Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Anne Inman, P.E.
Manger
Rule Registrations Section

Date: November 2, 2010

From: Daniel Menendez
Team Leader
Air Dispersion Modeling Team (ADMT)

Subject: Modeling Report - Standard Permit for Oil & Gas Transportation and Production Facilities

1.0 Project Identification Information. This modeling report is an update to the modeling reports dated August 15, 2007 (NSRG document numbers 7825 and 8001), February 11, 2010 (NSRG document number 9871), February 22, 2010 (NSRG document number 9880), and June 11, 2010 (NSRG document number 10434). The modeling results were updated to include predicted concentrations out to a distance of 5500 feet for all sources. The combustion units modeling was updated to include additional ranges of engines. Subsequent review of the pipeline blowdowns parameters used in the previous analysis were determined not to be representative of the activities occurring. The compressor blowdown parameters were determined to be representative for both pipeline and compressor blowdowns. The pipeline blowdown results are no longer necessary and are removed from the results table. This modeling report represents a complete report and supersedes previous modeling reports.

The modeling performed is in support of the Standard Permit for Oil & Gas Transportation and Production Facilities protectiveness review. Generic modeling was conducted for sources that would apply to all oil and gas production sites. Fugitive emissions evaluated included emissions associated with storage tanks, process equipment, and truck loading. Point source emissions evaluated considered vent emissions for six different stack heights, combustion units (reciprocating engines) for eleven different stack heights, thermal destruction devices (flares) for five different stack heights, and gas compressor and gas pipeline blowdown emissions for three different stack heights.

2.0 Report Summary. The modeling results are summarized in the following tables:

Table 1. Generic Modeling Results for Fugitives, $\mu g/m^3$ per lb/hr

Distance (feet)	Fugitives	Loading	Tank Hatches
50	4375	1232	305
100	4375	1232	305
150	3907	1232	305

Table 1. Generic Modeling Results for Fugitives, $\mu g/m^3$ per lb/hr			
Distance (feet)	Fugitives	Loading	Tank Hatches
200	3089	1232	305
300	1911	1193	294
400	1269	1048	291
500	901	858	274
600	674	698	271
700	525	574	271
800	423	479	261
900	349	406	244
1000	293	348	226
1100	250	302	208
1200	217	264	191
1300	189	233	176
1400	167	208	161
1500	149	186	149
1600	134	168	137
1700	121	153	127
1800	110	139	117
1900	100	128	109
2000	92	117	102
2100	85	108	95
2200	78	101	89
2300	73	94	83
2400	68	88	78

Table 1. Generic Modeling Results for Fugitives, $\mu g/m^3$ per lb/hr			
Distance (feet)	Fugitives	Loading	Tank Hatches
2500	64	82	74
2600	60	77	70
2700	56	73	66
2800	53	69	63
2900	50	65	60
3000	48	62	57
3500	37	49	46
4000	30	40	38
4500	25	33	32
5000	22	28	27
5500	19	25	24

Table 2. Generic Modeling Results for Process Vents, $\mu g/m^3$ per lb/hr						
Distance (feet)	10 feet Vent	20 feet Vent	30 feet Vent	40 feet Vent	50 feet Vent	60 feet Vent
50	469	168	90	70	65	28
100	469	168	90	70	65	28
150	469	168	90	70	65	28
200	440	168	90	70	65	28
300	412	168	90	70	65	28
400	319	168	90	70	65	28
500	243	157	90	70	65	28
600	189	138	89	70	65	28

Table 2. Generic Modeling Results for Process Vents, $\mu g/m^3$ per lb/hr						
Distance (feet)	10 feet Vent	20 feet Vent	30 feet Vent	40 feet Vent	50 feet Vent	60 feet Vent
700	150	120	88	70	65	28
800	124	105	85	70	65	28
900	105	93	81	70	65	28
1000	91	84	77	69	65	26
1100	90	77	72	67	63	25
1200	89	70	68	64	61	24
1300	88	65	64	61	58	24
1400	87	61	60	58	55	24
1500	84	57	57	55	53	24
1600	82	54	53	52	50	23
1700	79	51	51	49	47	23
1800	76	50	48	47	45	22
1900	73	49	46	44	43	22
2000	70	49	44	42	41	21
2100	67	48	42	41	39	21
2200	64	47	40	39	38	20
2300	61	46	39	37	36	19
2400	59	45	37	36	35	19
2500	56	43	36	35	34	18
2600	54	42	34	33	32	18
2700	52	41	33	32	31	17
2800	50	40	32	31	30	17
2900	48	39	31	30	29	16

Table 2. Generic Modeling Results for Process Vents, $\mu g/m^3$ per lb/hr						
Distance (feet)	10 feet Vent	20 feet Vent	30 feet Vent	40 feet Vent	50 feet Vent	60 feet Vent
3000	46	37	30	29	28	16
3500	38	32	26	25	25	14
4000	32	28	24	23	22	12
4500	28	25	21	20	20	11
5000	24	22	19	18	18	10
5500	21	19	17	17	16	9

Table 3. Generic Modeling Results for Gas Compressor & Gas Pipeline Blowdown, $\mu g/m^3$ per lb/hr			
Distance (feet)	3 feet	10 feet	20 feet
50	4304	791	244
100	4304	791	244
150	4250	777	244
200	3621	763	244
300	2367	750	225
400	1607	737	225
500	1156	671	224
600	871	581	218
700	682	498	212
800	551	427	210
900	456	368	204
1000	384	320	194
1100	328	281	182
1200	284	248	170

Table 3. Generic Modeling Results for Gas Compressor & Gas Pipeline Blowdown, $\mu g/m^3$ per lb/hr			
Distance (feet)	3 feet	10 feet	20 feet
1300	249	221	159
1400	220	198	147
1500	196	178	137
1600	176	162	127
1700	159	147	118
1800	145	135	110
1900	132	124	103
2000	121	114	96
2100	112	106	90
2200	103	98	85
2300	96	91	80
2400	90	86	75
2500	84	81	71
2600	79	76	68
2700	74	72	64
2800	70	68	61
2900	67	64	58
3000	63	61	55
3500	50	48	45
4000	40	39	37
4500	34	33	31
5000	29	28	27
5500	25	24	23

Table 4. Generic Modeling Results for Combustion Units less than 250 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
50	97	85	83	81	81	71	58	44	43	36	26
100	97	85	83	81	81	71	58	44	43	36	26
150	97	85	83	81	81	71	58	44	43	36	26
200	93	85	83	81	81	71	58	44	43	36	26
300	92	85	83	81	81	71	58	44	43	36	26
400	91	85	83	81	81	71	58	44	43	36	26
500	88	85	83	81	81	71	58	44	43	36	26
600	80	79	78	78	78	70	56	44	43	36	26
700	78	77	76	76	71	68	52	44	43	36	26
800	76	75	74	74	64	63	47	44	43	36	26
900	74	73	72	72	58	58	45	44	43	36	26
1000	72	71	71	71	53	53	44	43	43	36	26
1100	69	69	69	69	49	49	42	42	41	35	25
1200	66	66	66	65	45	45	40	40	40	35	24
1300	62	62	62	62	42	42	38	38	38	33	23
1400	59	59	59	59	39	39	36	36	36	32	23
1500	56	56	56	56	37	37	34	34	34	30	23
1600	53	53	53	53	35	35	32	32	32	29	22
1700	50	50	50	50	33	33	31	31	31	28	22
1800	48	48	48	48	31	31	29	29	29	26	22
1900	46	46	46	46	30	30	28	28	28	25	22

Table 4. Generic Modeling Results for Combustion Units less than 250 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
2000	44	44	44	44	28	28	26	26	26	24	21
2100	42	42	42	42	27	27	25	25	25	23	21
2200	40	40	40	40	26	26	24	24	24	22	20
2300	38	38	38	38	25	25	23	23	23	21	20
2400	37	37	37	37	24	24	22	22	22	20	20
2500	36	36	36	36	23	23	22	22	22	20	19
2600	34	34	34	34	22	22	21	21	21	19	19
2700	33	33	33	33	21	21	20	20	20	18	18
2800	32	32	32	32	21	21	19	19	19	18	18
2900	31	31	31	31	20	20	19	19	19	17	17
3000	30	30	30	30	19	19	18	18	18	17	17
3500	26	26	26	26	17	17	16	16	16	15	15
4000	23	23	23	23	15	15	14	14	14	13	13
4500	21	21	21	21	13	13	13	13	13	12	12
5000	19	19	19	19	12	12	11	11	11	11	11
5500	17	17	17	17	11	11	11	11	11	10	10

Table 5. Generic Modeling Results for Combustion Units with 250 HP - 500 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
50	60	59	54	43	43	34	34	24	21	20	17
100	60	59	54	43	43	34	34	24	21	20	17
150	60	59	54	43	43	34	34	24	21	20	17
200	60	59	54	43	43	34	34	24	21	20	17

Table 5. Generic Modeling Results for Combustion Units with 250 HP - 500 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
300	60	59	54	43	43	34	34	24	21	20	17
400	60	59	54	43	43	34	34	24	21	20	17
500	60	59	54	43	43	34	34	24	21	20	17
600	57	57	52	41	41	34	34	24	21	20	17
700	52	52	47	38	38	31	31	24	21	20	17
800	47	47	43	34	34	28	28	24	21	20	17
900	42	42	39	31	31	26	26	23	20	20	17
1000	39	39	35	28	28	23	23	21	20	20	17
1100	37	36	32	26	26	23	23	20	20	19	17
1200	35	35	30	25	24	23	23	20	20	18	17
1300	34	34	28	24	23	23	23	20	20	18	16
1400	32	32	26	24	23	23	23	20	20	17	16
1500	31	31	24	23	23	23	23	20	20	16	16
1600	29	29	23	23	23	23	23	19	19	16	16
1700	28	28	23	23	23	23	22	19	19	16	15
1800	27	27	22	22	22	22	22	19	19	16	15
1900	25	25	22	22	22	21	21	18	18	16	15
2000	24	24	22	22	22	21	21	17	17	16	15
2100	23	23	21	21	21	20	20	17	17	16	15
2200	22	22	21	21	21	19	19	17	17	15	15
2300	21	21	20	20	20	19	19	17	16	15	14
2400	21	21	20	20	20	19	18	16	16	15	14
2500	20	20	19	19	19	18	18	16	16	14	14

Table 5. Generic Modeling Results for Combustion Units with 250 HP - 500 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
2600	19	19	19	19	19	18	17	16	16	14	13
2700	18	18	18	18	18	17	17	15	15	14	13
2800	18	18	18	18	18	17	16	15	15	13	13
2900	17	17	17	17	17	16	16	15	15	13	13
3000	17	17	17	17	17	16	15	15	15	13	13
3500	15	15	15	15	15	14	14	13	13	12	11
4000	13	13	13	13	13	13	12	12	12	11	10
4500	12	12	12	12	12	11	11	10	10	10	9
5000	11	11	11	11	11	10	10	10	10	9	9
5500	10	10	10	10	10	9	9	9	9	8	8

Table 6. Generic Modeling Results for Combustion Units 500 HP - 1000 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
50	26	25	25	25	18	18	17	13	11	11	10
100	26	25	25	25	18	18	17	13	11	11	10
150	26	25	25	25	18	18	17	13	11	11	10
200	26	25	25	25	18	18	17	13	11	11	10
300	26	25	25	25	18	18	17	13	11	11	10
400	26	25	25	25	18	18	17	13	11	11	10
500	26	25	25	25	18	18	17	13	11	11	10
600	26	25	25	25	18	18	17	13	11	11	10
700	26	25	25	25	18	18	17	13	11	11	10
800	24	24	24	24	18	18	17	13	11	11	10

Table 6. Generic Modeling Results for Combustion Units 500 HP - 1000 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
900	23	23	23	23	18	18	17	13	11	11	10
1000	21	21	21	21	17	17	17	13	11	11	10
1100	20	20	20	20	17	17	16	13	11	11	10
1200	18	18	18	18	16	16	16	12	11	11	10
1300	17	17	17	17	15	15	15	12	11	10	10
1400	17	17	17	17	14	14	14	11	11	10	10
1500	17	17	16	16	13	13	13	11	11	10	9
1600	17	17	16	16	13	13	13	11	11	10	9
1700	16	16	15	15	13	12	12	11	11	9	9
1800	16	16	15	15	13	12	12	11	11	9	9
1900	15	15	14	14	13	12	12	11	10	9	9
2000	15	15	14	14	13	12	12	11	10	9	9
2100	14	14	13	13	12	12	12	11	10	9	9
2200	14	14	13	13	12	12	12	10	10	9	9
2300	13	13	12	12	12	11	11	10	10	9	8
2400	13	13	12	12	12	11	11	10	9	9	8
2500	12	12	12	12	11	11	11	10	9	9	8
2600	12	12	11	11	11	11	11	10	9	9	8
2700	12	12	11	11	11	10	10	10	9	8	8
2800	11	11	11	11	11	10	10	9	9	8	8
2900	11	11	10	10	10	10	10	9	9	8	8
3000	11	11	10	10	10	10	10	9	9	8	8
3500	9	9	9	9	9	9	9	8	8	7	7

Table 6. Generic Modeling Results for Combustion Units 500 HP - 1000 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
4000	8	8	8	8	8	8	8	7	7	7	6
4500	7	7	7	7	7	7	7	7	6	6	6
5000	7	7	7	7	6	6	6	6	6	6	5
5500	6	6	6	6	6	6	6	6	5	5	5

Table 7. Generic Modeling Results for Combustion Units with 1000 HP - 1500 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
50	17	13	12	10	10	10	10	9	8	8	7
100	17	13	12	10	10	10	10	9	8	8	7
150	17	13	12	10	10	10	10	9	8	8	7
200	17	13	12	10	10	10	10	9	8	8	7
300	17	13	12	10	10	10	10	9	8	8	7
400	17	13	11	10	10	10	10	9	8	8	7
500	17	13	11	10	10	10	10	9	8	8	7
600	17	12	11	10	10	10	10	9	8	8	7
700	17	11	11	10	10	10	10	9	8	8	7
800	17	11	11	10	10	10	10	9	8	8	7
900	17	11	11	10	10	10	10	9	8	8	7
1000	17	11	11	10	10	10	10	9	8	8	7
1100	16	11	11	10	10	10	10	9	8	8	7
1200	15	10	10	10	9	9	9	9	8	7	7

Table 7. Generic Modeling Results for Combustion Units with 1000 HP - 1500 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
1300	15	10	10	10	9	9	9	8	8	7	7
1400	14	10	10	10	9	9	8	8	8	7	7
1500	13	10	10	10	8	8	8	8	8	7	6
1600	12	10	10	10	8	8	8	8	8	7	6
1700	12	10	10	10	8	8	8	8	8	7	6
1800	11	10	10	10	8	8	8	8	8	7	6
1900	11	10	9	9	8	8	8	7	7	7	6
2000	10	9	9	9	8	8	8	7	7	7	6
2100	10	9	9	9	8	8	8	7	7	6	6
2200	10	9	9	9	8	8	8	7	7	6	6
2300	9	9	8	8	8	8	8	7	7	6	6
2400	9	9	8	8	7	7	7	7	7	6	6
2500	9	8	8	8	7	7	7	7	6	6	5
2600	8	8	8	8	7	7	7	7	6	6	5
2700	8	8	8	8	7	7	7	7	6	6	5
2800	8	8	7	7	7	7	7	6	6	6	5
2900	8	7	7	7	7	7	7	6	6	6	5
3000	7	7	7	7	7	7	6	6	6	5	5
3500	7	6	6	6	6	6	6	6	5	5	5
4000	6	6	6	6	5	5	5	5	5	4	4
4500	5	5	5	5	5	5	5	5	4	4	4
5000	5	5	5	5	5	5	4	4	4	4	4
5500	5	4	4	4	4	4	4	4	4	4	3

Table 8. Generic Modeling Results for Combustion Units with 1500 HP - 2000 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
50	10	9	8	8	8	7	7	7	6	5	5
100	10	9	8	8	8	7	7	7	6	5	5
150	10	9	8	8	8	7	7	7	6	5	5
200	10	9	8	8	8	7	7	7	6	5	5
300	10	9	8	8	8	7	7	7	6	5	5
400	10	9	8	8	8	7	7	7	6	5	5
500	10	9	8	8	8	7	7	7	6	5	5
600	10	9	8	8	8	7	7	7	6	5	5
700	9	8	8	8	8	7	7	7	6	5	5
800	9	8	8	8	8	7	7	7	6	5	5
900	9	8	8	8	8	7	7	7	6	5	5
1000	9	8	8	8	8	7	7	7	6	5	5
1100	9	8	8	8	8	7	7	7	6	5	5
1200	8	8	7	7	7	7	7	7	6	5	5
1300	8	8	7	7	7	7	7	6	6	5	5
1400	8	8	7	7	7	7	7	6	6	5	5
1500	8	8	7	7	7	7	7	6	5	5	5
1600	8	8	7	7	7	7	7	6	5	5	5
1700	8	8	7	7	7	7	7	6	5	5	5
1800	8	8	7	7	7	7	7	6	5	5	5
1900	7	7	7	7	7	7	6	6	5	5	5
2000	7	7	7	7	7	7	6	6	5	5	5
2100	7	7	6	6	6	6	6	6	5	5	5

Table 8. Generic Modeling Results for Combustion Units with 1500 HP - 2000 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
2200	7	7	6	6	6	6	6	6	5	5	4
2300	7	7	6	6	6	6	6	6	5	5	4
2400	7	7	6	6	6	6	6	5	5	5	4
2500	6	6	6	6	6	6	6	5	5	4	4
2600	6	6	6	6	6	6	5	5	5	4	4
2700	6	6	6	6	6	5	5	5	5	4	4
2800	6	6	6	6	5	5	5	5	4	4	4
2900	6	6	5	5	5	5	5	5	4	4	4
3000	6	5	5	5	5	5	5	5	4	4	4
3500	5	5	5	5	5	4	4	4	4	4	3
4000	4	4	4	4	4	4	4	4	4	3	3
4500	4	4	4	4	4	4	4	3	3	3	3
5000	4	4	4	3	3	3	3	3	3	3	3
5500	3	3	3	3	3	3	3	3	3	3	3

Table 9. Generic Modeling Results for Combustion Units with greater than 2000 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
50	7	6	6	6	5	5	5	5	4	4	4
100	7	6	6	6	5	5	5	5	4	4	4
150	7	6	6	6	5	5	5	5	4	4	4
200	7	6	6	6	5	5	5	5	4	4	4
300	7	6	6	6	5	5	5	5	4	4	4
400	7	6	6	6	5	5	5	5	4	4	4

Table 9. Generic Modeling Results for Combustion Units with greater than 2000 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
500	7	6	6	6	5	5	5	5	4	4	4
600	7	6	6	6	5	5	5	5	4	4	4
700	7	6	6	6	5	5	5	5	4	4	4
800	6	6	6	6	5	5	5	5	4	4	4
900	6	6	6	6	5	5	5	5	4	4	4
1000	6	6	6	6	5	5	5	5	4	4	4
1100	6	6	6	6	5	5	5	5	4	4	4
1200	6	6	6	6	5	5	5	5	4	4	4
1300	6	6	6	6	5	5	5	5	4	4	4
1400	6	6	6	6	5	5	5	5	4	4	4
1500	6	6	6	6	5	5	5	5	4	4	4
1600	6	6	6	6	5	5	5	5	4	4	4
1700	6	6	6	6	5	5	5	5	4	4	4
1800	6	6	6	6	5	5	5	5	4	4	4
1900	6	6	6	5	5	5	5	5	4	4	4
2000	6	6	6	5	5	5	5	5	4	4	3
2100	5	5	5	5	5	5	5	5	4	4	3
2200	5	5	5	5	5	5	5	4	4	4	3
2300	5	5	5	5	5	5	4	4	4	4	3
2400	5	5	5	5	5	5	4	4	4	4	3
2500	5	5	5	5	4	4	4	4	4	4	3
2600	5	5	5	5	4	4	4	4	4	3	3
2700	5	5	5	5	4	4	4	4	4	3	3

Table 9. Generic Modeling Results for Combustion Units with greater than 2000 HP, $\mu g/m^3$ per lb/hr											
Dist. (feet)	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet	20 feet	25 feet	30 feet	35 feet	40 feet
2800	5	5	5	4	4	4	4	4	4	3	3
2900	4	4	4	4	4	4	4	4	4	3	3
3000	4	4	4	4	4	4	4	4	3	3	3
3500	4	4	4	4	4	4	3	3	3	3	3
4000	3	3	3	3	3	3	3	3	3	3	3
4500	3	3	3	3	3	3	3	3	3	2	2
5000	3	3	3	3	3	3	3	2	2	2	2
5500	3	3	3	3	3	2	2	2	2	2	2

Table 10. Generic Modeling Results for Flares & Thermal Destruction Devices, $\mu g/m^3$ per lb/hr					
Distance (feet)	20 feet	30 feet	40 feet	50 feet	60 feet
50	58	43	26	25	23
100	58	43	26	25	23
150	58	43	26	25	23
200	58	43	26	25	23
300	58	43	26	25	23
400	58	43	26	25	23
500	58	43	26	25	23
600	56	43	26	25	23
700	52	43	26	25	23
800	47	43	26	25	23

Table 10. Generic Modeling Results for Flares & Thermal Destruction Devices, $\mu g/m^3$ per lb/hr					
Distance (feet)	20 feet	30 feet	40 feet	50 feet	60 feet
900	45	43	26	25	23
1000	44	43	26	25	23
1100	42	41	25	24	23
1200	40	40	24	24	22
1300	38	38	23	23	21
1400	36	36	23	21	21
1500	34	34	23	21	20
1600	32	32	22	21	20
1700	31	31	22	21	20
1800	29	29	22	20	20
1900	28	28	22	20	20
2000	26	26	21	20	19
2100	25	25	21	20	19
2200	24	24	20	20	19
2300	23	23	20	19	19
2400	22	22	20	19	18
2500	22	22	19	18	18
2600	21	21	19	18	17
2700	20	20	18	17	17
2800	19	19	18	17	16
2900	19	19	17	16	16
3000	18	18	17	16	16
3500	16	16	15	14	14

Table 10. Generic Modeling Results for Flares & Thermal Destruction Devices, $\mu g/m^3$ per lb/hr					
Distance (feet)	20 feet	30 feet	40 feet	50 feet	60 feet
4000	14	14	13	12	12
4500	13	13	12	11	11
5000	11	11	11	10	10
5500	11	11	10	9	9

3.0 Land Use. Rural dispersion coefficients and flat terrain were used in the modeling. These choices are typical for oil and gas production sites.

4.0 Modeling Emissions Inventory. Fugitive, vent, blowdown, combustion units, and flare emissions were evaluated using eighty-three source groups as indicated in Table 11.

Table 11. List of Sources and Modeled Representations			
Source Name	Modeled Source ID	Modeled Source Group	Source Type
Fugitives and Loading	1MFUG	1MFUG	AREACIRC
	3MTRCKLD	3MTRCKLD	POINT
	6MTNKFUG	6MTNKFUG	POINT
Process Vent Stack	VENT10FT	VENT10FT	POINT
Process Vent Stack	VENT20FT	VENT20FT	POINT
Process Vent Stack	VENT30FT	VENT30FT	POINT
Process Vent Stack	VENT40FT	VENT40FT	POINT
Process Vent Stack	VENT50FT	VENT50FT	POINT
Process Vent Stack	VENT60FT	VENT60FT	POINT
Blowdown Stack	CMPBDWNL	CMPBDWNL	POINT
Blowdown Stack	CMPBDWNM	CMPBDWNM	POINT
Blowdown Stack	CMPBDWNH	CMPBDWNH	POINT
Combustion Unit Exhaust Stack (engine less than 250 HP)	ENG1_8F	ENG1_8F	POINT

Table 11. List of Sources and Modeled Representations			
Source Name	Modeled Source ID	Modeled Source Group	Source Type
Combustion Unit Exhaust Stack (engine less than 250 HP)	ENG1_10F	ENG1_10F	POINT
Combustion Unit Exhaust Stack (engine less than 250 HP)	ENG1_12F	ENG1_12F	POINT
Combustion Unit Exhaust Stack (engine less than 250 HP)	ENG1_14F	ENG1_14F	POINT
Combustion Unit Exhaust Stack (engine less than 250 HP)	ENG1_16F	ENG1_16F	POINT
Combustion Unit Exhaust Stack (engine less than 250 HP)	ENG1_18F	ENG1_18F	POINT
Combustion Unit Exhaust Stack (engine less than 250 HP)	ENG1_20F	ENG1_20F	POINT
Combustion Unit Exhaust Stack (engine less than 250 HP)	ENG1_25F	ENG1_25F	POINT
Combustion Unit Exhaust Stack (engine less than 250 HP)	ENG1_30F	ENG1_30F	POINT
Combustion Unit Exhaust Stack (engine less than 250 HP)	ENG1_35F	ENG1_35F	POINT
Combustion Unit Exhaust Stack (engine less than 250 HP)	ENG1_40F	ENG1_40F	POINT
Combustion Unit Exhaust Stack (engine with 250 - 500 HP)	ENG2_8F	ENG2_8F	POINT
Combustion Unit Exhaust Stack (engine with 250 - 500 HP)	ENG2_10F	ENG2_10F	POINT
Combustion Unit Exhaust Stack (engine with 250 - 500 HP)	ENG2_12F	ENG2_12F	POINT
Combustion Unit Exhaust Stack (engine with 250 - 500 HP)	ENG2_14F	ENG2_14F	POINT
Combustion Unit Exhaust Stack (engine with 250 - 500 HP)	ENG2_16F	ENG2_16F	POINT
Combustion Unit Exhaust Stack (engine with 250 - 500 HP)	ENG2_18F	ENG2_18F	POINT
Combustion Unit Exhaust Stack (engine with 250 - 500 HP)	ENG2_20F	ENG2_20F	POINT
Combustion Unit Exhaust Stack (engine with 250 - 500 HP)	ENG2_25F	ENG2_25F	POINT
Combustion Unit Exhaust Stack (engine with 250 - 500 HP)	ENG2_30F	ENG2_30F	POINT
Combustion Unit Exhaust Stack (engine with 250 - 500 HP)	ENG2_35F	ENG2_35F	POINT
Combustion Unit Exhaust Stack (engine with 250 - 500 HP)	ENG2_40F	ENG2_40F	POINT

Table 11. List of Sources and Modeled Representations			
Source Name	Modeled Source ID	Modeled Source Group	Source Type
Combustion Unit Exhaust Stack (engine with 500 - 1000 HP)	ENG3_8F	ENG3_8F	POINT
Combustion Unit Exhaust Stack (engine with 500 - 1000 HP)	ENG3_10F	ENG3_10F	POINT
Combustion Unit Exhaust Stack (engine with 500 - 1000 HP)	ENG3_12F	ENG3_12F	POINT
Combustion Unit Exhaust Stack (engine with 500 - 1000 HP)	ENG3_14F	ENG3_14F	POINT
Combustion Unit Exhaust Stack (engine with 500 - 1000 HP)	ENG3_16F	ENG3_16F	POINT
Combustion Unit Exhaust Stack (engine with 500 - 1000 HP)	ENG3_18F	ENG3_18F	POINT
Combustion Unit Exhaust Stack (engine with 500 - 1000 HP)	ENG3_20F	ENG3_20F	POINT
Combustion Unit Exhaust Stack (engine with 500 - 1000 HP)	ENG3_25F	ENG3_25F	POINT
Combustion Unit Exhaust Stack (engine with 500 - 1000 HP)	ENG3_30F	ENG3_30F	POINT
Combustion Unit Exhaust Stack (engine with 500 - 1000 HP)	ENG3_35F	ENG3_35F	POINT
Combustion Unit Exhaust Stack (engine with 500 - 1000 HP)	ENG3_40F	ENG3_40F	POINT
Combustion Unit Exhaust Stack (engine with 1000-1500 HP)	ENG4_8F	ENG4_8F	POINT
Combustion Unit Exhaust Stack (engine with 1000-1500 HP)	ENG4_10F	ENG4_10F	POINT
Combustion Unit Exhaust Stack (engine with 1000-1500 HP)	ENG4_12F	ENG4_12F	POINT
Combustion Unit Exhaust Stack (engine with 1000-1500 HP)	ENG4_14F	ENG4_14F	POINT
Combustion Unit Exhaust Stack (engine with 1000-1500 HP)	ENG4_16F	ENG4_16F	POINT
Combustion Unit Exhaust Stack (engine with 1000-1500 HP)	ENG4_18F	ENG4_18F	POINT
Combustion Unit Exhaust Stack (engine with 1000-1500 HP)	ENG4_20F	ENG4_20F	POINT
Combustion Unit Exhaust Stack (engine with 1000-1500 HP)	ENG4_25F	ENG4_25F	POINT
Combustion Unit Exhaust Stack (engine with 1000-1500 HP)	ENG4_30F	ENG4_30F	POINT
Combustion Unit Exhaust Stack (engine with 1000-1500 HP)	ENG4_35F	ENG4_35F	POINT

Table 11. List of Sources and Modeled Representations			
Source Name	Modeled Source ID	Modeled Source Group	Source Type
Combustion Unit Exhaust Stack (engine with 1000-1500 HP)	ENG4_40F	ENG4_40F	POINT
Combustion Unit Exhaust Stack (engine with 1500-2000 HP)	ENG5_8F	ENG5_8F	POINT
Combustion Unit Exhaust Stack (engine with 1500-2000 HP)	ENG5_10F	ENG5_10F	POINT
Combustion Unit Exhaust Stack (engine with 1500-2000 HP)	ENG5_12F	ENG5_12F	POINT
Combustion Unit Exhaust Stack (engine with 1500-2000 HP)	ENG5_14F	ENG5_14F	POINT
Combustion Unit Exhaust Stack (engine with 1500-2000 HP)	ENG5_16F	ENG5_16F	POINT
Combustion Unit Exhaust Stack (engine with 1500-2000 HP)	ENG5_18F	ENG5_18F	POINT
Combustion Unit Exhaust Stack (engine with 1500-2000 HP)	ENG5_20F	ENG5_20F	POINT
Combustion Unit Exhaust Stack (engine with 1500-2000 HP)	ENG5_25F	ENG5_25F	POINT
Combustion Unit Exhaust Stack (engine with 1500-2000 HP)	ENG5_30F	ENG5_30F	POINT
Combustion Unit Exhaust Stack (engine with 1500-2000 HP)	ENG5_35F	ENG5_35F	POINT
Combustion Unit Exhaust Stack (engine with 1500-2000 HP)	ENG5_40F	ENG5_40F	POINT
Combustion Unit Exhaust Stack (engine with greater than 2000 HP)	ENG6_8F	ENG6_8F	POINT
Combustion Unit Exhaust Stack (engine with greater than 2000 HP)	ENG6_10F	ENG6_10F	POINT
Combustion Unit Exhaust Stack (engine with greater than 2000 HP)	ENG6_12F	ENG6_12F	POINT
Combustion Unit Exhaust Stack (engine with greater than 2000 HP)	ENG6_14F	ENG6_14F	POINT
Combustion Unit Exhaust Stack (engine with greater than 2000 HP)	ENG6_16F	ENG6_16F	POINT
Combustion Unit Exhaust Stack (engine with greater than 2000 HP)	ENG6_18F	ENG6_18F	POINT
Combustion Unit Exhaust Stack (engine with greater than 2000 HP)	ENG6_20F	ENG6_20F	POINT
Combustion Unit Exhaust Stack (engine with greater than 2000 HP)	ENG6_25F	ENG6_25F	POINT
Combustion Unit Exhaust Stack (engine with greater than 2000 HP)	ENG6_30F	ENG6_30F	POINT

Table 11. List of Sources and Modeled Representations			
Source Name	Modeled Source ID	Modeled Source Group	Source Type
Combustion Unit Exhaust Stack (engine with greater than 2000 HP)	ENG6_35F	ENG6_35F	POINT
Combustion Unit Exhaust Stack (engine with greater than 2000 HP)	ENG6_40F	ENG6_40F	POINT
Flare	FLR_20FT	FLR_20FT	POINT
Flare	FLR_30FT	FLR_30FT	POINT
Flare	FLR_40FT	FLR_40FT	POINT
Flare	FLR_50FT	FLR_50FT	POINT
Flare	FLR_60FT	FLR_60FT	POINT

Fugitives: This source comprises all fugitive emissions from a representative oil and gas site. Fugitive emissions were represented as three sources: a circular area source with a 1 meter release height and 9 meter diameter; a point source with a 3 meter release height; and a point source with a 6 meter release height. Low level fugitive emissions occur at various locations within a plant site. Since the resulting emissions are usually well distributed throughout a site, an area source representation is appropriate. The circular area source type was selected to minimize bias of any one wind direction or source orientation. The loading and tank fugitives emissions do not release to the atmosphere through standard stacks and generally are not distributed throughout a site. The loading and tank fugitive emissions are represented by the point source characterization co-located with the circular area source using pseudo-point source parameters.

Process Vent Stacks: These sources are representative of stacks/vents not associated with truck loading or storage tanks, such as amine treaters and glycol dehydration units. Stack parameters were derived from a review of permitted sources. Seven complex oil and gas sites were reviewed resulting in a compilation of source parameters for 21 facilities. Of the 21 facilities reviewed, stack heights ranged from 12 to 39 feet, stack diameters ranged from 0.05 to 3.5 feet, exit velocities ranged from 1 to 90 feet per second, and temperatures ranged from 80 °F to 800 °F. Reasonable worst-case parameters for air dispersion modeling were derived from this review. A stack flow rate of 500 acfm at 120 °F was used in the analysis. A stack diameter of 1 foot was modeled with an exit velocity 10.6 feet per second. The stack heights modeled ranged from 10 feet to 60 feet. These sources were represented as point sources.

Compressor Blowdown Stacks and Pipeline Blowdown: These sources are representative stacks used for the temporary venting of a gas compressor or temporary venting of a gas pipeline. Stack parameters were derived from a review of industry sources. Three sites with the highest planned MSS emissions of the sites reviewed were selected in order to derive representative worst-case modeling parameters for blowdowns. A stack flow rate of 100 acfm at ambient temperature was

used in the model. A stack diameter of 6 inches was modeled with an exit velocity of 8.5 feet per second. The stack heights modeled ranged from 3 feet to 20 feet. It was determined that stack-tip downwash was not appropriate due to the small diameter of the stacks and the short duration of the activity (generally less than 30 minutes).

Combustion Units: These sources are representative of all internal combustion processes associated with reciprocating engines. Reasonable worst-case stack parameters were derived from an industry review of sources. Six engine ranges are represented in the modeling. Engine exhaust stacks were modeled as point sources with release heights of 8, 10, 12, 14, 16, 18, 20, 25, 30, 35, and 40 feet. The engine ranges and exhaust parameters are listed in table 12.

Table 12. Engine HP ranges and Exhaust parameters

Source Group	Horsepower Range	Flow (acfm)	Diameter (inches)
ENG1	Less than 250	984	6
ENG2	250 to 500	2459	8
ENG3	500 to 1000	4920	10
ENG4	1000 to 1500	8198	12
ENG5	1500 to 2000	11842	12
ENG6	Greater than 2000	16330	16

Thermal Destruction Devices: These sources are representative of all processes associated with flares and other thermal destruction devices. Representative worst-case stack parameters were derived from a review of industry thermal control devices. The most common facility found was a flare. Emission rates and stack parameter data were gathered for approximately 20 sites. The assumptions used in developing the worst-case parameters were a minimum energy value of 200 btu/scf in accordance with New Source Performance Standards, Subpart A, Section 60.18 (40 CFR 60.18) and a minimum height of 20 feet. Five sites of those reviewed had low flow values ranging from 691 to 3129 scfh. These were averaged to derive a reasonable low flow value of 2400 scfh. Flares were modeled as point sources with temperature of 1273 K (1832 °F), exit velocity of 20 m/sec (66 ft/sec), release heights of 20, 30, 40, 50, and 60 feet, and a diameter of 6 inches. The values for the exit temperature and velocity are default values for modeling flares.

Table 13. On-Property Point Source Parameter Information

Source ID	Stack Height (feet)	Stack Temp (°F)	Stack Exit Velocity (feet/sec)	Stack Diameter (feet)

Table 13. On-Property Point Source Parameter Information				
Source ID	Stack Height (feet)	Stack Temp (°F)	Stack Exit Velocity (feet/sec)	Stack Diameter (feet)
3MTRCKLD	10	Ambient	0.003	0.003
6MTNKFUG	20	Ambient	0.003	0.003
VENT10FT	10	120	10.6	1
VENT20FT	20	120	10.6	1
VENT30FT	30	120	10.6	1
VENT40FT	40	120	10.6	1
VENT50FT	50	120	10.6	1
VENT60FT	60	120	10.6	1
CMPBDWNL	3	Ambient	8.5	0.5
CMPBDWNM	10	Ambient	8.5	0.5
CMPBDWNH	20	Ambient	8.5	0.5
ENG1_8F	8	900	83.5	0.5
ENG1_10F	10	900	83.5	0.5
ENG1_12F	12	900	83.5	0.5
ENG1_14F	14	900	83.5	0.5
ENG1_16F	16	900	83.5	0.5
ENG1_18F	18	900	83.5	0.5
ENG1_20F	20	900	83.5	0.5
ENG1_25F	25	900	83.5	0.5
ENG1_30F	30	900	83.5	0.5
ENG1_35F	35	900	83.5	0.5
ENG1_40F	40	900	83.5	0.5
ENG2_8F	8	900	117.3	0.667

Table 13. On-Property Point Source Parameter Information				
Source ID	Stack Height (feet)	Stack Temp (°F)	Stack Exit Velocity (feet/sec)	Stack Diameter (feet)
ENG2_10F	10	900	117.3	0.667
ENG2_12F	12	900	117.3	0.667
ENG2_14F	14	900	117.3	0.667
ENG2_16F	16	900	117.3	0.667
ENG2_18F	18	900	117.3	0.667
ENG2_20F	20	900	117.3	0.667
ENG2_25F	25	900	117.3	0.667
ENG2_30F	30	900	117.3	0.667
ENG2_35F	35	900	117.3	0.667
ENG2_40F	40	900	117.3	0.667
ENG3_8F	8	900	151.5	0.83
ENG3_10F	10	900	151.5	0.83
ENG3_12F	12	900	151.5	0.83
ENG3_14F	14	900	151.5	0.83
ENG3_16F	16	900	151.5	0.83
ENG3_18F	18	900	151.5	0.83
ENG3_20F	20	900	151.5	0.83
ENG3_25F	25	900	151.5	0.83
ENG3_30F	30	900	151.5	0.83
ENG3_35F	35	900	151.5	0.83
ENG3_40F	40	900	151.5	0.83
ENG4_8F	8	900	174	1
ENG4_10F	10	900	174	1

Table 13. On-Property Point Source Parameter Information				
Source ID	Stack Height (feet)	Stack Temp (°F)	Stack Exit Velocity (feet/sec)	Stack Diameter (feet)
ENG4_12F	12	900	174	1
ENG4_14F	14	900	174	1
ENG4_16F	16	900	174	1
ENG4_18F	18	900	174	1
ENG4_20F	20	900	174	1
ENG4_25F	25	900	174	1
ENG4_30F	30	900	174	1
ENG4_35F	35	900	174	1
ENG4_40F	40	900	174	1
ENG5_8F	8	900	251.3	1
ENG5_10F	10	900	251.3	1
ENG5_12F	12	900	251.3	1
ENG5_14F	14	900	251.3	1
ENG5_16F	16	900	251.3	1
ENG5_18F	18	900	251.3	1
ENG5_20F	20	900	251.3	1
ENG5_25F	25	900	251.3	1
ENG5_30F	30	900	251.3	1
ENG5_35F	35	900	251.3	1
ENG5_40F	40	900	251.3	1
ENG6_8F	8	900	195.9	1.33
ENG6_10F	10	900	195.9	1.33
ENG6_12F	12	900	195.9	1.33

Table 13. On-Property Point Source Parameter Information				
Source ID	Stack Height (feet)	Stack Temp (°F)	Stack Exit Velocity (feet/sec)	Stack Diameter (feet)
ENG6_14F	14	900	195.9	1.33
ENG6_16F	16	900	195.9	1.33
ENG6_18F	18	900	195.9	1.33
ENG6_20F	20	900	195.9	1.33
ENG6_25F	25	900	195.9	1.33
ENG6_30F	30	900	195.9	1.33
ENG6_35F	35	900	195.9	1.33
ENG6_40F	40	900	195.9	1.33
FLR_20FT	20	1832	66	0.5
FLR_30FT	30	1832	66	0.5
FLR_40FT	40	1832	66	0.5
FLR_50FT	50	1832	66	0.5
FLR_60FT	60	1832	66	0.5

Table 14. Area Source Parameter Information		
Source ID	Release Height (feet)	Radius (feet)
AREA1M	3	15

5.0 Building Wake Effects (Downwash). No downwash structures were included in the analysis. No significant structures would likely exist at these types of sites that would influence dispersion.

6.0 Meteorological Data. The modeling analysis used surface data from Austin and upper air data from Victoria for the years 1983, 1984, 1986, 1987, and 1988. Since the analysis is primarily for short-term concentrations, this five-year data set would include worst-case short-term meteorological conditions that could occur anywhere in the state. The wind directions were used at 10 degree intervals to be coincident with the receptor radials. This would provide predictions along the plume centerline which is a conservative result.

7.0 Receptor Grid. The modeling analysis used a polar receptor grid with 36 radials spaced every 10 degrees from true north. Receptors were located on each radial at distances of 50, 100, 150, 200, every one hundred feet out to 3000 feet, and every five hundred feet out to 5500 feet from the sources. This was done to determine the plume centerline concentration, as indicated in Section 6.0.

8.0 Model Used and Modeling Techniques. ISCST3 (Version 02035) was used. All sources were co-located in order to minimize bias due to source configuration and wind direction. This technique also provides conservative results (higher predicted concentrations) since the cumulative impact from all sources is maximized.

Each source was modeled separately at a unitized emission rate of one pound per hour. This determined a unitized maximum predicted ground-level concentration (GLCmax) for each source. The GLCmax for each source or source group can then be divided into the ESL or standard for each compound to determine the allowable emission rate for each compound.

This document can be found in the NSRG library under document number 10989. The modeling files can be found in the NSRG library under document number 10991.

Table 15. File Listings

File Name	Description	File Extension
O&G_Generic_5500ft_1983_OTHER	Model Input File	*.BND, *.DTA, *.RUN
	Model Output File	*.GRF, *.LST, *.USF
O&G_Generic_CmpBlwdn_5500ft_1983_OTHER	Model Input File	*.BND, *.DTA, *.RUN
	Model Output File	*.GRF, *.LST, *.USF
Engines_5500ft_1983_OTHER	Model Input File	*.BND, *.DTA, *.RUN
	Model Output File	*.GRF, *.LST, *.USF
O&G_Generic_1m_6m_Fugitives_5500ft_1983_OTHER	Model Input File	*.BND, *.DTA, *.RUN
	Model Output File	*.GRF, *.LST, *.USF
O&G_Generic_Truck_Loading_5500ft_1983_OTHER	Model Input File	*.BND, *.DTA, *.RUN
	Model Output File	*.GRF, *.LST, *.USF
O&G_Generic_5500f_CU&Flares.DTA	Model Input File	*.BND, *.DTA, *.RUN
	Model Output File	*.GRF, *.LST, *.USF