

Laurel Mountain Midstream Operating, LLC
SPRINGHILL COMPRESSOR STATION
 Application for Authorization to Use General Permit GP-5
Attachment C - Emission Calculations

Compressor Engine Emissions – 1,380 bhp CAT G3516B (4SLB) w/ OxCat

| Unit | Description | Reference | Pollutant | Pre-Controlled Emissions | | | Control Efficiency % | Controlled Emissions | | |
|---|--|---------------------|--------------|--------------------------|---------|---------|----------------------|----------------------|---------|---------|
| | | | | g/bhp-hr | lb/hr | tpy | | g/bhp-hr | lb/hr | tpy |
| Compressor Engines Unit CE-04 and CE-05 (each) | Caterpillar (CAT) G3516B (4SLB) 1,380 bhp (ea) 1,400 rpm 264 in3/cyl AFRC / Oxidation Catalyst NSPS UUU - Applicable NESHAP ZZZZ - No Req'ts 8,760 hr/yr 920 Bluscd (LHV) 1,020 Bluscd (HHV) 7,442 Blubhp-hr (LHV) 8,264 Blubhp-hr (HHV) 10.27 MMBtu/hr (LHV) 11.40 MMBtu/hr (HHV) 11.163 scf/hr 97.79 Mmscf/yr | Vendor Data | NOX | 0.50 | 1.52 | 6.66 | 0.0% | 0.50 | 1.52 | 6.66 |
| | | Vendor Data | CO | 2.43 | 7.39 | 32.38 | 93.0% | 0.17 | 0.52 | 2.27 |
| | | Vendor Data | THC | 4.75 | 14.45 | 63.30 | 4.9% | 4.52 | 13.75 | 60.23 |
| | | Vendor Data | NMHC | 0.71 | 2.16 | 9.46 | 32.5% | 0.48 | 1.46 | 6.39 |
| | | Vendor Data | NMNEHC | 0.48 | 1.46 | 6.40 | 48.0% | 0.25 | 0.76 | 3.33 |
| | | NMNEHC+HCHO | VOC | 0.91 | 2.77 | 12.13 | 69.3% | 0.28 | 0.85 | 3.73 |
| | | AP-42 Table 3.2-3 | SO2 | 2.2E-03 | 0.01 | 0.03 | 0.0% | 2.2E-03 | 0.01 | 0.03 |
| | | AP-42 Table 3.2-3 | PM10/2.5 | 0.04 | 0.11 | 0.50 | 0.0% | 0.04 | 0.11 | 0.50 |
| | | AP-42 Table 3.2-3 | Benzene | 1.6E-03 | 0.01 | 0.02 | 48.0% | 8.6E-04 | 2.6E-03 | 0.01 |
| | | AP-42 Table 3.2-3 | Ethylbenzene | 1.5E-04 | 4.5E-04 | 2.0E-03 | 48.0% | 7.7E-05 | 2.4E-04 | 1.0E-03 |
| | | Vendor Data | HCHO | 0.43 | 1.31 | 5.73 | 93.0% | 0.03 | 0.09 | 0.40 |
| | | AP-42 Table 3.2-3 | n-Hexane | 4.2E-03 | 0.01 | 0.06 | 48.0% | 2.2E-03 | 0.01 | 0.03 |
| | | AP-42 Table 3.2-3 | Methanol | 0.01 | 0.03 | 0.12 | 48.0% | 4.9E-03 | 0.01 | 0.06 |
| | | AP-42 Table 3.2-3 | Toluene | 1.5E-03 | 4.7E-03 | 0.02 | 48.0% | 8.0E-04 | 2.4E-03 | 0.01 |
| | | AP-42 Table 3.2-3 | 2,2,4-TMP | 9.4E-04 | 2.9E-03 | 0.01 | 48.0% | 4.9E-04 | 1.5E-03 | 0.01 |
| | | AP-42 Table 3.2-3 | Xylene | 6.9E-04 | 2.1E-03 | 0.01 | 48.0% | 3.6E-04 | 1.1E-03 | 4.8E-03 |
| | | AP-42 Table 3.2-3 | Other HAP | 0.05 | 0.16 | 0.72 | 48.0% | 0.03 | 0.09 | 0.37 |
| | | SUM | Total HAP | 0.50 | 1.53 | 6.70 | 86.5% | 0.07 | 0.21 | 0.90 |
| | | Vendor Data | CO2 | 472 | 1,436 | 6,290 | 0.0% | 472 | 1,436 | 6,290 |
| | | THC-NMHC | CH4 | 4.04 | 12.29 | 53.84 | 0.0% | 4 | 12 | 54 |
| | | 40CFR98 - Table C-2 | N2O | 8.3E-04 | 2.5E-03 | 0.01 | 0.0% | 8.3E-04 | 2.5E-03 | 0.01 |
| | | 40CFR98 - Table A-1 | CO2e | 573 | 1,744 | 7,639 | 0.0% | 573 | 1,744 | 7,639 |

- Notes:
- 1 - The emissions estimates are based on operation at 100% of rated load for 8,760 hrs/yr.
 - 2 - As per vendor specifications, NMNEHC (non-methane non-ethane hydrocarbon) does not include HCHO. VOC is the sum of NMNEHC and HCHO.
 - 3 - PM10/2.5 is filterable and condensable particulate matter, including PM10 and PM2.5
 - 4 - HCHO is Formaldehyde.
 - 5 - Other HAP includes Acetaldehyde, Acrolein, 1,3-Butadiene, Chloride, Methylene Chloride, and traces of other HAP.
 - 6 - The control efficiency (CE) for each HAP is assumed to be the same as the CE for NMNEHC, except for HCHO where the vendor provides specific data.
 - 7 - The fuel heating value will vary, 920 Bluscd (LHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.

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Compressor Engine Emissions – 1,380 bhp CAT G3516B (4SLB) w/ OxCat

| Unit | Description | Reference | Pollutant | Pre-Controlled Emissions | | | Control Efficiency % | Controlled Emissions | | |
|---|--|---------------------|-------------------|--------------------------|---------|---------|----------------------|----------------------|---------|---------|
| | | | | g/bhp-hr | lb/hr | tpy | | g/bhp-hr | lb/hr | tpy |
| Compressor Engines Unit CE-04 and CE-05 (each) Engine 04 Engine 05 | Caterpillar (CAT) G3516B (4SLB) 1,380 bhp (ea) 1,400 rpm 264 in ³ /cy | Vendor Data | NOX | 0.50 | 1.52 | 6.66 | 0.0% | 0.50 | 1.52 | 6.66 |
| | | Vendor Data | CO | 2.43 | 7.39 | 32.38 | 93.0% | 0.17 | 0.52 | 2.27 |
| | | Vendor Data | THC | 4.75 | 14.45 | 63.30 | 4.9% | 4.52 | 13.75 | 60.23 |
| | | Vendor Data | NMHC | 0.71 | 2.16 | 9.46 | 32.5% | 0.48 | 1.46 | 6.39 |
| | | Vendor Data | NMNEHC | 0.48 | 1.46 | 6.40 | 48.0% | 0.25 | 0.76 | 3.33 |
| | | AP-42 Table 3.2-3 | SO ₂ | 2.2E-03 | 0.01 | 0.03 | 69.3% | 0.28 | 0.85 | 3.73 |
| | | AP-42 Table 3.2-3 | PM10/2.5 | 0.04 | 0.11 | 0.50 | 0.0% | 2.2E-03 | 0.01 | 0.03 |
| | | AP-42 Table 3.2-3 | Benzene | 1.6E-03 | 0.01 | 0.02 | 48.0% | 0.04 | 0.11 | 0.50 |
| | | AP-42 Table 3.2-3 | Ethylbenzene | 1.5E-04 | 4.5E-04 | 2.0E-03 | 48.0% | 8.6E-04 | 2.6E-03 | 1.0E-03 |
| | | Vendor Data | HCHO | 0.43 | 1.31 | 5.73 | 93.0% | 0.03 | 0.09 | 0.40 |
| | AFRC / Oxidation Catalyst NSPS JJJJ - Applicable NESHAP ZZZZ - No Req's 8,760 hr/yr | AP-42 Table 3.2-3 | n-Hexane | 4.2E-03 | 0.01 | 0.06 | 48.0% | 2.2E-03 | 0.01 | 0.03 |
| | | AP-42 Table 3.2-3 | Methanol | 0.01 | 0.03 | 0.12 | 48.0% | 4.9E-03 | 0.01 | 0.06 |
| | | AP-42 Table 3.2-3 | Toluene | 1.5E-03 | 4.7E-03 | 0.02 | 48.0% | 8.0E-04 | 2.4E-03 | 0.01 |
| | | AP-42 Table 3.2-3 | 2,2,4-TMP | 9.4E-04 | 2.9E-03 | 0.01 | 48.0% | 4.9E-04 | 1.5E-03 | 0.01 |
| | | AP-42 Table 3.2-3 | Xylene | 6.9E-04 | 2.1E-03 | 0.01 | 48.0% | 3.6E-04 | 1.1E-03 | 4.8E-03 |
| | | AP-42 Table 3.2-3 | Other HAP | 0.05 | 0.16 | 0.72 | 48.0% | 0.03 | 0.09 | 0.37 |
| | | SUM | Total HAP | 0.50 | 1.53 | 6.70 | 86.5% | 0.07 | 0.21 | 0.90 |
| | | Vendor Data | CO ₂ | 472 | 1,436 | 6,290 | 0.0% | 472 | 1,436 | 6,290 |
| | | THC-NMHC | CH ₄ | 4.04 | 12.29 | 53.84 | 0.0% | 4 | 12 | 54 |
| | | 40CFR98 - Table C-2 | N ₂ O | 8.3E-04 | 2.5E-03 | 0.01 | 0.0% | 8.3E-04 | 2.5E-03 | 0.01 |
| | | 40CFR98 - Table A-1 | CO ₂ e | 573 | 1,744 | 7,639 | 0.0% | 573 | 1,744 | 7,639 |

- Notes:
- The emissions estimates are based on operation at 100% of rated load for 8,760 hrs/yr.
 - As per vendor specifications, NMNNEHC (non-methane non-ethane hydrocarbon) does not include HCHO. VOC is the sum of NMNNEHC and HCHO.
 - PM10/2.5 is filterable and condensable particulate matter, including PM10 and PM2.5
 - HCHO is Formaldehyde.
 - Other HAP includes Acetaldehyde, Acrolein, 1,3-Butadiene, Chloride, Methylene Chloride, and traces of other HAP.
 - The control efficiency (CE) for each HAP is assumed to be the same as the CE for NMNNEHC, except for HCHO where the vendor provides specific data.
 - The fuel heating value will vary, 920 Btu/scf (LHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.

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Compressor Rod Packing Leaks and Engine Crankcase Emissions (RPC)

| Unit Description | No. of Recip Comp-ressors | Cylinders per Recip Comp-ressor | scfh per Cylinder | Conti-n-gency | Total Leak Rate MMscf/yr | VOC 200.00 lb/MMscf | Formaldehyde na lb/MMscf | Hex, BTEX, TMP 1.00 lb/MMscf | Total HAP 6.00 lb/MMscf | CO2 800 lb/MMscf | CH4 42,275 lb/MMscf | CO2e 1,057,675 lb/MMscf | | | | |
|------------------------|---------------------------|---------------------------------|-------------------|---------------|--------------------------|---------------------|--------------------------|------------------------------|-------------------------|------------------|---------------------|-------------------------|------|-------|-----|-----|
| Compressor Rod Packing | 3 | 4 | 15.00 | 15% | 1.81 | 0.04 | — | 2.1E-04 | 9.1E-04 | 1.2E-03 | 0.17 | 0.73 | 8.75 | 38.33 | 219 | 959 |

| Unit Description | Total Recip Engine Horsepower (bhp) | Leak Rate 0.50 scf/bhp-hr MMscf/yr | Safety Factor | VOC 13.94 lb/MMscf | Formaldehyde 6.59 lb/MMscf | Hex, BTEX,TMP 0.19 lb/MMscf | Total HAP 7.70 lb/MMscf | CO2 7,229 lb/MMscf | CH4 62 lb/MMscf | CO2e 8,779 lb/MMscf | | | | | | | |
|------------------|-------------------------------------|------------------------------------|---------------|--------------------|----------------------------|-----------------------------|-------------------------|--------------------|-----------------|---------------------|----------|-------------|------------|------------|----------|----------|---------|
| Engine Crankcase | 2,760 | 12.09 | 250% | 0.05 lb/hr | 0.21 tpy | 0.02 lb/hr | 0.10 tpy | 6.4E-04 lb/hr | 0.00 tpy | 0.03 lb/hr | 0.12 tpy | 24.94 lb/hr | 109.23 tpy | 0.21 lb/hr | 0.93 tpy | 30 lb/hr | 133 tpy |

Operating h/yr: 8,760

Total RPC Emissions:

| VOC | Formaldehyde | Hex, BTEX,TMP | Total HAP | CO2 | CH4 | CO2e |
|-----------|--------------|---------------|-----------|--------------|------------|-----------|
| lb/hr tpy | lb/hr tpy | lb/hr tpy | lb/hr tpy | lb/hr tpy | lb/hr tpy | lb/hr tpy |
| 0.09 0.39 | 0.02 0.10 | 0.00 0.00 | 0.03 0.12 | 25.10 109.96 | 8.96 39.26 | 249 1,092 |

Notes:

1 - Fugitive equipment leaks from misc. equipment is a broad category covering leaks of natural gas from sealed surfaces, such as packing and gaskets, resulting from the wear of mechanical joints, seals, and rotating surfaces over time. It also includes the crankcase emissions from reciprocating engines.

2 - Emission estimates are based on 40CFR98, Subpart V and manufacturer's data.

3 - To be conservative, and to account for potential future changes, the following "worst-case" gas characteristics were assumed:

| Pollutant | Representative Gas Analysis | Worst-Case Assumption |
|-----------------------------|-----------------------------|-----------------------|
| CO2 | 385.03 lb/MMscf | 800 lb/MMscf |
| CH4 | 41.156 lb/MMscf | 42,275 lb/MMscf |
| VOC | 91 lb/MMscf | 200.00 lb/MMscf |
| n-Hex, BTEX, 2,2,4-TMP (ea) | Varies lb/MMscf | 1.00 lb/MMscf |
| Total HAP | 2 lb/MMscf | 6.00 lb/MMscf |

4 - Total Reciprocating Compressor Rod Packing Leak Rate:

$$\text{scf/yr} = \text{No. of Compressors} * \text{Cylinders/Compressor} * \text{scfh/Cylinder} * \text{Operating h/yr} * (1 + \text{Contingency})$$

5 - Engine crankcase emissions are based on vendor data: "As a general rule, blow-by (i.e., crankcase emissions) on a new engine is approximately 0.5 scf/bhp-hr." A "safety factor" is used to account for increasing blow-by as the engine "wears".

6 - Crankcase emissions are estimated as follows:

(Data from CAT G3516B Data Sheet and Emissions Calculation Spreadsheet.)

| Total Engine Exhaust (TEEX) (Volume): | 9,105 ft ³ /min (acfm) | 1,740 MMscf/yr TEEX* |
|---------------------------------------|-----------------------------------|--------------------------------|
| Pollutant | G3516B PTE | Crankcase Emission Factor** |
| Crankcase VOC emissions (Mass) | 12.13 tpy VOC | 13.94 lb VOC / MMscf TEEX |
| Crankcase HCHO emissions (Mass) | 5.73 tpy HCHO | 6.59 lb HCHO / MMscf TEEX |
| Crankcase BTEX (ea) emissions (Mass) | 0.16 tpy BTEX (ea) | 0.19 lb BTEX (ea) / MMscf TEEX |
| Crankcase HAP emissions (Mass) | 6.70 tpy HAP | 7.70 lb HAP / MMscf TEEX |
| Crankcase CO2 emissions (Mass) | 6,290 tpy CO2 | 7,229 lb CO2 / MMscf TEEX |
| Crankcase CH4 emissions (Mass) | 53.84 tpy CH4 | 62 lb CH4 / MMscf TEEX |
| Crankcase CO2e emissions (Mass) | 7,639 tpy CO2e | 8,779 lb CO2e / MMscf TEEX |

* Conversion from acfm to scf/yr based on 8,760 h/yr, 982 of exhaust temp, and 68 of std temp.

** Crankcase Emission Factor = PTE (tpy) from a G3516B Engine ÷ Total Engine Exhaust (TEEX) (MMscf/yr).

Startup, Shutdown and Maintenance (including Blowdown (BD) and Pigging Emissions (SSM))

| Unit ID | Description | No of Units | Total bhp | a. "Cold-Start" Gas | | b. Blowdown (BD) Gas | | Site-Wide SSM Events | |
|------------------------------|------------------------|-------------|-----------|---------------------|-----------|----------------------|-----------|----------------------|-----------|
| | | | | scf/Unit | scf/Event | scf/bhp | scf/Event | Events/wk | Events/yr |
| SSM (Start/Stop/Maintenance) | a. Cold-Start Engine | 2 | na | 700 | 1,400 | na | na | 4.0 | 208 |
| | b. Compressor Blowdown | 3 | 4,260 | na | na | 6.22 | 26,477 | 2.0 | 104 |
| | c. Pigging | 1 | na | na | na | na | 3,061 | 1.0 | 52 |

| Unit ID | Description | Total Gas Vented MMscf/yr | VOC 200.00 lb/MMscf tpy | Hex,BTEX,TMP 1.00 lb/MMscf tpy | Total HAP 6.00 lb/MMscf tpy | CO2 800 lb/MMscf tpy | CH4 42,275 lb/MMscf tpy | CO2e 1,057,675 lb/MMscf tpy |
|------------------------------|------------------------|---------------------------|-------------------------|--------------------------------|-----------------------------|----------------------|-------------------------|-----------------------------|
| SSM (Start/Stop/Maintenance) | a. Cold-Start Engine | 0.29 | 0.03 | 1.5E-04 | 8.7E-04 | 0.12 | 6 | 154 |
| | b. Compressor Blowdown | 2.75 | 0.28 | 1.4E-03 | 0.01 | 1.10 | 58 | 1,456 |
| | c. Pigging | 0.16 | 0.02 | 8.0E-05 | 4.8E-04 | 0.06 | 3 | 84 |
| | | | 0.32 | 1.5E-03 | 0.01 | 1.28 | 68 | 1,694 |

Notes:

- 1 - SSM Emissions are the sum of:
 a. Unburned fuel resulting from "cold-start" of idle gas-fired engines; and
 b. Natural gas that is purged (aka blowdown) from the compressor and associated piping and equipment.
- 2 - Starting gas quantity and blowdown (BD) gas quantity as per engineering department.
 (e.g., 8.577 scf/bd of a compressor with a 1,380 bhp engine equals 6.22 scf/bhp/bd.)

3 - To be conservative, and to account for potential future changes, the following "worst-case" gas characteristics were assumed:

| Pollutant | Representative Gas Analysis | Worst-Case Assumption |
|-----------------------------|-----------------------------|-----------------------|
| CO2 | 385 lb/MMscf | 800 lb/MMscf |
| CH4 | 41,156 lb/MMscf | 42,275 lb/MMscf |
| VOC | 91.01 lb/MMscf | 200.00 lb/MMscf |
| n-Hex, BTEX, 2,2,4-TMP (ea) | Varies lb/MMscf | 1.00 lb/MMscf |
| Total HAP | 1.54 lb/MMscf | 6.00 lb/MMscf |

- 4 - This estimate of SSM emissions is sufficient to account for other infrequent and (often) de-minimis emissions from various activities (e.g., pig launching) at the facility that are not necessarily associated with compressor blowdowns.
- 5 - Pigging calculations based on 52 events per year and 3,061 scf/event (assuming 50 scf of gas blowdown at 900 psig).

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Dehydrator Emissions - 25.0 MMscfd

| Unit ID | Description | Reference | Pollutant | Emission Factor lb/MMscf | lb/MMBtu | Pre-Controlled Emissions lb/hr | Control Eff % | Controlled Emissions lb/hr | Controlled Emissions tpy |
|---------|---|---------------------|--------------|-----------------------------|----------|-----------------------------------|------------------|-------------------------------|-----------------------------|
| DEHY-01 | Dehydrator 01 25.0 MMscfd 8,760 Hr/yr | — | NOX | — | — | — | — | — | — |
| | | — | CO | — | — | — | — | — | — |
| | | GRI-GL YCalc 4.0 | VOC | — | — | 2.26 | 0.0% | 2.26 | 9.90 |
| | | — | SO2 | — | — | — | — | — | — |
| | | — | PM10/2.5 | — | — | — | — | — | — |
| | | GRI-GL YCalc 4.0 | Benzene | — | — | 0.21 | 0.0% | 0.21 | 0.90 |
| | | GRI-GL YCalc 4.0 | Ethylbenzene | — | — | 0.18 | 0.0% | 0.18 | 0.80 |
| | | — | HCHO | — | — | — | — | — | — |
| | | GRI-GL YCalc 4.0 | n-Hexane | — | — | 2.3E-02 | 0.0% | 2.3E-02 | 0.10 |
| | | GRI-GL YCalc 4.0 | Methanol | — | — | — | — | — | — |
| | | GRI-GL YCalc 4.0 | Toluene | — | — | 0.14 | 0.0% | 0.14 | 0.60 |
| | | GRI-GL YCalc 4.0 | 2,2,4-TMP | — | — | 0.02 | 0.0% | 0.02 | 0.10 |
| | | GRI-GL YCalc 4.0 | Xylenes | — | — | 0.23 | 0.0% | 0.23 | 1.00 |
| | | GRI-GL YCalc 4.0 | Other HAP | — | — | — | — | — | — |
| | | GRI-GL YCalc 4.0 | Total HAP | — | — | 0.80 | 0.0% | 0.80 | 3.50 |
| DEHY-01 | 9,125 MMscfd/yr 1.04 MMscfd/hr NESHAP HH - Exempt | — | CO2 | — | — | — | — | — | — |
| | | GRI-GL YCalc 4.0 | CH4 | — | — | 135 | 0.0% | 135 | 590 |
| | | — | N2O | — | — | — | — | — | — |
| | | 40CFR98 - Table A-1 | CO2e | — | — | 3,368 | 0.0% | 3,368 | 14,750 |

Notes: 1 - To be conservative, and to account for potential future changes in gas quality, the following worst-case emissions were assumed:

| 25.0 MMscfd Dehydrator 01 | GRI-GL YCalc 4.0* Model Results | Controlled | Worst-Case Assumption | Controlled | *Dehydrator Operating Parameters (See Attachments D-2 - GRI-GL YCalc Model and D-3 - Extended Gas Analysis) | | | | |
|------------------------------|------------------------------------|------------|--------------------------|------------|---|------------------|----------------------------|------------|--|
| THC | 273.45 tpy | 273.45 tpy | 600.00 tpy | 600.00 tpy | Dry Gas Flow Rate: | 25.0 MMscfd | Extended Gas Analysis: | 02/13/14 | |
| NNMNEHC = VOC | 2.04 tpy | 2.04 tpy | 9.90 tpy | 9.90 tpy | Wet Gas Temperature: | 70 oF | Flash Tank Temperature: | na | |
| Benzene | 0.15 tpy | 0.15 tpy | 0.90 tpy | 0.90 tpy | Wet Gas Pressure: | 1,000 psig | Flash Tank Pressure: | na | |
| Ethylbenzene | 0.36 tpy | 0.36 tpy | 0.80 tpy | 0.80 tpy | Wet Gas Water Content: | Saturated | Flash Tank Off-Gas: | na | |
| HCHO | — | — | — | — | Dry Gas Water Content: | 7.0 lb H2O/MMscf | Stripping Gas: | na | |
| n-Hexane | 0.01 tpy | 0.01 tpy | 0.10 tpy | 0.10 tpy | Lean Glycol Water Content: | 1.5 wt% H2O | Stripping Gas Flow Rate: | na | |
| Methanol | — | — | — | — | Glycol Pump Type: | Gas Injection | Regen Overhead Control: | na | |
| Toluene | 0.26 tpy | 0.26 tpy | 0.60 tpy | 0.60 tpy | Glycol Pump Model: | Kimray 21020PV | Condenser Temperature: | na | |
| 2,2,4-TMP | 0.01 tpy | 0.01 tpy | 0.10 tpy | 0.10 tpy | Lean Glycol Circulation Rate: | 3.50 gpm | Condenser Pressure: | na | |
| Xylenes | 0.47 tpy | 0.47 tpy | 1.00 tpy | 1.00 tpy | Additional GRI-GL YCalc 4.0 Model Results: | | | | |
| Other HAP | — | — | — | — | Flash Tank Off-Gas Flow: | na | Wet Gas Water Content: | 0.049 Vol% | |
| Total HAP | 1.24 tpy | 1.24 tpy | 3.50 tpy | 3.50 tpy | Regen Overhead Stream: | 1,940 scfh | Dry Gas Water Content: | 0.002 Vol% | |
| CH4 | 259.08 tpy | 259.08 tpy | 590.00 tpy | 590.00 tpy | Lean Glycol Recirc Ratio: | 9.0 gal/lb-H2O | Rich Glycol Water Content: | 2.57 wt% | |

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Reboiler Emissions - 0.25 MMBtu/hr

| Unit ID | Description | Reference | Pollutant | Emission Factor | | Pre-Controlled | | Control | Controlled | |
|---------|---|-----------------------|--------------|-----------------|----------|----------------|---------|---------|------------|---------|
| | | | | lb/MMscf | lb/MMBtu | lb/hr | tpy | % | lb/hr | tpy |
| BLR-01 | Reboiler 01 | EPA AP-42 Table 1.4-1 | NOX | 100.00 | 9.80E-02 | 0.03 | 0.12 | na | 0.03 | 0.12 |
| | | EPA AP-42 Table 1.4-1 | CO | 84.00 | 8.24E-02 | 0.02 | 0.10 | na | 0.02 | 0.10 |
| | | EPA AP-42 Table 1.4-2 | VOC | 5.68 | 5.56E-03 | 1.5E-03 | 0.01 | na | 1.5E-03 | 0.01 |
| | 0.25 MMBtu/hr (LHV) | EPA AP-42 Table 1.4-2 | SO2 | 0.60 | 5.88E-04 | 1.6E-04 | 7.1E-04 | na | 1.6E-04 | 7.1E-04 |
| | | EPA AP-42 Table 1.4-2 | PM10/2.5 | 7.60 | 0.01 | 2.1E-03 | 0.01 | na | 2.1E-03 | 0.01 |
| | | EPA AP-42 Table 1.4-3 | Benzene | 2.1E-03 | 2.06E-06 | 5.7E-07 | 2.5E-06 | na | 5.7E-07 | 2.5E-06 |
| | 8,760 hr/yr | EPA AP-42 Table 1.4-3 | Ethylbenzene | — | — | — | — | — | — | — |
| | | EPA AP-42 Table 1.4-3 | HOHO | 0.08 | 7.35E-05 | 2.0E-05 | 8.9E-05 | na | 2.0E-05 | 8.9E-05 |
| | | EPA AP-42 Table 1.4-3 | n-Hexane | 1.80 | 1.76E-03 | 4.9E-04 | 2.1E-03 | na | 4.9E-04 | 2.1E-03 |
| | 920 Btu/scf (LHV) 1,020 Btu/scf (HHV) | EPA AP-42 Table 1.4-3 | Methanol | — | — | — | — | — | — | — |
| | | EPA AP-42 Table 1.4-3 | Toluene | — | — | — | — | — | — | — |
| | | EPA AP-42 Table 1.4-3 | 2,2,4-TMP | 3.4E-03 | 3.33E-06 | 9.2E-07 | 4.0E-06 | na | 9.2E-07 | 4.0E-06 |
| | 272 scf/hr 6.52 Mscfd 2.38 MMscf/yr | EPA AP-42 Table 1.4-3 | Xylenes | — | — | — | — | — | — | — |
| | | EPA AP-42 Table 1.4-3 | Other HAP | 1.9E-03 | 1.86E-06 | 5.2E-07 | 2.3E-06 | na | 5.2E-07 | 2.3E-06 |
| | | EPA AP-42 Table 1.4-3 | Total HAP | 1.88 | 1.85E-03 | 5.1E-04 | 2.2E-03 | na | 5.1E-04 | 2.2E-03 |
| | 40CFR98 - Table A-1 | EPA AP-42 Table 1.4-2 | CO2 | 120.000 | 118 | 33 | 143 | na | 33 | 143 |
| | | EPA AP-42 Table 1.4-2 | CH4 | 2.30 | 2.25E-03 | 6.3E-04 | 2.7E-03 | na | 6.3E-04 | 2.7E-03 |
| | | EPA AP-42 Table 1.4-2 | N2O | 2.20 | 2.16E-03 | 6.0E-04 | 2.6E-03 | na | 6.0E-04 | 2.6E-03 |
| | | | CO2e | 120.713 | 118 | 33 | 144 | na | 33 | 144 |

Notes: PM10/2.5 is filterable and condensable particulate matter, including PM10 and PM2.5.

Laurel Mountain Midstream Operating, LLC
SPRINGHILL COMPRESSOR STATION
 Application for Authorization to Use General Permit GP-5
 Attachment C - Emission Calculations
Dehydrator Emissions - 40.0 MMscfd

| Unit ID | Description | Reference | Pollutant | Emission Factor lb/MMscf | lb/MMBtu | Pre-Controlled Emissions lb/hr | tpy | Control Eff % | Controlled Emissions lb/hr | tpy |
|---------|--|-----------------|--------------|-----------------------------|----------|-----------------------------------|--------|------------------|-------------------------------|--------|
| DEHY-02 | Dehydrator 02 | — | NOX | — | — | — | — | — | — | — |
| | | — | CO | — | — | — | — | — | — | — |
| | | GR1-GLYCalc 4.0 | VOC | — | — | 1.12 | 4.90 | 0.0% | 1.12 | 4.90 |
| | | — | SO2 | — | — | — | — | — | — | — |
| | | — | PM10/2.5 | — | — | — | — | — | — | — |
| | | GR1-GLYCalc 4.0 | Benzene | — | — | 0.21 | 0.90 | 0.0% | 0.21 | 0.90 |
| | | GR1-GLYCalc 4.0 | Ethylbenzene | — | — | 0.25 | 1.10 | 0.0% | 0.25 | 1.10 |
| | | — | HCHO | — | — | — | — | — | — | — |
| | | GR1-GLYCalc 4.0 | n-Hexane | — | — | 2.3E-02 | 0.10 | 0.0% | 2.3E-02 | 0.10 |
| | | GR1-GLYCalc 4.0 | Methanol | — | — | — | — | — | — | — |
| | | GR1-GLYCalc 4.0 | Toluene | — | — | 0.18 | 0.80 | 0.0% | 0.18 | 0.80 |
| | | GR1-GLYCalc 4.0 | 2,2,4-TMP | — | — | 0.02 | 0.10 | 0.0% | 0.02 | 0.10 |
| | | GR1-GLYCalc 4.0 | Xylenes | — | — | 0.32 | 1.40 | 0.0% | 0.32 | 1.40 |
| | | GR1-GLYCalc 4.0 | Other HAP | — | — | — | — | — | — | — |
| | | GR1-GLYCalc 4.0 | Total HAP | — | — | 1.00 | 4.40 | 0.0% | 1.00 | 4.40 |
| DEHY-02 | 14,600 MMscfd 1.67 MMscfd/r NESHAP HH - Exempt | — | CO2 | — | — | — | — | — | — | — |
| | | — | CH4 | — | — | 136 | 595 | 0.0% | 136 | 595 |
| | | GR1-GLYCalc 4.0 | N2O | — | — | — | — | — | — | — |
| | | — | CO2e | — | — | 3,396 | 14,875 | 0.0% | 3,396 | 14,875 |

Notes: 1 - To be conservative, and to account for potential future changes in gas quality, the following worst-case emissions were assumed:

| 40.0 MMscfd Dehydrator 02 | GR1-GLYCalc 4.0* Model Results | Worst-Case Assumption | Dehydrator Operating Parameters (See Attachments D-2 - GR1-GLYCalc Model and D-3 - Extended Gas Analysis) |
|------------------------------|-----------------------------------|--------------------------|---|
| THC | 411.13 tpy | 600.00 tpy | Dry Gas Flow Rate: 40.0 MMscfd |
| NMNEHC = VOC | 3.65 tpy | 4.90 tpy | Wet Gas Temperature: 70 oF |
| Benzene | 0.29 tpy | 0.90 tpy | Wet Gas Pressure: 1,000 psig |
| Ethylbenzene | 0.71 tpy | 1.10 tpy | Wet Gas Water Content: Saturated |
| HCHO | — | — | Dry Gas Water Content: 7.0 lb H2O/MMscfd |
| n-Hexane | 0.01 tpy | 0.10 tpy | Lean Glycol Water Content: 1.5 wt% H2O |
| Methanol | — | — | Glycol Pump Type: Gas Injection |
| Toluene | 0.51 tpy | 0.80 tpy | Glycol Pump Model: Kinray 45020PV |
| 2,2,4-TMP | 0.01 tpy | 0.10 tpy | Lean Glycol Circulation Rate: 7.50 gpm |
| Xylenes | 0.91 tpy | 1.40 tpy | |
| Other HAP | — | — | |
| Total HAP | 2.44 tpy | 4.40 tpy | |
| CH4 | 388.79 tpy | 595.00 tpy | |

Additional GR1-GLYCalc 4.0 Model Results:

| | | | |
|---------------------------|-----------------|----------------------------|------------|
| Flash Tank Off-Gas Flow: | 3,090 scfh | Wet Gas Water Content: | 0.049 Vol% |
| Regen Overhead Stream: | 807 scfh | Dry Gas Water Content: | 0.002 Vol% |
| Lean Glycol Recirc Ratio: | 12.1 gal/lb-H2O | Rich Glycol Water Content: | 2.29 wt% |

Laurel Mountain Midstream Operating, LLC
SPRINGHILL COMPRESSOR STATION
Application for Authorization to Use General Permit GP-5
Attachment C - Emission Calculations
Reboiler Emissions - 0.75 MMBtu/hr

| Unit ID | Description | Reference | Pollutant | Emission Factor lb/MMscf | lb/MMBtu | Pre-Controlled lb/hr | Controlled tpy | Control % | Controlled lb/hr | Controlled tpy |
|---------|--|-----------------------|--------------|-----------------------------|----------|-------------------------|-------------------|--------------|---------------------|-------------------|
| BLR-02 | Reboiler 02 | EPA AP-42 Table 1.4-1 | NOX | 100.00 | 9.80E-02 | 0.08 | 0.36 | na | 0.08 | 0.36 |
| | | EPA AP-42 Table 1.4-1 | CO | 84.00 | 8.24E-02 | 0.07 | 0.30 | na | 0.07 | 0.30 |
| | | EPA AP-42 Table 1.4-2 | VOC | 5.68 | 5.56E-03 | 4.6E-03 | 0.02 | na | 4.6E-03 | 0.02 |
| | | EPA AP-42 Table 1.4-2 | SO2 | 0.60 | 5.88E-04 | 4.9E-04 | 2.1E-03 | na | 4.9E-04 | 2.1E-03 |
| | | EPA AP-42 Table 1.4-2 | PM10/2.5 | 7.60 | 0.01 | 6.2E-03 | 0.03 | na | 0.01 | 0.03 |
| | 0.75 MMBtu/hr (LHV) 0.83 MMBtu/hr (HHV) | EPA AP-42 Table 1.4-3 | Benzene | 2.1E-03 | 2.06E-06 | 1.7E-06 | 7.5E-06 | na | 1.7E-06 | 7.5E-06 |
| | | EPA AP-42 Table 1.4-3 | Ethylbenzene | — | — | — | — | — | — | — |
| | | EPA AP-42 Table 1.4-3 | HCHO | 0.08 | 7.35E-05 | 6.1E-05 | 2.7E-04 | na | 6.1E-05 | 2.7E-04 |
| | | EPA AP-42 Table 1.4-3 | n-Hexane | 1.80 | 1.76E-03 | 1.5E-03 | 0.01 | na | 1.5E-03 | 0.01 |
| | | EPA AP-42 Table 1.4-3 | Methanol | — | — | — | — | — | — | — |
| | 8,760 hr/yr | EPA AP-42 Table 1.4-3 | Toluene | — | — | — | — | — | — | — |
| | | EPA AP-42 Table 1.4-3 | 2,2,4-TMP | 3.4E-03 | 3.33E-06 | 2.8E-06 | 1.2E-05 | na | 2.8E-06 | 1.2E-05 |
| | | EPA AP-42 Table 1.4-3 | Xylenes | — | — | — | — | — | — | — |
| | | EPA AP-42 Table 1.4-3 | Other HAP | 1.9E-03 | 1.86E-06 | 1.5E-06 | 6.8E-06 | na | 1.5E-06 | 6.8E-06 |
| | | EPA AP-42 Table 1.4-3 | Total HAP | 1.88 | 1.85E-03 | 1.5E-03 | 0.01 | na | 1.5E-03 | 0.01 |
| | 920 Btu/scf (LHV) 1,020 Btu/scf (HHV) | EPA AP-42 Table 1.4-2 | CO2 | 120,000 | 118 | 98 | 428 | na | 98 | 428 |
| | | EPA AP-42 Table 1.4-2 | CH4 | 2.30 | 2.25E-03 | 1.9E-03 | 0.01 | na | 1.9E-03 | 0.01 |
| | | EPA AP-42 Table 1.4-2 | N2O | 2.20 | 2.16E-03 | 1.8E-03 | 0.01 | na | 1.8E-03 | 0.01 |
| | | 40CFR98 - Table A-1 | CO2e | 120,713 | 118 | 98 | 431 | na | 98 | 431 |
| | 815 scf/hr 19.57 Mscfd 7.14 MMBtu/yr | | | | | | | | | |

Notes: PM10/2.5 is filterable and condensable particulate matter, including PM10 and PM2.5.

Laurel Mountain Midstream Operating, LLC
SPRINGHILL COMPRESSOR STATION
 Application for Authorization to Use General Permit GP-5
Attachment C - Emission Calculations

Produced Water Storage Tank Emissions

| Unit No | Tank ID | Material Stored | Capacity | | Turn-overs per Year | Throughput | | VOC Emission Factor | CH4 Emission Factor | Total VOC | | Methano (CH4) | | Methanol (CH3OH) | | n-Hex, BTEX, and TMP (Est) 2.00% of VOC | Total HAP | | |
|---------|---------|-----------------|----------|-----|---------------------|------------|--------|---------------------|---------------------|-----------|------|---------------|------|------------------|------|---|-----------|------|-------|
| | | | gal | bbl | | gal/yr | bbl/yr | | | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy | | lb/hr | tpy | lb/hr |
| TKS | Tank 01 | Produced Water | 1,000 | 24 | 26 | 25,200 | 600 | 0.039 lb/bbl | 0.494 lb/bbl | 0.01 | 0.05 | 0.03 | 0.15 | 0.01 | 0.04 | 2.3E-04 | 1.0E-03 | 0.01 | 0.05 |
| | Tank 02 | Produced Water | 4,200 | 100 | 26 | 109,200 | 2,600 | 0.039 lb/bbl | 0.494 lb/bbl | 0.05 | 0.22 | 0.15 | 0.64 | 0.04 | 0.17 | 1.0E-03 | 4.4E-03 | 0.05 | 0.20 |
| | Tank 03 | Produced Water | 6,300 | 150 | 26 | 163,800 | 3,900 | 0.039 lb/bbl | 0.494 lb/bbl | 0.08 | 0.33 | 0.22 | 0.96 | 0.06 | 0.26 | 1.5E-03 | 0.01 | 0.07 | 0.30 |
| | Tank 04 | Produced Water | 6,300 | 150 | 26 | 163,800 | 3,900 | 0.039 lb/bbl | 0.494 lb/bbl | 0.08 | 0.33 | 0.22 | 0.96 | 0.06 | 0.26 | 1.5E-03 | 0.01 | 0.07 | 0.30 |

- Notes:
- 1 - Total VOC emissions are based on the total liquid throughput multiplied by an EPA emission factor.
 - 2 - Methane emissions are based on laboratory-staged flash analysis factor from the Cherry Compressor Station GPS Application of June 2014.
 - 3 - EPA-450/3-85-001a - "Volatile Organic Compound Emissions from Petroleum Refinery Wastewater Systems - Background Information for Proposed Standards" is a reasonable protocol for estimating potential produced water storage tank emissions. EPA-450/3-85-001a, page 3-39, gives a VOC emission factor of 420 kg/MMgal wastewater produced in an oil-water separator. (0.420 g/gal * 0.0022 lb/g * 42 gal/bbl = 0.039 lb/bbl)
 - 4 - These emission estimates are nearly 4X more conservative than emission factors required by the TCEQ on the Barnett Shale produced water tanks at gas-only sites. (<http://www.tceq.texas.gov/assets/public/implementation/air/psel/forms/producedwaterstoragetank.pdf>).

Table 1. Produced Water Storage Tank Flash Loss Emissions Factors for Barnett Shale Special Inventory Purpose ONLY

| Pollutant | Average Produced Water Emission Factor (lb/bbl) |
|--------------|---|
| | Gas Production Only Sites |
| VOC | 0.01 |
| Benzene | 0.0001 |
| Toluene | 0.0001 |
| Ethylbenzene | 0.000006 |
| Xylenes | 0.00006 |
| n-Hexane | NA |

- 5 - n-Hexane, each BTEX, and 2,2,4-TMP components are estimated at 5% of VOC emissions and Total HAP is estimated at 30% of VOC emissions. These are very conservative estimates, as exemplified above:
 - 0.01 lb-VOC/bbl / 350 lb-Tolal/bbl = 0.003% VOC (vs. 5%)
 - (0.0001+0.0003+0.000006+0.00006) lb-HAP/bbl / 0.01 lb-VOC/bbl = 4.7% of VOC (vs. 50%).

Laurel Mountain Midstream Operating, LLC
SPRINGHILL COMPRESSOR STATION
 Application for Authorization to Use General Permit GP-5
 Attachment C - Emission Calculations

Produced Water Truck Load-Out Emissions

| Unit ID | Description | S | P | M | T | CE | L _L | T-Put | VOC | n-Hexane, BTEX, and 2,2,4-TMP (Ea) | Total HAP |
|------------|----------------|-----------|------|-----------|-----|------|----------------|---------|-----------------------|------------------------------------|----------------------|
| | | sat. fac. | psia | lb/lb-mol | °R | % | lb/Mgal | Mgal/yr | AP-42 Sect 5.2 tpy | 5.00% of VOC tpy | 30.00% of VOC tpy |
| TLO | Truck Load-Out | 1.45 | 1.50 | 30.00 | 510 | 0.0% | 1.59 | 462 | 0.37 | 0.02 | 0.11 |
| TOTAL TLO: | | | | | | | | | 0.37 | 0.02 | 0.11 |

Notes: 1 - Emission factors and formulas are from AP-42 Section 5.2 "Transportation and Marketing of Petroleum Liquids":

$$L_L = 12.46 \times S \times P \times M / T \times (1 - CE)$$

where:

L_L = Loading loss, lb/1000 gal of liquid loaded.

S = Saturation factor, used 0.60 for "splash loading".

P = true vapor pressure of liquid loaded, psia. (Conservative estimate = 1.5 psia. Measured RVP (100 °F) ranges from 1.0 to 1.3 psia, so the actual TVP is expected to be less than 0.7 psia at common storage temperature.)

M = molecular weight of vapors, lb/lb-mol (Conservative estimate.)

T = Temperature of bulk liquid loaded, °R = °F + 460. (Conservatively assumed 50 °F.)

CE = Overall emission reduction efficiency (collection efficiency x control efficiency).

2 - Molecular weight and vapor pressure are based on operator experience and sampling data at various locations in the Marcellus Shale basin.

3 - It is estimated that each tank will be emptied up to:

4 - The total storage tank capacity at the facility is:

| | |
|-----|------------------|
| 26 | times per year. |
| 424 | tbl = 17,800 gal |

5 - n-Hexane, each BTEX, and 2,2,4-TMP components are estimated at 5% of VOC emissions and Total HAP is estimated at 30% of VOC emissions. E

Laurel Mountain Midstream Operating, LLC
SPRINGHILL COMPRESSOR STATION
 Application for Authorization to Use General Permit GP-5
 Attachment C - Emission Calculations

Process Piping and Equipment Fugitive Emissions

| Unit | Description | Component (Unit) Type (Gas) | Unit Count | THC Factor lb/hr/Unit | Tot Hydrocarbons (THC) lb/hr | VOC 0.46 Wg% tpy | Hex,BTEX,TMP-ea 2.3E-03 Wg% tpy | Total HAP 0.01 Wg% tpy | CO2 1.84 Wg% tpy | CH4 100.00 Wg% tpy | CO2e CH4 GWP = 25 lb/hr | | | | | | | |
|--------|--|-----------------------------|------------|-----------------------|------------------------------|------------------|---------------------------------|------------------------|------------------|--------------------|-------------------------|---------|---------|---------|------|-------|-----|-----|
| FUG | Process Piping and Equipment Fugitives (Gas) | Valves | 514 | 9.9E-03 | 5.10 | 22.33 | 0.02 | 1.2E-04 | 7.0E-04 | 0.09 | 0.41 | 5.10 | 22.33 | 128 | 559 | | | |
| | | Pump Seals | — | — | — | — | — | — | — | — | — | — | — | — | — | | | |
| | | Other | 60 | 1.9E-02 | 1.16 | 5.10 | 5.4E-03 | 0.02 | 2.7E-05 | 1.2E-04 | 1.6E-04 | 7.0E-04 | 0.02 | 0.09 | 1.16 | 5.10 | 29 | 128 |
| | | Connectors | 1,474 | 4.4E-04 | 0.65 | 2.85 | 3.0E-03 | 0.01 | 1.5E-05 | 6.6E-05 | 9.0E-05 | 3.9E-04 | 0.01 | 0.05 | 0.65 | 2.85 | 16 | 71 |
| | | Flanges | 240 | 8.6E-04 | 0.21 | 0.90 | 9.5E-04 | 4.2E-03 | 4.8E-06 | 2.1E-05 | 2.9E-05 | 1.2E-04 | 3.8E-03 | 0.02 | 0.21 | 0.90 | 5 | 23 |
| | | Open-ended lines | 28 | 4.4E-03 | 0.12 | 0.54 | 5.7E-04 | 2.5E-03 | 2.8E-06 | 1.2E-05 | 1.7E-05 | 7.5E-05 | 2.3E-03 | 1.0E-02 | 0.12 | 0.54 | 3 | 14 |
| Total: | | | 2,316 | | 7.24 | 31.72 | 0.03 | 0.15 | 1.7E-04 | 7.3E-04 | 1.0E-03 | 4.4E-03 | 0.13 | 0.58 | 7.24 | 31.72 | 181 | 793 |

Notes: 1 - Assumed 8,760 hours per year of fugitive emissions.

2 - Component counts are based on the default counts for compressor stations (GRU-HAPCalc model) multiplied by: 200%

3 - Gas emissions calculated using EPA Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017, Nov 1995.

| TABLE 2.4 | | Gas | |
|------------------|----|---------|---------|
| O&G PROD (AVE) | | Kg/hr | lb/hr |
| Valves | | 4.5E-03 | 9.9E-03 |
| Pump Seals | na | na | na |
| Others | | 8.8E-03 | 1.9E-02 |
| Connectors | | 2.0E-04 | 4.4E-04 |
| Flanges | | 3.9E-04 | 8.6E-04 |
| Open-Ended Lines | | 2.0E-03 | 4.4E-03 |

4 - "Other" components include compressor seals, relief valves, diaphragms, drains, meters, etc.
 5 - To be conservative, the following gas characteristics were assumed:

| Pollutant | Analysis | Gas (Inlet) | Estimated |
|-----------------------|-------------|-------------|-------------|
| Carbon Dioxide | 0.89 Wg% | | 1.84 Wg% |
| Methane | 94.85 Wg% | | 100.00 Wg% |
| VOC | 0.21 Wg% | | 0.46 Wg% |
| n-Hex, BTEX, TMP (ea) | Varies | | 2.3E-03 Wg% |
| Total HAP | 3.5E-03 Wg% | | 0.01 Wg% |

CAT

CATERPILLAR

Ser No JEF03097

LOW EMISSION

Ar No 3308202

Comp. Ratio 8

Aftercooler Temperature 54 °C 130 °F

Injection Timing (STDC)

Advancing 1025

Retarding 1400

ATTACHMENT D-2
SUPPORTING DOCUMENTS

MODEL RESULTS

DEHYDRATOR

- 25.0 MMscfd TEG Dehydrator (DEHY-01)
 - GRI-GLYCalc 4.0 – Emission Summary
 - GRI-GLYCalc 4.0 – Summary of Input Values
 - GRI-GLYCalc 4.0 – Aggregate Calculations Report

- 40.0 MMscfd TEG Dehydrator (DEHY-02)
 - GRI-GLYCalc 4.0 – Emission Summary
 - GRI-GLYCalc 4.0 – Summary of Input Values
 - GRI-GLYCalc 4.0 – Aggregate Calculations Report