

Battery Application 13-18-02-28

APPENDIX B- Gas Dispersion Information

Assumptions used in Modeling

Input 2 different scenarios:

Oil Volume (m³/d): (1) 4.5, (2) 30

Water Volume (m³/d): (1) 2.7, (2) 2.7

FORMATION GOR (m³/m³): (1) 90, (2) 90

Assumption of total gas volume (m³/d)= (1) 405, (2) 2700

H₂S volume: used gas analysis from 100/16-18-2-28 and 100/11-18-2-28 (Aug 23, 2022).

Branch Screen3 Calculator. 4.5 m3/day oil. GOR 90

Company Tundra Date Reviewed 30-Aug-22
 Facility 13-18-2-28 Name J.Abey, L. Flannery

RED are inputs

Oil (m3)	4.5 10 day avg	Treater	Flare	Tank Vent	
H2O (m3)	2.7	% volume of total	0	100	0
GOR (m3/m3)	90	m3	0	405	0
Total Gas= 405 m3					405

Mole Fraction **0.00575** Date of test Pad location includes production from the 3 wells noted below
 Averaged from 100/16-18-2-28 and 100/11-18-2-28 dated Aug 23, 2022
 Sample taken from 102/16-18-2-28 also taken but shows 0% H2S- not used in avg.

Treater	Flare	Tank Vent	
Vent Height (m)	0	Vent Height (m) 12.2	Vent Height (m) 0
Stack ID (m)	0	Stack ID (m) 0.0762	Stack ID (m) 0
point	point	point	Source

RESULTS

Flare	
Vent stack Exit Flow Rate	2.69531E-05 m3/s
Emission Rate	H2S 0.038850504 g/s
	SO2 0.073028684 g/s
Vent stack area	0.004560233 m2
Vent stack exit velocity	1.027908046 m/s



Sour Gas Flare Properties

Company Tundra Oil & Gas
Facility 13-18-2-28
Case SWB- SO2 (100/16-18-2-28)

Flow Rate

Gas Stream	flare	scrubber	total gas	
Flow Rate	0.405	0.000	0.405	10 ³ m ³ /d at 15°C and 101.3 kPa
Percentage	100.0	0.0	100.0	%
Reference Temp	15	15	15	°C

Composition (dry)

				Mole Fraction
H ₂	0.0003		0.0003	
He	0.0002		0.0002	
N ₂	0.0705		0.0705	
CO ₂	0.0181		0.0181	
H ₂ S	0.0072		0.0072	
C ₁	0.3775		0.3775	
C ₂	0.1822		0.1822	
C ₃	0.1807		0.1807	
iC ₄	0.0279		0.0279	
nC ₄	0.0757		0.0757	
iC ₅	0.0192		0.0192	
nC ₅	0.0232		0.0232	
C ₆	0.0098		0.0098	
C ₇₊	0.0075		0.0075	
Total	1.0000	0.0000	1.0000	

Gas Stream Properties

Molecular Mass	33.20	0.00	33.20	kg/kmole
Net Heating Value	60.14	0.00	60.14	10 ³ m ³ /d at 15°C and 101.3 kPa
Net Heat Release Rate	67,328	0	67,328	cal/s
Equivalent SO ₂ Inlet	0.008	0.000	0.008	t/d
Equivalent SO ₂ Inlet	0.09	0.00	0.09	g/s

Stack Parameters

Flare Stack Height	12.2	m		
Flare Stack Diameter	76.00	mm		
Actual Exit Velocity	1.03	m/s		
Length of Flame:	1.17	m		
Heat Intensity at Base	1.07	kW/m ²		Background = 1.04 kW/m ²
Conversion Efficiency	100.00	%		
Radiation Loss	25	%		(Brode => 55%, AENV => 25%)
Sensible Heat Release	50,496	cal/s		Based on conversion efficiency & radiation loss

Model Input Parameters

Effective Stack Height	13.13	m		(per EPA and Beychok, M.; 1979)
Pseudo-diameter	0.977	m		based on actual exit velocity
Actual Exit Velocity	1.03	m/s		
Exit Temperature	1273	K	1000	°C
Ambient temperature	288	K		Pseudo temperature for modelling

Emissions

SO ₂ Emission	0.091	g/s		Based on user-specified conversion efficiency
H ₂ S Emission	0.000	g/s		Based on user-specified conversion efficiency
NO _x Emission	0.008	g/s		Based on US EPA AP-42

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BUOY. FLUX = 1.116 M**4/S**3; MOM. FLUX = 0.681 M**4/S**2.

*** FULL METEOROLOGY ***

*** SCREEN AUTOMATED DISTANCES ***

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	U10M STAB	USTK (M/S)	MIX HT (M/S)	PLUME (M)	SIGMA HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
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1.	0.000	1	1.0	1.0	320.0	35.96	0.79	0.70	NO
100.	8.677	1	2.5	2.5	800.0	22.26	26.98	14.19	NO
200.	9.928	3	2.5	2.6	800.0	22.18	23.76	14.27	NO
300.	10.40	3	1.5	1.5	480.0	28.22	34.56	20.78	NO
400.	9.682	3	1.0	1.0	320.0	35.77	45.11	27.23	NO
500.	8.915	4	1.5	1.6	480.0	28.02	36.40	18.79	NO
600.	8.629	4	1.5	1.6	480.0	28.02	42.93	21.63	NO
700.	8.155	4	1.0	1.0	320.0	35.46	49.60	24.87	NO
800.	7.876	4	1.0	1.0	320.0	35.46	55.94	27.53	NO
900.	7.423	4	1.0	1.0	320.0	35.46	62.21	30.15	NO
1000.	6.903	4	1.0	1.0	320.0	35.46	68.43	32.72	NO
1100.	6.374	4	1.0	1.0	320.0	35.46	74.58	34.72	NO
1200.	5.888	4	1.0	1.0	320.0	35.46	80.69	36.65	NO
1300.	5.446	4	1.0	1.0	320.0	35.46	86.75	38.53	NO
1400.	5.048	4	1.0	1.0	320.0	35.46	92.77	40.37	NO
1500.	4.689	4	1.0	1.0	320.0	35.46	98.75	42.16	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:

283.	10.45	3	1.5	1.5	480.0	28.22	32.89	19.81	NO
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DWASH= MEANS NO CALC MADE (CONC = 0.0)

DWASH=NO MEANS NO BUILDING DOWNWASH USED

DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED

DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** SUMMARY OF SCREEN MODEL RESULTS ***

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
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SIMPLE TERRAIN	10.45	283.	0.
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** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **

Branch Screen3 Calculator 30 m3/day oil. GOR 90

Company Tundra Date Reviewed 30-Aug-22
 Facility 13-18-2-28 Name J.Abey, L. Flannery

RED are inputs

Oil (m3)	30 10 day avg		Treater	Flare	Tank Vent	
H2O (m3)	2.7	% volume of total		0	100	0
GOR (m3/m3)	90	m3		0	2700	0
Total Gas= 2700 m3						2700

Mole Fraction **0.00575** Date of test Pad location includes production from the 3 wells noted below
 Averaged from 100/16-18-2-28 and 100/11-18-2-28 dated Aug 23, 2022
 Sample taken from 102/16-18-2-28 also taken but shows 0% H2S- not used in avg.

Treater	Flare	Tank Vent	
Vent Height (m)	0	Vent Height (m) 12.2	Vent Height (m) 0
Stack ID (m)	0	Stack ID (m) 0.0762	Stack ID (m) 0
point	point	point	Source

RESULTS

Flare	
Vent stack Exit Flow Rate	0.000179688 m3/s
Emission Rate H2S	0.259003359 g/s
SO2	0.486857891 g/s
Vent stack area	0.004560233 m2
Vent stack exit velocity	6.852720303 m/s



Sour Gas Flare Properties

Company Tundra Oil & Gas
Facility 13-18-2-28
Case SWB- SO2 (100/16-18-2-28)

Flow Rate

Gas Stream	flare	scrubber	total gas	
Flow Rate	2.700	0.000	2.700	10 ³ m ³ /d at 15°C and 101.3 kPa
Percentage	100.0	0.0	100.0	%
Reference Temp	15	15	15	°C

Composition (dry)

				Mole Fraction
H ₂	0.0003		0.0003	
He	0.0002		0.0002	
N ₂	0.0705		0.0705	
CO ₂	0.0181		0.0181	
H ₂ S	0.0072		0.0072	
C ₁	0.3775		0.3775	
C ₂	0.1822		0.1822	
C ₃	0.1807		0.1807	
iC ₄	0.0279		0.0279	
nC ₄	0.0757		0.0757	
iC ₅	0.0192		0.0192	
nC ₅	0.0232		0.0232	
C ₆	0.0098		0.0098	
C ₇₊	0.0075		0.0075	
Total	1.0000	0.0000	1.0000	

Gas Stream Properties

Molecular Mass	33.20	0.00	33.20	kg/kmole
Net Heating Value	60.14	0.00	60.14	10 ³ m ³ /d at 15°C and 101.3 kPa
Net Heat Release Rate	448,855	0	448,855	cal/s
Equivalent SO ₂ Inlet	0.053	0.000	0.053	t/d
Equivalent SO ₂ Inlet	0.61	0.00	0.61	g/s

Stack Parameters

Flare Stack Height	12.2	m		
Flare Stack Diameter	76.00	mm		
Actual Exit Velocity	6.89	m/s		
Length of Flame:	2.89	m		
Heat Intensity at Base	1.22	kW/m ²		Background = 1.04 kW/m ²
Conversion Efficiency	100.00	%		
Radiation Loss	25	%		(Brode => 55%, AENV => 25%)
Sensible Heat Release	336,641	cal/s		Based on conversion efficiency & radiation loss

Model Input Parameters

Effective Stack Height	14.49	m		(per EPA and Beychok, M.; 1979)
Pseudo-diameter	0.977	m		based on actual exit velocity
Actual Exit Velocity	6.89	m/s		
Exit Temperature	1273	K	1000	°C
Ambient temperature	288	K		Pseudo temperature for modelling

Emissions

SO ₂ Emission	0.610	g/s		Based on user-specified conversion efficiency
H ₂ S Emission	0.000	g/s		Based on user-specified conversion efficiency
NO _x Emission	0.055	g/s		Based on US EPA AP-42

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BUOY. FLUX = 7.442 M**4/S**3; MOM. FLUX = 4.538 M**4/S**2.

*** FULL METEOROLOGY ***

*** SCREEN AUTOMATED DISTANCES ***

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	U10M STAB	USTK (M/S)	MIX HT (M/S)	PLUME (M)	SIGMA HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
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1.	0.000	1	1.0	1.0	320.0	108.56	1.33	1.28	NO
100.	2.137	2	5.0	5.1	1600.0	33.31	19.63	11.25	NO
200.	13.94	2	5.0	5.1	1600.0	33.31	36.56	20.93	NO
300.	14.84	3	5.0	5.2	1600.0	33.10	34.70	21.01	NO
400.	14.68	3	4.5	4.7	1440.0	35.17	45.04	27.10	NO
500.	13.57	3	3.5	3.6	1120.0	41.07	55.29	33.31	NO
600.	12.69	4	5.0	5.3	1600.0	32.76	43.03	21.84	NO
700.	12.44	4	5.0	5.3	1600.0	32.76	49.46	24.59	NO
800.	11.91	4	4.5	4.8	1440.0	34.79	55.87	27.40	NO
900.	11.38	4	4.0	4.2	1280.0	37.32	62.23	30.18	NO
1000.	10.88	4	3.5	3.7	1120.0	40.58	68.53	32.95	NO
1100.	10.30	4	3.0	3.2	960.0	44.93	74.82	35.22	NO
1200.	9.798	4	3.0	3.2	960.0	44.93	80.91	37.12	NO
1300.	9.295	4	3.0	3.2	960.0	44.93	86.95	38.98	NO
1400.	8.893	4	2.5	2.6	800.0	51.02	93.14	41.20	NO
1500.	8.525	4	2.5	2.6	800.0	51.02	99.09	42.96	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:

336.	15.15	3	5.0	5.2	1600.0	33.10	38.52	23.23	NO
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DWASH= MEANS NO CALC MADE (CONC = 0.0)

DWASH=NO MEANS NO BUILDING DOWNWASH USED

DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED

DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** SUMMARY OF SCREEN MODEL RESULTS ***

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
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SIMPLE TERRAIN	15.15	336.	0.
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** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
