previously determined and are documented (Slekak et al. 1999, Slezak and Bratzel 1997). The modified version is identified as Resolve! Version 2.13.

The acceptance test plan (ATP) is the primary method used by the TFC Team to determine acceptance of Resolve! Version 2.13. This plan will also verify the closure of discrepancy or deficiency reports generated during the testing and implementation of Version 2.13. Two acceptance test plans have been developed, one addresses the Single-Shell Tanks (SSTs) and the other addresses the DSTs. To provide a better understanding of the behavior of the waste the two test plans evaluate the same parameter changes; however, where appropriate additional tests have been identified based on the characteristics of the waste contained in the tanks. For example, buoyant displacement gaseous release events are only evaluated with DSTs. Tables 1 and 2 identify the tests and input parameters and variables modified for each test that will be performed for SSTs and DSTs, respectively.

Each ATP is divided into three primary areas. The three areas are: "Features Testing," "Characteristics Testing," and "Trend Testing." The purpose of the "Features Testing" (see Section 2.1) is to ensure that all of the options and features of the computer code run. The purpose of the "Characteristics Testing" (see Section 2.2) is to verify that the calculated results are consistent with each other and repeatable and to quantify the baseline stability or behavior of the computer code. "Trend Testing" (see Section 2.3) is performed to evaluate the effects of the changes to the parameter values on the frequency and consequence trends (i.e. increase, decrease, or no change) associated with gas deflagrations or detonations. In addition, previously generated discrepancy reports (see Section 2.4) as well as existing and previously identified code limitations (see Section 2.5) are identified and, where appropriate, tested and evaluated. Each of these test areas is described further in the following.

Discrepancies and issues identified during testing are discussed and summarized in Section 4.0.

2.1 FEATURES TESTING

Testing the features of Resolve! 2.13 ensures that it runs properly and produces the proper outputs while various available options are selected. To test all the features, an analyst systematically works through the available screens and makes every allowable adjustment. In addition, feature testing includes verifying that the code and data libraries are consistent with the baseline documentation.

Additional features tests are identified for DSTs. The additional DST features test include turning on the mixer pump (normally off) and creating buoyant displacement GREs in non-buoyant tanks by modifying the characteristics of the waste.

Acceptable behavior is that all features perform the function intended by the programmers and that no feature causes the program to "crash" or result in an error message. The baseline code and the data libraries must also be consistent with the documentation. This testing also includes running sample cases provided by the code developers to verify the installation of the computer code. The verification involves comparing the results of the sample case run(s) at a user workstation to the results of the code developer sample case run(s). Results of Feature Testing are summarized in Section 3.1. Any discrepancy reports generated as a result of this testing are presented in Appendix A.

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Table 1. Single-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[a]	Test Description	Input variable and parameter
FEATURES TESTING OF SSTs (see Section 2.1.1)		
Features testing	All parameters for Tank SX-103	See Acceptance Test Procedures for variable values
CHARACTERISTICS TESTING OF SSTs (see Section 2.2.1)		
Transport test (see Section 2.2.1)	Tests repeatability of benchmark case on multiple workstations	Tank: SX-103 Analysis type: Benchmark Sample count: 1000 Sample seed: 90,000,000
Sample Count Stability (see Section 2.2.2)	This test is used to establish the statistical stability of Resolve Version 2.13	Tank: SX-103 Analysis type: Sensitivity Sample count: 200 to 1000 in increments of 50 Sample seed: 90,000,000
Sample Seed Stability (see Section 2.2.3)	This test is used to establish the statistical stability of Resolve Version 2.13	Tank: SX-103 Analysis type: Sensitivity Sample count: 1000 Sample seed: 10,000,000 to 97,000,000 in increments of 30,000,000
Sample Count and Sample Seed Stability (see Section 2.2.4)	This test is used to establish the statistical stability of Resolve Version 2.13	Tank: SX-103 Analysis type: Sensitivity Sample count: 500, 750, 1000 Sample seed: 10,000,000 to 52,000,000 in increments of 30,000,000
Tank Properties Testing (see Section 2.2.5)	The purpose of the tank characteristics test is to verify that tanks with the same properties are evaluated the same in Resolve Version 2.13	Benchmark Tank: SX-103 / S-102 Analysis type: Benchmark / Sensitivity Sample count: 1000 / 1000 Sample seed: 90,000,000 / 90,000,000
TREND TESTING OF SSTs (see Section 2.3.1)		
Initial Trend Test Case (see Section 2.3)	Establish benchmarks for low, medium and high fill factor tanks	Tanks: 241-B-111 241-S-102 241-U-111 241-T-203 Analysis type: Benchmark Sample count: 1000 Sample seed: 90,000,000

Table 1. Single-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[a]	Test Description	Input variable and parameter
Saltwell pumping (see Section 2.3.1)	Trend test cases are run to explore the effect of saltwell pumping on risk	Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: Pump status Benchmark: never pumped Trend case: previously pumped
Waste Volume Reduction (see Section 2.3.2)	Trend test cases are run to explore the effect of changing the waste volume on risk	Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: Waste volume Tank / Benchmark / Trend case 241-B-111 / 327 / 166 241-S-102 / 549 / 384 241-U-111 / 329 / 230 241-T-203 / 329 / 230
Number of Intrusive Operations (see Section 2.3.3)	Trend test cases are run to explore the effect of increasing the number of equipment insertions and/or removal operations on risk	Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: In-Tank: All waste disturbing; Intrusive operations Variable / Benchmark / Trend case Non waste disturbing / Triangular(0,1.5,11) / Triangular(5,7.5,55) Locally waste disturbing / Triangular(0,0.32,3) / Triangular(0,1.6,15) Globally waste disturbing / Triangular(0,0.07,4) Triangular(0,0.35,20)
		Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: In-Tank: Non waste disturbing; Intrusive operations Variable / Benchmark / Trend case Non waste disturbing / Triangular(0,1.5,11) / Triangular(5,7.5,55)

Table 1. Single-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[(a)]	Test Description	Input variable and parameter
Number of Intrusive Operations (see Section 2.3.3)(Continued)		Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: In-Tank: Locally waste disturbing; Intrusive operations <u>Variable</u> <u>Benchmark</u> <u>Trend case</u> Locally waste disturbing Triangular(0,0.32,3) Triangular(0,1.6,15)
		Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: In-Tank: Globally waste disturbing; Intrusive operations <u>Variable</u> <u>Benchmark</u> <u>Trend case</u> Globally waste disturbing Triangular(0,0.07,4) Triangular(0,0.35,20)
		Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: Ex-Tank: All waste disturbing; Intrusive operations <u>Ex-Tank Variable</u> <u>Benchmark</u> <u>Trend case</u> Waste disturbing Triangular(0,1.5,11) Triangular(0,1.5,11))

Table 1. Single-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[a]	Test Description	Input variable and parameter
Number of Intrusive Operations (see Section2.3.3) (Continued)		Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: In-/Ex-Tank: All waste disturbing; Intrusive operations In-Tank Variable — Benchmark — Trend case Non waste disturbing — Triangular(0,1.5,11) — Triangular(5,7.5,55) Locally waste disturbing — Triangular(0,0.32,3) — Triangular(0,1.6,15) Globally waste disturbing — Triangular(0,0.07,4) — Triangular(0,0.35,20) Ex-Tank Variable — Benchmark — Trend case Waste disturbing — Triangular(0,1.5,11) — Triangular(0,1.5,11)
Ignition Control Set (see Section 2.3.4)	Trend test cases are run to explore the effect of changing the ignition controls on risk	Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: Ignition control, all waste disturbing activities Benchmark — Trend case Control Set II — past practices
Ventilation rate (see Section 2.3.5)	Trend test cases are run to explore the effect of changing the ventilation rate on risk	Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: Ventilation flow rate, reduction Tank — Benchmark — Trend case 241-B-111 — 0.2566 — 0.0257 241-S-102 — 0.2124 — 0.0212 241-U-111 — 0.2173 — 0.0217 241-T-203 — 0.0000 — 0.0000

Table 1. Single-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[a]	Test Description	Input variable and parameter
Ventilation rate (see Section2.3.5) (Continued)	Trend test cases are run to explore the effect of inerting the tank headspace on risk	Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: Ventilation flow rate, increase Tank / Benchmark / Trend case 241-B-111 / 0.2566 / 2.57 241-S-102 / 0.2124 / 2.12 241-U-111 / 0.2173 / 2.17 241-T-203 / 0.0000 / 0.00
Inerting Tank Headspace (see Section 2.3.6)	Trend test cases are run to explore the effect of inerting the tank headspace on risk	Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: Headspace atmosphere; Residual oxygen Headspace atmosphere: Benchmark / Trend case Normal / nitrogen Residual oxygen (inerting efficiency) Benchmark / Trend case 21% / 5%
		Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: Headspace atmosphere; Residual oxygen Headspace atmosphere: Benchmark / Trend case Normal / nitrogen Residual oxygen (inerting efficiency) Benchmark / Trend case 21% / 10%

Table 1. Single-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[(a)]	Test Description	Input variable and parameter
Tank Failure (cracking) Pressure (see Section 2.3.7)	Trend test cases are run to determine the effect of changing the tank cracking pressure on risk	Tanks effected: 241-B-111, 241-S-102, 241-U-111, 241-T-203 Parameter modified: Tank dome cracking pressure, reduction Tank / Benchmark / Trend case 241-B-111 / 15 / 7.5 241-S-102 / 13 / 6.5 241-U-111 / 15 / 7.5 241-T-203 / 15 / 7.5
		Tanks effected: 241-B-111, 241-S-102, 241-U-111, 241-T-203 Parameter modified: Tank dome cracking pressure, increase Tank / Benchmark / Trend case 241-B-111 / 15 / 30 241-S-102 / 13 / 26 241-U-111 / 15 / 30 241-T-203 / 15 / 30
Tank Failure (collapse) Pressure (see Section 2.3.8)	Trend test cases are run to determine the effect of changing the tank collapse pressure on risk	Tanks effected: 241-B-111, 241-S-102, 241-U-111, 241-T-203 Parameter modified: Tank dome collapse pressure Benchmark / Trend case Triangular(22,44,88) / Triangular(11,22,44)
Waste Intrusive Equipment Burns (see Section 2.3.9)	Trend test cases are run to determine the effects of changing individual parameters characterizing waste intrusive equipment characteristics and operations	Tanks effected: 241-B-111, 241-S-102, 241-U-111, 241-T-203 Parameter modified: Waste intrusive equipment number of operations per year Benchmark / Trend case 0 / 5

Table 1. Single-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[(a)]	Test Description	Input variable and parameter
Waste Intrusive Equipment Burns (see Section 2.3.9) (Continued)		Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: Waste intrusive equipment ignition control (5 operations per year) Benchmark: NFPA purge Trend case: No purge
		Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: Waste intrusive equipment; equipment diameter (5 operations per year) Benchmark: 3 Trend case: 6
		Tanks effected: 241-B-111 241-S-102 241-U-111 241-T-203 Parameter modified: Waste intrusive equipment; equipment length (5 operations per year) Benchmark: NFPA purge Trend case: No purge

(a) Sections identified provide detailed discussion of test performed.

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[a]	Test Description	Input parameter and variable values
FEATURES TESTING OF DSTs (see Section 2.1.2)		
Features testing	All parameters for Tank SY-103	See Acceptance Test Procedures for variable values
Buoyant displacement go/no-go	Average density criteria. BD's occur at average densities >1.41kg/L	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000
	Sodium concentration criteria. BD's occur at sodium concentrations >10 molar and TOC > ~0.3wt%.	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000
	Nitrite concentration. BD's occur at nitrite concentrations > 2 molar and TOC > ~0.3wt%.	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000
	Aluminate concentration. BD's occur at aluminate concentrations > 0.9 molar and TOC > ~0.3wt%.	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000
	Layer levels and densities. Layer characteristics are an important factor to control the density criteria and the Energy Equation (BD's occur at $ER_{min} > 1$)	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000
Mixer pump	Test to determine if the Mixer Pumps can be turned on and if they have an impact on consequences.	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000 Benchmark: mixer pump off Sensitivity: mixer pump on
Waste intrusive equipment burns	Test to determine In-tank equipment burns can be turned on. Results, both % LFL and Consequences, will need to be compared f or WIE burns (TDS).	Tank: SY-103 Analysis type: Sensitivity Sample count: 1000 Seed: 90,000,000 Benchmark: equipment frequency = 0 Sensitivity: equipment frequency = 5

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[(a)]	Test Description	Input parameter and variable values
Waste transfers		
CHARACTERISTICS TESTING OF DSTs (see Section 2.2.2)		
Transport test (see Section 2.2.1)	Tests repeatability of benchmark case on multiple workstations	Tank: SY-103 Analysis type: Benchmark Sample count: 1000 Seed: 90,000,000
Sample Count Stability (see Section 2.2.2)	This test is used to establish the statistical stability of Resolve Version 2.1	Tank: SY-103 Analysis type: Benchmark Sample count: 200 to 1000 in increments of 50 (e.g., 200, 250, 300, …….) Seed: 90,000,000
Sample Seed Stability (see Section 2.2.3)	This test is used to establish the statistical stability of Resolve Version 2.1	Tank: SY-103 Analysis type: Benchmark Sample count: 1000 Seed: 10,000,000 to 97,000,000 in increments of 3,000,000 (e.g., 10,000,000, 13,000,000, 16,000,000, …….)
Sample Count and Sample Seed Stability (see Section 2.2.4)	This test is used to establish the statistical stability of Resolve Version 2.1	Tank: SY-103 Analysis type: Benchmark Sample count: 500, 750, 1000 Seed: 25,000,000 to 52,000,000 in increments of 3,000,000 (e.g., 28,000,000, 31,000,000, 34,000,000, …….)
Tank Properties Testing (see Section 2.2.5)	The purpose of the tank characteristics test is to verify that tanks with the same properties are evaluated the same in Resolve Version 2.1	Benchmark Tank — Test Tank Tank: SY-103 — AN-107 Analysis type: Benchmark — Sensitivity Sample count: 1000 — 1000 Seed: 90,000,000 — 90,000,000
TREND TESTING OF DSTs (see Section 2.3.2)		
Initial Trend Test Case (see Section 2.3)	Establish benchmarks for low, medium and high fill factor tanks	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Analysis type: Benchmark Sample count: 1000 Seed: 90,000,000

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[(a)]	Test Description	Input parameter and variable values
Waste Volume Reduction (see Section 2.3.2)	Trend test cases are run to explore the effect of changing the waste volume on risk. Test evaluates reducing the total waste volume 5% by reducing the volume of liquids in the tank.	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Liquid volume (cu.ft.), Tank average specific gravity, Liquid thickness (ft.), Total waste volume (gal.). Tank / Benchmark cuft / Trend case: Liquid vol. / Avg sPg / Liq Thick. / Waste Volume 241-SY-101 / 76,561 / 46,957 / 1.63 / 10.6 / 885,686 241-SY-103 / 48,850 / 28,816 / 1.56 / 6.5 / 599,360 241-AN-107 / 107,470 / 79,368 / 1.47 / 18.0 / 840,720 241-AW-106 / 46,960 / 31,470 / 1.56 / 7.1 / 463,440
Number of Intrusive Operations (see Section 2.3.3)	Trend test cases are run to explore the effect of decreasing/increasing the number of equipment insertions and/or removal operations on risk	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: In-Tank: All waste disturbing; Intrusive operations / Benchmark / Trend case Non-waste disturbing / Triangular(0,1.3,6) / Triangular(0,2.6,12) Locally waste disturbing / Triangular(0,1.7,39) / Triangular(0,3.4,78) Globally waste disturbing / Triangular(0,2.6,23) / Triangular(0,5.2,46)
		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: In-Tank: Non waste disturbing; Intrusive operations / Benchmark / Trend case Non-waste disturbing / Triangular(0,1.3,6) / Triangular(0,2.6,12)
		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: In-Tank: Locally waste disturbing; Intrusive operations / Benchmark / Trend case Locally waste disturbing / Triangular(0,1.7,39) / Triangular(0,3.4,78)

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[(a)]	Test Description	Input parameter and variable values
Number of Intrusive Operations (see Section 2.3.3) (Continued)		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: In-Tank: Globally waste disturbing; Intrusive operations Benchmark / Trend case Globally waste disturbing: Triangular(0,2.6,23) / Triangular(0,5.2,46)
		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Ex-Tank: Waste disturbing; Intrusive operations Benchmark / Trend case Waste disturbing: Triangular(60,110,298) / Triangular(120,220,596)
		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: In-Tank: All waste disturbing; Intrusive operations Benchmark / Trend case Non-waste disturbing: Triangular(0,1.3,6) / Triangular(0,2.6,12) Locally waste disturbing: Triangular(0,1.7,39) / Triangular(0,3.4,78) Globally waste disturbing: Triangular(0,2.6,23) / Triangular(0,5.2,46) Parameter modified: Ex-Tank: Waste disturbing; Intrusive operations Benchmark / Trend case Waste disturbing: Triangular(60,110,298) / Triangular(120,220,596)
In-Tank Ignition Control Set (see Section 2.3.4)	Trend test cases are run to explore the effect of changing the In-Tank ignition controls on risk	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Ignition control set All waste disturbing options Benchmark / Trend case Control set II / Past practices

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[a]	Test Description	Input parameter and variable values
Ex-Tank Ignition Control Set (see Section 2.3.4)	Trend test cases are run to explore the effect of changing the Ex-Tank ignition controls on risk	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Ignition control set Operations Tank / Benchmark / Trend case 241-SY-101 Control set II Past practices 241-SY-103 Control set II Past practices 241-AN-107 Past practices Control set II 241-AW-106 Past practices Control set II
In- and Ex-Tank Ignition Control Set (see Section 2.3.4)	Trend test cases are run to explore the effect of changing the Ex-Tank ignition controls on risk	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Ignition control set In-Tank: All waste disturbing options Benchmark: Control set II; Trend case: Past practices Ex-Tank: Operations Tank / Benchmark / DTT5c 241-SY-101 Control set II Past practices 241-SY-103 Control set II Past practices 241-AN-107 Past practices Control set II 241-AW-106 Past practices Control set II
Ventilation rate (see Section 2.3.5)	Trend test cases are run to explore the effect of changing the ventilation rate on risk	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Ventilation flow rate Tank / Benchmark / Trend case 241-SY-101 485 48.5 241-SY-103 99 9.9 241-AN-107 126 12.6 241-AW-106 151 15.1

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[(a)]	Test Description	Input parameter and variable values
Ventilation rate (see Section 2.3.5) Continued		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Ventilation flow rate Tank / Benchmark / Trend case 241-SY-101 / 485 / 4850 241-SY-103 / 99 / 990 241-AN-107 / 126 / 1260 241-AW-106 / 151 / 1510
Inerting Tank Headspace (see Section 2.3.6)	Trend test cases are run to explore the effect of inerting the tank headspace on risk	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Headspace atmosphere; Residual oxygen Headspace atmosphere: Benchmark / Trend case Normal / nitrogen Residual oxygen (inerting efficiency) Benchmark / Trend case 21% / 5%
		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Headspace atmosphere; Residual oxygen Headspace atmosphere: Benchmark / Trend case Normal / nitrogen Residual oxygen (inerting efficiency) Benchmark / Trend case 21% / 10%

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[a]	Test Description	Input parameter and variable values
Tank Failure (collapse) Pressure (see Section 2.3.8)	Trend test cases are run to determine the effect of changing the tank collapse pressure on risk	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Tank dome collapse pressure (psig) <u>Benchmark</u> <u>Trend case</u> Uniform(55,60) Uniform(27.5,30)
Waste Intrusive Equipment Burns (see Section 2.3.9)	Trend test cases are run to determine the effects of changing individual parameters characterizing waste intrusive equipment characteristics and operations	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Waste intrusive equipment number of operations per year <u>Benchmark</u> <u>Trend case</u> 0 5
		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Ignition Control Strategy (Operations at 5 times per year) <u>Benchmark</u> <u>Trend case</u> Purged Not purged
		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Waste intrusive equipment design Equipment diameter (Operations at 5 times per year) <u>Benchmark</u> <u>Trend case</u> 3 6

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[a]	Test Description	Input parameter and variable values
		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Parameter modified: Waste intrusive equipment design Equipment length (Operations at 5 times per year) Benchmark / Trend case 55 / 65
Density ratio of liquids to solids (see Section 2.3.2.10)	Trend test cases are run to explore the effects of increasing the settled and immobile solids bulk density (layer thickness and liquid layer characteristics are not changed) Note: 241-SY-101 has no immobile solids and is not analyzed	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Benchmark Tank / Liquids / Settled solids / Immobile solids 241-SY-101 / 98.01 / 106.13 / unspecified 241-SY-103 / 86.77 / 91.77 / 97.17 241-AN-107 / 91.77 / 98.01 / 98.01 241-AW-106 / 69.3 / 98.01 / 97.17 Parameter modified: Settled solids bulk density Tank / Trend case 241-SY-101 / 159.20 241-SY-103 / 137.66 241-AN-107 / 147.02 241-AW-106 / 103.95

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[a]	Test Description	Input parameter and variable values
		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Benchmark Tank / Liquids / Settled solids / Immobile solids 241-SY-103 86.77 91.77 97.17 241-AN-107 91.77 98.01 98.01 241-AW-106 69.3 98.01 97.17 Parameter modified: Immobile solids bulk density Tank / Trend case 241-SY-103 145.76 241-AN-107 147.02 241-AW-106 145.06
Waste gas generation rate (see Section 2.3.11)	Trend test cases are run to explore the effects of increasing the settled and immobile solids waste gas generation rates (liquid gas generation rates are not changed)	Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Benchmark Tank / Liquids / Settled solids / Immobile solids 241-SY-101 1.36E-07 1.49E-07 3.16E-08 241-SY-103 3.38E-08 3.75E-08 3.75E-08 241-AN-107 1.27E-07 1.67E-07 3.16E-08 241-AW-106 3.17E-09 1.13E-08 3.16E-08 Parameter modified: Settled solids gas generation rate Tank / Trend case 241-SY-101 1.49E-06 241-SY-103 3.75E-07 241-AN-107 1.67E-06 241-AW-106 1.13E-07

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[a]	Test Description	Input parameter and variable values
		Tanks: 241-SY-101 241-SY-103 241-AN-107 241-AW-106 Benchmark Tank / Liquids / Settled solids / Immobile solids 241-SY-101 / 1.36E-07 / 1.49E-07 / 3.16E-08 241-SY-103 / 3.38E-08 / 3.75E-08 / 3.75E-08 241-AN-107 / 1.27E-07 / 1.67E-07 / 3.16E-08 241-AW-106 / 3.17E-09 / 1.13E-08 / 3.16E-08 Parameter modified: Immobile solids gas generation rate Tank / Trend case 241-SY-101 / 3.16E-07 241-SY-103 / 3.75E-07 241-AN-107 / 3.16E-07 241-AW-106 / 3.16E-07
Buoyant Displacement	Trend test cases are run to explore the effects of different parameters on whether or not BD GREs occur.	Tanks: 241-SY-101 241-SY-103 241-AN-107 Tank SY-103 / Bench Mark / Parameter Minium / Parameter Maxium Tot Vol / 749500 / 457000 / 1155000 Ave Den / 1.52 / 1.24 / 1.74 Crust Thick / 0.66 / 0.66 / 0.66 Crust Den / 90 / 61 / 90 Liq Thick / 11 / 3 / 23 Liq Den / 92 / 62 / 92 SS Thick / 7.6 / 2 / 7.6 SS Den / 98 / 77 / 135 IS Thick / 3.4 / 3.4 / 5 IS Den / 98 / 81 / 135 Al / 0.96 / 0.80 / 0.96 NO2 / 2.89 / 1.89 / 2.89

Table 2. Double-Shell Tanks: Acceptance Tests and Input Variables and Parameters.

Test Title[a]	Test Description	Input parameter and variable values
		Na 11 9 11 TOC 0.88 0.2 0.88
Mixer Pump Installation	Trend test cases are run to explore if the GRE consequences are affected by mixer pump operations parameters.	Tank: 241-SY-101 Tank SY-101 / Bench Mark / Trend Case Pump Stat / Off / On GRE Window / 30 / 90 Circ Rate / 26740 / 21392 SS Dist Rate / 96.6 / 77.3 Mix OPS Dur / 5.5 / 2.8 to 8.3 Mix OPS Freq / 12 / 6 to 24 Mix OPS Rad / 37 / 25 Mix Post OPS Void / 4.5 / 3.6 to 5.4

(a) Sections identified provide detailed discussion of test performed.

2.2 CHARACTERISTIC TESTING

Characteristic Testing is performed following the successful completion of the "Features Testing." The purpose of the "Characteristic Testing" is to verify that the calculated results are stable and repeatable and to determine the number of trials (or samples) required to achieve stable and repeatable results. These tests are performed at different workstations using the identical statistical analysis parameters. Characteristics Testing is also used to establish system baseline stability or behavior due to changes in statistical analysis parameters. Typically, it would be necessary to test the Analysis Tool as an integrated tool; however, due to the addition of the DST analysis, it is necessary to test both the SST and DST stability. The following subsections describe the characteristics testing, which is common to both SSTs and DSTs and the expected changes to the results caused by the testing. Results of Characteristic Testing are summarized in Section 3.2.

To test system stability the variance, standard deviation and the relative standard deviation values are calculated. The relative standard deviation is calculated using two methods 1) dividing the square root of the variance by the average, and 2) dividing the standard deviation by the average. Simply stated, the standard deviation equals the square root of the variance. In order to comply, the values must not vary by more than a factor or two. Translated to the percentile notation common with relative standard deviations, the values cannot be over 200%.

2.2.1 Transport Testing

The purpose of the transport test is to verify that the installed versions of Resolve! 2.13 are repeatable on multiple workstations. That is, for a specific tank, given the same input parameters, Resolve! 2.13 will calculate identical results. An analyst performs two Benchmark case runs using the same tank, the same sample seed value, and the same sample count. Each analyst performs the same case runs at their work station. The mean and the median of the onsite radiological and toxicological results are shown on the GUI and are compared. In addition, the first ten frequency-consequence pairs for the onsite radiological and toxicological results recorded in the analysis output file (.afo) for each run are compared.

This case will be the Benchmark Case. All new installations will be required to perform the same case and verify the results of the analysis at the new work station are identical to the benchmark case analysis results. Additionally, it is recommended that each analyst rerun this case prior to performing new analyses. See Tables 1 and 2 for a description of the tests performed.

2.2.2 Sample Count Stability

This test is used to establish the stability of Resolve! 2.13. That is, changing the number of sample analyzed will impact the statistical analysis and the reported results. It is expected that the reported results for each case based on the number of samples analyzed will vary; however, the variance should not be significant. An analyst performs 17 benchmark runs using a single tank and the same sample seed value. For each run, the sample count is iterated from 200 to 1000 in increments of 50.

The median of the onsite radiological and toxicological results as shown on the GUI, for 17 runs, are compared. The relative standard deviation should be less than 200%. See Tables 1 and 2 for a description of the tests performed.

2.2.3 Sample Seed Stability

This test is also used to establish the stability of Resolve! 2.13, similar to the Sample Count Sensitivity test discussed above. That is, changing the seed value will impact the statistical analysis and the reported results. It is expected that the reported results for each sample seed value analyzed will vary; however, the variance should not be significant. An analyst performs 30 benchmark runs using a single tank and the same sample count. For each run, the sample seed is iterated from 100,000,000 to 970,000,000 in increments of 3,000,000.

The median of the onsite radiological and toxicological results are shown on the GUI, for all 30 runs, are compared. The relative standard deviation should be less than 200. See Tables 1 and 2 for a description of the tests performed.

2.2.4 Sample Count and Sample Seed Stability

This test is also used to establish the stability of Resolve! 2.13, similar to the Sample Count and Sample Seed Sensitivity tests discussed above. That is, changing the sample count and the sample seed value will impact the statistical analysis and the report results. It is expected that the reported results for each case will vary; however, the variance should not be significant. A total of 30 runs will be performed. That is for 10 different sample seeds, 3 different sample counts are analyzed See Tables 1 and 2 for a description of the tests performed.

The median of the onsite radiological and toxicological results as shown on the GUI, for all 30 runs, are compared. The relative standard deviation should be less than 200%.

2.2.5 Tank Characteristics Testing

The purpose of the tank characteristics test is to verify that tanks with the same characteristics are evaluated the same in Resolve! 2.13. That is, for two tanks, given the same input parameters and characteristics, Resolve! 2.13 will calculate identical results. As a basis for this test, the analyst uses the tank characteristics (e.g., fill, waste type) as the benchmark case tank (SX-103) to re-characterize a tank from another tank farm. The analyst performs a sensitivity analysis using the same tank characteristics, the same sample seed value, and the same sample count used in the Transport Test. The mean of the onsite radiological and toxicological results as shown on the GUI are compared. See Tables 1 and 2 for a description of the tests performed.

2.3 TREND TESTING

Trend testing is performed to evaluate the effects of changes in the pedigreed data values and the predefined controls on the frequency and consequences of a flammable gaseous release. The trend testing is performed by comparing the Benchmark case to the modified (i.e., changed, pedigreed data values and predefined controls) case. As discussed previously (Section 1.1), the major improvement of the refined safety analysis tool is the ability to analysis and evaluate DSTs. Additional changes to the refined safety analysis tool include the buoyant displacement model, the revised mass balance, waste intrusive equipment burns, the mixer pump, waste transfers, and the GUI. Four representative SSTs and DTSs were selected for trend analysis. Tables 2 and 3 for SSTs and DSTs, respectively, identify the tanks and the parameters selected for trend testing.

Table 3. Summary of Single Shell Tanks Used in Trend Testing.

Tank	Tank volume (kgal)[a]	Waste volume (kgal)[a]	Fill factor	Saltwell pump status	Ventilation flow rate (cfm)	GRE behavior[b]
241-B-111	530	237	0.3 (medium)	never pumped	0.3	NBD
241-S-102	758	549	0.5 (medium)	never pumped	0.2	NBD
241-U-111	530	329	0.4 (medium)	never pumped	0.2	NBD
241-T-203	38	35	0.9 (high)	never pumped	0.4	NBD

(a) Volumes shown are approximates. kgal = thousand gallons
(b) GRE - Gas release event
BD - Buoyant displacement
NBD - Non-buoyant displacement
NGRE - No observed GRE's

Table 4. Summary of Double Shell Tanks Used in Trend Testing.

Tank	Waste volume[a]	Waste characteristics[b]			Ventilation flow rate (cfm)	GRE behavior[c]
		Volume (ft^3)	Gas generation rate (moles/m^3 sec)	Bulk density (lbm/ft^3)		
241-AW-106	579,300	C-0	C-NA	C-NA	151	NBD
		L-46,960	L-3.17E-09	L-69.3		
		SS-30,480	SS-1.13E-8	SS-98.01		
		IS-0	IS-NA	IS-NA		
241-AN-107	1,050,900	C-0	C-NA	C-NA	126	NBD
		L-107,490	L-1.27E-07	L-86.77		
		SS-33,000	SS-1.67E-07	SS-91.77		
		IS-0	IS-NA	IS-NA		
241-SY-101	1,107,110	C-14,710	C-8.78E-08	C-84.3	485	BD
		L-76,560	L-1.36E-07	L-98.01		
		SS-56,680	SS-1.49E-07	SS-106.13		
		IS-0	IS-NA	IS-NA		
241-SY-103	749,200	C-2,920	C-4.27E-08	C-89.93	99	BD
		L-48,860	L-3.38E-08	L-91.77		
		SS-33,490	SS-3.75E-08	SS-98.01		
		IS-14,930	IS-3.75E-08	IS-98.01		

NA – Not applicable
(a) Volumes shown are approximate.
(b) Volumes shown are approximate. lbm/cuft = pound moles per cubic foot
C - crust layer
L - liquid layer
SS - settled solids layer
IS - immobile solids layer
(c) GRE - Gas release event
BD - Buoyant displacement
NBD - Non-buoyant displacement
NGRE - No observed GRE's

The general approach followed in trend testing is to develop a Benchmark case for each tank maximizing the sensitivity of the program and to perform multiple analyses or sensitivity case runs for each tank changing only one parameter (i.e., pedigreed data value or predefined control) per analysis. The output from each run or analysis (e.g., frequency and/or consequences) are tabulated and compared. This approach will test the effects of significantly increasing or decreasing a parameter.

Tables 1 and 2 for SSTs and DSTs, respectively, provide a listing of the input parameters and values that are changed for each test. Each trend test uses the Benchmark Case as a template. That is, the Benchmark Case file is "opened" and modified. For all trend tests the Analysis Type is changed from "Benchmark" to "Sensitivity" and the appropriate input parameters and values are changed to the values specified for each test.

The following subsections describe the trend testing. The expected results due to the parameter changes are shown in Tables 5 and 6 for SSTs and DSTs, respectively. Based on the expected results specific results (e.g., frequency, deflagrations, detontations) are compared for each trend test to the benchmark case results.

2.3.1 Saltwell Pumping

This test applies to SSTs only. Trend testing cases are run to explore the effect of saltwell pumping on risk. Only the saltwell pupming status is varied; the waste volume, which would change if a tank were actually saltwell pumped, is left unchanged. The influence of saltwell pumping on gas retention characteristics was an elicited parameter (Slezak and Bratzel 1997). Tanks identified as "never pumped" are changed to "previously pumped" and vice versa. Changing the saltwell pumping status from "never pumped" to "previously pumped" is expected to decrease risk. Changing the status to "previously pumped" changes the waste void fraction and GRE frequency, elicitation. The end result should be a reduction in the number of flammable events, frequency and magnitude of radiological and toxicological consequences. Table1 provides a listing of the input parameters and values that are changed for each test.

2.3.2 Waste Volume

This test applies to SSTs and DSTs. Trend testing cases were run to explore the effect of changing the waste volume on risk. The waste volume is changed significantly. A reduction in the waste volume will increase the headspace volume. This effect may impact the ability of the headspace gases to reach the lower flammability limit. To test the effect of reducing waste volume, 30 percent of the existing waste was removed. Reducing the waste volume decreases the retained gas volume by providing less waste in which the gas can be stored. In addition, reducing the waste volume increases the headspace volume in which to dilute the GRE gases. Therefore, the size of the GREs and the fraction of the GREs that produce flammable conditions would decrease, which would result in a decrease in the number of events. Due to the properties of the waste the impacts on the frequency and consequences are indeterminate. See Tables 1 and 2 for SSTs and DSTs, respectively, for test input parameters. Therefore DST volume is reduced but is taken from liquids only.

2.3.3 Number of Intrusive Operations

This test applies to SSTs and DSTs. Trend testing cases are run to explore the effect of increasing the number of equipment insertion and/or removal operations on risk. The number of operations is increased by a factor of five over the default value. It is expected that the increase in the number of operations increases the risk by increasing the frequency of induced GREs and increasing the frequency of ignition sources. Only the frequency is expected to increase. There should be no change in the number of flammable events and the radiological and toxicological consequences. See Tables 1 and 2 for SSTs and DSTs, respectively, for test input parameters.

2.3.4 Ignition Control Set

This test applies to SSTs and DSTs. Trend testing cases were run to explore the effect of changing the ignition controls on risk. It is expected that frequency increases as the level of ignition control is decreased from "Control Set 1" or "Control Set 2" (HNF-1999) to "Past Practices" (i.e., no controls). The ignition control sets, "Control Set 1," "Control Set 2" and "Past Practices" are described in Appendix B of Slezak and Bratzel (1997). Because the controls do affect the GREs, the controls are expected to affect the frequency but have little effect on the radiological and toxicological consequences. All tanks evaluated in the trend test have Ignition Control Set 2. It is expected that changing controls from Ignition Control Set II to Past Practices should not change the number of flammable events or consequences; however, the frequency should increase. See Tables 1 and 2 for SSTs and DSTs, respectively, for test input parameters.

2.3.5 Ventilation Rate

This test applies to SSTs and DSTs. Trend testing cases were run to explore the effect of changing the ventilation rate (i.e., increasing or decreasing) on risk. This test involves reducing or increasing the default ventilation flow rate by a factor of 10. It is expected that actively ventilating a tank, compared to passive ventilation could reduce the time at risk and the computed burn pressures, and perhaps even eliminate flammable conditions altogether (Slezak and Bratzel 1997). Conversely reducing the flow rate could increase the time at risk and the computed burn pressure. Therefore, the expected result of increasing the ventilation rate is a decrease in risk, and decreasing the ventilation rate is an increase in risk. As the ventilation flow rate is modified, gases may be swept out of the tank (increased flow rate) or allowed to accumulate in the headspace (decreased flow rate). See Tables 1 and 2 for SSTs and DSTs, respectively, for test input parameters

2.3.6 Inerting the Tank Headspace, with Nitrogen

This test applies to SSTs and DSTs. Trend testing cases were run to determine the impact of inerting the headspace. Sufficient inerting of the headspace will increase the size of GREs needed to reach flammability and can prevent combustion of mixtures that are flammable before release (Slezak and Bratzel 1997). Inerting the headspace reduces the oxidizer for the burn typically furnished by air. Inerting the tank headspace should reduce GRE flammable event frequencies and should result in less damage to the tank as well as reducing the dose consequences. Risk is expected to decrease as inerting is applied. The number of hits, as well as the frequency of burns should decrease, with a small reduction in the consequences. See Tables 1 and 2 for SSTs and DSTs, respectively, for test input parameters.

2.3.7 Tank Failure (Cracking) Pressure

This test applies to SSTs only. Trend testing cases were run to explore the effect on risk of decreasing or increasing the dome cracking pressure. For this test, the dome cracking pressure is decreased or increased by 50%. Structural capacity and failure evaluations are discussed in Slezak and Bratzel (1997). It is expected that risk will increase as failure pressure is reduced, and conversely decrease as failure pressure is increased. A decrease or increase in the cracking pressure from the default value should, respectively, increase or decrease the consequences but should not affect the frequency. Additionally, the number of flammable events for an increase or decrease in the cracking pressure should not change. For a decrease in the cracking pressure, more material would be released to the environment for lower combustion pressures. Conversely for the same combustion pressures, less material would be released to the environment, thus resulting in lower consequences. See Table 1 for test input parameters

2.3.8 Tank Failure (Collapse) Pressure

This test applies to SSTs and DSTs. Trend testing cases were run to explore the effect on risk of decreasing the dome collapse pressure. The dome collapse pressure is reduced to one-half of the default value. Structural capacities and failure evaluations are discussed in Slezak and Bratzel 1997. It is expected that risk will increase as failure pressure is reduced. Reducing the dome collapse pressure should result in the same conclusions reached in the Tank Failure (Cracking) pressure test (see Section 2.3.7); i.e., the consequences should increase but the frequency should not be affected. Additionally, the number of flammable events for an increase or decrease in the cracking pressure should not change. The risk would therefore increase somewhat. More material would be released to the environment for lower combustion pressures. See Tables 1 and 2 for SST and DSTs, respectively, for test input parameters.

2.3.9 Waste Intrusive Equipment

This test applies to SSTs and DSTs. Trend testing cases were run to explore the effect on risk of waste intrusive equipment flammable events. A series of four tests are performed: 1) increase the number of operations per year; 2) change the ignition control from purged to not purged; 3) increase the diameter of the equipment; and 4) increase the length of the equipment. The benchmark case shows no operations thus increasing the number of operations will increase risk. The current ignition control requires purging waste intrusive equipment in accordance with National Fire Prevention Association (NFPA); therefore, not purging the equipment (maintaining operations at 5 per year) the risk will increase over benchmark conditions and test 1 in this series. Tests 3 and 4 of the series should effect the detonation cell size thus an impact is expected on the number of flammable events. However, realistic changes in the equipment design (e.g., diameter and length) may be insufficient to impact the results of Test 1 in this series. Therefore the expected changes at this time are indeterminate.

2.3.10 Increase in Bulk Density Ratio of Solids to Liquids

This test applies to DSTs only. Two tests are performed to determine the relative impacts of increasing the bulk density of the settled solids and immobile solids with respect to GRE behavior. These tests, unlike the previous tests, do not model operations or potential controls that would be implemented in the tank farms. However, based on the behavior of the waste it is anticipated that GRE behavior will be affected. That is, the higher the densities the more gas that will be retained in the waste and released spontaneously or due to some initiating event such as a seismic event or intrusive operation. Thus, it is anticipated that the risk will increase.

2.3.11 Increase in Waste Gas Generation Rate

This test applies to DSTs only. Two tests are performed to determine the relative impacts of increasing the gas generation rate in the settled solids and immobile solids with respect to GRE behavior. These tests unlike the previous tests do not model operations or potential controls that would be implemented in the tank farms. It is anticipated that the risk will increase relatively proportional to the increased rates.

2.3.12 Mixer Pump

This test applies to DSTs only. The tests, in addition to the Features Tests, were performed to determine the impacts of a mixer pump on consequences. Based on operational experience it is well understood that the mixer pump will reduce the efficiency of the GREs thus the consequences should decrease. Similarly, the frequency of buoyant GREs will also decrease.

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Table 5. Single-Shell Tanks: Expected Results from Acceptance Testing.

Test Title[a]	Test Description	Expected Test Results[b]
FEATURES TESTING OF SSTs (see Section 2.1.1)		
Features testing	All parameters for Tank SX-103	See Acceptance Test Procedures for expected testing results
CHARACTERISTICS TESTING OF SSTs (see Section 2.2.1)		
Transport test (see Section 2.2.1)	Tests repeatability of benchmark case on multiple workstations	Results are same on two independent user workstations
Sample Count Stability (see Section 2.2.2)	This test is used to establish the statistical stability of Resolve Version 2.13	Relative standard deviation is less than 200% (i.e., 2)
Sample Seed Stability (see Section 2.2.3)	This test is used to establish the statistical stability of Resolve Version 2.13	Relative standard deviation is less than 200% (i.e., 2)
Sample Count and Sample Seed Stability (see Section 2.2.4)	This test is used to establish the statistical stability of Resolve Version 2.13	Relative standard deviation is less than 200% (i.e., 2)
Tank Properties Testing (see Section 2.2.5)	The purpose of the tank characteristics test is to verify that tanks with the same properties are evaluated the same in Resolve Version 2.13	Results are same for two tanks
TREND TESTING OF SSTs (see Section 2.3.1)		
Initial Trend Test Case (see Section 2.3.1)	Establish benchmarks for low, medium and high fill factor tanks	Not Applicable
Saltwell pumping (see Section 2.3.2)	Trend test cases are run to explore the effect of saltwell pumping on risk	Never to previously pumped: All tanks Frequency: Decrease Consequences: Decrease Expected risk: Decrease
Waste Volume Reduction (see Section 2.3.3)	Trend test cases are run to explore the effect of changing the waste volume on risk	Waste volume reduced 30% in all tanks: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease

Table 5. Single-Shell Tanks: Expected Results from Acceptance Testing.

Test Title[a]	Test Description	Expected Test Results[b]
Number of Intrusive Operations (see Section 2.3.4)	Trend test cases are run to explore the effect of increasing the number of equipment insertions and/or removal operations on risk	Increase number of intrusive operations for all activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Increase number of intrusive operations for non waste disturbing activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
Number of Intrusive Operations (see Section2.3.4) (Continued)		Increase number of intrusive operations for locally waste disturbing activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Increase number of intrusive operations for globally waste disturbing activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Increase number of intrusive operations Ex-Tank activities: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
Ignition Control Set (see Section 2.3.5)	Trend test cases are run to explore the effect of changing the ignition controls on risk	In-tank ignition control set changed from control set II to past practices: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Ex-tank ignition control set changed from past practices to control set II: All tanks Frequency: Increase Consequences: No change Expected risk: Increase

Table 5. Single-Shell Tanks: Expected Results from Acceptance Testing.

Test Title[a]	Test Description	Expected Test Results[b]
Ventilation rate (see Section 2.3.6)	Trend test cases are run to explore the effect of changing the ventilation rate on risk	Reduce ventilation flow rate: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Increase ventilation flow rate: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Inerting Tank Headspace (see Section 2.3.7)	Trend test cases are run to explore the effect of inerting the tank headspace on risk	Inerting tank headspace with nitrogen 5% residual oxygen: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Inerting Tank Headspace (see Section 2.3.7) (Continued)		Inerting tank headspace with nitrogen 10% residual oxygen: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Tank Failure (cracking) Pressure (see Section 2.3.8)	Trend test cases are run to determine the effect of changing the tank cracking pressure on risk	Reduce tank failure (cracking) pressure: All tanks Frequency: No change Consequences: No change Expected risk: No change
		Increase tank failure (cracking) pressure: All tanks Frequency: No change Consequences: Increase Expected risk: Increase
Tank Failure (collapse) Pressure (see Section 2.3.9)	Trend test cases are run to determine the effect of changing the tank collapse pressure on risk	Reduce tank failure (collapse) pressure: All tanks Frequency: No change Consequences: Increase Expected risk: Increase

Table 5. Single-Shell Tanks: Expected Results from Acceptance Testing.

Test Title[a]	Test Description	Expected Test Results[b]
Waste Intrusive Equipment Burns (see Section 2.3.10)	Trend test cases are run to determine the effects of changing individual parameters characterizing waste intrusive equipment characteristics and operations	Increase the number of operations to 5 per year: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Change ignition control to no inerting (5 operations per year): All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Increase the diameter of the equipment (5 operations per year): All tanks Frequency: Decrease Consequences: Increase Expected risk: Increase
		Increase the length of the equipment (5 operations per year): All tanks: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase

(a) Sections identified provide detailed discussion of test performed. See also Table 1.
(b) Expected analysis results based on parameter modified and anticipated effects associated with the modification.

Table 6. Double-Shell Tanks: Expected Results from Acceptance Testing.

Test Title[(a)]	Test Description	Expected Test Results[(b)]
FEATURES TESTING OF DSTs (see Section 2.1.1)		
Features testing	All parameters for Tank SY-103	See Acceptance Test Procedures for expected testing results
	Buoyant displacement	Buoyant displacement GREs can be turned off or on as a function of tank conditions. Check of Average Tank Density, Sodium Concentration, Nitrite Concentration, Aluminate Concentration, and Energy Criteria.
	Mixer pump	Mixer pump turned on reducing the frequency of buoyant displacement GREs and is sensitive to pump operating parameters; pump status, time since last GRE, pump circulation rate, pump circulation rate, settled-solids disturbance rate, mixer pump operations duration, mixer pump operations frequency, mixer pump radius of influence, and post mixer pump operations void fraction.
CHARACTERISTICS TESTING OF DSTs (see Section 2.2.1)		
Transport test (see Section 2.2.1)	Tests repeatability of benchmark case on multiple workstations	Results are same on two independent user workstations
Sample Count Stability (see Section 2.2.2)	This test is used to establish the statistical stability of Resolve Version 2.13	Relative standard deviation is less than 200% (i.e., 2)
Sample Seed Stability (see Section 2.2.3)	This test is used to establish the statistical stability of Resolve Version 2.13	Relative standard deviation is less than 200% (i.e., 2)
Sample Count and Sample Seed Stability (see Section 2.2.4)	This test is used to establish the statistical stability of Resolve Version 2.13	Relative standard deviation is less than 200% (i.e., 2)
Tank Properties Testing (see Section 2.2.5)	The purpose of the tank characteristics test is to verify that tanks with the same properties are evaluated the same in Resolve Version 2.13	Results are same for two tanks
TREND TESTING OF DSTs (see Section 2.3.1)		
Initial Trend Test Case (see Section 2.3)	Establish benchmarks for low, medium and high fill factor tanks	Not Applicable
Waste Volume Reduction (see Section 2.3.2)	Trend test cases are run to explore the effect of changing the waste volume on risk	Waste volume reduced 30% in all tanks: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease

Table 6. Double-Shell Tanks: Expected Results from Acceptance Testing.

Test Title[(a)]	Test Description	Expected Test Results[(b)]
Ventilation rate (see Section 2.3.5)	Trend test cases are run to explore the effect of changing the ventilation rate on risk	Reduce ventilation flow rate: All tanks Frequency: Increase Consequences: No change Expected risk: Increase
		Increase ventilation flow rate: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Inerting Tank Headspace (see Section 2.3.6)	Trend test cases are run to explore the effect of inerting the tank headspace on risk	Inerting tank headspace with nitrogen 5% residual oxygen: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
		Inerting tank headspace with nitrogen 10% residual oxygen: All tanks Frequency: Decrease Consequences: No change Expected risk: Decrease
Tank Failure (collapse) Pressure (see Section 2.3.8)	Trend test cases are run to determine the effect of changing the tank collapse pressure on risk	Reduce tank failure (collapse) pressure: All tanks Frequency: No change Consequences: Increase Expected risk: Increase
Waste Intrusive Equipment Burns (see Section 2.3.9)	Trend test cases are run to determine the effects of changing individual parameters characterizing waste intrusive equipment characteristics and operations	Increase the number of operations to 5 per year: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Change ignition control to no inerting (5 operations per year): All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Increase the diameter of the equipment (5 operations per year): All tanks Frequency: Decrease Consequences: Increase Expected risk: Increase

Table 6. Double-Shell Tanks: Expected Results from Acceptance Testing.

Test Title[(a)]	Test Description	Expected Test Results[(b)]
		Increase the length of the equipment (5 operations per year): All tanks: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
Density ratio of solids to liquids (see Section 2.3.2.10)	Trend test cases are run to explore the effects of increasing the settled and immobile solids bulk density (layer thickness and liquid layer characteristics are not changed) Note: 241-SY-101 has no immobile solids and is not analyzed	Increase the settled solids bulk density: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Increase the immobile solids bulk density: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
Waste gas generation rate (see Section 2.3.11)	Trend test cases are run to explore the effects of increasing the settled and immobile solids waste gas generation rates (liquid gas generation rates are not changed)	Increase the settled solids gas generation rate: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase
		Increase the immobile solids gas generation rate: All tanks Frequency: Increase Consequences: Increase Expected risk: Increase

(c) Sections identified provide detailed discussion of test performed. See also Table 2.
(d) Expected analysis results based on parameter modified and anticipated effects associated with the modification

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3.0 SUMMARY OF TEST RESULTS

The results or conclusions reached regarding the acceptability of version 2.13 or the insights gained during testing are summarized in the following Sections. Appendix C provides a listing of all discrepancy reports generated during the developmental testing and the Acceptance Tests.

3.1 FEATURES TESTING

The Features Test performed were designed to test all facets of the Analysis Tool. For both the SSTs and DSTs this involved testing all of the options available and ensuring the computer code did not "crash" as a result. During the development of this version significant developmental testing was performed by both the TFC Team and SNL personnel. As a result of the developmental testing all features performed as expected.

Additional Features Tests were performed for the DSTs, including turning on and off the mixer pump, buoyant displacement GRE go/no-go tests, waste transfers, and waste intrusive equipment impacts. As stated previously stated, significant developmental testing was performed prior to finalization of Version 2.13. As a result of this testing all features performed as expected.

3.2 CHARACTERISTICS TEST

The following table (Table 7) summarizes the results of the Characteristics Tests performed. As can be seen all results meet the established criteria discussed in Section 2.2.

3.3 SUMMARY OF TREND TESTING RESULTS

Figures 1 through 11 provide a summary of the trend testing results by tank for each of the parameters modified. Appendices B and C provide the detailed data and qualitative comparisons of the calculated results for the parameter modifications to the benchmark case.

As can be seen from Figures 1 through 8 the majority of the parameters modified for both DSTs and SSTs did not significantly affect the benchmark results. The parameter modifications that did significantly impact the results include waste volume reduction and an increase or decrease in ventilation flow rate. In each of these cases the results trend as expected. Although the majority of the results trended as expected, it should be noted that results for increasing globally waste disturbing activities in SSTs (see Figure 4) did not. This issue has been discussed with the refined safety analysis development team. It was determined at this time that this will be identified as a limitation (see Section 4).

With respect to waste intrusive equipment, as expected (see Figures 9 and 10) for both DSTs and SSTs, increasing the number of waste intrusive activities increased the number of potential deflagrations and detonations when compared to the benchmark case. Additionally, as expected, removing the purge from the waste intrusive equipment significantly increased the number of potential deflagrations and detonations when compared to the base case or five operations per year. Increasing the equipment diameter or length had no impact on the base case results.

Table 7. Summary of the Results of the Characteristics Tests Performed.

Characteristic Test	Test results – Relative standard deviation (%)				
	Number of events modeled	Accident frequency	Radiological consequences	Toxicological consequences	Expected risk
SSTs – S-102					
Transport	Results obtained at two workstations for same tank were identical				
Sample count sensitivity	40.69	11.51	24.41	25.38	136.38
Sample seed sensitivity	4.20	10.39	26.20	23.40	95.75
Sample count and sample seed sensitivity (Count =1000)	3.60	7.84	12.93	6.30	101.57
Tank characteristics	Results obtained two tanks characterized the same were identical				
Characteristic Test	Test results – Relative standard deviation (%)				
	Number of events modeled	Accident frequency	Radiological consequences	Toxicological consequences	Expected risk
DST – SY-103					
Transport	Results obtained at two workstations for same tank were identical				
Sample count sensitivity	42.40	7.41	30.05	38.70	114.98
Sample seed sensitivity	1.43	5.54	30.47	31.71	112.60
Sample count and sample seed sensitivity (Count =1000)	1.01	3.96	38.23	40.52	45.29
Tank characteristics	Results obtained two tanks characterized the same were identical				

Figure 11 graphically shows the results obtained due to modifications in the characteristics of the settled solids and the immobile solids (hard pan). As can be seen increasing the ratio of the settled solids to the liquids increased the number of deflagrations in all tanks and in most tanks increased the number of detonations. Of particular interest, an increase in the ratio of settled solids to liquids created buoyant displacement GREs in Tank 241-AW-106 (identified as a non-buoyant tank). As a result of the change the waste passed the energy criteria discussed in Slezak and Bratzel (1999). Also of particular interest is changes in the gas generation rate of the settled solids reduced the potential number of non-buoyant displacement GREs in Tank 241-AW-106. Similar results were obtained in Tank 241-SY-103 when the gas generation rate in the immobile solids was changed.

Not shown graphically are the results obtained from buoyant displacement and mixer pump testing. As expected changes in the five criteria identified in Table 6 (Features Testing) created buoyant displacement GREs in non-buoyant displacement tanks and vice versa. Similarly as expected, the calculated results due to turning on the mixer pump and changing selected parameters to model existing conditions in Tank 241-SY-101 were validated to current conditions or observed GRE behavior in the tank.

4.0 DISCREPANCY TESTING AND LIMITATIONS

This section discusses discrepancy reports generated during testing and the limitations identified as a result of acceptance testing.

4.1 DISCREPANCY REPORTS

All discrepancy reports generated during developmental testing of Resolve! Version 1.51 to Version 2.13 are closed. Appendix A provides a listing of the discrepancy reports generated during developmental testing and acceptance testing. As discussed previously, due to the extensive developmental process and developmental testing with the exception of the limitation identified in Section 4.2, no discrepancy reports were generated as a result of acceptance testing. The discrepancy reports generated during developmental testing, as expected, were due to the significant refined safety analysis Tool modifications to include DSTs, buoyant displacement GRE behavior, and mixer pump modeling.

4.2 LIMITATIONS/OBSERVATIONS

As a result of acceptance testing the only limitation identified is associated with increased globally waste disturbing activities in SSTs. As discussed in Section 3.3, the results obtained for the these operations (only frequency) are contrary to expectations. This limitation will be addressed in finalization activities of the refined safety analysis tool.

Additionally, it should be noted that additional testing is required to understand GRE behavior, i.e., efficiency and source of the GRE, and spontaneous versus induced versus seismic and the source impacts on GRE behavior.

5.0 REFRENCES

Lavender, J. C., B. D. Lacey, and A. B. Webb, 1998, *Letter Report: Resolve Version 1.51 Acceptance Testing: Test Plan and Test Results,* Pacific Northwest National Laboratory, Richland, Washington.

Slezak, S. E., F. Gelbard, and W. Cheng, 1999, *Implmentation Details of the Flammable Gas Refined Safety Analysis Methodology,* Sandia National Laboratories, Albuquerque, New Mexico.

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APPENDIX A

ALL ARS DISCREPANCY REPORT

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APPENDIX A

This Appendix provides a listing of all Discrepancy Reports generated by the TFC Team and the refined safety analysis tool development team during development and acceptance testing of Resolve Version 2.13.

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All ARS Discrepancy Reports

DR#	oldDRN	Submitted	Evaluated	Closed	Deferred	AT Ver	Severity	ProbArea	Evaluator	Status
1		2/5/99	3/1/99	3/9/99		2.03	Low	GUI	Eunice Young	Closed
2		2/8/99	3/1/99	3/16/99		2.03	High	GUI	Eunice Young	Closed
3		2/8/99	3/23/99	4/1/99		2.03	Low	AFE	Steven Humphreys	Closed
4		2/8/99	3/1/99	3/12/99		2.03	Medium	GUI	Eunice Young	Closed
5		2/10/99	3/1/99	3/16/99		2.03	Medium	GUI	Eunice Young	Closed
6		2/12/99	3/15/99	3/16/99		2.03	Severe	AFE	Steven Humphreys	Closed
7		2/12/99	3/24/99	3/24/99		2.03	High	V&V	Ann Hodges	Closed
8	WCC-12	2/15/99			4/13/99	2.03	Medium	AF	Scott Slezak	Deferred
9	WCC-10	2/15/99	6/16/99	6/18/99	4/13/99	2.00	Medium	AFE	Steven Humphreys	Closed
10	JCL-6	2/15/99	3/15/99	3/26/99		2.00	Medium	AFE	Steven Humphreys	Closed
11	AR-48	2/15/99	3/15/99	4/1/99		2.00	Medium	AFE	Steven Humphreys	Closed
12	AR-49	2/15/99	3/16/99	4/1/99		2.01	Medium	AFE	Steven Humphreys	Closed
13	AR-50	2/15/99			4/13/99	2.01	Low	AF	Scott Slezak	Deferred
14	AR-51	2/15/99	3/16/99	4/1/99		2.01	High	Database	Eunice Young	Closed
15	AR-52	2/15/99	4/2/99	4/9/99		2.01	High	AFE	Steven Humphreys	Closed
16	WCC-11	2/15/99	3/15/99	3/22/99		2.00	Medium	AFE	Steven Humphreys	Closed
17	SES-60	2/15/99			4/13/99	1.92	Medium	Database	Steve Barker	Open
18	SES-61	2/15/99	3/12/99	4/5/99		1.92	Medium	AFE	Steven Humphreys	Closed
19	SES-62	2/15/99	3/15/99	4/7/99		2.00	High	AFE	Steven Humphreys	Closed
20	SES-63	2/15/99	3/16/99	4/7/99		2.01	High	AFE	Steven Humphreys	Closed
21	SES-64	2/15/99	3/12/99	4/7/99		1.92	High	AFE	Steven Humphreys	Closed
22	SES-65	2/15/99	3/17/99	4/7/99		1.92	High	AFE	Steven Humphreys	Closed
23	SES-66	2/15/99	3/29/99	4/5/99		2.02	High	GUI	Eunice Young	Closed
24	SES-67	2/15/99	3/23/99	4/6/99		2.03	High	AFE	Steven Humphreys	Closed
25		2/16/99	4/10/99	9/21/99	4/13/99	2.01	High	V&V	Ann Hodges	Closed
26		2/16/99	3/24/99	3/27/99		2.03	High	AFE	Steven Humphreys	Closed
27		2/17/99	4/6/99	4/7/99		2.03	Medium	AFE	Steven Humphreys	Closed
28		2/17/99	3/24/99	4/1/99		2.03	Medium	AFE	Steven Humphreys	Closed
29		2/22/99	3/24/99	4/1/99		2.03	Low	AFE	Steven Humphreys	Closed
30	ALH-13	2/23/99	3/3/99	3/16/99		1.92	High	AFE	Steven Humphreys	Closed

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31	ALH-14	2/23/99	3/3/99	3/16/99		1.92	High	AFE	Steven Humphreys	Closed
32	AR-32	2/23/99	4/9/99	4/9/99		1.92	Medium	AFE	Steven Humphreys	Closed
33	ALH-15	2/23/99	6/16/99		4/13/99	1.92	Medium	AFE	Steven Humphreys	Pending Closure
34	AR-42	2/23/99	3/12/99	4/1/99		1.92	High	AFE	Steven Humphreys	Closed
35	SAB-003	2/23/99	6/16/99		4/13/99	1.92	Medium	AFE	Steven Humphreys	Pending Closure
36	DUP	See ARS#21 for resolution of SES-64				1.92	High	AFE	Steven Humphreys	Closed
37	BDL-23	2/23/99	3/16/99	3/25/99		2.01	High	AFE	Steven Humphreys	Closed
38	AR-53	2/23/99			4/13/99	2.01	Medium	Database	Steve Barker	Open
39	AR-56	2/23/99	4/1/99	4/1/99		2.01	High	AFE	Steven Humphreys	Closed
40	AR-59	2/23/99	4/2/99	4/7/99		2.01	High	AFE	Steven Humphreys	Closed
41	JCK-3	2/23/99	3/15/99	4/6/99		2.01	High	AFE	Steven Humphreys	Closed
42	AR-62	2/23/99	3/16/99	3/17/99		2.01	High	AFE	Steven Humphreys	Closed
43	AR-63	2/23/99	3/16/99	4/1/99		2.01	High	AFE	Steven Humphreys	Closed
44	ABW-61	2/23/99	3/12/99	3/25/99		2.01	High	AFE	Steven Humphreys	Closed
45	ABW-62	2/23/99	3/16/99	3/25/99		2.01	Medium	AFE	Steven Humphreys	Closed
46	ALH-23	2/23/99	3/15/99	3/16/99		2.01	High	AFE	Steven Humphreys	Closed
47	AR-68	2/23/99	3/16/99	4/1/99		2.02	High	AFE	Steven Humphreys	Closed
48	AR-70	2/23/99	3/16/99	4/1/99		2.02	High	AFE	Steven Humphreys	Closed
49	AR-72	2/23/99			4/13/99	2.02	Medium	AF	Scott Slezak	Deferred
50	JCL-7	2/23/99	3/16/99	3/26/99		2.02	High	AFE	Steven Humphreys	Closed
51	AR-73	2/23/99	4/6/99	4/6/99		2.02	Medium	V&V	Ann Hodges	Closed
52	SAB-005	2/23/99			4/13/99	2.02	Medium	AF	Scott Slezak	Deferred
53	SAB-006	2/23/99	4/5/99			2.02	High	AFE	Steven Humphreys	Pending Closure
54	AR-74	2/23/99	3/15/99	4/1/99		2.03	High	AFE	Steven Humphreys	Closed
55	AR-75	2/23/99	3/16/99	4/1/99		2.03	High	AFE	Steven Humphreys	Closed
56	AR-55	2/23/99	4/1/99	4/1/99		2.01	High	AFE	Steven Humphreys	Closed
57	ABW-63	2/23/99	3/2/99	4/15/99		2.03	High	GUI	Eunice Young	Closed
58	ABW-64	2/23/99	3/1/99	3/25/99		2.03	Low	GUI	Eunice Young	Closed
59	ABW-65	2/23/99	3/22/99	4/8/99		2.03	Medium	GUI	Eunice Young	Closed
60	ABW-66	2/23/99	3/16/99	3/25/99		2.03	Medium	AFE	Steven Humphreys	Closed
61	ABW-67	2/23/99	3/25/99	4/15/99		2.03	Medium	AFE	Steven Humphreys	Closed
62	RS-001	2/23/99	3/2/99	3/30/99		2.03	High	GUI	Eunice Young	Closed
63		2/26/99	3/1/99	7/12/99		2.04	Medium	GUI	Eunice Young	Closed
64	AR-7	2/26/99			4/13/99	1.90	Medium	Database	Steve Barker	Open
65	AR-9	2/26/99	3/10/99	4/1/99		1.90	High	Database	Eunice Young	Closed

66	AR-12	2/26/99	3/10/99	4/1/99		1.90	High	AFE	Steven Humphreys	Closed
67	WCC-2	2/26/99	3/1/99	3/1/99		1.90	Medium	GUI	Eunice Young	Closed
68	BDL-6	2/26/99	3/1/99	4/8/99		1.90	High	GUI	Eunice Young	Closed
69	BDL-7	2/26/99	3/10/99	4/8/99		1.90	High	AFE	Steven Humphreys	Closed
70		2/28/99	3/1/99	3/9/99		2.04	High	GUI	Eunice Young	Closed
71		2/28/99		9/21/99	4/13/99	2.04	Medium	V&V	Ann Hodges	Closed
72		2/28/99	4/5/99	4/6/99		2.04	Low	GUI	Eunice Young	Closed
73		2/28/99	3/9/99	3/9/99		2.04	High	V&V	Ann Hodges	Closed
74		2/28/99	3/1/99	3/10/99		2.04	Medium	GUI	Eunice Young	Closed
75		2/28/99	3/2/99	3/18/99		2.04	Medium	V&V	Ann Hodges	Closed
76		2/28/99	3/23/99	4/1/99		2.04	High	AFE	Steven Humphreys	Closed
77		2/28/99	3/23/99	4/1/99		2.04	High	AFE	Steven Humphreys	Closed
78	DUP	See ARS#95 for resolution of LFM-011				2.04	High	AFE	Steven Humphreys	Closed
79	WCC-4	3/1/99	3/10/99	3/10/99		1.90	Severe	AFE	Steven Humphreys	Closed
80	LFM-012	3/1/99	3/10/99	4/5/99		1.90	Medium	GUI	Eunice Young	Closed
81	SGA-002	3/1/99			4/13/99	1.90	Medium	Documentation	Jaye Bullington	Deferred
82	SGA-006	3/1/99	3/10/99	4/9/99		1.90	High	Documentation	Jaye Bullington	Closed
83		3/1/99	3/8/99	4/1/99		2.04	Low	GUI	Eunice Young	Closed
84	SES-57	3/2/99	3/12/99	8/17/99		1.92	High	AFE	Steven Humphreys	Closed
85	SES-56	3/2/99	3/12/99	8/17/99		1.92	High	AFE	Steven Humphreys	Closed
86	SES-55	3/2/99	3/12/99	4/7/99		1.92	High	AFE	Steven Humphreys	Closed
87	SES-54	3/2/99	3/2/99	4/7/99		1.92	Medium	AFE	Steven Humphreys	Closed
88	WMG-01	3/2/99	3/2/99	3/8/99		1.90	Medium	GUI	Eunice Young	Closed
89	SES-42	3/2/99	3/12/99	4/5/99		1.92	Medium	AFE	Steven Humphreys	Closed
90	SES-40	3/2/99	3/12/99	4/5/99		1.92	High	AFE	Steven Humphreys	Closed
91		3/2/99	3/8/99	3/23/99		2.04	Medium	GUI	Eunice Young	Closed
92		3/2/99	6/16/99		4/13/99	2.04	Medium	AFE	Steven Humphreys	Pending Closure
93		3/2/99	4/8/99	4/11/99		2.04	High	AFE	Steven Humphreys	Closed
94		3/2/99		3/23/99		2.04	High	V&V	Ann Hodges	Closed
95	LFM-011	3/3/99	3/3/99	4/8/99		1.90	Medium	GUI	Eunice Young	Closed
96	SES-33	3/3/99	3/12/99	4/7/99		1.92	High	AFE	Steven Humphreys	Closed
97	SES-27	3/3/99	3/8/99	8/17/99		1.92	High	AFE	Steven Humphreys	Closed
98	SES-26	3/3/99	3/8/99	4/5/99		1.92	High	AFE	Steven Humphreys	Closed
99	SGA-007	3/3/99			4/13/99	1.90	Low	Documentation	Jaye Bullington	Deferred
100	SGA-012	3/3/99	3/4/99	4/5/99		1.90	Medium	GUI	Eunice Young	Closed

101	AR-22	3/3/99	3/3/99	3/9/99		1.90	High	AFE	Steven Humphreys	Closed
102	SES-24	3/3/99	3/8/99	8/17/99		1.92	High	AFE	Steven Humphreys	Closed
103	SES-25	3/3/99	3/8/99	4/5/99		1.92	High	AFE	Steven Humphreys	Closed
104	WMG-35	3/3/99	3/3/99	3/8/99		1.90	Low	Database	Eunice Young	Closed
105	SES-23	3/3/99	3/8/99	4/5/99		1.92	High	AFE	Steven Humphreys	Closed
106	SES-22	3/3/99	3/8/99	4/5/99		1.92	High	AFE	Steven Humphreys	Closed
107	AR-30	3/3/99	4/9/99	4/9/99		1.92	Medium	AFE	Steven Humphreys	Closed
108	SES-01	3/3/99	3/3/99	4/5/99		1.92	Medium	AFE	Steven Humphreys	Closed
109		3/3/99	3/26/99	4/1/99		2.04	Medium	AFE	Steven Humphreys	Closed
110		3/4/99	4/12/99	7/21/99	4/9/99	2.04	Medium	AFE	Steven Humphreys	Closed
111	SES-05	3/4/99	3/4/99	4/5/99		1.92	Medium	AFE	Steven Humphreys	Closed
112	SES-06	3/4/99	3/4/99	8/17/99		1.92	Medium	AFE	Steven Humphreys	Closed
113	SES-07	3/4/99	3/4/99	8/17/99		1.92	Medium	AFE	Steven Humphreys	Closed
114	SES-08	3/4/99	3/4/99	8/17/99		1.92	Medium	AFE	Steven Humphreys	Closed
115	AR-31	3/4/99	4/9/99	4/9/99		1.92	Medium	AFE	Steven Humphreys	Closed
116	SAB-007	3/4/99	3/8/99	3/29/99		2.04	Medium	GUI	Eunice Young	Closed
117	SES-10	3/4/99	3/4/99	4/5/99		1.92	Medium	AFE	Steven Humphreys	Closed
118	SAB-008	3/4/99	3/26/99	4/8/99		2.04	High	AFE	Steven Humphreys	Closed
119	SES-11	3/4/99	3/4/99	4/5/99		1.92	Low	AFE	Steven Humphreys	Closed
120	SAB-009	3/4/99	3/8/99	3/29/99		2.04	High	GUI	Eunice Young	Closed
121	SAB-010	3/4/99	3/15/99	4/9/99		2.04	Medium	AFE	Steven Humphreys	Closed
122	SES-12	3/4/99	7/29/99	8/17/99	4/13/99	1.92	Low	AFE	Steven Humphreys	Closed
123	SES-15	3/4/99	3/4/99	8/17/99		1.92	Medium	AFE	Steven Humphreys	Closed
124	ABW-68	3/4/99	3/26/99	4/8/99		2.04	High	AFE	Steven Humphreys	Closed
125	WMG-39	3/8/99	3/15/99	4/5/99		2.04	Low	GUI	Eunice Young	Closed
126	WMG-40	3/8/99	3/15/99	4/5/99		2.04	Medium	GUI	Eunice Young	Closed
127	SAB-011	3/8/99	3/26/99	4/8/99		2.04	High	AFE	Steven Humphreys	Closed
128		3/8/99	3/27/99	4/7/99		2.05	High	AFE	Steven Humphreys	Closed
129		3/8/99	3/27/99	4/7/99		2.05	Low	AFE	Steven Humphreys	Closed
130		3/8/99	3/27/99	4/7/99		2.05	High	AFE	Steven Humphreys	Closed
131		3/9/99	3/27/99	4/1/99		2.05	Medium	AFE	Steven Humphreys	Closed
132		3/9/99	3/27/99	4/1/99		2.05	Medium	AFE	Steven Humphreys	Closed
133	SAB-012	3/9/99	4/8/99	4/14/99		2.05	High	AFE	Steven Humphreys	Closed
134	SAB-013	3/9/99		4/9/99		2.05	Low	GUI	Eunice Young	Closed
135	SAB-014	3/9/99		4/9/99		2.05	Low	GUI	Eunice Young	Closed

136	SAB-015	3/9/99			4/13/99	2.05	Medium	Database	Steve Barker	Open
137	SAB-016	3/9/99	3/27/99	4/8/99		2.05	Medium	AFE	Steven Humphreys	Closed
138	SAB-017	3/9/99			4/13/99	2.05	Medium	AF	Scott Slezak	Deferred
139	SAB-018	3/9/99	3/28/99	4/8/99		2.05	High	AFE	Steven Humphreys	Closed
140	SAB-019	3/9/99	4/6/99	4/14/99		2.05	Low	AF	Scott Slezak	Closed
141		3/9/99	3/28/99	4/1/99		2.05	High	AFE	Steven Humphreys	Closed
142		3/9/99	4/8/99	4/9/99		2.05	High	AFE	Steven Humphreys	Closed
143		3/9/99	4/9/99	4/9/99		2.05	High	AFE	Steven Humphreys	Closed
144		3/9/99	3/15/99	3/21/99		2.05	High	GUI	Eunice Young	Closed
145		3/10/99	3/15/99	3/23/99		2.05	High	GUI	Eunice Young	Closed
146	SAB-021	3/10/99	3/22/99	4/8/99		2.05	Medium	GUI	Eunice Young	Closed
147	SAB-022	3/10/99	3/22/99	4/8/99		2.05	Medium	GUI	Eunice Young	Closed
148		3/11/99	4/2/99	4/7/99		2.05	High	AFE	Steven Humphreys	Closed
149		3/11/99	4/10/99	7/21/99		2.05	Low	AFE	Steven Humphreys	Closed
150		3/12/99	4/12/99			2.05	Medium	AFE	Steven Humphreys	Pending Closure
151	SGA-24	3/12/99			4/13/99	1.92	Low	Documentation	Jaye Bullington	Deferred
152		3/15/99			4/13/99	2.05	Medium	AF	Scott Slezak	Deferred
153	SAB-023	3/15/99	4/11/99	4/14/99		2.05	Low	AFE	Steven Humphreys	Closed
154	SAB-024	3/15/99			4/13/99	2.05	Low	AF	Scott Slezak	Deferred
155	SAB-025	3/15/99	3/22/99	4/8/99		2.05	Medium	GUI	Eunice Young	Closed
156	JCL-8	3/15/99	3/26/99	4/8/99		2.04	Medium	AFE	Steven Humphreys	Closed
157	JCL-9	3/15/99	3/27/99	4/8/99		2.04	Medium	AFE	Steven Humphreys	Closed
158	JCL-10	3/15/99	3/27/99	4/8/99		2.04	Medium	AFE	Steven Humphreys	Closed
159	JCL-11	3/15/99	3/29/99	4/8/99		2.04	Medium	GUI	Eunice Young	Closed
160	JCL-12	3/15/99	4/8/99	4/12/99		2.05	High	AFE	Steven Humphreys	Closed
161		3/16/99	3/22/99	3/23/99		2.05	High	GUI	Eunice Young	Closed
162		3/16/99	3/22/99	3/22/99		2.05	High	AFE	Steven Humphreys	Closed
163		3/16/99	3/29/99	3/29/99		2.05	High	GUI	Eunice Young	Closed
164	ABW-69	3/17/99	3/27/99	4/8/99		2.04	Medium	AFE	Steven Humphreys	Closed
165	ABW-70	3/17/99	3/27/99	4/8/99		2.04	Medium	AFE	Steven Humphreys	Closed
166	ABW-71	3/17/99	3/31/99	4/15/99		2.04	Medium	GUI	Eunice Young	Closed
167	ABW-72	3/18/99	3/22/99	4/8/99		2.04	Low	GUI	Eunice Young	Closed
168		3/18/99			4/13/99	2.20	Medium	Database	Steve Barker	Open
169		3/21/99	3/29/99	4/1/99		2.06	Medium	GUI	Eunice Young	Closed
170		3/22/99	6/16/99		4/13/99	2.06	Medium	AFE	Steven Humphreys	Pending Closure

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171	JCL-14	3/23/99	3/27/99	4/8/99		2.04	Medium	AFE	Steven Humphreys	Closed
172	JCL-13	3/23/99	3/27/99	4/8/99		2.04	Medium	AFE	Steven Humphreys	Closed
173		3/23/99	4/1/99	4/1/99		2.06	High	AFE	Steven Humphreys	Closed
174	SAB-026	3/23/99	4/11/99	4/20/99		2.05	High	AFE	Steven Humphreys	Closed
175	ABW-73	3/23/99	3/31/99	4/15/99		2.06	Medium	GUI	Eunice Young	Closed
176		3/23/99	4/11/99	7/23/99		2.06	High	AFE	Steven Humphreys	Closed
177	JCL-15	3/24/99	8/17/99		4/9/99	2.04	Medium	AFE	Steven Humphreys	Pending Closure
178	JCL-17	3/24/99	4/11/99	4/12/99		2.06	High	AFE	Steven Humphreys	Closed
179	JCL-16	3/24/99		3/24/99		2.06	High	AFE	Steven Humphreys	Closed
180		3/24/99	6/16/99	6/18/99	4/13/99	2.06	Medium	AFE	Steven Humphreys	Closed
181		3/24/99	4/12/99			2.06	High	AFE	Steven Humphreys	Pending Closure
182	DUP	3/25/99	3/26/99	3/26/99		2.06	Medium	AFE	Steven Humphreys	Closed
183	DUP	3/25/99		3/26/99		2.06	Medium	AFE	Steven Humphreys	Closed
184	DUP	3/25/99	3/26/99	3/26/99		2.06	Medium	AFE	Steven Humphreys	Closed
185	DUP	3/25/99		3/26/99		2.06	Medium	AFE	Steven Humphreys	Closed
186	SAB-004	3/26/99	4/5/99	4/14/99		2.01	Medium	AFE	Steven Humphreys	Closed
187	SAB-020	3/26/99	3/29/99	4/12/99	4/9/99	2.05	Medium	GUI	Eunice Young	Closed
188	SES-21	3/29/99	7/29/99	8/17/99	4/13/99	1.92	Medium	AFE	Steven Humphreys	Closed
189	ABW-74	3/31/99	4/12/99	4/15/99		2.06	Medium	AFE	Steven Humphreys	Closed
190	SES-68	3/31/99	4/2/99	4/5/99		2.07	Medium	AFE	Steven Humphreys	Closed
191	SES-69	3/31/99	4/11/99	8/17/99		2.07	Medium	AFE	Steven Humphreys	Closed
192	SES-70	3/31/99	4/1/99	4/5/99		2.07	Medium	AFE	Steven Humphreys	Closed
193	SES-71	3/31/99	4/2/99	4/5/99		2.07	High	AFE	Steven Humphreys	Closed
194	SES-72	3/31/99	4/2/99	4/5/99		2.07	High	AFE	Steven Humphreys	Closed
195	SES-73	3/31/99	4/2/99	4/5/99		2.07	High	AFE	Steven Humphreys	Closed
196	SES-74	3/31/99	4/11/99	4/12/99		2.07	Low	AFE	Steven Humphreys	Closed
197	SES-75	3/31/99	4/11/99	4/12/99		2.07	Low	AFE	Steven Humphreys	Closed
198	SES-76	3/31/99	4/2/99	4/5/99		2.07	High	AFE	Steven Humphreys	Closed
199	SES-77	3/31/99	4/2/99	4/5/99		2.07	High	AFE	Steven Humphreys	Closed
200	SES-78	3/31/99	4/2/99	4/5/99		2.07	High	AFE	Steven Humphreys	Closed
201	SES-79	3/31/99	4/2/99	4/5/99		2.07	High	AFE	Steven Humphreys	Closed
202	SES-80	3/31/99	4/2/99	4/5/99		2.07	Low	AFE	Steven Humphreys	Closed
203		4/1/99	6/16/99	6/16/99	4/13/99	2.07	Medium	AFE	Steven Humphreys	Closed
204		4/1/99	4/6/99	4/6/99		2.07	High	AFE	Steven Humphreys	Closed
205		4/1/99	4/27/99	6/16/99	4/13/99	2.07	Medium	AFE	Steven Humphreys	Closed

206		4/1/99	4/27/99	6/16/99	4/13/99	2.07	Medium	AFE	Steven Humphreys	Closed
207		4/1/99	4/27/99	6/16/99	4/13/99	2.07	Medium	AFE	Steven Humphreys	Closed
208		4/1/99	4/27/99	6/16/99	4/13/99	2.07	Medium	AFE	Steven Humphreys	Closed
209		4/1/99	4/27/99	6/16/99	4/13/99	2.07	Medium	AFE	Steven Humphreys	Closed
210		4/1/99	4/8/99	4/12/99		2.07	Medium	AFE	Steven Humphreys	Closed
211		4/1/99	4/11/99	4/12/99		2.07	Medium	AFE	Steven Humphreys	Closed
212		4/1/99	4/11/99	8/17/99		2.07	Medium	AFE	Steven Humphreys	Closed
213		4/1/99			4/13/99	2.07	Low	Database	Steve Barker	Open
214		4/2/99	4/5/99	4/16/99		2.07	Medium	GUI	Eunice Young	Closed
215		4/5/99	6/15/99	6/16/99	4/13/99	2.07	Medium	AFE	Steven Humphreys	Closed
216		4/5/99	8/17/99		4/13/99	2.07	Medium	AFE	Steven Humphreys	Pending Closure
217		4/5/99	4/27/99	6/16/99	4/13/99	2.07	Medium	AFE	Steven Humphreys	Closed
218		4/5/99	4/7/99	4/8/99		2.07	High	AFE	Steven Humphreys	Closed
219		4/5/99	4/7/99	4/8/99		2.07	Severe	AFE	Steven Humphreys	Closed
220		4/5/99	4/6/99	4/7/99		2.07	Severe	AFE	Steven Humphreys	Closed
221		4/5/99	4/7/99	4/8/99		2.07	Severe	AFE	Steven Humphreys	Closed
222		4/5/99	4/7/99	4/8/99		2.07	Medium	AFE	Steven Humphreys	Closed
223		4/5/99	4/11/99	4/12/99		2.07	Low	AFE	Steven Humphreys	Closed
224		4/5/99	4/11/99	4/12/99		2.07	Medium	AFE	Steven Humphreys	Closed
225		4/5/99	4/11/99	4/12/99		2.07	Medium	AFE	Steven Humphreys	Closed
226		4/5/99	4/11/99	4/12/99		2.07	Low	AFE	Steven Humphreys	Closed
227		4/5/99	4/7/99	4/7/99		2.07	Severe	AFE	Steven Humphreys	Closed
228		4/5/99	4/7/99	4/7/99		2.07	Severe	AFE	Steven Humphreys	Closed
229		4/6/99	4/7/99	4/8/99		2.07	High	AFE	Steven Humphreys	Closed
230		4/6/99	4/7/99	4/8/99		2.07	Severe	AFE	Steven Humphreys	Closed
231		4/6/99	4/10/99	4/12/99		2.07	High	AFE	Steven Humphreys	Closed
232		4/6/99	6/16/99	6/16/99	4/13/99	2.07	Medium	AFE	Steven Humphreys	Closed
233		4/7/99	4/12/99			2.06	High	AFE	Steven Humphreys	Pending Closure
234		4/7/99	4/9/99	4/9/99		N/A	Medium	Documentation	Jaye Bullington	Closed
235		4/7/99	4/9/99	4/11/99		2.08	Severe	GUI	Eunice Young	Closed
236	SGA-46	4/8/99	4/9/99	4/14/99		2.08	Medium	Database	Eunice Young	Closed
237		4/10/99	4/11/99			2.09	Medium	GUI	Eunice Young	Pending Closure
238		4/10/99	4/10/99	9/21/99	4/13/99	2.09	High	V&V	Ann Hodges	Closed
239	BDL-22	4/12/99	8/13/99		4/12/99	2.01	Medium	AFE	Steven Humphreys	Pending Closure
240	JCK-8	4/15/99	4/15/99	5/3/99		2.10	Severe	AFE	Steven Humphreys	Closed

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241	ALH-19	4/15/99	6/16/99		5/19/99	2.01	Medium	AFE	Steven Humphreys	Pending Closure
242		4/21/99	5/3/99	7/21/99		2.10	Low	GUI	Eunice Young	Closed
243		4/28/99	8/18/99			2.10	Low	AFE	Steven Humphreys	Pending Closure
244		5/6/99	8/18/99			2.10	Medium	AFE	Steven Humphreys	Pending Closure
245		5/17/99	5/20/99	5/20/99		2.11	Medium	GUI	Eunice Young	Closed
246		5/19/99	6/16/99	6/16/99		2.11	Medium	AFE	Steven Humphreys	Closed
247	MLS-001	5/20/99	5/20/99	6/30/99		2.11	Medium	GUI	Eunice Young	Closed
248	ABW-75	6/2/99	8/13/99			2.11	Medium	AFE	Steven Humphreys	Pending Closure
249		6/18/99	8/23/99	9/21/99		2.10	Low	GUI	Eunice Young	Closed
250		6/25/99	6/28/99	6/29/99		2.13	High	GUI	Eunice Young	Closed
251		6/29/99	8/23/99	9/20/99		2.13	High	GUI	Eunice Young	Closed
252		7/2/99	8/13/99	8/16/99		2.14	Medium	AFE	Steven Humphreys	Closed
253		7/12/99	8/13/99	8/17/99		2.14	High	AFE	Steven Humphreys	Closed
254		7/12/99	8/13/99	8/17/99		2.14	Low	AFE	Steven Humphreys	Closed
255		7/12/99	8/13/99	8/17/99		2.14	Medium	AFE	Steven Humphreys	Closed
256		7/15/99	8/16/99	8/16/99		2.13	Medium	AFE	Steven Humphreys	Closed
257		8/3/99	8/4/99	8/17/99		2.14	High	AFE	Steven Humphreys	Closed
258		8/11/99	8/13/99	8/16/99		2.14	Medium	AFE	Steven Humphreys	Closed
259		8/12/99	8/23/99	9/20/99		2.14	Medium	GUI	Eunice Young	Closed
260		8/25/99	9/20/99	9/21/99		2.20	Medium	GUI	Eunice Young	Closed
261		8/26/99				2.20	Low	Database	Steve Barker	Open
262		8/26/99	8/30/99	9/20/99		2.20	Low	AFE	Steven Humphreys	Closed
263		8/26/99	9/20/99	9/20/99		2.20	High	GUI	Eunice Young	Closed
264		8/26/99	9/20/99	9/20/99		2.20	Medium	GUI	Eunice Young	Closed
265		8/27/99	9/20/99			2.20	Medium	GUI	Eunice Young	Pending Closure
266		8/27/99	9/20/99			2.20	High	GUI	Eunice Young	Re-eval
267		8/27/99	9/20/99	9/20/99		2.20	Low	GUI	Eunice Young	Closed
268		9/1/99	9/20/99			2.20	High	GUI	Eunice Young	Re-eval
269		9/1/99	9/20/99			2.14	High	GUI	Eunice Young	Pending Closure
270		9/1/99	9/20/99			2.20	Medium	GUI	Eunice Young	Re-eval
271		9/1/99				2.20	Medium	Database	Steve Barker	Reassigned
272	JCK-9	9/1/99				2.10	Low	GUI	Eunice Young	Reassigned
273		9/8/99	9/20/99	9/20/99		2.20	Medium	GUI	Eunice Young	Closed
274		9/9/99	9/10/99	9/20/99		2.20	Medium	AFE	Steven Humphreys	Closed
275	SAB-027	9/9/99	9/20/99			2.20	Medium	GUI	Eunice Young	Pending Closure

276	SAB-028	9/9/99	9/20/99		2.20	High	GUI	Eunice Young	Pending Closure
277	SAB-029	9/9/99	9/20/99		2.20	Medium	GUI	Eunice Young	Pending Closure
278	SAB-030	9/9/99	9/20/99		2.20	Low	GUI	Eunice Young	Pending Closure
279	SAB-031	9/9/99	9/20/99		2.20	Medium	GUI	Eunice Young	Pending Closure
280	SAB-032	9/9/99			2.20	High	GUI	Eunice Young	Reassigned
281	SAB-033	9/9/99	9/20/99		2.20	Low	GUI	Eunice Young	Pending Closure
282	WMG-41	9/9/99	9/10/99		2.20	Low	Documentation	Jaye Bullington	Pending Deferral
283	WMG-42	9/9/99			2.20	Low	Documentation	Jaye Bullington	Pending Deferral
284	SGA-47	9/9/99	9/20/99	9/22/99	2.20	Medium	GUI	Eunice Young	Closed
285	SGA-48	9/9/99	9/20/99	9/22/99	2.20	Medium	GUI	Eunice Young	Closed
286	SGA-49	9/9/99	9/20/99	9/22/99	2.20	Medium	GUI	Eunice Young	Closed
287	JCK-10	9/9/99	9/20/99	9/22/99	2.20	High	GUI	Eunice Young	Closed
288	JCK-11	9/9/99	9/20/99	9/22/99	2.20	High	GUI	Eunice Young	Closed
289	JCK-12	9/9/99	9/20/99	9/22/99	2.20	High	GUI	Eunice Young	Closed
290	JCK-13	9/9/99	9/20/99	9/22/99	2.20	Severe	GUI	Eunice Young	Closed
291	JCK-14	9/9/99	9/10/99	9/22/99	2.20	High	AFE	Steven Humphreys	Closed
292		9/9/99			2.20	Medium	Database	Steve Barker	Open
293		9/9/99	9/10/99	9/16/99	2.20	High	AFE	Steven Humphreys	Closed
294		9/14/99			2.20	Medium	Database	Steve Barker	Open
295		9/15/99			2.20	Low	Database	Steve Barker	Open
296		9/16/99			2.20	Medium	AF	Scott Slezak	Open
297		9/16/99			2.21	Medium	Database	Steve Barker	Open
298		9/16/99			2.21	Medium	AF	Scott Slezak	Open
299		9/20/99			2.21	Medium	AF	Scott Slezak	Open
300		9/22/99			2.23	Medium	AFE	Steven Humphreys	Open

Pending Closure:	24
Closed:	243
Pending Deferral:	2
Deferred:	10
Re-evaluate:	3
Open:	15
Subtotal	297
Old DR system:	348

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GRAND TOTAL:	645

Severity Definitions:

Severe: The system is not functioning at all or it is not functioning correctly such that the mission is being affected, and there is no acceptable workaround.

High: The system is functioning, but operations have been significantly impacted. A workaround may exist, but the workaround causes extensive effort for the operators.

Medium: The system is functioning with an acceptable workaround or some aspect of the system is not functioning, but it is not impacting the mission.

Low: The system is functioning, but it could be functioning better. This documents the issue.

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APPENDIX B

DST ACCEPTANCE TEST RESULTS

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APPENDIX B

This Appendix provides the results of the DST acceptance testing. A strict comparison of the benchmark results to the trend analysis results does not consider the magnitude of the difference. For example, if the benchmark mean consequence value is 4.567E-05 Sv and the mean trend test analysis result is 4.566E-05 Sv, a comparison of this type would indicate, that by modifying a specific parameter, the consequences decreased; however, based on the conservatisms and uncertainties incorporated in the Analysis Tool, a better conclusion would be that there is no change. Therefore, to interpret the results, i.e., determine the change in the benchmark values due to changing specific parameters, the comparisons shown in the tables provided for each of the trend test analysis results are based +/- 10%.

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DST Acceptance test results:											
Seed: 90000000											
Sample count: 1000											
Benchmark - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	B	92	B	8	B	3.58E-03	B	2.36	B
	small	1220	B	12	B	0	B	1.25E-03	B	0.251	B
	medium	2003	B	80	B	8	B	7.87E-02	B	2.68	B
	large	1000	B	0	B	0	B	1.19E-03	B	16.4	B
	Buoyant displ	1229	B	18	B	8	B	6.08E+01	B	2.33	B
	Non-buoyant	2994	B	76	B	0	B	1.22E-03	B	2.38	B
AW-106	all	11811	B	104	B	0	B	8.36E-04	B	2.2	B
	small	3931	B	12	B	0	B	4.98E-03	B	0.239	B
	medium	3940	B	92	B	0	B	1.28E-03	B	2.38	B
	large	3940	B	0	B	0	B	1.68E-04	B	12.6	B
	Buoyant displ	0	B	0	B	0	B	0.00E+00	B	0	B
	Non-buoyant	11811	B	104	B	0	B	8.36E-04	B	2.2	B
SY-103	all sizes	4638	B	95	B	10	B	5.20E-03	B	3.96	B
	small	1841	B	14	B	0	B	7.85E-03	B	0.775	B
	medium	1787	B	81	B	10	B	9.91E-03	B	3.93	B
	large	1010	B	0	B	0	B	1.19E-03	B	20.4	B
	Buoyant displ	1614	B	34	B	10	B	7.71E+00	B	4.25	B
	Non-buoyant	3024	B	61	B	0	B	1.21E-03	B	3.75	B
SY-101	all sizes	4330	B	585	B	23	B	3.95E-03	B	6.71	B
	small	1061	B	38	B	0	B	8.66E-04	B	0.242	B
	medium	2220	B	192	B	14	B	2.54E+00	B	7.51	B
	large	1049	B	337	B	9	B	1.28E-03	B	70.4	B
	Buoyant displ	1336	B	85	B	23	B	1.05E+01	B	7.35	B
	Non-buoyant	2994	B	500	B	0	B	1.22E-03	B	6.04	B
WIE All Tanks		0	B	0	B	0	B	0.00E+00	B	0	B
Inerting-5% - %LFL		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.37	=
AW-106	all sizes	11811	=	32	<	0	=	8.36E-04	=	2.2	=
SY-103	all sizes	4638	=	78	<	8	<	5.20E-03	=	3.96	=
SY-101	all sizes	4330	=	512	<	21	<	3.95E-03	=	6.73	=
Inerting-10% - %LFL		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.37	=
AW-106	all sizes	11811	=	32	<	0	=	8.36E-04	=	2.2	=
SY-103	all sizes	4638	=	94	<	11	>	5.20E-03	=	3.96	=
SY-101	all sizes	4330	=	567	=	24	>	3.95E-03	=	6.71	=
Waste vol. red. - %LFL		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4352	>	80	<	9	>	4.01E-03	>	1.58	<
	Buoyant displ	1229	=	57	>	19	>	6.08E+01	=	5.7	>
	Non-buoyant	2994	=	78	=	0	=	1.22E-03	=	4.58	>
AW-106	all sizes	11788	=	68	<	4	>	8.99E-04	>	1.86	<
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	11811	=	104	=	0	=	8.36E-04	=	3.43	>
SY-103	all sizes	4800	>	74	<	8	<	6.38E-03	>	2.91	<
	Buoyant displ	1614	=	58	>	28	>	7.71E+00	=	8.85	>
	Non-buoyant	3024	=	61	=	0	=	1.21E-03	=	5.59	>
SY-101	all sizes	4582	>	245	<	15	<	5.21E-03	>	4.2	<
	Buoyant displ	1336	=	258	>	94	>	1.05E+01	=	29.3	>
	Non-buoyant	2994	=	630	>	0	=	1.22E-03	=	18.6	>
Vent. Rate-red. - %LFL		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	133	>	19	>	3.58E-03	=	4.65	>
	small	1220	=	12	=	0	=	1.25E-03	=	0.771	>
	medium	2003	=	121	>	19	>	7.87E-02	=	4.65	>
	large	1000	=	0	=	0	=	1.19E-03	=	20.2	>
	Buoyant displ	1229	=	57	>	19	>	6.08E+01	=	5.7	>
	Non-buoyant	2994	=	78	=	0	=	1.22E-03	=	4.58	>
AW-106	all	11811	=	104	=	0	=	8.36E-04	=	3.43	>
	small	3931	=	12	=	0	=	4.98E-03	=	0.584	>
	medium	3940	=	92	=	0	=	1.28E-03	=	3.44	>
	large	3940	=	0	=	0	=	1.68E-04	=	15.4	>
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	11811	=	104	=	0	=	8.36E-04	=	3.43	>
SY-103	all sizes	4638	=	117	>	26	>	5.20E-03	=	6.39	>
	small	1841	>	14	<	0	<	7.85E-03	<	1.3	<
	medium	1787	>	103	>	26	>	9.91E-03	>	5.5	<
	large	1010	<	0	<	0	<	1.19E-03	<	24.4	>
	Buoyant displ	1614	=	58	>	28	>	7.71E+00	=	8.85	>
	Non-buoyant	3024	=	61	=	0	=	1.21E-03	=	5.59	>
SY-101	all sizes	4330	=	866	>	94	>	3.95E-03	=	21.5	>
	small	1061	=	38	=	0	=	8.66E-04	=	1.97	>
	medium	2220	=	378	>	81	>	2.54E+00	=	21.7	>
	large	1049	=	472	>	13	>	1.28E-03	=	94.4	>
	Buoyant displ	1338	=	256	>	94	>	1.05E+01	=	29.3	>
	Non-buoyant	2994	=	630	>	0	=	1.22E-03	=	18.6	>

Vent. Rate-inc. - %LFL		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	66	<	2	<	3.58E-03	=	0.549	<
	small	1220	=	12	=	0	=	1.25E-03	=	0.033	<
	medium	2003	=	74	<	2	<	7.87E-02	=	0.562	<
	large	1000	=	0	=	0	=	1.19E-03	=	10.7	<
	Buoyant displ	1229	=	10	<	2	<	6.08E+01	=	0.447	<
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	0.665	<
AW-106	all	11811	=	104	=	0	=	8.36E-04	=	0.705	<
	small	3931	=	12	=	0	=	4.98E-03	=	0.0261	<
	medium	3940	=	92	=	0	=	1.28E-03	=	0.923	<
	large	3940	=	0	=	0	=	1.68E-04	=	9.42	<
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	11811	=	104	=	0	=	8.36E-04	=	0.705	<
SY-103	all sizes	4638	=	74	<	1	<	5.20E-03	=	0.957	<
	small	1841	>	14	<	0	<	7.85E-03	<	0.247	<
	medium	1787	>	60	>	1	>	9.91E-03	>	1.18	<
	large	1010	<	0	<	0	<	1.19E-03	<	15.4	>
	Buoyant displ	1614	=	13	<	1	<	7.71E+00	=	0.761	<
	Non-buoyant	3024	=	61	=	0	=	1.21E-03	=	1.3	<
SY-101	all sizes	4330	=	368	<	2	<	3.95E-03	=	1.11	<
	small	1061	=	36	=	0	=	8.66E-04	=	0.0256	<
	medium	2220	=	184	<	2	<	2.54E+00	=	1.07	<
	large	1049	=	148	<	0	<	1.28E-03	=	20.1	<
	Buoyant displ	1336	=	56	<	2	<	1.05E+01	=	1.09	<
	Non-buoyant	2994	=	312	<	0	=	1.22E-03	=	1.16	<
Intrusive ops.	All - inc	No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
	small	1220	=	12	=	0	=	1.25E-03	=	0.251	=
	medium	2003	=	80	=	8	=	1.57E-02	<	2.68	=
	large	1000	=	0	=	0	=	1.19E-03	=	16.4	=
	Buoyant displ	1229	=	16	=	8	=	6.03E+01	=	2.33	=
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	2.38	=
AW-106	all	12004	>	88	<	4	>	5.54E-04	<	2.23	>
	small	3996	>	8	<	4	>	3.59E-03	<	0.234	<
	medium	4004	>	80	<	0	=	9.31E-04	<	2.37	=
	large	4004	>	0	=	0	=	9.53E-05	<	12.9	>
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	12004	>	88	<	4	>	5.54E-04	<	2.23	>
SY-103	all sizes	4574	<	93	<	13	>	4.99E-03	<	4.17	>
	small	1817	>	16	<	0	<	7.60E-03	<	0.774	<
	medium	1754	>	77	>	13	>	9.83E-03	>	3.97	<
	large	1003	<	0	<	0	<	1.15E-03	<	20.5	>
	Buoyant displ	1569	<	27	<	13	>	8.05E+00	>	4.64	>
	Non-buoyant	3005	=	66	>	0	=	1.19E-03	<	3.87	>
SY-101	all sizes	4320	=	572	>	29	>	3.86E-03	<	6.75	=
	small	1055	=	45	>	0	=	7.90E-04	<	0.247	>
	medium	2214	=	174	<	21	>	3.17E+00	>	7.41	<
	large	1051	=	353	>	8	<	1.31E-03	>	72.7	>
	Buoyant displ	1323	=	57	<	29	>	1.07E+01	>	7.48	>
	Non-buoyant	2997	=	515	>	0	=	1.23E-03	=	5.65	<
Intrusive ops.	Non - red	No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.38	=
	small	1220	=	12	=	0	=	1.25E-03	=	0.251	=
	medium	2003	=	80	=	8	=	7.87E-02	=	2.68	=
	large	1000	=	0	=	0	=	1.19E-03	=	16.4	=
	Buoyant displ	1229	=	16	=	8	=	6.08E+01	=	2.33	=
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	2.38	=
AW-106	all	11811	=	104	=	0	=	8.36E-04	=	2.2	=
	small	3931	=	12	=	0	=	4.98E-03	=	0.239	=
	medium	3940	=	92	=	0	=	1.28E-03	=	2.38	=
	large	3940	=	0	=	0	=	1.68E-04	=	12.8	=
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	11811	=	104	=	0	=	8.36E-04	=	2.2	=
SY-103	all sizes	4638	=	95	=	10	=	5.20E-03	=	3.96	=
	small	1841	>	14	<	0	<	7.85E-03	<	0.775	<
	medium	1787	>	81	>	10	>	9.91E-03	>	3.93	<
	large	1010	<	0	<	0	<	1.19E-03	<	20.4	>
	Buoyant displ	1614	=	34	=	10	=	7.71E+00	=	4.25	=
	Non-buoyant	3024	=	61	=	0	=	1.21E-03	=	3.75	=
SY-101	all sizes	4330	=	565	=	23	=	3.95E-03	=	6.71	=
	small	1061	=	36	=	0	=	8.66E-04	=	0.242	=
	medium	2220	=	192	=	14	=	2.54E+00	=	7.51	=
	large	1049	=	337	=	9	=	1.26E-03	=	70.4	=
	Buoyant displ	1336	=	65	=	23	=	1.05E+01	=	7.35	=
	Non-buoyant	2.994	<	500	=	0	=	1.22E-03	=	6.04	=

Intrusive ops.	Non - inc	No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
	small	1220	=	12	=	0	=	1.25E-03	=	0.251	=
	medium	2003	=	80	=	8	=	7.87E-02	=	2.68	=
	large	1000	=	0	=	0	=	1.19E-03	=	16.4	=
	Buoyant displ	1229	=	16	=	8	=	6.06E+01	=	2.33	=
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	2.38	=
AW-106	all	11811	=	104	=	0	=	6.36E-04	=	2.2	=
	small	3931	=	12	=	0	=	4.98E-03	=	0.239	=
	medium	3940	=	92	=	0	=	1.28E-03	=	2.36	=
	large	3940	=	0	=	0	=	1.66E-04	=	12.6	=
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	11811	=	104	=	0	=	6.36E-04	=	2.2	=
SY-103	all sizes	4638	=	95	=	10	=	5.20E-03	=	3.96	=
	small	1841	>	14	<	0	<	7.85E-03	<	0.775	<
	medium	1787	>	81	>	10	>	9.91E-03	>	3.93	<
	large	1010	<	0	<	0	<	1.19E-03	<	20.4	>
	Buoyant displ	1614	=	34	=	10	=	7.71E+00	=	4.25	=
	Non-buoyant	3024	=	61	=	0	=	1.21E-03	=	3.75	=
SY-101	all sizes	4330	=	565	=	23	=	3.95E-03	=	6.71	=
	small	1061	=	36	=	0	=	8.68E-04	=	0.242	=
	medium	2220	=	192	=	14	=	2.54E+00	=	7.51	=
	large	1049	=	337	=	9	=	1.28E-03	=	70.4	=
	Buoyant displ	1336	=	65	=	23	=	1.05E+01	=	7.35	=
	Non-buoyant	294	<	500	=	0	=	1.22E-03	=	6.04	=
Intrusive ops	Local-red	No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.38	=
	small	1220	=	12	=	0	=	1.26E-03	=	0.251	=
	medium	2003	=	80	=	8	=	7.87E-02	=	2.68	=
	large	1000	=	0	=	0	=	1.19E-03	=	16.4	=
	Buoyant displ	1229	=	16	=	8	=	6.06E+01	=	2.33	=
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	2.38	=
AW-106	all	12003	>	108	>	0	=	6.61E-04	>	2.23	>
	small	3995	>	12	=	0	=	4.65E-03	<	0.232	<
	medium	4004	>	96	>	0	=	1.44E-03	>	2.44	>
	large	4004	>	0	=	0	=	1.62E-04	<	13	>
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	12003	>	108	>	0	=	6.61E-04	>	2.23	>
SY-103	all sizes	4603	=	115	>	7	<	5.08E-03	<	3.96	=
	small	1826	>	24	<	0	<	7.69E-03	<	0.768	<
	medium	1772	>	91	>	7	>	9.78E-03	>	3.89	<
	large	1005	<	0	<	0	<	1.20E-03	<	20.3	>
	Buoyant displ	1594	<	48	>	7	<	7.85E+00	>	4.27	=
	Non-buoyant	3009	=	67	>	0	=	1.20E-03	=	3.82	>
SY-101	all sizes	4330	=	565	=	23	=	3.95E-03	=	6.71	=
	small	1061	=	36	=	0	=	8.66E-04	=	0.242	=
	medium	2220	=	192	=	14	=	2.54E+00	=	7.51	=
	large	1049	=	337	=	9	=	1.28E-03	=	70.4	=
	Buoyant displ	1336	=	65	=	23	=	1.05E+01	=	7.35	=
	Non-buoyant	2994	=	500	=	0	=	1.22E-03	=	6.04	=
Intrusive ops	Local-inc	No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
	small	1220	=	12	=	0	=	1.25E-03	=	0.251	=
	medium	2003	=	80	=	8	=	7.87E-02	=	2.68	=
	large	1000	=	0	=	0	=	1.19E-03	=	16.4	=
	Buoyant displ	1229	=	16	=	8	=	6.06E+01	=	2.33	=
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	2.38	=
AW-106	all	11920	=	100	<	0	=	7.99E-04	<	2.18	=
	small	3966	=	8	<	0	=	4.90E-03	<	0.238	=
	medium	3976	=	92	=	0	=	1.32E-03	>	2.31	<
	large	3976	=	0	=	0	=	1.56E-04	<	12.8	>
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	11920	=	100	<	0	=	7.99E-04	<	2.18	=
SY-103	all sizes	4638	=	95	=	10	=	5.20E-03	=	3.96	=
	small	1841	>	14	<	0	<	7.85E-03	<	0.775	<
	medium	1787	>	81	>	10	>	9.91E-03	>	3.93	<
	large	1010	<	0	<	0	<	1.19E-03	<	20.4	>
	Buoyant displ	1614	=	34	=	10	=	7.70E+00	=	4.25	=
	Non-buoyant	3024	=	61	=	0	=	1.21E-03	=	3.75	=
SY-101	all sizes	4330	=	565	=	23	=	3.96E-03	=	6.71	=
	small	1061	=	36	=	0	=	8.66E-04	=	0.242	=
	medium	2220	=	192	=	14	=	2.51E+00	<	7.51	=
	large	1049	=	337	=	9	=	1.28E-03	=	70.4	=
	Buoyant displ	1336	=	65	=	23	=	1.05E+01	=	7.35	=
	Non-buoyant	2994	=	500	=	0	=	1.22E-03	=	6.04	=

Intrusive ops	Global-red	No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
	small	1220	=	12	=	0	=	1.25E-03	=	0.251	=
	medium	2003	=	80	=	8	=	3.94E-02	<	2.68	=
	large	1000	=	0	=	0	=	1.19E-03	=	16.4	=
	Buoyant displ	1229	=	16	=	8	=	6.11E+01	=	2.33	=
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	2.38	=
AW-106	all	11885	=	72	<	4	>	1.16E-03	>	2.2	=
	small	3957	=	4	<	4	>	6.61E-03	>	0.25	>
	medium	3964	=	68	<	0	=	2.00E-03	>	2.37	=
	large	3964	=	0	=	0	=	2.32E-04	>	12.8	>
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	11885	=	72	<	4	>	1.16E-03	>	2.2	=
SY-103	all sizes	4609	=	91	<	4	<	5.37E-03	>	4.03	>
	small	1825	>	15	<	0	<	7.76E-03	<	0.834	<
	medium	1782	>	76	>	4	>	9.89E-03	>	3.87	<
	large	1002	<	0	<	0	<	1.19E-03	<	20.5	>
	Buoyant displ	1608	=	33	<	4	<	6.98E+00	<	4.54	>
	Non-buoyant	3001	=	58	<	0	=	1.19E-03	<	3.69	<
SY-101	all sizes	4330	=	565	=	23	=	3.95E-03	=	6.71	=
	small	1061	=	36	=	0	=	8.66E-04	=	0.242	=
	medium	2220	=	192	=	14	=	1.38E+00	<	7.51	=
	large	1049	=	337	=	9	=	1.28E-03	=	70.4	=
	Buoyant displ	1336	=	65	=	23	=	1.06E+01	=	7.35	=
	Non-buoyant	2994	=	500	=	0	=	1.22E-03	=	6.04	=
Intrusive ops	Global-inc	No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
	small	1220	=	12	=	0	=	1.25E-03	=	0.251	=
	medium	2003	=	80	=	8	=	1.57E-01	>	2.68	=
	large	1000	=	0	=	0	=	1.19E-03	=	16.4	=
	Buoyant displ	1229	=	16	=	8	=	6.03E+01	=	2.33	=
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	2.38	=
AW-106	all	12123	>	112	>	0	=	5.50E-04	<	2.22	=
	small	4035	>	12	=	0	=	3.51E-03	<	0.229	<
	medium	4044	>	100	>	0	=	9.43E-04	<	2.44	>
	large	4044	>	0	=	0	=	1.03E-04	<	13	>
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	12123	>	112	>	0	=	5.50E-04	<	2.22	=
SY-103	all sizes	4580	<	93	<	13	>	5.02E-03	<	4.17	>
	small	1819	>	16	<	0	<	7.60E-03	<	0.774	<
	medium	1757	>	77	>	13	>	9.83E-03	>	3.96	<
	large	1004	<	0	<	0	<	1.15E-03	<	20.5	>
	Buoyant displ	1572	<	27	<	13	>	8.04E+00	>	4.63	>
	Non-buoyant	3008	=	66	>	0	=	1.19E-03	<	3.87	>
SY-101	all sizes	4279	<	563	=	33	>	3.88E-03	<	6.6	<
	small	1054	=	35	<	0	=	6.44E-04	<	0.265	>
	medium	2179	<	183	<	20	>	3.40E+00	>	7.39	<
	large	1048	=	345	>	13	>	1.28E-03	=	72.1	>
	Buoyant displ	1297	<	64	<	33	>	1.09E+01	>	7.36	=
	Non-buoyant	2982	=	499	=	0	=	1.23E-03	=	5.96	<
Intrusive ops	Ex-Tank-inc	No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
	small	1220	=	12	=	0	=	1.25E-03	=	0.251	=
	medium	2003	=	80	=	8	=	7.87E-02	=	2.68	=
	large	1000	=	0	=	0	=	1.19E-03	=	16.4	=
	Buoyant displ	1229	=	16	=	8	=	6.08E+01	=	2.33	=
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	2.38	=
AW-106	all	11811	=	104	=	0	=	8.36E-04	=	2.2	=
	small	3931	=	12	=	0	=	4.98E-03	=	0.239	=
	medium	3940	=	92	=	0	=	1.28E-03	=	2.38	=
	large	3940	=	0	=	0	=	1.68E-04	=	12.8	=
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	11811	=	104	=	0	=	8.36E-04	=	2.2	=
SY-103	all sizes	4638	=	95	=	10	=	5.20E-03	=	3.96	=
	small	1841	>	14	<	0	<	7.85E-03	<	0.00785	<
	medium	1767	>	81	>	10	>	9.91E-03	>	3.93	<
	large	1010	<	0	<	0	<	1.19E-03	<	20.4	>
	Buoyant displ	1614	=	34	=	10	=	7.71E+00	=	4.25	=
	Non-buoyant	3024	=	61	=	0	=	1.21E-03	=	3.75	=
SY-101	all sizes	4330	=	565	=	23	=	3.95E-03	=	6.71	=
	small	1061	=	36	=	0	=	6.70E-04	=	0.242	=
	medium	2220	=	192	=	14	=	2.54E+00	=	7.51	=
	large	1049	=	337	=	9	=	1.28E-03	=	70.4	=
	Buoyant displ	1336	=	65	=	23	=	1.05E+01	=	7.35	=
	Non-buoyant	2994	=	500	=	0	=	1.22E-03	=	6.04	=

Ign. Ctrl. Sat - In-Tank -		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
AW-106	all sizes	11811	=	104	=	0	=	8.38E-04	=	2.2	=
SY-103	all sizes	4638	=	95	=	10	=	5.20E-03	=	3.96	=
SY-101	all sizes	4330	=	585	=	23	=	3.95E-03	=	6.71	=
Ign. Ctrl. Sat - Ex-Tank -		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
AW-106	all sizes	11811	=	104	=	0	=	8.38E-04	=	2.2	=
SY-103	all sizes	4638	=	95	=	10	=	5.20E-03	=	3.96	=
SY-101	all sizes	4330	=	585	=	23	=	3.95E-03	=	6.71	=
Ign. Ctrl. Sat - In/Ex-Tank -		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
AW-106	all sizes	11811	=	104	=	0	=	8.38E-04	=	2.2	=
SY-103	all sizes	4638	=	95	=	10	=	5.20E-03	=	3.96	=
SY-101	all sizes	4330	=	585	=	23	=	3.95E-03	=	6.71	=
Density ratio Liq to S.Sol		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4354	>	1109	>	53	>	3.92E-03	>	19.9	>
	Buoyant displ	1356	>	155	>	52	>	7.33E+00	<	18	>
	Non-buoyant	2998	=	954	>	1	>	1.21E-03	=	21.5	>
AW-106	all sizes	3958	<	1049	>	45	>	2.92E-03	>	26	>
	Buoyant displ	1040	>	253	>	45	>	1.51E-01	>	32.3	>
	Non-buoyant	2918	<	796	>	0	=	1.19E-03	>	23.8	>
SY-103	all sizes	4544	<	1131	>	51	>	4.46E-03	<	27.7	>
	Buoyant displ	1481	<	191	>	51	>	1.20E+00	<	27.3	>
	Non-buoyant	3063	>	940	>	0	=	1.24E-03	>	28	>
SY-101	all sizes	4233	<	1174	>	457	>	3.44E-03	<	40.1	>
	Buoyant displ	1245	<	275	>	99	>	2.24E+00	<	42.7	>
	Non-buoyant	2988	=	899	>	358	>	1.21E-03	=	38	>
Density ratio Liq to I.Sol		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
	Buoyant displ	1229	=	16	=	8	=	6.08E+01	=	2.33	=
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	2.38	=
AW-106	all sizes	11811	=	104	=	0	=	8.38E-04	=	2.2	=
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	11811	=	104	=	0	=	8.38E-04	=	2.2	=
SY-103	all sizes	4638	=	95	=	10	=	5.20E-03	=	3.96	=
	Buoyant displ	1614	=	34	=	10	=	7.71E+00	=	4.25	=
	Non-buoyant	3024	=	61	=	0	=	1.21E-03	=	3.75	=
SY-101	all sizes	4233	<	1174	>	457	>	3.44E-03	<	40.1	>
	Buoyant displ	1336	=	65	=	23	=	1.05E+01	=	7.35	=
	Non-buoyant	2994	=	500	=	0	=	1.22E-03	=	6.04	=
Gas generation-S.Sol-inc		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
	small	1220	=	12	=	0	=	1.25E-03	=	0.251	=
	medium	2003	=	80	=	8	=	7.87E-02	=	2.68	=
	large	1000	=	0	=	0	=	1.19E-03	=	16.4	=
	Buoyant displ	1229	=	16	=	8	=	6.11E+02	>	2.33	=
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	2.38	=
AW-106	all	12016	>	88	<	0	=	2.82E-03	>	2.16	<
	small	4000	>	16	>	0	=	1.93E-02	>	0.233	<
	medium	4008	>	72	<	0	=	5.68E-03	>	2.31	<
	large	4008	>	0	=	0	=	5.98E-04	>	12.6	=
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	12016	>	88	<	0	=	2.82E-03	>	2.16	<
SY-103	all sizes	4602	=	91	<	11	>	5.25E-03	=	3.98	=
	small	1819	>	19	<	0	<	7.43E-03	<	0.755	<
	medium	1783	>	72	>	11	>	9.88E-03	>	3.89	<
	large	1000	<	0	<	0	<	1.19E-03	<	20.7	>
	Buoyant displ	1608	=	31	<	11	>	6.64E+01	>	4.38	>
	Non-buoyant	2994	=	60	<	0	=	1.21E-03	=	3.78	=
SY-101	all sizes	4331	=	565	=	23	=	3.95E-03	=	6.7	=
	small	1061	=	36	=	0	=	8.88E-04	=	0.242	=
	medium	2221	=	192	=	14	=	2.78E+00	>	7.51	=
	large	1049	=	337	=	9	=	1.28E-03	=	70.4	=
	Buoyant displ	1337	=	65	=	23	=	1.08E+02	>	7.35	=
	Non-buoyant	2994	=	500	=	0	=	1.22E-03	=	6.04	=

Gas generation-I.Sol-inc		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
	small	1220	=	12	=	0	=	1.25E-03	=	0.251	=
	medium	2003	=	80	=	8	=	7.87E-02	=	2.68	=
	large	1000	=	0	=	0	=	1.19E-03	=	16.4	=
	Buoyant displ	1229	=	16	=	8	=	8.08E+01	=	2.33	=
	Non-buoyant	2994	=	76	=	0	=	1.22E-03	=	2.38	=
AW-108	all	11811	=	104	=	0	=	8.36E-04	=	2.2	=
	small	3931	=	12	=	0	=	4.98E-03	=	0.239	=
	medium	3940	=	92	=	0	=	1.28E-03	=	2.38	=
	large	3940	=	0	=	0	=	1.68E-04	=	12.6	=
	Buoyant displ	0	=	0	=	0	=	0.00E+00	=	0	=
	Non-buoyant	11811	=	104	=	0	=	8.36E-04	=	2.2	=
SY-103	all sizes	4602	=	91	<	11	>	5.25E-03	=	3.98	=
	small	1819	>	19	<	0	<	7.43E-03	<	0.755	<
	medium	1783	>	72	>	11	>	9.86E-03	>	3.89	<
	large	1000	<	0	<	0	<	1.19E-03	<	20.7	>
	Buoyant displ	1808	=	31	<	11	>	8.26E+00	>	4.38	>
	Non-buoyant	2994	=	80	<	0	=	1.21E-03	=	3.78	=
SY-101	all sizes	4330	=	565	=	23	=	3.95E-03	=	6.71	=
	small	1061	=	36	=	0	=	8.66E-04	=	0.242	=
	medium	2220	=	192	=	14	=	2.54E+00	=	7.51	=
	large	1049	=	337	=	9	=	1.28E-03	=	70.4	=
	Buoyant displ	1336	=	65	=	23	=	1.05E+01	=	7.35	=
	Non-buoyant	2994	=	500	=	0	=	1.22E-03	=	6.04	=
Tank fail press red.		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4223	=	92	=	8	=	3.58E-03	=	2.36	=
AW-106	all sizes	11811	=	104	=	0	=	8.36E-04	=	2.2	=
SY-103	all sizes	4638	=	95	=	10	=	5.20E-03	=	3.96	=
SY-101	all sizes	4330	=	565	=	23	=	3.95E-03	=	6.71	=
WIE Ops inc		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4252	=	117	>	12	>	3.69E-03	>	2.41	>
	WIEquip (all s	29	>	25	>	4	>	1.00E+00	>	134	>
AW-108	all sizes	11814	=	105	=	2	>	8.38E-04	=	2.2	=
	WIEquip (all s	0	=	0	=	0	=	0.00E+00	=	0	=
SY-103	all sizes	4647	=	95	=	19	>	5.23E-03	=	3.99	=
	WIEquip (all s	9	>	0	=	9	>	1.00E+00	>	124	>
SY-101	all sizes	4349	=	574	>	33	>	4.00E-03	>	6.79	>
	WIEquip (all s	19	>	9	>	10	>	1.00E+00	>	127	>
WIE Ops inc-	ign.ctrl	No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4771	>	543	>	105	>	6.25E-03	>	3.39	>
	WIEquip (all s	548	>	451	>	97	>	1.00E+00	=	216	>
AW-106	all sizes	12561	>	503	>	351	>	1.15E-03	>	2.82	>
	WIEquip (all s	0	=	0	=	0	=	0.00E+00	=	0	=
SY-103	all sizes	5368	>	472	>	383	>	8.82E-03	>	5.95	>
	WIEquip (all s	730	>	377	>	353	>	1.00E+00	=	242	>
SY-101	all sizes	4997	>	964	>	291	>	7.55E-03	>	10.3	>
	WIEquip (all s	667	>	399	>	268	>	1.00E+00	=	258	>
WIE Ops inc-equip dia		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4252	=	117	=	12	=	3.69E-03	=	2.41	=
	WIEquip (all s	29	=	25	=	4	=	1.00E+00	=	134	=
AW-106	all sizes	11814	=	105	=	2	=	8.38E-04	=	2.2	=
	WIEquip (all s	0	=	0	=	0	=	0.00E+00	=	0	=
SY-103	all sizes	4647	=	95	=	19	=	5.23E-03	=	3.99	=
	WIEquip (all s	9	=	0	=	9	=	1.00E+00	=	124	=
SY-101	all sizes	4349	=	574	=	33	=	4.00E-03	=	6.79	=
	WIEquip (all s	19	=	9	=	10	=	1.00E+00	=	127	=
WIE Ops inc-equip len		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
AN-107	all sizes	4252	=	117	=	12	=	3.69E-03	=	2.41	=
	WIEquip (all s	29	=	25	=	4	=	1.00E+00	=	134	=
AW-106	all sizes	11814	=	105	=	2	=	8.38E-04	=	2.2	=
	WIEquip (all s	0	=	0	=	0	=	0.00E+00	=	0	=
SY-103	all sizes	4647	=	95	=	19	=	5.23E-03	=	3.99	=
	WIEquip (all s	9	=	0	=	9	=	1.00E+00	=	124	=
SY-101	all sizes	4349	=	574	=	33	=	4.00E-03	=	6.79	=
	WIEquip (all s	19	=	9	=	10	=	1.00E+00	=	127	=

Benchmark - On-site Rad									
Tank		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	B	1.46E-05	B	2.75E-10	B	5.83E-05	B
	Onsite Rad:	82	B	1.00E-05	B	2.38E-11	B	4.68E-09	B
	Onsite Rad:	3	B	2.90E-01	B	7.67E-06	B	1.73E-05	B
	Onsite Rad:	15	B	3.83E-01	B	6.39E-05	B	3.97E-03	B
AW-106	all TDS	104	B	3.07E-06	B	8.92E-10	B	5.44E-09	B
	Onsite Rad:	84	B	2.39E-06	B	4.68E-12	B	6.17E-11	B
	Onsite Rad:	16	B	1.82E-05	B	7.98E-04	B	1.96E-06	B
	Onsite Rad:	24	B	1.64E-06	B	5.50E-06	B	3.83E-07	B
SY-103	all TDS	105	B	2.45E-05	B	2.18E-04	B	3.33E-05	B
	Onsite Rad:	15	B	1.53E-03	B	8.19E-10	B	4.38E-06	B
	Onsite Rad:	39	B	7.32E-06	B	2.67E-04	B	4.25E-04	B
	Onsite Rad:	51	B	4.41E-04	B	6.28E-04	B	1.35E-03	B
SY-101	all TDS	588	B	1.24E-04	B	1.16E-05	B	4.74E-03	B
	Onsite Rad:	275	B	4.70E-05	B	1.59E-06	B	9.57E-07	B
	Onsite Rad:	184	B	1.59E-04	B	2.43E-04	B	7.69E-03	B
	Onsite Rad:	129	B	3.40E-04	B	9.02E-04	B	3.36E-02	B
WIE All Tanks		0	B	0.00E+00	B	0.00E+00	B	0.00E+00	B
Inerting-5% - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.03E-11	<	5.91E-05	>
AW-106	all TDS	32	<	1.02E-05	>	6.80E-05	>	6.27E-09	>
SY-103	all TDS	86	<	1.33E-05	<	6.54E-05	<	1.35E-05	<
SY-101	all TDS	533	<	1.09E-04	<	7.47E-06	<	4.80E-03	>
Inerting-10% - Rad		No. events		Median freq.		Median conc.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.03E-11	<	5.91E-05	>
AW-106	all TDS	32	<	1.02E-05	>	6.80E-05	>	6.27E-09	>
SY-103	all TDS	105	=	2.45E-05	=	1.21E-04	<	4.50E-05	>
SY-101	all TDS	591	=	1.25E-04	=	8.92E-06	<	4.75E-03	=
Waste vol. red. - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	89	<	1.34E-05	<	5.07E-11	<	5.56E-05	<
	Onsite Rad:	75	<	9.80E-06	<	5.16E-13	<	1.73E-09	<
	Onsite Rad:	2	<	6.44E+00	>	1.18E-04	>	3.03E-03	>
	Onsite Rad:	12	<	4.72E-01	>	8.33E-05	=	4.01E-03	>
AW-106	all TDS	72	<	3.42E-06	>	4.37E-08	>	9.81E-10	<
	Onsite Rad:	44	<	7.93E-07	<	5.00E-24	<	3.76E-09	>
	Onsite Rad:	16	=	1.11E-05	<	2.29E-08	<	1.15E-07	<
	Onsite Rad:	12	<	8.09E-06	>	2.08E-06	<	1.57E-07	<
SY-103	all TDS	82	<	2.08E-05	<	8.43E-05	<	9.83E-04	>
	Onsite Rad:	20	>	8.13E-06	<	1.66E-09	>	2.66E-10	<
	Onsite Rad:	28	<	1.94E-05	>	9.88E-05	<	4.34E-04	>
	Onsite Rad:	34	<	5.25E-05	<	5.78E-04	<	6.62E-02	>
SY-101	all TDS	260	<	4.47E-05	<	5.21E-06	<	5.39E-03	>
	Onsite Rad:	203	<	2.47E-05	<	7.95E-09	<	5.81E-07	<
	Onsite Rad:	27	<	4.78E-04	>	5.61E-04	>	5.48E-03	<
	Onsite Rad:	30	<	5.14E-02	>	2.08E-04	<	3.38E-02	=
Vent. rate-red - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	152	>	2.31E-04	>	9.16E-09	>	9.06E-05	>
AW-106	all TDS	104	=	3.07E-06	=	8.92E-10	=	5.44E-09	=
SY-103	all TDS	143	>	1.58E-03	>	2.11E-04	<	6.58E-04	>
SY-101	all TDS	980	>	3.44E-04	>	6.29E-05	>	6.91E-02	>
Vent. rate-inc - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	88	<	1.24E-05	<	2.00E-11	<	4.91E-05	<
AW-106	all TDS	104	=	3.07E-06	=	8.92E-10	=	5.42E-09	=
SY-103	all TDS	75	<	1.07E-05	<	2.00E-04	<	1.05E-05	<
SY-101	all TDS	370	<	6.17E-05	<	4.84E-07	<	4.42E-04	<
Int ops- All inc - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.99E-05	>
AW-106	all TDS	92	<	2.24E-06	<	3.26E-09	>	5.58E-09	>
SY-103	all TDS	106	=	3.32E-05	>	5.75E-04	>	1.60E-04	>
SY-101	all TDS	601	>	1.40E-04	>	1.99E-05	>	4.30E-03	<
Int ops-Non red - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.83E-05	=
AW-106	all TDS	104	=	3.07E-06	=	8.92E-10	=	5.44E-09	=
SY-103	all TDS	105	=	2.45E-05	=	2.18E-04	=	3.33E-05	=
SY-101	all TDS	588	=	1.23E-04	=	1.16E-05	=	4.74E-03	=

Benchmark - On-site Tox							
Tank		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	B	1.46E-05	B	5.03E-06	B
	Onsite Tox:	82	B	1.00E-05	B	5.20E-07	B
	Onsite Tox:	3	B	2.90E-01	B	3.71E+00	B
	Onsite Tox:	15	B	3.83E-01	B	5.24E+01	B
AW-106	all TDS	104	B	3.07E-06	B	9.67E-06	B
	Onsite Tox:	84	B	2.39E-06	B	2.36E-06	B
	Onsite Tox:	16	B	1.82E-05	B	1.37E+01	B
	Onsite Tox:	24	B	1.64E-06	B	1.06E-01	B
SY-103	all TDS	105	B	2.45E-05	B	4.90E-01	B
	Onsite Tox:	15	B	1.53E-03	B	4.37E-06	B
	Onsite Tox:	39	B	7.32E-06	B	3.94E-01	B
	Onsite Tox:	51	B	4.41E-04	B	7.22E+00	B
SY-101	all TDS	588	B	1.24E-04	B	3.08E-02	B
	Onsite Tox:	275	B	4.70E-05	B	4.41E-05	B
	Onsite Tox:	184	B	1.59E-04	B	4.33E-01	B
	Onsite Tox:	129	B	3.40E-04	B	5.56E+00	B
WIE All Tanks		0	B	0.00E+00	B	0.00E+00	B
Inerting-5% - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.82E-07	<
AW-106	all TDS	32	<	1.02E-05	>	3.61E-01	>
SY-103	all TDS	86	<	1.33E-05	<	8.88E-02	<
SY-101	all TDS	588	=	1.24E-04	=	3.08E-02	=
Inerting-10% - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.82E-07	<
AW-106	all TDS	32	<	1.02E-05	>	3.61E-01	>
SY-103	all TDS	105	=	2.45E-05	=	3.05E-01	<
SY-101	all TDS	588	=	1.24E-04	=	3.08E-02	=
Waste vol. red.- Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	89	<	1.34E-05	<	6.62E-07	<
	Onsite Tox:	75	<	9.80E-06	<	3.32E-08	<
	Onsite Tox:	2	<	6.44E+00	>	1.51E+02	>
	Onsite Tox:	12	<	4.72E-01	>	4.84E+01	<
AW-106	all TDS	72	<	3.42E-06	>	4.60E-04	>
	Onsite Tox:	44	<	7.93E-07	<	6.21E-20	<
	Onsite Tox:	16	=	1.11E-05	<	1.37E-01	<
	Onsite Tox:	12	<	8.09E-06	>	2.04E-01	>
SY-103	all TDS	82	<	2.08E-05	<	2.27E-01	<
	Onsite Tox:	20	>	8.13E-06	<	1.10E-05	>
	Onsite Tox:	28	<	1.94E-05	>	2.68E-01	<
	Onsite Tox:	34	<	5.25E-05	<	4.61E+00	<
SY-101	all TDS	260	<	4.47E-05	<	1.15E-04	<
	Onsite Tox:	203	<	2.47E-05	<	1.75E-05	<
	Onsite Tox:	27	<	4.78E-04	>	6.84E+00	>
	Onsite Tox:	30	<	5.14E-02	>	3.29E+01	>
Vent. rate-red - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	152	>	2.31E-04	>	2.22E-04	>
AW-106	all TDS	104	=	3.07E-06	=	9.67E-06	=
SY-103	all TDS	143	>	1.59E-03	>	1.20E+00	>
SY-101	all TDS	980	>	3.44E-04	>	2.34E-01	>
Vent. rate-inc - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	88	<	1.24E-05	<	5.20E-07	<
AW-106	all TDS	104	=	3.07E-06	=	9.67E-06	=
SY-103	all TDS	75	<	1.07E-05	<	3.90E-01	<
SY-101	all TDS	370	<	6.17E-05	<	1.17E-03	<
Int ops- All inc - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	92	<	2.24E-06	<	9.30E-05	>
SY-103	all TDS	106	=	3.32E-05	>	4.90E-01	=
SY-101	all TDS	601	>	1.40E-04	>	5.60E-02	>
Int ops- Non red - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	104	=	3.07E-06	=	9.67E-06	=
SY-103	all TDS	105	=	2.45E-05	=	4.90E-01	=
SY-101	all TDS	588	=	1.23E-04	=	3.08E-02	=

Int ops- Non inc - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.83E-05	=
AW-106	all TDS	104	=	3.07E-06	=	8.92E-10	=	5.44E-09	=
SY-103	all TDS	105	=	2.45E-05	=	2.18E-04	=	3.33E-05	=
SY-101	all TDS	588	=	1.24E-04	=	1.16E-05	=	4.74E-03	=
Int ops-Local red - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.82E-05	=
AW-106	all TDS	108	>	2.86E-06	<	4.83E-07	>	1.62E-08	>
SY-103	all TDS	122	>	6.12E-05	>	6.56E-05	<	1.06E-05	<
SY-101	all TDS	588	=	1.24E-04	=	1.16E-05	=	4.74E-03	=
Int ops- Local inc - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.83E-05	=
AW-106	all TDS	100	<	2.42E-06	<	6.67E-11	<	1.68E-07	>
SY-103	all TDS	105	=	2.45E-05	=	2.18E-04	=	3.34E-05	=
SY-101	all TDS	588	=	1.24E-04	=	1.16E-05	=	4.74E-03	=
Int ops-Global red - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.75E-05	<
AW-106	all TDS	76	<	7.63E-06	>	6.88E-09	>	4.30E-08	>
SY-103	all TDS	95	<	2.68E-05	>	2.95E-04	>	1.13E-04	>
SY-101	all TDS	588	=	1.23E-04	=	1.16E-05	=	4.73E-03	=
Int ops- Global inc - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.98E-05	>
AW-106	all TDS	112	>	1.43E-06	<	6.98E-07	>	1.97E-08	>
SY-103	all TDS	106	=	3.32E-05	>	5.75E-04	>	1.55E-04	>
SY-101	all TDS	596	>	1.46E-04	>	2.49E-05	>	4.71E-02	>
Int ops- Ex-tank inc - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.87E-05	=
AW-106	all TDS	104	=	3.07E-06	=	8.92E-10	=	5.44E-09	=
SY-103	all TDS	105	=	2.45E-05	=	2.18E-04	=	3.33E-05	=
SY-101	all TDS	588	=	1.20E-04	<	1.16E-05	=	4.74E-03	=
Ign. Ctrl Set- In-tank - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.93E-05	>
AW-106	all TDS	104	=	4.97E-06	>	8.92E-10	=	4.49E-08	>
SY-103	all TDS	105	=	2.45E-05	=	2.18E-04	=	1.60E-04	>
SY-101	all TDS	588	=	1.26E-04	>	1.16E-05	=	4.77E-03	=
Ign. Ctrl Set- Ex-tank - Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.79E-05	=
AW-106	all TDS	104	=	4.97E-06	>	8.92E-10	=	4.49E-08	>
SY-103	all TDS	105	=	2.45E-05	=	2.18E-04	=	3.33E-05	=
SY-101	all TDS	588	=	1.24E-04	=	1.16E-05	=	4.75E-03	=
Ign. Ctrl Set- In/Ex-tank - R		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.89E-05	>
AW-106	all TDS	104	=	4.97E-06	>	8.92E-10	=	4.49E-08	>
SY-103	all TDS	105	=	2.45E-05	=	2.18E-04	=	1.60E-04	>
SY-101	all TDS	588	=	1.26E-04	>	1.16E-05	=	4.78E-03	=
Density ratio Liq to S.Sol -		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	1162	>	1.21E-04	>	1.05E-06	>	1.83E-03	>
AW-106	all TDS	1094	>	1.52E-04	>	2.15E-06	>	7.99E-07	>
SY-103	all TDS	1182	>	1.36E-04	>	1.23E-04	<	4.21E-04	>
SY-101	all TDS	1631	>	1.71E-04	>	2.55E-04	>	1.74E-02	>
Density ratio Liq to l.sol - R		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.83E-05	=
AW-106	all TDS	104	=	3.07E-06	=	8.92E-10	=	5.44E-09	=
SY-103	all TDS	105	=	2.45E-05	=	2.02E-04	<	3.09E-05	<
SY-101	all TDS	588	=	1.24E-04	=	1.15E-05	=	4.74E-03	=
Gas generation rate S.sol -		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.69E-04	>
AW-106	all TDS	88	<	6.76E-06	>	8.46E-07	>	6.51E-08	>
SY-103	all TDS	102	<	4.56E-05	>	1.15E-04	<	2.10E-04	>
SY-101	all TDS	588	=	1.28E-04	>	1.16E-05	=	4.72E-02	>
Gas generation rate l.sol -		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	3	<	2.90E-01	>	7.67E-08	>	1.73E-05	<
AW-106	all TDS	16	<	1.82E-05	>	7.96E-04	>	1.96E-08	>
SY-103	all TDS	39	<	7.32E-06	<	2.67E-04	>	4.25E-04	>
SY-101	all TDS	184	<	1.59E-04	>	2.43E-04	>	7.69E-03	>

Int ops- Non inc - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	104	=	3.07E-06	=	9.67E-06	=
SY-103	all TDS	105	=	2.45E-05	=	4.90E-01	=
SY-101	all TDS	588	=	1.24E-04	=	3.08E-02	=
Int ops- Local red - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	108	>	2.86E-06	<	3.10E-03	>
SY-103	all TDS	122	>	6.12E-05	>	3.13E-01	<
SY-101	all TDS	588	=	1.24E-04	=	3.08E-02	=
Int ops- Local inc - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	100	<	2.42E-06	<	2.12E-06	<
SY-103	all TDS	105	=	2.45E-05	=	6.30E-01	>
SY-101	all TDS	588	=	1.24E-04	=	3.08E-02	=
Int ops- Global red - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	76	<	7.63E-06	>	1.34E-04	>
SY-103	all TDS	95	<	2.68E-05	>	9.50E-01	>
SY-101	all TDS	588	=	1.23E-04	=	3.08E-02	=
Int ops- Global inc - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	112	>	1.43E-06	<	1.68E-02	>
SY-103	all TDS	106	=	3.32E-05	>	1.56E+00	>
SY-101	all TDS	596	>	1.46E-04	>	5.49E-02	>
Int ops- Ex-tank inc - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	104	=	3.07E-06	=	9.67E-06	=
SY-103	all TDS	105	=	2.45E-05	=	4.90E-01	=
SY-101	all TDS	588	=	1.20E-04	<	3.08E-02	=
Ign. Ctrl Set- In-tank - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	104	=	4.97E-06	>	1.23E-05	>
SY-103	all TDS	105	=	2.45E-05	=	6.66E-01	>
SY-101	all TDS	588	=	1.26E-04	>	3.08E-02	=
Ign. Ctrl Set- Ex-tank - Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	104	=	4.97E-06	>	1.23E-05	>
SY-103	all TDS	105	=	2.45E-05	=	4.90E-01	=
SY-101	all TDS	588	=	1.26E-04	>	3.08E-02	=
Ign. Ctrl Set- In/Ex-tank - T		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	104	=	4.97E-06	>	1.23E-05	>
SY-103	all TDS	105	=	2.45E-05	=	6.66E-01	>
SY-101	all TDS	588	=	1.24E-04	=	3.08E-02	=
Density ratio Liq to S.Sol - T		No. events		Median freq.		Median cons.	
AN-107	all TDS	1162	>	1.21E-04	>	2.17E-02	>
AW-106	all TDS	1094	>	1.52E-04	>	4.54E-02	>
SY-103	all TDS	1182	>	1.36E-04	>	2.41E-01	<
SY-101	all TDS	588	=	1.26E-04	>	3.08E-02	=
Density ratio Liq to l.sol - T		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	104	=	3.07E-06	=	9.67E-06	=
SY-103	all TDS	105	=	2.45E-05	=	4.55E-01	<
SY-101	all TDS	588	=	1.24E-04	=	3.08E-02	=
Gas generation rate S.sol -		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
AW-106	all TDS	88	<	6.76E-06	>	6.96E-03	>
SY-103	all TDS	102	<	4.56E-05	>	3.61E-01	<
SY-101	all TDS	588	=	1.24E-04	=	3.08E-02	=
Gas generation rate l.sol - T		No. events		Median freq.		Median cons.	
AN-107	all TDS	3	<	2.90E-01	>	3.71E+00	>
AW-106	all TDS	16	<	1.82E-05	>	1.37E+01	>
SY-103	all TDS	39	<	7.32E-06	<	3.94E-01	<
SY-101	all TDS	104	<	1.22E-04	<	3.09E-01	>

Tank fail press red.- Rad		No. events		Median freq.		Median cons.		Ex. Risk	
AN-107	all TDS	100	=	1.46E-05	=	2.75E-10	=	5.63E-05	=
	Onsite Rad:	82	=	1.00E-05	=	2.36E-11	=	4.88E-09	=
	Onsite Rad:	3	=	2.90E-01	=	7.67E-08	=	1.73E-05	=
	Onsite Rad:	15	=	3.83E-01	=	6.39E-05	=	3.97E-03	=
AW-106	all TDS	104	=	3.07E-06	=	8.92E-10	=	8.53E-10	<
	Onsite Rad:	64	=	2.39E-06	=	4.66E-12	=	6.17E-11	=
	Onsite Rad:	8	<	2.44E-05	>	1.50E-05	<	2.05E-08	<
	Onsite Rad:	32	>	2.68E-06	>	6.65E-06	>	2.29E-07	<
SY-103	all TDS	105	=	2.45E-05	=	3.18E-04	>	3.29E-05	<
	Onsite Rad:	15	=	1.53E-03	=	8.19E-10	=	4.36E-08	=
	Onsite Rad:	17	<	5.04E-06	<	2.88E-04	>	1.66E-04	<
	Onsite Rad:	73	>	3.47E-05	<	1.13E-03	>	1.32E-03	<
SY-101	all TDS	568	=	1.24E-04	=	9.95E-08	<	4.80E-03	>
	Onsite Rad:	275	=	4.70E-05	=	1.59E-08	=	9.57E-07	=
	Onsite Rad:	104	<	1.22E-04	<	3.97E-04	>	6.38E-03	>
	Onsite Rad:	209	>	2.99E-04	<	1.09E-03	>	3.16E-02	<
WIE Ops inc		No. events		Median freq.		Median cons		Ex. Risk	
AN-107	all TDS	129	>	2.87E-05	>	7.46E-10	>	6.40E-05	>
	WIEquip (all T	29	>	1.07E-02	>	2.96E-09	>	5.68E-06	>
AW-106	all TDS	107	>	3.67E-06	>	1.01E-09	>	1.01E-06	>
	WIEquip (all T	3	>	7.66E-03	>	9.49E-08	>	1.53E-06	>
SY-103	all TDS	114	>	3.15E-05	>	2.55E-04	>	9.62E-04	>
	WIEquip (all T	9	>	1.67E-02	>	7.91E-04	>	9.49E-04	>
SY-101	all TDS	607	>	1.27E-04	>	1.10E-05	<	3.63E-03	<
	WIEquip (all T	19	>	3.98E-03	>	5.68E-07	>	2.05E-04	>
WIE Ops inc- ign.ctrl		No. events		Median freq.		Median cons		Ex. Risk	
AN-107	all TDS	646	>	6.58E-03	>	7.55E-07	>	1.51E-04	>
	WIEquip (all T	546	>	6.58E-03	<	7.55E-07	>	1.51E-04	>
AW-106	all TDS	854	>	6.32E-03	>	1.97E-06	>	2.41E-04	>
	WIEquip (all T	750	>	6.32E-03	<	1.97E-06	>	2.41E-04	>
SY-103	all TDS	835	>	7.09E-03	>	1.06E-04	<	2.55E-02	>
	WIEquip (all T	730	>	7.09E-03	<	1.06E-04	<	2.55E-02	>
SY-101	all TDS	1255	>	1.13E-03	>	2.73E-05	>	2.44E-03	<
	WIEquip (all T	687	>	1.13E-03	<	2.73E-05	>	2.44E-03	>
WIE Ops inc-equip dis		No. events		Median freq.		Median cons		Ex. Risk	
AN-107	all TDS	129	=	2.87E-05	=	6.47E-10	<	6.22E-05	<
	WIEquip (all T	29	=	1.07E-02	=	2.06E-09	<	3.95E-06	<
AW-106	all TDS	107	=	3.67E-06	=	1.01E-09	=	8.71E-09	<
	WIEquip (all T	3	=	7.66E-03	=	6.64E-08	<	1.06E-06	<
SY-103	all TDS	114	=	3.15E-05	=	2.43E-04	<	6.97E-04	<
	WIEquip (all T	9	=	1.67E-02	=	5.46E-04	<	6.64E-04	<
SY-101	all TDS	607	=	1.27E-04	=	1.10E-05	=	3.61E-03	=
	WIEquip (all T	19	=	3.98E-03	=	3.98E-07	<	1.43E-04	<
WIE Ops inc-equip len		No. events		Median freq.		Median cons		Ex. Risk	
AN-107	all TDS	129	=	2.87E-05	=	7.46E-10	=	6.46E-05	=
	WIEquip (all T	29	=	1.07E-02	=	3.28E-09	>	6.29E-06	>
AW-106	all TDS	107	=	3.67E-06	=	1.01E-09	=	9.71E-09	<
	WIEquip (all T	3	=	7.66E-03	=	8.69E-08	<	1.41E-06	<
SY-103	all TDS	114	=	3.15E-05	=	2.66E-04	>	1.09E-03	>
	WIEquip (all T	9	=	1.67E-02	=	8.80E-04	>	1.05E-03	>
SY-101	all TDS	607	=	1.27E-04	=	1.10E-05	=	3.64E-03	=
	WIEquip (all T	19	=	3.98E-03	=	3.98E-07	<	1.43E-04	<

Tank fail press red.- Tox		No. events		Median freq.		Median cons.	
AN-107	all TDS	100	=	1.46E-05	=	5.03E-06	=
	Onsite Tox:	82	=	1.00E-05	=	5.20E-07	=
	Onsite Tox:	3	=	2.90E-01	=	3.71E+00	=
	Onsite Tox:	15	=	3.83E-01	=	5.24E+01	=
AW-106	all TDS	104	=	3.07E-06	=	9.67E-06	=
	Onsite Tox:	64	=	2.39E-06	=	2.36E-08	=
	Onsite Tox:	8	<	2.44E-05	>	1.33E-01	<
	Onsite Tox:	32	>	2.68E-06	>	8.60E-02	<
SY-103	all TDS	105	=	2.45E-05	=	1.84E+00	>
	Onsite Tox:	15	=	1.53E-03	=	4.37E-06	=
	Onsite Tox:	17	<	5.04E-06	<	2.41E-01	<
	Onsite Tox:	73	>	3.47E-05	<	6.19E+00	<
SY-101	all TDS	568	=	1.24E-04	=	3.08E-02	=
	Onsite Tox:	275	=	4.70E-05	=	4.41E-05	=
	Onsite Tox:	184	=	1.59E-04	=	4.33E-01	=
	Onsite Tox:	129	=	3.40E-04	=	5.58E+00	=
WIE Ops inc		No. events		Median freq.		Median cons	
AN-107	all TDS	129	>	2.87E-05	>	1.21E-05	>
	WIEquip (all T	29	>	1.07E-02	>	8.64E-03	>
AW-106	all TDS	107	>	3.67E-06	>	9.67E-06	=
	WIEquip (all T	3	>	7.66E-03	>	1.26E-02	>
SY-103	all TDS	114	>	3.15E-05	>	6.48E-01	>
	WIEquip (all T	9	>	1.67E-02	>	1.13E+02	>
SY-101	all TDS	607	>	1.27E-04	>	3.41E-02	>
	WIEquip (all T	19	>	3.98E-03	>	1.37E+00	>
WIE Ops inc- ign.ctrl		No. events		Median freq.		Median cons	
AN-107	all TDS	646	>	6.58E-03	>	9.64E-01	>
	WIEquip (all T	646	>	6.58E-03	<	9.64E-01	>
AW-106	all TDS	854	>	6.32E-03	>	2.20E+00	>
	WIEquip (all T	854	>	6.32E-03	<	2.20E+00	>
SY-103	all TDS	835	>	7.09E-03	>	1.07E+01	>
	WIEquip (all T	835	>	7.09E-03	<	1.07E+01	<
SY-101	all TDS	1255	>	1.13E-03	>	6.06E-01	>
	WIEquip (all T	667	>	8.44E-03	>	7.09E+00	>
WIE Ops inc-equip dis		No. events		No. deflag.		No. deton.	
AN-107	all TDS	129	=	2.87E-05	=	1.21E-05	=
	WIEquip (all T	29	=	1.07E-02	=	4.66E-03	<
AW-106	all TDS	107	=	3.67E-06	=	9.67E-06	=
	WIEquip (all T	3	=	7.66E-03	=	8.96E-03	<
SY-103	all TDS	114	=	3.15E-05	=	6.48E-01	=
	WIEquip (all T	9	=	1.67E-02	=	7.99E+01	<
SY-101	all TDS	607	=	1.27E-04	=	3.41E-02	=
	WIEquip (all T	19	=	3.98E-03	=	9.59E-01	<
WIE Ops inc-equip len		No. events		No. deflag.		No. deton.	
AN-107	all TDS	129	=	2.87E-05	=	1.21E-05	=
	WIEquip (all T	29	=	1.07E-02	=	7.33E-03	>
AW-106	all TDS	107	=	3.67E-06	=	9.67E-06	=
	WIEquip (all T	3	=	7.66E-03	=	1.16E-02	<
SY-103	all TDS	114	=	3.15E-05	=	6.48E-01	=
	WIEquip (all T	9	=	1.67E-02	=	1.25E+02	>
SY-101	all TDS	607	=	1.27E-04	=	3.41E-02	=
	WIEquip (all T	19	=	3.98E-03	=	1.26E+00	<

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APPENDIX C

SST ACCEPTANCE TEST RESULTS

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APPENDIX C

This Appendix provides the results of the SST acceptance testing. A strict comparison of the benchmark results to the trend analysis results does not consider the magnitude of the difference. For example, if the benchmark mean consequence value is 4.567E-05 Sv and the mean trend test analysis result is 4.566E-05 Sv, a comparison of this type would indicate, that by modifying a specific parameter, the consequences decreased; however, based on the conservatisms and uncertainties incorporated in the Analysis Tool, a better conclusion would be that there is no change. Therefore, to interpret the results, i.e., determine the change in the benchmark values due to changing specific parameters, the comparisons shown in the tables provided for each of the trend test analysis results are based +/- 10%.

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SST Acceptance test results:											
Seed: 90000000											
Sample count: 1000											
Benchmark - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	11877	B	2116	B	0	B	5.89E-05	B	12.5	B
	small	3957	B	204	B	0	B	5.47E-04	B	2.77	B
	medium	3960	B	532	B	0	B	7.78E-05	B	17.1	B
	large	3960	B	1380	B	0	B	4.47E-06	B	73	B
U-111	all	12272	B	716	B	0	B	6.34E-05	B	5.19	B
	small	4088	B	104	B	0	B	6.35E-04	B	1.04	B
	medium	4092	B	304	B	0	B	9.44E-05	B	6.99	B
	large	4092	B	308	B	0	B	4.86E-06	B	29.8	B
T-203	all sizes	11985	B	1536	B	84	B	5.20E-06	B	7.43	B
	small	3993	B	12	B	0	B	4.05E-05	B	1.95	B
	medium	3996	B	184	B	0	B	7.27E-06	B	11.6	B
	large	3996	B	1340	B	84	B	4.35E-07	B	56	B
B-111	all sizes	12034	B	268	B	0	B	3.45E-05	B	1.63	B
	small	4010	B	8	B	0	B	3.09E-04	B	0.451	B
	medium	4012	B	68	B	0	B	5.32E-05	B	2.53	B
	large	4012	B	192	B	0	B	2.70E-06	B	11.7	B
WIE All Tanks		0	B	0	B	0	B	0.00E+00	B	0	B
S.Well pumping - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	11984	=	1824	<	0	=	3.73E-05	<	11.4	<
U-111	all sizes	11974	<	560	<	0	=	4.37E-05	<	4.31	<
T-203	all sizes	12236	>	1488	<	56	<	4.17E-06	<	6.56	<
B-111	all sizes	11913	<	204	<	0	=	2.90E-05	<	1.31	<
Waste vol. red. - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	11913	=	856	<	0	=	6.11E-05	>	6.09	<
U-111	all sizes	12199	=	312	<	0	=	6.34E-05	=	2.76	<
T-203	all sizes	11974	=	636	<	4	<	5.91E-06	>	3.51	<
B-111	all sizes	11877	<	88	<	0	=	3.73E-05	>	0.921	<
Intrusive ops. All - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	12164	>	2223	>	0	=	2.81E-05	<	14.7	>
	small	4052	>	219	>	0	=	3.70E-04	<	2.88	>
	medium	4056	>	524	<	0	=	3.99E-05	<	18.4	>
	large	4056	>	1480	>	0	=	1.71E-06	<	71.8	<
U-111	all sizes	11937	<	736	>	0	=	3.39E-05	<	5.7	>
	small	3977	<	124	>	0	=	4.82E-04	<	1.19	>
	medium	3980	<	316	>	0	=	5.23E-05	<	7.3	>
	large	3980	<	296	<	0	=	2.08E-06	<	32.1	>
T-203	all sizes	12226	>	1592	>	116	>	2.47E-06	<	8.95	>
	small	4074	>	4	<	0	=	3.30E-05	<	2.29	>
	medium	4076	>	208	>	0	=	4.00E-06	<	13.4	>
	large	4076	>	1380	>	116	>	1.34E-07	<	61.4	>
B-111	all sizes	11709	<	220	<	0	=	1.80E-05	<	1.99	>
	small	3901	<	12	>	0	=	1.99E-04	<	0.526	>
	medium	3904	<	72	>	0	=	2.95E-05	<	3.28	>
	large	3904	<	136	<	0	=	1.02E-06	<	13.4	>

Intrusive ops. Non - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	11677	=	2116	=	0	=	5.89E-05	=	12.5	=
	small	3957	=	204	=	0	=	5.47E-04	=	2.77	=
	medium	3960	=	532	=	0	=	7.78E-05	=	17.1	=
	large	3960	=	1380	=	0	=	4.47E-06	=	73	=
U-111	all sizes	12272	=	716	=	0	=	6.34E-05	=	5.19	=
	small	4088	=	104	=	0	=	6.35E-04	=	1.04	=
	medium	4092	=	304	=	0	=	9.44E-05	=	6.99	=
	large	4092	=	308	=	0	=	4.86E-06	=	29.8	=
T-203	all sizes	11985	=	1536	=	84	=	5.20E-06	=	7.43	=
	small	3993	=	12	=	0	=	4.05E-05	=	1.95	=
	medium	3996	=	184	=	0	=	7.27E-06	=	11.6	=
	large	3996	=	1340	=	84	=	4.35E-07	=	56	=
B-111	all sizes	12034	=	268	=	0	=	3.45E-05	=	1.63	=
	small	4010	=	8	=	0	=	3.09E-04	=	0.451	=
	medium	4012	=	68	=	0	=	5.32E-05	=	2.53	=
	large	4012	=	192	=	0	=	2.70E-06	=	11.7	=
Intrusive ops. local - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	11852	=	2096	=	0	=	6.39E-05	>	12.8	>
	small	3948	=	140	<	0	=	8.51E-04	>	2.79	=
	medium	3952	=	540	>	0	=	9.91E-05	>	16.7	<
	large	3952	=	1416	>	0	=	4.37E-06	<	73	=
U-111	all sizes	12033	<	768	>	0	=	7.30E-05	>	5.25	>
	small	4009	<	116	>	0	=	9.78E-04	>	1.06	>
	medium	4012	<	360	>	0	=	1.06E-04	>	6.9	<
	large	4012	<	292	<	0	=	5.41E-06	>	30.5	>
T-203	all sizes	11732	<	1588	>	80	<	6.16E-06	>	7.85	>
	small	3908	<	0	<	4	>	6.58E-05	>	1.89	<
	medium	3912	<	212	>	0	=	8.95E-06	>	12.1	>
	large	3912	<	1376	>	76	<	3.90E-07	<	56.5	=
B-111	all sizes	12081	=	252	<	0	=	4.17E-05	>	1.76	>
	small	4025	=	8	=	0	=	4.16E-04	>	0.507	>
	medium	4028	=	48	<	0	=	7.01E-05	>	2.74	>
	large	4028	=	196	>	0	=	2.83E-06	>	12.3	>
Intrusive ops. Glob - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	12022	>	2228	>	0	=	2.02E-05	<	14.7	>
	small	4006	>	204	=	0	=	2.31E-04	<	3.04	>
	medium	4008	>	576	>	0	=	2.95E-05	<	17.3	>
	large	4008	>	1448	>	0	=	1.18E-06	<	75.1	>
U-111	all sizes	11804	<	807	>	0	=	2.74E-05	<	5.67	>
	small	3932	<	107	>	0	=	2.71E-04	<	1.15	>
	medium	3936	<	392	>	0	=	3.50E-05	<	7.21	>
	large	3936	<	308	=	0	=	1.53E-06	<	31.9	>
T-203	all sizes	11997	=	1572	>	100	>	1.80E-06	<	8.6	>
	small	3997	=	4	<	0	=	1.55E-05	<	2.2	>
	medium	4000	=	204	>	0	=	2.52E-06	<	14.1	>
	large	4000	=	1364	>	100	>	1.20E-07	<	60.4	>
B-111	all sizes	11889	<	268	=	0	=	1.44E-05	<	2	>
	small	3961	<	8	=	0	=	1.23E-04	<	0.5	>
	medium	3964	<	68	=	0	=	2.03E-05	<	3.07	>
	large	3964	<	192	=	0	=	8.05E-07	<	13.3	>

Intrusive ops. Ex-Tank - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	11877	=	2116	=	0	=	5.89E-05	=	12.5	=
	small	3957	=	204	=	0	=	5.47E-04	=	2.77	=
	medium	3960	=	532	=	0	=	7.78E-05	=	17.1	=
	large	3960	=	1380	=	0	=	4.47E-06	=	73	=
U-111	all sizes	12272	=	716	=	0	=	6.34E-05	=	5.19	=
	small	4088	=	104	=	0	=	6.35E-04	=	1.04	=
	medium	4092	=	304	=	0	=	9.44E-05	=	6.99	=
	large	4092	=	308	=	0	=	4.86E-06	=	29.8	=
T-203	all sizes	11985	=	1536	=	84	=	5.20E-06	=	7.43	=
	small	3993	=	12	=	0	=	4.05E-05	=	1.95	=
	medium	3996	=	184	=	0	=	7.27E-06	=	11.6	=
	large	3996	=	1340	=	84	=	4.35E-07	=	56	=
B-111	all sizes	12034	=	268	=	0	=	3.45E-05	=	1.63	=
	small	4010	=	8	=	0	=	3.09E-04	=	0.451	=
	medium	4012	=	68	=	0	=	5.32E-05	=	2.53	=
	large	4012	=	192	=	0	=	2.70E-06	=	11.7	=
Ign. Ctrl. Set - In-Tank - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	11877	=	2116	=	0	=	5.89E-05	=	12.5	=
U-111	all sizes	12272	=	716	=	0	=	6.34E-05	=	5.19	=
T-203	all sizes	11985	=	1536	=	84	=	5.20E-06	=	7.43	=
B-111	all sizes	12034	=	268	=	0	=	3.45E-05	=	1.63	=
Ign. Ctrl. Set - In/Ex-Tank - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	11877	=	2116	=	0	=	5.89E-05	=	12.5	=
U-111	all sizes	12272	=	716	=	0	=	6.34E-05	=	5.19	=
T-203	all sizes	11985	=	1536	=	84	=	5.20E-06	=	7.43	=
B-111	all sizes	12034	=	268	=	0	=	3.45E-05	=	1.63	=
Vent. Rate-red. - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	11877	=	2124	=	0	=	5.89E-05	=	12.9	>
	small	3957	=	204	=	0	=	5.47E-04	=	2.97	>
	medium	3960	=	532	=	0	=	7.78E-05	=	17.2	=
	large	3960	=	1388	=	0	=	4.47E-06	=	73.8	>
U-111	all sizes	12272	=	728	>	0	=	6.34E-05	=	5.58	>
	small	3932	<	104	=	0	=	6.35E-04	=	1.23	>
	medium	3932	<	304	=	0	=	9.44E-05	=	7.33	>
	large	4092	=	320	>	0	=	4.86E-06	=	30.8	>
T-203	all sizes	11985	=	1612	>	88	>	5.20E-06	=	8.2	>
	small	3993	=	12	=	0	=	4.05E-05	=	2.35	>
	medium	3996	=	216	>	0	=	7.27E-06	=	12.5	>
	large	3996	=	1384	>	88	>	4.35E-07	=	58	>
B-111	all sizes	12034	=	268	=	0	=	3.45E-05	=	1.7	>
	small	4010	=	8	=	0	=	3.09E-04	=	0.495	>
	medium	4012	=	68	=	0	=	5.32E-05	=	2.66	>
	large	4012	=	192	=	0	=	2.70E-06	=	12.1	>
Vent. Rate-inc. - %LFL								%LFL		%LFL	
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.	
S-102	all sizes	11877	=	1932	<	0	=	5.89E-05	=	10.4	<
	small	3957	=	204	=	0	=	5.47E-04	=	1.64	<
	medium	3960	=	512	<	0	=	7.78E-05	=	13.6	<
	large	3960	=	1216	<	0	=	4.47E-06	=	63.7	<
U-111	all sizes	12272	=	660	<	0	=	6.34E-05	=	3.29	<
	small	3932	<	104	=	0	=	6.35E-04	=	0.435	<
	medium	3932	<	304	=	0	=	9.44E-05	=	4.4	<
	large	4092	=	252	<	0	=	4.86E-06	=	24.4	<
T-203	all sizes	11985	=	1252	<	60	<	5.20E-06	=	4.45	<
	small	3993	=	12	=	0	=	4.05E-05	=	0.714	<
	medium	3996	=	128	<	0	=	7.27E-06	=	7.65	<
	large	3996	=	1112	<	60	<	4.35E-07	=	42.7	<
B-111	all sizes	12034	=	240	<	0	=	3.45E-05	=	1.23	<
	small	4010	=	8	=	0	=	3.09E-04	=	0.257	<
	medium	4012	=	68	=	0	=	5.32E-05	=	2.17	<
	large	4012	=	164	<	0	=	2.70E-06	=	10.1	<

Inerting-5% - %LFL								%LFL		%LFL		
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.		
S-102	all sizes	11877	=	992	<	0	=	5.89E-06	<	12.6	=	
U-111	all sizes	12272	=	500	<	0	=	6.34E-05	=	5.2	=	
T-203	all sizes	11985	=	28	<	0	<	5.20E-06	=	7.44	=	
B-111	all sizes	12034	=	32	<	0	=	3.45E-05	=	1.59	<	
Inerting-10% - %LFL								%LFL		%LFL		
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.		
S-102	all sizes	11877	=	2156	>	0	=	5.89E-06	<	12.5	=	
U-111	all sizes	12272	=	500	<	0	=	6.34E-05	=	5.2	=	
T-203	all sizes	11985	=	36	<	0	<	5.20E-06	=	7.44	=	
B-111	all sizes	12034	=	32	<	0	=	3.45E-05	=	1.59	<	
Tank crack red. - %LFL								%LFL		%LFL		
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.		
S-102	all sizes	11877	=	2116	=	0	=	5.89E-06	<	12.5	=	
U-111	all sizes	12272	=	716	=	0	=	6.34E-05	=	5.19	=	
T-203	all sizes	11985	=	1536	=	84	=	5.20E-06	=	7.43	=	
B-111	all sizes	12034	=	268	=	0	=	3.45E-05	=	1.63	=	
Tank crack inc. - %LFL								%LFL		%LFL		
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.		
S-102	all sizes	11877	=	2116	=	0	=	5.89E-06	<	12.5	=	
U-111	all sizes	12272	=	716	=	0	=	6.34E-05	=	5.19	=	
T-203	all sizes	11985	=	1536	=	84	=	5.20E-06	=	7.43	=	
B-111	all sizes	12034	=	268	=	0	=	3.45E-05	=	1.63	=	
Tank coll. red. - %LFL								%LFL		%LFL		
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.		
S-102	all sizes	11877	=	2116	=	0	=	5.89E-06	<	12.5	=	
U-111	all sizes	12272	=	716	=	0	=	6.34E-05	=	5.19	=	
T-203	all sizes	11985	=	1536	=	84	=	5.20E-06	=	7.43	=	
B-111	all sizes	12034	=	268	=	0	=	3.45E-05	=	1.63	=	
Waste intrusive equipment - %LFL - operations increase												
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.		
S-102	all sizes	11890	=	2127	=	2	>	5.96E-05	>	12.6	=	
	WIEquip (all s	13	>	11	>	2	>	1.00E+00	>	115	>	
U-111	all sizes	12301	=	744	>	1	>	6.43E-05	>	5.22	=	
	WIEquip (all s	29	>	28	>	1	>	1.00E+00	>	124	>	
T-203	all sizes	11986	=	1536	=	85	>	5.21E-06	=	7.43	=	
	WIEquip (all s	1	>	0	=	1	>	1.00E+00	>	104	>	
B-111	all sizes	12038	=	272	>	0	=	3.46E-05	=	1.63	=	
	WIEquip (all s	4	>	4	>	0	=	1.00E+00	>	107	>	
Waste intrusive equipment - %LFL - ignition control												
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.		
S-102	all sizes	12547	>	2651	>	135	>	8.05E-05	>	15.5	>	
	WIEquip (all s	670	>	535	>	135	>	1.00E+00	=	236	>	
U-111	all sizes	12959	>	1294	>	109	>	9.10E-05	>	6.05	>	
	WIEquip (all s	687	>	578	>	109	>	1.00E+00	=	254	>	
T-203	all sizes	12752	>	1958	>	429	>	8.30E-06	>	9.07	>	
	WIEquip (all s	767	>	422	>	345	>	1.00E+00	=	225	>	
B-111	all sizes	12804	>	941	>	97	>	5.72E-05	>	2.01	>	
	WIEquip (all s	770	>	673	>	97	>	1.00E+00	=	223	>	
Waste intrusive equipment - %LFL - equipment diameter												
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.		
S-102	all sizes	11890	=	2127	=	2	=	5.96E-05	=	12.6	=	
	WIEquip (all s	13	=	11	=	2	=	1.00E+00	=	115	=	
U-111	all sizes	12301	=	744	=	1	=	6.43E-05	=	5.22	=	
	WIEquip (all s	29	=	28	=	1	=	1.00E+00	=	124	=	
T-203	all sizes	11986	=	1536	=	85	=	5.21E-06	=	7.43	=	
	WIEquip (all s	1	=	0	=	1	=	1.00E+00	=	104	=	
B-111	all sizes	12038	=	272	=	0	=	3.46E-05	=	1.63	=	
	WIEquip (all s	4	=	4	=	0	=	1.00E+00	=	107	=	

Waste intrusive equipment - %LFL - equipment length												
Tank		No. events		No. deflag.		No. deton.		Median freq.		Median conc.		
S-102	all sizes	11890	=	2127	=	2	=	5.96E-05	=	12.6	=	
	WIEquip (all s	13	=	11	=	2	=	1.00E+00	=	115	=	
U-111	all sizes	12301	=	744	=	1	=	6.43E-05	=	5.22	=	
	WIEquip (all s	29	=	28	=	1	=	1.00E+00	=	124	=	
T-203	all sizes	11986	=	1536	=	85	=	5.21E-06	=	7.43	=	
	WIEquip (all s	1	=	0	=	1	=	1.00E+00	=	104	=	
B-111	all sizes	12038	=	272	=	0	=	3.46E-05	=	1.63	=	
	WIEquip (all s	4	=	4	=	0	=	1.00E+00	=	107	=	

Benchmark - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2116	B	2.18E-07	B	2.07E-04	B	1.11E-05	B
	all, No dam.	*348*	*B*	*3.48E-07*	*B*	*1.57E-07*	*B*	*2.67E-05*	*B*
	all,HEPA	332	B	2.07E-07	B	9.50E-06	B	3.05E-05	B
	all,Dome crac	628	B	2.26E-07	B	2.11E-04	B	1.14E-05	B
	all, Dome fail.	808	B	1.82E-07	B	2.84E-03	B	7.80E-05	B
U-111	all TDS	716	B	9.45E-08	B	1.12E-06	B	3.09E-05	B
	all, No dam.	476	B	7.60E-08	B	9.36E-08	B	6.65E-08	B
	all,HEPA	80	B	8.13E-08	B	5.61E-06	B	4.82E-07	B
	all,Dome crac	92	B	1.81E-07	B	2.31E-04	B	8.05E-06	B
	all, Dome fail.	*68*	*B*	*2.96E-07*	*B*	*4.20E-03*	*B*	*3.67E-03*	*B*
T-203	all TDS	1620	B	2.12E-08	B	3.13E-04	B	5.09E-06	B
	all, No dam.	308	B	3.40E-08	B	1.53E-07	B	5.17E-07	B
	all,HEPA	432	B	2.16E-08	B	4.09E-05	B	2.36E-05	B
	all,Dome crac	540	B	2.13E-08	B	1.63E-03	B	1.49E-05	B
	all, Dome fail.	340	B	1.14E-08	B	6.56E-03	B	3.72E-05	B
B-111	all TDS	268	B	5.56E-08	B	5.03E-06	B	2.07E-06	B
	all, No dam.	128	B	9.51E-08	B	4.41E-08	B	8.36E-08	B
	all,HEPA	*56*	*B*	*3.74E-08*	*B*	*5.74E-06*	*B*	*2.64E-07*	*B*
	all,Dome crac	60	B	6.94E-08	B	6.40E-04	B	1.79E-03	B
	all, Dome fail.	24	B	4.07E-09	B	1.14E-03	B	3.30E-06	B
WIE All Tanks		0	B	0.00E+00	B	0.00E+00	B	0.00E+00	B

Benchmark - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2116	B	2.18E-07	B	1.50E+00	B
	all, No dam.	348	B	3.48E-07	B	2.89E-03	B
	all,HEPA	332	B	2.07E-07	B	1.17E-01	B
	all,Dome crac	628	B	2.26E-07	B	1.26E+00	B
	all, Dome fail.	808	B	1.82E-07	B	2.56E+01	B
U-111	all TDS	716	B	9.45E-08	B	5.85E-03	B
	all, No dam.	476	B	7.60E-08	B	5.92E-04	B
	all,HEPA	80	B	8.13E-08	B	4.75E-02	B
	all,Dome crac	92	B	1.81E-07	B	1.43E+00	B
	all, Dome fail.	68	B	2.96E-07	B	5.08E+01	B
T-203	all TDS	1620	B	2.12E-08	B	1.33E+00	B
	all, No dam.	308	B	3.40E-08	B	2.03E-03	B
	all,HEPA	432	B	2.16E-08	B	6.74E-01	B
	all,Dome crac	540	B	2.13E-08	B	2.66E+00	B
	all, Dome fail.	340	B	1.14E-08	B	8.64E+01	B
B-111	all TDS	268	B	5.56E-08	B	2.87E-02	B
	all, No dam.	128	B	9.51E-08	B	6.43E-04	B
	all,HEPA	56	B	3.74E-08	B	8.82E-02	B
	all,Dome crac	60	B	6.94E-08	B	1.09E+00	B
	all, Dome fail.	24	B	4.07E-09	B	1.54E+01	B
WIE All Tanks		0	B	0.00E+00	B	0.00E+00	B

S.Well pumping - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	1824	<	1.66E-07	<	1.57E-04	<	2.65E-05	>
U-111	*all TDS*	*560*	<	*5.28E-08*	<	*6.44E-07*	<	*1.08E-07*	<
T-203	all TDS	1544	<	1.26E-08	<	7.12E-04	>	6.37E-06	>
B-111	all TDS	204	<	2.55E-08	<	1.68E-05	>	5.37E-09	<

S.Well pumping - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	1824	<	1.66E-07	<	9.13E-01	<
U-111	*all TDS*	560	<	5.28E-08	<	4.57E-03	<
T-203	all TDS	1544	<	1.26E-08	<	2.60E+00	>
B-111	all TDS	204	<	2.55E-08	<	4.66E-02	>

Waste vol. red. - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	856	<	9.50E-08	<	3.18E-05	<	3.43E-06	<
	all, No dam.	252	<	1.11E-07	<	7.89E-08	<	9.47E-06	<
	all,HEPA	*132*	<	*1.49E-07*	<	*3.94E-06*	<	*8.22E-07*	<
	all,Dome crac	244	<	1.26E-07	<	1.69E-04	<	5.07E-05	>
	all, Dome fail.	228	<	5.03E-08	<	2.52E-03	<	1.01E-04	>
U-111	all TDS	312	<	4.77E-08	<	3.42E-07	<	2.52E-08	<
	all, No dam.	272	<	4.63E-08	<	1.55E-07	>	4.22E-07	>
	all,HEPA	24	<	4.54E-08	<	7.03E-06	>	1.37E-07	<
	all,Dome crac	12	<	1.29E-07	<	1.89E-06	<	4.72E-09	<
	all, Dome fail.	4	<	9.63E-08	<	2.37E-03	<	3.40E-06	<
T-203	*all TDS*	*640*	<	*9.97E-09*	<	*8.095-e*	>	*2.19E-06*	<
	all, No dam.	176	<	8.05E-09	<	6.24E-07	>	2.20E-07	<
	all,HEPA	196	<	1.09E-08	<	4.55E-05	>	4.29E-05	>
	all,Dome crac	224	<	1.21E-08	<	3.52E-04	<	8.02E-07	<
	all, Dome fail.	44	<	1.51E-09	<	2.14E-03	<	2.84E-05	<
B-111	all TDS	88	<	2.20E-08	<	1.10E-05	>	6.93E-10	<
	all, No dam.	48	<	1.07E-08	<	7.59E-08	>	1.89E-10	<
	all,HEPA	12	<	7.33E-09	<	1.36E-05	>	1.78E-09	<
	all,Dome crac	*12*	<	*8.08E-07*	>	*5.56E-04*	<	*3.29E-07*	<
	all, Dome fail.	16	<	8.27E-08	>	5.76E-04	<	5.62E-09	<

Waste vol. red. - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	856	<	9.50E-08	<	2.78E-01	<
	all, No dam.	252	<	1.11E-07	<	1.91E-03	<
	all,HEPA	132	<	1.49E-07	<	1.13E-01	<
	all,Dome crac	244	<	1.26E-07	<	5.92E-01	<
	all, Dome fail.	228	<	5.03E-08	<	2.42E+01	<
U-111	all TDS	312	<	4.77E-08	<	9.54E-04	<
	all, No dam.	272	<	4.63E-08	<	6.79E-04	>
	all,HEPA	24	<	4.54E-08	<	4.30E-02	<
	all,Dome crac	12	<	1.29E-07	<	6.88E-02	<
	all, Dome fail.	4	<	9.63E-08	<	1.46E+01	<
T-203	*all TDS*	640	<	9.97E-09	<	6.11E-01	<
	all, No dam.	176	<	8.05E-09	<	3.02E-03	>
	all,HEPA	196	<	1.09E-08	<	3.01E-01	<
	all,Dome crac	224	<	1.21E-08	<	9.51E-01	<
	all, Dome fail.	44	<	1.51E-09	<	4.76E+00	<
B-111	all TDS	88	<	2.20E-08	<	2.31E-02	<
	all, No dam.	48	<	1.07E-08	<	4.81E-04	<
	all,HEPA	12	<	7.33E-09	<	1.71E-01	>
	all,Dome crac	12	<	8.08E-07	>	7.29E-01	<
	all, Dome fail.	16	<	8.27E-08	>	3.03E+00	<

Intrusive ops. All - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2223	>	1.08E-07	<	2.02E-04	<	1.34E-05	>
U-111	all TDS	736	>	4.19E-08	<	1.31E-06	>	4.05E-07	<
T-203	all TDS	1708	>	7.75E-09	<	4.59E-04	>	1.24E-05	>
B-111	*all TDS*	*220*	<	*1.60E-08*	<	*7.96E-06*	>	*6.28E-08*	<

Intrusive ops. All - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2223	>	1.08E-07	<	1.35E+00	<
U-111	all TDS	736	>	4.19E-08	<	1.64E-02	>
T-203	all TDS	1708	>	7.75E-09	<	1.38E+00	>
B-111	*all TDS*	220	<	1.60E-08	<	4.12E-02	>

Intrusive ops. Non - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2116	=	2.19E-07	=	2.07E-04	=	1.15E-05	>
U-111	all TDS	716	=	9.45E-08	=	1.12E-06	=	3.09E-05	=
T-203	all TDS	1620	=	2.18E-08	>	3.13E-04	=	5.11E-06	=
B-111	all TDS	268	=	5.67E-08	>	5.03E-06	=	2.07E-06	=

Intrusive ops. Non - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2116	=	2.19E-07	=	1.50E+00	=
U-111	all TDS	716	=	9.45E-08	=	5.85E-03	=
T-203	all TDS	1620	=	2.18E-08	>	1.33E+00	=
B-111	all TDS	268	=	5.67E-08	>	2.87E-02	=

Intrusive ops. local - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2096	=	2.35E-07	>	1.63E-04	<	3.61E-05	>
U-111	all TDS	768	>	1.27E-07	>	1.24E-06	>	8.99E-08	<
T-203	all TDS	1668	>	1.88E-08	<	4.28E-04	>	5.97E-06	>
B-111	all TDS	252	<	7.16E-08	>	3.38E-06	<	1.66E-07	<

Intrusive ops. local - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2096	=	2.35E-07	>	8.86E-01	<
U-111	all TDS	768	>	1.27E-07	>	7.73E-03	>
T-203	all TDS	1668	>	1.88E-08	<	1.91E+00	>
B-111	all TDS	252	<	7.16E-08	>	3.54E-02	>

Intrusive ops. Glob - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2228	>	9.05E-08	<	1.74E-04	<	1.82E-04	>
U-111	all TDS	807	>	2.49E-08	<	1.28E-06	>	4.23E-07	<
T-203	all TDS	1672	>	6.28E-09	<	4.29E-04	>	4.98E-06	<
B-111	all TDS	268	=	1.49E-08	<	4.65E-06	<	4.64E-08	<

Intrusive ops. Glob - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2228	>	9.05E-08	<	1.28E+00	<
U-111	all TDS	807	>	2.49E-08	<	9.23E-03	>
T-203	all TDS	1672	>	6.28E-09	<	1.47E+00	>
B-111	all TDS	268	=	1.49E-08	<	9.22E-02	>

Intrusive ops. Ex-Tank - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2116	=	2.41E-07	>	2.07E-04	=	1.15E-05	>
U-111	all TDS	716	=	1.01E-07	>	1.12E-06	=	3.09E-05	=
T-203	all TDS	1620	=	2.63E-08	>	3.13E-04	=	5.28E-06	>
B-111	all TDS	268	=	5.67E-08	>	5.03E-06	=	2.07E-06	=

Intrusive ops. Ex-Tank - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2116	=	2.41E-07	>	1.51E+00	=
U-111	all TDS	716	=	1.01E-07	>	5.85E-03	=
T-203	all TDS	1620	=	2.63E-08	>	1.38E+00	>
B-111	all TDS	268	=	5.67E-08	>	2.87E-02	=

Ign. Ctrl. Set - In-Tank - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2116	=	2.86E-07	>	2.07E-04	=	1.37E-05	>
U-111	all TDS	716	=	1.61E-07	>	1.12E-06	=	3.52E-05	>
T-203	all TDS	1620	=	2.46E-08	>	3.13E-04	=	6.21E-06	>
B-111	all TDS	268	=	6.99E-08	>	5.03E-06	=	2.66E-06	>

Ign. Ctrl. Set - In-Tank - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2116	=	2.86E-07	>	1.55E+00	>
U-111	all TDS	716	=	1.61E-07	>	7.40E-03	>
T-203	all TDS	1620	=	2.46E-08	>	1.38E+00	>
B-111	all TDS	268	=	6.99E-08	>	3.36E-02	>

Ign. Ctrl. Set - In/Ex-Tank - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2116	=	2.48E-07	>	2.07E-04	=	1.10E-05	=
U-111	all TDS	716	=	1.61E-07	>	1.12E-06	=	3.52E-05	>
T-203	all TDS	1620	=	2.15E-08	>	3.13E-04	=	6.17E-06	>
B-111	all TDS	268	=	5.43E-08	<	5.03E-06	=	2.07E-06	=

Ign. Ctrl. Set - In/Ex-Tank - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2116	=	1.82E-07	<	1.50E+00	=
U-111	all TDS	716	=	1.61E-07	>	7.40E-03	>
T-203	all TDS	1620	=	2.15E-08	>	1.38E+00	>
B-111	all TDS	268	=	5.43E-08	<	2.87E-02	=

Vent. Rate-red. - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2114	=	3.05E-07	>	2.07E-04	=	1.15E-05	>
U-111	all TDS	728	>	1.15E-07	>	1.15E-06	>	3.09E-05	=
T-203	all TDS	1700	>	3.57E-08	>	3.10E-04	=	5.79E-06	>
B-111	all TDS	268	=	7.13E-08	>	5.03E-06	=	2.07E-06	=

Vent. Rate-red. - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2114	=	3.05E-07	>	1.51E+00	=
U-111	all TDS	728	>	1.15E-07	>	8.16E-03	>
T-203	all TDS	1700	>	3.57E-08	>	1.42E+00	>
B-111	all TDS	268	=	7.13E-08	>	3.36E-02	>

Vent. Rate-inc. - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	1932	<	1.35E-07	<	2.32E-04	>	1.10E-05	=
U-111	all TDS	660	<	7.53E-08	<	7.93E-07	<	3.09E-05	=
T-203	all TDS	1312	<	1.34E-08	<	2.51E-04	<	2.87E-06	<
B-111	all TDS	240	<	5.09E-08	<	3.53E-06	<	2.06E-06	=

Vent. Rate-inc. - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	1932	<	1.35E-07	<	1.50E+00	=
U-111	all TDS	660	<	7.53E-08	<	3.99E-03	<
T-203	all TDS	1312	<	1.34E-08	<	1.22E+00	<
B-111	all TDS	240	<	5.09E-08	<	2.20E-02	<

Inerting-5% - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	992	<	9.35E-08	<	7.39E-05	<	3.09E-06	<
U-111	all TDS	500	<	7.57E-08	<	3.13E-07	<	2.15E-05	<
T-203	all TDS	28	<	3.01E-08	>	3.92E-03	>	1.17E-08	<
B-111	all TDS	32	<	3.40E-08	<	1.00E-06	<	7.48E-11	<

Inerting-5% - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	992	<	9.35E-08	<	4.14E-01	<
U-111	all TDS	500	<	7.57E-08	<	1.16E-03	<
T-203	all TDS	28	<	3.01E-08	>	2.10E+01	>
B-111	all TDS	32	<	3.40E-08	<	2.86E-03	<

Inerting-10% - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2156	>	2.25E-07	>	1.64E-04	<	1.27E-05	>
U-111	all TDS	500	<	7.57E-08	<	3.13E-07	<	2.15E-05	<
T-203	all TDS	36	<	8.82E-09	<	5.30E-03	>	1.69E-08	<
B-111	all TDS	32	<	3.40E-08	<	1.00E-06	<	7.48E-11	<

Inerting-10% - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2156	>	2.25E-07	>	9.01E-01	<
U-111	all TDS	500	<	7.57E-08	<	1.16E-03	<
T-203	all TDS	36	<	8.82E-09	<	3.41E+01	>
B-111	all TDS	32	<	3.40E-08	<	2.86E-03	<

Tank crack red. - OnSite Rad - Consequences								Expected			Tank crack red. - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.		Risk			Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2116	=	2.18E-07	=	2.14E-04	>	9.97E-06	<		S-102	all TDS	2116	=	2.18E-07	=	1.70E+00	>
	all, No dam.	348	=	1.80E+02	>	1.57E-07	=	2.67E-05	=			all, No dam.	348	=	3.48E-07	=	2.89E-03	=
	all,HEPA	180	<	7.80E+02	>	1.03E-06	<	1.56E-06	<			all,HEPA	180	<	2.01E-07	<	6.11E-02	<
	all,Dome crac	780	>	8.08E+02	>	2.03E-04	<	1.45E-06	<			all,Dome crac	780	>	2.26E-07	=	1.12E+00	<
	all, Dome fail.	808	=	1.82E-07	=	2.84E-03	=	7.80E-05	=			all, Dome fail.	808	=	1.82E-07	=	2.56E+01	=
U-111	all TDS	716	=	9.45E-08	=	1.17E-06	>	3.09E-05	=		U-111	all TDS	716	=	9.45E-08	=	9.14E-03	>
	all, No dam.	476	=	7.60E-08	=	9.36E-08	=	6.65E-08	=			all, No dam.	476	=	7.60E-08	=	5.92E-04	=
	all,HEPA	56	<	6.53E-08	<	1.09E-05	>	8.74E-07	>			all,HEPA	56	<	6.53E-08	<	4.75E-02	=
	all,Dome crac	116	>	1.81E-07	=	1.36E-04	<	7.23E-06	<			all,Dome crac	116	>	1.81E-07	=	9.86E-01	<
	all, Dome fail.	68	=	2.96E-07	=	4.20E-03	=	3.67E-03	=			all, Dome fail.	68	=	2.96E-07	=	5.08E+01	=
T-203	all TDS	1620	=	2.12E-08	=	5.81E-04	>	5.24E-06	>		T-203	all TDS	1620	=	2.12E-08	=	2.04E+00	>
	all, No dam.	308	=	3.40E-08	=	1.53E-07	=	5.17E-07	=			all, No dam.	308	=	3.40E-08	=	2.30E-03	>
	all,HEPA	252	<	3.72E-08	>	5.40E-05	>	2.09E-05	<			all,HEPA	252	<	3.72E-08	>	9.12E-01	>
	all,Dome crac	720	>	1.95E-08	<	1.70E-03	>	1.42E-05	<			all,Dome crac	720	>	1.95E-08	<	3.73E+00	>
	all, Dome fail.	340	=	1.14E-08	=	6.56E-03	=	3.72E-05	=			all, Dome fail.	340	=	1.14E-08	=	8.64E+01	=
B-111	all TDS	268	=	5.56E-08	=	5.03E-06	=	2.08E-06	=		B-111	all TDS	268	=	5.56E-08	=	2.29E-02	<
	all, No dam.	128	=	9.51E-08	=	4.41E-08	=	8.36E-08	=			all, No dam.	128	=	9.51E-08	=	6.43E-04	=
	all,HEPA	24	<	3.74E-08	=	5.53E-06	<	3.11E-07	>			all,HEPA	24	<	3.74E-08	=	3.48E-02	<
	all,Dome crac	92	>	5.56E-08	<	1.99E-04	<	1.78E-03	=			all,Dome crac	92	>	5.56E-08	<	4.72E-01	<
	all, Dome fail.	24	=	4.07E-09	=	1.14E-03	=	3.30E-06	=			all, Dome fail.	24	=	4.07E-09	=	1.54E+01	=
Tank crack inc. - OnSite Rad - Consequences								Expected			Tank crack inc. - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.		Risk			Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2116	=	2.18E-07	=	1.92E-04	<	1.05E-05	<		S-102	all TDS	2116	=	2.18E-07	=	1.38E+00	<
	all, No dam.	348	=	3.48E-07	=	1.57E-07	=	2.67E-05	=			all, No dam.	348	=	3.48E-07	=	2.89E-03	=
	all,HEPA	520	>	2.28E-07	>	1.11E-05	>	2.23E-05	<			all,HEPA	520	>	2.28E-07	>	6.11E-02	<
	all,Dome crac	440	<	1.96E-07	<	1.93E-04	<	5.95E-06	<			all,Dome crac	440	<	1.96E-07	<	1.12E+00	<
	all, Dome fail.	808	=	1.82E-07	=	2.84E-03	=	7.80E-05	=			all, Dome fail.	808	=	1.82E-07	=	2.56E+01	=
U-111	all TDS	716	=	9.45E-08	=	9.27E-07	<	3.09E-05	=		U-111	all TDS	716	=	9.45E-08	=	4.94E-03	<
	all, No dam.	476	=	7.60E-08	=	9.36E-08	=	6.65E-08	=			all, No dam.	476	=	7.60E-08	=	5.92E-04	=
	all,HEPA	112	>	1.00E-07	>	5.61E-06	=	3.06E-07	<			all,HEPA	112	>	1.00E-07	>	5.31E-02	>
	all,Dome crac	60	<	1.81E-07	=	3.78E-05	<	5.61E-06	<			all,Dome crac	60	<	1.81E-07	=	5.12E-01	<
	all, Dome fail.	68	=	2.96E-07	=	4.20E-03	=	3.67E-03	=			all, Dome fail.	68	=	2.96E-07	=	5.08E+01	=
T-203	all TDS	1620	=	2.12E-08	=	1.07E-04	<	4.55E-06	<		T-203	all TDS	1620	=	2.12E-08	=	9.34E-01	<
	all, No dam.	308	=	3.40E-08	=	1.53E-07	=	5.17E-07	=			all, No dam.	308	=	3.40E-08	=	2.30E-03	>
	all,HEPA	772	>	2.45E-08	>	4.83E-05	>	1.66E-05	<			all,HEPA	772	>	2.45E-08	>	6.57E-01	<
	all,Dome crac	200	<	1.46E-08	<	1.77E-03	>	6.89E-06	<			all,Dome crac	200	<	1.46E-08	<	3.70E+00	>
	all, Dome fail.	340	=	1.14E-08	=	6.56E-03	=	3.72E-05	=			all, Dome fail.	340	=	1.14E-08	=	8.64E+01	=
B-111	all TDS	268	=	5.56E-08	=	3.57E-06	<	2.07E-06	=		B-111	all TDS	268	=	5.56E-08	=	2.02E-02	<
	all, No dam.	128	=	9.51E-08	=	4.41E-08	=	8.36E-08	=			all, No dam.	128	=	9.51E-08	=	6.43E-04	=
	all,HEPA	76	>	3.94E-08	>	6.04E-06	>	2.04E-07	<			all,HEPA	76	>	3.94E-08	>	3.48E-02	<
	all,Dome crac	40	<	8.14E-08	>	9.20E-04	>	1.80E-03	=			all,Dome crac	40	<	8.14E-08	>	1.78E+00	>
	all, Dome fail.	24	=	4.07E-09	=	1.14E-03	=	3.30E-06	=			all, Dome fail.	24	=	4.07E-09	=	1.54E+01	=
Tank coll. red. - OnSite Rad - Consequences								Expected			Tank coll. red. - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.		Risk			Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2116	=	2.18E-07	=	5.41E-04	>	9.67E-05	>		S-102	all TDS	2116	=	2.18E-07	=	5.24E+00	>
	all, No dam.	348	=	3.48E-07	=	1.57E-07	=	2.67E-05	=			all, No dam.	348	=	3.48E-07	=	2.89E-03	=
	all,HEPA	520	>	2.07E-07	=	9.50E-06	=	3.05E-05	=			all,HEPA	520	>	2.07E-07	=	1.17E-01	=
	all,Dome crac	332	<	2.99E-07	>	2.27E-04	>	2.52E-05	>			all,Dome crac	332	<	2.99E-07	>	1.36E+00	>
	all, Dome fail.	176	<	1.92E-07	>	3.49E-03	>	8.46E-04	>			all, Dome fail.	176	<	1.92E-07	>	3.38E+01	>
U-111	all TDS	716	=	9.45E-08	=	1.31E-06	>	3.11E-05	=		U-111	all TDS	716	=	9.45E-08	=	5.85E-03	=
	all, No dam.	476	=	7.60E-08	=	9.36E-08	=	6.65E-08	=			all, No dam.	476	=	7.60E-08	=	5.92E-04	=
	all,HEPA	80	=	8.13E-08	=	5.61E-06	=	4.82E-07	=			all,HEPA	80	=	8.13E-08	=	4.75E-02	=
	all,Dome crac	20	<	1.01E-07	<	8.18E-04	>	3.46E-06	<			all,Dome crac	20	<	1.01E-07	<	2.86E+00	>
	all, Dome fail.	140	>	2.32E-07	<	4.00E-03	<	1.53E-03	<			all, Dome fail.	140	>	2.32E-07	<	2.94E+01	<
T-203	all TDS	1620	=	2.12E-08	=	1.03E-03	>	1.69E-05	>		T-203	all TDS	1620	=	2.12E-08	=	4.35E+00	>
	all, No dam.	308	=	3.40E-08	=	1.53E-07	=	5.17E-07	=			all, No dam.	308	=	3.40E-08	=	2.30E-03	>
	all,HEPA	432	=	2.45E-08	>	4.09E-05	=	2.36E-05	=			all,HEPA	432	=	2.45E-08	>	6.74E-01	=
	all,Dome crac	88	<	1.46E-08	<	1.16E-03	<	5.36E-06	<			all,Dome crac	88	<	1.46E-08	<	1.90E+00	<
	all, Dome fail.	792	>	1.14E-08	=	1.95E-02	>	9.87E-05	>			all, Dome fail.	792	>	1.14E-08	=	9.98E+01	>
B-111	all TDS	268	=	5.56E-08	=	5.03E-06	=	9.26E-07	<		B-111	all TDS	268	=	5.56E-08	=	2.87E-02	=
	all, No dam.	128	=	9.51E-08	=	4.41E-08	=	8.36E-08	=			all, No dam.	128	=	9.51E-08	=	6.43E-04	=
	all,HEPA	56	=	3.74E-08	=	5.74E-06	=	2.64E-07	=			all,HEPA	56	=	3.74E-08	=	8.82E-02	=
	all,Dome crac	16	<	3.99E-08	<	3.70E-04	<	9.76E-05	<			all,Dome crac	16	<	3.99E-08	<	8.98E-01	<
	all, Dome fail.	68	>	4.31E-08	>	3.48E-03	>	6.08E-04	>			all, Dome fail.	68	>	4.31E-08	>	1.83E+01	>

Waste intrusive equipment - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2129	=	2.26E-07	>	2.07E-04	=	1.15E-05	>
	WIEquip (all T	13	>	4.47E-03	>	3.31E-08	>	3.26E-05	>
U-111	all TDS	745	>	1.34E-07	>	1.17E-06	>	8.59E-04	>
	WIEquip (all T	29	>	1.97E-02	>	7.31E-05	>	3.00E-02	>
T-203	all TDS	1621	=	2.14E-08	=	3.13E-04	=	5.29E-06	>
	WIEquip (all T	1	>	5.03E-02	>	2.02E-03	>	2.03E-04	>
B-111	all TDS	272	>	5.92E-08	>	5.03E-06	=	2.11E-06	>
	WIEquip (all T	4	>	1.29E-01	>	1.26E-05	>	1.03E-05	>

Waste intrusive equipment - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2129	=	2.26E-07	>	1.46E+00	<
	WIEquip (all T	13	>	4.47E-03	>	1.09E-01	>
U-111	all TDS	745	>	1.34E-07	>	9.46E-03	>
	WIEquip (all T	29	>	7.31E-05	>	1.82E+01	>
T-203	all TDS	1621	=	2.14E-08	=	1.34E+00	=
	WIEquip (all T	1	>	5.03E-02	>	1.73E+02	>
B-111	all TDS	272	>	5.92E-08	>	3.36E-02	>
	WIEquip (all T	4	>	1.29E-01	>	3.35E+00	>

Waste intrusive equipment - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2786	>	1.65E-06	>	1.56E-04	<	1.37E-03	>
	WIEquip (all T	670	>	7.68E-03	>	1.69E-05	>	3.63E-03	>
U-111	all TDS	1403	>	4.97E-05	>	4.41E-08	>	1.18E-03	>
	WIEquip (all T	687	>	9.54E-03	<	1.65E-05	<	2.85E-03	<
T-203	all TDS	2387	>	6.20E-07	>	2.09E-04	<	1.01E-02	>
	WIEquip (all T	767	>	8.89E-03	<	5.91E-05	<	2.33E-02	>
B-111	all TDS	1038	>	3.44E-03	>	1.46E-05	>	1.15E-03	>
	WIEquip (all T	770	>	8.17E-03	<	2.43E-05	>	2.64E-03	>

Waste intrusive equipment - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2786	>	1.65E-06	>	2.79E+00	>
	WIEquip (all T	670	>	7.68E-03	>	1.11E+01	>
U-111	all TDS	1403	>	4.97E-05	>	5.11E-01	>
	WIEquip (all T	687	>	9.54E-03	>	7.89E+00	<
T-203	all TDS	2387	>	6.20E-07	>	2.60E+00	>
	WIEquip (all T	767	>	8.89E-03	<	1.38E+01	<
B-111	all TDS	1038	>	3.44E-03	>	2.22E+00	>
	WIEquip (all T	770	>	8.17E-03	<	7.29E+00	>

Waste intrusive equipment - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2129	=	2.26E-07	=	2.07E-04	=	1.14E-05	=
	WIEquip (all T	13	=	4.47E-03	=	2.31E-08	<	2.27E-05	<
U-111	all TDS	745	=	1.34E-07	=	1.17E-06	=	6.07E-04	<
	WIEquip (all T	29	=	1.97E-02	=	5.11E-05	<	2.09E-02	<
T-203	all TDS	1621	=	2.14E-08	=	3.13E-04	=	5.23E-06	<
	WIEquip (all T	1	=	5.03E-02	=	1.42E-03	<	1.43E-04	<
B-111	all TDS	272	=	5.92E-08	=	5.03E-06	=	2.10E-06	=
	WIEquip (all T	4	=	1.29E-01	=	8.84E-06	<	7.23E-06	<

Waste intrusive equipment - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2129	=	2.26E-07	=	1.46E+00	=
	WIEquip (all T	13	=	4.47E-03	=	7.61E-02	<
U-111	all TDS	745	=	1.34E-07	=	9.48E-03	=
	WIEquip (all T	29	=	1.97E-02	>	1.27E+01	<
T-203	all TDS	1621	=	2.14E-08	=	1.34E+00	=
	WIEquip (all T	1	=	5.03E-02	=	1.21E+03	>
B-111	all TDS	272	=	5.92E-08	=	3.36E-02	=
	WIEquip (all T	4	=	1.29E-01	=	2.36E+00	<

Waste intrusive equipment - OnSite Rad - Consequences								Expected	
Tank		No. events		Median freq.		Median cons.		Risk	
S-102	all TDS	2129	=	2.26E-07	=	2.07E-04	=	1.15E-05	=
	WIEquip (all T	13	=	4.47E-03	=	2.98E-08	<	2.94E-05	<
U-111	all TDS	745	=	1.34E-07	=	1.17E-06	=	7.61E-04	<
	WIEquip (all T	29	=	1.97E-02	=	5.11E-05	<	2.65E-02	<
T-203	all TDS	1621	=	2.14E-08	=	3.13E-04	=	5.32E-06	=
	WIEquip (all T	1	=	5.03E-02	=	2.37E-03	>	2.38E-04	>
B-111	all TDS	272	=	5.92E-08	=	5.03E-06	=	2.11E-06	=
	WIEquip (all T	4	=	1.29E-01	=	1.12E-05	<	9.15E-06	<

Waste intrusive equipment - OnSite Tox - Consequences							
Tank		No. events		Median freq.		Median cons.	
S-102	all TDS	2129	=	2.26E-07	=	1.46E+00	=
	WIEquip (all T	13	=	4.47E-03	=	9.82E-02	<
U-111	all TDS	745	=	1.34E-07	=	9.48E-03	=
	WIEquip (all T	29	=	1.97E-02	>	1.61E+01	<
T-203	all TDS	1621	=	2.14E-08	=	1.34E+00	=
	WIEquip (all T	1	=	5.03E-02	=	2.01E+03	>
B-111	all TDS	272	=	5.92E-08	=	3.36E-02	=
	WIEquip (all T	4	=	1.29E-01	=	2.98E+00	<

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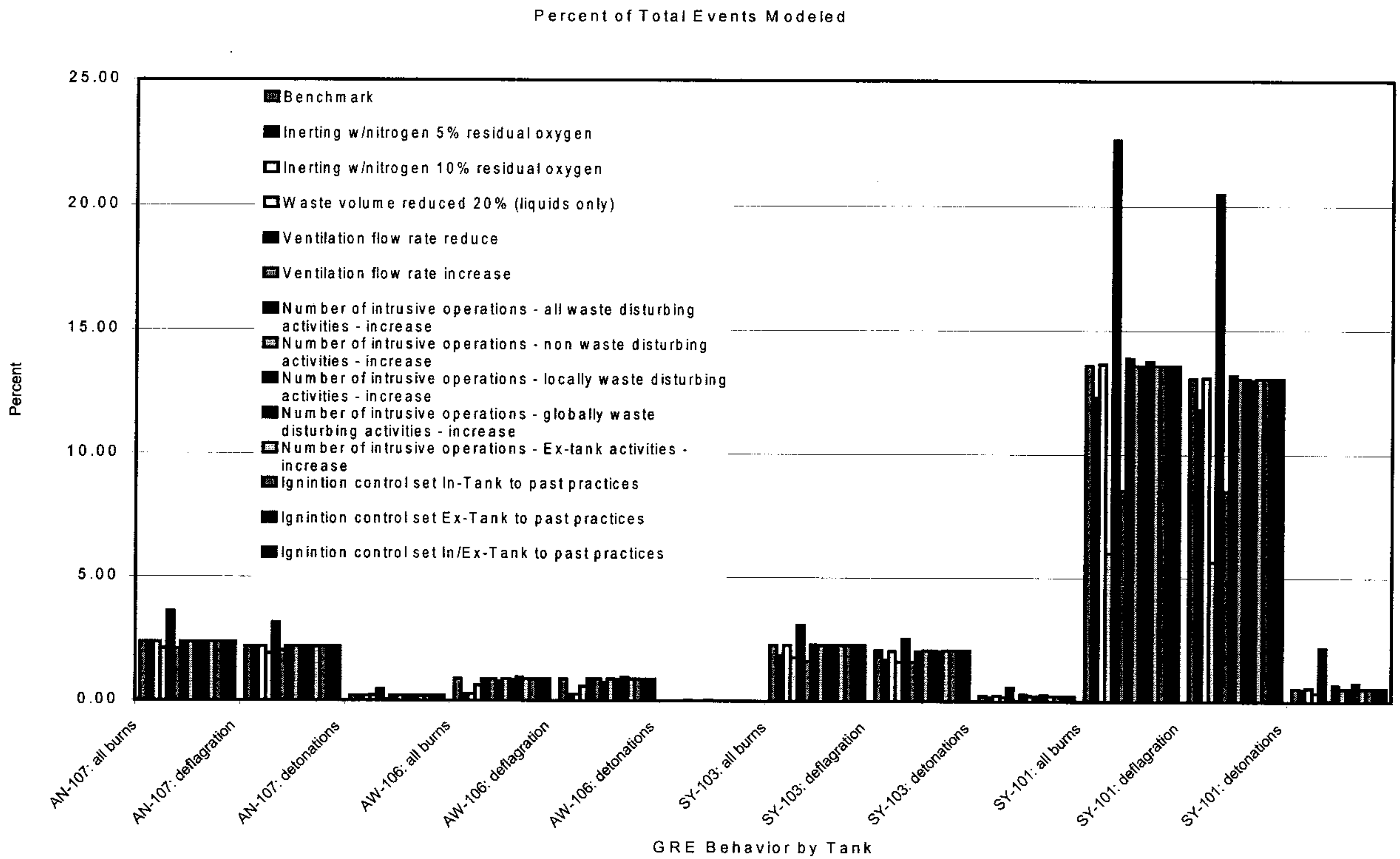

Figure 1. DST: Percent Increase in Total GRE Deflagrations and Detonations due to Parameter Modifications.

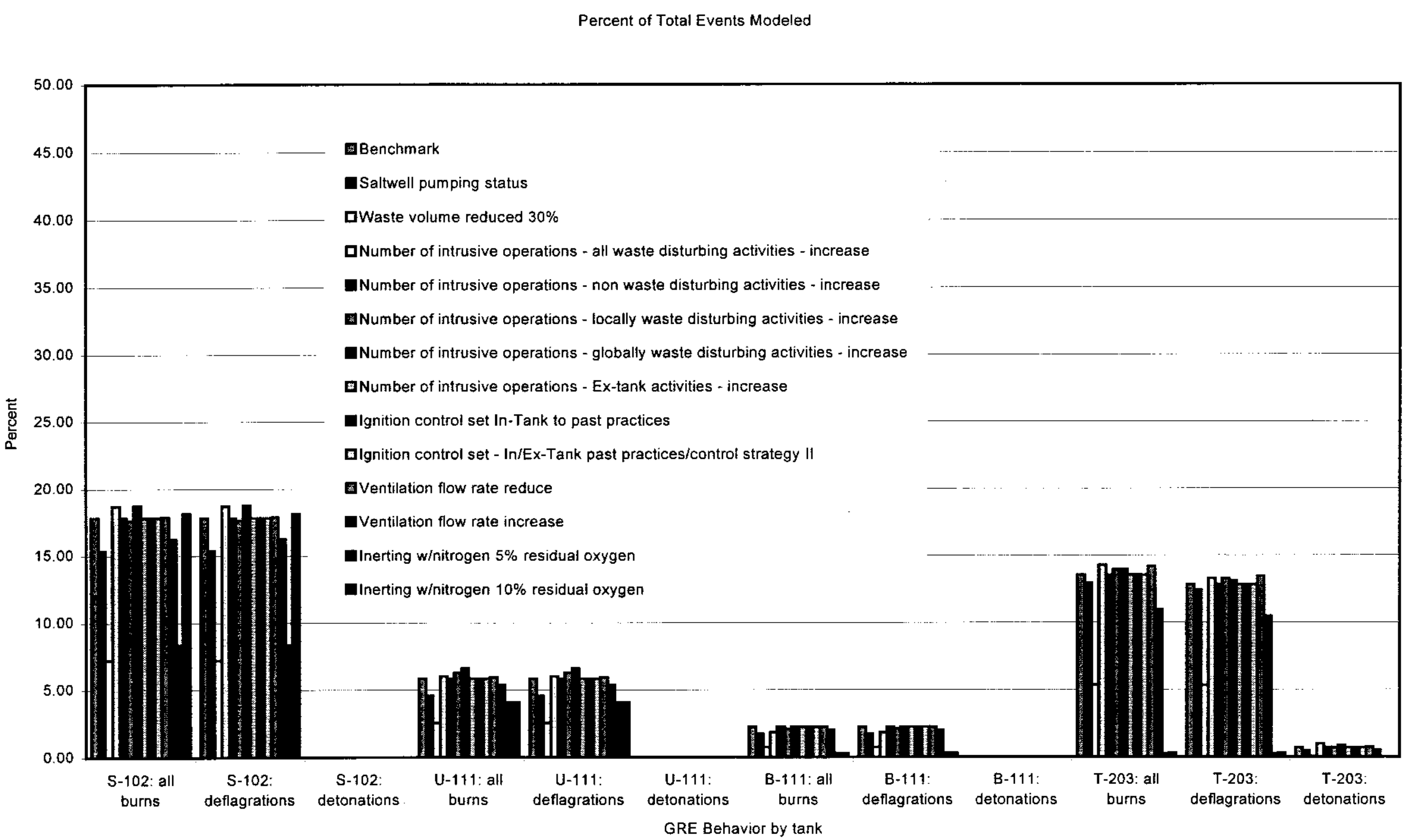

Figure 2. SST: Percent Increase in Total GRE Deflagrations and Detonations due to Parameter Modifications.

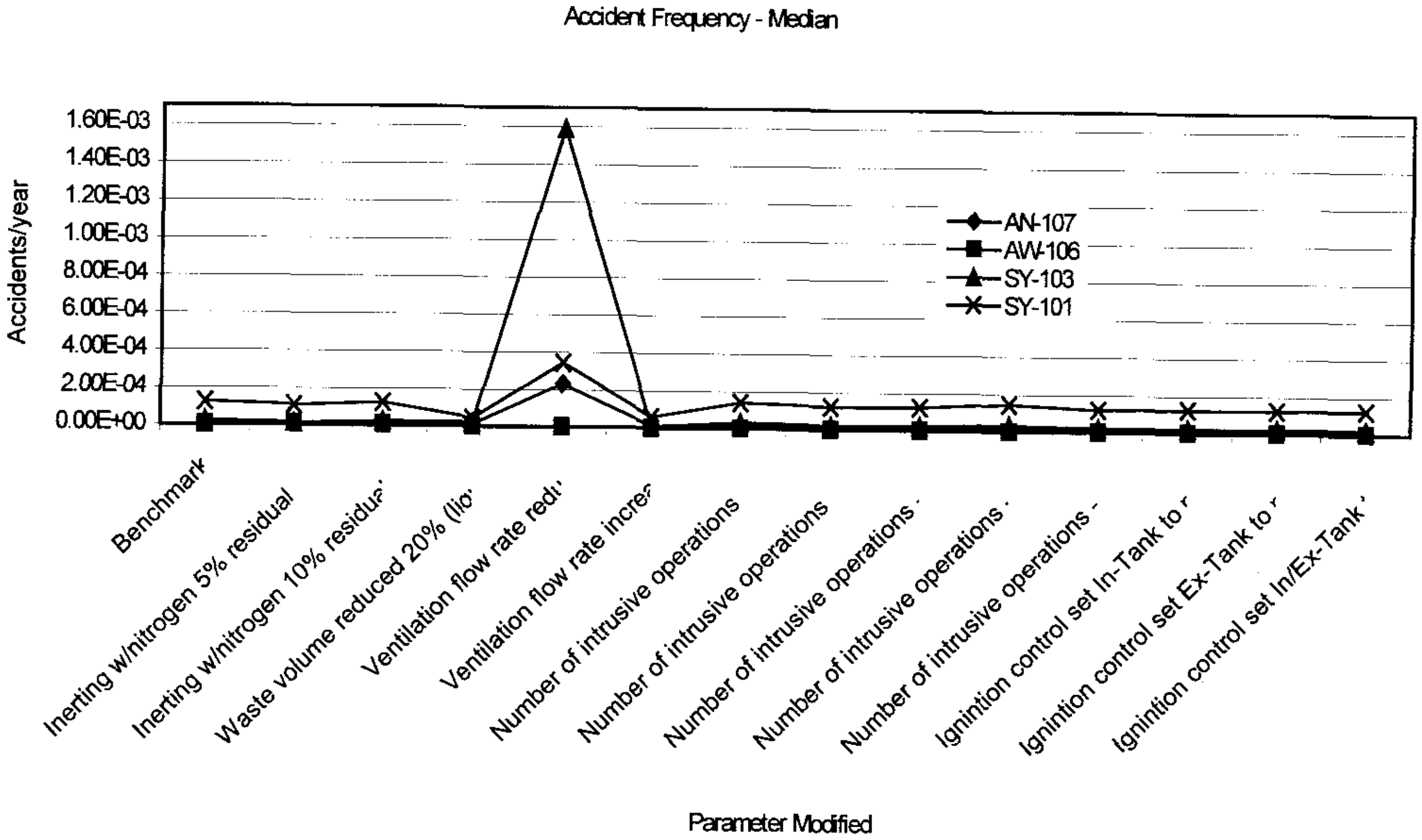

Figure 3. DST: Change in Accident Frequency due to Parameter Modification.

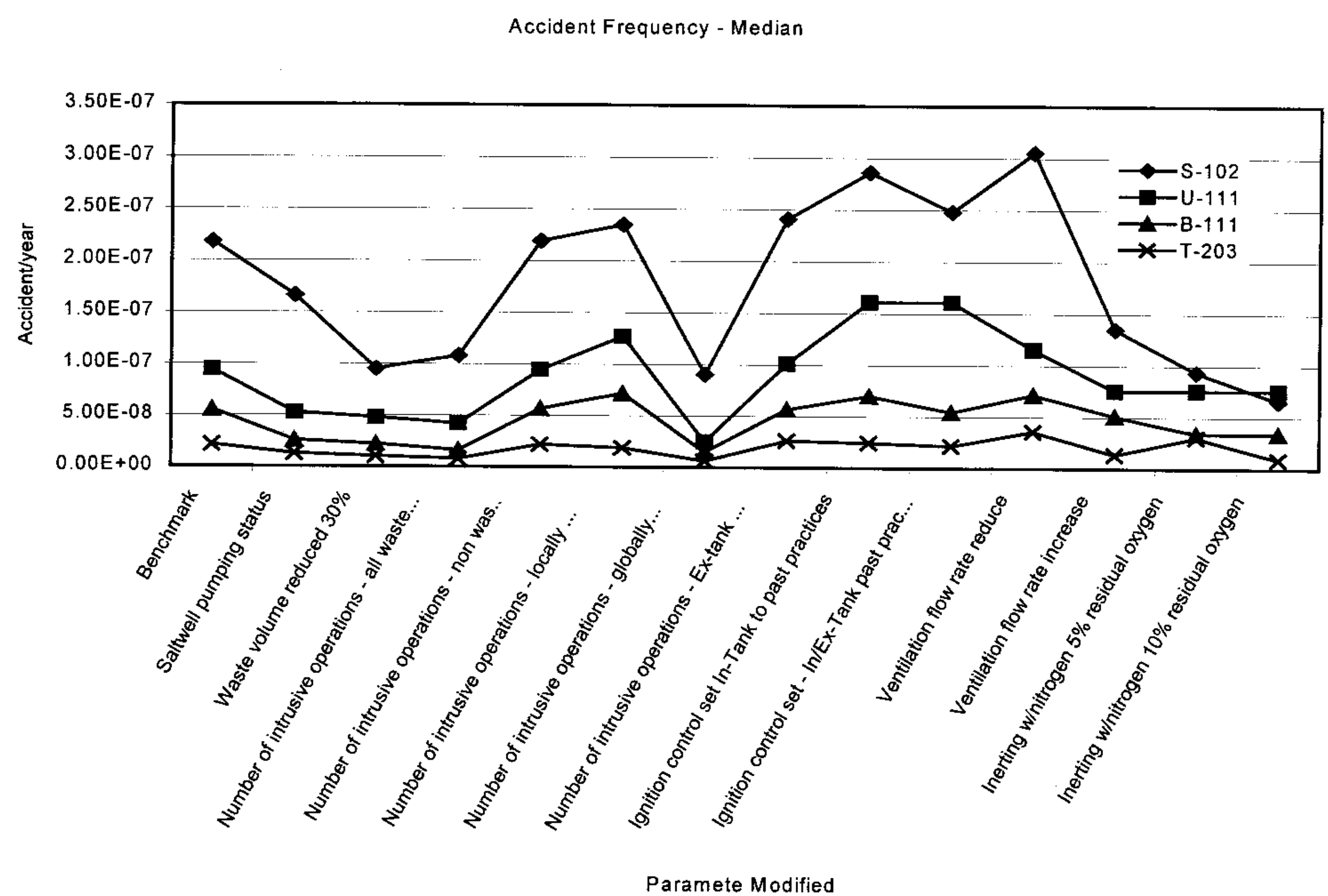

Figure 4. SST: Change in Accident Frequency due to Parameter Modification.

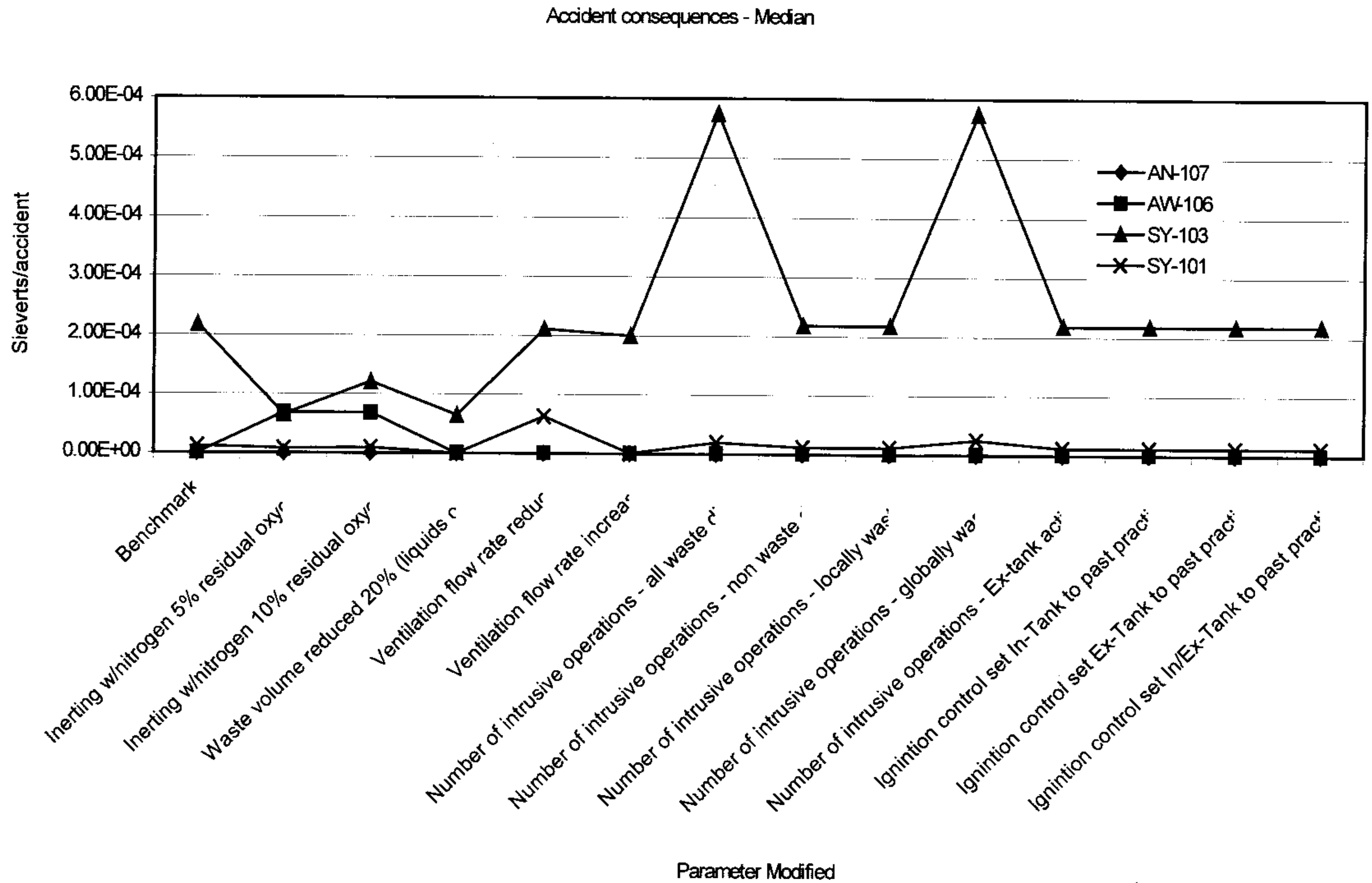

Figure 5. DST: Change in Accident Consequences due to Parameter Modification.

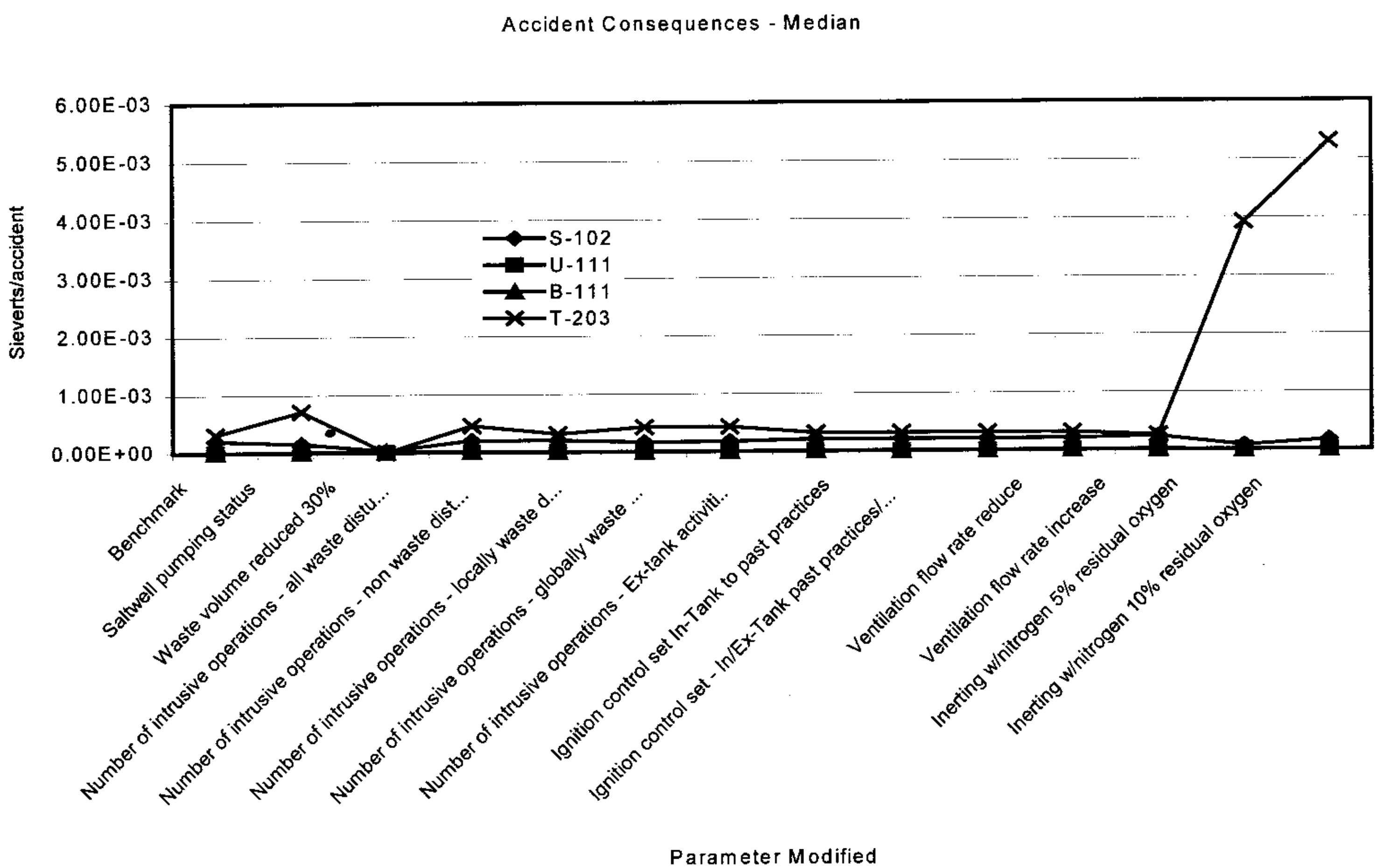

Figure 6. SST: Change in Accident Consequences due to Parameter Modification.

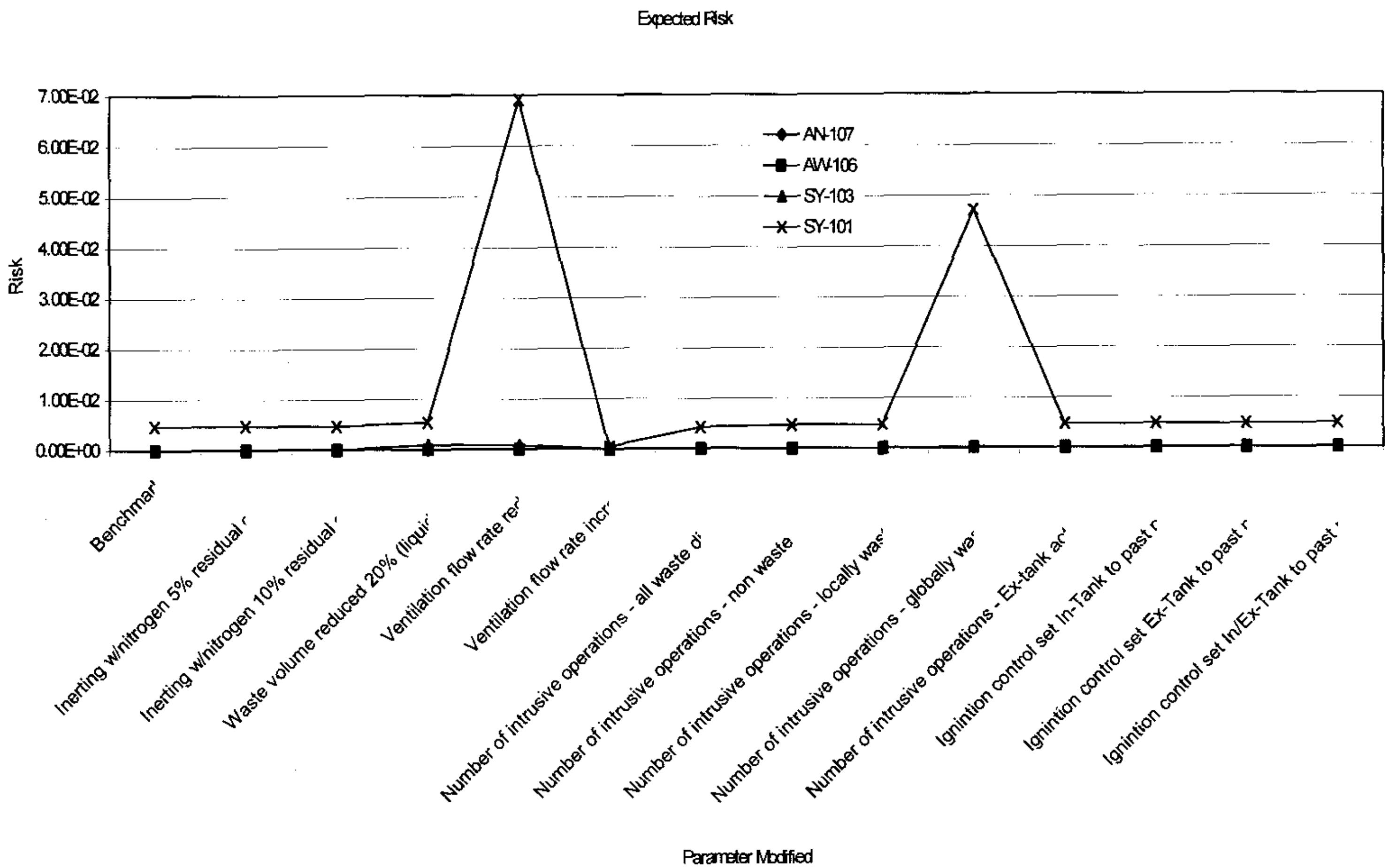

Figure 7. DST: Change in Expected Risk due to Parameter Modification.

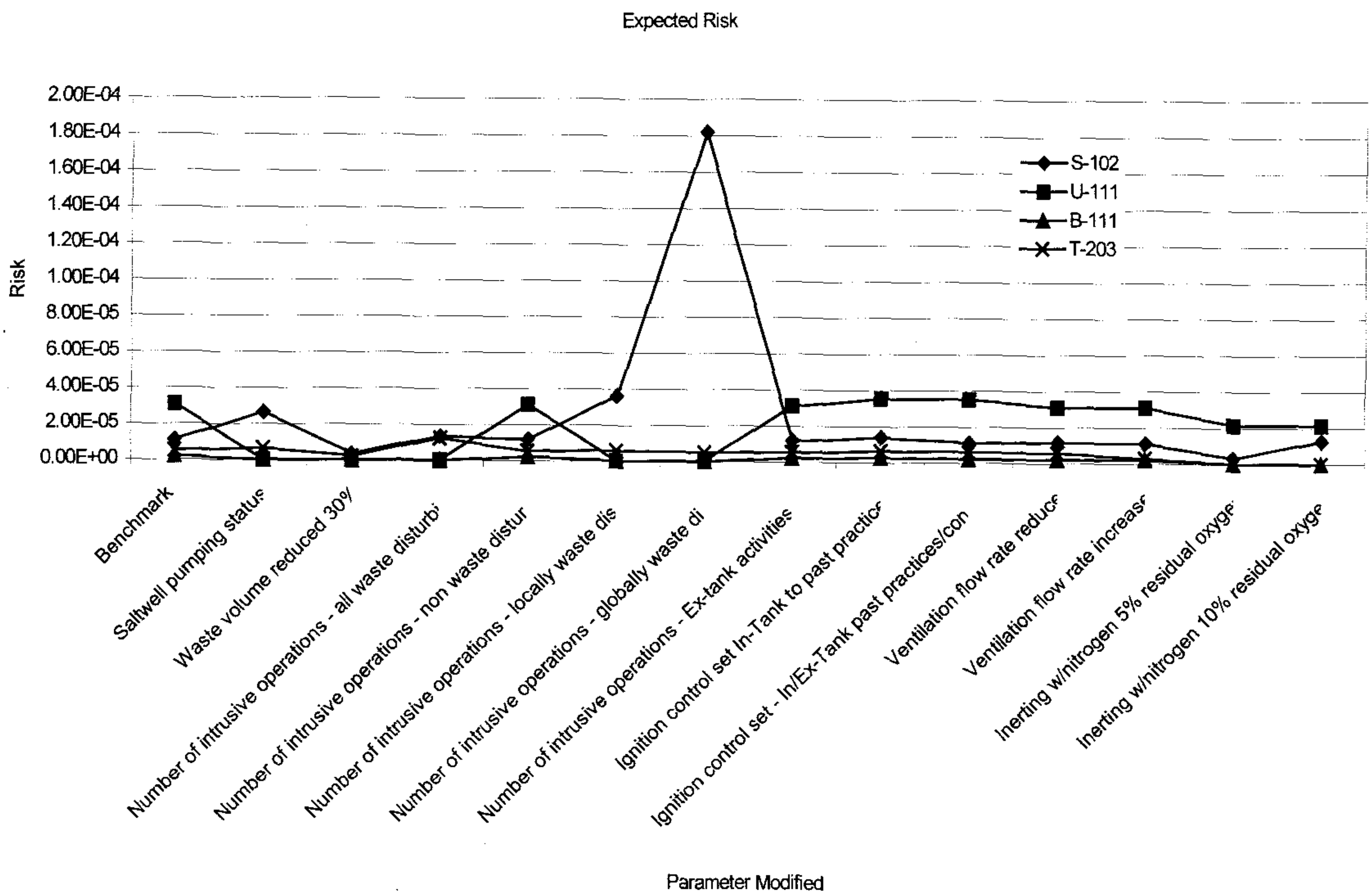

Figure 8. SST: Change in Expected Risk due to Parameter Modification.

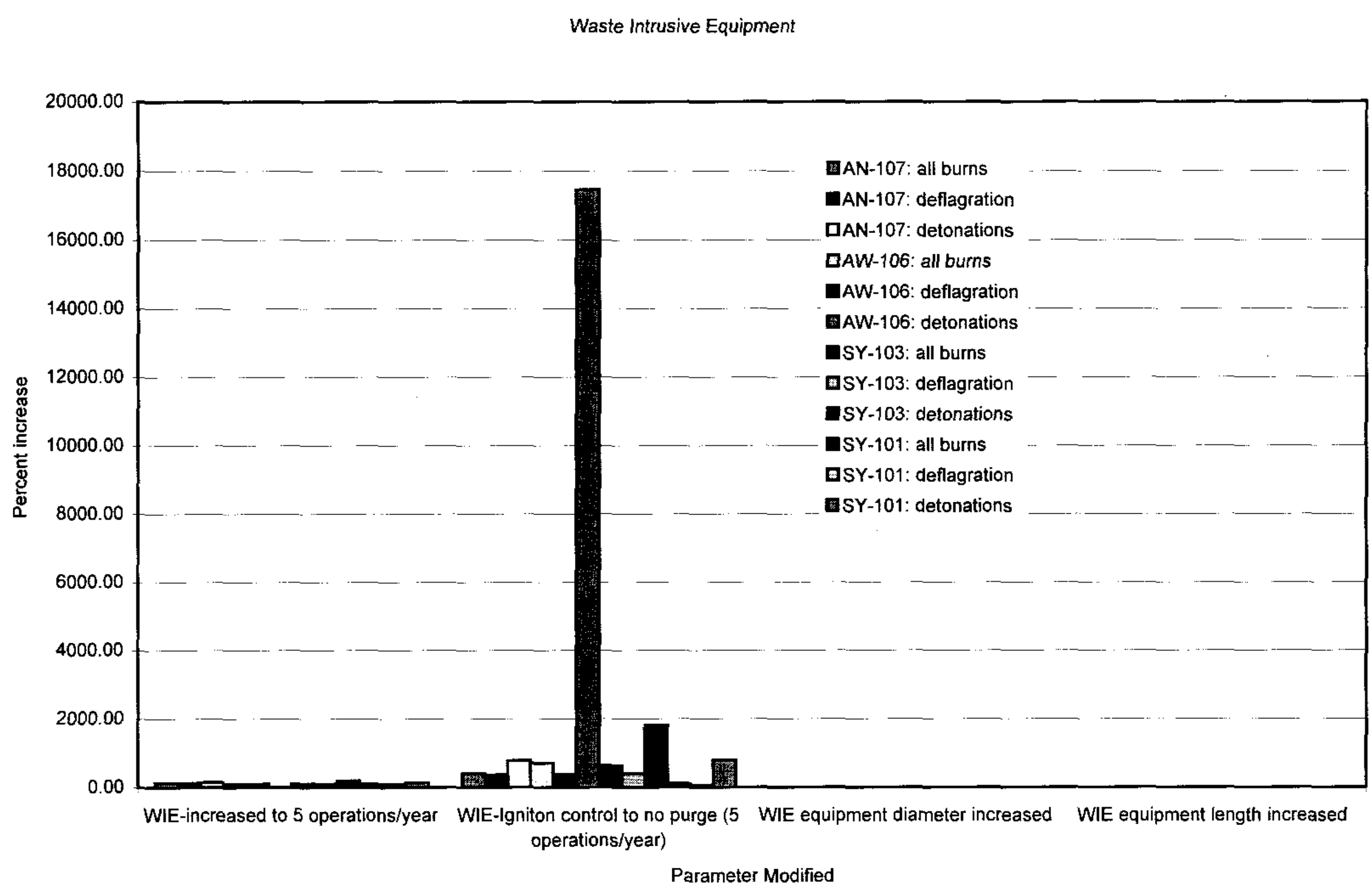

Figure 9. DST: Percent Increase in GRE Behavior due to Operations and Engineering Changes in Waste Intrusive Equipment Parameters.

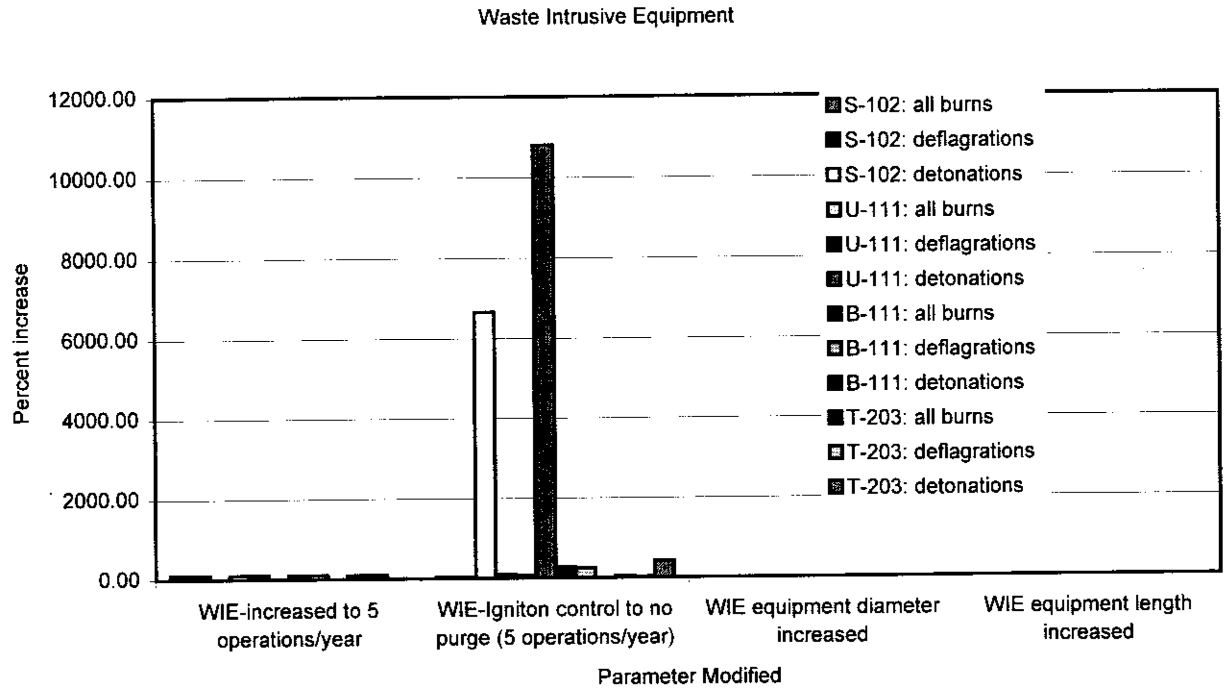

Figure 10. SST: Percent Increase in GRE Behavior due to Operations and Engineering Changes in Waste Intrusive Equipment Parameters.

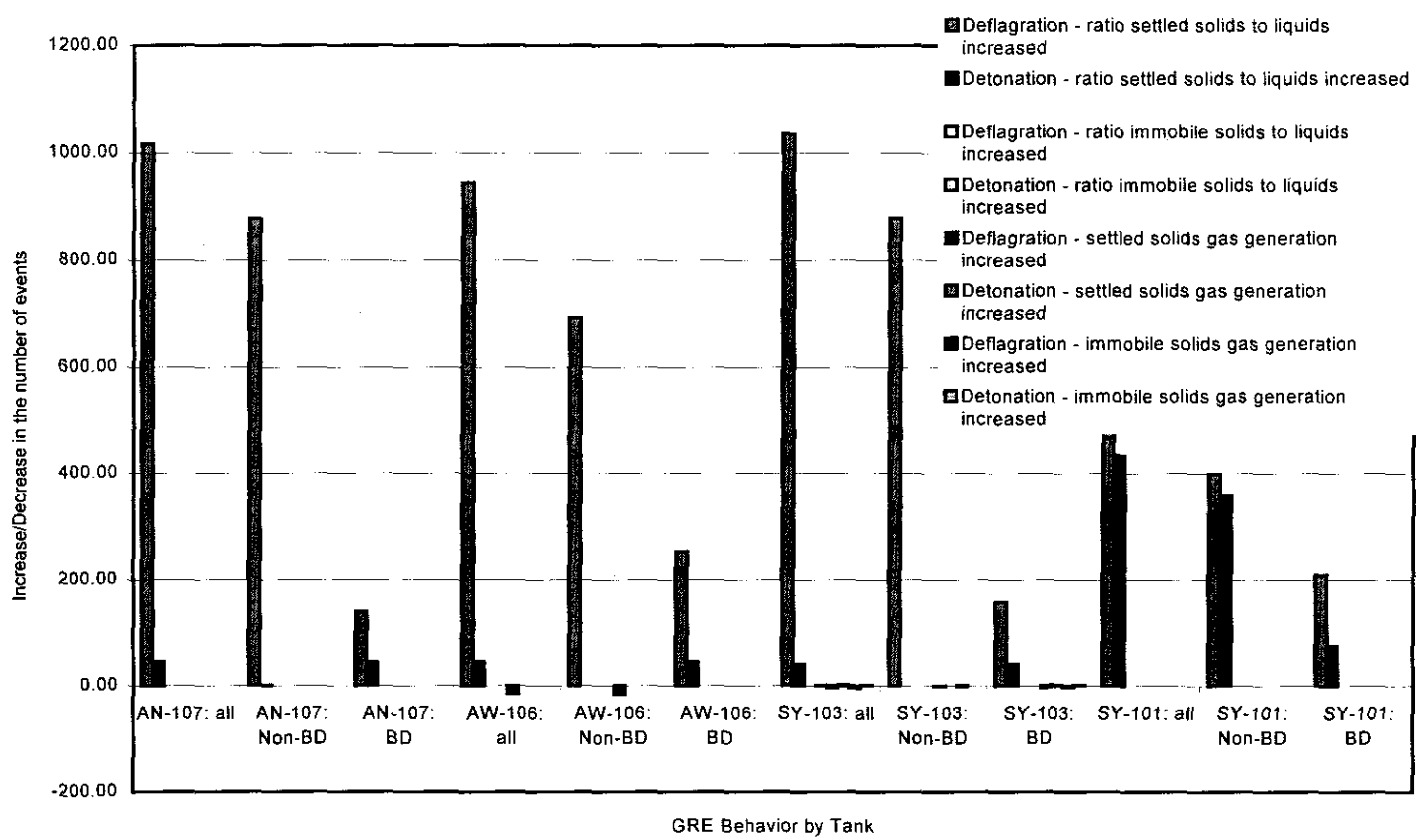

Figure 11. DST: Changes in GRE Behavior due to Changes in Waste Characteristics

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