

AUG 06 1996  
Sta. 37

ENGINEERING DATA TRANSMITTAL

1. EDT No 614686

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Process Engineering Analysis	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: W-030	6. Cog. Engr.: D. M. Ogden	7. Purchase Order No.: N/A
8. Originator Remarks: Approval/Release		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: N/A
11. Receiver Remarks:		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date:

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designator	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	WHC-SD-WM-ER-592		0	Assessment of the Project W-030 Ventilation System Following a Hypothetical Gas Release Event	N/A	1	1	

16. APPROVAL DESIGNATOR (F)		REASON FOR TRANSMITTAL (G)			DISPOSITION (H) & (I)		
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)		1. Approval	4. Review	1. Approved	4. Reviewed no/comment		
		2. Release	5. Post-Review	2. Approved w/comment	5. Reviewed w/comment		
		3. Information	6. Dist. (Receipt Acknow. Required)	3. Disapproved w/comment	6. Receipt acknowledged		

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# Assessment of the Project W-030 Ventilation System Following a Hypothetical Gas Release Event

D. M. Ogden

Westinghouse Hanford Company, Richland, WA 99352  
U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: 614686 UC: 2020  
Org Code: 74A50 Charge Code: NB602  
B&R Code: EW3135040 Total Pages: 59

Key Words: Hydrogen Concentration, Gas Release Event, Tank Ventilation System, GOTH, Hydraulic Analysis

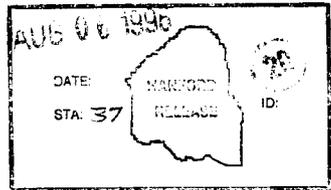
Abstract: The purpose of this evaluation was to determine the potential for hydrogen concentrations exceeding the allowable limits at spark sources within the W-030 ventilation system following a hypothetical gas release event (GRE) in tank 241-AY-101.

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# **Assessment of the Project W-030 Ventilation System Following a Hypothetical Gas Release Event**

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July 1996

Issued by  
WESTINGHOUSE HANFORD COMPANY  
for the

U.S. DEPARTMENT OF ENERGY  
RICHLAND OPERATIONS OFFICE  
RICHLAND, WASHINGTON

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**ASSESSMENT OF THE PROJECT W-030 VENTILATION SYSTEM  
FOLLOWING A HYPOTHETICAL GAS RELEASE EVENT****1.0 INTRODUCTION**

A flammable gas screening of the 177 waste tanks was recently completed (Hodgson 1996). The screening was performed using a barometric pressure method to estimate the trapped gas volume in the waste. The estimated gas volumes were based on very conservative assumptions and were intended to provide a conservative upper bound for the volume of trapped gas at tank bottom pressure. Tank 241-AY-101 was estimated to contain 3313 ft<sup>3</sup> of trapped gas. Efforts are under way to provide improved tank waste level data to remove unnecessary conservatism and improve the gas volume estimate. However, a potential for a spontaneous Gas Release Event (GRE) may exist for tank 241-AY-101. As a result of the flammable gas screening, the safety of the operation of the Project W-030 ventilation system in a potential flammable gas environment now exists. An evaluation has been performed to assess the performance of the ventilation system during a hypothetical GRE. The purpose of this evaluation was to determine the potential for hydrogen concentrations exceeding the allowable limits at spark sources within the W-030 ventilation system following a hypothetical GRE in tank 241-AY-101.

The potential for spark sources exists within the individual tank recirculation systems and primary ventilation system for the tank farm containing tank 241-AY-101. The recirculation ventilation system for tank 241-AY-101 will be de-energized to eliminate any spark sources in this potentially flammable gas tank. However, potential spark sources will still exist in the other AY and AZ tanks and the primary ventilation system. Analyses were performed with the GOTH<sup>1</sup> thermal hydraulic computer code to evaluate the potential for hydrogen concentrations exceeding 25% of the Lower Flammability Limit (LFL) given a hypothetical GRE in tank 241-AY-101. The hydrogen concentration in the region of the remaining potential spark sources was the primary concern. The analyses considered three GREs, which are described in Section 4.1. Both the ventilation system pressure and flow response to the GREs, and the flammable gas transport and mixing were evaluated. The analyses demonstrated that a GRE in tank 241-AY-101 would not result in back flow into the other AY and AZ tanks and the hydrogen concentration at the primary ventilation system exhaust fan would not exceed 25% of the LFL.

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<sup>1</sup>GOTH is a trademark of JMI, which is derived from GOTHIC - a registered trademark of the EPRI Corp.

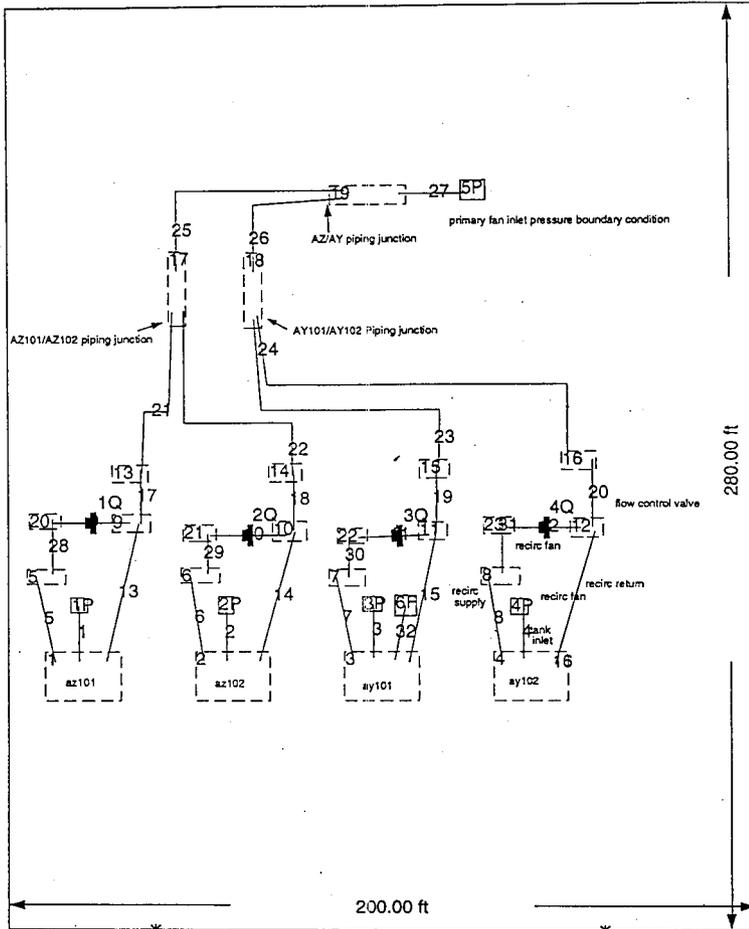
## 2.0 METHODOLOGY

The methodology and modeling approach consisted of the following. First, data for tank 241-AY-101, and the tank farm Project W-030 ventilation system consisting of primary and recirculation ventilation systems geometric data was collected. This included system drawings, prior design calculations, and vendor data. Second, this data was used to prepare the input for the GOTH thermal hydraulic computer program (Thurgood 1992) using the HUB electronic engineering software, and the GOTH preprocessor. Finally, analyses of hypothetical GREs in tank 241-AY-101 were simulated with the GOTH model. The results were graphed with the GOTH post processor and evaluated.

Figure 2-1 shows a schematic of the GOTH model used for the evaluation. The dome space of each tank is modeled as a single lumped parameter volume. The model and subsequent analyses did not evaluate the multi-dimensional effects of gas mixing in the dome space of tank 241-AY-101. The ventilation system is modeled with a series of one-dimensional connected volumes in a network model. All known flow resistances, significant valves, and components are modeled. The recirculation fans are modeled with appropriate fan curves. The inlet pressure at the primary exhaust fan is set at its design inlet pressure for normal operation.

Figure 2-1. GOTH Computer Model.

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GOTH Version 3.4 - April 1991



### 3.0 ASSUMPTIONS, INPUT AND BASES FOR THE ANALYSIS

#### 3.1 SYSTEM DESCRIPTION

The 241-AZ/AY tank farm and associated Project W-030 ventilation system are illustrated below in Figure 3-1 in consistent geometric scale (WHC 1994). The system is shown schematically in Figures 3-2a and 3-2b. An additional system description is contained in the noted reference (Friedrich 1994).

The normal system configuration is shown in Figure 3-2a. The tanks dome space pressure is maintained between 1-3 inches of H<sub>2</sub>O vacuum with a pressure controlled inlet valve. In normal operation, bleed flow from each tank's recirculation loop is limited to 100 cfm using a flow control valve. The flow is monitored with a pitot tube flow meter located within the piping downstream of the junction between the recirculation loop piping and the primary system piping. The recirculation system was designed for a normal flow through the supply line to the recirculation condenser of 500 cfm, and the return flow of 400 cfm. The condenser, moisture separator, and recirculation fan are located upstream of the bleed flow junction. The primary system condenser, mist eliminator, heater, High-Efficiency Particulate Air (HEPA) filter, and exhaust fan are located in the primary vent building.

A second configuration which provides more dilution at the primary exhaust fan is shown in Figure 3-2b. The flow from tank 241-AZ-101 is increased from 100 to 500 cfm by adjusting the primary exhaust fan inlet pressure and the system flow control valves. The flow from the remaining tanks is 100 cfm. This proposed system configuration is used for the Maximum Bounding GRE discussed in Section 4.1.3.

#### 3.2 ICF KAISER ENGINEERS DESIGN AND OPERATING BASIS

In the design of the system for the design flow rates, the pressure drops for the recirculation and primary ventilation system were calculated by ICF Kaiser Engineers to provide a basis for specifying the head/flow requirements of the recirculation and primary fans (Umphrey 1992), (Rice 1992).

The index numbers for the piping system junctions/sections used in the design of the system are shown in Figure 3-3. These are referred to in following tables. The pressure drops in the system based on the original design flow rates are listed Table 3-1.

#### 3.3 WHC MODIFICATIONS OF THE OPERATING CONDITIONS BASED ON VENDOR SUPPLIED RECIRCULATION FAN

The recirculation fan procured will provide more head at the design flow, and therefore more recirculation flow than the design basis (Vendor File 1). In the model, the procured fan head/flow curve is used. To set the bleed flow control valves in the model at the approximate closure required to obtain 100 cfm bleed flow, a steady-state balancing calculation was performed based on the prior ICF Kaiser results and the actual fan curve to obtain flow resistances, etc. as input to the GOTH model. The GOTH model was then run in

the steady-state mode to insure that the model operated at the desired design conditions of 3 inches of H<sub>2</sub>O vacuum in each tank dome space, the primary exhaust fan inlet pressure at the design value, and with 100 cfm at each tank's recirculation bleed flow to the primary system. The new revised operating conditions are summarized in Table 3-2.

The vendor supplied fan curve and a recirculation pressure drop versus flow curve based on the ICF Kaiser pressure drop calculations is provided in Figure 3-4. The recirculation supply flow based on the vendor-supplied fan curve and the hydraulic loss curve for the recirculation loop will result in recirculation supply flows of the order of 600 cfm.

### 3.4 CONTROL SYSTEM OPERATION

Under normal operation, the tank inlet control valve will adjust until the tank vacuum is at a set point of 1 to 3 inches of H<sub>2</sub>O vacuum. The bleed valve, which controls flow from the recirculation loop to the primary exhaust system, will adjust until the flow rate is 100 cfm. The primary exhaust fan speed will adjust until a pressure set point (yet to be defined) located between the HEME mist eliminator and the HEPA filters is reached. The set point will be defined during startup operations such that adequate vacuum is produced upstream of the fan to produce the desired vacuum in the tanks, plus allow closure of the bleed control valves adequate to provide valve flow control sensitivity. At 100 cfm, the valves must be closed to 10-50 degrees of closure to have reasonable and significant flow control sensitivity.

Once the exhaust fan upstream pressure set point is established, the system should run with little control action unless filters begin to plug up. There will be minor control action to compensate for barometric pressure changes.

The recirculation bleed valve closure angle for each tank was computed based on the pressure drop required to limit flow to 100 cfm (Nelson 1996), while still maintaining the overall system pressure balance and fan inlet pressure defined per ICF Kaiser's pressure drop calculations and modified by WHC as discussed above. These valve closure angles provide valve flow sensitivity at each tank and are therefore reasonably close to that which will be selected during the startup operations.

### 3.5 PIPING GEOMETRY

The information required for the GOTH model on the piping geometry is summarized in Table 3-3. Piping lengths are calculated from west/north coordinates at the ends of each piping section (Drawing Set 1). Piping in the recirculation and primary systems consists of 8 and 10-inch schedule 40 stainless steel pipe.

Figure 3-1. Tank Farm 241-AZ/AZ and W-030 Ventilation System Piping.

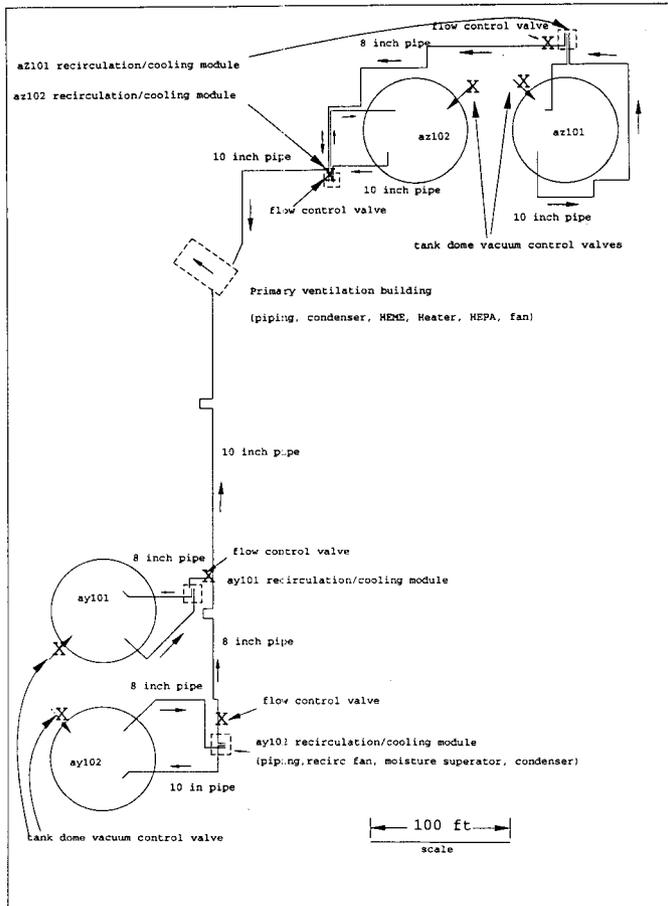


Figure 3-2a. Tanks 241-AZ/AZ W-030 Recirculation and Primary Ventilation System Schematic.

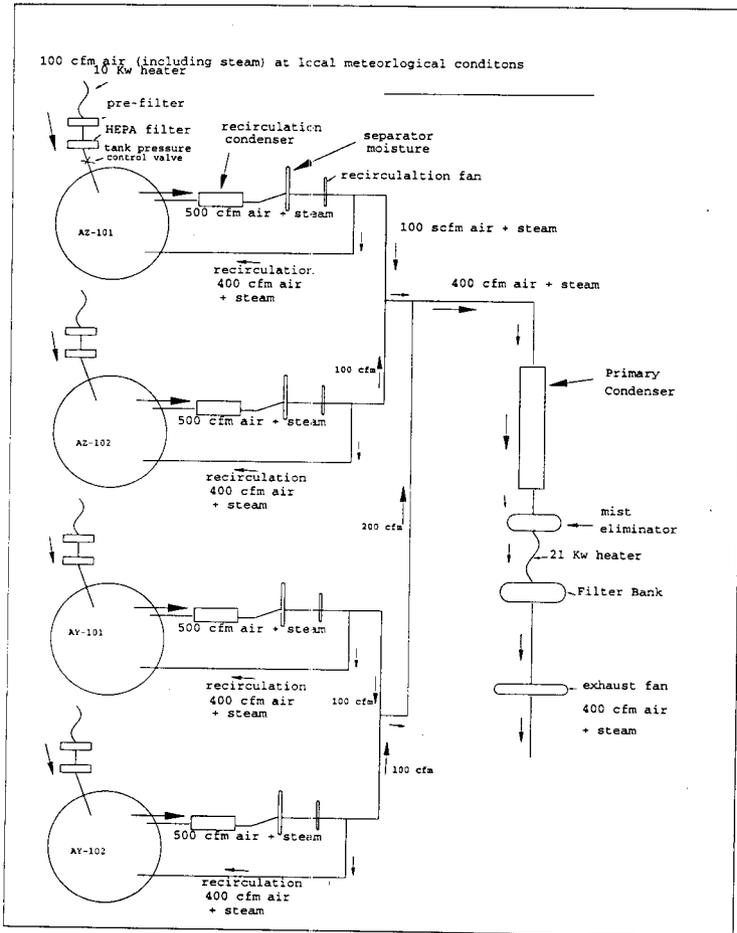


Figure 3-2b. Proposed W-030 Ventilation System Configuration.

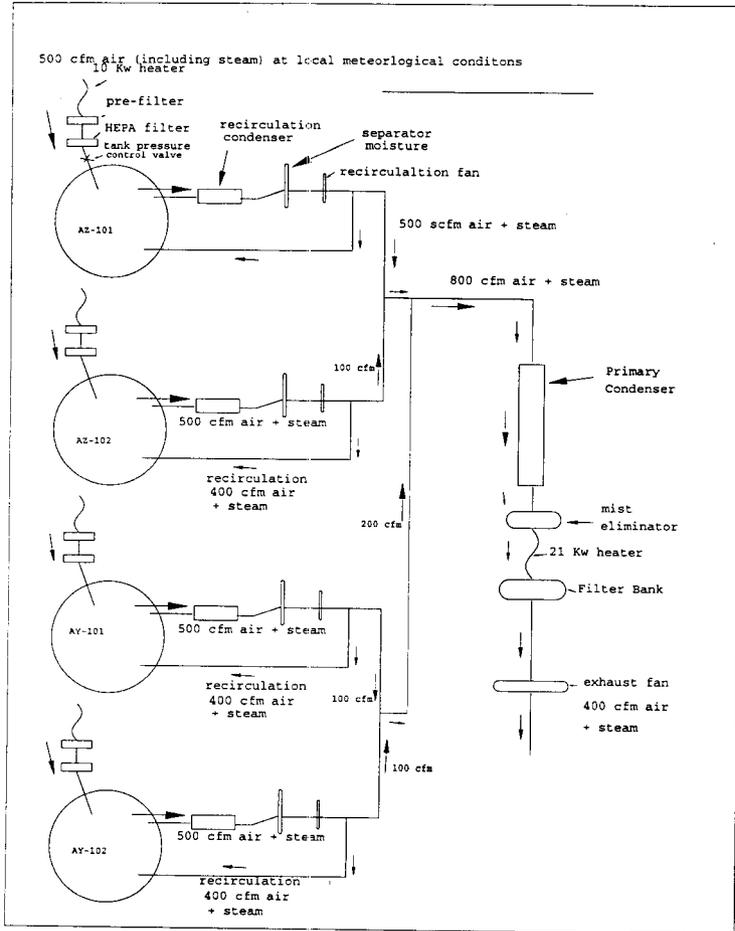


Figure 3-3. Tank Farm 241-AY/AZ and W-030 Ventilation System Piping Showing ICF Kaiser Section/Junction Numbering System.

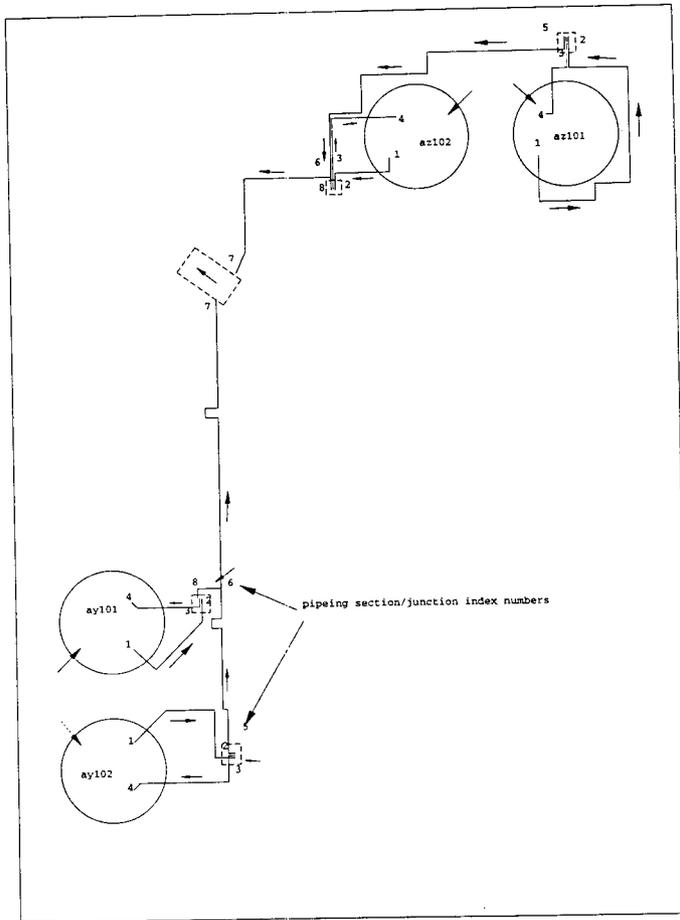


Table 3-1. ICF Kaiser Normal/Design Operating Pressure Drop and Pressures.

Location	Pressure difference in to out (In. W.G.)	Gas pressure (In. W.G.)
Atmosphere	0.0000	0.0000
Atmosphere to tank 241-AZ-101	-3.0000	-3.0000
Tank to recirculation fan inlet, 1-2	-14.9000	-17.9000
Fan inlet to outlet	16.0000	-1.9000
Fan outlet to tank, 3-4	-0.6000	-2.5000
Fan outlet to tank 241-AZ-101/102 junc, 5-6	-0.0653	-1.9653
Flow control valve, 5-6	-2.7680	-4.7333
Atmosphere to tank 241-AZ-102	-3.0000	-3.0000
Tank to recirculation fan inlet, 1-2	-14.9000	-17.9000
Fan inlet to outlet	16.0000	-1.9000
Fan outlet to tank, 3-4	-0.6000	-2.5000
Fan outlet to tank 241-AZ-102/101 junc, 8-6	-0.0387	-1.9387
Flow control valve, 8-6	-2.7680	-4.7068
tank 241-AZ-101/102 to tank 241-AY-101/102 junc, 6-7	-0.0556	-4.7889
Atmosphere to tank 241-AY-101	-3.0000	-3.0000
Tank to recirculation fan inlet, 1-2	-13.1100	-16.1100
Fan inlet to outlet	16.0000	-0.1100
Fan outlet to tank, 3-4	-0.6000	-0.7100
Fan outlet to tank 241-AY-101/102 junc, 8-6	-0.0387	-0.1487
Flow control valve, 8-6	-2.7680	-2.9167
Atmosphere to tank 241-AY-102	-3.0000	-3.0000
Tank to recirculation fan inlet, 1-2	-13.1100	-16.1100
Fan inlet to outlet	16.0000	-0.1100
Fan outlet to tank, 3-4	-0.6000	-0.7100
Fan outlet to tank 241-AY-102/101 junc, 5-6	-0.0387	-0.1487
Flow control valve, 5-6	-2.7680	-2.9167
Tank 241-AY-101/102 to tank AZ-101/102 junc, 6-7	-0.2000	-3.1168
Tank 241-AY/AZ junc to exhaust fan inlet	-7.5400	-14.7400
Fan inlet to outlet	15.0000	0.2600
Array: Press		

Table 3-2. WHC Modified Normal/Design Operating Pressure Drops and Pressure.

Location	Pressure Difference in to out		gage pressure		Absolute Pressure		Pipe Diameter	Volumetric Flow Rate		Equivalent Pipe Area		Pipe Gas Velocity
	inW	inW	inW	psi	inW	psia		in	ft <sup>3</sup> min	ft <sup>2</sup>	ft SEC	
atmosphere	0.000	0.000	0.000	0.000	406.91	14.70	0.00	0.00	0.00	0.00	0.00	0.00
Atm to Tank Az-101	-3.000	-3.000	-0.108	-0.108	403.91	14.59	6.07	100.00	194.26	0.20	8.31	8.31
Tank to Recirc Fan Inlet, 1-2	-19.918	-22.918	-0.828	-0.828	383.99	13.87	10.02	578.10	287.51	0.55	17.59	17.59
Fan Inlet to Outlet	20.774	-2.141	-0.077	-0.077	404.71	14.62	0.00	0.00	0.00	0.00	0.00	0.00
Fan Outlet to Tank, 3-4	-0.851	-3.000	-0.108	-0.108	403.91	14.59	7.98	478.10	7.28	0.35	22.94	22.94
Fan Outlet to AZ101/102 Junc, 5-6	-0.065	-2.208	-0.080	-0.080	404.70	14.62	7.98	100.00	12.66	0.35	4.80	4.80
Flow control valve, 5-6	-4.938	-7.144	-0.258	-0.258	399.76	14.44	7.98	100.00	958.41	0.35	4.80	4.80
Atm to Tank Az-102	-3.000	-3.000	-0.108	-0.108	403.91	14.59	6.07	100.00	194.26	0.20	8.31	8.31
Tank to Recirc Fan Inlet, 1-2	-19.918	-22.918	-0.828	-0.828	383.99	13.87	10.02	578.10	287.51	0.55	17.59	17.59
Fan Inlet to Outlet	20.774	-2.141	-0.077	-0.077	404.71	14.62	0.00	0.00	0.00	0.00	0.00	0.00
Fan Outlet to Tank, 3-4	-0.851	-3.000	-0.108	-0.108	403.91	14.59	7.98	478.10	7.28	0.35	22.94	22.94
Fan Outlet to AZ201/101 Junc, 8-6	-0.039	-2.182	-0.075	-0.075	404.71	14.62	7.98	100.00	7.52	0.35	4.80	4.80
Flow control valve, 8-6	-4.961	-7.144	-0.258	-0.258	399.76	14.44	7.98	100.00	963.58	0.35	4.80	4.80
AZ101/102 to AY101/102 Junc, 6-7	-0.056	-7.200	-0.260	-0.260	399.71	14.44	10.02	200.00	6.70	0.55	6.09	6.09
Atm to Tank AY-101	-3.000	-3.000	-0.108	-0.108	403.91	14.59	6.07	100.00	194.26	0.20	8.31	8.31
Tank Inlet to Recirc Fan Inlet, 1-2	-19.455	-22.455	-0.811	-0.811	384.45	13.99	10.02	609.10	252.97	0.55	18.54	18.54
Fan Inlet to Outlet	20.427	-2.028	-0.071	-0.071	404.68	14.63	0.00	0.00	0.00	0.00	0.00	0.00
Fan Outlet to Tank, 3-4	-0.972	-3.000	-0.108	-0.108	403.91	14.59	7.98	509.10	7.28	0.35	24.42	24.42
Fan Outlet to AY101/102 Junc, 8-6	-0.039	-2.067	-0.075	-0.075	404.64	14.63	7.98	100.00	7.52	0.35	4.80	4.80
Flow control valve, 8-6	-4.931	-7.000	-0.255	-0.255	399.91	14.45	6.07	100.00	957.83	0.35	4.80	4.80
Atm to Tank AY-102	-3.000	-3.000	-0.108	-0.108	403.91	14.59	6.07	100.00	194.26	0.20	8.31	8.31
Tank to Recirc Fan Inlet, 1-2	-19.455	-22.455	-0.811	-0.811	384.45	13.99	10.02	609.10	252.97	0.55	18.54	18.54
Fan Inlet to Outlet	20.427	-2.028	-0.071	-0.071	404.68	14.63	0.00	0.00	0.00	0.00	0.00	0.00
Fan Outlet to Tank, 3-4	-0.972	-3.000	-0.108	-0.108	403.91	14.59	7.98	509.10	7.28	0.35	24.42	24.42
Fan Outlet to AY102/101 Junc, 5-6	-0.039	-2.067	-0.075	-0.075	404.64	14.63	7.98	100.00	7.52	0.35	4.80	4.80
Flow control valve, 5-6	-4.931	-7.000	-0.255	-0.255	399.91	14.45	6.07	100.00	957.83	0.35	4.80	4.80
Fan Outlet to AZ101/102 Junc, 6-7	-0.200	-7.200	-0.260	-0.260	399.71	14.44	10.02	200.00	24.11	0.55	6.09	6.09
AY/AZ Junc to exhaust fan inlet	-7.560	-14.740	-0.532	-0.532	392.17	14.17	10.02	400.00	227.31	0.55	12.17	12.17
Exhaust Fan Inlet to Outlet	15.000	0.260	0.003	0.003	407.11	14.71	0.00	0.00	0.00	0.00	0.00	0.00

ARRAY: \*\*\*\*

ARRAY: \*\*\*\*

Figure 3-4. Recirculation Fan Characteristics.

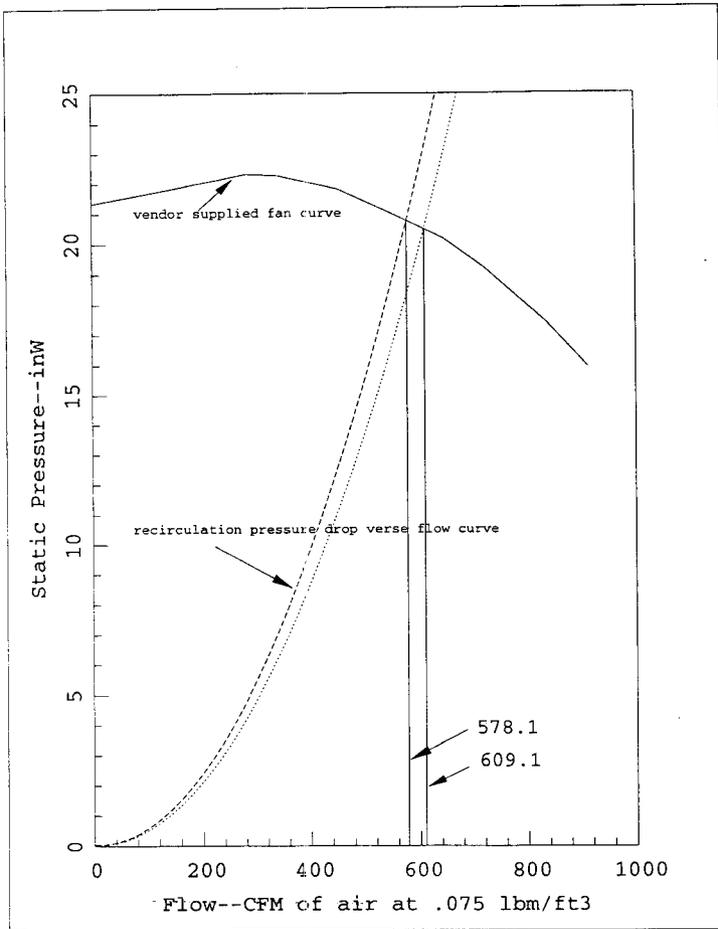


Table 3-3. W-30 Tank Inlet, Recirculation, and Primary Ventilation System Piping--Based on Coordinate Calculated Lengths.

Location	west1	north1	west2	north2	Dia.	Length	Flow	Volume	Sweep Time
	ft	ft	ft	ft					
UAZ-101 tank to fan, 1-2, 1	0.00	0.00	0.00	0.00	10.020	7.23	500	13.84	0.5
2	47525.97	42061.95	47525.97	42032.00	10.020	12.95	500	18.04	2.2
0	47525.97	42032.00	47486.00	42032.00	10.020	39.97	500	21.89	2.6
3	47486.00	42032.00	47486.00	42044.00	10.020	12.00	500	6.57	0.8
0	47486.00	42044.00	47461.00	42044.00	10.020	25.00	500	13.49	1.6
0	47461.00	42044.00	47461.00	42327.00	10.020	83.00	500	45.45	5.5
0	47461.00	42327.00	47502.58	42327.00	10.020	41.58	500	22.77	2.7
0	47502.58	42327.00	47502.58	42349.00	10.020	22.00	500	12.05	1.4
0	0.00	0.00	0.00	0.00	10.020	263.73	500	144.42	17.3
3 AZ-101 fan to tank, 3-4, 1	47520.14	42091.14	47515.00	42094.14	7.981	5.14	400	1.79	0.3
0	47515.00	42091.14	47515.00	42127.00	7.981	32.86	400	11.42	1.7
0	47515.00	42127.00	47504.08	42127.00	7.981	10.92	400	3.79	0.6
0	47504.08	42127.00	47504.08	42169.00	7.981	22.00	400	7.44	1.1
0	0.00	0.00	0.00	0.00	7.981	6.71	400	2.33	0.3
0	0.00	0.00	0.00	0.00	7.981	77.63	400	26.97	4.3
0	0.00	0.00	0.00	0.00	7.981	9.00	100	3.13	1.9
0	47505.58	42144.00	47504.08	42140.00	7.981	98.42	100	34.19	20.5
0	47504.08	42144.00	47504.08	42325.00	7.981	15.00	100	5.22	3.1
0	47504.08	42325.00	47502.58	42325.00	7.981	48.00	100	16.68	10.0
0	47502.58	42325.00	47502.58	42097.50	7.981	27.50	100	9.55	5.7
0	47502.58	42097.50	47505.08	42097.50	7.981	23.08	100	8.02	4.8
0	47505.08	42097.50	47505.08	42052.00	7.981	45.50	100	15.41	9.5
0	0.00	0.00	0.00	0.00	7.981	266.50	100	92.58	55.6
5 AZ-102 tank to fan, 1-2, 1	0.00	0.00	0.00	0.00	10.020	7.23	500	3.96	0.5
6	47632.97	42064.95	47632.97	42055.00	10.020	3.95	500	5.45	0.7
0	47632.97	42055.00	47632.97	42055.00	10.020	39.31	500	21.42	2.6
0	47632.08	42055.00	47632.08	42042.92	10.020	12.08	500	6.61	0.8
0	0.00	0.00	0.00	0.00	10.020	68.37	500	37.44	4.5
7 AZ-102 fan to tank, 3-4, 1	47627.14	42091.14	47673.58	42094.14	7.981	46.44	400	16.13	2.4
0	47673.58	42091.14	47673.58	42042.92	7.981	51.22	400	17.79	2.7
0	0.00	0.00	0.00	0.00	7.981	6.71	400	2.33	0.3
0	0.00	0.00	0.00	0.00	7.981	104.36	400	36.24	5.4
8 AZ-102 to 101 junc, 8-6, 1	47675.08	42041.92	47675.08	42052.00	7.981	9.08	100	3.15	1.9
0	47675.08	42052.00	47737.00	42052.00	10.020	61.92	200	33.90	10.2
0	47737.00	42052.00	47737.00	41999.40	10.020	52.38	200	28.48	8.6
9 AZ101/102 to Prim.6-7, 1	47737.00	41999.40	47743.93	41984.20	10.020	16.81	200	9.26	2.8
0	0.00	0.00	0.00	0.00	10.020	131.20	200	71.85	21.6
10 AY-101 tank to fan, 1-2, 1	0.00	0.00	0.00	0.00	10.020	6.00	500	3.29	0.4
11	47820.95	41731.53	47809.10	41698.66	10.020	21.72	500	11.89	1.4
0	47809.10	41698.66	47772.08	41732.86	10.020	47.52	500	26.02	3.1
0	47772.08	41732.86	47772.08	41749.82	10.020	16.96	500	9.29	1.1
0	0.00	0.00	0.00	0.00	10.020	92.20	500	49.49	6.1
12 AY-101 fan to tank, 3-4, 1	47821.86	41747.64	47817.72	41743.50	7.981	5.85	400	2.03	0.3
0	47817.72	41743.50	47773.58	41743.50	7.981	44.14	400	15.33	2.3
0	47773.58	41743.50	47773.58	41749.90	7.981	6.42	400	2.21	0.3
0	0.00	0.00	0.00	0.00	7.981	5.78	400	2.01	0.3
0	0.00	0.00	0.00	0.00	7.981	62.20	400	21.61	3.2
13 AZ-101 to 102 junc, 8-6, 1	47775.08	41741.92	47775.08	41757.00	7.981	7.08	100	2.46	1.5
0	47775.08	41757.00	47758.50	41757.00	7.981	16.98	100	5.76	3.5
0	0.00	0.00	0.00	0.00	7.981	23.66	100	8.22	4.9
14 AY-102 tank to fan, 1-2, 1	0.00	0.00	0.00	0.00	10.020	6.00	500	3.29	0.4
15	47821.46	41661.47	47799.60	41669.33	10.020	32.33	500	17.70	2.1
0	47799.60	41669.33	47764.50	41669.33	10.020	34.10	500	18.67	2.2
0	47764.50	41669.33	47764.50	41634.58	10.020	14.75	500	19.03	2.3
0	47764.50	41634.58	47750.08	41634.58	10.020	14.42	500	7.90	0.9
0	0.00	0.00	0.00	0.00	10.020	121.69	500	66.59	8.0
16 AY-102 fan to tank, 3-4, 1	47823.36	41681.36	47813.72	41631.00	7.981	6.56	400	2.28	0.3
0	47813.72	41631.00	47755.00	41631.00	7.981	68.72	400	21.79	3.1
0	47755.00	41631.00	47755.00	41636.08	7.981	19.08	400	6.63	1.0
0	47755.00	41636.08	47750.08	41636.10	7.981	4.92	400	1.71	0.3
0	0.00	0.00	0.00	0.00	7.981	5.78	400	2.01	0.3
0	0.00	0.00	0.00	0.00	7.981	98.42	400	34.42	5.2
17 AY-101 to 102 junc, 5-6, 1	47750.08	41637.58	47755.00	41637.58	7.981	4.92	100	1.71	1.0
0	47755.00	41637.58	47755.00	41669.33	7.981	31.75	100	11.03	6.6
0	47755.00	41669.33	47758.50	41669.90	7.981	3.55	100	1.23	0.7
0	47758.50	41669.90	47758.50	41728.00	7.981	58.10	100	20.18	12.1
0	47758.50	41728.00	47765.50	41728.00	7.981	7.00	100	2.43	1.5
0	47765.50	41728.00	47765.50	41735.00	7.981	7.00	100	2.43	1.5
0	47765.50	41735.00	47758.50	41735.00	7.981	7.00	100	2.43	1.5
0	47758.50	41735.00	47758.50	41757.00	7.981	22.00	100	7.44	4.6
0	0.00	0.00	0.00	0.00	7.981	141.32	100	49.09	29.5
18 AZ101/102 to Prim.6-7, 1	47758.50	41757.00	47758.50	41880.50	10.020	123.50	200	67.63	20.3
0	47758.50	41880.50	47747.50	41880.50	10.020	9.00	200	4.93	1.5
0	47767.50	41880.50	47767.50	41880.50	10.020	7.00	200	1.83	1.1
0	47767.50	41880.50	47758.50	41887.50	10.020	9.00	200	9.3	1.5
0	47758.50	41887.50	47758.50	41966.38	10.020	78.88	200	43.19	13.0
0	47758.50	41966.38	47754.83	41967.42	10.020	3.81	200	2.09	0.6
0	0.00	0.00	0.00	0.00	10.020	231.19	200	126.60	38.0
19 AY/AZ primary to condenser	0.00	0.00	0.00	0.00	10.020	50.00	400	26.18	3.6
20 Each Tank Gas Volume	0.00	0.00	0.00	0.00	900.000	12.86	100	5883.74	14088.2

### 3.6 DE-ENERGIZING TANK 241-AY-101 RECIRCULATION SYSTEM

To eliminate spark sources in the tank 241-AY-101 recirculation system it has been proposed to de-energize that system. The details of whether the supply line would be valved out have not been developed. Whether the supply line is valved out or not, based on the above pressure drop table, in the de-energized mode, most of the 100 cfm flow from the tank to the flow control valve will be in the return line, and the resulting pressure drop from the tank to the line will be very small. To compensate for the decrease in pressure upstream of the flow control valve, the valve can be set to a larger open angle to maintain the 100 cfm through the valve and thereby maintain the same pressures and flows throughout the balance of the primary system.

Because it is not known at this time how the system will be de-energized for the simulations conducted, the recirculation system at tank 241-AY-101 was assumed to be energized. The results of the simulation would not change significantly if the simulation were conducted with the recirculation system de-energized, including the effects of resetting the control valve open angle.

## 4.0 ANALYSIS ASSUMPTIONS

### 4.1 GAS RELEASE EVENT

Three GREs were considered for the flammable gas evaluation of the Project W-030 ventilation system upgrade as described in the following section. In all cases, the limiting hydrogen concentration used for the evaluation was the Lower Flammability Limit (LFL) of 4% hydrogen.

#### 4.1.1 Maximum Pressurization GRE

The spark sources for the Project W-030 ventilation system are the recirculation fans and equipment associated with each individual tank and the primary ventilation system exhaust fan. Although the equipment within AY-101 will be deactivated, back flow resulting from a large GRE may result in unacceptable hydrogen concentrations in tank 241-AV-102 or possibly the AZ tanks. To evaluate the potential for this back flow, an ultra-conservative, upper bound GRE was used (Maximum Pressurization GRE). The September 1992 GRE was one of the largest estimated GRE's for tank 241-SY-101. An estimate of the release was of the order of 15000 ft<sup>3</sup> (Wood 1993) with a release time of over 3 hours. While the total release volume was large, many releases in tank 241-SY-101 have occurred over shorter periods of time. Figure 4-1a shows a hypothetical release history used for the Safety Assessment for tank 241-SY-101 mixer pump (Sullivan 1995). It consists of a rapid early release (10%), followed by a steady release (60%), followed by a decaying release (30%). This is considered a bounding release history for tank 241-SY-101. The September 1992 release volume was combined with the release history of Figure 4-1a to provide a Maximum Pressurization GRE. This magnitude of the GRE is not possible for tank AY-101 but used only as a very conservative upper bound to evaluate the potential for flow reversal resulting for a GRE. The release history and quantity associated with the larger value of 15000 ft<sup>3</sup> is shown in Figure 4-1b.

#### 4.1.2 Conservative GRE

A conservative, but more realistic GRE was used to evaluate the potential for exceeding the hydrogen concentration limits at the primary exhaust fan. This conservative GRE (shown in Figure 4-1b) is based upon recent estimates of the maximum possible gas storage in 241-AV-101 (Hodgson 1996) of 3313 ft<sup>3</sup>. The storage volume estimate was based upon a very conservative barometric pressure evaluation of all double-shell and single-shell tanks. The conservative GRE further assumes that the total inventory of gas is at tank bottom pressure. A release fraction of 50%, which bounds all know releases in tank 241-SY-101 was used. The total release into the dome space after expansion to atmospheric pressure from a tank bottom pressure of 30.6 psia is 3476 ft<sup>3</sup>. The concentration of hydrogen within the released gas is assumed to be 50% by volume. This is an upper limit on the maximum possible H<sub>2</sub> concentration. This upper limit is supported by recent Retained Gas Samples (RGS) from double shell tanks and physical arguments based upon the chemistry of the gas generation, which show that sludge gases are over 50% nitrogen and

nitrogen compounds (Van Vleet 1996), leaving less than 50% as the maximum possible for hydrogen. The time history for the conservative release was based upon the 241-SY-101 mixer pump GRE discussed in the previous section. This conservative GRE, shown in Figure 4-1b, is a conservative and credible bounding GRE for the flammable gas evaluation of the Project W-030 ventilation system.

#### 4.1.3 Maximum Bounding GRE

A third GRE was also used for the flammable gas evaluation. It adds another level of conservatism. This Maximum Bounding GRE derived from the Conservative GRE of the previous section. The assumed release fraction was increased from 50% to 100% of the trapped gas and the hydrogen concentration of the trapped gas was assumed to be 100%. The release history of Figure 4.1a was used. The total gas released to the dome space for the Maximum Bounding GRE is 6952 ft<sup>3</sup> as shown in Figure 4-1b. This is a very conservative GRE which bounds all credible releases in 241-AY-101. The flow was increased in tank 241-AZ-101 to 500 cfm for this release scenario to provide more dilution at the exhaust fan.

#### 4.2 CONTROL SYSTEM OPERATION DURING GRE

During a GRE in tank 241-AY-101, the transient response would depend on the response characteristics of the control system and the controlled valves and fan. If the system response of the control valve is fast, then the following would be expected. The inlet valve will move toward closure as the pressure increases--finally closing if the pressure does not decrease as the valve begins to close. If the tank inlet valve moved to closure, no inflow into the tank would occur, nor would any outflow occur through the normal inlet paths--excluding uncontrolled leakage paths. The recirculation system outlet valve for tank 241-AY-101 will also move toward closure, reducing flow to 100 cfm. If the valve control system were fast enough, then the flow from the recirculation system to the primary system of tank 241-AY-101 would not increase. In this case, the exhaust fan speed would not increase since pressures in the primary system would not increase.

If the valve control response was very slow compared to the time period of the GRE, then the inlet and recirculation system outlet valve would not close and the valves flow resistance would be essentially constant. In this case, flow into the tank through the normal inlet would decrease, and if pressure rises above atmospheric pressure during the GRE, the flow would reverse out the normal inlet path. Flow out of the recirculation bleed valve would increase, as would pressures in the primary system. This case would produce higher flows into the primary system, and higher pressures, potentially leading to back flow into other tanks' recirculation systems--when compared to the fast response control system scenario. Therefore, it is assumed for the simulations discussed in Section 5.0 that the control valve response is slow.

Figure 4-1a. Normalized Hypothetical Release History.

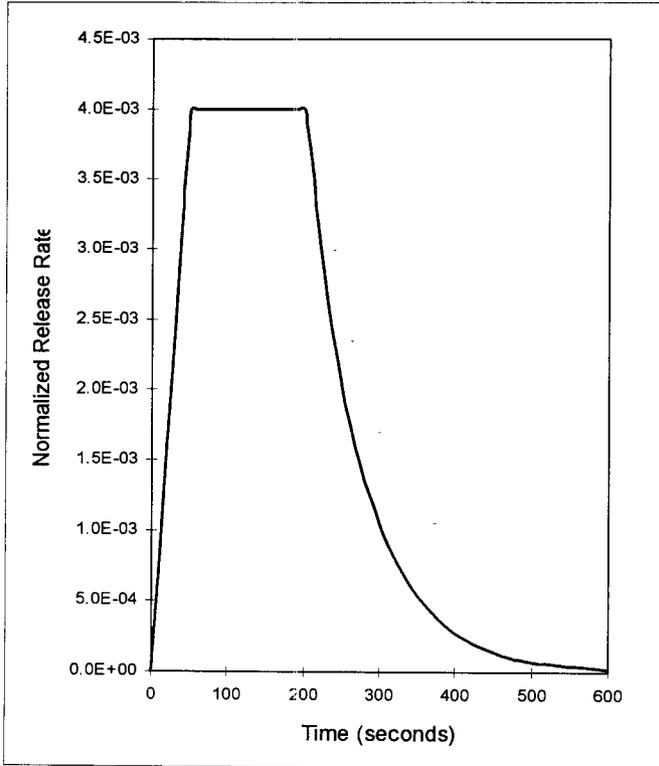
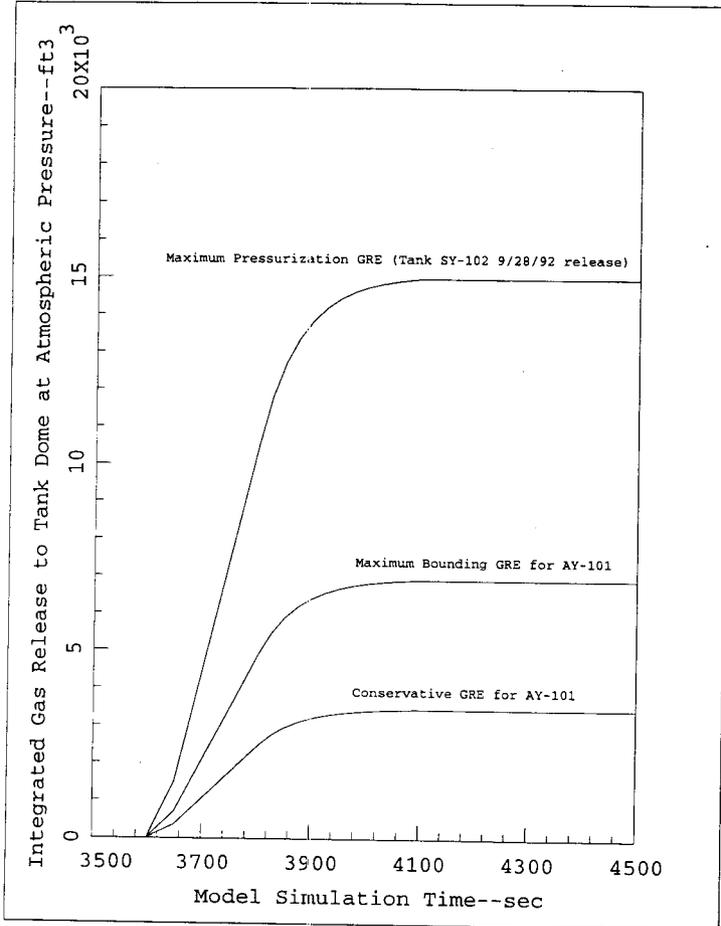


Figure 4-1b. Gas Release Events Assumed.



## 5.0 RESULTS OF THE EVALUATION

An evaluation of the Project W-030 ventilation system was performed. The three GREs described in Section 4.1 were analyzed using the GOTH computer code. A description of the analyses is provided in the following sections.

### 5.1 MAXIMUM PRESSURIZATION AND FLOW ANALYSES

The results of the GOTH simulation model for the Maximum Pressurization GRE in tank 241-AY-101, its recirculation system, the primary system, and the other tanks are shown in Figures 5-1 through 5-5. As indicated in Figures 5-1 through 5-2, pressures within tank 241-AY-101 and its recirculation system change abruptly upon initiation of the release. The tank and recirculation system then return to near normal operation by end of the GRE. Tank pressure rises above atmospheric pressure and reverse flow at the tank inlet occurs. Bleed flow from the recirculation loop through the flow control valve to the primary system increases abruptly. As discussed previously, in this simulation the tank inlet pressure and recirculation bleed flow control valves are assumed to respond very slowly, maintaining a fixed open angle during the GRE. Flow in the recirculation system increases in the supply side and decreases in the return side due to the initial pressurization. Subsequently, as the system slowly depressurizes the loop flow is slightly below normal, and finally returns to normal.

Flow through the recirculation bleed flow control valves for each tank are compared in Figure 5-3. As shown, control valve flows decrease in tanks 241-AY-102, 241-AZ-101, and 241-AZ-102 rapidly. A very small flow reversal occurs into tank 241-AY-102. However, the duration and flow rate are extremely small, and no hydrogen was carried to the recirculation systems of these tanks even under ultra-conservative gas release assumptions. Pressures downstream of the control valves are shown in Figure 5-4. Pressure increases are not large at these locations. Tank dome pressures are compared in Figure 5-5 and flows in the three main primary system branches are shown in Figure 5-6.

The results of the analyses of the Maximum Pressurization GRE demonstrate that an extremely conservative GRE in tank 241-AY-101 results in a very short flow reversal into tank 241-AY-102 but does not introduce flammable gas into the tank. Therefore, there is not a potential for flammable gas concentrations at the location of the recirculation fans that are of concern.

### 5.2 CONSERVATIVE GRE ANALYSES

The ventilation system response for a significantly lower, but still conservative GRE was evaluated with the Conservative GRE shown in Figure 4-1b. The total release was 3456 ft<sup>3</sup>. Graphical results similar to those discussed above for the Maximum Pressurization GRE are provided in Figures 5-7 through Figures 5-12. As would be expected, when compared to the larger release, the pressure and flow changes are significantly reduced. Pressure increases are

large enough to cause reverse flow out the normal inlet of tank 241-AY-101. Flow at the tank 241-AY-101 outlet control valve doubles for a short period. The most significant change from normal operation is the flow out the tank 241-AY-101 recirculation bleed flow control valve as shown in Figure 5-9. Flows through the other tank outlet control valves decrease but do not reverse.

Hydrogen concentration in tank 241-AY-101 dome space and the piping between the tank 241-AY/AZ piping junction exceeds 25% of the LFL (1%) of hydrogen in air as shown in Figure 5-13. The flammability limit is not exceeded in this region. Downstream of the tank 241-AY-101/241-AY-102 piping junction towards the primary exhaust fan, the hydrogen concentrations just exceed 25% of the LFL for a very short period of time. Since there were no flow reversals towards the other tanks and the concentration of hydrogen in other tanks or recirculation systems will be at the normal tank operating concentration.

For the Conservative GRE, the hydrogen concentration exceeds 25% of the LFL in tank 241-AY-101 dome space and piping system. The hydrogen concentrations at the primary exhaust fan, one of the locations of the potential spark sources locations, only briefly exceeds 25% of the LFL and does not exceed the LFL. Therefore, the hydrogen concentrations at the locations of the spark sources are within acceptable limits.

### 5.3 MAXIMUM BOUNDING GRE ANALYSES

The hydrogen concentration that would result due to release of 100% of the maximum estimated tank 241-AY-101 sludge gas (Maximum Bounding GRE shown in Figure 4-1b) at 100 % hydrogen concentration was evaluated using the GOTH model discussed in Section 2.0. A second ventilation system configuration was used for this analyses which was presented in Section 3.1. The bleed flow from tank 241-AZ-101 was increased from 100 cfm to 500 cfm while maintaining 100 cfm from the remaining tanks. This system configuration is intended to increase the dilution at the primary exhaust fan.

The time history of the hydrogen concentrations for the Maximum Bounding GRE analyses is shown in Figure 5-14. The hydrogen concentration in tank 241-AY-101 dome space and the piping between the AY tanks and the AY/AZ piping junction, exceeds the LFL of 4% hydrogen. However, at the exhaust fan, a possible spark source, the hydrogen concentration exceeds 25% of the LFL but does not exceed the limiting condition of 4% hydrogen (LFL).

Ventilation system flow rates through the flow control valves is shown in Figure 5-15. The rapid-GRE in tank-241-AY-101 reduces the flow from the other tanks. However, it results in only a small reverse flow similar to that seen in the Maximum Pressurization GRE (Section 5.1). Therefore, the recirculation fans do not present a hazard.

Thus, for this very conservative bounding case, the hydrogen concentration at the location of the spark source does not exceed acceptable limits.

Figure 5-1. Pressure Within Tank 241-AY-101 and its Recirculation Systems.

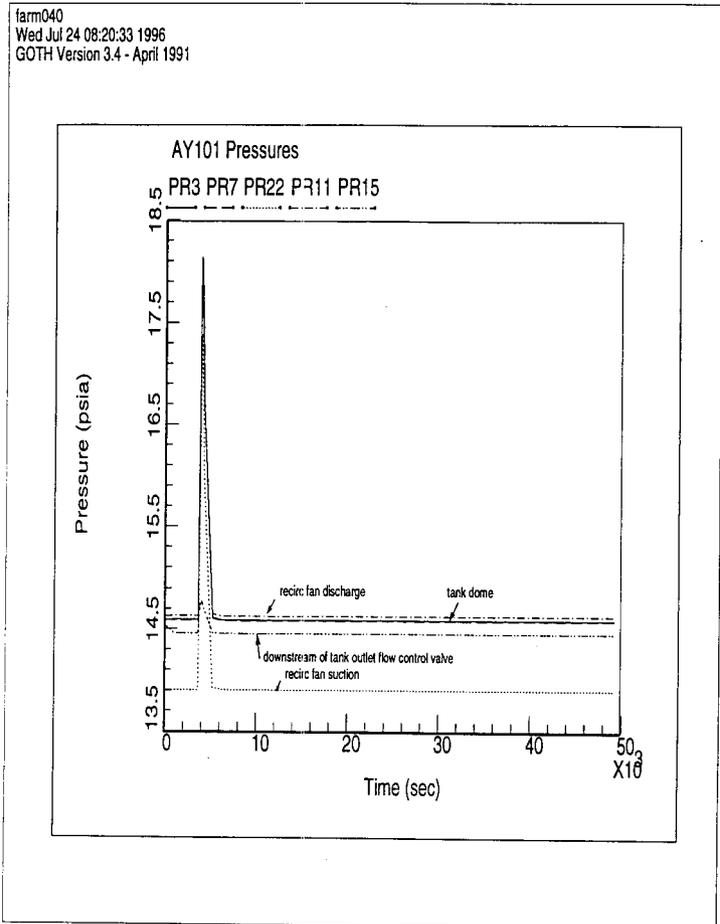


Figure 5-2. Flows Within Tank 241-AY-101 Recirculation System and Bleed Flow to Primary System.

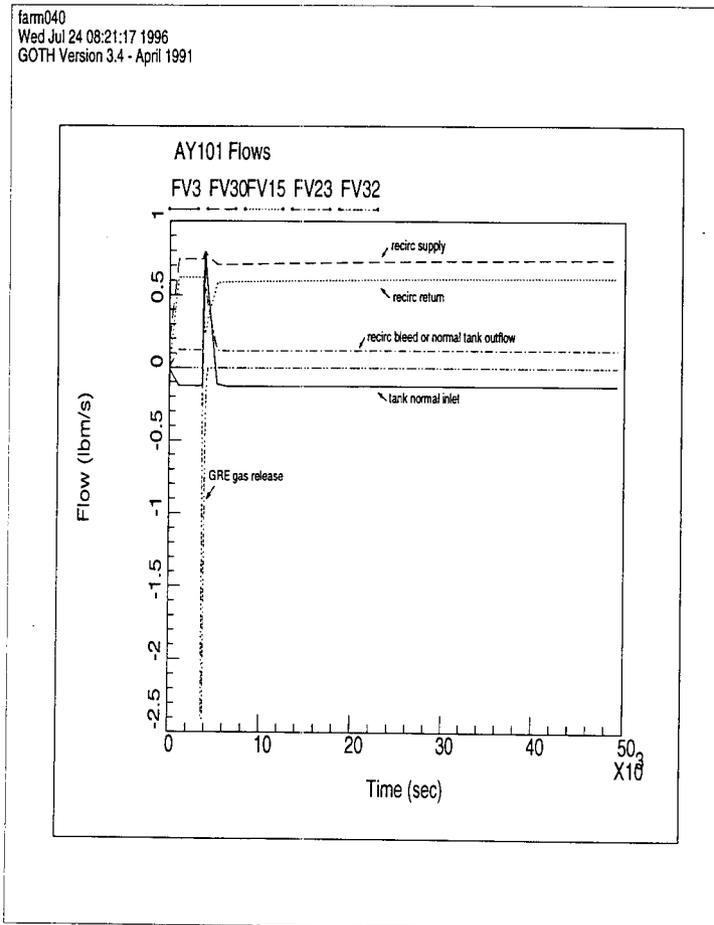


Figure 5-3. Flow Through Tanks Bleed Flow Control Valves.

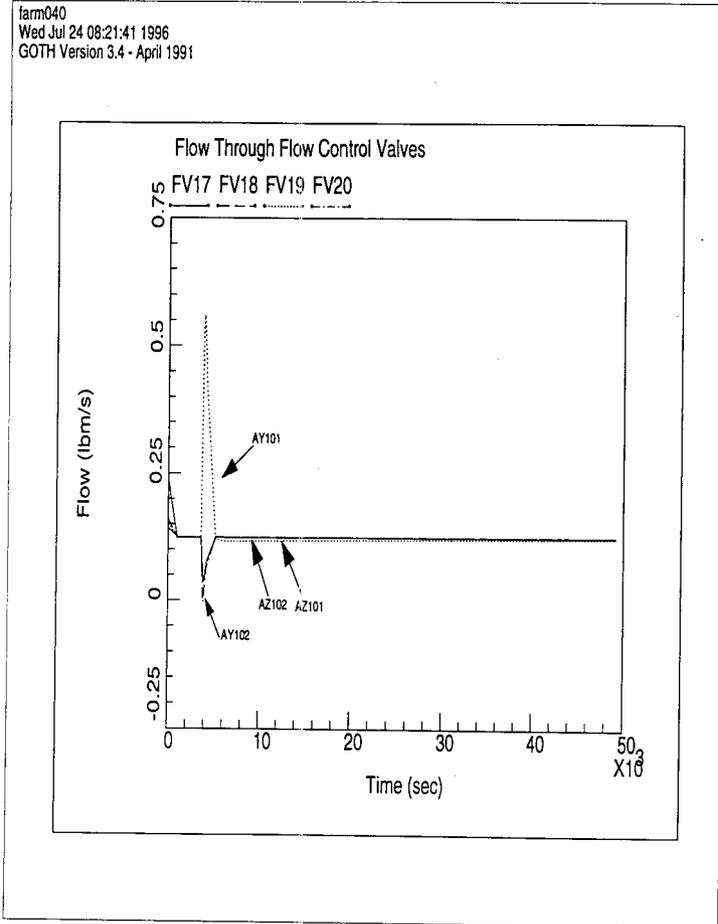


Figure 5-4. Pressures Downstream of Flow Control Valves and Upstream of Primary Exhaust Fan Inlet.

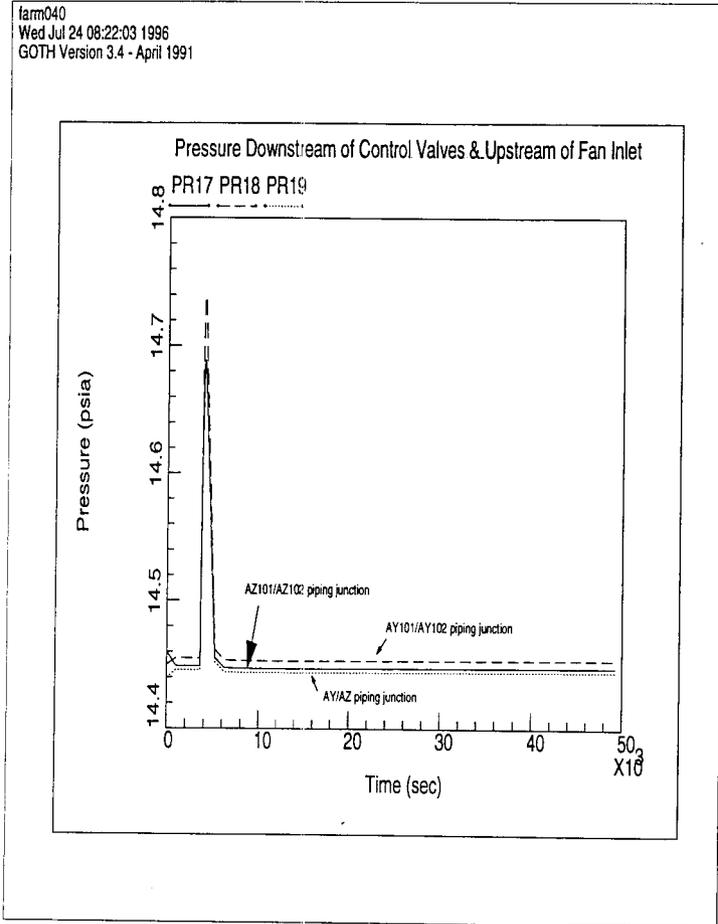


Figure 5-5. Tanks Dome Pressures.

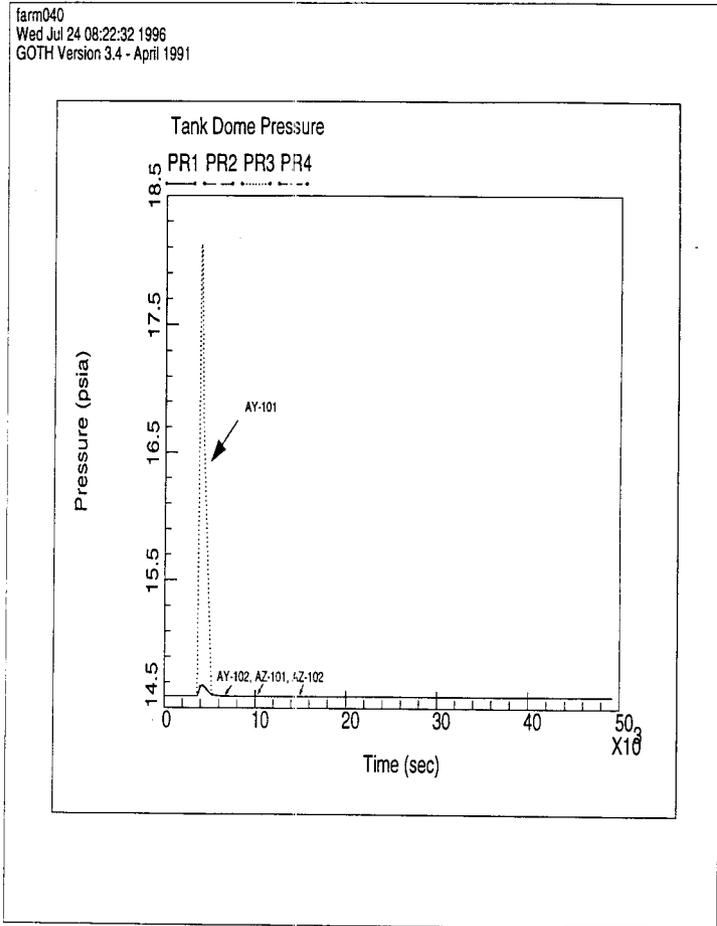


Figure 5-6. Flow in Primary System Manifold Piping.

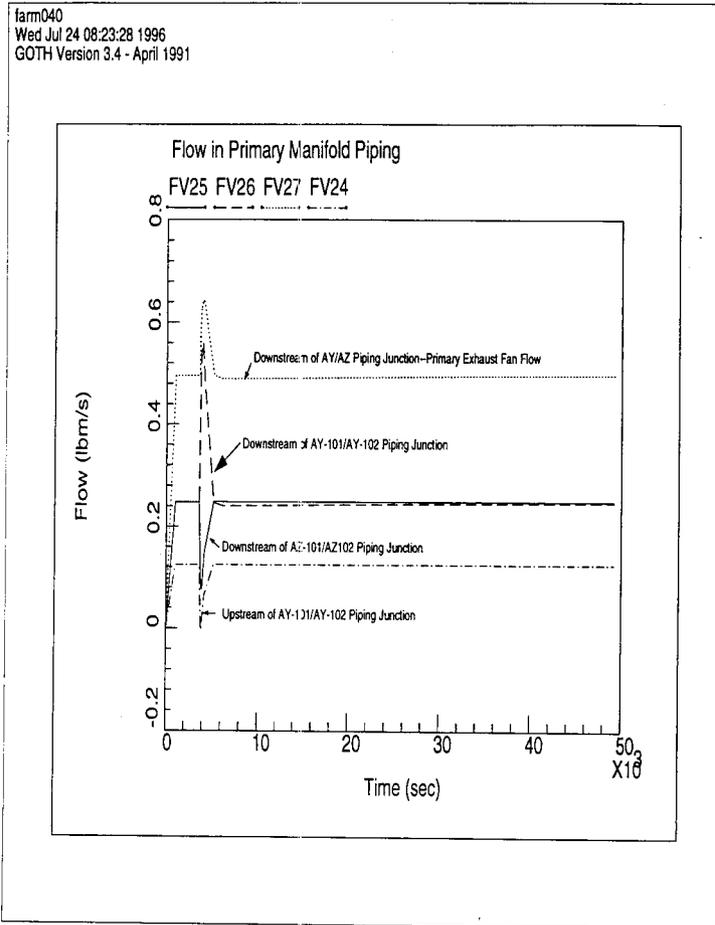


Figure 5-7. Pressures Within Tank 241-AY-101 and its Recirculation Systems.

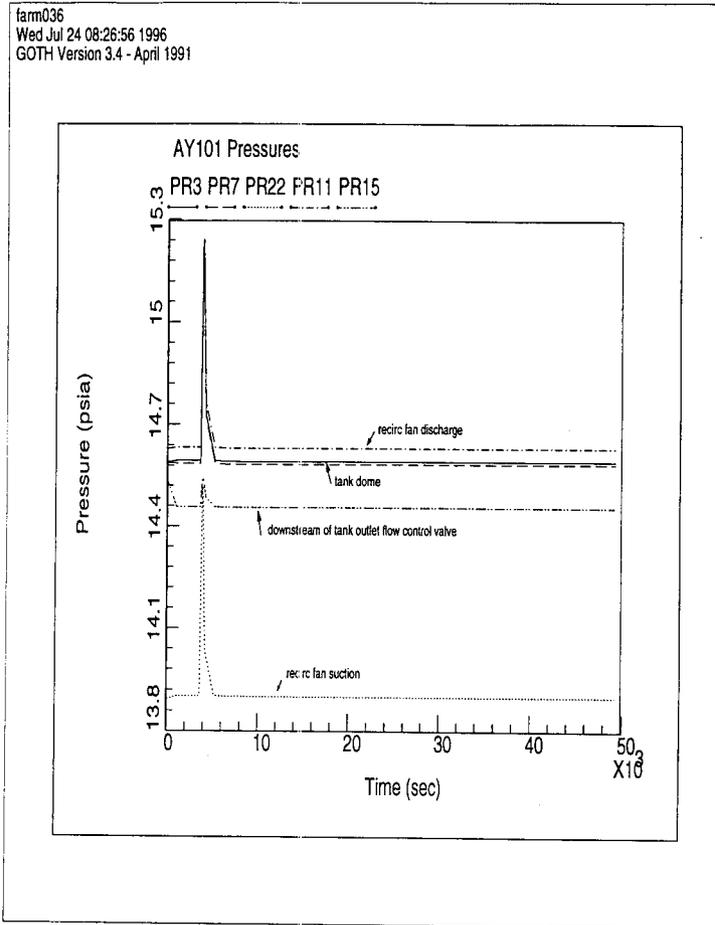


Figure 5-8. Flows Within Tank 241-AY-101 Recirculation System and Bleed Flow to Primary System.

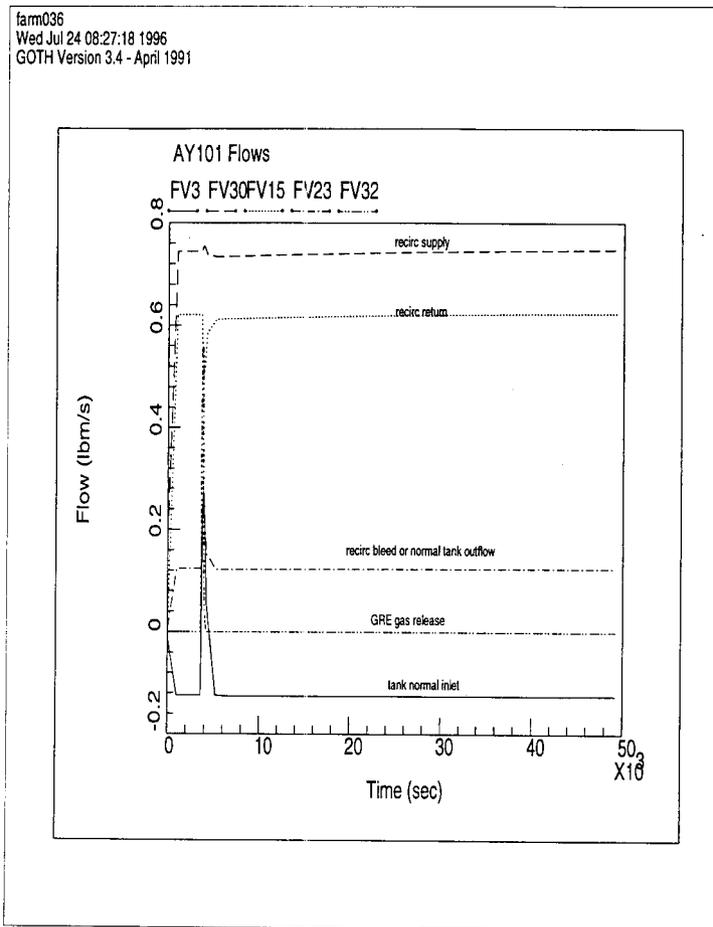


Figure 5-9. Flow Through Tanks Bleed Flow Control Valves.

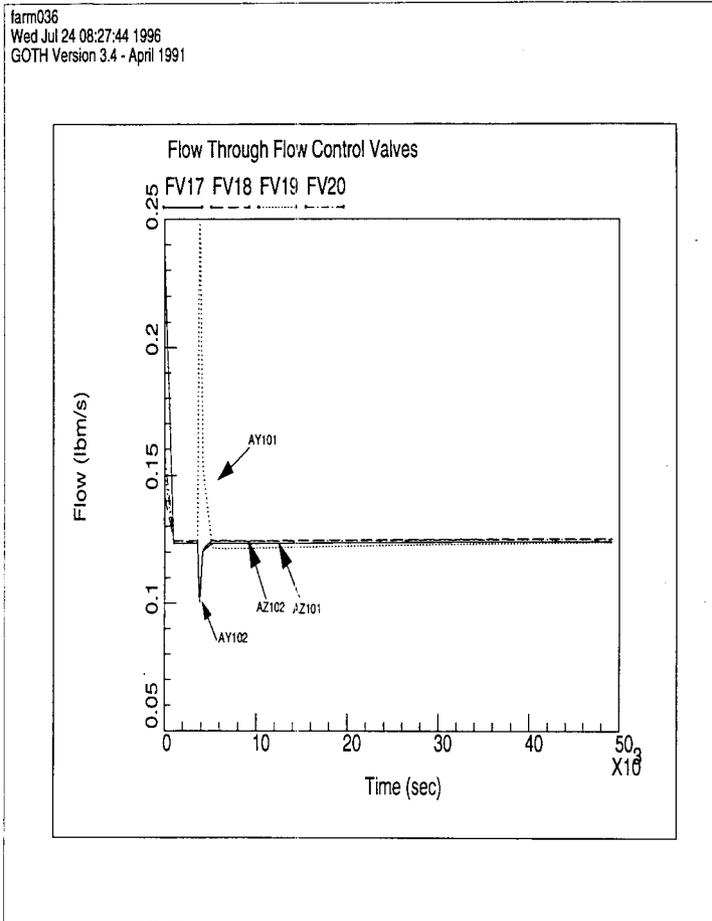


Figure 5-10. Pressures Downstream of Flow Control Valves and Upstream of Primary Exhaust Fan Inlet.

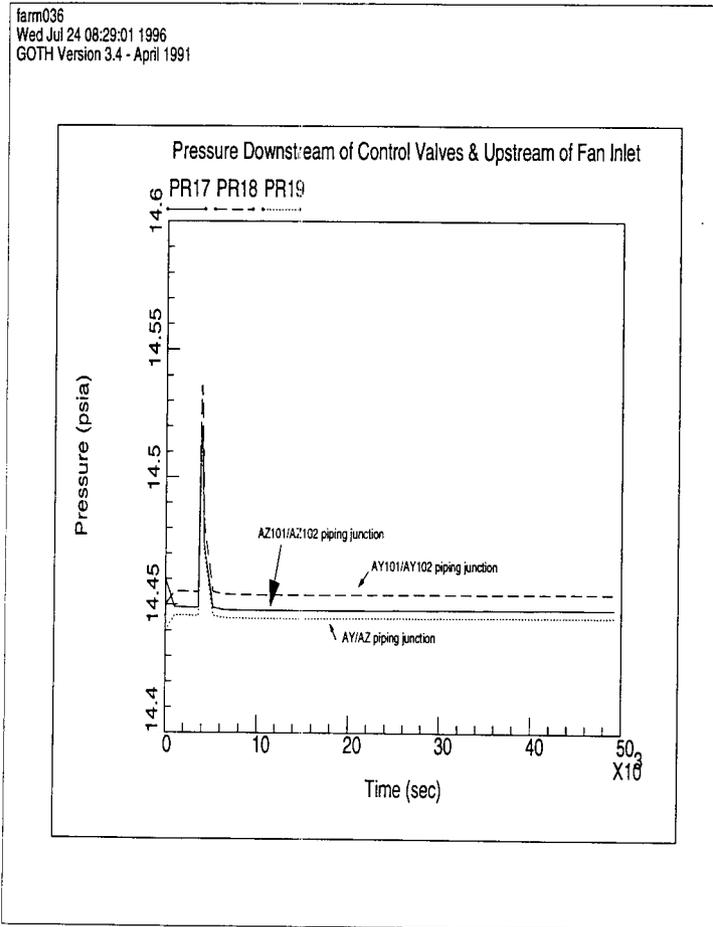


Figure 5-11. Tanks Dome Pressures.

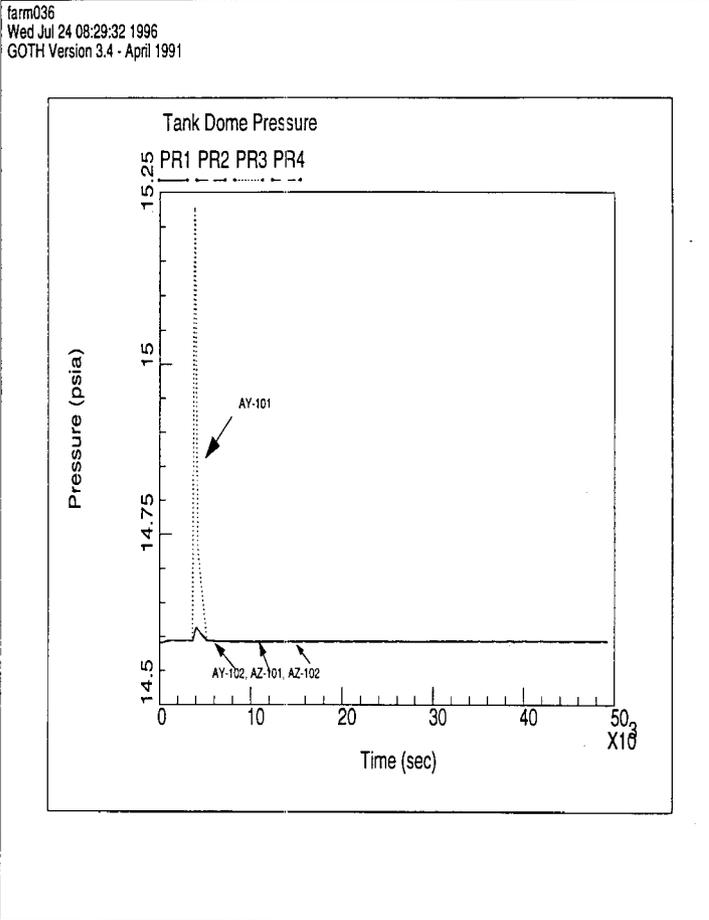


Figure 5-12. Flow in Primary System Manifold Piping.

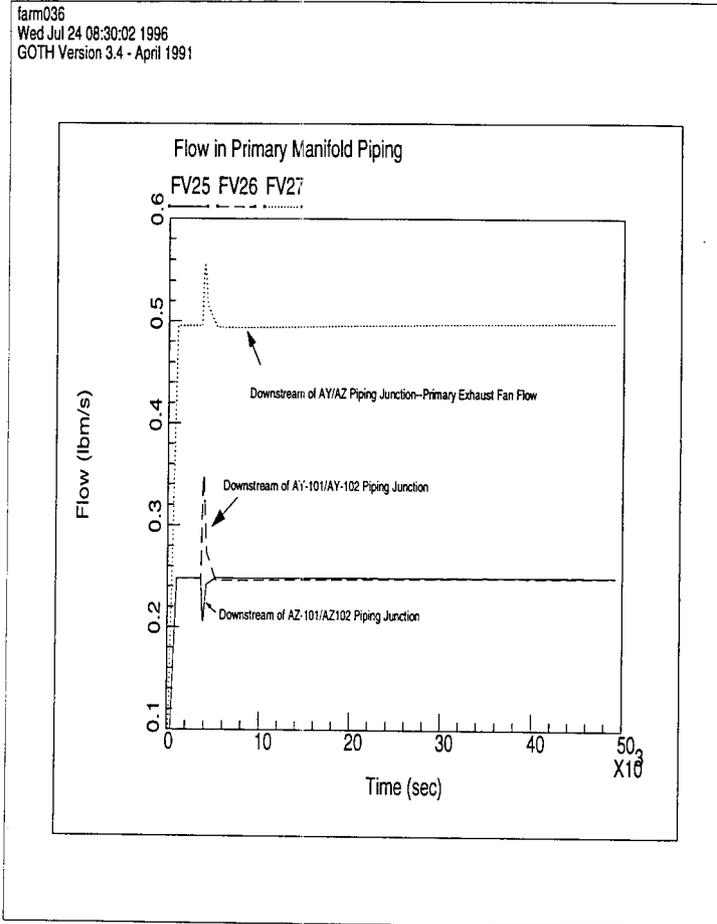


Figure 5-13. Hydrogen Concentrations for Conservative GRE.

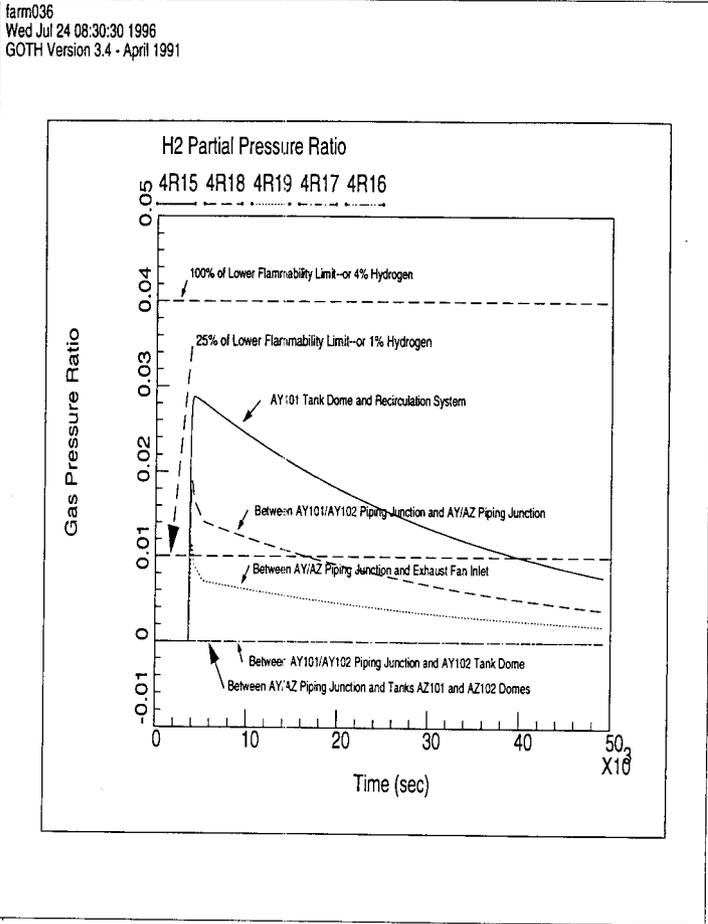


Figure 5-14. Hydrogen Concentrations for Maximum Bounding GRE.

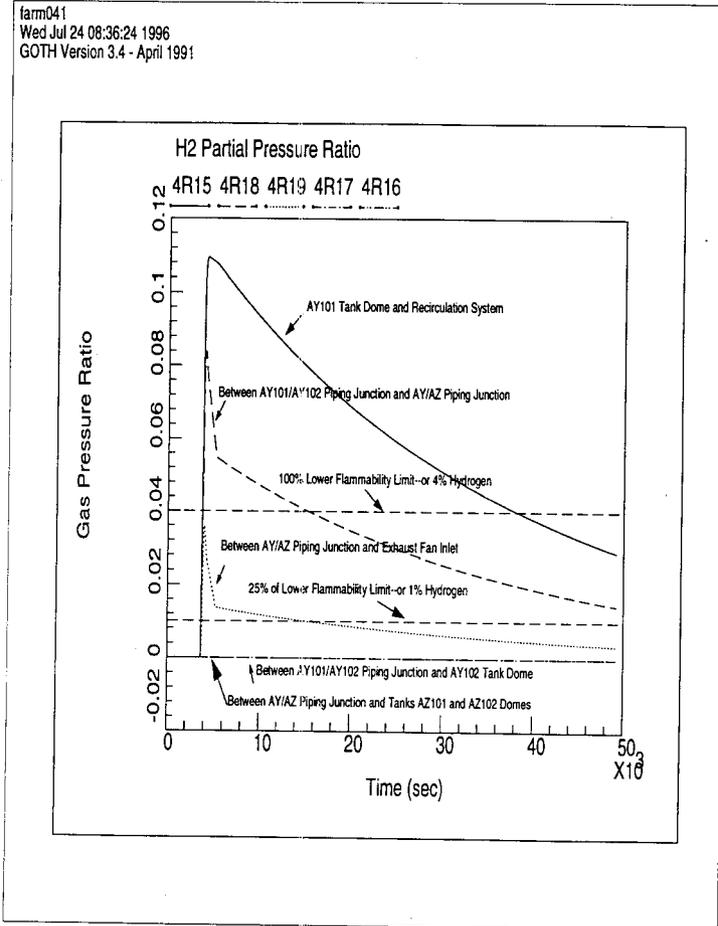
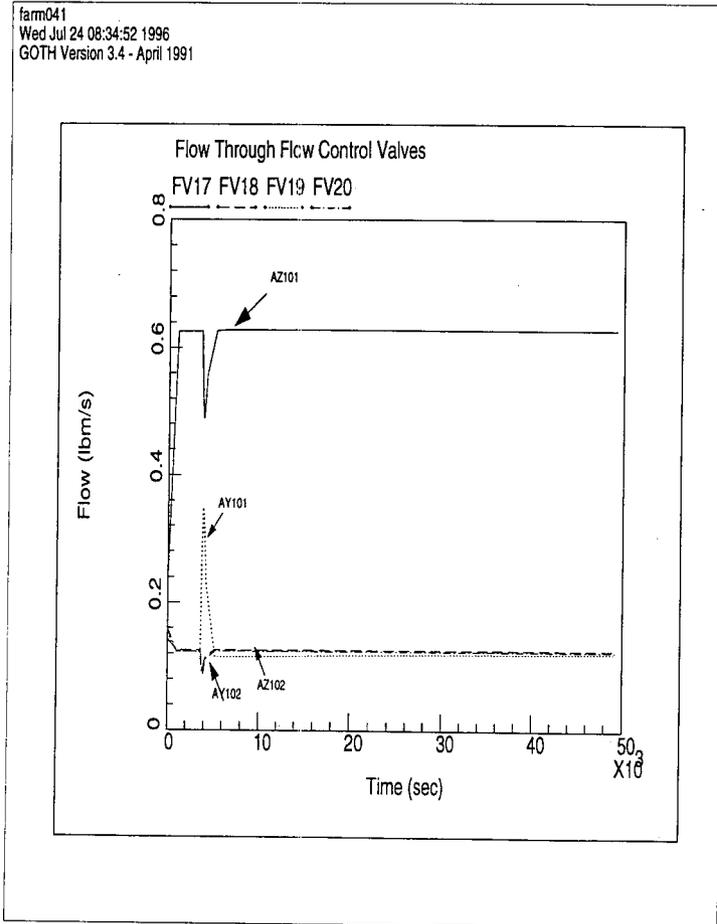


Figure 5-15. Flow Through Tanks Bleed Flow Control Valves for the Maximum Bounding GRE.



## 6.0 CONCLUSIONS

- The analyses of the Maximum Pressurization GRE demonstrated that a GRE in tank 241-AY-101 will result in only small back flow into the recirculation systems of other tanks in the AY/AZ farm. However, the duration is very short, with no transport of hydrogen to recirculation systems in the remaining tanks. Therefore, the spark potential of the recirculation fans are not a concern.
- The hydrogen concentration at the primary ventilation system exhaust fan exceeds 25% of the LFL but does exceed the LFL for the conservative and maximum bounding GREs in tank 241-AY-101.
- The maximum bounding GRE requires the additional dilution at the exhaust fan provided by the system configuration discussed in Section 3.1.
- The hydrogen concentration in the dome space of tank 241-AY-101 can exceed the LFL for the maximum bounding GRE. However, there are no available spark sources if the recirculation system of tank 241-AY-101 is de-energized.
- The evaluation of the Project W-030 ventilation system has shown that potential GREs in tank 241-AY-101 will not result in unsafe conditions resulting from the release of flammable gas.

## 7.0 REFERENCES

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- Vendor File 1, *Recirculation Cooling Fans*, Fan Engineering Company, VI No. 22525, Supp33, January 19, 1996.
- WHC, 1994, Drawing Set 1, Drawings: H-2-131088, sheets 1-4, H-2-131086, sheets 1-4, H-2-131087, sheets 1-2, Westinghouse Hanford Company.
- Wood, S. A., 1993, *FATHOMS Simulation of the September 3, 1992, Tank 101-SY GRE*, (internal letter 23230-93-SAW-001 to G. D. Johnson, January 12), Westinghouse Hanford Company, Richland, Washington.

**APPENDIX A. LETTER REPORT 23230-93-SAW-001.**

Westinghouse  
Hanford CompanyInternal  
Memo

From: Waste Characterization Analysis 23230-93-SAW-001  
 Phone: 6-8658 H0-34  
 Date: January 12, 1993  
 Subject: FATHOMS SIMULATION OF THE SEPTEMBER 3, 1992, TANK 101-SY GRE

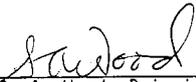
To: G. D. Johnson R2-78

cc: R. T. Allemann K7-15 R. M. Marusich H5-32  
 T. M. Burke H0-34 T. B. McCall H0-33  
 S. C. Chang H0-34 N. G. McDuffie R2-78  
 W. L. Cowley H5-31 M. D. Northey L5-07  
 L. E. Efferding H0-33 D. M. Ogden H0-34  
 J. C. Fulton R2-31 D. A. Reynolds R2-11  
 J. M. Grigsby H5-32 K. Sathyanarayana H0-34  
 N. W. Kirch R2-11 L. K. Severud H5-60  
 W. L. Knecht H0-34 SAW File/LB  
 M. R. Kreiter K7-90  
 J. W. Lentsch R2-78

Reference: Internal Memo, S. A. Wood to Distribution, "Estimate of the September 1992, GAS RELEASE VOLUME IN TANK 101-SY," dated September 28, 1992.

The FATHOMS<sup>2</sup> code was used to simulate the September 3, 1992, Gas Release Event (GRE) which occurred in Tank 101-SY. Problems in interpreting the measured tank gas pressure have delayed issuing this memo, and have prevented arriving at any definitive estimates for the volume of gas released. Attempts at resolving the apparently anomalous pressure data have been partially successful. The range of estimated released gas volume based on the current FATHOMS results lies between 6,000 and 15,000 cubic feet, with a probable value of about 10,000 cubic feet.

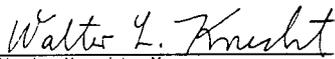
Attached is a discussion of the FATHOMS analysis results.

  
 S. A. Wood, Principal Engineer

WLK

Attachment

CONCURRENCE:

  
 W. L. Knecht, Manager  
 Waste Characterization Analysis

<sup>2</sup>FATHOMS is a registered trademark of Numerical Applications, Inc.  
 Hanford Operations and Engineering Contractor for the US Department of Energy

**FATHOMS SIMULATION OF THE SEPTEMBER 3, 1992, TANK 101-SY GRE**BACKGROUND

On September 3, 1992, a Gas Release Event (GRE) occurred in Tank 101-SY at about 2:40 p.m. Measured data became available by the following afternoon, and was input into the FATHOMS code in an attempt to estimate the volume of gas released during the GRE. When these results seemed inconsistent with both the measured pressure increase and the tank waste surface level change, an alternate procedure using only measured data was employed. An Internal Memo was issued with the alternate estimate of 8,400 cubic feet of gas released (reference). This report is to present the status of additional FATHOMS analyses made in an attempt to resolve the inconsistencies.

FATHOMS MODEL

All the FATHOMS calculations described in this report employed the same lumped parameter model as had been used in all previous Tank 101-SY GRE simulations. The only changes were the measured tank gas pressure and surface level changes as a function of time which are used as input for the FATHOMS analysis. This data is obtained directly from computer workstations located in the 200 Area where data obtained from the Tank 101-SY data loggers is stored.

Data input preparation for the FATHOMS analyses consists of converting the measured tank gas pressure (in inches wg) into absolute pressure (PSIA), and then dividing by the pre-release tank pressure to obtain relative pressure change as a function of time. For the initial FATHOMS calculations, tank surface level data from the radar gauge was used. Subsequent evaluation of the radar gauge has called into question the accuracy of its results. Hence, all subsequent FATHOMS analyses have used FIC level data. Since FATHOMS cannot dynamically change a solid surface level, tank level changes have been modeled by including a pool of water at the bottom of the model's gas space, and then causing flow in or out of this pool so as to match the measured tank surface level changes. The measured level data is therefore converted into a flow rate as a function of time in order to simulate the measured level changes.

The FATHOMS calculated tank gas pressure and surface level are compared to the measured data to verify that the input was correctly prepared.

FATHOMS RESULTS

Figure 1 presents the measured surface level in Tank 101-SY during the GRE period which was used for part of the FATHOMS input as explained above. This data was obtained with the FIC gauge operated in a manual mode. Figure 2 shows the Tank 101-SY gas space pressure as measured by the exhaust duct pressure detector. The time period for this plot begins at midnight on September 1, two days before the gas release, and continues through noon on September 4, the day after the release. The additional time period is included to show the pressure changes in the tank which occur on a daily basis, and appear related to changes in atmospheric temperature. If an even wider time period were chosen, tank pressure changes due to more gradual changes in atmospheric pressure could also be observed. This information is given to illustrate some of the difficulties in isolating pressure changes

due to gas release from changes which appear to be unrelated to gas releases. The vertical axis scale for Figure 2 was chosen to better display the daily pressure variations, but does not show the peak tank pressure, which was recorded as +5.4 inches wg. The surface level data in Figure 1 do not show any indication of significant gas releases from September 1 to the afternoon of September 3. The FATHOMS code model explicitly assumes that pressures in the tank above the pre-release value is due to gas release, so any pressure changes unrelated to gas release has to be removed from the data prior to use with the code. From Figure 2, it appears that the pressure changes on September 3 prior to the sharp increase in pressure is part of the daily variation, and that pressure changes due to the GRE are superimposed on top of the daily variation.

Figure 3 is an expanded scale plot of the tank gas space pressure, beginning at noon and continuing to midnight on September 3. In order to remove some of the uncertainty associated with using data from a single instrument, pressure data from the Gas Monitoring System (GMS) detector is also shown. Both sets of pressure data show essentially the same response--a sharp pressure rise at about 2:40 p.m. starting from about -2.35 inches wg, a corresponding quick pressure decrease to about -2.15 inches wg, followed by a gradual decrease which reaches the pre-release pressure at about 6:20 p.m. Initial FATHOMS calculations were made using just the pressure changes between 2:00 p.m. and 6:00 p.m. which were believed due to released gas, plus the surface level changes shown in Figure 1.

Results from this initial calculation are shown in Figures 4 and 5. Figure 4 presents the FATHOMS predicted gas space hydrogen concentration which assumes perfect mixing, and which peaks at about 3.9%. The relatively flat top of the curve is due to gas release predicted by the code during the long slow pressure change period described above. Cumulative gas release versus time is shown in Figure 5. Careful examination of this data indicates that these results are composed of three components. The first, showing a rapid increase to about 6,000 cubic feet, is due to the initial sharp increase in pressure and the rapid drop in surface level. The second component, increasing the volume from 6,000 to about 10,000 cubic feet, is due primarily to the continuing surface level decrease which the FATHOMS code translates into gas release. The final component of the calculated release volume, increasing the volume from 10,000 to about 15,000 cubic feet, is primarily due to the slightly elevated tank pressure which persists until about 6:00 p.m., the same time that the calculated release volume increase terminates. Other sources have estimated release volumes of about 10,000 cubic feet, so it is important to verify the validity of the four hour slightly elevated tank pressure to determine if this additional volume is valid.

The usual technique used to verify the accuracy of the FATHOMS calculations is to compare measured/calculated values for hydrogen concentration and exhaust flow rate. Figure 6 shows measured hydrogen concentration data from the two Whitaker detectors located about 18 inches above the waste surface. Usually data from the Teledyne detector which measures hydrogen concentrations in the exhaust duct is used since it better represents mixed tank conditions calculated by FATHOMS. Unfortunately, the Teledyne data was useless for this release due to a problem with this system. However, data from the May 1992 GRE in Tank 101-SY showed that the Teledyne and Whitaker data were essentially the same, indicating good mixing and/or uniformity of gas release. Thus, there is reasonable validity in comparing Whitaker data

and FATHOMS predictions of hydrogen concentration. Comparison between measured and FATHOMS calculated hydrogen concentrations for previous GRE's have been quite good, usually agreeing within a few tenths of a percent. However, for this release the peak measured concentration was about 4.9% and the corresponding FATHOMS value was only 3.9%. The shape of the two curves don't agree very well either, with the FATHOMS data implying more release after the initial peak which is consistent with questions about the estimated release gas volume.

Figure 7 is the measured high range exhaust flow, and Figure 8 is the FATHOMS calculated exhaust flow. It is clear that FATHOMS is under-predicting the peak exhaust flow. This peak flow is directly defined by the peak tank pressure input for the analysis. It therefore appears that the measured tank pressure recorded on the data loggers is too low, which would also explain why the FATHOMS peak hydrogen concentration is too low. Figure 9 is an expanded scale plot of the measured exhaust flow, and Figure 10 is the FATHOMS calculated exhaust flow on the same scale. Picking precise values of flow from the measured data is difficult due to the rapid variations in the data, but it is clear that the measured exhaust flow returns to pre-release values by about 3:30 p.m., implying that the release has terminated by then. However, because of the slightly elevated pressure data used for the input, the FATHOMS calculated flow remains high for the entire time period. This strongly implies that the slightly elevated pressure after the main part of the release was due to something not related to gas release.

In an attempt to determine the sensitivity of the FATHOMS results to post peak release tank pressure input, a run was made using pressure data input that was arbitrarily truncated immediately after the peak. Figure 11 shows a 30 minute slice of the pressure data around the peak. The heavy dotted line is the modified pressure values. Figure 12 is the FATHOMS calculated hydrogen concentration for the modified pressure input. The peak value is too low as expected, but the shape appears closer to the measured data in Figure 6. The calculated release volume in Figure 13 indicates that the truncation was too abrupt, causing an under-prediction of the volume. This sensitivity calculation was not intended to provide a definitive answer, but does lend support to the contention that the four hour elevation in the pressure data after the release was not due to gas release.

## CONCLUSION

Difficulties in determining what part of the pressure increases in Tank 101-SY during the September 3, 1992, GRE were due to released gas have caused a large uncertainty in the FATHOMS simulation of the event. The best that can be said about estimated gas release volume is that a value of about 10,000 cubic feet seems reasonable.

Figure 1. Tank 241-SY-101 Surface Levels.

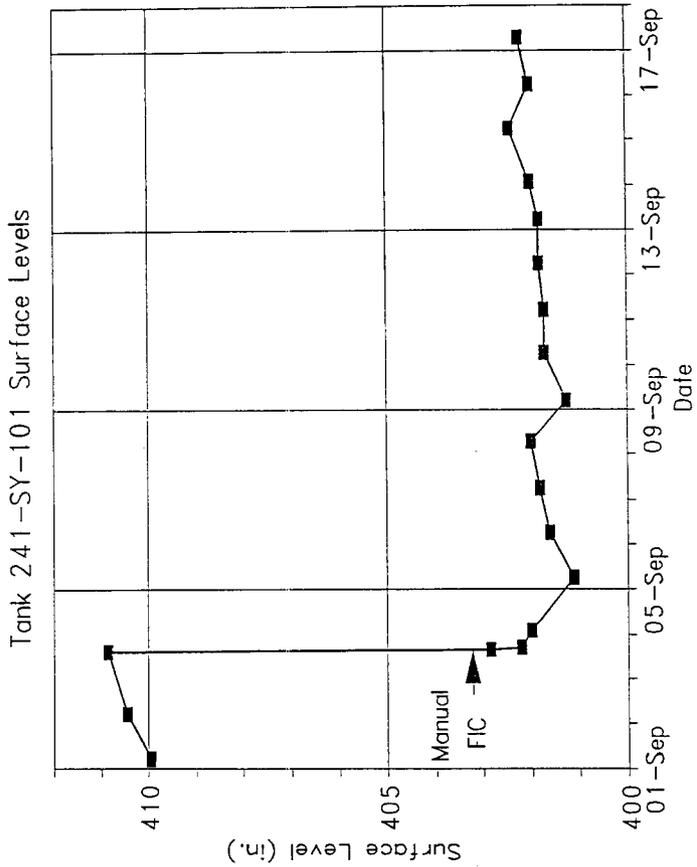


Figure 2. Measured Tank 101-ST Data  
Tank Pressure for September 3, 1992.

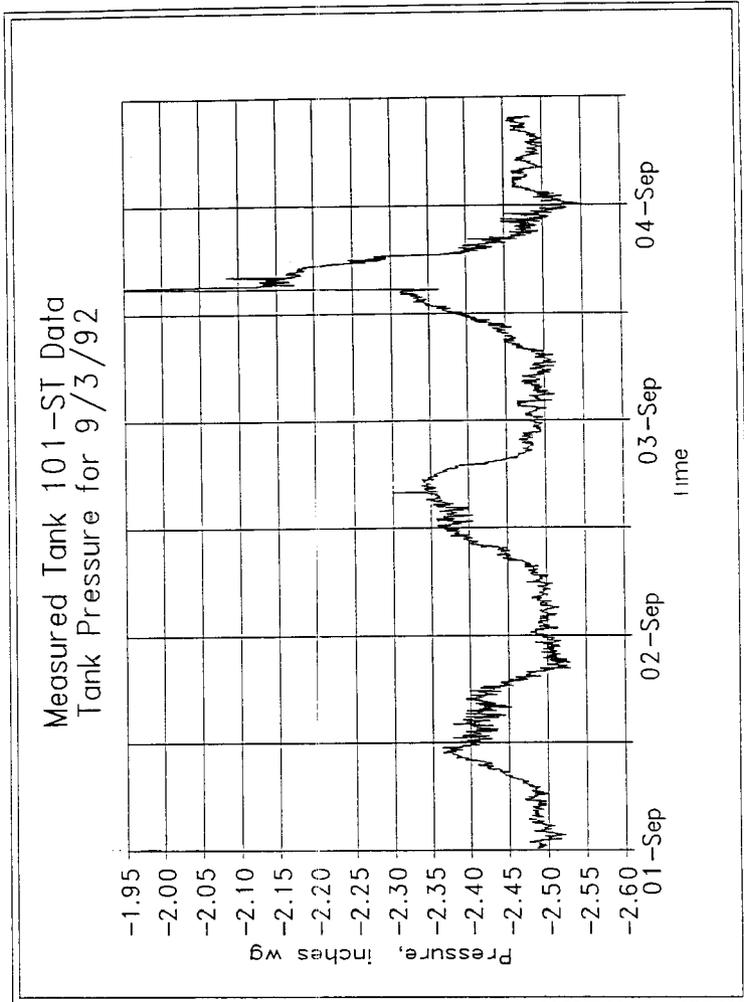


Figure 3. Tank 101-SY September 3, 1992, Release  
GMS and WAVETEK Tank Pressures.

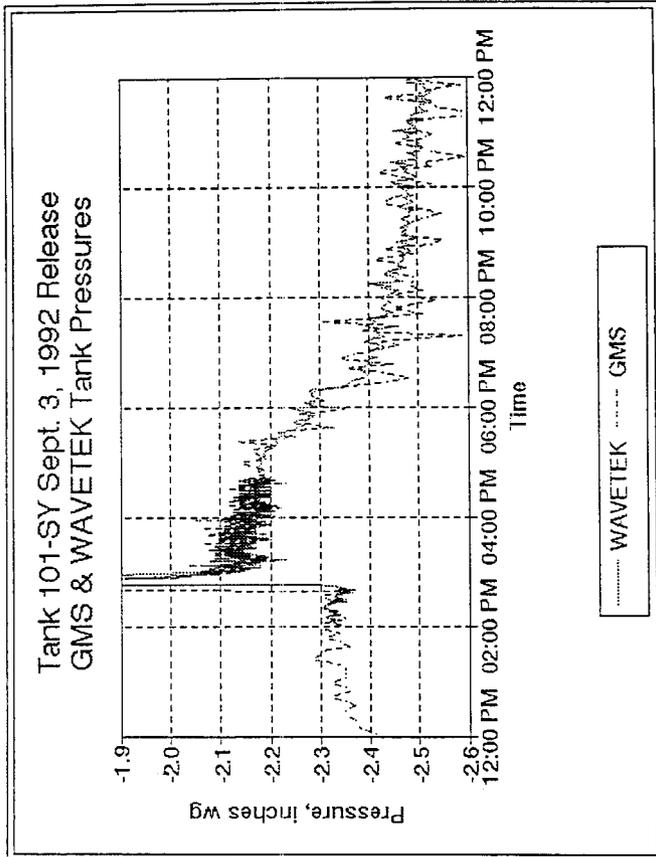


Figure 4. FATHOMS Results for September 3, 1992, GRE Gas Space Hydrogen Concentration.

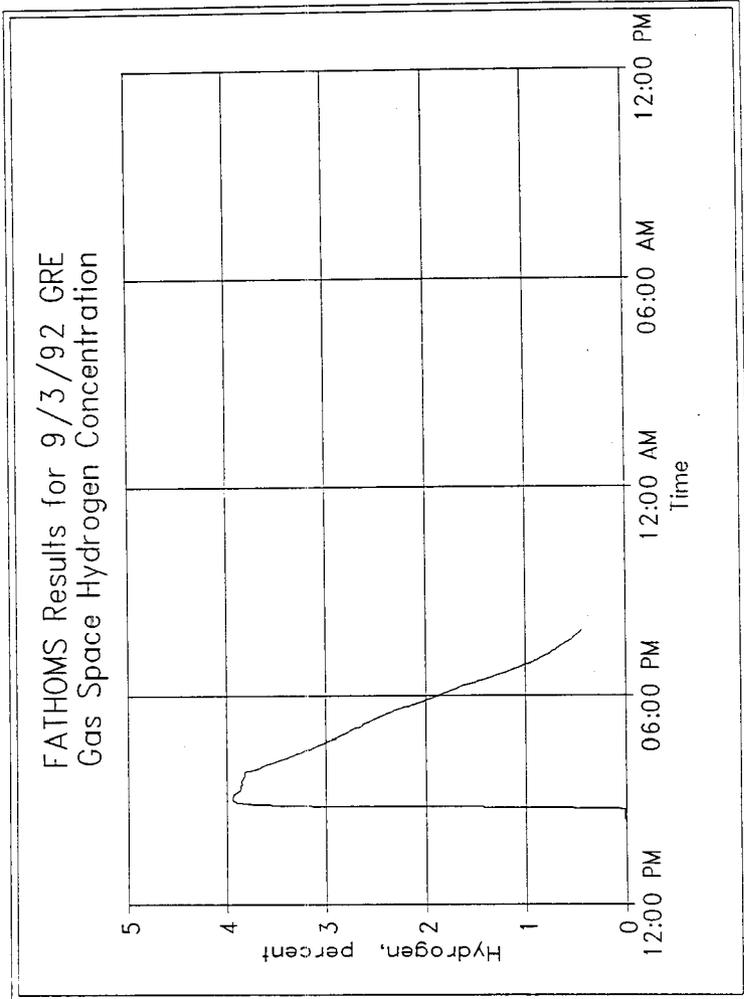


Figure 5. FATHOMS Results for September 3, 1992, GRE  
Gas Release Volume.

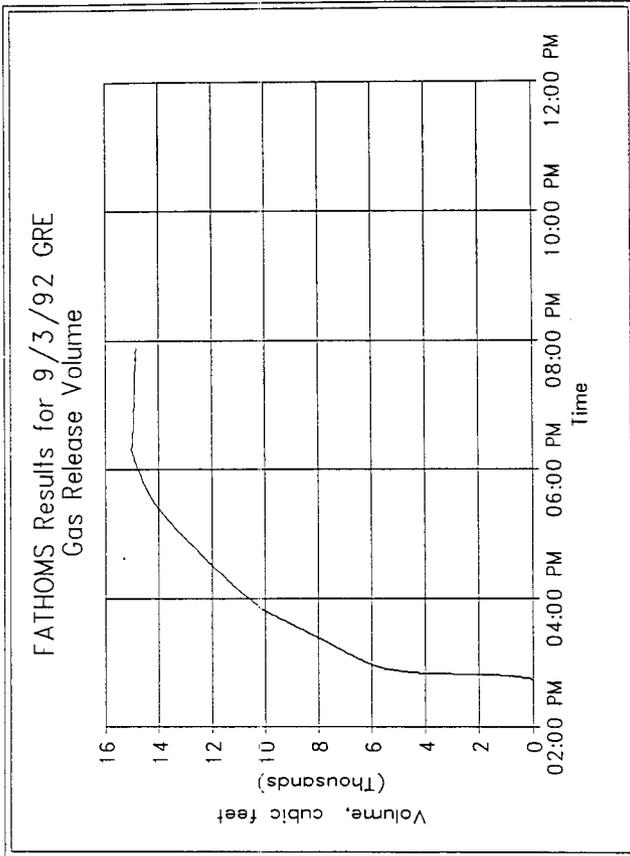


Figure 6. Tank 101-SY September 3, 1992, Release/  
Whitaker Hydrogen Concentration.

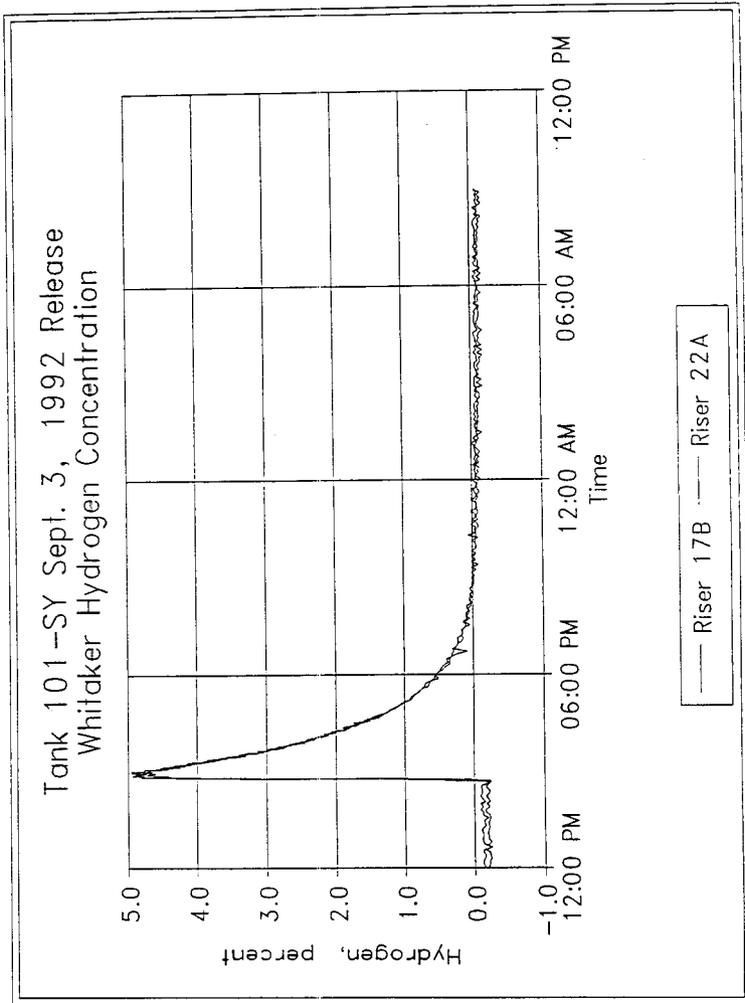


Figure 7. Tank 101-SY September 3, 1992, Release  
Wavetek High Range Exhaust Flow.

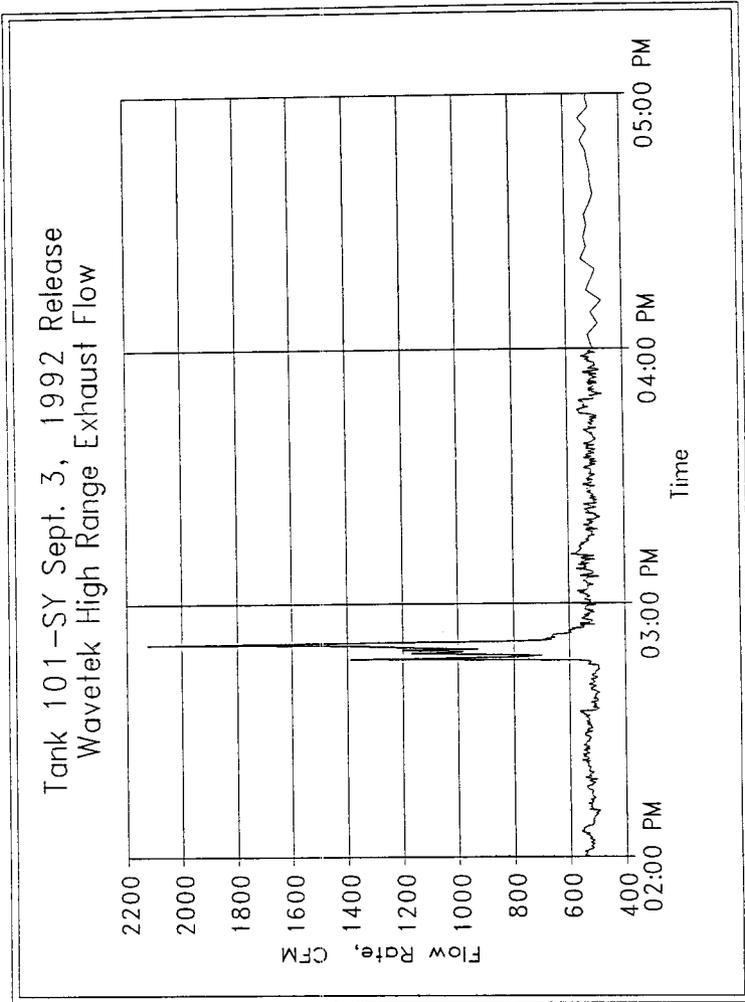


Figure 8. FATHOMS Results for September 3, 1992, GRE Exhaust Gas Flow.

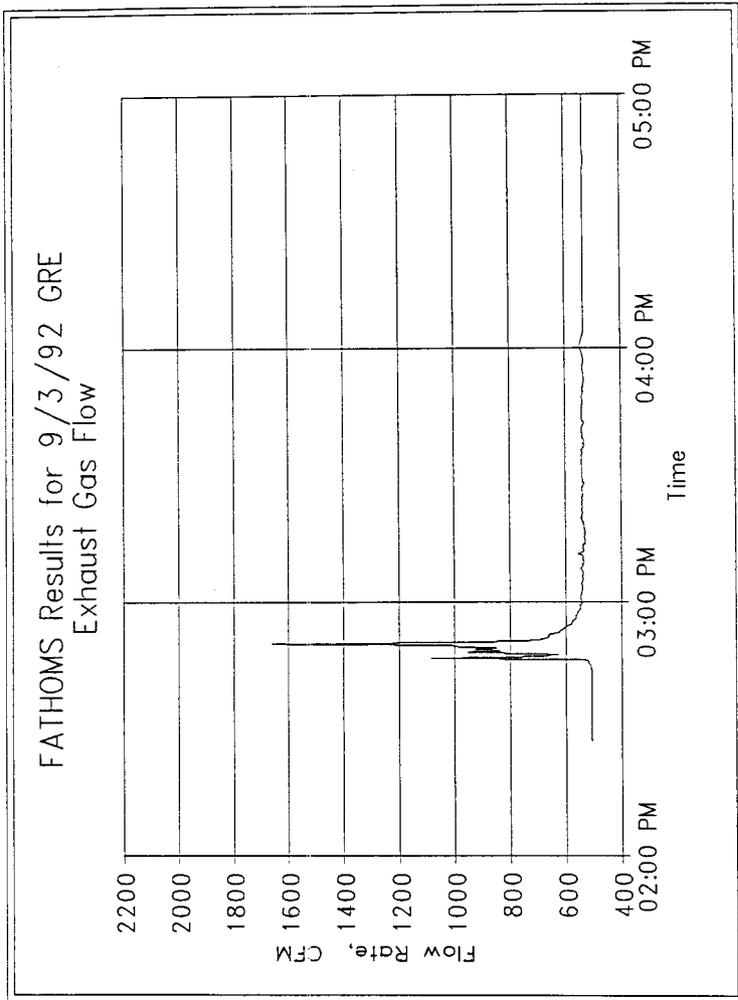


Figure 9. Tank 101-SY September 3, 1992, Release  
Wavetek High Range Exhaust Flow.

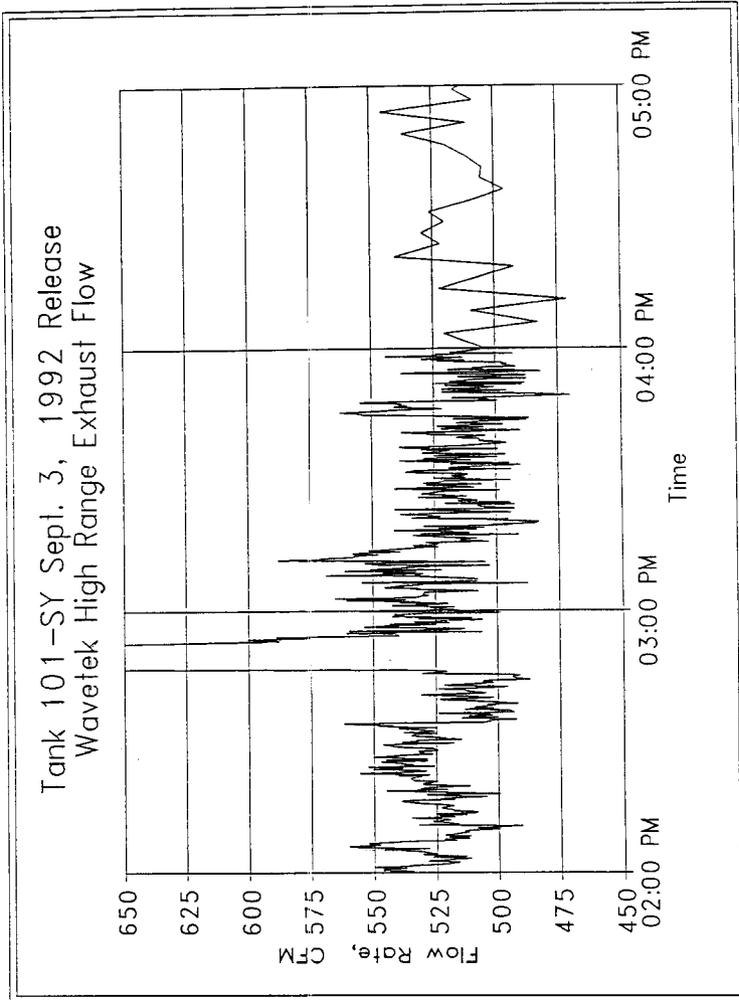


Figure 10. FATHOMS Results for September 3, 1992, GRE  
Exhaust Gas Flow

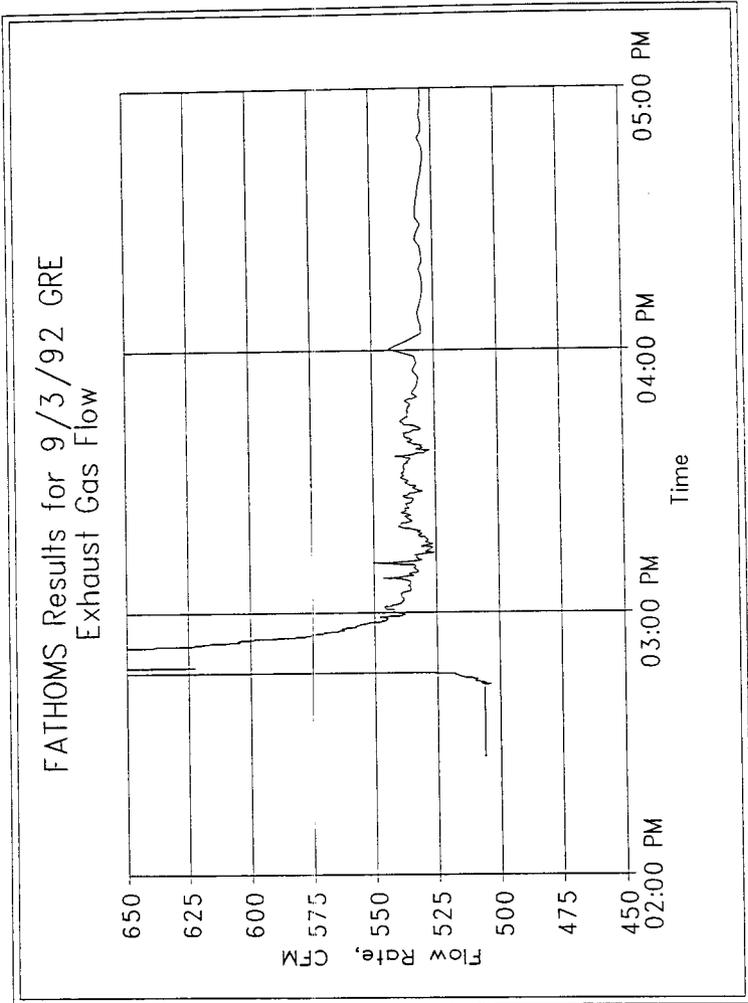


Figure 11. Tank 101-SY September 3, 1992, Release  
Wavetek Tank Pressure.

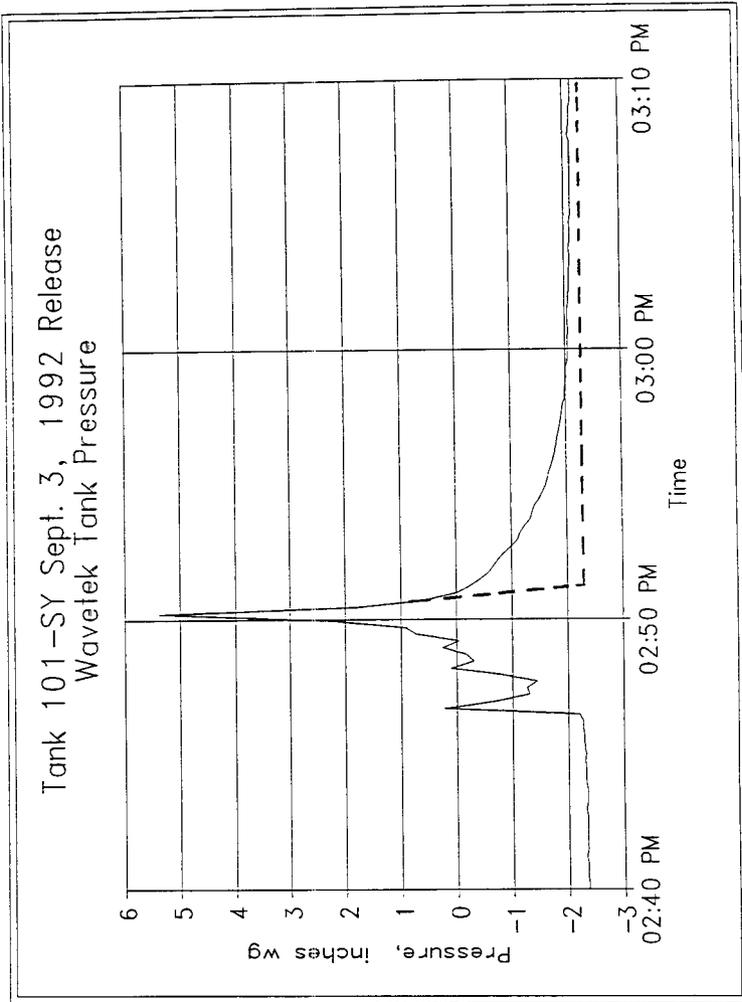


Figure 12. September 3, 1992, GRE Tank 101-SY FATHOMS Results  
Gas Space Hydrogen Concentration.

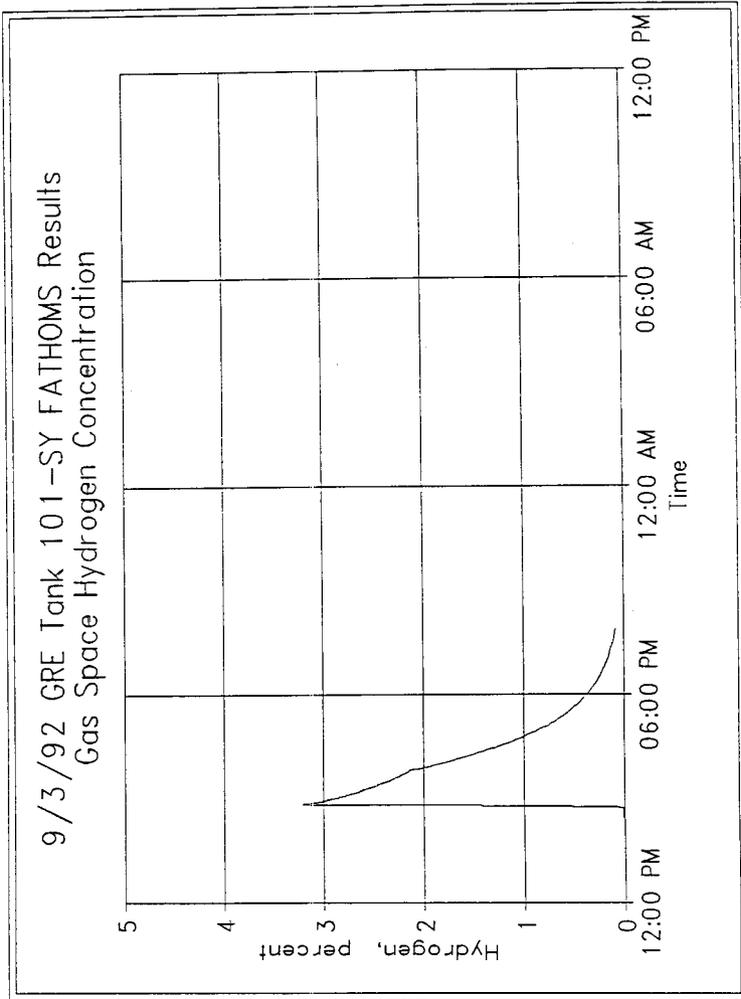
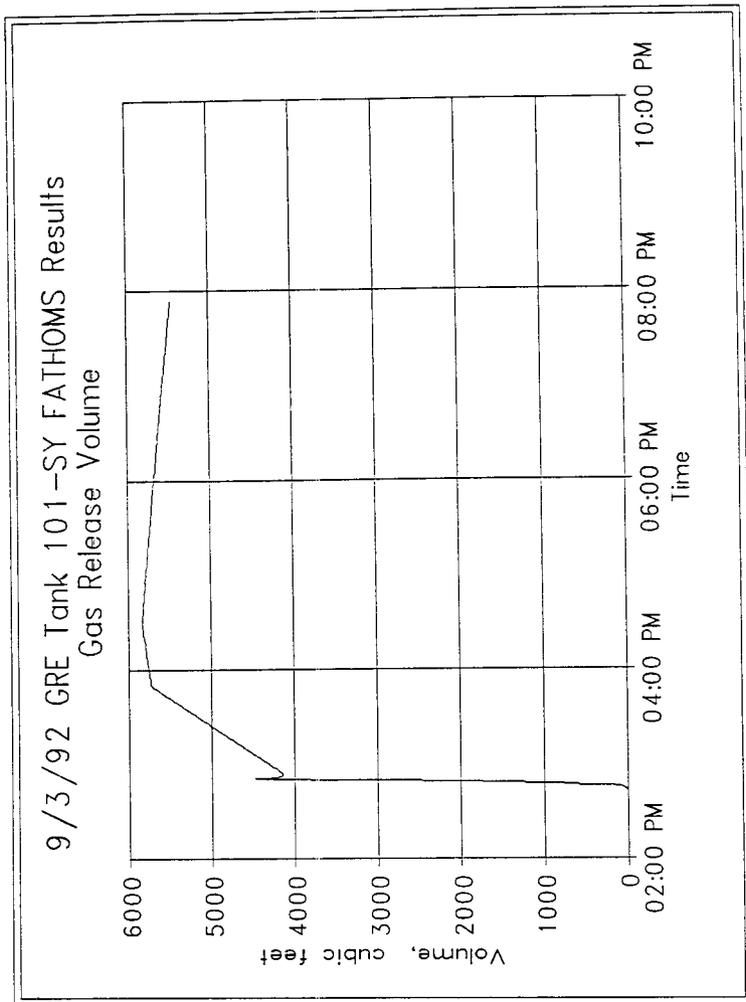


Figure 13. FATHOMS Results for September 3, 1992, GRE  
Gas Release Volume.



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W-030/NB602		ECN No. N/A

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