

# APPENDIX A – INLET FLOWMETER CALIBRATION REPORT

## GoR 5-10-50-5(GoR )-Sensor1 Calibration Report

### Summary Information

Flow Computer ID: GoR  
Operator's PC Date: 5/24/2019 9:08:50AM  
Flow Computer Date: 5/24/2019 9:02:24AM  
Meter data reporting period: 1 second

### Run 1 Information

Sensor Type: 4203 DS                      Sensor Tag:                      Run ID: GoR Unit #  
T0 25477  
Flow Run Type: Gas

### Meter Parameters

Flow Calculation Type: AGA-3 (1992)  
Compressibility Calculation Type: AGA-8 Detailed  
Differential Pressure at Zero Scale: 0.000 kPa  
Differential Pressure at Full Scale: 75.000 kPa  
Static Pressure at Zero Scale: -0.000008 kPa  
Static Pressure at Full Scale: 10342.133789 kPa  
Temperature at Zero Scale: -17.778 C  
Temperature at Full Scale: 93.333 C  
Static Pressure tap location: Up Stream  
Static Pressure tap type: Gage Pressure  
Atmospheric Pressure: 93.812 kPa

### Flow Configuration

Orifice Material: Type 304 & 316 stainless steel  
Pipe Material: Carbon Steel  
Orifice Diameter: 3.000 mm  
Orifice Reference Temperature: 68.00 C  
Pipe Diameter: 4.026 mm  
Pipe Reference Temperature: 68.00 C  
Isentropic Exponent: 1.3000  
Viscosity: 0.010268 cP  
Flow Extension: Method 1

### Gas Analysis

Methane CH4:	100.000%
Nitrogen:	0.000%
Carbon Dioxide:	0.000%
Ethane C2H6:	0.000%
Propane C3H8:	0.000%
Water:	0.000%
Hydrogen Sulfide:	0.000%
Hydrogen:	0.000%
Carbon Monoxide:	0.000%
Oxygen:	0.000%
i-Butane:	0.000%
n-Butane:	0.000%
i-Pentane:	0.000%
n-Pentane:	0.000%
Helium:	0.000%
Argon:	0.000%
n-Hexane:	0.000%
n-Heptane:	0.000%
n-Octane:	0.000%
n-Nonane:	0.000%
n-Decane:	0.000%
Configuration Events:	Log Changes
Relative Density (Specific Gravity):	Calculated
Heating Value:	Calculated

GoR 5-10-50-5(GoR )-Sensor1 Calibration Report

Current Run Readings for As Found of Run 1

Time as found: Friday, May 24, 2019 09:09:05  
 Flow Volume as found: 0.002 E3m3  
 Static Pressure as found: -1.802 kPag  
 Differ. Pressure as found: 0.199 kPa  
 Temperature as found: 0.000 C  
 Monthly Volume as found: 0.002 E3m3

Calibrate Sensor1

Temperature: Lower Range Limit: -200.000000 Upper Range Limit: 650.000000

Static Pressure: Lower Range Limit: -93.812050 Upper Range Limit: 10248.322266

Differential Pressure: Lower Range Limit: -74.592323 Upper Range Limit: 74.592323

Forced value of Static Pressure: 0.000 kPag

Forced value of Differential Pressure: 0.199 kPa

As Found For Differential Pressure: Applied: 0.000 Measured: 0.201 kPa

Deviation: 0.269%

As Found For Differential Pressure: Applied: 75.000 Measured: 75.257 kPa

Deviation: 0.344%

Sensor Span Calibration for Differential Pressure: Applied value: 75.000

Measured Value: 75.163 kPa

After Span for Differential Pressure: Applied Value: 75.000 Measured Value:

75.008 kPa

Sensor Re-zero for Differential Pressure: Applied Value: 0.000 Measured

Value: 0.146 kPa

After Re-Zero for Differential Pressure: Applied value: 0.000 Measured

Value: -0.001 kPa

Sensor Span Calibration for Differential Pressure: Applied Value: 0.000

Measured Value: 74.826 kPa

After Span for Differential Pressure: Applied Value: 0.000 Measured Value:

74.821 kPa

Sensor Span Calibration for Differential Pressure: Applied value: 75.000

Measured Value: 74.818 kPa

After Span for Differential Pressure: Applied Value: 75.000 Measured Value:

75.000 kPa

As Left For Differential Pressure: Applied: 0.000 Measured: -0.002 kPa

Deviation: -0.003%

As Left For Differential Pressure: Applied: 18.750 Measured: 18.790 kPa

Deviation: 0.053%

As Left For Differential Pressure: Applied: 37.500 Measured: 37.538 kPa

Deviation: 0.051%

As Left For Differential Pressure: Applied: 56.250 Measured: 56.280 kPa

Deviation: 0.040%

As Left For Differential Pressure: Applied: 75.000 Measured: 75.040 kPa

Deviation: 0.053%

As Found for Static Pressure: Applied: 0.000 Measured: -1.900 kPag

Deviation: -0.019%

As Found for Static Pressure: Applied: 10000 Measured: 10006 kPag

Deviation: 0.0650%

Sensor Re-zero for Static Pressure: Applied Value: 0.000 Measured Value:

-0.381 kPag

After Re-Zero for Static Pressure: Applied Value: 0.000 Measured Value:

-0.100 kPag

Sensor Re-zero for Static Pressure: Applied Value: 0.000 Measured Value:

-0.099 kPag

After Re-Zero for Static Pressure: Applied Value: 0.000 Measured Value:

-0.085 kPag

Sensor Re-zero for Static Pressure: Applied Value: 0.000 Measured Value:

-0.090 kPag

After Re-Zero for Static Pressure: Applied Value: 0.000 Measured Value:

-0.027 kPag

GOR 5-10-50-5(GoR )-Sensor1 Calibration Report

Sensor Span Calibration for Static Pressure: Applied Value: 10000.000  
Measured Value: 10007.772 kPag  
After Span for Static Pressure: Applied Value: 10000.000 Measured Value:  
10003.447 kPag  
As Left for Static Pressure: Applied: 10000.000 Measured: 9999.965  
kPag Deviation: -0.000%  
As Left for Static Pressure: Applied: 7500.000 Measured: 7499.917  
kPag Deviation: -0.001%  
As Left for Static Pressure: Applied: 5000.000 Measured: 4999.109  
kPag Deviation: -0.009%  
As Left for Static Pressure: Applied: 2500.000 Measured: 2499.348  
kPag Deviation: -0.006%  
As Left for Static Pressure: Applied: 0.000 Measured: -0.976 kPag  
Deviation: -0.010%

Current Run Readings for As Left of Run 1  
Time as left: Friday, May 24, 2019 09:30:40  
Flow Volume as left: 0.004 E3m3  
Static Pressure as left: -0.937 kPag  
Differ. Pressure as left: 0.481 kPa  
Temperature as left: 0.000 C  
Monthly Volume as left: 0.004 E3m3

User Comments:  
Calibration Information Guest Controls S/N: T0 25186

Lease Number: 5-10-50-5 w4m

Name of Purchaser: Sask Gov / Husky Energy

Normal Operating Static Pressure (SP): TBD

Normal Operating Differential Pressure (DP): TBD

Test Equipment Calibration Date: JUNE 2018

Test Equipment Producer or Seller: Crystal 30 series

# APPENDIX B – GAS CHROMATOGRAPHS



## Gas Analysis Report

Test sample no. and date code
<b>05-10-0-05282019</b>

Time of sample analysis
5/28/2019 02:40:00 PM

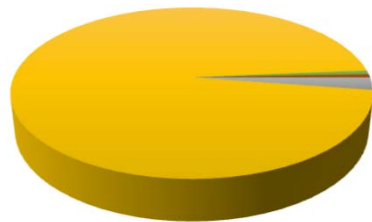
Pressure	kPa	PSI
	96.52664	14

Current Conditions		
Heat Rate	10.0	MMBTU/hr
Pressure	700	PSI
Water flow	16	GPM
Equivalence	0.97	Ratio
Air flow	687	SCFM
Fuel Flow	69.52	SCFM

	External standard %			Normalized
	Run 1	Run 2	Average	
Helium	0.012489	0.01318	0.0128345	0.012912215
Hydrogen	0	0	0	0
Oxygen	0	0	0	0
Nitrogen	2.358129	2.357292	2.3577105	2.371986836
Methane	95.751944	95.631755	95.6918495	96.27127986
CO	0	0	0	0
Carbon Dioxide	0.681842	0.693587	0.6877145	0.691878728
Ethene	0	0	0	0
Ethane	0.625225	0.64368	0.6344525	0.638294217
Hydrogen Sulphid	0.000235	0.000588	0.0004115	0.000413992
Propane	0.013506	0.012803	0.0131545	0.013234153
Propene	0	0	0	0
i-Butane	0	0	0	0
n-Butane	0	0	0	0
i-Pentane	0	0	0	0
n-Pentane	0	0	0	0
n-Hexane	0	0	0	0
<b>total</b>			<b>99.385293</b>	<b>100</b>

Sample ID

**05-10-0-05282019**



- Hydrogen    ■ Oxygen    ■ Nitrogen
- Methane    ■ CO    ■ CO2
- Ethene    ■ Ethane    ■ H2S
- Propane    ■ Propene    ■ i-Butane
- n-Butane    ■ i-Pentane    ■ n-Pentane
- n-Hexane



Gas Analysis Report

Test sample no. and date code
<b>05-10-1-05282019</b>

Time of sample analysis
5/28/2019 02:18:00 PM

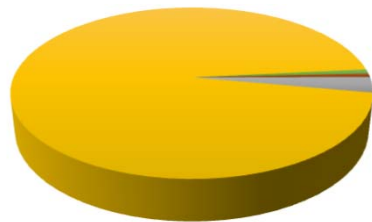
Pressure	kPa	PSI
	6.89476	1

Current Conditions		
Heat Rate	10.0	MMBTU/hr
Pressure	700	PSI
Water flow	16	GPM
Equivalence	0.97	Ratio
Air flow	687	SCFM
Fuel Flow	69.52	SCFM

	External standard %			Normalized
	Run 1	Run 2	Average	
Helium	0.011601	0.010465	0.011033	0.011281331
Hydrogen	0	0	0	0
Oxygen	0	0	0	0
Nitrogen	2.812297	2.805048	2.8086725	2.871890081
Methane	93.92702	92.985967	93.4564935	95.5600116
CO	0	0	0	0
Carbon Dioxide	0.773386	0.763354	0.76837	0.785664467
Ethene	0	0	0	0
Ethane	0.656354	0.634217	0.6452855	0.659809582
Hydrogen Sulphid	0	0	0	0
Propane	0.04081	0.019746	0.030278	0.030959497
Propene	0	0	0	0
i-Butane	0.036234	0.013607	0.0249205	0.02548141
n-Butane	0.059999	0.020853	0.040426	0.041335908
i-Pentane	0.026535	0	0.0132675	0.013566125
n-Pentane	0	0	0	0
n-Hexane	0	0	0	0
<b>total</b>			<b>97.7877135</b>	<b>100</b>

Sample ID

**05-10-1-05282019**



- Hydrogen    ■ Oxygen    ■ Nitrogen
- Methane    ■ CO    ■ CO2
- Ethene    ■ Ethane    ■ H2S
- Propane    ■ Propene    ■ i-Butane
- n-Butane    ■ i-Pentane    ■ n-Pentane
- n-Hexane



Gas Analysis Report

Test sample no. and date code
<b>05-10-2-05282019</b>

Time of sample analysis
5/28/2019 03:09:00 PM

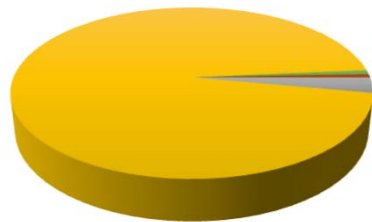
Pressure	kPa	PSI
	6.89476	1

Current Conditions		
Heat Rate	10.0	MMBTU/hr
Pressure	700	PSI
Water flow	16	GPM
Equivalence	0.97	Ratio
Air flow	687	SCFM
Fuel Flow	69.52	SCFM

	External standard %			Normalized
	Run 1	Run 2	Average	
Helium	0.011107	0.011551	0.011329	0.011494007
Hydrogen	0	0	0	0
Oxygen	0.035555	0.034422	0.0349885	0.035498109
Nitrogen	2.85802	2.846868	2.852444	2.893989946
Methane	94.318939	94.214577	94.266758	95.63975661
CO	0	0	0	0
Carbon Dioxide	0.738301	0.738049	0.738175	0.748926545
Ethene	0	0	0	0
Ethane	0.642267	0.647919	0.645093	0.654488802
Hydrogen Sulphid	0.001	0.000706	0.000853	0.000865424
Propane	0.015029	0.014502	0.0147655	0.01498056
Propene	0	0	0	0
i-Butane	0	0	0	0
n-Butane	0	0	0	0
i-Pentane	0	0	0	0
n-Pentane	0	0	0	0
n-Hexane	0	0	0	0
<b>total</b>			<b>98.553077</b>	<b>100</b>

Sample ID

**05-10-2-05282019**



- Hydrogen    ■ Oxygen    ■ Nitrogen
- Methane    ■ CO    ■ CO2
- Ethene    ■ Ethane    ■ H2S
- Propane    ■ Propene    ■ i-Butane
- n-Butane    ■ i-Pentane    ■ n-Pentane
- n-Hexane



Gas Analysis Report

Test sample no. and date code
<b>05-10-3-05282019</b>

Time of sample analysis
5/28/2019 05:19:00 PM

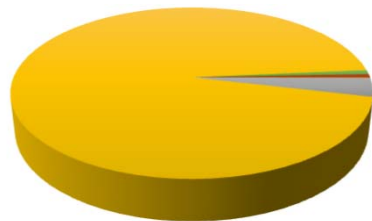
Pressure	kPa	PSI
	6.89476	1

Current Conditions		
Heat Rate	10.0	MMBTU/hr
Pressure	700	PSI
Water flow	16	GPM
Equivalence	0.97	Ratio
Air flow	687	SCFM
Fuel Flow	69.52	SCFM

	External standard %			Normalized
	Run 1	Run 2	Average	
Helium	0.011502	0.010762	0.011132	0.011372126
Hydrogen	0	0	0	0
Oxygen	0.096248	0.108075	0.1021615	0.1043652
Nitrogen	3.457444	3.471105	3.4642745	3.53900149
Methane	93.259639	92.585688	92.9226635	94.92707479
CO	0	0	0	0
Carbon Dioxide	0.721716	0.725547	0.7236315	0.739240772
Ethene	0	0	0	0
Ethane	0.644108	0.644279	0.6441935	0.658089235
Hydrogen Sulphid	0	0	0	0
Propane	0.014853	0.015058	0.0149555	0.015278101
Propene	0	0	0	0
i-Butane	0.005321	0.0056	0.0054605	0.005578287
n-Butane	0	0	0	0
i-Pentane	0	0	0	0
n-Pentane	0	0	0	0
n-Hexane	0	0	0	0
<b>total</b>			<b>97.8773405</b>	<b>100</b>

Sample ID

**05-10-3-05282019**



- Hydrogen    ■ Oxygen    ■ Nitrogen
- Methane    ■ CO    ■ CO2
- Ethene    ■ Ethane    ■ H2S
- Propane    ■ Propene    ■ i-Butane
- n-Butane    ■ i-Pentane    ■ n-Pentane
- n-Hexane



Gas Analysis Report

Test sample no. and date code
<b>05-10-4-05282019</b>

Time of sample analysis
5/28/2019 06:30:00 PM

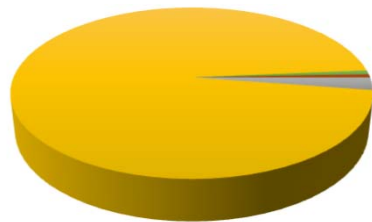
Pressure	kPa	PSI
	6.89476	1

Current Conditions		
Heat Rate	10.0	MMBTU/hr
Pressure	700	PSI
Water flow	16	GPM
Equivalence	0.97	Ratio
Air flow	687	SCFM
Fuel Flow	69.52	SCFM

	External standard %			Normalized
	Run 1	Run 2	Average	
Helium	0.010712	0.011206	0.010959	0.01105603
Hydrogen	0	0	0	0
Oxygen	0.025498	0.025356	0.025427	0.02565213
Nitrogen	2.356456	2.346698	2.351577	2.372397756
Methane	95.622648	95.145477	95.3840625	96.22858865
CO	0	0	0	0
Carbon Dioxide	0.70382	0.69389	0.698855	0.70504263
Ethene	0	0	0	0
Ethane	0.647062	0.630791	0.6389265	0.644583526
Hydrogen Sulphid	0	0	0	0
Propane	0.012978	0.012158	0.012568	0.012679277
Propene	0	0	0	0
i-Butane	0	0	0	0
n-Butane	0	0	0	0
i-Pentane	0	0	0	0
n-Pentane	0	0	0	0
n-Hexane	0	0	0	0
total			99.111416	100

Sample ID

**05-10-4-05282019**



- Hydrogen    ■ Oxygen    ■ Nitrogen
- Methane    ■ CO    ■ CO2
- Ethene    ■ Ethane    ■ H2S
- Propane    ■ Propene    ■ i-Butane
- n-Butane    ■ i-Pentane    ■ n-Pentane
- n-Hexane





Gas Analysis Report

Test sample no. and date code
<b>05-10-1-05292019</b>

Time of sample analysis
5/29/2019 08:45:00 AM

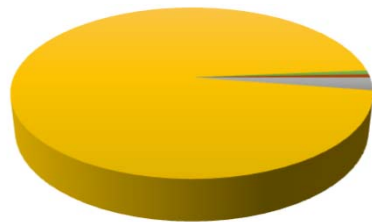
Pressure	kPa	PSI
	6.89476	1

Current Conditions		
Heat Rate	10.0	MMBTU/hr
Pressure	700	PSI
Water flow	16	GPM
Equivalence	0.97	Ratio
Air flow	687	SCFM
Fuel Flow	69.52	SCFM

	External standard %			Normalized
	Run 1	Run 2	Average	
Helium	0.013131	0.010515	0.011823	0.011968688
Hydrogen	0	0	0	0
Oxygen	0.032722	0.033714	0.033218	0.033627325
Nitrogen	2.369838	2.378202	2.37402	2.40327362
Methane	94.994234	95.044848	95.019541	96.19040962
CO	0	0	0	0
Carbon Dioxide	0.697922	0.695351	0.6966365	0.705220732
Ethene	0	0	0	0
Ethane	0.636657	0.633103	0.63488	0.642703244
Hydrogen Sulphid	0	0	0	0
Propane	0.01289	0.012392	0.012641	0.012796767
Propene	0	0	0	0
i-Butane	0	0	0	0
n-Butane	0	0	0	0
i-Pentane	0	0	0	0
n-Pentane	0	0	0	0
n-Hexane	0	0	0	0
<b>total</b>			<b>98.7709365</b>	<b>100</b>

Sample ID

**05-10-1-05292019**



- Hydrogen    ■ Oxygen    ■ Nitrogen
- Methane    ■ CO    ■ CO2
- Ethene    ■ Ethane    ■ H2S
- Propane    ■ Propene    ■ i-Butane
- n-Butane    ■ i-Pentane    ■ n-Pentane
- n-Hexane



Gas Analysis Report

Test sample no. and date code
<b>05-10-2-05292019</b>

Time of sample analysis
5/29/2019 10:34:00 AM

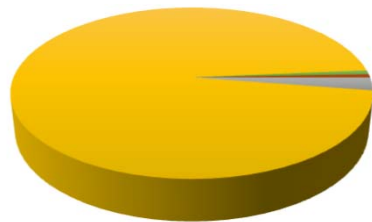
Pressure	kPa	PSI
	6.89476	1

Current Conditions		
Heat Rate	10.0	MMBTU/hr
Pressure	700	PSI
Water flow	16	GPM
Equivalence	0.97	Ratio
Air flow	687	SCFM
Fuel Flow	69.52	SCFM

	External standard %			Normalized
	Run 1	Run 2	Average	
Helium	0.012045	0.01165	0.0118475	0.011945552
Hydrogen	0	0	0	0
Oxygen	0.035839	0.034847	0.035343	0.035635506
Nitrogen	2.412774	2.3927	2.402737	2.422622552
Methane	95.713275	95.055747	95.384511	96.17393309
CO	0	0	0	0
Carbon Dioxide	0.689151	0.690512	0.6898315	0.695540689
Ethene	0	0	0	0
Ethane	0.643808	0.64171	0.642759	0.648078607
Hydrogen Sulphid	0	0	0	0
Propane	0.012363	0.011924	0.0121435	0.012244002
Propene	0	0	0	0
i-Butane	0	0	0	0
n-Butane	0	0	0	0
i-Pentane	0	0	0	0
n-Pentane	0	0	0	0
n-Hexane	0	0	0	0
<b>total</b>			<b>99.167325</b>	<b>100</b>

Sample ID

**05-10-2-05292019**



- Hydrogen    ■ Oxygen    ■ Nitrogen
- Methane    ■ CO    ■ CO2
- Ethene    ■ Ethane    ■ H2S
- Propane    ■ Propene    ■ i-Butane
- n-Butane    ■ i-Pentane    ■ n-Pentane
- n-Hexane



Gas Analysis Report

Test sample no. and date code
<b>05-10-3-05292019</b>

Time of sample analysis
5/29/2019 01:09:00 PM

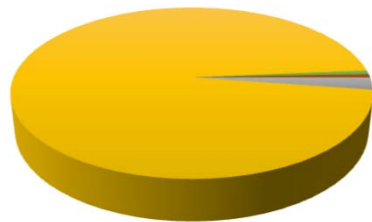
Pressure	kPa	PSI
	6.89476	1

Current Conditions		
Heat Rate	10.0	MMBTU/hr
Pressure	700	PSI
Water flow	16	GPM
Equivalence	0.97	Ratio
Air flow	687	SCFM
Fuel Flow	69.52	SCFM

	External standard %			Normalized
	Run 1	Run 2	Average	
Helium	0.012983	0.012539	0.012761	0.012849684
Hydrogen	0	0	0	0
Oxygen	0	0	0	0
Nitrogen	2.302926	2.320769	2.3118475	2.327913994
Methane	95.310307	95.972165	95.641236	96.30590759
CO	0	0	0	0
Carbon Dioxide	0.693688	0.688092	0.69089	0.695691433
Ethene	0	0	0	0
Ethane	0.645692	0.635544	0.640618	0.645070061
Hydrogen Sulphid	0	0	0	0
Propane	0.012949	0.012012	0.0124805	0.012567235
Propene	0	0	0	0
i-Butane	0	0	0	0
n-Butane	0	0	0	0
i-Pentane	0	0	0	0
n-Pentane	0	0	0	0
n-Hexane	0	0	0	0
<b>total</b>			<b>99.297072</b>	<b>100</b>

Sample ID

**05-10-3-05292019**



- Hydrogen    ■ Oxygen    ■ Nitrogen
- Methane    ■ CO    ■ CO2
- Ethene    ■ Ethane    ■ H2S
- Propane    ■ Propene    ■ i-Butane
- n-Butane    ■ i-Pentane    ■ n-Pentane
- n-Hexane



Gas Analysis Report

Test sample no. and date code
<b>05-10-4-05292019</b>

Time of sample analysis
5/29/2019 02:52:00 PM

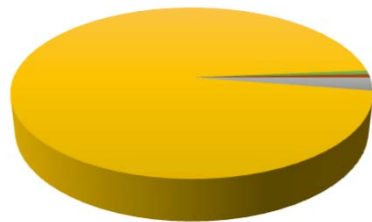
Pressure	kPa	PSI
	6.89476	1

Current Conditions		
Heat Rate	10.0	MMBTU/hr
Pressure	700	PSI
Water flow	16	GPM
Equivalence	0.97	Ratio
Air flow	687	SCFM
Fuel Flow	69.52	SCFM

	External standard %			Normalized
	Run 1	Run 2	Average	
Helium	0.012637	0.01244	0.0125385	0.012624711
Hydrogen	0	0	0	0
Oxygen	0.037822	0.04278	0.040301	0.040578099
Nitrogen	2.440096	2.457103	2.4485995	2.465435404
Methane	95.645939	95.295825	95.470882	96.1273138
CO	0	0	0	0
Carbon Dioxide	0.693386	0.685018	0.689202	0.693940765
Ethene	0	0	0	0
Ethane	0.646334	0.640725	0.6435295	0.647954234
Hydrogen Sulphid	0	0	0	0
Propane	0.012363	0.011777	0.01207	0.01215299
Propene	0	0	0	0
i-Butane	0	0	0	0
n-Butane	0	0	0	0
i-Pentane	0	0	0	0
n-Pentane	0	0	0	0
n-Hexane	0	0	0	0
<b>total</b>			<b>99.304584</b>	<b>100</b>

Sample ID

**05-10-4-05292019**



- Hydrogen    ■ Oxygen    ■ Nitrogen
- Methane    ■ CO    ■ CO2
- Ethene    ■ Ethane    ■ H2S
- Propane    ■ Propene    ■ i-Butane
- n-Butane    ■ i-Pentane    ■ n-Pentane
- n-Hexane

# APPENDIX C – INLET CONDITIONS

BGR Combustor Test Lab Book Data

Flowmeter: SCADASense      Model: 4203-05222101UAI-L

10% Flowrate Tests      Date: 28-May-19

P atm = 93.5 kPa

Run #1

Time	Flowrate (decs)	Flowrate (m3/day)	Pressure (kPa)	Temperature (°C)	Samples
12:50	0.2975	297.5	7.00	29.1	Inlet gas sample #1
13:00	0.3001	300.1	6.23	29.1	
13:10	0.3008	300.8	7.58	29.1	
13:20	0.2894	289.4	4.15	29.2	
13:30	0.3393	339.3	7.777	29.4	
13:40	0.3222	322.2	7.545	29.4	
13:50	0.3012	301.2	7.464	29.7	Suma canister #4
Average	0.3072	307.2	6.82	29.3	
Remove outliers	0.3102	310.2	7.27	29.3	

Run #2

Time	Flowrate (decs)	Flowrate (m3/day)	Pressure (kPa)	Temperature (°C)	Samples
15:00	0.399	399	1.14	30.6	Inlet gas sample #2
15:10	0.3359	335.9	1.004	30.6	
15:20	0.3488	348.8	1.18	30.7	
15:30	0.3677	367.7	1.14	30.4	
15:32	Burner flame out				
15:47	Restart combustor				
15:48	0.3008	300.8	0.789	32.4	
15:58	0.3491	349.1	1.047	32.5	
16:08	0.3469	346.9	1.11	32.5	
16:18	0.2679	267.9	0.45	31.5	Suma canister #5
Average	0.3395	339.5	0.98	31.4	
Remove outliers	0.3497	346.8	1.06	31.4	

Run #3

Time	Flowrate (decs)	Flowrate (m3/day)	Pressure (kPa)	Temperature (°C)	Samples
17:06	0.3004	300.4	1.14	33.6	Inlet gas sample #3
17:16	0.3429	342.9	1.16	33.7	
17:26	0.3819	381.9	2.77	33.1	
17:36	0.3835	383.5	3.02	32.8	
17:46	0.3885	388.5	1.343	32.3	
17:56	0.4024	402.4	1.261	31.8	
18:06	0.3242	324.2	1.00	31.4	Inlet gas sample #4
Average	0.36054	360.5	1.67	32.7	Tedlar bag

100% Flowrate Tests

Date: 29-May-19

P atm = 28.1 in Hg

Run #4

Time	Flowrate (decs)	Flowrate (m3/day)	Pressure (kPa)	Temperature (°C)	Samples
9:25	2.53	2530	14.53	26.4	Inlet gas sample #1
9:35	2.677	2677	16.99	26.4	
9:45	2.65	2650	17.60	26.7	
9:55	2.734	2734	18.17	27	
10:05	2.698	2698	17.11	27.3	
10:15	2.702	2702	16.803	27.5	
10:25	2.654	2654	16.45	27.7	Inlet gas sample #2
Average	2.664	2664	16.81	27.0	Tedlar bag

Run #2

Time	Flowrate (decs)	Flowrate (m3/day)	Pressure (kPa)	Temperature (°C)	Combustor Skin Temp (°C)	Samples
11:13	2.48	2480	13.40	28.6	170	
11:23	2.579	2579	14.40	28.7	184	
11:33	2.6442	2644.2	15.60	29.0	227	
11:43	2.360	2360	10.53	29.2	270	
11:53	2.6278	2627.8	14.32	29.3	275	
12:03	2.678	2678	16.02	29.5	284	
12:13	2.683	2683	15.93	29.6	282	
Average	2.579	2579	14.31	29.1	242	Tedlar bag

Run #3

Time	Flowrate (decs)	Flowrate (m3/day)	Pressure (kPa)	Temperature (°C)	Combustor Skin Temp (°C)	Samples
13:07	2.700	2700	15.40	30.2	105	Inlet gas sample #3
13:17	2.394	2394	11.90	30.3	128	
13:27	2.613	2613	13.40	30.4	204	
13:37	2.650	2650	15.03	30.5	239	
13:47	2.329	2329	10.25	30.6	269	
13:57	2.543	2543	13.16	30.8	289	
14:07	2.591	2591	13.09	30.7	309	Inlet gas sample #4
Average	2.546	2546	13.18	30.5	220	Tedlar bag

## APPENDIX D - STACK TESTING RESULTS

The raw data, computer printouts, and example calculations are contained in the first section of this Appendix, while the calibration data is contained in the second section, along with the operator certification. Gas measurements for moisture, oxygen, carbon dioxide and carbon monoxide (for stack gas molecular weight determination) were performed during the tests.

**Tables D-1** and **D-2** contain the speciated reduced sulfur compound (RSC) results for both inlet feed line and combustor exhaust under both flow conditions. Similarly, **Tables D-3** and **D-4** contain the speciated volatile organic compound (VOC) test results, including NMHC, BTEX and methane for both the fuel feed inlet and combustor exhaust under both load conditions.

**Table D-1: RSC Test Results – BGR-36LP Combustor Inlet- May 28 & 29, 2019**

Test ID:	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Date:	Inlet - May 28, 2019 (10% Load)		Inlet - May 29, 2019 (100% Load)			
Start time:	12:38	14:36	17:13	9:28	11:12	13:11
End Time:	-	-	-	-	-	-
Compound	Concentration (ppm)					
2,5-Dimethylthiophene	<0.0003	<0.0031	<0.0020	<0.0020	<0.0020	-
2-Ethylthiophene	<0.0002	<0.0020	<0.0013	<0.0013	<0.0013	-
2-Methylthiophene	<0.0002	<0.0020	<0.0013	<0.0013	<0.0013	-
3-Methylthiophene	<0.0003	<0.0031	<0.0020	<0.0020	<0.0020	-
Butyl mercaptan	<0.0003	<0.0031	<0.0020	<0.0020	<0.0020	-
Carbon disulphide	0.0018	<0.0020	<0.0013	<0.0013	<0.0013	-
Carbonyl sulphide	0.0015	<0.0031	<0.0020	<0.0020	0.0020	-
Dimethyl disulphide	0.0049	<0.0020	<0.0013	<0.0013	<0.0013	-
Dimethyl sulphide	0.15	0.24	<0.0013	<0.0013	<0.0013	-
Ethyl mercaptan	<0.0003	0.015	<0.0020	<0.0020	<0.0020	-
Ethyl sulphide	<0.0003	<0.0031	<0.0020	<0.0020	<0.0020	-
Hydrogen sulphide	<0.0001	0.57	0.44	0.36	0.54	-
Isobutyl mercaptan	<0.0003	<0.0031	<0.0020	<0.0020	<0.0020	-
Isopropyl mercaptan	<0.0003	0.0042	<0.0020	<0.0020	<0.0020	-
Methyl mercaptan	<0.0002	0.014	0.0066	<0.0013	<0.0013	-
Pentyl mercaptan	<0.0004	<0.0041	<0.0027	<0.0027	<0.0027	-
Propyl mercaptan	<0.0004	<0.0041	<0.0027	<0.0027	<0.0027	-
tert-Butyl mercaptan	<0.0003	<0.0031	<0.0020	<0.0020	<0.0020	-
Thiophene	0.0002	<0.0020	<0.0013	<0.0013	<0.0013	-
<b>Total RSC Concentration*</b>	<b>0.15</b>	<b>0.84</b>	<b>0.45</b>	<b>0.36</b>	<b>0.54</b>	<b>-</b>

<b>Total RSC Concentration (mg/drm<sup>3</sup>)<sup>+</sup>*</b>	<b>0.22</b>	<b>1.17</b>	<b>0.62</b>	<b>0.50</b>	<b>0.75</b>	<b>-</b>
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\*Total RSC results do not include concentrations found below the limit of detection (<).

+ RSC by mass expressed as H<sub>2</sub>S.

Only the reduced sulfur compounds (RSC) that were above the detection limit (highlighted in blue) are included in the total.

**Table D-2: RSC Test Results – BGR-36LP Combustor Exhaust- May 28 & 29, 2019**

Test ID:	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
	Outlet - May 28, 2019 (10% Load)			Outlet - May 29, 2019 (100% Load)		
Date:						
Start time:	12:38	14:36	17:13	9:28	11:12	13:11
End Time:	13:38	16:00	18:13	10:29	12:12	14:12
Compound	Concentration (ppm)					
2,5-Dimethylthiophene	<0.0005	<0.0005	<0.0005	<0.0005	<0.0004	<0.0005
2-Ethylthiophene	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
2-Methylthiophene	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
3-Methylthiophene	<0.0005	<0.0005	<0.0005	<0.0005	<0.0004	<0.0005
Butyl mercaptan	<0.0005	<0.0005	<0.0005	<0.0005	<0.0004	<0.0005
Carbon disulphide	<0.0003	<0.0003	<0.0003	0.0037	<0.0003	0.0004
Carbonyl sulphide	<0.0005	0.0006	<0.0005	0.0022	0.0006	<0.0005
Dimethyl disulphide	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Dimethyl sulphide	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Ethyl mercaptan	<0.0005	<0.0005	<0.0005	<0.0005	<0.0004	<0.0005
Ethyl sulphide	<0.0005	<0.0005	<0.0005	<0.0005	<0.0004	<0.0005
Hydrogen sulphide	0.0083	0.0023	0.0032	0.0012	0.0005	0.0020
Isobutyl mercaptan	<0.0005	<0.0005	<0.0005	<0.0005	<0.0004	<0.0005
Isopropyl mercaptan	<0.0005	<0.0005	<0.0005	<0.0005	<0.0004	<0.0005
Methyl mercaptan	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Pentyl mercaptan	<0.0006	<0.0007	<0.0007	<0.0007	<0.0006	<0.0007
Propyl mercaptan	<0.0006	<0.0007	<0.0007	<0.0007	<0.0006	<0.0007
tert-Butyl mercaptan	<0.0005	<0.0005	<0.0005	<0.0005	<0.0004	<0.0005
Thiophene	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
<b>Total RSC*</b>	<b>0.0083</b>	<b>0.0029</b>	<b>0.0032</b>	<b>0.0071</b>	<b>0.0011</b>	<b>0.0024</b>
<b>Total RSC Concentration (mg/drm<sup>3</sup>)<sup>+</sup>*</b>	<b>0.012</b>	<b>0.0040</b>	<b>0.0045</b>	<b>0.0099</b>	<b>0.0015</b>	<b>0.0033</b>
<b>Total RSC Emission (kg/h)<sup>+</sup></b>	<b>0.025</b>	<b>0.010</b>	<b>0.012</b>	<b>0.027</b>	<b>0.0043</b>	<b>0.010</b>

\*Total RSC results do not include concentrations found below the limit of detection (<).

+ RSC by mass expressed as H<sub>2</sub>S.



**Table D-3: VOC Test Results – BGR-36LP Combustor Inlet- May 28 & 29, 2019**

Test ID:	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Date:	Inlet - May 28, 2019			Inlet - May 29, 2019		
Start time:	12:38	14:36	17:13	9:28	11:12	13:11
End Time:	-	-	-	-	-	-
Compound	Concentration (ppm)					
1,1,1-Trichloroethane	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
1,1,2,2-Tetrachloroethane	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
1,1,2-Trichloroethane	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
1,1-Dichloroethane	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
1,1-Dichloroethylene	<0.0013	<0.010	<0.010	<0.010	<0.010	-
1,2,3-Trimethylbenzene	0.0063	<0.013	<0.013	<0.013	<0.013	-
1,2,4-Trichlorobenzene	<0.026	<0.20	<0.20	<0.20	<0.20	-
1,2,4-Trimethylbenzene	0.0051	<0.013	<0.013	<0.013	<0.013	-
1,2-Dibromoethane	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
1,2-Dichlorobenzene	<0.0010	<0.0076	<0.0076	<0.0076	<0.0076	-
1,2-Dichloroethane	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
1,2-Dichloropropane	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
1,3,5-Trimethylbenzene	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
1,3-Butadiene	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
1,3-Dichlorobenzene	<0.0098	<0.076	<0.076	<0.076	<0.076	-
1,4-Dichlorobenzene	<0.013	<0.10	<0.10	<0.10	<0.10	-
1,4-Dioxane	<0.013	<0.10	<0.10	<0.10	<0.10	-
1-Butene/Isobutylene	0.031	<0.0050	0.010	<0.0050	0.013	-
1-Hexene/2-Methyl-1-pentene	0.0087	<0.0050	<0.0050	<0.0050	<0.0050	-
1-Pentene	0.032	0.015	0.021	0.016	0.022	-
2,2,4-Trimethylpentane	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
2,2-Dimethylbutane	0.33	0.94	1.20	0.93	1.29	-
2,3,4-Trimethylpentane	0.0077	<0.0025	<0.0025	<0.0025	<0.0025	-
2,3-Dimethylbutane	0.54	0.44	0.52	0.43	0.55	-
2,3-Dimethylpentane	0.051	0.039	0.049	0.037	0.053	-
2,4-Dimethylpentane	0.035	0.018	0.024	0.016	0.027	-
2-Methylheptane	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
2-Methylhexane	0.037	0.022	0.028	0.020	0.031	-
2-Methylpentane	0.20	0.14	0.16	0.13	0.17	-
3-Methylheptane	0.020	<0.0050	<0.0050	<0.0050	<0.0050	-
3-Methylhexane	0.038	0.023	0.030	0.021	0.033	-
3-Methylpentane	0.053	0.058	0.052	0.040	0.057	-
Acetone	<0.013	<0.10	<0.10	<0.10	<0.10	-
Acrolein	0.011	<0.076	<0.076	<0.076	<0.076	-
Benzene	0.0010	<0.0025	<0.0025	<0.0025	<0.0025	-
Benzyl chloride	<0.013	<0.10	<0.10	<0.10	<0.10	-
Bromodichloromethane	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
Bromoform	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
Bromomethane	<0.0003	<0.0025	<0.0025	<0.0025	<0.0025	-

Test ID:	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Date:	Inlet - May 28, 2019			Inlet - May 29, 2019		
Start time:	12:38	14:36	17:13	9:28	11:12	13:11
End Time:	-	-	-	-	-	-
Compound	Concentration (ppm)					
Carbon disulfide	0.0019	<0.0025	<0.0025	<0.0025	<0.0025	-
Carbon tetrachloride	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
Chlorobenzene	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
Chloroethane	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
Chloroform	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
Chloromethane	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
cis-1,2-Dichloroethene	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
cis-1,3-Dichloropropene	<0.0013	<0.010	<0.010	<0.010	<0.010	-
cis-2-Butene	0.071	0.057	0.073	0.058	0.074	-
cis-2-Pentene	0.027	0.0086	0.014	0.0080	0.015	-
Cyclohexane	0.40	0.31	0.37	0.30	0.39	-
Cyclopentane	0.054	0.037	0.052	0.033	0.051	-
Dibromochloromethane	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
Ethanol	<0.0098	0.094	0.2240	<0.076	<0.076	-
Ethyl acetate	<0.013	<0.10	<0.10	<0.10	<0.10	-
Ethylbenzene	0.0017	<0.0025	<0.0025	<0.0025	<0.0025	-
Freon-11	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
Freon-113	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
Freon-114	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
Freon-12	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
Hexachloro-1,3-butadiene	<0.016	<0.13	<0.13	<0.13	<0.13	-
Isobutane	0.59	1.94	2.38	1.93	2.42	-
Isopentane	0.27	0.80	1.00	0.78	1.05	-
Isoprene	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
Isopropyl alcohol	0.064	<0.10	<0.10	0.75	<0.10	-
Isopropylbenzene	<0.00033	<0.0025	<0.0025	0.0146	<0.0025	-
m,p-Xylene	0.0068	<0.0076	<0.0076	<0.0076	<0.0076	-
m-Diethylbenzene	<0.0013	<0.010	<0.010	<0.010	<0.010	-
m-Ethyltoluene	<0.0026	<0.020	<0.020	<0.020	<0.020	-
Methyl butyl ketone	<0.016	<0.13	<0.13	<0.13	<0.13	-
Methyl ethyl ketone	<0.0098	<0.076	<0.076	<0.076	<0.076	-
Methyl isobutyl ketone	<0.013	<0.10	<0.10	<0.10	<0.10	-
Methyl methacrylate	<0.0023	<0.018	<0.018	<0.018	<0.018	-
Methyl tert butyl ether	<0.0010	<0.0076	<0.0076	<0.0076	<0.0076	-
Methylcyclohexane	0.29	0.23	0.27	0.22	0.27	-
Methylcyclopentane	0.18	0.15	0.17	0.13	0.17	-
Methylene chloride	0.0098	0.076	0.076	0.076	0.076	-
n-Butane	1.79	4.67	6.04	4.63	5.96	-
n-Decane	<0.0020	<0.015	<0.015	0.029	<0.015	-
n-Dodecane	<0.013	<0.10	<0.10	<0.10	<0.10	-

Test ID:	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Date:	Inlet - May 28, 2019			Inlet - May 29, 2019		
Start time:	12:38	14:36	17:13	9:28	11:12	13:11
End Time:	-	-	-	-	-	-
Compound	Concentration (ppm)					
n-Heptane	0.083	0.050	0.070	0.045	0.073	-
n-Hexane	0.24	0.24	0.20	0.16	0.22	-
n-Nonane	0.00082	<0.0025	<0.0025	<0.0025	<0.0025	-
n-Octane	0.013	<0.0050	<0.0050	<0.0050	<0.0050	-
n-Pentane	0.28	0.75	0.98	0.66	1.03	-
n-Propylbenzene	<0.0016	<0.013	<0.013	<0.013	<0.013	-
n-Undecane	<0.016	<0.13	<0.13	<0.13	<0.13	-
Naphthalene	<0.016	<0.13	<0.13	<0.13	<0.13	-
o-Ethyltoluene	0.0014	<0.0025	<0.0025	<0.0025	<0.0025	-
o-Xylene	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
p-Diethylbenzene	0.031	0.013	0.015	0.018	0.014	-
p-Ethyltoluene	<0.0023	<0.018	<0.018	<0.018	<0.018	-
Styrene	0.0017	<0.010	<0.010	<0.010	<0.010	-
Tetrachloroethylene	<0.0013	<0.010	<0.010	<0.010	<0.010	-
Tetrahydrofuran	<0.013	<0.10	<0.10	<0.10	<0.10	-
Toluene	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
trans-1,2-Dichloroethylene	<0.00033	<0.0025	<0.0025	<0.0025	<0.0025	-
trans-1,3-Dichloropropylene	<0.0013	<0.010	<0.010	<0.010	<0.010	-
trans-2-Butene	<0.00033	<0.0025	0.16	0.15	0.18	-
trans-2-Pentene	0.13	0.088	0.11	0.088	0.12	-
Trichloroethylene	<0.0013	<0.010	<0.010	<0.010	<0.010	-
Vinyl acetate	<0.013	<0.10	<0.10	<0.10	<0.10	-
Vinyl chloride	<0.00065	<0.0050	<0.0050	<0.0050	<0.0050	-
Methane (ppm)	619000	922000	911000	911000	752000	-
Methane (mg/drm <sup>3</sup> )*	405589	604124	596917	596917	492735	-
Total NMHC (ppm)	8300	11700	11600	11600	10600	-
Total NMHC (mg/drm <sup>3</sup> )**	31233	44027	43651	43651	39888	-
BTEX (ppm)	0.0101	0.0176	0.0176	0.0176	0.0176	-
BTEX (mg/drm <sup>3</sup> )**	0.0380	0.0664	0.0664	0.0664	0.0664	-

\*drm<sup>3</sup> = dry reference cubic metres; reference conditions 101.3 kPa, 25 °C.

\*\*NMHC and BTEX by mass expressed as Toluene.

**Table D-4: VOC Test Results – BGR-36LP Combustor Exhaust- May 28 & 29, 2019**

Compound	Test ID:	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
	Date:	Outlet - May 28, 2019			Outlet - May 29, 2019		
	Start time:	12:38	14:36	17:13	9:28	11:12	13:11
	End Time:	13:38	16:00	18:13	10:29	12:12	14:12
	Concentration (ppm)						
1,1,1-Trichloroethane	<0.00006	<0.00006	<0.00007	<0.00007	<0.00006	<0.00007	
1,1,2,2-Tetrachloroethane	<0.00006	<0.00006	<0.00007	<0.00007	<0.00006	<0.00007	
1,1,2-Trichloroethane	<0.00006	<0.00006	<0.00007	<0.00007	<0.00006	<0.00007	
1,1-Dichloroethane	<0.00006	<0.00006	<0.00007	<0.00007	<0.00006	<0.00007	
1,1-Dichloroethylene	<0.00013	<0.00012	<0.00013	<0.00013	<0.00011	<0.00014	
1,2,3-Trimethylbenzene	<0.00016	<0.00015	<0.00017	0.00022	<0.00014	<0.00017	
1,2,4-Trichlorobenzene	<0.0026	<0.0024	<0.0027	<0.0026	<0.0023	<0.0028	
1,2,4-Trimethylbenzene	<0.00016	<0.00015	<0.00017	0.00019	<0.00014	<0.00017	
1,2-Dibromoethane	<0.00006	<0.00006	<0.00007	<0.00007	<0.00006	<0.00007	
1,2-Dichlorobenzene	<0.00010	<0.00009	<0.00010	<0.00010	<0.00009	<0.00010	
1,2-Dichloroethane	<0.00003	<0.00003	<0.00003	0.00004	<0.00003	<0.00003	
1,2-Dichloropropane	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
1,3,5-Trimethylbenzene	<0.00006	<0.00006	<0.00007	0.00013	<0.00006	<0.00007	
1,3-Butadiene	<0.00006	0.00015	<0.00007	<0.00007	<0.00006	<0.00007	
1,3-Dichlorobenzene	<0.0010	<0.00090	<0.0010	<0.0010	<0.00090	<0.0010	
1,4-Dichlorobenzene	<0.0013	<0.0012	<0.0013	<0.0013	<0.0011	<0.0014	
1,4-Dioxane	<0.0013	<0.0012	<0.0013	<0.0013	<0.0011	<0.0014	
1-Butene/Isobutylene	0.00500	0.00460	<0.00007	<0.00007	<0.00006	0.0011	
1-Hexene/2-Methyl-1-pentene	<0.00006	0.00022	<0.00007	0.00009	<0.00006	0.00010	
1-Pentene	0.0014	0.0018	<0.00003	0.00087	0.00043	0.0011	
2,2,4-Trimethylpentane	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
2,2-Dimethylbutane	0.0044	0.0087	0.00092	<0.00003	<0.00003	<0.00003	
2,3,4-Trimethylpentane	<0.00003	<0.00003	0.00003	<0.00003	<0.00003	<0.00003	
2,3-Dimethylbutane	0.0025	0.0046	0.00048	<0.00007	<0.00006	<0.00007	
2,3-Dimethylpentane	0.00016	0.00042	<0.00007	<0.00007	<0.00006	<0.00007	
2,4-Dimethylpentane	<0.00003	0.00014	<0.00003	<0.00003	<0.00003	<0.00003	
2-Methylheptane	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
2-Methylhexane	0.00018	0.00022	<0.00003	0.00007	<0.00003	<0.00003	
2-Methylpentane	0.0026	0.0018	<0.00003	0.00011	<0.00003	<0.00003	
3-Methylheptane	<0.00006	<0.00006	<0.00007	<0.00007	<0.00006	<0.00007	
3-Methylhexane	0.00008	0.00021	<0.00007	<0.00007	<0.00006	<0.00007	
3-Methylpentane	0.011	0.0024	<0.00003	0.00018	0.00016	0.00031	
Acetone	0.071	0.072	0.0044	0.069	0.034	0.050	
Acrolein	<0.0010	<0.00090	<0.0010	<0.0010	<0.00090	<0.0010	
Benzene	0.00190	0.00065	<0.00003	0.00021	<0.00003	<0.00003	
Benzyl chloride	<0.0013	<0.0012	<0.0013	<0.0013	<0.0011	<0.0014	
Bromodichloromethane	<0.00006	<0.00006	<0.00007	<0.00007	<0.00006	<0.00007	
Bromoform	<0.00006	<0.00006	<0.00007	0.00013	<0.00006	<0.00007	
Bromomethane	<0.00003	<0.00003	<0.00003	0.00005	<0.00003	<0.00003	

Compound	Test ID:	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
	Date:	Outlet - May 28, 2019			Outlet - May 29, 2019		
	Start time:	12:38	14:36	17:13	9:28	11:12	13:11
	End Time:	13:38	16:00	18:13	10:29	12:12	14:12
	Concentration (ppm)						
Carbon disulfide	<0.00003	<0.00003	<0.00003	0.0049	0.00033	0.00073	
Carbon tetrachloride	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
Chlorobenzene	<0.00006	<0.00006	<0.00007	0.00012	<0.00006	<0.00007	
Chloroethane	<0.00006	<0.00006	<0.00007	0.00030	<0.00006	<0.00007	
Chloroform	<0.00006	<0.00006	<0.00007	0.00011	<0.00006	<0.00007	
Chloromethane	0.00071	0.00060	<0.00007	0.0012	0.00045	0.00011	
cis-1,2-Dichloroethene	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
cis-1,3-Dichloropropene	<0.00013	<0.00012	<0.00013	<0.00013	<0.00011	<0.00014	
cis-2-Butene	0.00031	0.00065	<0.00007	0.00040	<0.00006	<0.00007	
cis-2-Pentene	<0.00006	0.00010	<0.00007	<0.00007	<0.00006	<0.00007	
Cyclohexane	0.0042	0.0049	<0.00007	<0.00007	0.00059	0.00015	
Cyclopentane	0.00015	0.00035	<0.00003	<0.00003	<0.00003	<0.00003	
Dibromochloromethane	<0.00003	<0.00003	<0.00003	0.00007	<0.00003	<0.00003	
Ethanol	<0.0010	0.0039	<0.0010	<0.0010	0.0044	<0.0010	
Ethyl acetate	<0.0013	<0.0012	<0.0013	<0.0013	<0.0011	<0.0014	
Ethylbenzene	<0.00003	<0.00003	<0.00003	0.00013	<0.00003	<0.00003	
Freon-11	<0.00006	<0.00006	<0.00007	<0.00007	<0.00006	<0.00007	
Freon-113	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
Freon-114	<0.00006	<0.00006	<0.00007	<0.00007	<0.00006	<0.00007	
Freon-12	0.00023	0.00023	<0.00007	<0.00007	0.00027	<0.00007	
Hexachloro-1,3-butadiene	<0.0016	<0.0015	<0.0017	<0.0016	<0.0014	<0.0017	
Isobutane	0.00579	0.014	<0.00007	<0.00007	<0.00006	<0.00007	
Isopentane	0.0051	0.0062	0.00068	0.00048	0.00024	0.00034	
Isoprene	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
Isopropyl alcohol	<0.0013	0.042	<0.0013	<0.0013	<0.0011	<0.0014	
Isopropylbenzene	<0.00003	<0.00003	<0.00003	0.00008	<0.00003	<0.00003	
m,p-Xylene	0.00026	0.00011	<0.00010	0.00060	<0.00009	<0.00010	
m-Diethylbenzene	<0.00013	<0.00012	<0.00013	<0.00013	<0.00011	<0.00014	
m-Ethyltoluene	<0.00026	<0.00024	<0.00027	<0.00026	<0.00023	<0.00028	
Methyl butyl ketone	<0.00162	<0.00153	<0.00168	<0.0016	<0.0014	<0.0017	
Methyl ethyl ketone	<0.0010	<0.00090	<0.0010	0.0090	<0.00090	<0.0010	
Methyl isobutyl ketone	<0.0013	<0.0012	<0.0013	<0.0013	<0.0011	<0.0014	
Methyl methacrylate	<0.00023	<0.00021	<0.00024	<0.00023	<0.00020	<0.00024	
Methyl tert butyl ether	<0.00010	<0.00090	<0.00010	<0.00010	<0.00090	<0.00010	
Methylcyclohexane	0.0012	0.0024	0.00006	<0.00003	<0.00003	<0.00003	
Methylcyclopentane	0.024	0.0050	<0.00007	0.00047	0.00059	0.0011	
Methylene chloride	<0.0010	<0.00090	<0.0010	<0.0010	<0.00090	<0.0010	
n-Butane	0.026	0.04495	0.00414	<0.00010	<0.00009	<0.00010	
n-Decane	<0.00019	<0.00018	<0.00020	0.00031	<0.00017	0.00021	
n-Dodecane	<0.0013	<0.0012	<0.0013	<0.0013	<0.0011	<0.0014	

Test ID:	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Date:	Outlet - May 28, 2019			Outlet - May 29, 2019		
Start time:	12:38	14:36	17:13	9:28	11:12	13:11
End Time:	13:38	16:00	18:13	10:29	12:12	14:12
Compound	Concentration (ppm)					
n-Heptane	0.00014	0.00064	<0.00003	<0.00003	<0.00003	<0.00003
n-Hexane	0.041	0.00689	<0.00003	0.00049	0.00061	0.00112
n-Nonane	<0.00003	<0.00003	<0.00003	0.00017	<0.00003	<0.00003
n-Octane	0.00014	0.00018	<0.00007	0.00015	<0.00006	<0.00007
n-Pentane	0.0047	0.0068	0.00080	0.00040	<0.00030	<0.00030
n-Propylbenzene	<0.00016	<0.00015	<0.00017	<0.00016	<0.00014	<0.00017
n-Undecane	<0.0016	<0.0015	<0.0017	<0.0016	<0.0014	<0.0017
Naphthalene	<0.0016	<0.0015	<0.0017	<0.0016	<0.0014	<0.0017
o-Ethyltoluene	<0.00003	<0.00003	<0.00003	0.00011	<0.00003	<0.00003
o-Xylene	<0.00003	<0.00003	<0.00003	0.00010	<0.00003	<0.00003
p-Diethylbenzene	<0.00013	<0.00012	<0.00013	0.00018	<0.00011	<0.00014
p-Ethyltoluene	<0.00023	<0.00021	<0.00024	<0.00023	<0.0002	<0.00024
Styrene	0.00041	0.00018	<0.00013	0.00022	0.00016	<0.00014
Tetrachloroethylene	<0.00013	<0.00012	<0.00013	<0.00013	<0.00011	<0.00014
Tetrahydrofuran	<0.0013	<0.0012	<0.0013	<0.0013	<0.0011	<0.0014
Toluene	0.00045	0.00020	<0.00003	0.00043	<0.00003	<0.00003
trans-1,2-Dichloroethylene	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003
trans-1,3-Dichloropropylene	<0.00013	<0.00012	<0.00013	<0.00013	<0.00011	<0.00014
trans-2-Butene	<0.00003	<0.00003	<0.00003	0.00058	<0.00003	<0.00003
trans-2-Pentene	0.00043	0.00090	<0.00007	0.00007	<0.00006	<0.00007
Trichloroethylene	<0.00013	<0.00012	<0.00013	<0.00013	<0.00011	<0.00014
Vinyl acetate	<0.0013	<0.0012	<0.0013	<0.0013	<0.0011	<0.0014
Vinyl chloride	<0.00006	<0.00006	<0.00007	<0.00007	<0.00006	<0.00007
Methane (ppm) <sup>+</sup>	2430	4870	5380	<0.20	1.70	<0.20
Methane (mg/drm <sup>3</sup> )*	1592	3191	3525	<0.13	1.11	<0.13
Methane (kg/h)	3.40	7.97	9.39	<0.0004	0.0031	<0.0004
Total NMHC (ppm)	29.5	59.8	67.0	<0.080	<0.070	<0.090
Total NMHC (mg/drm <sup>3</sup> )**	111	225	252	<0.30	<0.26	<0.34
Total NMHC (kg/h)**	0.24	0.56	0.67	<0.0008	<0.0007	<0.0011
BTEX (ppm)	0.0027	0.0010	0.00022	0.0015	0.00021	0.00022
BTEX (mg/drm <sup>3</sup> )**	0.010	0.0038	0.00083	0.0055	0.00079	0.00083
BTEX (g/h)**	0.021	0.010	0.0022	0.015	0.0022	0.0026

\*drm<sup>3</sup> = dry reference cubic metres; reference conditions 101.3 kPa, 25 °C.

\*\*NMHC and BTEX by mass expressed as Toluene.

<sup>+</sup> Methane results for the combustor exhaust determined by gas chromatograph used to validate reported FTIR methane concentration.

Tables D-5 and D-6 display the velocity test results from the BGR-36LP exhaust under 10% and 100% fuel feed load respectively.

**Table D-5: Velocity Profiles – BGR-36LP Combustor Exhaust (10%)- May 28, 2019**

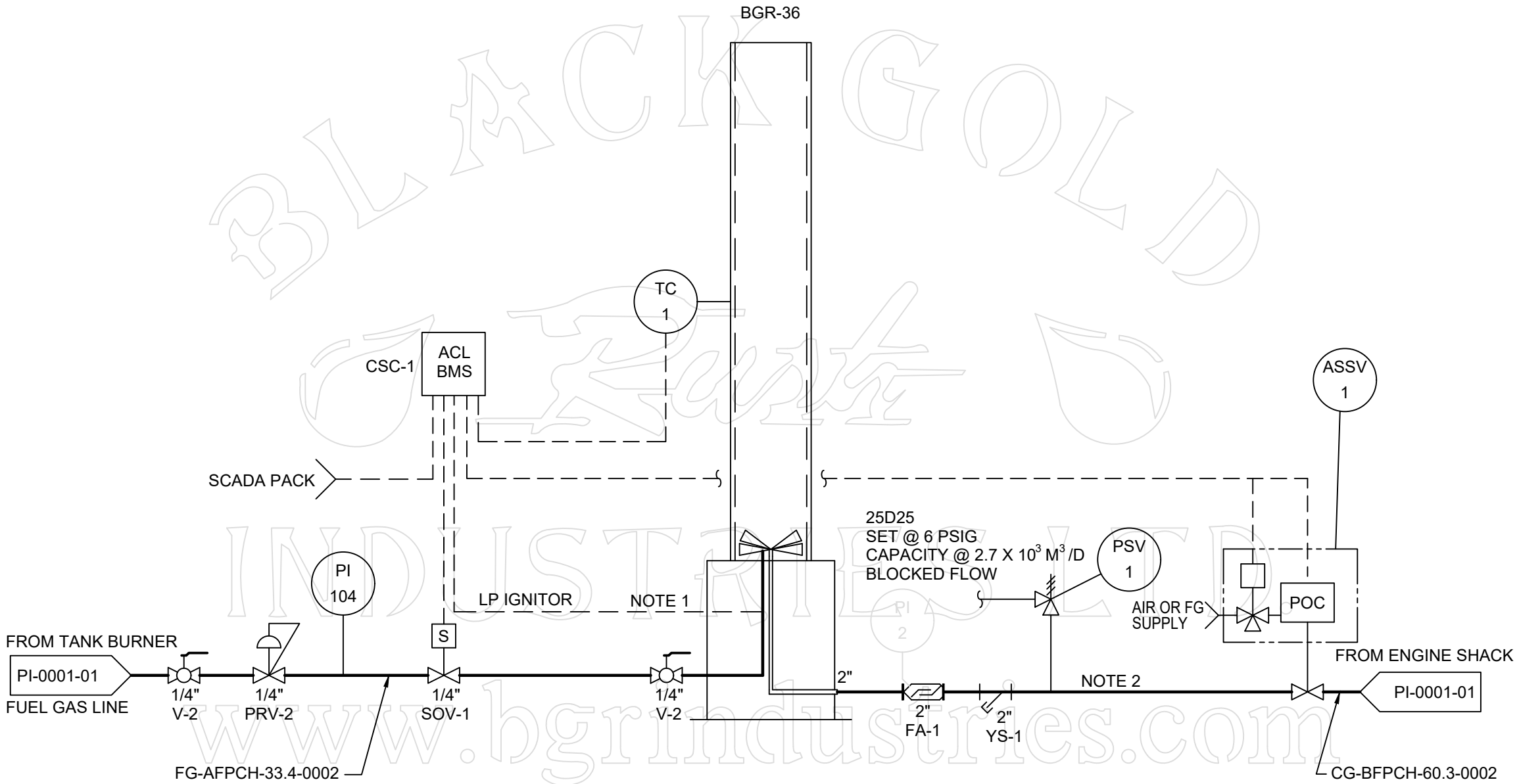
Source:	BGR 1	Pitot Id:	5-14-I	O2 %:	0.186	Three Test Average						
Pstatic:	-0.027	Cp:	0.81	CO2 %:	0.006	ΔP	T	Vs	Qs	Qs	Velocity	
Pstack:	28.03	Md:	28.01	CO %:	0.000	"H2O	oR	ft/sec	dscf/sec	drms/s	m/s	
Dia. (ft):	2.500	Ms:	27.89	CH4 %:	0.004	Average	0.012	756.34	7.34	23.86	0.68	2.24
Area:	4.909	Bwro:	0.012									
Test 1												
	ΔP	ΔP	T	T	Vs	Qs	Qs	Qs	Vs	Qs	T	T
	mmH2O	"H2O	°C	°K	ft/sec	dscf/sec	drms/s	drms/hr	m/s	wrm3/hour	°F	oR
1	0.254	0.010	198.89	472.04	7.21	20.67	0.59	2107	2.20	2133	390.00	849.67
2	0.254	0.010	198.89	472.04	7.21	20.67	0.59	2107	2.20	2133	390.00	849.67
3	0.127	0.005	198.89	472.04	5.10	14.61	0.41	1490	1.55	1508	390.00	849.67
4	0.127	0.005	198.89	472.04	5.10	14.61	0.41	1490	1.55	1508	390.00	849.67
5	0.127	0.005	198.89	472.04	5.10	14.61	0.41	1490	1.55	1508	390.00	849.67
6	0.254	0.010	198.89	472.04	7.21	20.67	0.59	2107	2.20	2133	390.00	849.67
7	0.127	0.005	198.89	472.04	5.10	14.61	0.41	1490	1.55	1508	390.00	849.67
8	0.254	0.010	198.89	472.04	7.21	20.67	0.59	2107	2.20	2133	390.00	849.67
9	0.254	0.010	198.89	472.04	7.21	20.67	0.59	2107	2.20	2133	390.00	849.67
10	0.254	0.010	198.89	472.04	7.21	20.67	0.59	2107	2.20	2133	390.00	849.67
11	0.127	0.005	198.89	472.04	5.10	14.61	0.41	1490	1.55	1508	390.00	849.67
12	0.127	0.005	198.89	472.04	5.10	14.61	0.41	1490	1.55	1508	390.00	849.67
1	0.254	0.010	198.89	472.04	7.21	20.67	0.59	2107	2.20	2133	390.00	849.67
2	0.254	0.010	198.89	472.04	7.21	20.67	0.59	2107	2.20	2133	390.00	849.67
3	0.381	0.015	198.89	472.04	8.83	25.31	0.72	2580	2.69	2612	390.00	849.67
4	0.381	0.015	198.89	472.04	8.83	25.31	0.72	2580	2.69	2612	390.00	849.67
5	0.508	0.020	198.89	472.04	10.19	29.23	0.83	2979	3.11	3016	390.00	849.67
6	0.635	0.025	198.89	472.04	11.39	32.68	0.93	3331	3.47	3372	390.00	849.67
7	0.635	0.025	198.89	472.04	11.39	32.68	0.93	3331	3.47	3372	390.00	849.67
8	0.508	0.020	198.89	472.04	10.19	29.23	0.83	2979	3.11	3016	390.00	849.67
9	0.381	0.015	198.89	472.04	8.83	25.31	0.72	2580	2.69	2612	390.00	849.67
10	0.254	0.010	198.89	472.04	7.21	20.67	0.59	2107	2.20	2133	390.00	849.67
11	0.127	0.005	198.89	472.04	5.10	14.61	0.41	1490	1.55	1508	390.00	849.67
12	0.127	0.005	198.89	472.04	5.10	14.61	0.41	1490	1.55	1508	390.00	849.67
Average	0.280	0.011	198.89	472.04	7.30	20.94	0.59	2135	2.23	2161	390.00	849.67
Test 2												
	ΔP	ΔP	T	T	Vs	Qs	Qs	Qs	Vs	Qs	T	T
	mmH2O	"H2O	°C	°K	ft/sec	dscf/sec	drms/s	drms/hr	m/s	wrm3/hour	°F	oR
1	0.381	0.015	137.78	410.93	8.23	27.13	0.77	2765	2.51	2799	280.00	739.67
2	0.381	0.015	137.78	410.93	8.23	27.13	0.77	2765	2.51	2799	280.00	739.67
3	0.381	0.015	137.78	410.93	8.23	27.13	0.77	2765	2.51	2799	280.00	739.67
4	0.457	0.018	137.78	410.93	9.02	29.72	0.84	3029	2.75	3067	280.00	739.67
5	0.457	0.018	137.78	410.93	9.02	29.72	0.84	3029	2.75	3067	280.00	739.67
6	0.508	0.020	137.78	410.93	9.51	31.32	0.89	3193	2.90	3233	280.00	739.67
7	0.381	0.015	137.78	410.93	8.23	27.13	0.77	2765	2.51	2799	280.00	739.67
8	0.330	0.013	137.78	410.93	7.67	25.25	0.72	2574	2.34	2606	280.00	739.67
9	0.254	0.010	137.78	410.93	6.72	22.15	0.63	2258	2.05	2286	280.00	739.67
10	0.254	0.010	137.78	410.93	6.72	22.15	0.63	2258	2.05	2286	280.00	739.67
11	0.254	0.010	137.78	410.93	6.72	22.15	0.63	2258	2.05	2286	280.00	739.67
12	0.254	0.010	137.78	410.93	6.72	22.15	0.63	2258	2.05	2286	280.00	739.67
1	0.330	0.013	137.78	410.93	7.67	25.25	0.72	2574	2.34	2606	280.00	739.67
2	0.330	0.013	137.78	410.93	7.67	25.25	0.72	2574	2.34	2606	280.00	739.67
3	0.305	0.012	137.78	410.93	7.37	24.26	0.69	2473	2.24	2504	280.00	739.67
4	0.305	0.012	137.78	410.93	7.37	24.26	0.69	2473	2.24	2504	280.00	739.67
5	0.305	0.012	137.78	410.93	7.37	24.26	0.69	2473	2.24	2504	280.00	739.67
6	0.381	0.015	137.78	410.93	8.23	27.13	0.77	2765	2.51	2799	280.00	739.67
7	0.381	0.015	137.78	410.93	8.23	27.13	0.77	2765	2.51	2799	280.00	739.67
8	0.305	0.012	137.78	410.93	7.37	24.26	0.69	2473	2.24	2504	280.00	739.67
9	0.254	0.010	137.78	410.93	6.72	22.15	0.63	2258	2.05	2286	280.00	739.67
10	0.203	0.008	137.78	410.93	6.01	19.81	0.56	2020	1.83	2044	280.00	739.67
11	0.127	0.005	137.78	410.93	4.75	15.66	0.44	1597	1.45	1616	280.00	739.67
12	0.127	0.005	137.78	410.93	4.75	15.66	0.44	1597	1.45	1616	280.00	739.67
Average	0.319	0.013	137.78	410.93	7.44	24.51	0.69	2498	2.27	2529	280.00	739.67
Test 3												
	ΔP	ΔP	T	T	Vs	Qs	Qs	Qs	Vs	Qs	T	T
	mmH2O	"H2O	°C	°K	ft/sec	dscf/sec	drms/s	drms/hr	m/s	wrm3/hour	°F	oR
1	0.381	0.015	104.44	377.59	7.89	28.30	0.80	2885	2.41	2920	220.00	679.67
2	0.381	0.015	104.44	377.59	7.89	28.30	0.80	2885	2.41	2920	220.00	679.67
3	0.381	0.015	104.44	377.59	7.89	28.30	0.80	2885	2.41	2920	220.00	679.67
4	0.330	0.013	104.44	377.59	7.35	26.35	0.75	2686	2.24	2719	220.00	679.67
5	0.279	0.011	104.44	377.59	6.76	24.23	0.69	2470	2.06	2501	220.00	679.67
6	0.330	0.013	104.44	377.59	7.35	26.35	0.75	2686	2.24	2719	220.00	679.67
7	0.330	0.013	104.44	377.59	7.35	26.35	0.75	2686	2.24	2719	220.00	679.67
8	0.254	0.010	104.44	377.59	6.45	23.11	0.65	2355	1.96	2385	220.00	679.67
9	0.254	0.010	104.44	377.59	6.45	23.11	0.65	2355	1.96	2385	220.00	679.67
10	0.229	0.009	104.44	377.59	6.11	21.92	0.62	2235	1.86	2262	220.00	679.67
11	0.203	0.008	104.44	377.59	5.76	20.67	0.59	2107	1.76	2133	220.00	679.67
12	0.203	0.008	104.44	377.59	5.76	20.67	0.59	2107	1.76	2133	220.00	679.67
1	0.279	0.011	104.44	377.59	6.76	24.23	0.69	2470	2.06	2501	220.00	679.67
2	0.279	0.011	104.44	377.59	6.76	24.23	0.69	2470	2.06	2501	220.00	679.67
3	0.508	0.020	104.44	377.59	9.11	32.68	0.93	3331	2.78	3372	220.00	679.67
4	0.533	0.021	104.44	377.59	9.34	33.48	0.95	3413	2.85	3455	220.00	679.67
5	0.533	0.021	104.44	377.59	9.34	33.48	0.95	3413	2.85	3455	220.00	679.67
6	0.508	0.020	104.44	377.59	9.11	32.68	0.93	3331	2.78	3372	220.00	679.67
7	0.356	0.014	104.44	377.59	7.63	27.34	0.77	2787	2.32	2821	220.00	679.67
8	0.330	0.013	104.44	377.59	7.35	26.35	0.75	2686	2.24	2719	220.00	679.67
9	0.279	0.011	104.44	377.59	6.76	24.23	0.69	2470	2.06	2501	220.00	679.67
10	0.279	0.011	104.44	377.59	6.76	24.23	0.69	2470	2.06	2501	220.00	679.67
11	0.254	0.010	104.44	377.59	6.45	23.11	0.65	2355	1.96	2385	220.00	679.67
12	0.254	0.010	104.44	377.59	6.45	23.11	0.65	2355	1.96	2385	220.00	679.67
Average	0.331	0.013	104.44	377.59	7.28	26.12	0.74	2662	2.22	2695	220.00	679.67

**Table D-6: Velocity Profiles – BGR-36L Combustor Exhaust (100%)- May 29, 2019**

Source:	BGR 1	Pitot id:	5-14-I	O2 %:	0.128	Three Test Average						
Pstatic:	-0.052	Cp:	0.81	CO2 %:	0.035	ΔP	T	Vs	Qs	Qs	Velocity	
Pstack:	27.93	Md:	28.01	CO %:	0.000	"H2O	oR	ft/sec	dscf/sec	drms/s	drms/hr	
meter (ft):	2.500	Ms:	27.29	CH4 %:	0.000	Average	0.045	1783.67	22.18	28.37	0.80	6.76
Area:	4.909	Bwo:	0.072									
Test 4												
	ΔP mmH2O	ΔP "H2O	T °C	T °K	Vs ft/sec	Qs dscf/sec	Qs drms/s	Qs drms/hr	Vs m/s	Qs wrms/hour	T °F	T oR
1	0.635	0.025	705.56	978.71	16.61	21.52	0.61	2193	5.06	2363	1302.00	1761.67
2	0.635	0.025	705.56	978.71	16.61	21.52	0.61	2193	5.06	2363	1302.00	1761.67
3	1.143	0.045	705.56	978.71	22.29	28.87	0.82	2943	6.79	3170	1302.00	1761.67
4	1.270	0.050	705.56	978.71	23.49	30.43	0.86	3102	7.16	3342	1302.00	1761.67
5	1.397	0.055	705.56	978.71	24.64	31.91	0.90	3253	7.51	3505	1302.00	1761.67
6	1.524	0.060	705.56	978.71	25.74	33.33	0.94	3398	7.84	3661	1302.00	1761.67
7	1.397	0.055	705.56	978.71	24.64	31.91	0.90	3253	7.51	3505	1302.00	1761.67
8	1.270	0.050	705.56	978.71	23.49	30.43	0.86	3102	7.16	3342	1302.00	1761.67
9	1.143	0.045	705.56	978.71	22.29	28.87	0.82	2943	6.79	3170	1302.00	1761.67
10	1.016	0.040	705.56	978.71	21.01	27.22	0.77	2775	6.41	2989	1302.00	1761.67
11	1.016	0.040	705.56	978.71	21.01	27.22	0.77	2775	6.41	2989	1302.00	1761.67
12	1.016	0.040	705.56	978.71	21.01	27.22	0.77	2775	6.41	2989	1302.00	1761.67
1	0.635	0.025	705.56	978.71	16.61	21.52	0.61	2193	5.06	2363	1302.00	1761.67
2	0.635	0.025	705.56	978.71	16.61	21.52	0.61	2193	5.06	2363	1302.00	1761.67
3	0.762	0.030	705.56	978.71	18.20	23.57	0.67	2403	5.55	2588	1302.00	1761.67
4	0.889	0.035	705.56	978.71	19.66	25.46	0.72	2595	5.99	2796	1302.00	1761.67
5	0.889	0.035	705.56	978.71	19.66	25.46	0.72	2595	5.99	2796	1302.00	1761.67
6	1.016	0.040	705.56	978.71	21.01	27.22	0.77	2775	6.41	2989	1302.00	1761.67
7	1.270	0.050	705.56	978.71	23.49	30.43	0.86	3102	7.16	3342	1302.00	1761.67
8	1.270	0.050	705.56	978.71	23.49	30.43	0.86	3102	7.16	3342	1302.00	1761.67
9	1.143	0.045	705.56	978.71	22.29	28.87	0.82	2943	6.79	3170	1302.00	1761.67
10	1.016	0.040	705.56	978.71	21.01	27.22	0.77	2775	6.41	2989	1302.00	1761.67
11	0.889	0.035	705.56	978.71	19.66	25.46	0.72	2595	5.99	2796	1302.00	1761.67
12	0.914	0.036	705.56	978.71	19.94	25.82	0.73	2632	6.08	2836	1302.00	1761.67
Average	1.033	0.041	705.56	978.71	21.02	27.23	0.77	2775	6.41	2990	1302.00	1761.67
Test 5												
	ΔP mmH2O	ΔP "H2O	T °C	T °K	Vs ft/sec	Qs dscf/sec	Qs drms/s	Qs drms/hr	Vs m/s	Qs wrms/hour	T °F	T oR
1	1.143	0.045	721.11	994.26	22.47	28.64	0.81	2920	6.85	3145	1330.00	1789.67
2	1.143	0.045	721.11	994.26	22.47	28.64	0.81	2920	6.85	3145	1330.00	1789.67
3	1.219	0.048	721.11	994.26	23.20	29.58	0.84	3015	7.07	3248	1330.00	1789.67
4	1.270	0.050	721.11	994.26	23.68	30.19	0.85	3078	7.22	3315	1330.00	1789.67
5	1.397	0.055	721.11	994.26	24.84	31.66	0.90	3228	7.57	3477	1330.00	1789.67
6	1.524	0.060	721.11	994.26	25.94	33.07	0.94	3371	7.91	3632	1330.00	1789.67
7	1.524	0.060	721.11	994.26	25.94	33.07	0.94	3371	7.91	3632	1330.00	1789.67
8	1.143	0.045	721.11	994.26	22.47	28.64	0.81	2920	6.85	3145	1330.00	1789.67
9	1.067	0.042	721.11	994.26	21.70	27.67	0.78	2821	6.62	3039	1330.00	1789.67
10	1.016	0.040	721.11	994.26	21.18	27.00	0.76	2753	6.46	2965	1330.00	1789.67
11	0.762	0.030	721.11	994.26	18.34	23.39	0.66	2384	5.59	2568	1330.00	1789.67
12	0.762	0.030	721.11	994.26	18.34	23.39	0.66	2384	5.59	2568	1330.00	1789.67
1	0.635	0.025	721.11	994.26	16.74	21.35	0.60	2176	5.10	2344	1330.00	1789.67
2	0.635	0.025	721.11	994.26	16.74	21.35	0.60	2176	5.10	2344	1330.00	1789.67
3	0.762	0.030	721.11	994.26	18.34	23.39	0.66	2384	5.59	2568	1330.00	1789.67
4	0.762	0.030	721.11	994.26	18.34	23.39	0.66	2384	5.59	2568	1330.00	1789.67
5	1.016	0.040	721.11	994.26	21.18	27.00	0.76	2753	6.46	2965	1330.00	1789.67
6	1.219	0.048	721.11	994.26	23.20	29.58	0.84	3015	7.07	3248	1330.00	1789.67
7	1.321	0.052	721.11	994.26	24.15	30.79	0.87	3139	7.36	3381	1330.00	1789.67
8	1.270	0.050	721.11	994.26	23.68	30.19	0.85	3078	7.22	3315	1330.00	1789.67
9	1.270	0.050	721.11	994.26	23.68	30.19	0.85	3078	7.22	3315	1330.00	1789.67
10	1.143	0.045	721.11	994.26	22.47	28.64	0.81	2920	6.85	3145	1330.00	1789.67
11	0.889	0.035	721.11	994.26	19.81	25.26	0.72	2575	6.04	2774	1330.00	1789.67
12	0.889	0.035	721.11	994.26	19.81	25.26	0.72	2575	6.04	2774	1330.00	1789.67
Average	1.074	0.042	721.11	994.26	21.61	27.56	0.78	2809	6.59	3026	1330.00	1789.67
Test 6												
	ΔP mmH2O	ΔP "H2O	T °C	T °K	Vs ft/sec	Qs dscf/sec	Qs drms/s	Qs drms/hr	Vs m/s	Qs wrms/hour	T °F	T oR
1	1.016	0.040	726.67	999.82	21.24	26.93	0.76	2745	6.47	2957	1340.00	1799.67
2	1.016	0.040	726.67	999.82	21.24	26.93	0.76	2745	6.47	2957	1340.00	1799.67
3	1.219	0.048	726.67	999.82	23.27	29.50	0.84	3007	7.09	3239	1340.00	1799.67
4	1.270	0.050	726.67	999.82	23.75	30.11	0.85	3069	7.24	3306	1340.00	1799.67
5	1.270	0.050	726.67	999.82	23.75	30.11	0.85	3069	7.24	3306	1340.00	1799.67
6	1.524	0.060	726.67	999.82	26.01	32.98	0.93	3362	7.93	3622	1340.00	1799.67
7	1.524	0.060	726.67	999.82	26.01	32.98	0.93	3362	7.93	3622	1340.00	1799.67
8	1.321	0.052	726.67	999.82	24.22	30.70	0.87	3130	7.38	3372	1340.00	1799.67
9	1.270	0.050	726.67	999.82	23.75	30.11	0.85	3069	7.24	3306	1340.00	1799.67
10	1.067	0.042	726.67	999.82	21.76	27.59	0.78	2813	6.63	3030	1340.00	1799.67
11	1.016	0.040	726.67	999.82	21.24	26.93	0.76	2745	6.47	2957	1340.00	1799.67
12	1.016	0.040	726.67	999.82	21.24	26.93	0.76	2745	6.47	2957	1340.00	1799.67
1	0.889	0.035	726.67	999.82	19.87	25.19	0.71	2568	6.06	2766	1340.00	1799.67
2	0.889	0.035	726.67	999.82	19.87	25.19	0.71	2568	6.06	2766	1340.00	1799.67
3	1.143	0.045	726.67	999.82	22.53	28.56	0.81	2912	6.87	3137	1340.00	1799.67
4	1.143	0.045	726.67	999.82	22.53	28.56	0.81	2912	6.87	3137	1340.00	1799.67
5	1.270	0.050	726.67	999.82	23.75	30.11	0.85	3069	7.24	3306	1340.00	1799.67
6	1.778	0.070	726.67	999.82	28.10	35.62	1.01	3631	8.56	3912	1340.00	1799.67
7	1.905	0.075	726.67	999.82	29.08	36.87	1.04	3759	8.86	4049	1340.00	1799.67
8	1.905	0.075	726.67	999.82	29.08	36.87	1.04	3759	8.86	4049	1340.00	1799.67
9	1.778	0.070	726.67	999.82	28.10	35.62	1.01	3631	8.56	3912	1340.00	1799.67
10	1.524	0.060	726.67	999.82	26.01	32.98	0.93	3362	7.93	3622	1340.00	1799.67
11	1.270	0.050	726.67	999.82	23.75	30.11	0.85	3069	7.24	3306	1340.00	1799.67
12	1.270	0.050	726.67	999.82	23.75	30.11	0.85	3069	7.24	3306	1340.00	1799.67
Average	1.304	0.051	726.67	999.82	23.91	30.32	0.86	3090	7.29	3329	1340.00	1799.67



# APPENDIX E: BGR 36LP Combustor P&ID

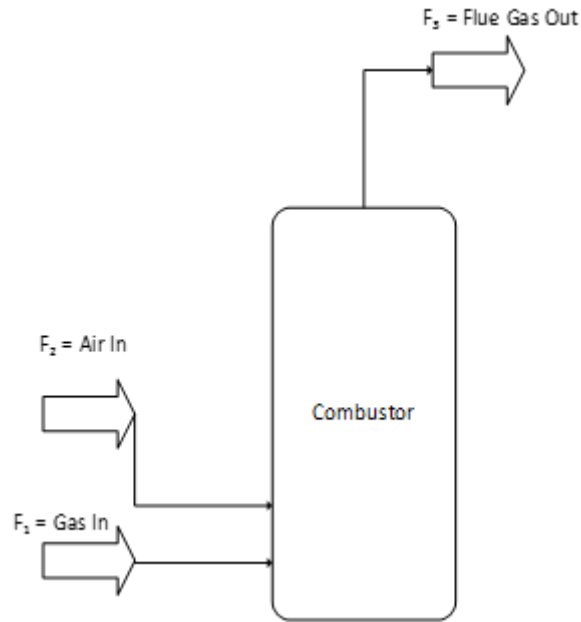


DESIGN BASIS	
INLET WASTE GAS PRESSURE	0.09 PSI TO 3 PSI
WASTE GAS CAPACITY	100,000 SCFD
CONTROLLER POWER	12-24 VDC AND SOLAR

## NOTES:

1. CONTINUOUS PILOT SYSTEM UTILIZING FLAME IONIZING TECHNOLOGY.
2. WASTE GAS LINE NOT REQUIRED TO BE CSA 149.3 COMPLIANT.

## APPENDIX F – MASS BALANCE CALCULATIONS



The general mass balance equation applied is: In – Out + Generation – Consumption = Accumulation

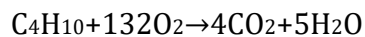
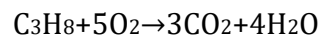
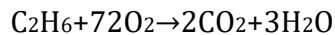
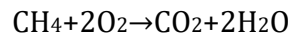
This mass balance assumes steady state, i.e. that there is no accumulation of material in the combustor. The resulting balance equations are provided below:

Overall Balance:  $F_1 + F_2 = F_3$

Component Balance:  $F_1 x_{1,i} + F_2 x_{2,i} + X_{i,generated} - X_{i,consumed} = F_3 x_{3,i}$

for all components, i.

Generation/Consumption Reactions:



## Mass Balance for Run 1 (10% Flowrate)

### Inlet Gas Conditions:

$$Q1 = 310.18 \text{ m}^3/\text{d}$$

Components (measured by GC, see Appendix B):

Components	CH <sub>4</sub>	N <sub>2</sub>	CO <sub>2</sub>	C2	O <sub>2</sub>	C3	C4	He
mol %	95.5600	2.8719	0.7857	0.6598	0.0000	0.0310	0.0668	0.0113
wt %	91.62	4.81	2.07	1.19	0.00	0.08	0.232	0.003

Where 
$$wt\% = \frac{x_i \times MW_i}{\sum_i (x_i \times MW_i)}$$

Calculate average density: 
$$\rho_1 = \sum_i (wt\%_i \times \rho_i) = 0.7240 \text{ kg/m}^3$$

Calculate mass flow rate: 
$$F1 = Q1 \times \rho_1 = 9.36 \text{ kg/h}$$

### Outlet Gas Conditions:

$$Q3 = 2161 \text{ wet ref. m}^3/\text{d}$$

$$Q3 = 2135 \text{ dry ref m}^3/\text{d}$$

Components (measured by FTIR, see Appendix D):

Components	CH <sub>4</sub>	CO <sub>2</sub>	NMHC	O <sub>2</sub>	H <sub>2</sub> O	N <sub>2</sub>
vol %	0.2430	0.5600	0.0030	19.3000	1.2200	78.6741
Mass flow (kg/h)	3.3989	21.5208	0.2370	539.0042	19.2299	1930.07

### CO<sub>2</sub> Balance

$$F1 \times x_{1,CO_2} + F2 \times x_{1,CO_2} + CO_{2,generated} = F3 \times x_{3,CO_2}$$

Where

$$CO_{2,generated} = \left[ \frac{F1 \times x_{1,CH_4}}{MW_{CH_4}} \times \frac{1 \text{ mole } CO_2}{1 \text{ mole } CH_4} + \frac{F1 \times x_{1,C_2}}{MW_{C_2}} \times \frac{2 \text{ mole } CO_2}{1 \text{ mole } C_2} + \frac{F1 \times x_{1,C_3}}{MW_{C_3}} \times \frac{3 \text{ mole } CO_2}{1 \text{ mole } C_3} + \frac{F1 \times x_{1,C_4}}{MW_{C_4}} \times \frac{4 \text{ mole } CO_2}{1 \text{ mole } C_4} \right] \times MW_{CO_2}$$

To calculate the inlet flowrate required for complete combustion to CO<sub>2</sub>, we substitute F2 = F3-F1 for the unknown F2 and solve for F1 = 7.73 kg/h. This results in the methane balance calculation in the following section.

### **Methane balance:**

$$F1_{measured} \times x_{CH_4} - CH_{4,consumed} = F3 \times x_3$$

$$\frac{9.36kg}{h} \times 0.9162 - \frac{7.73kg}{h} \times 0.9162 = \frac{3.3989kg}{h}$$

$$\frac{1.49kg}{h} \neq 3.39kg/h$$

Therefore, we recalculate the inlet flowrate based on the CO<sub>2</sub> balance and the excess methane, such that:

$$F1_{new} = \frac{\frac{3.3989kg}{h} + \frac{7.73kg}{h} \times 0.9162}{0.9612}$$

$$F1_{new} = 11.44 \text{ kg/h}$$

Calculation of the mass balance for the remaining components is relatively straightforward. The results are tabulated in the following pages:

**Table F-1: Run 1 Mass Balance**

Components	CH4	N2	NMHC	CO2	O2	H2O	Overall
In (kg/h)	10.48	1977.44	0.17	1.83	605.95	0	2629.40
Out (kg/h)	-3.3989	-1977.44	-0.24	-21.52	-539.00	-19.23	-2513.46
Generated	0.00	0	0.00	19.43	0.00	15.896	
Consumed	-7.08	0		0	-28.26		
Balance	0.00	0.00	-0.07	-0.26	38.69	-3.33	115.94
% Difference	0%	0%	38%	1%	6%	17%	4%
Destruction Efficiency	67.5721						

**Table F-2: Run 2 Mass Balance**

Components	CH4	N2	NMHC	CO2	O2	H2O	Overall
In (kg/h)	15.75	2322.36	0.21	2.21	711.60	0	3091.49
Out (kg/h)	-7.9711	-2322.36	-0.56	-23.68	-612.51	-20.83	-2936.09
Generated	0.00	0	0.00	21.34	0.00	17.458	
Consumed	-7.78	0		0	-31.04		
Balance	0.00	0.00	-0.35	-0.13	68.05	-3.37	155.40
% Difference	0%	0%	169%	1%	10%	16%	5%
Destruction Efficiency	49.3886						

**Table F-3: Run 3 Mass Balance**

Components	CH4	N2	NMHC	CO2	O2	H2O	Overall
In (kg/h)	17.47	2476.96	0.23	2.37	758.92	0	3297.93
Out (kg/h)	-8.8055	-2476.96	-0.63	-26.29	-600.46	-23.78	-3127.65
Generated	0.00	0	0.00	23.78	0.00	19.448	
Consumed	-8.67	0		0	-34.57		
Balance	0.00	0.00	-0.39	-0.15	123.88	-4.34	170.28
% Difference	0%	0%	168%	1%	16%	18%	5%
Destruction Efficiency	49.5984						

**Table F-4: Average of 10% Rate Mass Balance**

Components	CH4	N2	NMHC	CO2	O2	H2O	Overall
In (kg/h)	14.78	2258.56	0.21	2.13	692.06	0	3006.02
Out (kg/h)	-6.7341	-2258.56	-0.48	-24.38	-598.22	-21.78	-2859.34
Generated	0.00	0	0.00	22.07	0.00	18.050	
Consumed	-8.04	0		0	-32.09		
Balance	0.00	0.00	-0.27	-0.19	61.75	-3.73	146.68
% Difference	0%	0%	128%	1%	9%	17%	5%
Destruction Efficiency	54.4266		-127.5081				

**Table F-5: Run 4 Mass Balance**

Components	CH4	N2	NMHC	CO2	O2	H2O	Overall
In (kg/h)	81.25	2707.29	1.05	3.81	828.80	0	3668.05
Out (kg/h)	-0.0004	-2707.29	-0.001	-180.89	-512.18	-116.35	-3535.72
Generated	0.00	0	0.00	225.98	0.00	184.226	
Consumed	-81.25	0	-1.05	0	-331.48		
Balance	0.00	0.00	0.00	48.90	-14.86	67.88	132.33
% Difference	0%	0%	0%	22%	2%	58%	4%
Destruction Efficiency	99.9996						

**Table F-6: Run 5 Mass Balance**

Components	CH4	N2	NMHC	CO2	O2	H2O	Overall
In (kg/h)	76.43	2675.94	0.99	1.52	819.24	0	3621.60
Out (kg/h)	-0.0035	-2675.94	-0.0007	-196.87	-500.81	-160.07	-3581.30
Generated	0.00	0	0.00	212.61	0.00	173.317	
Consumed	-76.43	0	-0.9916	0	-311.88		
Balance	0.00	0.00	0.00	17.25	6.56	13.24	40.30
% Difference	0%	0%	0%	8%	1%	8%	1%
Destruction Efficiency	99.9955						

**Table F-7: Run 6 Mass Balance**

Components	CH4	N2	NMHC	CO2	O2	H2O	Overall
In (kg/h)	74.47	2931.92	0.96	1.48	897.72	0	3958.58
Out (kg/h)	-0.0004	-2931.92	-0.0011	-216.87	-549.79	-183.52	3939.18
Generated	0.00	0	0.00	207.14	0.00	168.861	
Consumed	-74.47	0	-0.9608	0	-303.84		
Balance	0.00	0.00	0.00	-8.26	44.09	-14.66	19.39
% Difference	0%	0%	0%	3.99%	4.9%	8.0%	0.5%
Destruction Efficiency	99.9995						

**Table F-8: Average 100% Rate Mass Balance**

Components	CH4	N2	NMHC	CO2	O2	H2O	Overall
In (kg/h)	77.33	2772.86	1.0009	3.77	848.94	0	3750.87
Out (kg/h)	-0.0014	-2772.86	-0.0009	-198.01	-521.19	-152.57	-3685.37
Generated	0.00	0	0.00	215.09	0.00	175.347	
Consumed	-77.33	0	-1.0000	0	-315.52		
Balance	0.00	0.00	0.00	20.85	12.23	22.78	65.50
% Difference	0%	0%	0%	10%	1%	15%	2%
Destruction Efficiency	99.9981						

## APPENDIX G – AERSCREEN RESULTS

### METHODOLOGY

#### Model Description

The dispersion modelling was conducted using aerscreen version 16216. Aerscreen is a U.S. EPA model based on aermod, the aerscreen model used the aermod EPA executable 18081. The current model was conducted using Breeze aerscreen version 1.9 as a software interface.

#### Operating Schedule

The current model assumed full continuous operation, to provide a conservative estimate for the model. It was assumed the effluent was 100% load and 10% load, in accordance with stack testing.

#### Temperature Range

Aerscreen allows a simulation of weather. For the current model a range of 230 K to 320 K (-43°C to 47°C).

#### Surface Characteristics

A variety of terrain data is possible with aerscreen. The different terrain will affect the dispersion and various terrain were applied to the source. As BGR is proposing to use the burner in a variety of locations; local terrain data is not applicable for the aerscreen model. The current model assumed a simple flat terrain.

#### Scaling Ratios

To convert from default 1-hour results, aerscreen uses fixed ratios. The current ratios (2016) recommended by the EPA are:

- |                                |              |
|--------------------------------|--------------|
| 1. 3-hour fixed ratio of 1.00  | Screen3 0.90 |
| 2. 8-hour fixed ratio of 0.90  | Screen3 0.70 |
| 3. 24-hour fixed ratio of 0.60 | Screen3 0.40 |
| 4. Annual fixed ratio of 0.10  | Screen3 0.08 |

Older ratios for Screen3 (the predecessor model) are included for comparison.



## EMISSION SOURCES

### Modeled Sources

Table G-1 contains the source summaries of the two scenarios.

The emissions were measured by SRC on May 28 to 29, 2019.

**Table G-1 Emission Source Summary**

Source Description	Maximum Emission (g/s)	Technique (source)	Quality (OEM Guideline)
BGR 100%	Multiple*	Measured	Average
BGR 10%	Multiple*	Measured	Average

\*refer to SRC Report 14656-2C19

The emission data estimation techniques employed were obtained from the Ontario Ministry of the Environment (2005). The data quality is divided into four categories; Highest, Above Average, Average and Marginal or Uncertain Data Quality. The measured data is of average quality, due to the single campaign. These estimates are equivalent to AP-42 “A,” highest, “B” above average, “C” average and “D,” marginal or uncertain, ratings. More testing would be required to improve confidence in the emissions.

### Ambient Background Levels

Due to the variety of potential placements it is not feasible to provide backgrounds for all locations. It is recommended the model results do not exceed 50% of the standards for the pollutants that are normally present in the environment (i.e. TSP, CO, NO<sub>2</sub>). This extends to H<sub>2</sub>S as the locations where this technology is likely to be utilized are also likely to have H<sub>2</sub>S in the ambient air from other facilities.

### Ambient Standards

Reference standards for Saskatchewan are required for air contaminants that may cause harm; requiring utilization of standards from other jurisdictions in some cases. For example, to evaluate the potential VOC risk, it is necessary to find standards from alternate jurisdictions; the recommendation is Alberta, Ontario and Texas.

Alberta utilizes a set list of compounds with standards. For the purpose of this report compounds without a standard in Alberta, but with standards in Saskatchewan, will use Saskatchewan as reference.

## BUILDING AND STACK PARAMETERS

### Building Parameters

At the current test site, no buildings are identified.

### Stack Parameters

Table G-2 provides details on the physical characteristics of the stack modelled.

**Table G-2 Stack Parameters**

	Description	Source Data Exit Dimensions				Quality
		Flow (m/s)	Temp. (°C)	Diameter (m)	Height (m)	
100%	Combustor	6.760	717	0.762	7.331	Uncertain
10%	Combustor	2.237	146	0.762	7.331	Uncertain

A rough elevation of 500 m ASL was utilized to account for pressure differentials from sea level.

## RESULTS

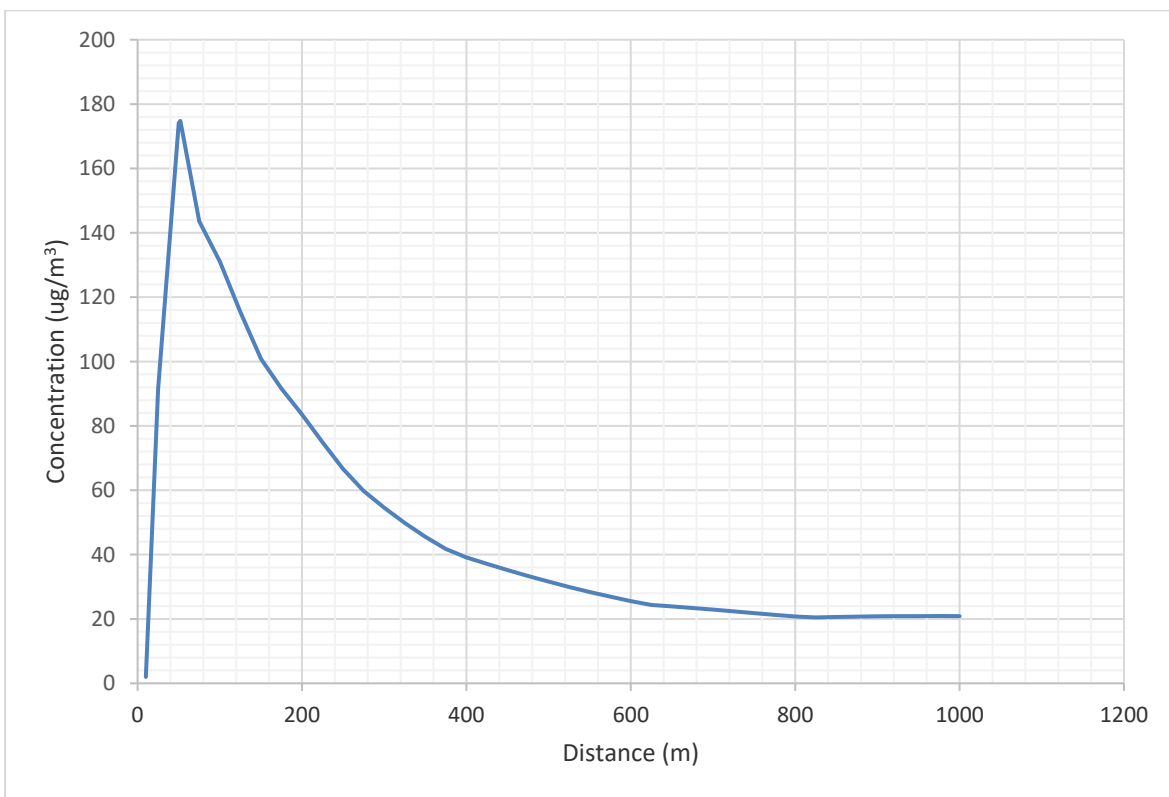
Terrain influence at four distances were compared to evaluate the relative differences. Using a baseline of 100% for cultivated land (identical to water) the various terrains were compared to evaluate the increase or decrease each would cause. When sites are chosen for the combustor the local terrain will impact the predicted model response; the terrain influence table provides adjustment factors to the predicted model responses. As an example, if the combustor is surrounded by coniferous forest the model predicts the overall ambient concentration should be multiplied by 1.241 at 500 m.

**Table G-3 Terrain Influence**

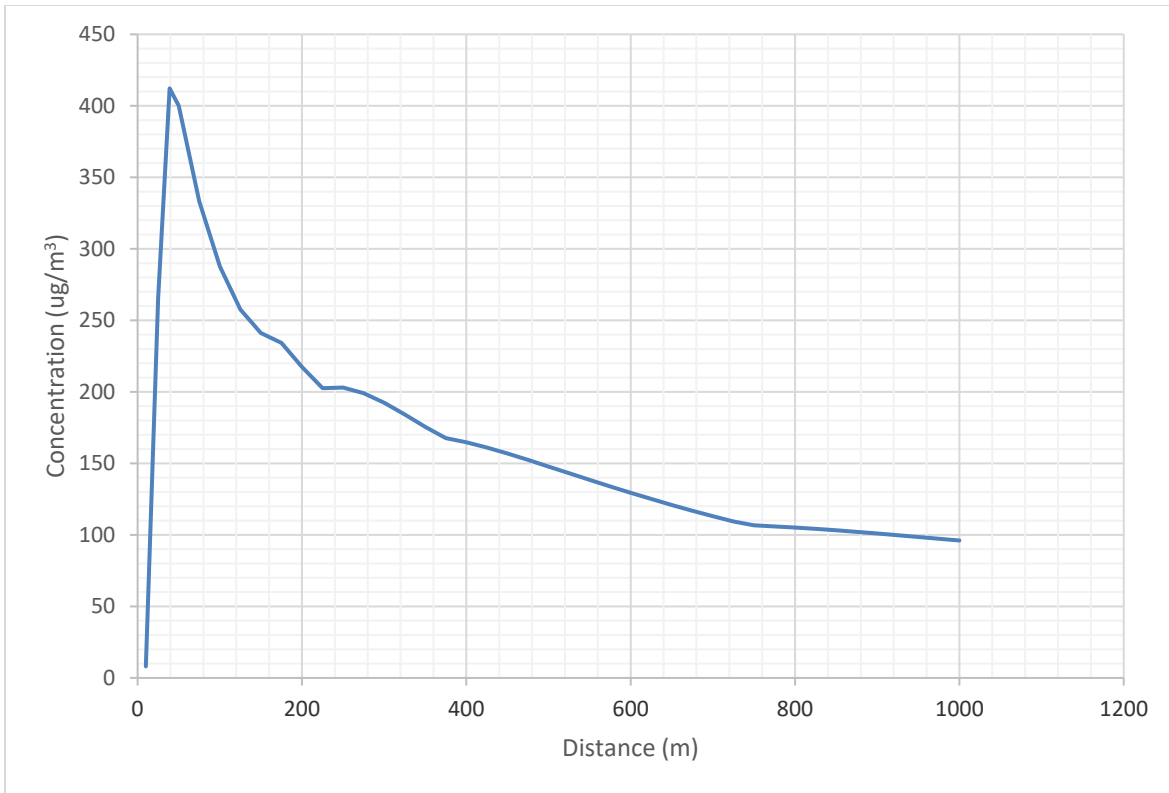
Terrain Description	Distance			
	100 m	250 m	500 m	1000 m
Cultivated Land	100.0%	100.0%	100.0%	100.0%
Water	100.0%	100.0%	100.0%	100.0%
Coniferous Forest	61.8%	107.5%	124.1%	136.3%
Deciduous Forest	42.9%	39.1%	47.3%	42.3%
Grassland	62.1%	55.8%	58.1%	46.4%

Desert Shrubland	100.0%	107.5%	124.1%	136.7%
Swamp	85.2%	67.3%	71.7%	56.6%
Urban	90.4%	82.2%	86.8%	65.0%

As a reference for the model cultivated land was chosen to represent generic terrain. Figure 1 illustrates the aeroscreen predictions of concentration vs. distance for a generic 1 g/s release. In the first 50 m it is normal for ambient concentrations to increase, this is the distance it takes to reach the ground from the stack exhaust. From approximately 50 m onwards there is a rapid decrease in concentration until the concentrations start levelling off. Although the model predicts continuation of concentration it is largely a relic, the model will continue to predict concentrations past 10 km.



**Figure G-1 Concentration vs. Distance for full load**



**Figure G-2 Concentration vs. Distance for reduced load**

In contrast to full load the reduced load profile shows a lower dilution rate and higher concentrations further out. The reduction in initial vertical mixing is expected at lower exhaust rates and temperatures.

Tables G-4 and G-5 may be used to estimate the percentage reduction of the plume. At full load the residual (%) of the initial release concentration is presented from 10 m to 1000 m. Included is the peak value at 35 m for reference. The table can be used to estimate ambient ground levels; or used to calculate the maximum concentration release if a desired level is known.

To illustrate how a maximum release can be determined it is necessary to choose a distance, in this case 500 m, which has a residual amount of 0.00316%. If the ambient limit of a pollutant is  $5 \mu\text{g}/\text{m}^3$  then the maximum release from the stack is:

$$\frac{5 \mu\text{g}/\text{m}^3}{0.0000316} = 0.158\text{g}/\text{m}^3$$

**Table G-4 Percentage Remaining of Initial Release**

Distance	% Remaining	Distance	% Remaining	Distance	% Remaining	Distance	% Remaining
10	0.0001987%	275	0.0059754%	525	0.0029941%	775	0.0021293%
25	0.0091487%	300	0.0054564%	550	0.0028382%	800	0.0020757%
50	0.0174180%	325	0.0049820%	575	0.0026923%	825	0.0020456%
52	0.0174780%	350	0.0045553%	600	0.0025560%	850	0.0020615%
75	0.0143570%	375	0.0041742%	625	0.0024361%	875	0.0020735%
100	0.0131040%	400	0.0039126%	650	0.0023902%	900	0.0020820%
125	0.0115420%	425	0.0037150%	675	0.0023410%	925	0.0020875%
150	0.0100830%	450	0.0035220%	700	0.0022896%	950	0.0020901%
175	0.0091590%	475	0.0033365%	725	0.0022367%	975	0.0020902%
200	0.0083584%	500	0.0031603%	750	0.0021831%	1000	0.0020881%
225	0.0074886%						
250	0.0066639%						

**Table G-5 Percentage Remaining of Initial Release from reduced operation**

Distance	% Remaining	Distance	% Remaining	Distance	% Remaining	Distance	% Remaining
10	0.0008045%	275	0.0199070%	525	0.0143130%	775	0.0105970%
25	0.0265270%	300	0.0192380%	550	0.0138490%	800	0.0105150%
50	0.0412200%	325	0.0184240%	575	0.0133910%	825	0.0104230%
52	0.0400020%	350	0.0175480%	600	0.0129450%	850	0.0103220%
75	0.0333290%	375	0.0167620%	625	0.0125120%	875	0.0102140%
100	0.0287730%	400	0.0164730%	650	0.0120950%	900	0.0101000%
125	0.0257590%	425	0.0161060%	675	0.0116930%	925	0.0099805%
150	0.0241120%	450	0.0156900%	700	0.0113070%	950	0.0098579%
175	0.0234270%	475	0.0152430%	725	0.0109380%	975	0.0097325%
200	0.0217480%	500	0.0147810%	750	0.0106660%	1000	0.0096050%
225	0.0202630%						
250	0.0203040%						

### VOC Emissions Compared to Standards

The VOC standards for Texas are the most inclusive and are presented in Table G-6. Alongside the values are the average measured inlet and outlet concentrations; further refined by removing compounds below the Minimum Detection Limit (MDL). In cases where one of three tests reported a value, that value is used exclusively (high bias). Similarly, when two tests report a positive value, the average is of the two results.

**Table G-6 Inlet and Outlet VOC concentrations alongside Texas Standards**

Compound	Inlet		Outlet		Texas	24 hour	Annual
	10% Average	100% Average	10% Average	100% Average	1 hour		
Concentration (ppm)							
1,1,1-Trichloroethane					1.7	0	0.93
1,1,2,2-Tetrachloroethane					0.01	0	0.001
1,1,2-Trichloroethane					0.1	0	0.01
1,1-Dichloroethane					1	0	0.1
1,1-Dichloroethylene					0.18	0	0.086
1,2,3-Trimethylbenzene	0.0063			0.00022	3	0	0.037
1,2,4-Trichlorobenzene							
1,2,4-Trimethylbenzene	0.0051			0.00019	3	0	0.037
1,2-Dibromoethane							
1,2-Dichlorobenzene							
1,2-Dichloroethane				0.00004			
1,2-Dichloropropane					0.1	0	0.01
1,3,5-Trimethylbenzene				0.00013	3	0	0.037
1,3-Butadiene			0.00015		1.7	0.43	0.009
1,3-Dichlorobenzene							
1,4-Dichlorobenzene							
1,4-Dioxane							
1-Butene/Isobutylene	0.0205	0.013	0.0048	0.0011	27	0	2.3
1-Hexene/2-Methyl-1-pentene			0.00022	0.000095	0.5	0	0.05
1-Pentene	0.022667	0.019	0.0016	0.0008	12	0	0.56
2,2,4-Trimethylpentane					4.1	0	0.38
2,2-Dimethylbutane	0.823333	1.11			5.4	5.4	0.19
2,3,4-Trimethylpentane	0.0077		0.00003		4.1	0	0.38
2,3-Dimethylbutane	0.5	0.49	0.002527		5.4	5.4	0.19
2,3-Dimethylpentane	0.046333	0.045	0.00029		8.3	0	2.2
2,4-Dimethylpentane	0.025667	0.0215	0.00014		8.3	0	2.2
2-Methylheptane					4.1	0	0.38

2-Methylhexane	0.029	0.0255	0.0002	0.00007	8.3	0	2.2
2-Methylpentane	0.166667	0.15	0.0022	0.00011	5.4	5.4	0.19
3-Methylheptane	0.02				4.1	0	0.38
3-Methylhexane	0.030333	0.027			8.3	0	2.2
3-Methylpentane	0.054333	0.0485		0.000217	5.4	5.4	0.19
Acetone			0.049133	0.051	11	0	6.7
Acrolein	0.011				0.0048	0.0048	0.0012
Benzene	0.001		0.001275	0.00021	0.18	0.1	0.0014
Benzyl chloride							
Bromodichloromethane							
Bromoform				0.00013			
Bromomethane				0.00005	0.03	0	0.003
Carbon disulfide	0.0019			0.001987			
Carbon tetrachloride					0.02	0	0.002
Chlorobenzene				0.00012	0.1	0	0.01
Chloroethane				0.0003			
Chloroform				0.00011	0.02	0	0.002
Chloromethane			0.000655	0.000587	0.5	0	0.05
cis-1,2-Dichloroethene							
cis-1,3-Dichloropropene					0.0099	0	0.00099
cis-2-Butene	0.067	0.066	0.00048	0.0004	15	0	0.7
cis-2-Pentene	0.016533	0.0115	0.0001		12	0	0.56
Cyclohexane	0.36	0.345	0.00455	0.00037	1	0	0.1
Cyclopentane	0.047667	0.042	0.00025		5.9	0	0.59
Dibromochloromethane				0.00007			
Ethanol	0.159		0.0039	0.0044			
Ethyl acetate					4	0	0.4
Ethylbenzene	0.0017			0.00013	20	0	0.44
Freon-11							
Freon-113							
Freon-114							
Freon-12			0.00023	0.00027	10	0	1
Hexachloro-1,3-butadiene							
Isobutane	1.636667	2.175			33	0	10
Isopentane	0.69	0.915	0.003993	0.000353	68	0	8.1
Isoprene					1.4	0	0.14
Isopropyl alcohol	0.064	0.75	0.042				
Isopropylbenzene		0.0146		0.00008			
m,p-Xylene	0.0068		0.000185	0.0006	1.7	0	0.14
m-Diethylbenzene							



m-Ethyltoluene							
Methyl butyl ketone					0.01	0	0.001
Methyl ethyl ketone				0.009	20	0	3
Methyl isobutyl ketone					0.2	0	0.02
Methyl methacrylate							
Methyl tert butyl ether					0.5	0	0.05
Methylcyclohexane	0.263333	0.245	0.00122		4	0	0.4
Methylcyclopentane	0.166667	0.15	0.0145	0.00072	0.75	0	0.075
Methylene chloride	0.053933	0.076			3.4	0	0.1
n-Butane	4.166667	5.295	0.02503		92	0	10
n-Decane				0.00026	1	0	0.19
n-Dodecane							
n-Heptane	0.067667	0.059	0.00039		8.3	0	2.2
n-Hexane	0.226667	0.19	0.023945	0.00074	5.4	5.4	0.19
n-Nonane				0.00017	3	0	0.28
n-Octane			0.00016	0.00015	4.1	0	0.38
n-Pentane	0.67	0.845	0.0041	0.0004	68	0	8.1
n-Propylbenzene					0.51	0	0.051
n-Undecane					0.55	0	0.055
Naphthalene					0.095	0	0.0095
o-Ethyltoluene				0.00011	0.25	0	0.025
o-Xylene				0.0001	1.7	0	0.14
p-Diethylbenzene	0.019667	0.016		0.00018	0.45	0	0.045
p-Ethyltoluene					0.25	0	0.025
Styrene			0.000295	0.00019	5.2	0	0.11
Tetrachloroethylene					1	0	0.0038
Tetrahydrofuran							
Toluene			0.000325	0.00043	4	0	1.1
trans-1,2-Dichloroethylene							
trans-1,3-Dichloropropylene							
trans-2-Butene	0.16	0.165		0.00058	15	0	0.7
trans-2-Pentene	0.109333	0.104	0.000665	0.00007	12	0	0.56
Trichloroethylene							
Vinyl acetate							
Vinyl chloride					27	0	0.00047

The results indicate that VOCs were not emitted in concentrations in excess of the standards.

## VOC Formation

Some compounds are commonly formed during combustion; the release rate is higher than the inlet concentration. The current VOC list has several compounds that were measured at higher amounts in the outlet than the inlet; suggesting either formation or analysis error.

**Table G-7 VOCs that had an increase at the outlet**

Compound	10% Load	100% Load
1,2,3-Trimethylbenzene		X
1,2,4-Trimethylbenzene		X
1,2-Dichloroethane		X
1,3,5-Trimethylbenzene		X
1,3-Butadiene	X	
1-Hexene/2-Methyl-1-pentene	X	X
Acetone	X	X
Benzene	X	X
Bromoform		X
Bromomethane		X
Carbon disulfide		X
Chlorobenzene		X
Chloroethane		X
Chloroform		X
Chloromethane	X	X
Dibromochloromethane		X
Ethanol		X
Ethylbenzene		x
Freon-12	X	X
Methyl ethyl ketone		X
n-Decane		X
o-Ethyltoluene		X
o-Xylene		X
Styrene	X	X
Toluene	X	X

### VOC Concentration Reductions

Most compounds in the VOC test were below detection, mathematical analysis is not advised for those compounds as true values range from 0.0 to MDL. Of the compounds that were positively identified, some were identified in the inlet and outlet, allowing a comparison. At 10% load, of the compounds that were above MDL, there was an average 94.29% reduction in concentration. Similarly, at the 100% load there was a 98.85% reduction in concentrations. Due to the limited data set it is hard to ascribe an exact concentration reduction, the lab error plays a significant role at these low levels in altering calculated efficiencies.

Concentration rather than overall release rate was used as dilution rates will create lower ambient results.

### Sulfur and H<sub>2</sub>S Results

**Table G-8 Sulfur Compounds and emission limits**

Pollutant	Emission Rate (g/sec)	Averaging Period	Concentration		Standard	Jurisdiction	Basis Or Comments
			100% (500m) (µg/m <sup>3</sup> )	10% (500m) (µg/m <sup>3</sup> )			
H <sub>2</sub> S	0.0000014 (1.2 ppb)	1 hour	0.000442	0.000606	15 (11 ppb)	SK	
					14 (10)	AB	Odour
	0.0000041 (4.6 ppb)*	24 hour	0.000265	0.000364	5 (3.6 ppb)	SK	
					4 (3 ppb)	AB	Health
SO <sub>2</sub>	ND	1 hour	ND	ND	450 (172 ppb)	SK	
		24 hour	ND	ND	125 (48 ppb)	SK	
		Annual	ND	ND	20 (8 ppb)	SK	
TRS (RSC)	0.0000039 (3.53 ppb)	1 hour	0.000123	0.000636	7 (5)	B.C.	Forest Products
	0.0000043 (4.8ppb)*	24 hour	0.0000738	0.000382	3 (2)	B.C.	Forest Products

\*reduced load concentrations

H<sub>2</sub>S inlet and outlet concentration were measured at 100%; 450 ppb and 1.23 ppb; a 99.7% reduction. The chosen site had emissions lower than the ambient standard. With the measured reduction, an initial concentration in excess of 10% H<sub>2</sub>S is required; however, at such a high concentration it is uncertain if the burner would operate at higher or lower efficiencies as the burn characteristics may alter. H<sub>2</sub>S is not the only gas that may affect burn characteristics and is used to illustrate the process of determining inlet gas concentrations and the effect that changes may have on the model results.

## BTEX results

The standards for BTEX are provided below. The emission data provided for the source test found BTEX (as toluene) emissions were 0.0066 g/hour with an average concentration of 0.64 ppb. The emitted concentrations are below individual compound ambient standards.

**Table G-9 BTEX standards**

Pollutant	Emission Rate (g/sec)	Averaging Period	Concentration 100% (500m) ( $\mu\text{g}/\text{m}^3$ )	Concentration 10% (500m) ( $\mu\text{g}/\text{m}^3$ )	Standard	Jurisdiction	Basis Or Comments
Benzene	5.17E-07	1 hour	0.0000163	0.000372	30 (9 ppb)	AB	Haematological Effects
	2.52E-06*	24 hour	0.00000978	0.000223			
		Annual	0.00000163	0.0000372	3 (0.9 ppb)	AB	Carcinogenic Effects
Toluene	1.25E-06	1 hour	0.0000395	0.000121	1880 (499 ppb)	AB	Adopted from Texas
	8.19E-07*	24 hour	0.0000237	0.0000726	400 (106 ppb)	AB	Adopted from Michigan and Wisconsin
Ethylbenzene	4.35E-07	1 hour	0.0000137	0.000114	1200 (1050 ppb)	AB	Crop Yields
	7.72E-08*	3 day**	0.00000822	0.0000684	45 (40 ppb)	AB	Crop Yields
		Annual	0.000000137	0.0000114	30 (26 ppb)	AB	Conifers and Perennials
Xylene	2.34 E-06	1 hour	0.0000739	0.0000852	3000	ON	Odour (10 min)
	5.77E-07*				2300 (530 ppb)	AB	Adopted (ON)
		24 hour	0.0000443	0.0000511	700 (161 ppb)	AB	Adopted (California)
		Annual	0.00000739	0.00000852	610 (140ppb)	TX	

\*reduced load concentrations

\*\*Reduced by 24-hour factor

## CO and NO<sub>x</sub> Results

CO results are provided in Table G-10.

Total conversion of NO<sub>x</sub> was done to compare the release of NO<sub>2</sub> and NO from the source.

**Table G-10 CO and NO<sub>x</sub> results**

Pollutant	Emission Rate (g/sec)	Averaging Period	Concentration 100% (500m)	Concentration 10% (500m)	Standard	Jurisdiction	Basis Or Comments
NO <sub>2</sub>	0.072	1 hour	2.75	0.41	300-As NO <sub>2</sub>	SK	
	0.00278*	24 hour	1.65	0.25	200	SK	
		Annual	0.275	0.041	45-As NO <sub>2</sub>	SK	
CO	0.0075	1 hour	0.237	3.32	15000 (13000ppb)	SK	
	0.0225*				14300 (13000 ppb)	B.C.	
		8 hour	0.213	2.99	6000 (5000 ppb)	SK	
					5500 (5000 ppb)	B.C.	

\*reduced load concentrations

## Particulates

Particulates were not measured at the combustor. Particulate from the source will be primarily fine (PM<sub>2.5</sub>) and condensable particulate; which is also in the fine fraction. Standards for PM<sub>10</sub> and TSP are included for reference but are not applicable to this source; the fine standards are the most restrictive.

Emission factors (EF) can be used to estimate particulate release in select cases. In this case a proxy EF is used, the assumption is the exhaust will mimic natural gas combustion. The inlet concentrations were measured as greater than 90% except for a sample that was at 63% and appeared to have suffered sample loss.

The combustor design rate is 100,000 scf/day.

**Table G-11 Estimated Particulate Release**

Pollutant	Factor (lb/10 <sup>6</sup> scf)	Release (g/s)	Rating
Total	7.6	0.00399	Uncertain
Condensable	5.7	0.00299	Uncertain
Filterable	1.9	0.000997	Uncertain

**Table G-12 Particulate standards**

Pollutant	Emission Rate (g/sec)	Averaging Period	Maximum Concentration (full)	Standard	Jurisdiction	Basis Or Comments
Particulate	0.00399	1 hour	0.1007	80	AB – not an Objective	Guideline Derived from CWS
PM <sub>2.5</sub>		24 hour	0.060	28	SK	Derived from CWS
				29	AB	Health
				25	B.C.	
		Annual	0.01007	10	SK	
				8	B.C.	
Particulate		1 hour	0.1007			
PM <sub>10</sub>		24 hour	0.060	50	SK, BC	
		Annual				

<b>Particulate</b>		1 hour	0.1007			
<b>TSP</b>		24 hour	0.060	100	SK, AB	AB – Pulmonary Effects
				120	B.C.	
		Annual	0.01007	60	SK, AB, B.C.	

## REFERENCES

Alberta Environment and Sustainable Resource Development. *Air Quality Model Guideline*. October 2013.

British Columbia Ministry of Environment. *British Columbia Air Quality Dispersion Modelling Guideline*. December 2015.

Ontario Ministry of the Environment. 2018. *Procedure for Preparing an Emission Summary and Dispersion Modelling Report – Version 4.1*. Ontario Ministry of the Environment, Toronto, Ontario. 116 pp.

Ontario Ministry of the Environment. 2005b. *Summary of O. Reg. 419/05 Standards and Point of Impingement Standards and Ambient Air Quality Criteria (AAQCs)*. Standards Development Branch, December 2005.

Saskatchewan Ministry of the Environment. *Saskatchewan Air Quality Modelling Guideline*. March 2012

U.S. Environmental Protection Agency. *AERSCREEN User's Guide*. December 2016

The following online sites were accessed in August 2019 for ambient standards:

Ontario: <https://www.ontario.ca/page/ontarios-ambient-air-quality-criteria-sorted-contaminant-name>

Alberta: <https://open.alberta.ca/dataset/Od2ad470-117e-410f-ba4f-aa352cb02d4d/resource/4ddd8097-6787-43f3-bb4a-908e20f5e8f1/download/aaqo-summary-jan2019.pdf>

Texas: <https://www.tceq.texas.gov/assets/public/permitting/air/Modeling/guidance/airquality-mod-guidelines6232.pdf>

BC: <https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/aqotable.pdf>