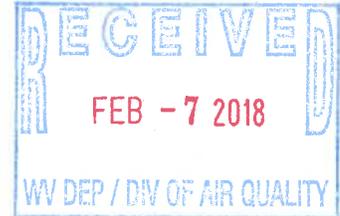




**Appalachia Midstream Services, LLC**  
100 Teletech Drive, Suite 2  
Moundsville, WV 26041-2352  
Telephone: (304) 843-3100

February 2, 2018  
**(Via Federal Express)**

William F. Durham  
Director  
Division of Air Quality  
West Virginia Department of Environmental Protection  
601 57th Street SE  
Charleston, WV 25304-2345



**Subject: Application for 45CSR30 TVOP Application  
Appalachia Midstream Services, LLC (AMS)  
Sand Hill Compressor Station (SHCS)  
NSR Permit No. R13-2913B (Pending)  
Plant ID No 051-00145  
Marshall County, West Virginia**

Dear Mr. Durham:

Appalachia Midstream Services, LLC (AMS) is submitting one (1) original paper copy and two (2) CD-ROMs of an Application for 45CSR30 Title V Operating Permit (TVOP) for the existing Sand Hill Compressor Station (SHS), located on Golden Rd / McCausland Hill Rd (Approx. 2.5 miles SW of Dallas), in the Sand Hill Tax District of Marshall County, West Virginia.

Note that AMS has recently submitted an application for 45CSR13 NSR Permit Modification for the SHCS. The current NSR permit underestimates the facility-wide potential-to-emit (PTE). The application for NSR Permit Modification, and this application for a TVOP, are both based on a thoroughly reviewed, and more comprehensive and accurate, PTE estimate.

If you have any questions concerning this submittal, or need additional information, please contact me by telephone at (304) 843-3125 or by e-mail at [Dave.Morris@Williams.com](mailto:Dave.Morris@Williams.com).

Sincerely,

A handwritten signature in blue ink that reads "David Morris".

David Morris  
Environmental Specialist

Enclosures:

- TVOP Application Checklist
- Application for Title V Operating Permit
- Attachment A thru H
- Supplement S1 thru S7

**Application for  
45CSR30 Title V Operating Permit (TVOP)**

*For the:*

Appalachia Midstream Services, LLC (AMS)

**Sand Hill Compressor Station (SHCS)**

Plant ID No. 051-00145

Marshall County, West Virginia

*Submitted to:*



**West Virginia**

**Department of Environmental Protection**

**Division of Air Quality**

*Submitted by:*



**Appalachia Midstream Services, LLC**

100 Teletech Drive, Suite 2

Moundsville, WV 26041-2352

*Prepared by:*



**EcoLogic Environmental Consultants, LLC**

864 Windsor Court

Santa Barbara, CA 93111-1037

**February 2018**

**Application for  
45CSR30 Title V Operating Permit (TVOP)**

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**

Plant ID No. 051-00145  
Marshall County, West Virginia

**Table of Contents**

**Cover Letter**

**Title Page / Table of Contents**

**Title V Operating Permit Application - Checklist**

**Application for Title V Operating Permit (TVOP)**

- Section 1. General Information
- Section 2. Applicable Requirements
- Section 3. Facility-Wide Emissions
- Section 4. Insignificant Activities
- Section 5. Emission Units, Control Devices, and Emission Points
- Section 6. Certification of Information

**Attachments to the TVOP Application**

- Attachment A Area Map
- Attachment B Plot Plan(s)
- Attachment C Process Flow Diagram(s) (PFD)
- Attachment D Equipment Table
- Attachment E Emissions Unit Form(s)
- Attachment F Schedule of Compliance Form(s) (NA)
- Attachment G Air Pollution Control Device Forms(s)
- Attachment H Compliance Assurance Monitoring (CAM) Forms (NA)

**Supplements to the TVOP Application**

- Supplement S1 Process Description
- Supplement S2 Regulatory Discussion
- Supplement S3 Emission Calculations
- Supplement S4 Lab Analysis (Inlet Gas)
- Supplement S5 Vendor Data (CAT G3516B / Capstone C600 / BTEX Buster / VRU / CarbCan)
- Supplement S6 Emission Programs (TANKS-4.0.9d / GRI-GLYCalc)
- Supplement S7 AP-42/EPA Emission Factors

**TITLE V PERMIT APPLICATION CHECKLIST  
FOR ADMINISTRATIVE COMPLETENESS**

A complete application is demonstrated when all of the information required below is properly prepared, completed and attached. The items listed below are required information which must be submitted with a Title V permit application. Any submittal will be considered incomplete if the required information is not included.\*

<input checked="" type="checkbox"/>	Two signed copies of the application (at least one <u>must</u> contain the original “ <i>Certification</i> ” page signed and dated in blue ink)
<input checked="" type="checkbox"/>	Correct number of copies of the application on separate CDs or diskettes, (i.e. at least one disc per copy)
<input checked="" type="checkbox"/>	*Table of Contents (needs to be included but not for administrative completeness)
<input checked="" type="checkbox"/>	Facility information
<input checked="" type="checkbox"/>	Description of process and products, including NAICS and SIC codes, and including alternative operating scenarios
<input checked="" type="checkbox"/>	Area map showing plant location
<input checked="" type="checkbox"/>	Plot plan showing buildings and process areas
<input checked="" type="checkbox"/>	Process flow diagram(s), showing all emission units, control equipment, emission points, and their relationships
<input checked="" type="checkbox"/>	Identification of all applicable requirements with a description of the compliance status, the methods used for demonstrating compliance, and a Schedule of Compliance Form (ATTACHMENT F) for all requirements for which the source is not in compliance
<input checked="" type="checkbox"/>	Listing of all active permits and consent orders (if applicable)
<input checked="" type="checkbox"/>	Facility-wide emissions summary
<input checked="" type="checkbox"/>	Identification of Insignificant Activities
<input checked="" type="checkbox"/>	ATTACHMENT D - Title V Equipment Table completed for all emission units at the facility except those designated as insignificant activities
<input checked="" type="checkbox"/>	ATTACHMENT E - Emission Unit Form completed for each emission unit listed in the Title V Equipment Table (ATTACHMENT D) and a Schedule of Compliance Form (ATTACHMENT F) for all requirements for which the emission unit is not in compliance
<input checked="" type="checkbox"/>	ATTACHMENT G - Air Pollution Control Device Form completed for each control device listed in the Title V Equipment Table (ATTACHMENT D)
<input checked="" type="checkbox"/>	ATTACHMENT H – Compliance Assurance Monitoring (CAM) Plan Form completed for each control device for which the “Is the device subject to CAM?” question is answered “Yes” on the Air Pollution Control Device Form (ATTACHMENT G)
<input checked="" type="checkbox"/>	General Application Forms signed by a Responsible Official
<input type="checkbox"/>	Confidential Information submitted in accordance with 45CSR31

## **Application for 45CSR30 Title V Operating Permit (TVOP)**

---

- **Section 1. General Information**
  - **Section 2. Applicable Requirements**
  - **Section 3. Facility-Wide Emissions**
  - **Section 4. Insignificant Activities**
  - **Section 5. Emission Units, Control Devices, and Emission Points**
  - **Section 6. Certification of Information**
-



WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF AIR QUALITY

601 57th Street SE
Charleston, WV 25304
Phone: (304) 926-0475
www.dep.wv.gov/daq

INITIAL/RENEWAL TITLE V PERMIT APPLICATION - GENERAL FORMS

Section 1: General Information

Form with 10 sections: 1. Name of Applicant (Appalachia Midstream Services, LLC), 2. Facility Name (Sand Hill Compressor Station), 3. DAQ Plant ID No. (051-00145), 4. Federal Employer ID No. (26-3678972), 5. Permit Application Type (Initial Permit), 6. Type of Business Entity (LLC), 7. Is the Applicant the: (Both), 8. Number of On-site Employees (---), 9. Governmental Code (Privately owned and operated; 0), 10. Business Confidentiality Claims (No).

<b>11. Mailing Address</b>		
<b>Street or P.O. Box:</b> Appalachia Midstream Services, LLC (AMS) 100 Teletech Drive, Suite 2		
<b>City:</b> Moundsville	<b>State:</b> WV	<b>Zip:</b> 26041-2352
<b>Telephone Number:</b> (304) 843-3100	<b>Fax Number:</b> (304) 843-3131	

<b>12. Facility Location</b>		
<b>Street:</b> Golden Rd / McCausland Hill Rd (Approx 2.5 miles SW of Dallas)	<b>City:</b> Dallas	<b>County:</b> Marshall
<b>UTM Easting:</b> 537.897 km	<b>UTM Northing:</b> 4,426.495 km	<b>Zone:</b> <input checked="" type="checkbox"/> 17 <input type="checkbox"/> 18
<b>Directions:</b> From Dallas, WV: 1) Head south on Number 2 Ridge Rd                      ~2.3 mi; 2) Turn right onto Golden Rd / McCausland Hill Rd    ~1.4 mi; 3) Destination is on the right.		
<b>Portable Source?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
<b>Is facility located w/in a nonattainment area?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<b>If yes, for what air pollutants?</b> na	
<b>Is facility located w/n 50 miles of another state?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<b>If yes, name the affected state(s).</b> Ohio and Pennsylvania	
<b>Is facility located w/in 100 km of a Class I Area<sup>1</sup>?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <b>If no, do emissions impact a Class I Area<sup>1</sup>?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<b>If yes, name the area(s).</b> na (~140 km to Otter Creek WA)	
<sup>1</sup> Class I areas include Dolly Sods and Otter Creek Wilderness Areas in West Virginia, and Shenandoah National Park James River Face Wilderness Area in Virginia.		

<b>13. Contact Information</b>		
<b>Responsible Official:</b> Paul V. Hunter		<b>Title:</b> Vice President
<b>Street or P.O. Box:</b> Appalachia Midstream Services, LLC (AMS) Park Place II, 2000 Commerce Dr		
<b>City:</b> Pittsburgh	<b>State:</b> PA	<b>Zip:</b> 15275-1026
<b>Telephone Number:</b> (412) 787-7300	<b>Fax Number:</b> na	
<b>E-mail address:</b> PaulV.Hunter@Williams.Com		
<b>Environmental Contact:</b> David Morris		<b>Title:</b> Environmental Specialist
<b>Street or P.O. Box:</b> Appalachia Midstream Services, LLC (AMS) 100 Teletech Drive, Suite 2		
<b>City:</b> Moundsville	<b>State:</b> WV	<b>Zip:</b> 26041-2352
<b>Telephone Number:</b> (304) 843-3125	<b>Fax Number:</b> na	
<b>E-mail address:</b> Dave.Morris@Williams.Com		
<b>Application Preparer:</b> Walter Konkel, III		<b>Title:</b> Principal Scientist
<b>Company:</b> EcoLogic Environmental Consultants, LLC		
<b>Street or P.O. Box:</b> 864 Windsor Court		
<b>City:</b> Santa Barbara	<b>State:</b> CA	<b>Zip:</b> 93111-1037
<b>Telephone Number:</b> (805) 964-7597	<b>Fax Number:</b> na	
<b>E-mail address:</b> wkonkel@elogicllc.com		

**14. Facility Description**

List all processes, products, NAICS and SIC codes for normal operation, in order of priority. Also list any process, products, NAICS and SIC codes associated with any alternative operating scenarios if different from those listed for normal operation.

Process	Products	NAICS	SIC
Oil and Gas Field Services, NEC	Compressed and Dehydrated Natural Gas	213112	1389

**Provide a general description of operations.**

Please reference SUPPLEMENT S1 – Process Description

\* The Appalachia Midstream Services, LLC (AMS), Sand Hill Compressor Station (SHCS) compresses and dehydrates up to 165 MMscf of locally produced natural gas.

\* Primary equipment includes:

- Twelve (12) natural gas compressors, and
- Three (3) natural gas dehydrators, each with flash tank, regenerator/still and reboiler.

\* Auxiliary equipment includes:

- One (1) electricity generator,
- Two (2) heater-treaters, and
- Ten (10) storage tanks.

**15. Provide an Area Map showing plant location as ATTACHMENT A.**

16. Provide a Plot Plan(s), e.g. scaled map(s) and/or sketch(es) showing the location of the property on which the stationary source(s) is located as ATTACHMENT B. For instructions, refer to “Plot Plan - Guidelines.”

17. Provide a detailed **Process Flow Diagram(s)** showing each process or emissions unit as **ATTACHMENT C**. Process Flow Diagrams should show all emission units, control equipment, emission points, and their relationships.

**Section 2: Applicable Requirements**

<b>18. Applicable Requirements Summary</b>	
Instructions: Mark all applicable requirements.	
<input type="checkbox"/> SIP	<input type="checkbox"/> FIP
<input checked="" type="checkbox"/> <b>Minor Source NSR (45CSR13)</b>	<input type="checkbox"/> PSD (45CSR14)
<input checked="" type="checkbox"/> <b>NESHAP (45CSR34) (HH, ZZZZ)</b>	<input type="checkbox"/> Nonattainment NSR (45CSR19)
<input checked="" type="checkbox"/> <b>Section 111 NSPS (JJJJ and OOOO)</b>	<input type="checkbox"/> Section 112(d) MACT Standards
<input type="checkbox"/> Section 112(g) Case-by-case MACT	<input type="checkbox"/> 112(r) RMP
<input type="checkbox"/> Section 112(i) Early Reduction of HAP	<input type="checkbox"/> Consumer/Commercial Prod. Reqts., Sect 183(e)
<input type="checkbox"/> Section 129 Standards/Reqts.	<input type="checkbox"/> Stratospheric Ozone (Title VI)
<input type="checkbox"/> Tank vessel Req., Section 183(f)	<input type="checkbox"/> Emissions Cap 45CSR§30-2.6.2
<input type="checkbox"/> NAAQS, Increments or Visibility (temp. sources)	<input type="checkbox"/> 45CSR27 State Enforceable Only Rule (CPU)
<input checked="" type="checkbox"/> <b>45CSR4 State Enforceable Only Rule (Odors)</b>	<input type="checkbox"/> Acid Rain (Title IV, 45CSR33)
<input type="checkbox"/> Emissions Trading and Banking (45CSR28)	<input type="checkbox"/> Compliance Assurance Monitoring (CAM)
<input type="checkbox"/> CAIR NOx Annual Trading Program (45CSR39)	<input type="checkbox"/> CAIR NOx Ozone Trading Program (45CSR40)
<input type="checkbox"/> CAIR SO2 Trading Program (45CSR41)	

<b>19. Non-Applicability Determinations</b>
<p>List all requirements which the source has determined not applicable and for which a permit shield is requested. The listing shall also include the rule citation and the reason why the shield applies.</p> <p style="text-align: center;"><b><u>Please reference SUPPLEMENT S2 – Regulatory Discussion</u></b></p>
<input type="checkbox"/> <b>Permit Shield</b>

**20. Facility-Wide Applicable Requirements - Attach additional pages as necessary.**

List all facility-wide applicable requirements. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number.

(Note: Title V permit condition numbers alone are not the underlying applicable requirements).

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

**Permit Shield**

For all facility-wide applicable requirements listed above, provide monitoring/testing/recordkeeping/ reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number and/or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

**Are you in compliance with all facility-wide applicable requirements?**

Yes  No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

**Not Applicable**



Section 3: Facility-Wide Emissions

<b>23. Facility-Wide Emissions Summary [Tons per Year]</b>	
<b>Criteria Pollutants</b>	<b>Potential Emissions (Including Fugitives)</b>
	<b>R13-2913B (Pending)</b>
Nitrogen Oxides (NOX)	83.98
Carbon Monoxide (CO)	79.95
Volatile Organic Compounds (VOC)	207.33
Particulate Matter (PM2.5) <sup>1</sup>	6.24
Particulate Matter (PM10) <sup>1</sup>	6.24
Total Particulate Matter (TSP)	6.24
Sulfur Dioxide (SO2)	0.38
<b>Hazardous Air Pollutants<sup>2</sup></b>	<b>Potential Emissions (Including Fugitives)</b>
	<b>R13-2913B (Pending)</b>
Acetaldehyde	1.25
Acrolein	0.77
Benzene	1.29
Butadiene, 1,3-	0.04
Ethylbenzene	0.46
Formaldehyde (HCHO)	6.44
n-Hexane	6.43
Methanol (MeOH)	0.37
Polycyclic Organic Matter (POM)	0.05
Toluene	1.78
2,2,4-Trimethylpentane (TMP)	0.47
Xylenes	0.94
Other/Trace HAP*	0.05
Total Hazardous Air Pollutants (HAPs)	20.34
<b>Regulated Pollutants (Other than Criteria and HAP)</b>	<b>Potential Emissions (Including Fugitives)</b>
	<b>R13-2913B (Pending)</b>
Carbon Dioxide (CO <sub>2</sub> )	87,330
Methane (CH <sub>4</sub> )	946
Nitrous Oxide (N <sub>2</sub> O)	0.26
CO <sub>2</sub> equivalent (CO <sub>2</sub> e)	111,046
<sup>1</sup> PM2.5 and PM10 are components of TSP. <sup>2</sup> For HAPs that are also considered PM or VOCs, emissions should be included in both the HAPs section and the Criteria Pollutants section.  *Other/Trace HAPs include: Carbon Tetrachloride, Chlorobenzene, Chloroform, Dichloropropene, 1,3-Dichloropropene, Ethylene Dibromide, Methylene Chloride, Phenol, Propylene Oxide, Styrene, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, and Vinyl Chloride (as per AP-42).	
<b><u>Please reference SUPPLEMENT S3 – Emission Calculations</u></b>	

**Section 4: Insignificant Activities**

<b>24. Insignificant Activities (Check all that apply)</b>	
<input checked="" type="checkbox"/>	1 Air compressors and pneumatically operated equipment, including hand tools.
<input checked="" type="checkbox"/>	2 Air contaminant detectors or recorders, combustion controllers or shutoffs.
<input checked="" type="checkbox"/>	3 Any consumer product used in the same manner as in normal consumer use, provided the use results in a duration and frequency of exposure which are not greater than those experienced by consumer, and which may include, but not be limited to, personal use items; janitorial cleaning supplies, office supplies and supplies to maintain copying equipment.
<input checked="" type="checkbox"/>	4 Bathroom/toilet vent emissions.
<input checked="" type="checkbox"/>	5 Batteries and battery charging stations, except at battery manufacturing plants.
<input checked="" type="checkbox"/>	6 Bench-scale laboratory equipment used for physical or chemical analysis, but not lab fume hoods or vents. Many lab fume hoods or vents might qualify for treatment as insignificant (depending on the applicable SIP) or be grouped together for purposes of description.
<input type="checkbox"/>	7 Blacksmith forges.
<input type="checkbox"/>	8 Boiler water treatment operations, not including cooling towers.
<input checked="" type="checkbox"/>	9 Brazing, soldering or welding equipment used as an auxiliary to the principal equipment at the source.
<input type="checkbox"/>	10 CO2 lasers, used only on metals and other materials which do not emit HAP in the process.
<input checked="" type="checkbox"/>	11 Combustion emissions from propulsion of mobile sources, except for vessel emissions from Outer Continental Shelf sources.
<input checked="" type="checkbox"/>	12 Combustion units designed and used exclusively for comfort heating that use liquid petroleum gas or natural gas as fuel.
<input checked="" type="checkbox"/>	13 Comfort air conditioning or ventilation systems not used to remove air contaminants generated by or released from specific units of equipment.
<input type="checkbox"/>	14 Demineralized water tanks and demineralizer vents.
<input type="checkbox"/>	15 Drop hammers or hydraulic presses for forging or metalworking.
<input type="checkbox"/>	16 Electric or steam-heated drying ovens and autoclaves, but not the emissions from the articles or substances being processed in the ovens or autoclaves or the boilers delivering the steam.
<input type="checkbox"/>	17 Emergency (backup) electrical generators at residential locations.
<input type="checkbox"/>	18 Emergency road flares.
<input type="checkbox"/>	19 Emission units which do not have any applicable requirements and which emit criteria pollutants (CO, NOx, SO2, VOC and PM) into the atmosphere at a rate of less than 1 pound per hour and less than 10,000 pounds per year aggregate total for each criteria pollutant from all emission units.  Please specify all emission units for which this exemption applies along with the quantity of criteria pollutants emitted on an hourly and annual basis: na

**24. Insignificant Activities (Check all that apply) (Continued)**

<input type="checkbox"/>	20 Emission units which do not have any applicable requirements and which emit hazardous air pollutants into the atmosphere at a rate of less than 0.1 pounds per hour and less than 1,000 pounds per year aggregate total for all HAPs from all emission sources. This limitation cannot be used for any source which emits dioxin/furans nor for toxic air pollutants as per 45CSR27.  Please specify all emission units for which this exemption applies along with the quantity of hazardous air pollutants emitted on an hourly and annual basis:
<input type="checkbox"/>	21 Environmental chambers not using hazardous air pollutant (HAP) gases.
<input checked="" type="checkbox"/>	22 Equipment on the premises of industrial and manufacturing operations used solely for the purpose of preparing food for human consumption.
<input type="checkbox"/>	23 Equipment used exclusively to slaughter animals, but not including other equipment at slaughterhouses, such as rendering cookers, boilers, heating plants, incinerators, and electrical power generating equipment.
<input checked="" type="checkbox"/>	24 Equipment used for quality control/assurance or inspection purposes, including sampling equipment used to withdraw materials for analysis.
<input checked="" type="checkbox"/>	25 Equipment used for surface coating, painting, dipping or spray operations, except those that will emit VOC or HAP.
<input checked="" type="checkbox"/>	26 Fire suppression systems.
<input checked="" type="checkbox"/>	27 Firefighting equipment and the equipment used to train firefighters.
<input type="checkbox"/>	28 Flares used solely to indicate danger to the public.
<input checked="" type="checkbox"/>	29 Fugitive emission related to movement of passenger vehicle provided the emissions are not counted for applicability purposes and any required fugitive dust control plan or its equivalent is submitted.
<input checked="" type="checkbox"/>	30 Hand-held applicator equipment for hot melt adhesives with no VOC in the adhesive formulation.
<input checked="" type="checkbox"/>	31 Hand-held equipment for buffing, polishing, cutting, drilling, sawing, grinding, turning or machining wood, metal or plastic.
<input type="checkbox"/>	32 Humidity chambers.
<input checked="" type="checkbox"/>	33 Hydraulic and hydrostatic testing equipment.
<input checked="" type="checkbox"/>	34 Indoor or outdoor kerosene heaters.
<input checked="" type="checkbox"/>	35 Internal combustion engines used for landscaping purposes.
<input type="checkbox"/>	36 Laser trimmers using dust collection to prevent fugitive emissions.
<input type="checkbox"/>	37 Laundry activities, except for dry-cleaning and steam boilers.
<input checked="" type="checkbox"/>	38 Natural gas pressure regulator vents, excluding venting at oil and gas production facilities.
<input type="checkbox"/>	39 Oxygen scavenging (de-aeration) of water.
<input type="checkbox"/>	40 Ozone generators.

**24. Insignificant Activities (Check all that apply) (Continued)**

<input checked="" type="checkbox"/>	41 Plant maintenance and upkeep activities (e.g., grounds-keeping, general repairs, cleaning, painting, welding, plumbing, re-tarring roofs, installing insulation, and paving parking lots) provided these activities are not conducted as part of a manufacturing process, are not related to the source's primary business activity, and not otherwise triggering a permit modification. (Cleaning and painting activities qualify if they are not subject to VOC or HAP control requirements. Asphalt batch plant owners/operators must still get a permit if otherwise requested.)
<input checked="" type="checkbox"/>	42 Portable electrical generators that can be moved by hand from one location to another. "Moved by Hand" means that it can be moved without the assistance of any motorized or non-motorized vehicle, conveyance, or device.
<input type="checkbox"/>	43 Process water filtration systems and demineralizers.
<input checked="" type="checkbox"/>	44 Repair or maintenance shop activities not related to the source's primary business activity, not including emissions from surface coating or de-greasing (solvent metal cleaning) activities, and not otherwise triggering a permit modification.
<input checked="" type="checkbox"/>	45 Repairs or maintenance where no structural repairs are made and where no new air pollutant emitting facilities are installed or modified.
<input checked="" type="checkbox"/>	46 Routing calibration and maintenance of laboratory equipment or other analytical instruments.
<input type="checkbox"/>	47 Salt baths using nonvolatile salts that do not result in emissions of any regulated air pollutants. Shock chambers.
<input type="checkbox"/>	48 Shock chambers.
<input type="checkbox"/>	49 Solar simulators.
<input checked="" type="checkbox"/>	50 Space heaters operating by direct heat transfer.
<input type="checkbox"/>	51 Steam cleaning operations.
<input checked="" type="checkbox"/>	52 Steam leaks.
<input type="checkbox"/>	53 Steam sterilizers.
<input checked="" type="checkbox"/>	54 Steam vents and safety relief valves.
<input type="checkbox"/>	55 Storage tanks, reservoirs, and pumping and handling equipment of any size containing soaps, vegetable oil, grease, animal fat, and nonvolatile aqueous salt solutions, provided appropriate lids and covers are utilized.
<input checked="" type="checkbox"/>	56 Storage tanks, vessels, and containers holding or storing liquid substances that will not emit any VOC or HAP. Exemptions for storage tanks containing petroleum liquids or other volatile organic liquids should be based on size limits such as storage tank capacity and vapor pressure of liquids stored and are not appropriate for this list.
<input type="checkbox"/>	57 Such other sources or activities as the Director may determine.
<input checked="" type="checkbox"/>	58 Tobacco smoking rooms and areas.
<input checked="" type="checkbox"/>	59 Vents from continuous emissions monitors and other analyzers.

*Section 5: Emission Units, Control Devices, and Emission Points*

**25. Equipment Table**

Fill out the **Title V Equipment Table** and provide it as **ATTACHMENT D**.

**26. Emission Units**

For each emission unit listed in the **Title V Equipment Table**, fill out and provide an **Emission Unit Form** as **ATTACHMENT E**.

For each emission unit not in compliance with an applicable requirement, fill out a **Schedule of Compliance Form** as **ATTACHMENT F**.

**27. Control Devices**

For each control device listed in the **Title V Equipment Table**, fill out and provide an **Air Pollution Control Device Form** as **ATTACHMENT G**.

For any control device that is required on an emission unit in order to meet a standard or limitation for which the potential pre-control device emissions of an applicable regulated air pollutant is greater than or equal to the Title V Major Source Threshold Level, refer to the **Compliance Assurance Monitoring (CAM) Form(s)** for CAM applicability. Fill out and provide these forms, if applicable, for each Pollutant Specific Emission Unit (PSEU) as **ATTACHMENT H**.

**Section 6: Certification of Information**

**28. Certification of Truth, Accuracy and Completeness and Certification of Compliance**

*Note: This Certification must be signed by a responsible official. The **original**, signed in **blue ink**, must be submitted with the application. Applications without an **original** signed certification will be considered as incomplete.*

**a. Certification of Truth, Accuracy and Completeness**

I certify that I am a responsible official (as defined at 45CSR§30-2.38) and am accordingly authorized to make this submission on behalf of the owners or operators of the source described in this document and its attachments. I certify under penalty of law that I have personally examined and am familiar with the statements and information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the statements and information are to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine and/or imprisonment.

**b. Compliance Certification**

Except for requirements identified in the Title V Application for which compliance is not achieved, I, the undersigned hereby certify that, based on information and belief formed after reasonable inquiry, all air contaminant sources identified in this application are in compliance with all applicable requirements.

**Responsible official (type or print)**

Paul V. Hunter

**Title:**

Vice President

**Responsible official's signature:**

Signature:  Signature Date: 02-05-2018  
*(Must be signed and dated in blue ink)*

**Note: Please check all applicable attachments included with this permit application:**

<input checked="" type="checkbox"/>	ATTACHMENT A: Area Map
<input checked="" type="checkbox"/>	ATTACHMENT B: Plot Plan(s)
<input checked="" type="checkbox"/>	ATTACHMENT C: Process Flow Diagram(s)
<input checked="" type="checkbox"/>	ATTACHMENT D: Equipment Table
<input checked="" type="checkbox"/>	ATTACHMENT E: Emission Unit Form(s)
<input checked="" type="checkbox"/>	ATTACHMENT F: Schedule of Compliance Form(s) (NA)
<input checked="" type="checkbox"/>	ATTACHMENT G: Air Pollution Control Device Form(s)
<input checked="" type="checkbox"/>	ATTACHMENT H: Compliance Assurance Monitoring (CAM) Form(s) (NA)

*All of the required forms and additional information can be found and downloaded from, the DEP website at [www.dep.wv.gov/dag](http://www.dep.wv.gov/dag), requested by phone (304) 926-0475, and/or obtained through the mail.*

## Attachment A

### Area Map

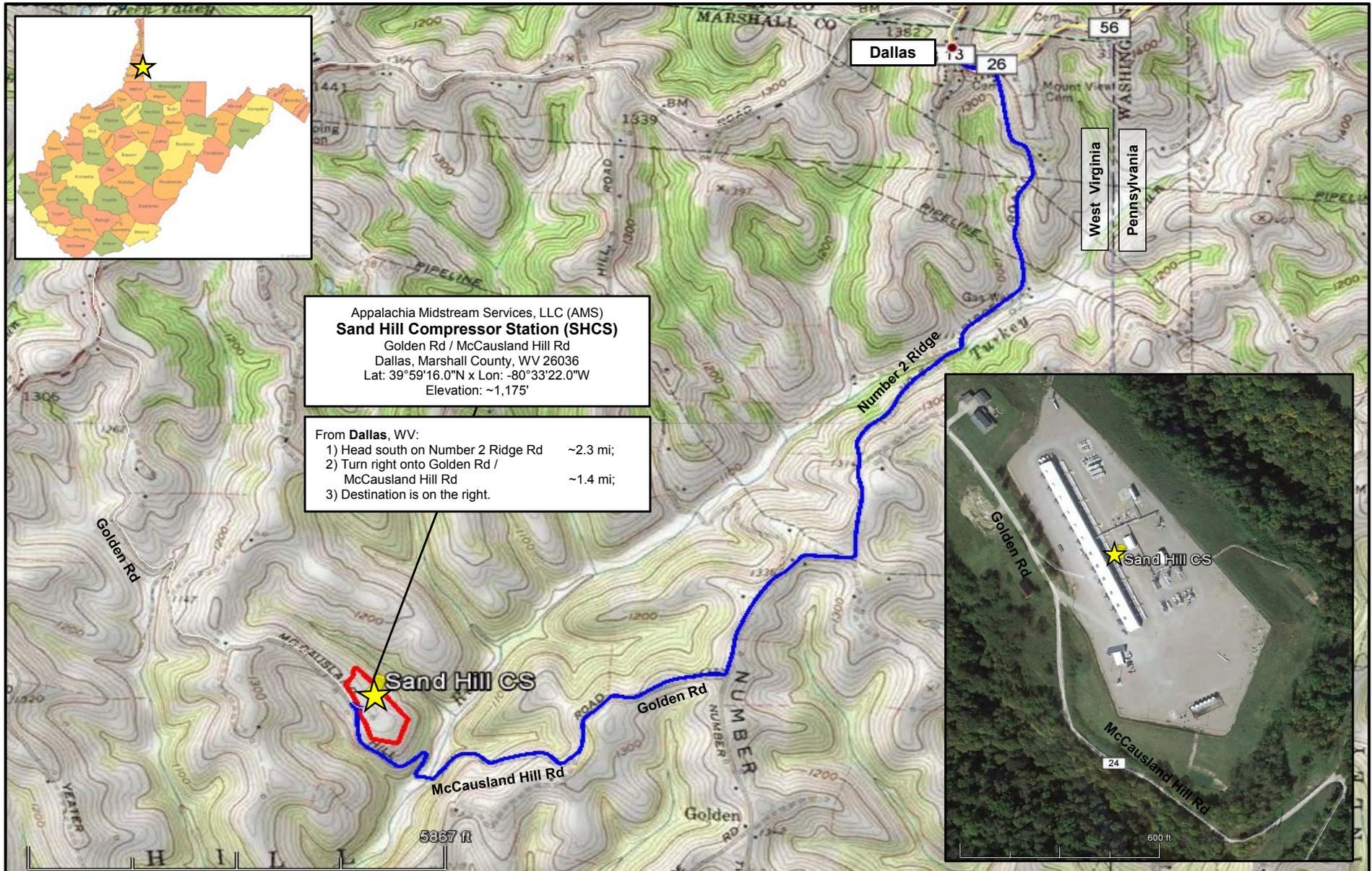
---

“15. Provide an Area Map showing plant location as ATTACHMENT A.”

---

- **Location:**  
Sand Hill Compressor Station (SHCS)  
McCausland Rd  
(Approximately 2.5 miles SW of Dallas)  
Dallas, Marshall County, WV 26036
  
  - **Latitude and Longitude:**  
Lat: 39°59'16.0"N x Lon: -80°33'22.0"W  
Lat: 39.9878°N x Lon: -80.5561°W
  
  - **UTM:**  
537.897 km E x 4,426.495 km N x 17T
  
  - **Elevation:**  
~1,175'
  
  - **USGS:**  
2016 USGS US Topo 7.5 - minute map for MAJORSVILLE, WV-PA
  
  - **Directions:**  
From Dallas, WV:  
1) Head south on Number 2 Ridge Rd ~2.3 mi;  
2) Turn right onto Golden Rd / McCausland Hill Rd ~1.4 mi;  
3) Destination is on the right.
-

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)  
**Attachment A - Location Map / Topographic Map**



## **Attachment B**

### **Plot Plan(s)**

---

“16. Provide a Plot Plan(s), e.g. scaled map(s) and/or sketch(es) showing the location of the property on which the stationary source(s) is located as ATTACHMENT B. For instructions, refer to Plot Plan - Guidelines.”

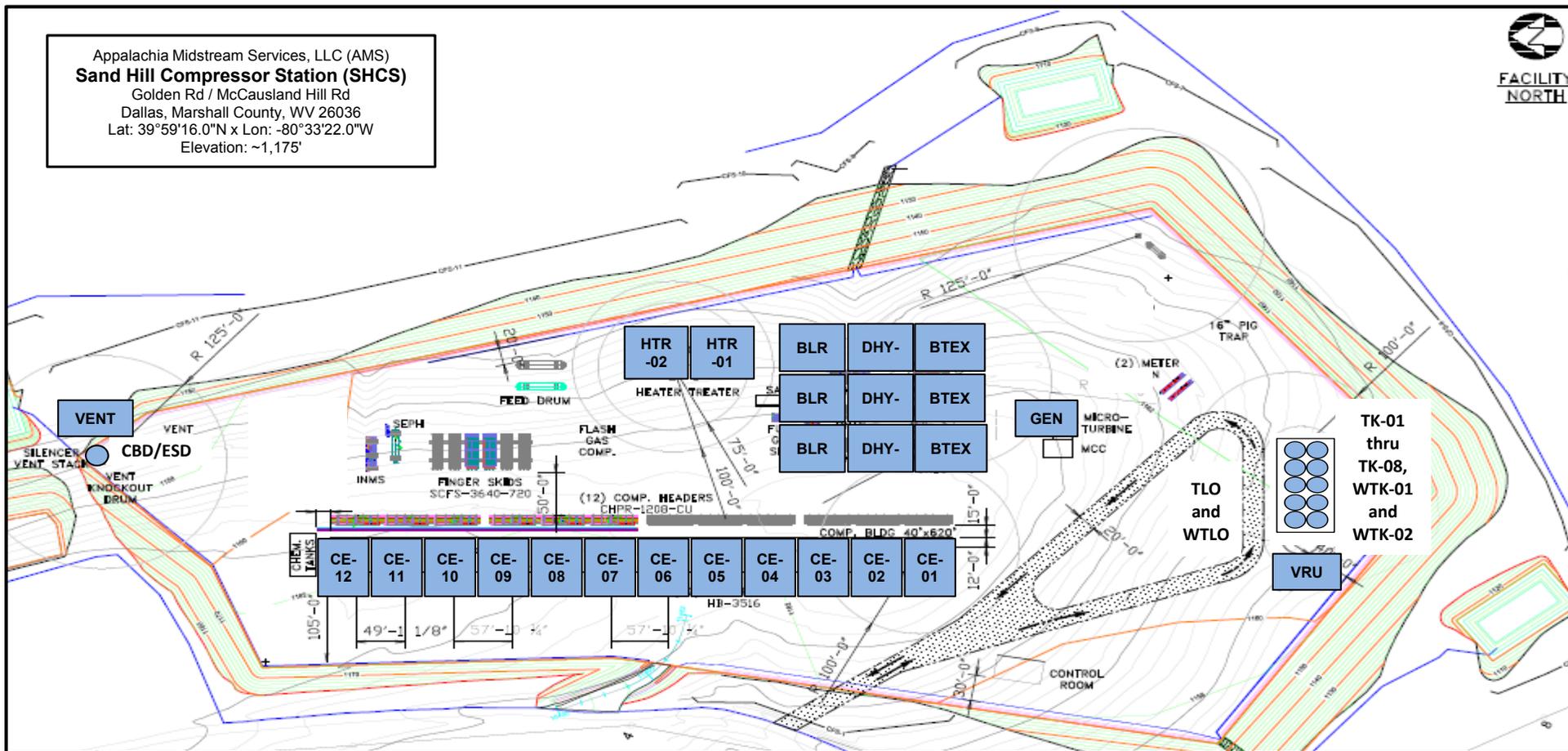
---

- **Plot Plan – Sand Hill Compressor Station (SHCS)**
-

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)  
**Attachment B - Plot Plan**



Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Golden Rd / McCausland Hill Rd  
 Dallas, Marshall County, WV 26036  
 Lat: 39°59'16.0"N x Lon: -80°33'22.0"W  
 Elevation: ~1,175'



<u>Unit No.</u>	<u>Company ID - Description</u>	<u>Unit No.</u>	<u>Company ID - Description</u>
CE-01 thru CE-12	1,380 bhp CAT G3516B Compressor Engines	VRU	Vapor Recovery Unit
GEN	805 bhp Capstone C600 Microturbine Generator	WTK-01 and WTK-02	400 bbl Produced Water (PW) - Storage Tanks
CRP	Compressor Rod-Packing	TLO	Stabilized Condensate (SC) - Truck Load-Out
DHY-01 thru DHY-03	55.0 MMscfd Dehydrators	CARB-CAN	Carbon Canisters
BTEX-01 thru BTEX-03	Condensers (BTEX Busters)	WTLO	Produced Water (PW) - Truck Load-Out
BLR-01 thru BLR-03	1.00 MMBtu/hr Reboilers	CBD/ESD	Compressor Blowdown / Emergency Shutdown
HTR-01 and HTR-02	0.50 MMBtu/hr Heater Treater Burners	FUG-G and FUG-O	Process Piping and Equipment Leaks
TK-01 thru TK-08	400 bbl Stabilized Condensate (SC) - Tanks	ECC	Engine Crankcase

## **Attachment C**

### **Process Flow Diagram(s) (PFD)**

---

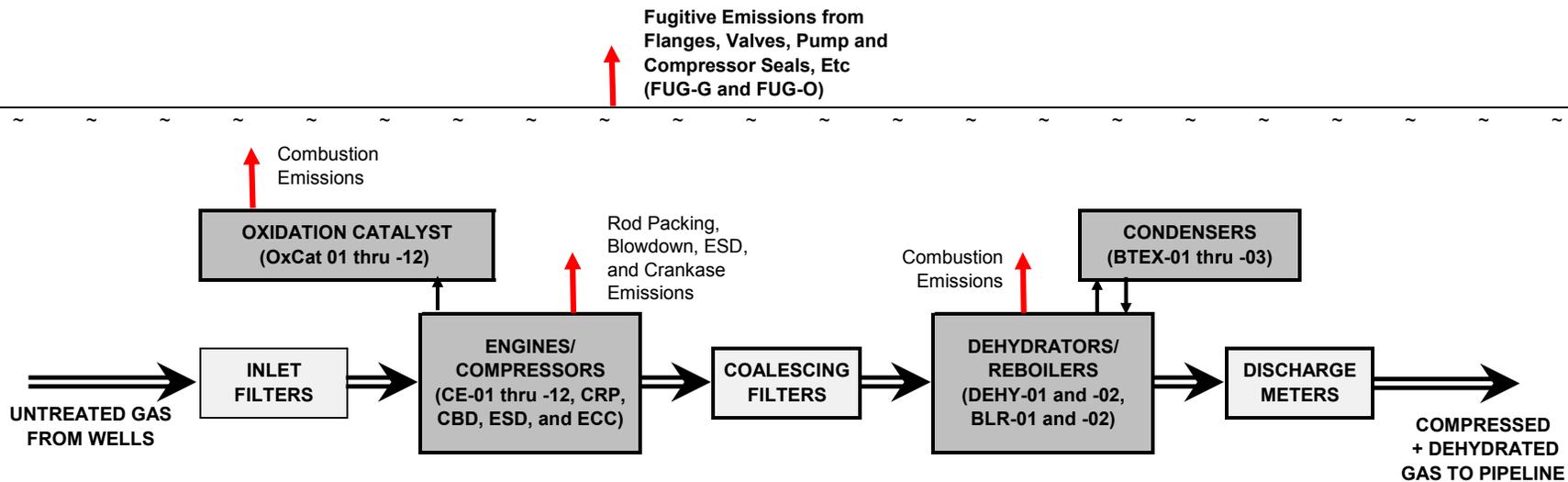
“17. Provide a detailed Process Flow Diagram(s) showing each process or emissions unit as ATTACHMENT C. Process Flow Diagrams should show all emission units, control equipment, emission points, and their relationships.”

---

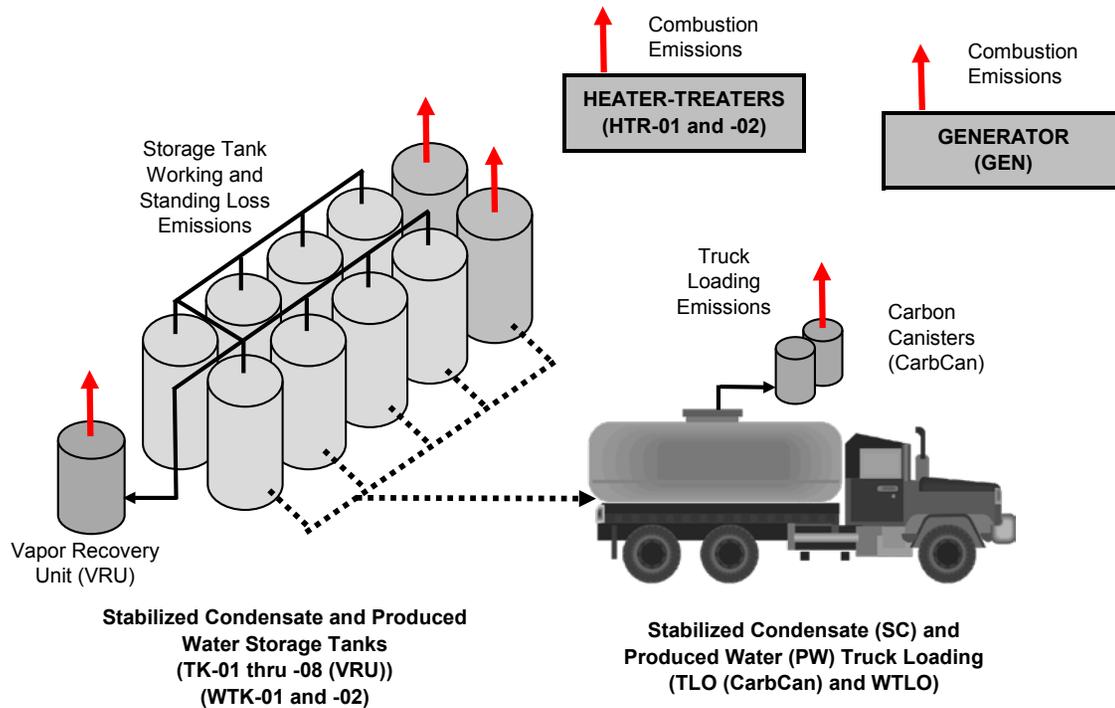
- **Process Flow Diagram (PFD) – Sand Hill Compressor Station (SHCS)**
-

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Attachment C - Process Flow Diagram (PFD)**



<u>Unit No.</u>	<u>Company ID - Description</u>
CE-01 thru CE-12	1,380 bhp CAT G3516B Compressor Engines
CRP	Compressor Rod-Packing
GEN	805 bhp Capstone C600 Microturbine Generator
DHY-01 thru DHY-03	55.0 MMscfd Dehydrators
BTEX-01 thru BTEX-03	Condensers (BTEX Busters)
BLR-01 thru BLR-03	1.00 MMBtu/hr Reboilers
HTR-01 and HTR-02	0.50 MMBtu/hr Heater Treater Burners
TK-01 thru TK-08	400 bbl Stabilized Condensate (SC) - Tanks
VRU	Vapor Recovery Unit
WTK-01 and WTK-02	400 bbl Produced Water (PW) - Storage Tanks
TLO	Stabilized Condensate (SC) - Truck Load-Out
CARB-CAN	Carbon Canisters
WTLO	Produced Water (PW) - Truck Load-Out
CBD/ESD	Compressor Blowdown / Emergency Shutdown
FUG-G and FUG-O	Process Piping and Equipment Leaks
ECC	Engine Crankcase



## **Attachment D**

### **Equipment Table**

---

“25. Fill out the Title V Equipment Table and provide it as ATTACHMENT D.”

---

- **Title V Equipment Table – Sand Hill Compressor Station (SHCS)**
-

**Attachment D  
TITLE V EQUIPMENT TABLE**

(includes all emission units at the facility except those designated as insignificant activities in Section 4, Item 24 of the General Forms)

Emission Point ID <sup>1</sup>	Control Device <sup>1</sup>	Emission Unit ID <sup>1</sup>	Source ID	Emission Unit Description	Design Capacity	Installed/Modified
EPCE-1	OxCat-01	EUCE-1	CE-01	Compressor Engine 01 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCE-2	OxCat-02	EUCE-2	CE-02	Compressor Engine 02 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCE-3	OxCat-03	EUCE-3	CE-03	Compressor Engine 03 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCE-4	OxCat-04	EUCE-4	CE-04	Compressor Engine 04 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCE-5	OxCat-05	EUCE-5	CE-05	Compressor Engine 05 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCE-6	OxCat-06	EUCE-6	CE-06	Compressor Engine 06 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCE-7	OxCat-07	EUCE-7	CE-07	Compressor Engine 07 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCE-8	OxCat-08	EUCE-8	CE-08	Compressor Engine 08 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCE-9	OxCat-09	EUCE-9	CE-09	Compressor Engine 09 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCE-10	OxCat-10	EUCE-10	CE-10	Compressor Engine 10 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCE-11	OxCat-11	EUCE-11	CE-11	Compressor Engine 11 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCE-12	OxCat-12	EUCE-12	CE-12	Compressor Engine 12 - CAT G3516B (OxCat)	1,380 bhp	'12/'18
EPCRP	---	EUCRP	CRP	Compressor Rod Packing	12 Units	'12/'18
EPGEN-1	---	EUGEN-1	GEN	Generator - Capstone C600 Microturbine	805 bhp	'12/'18
EPSTL-1	BTEX-01	EUDHY-1	DHY-01	Dehydrator 01 (BTEX Buster)	55.0 MMscfd	'12/'18
EPSTL-2	BTEX-02	EUDHY-2	DHY-02	Dehydrator 02 (BTEX Buster)	55.0 MMscfd	'12/'18
EPSTL-3	BTEX-03	EUDHY-3	DHY-03	Dehydrator 03 (BTEX Buster)	55.0 MMscfd	'12/'18
EPRBL-1	---	EURBL-1	BLR-01	Reboiler 01	1.00 MMBtu/hr	'12/'18
EPRBL-2	---	EURBL-2	BLR-02	Reboiler 02	1.00 MMBtu/hr	'12/'18
EPRBL-3	---	EURBL-3	BLR-03	Reboiler 03	1.00 MMBtu/hr	'12/'18
EPHT-1	---	EUHT-1	HTR-01	Heater-Treater Burner 01	0.50 MMBtu/hr	'12/'18
EPHT-2	---	EUHT-2	HTR-02	Heater-Treater Burner 02	0.50 MMBtu/hr	'12/'18
EPTK-1	VRU	EUTK-1	TK-01	Storage Tank 01 - Stabilized Condensate (SC) (VRU)	400 bbl	'12/'18
EPTK-2	VRU	EUTK-2	TK-02	Storage Tank 02 - Stabilized Condensate (SC) (VRU)	400 bbl	'12/'18
EPTK-3	VRU	EUTK-3	TK-03	Storage Tank 03 - Stabilized Condensate (SC) (VRU)	400 bbl	'12/'18
EPTK-4	VRU	EUTK-4	TK-04	Storage Tank 04 - Stabilized Condensate (SC) (VRU)	400 bbl	'12/'18
EPTK-5	VRU	EUTK-5	TK-05	Storage Tank 05 - Stabilized Condensate (SC) (VRU)	400 bbl	'12/'18
EPTK-6	VRU	EUTK-6	TK-06	Storage Tank 06 - Stabilized Condensate (SC) (VRU)	400 bbl	'12/'18
EPTK-7	VRU	EUTK-7	TK-07	Storage Tank 07 - Stabilized Condensate (SC) (VRU)	400 bbl	'12/'18
EPTK-8	VRU	EUTK-8	TK-08	Storage Tank 08 - Stabilized Condensate (SC) (VRU)	400 bbl	'12/'18
EPWTK-9	---	EUWTK-9	WTK-01	Storage Tank W01 - Produced Water (PW)	400 bbl	'12/'18
EPWTK-10	---	EUWTK-10	WTK-02	Storage Tank W02 - Produced Water (PW)	400 bbl	'12/'18
EPLOAD-1	CarbCan	EULOAD-1	TLO	Truck Loading - Stabilized Condensate (SC) (CarbCan)	9,965 Mgal/yr	'12/'18
EPLOAD-2	---	EULOAD-2	WTLO	Truck Loading - Produced Water (PW)	1,533 Mgal/yr	'12/'18
EPBD	---	EUBD	CBD/ESD	Compressor Blowdown/Emergency Shutdown Tests	1,249 events/yr	'12/'18
EPFUG	---	EUFG	FUG-G	Piping & Equip Leaks - Gas	7,472 Units	'12/'18
			FUG-O	Piping & Equip Leaks - Light Liquid	3,407 Units	'12/'18
EPECC	---	EUECC	ECC	Engine Crankcase Fugitives	17,365 bhp	'12/'18

<sup>1</sup> For 45CSR13 permitted sources, the numbering system used for the emission points, control devices, and emission units should be consistent with the numbering system used in the 45CSR13 permit. For grandfathered sources, the numbering system should be consistent with registrations or emissions inventory previously submitted to DAQ. For emission points, control devices, and emissions units which have not been previously labeled, use the following 45CSR13 numbering system: 1S, 2S, 3S,... or other appropriate description for emission units; 1C, 2C, 3C,... or other appropriate designation for control devices; 1E, 2E, 3E, ... or other appropriate designation for emission points.

## **Attachment E**

### **Emissions Unit Form(s)**

---

“26. For each emission unit listed in the Title V Equipment Table, fill out and provide an Emission Unit Form as ATTACHMENT E.”

---

- **1,380 bhp CAT G3516B Generator Engines (CE-01 thru CE-12)**
  - **805 bhp Capstone C600 Microturbine Generator (GEN)**
  - **55.0 MMscfd Dehydrators (DHY-01 thru DHY-03)**
  - **1.00 MMBtu/hr Reboilers (BLR-01 thru BLR-03)**
  - **0.50 MMBtu/hr Heater Treaters (HTR-01 and HTR-02)**
  - **Storage Tanks - Stabilized Condensate (SC) (TK-01 thru TK-08)**
  - **Storage Tanks - Produced Water (PW) (WTK-01 and WTK-02)**
  - **Truck Load-Out - Stabilized Condensate (SC) (TLO)**
  - **Truck Load-Out - Produced Water (PW) (WTLO)**
-



**Attachment E  
Emission Unit Form - Continued**

<i>Emission Data</i>		CE-01 thru CE-12 (each)	
Criteria Pollutants	Pollutant Emissions		
	PPH	TPY	
Nitrogen Oxides (NOX)	1.52	6.66	
Carbon Monoxide (CO)	1.36	5.96	
Volatile Organic Compounds (VOC)	0.98	4.28	
Particulate Matter (PM2.5/10/TSP)	0.11	0.49	
Sulfur Dioxide (SO2)	0.01	0.03	
Hazardous Air Pollutants	Pollutant Emissions		
	PPH	TPY	
Acetaldehyde	0.02	0.10	
Acrolein	0.01	0.06	
Benzene	1E-03	5E-03	
Butadiene, 1,3-	7E-04	3E-03	
Ethylbenzene	1E-04	5E-04	
Formaldehyde	0.12	0.52	
n-Hexane	3E-03	0.01	
Methanol	0.01	0.03	
POM	1E-03	4E-03	
Toluene	1E-03	5E-03	
TMP, 2,2,4-	7E-04	3E-03	
Xylenes	5E-04	2E-03	
Other/Trace HAP	9E-04	4E-03	
Total HAP	0.17	0.76	
Regulated Pollutants other than Criteria and HAP	Pollutant Emissions		
	PPH	TPY	
Carbon Dioxide (CO2)	1,552	6,796	
Methane (CH4) (GWP=25)	14.04	61.49	
Nitrous Oxide (N2O) (GWP=298)	2E-03	0.01	
CO2 Equivalent (CO2e)	1,903	8,336	
<p><b>List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).</b></p> <p>Vendor Data, AP-42, and 40CFR98, as applicable.</p> <p align="center"><b>Please reference SUPPLEMENT S3 – Emission Calculations Also Supplement S5 – Vendor Data</b></p>			

**Attachment E  
Emission Unit Form - Continued**

*Applicable Requirements*

CE-01 thru CE-12 (each)

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (Note: Title V permit condition numbers alone are not the underlying applicable requirements). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

- 5.1.1. To demonstrate compliance with Section 5.1.2, the quantity of natural gas that shall be consumed in each of the twelve (12) 1,380 hp natural gas fired reciprocating engines, Caterpillar G3516B (EPCE-1 - EPCE-12) shall not exceed ~~9,233~~ **11,010** scf/hr and ~~80.88~~ **96.45** x 10<sup>6</sup> scf/yr for each engine.
- 5.1.2. Maximum emissions from each of the twelve (12) 1,380 hp natural gas fired reciprocating engines, Caterpillar G3516B (EPCE-1 - EPCE-12) shall not exceed the following limits:

Pollutant	Maximum lb/hr	Maximum ton/yr
Nitrogen Oxides	1.52	6.66
Carbon Monoxide	1.36	5.96
Volatile Organic Compounds	<del>0.88</del> <b>0.98</b>	<del>3.86</del> <b>4.28</b>
Formaldehyde	<del>0.06</del> <b>0.12</b>	<del>0.27</del> <b>0.52</b>

Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

Are you in compliance with all applicable requirements for this emission unit?  Yes  No

If no, complete the **Schedule of Compliance Form** as ATTACHMENT F.



**Attachment E  
Emission Unit Form - Continued**

<i>Emission Data</i>		GEN	
Criteria Pollutants	Pollutant Emissions		
	PPH	TPY	
Nitrogen Oxides (NOX)	0.48	2.10	
Carbon Monoxide (CO)	1.32	5.78	
Volatile Organic Compounds (VOC)	0.13	0.57	
Particulate Matter (PM2.5/10/TSP)	0.05	0.20	
Sulfur Dioxide (SO2)	4E-03	0.02	
Hazardous Air Pollutants	Pollutant Emissions		
	PPH	TPY	
Acetaldehyde	0.00	0.00	
Acrolein	0.00	0.00	
Benzene	0.00	0.00	
Butadiene, 1,3-	6E-06	0.00	
Ethylbenzene	4E-04	2E-03	
Formaldehyde	0.01	0.04	
n-Hexane	---	---	
Methanol	---	---	
POM	4E-04	2E-03	
Toluene	2E-03	0.01	
TMP, 2,2,4-	---	---	
Xylenes	9E-04	4E-03	
Other/Trace HAP	4E-04	2E-03	
Total HAP	0.01	0.06	
Regulated Pollutants other than Criteria and HAP	Pollutant Emissions		
	PPH	TPY	
Carbon Dioxide (CO2)	798	3,494	
Methane (CH4) (GWP=25)	0.12	0.52	
Nitrous Oxide (N2O) (GWP=298)	2E-02	9E-02	
CO2 Equivalent (CO2e)	807	3,534	
<p><b>List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).</b></p> <p>Vendor Data, AP-42, and 40CFR98, as applicable.</p> <p align="center"><b>Please reference SUPPLEMENT S3 – Emission Calculations Also Supplement S5 – Vendor Data</b></p>			

**Attachment E  
Emission Unit Form - Continued**

*Applicable Requirements*

GEN

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (Note: Title V permit condition numbers alone are not the underlying applicable requirements). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

6.1.1. To demonstrate compliance with Section 6.1.2, the quantity of natural gas that shall be consumed in 805 hp natural gas-fired microturbine generator, Capstone C600 (EPGEN-1) shall not exceed ~~5,623~~ **6,709** scf/hr and ~~49.26~~ **58.77** x 10<sup>6</sup> scf/yr.

6.1.2. Maximum emissions from the 805 hp natural gas-fired microturbine, Capstone C600 (EPGEN-1) shall not exceed the following limits:

Pollutant	Maximum lb/hr	Maximum ton/yr
Nitrogen Oxides	<del>0.25</del> <b>0.48</b>	<del>1.09</del> <b>2.10</b>
Carbon Monoxide	<del>0.62</del> <b>1.32</b>	<del>2.70</del> <b>5.78</b>
Volatile Organic Compounds	<del>0.02</del> <b>0.13</b>	<del>0.07</del> <b>0.57</b>
Formaldehyde	<del>0.01</del> <b>0.01</b>	<del>0.02</del> <b>0.04</b>

Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

Are you in compliance with all applicable requirements for this emission unit?  Yes  No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

**Sand Hill Compressor Station (SHCS)**

Application for 45CSR30 Title V Operating Permit (TVOP)

**Attachment E****Emission Unit Form**

<i>Emission Unit Description</i>		DHY-01 thru DHY-03	
<b>Emission unit ID number</b> EUDHY-1 thru EUDHY-3 (Each)	<b>Emission unit name:</b> Dehydrator 01 thru 03	<b>List any control devices associated with this emission unit:</b> BTEX-01 thru BTEX-03	
<b>Provide a description of the emissions unit (type, Method of operation, design parameters, etc.):</b>  Each Natural Gas Dehydration unit w/ 100% Flash Gas Recycle and 95% Regenerator/Still Vent Control (BTEX Buster).			
<b>Manufacturer:</b> NATCO	<b>Model number:</b> 55.0 MMscfd w/ BTEX Buster	<b>Serial number(s):</b> ---	
<b>Construction date:</b> 2012	<b>Installation date:</b> 2012	<b>Modification date(s):</b> na	
<b>Design Capacity (examples: furnaces - tons/hr, tanks - gallons):</b> 55.0 MMscfd			
<b>Maximum Hourly Throughput:</b> 2.29 scf/hr	<b>Maximum Annual Throughput:</b> 20,075 MMscf/yr	<b>Maximum Operating Schedule:</b> 8,760 hr/yr	
<b>Fuel Usage Data (fill out all applicable fields)</b>			
<b>Does this emission unit combust fuel?</b> ___ Yes <u>X</u> No		<b>If yes, is it?</b> ___ Indirect Fired    ___ Direct Fired	
<b>Maximum design heat input and/or maximum horsepower rating:</b> ---		<b>Type and Btu/hr rating of burners:</b> ---	
<b>List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.</b>  na			
<b>Describe each fuel expected to be used during the term of the permit.</b>			
Fuel Type	Max Sulfur Content	Max Ash Content	BTU Value
na			

**Attachment E  
Emission Unit Form - Continued**

<i>Emission Data</i>	<b>DHY-01 thru DHY-03</b>	
<b>Criteria Pollutants</b>	<b>Pollutant Emissions</b>	
	<b>PPH</b>	<b>TPY</b>
Nitrogen Oxides (NOX)	---	---
Carbon Monoxide (CO)	---	---
Volatile Organic Compounds (VOC)	1.79	7.85
Particulate Matter (PM2.5/10/TSP)	---	---
Sulfur Dioxide (SO2)	---	---
<b>Hazardous Air Pollutants</b>	<b>Pollutant Emissions</b>	
	<b>PPH</b>	<b>TPY</b>
Acetaldehyde	---	---
Acrolein	---	---
Benzene	0.06	0.27
Butadiene, 1,3-	---	---
Ethylbenzene	4E-03	0.02
Formaldehyde	---	---
n-Hexane	0.09	0.40
Methanol	---	---
POM	---	---
Toluene	0.10	0.43
TMP, 2,2,4-	2E-03	0.01
Xylenes	0.04	0.17
Other/Trace HAP	---	---
Total HAP	0.30	1.30
<b>Regulated Pollutants other than Criteria and HAP</b>	<b>Pollutant Emissions</b>	
	<b>PPH</b>	<b>TPY</b>
Carbon Dioxide (CO2)	0.58	2.54
Methane (CH4) (GWP=25)	0.09	0.39
Nitrous Oxide (N2O) (GWP=298)	---	--
CO2 Equivalent (CO2e)	2.79	12.20

**List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).**

GRI-GLYCalc, AP-42, and 40CFR98, as applicable.

**Please reference SUPPLEMENT S3 – Emission Calculations**

**Also Supplement S6 – Emission Program Data**

**Attachment E  
Emission Unit Form - Continued**

*Applicable Requirements*

**DHY-01 thru DHY-03**

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (Note: Title V permit condition numbers alone are not the underlying applicable requirements). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

7.1.5. Maximum emissions from each of the Glycol Regenerator Still Columns (EPSTL-1, EPSTL-2, EPSTL-3) shall not exceed the following limits:

Pollutant	Maximum lb/hr	Maximum ton/yr
Volatile Organic Compounds	<del>0.42</del> <b>1.79</b>	<del>1.84</del> <b>7.85</b>
Total HAPs	<del>0.01</del> <b>0.30</b>	<del>0.01</del> <b>1.30</b>

Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

Are you in compliance with all applicable requirements for this emission unit?  Yes  No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.



**Attachment E  
Emission Unit Form - Continued**

<i>Emission Data</i>		<b>BLR-01 thru BLR-03</b>	
<b>Criteria Pollutants</b>	<b>Pollutant Emissions</b>		
	<b>PPH</b>	<b>TPY</b>	
Nitrogen Oxides (NOX)	0.10	0.43	
Carbon Monoxide (CO)	0.08	0.36	
Volatile Organic Compounds (VOC)	0.01	0.02	
Particulate Matter (PM2.5/10/TSP)	0.01	0.03	
Sulfur Dioxide (SO2)	6E-04	3E-03	
<b>Hazardous Air Pollutants</b>	<b>Pollutant Emissions</b>		
	<b>PPH</b>	<b>TPY</b>	
Acetaldehyde	---	---	
Acrolein	---	---	
Benzene	2E-06	9E-06	
Butadiene, 1,3-	---	---	
Ethylbenzene	---	---	
Formaldehyde	7E-05	3E-04	
n-Hexane	2E-03	0.01	
Methanol	---	---	
POM	7E-07	3E-06	
Toluene	3E-06	1E-05	
TMP, 2,2,4-	---	---	
Xylenes	---	---	
Other/Trace HAP	1E-06	5E-06	
Total HAP	2E-03	0.01	
<b>Regulated Pollutants other than Criteria and HAP</b>	<b>Pollutant Emissions</b>		
	<b>PPH</b>	<b>TPY</b>	
Carbon Dioxide (CO2)	117.65	515.29	
Methane (CH4) (GWP=25)	2E-03	0.01	
Nitrous Oxide (N2O) (GWP=298)	2E-03	0.01	
CO2 Equivalent (CO2e)	118.35	518.36	
<p><b>List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).</b></p> <p>AP-42 and 40CFR98, as applicable.</p> <p align="center"><b>Please reference SUPPLEMENT S3 – Emission Calculations</b></p>			

**Attachment E  
Emission Unit Form - Continued**

*Applicable Requirements*

**BLR-01 thru BLR-03**

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (Note: Title V permit condition numbers alone are not the underlying applicable requirements). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

- 7.1.3. To demonstrate compliance with Section 7.1.4, the quantity of natural gas that shall be consumed in each of the 1.0 MMBtu/hr Glycol Reboilers (EPRBL-1, EPRBL-2, EPRBL-3) shall not exceed ~~750~~ **980** scf/hr and ~~6.55~~ **8.59** x 10<sup>6</sup> scf/yr for each reboiler.
- 7.1.4. Maximum emissions from each of the Glycol Reboilers (EURBL-1, EURBL-2, EURBL-3) shall not exceed the following limits:

Pollutant	Maximum lb/hr	Maximum ton/yr
Nitrogen Oxides	<del>0.08</del> <b>0.10</b>	<del>0.33</del> <b>0.43</b>
Carbon Monoxide	<del>0.06</del> <b>0.08</b>	<del>0.28</del> <b>0.36</b>
Volatile Organic Compounds	0.01	0.02

Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

Are you in compliance with all applicable requirements for this emission unit?  Yes  No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Attachment E**  
**Emission Unit Form**

<i>Emission Unit Description</i>		<b>HTR-01 and HTR-02</b>	
<b>Emission unit ID number</b> EUHT-1 and EUHT-2 (Each)	<b>Emission unit name:</b> Heater-Treater 01 and 02 0.50 MMBtu/hr (Each)	<b>List any control devices associated with this emission unit:</b>  na	
<b>Provide a description of the emissions unit (type, Method of operation, design parameters, etc.):</b>  Natural Gas Fired Heater-Treater (Stabilizes Condensate)			
<b>Manufacturer:</b>  ---	<b>Model number:</b>  ---	<b>Serial number(s):</b>  ---	
<b>Construction date:</b> 2012	<b>Installation date:</b> 2012	<b>Modification date(s):</b> na	
<b>Design Capacity (examples: furnaces - tons/hr, tanks - gallons):</b> 0.50 MMBtu/hr			
<b>Maximum Hourly Throughput:</b> 600 scf/hr	<b>Maximum Annual Throughput:</b> 4.29 MMscf/yr	<b>Maximum Operating Schedule:</b> 8,760 hr/yr	
<b>Fuel Usage Data (fill out all applicable fields)</b>			
<b>Does this emission unit combust fuel?</b> 0.50 MMBtu/hr		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No 4.29 MMBtu/yr	
		<b>If yes, is it?</b> <input type="checkbox"/> Indirect Fired <input checked="" type="checkbox"/> Direct Fired	
<b>Maximum design heat input and/or maximum horsepower rating:</b> 0.50 MMBtu/hr		<b>Type and Btu/hr rating of burners:</b> 0.50 MMBtu/hr	
<b>List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.</b>  na			
<b>Describe each fuel expected to be used during the term of the permit.</b>			
<b>Fuel Type</b>	<b>Max Sulfur Content</b>	<b>Max Ash Content</b>	<b>BTU Value</b>
Natural gas	<0.01%	negligible	1,020 Btu/scf

**Attachment E  
Emission Unit Form - Continued**

<i>Emission Data</i>		<b>HTR-01 and HTR-02</b>	
<b>Criteria Pollutants</b>	<b>Pollutant Emissions</b>		
	<b>PPH</b>	<b>TPY</b>	
Nitrogen Oxides (NOX)	0.06	0.21	
Carbon Monoxide (CO)	0.05	0.18	
Volatile Organic Compounds (VOC)	3E-03	0.01	
Particulate Matter (PM2.5/10/TSP)	5E-03	0.02	
Sulfur Dioxide (SO2)	4E-04	1E-03	
<b>Hazardous Air Pollutants</b>	<b>Pollutant Emissions</b>		
	<b>PPH</b>	<b>TPY</b>	
Acetaldehyde	---	---	
Acrolein	---	---	
Benzene	1E-06	5E-06	
Butadiene, 1,3-	---	---	
Ethylbenzene	---	---	
Formaldehyde	5E-05	2E-04	
n-Hexane	1E-03	4E-03	
Methanol	---	---	
POM	4E-07	1E-06	
Toluene	2E-06	7E-06	
TMP, 2,2,4-	---	---	
Xylenes	---	---	
Other/Trace HAP	7E-07	3E-06	
Total HAP	1E-03	4E-03	
<b>Regulated Pollutants other than Criteria and HAP</b>	<b>Pollutant Emissions</b>		
	<b>PPH</b>	<b>TPY</b>	
Carbon Dioxide (CO2)	72.00	257.65	
Methane (CH4) (GWP=25)	1E-03	5E-03	
Nitrous Oxide (N2O) (GWP=298)	1E-03	5E-03	
CO2 Equivalent (CO2e)	59.17	259.18	
<p><b>List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).</b></p> <p>AP-42 and 40CFR98, as applicable.</p> <p align="center"><b>Please reference SUPPLEMENT S3 – Emission Calculations</b></p>			

**Attachment E  
Emission Unit Form - Continued**

*Applicable Requirements*

**HTR-01 and HTR-02**

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (Note: Title V permit condition numbers alone are not the underlying applicable requirements). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

8.1.2. Maximum emissions from each of the 0.50 MMBTU/hr Heater-Treaters (EPHT-1, EPHT-2) shall not exceed the following limits:

Pollutant	Maximum lb/hr	Maximum ton/yr
Nitrogen Oxides	<del>0.04</del> <b>0.06</b>	<del>0.16</del> <b>0.21</b>
Carbon Monoxide	<del>0.03</del> <b>0.05</b>	<del>0.14</del> <b>0.18</b>

8.1.3. To demonstrate compliance with Section 8.1.2, the quantity of natural gas that shall be consumed in each of the 0.50 MMBTU/hr Heater-Treaters (EPHT-1, EPHT-2) shall not exceed ~~375~~ **600** scf/hr and ~~3.27~~ **4.29** x 10<sup>6</sup> scf/yr.

Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)  
(Also SUPPLEMENT S2 – Regulatory Discussion)**

Are you in compliance with all applicable requirements for this emission unit?  Yes  No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

**Sand Hill Compressor Station (SHCS)**

Application for 45CSR30 Title V Operating Permit (TVOP)

**Attachment E****Emission Unit Form**

<i>Emission Unit Description</i>		TK-01 thru TK-08, and WTK-01 and WTK-02	
<b>Emission unit ID number</b> EUTK-1 thru EUTK-8 (Each), and EUWTK-1 and EUWTK-2	<b>Emission unit name:</b> Stabilized Condensate Tanks 23 thru 08, and Produced Water Tanks 01 and 02.	<b>List any control devices associated with this emission unit:</b> VRU (TK 01 thru TK-08)	
<b>Provide a description of the emissions unit (type, Method of operation, design parameters, etc.):</b>  Stabilized Condensate and Produced Water Storage Tanks. (TK-01 thru TK-08) (EUTK-1 thru EUTK-8) are controlled 95% with a Vapor Recovery Unit (VRU).			
<b>Manufacturer:</b> ---	<b>Model number:</b> ---	<b>Serial number(s):</b> ---	
<b>Construction date:</b> 2012	<b>Installation date:</b> 2012	<b>Modification date(s):</b> na	
<b>Design Capacity (examples: furnaces - tons/hr, tanks - gallons):</b> 400 bbl			
<b>Maximum Hourly Throughput:</b> 31.25 bbl/hr	<b>Maximum Annual Throughput:</b> 273,750 bbl/yr	<b>Maximum Operating Schedule:</b> 8,760 hr/yr	
<b>Fuel Usage Data (fill out all applicable fields)</b>			
<b>Does this emission unit combust fuel?</b> ___ Yes <u>X</u> No na		<b>If yes, is it?</b> ___ Indirect Fired    ___ Direct Fired	
<b>Maximum design heat input and/or maximum horsepower rating:</b> na		<b>Type and Btu/hr rating of burners:</b> na	
<b>List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.</b> na			
<b>Describe each fuel expected to be used during the term of the permit.</b>			
Fuel Type	Max Sulfur Content	Max Ash Content	BTU Value
na			

**Attachment E**  
**Emission Unit Form - Continued**

<i>Emission Data</i>		TK-01 thru TK-08, and WTK-01 and WTK-02				
Criteria Pollutants	PPH			TPY		
	TK	WTK	TOTAL	TK	WTK	TOTAL
Nitrogen Oxides (NOX)	---	---	---	---	---	---
Carbon Monoxide (CO)	---	---	---	---	---	---
Volatile Organic Compounds (VOC)	0.31	0.01	0.32	1.35	0.06	1.41
Particulate Matter (PM2.5/10/TSP)	---	---	---	---	---	---
Sulfur Dioxide (SO2)	---	---	---	---	---	---
Hazardous Air Pollutants	PPH			TPY		
	TK	WTK	TOTAL	TK	WTK	TOTAL
Acetaldehyde	---	---	---	---	---	---
Acrolein	---	---	---	---	---	---
Benzene	0.01	3E-04	0.01	0.03	1E-03	0.03
Butadiene, 1,3-	---	---	---	---	---	---
Ethylbenzene	0.01	3E-04	0.01	0.03	1E-03	0.03
Formaldehyde	---	---	---	---	---	---
n-Hexane	0.06	3E-03	0.06	0.27	0.01	0.28
Methanol	---	---	---	---	---	---
POM	---	---	---	---	---	---
Toluene	0.01	3E-04	0.01	0.03	1E-03	0.03
TMP, 2,2,4-	0.01	3E-04	0.01	0.03	1E-03	0.03
Xylenes	0.01	3E-04	0.01	0.03		0.03
Other/Trace HAP	---	---	---	---	---	---
Total HAP	0.09	4E-03	0.10	0.40	0.02	0.42
Regulated Pollutants other than Criteria and HAP	PPH			TPY		
	TK	WTK	TOTAL	TK	WTK	TOTAL
Carbon Dioxide (CO2)	---	---	---	---	---	---
Methane (CH4) (GWP=25)	---	---	---	---	---	---
Nitrous Oxide (N2O) (GWP=298)	---	---	---	---	---	---
CO2 Equivalent (CO2e)	---	---	---	---	---	---
<p><b>List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).</b></p> <p>EPA Tanks 4.0.9d and 40CFR98, as applicable.</p> <p align="center"><b>Please reference SUPPLEMENT S3 – Emission Calculations</b> <b>Also Supplement S6 – Emission Program Data</b></p>						

**Attachment E**  
**Emission Unit Form - Continued**

*Applicable Requirements*

TK-01 thru TK-08, and WTK-01 and WTK-02

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (Note: Title V permit condition numbers alone are not the underlying applicable requirements). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)**  
**(Also SUPPLEMENT S2 – Regulatory Discussion)**

- 9.1.1. Emissions from the stabilized condensate storage tanks (EPTK-1 - EPTK-8; ~~EPWTK-1, EPWTK-2~~) shall be controlled by a vapor recovery system. This vapor recovery system shall be designed to achieve a minimum guaranteed control efficiency of ~~98%~~ 95% for volatile organic compound (VOC) emissions.
- 9.1.2. The vapor recovery system must be installed and operating prior to start-up of the storage tanks (EPTK-1 - EPTK-8; ~~EPWTK-1, EPWTK-2~~).

Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)**  
**(Also SUPPLEMENT S2 – Regulatory Discussion)**

- 9.2.1. For the purposes of determining compliance with Section 9.1.1, the permittee shall conduct monitoring to show compliance with the capture efficiency requirement of the storage tanks (EPTK-1 - EPTK-8; ~~EPWTK-1, EPWTK-2~~). The monitoring shall be conducted initially within 60 days after achieving the maximum reduction rate at which the facility will be operated or within 180 days of start-up, whichever is earlier. Monitoring will be conducted once every calendar year thereafter per the requirements of §60.482-10.
- a. The vapor recovery system will be operated and monitored in compliance with §60.482-10(b), (f) through (m), and §60.485.
- b. Records of the vapor recovery system will be maintained according to the requirements of §60.486 and §60.635(b).

Are you in compliance with all applicable requirements for this emission unit?  Yes  No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

**Sand Hill Compressor Station (SHCS)**

Application for 45CSR30 Title V Operating Permit (TVOP)

**Attachment E****Emission Unit Form**

<i>Emission Unit Description</i>		<b>TLO and WTLO</b>	
<b>Emission unit ID number</b> EULOAD-1 and EULOAD-2	<b>Emission unit name:</b> Stabilized Condensate Truck Load Out and Produced Water Truck Load Out	<b>List any control devices associated with this emission unit:</b> CarbCan (TLO)	
<b>Provide a description of the emissions unit (type, Method of operation, design parameters, etc.):</b>  Stabilized Condensate Truck Load Out and Produced Water Truck Load Out. (TLO (EULOAD-1) is controlled 66.5% (70% collection x 95% carbon canisters).)			
<b>Manufacturer:</b> ---	<b>Model number:</b> ---	<b>Serial number(s):</b> ---	
<b>Construction date:</b> 2012	<b>Installation date:</b> 2012	<b>Modification date(s):</b> na	
<b>Design Capacity (examples: furnaces - tons/hr, tanks - gallons):</b> 400 bbl			
<b>Maximum Hourly Throughput:</b> 31.25 bbl/hr	<b>Maximum Annual Throughput:</b> 273,750 bbl/yr	<b>Maximum Operating Schedule:</b> na	
<b>Fuel Usage Data (fill out all applicable fields)</b>			
<b>Does this emission unit combust fuel?</b> ___ Yes <u>X</u> No na		<b>If yes, is it?</b> ___ Indirect Fired    ___ Direct Fired	
<b>Maximum design heat input and/or maximum horsepower rating:</b> na		<b>Type and Btu/hr rating of burners:</b> na	
<b>List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.</b> na			
<b>Describe each fuel expected to be used during the term of the permit.</b>			
<b>Fuel Type</b>	<b>Max Sulfur Content</b>	<b>Max Ash Content</b>	<b>BTU Value</b>
na			

<b>Emission Data</b>				<b>TLO and WTLO</b>		
<b>Criteria Pollutants</b>	<b>PPH</b>			<b>TPY</b>		
	<b>TLO</b>	<b>WTLO</b>	<b>TOTAL</b>	<b>TLO</b>	<b>WTLO</b>	<b>TOTAL</b>
Nitrogen Oxides (NOX)	---	---	---	---	---	---
Carbon Monoxide (CO)	---	---	---	---	---	---
Volatile Organic Compounds (VOC)	11.97	0.01	11.98	8.52	0.06	8.58
Particulate Matter (PM2.5/10/TSP)	---	---	---	---	---	---
Sulfur Dioxide (SO2)	---	---	---	---	---	---
<b>Hazardous Air Pollutants</b>	<b>PPH</b>			<b>TPY</b>		
	<b>TLO</b>	<b>WTLO</b>	<b>TOTAL</b>	<b>TLO</b>	<b>WTLO</b>	<b>TOTAL</b>
Acetaldehyde	---	---	---	---	---	---
Acrolein	---	---	---	---	---	---
Benzene	0.01	3E-04	0.01	0.03	1E-03	0.03
Butadiene, 1,3-	---	---	---	---	---	---
Ethylbenzene	0.01	3E-04	0.01	0.03	0.00	0.03
Formaldehyde	---	---	---	---	---	---
n-Hexane	0.06	3E-03	0.06	0.27	1E-02	0.28
Methanol	---	---	---	---	---	---
POM	---	---	---	---	---	---
Toluene	0.01	3E-04	0.01	0.03	1E-03	0.03
TMP, 2,2,4-	0.01	3E-04	0.01	0.03	1E-03	0.03
Xylenes	0.01	3E-04	0.01	0.03		0.03
Other/Trace HAP	---	---	---	---	---	---
Total HAP	0.09	4E-03	0.10	0.40	0.02	0.42
<b>Regulated Pollutants other than Criteria and HAP</b>	<b>PPH</b>			<b>TPY</b>		
	<b>TLO</b>	<b>WTLO</b>	<b>TOTAL</b>	<b>TLO</b>	<b>WTLO</b>	<b>TOTAL</b>
Carbon Dioxide (CO2)	---	---	---	---	---	---
Methane (CH4) (GWP=25)	---	---	---	---	---	---
Nitrous Oxide (N2O) (GWP=298)	---	---	---	---	---	---
CO2 Equivalent (CO2e)	---	---	---	---	---	---
<p><b>List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).</b></p> <p>EPA Tanks 4.0.9d and 40CFR98, as applicable.</p> <p style="text-align: center;"><b>Please reference SUPPLEMENT S3 – Emission Calculations</b></p>						

**Attachment E**  
**Emission Unit Form - Continued**

*Applicable Requirements*

TLO and WTLO

List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (Note: Title V permit condition numbers alone are not the underlying applicable requirements). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)**  
**(Also SUPPLEMENT S2 – Regulatory Discussion)**

- 10.1.1. Maximum Throughput Limitation. The maximum condensate throughput to the Condensate Truck Loading (EPLOAD-1) shall not exceed ~~15.2~~ **134.4** x 10<sup>3</sup> gal/day and ~~2.52~~ **9.965** x 10<sup>6</sup> gal/yr. Compliance with the Maximum Throughput Limitation shall be determined using a twelve month rolling total. A twelve month rolling total shall mean the sum of the monthly throughput at any given time during the previous twelve consecutive calendar months.
- 10.1.2. Maximum Throughput Limitation. The maximum produced water throughput to the Produced Water Truck Loading (EPLOAD-2) shall not exceed ~~15.12~~ **33.6** x 10<sup>3</sup> gal/day and ~~15.33~~ **1.53** x 10<sup>6</sup> gal/yr. Compliance with the Maximum Throughput Limitation shall be determined using a twelve-month rolling total. A twelve-month rolling total shall mean the sum of the monthly throughput at any given time during the previous twelve consecutive calendar months.
- 10.1.3. The Condensate Truck Loading (EPLOAD-1) and the Produced Water Truck Loading (EPLOAD-2) shall be operated in accordance with the plans and specifications filed in Permit Application R13-2916. All emissions from the Condensate Truck Loading (EPLOAD-1) ~~and the Produced Water Truck Loading (EPLOAD-2)~~ will be controlled by a carbon canister (APC-CARBON) that shall be designed to achieve a minimum guaranteed control efficiency of 95% for volatile organic compound (VOC) emissions.
- 10.1.4. The carbon canister (APC-CARBON) must be operated at all times when gases, vapors, and fumes are vented from the Condensate Truck Loading (EPLOAD-1) ~~and the Produced Water Truck Loading (EPLOAD-2)~~. In addition, the carbon canister must be operated in series, as dual carbon canisters, in case of emission breakthrough in one carbon canister.

Permit Shield

For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

**Please Reference WVDEP-DAQ Permit R13-2913B (Pending)**  
**(Also SUPPLEMENT S2 – Regulatory Discussion)**

Are you in compliance with all applicable requirements for this emission unit?  Yes  No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

**Attachment F**  
**Schedule of Compliance**  
**(Not Applicable)**

---

“26. For each emission unit not in compliance with an applicable requirement, fill out a Schedule of Compliance Form as ATTACHMENT F.”

---

- **Schedule of Compliance Form – Not Applicable**
-

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Not  
Applicable**

**Attachment F**  
**Schedule of Compliance Form**

Complete this section if you indicated noncompliance with any of the applicable requirements identified in the permit application. For each emission unit which is not in compliance, identify the applicable requirement, the reason(s) for noncompliance, a description of how the source will achieve compliance, and a detailed schedule of compliance. If there is a consent order that applies to this requirement, attach a copy to this form.

<b>1. Applicable Requirement:</b>	
<b>Not Applicable</b>	
<b>Unit(s):</b>	<b>Applicable Requirement:</b>
<b>2. Reason for Non-Compliance:</b>	
<b>3. How will Compliance be Achieved?:</b>	
<b>4. Consent Order Number (if applicable):</b>	
<b>5. Schedule of Compliance.</b> Provide a schedule of remedial measures, including an enforceable sequence of actions with milestones, leading to compliance, including a date for final compliance.	
<b>Remedial Measure or Action</b>	<b>Date to be Achieved</b>
<b>6. Submittal of Progress Reports.</b>	
<b>Content of Progress Report:</b>	<b>Report Start Date:</b>
	<b>Submittal Frequency:</b>

## **Attachment G**

### **Air Pollution Control Device Forms(s)**

---

“27. For each control device listed in the Title V Equipment Table, fill out and provide an Air Pollution Control Device Form as ATTACHMENT G.”

---

- **Oxidation Catalyst (OxCat-01 thru OxCat-12) (Serves CE-01 thru CE-12)**
  - **BTEX Buster/Condenser (BTEX-01 thru BTEX-03) (Serves DHY-01 thru DHY-03)**
  - **Vapor Recovery Unit (VRU) (Serves TK-01 thru TK-08)**
  - **Carbon Cannister (CarbCan) (Serves TLO)**
-

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Attachment G**  
**Air Pollution Control Device Form**

<b>Control Device ID Number</b>  OxCat-01 thru OxCat-12 (Each)	<b>List all emission units associated with this control device.</b>  Compressor Engines 01 thru 12 (CE-01 thru CE-12)	
<b>Manufacturer:</b>  EMIT Technologies	<b>Model Number:</b>  ELH-4200V-1616F-42CEE-242	<b>Installation Date</b>  2012
<b>Type of Air Pollution Control Device:</b>		
<input type="checkbox"/> Baghouse/Fabric Filter	<input type="checkbox"/> Venturi Scrubber	<input type="checkbox"/> Multicyclone
<input type="checkbox"/> Carbon Bed Adsorber	<input type="checkbox"/> Packed Tower Scrubber	<input type="checkbox"/> Single Cyclone
<input type="checkbox"/> Carbon Drums	<input type="checkbox"/> Other Wet Scrubber	<input type="checkbox"/> Cyclone Bank
<input type="checkbox"/> Catalytic Incinerator	<input type="checkbox"/> Condenser	<input type="checkbox"/> Settling Chamber
<input type="checkbox"/> Thermal Incinerator	<input type="checkbox"/> Flare	<input checked="" type="checkbox"/> <b>Other (describe): Oxidation Catalyst</b>
<input type="checkbox"/> Wet Plate Electrostatic Precipitator	<input type="checkbox"/> Dry Plate Electrostatic Precipitator	
<b>List the pollutants for which this device is intended to control and the capture and control efficiencies</b>		
Pollutant	Capture Efficiency	Control Efficiency
CO	100%	85.0%
VOC (w/o HCHO)	100%	75.0%
VOC (w/ HCHO)	100%	78.8%
HCHO	100%	90.0%
<b>Explain the characteristic design parameters of this control device (flow rates, pressure drops, number of bags, size, temperatures, etc.).</b>		
Engine Exhaust Flow Rate: 9,240 acfm Engine Exhaust temperature: 1,012 oF		
<b>Is this device subject to the CAM requirements of 30 C.F.R. 64? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</b>		
<b>If Yes, Complete ATTACHMENT H</b>		
<b>If No, provide justification:</b>		
The potential pre-control emissions of each applicable regulated air pollutant is < 100% of the amount required to be classified as a major source (§64.2).		
<b>Describe the parameters monitored and/or methods used to indicate performance of this control device.</b>		
<b>Please Reference WVDEP-DAQ Permit R13-2913B (Pending)</b> <b>(Also SUPPLEMENT S2 – Regulatory Discussion)</b>		

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Attachment G**  
**Air Pollution Control Device Form**

<b>Control Device ID Number</b>  BTEX-01 thru BTEX-03 (Each)	<b>List all emission units associated with this control device.</b>  Dehydrator 01 thru 03 (DHY-01 thru DHY-03)	
<b>Manufacturer:</b>  NATCO	<b>Model Number:</b>  BTEX Buster	<b>Installation Date</b>  2012
<b>Type of Air Pollution Control Device:</b>		
<input type="checkbox"/> Baghouse/Fabric Filter	<input type="checkbox"/> Venturi Scrubber	<input type="checkbox"/> Multicyclone
<input type="checkbox"/> Carbon Bed Adsorber	<input type="checkbox"/> Packed Tower Scrubber	<input type="checkbox"/> Single Cyclone
<input type="checkbox"/> Carbon Drums	<input type="checkbox"/> Other Wet Scrubber	<input type="checkbox"/> Cyclone Bank
<input type="checkbox"/> Catalytic Incinerator	<input checked="" type="checkbox"/> <b>Condenser</b>	<input type="checkbox"/> Settling Chamber
<input type="checkbox"/> Thermal Incinerator	<input type="checkbox"/> Flare	<input type="checkbox"/> Other (Specify):
<input type="checkbox"/> Wet Plate Electrostatic Precipitator		<input type="checkbox"/> Dry Plate Electrostatic Precipitator
<b>List the pollutants for which this device is intended to control and the capture and control efficiencies</b>		
Pollutant	Capture Efficiency	Control Efficiency
VOC	100%	95.0%
HAPs	100%	95.0%
<b>Explain the characteristic design parameters of this control device (flow rates, pressure drops, number of bags, size, temperatures, etc.).</b>  Vapors emitted from the dehydrator's glycol still column (aka, regenerator) are cooled with natural draft, ambient air, to temperatures below 120oF.		
<b>Is this device subject to the CAM requirements of 30 C.F.R. 64? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Deferred</b>		
<b>If Yes, Complete ATTACHMENT H</b>		
<b>If No, provide justification:</b>  ONLY large PSEUs (i.e., PSEUs with potential <u>post</u> -control device emissions of an applicable regulated air pollutant that are ≥ Major Source Threshold Levels) need to be addressed in this TVOP application.		
<b>Describe the parameters monitored and/or methods used to indicate performance of this control device.</b>  <b>Please Reference WVDEP-DAQ Permit R13-2913B (Pending)</b> <b>(Also SUPPLEMENT S2 – Regulatory Discussion)</b>		

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Attachment G**  
**Air Pollution Control Device Form**

<b>Control Device ID Number</b>  VRU	<b>List all emission units associated with this control device.</b>  Stabilized Condensate Storage Tanks (TK-01 thru TK-08)	
<b>Manufacturer:</b>  ---	<b>Model Number:</b>  ---	<b>Installation Date</b>  2012
<b>Type of Air Pollution Control Device:</b>		
<input type="checkbox"/> Baghouse/Fabric Filter	<input type="checkbox"/> Venturi Scrubber	<input type="checkbox"/> Multicyclone
<input type="checkbox"/> Carbon Bed Adsorber	<input type="checkbox"/> Packed Tower Scrubber	<input type="checkbox"/> Single Cyclone
<input type="checkbox"/> Carbon Drums	<input type="checkbox"/> Other Wet Scrubber	<input type="checkbox"/> Cyclone Bank
<input type="checkbox"/> Catalytic Incinerator	<input type="checkbox"/> Condenser	<input type="checkbox"/> Settling Chamber
<input type="checkbox"/> Thermal Incinerator	<input type="checkbox"/> Flare	<input checked="" type="checkbox"/> <b>Other: Vapor Recovery Unit (VRU)</b>
<input type="checkbox"/> Wet Plate Electrostatic Precipitator	<input type="checkbox"/> Dry Plate Electrostatic Precipitator	
<b>List the pollutants for which this device is intended to control and the capture and control efficiencies</b>		
Pollutant	Capture Efficiency	Control Efficiency
VOC	100%	95.0%
HAP	100%	95.0%
<b>Explain the characteristic design parameters of this control device (flow rates, pressure drops, number of bags, size, temperatures, etc.).</b>  ---		
<b>Is this device subject to the CAM requirements of 30 C.F.R. 64? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</b>		
<b>If Yes, Complete ATTACHMENT H</b>		
<b>If No, provide justification:</b>  The potential pre-control emissions of the applicable regulated air pollutant is < 100% of the amount required to be classified as a major source (§64.2).		
<b>Describe the parameters monitored and/or methods used to indicate performance of this control device.</b>  Please Reference WVDEP-DAQ Permit R13-2913B (Pending) (Also SUPPLEMENT S2 – Regulatory Discussion)		

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Attachment G**  
**Air Pollution Control Device Form**

<b>Control Device ID Number</b>  CarbCan	<b>List all emission units associated with this control device.</b>  Stabilized Condensate Truck Loading (TLO)	
<b>Manufacturer:</b>  ---	<b>Model Number:</b>  ---	<b>Installation Date</b>  2012
<b>Type of Air Pollution Control Device:</b>		
<input type="checkbox"/> Baghouse/Fabric Filter	<input type="checkbox"/> Venturi Scrubber	<input type="checkbox"/> Multicyclone
<input type="checkbox"/> Carbon Bed Adsorber	<input type="checkbox"/> Packed Tower Scrubber	<input type="checkbox"/> Single Cyclone
<input checked="" type="checkbox"/> Carbon Drums	<input type="checkbox"/> Other Wet Scrubber	<input type="checkbox"/> Cyclone Bank
<input type="checkbox"/> Catalytic Incinerator	<input type="checkbox"/> Condenser	<input type="checkbox"/> Settling Chamber
<input type="checkbox"/> Thermal Incinerator	<input type="checkbox"/> Flare	<input type="checkbox"/> Other (Specify):
<input type="checkbox"/> Wet Plate Electrostatic Precipitator	<input type="checkbox"/> Dry Plate Electrostatic Precipitator	
<b>List the pollutants for which this device is intended to control and the capture and control efficiencies</b>		
Pollutant	Capture Efficiency	Control Efficiency
VOC	70%	95.0%
HAP	70%	95.0%
<b>Explain the characteristic design parameters of this control device (flow rates, pressure drops, number of bags, size, temperatures, etc.).</b>  ---		
<b>Is this device subject to the CAM requirements of 30 C.F.R. 64? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</b>		
<b>If Yes, Complete ATTACHMENT H</b>		
<b>If No, provide justification:</b>  The potential pre-control emissions of the applicable regulated air pollutant is < 100% of the amount required to be classified as a major source (§64.2).		
<b>Describe the parameters monitored and/or methods used to indicate performance of this control device.</b>  Please Reference WVDEP-DAQ Permit R13-2913B (Pending) (Also SUPPLEMENT S2 – Regulatory Discussion)		

**Attachment H**  
**Compliance Assurance Monitoring (CAM) Forms**  
**(Not Applicable)**

---

“27. For any control device that is required on an emission unit in order to meet a standard or limitation for which the potential pre-control device emissions of an applicable regulated air pollutant is greater than or equal to the Title V Major Source Threshold Level, refer to the Compliance Assurance Monitoring (CAM) Form(s) for CAM applicability. Fill out and provide these forms, if applicable, for each Pollutant Specific Emission Unit (PSEU) as ATTACHMENT H.”

---

- **Compliance Assurance Monitoring (CAM) Plan Form – Not Applicable**
-

**Attachment H**  
**Compliance Assurance Monitoring (CAM) Plan Form**

For definitions and information about the CAM rule, please refer to 40 CFR Part 64. Additional information (including guidance documents) may also be found at <http://www.epa.gov/ttn/emc/cam.html>

**CAM Applicability Determination**

1) Does the facility have a PSEU (Pollutant-Specific Emissions Unit considered separately with respect to EACH regulated air pollutant) that is subject to CAM (40 CFR Part 64), which must be addressed in this CAM plan submittal? To determine applicability, a PSEU must meet all of the following criteria (If No, then the remainder of this form need not be completed):  Yes  No

- a. The PSEU is located at a major source that is required to obtain a Title V permit;
- b. The PSEU is subject to an emission limitation or standard for the applicable regulated air pollutant that is NOT exempt;

LIST OF EXEMPT EMISSION LIMITATIONS OR STANDARDS:

- \* NSPS (40 CFR Part 60) or NESHAP (40 CFR Parts 61 and 63) proposed after 11/15/1990.
- \* Stratospheric Ozone Protection Requirements.
- \* Acid Rain Program Requirements.
- \* Emission Limitations or Standards for which a WVDEP Division of Air Quality Title V permit specifies a continuous compliance determination method, as defined in 40 CFR §64.1.
- \* An emission cap that meets the requirements specified in 40 CFR §70.4(b)(12).
- c. The PSEU uses an add-on control device (as defined in 40 CFR §64.1) to achieve compliance with an emission limitation or standard;
- d. The PSEU has potential pre-control device emissions of the applicable regulated air pollutant that are equal to or greater than the Title V Major Source Threshold Levels; AND
- e. The PSEU is NOT an exempt backup utility power emissions unit that is municipally-owned.

**Basis of CAM Submittal**

2) Mark the appropriate box below as to why this CAM plan is being submitted as part of an application for a Title V permit

- RENEWAL APPLICATION. ALL PSEUs for which a CAM plan has not yet been approved need to be addressed in this CAM plan submittal.
- INITIAL APPLICATION (submitted after 4/20/98). ONLY large PSEUs (i.e., PSEUs with potential post -cor device emissions of an applicable regulated air pollutant that are equal to or greater than Major Source Threshold Levels) need to be addressed in this CAM plan submittal.
- SIGNIFICANT MODIFICATION TO LARGE PSEUs. ONLY large PSEUs being modified after 4/20/98 need to be addressed in this CAM plan submittal. For large PSEUs with an approved CAM plan, Only address the appropriate monitoring requirements affected by the significant modification.

# Supplement S1

## Process Description

---

“14. Provide a general description of operations.”

---

- **Process Description – Sand Hill Compressor Station (SHCS)**
-

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
Application for 45CSR30 Title V Operating Permit (TVOP)

**Supplement S1**  
**Process Description**

The natural gas inlet stream from surrounding area wells enters the facility at low pressure through a two-phase low-pressure inlet separator that gravity separates the inlet stream into two streams: gas and hydrocarbon/water liquids. Low-pressure inlet gas is compressed via three-stage reciprocating compressors with inter-stage cooling. Discharge from the compressors passes through filter/coalescer-separators to remove any condensed or entrained liquids present.

After the inlet gas passes through compressors, it goes through the dehydration process before exiting the facility via a sales pipeline. A portion of the discharge gas is removed prior to outlet metering for use as fuel gas.

Triethylene glycol (TEG) dehydration units are used to remove water from the gas. The units are comprised of both a glycol contactor skid and a glycol regeneration skid. In the dehydration process, gas passes through a contactor vessel where water is absorbed by the glycol. The “rich” glycol containing water goes to the glycol reboiler where heat is used to remove the water and regenerate the glycol. The heat is supplied by a natural gas-fired reboiler that exhausts to the atmosphere.

Flash tank off-gases from the glycol regeneration skid are routed to the reboiler to be burned as fuel (100% recycle). Overhead still column emissions from the glycol regeneration skid are controlled by an air-cooled condenser. The non-condensables from the still column overheads are also routed to the reboiler and burned with 95% destruction efficiency.

The TEG reboilers are equipped with a burner management system to ensure a constant flame for combustion of the vapors. Any excess vapors not burned as fuel is recycled or recompressed for 100% control efficiency.

After dehydration, fuel gas is pulled from the discharge side of the process. A fuel gas skid (not an emission source) reduces the pressure of a portion of the discharge gas to a pressure suitable for use by fuel-burning equipment.

Inlet liquids will flow from the two-phase low-pressure inlet separator to a heater-treater feed drum, a three-phase low pressure separator. Heavy liquids (water) will be separated and sent to atmospheric produced water storage tanks. Produced water will be transported off site via truck. Liquid hydrocarbons (condensate) will flow from the feed drum to the heater treater.

Any vapors evolved from the liquid to the feed drum will be routed to the electric-driven flash gas compressor and recycled to the two-phase low-pressure inlet separator. After stabilization, condensate will be sent to atmospheric condensate storage tanks. The stabilized condensate storage tanks include vapor recovery unit (VRU) which operates at a minimum of 95% control efficiency.

Produced water and stabilized condensate will be transported off site via truck. Vapors evolved from truck loading stabilized condensate are routed to carbon canisters for VOC recovery with 70% collection effectiveness and 95% control efficiency (66.5% combined).

The facility has several liquid recycle streams to reduce emissions. All high-pressure liquids are cascaded to lower pressure separators to capture gases evolved as a result of pressure reduction. All liquids formed by gas cooling in the inter-stage coolers of the three-stage reciprocating compressors are cascaded to lower pressure scrubbers on the compressor skid.

The facility also has several gas recycle streams. All condensate storage tank emissions are controlled 95% by vapor recovery compression. The vapor recovery compressors discharge in the flash gas compressor. The flash gas compressor compresses these gases and discharge into the two-phase low-pressure inlet separator. Overhead gases from the heater-treater feed drum and heater treater are routed to the flash gas compressor and recycled to the two-phase low-pressure inlet separator.

The generator provides electric power to the vapor recovery and flash gas compressors, electric glycol pumps, and other electrical equipment. Fugitive emissions from component leaks will also occur.

Please note that the compressor station will have two primary suction pressure operating points, 125 psig and 50 psig. The expected discharge pressure range is 900 – 1,200 psig. The facility initially operates at 125 psig suction pressure and will continue to do so until such time that field production volumes decline. At that time, the suction pressure will be lowered to 50 psig, resulting in a diminished facility capacity.

## Supplement S2

### Regulatory Discussion

---

“19. **Non-Applicability Determinations.** List all requirements which the source has determined not applicable and for which a permit shield is requested. The listing shall also include the rule citation and the reason why the shield applies.”

“20. **Facility-Wide Applicable Requirements.** List all facility-wide applicable requirements. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number.”

“**Section E.** List all applicable requirements for [each] emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included.”

---

- **Regulatory Discussion – Sand Hill Compressor Station (SHCS)**
    - A. Applicability of New Source Review (NSR) Regulations
    - B. Applicability of Federal Regulations
    - C. Applicability of Source Aggregation
    - D. Applicability of State Regulations
-

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
Application for 45CSR30 Title V Operating Permit (TVOP)

**Supplement S2**  
**Regulatory Discussion**

A. Applicability of New Source Review (NSR) Regulations

The following New Source Review (NSR) regulations are potentially applicable to natural gas compressor stations. Applicability to the subject facility has been determined as follows:

**1. Prevention of Significant Deterioration (PSD)** [Not Applicable]

This rule does not apply to the subject facility because the total PTE for the entire facility qualifies as a “PSD Minor Source” for each regulated pollutant; as follows:

- NOx: PSD Natural Minor Source with Pre-Controlled PTE < 250 tpy
- CO: PSD Synthetic Minor Source with Controlled PTE < 250 tpy
- VOC: PSD Synthetic Minor Source with Controlled PTE < 250 tpy
- SO<sub>2</sub>: PSD Natural Minor Source with Pre-Controlled PTE < 250 tpy
- PM<sub>10/2.5</sub>: PSD Natural Minor Source with Pre-Controlled PTE < 250 tpy

**2. Non-Attainment New Source Review (NNSR)** [Not Applicable]

This rule does not apply to the subject facility. The operations are in the Sand Hill Tax District of Marshal County, WV, which is currently classified as Attainment, Unclassified, or Maintenance for all national ambient air quality standards (NAAQS).

**3. Major Source of Hazardous Air Pollutants (HAPs)** [Not Applicable]

This rule does not apply to the subject facility because the entire facility qualifies as a “HAP Area Source” as follows:

- Each HAP: HAP Area Source with Controlled Individual HAP PTE < 10 tpy
- Total HAPs: HAP Area Source with Controlled Total of All HAPs PTE < 25 tpy

**4. Title V Operating Permit (TVOP)** [Applicable]

This rule does apply because the potential to emit VOC is above than the Title V Major Source threshold of 100 tpy.

## B. Applicability of Federal Regulations

The following federal regulations are potentially applicable to natural gas compressor stations. Applicability to the subject facility has been determined as follows:

### 1. **NSPS A, General Provisions**

40CFR§60.1-§60.19

[Applicable]

This rule does apply to all sources subject to an NSPS (unless a specific provision is excluded within the source NSPS). Requirements include notification (§60.7); monitoring (§60.7); recordkeeping (§60.11); and reporting (§60.18)

### 2. **NSPS A, Control Devices - Flares**

40CFR§60.18(b)

[Not Applicable]

This rule does not apply because there is no flare at the subject facility.

### 3. **NSPS D (also Da, Db, and Dc), Steam Generating Units**

40CFR§60.40-§60.48

[Not Applicable]

These rules do not apply because there is no steam generating unit (including line heaters) at the subject facility with a maximum design heat input capacity  $\geq 10$  MMBtu/hr and  $\leq 100$  MMBtu/hr (§60.40c(a)).

### 4. **NSPS K (also Ka and Kb), Volatile Organic Liquid Storage Vessels**

40CFR§60.40-§60.48

[Not Applicable]

This rule does not apply because there is no tank with capacity  $\geq 75$  m<sup>3</sup> (471.7 bbl or 19,813 gal) that is used to store volatile organic liquids (VOL) at the subject facility (§60.110(a)).

### 5. **NSPS GG, Stationary Gas Turbines**

40CFR§60.330-§60.335

[Not Applicable]

This rule does not apply because there is no stationary gas turbine at the subject facility with a heat input at peak load equal to or greater than 10.7 gigajoules (10 million Btu) per hour, based on the lower heating value of the fuel fired. (§60.330).

### 6. **NSPS KKK, Leaks from Natural Gas Processing Plants**

40CFR§60.630-§60.636

[Not Applicable]

This rule does not apply because the subject facility is not a natural gas processing plant (§60.630(a)).

### 7. **NSPS LLL, Onshore Natural Gas Processing: SO<sub>2</sub> Emissions**

40CFR§60.640-§60.648

[Not Applicable]

This rule does not apply because there is no gas sweetening operation at the subject facility (§60.640(a)).

**8. NSPS IIII, Compression Ignition Reciprocating Internal Combustion Engines**  
40CFR§60.4200-§60.4219 [Not Applicable]

This rule does not apply because there is no stationary compression ignition engine at the subject facility (§60.4200(a)).

**9. NSPS JJJJ, Stationary Spark Ignition (SI) Internal Combustion Engines (ICE)**  
40CFR§60.4230-§60.4248 [Applicable]

This rule does apply to the 1,380 bhp Caterpillar G3516B compressor engines (CE-01 thru CE-12) because each engine has a power rating greater than 500 HP and each engine was manufactured on or after 07/01/07 (§60.4230(a)(4)(i)).

Requirements include NO<sub>x</sub>, CO and VOC emission limits (§60.4233(e-f)); operating limits (§60.4243); performance testing (§60.4244); and notification and recordkeeping (§60.4245).

**10. NSPS KKKK, Stationary Combustion Turbines**  
40CFR§60.4300-§60.4420 [Not Applicable]

This rule does not apply because there is no stationary gas turbine at the subject facility with a heat input at peak load equal to or greater than 10.7 gigajoules (10 million Btu) per hour, based on the higher heating value of the fuel fired. (§60.4305(a)).

**11. NSPS OOOO, Crude Oil and Natural Gas Production**  
40CFR§60.5360-§60.5430 [Applicable]

This rule does apply to each reciprocating compressor driven by a CAT G3516B engine (CE-01 thru CE-12) because the subject facility is identified within the natural gas production segment and the compressors commenced construction after 08/23/11 (§60.5360 and §60.5365(c)).

Requirements include replacing rod packing systems on a specified schedule (§60.5385(a)) and notification, monitoring, recordkeeping and reporting (§60.5410(c), §60.5415(c), §60.5420(b)(1) and §60.5420(b)(4)).

This rule does not apply to the stabilized condensate (SC) storage tanks (TK-01 thru TK-08) nor to the produced water (PW) storage tanks (WTK-01 and WTK-02) because each tank has a potential to emit VOC < 6 TPY. Note, however, there is a requirement to document that VOC PTE < 6 tpy per tank (§60.5420).

This rule does not apply to the pneumatic controllers because they are compressed air driven, else they have a bleed rate ≤ 6 scfh, are located between the wellhead and point of custody transfer, and are not located at a natural gas processing plant (§60.5365(d)(1)).

**12. NSPS OOOOa, Crude Oil and Natural Gas Production**  
40CFR§60.5360a-§60.5430a [NOT Applicable]

This rule does not apply because the subject facility was constructed prior to September 18, 2015 (§60.5360a)

**13. NESHAP Part 61 - Designated Source Standards**

40CFR§61.01-§61.359

[Not Applicable]

This rule does not apply because the subject facility is not a NESHAP Designated Facility (or Source).

Specifically, NESHAP J - Equipment Leaks (Fugitive Emission Sources) of Benzene and NESHAP V - Equipment Leaks (Fugitive Emission Sources) do not apply because all the fluids (liquid or gas) at the subject facility are < 10 wt% volatile hazardous air pollutant (VHAP) (§61.111 and §61.241).

**14. NESHAP A (Part 63 (aka, MACT)) - General Provisions**

40CFR§63.1-§63.16

[Applicable]

This rule does apply because the dehydrators (DHY-01 thru DHY-03) are subject NESHAP HH–Oil and Natural Gas Production Facilities and the compressor engines (CE-01 thru CE-12) are subject to NESHAP ZZZZ– Reciprocating Internal Combustion Engines (RICE).

**15. NESHAP HH, Oil and Natural Gas Production Facilities**

40CFR§63.760-§63.779

[Applicable/Exempt]

This rule does apply; however, because the subject facility is an area source of HAP emissions, and the actual average emissions of benzene from each glycol dehydration unit process vent to the atmosphere is < 0.90 megagram per year (1.0 tpy), the dehydration units (DHY-01 thru DHY-03) are exempt. The only requirement is to maintain records of the actual average benzene emissions per year (§63.774(d)(1)(i)).

This rule does not apply to storage vessels (tanks), compressors, or ancillary equipment because the subject facility is an area source of HAP emissions (§63.760(b)(2)).

**16. NESHAP HHH, Natural Gas Transmission and Storage Facilities**

40CFR§63.1270-§63.1289

[Not Applicable]

This rule does not apply because the subject facility is not a natural gas transmission or storage facility transporting or storing natural gas prior to local distribution (§63.1270(a)).

**17. NESHAP YYYY, Stationary Combustion Turbines**

40CFR§63.6080-§63.6175

[Not Applicable]

This rule does not apply because subject facility is not a major source of HAP emissions (§63.6085).

**18. NESHAP ZZZZ, Stationary Reciprocating Internal Combustion Engines (RICE)**

40CFR§63.6580-§63.6675

[Applicable]

This rule does apply to the 1,380 bhp CAT G3516B Compressor Engines (CE-01 thru CE-12). However, because each engine is “new”; i.e., commenced construction or reconstruction on or after 06/12/06 (§63.6590(a)(2)(iii)); the only requirement is compliance with §60.4230-§60.4248 (NSPS JJJJ) for Spark Ignition Internal Combustion Engines.

**19. NESHAP DDDDD, Industrial, Commercial, and Institutional Boilers and Process Heaters – Major Sources**

40CFR§63.7480 – §63.7575

[Not Applicable]

This rule does not apply because the subject facility is an area source of HAP emissions (§63.7485).

**20. NESHAP JJJJJJ, Industrial, Commercial, and Institutional Boilers and Process Heaters – Area Sources**

40CFR§63.11193 – §63.11237

[Not Applicable]

This rule does not apply because all boilers (BLR-01 thru BLR-03) and heaters (HTR-01 and HTR-02) at the subject facility are gas-fired (§63.11195(e)).

**21. Compliance Assurance Monitoring (CAM)**

40CFR§64.1-§64.10

[Applicable/Deferred]

This rule does apply to the dehydrators (DHY-01 thru DHY-03) because they are:

- a) Pollutant-specific emission units (PSEU) at a major source that is required to obtain a Title V operating permit;
- b) Subject to an emissions limitation or standard;
- c) Use a control device to achieve compliance with any such emission limitation or standard; and
- d) The potential pre-control emissions of the applicable regulated air pollutant are  $\geq$  100% of the amount required to be classified as a major source (§64.2).

Note: Only large PSEUs (i.e., PSEUs with potential post-control device emissions of an applicable regulated air pollutant that are  $\geq$  Major Source Threshold Levels) need to submit a CAM plan with the initial TVOP application. At the subject facility, the post-control emissions are  $<$  Major Source Threshold Levels (§64.5(b)).

**22. Chemical Accident Prevention Provisions (Risk Management Plan (RMP))**

40CFR§68.1-§68.220

[Not Applicable]

This rule does not apply because the subject facility does not store more than a threshold quantity of a regulated substance in a process. Specifically, “Prior to entry into a natural gas processing plant or a petroleum refining process unit, regulated substances in naturally occurring hydrocarbon mixtures need not be considered when determining whether more than a threshold quantity is present at a stationary source” (§68.115(b)(2)(iii)).

## 23. Mandatory Greenhouse Gases (GHG) Reporting

40CFR§98.1-§98.9

[Applicable]

This rule does apply because:

- a) The facility is not a listed source category;
- b) The aggregate max heat input capacity of stationary fuel combustion units at the facility is  $\geq 30$  MMBtu/hr;
- c) The CO<sub>2</sub>e emissions from all stationary sources combined within the hydrocarbon basin as defined in 40 CFR Part 98 is  $\geq 25,000$  metric ton/yr (§98.2(a)(3)).

Requirements include monitoring, recordkeeping, and annual reporting of GHG from stationary fuel combustion sources only (§98.2(a)(3)).

### C. Applicability of Source Aggregation

The operations of the subject facility have not been aggregated with any other gas production, midstream service facilities, or transportation operations because there are no oil and gas facilities or operations “contiguous and adjacent” to the subject facility. Furthermore, there are no related facilities or operations that meet the common-sense notion of a plant and/or are under common control.

### D. Applicability of State Regulations

The following state regulations are potentially applicable to natural gas compressor stations. Applicability to the subject facility has been determined as follows:

#### 1. **Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers**

§45CSR2

[Not Applicable]

This rule does not apply because there is no indirect heat exchanger at the subject facility with input capacity  $\geq 10$  MMBtu/hr.

#### 2. **Prevent and Control the Discharge of Air Pollutants into the Open Air Which Causes or Contributes to an Objectionable Odor or Odors**

§45CSR4

[Applicable]

This rule does apply and states that an objectionable odor is an odor that is deemed objectionable when in the opinion of a duly authorized representative of the Air Pollution Control Commission (Division of Air Quality), based upon their investigations and complaints, such odor is objectionable.

#### 3. **Control of Air Pollution from Combustion of Refuse**

45CSR6

[Not Applicable]

This rule does not apply because there is no refuse combustion performed at the subject facility.

- 4. Prevent and Control Air Pollution from the Emission of Sulfur Oxides**  
45CSR10 [Applicable]
- This rule does apply and limits the discharge of SO<sub>2</sub> to 3.1 lb/hr per million Btu of total design heat input (§45-10-3.1.d).
- 5. Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, and Procedures for Evaluation**  
45CSR13 [Applicable]
- This rule does apply because the increase in VOC emissions is > 6 lb/hr and 10 tpy.
- Regulation 45CSR13 is applicable to new sources or modifications that result in an emission increase of:
- 6 lb/hr and 10 tons/yr of any regulated pollutant, or
  - 144 lb/day of any regulated pollutant, or
  - 2 lb/hr or 5 tons/yr of HAPs
- Appalachia Midstream Services, LLC (AMS) is applying for a 45CSR13 New Source Review Permit Modification and has published the required Class I legal advertisement notifying the public of this application and paid the appropriate application fee.
- 6. Permits for Construction and Major Modification of Major Stationary Sources of Air Pollutants for Prevention of Significant Deterioration**  
45CSR14 [Not Applicable]
- The rule does not apply because the subject facility is neither a new PSD major source of pollutants nor is the proposed facility a modification to an existing PSD major source.
- 7. Standards of Performance for New Stationary Sources Pursuant to 40 CFR Part 60**  
45CSR16 [Applicable]
- The rule does apply to this source by reference to §40CFR60 Subparts JJJJ and OOOO. The subject facility is subject to the notification, testing, monitoring, recordkeeping and reporting requirements of these Subparts.
- 8. Permits for Construction and Major Modification of Major Stationary Sources of Air Pollution Which Cause or Contribute to Nonattainment**  
45CSR19 [Not Applicable]
- This rule does not apply. The subject facility location is designated as “Attainment/Unclassified” for all criteria pollutants.
- 9. Regulation of Volatile Organic Compounds (VOC)**  
45CSR21 [Not Applicable]
- This rule does not apply because the subject facility is not located in Putnam County, Kanawha County, Cabell County, Wayne County, or Wood County

**10. Air Quality Management Fees Program**

45CSR22

[Applicable]

This rule does apply. It establishes a program to collect fees for certificates to operate and for permits to construct, modify or relocate sources of air pollution.

**11. Prevent and Control Emissions of Toxic Air Pollutants (Best Available Control Technology (BAT))**

45CSR27

[Not Applicable]

This rule does not apply because equipment used in the production and distribution of petroleum products is exempt, provided that the product contains no more than 5% benzene by weight (§45-27-2.4).

**12. Air Pollution Emissions Banking and Trading**

45CSR28

[Not Applicable]

This rule does not apply. Appalachia Midstream Services, LLC (AMS) does not choose to participate in the voluntarily statewide air pollutant emissions trading program.

**13. Emission Statements for VOC and NOX**

45CSR29

[Not Applicable]

This rule does not apply because subject facility is not located in Putnam, Kanawha, Cabell, Wayne, Wood, or Greenbrier Counties (§45-29-1).

**14. Requirements for Operating Permits**

45CSR30

[Applicable]

This rule does apply because the potential to emit VOC is above the Title V Major Source threshold of 100 tpy (§45-30-4.1.a.2).

**15. Emission Standards for Hazardous Air Pollutants (HAP)**

45CSR34

[Applicable]

This rule does apply because it incorporates by reference the federal air toxic regulations under the NESHAP program (40CFR61 and 40CFR63).

## **Supplement S3**

### **Emission Calculations**

---

- **Emission Summary Spreadsheets**
    - Potential to Emit (PTE) – Criteria Pollutants – Controlled
    - Potential to Emit (PTE) – Hazardous Air Pollutants (HAP) – Controlled
    - Potential to Emit (PTE) – Greenhouse Gases (GHG) – Controlled
    - Potential to Emit (PTE) – Criteria Pollutants – PRE-Controlled
    - Potential to Emit (PTE) – Hazardous Air Pollutants (HAP) – PRE-Controlled
    - Potential to Emit (PTE) – Greenhouse Gases (GHG) – PRE-Controlled
  
  - **Unit-Specific Emission Spreadsheets**
    - Compressor Engine (CE-01 thru CE-12) Emissions
    - Compressor Rod Packing (CRP) Emissions
    - Microturbine Generator (GEN) Emissions
    - Dehydrator (DHY-01 thru DHY-03) Emissions
    - Reboiler (BLR-01 thru BLR-03) Emissions
    - Heater Treater (HTR-01 and HTR-02) Emissions
    - Stabilized Condensate - Storage Tank (TK-01 thru TK-08) Emissions
    - Produced Water - Storage Tank (WTK-01 and WTK-02) Emissions
    - Stabilized Condensate (SC) - Truck Load-Out (TLO) Emissions
    - Produced Water (PW) - Truck Load-Out (WTLO) Emissions
    - Compressor Blowdown (CBD) / Emergency Shutdown (ESD) Emissions
  
  - **Fugitive Emissions**
    - Process Piping and Equipment Leak (FUG-G) Emissions – Gas
    - Process Piping and Equipment Leak (FUG-O) Emissions – Light Liquid
    - Engine Crankcase (ECC) Emissions
-

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Criteria Pollutants - Controlled**

Unit ID	Point ID	Source ID	Description	Site Rating	NOX		CO		VOC (w/HCHO)		PM10/2.5		SO2	
					lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy
<b>Sand Hill Compressor Station (SHCS) - Point Sources</b>														
EUCE-1	EPCE-1	CE-01	Compressor Engine 01 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCE-2	EPCE-2	CE-02	Compressor Engine 02 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCE-3	EPCE-3	CE-03	Compressor Engine 03 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCE-4	EPCE-4	CE-04	Compressor Engine 04 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCE-5	EPCE-5	CE-05	Compressor Engine 05 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCE-6	EPCE-6	CE-06	Compressor Engine 06 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCE-7	EPCE-7	CE-07	Compressor Engine 07 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCE-8	EPCE-8	CE-08	Compressor Engine 08 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCE-9	EPCE-9	CE-09	Compressor Engine 09 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCE-10	EPCE-10	CE-10	Compressor Engine 10 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCE-11	EPCE-11	CE-11	Compressor Engine 11 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCE-12	EPCE-12	CE-12	Compressor Engine 12 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	1.36	5.96	0.98	4.28	0.11	0.49	0.01	0.03
EUCRP	EPCRP	CRP	Compressor Rod Packing	12 Units	---	---	---	---	9.87	43.23	---	---	---	---
EUGEN-1	EPGEN-1	GEN	Generator - Capstone C600 Microturbine	805 bhp	0.48	2.10	1.32	5.78	0.13	0.57	0.05	0.20	4E-03	0.02
EUDHY-1	EPSTL-1	DHY-01	Dehydrator 01 (BTEX Buster)	55.0 MMscfd	---	---	---	---	1.79	7.85	---	---	---	---
EUDHY-2	EPSTL-2	DHY-02	Dehydrator 02 (BTEX Buster)	55.0 MMscfd	---	---	---	---	1.79	7.85	---	---	---	---
EUDHY-3	EPSTL-3	DHY-03	Dehydrator 03 (BTEX Buster)	55.0 MMscfd	---	---	---	---	1.79	7.85	---	---	---	---
EURBL-1	EPRBL-1	BLR-01	Reboiler 01	1.00 MMBtu/hr	0.10	0.43	0.08	0.36	0.01	0.02	0.01	0.03	6E-04	3E-03
EURBL-2	EPRBL-2	BLR-02	Reboiler 02	1.00 MMBtu/hr	0.10	0.43	0.08	0.36	0.01	0.02	0.01	0.03	6E-04	3E-03
EURBL-3	EPRBL-3	BLR-03	Reboiler 03	1.00 MMBtu/hr	0.10	0.43	0.08	0.36	0.01	0.02	0.01	0.03	6E-04	3E-03
EUHT-1	EPHT-1	HTR-01	Heater-Treater Burner 01	0.50 MMBtu/hr	0.06	0.21	0.05	0.18	3E-03	0.01	5E-03	0.02	4E-04	1E-03
EUHT-2	EPHT-2	HTR-02	Heater-Treater Burner 02	0.50 MMBtu/hr	0.06	0.21	0.05	0.18	3E-03	0.01	5E-03	0.02	4E-04	1E-03
EUTK-1	EPTK-1	TK-01	Storage Tank 01 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.04	0.17	---	---	---	---
EUTK-2	EPTK-2	TK-02	Storage Tank 02 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.04	0.17	---	---	---	---
EUTK-3	EPTK-3	TK-03	Storage Tank 03 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.04	0.17	---	---	---	---
EUTK-4	EPTK-4	TK-04	Storage Tank 04 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.04	0.17	---	---	---	---
EUTK-5	EPTK-5	TK-05	Storage Tank 05 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.04	0.17	---	---	---	---
EUTK-6	EPTK-6	TK-06	Storage Tank 06 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.04	0.17	---	---	---	---
EUTK-7	EPTK-7	TK-07	Storage Tank 07 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.04	0.17	---	---	---	---
EUTK-8	EPTK-8	TK-08	Storage Tank 08 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.04	0.17	---	---	---	---
EUWTK-9	EPWTK-9	WTK-01	Storage Tank W01 - Produced Water (PW)	400 bbl	---	---	---	---	0.01	0.03	---	---	---	---
EUWTK-10	EPWTK-10	WTK-02	Storage Tank W02 - Produced Water (PW)	400 bbl	---	---	---	---	0.01	0.03	---	---	---	---
EULOAD-1	EPLOAD-1	TLO	Truck Loading - Stabilized Condensate (SC) (CarbCan)	9,965 Mgal/yr	---	---	---	---	11.97	8.52	---	---	---	---
EULOAD-2	EPLOAD-2	WTLO	Truck Loading - Produced Water (PW)	1,533 Mgal/yr	---	---	---	---	0.72	0.08	---	---	---	---
EUBD	EPBD	CBD/ESD	Compressor Blowdown/Emergency Shutdown Tests	1,249 events/yr	---	---	---	---	28.31	24.94	---	---	---	---
<b>Sand Hill Compressor Station (SHCS) - Point Sources</b>					<b>19.15</b>	<b>83.77</b>	<b>17.99</b>	<b>78.70</b>	<b>68.45</b>	<b>153.79</b>	<b>1.42</b>	<b>6.22</b>	<b>0.09</b>	<b>0.38</b>
<b>Sand Hill Compressor Station (SHCS) - Fugitives</b>														
EUFUG	EPFUG	FUG-G	Piping & Equip Leaks - Gas	7,472 Units	---	---	---	---	4.62	20.23	---	---	---	---
		FUG-O	Piping & Equip Leaks - Light Liquid	3,407 Units	---	---	---	---	7.46	32.68	---	---	---	---
EUECC	EPECC	ECC	Engine Crankcase Fugitives	17,365 bhp	0.05	0.21	0.28	1.24	0.14	0.63	4E-03	0.02	2E-04	9E-04
<b>Sand Hill Compressor Station (SHCS) - Fugitives</b>					<b>0.05</b>	<b>0.21</b>	<b>0.28</b>	<b>1.24</b>	<b>12.22</b>	<b>53.54</b>	<b>4E-03</b>	<b>0.02</b>	<b>2E-04</b>	<b>9E-04</b>
<b>Sand Hill Compressor Station (SHCS) - Total</b>														
<b>Sand Hill Compressor Station (SHCS) - Total</b>					<b>19.20</b>	<b>83.98</b>	<b>18.27</b>	<b>79.95</b>	<b>80.67</b>	<b>207.33</b>	<b>1.43</b>	<b>6.24</b>	<b>0.09</b>	<b>0.38</b>

\* = lb/hr is based on 8,760 hr/yr, except Compressor Blowdowns (CBD/ESD), Truck Load-Out (TLO, WTLO), and Pigging (PIG) are less frequent.

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Hazardous Air Pollutants (HAP) - Controlled**

Source ID	Acetaldehyde		Acrolein		Benzene		Butadiene, 1,3-		Ethylbenzene		HCHO		n-Hexane		Methanol		POM		Toluene		TMP, 2,2,4-		Xylenes		Other HAP		TOTAL HAPs	
	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy
<b>Sand Hill Compressor Station (SHCS) - Point Sources</b>																												
CE-01	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CE-02	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CE-03	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CE-04	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CE-05	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CE-06	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CE-07	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CE-08	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CE-09	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CE-10	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CE-11	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CE-12	0.02	0.10	0.01	0.06	1E-03	5E-03	7E-04	3E-03	1E-04	5E-04	0.12	0.52	3E-03	0.01	0.01	0.03	1E-03	4E-03	1E-03	5E-03	7E-04	3E-03	5E-04	2E-03	9E-04	4E-03	0.17	0.76
CRP	---	---	---	---	0.02	0.07	---	---	0.02	0.07	---	---	0.25	1.09	---	---	---	---	0.02	0.07	0.02	0.07	0.02	0.07	---	---	0.33	1.45
GEN	0.00	0.00	0.00	0.00	0.00	0.00	6E-06	0.00	4E-04	2E-03	0.01	0.04	---	---	---	---	4E-04	2E-03	2E-03	0.01	---	---	9E-04	4E-03	4E-04	2E-03	0.01	0.06
DHY-01	---	---	---	---	0.06	0.27	---	---	4E-03	0.02	---	---	0.09	0.40	---	---	---	---	0.10	0.43	2E-03	0.01	0.04	0.17	---	---	0.30	1.30
DHY-02	---	---	---	---	0.06	0.27	---	---	4E-03	0.02	---	---	0.09	0.40	---	---	---	---	0.10	0.43	2E-03	0.01	0.04	0.17	---	---	0.30	1.30
DHY-03	---	---	---	---	0.06	0.27	---	---	4E-03	0.02	---	---	0.09	0.40	---	---	---	---	0.10	0.43	2E-03	0.01	0.04	0.17	---	---	0.30	1.30
BLR-01	---	---	---	---	2E-06	9E-06	---	---	---	---	7E-05	3E-04	2E-03	0.01	---	---	7E-07	3E-06	3E-06	1E-05	---	---	---	---	1E-06	5E-06	2E-03	0.01
BLR-02	---	---	---	---	2E-06	9E-06	---	---	---	---	7E-05	3E-04	2E-03	0.01	---	---	7E-07	3E-06	3E-06	1E-05	---	---	---	---	1E-06	5E-06	2E-03	0.01
BLR-03	---	---	---	---	2E-06	9E-06	---	---	---	---	7E-05	3E-04	2E-03	0.01	---	---	7E-07	3E-06	3E-06	1E-05	---	---	---	---	1E-06	5E-06	2E-03	0.01
HTR-01	---	---	---	---	1E-06	5E-06	---	---	---	---	5E-05	2E-04	1E-03	4E-03	---	---	4E-07	1E-06	2E-06	7E-06	---	---	---	---	7E-07	3E-06	1E-03	4E-03
HTR-02	---	---	---	---	1E-06	5E-06	---	---	---	---	5E-05	2E-04	1E-03	4E-03	---	---	4E-07	1E-06	2E-06	7E-06	---	---	---	---	7E-07	3E-06	1E-03	4E-03
TK-01	---	---	---	---	8E-04	3E-03	---	---	8E-04	3E-03	---	---	0.01	0.03	---	---	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	---	---	0.01	0.05
TK-02	---	---	---	---	8E-04	3E-03	---	---	8E-04	3E-03	---	---	0.01	0.03	---	---	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	---	---	0.01	0.05
TK-03	---	---	---	---	8E-04	3E-03	---	---	8E-04	3E-03	---	---	0.01	0.03	---	---	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	---	---	0.01	0.05
TK-04	---	---	---	---	8E-04	3E-03	---	---	8E-04	3E-03	---	---	0.01	0.03	---	---	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	---	---	0.01	0.05
TK-05	---	---	---	---	8E-04	3E-03	---	---	8E-04	3E-03	---	---	0.01	0.03	---	---	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	---	---	0.01	0.05
TK-06	---	---	---	---	8E-04	3E-03	---	---	8E-04	3E-03	---	---	0.01	0.03	---	---	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	---	---	0.01	0.05
TK-07	---	---	---	---	8E-04	3E-03	---	---	8E-04	3E-03	---	---	0.01	0.03	---	---	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	---	---	0.01	0.05
TK-08	---	---	---	---	8E-04	3E-03	---	---	8E-04	3E-03	---	---	0.01	0.03	---	---	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	---	---	0.01	0.05
WTK-01	---	---	---	---	1E-04	6E-04	---	---	1E-04	6E-04	---	---	1E-03	0.01	---	---	---	---	1E-04	6E-04	1E-04	6E-04	1E-04	6E-04	---	---	2E-03	0.01
WTK-02	---	---	---	---	1E-04	6E-04	---	---	1E-04	6E-04	---	---	1E-03	0.01	---	---	---	---	1E-04	6E-04	1E-04	6E-04	1E-04	6E-04	---	---	2E-03	0.01
TLO	---	---	---	---	0.24	0.17	---	---	0.24	0.17	---	---	2.39	1.70	---	---	---	---	0.24	0.17	0.24	0.17	0.24	0.17	---	---	3.59	2.56
WTLO	---	---	---	---	0.01	2E-03	---	---	0.01	2E-03	---	---	0.14	0.02	---	---	---	---	0.01	2E-03	0.01	2E-03	0.01	2E-03	---	---	0.22	0.02
CBD/ESD	---	---	---	---	0.05	0.04	---	---	0.05	0.04	---	---	0.71	0.63	---	---	---	---	0.05	0.04	0.05	0.04	0.05	0.04	---	---	0.95	0.84
<b>SHCS-PS</b>	<b>0.28</b>	<b>1.24</b>	<b>0.17</b>	<b>0.76</b>	<b>0.53</b>	<b>1.20</b>	<b>0.01</b>	<b>0.04</b>	<b>0.34</b>	<b>0.37</b>	<b>1.43</b>	<b>6.28</b>	<b>3.88</b>	<b>5.10</b>	<b>0.08</b>	<b>0.37</b>	<b>0.01</b>	<b>0.05</b>	<b>0.64</b>	<b>1.69</b>	<b>0.34</b>	<b>0.38</b>	<b>0.45</b>	<b>0.85</b>	<b>0.01</b>	<b>0.05</b>	<b>8.17</b>	<b>18.37</b>
<b>Sand Hill Compressor Station (SHCS) - Fugitives</b>																												
FUG-G	---	---	---	---	0.01	0.03	---	---	0.01	0.03	---	---	0.12	0.51	---	---	---	---	0.01	0.03	0.01	0.03	0.01	0.03	---	---	0.16	0.68
FUG-O	---	---	---	---	0.01	0.05	---	---	0.01	0.05	---	---	0.19	0.82	---	---	---	---	0.01	0.05	0.01	0.05	0.01	0.05	---	---	0.25	1.10
ECC	3E-03	0.01	2E-03	0.01	2E-04	7E-04	9E-05	4E-04	1E-05	6E-05	0.04	0.16	4E-04	2E-03	9E-04	4E-03	1E-04	5E-04	1E-04	6E-04	9E-05	4E-04	6E-05	3E-04	1E-04	5E-04	0.04	0.19
<b>SHCS-FUG</b>	<b>3E-03</b>	<b>0.01</b>	<b>2E-03</b>	<b>0.01</b>	<b>0.02</b>	<b>0.09</b>	<b>9E-05</b>	<b>4E-04</b>	<b>0.02</b>	<b>0.09</b>	<b>0.04</b>	<b>0.16</b>	<b>0.30</b>	<b>1.33</b>	<b>9E-04</b>	<b>4E-03</b>	<b>1E-04</b>	<b>5E-04</b>	<b>0.02</b>	<b>0.09</b>	<b>0.02</b>	<b>0.09</b>	<b>0.02</b>	<b>0.09</b>	<b>1E-04</b>	<b>5E-04</b>	<b>0.45</b>	<b>1.97</b>
<b>Sand Hill Compressor Station (SHCS) - Total</b>																												
<b>SHCS-TOT</b>	<b>0.29</b>	<b>1.25</b>	<b>0.18</b>	<b>0.77</b>	<b>0.55</b>	<b>1.29</b>	<b>0.01</b>	<b>0.04</b>	<b>0.36</b>	<b>0.46</b>	<b>1.47</b>	<b>6.44</b>	<b>4.18</b>	<b>6.43</b>	<b>0.09</b>	<b>0.37</b>	<b>0.01</b>	<b>0.05</b>	<b>0.66</b>	<b>1.78</b>	<b>0.36</b>	<b>0.47</b>	<b>0.47</b>	<b>0.94</b>	<b>0.01</b>	<b>0.05</b>	<b>8.62</b>	<b>20.34</b>

\* = lb/hr is based on 8,760 hr/yr, except Compressor Blowdowns (CBD/ESD), Truck Load-Out (TLO, WTLO), and Pigging (PIG) are less frequent.

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Greenhouse Gas (GHG) Pollutants - Controlled**

Source ID	Description	Site Rating	Heat Input MMBtu/hr (HHV)	Hours of Operation hr/yr*	CO2		CH4		N2O		TOTAL CO2e	
					GWP: 1 tpy	CO2e tpy	GWP: 25 tpy	CO2e tpy	GWP: 298 tpy	CO2e tpy	lb/hr*	tpy
<b>Sand Hill Compressor Station (SHCS) - Point Sources</b>												
CE-01	Compressor Engine 01 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-02	Compressor Engine 02 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-03	Compressor Engine 03 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-04	Compressor Engine 04 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-05	Compressor Engine 05 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-06	Compressor Engine 06 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-07	Compressor Engine 07 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-08	Compressor Engine 08 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-09	Compressor Engine 09 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-10	Compressor Engine 10 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-11	Compressor Engine 11 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-12	Compressor Engine 12 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CRP	Compressor Rod Packing	12 Units	---	8,760	0.44	0.44	99.81	2,495	---	---	570	2,496
GEN	Generator - Capstone C600 Microturbine	805 bhp	6.84	8,760	3,494	3,494	0.52	13	9E-02	26.80	807	3,534
DHY-01	Dehydrator 01 (BTEX Buster)	55.0 MMscfd	---	8,760	2.54	2.54	0.39	9.66	---	---	2.79	12.20
DHY-02	Dehydrator 02 (BTEX Buster)	55.0 MMscfd	---	8,760	2.54	2.54	0.39	9.66	---	---	2.79	12.20
DHY-03	Dehydrator 03 (BTEX Buster)	55.0 MMscfd	---	8,760	2.54	2.54	0.39	9.66	---	---	2.79	12.20
BLR-01	Reboiler 01	1.00 MMBtu/hr	1.00	8,760	515	515	0.01	0.25	0.01	2.82	118	518
BLR-02	Reboiler 02	1.00 MMBtu/hr	1.00	8,760	515	515	0.01	0.25	0.01	2.82	118	518
BLR-03	Reboiler 03	1.00 MMBtu/hr	1.00	8,760	515	515	0.01	0.25	0.01	2.82	118	518
HTR-01	Heater-Treater Burner 01	0.50 MMBtu/hr	0.50	8,760	258	258	5E-03	0.12	5E-03	1.41	59.17	259
HTR-02	Heater-Treater Burner 02	0.50 MMBtu/hr	0.50	8,760	258	258	5E-03	0.12	5E-03	1.41	59.17	259
TK-01	Storage Tank 01 - Stabilized Condensate (SC) (VRU)	There are De Minimis GHGs in Stabilized Condensate (SC) Storage Tank Emissions										
TK-02	Storage Tank 02 - Stabilized Condensate (SC) (VRU)											
TK-03	Storage Tank 03 - Stabilized Condensate (SC) (VRU)											
TK-04	Storage Tank 04 - Stabilized Condensate (SC) (VRU)											
TK-05	Storage Tank 05 - Stabilized Condensate (SC) (VRU)											
TK-06	Storage Tank 06 - Stabilized Condensate (SC) (VRU)											
TK-07	Storage Tank 07 - Stabilized Condensate (SC) (VRU)											
TK-08	Storage Tank 08 - Stabilized Condensate (SC) (VRU)											
WTK-01	Storage Tank W01 - Produced Water (PW)	There are De Minimis GHGs in Produced Water (PW) Storage Tank Emissions										
WTK-02	Storage Tank W02 - Produced Water (PW)											
TLO	Truck Loading - Produced Water (PW)	There are De Minimis GHGs in Stabilized Condensate (SC) Truck Loading Emissions										
WTLO	Truck Loading - Stabilized Condensate (SC) (CarbCan)											
CBD/ESD	Compressor Blowdown/Emergency Shutdown Tests	1,249 events/yr	---	8,760	0.25	0.25	57.57	1,439	---	---	329	1,440
<b>Sand Hill Compressor Station (SHCS) - Point Sources</b>					<b>87,117</b>	<b>87,117</b>	<b>897</b>	<b>22,423</b>	<b>0.26</b>	<b>76.84</b>	<b>25,027</b>	<b>109,617</b>
<b>Sand Hill Compressor Station (SHCS) - Fugitives</b>												
FUG-G	Piping & Equip Leaks - Gas	7,472 Units	---	8,760	0.20	0.20	46.71	1,168	---	---	267	1,168
FUG-O	Piping & Equip Leaks - Light Liquid	There are De Minimis GHGs in Light Liquid Piping & Equip Leak Emissions										
ECC	Engine Crankcase Fugitives											
<b>Sand Hill Compressor Station (SHCS) - Fugitives</b>					<b>213</b>	<b>213</b>	<b>48.63</b>	<b>1,216</b>	<b>3E-04</b>	<b>0.10</b>	<b>326</b>	<b>1,429</b>
<b>Sand Hill Compressor Station (SHCS) - Total</b>												
<b>Sand Hill Compressor Station (SHCS) - Total</b>					<b>87,330</b>	<b>87,330</b>	<b>946</b>	<b>23,639</b>	<b>0.26</b>	<b>76.94</b>	<b>25,353</b>	<b>111,046</b>

\* = lb/hr is based on 8,760 hr/yr, except Compressor Blowdowns (CBD/ESD), Truck Load-Out (TLO, WTLO), and Pigging (PIG) are less frequent.

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Criteria Pollutants - PRE-Control**

Unit ID	Point ID	Source ID	Description	Site Rating	NOX		CO		VOC (w/HCHO)		PM10/2.5		SO2	
					lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy
<b>Sand Hill Compressor Station (SHCS) - Point Sources - PRE-Control</b>														
EUCE-1	EPCE-1	CE-01	Compressor Engine 01 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EUCE-2	EPCE-2	CE-02	Compressor Engine 02 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EUCE-3	EPCE-3	CE-03	Compressor Engine 03 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EUCE-4	EPCE-4	CE-04	Compressor Engine 04 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EUCE-5	EPCE-5	CE-05	Compressor Engine 05 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EUCE-6	EPCE-6	CE-06	Compressor Engine 06 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EUCE-7	EPCE-7	CE-07	Compressor Engine 07 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EUCE-8	EPCE-8	CE-08	Compressor Engine 08 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EUCE-9	EPCE-9	CE-09	Compressor Engine 09 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EUCE-10	EPCE-10	CE-10	Compressor Engine 10 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EUCE-11	EPCE-11	CE-11	Compressor Engine 11 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EUCE-12	EPCE-12	CE-12	Compressor Engine 12 - CAT G3516B (OxCat)	1,380 bhp	1.52	6.66	9.07	39.71	4.62	20.25	0.11	0.49	0.01	0.03
EU CRP	EP CRP	CRP	Compressor Rod Packing	12 Units	---	---	---	---	9.87	43.23	---	---	---	---
EUGEN-1	EPGEN-1	GEN	Generator - Capstone C600 Microturbine	805 bhp	0.48	2.10	1.32	5.78	0.13	0.57	0.05	0.20	4E-03	0.02
EUDHY-1	EPSTL-1	DHY-01	Dehydrator 01 (BTEX Buster)	55.0 MMscfd	---	---	---	---	52.27	229	---	---	---	---
EUDHY-2	EPSTL-2	DHY-02	Dehydrator 02 (BTEX Buster)	55.0 MMscfd	---	---	---	---	52.27	229	---	---	---	---
EUDHY-3	EPSTL-3	DHY-03	Dehydrator 03 (BTEX Buster)	55.0 MMscfd	---	---	---	---	52.27	229	---	---	---	---
EURBL-1	EPRBL-1	BLR-01	Reboiler 01	1.00 MMBtu/hr	0.10	0.43	0.08	0.36	0.01	0.02	0.01	0.03	6E-04	3E-03
EURBL-2	EPRBL-2	BLR-02	Reboiler 02	1.00 MMBtu/hr	0.10	0.43	0.08	0.36	0.01	0.02	0.01	0.03	6E-04	3E-03
EURBL-3	EPRBL-3	BLR-03	Reboiler 03	1.00 MMBtu/hr	0.10	0.43	0.08	0.36	0.01	0.02	0.01	0.03	6E-04	3E-03
EUHT-1	EPHT-1	HTR-01	Heater-Treater Burner 01	0.50 MMBtu/hr	0.06	0.21	0.05	0.18	3E-03	0.01	5E-03	0.02	4E-04	1E-03
EUHT-2	EPHT-2	HTR-02	Heater-Treater Burner 02	0.50 MMBtu/hr	0.06	0.21	0.05	0.18	3E-03	0.01	5E-03	0.02	4E-04	1E-03
EUTK-1	EPTK-1	TK-01	Storage Tank 01 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.77	3.37	---	---	---	---
EUTK-2	EPTK-2	TK-02	Storage Tank 02 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.77	3.37	---	---	---	---
EUTK-3	EPTK-3	TK-03	Storage Tank 03 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.77	3.37	---	---	---	---
EUTK-4	EPTK-4	TK-04	Storage Tank 04 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.77	3.37	---	---	---	---
EUTK-5	EPTK-5	TK-05	Storage Tank 05 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.77	3.37	---	---	---	---
EUTK-6	EPTK-6	TK-06	Storage Tank 06 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.77	3.37	---	---	---	---
EUTK-7	EPTK-7	TK-07	Storage Tank 07 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.77	3.37	---	---	---	---
EUTK-8	EPTK-8	TK-08	Storage Tank 08 - Stabilized Condensate (SC) (VRU)	400 bbl	---	---	---	---	0.77	3.37	---	---	---	---
EUWTK-9	EPWTK-9	WTK-01	Storage Tank W01 - Produced Water (PW)	400 bbl	---	---	---	---	0.01	0.03	---	---	---	---
EUWTK-10	EPWTK-10	WTK-02	Storage Tank W02 - Produced Water (PW)	400 bbl	---	---	---	---	0.01	0.03	---	---	---	---
EULOAD-1	EPLOAD-1	TLO	Truck Loading - Produced Water (PW)	9,965 Mgal/yr	---	---	---	---	35.72	25.43	---	---	---	---
EULOAD-2	EPLOAD-2	WTLO	Truck Loading - Stabilized Condensate (SC) (CarbCan)	1,533 Mgal/yr	---	---	---	---	0.72	0.08	---	---	---	---
EU BD	EP BD	CBD/ESD	Compressor Blowdown/Emergency Shutdown Tests	1,249 events/yr	---	---	---	---	5.69	24.94	---	---	---	---
<b>Sand Hill Compressor Station (SHCS) - Point Sources - PRE-Control</b>					<b>19.15</b>	<b>84</b>	<b>110</b>	<b>484</b>	<b>271</b>	<b>1,051</b>	<b>1.42</b>	<b>6.22</b>	<b>0.09</b>	<b>0.38</b>
<b>Sand Hill Compressor Station (SHCS) - Fugitives - PRE-Control</b>														
EUFUG	EPFUG	FUG-G	Piping & Equip Leaks - Gas	7,472 Units	---	---	---	---	4.62	20.23	---	---	---	---
		FUG-O	Piping & Equip Leaks - Light Liquid	3,407 Units	---	---	---	---	7.46	32.68	---	---	---	---
EUECC	EPECC	ECC	Engine Crankcase Fugitives	17,365 bhp	0.05	0.21	0.28	1.24	0.14	0.63	4E-03	0.02	2E-04	9E-04
<b>Sand Hill Compressor Station (SHCS) - Fugitives - PRE-Control</b>					<b>0.05</b>	<b>0.21</b>	<b>0.28</b>	<b>1.24</b>	<b>12.22</b>	<b>53.54</b>	<b>4E-03</b>	<b>0.02</b>	<b>2E-04</b>	<b>9E-04</b>
<b>Sand Hill Compressor Station (SHCS) - Total - PRE-Control</b>														
<b>Sand Hill Compressor Station (SHCS) - Total - PRE-Control</b>					<b>19.20</b>	<b>84</b>	<b>111</b>	<b>485</b>	<b>283</b>	<b>1,105</b>	<b>1.43</b>	<b>6.24</b>	<b>0.09</b>	<b>0.38</b>

\* = lb/hr is based on 8,760 hr/yr, except Compressor Blowdowns (CBD/ESD), Truck Load-Out (TLO, WTLO), and Pigging (PIG) are less frequent.

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Hazardous Air Pollutants (HAP) - PRE-Control**

Source ID	Acetaldehyde		Acrolein		Benzene		Butadiene, 1,3-		Ethylbenzene		HCHO		n-Hexane		Methanol		POM		Toluene		TMP, 2,2,4-		Xylenes		Other HAP		TOTAL HAPs	
	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy
<b>Sand Hill Compressor Station (SHCS) - Point Sources - PRE-Control</b>																												
CE-01	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CE-02	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CE-03	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CE-04	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CE-05	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CE-06	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CE-07	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CE-08	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CE-09	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CE-10	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CE-11	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CE-12	0.09	0.41	0.06	0.25	5E-03	0.02	3E-03	0.01	4E-04	2E-03	1.19	5.20	0.01	0.05	0.03	0.12	4E-03	0.02	5E-03	0.02	3E-03	0.01	2E-03	0.01	4E-03	0.02	1.40	6.15
CRP	---	---	---	---	0.02	0.07	---	---	0.02	0.07	---	---	0.25	1.09	---	---	---	---	0.02	0.07	0.02	0.07	---	---	---	---	0.33	1.45
GEN	0.00	0.00	0.00	0.00	0.00	0.00	6E-06	0.00	4E-04	2E-03	0.01	0.04	---	---	---	---	4E-04	2E-03	2E-03	0.01	---	---	9E-04	4E-03	4E-04	2E-03	0.01	0.06
DHY-01	---	---	---	---	1.75	7.66	---	---	0.32	1.41	---	---	2.30	10.07	---	---	---	---	4.42	19.35	0.23	1.00	3.79	16.58	---	---	12.80	56.07
DHY-02	---	---	---	---	1.75	7.66	---	---	0.32	1.41	---	---	2.30	10.07	---	---	---	---	4.42	19.35	0.23	1.00	3.79	16.58	---	---	12.80	56.07
DHY-03	---	---	---	---	1.75	7.66	---	---	0.32	1.41	---	---	2.30	10.07	---	---	---	---	4.42	19.35	0.23	1.00	3.79	16.58	---	---	12.80	56.07
BLR-01	---	---	---	---	2E-06	9E-06	---	---	---	---	7E-05	3E-04	2E-03	0.01	---	---	7E-07	3E-06	3E-06	1E-05	---	---	---	---	1E-06	5E-06	2E-03	0.01
BLR-02	---	---	---	---	2E-06	9E-06	---	---	---	---	7E-05	3E-04	2E-03	0.01	---	---	7E-07	3E-06	3E-06	1E-05	---	---	---	---	1E-06	5E-06	2E-03	0.01
BLR-03	---	---	---	---	2E-06	9E-06	---	---	---	---	7E-05	3E-04	2E-03	0.01	---	---	7E-07	3E-06	3E-06	1E-05	---	---	---	---	1E-06	5E-06	2E-03	0.01
HTR-01	---	---	---	---	1E-06	5E-06	---	---	---	---	5E-05	2E-04	1E-03	4E-03	---	---	4E-07	1E-06	2E-06	7E-06	---	---	---	---	7E-07	3E-06	1E-03	4E-03
HTR-02	---	---	---	---	1E-06	5E-06	---	---	---	---	5E-05	2E-04	1E-03	4E-03	---	---	4E-07	1E-06	2E-06	7E-06	---	---	---	---	7E-07	3E-06	1E-03	4E-03
TK-01	---	---	---	---	0.02	0.07	---	---	0.02	0.07	---	---	0.15	0.67	---	---	---	---	0.02	0.07	0.02	0.07	0.02	0.07	---	---	0.23	1.01
TK-02	---	---	---	---	0.02	0.07	---	---	0.02	0.07	---	---	0.15	0.67	---	---	---	---	0.02	0.07	0.02	0.07	0.02	0.07	---	---	0.23	1.01
TK-03	---	---	---	---	0.02	0.07	---	---	0.02	0.07	---	---	0.15	0.67	---	---	---	---	0.02	0.07	0.02	0.07	0.02	0.07	---	---	0.23	1.01
TK-04	---	---	---	---	0.02	0.07	---	---	0.02	0.07	---	---	0.15	0.67	---	---	---	---	0.02	0.07	0.02	0.07	0.02	0.07	---	---	0.23	1.01
TK-05	---	---	---	---	0.02	0.07	---	---	0.02	0.07	---	---	0.15	0.67	---	---	---	---	0.02	0.07	0.02	0.07	0.02	0.07	---	---	0.23	1.01
TK-06	---	---	---	---	0.02	0.07	---	---	0.02	0.07	---	---	0.15	0.67	---	---	---	---	0.02	0.07	0.02	0.07	0.02	0.07	---	---	0.23	1.01
TK-07	---	---	---	---	0.02	0.07	---	---	0.02	0.07	---	---	0.15	0.67	---	---	---	---	0.02	0.07	0.02	0.07	0.02	0.07	---	---	0.23	1.01
TK-08	---	---	---	---	0.02	0.07	---	---	0.02	0.07	---	---	0.15	0.67	---	---	---	---	0.02	0.07	0.02	0.07	0.02	0.07	---	---	0.23	1.01
WTK-01	---	---	---	---	1E-04	6E-04	---	---	1E-04	6E-04	---	---	1E-03	0.01	---	---	---	---	1E-04	6E-04	1E-04	6E-04	1E-04	6E-04	---	---	2E-03	0.01
WTK-02	---	---	---	---	1E-04	6E-04	---	---	1E-04	6E-04	---	---	1E-03	0.01	---	---	---	---	1E-04	6E-04	1E-04	6E-04	1E-04	6E-04	---	---	2E-03	0.01
TLO	---	---	---	---	0.71	0.51	---	---	0.71	0.51	---	---	7.14	5.09	---	---	---	---	0.71	0.51	0.71	0.51	0.71	0.51	---	---	10.72	7.63
WTLO	---	---	---	---	0.01	2E-03	---	---	0.01	2E-03	---	---	0.14	0.02	---	---	---	---	0.01	2E-03	0.01	2E-03	0.01	2E-03	---	---	0.22	0.02
CBD/ESD	---	---	---	---	0.05	0.04	---	---	0.05	0.04	---	---	0.71	0.63	---	---	---	---	0.05	0.04	0.05	0.04	0.05	0.04	---	---	0.95	0.84
SHCS-PS	1.13	4.94	0.69	3.03	6.22	24.41	0.04	0.16	1.89	5.42	14.25	62.41	16.53	43.11	0.34	1.48	0.05	0.21	14.23	59.47	1.64	4.32	12.30	51.02	0.04	0.19	69.34	260.16
<b>Sand Hill Compressor Station (SHCS) - Fugitives - PRE-Control</b>																												
FUG-G	---	---	---	---	0.01	0.03	---	---	0.01	0.03	---	---	0.12	0.51	---	---	---	---	0.01	0.03	0.01	0.03	0.01	0.03	---	---	0.16	0.68
FUG-O	---	---	---	---	0.01	0.05	---	---	0.01	0.05	---	---	0.19	0.82	---	---	---	---	0.01	0.05	0.01	0.05	0.01	0.05	---	---	0.25	1.10
ECC	3E-03	0.01	2E-03	0.01	2E-04	7E-04	9E-05	4E-04	1E-05	6E-05	0.04	0.16	4E-04	2E-03	9E-04	4E-03	1E-04	5E-04	1E-04	6E-04	9E-05	4E-04	6E-05	3E-04	1E-04	5E-04	0.04	0.19
SHCS-FUG	3E-03	0.01	2E-03	0.01	0.02	0.09	9E-05	4E-04	0.02	0.09	0.04	0.16	0.30	1.33	9E-04	4E-03	1E-04	5E-04	0.02	0.09	0.02	0.09	0.02	0.09	1E-04	5E-04	0.45	1.97
<b>Sand Hill Compressor Station (SHCS) - Total - PRE-Control</b>																												
SHCS-TOT	1.13	4.95	0.69	3.04	6.24	24.50	0.04	0.16	1.91	5.51	14.29	62.57	16.84	44.44	0.34	1.48	0.05	0.21	14.25	59.56	1.66	4.41	12.32	51.11	0.04	0.19	69.79	262.12

\* = lb/hr is based on 8,760 hr/yr, except Compressor Blowdowns (CBD/ESD), Truck Load-Out (TLO, WTLO), and Pigging (PIG) are less frequent.

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Greenhouse Gas (GHG) Pollutants - PRE-Control**

Source ID	Description	Site Rating	Heat Input MMBtu/hr (HHV)	Hours of Operation hr/yr*	CO2	CO2e	CH4	CO2e	N2O	CO2e	TOTAL	
					GWP: 1 tpy	1 tpy	GWP: 25 tpy	25 tpy	GWP: 298 tpy	298 tpy	lb/hr*	tpy
<b>Sand Hill Compressor Station (SHCS) - Point Sources - PRE-Control</b>												
CE-01	Compressor Engine 01 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-02	Compressor Engine 02 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-03	Compressor Engine 03 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-04	Compressor Engine 04 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-05	Compressor Engine 05 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-06	Compressor Engine 06 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-07	Compressor Engine 07 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-08	Compressor Engine 08 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-09	Compressor Engine 09 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-10	Compressor Engine 10 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-11	Compressor Engine 11 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CE-12	Compressor Engine 12 - CAT G3516B (OxCat)	1,380 bhp	11.23	8,760	6,796	6,796	61.49	1,537	0.01	3.23	1,903	8,336
CRP	Compressor Rod Packing	12 Units	---	8,760	0.44	0.44	99.81	2,495	---	---	570	2,496
GEN	Generator - Capstone C600 Microturbine	805 bhp	6.84	8,760	3,494	3,494	0.52	12.95	0.09	26.80	807	3,534
DHY-01	Dehydrator 01 (BTEX Buster)	55.0 MMscfd	---	8,760	2.54	2.54	7.73	193	---	---	44.70	196
DHY-02	Dehydrator 02 (BTEX Buster)	55.0 MMscfd	---	8,760	2.54	2.54	7.73	193	---	---	44.70	196
DHY-03	Dehydrator 03 (BTEX Buster)	55.0 MMscfd	---	8,760	2.54	2.54	7.73	193	---	---	44.70	196
BLR-01	Reboiler 01	1.00 MMBtu/hr	1.00	8,760	515	515	0.01	0.25	0.01	2.82	118	518
BLR-02	Reboiler 02	1.00 MMBtu/hr	1.00	8,760	515	515	0.01	0.25	0.01	2.82	118	518
BLR-03	Reboiler 03	1.00 MMBtu/hr	1.00	8,760	515	515	0.01	0.25	0.01	2.82	118	518
HTR-01	Heater-Treater Burner 01	0.50 MMBtu/hr	0.50	8,760	258	258	5E-03	0.12	5E-03	1.41	59.17	259
HTR-02	Heater-Treater Burner 02	0.50 MMBtu/hr	0.50	8,760	258	258	5E-03	0.12	5E-03	1.41	59.17	259
TK-01	Storage Tank 01 - Stabilized Condensate (SC) (VRU)	There are De Minimis GHGs in Stabilized Condensate (SC) Storage Tank Emissions										
TK-02	Storage Tank 02 - Stabilized Condensate (SC) (VRU)											
TK-03	Storage Tank 03 - Stabilized Condensate (SC) (VRU)											
TK-04	Storage Tank 04 - Stabilized Condensate (SC) (VRU)											
TK-05	Storage Tank 05 - Stabilized Condensate (SC) (VRU)											
TK-06	Storage Tank 06 - Stabilized Condensate (SC) (VRU)											
TK-07	Storage Tank 07 - Stabilized Condensate (SC) (VRU)											
TK-08	Storage Tank 08 - Stabilized Condensate (SC) (VRU)											
WTK-01	Storage Tank W01 - Produced Water (PW)	There are De Minimis GHGs in Produced Water (PW) Storage Tank Emissions										
WTK-02	Storage Tank W02 - Produced Water (PW)											
TLO	Truck Loading - Produced Water (PW)	There are De Minimis GHGs in Stabilized Condensate (SC) Truck Loading Emissions										
WTLO	Truck Loading - Stabilized Condensate (SC) (CarbCan)											
CBD/ESD	Compressor Blowdown/Emergency Shutdown Tests	1,249 events/yr	---	8,760	0.25	0.25	57.57	1,439	---	---	329	1,440
<b>Sand Hill Compressor Station (SHCS) - Point Sources</b>					<b>87,117</b>	<b>87,117</b>	<b>919</b>	<b>22,974</b>	<b>0.26</b>	<b>76.8</b>	<b>25,152</b>	<b>110,168</b>
<b>Sand Hill Compressor Station (SHCS) - Fugitives - PRE-Control</b>												
FUG-G	Piping & Equip Leaks - Gas	7,472 Units	---	8,760	0.20	0.20	46.71	1,168	---	---	267	1,168
FUG-O	Piping & Equip Leaks - Light Liquid	There are De Minimis GHGs in Light Liquid Piping & Equip Leak Emissions										
ECC	Engine Crankcase Fugitives	17,365 bhp	---	8,760	213	213	1.93	48.15	3E-04	0.10	59.62	261
<b>Sand Hill Compressor Station (SHCS) - Fugitives</b>					<b>213</b>	<b>213</b>	<b>48.63</b>	<b>1,216</b>	<b>3E-04</b>	<b>0.10</b>	<b>326</b>	<b>1,429</b>
<b>Sand Hill Compressor Station (SHCS) - Total - PRE-Control</b>												
<b>Sand Hill Compressor Station (SHCS) - Total</b>					<b>87,330</b>	<b>87,330</b>	<b>968</b>	<b>24,190</b>	<b>0.26</b>	<b>76.94</b>	<b>25,479</b>	<b>111,597</b>

\* = lb/hr is based on 8,760 hr/yr, except Compressor Blowdowns (CBD/ESD), Truck Load-Out (TLO, WTLO), and Pigging (PIG) are less frequent.

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Compressor Engine (CE-01 thru CE-12) Emissions**

Source ID	Description	Reference	Pollutant	Pre-Controlled Emissions				Control Efficiency	Controlled Emissions		
				g/bhp-hr	lb/MMBtu	lb/hr	tpy		g/bhp-hr	lb/hr	tpy
CE-01 CE-02 CE-03 CE-04 CE-05 CE-06 CE-07 CE-08 CE-09 CE-10 CE-11 CE-12  (Each)	Compressor Engines 01 thru 12 (Each) (OxCat-01 thru OxCat-12)	Vendor Data	NOX	0.50	0.14	1.52	6.66	---	0.50	1.52	6.66
		Vendor Data	CO	2.98	0.81	9.07	39.71	85.0%	0.45	1.36	5.96
		Vendor Data	NMNEHC	1.08	0.29	3.29	14.39	75.0%	0.27	0.82	3.60
		Sum	VOC (w/Aldehyde)	1.52	0.41	4.62	20.25	78.8%	0.32	0.98	4.28
	Caterpillar (CAT) G3516B (4SLB)	AP-42 Table 3.2-2	PM10/2.5	3.69E-02	9.99E-03	0.11	0.49	---	0.04	0.11	0.49
		AP-42 Table 3.2-2	SO2	2.17E-03	5.88E-04	0.01	0.03	---	2E-03	0.01	0.03
		AP-42 Table 3.2-2	*Acetaldehyde	3.09E-02	8.36E-03	0.09	0.41	75.0%	0.01	0.02	0.10
		AP-42 Table 3.2-2	*Acrolein	1.90E-02	5.14E-03	0.06	0.25	75.0%	5E-03	0.01	0.06
	1,380 bhp (Each)	AP-42 Table 3.2-2	Benzene	1.62E-03	4.40E-04	5E-03	0.02	75.0%	4E-04	1E-03	5E-03
	8,760 hr/yr (Each)	AP-42 Table 3.2-2	Butadiene, 1,3-	9.86E-04	2.67E-04	3E-03	0.01	75.0%	2E-04	7E-04	3E-03
	1,400 rpm, 16 cyl	AP-42 Table 3.2-2	Ethylbenzene	1.47E-04	3.97E-05	4E-04	2E-03	75.0%	4E-05	1E-04	5E-04
	264 in3/cyl	Vendor Data	*Formaldehyde	0.39	0.11	1.19	5.20	90.0%	0.04	0.12	0.52
	1,012 Exhaust Temp (oF)	AP-42 Table 3.2-2	n-Hexane	4.10E-03	1.11E-03	0.01	0.05	75.0%	1E-03	3E-03	0.01
	9,240 Exhaust Flow (acfm)	AP-42 Table 3.2-2	Methanol	9.23E-03	2.50E-03	0.03	0.12	75.0%	2E-03	0.01	0.03
	Manufactured ≥ 07/01/10 NSPS JJJJ Affected	AP-42 Table 3.2-2	POM	1.28E-03	3.47E-04	4E-03	0.02	75.0%	3E-04	1E-03	4E-03
		AP-42 Table 3.2-2	Toluene	1.51E-03	4.08E-04	5E-03	0.02	75.0%	4E-04	1E-03	5E-03
		AP-42 Table 3.2-2	TMP, 2,2,4-	9.86E-04	2.67E-04	3E-03	0.01	75.0%	2E-04	7E-04	3E-03
		AP-42 Table 3.2-2	Xylenes	6.79E-04	1.84E-04	2E-03	0.01	75.0%	2E-04	5E-04	2E-03
	8,138 Btu/bhp-hr (HHV)	AP-42 Table 3.2-2	Other/Trace HAP	1.18E-03	3.21E-04	4E-03	0.02	75.0%	3E-04	9E-04	4E-03
	11.23 MMBtu/hr (HHV) (Each)	Sum	Total HAP	0.46	0.13	1.40	6.15	87.7%	0.06	0.17	0.76
11,010 scf/hr (Each)	Vendor Data	CO2 (GWP=1)	510	138	1,552	6,796	---	510	1,552	6,796	
96.45 MMscf/yr (Each)	AP-42 Table 3.2-2	CH4 (GWP=25)	4.61	1.25	14.04	61.49	---	4.61	14.04	61.49	
1,020 Btu/scf (HHV)	40CFR98 - Table C2	N2O (GWP=298)	8.14E-04	2.20E-04	2E-03	0.01	---	8E-04	2E-03	0.01	
	Weighted Sum	CO2e	626	169	1,903	8,336	---	626	1,903	8,336	

\* = Aldehyde

Notes:

- The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr. Actual load and operating hours will be less.
- As per vendor specifications, NMNEHC (non-methane/non-ethane hydrocarbons) do NOT include aldehydes. VOC is the sum of NMNEHC, Acetaldehyde, Acrolein, and Formaldehyde.
- PM10/2.5 is filterable and condensable particulate matter; including PM10 and PM2.5
- "Other/Trace HAPs" includes: CarbonTetrachloride, Chlorobenzene, Chloroform, Dichloropropene, Ethylene Dibromide, Methylene Chloride, Phenol, Propylene Oxide, Styrene, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, and Vinyl Chloride (as per AP-42).
- The fuel heating value will vary, 1,020 Btu/scf (HHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.
- Total NMNEHC, VOC, HCHO, HAP and CO2e emissions include Compressor Rod Packing (CRP), Compressor Blowdown (CBD), Engine Start-up (ESU), and Engine Crankcase (ECC) Emissions:

Description (Each Engine w/ Compressor)	NMNEHC	VOC	HCHO	Tot HAP	CO2e
Engine Operations (See Above)	3.60 tpy	4.28 tpy	0.52 tpy	0.76 tpy	8,336 tpy
Compressor Rod Packing (CRP)	3.60 tpy	3.60 tpy	---	0.12 tpy	208 tpy
Compressor Blowdown (CBD)	1.47 tpy	1.47 tpy	---	0.05 tpy	84.98 tpy
Engine Start-up (ESU)	Electric or Compressed Air Starter - No Start-up Emissions				
Engine Crankcase (ECC)	0.04 tpy	0.05 tpy	0.01 tpy	0.02 tpy	20.75 tpy
<b>TOTAL:</b>	<b>8.71 tpy</b>	<b>9.41 tpy</b>	<b>0.53 tpy</b>	<b>0.94 tpy</b>	<b>8,650 tpy</b>

- Last permit application showed CO control at 98%. To be conservative this has been reduced to 93%.
- Last permit application showed HCHO control at 95%. To be conservative this has been reduced to 90%.

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Compressor Rod Packing (CRP) Emissions**

Source ID	Unit Description (Compressor Rod Packing)	No of Cylinders	scfh per Cylinder	Contingency	Total Fugitive Leak Rate		Control Efficiency	VOC		CO2		CH4		CO2e	
					scfh	MMscfy		14,900.00 lb/MMscf		150.00 lb/MMscf		34,400.00 lb/MMscf		CH4 GWP = 25	
								lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
CRP	Reciprocating Compressor - 01	4	12.0	15%	55.20	0.48	na	0.82	3.60	0.01	0.04	1.90	8.32	47	208
	Reciprocating Compressor - 02	4	12.0	15%	55.20	0.48		0.82	3.60	0.01	0.04	1.90	8.32	47	208
	Reciprocating Compressor - 03	4	12.0	15%	55.20	0.48		0.82	3.60	0.01	0.04	1.90	8.32	47	208
	Reciprocating Compressor - 04	4	12.0	15%	55.20	0.48		0.82	3.60	0.01	0.04	1.90	8.32	47	208
	Reciprocating Compressor - 05	4	12.0	15%	55.20	0.48		0.82	3.60	0.01	0.04	1.90	8.32	47	208
	Reciprocating Compressor - 06	4	12.0	15%	55.20	0.48		0.82	3.60	0.01	0.04	1.90	8.32	47	208
	Reciprocating Compressor - 07	4	12.0	15%	55.20	0.48		0.82	3.60	0.01	0.04	1.90	8.32	47	208
	Reciprocating Compressor - 08	4	12.0	15%	55.20	0.48		0.82	3.60	0.01	0.04	1.90	8.32	47	208
	Reciprocating Compressor - 09	4	12.0	15%	55.20	0.48		0.82	3.60	0.01	0.04	1.90	8.32	47	208
	Reciprocating Compressor - 10	4	12.0	15%	55.20	0.48		0.82	3.60	0.01	0.04	1.90	8.32	47	208
	Reciprocating Compressor - 11	4	12.0	15%	55.20	0.48		0.82	3.60	0.01	0.04	1.90	8.32	47	208
	Reciprocating Compressor - 12	4	12.0	15%	55.20	0.48		0.82	3.60	0.01	0.04	1.90	8.32	47	208
<b>TOTAL:</b>								<b>9.87</b>	<b>43.23</b>	<b>0.10</b>	<b>0.44</b>	<b>22.79</b>	<b>99.81</b>	<b>570</b>	<b>2,496</b>

Source ID	Unit Description (Compressor Rod Packing)	Benzene		E-Benzene		n-Hexane		Toluene		2,2,4-TMP		Xylene		Tot HAP	
		25.00 lb/MMscf		25.00 lb/MMscf		375.00 lb/MMscf		25.00 lb/MMscf		25.00 lb/MMscf		25.00 lb/MMscf		500.00 lb/MMscf	
		lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
CRP	Reciprocating Compressor - 01	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
	Reciprocating Compressor - 02	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
	Reciprocating Compressor - 03	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
	Reciprocating Compressor - 04	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
	Reciprocating Compressor - 05	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
	Reciprocating Compressor - 06	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
	Reciprocating Compressor - 07	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
	Reciprocating Compressor - 08	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
	Reciprocating Compressor - 09	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
	Reciprocating Compressor - 10	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
	Reciprocating Compressor - 11	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
	Reciprocating Compressor - 12	1E-03	0.01	1E-03	0.01	0.02	0.09	1E-03	0.01	1E-03	0.01	1E-03	0.01	0.03	0.12
<b>TOTAL:</b>		<b>0.02</b>	<b>0.07</b>	<b>0.02</b>	<b>0.07</b>	<b>0.25</b>	<b>1.09</b>	<b>0.02</b>	<b>0.07</b>	<b>0.02</b>	<b>0.07</b>	<b>0.02</b>	<b>0.07</b>	<b>0.33</b>	<b>1.45</b>

Notes: 1 - As per the manufacturer (Ariel): "Packing in new and broken-in condition will leak 5-10 scfh through the vent. This leakage rate will increase over time due to wear of the non-metallic sealing rings." The Williams' engineering department provides a conservative leak rate estimate of 12 scfh/cylinder (equal to 48 scfh/compressor). In this instance, an additional 15% contingency was added to yield 55.20 scfh/compressor.

3 - Prior permit applications did not include Compressor Rod Packing (CRP) emissions.

2 - The results of a representative **Wet Gas Analysis** were used to determine the following worst-case components (See Appendix A - Lab Data):

Pollutant	Wet Gas	Minimum Contingency: 10%		
		Worst Case	%Total	%VOC
CO2	101 lb/MMscf	150 lb/MMscf	0.24	---
Methane (CH4)	31,244 lb/MMscf	34,400 lb/MMscf	54.17	---
N2/Water/Ethane/Etc	12,858 lb/MMscf	14,050 lb/MMscf	22.13	---
VOC	13,518 lb/MMscf	14,900 lb/MMscf	23.46	100.00
TOTAL Gas	57,720 lb/MMscf	63,500 lb/MMscf	100.00	100.00

Pollutant	Wet Gas	Minimum Contingency: 10%		
		Worst Case	%Total	%VOC
Benzene	4 lb/MMscf	25 lb/MMscf	0.04	0.17
Ethylbenzene	1 lb/MMscf	25 lb/MMscf	0.04	0.17
n-Hexane	322 lb/MMscf	375 lb/MMscf	0.59	2.52
Toluene	8 lb/MMscf	25 lb/MMscf	0.04	0.17
2,2,4-TMP	6 lb/MMscf	25 lb/MMscf	0.04	0.17
Xylenes	5 lb/MMscf	25 lb/MMscf	0.04	0.17
Total HAP	346 lb/MMscf	500 lb/MMscf	0.79	3.36

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Generator Engine (GEN) Emissions**

Source ID	Description	Reference	Pollutant	Pre-Controlled Emissions				Control Efficiency	Controlled Emissions		
				g/bhp-hr	lb/MMBtu	lb/hr	tpy		g/bhp-hr	lb/hr	tpy
GEN	Non-Emergency Microturbine Generator	Vendor Data x 2	NOX	0.27	7.01E-02	0.48	2.10	---	0.27	0.48	2.10
		Vendor Data x 2	CO	0.74	0.19	1.32	5.78	---	0.74	1.32	5.78
		Vendor Data x 2	NMNEHC	6.76E-02	1.75E-02	0.12	0.53	---	0.07	0.12	0.53
		SUM	VOC (w/HCHO)	7.34E-02	1.90E-02	0.13	0.57	---	0.07	0.13	0.57
	Capstone C600	AP-42 Table 3.1-2a	PM10/2.5	2.56E-02	6.63E-03	0.05	0.20	---	0.03	0.05	0.20
		AP-42 Table 3.1-2a	SO2	2.27E-03	5.88E-04	4E-03	0.02	---	2E-03	4E-03	0.02
	805 bhp 8,760 hr/yr	AP-42 Table 3.1-3 x 2	Acetaldehyde	3.08E-04	8.00E-05	5.47E-04	2E-03	---	3E-04	5E-04	2E-03
		AP-42 Table 3.1-3 x 2	Acrolein	4.94E-05	1.28E-05	8.76E-05	4E-04	---	5E-05	9E-05	4E-04
	535 Exhaust Temp (oF)	AP-42 Table 3.1-3 x 2	Benzene	9.25E-05	2.40E-05	1.64E-04	7E-04	---	9E-05	2E-04	7E-04
		AP-42 Table 3.1-3 x 2	Butadiene, 1,3-	3.32E-06	8.60E-07	6E-06	3E-05	---	3E-06	6E-06	3E-05
		AP-42 Table 3.1-3 x 2	Ethylbenzene	2.47E-04	6.40E-05	4E-04	2E-03	---	2E-04	4E-04	2E-03
		AP-42 Table 3.1-3 x 2	Formaldehyde	5.48E-03	1.42E-03	9.72E-03	0.04	---	0.01	0.01	0.04
		AP-42 Table 3.1-3 x 2	n-Hexane	---	---	---	---	---	---	---	---
		AP-42 Table 3.1-3 x 2	Methanol	---	---	---	---	---	---	---	---
		AP-42 Table 3.1-3 x 2	POM	2.51E-04	6.50E-05	4E-04	2E-03	---	3E-04	4E-04	2E-03
		AP-42 Table 3.1-3 x 2	Toluene	1.00E-03	2.60E-04	2E-03	0.01	---	1E-03	2E-03	0.01
		AP-42 Table 3.1-3 x 2	TMP, 2,2,4-	---	---	---	---	---	---	---	---
		AP-42 Table 3.1-3 x 2	Xylenes	4.94E-04	1.28E-04	9E-04	4E-03	---	5E-04	9E-04	4E-03
	8,501 Btu/bhp-hr (HHV) 6.84 MMBtu/hr (HHV) 6,709 scf/hr 58.77 MMscf/yr 1,020 Btu/scf (HHV)	AP-42 Table 3.1-3 x 2	Other/Trace HAP	2.24E-04	5.80E-05	4E-04	2E-03	---	2E-04	4E-04	2E-03
		Sum	Total HAP	8.15E-03	2.11E-03	0.01	0.06	---	0.01	0.01	0.06
		Vendor Data	CO2 (GWP=1)	450	117	798	3,494	---	450	798	3,494
		AP-42 Table 3.1-3 x 2	CH4 (GWP=25)	6.66E-02	1.73E-02	0.12	0.52	---	0.07	0.12	0.52
		40CFR98 - Table C2	N2O (GWP=298)	1.16E-02	3.00E-03	2E-02	0.09	---	1E-02	2E-02	9E-02
Weighted Sum		CO2e	455	118	807	3,534	---	455	807	3,534	

\* = Aldehyde

- Notes:
- 1 - The emissions estimates are based on operation at 100% of rated load for 8,760 hr/yr. Actual load and operating hours will be less.
  - 2 - A footnote to AP-42 Table 3.4-1 indicates that "THC is based on EPA Test Method 25A" and "VOC = THC - Methane". However, EPA Method 25A does NOT measure aldehydes (or methanol). Accordingly, and to be conservative, total VOC is estimated by NMNEHC + aldehydes.
  - 3 - PM10/2.5 is filterable and condensable particulate matter; including PM10 and PM2.5
  - 4 - The fuel heating value will vary, 1,020 Btu/scf (HHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.
  - 5 - The turbine's operating load has a considerable effect on the resulting emission levels. With reduced loads (lower than 80 percent) the NOX, CO, and THC (NMNEHC, VOC, HAP, and CH4) emissions are expected to be higher. The vendor states that "fuel flows can be up to two times higher than steady state values." Accordingly, and to be conservative, the vendor and AP-42 [full load, steady-state] emission factor data are increased by a factor of two (2). (The Capstone C600 is comprised of three (3) 200 kWhe turbine generators operating in parallel, thus minimizing the low-load operations.)

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Dehydrator (DHY-01 thru -03) Emissions**

Source ID	Description	Reference	Pollutant	Worst-Case PRE-Control Emissions		Control Efficiency %	Worst-Case Controlled Emissions	
				lb/hr	tpy		lb/hr	tpy
DHY-01 DHY-02 DHY-03  (Each)	Dehydrator 01 thru 03 (Each)  (No Combustion Emissions Shown, See BLR-01 thru 03)  55.0 MMscfd (Each)  8,760 hr/yr (Each)  *All the Flash-Tank Off-Gas Stream is Recycled as Fuel or otherwise reclaimed. Recycle/reclaim is <u>NOT</u> an Emissions Control Technology.  20,075 MMscf/yr (Each)  2.29 MMscf/hr (Each)  NESHAP HH - Exempt (Less than 1.0 tpy Benzene)	See BLR-01 thru BLR-03	NOX			See BLR-01 thru BLR-03		
		See BLR-01 thru BLR-03	CO			See BLR-01 thru BLR-03		
		GRI-GLYCalc 4.0	NMNEHC	52.27	228.93	96.6%	1.79	7.85
		GRI-GLYCalc 4.0	VOC	52.27	228.93	96.6%	1.79	7.85
		See BLR-01 thru BLR-03	SO2			See BLR-01 thru BLR-03		
		See BLR-01 thru BLR-03	PM10/2.5			See BLR-01 thru BLR-03		
		See BLR-01 thru BLR-03	Acetaldehyde			See BLR-01 thru BLR-03		
		See BLR-01 thru BLR-03	Acrolein			See BLR-01 thru BLR-03		
		GRI-GLYCalc 4.0	Benzene	1.75	7.66	96.4%	0.06	0.27
		See BLR-01 thru BLR-03	Butadiene, 1,3-			See BLR-01 thru BLR-03		
		GRI-GLYCalc 4.0	Ethylbenzene	0.32	1.41	98.9%	4E-03	0.02
		See BLR-01 thru BLR-03	Formaldehyde			See BLR-01 thru BLR-03		
		GRI-GLYCalc 4.0	n-Hexane	2.30	10.07	96.1%	0.09	0.40
		See BLR-01 thru BLR-03	Methanol			See BLR-01 thru BLR-03		
		See BLR-01 thru BLR-03	POM			See BLR-01 thru BLR-03		
		GRI-GLYCalc 4.0	Toluene	4.42	19.35	97.8%	0.10	0.43
		GRI-GLYCalc 4.0	TMP, 2,2,4-	0.23	1.00	99.0%	2E-03	0.01
		GRI-GLYCalc 4.0	Xylenes	3.79	16.58	99.0%	0.04	0.17
		See BLR-01 thru BLR-03	Other/Trace HAP			See BLR-01 thru BLR-03		
		SUM	Total HAP	12.80	56.07	97.7%	0.30	1.30
GRI-GLYCalc 4.0	CO2 (GWP=1)	0.58	2.54	---	0.58	2.54		
GRI-GLYCalc 4.0	CH4 (GWP=25)	1.76	7.73	95.0%	0.09	0.39		
GRI-GLYCalc 4.0	N2O (GWP=298)			GRI-GLYCalc 4.0				
WEIGHTED SUM	CO2e	44.70	195.78	94%	2.79	12.20		

Notes: 1 - Results of GRI-GLYCalc Model are shown below:

55.0 MMscfd DHY-01	GRI-GLYCalc 4.0*				*Dehydrator Operating Parameters (See Supplement S6 - Emission Programs)		
	PRE-Control Emissions		Controlled Emissions		Manufacturer:	Dry Gas Flow Rate:	55.0 MMscfd
	GLYCalc Results	Worst-Case**	GLYCalc Results	Worst-Case**	Wet Gas:	Gas Analysis:	11/02/16
NMNEHC = VOC	208.12 tpy	228.93 tpy	7.14 tpy	7.85 tpy	Wet Gas:	Primary Pump:	Electric
Benzene	6.96 tpy	7.66 tpy	0.25 tpy	0.27 tpy	Wet Gas:	Backup Pump:	2xKimray 45020PV
Ethylbenzene	1.28 tpy	1.41 tpy	1E-02 tpy	0.02 tpy	Wet Gas:	Glycol Circ Rate:	22.00 gpm
n-Hexane	9.15 tpy	10.07 tpy	0.36 tpy	0.40 tpy	Wet Gas:	Glycol Circ Ratio:	12.57 gal/lb-H2O
Toluene	17.59 tpy	19.35 tpy	0.40 tpy	0.43 tpy	Dry Gas:	Rich Glycol:	2.30 wt% H2O
2,2,4-TMP	0.11 tpy	1.00 tpy	3E-03 tpy	0.01 tpy	Lean Glycol:	Flash Temp:	120.00 oF
Xylenes	15.07 tpy	16.58 tpy	0.15 tpy	0.17 tpy	Flash Temp:	Flash Pressure:	50.00 psig
Total HAP	50.17 tpy	56.07 tpy	1.17 tpy	1.30 tpy	Flash Off-Gas:	Flash Off-Gas:	1,560 scfh
Carbon Dioxide (CO2)	2.31 tpy	2.54 tpy	2.31 tpy	2.54 tpy	Off-Gas Recycle:	Off-Gas Recycle:	100.00%
Methane (CH4)	7.03 tpy	7.73 tpy	0.35 tpy	0.39 tpy	Off-Gas Control:	Off-Gas Control:	na
					Stripping Gas:	Stripping Gas:	na

(\*\*Worst-Case is determined with a 110% "Safety Margin".)

- 2 - The emissions shown are based on operation at 100% of rated capacity for 8,760 hr/yr. Actual load and operating hours will be less.
- 3 - Emissions from utilization of the Kimray 45020PV Backup glycol pump (2x7.5 gpm) actually results in a reduction of hourly VOC emissions (Kimray: 0.71 lb/hr vs Electric: 1.72 lb/hr)

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Reboiler (BLR-01 thru -03) Emissions**

Source ID	Description	Reference	Pollutant	Emission Factor		Emissions	
				lb/MMscf	lb/MMBtu	lb/hr	tpy
BLR-01 BLR-02 BLT-03  (Each)	Reboiler 01 thru 03 (Each)	EPA AP-42 Table 1.4-1	NOX	100	9.80E-02	0.10	0.43
		EPA AP-42 Table 1.4-1	CO	84	8.24E-02	0.08	0.36
		EPA AP-42 Table 1.4-2	NMNEHC	5.5	5.39E-03	0.01	0.02
		EPA AP-42 Table 1.4-2	VOC	5.5	5.39E-03	0.01	0.02
		EPA AP-42 Table 1.4-2	PM10/2.5	7.6	7.45E-03	0.01	0.03
		EPA AP-42 Table 1.4-2	SO2	0.6	5.88E-04	6E-04	3E-03
	1.00 MMBtu/hr (HHV) (Each)	EPA AP-42 Table 1.4-3	Acetaldehyde	---	---	---	---
		EPA AP-42 Table 1.4-3	Acrolein	---	---	---	---
		EPA AP-42 Table 1.4-3	Benzene	2.10E-03	2.06E-06	2E-06	9E-06
		EPA AP-42 Table 1.4-4	Butadiene, 1,3-	---	---	---	---
		EPA AP-42 Table 1.4-3	Ethylbenzene	---	---	---	---
		EPA AP-42 Table 1.4-3	Formaldehyde	7.50E-02	7.35E-05	7E-05	3E-04
	1,020 Btu/scf (HHV)	EPA AP-42 Table 1.4-3	n-Hexane	1.80	1.76E-03	2E-03	0.01
		EPA AP-42 Table 1.4-3	Methanol	---	---	---	---
		EPA AP-42 Table 1.4-3	POM	6.98E-04	6.85E-07	7E-07	3E-06
		EPA AP-42 Table 1.4-3	Toluene	3.40E-03	3.33E-06	3E-06	1E-05
		EPA AP-42 Table 1.4-3	TMP, 2,2,4-	---	---	---	---
		EPA AP-42 Table 1.4-3	Xylenes	---	---	---	---
	8,760 hr/yr (Each)	EPA AP-42 Table 1.4-3	Other/Trace HAP	1.20E-03	1.18E-06	1E-06	5E-06
		SUM	Total HAP	1.88	1.85E-03	2E-03	0.01
	980 scf/hr (Each)	EPA AP-42 Table 1.4-2	CO2 (GWP=1)	120,000	118	118	515
EPA AP-42 Table 1.4-2		CH4 (GWP=25)	2.30	2.25E-03	2E-03	0.01	
8.59 MMscf/yr (Each)	EPA AP-42 Table 1.4-2	N2O (GWP=298)	2.20	2.16E-03	2E-03	0.01	
	WEIGHTED SUM	CO2e	120,713	118	118	518	

- Notes:
- 1 - The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr. Actual load and operating hours will be less.
  - 2 - The fuel heating value will vary, 1,020 Btu/scf (HHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.
  - 3 - PM10/2.5 is filterable and condensable particulate matter; including PM10 and PM2.5
  - 4 - "Other/Trace HAPs" includes: CarbonTetrachloride, Chlorobenzene, Chloroform, Dichloropropene, 1,3-Dichloropropene, Ethylene Dibromide, Methylene Chloride, Phenol, Propylene Oxide, Styrene, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, and Vinyl Chloride (as per AP-42).

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Heater-Treater (HTR-01 and HTR-02) Emissions**

Source ID	Description	Reference	Pollutant	Emission Factor		Emissions	
				lb/MMscf	lb/MMBtu	lb/hr	tpy
HTR-01 HTR-02	Heater-Treater 01 and 02 (Each)	EPA AP-42 Table 1.4-1	NOX	100	9.80E-02	0.06	0.21
		EPA AP-42 Table 1.4-1	CO	84	8.24E-02	0.05	0.18
		EPA AP-42 Table 1.4-2	NMNEHC	5.5	5.39E-03	3E-03	0.01
		EPA AP-42 Table 1.4-2	VOC	5.5	5.39E-03	3E-03	0.01
		EPA AP-42 Table 1.4-2	PM10/2.5	7.6	7.45E-03	5E-03	0.02
		EPA AP-42 Table 1.4-2	SO2	0.6	5.88E-04	4E-04	1E-03
	0.50 MMBtu/hr (HHV) (Each)	EPA AP-42 Table 1.4-3	Acetaldehyde	---	---	---	---
		EPA AP-42 Table 1.4-3	Acrolein	---	---	---	---
		EPA AP-42 Table 1.4-3	Benzene	2.10E-03	2.06E-06	1E-06	5E-06
		EPA AP-42 Table 1.4-4	Butadiene, 1,3-	---	---	---	---
		EPA AP-42 Table 1.4-3	Ethylbenzene	---	---	---	---
		EPA AP-42 Table 1.4-3	Formaldehyde	7.50E-02	7.35E-05	5E-05	2E-04
	1,020 Btu/scf (HHV)	EPA AP-42 Table 1.4-3	n-Hexane	1.80	1.76E-03	1E-03	4E-03
		EPA AP-42 Table 1.4-3	Methanol	---	---	---	---
		EPA AP-42 Table 1.4-3	POM	6.98E-04	6.85E-07	4E-07	1E-06
		EPA AP-42 Table 1.4-3	Toluene	3.40E-03	3.33E-06	2E-06	7E-06
		EPA AP-42 Table 1.4-3	TMP, 2,2,4-	---	---	---	---
		EPA AP-42 Table 1.4-3	Xylenes	---	---	---	---
	8,760 hr/yr (Each)	EPA AP-42 Table 1.4-3	Other/Trace HAP	1.20E-03	1.18E-06	7E-07	3E-06
		SUM	Total HAP	1.88	1.85E-03	1E-03	4E-03
	600 scf/hr (Each)	EPA AP-42 Table 1.4-2	CO2 (GWP=1)	120,000	118	72	258
		EPA AP-42 Table 1.4-2	CH4 (GWP=25)	2.30	2.25E-03	1E-03	5E-03
	4.29 MMscf/yr (Each)	EPA AP-42 Table 1.4-2	N2O (GWP=298)	2.20	2.16E-03	1E-03	5E-03
WEIGHTED SUM		CO2e	120,713	118	59	259	

- Notes:
- 1 - The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr. Actual load and operating hours will be less.
  - 2 - The fuel heating value will vary, 1,020 Btu/scf (HHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate. (Operator experience indicates 600 scf/hr is requisite for "cold-starts".)
  - 3 - PM10/2.5 is filterable and condensable particulate matter; including PM10 and PM2.5
  - 4 - "Other/Trace HAPs" includes: CarbonTetrachloride, Chlorobenzene, Chloroform, Dichloropropene, 1,3-Dichloropropene, Ethylene Dibromide, Methylene Chloride, Phenol, Propylene Oxide, Styrene, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, and Vinyl Chloride (as per AP-42).

**Stabilized Condensate - Storage Tank (TK01 thru TK-08) Emissions**

Source ID	Source ID	Material Stored	Capacity bbl	T-Put bbl/yr	PRE-CONTROL			VRU Control Efficiency	VOC (100%)		CO2 (w/o Control) --- VOC		CH4 --- VOC		CO2e CH4 GWP = 25	
					W+B	Flash	Total		lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
					lb/yr	lb/yr	lb/yr									
EUTK1-8	TK-01	Stabilized Condensate	400	29,656	6,741	---	6,741	0.04	0.17	---	---	---	---	---	---	---
	TK-02	Stabilized Condensate	400	29,656	6,741	---	6,741	0.04	0.17	---	---	---	---	---	---	---
	TK-03	Stabilized Condensate	400	29,656	6,741	---	6,741	0.04	0.17	---	---	---	---	---	---	---
	TK-04	Stabilized Condensate	400	29,656	6,741	---	6,741	0.04	0.17	---	---	---	---	---	---	---
	TK-05	Stabilized Condensate	400	29,656	6,741	---	6,741	0.04	0.17	---	---	---	---	---	---	---
	TK-06	Stabilized Condensate	400	29,656	6,741	---	6,741	0.04	0.17	---	---	---	---	---	---	---
	TK-07	Stabilized Condensate	400	29,656	6,741	---	6,741	0.04	0.17	---	---	---	---	---	---	---
	TK-08	Stabilized Condensate	400	29,656	6,741	---	6,741	0.04	0.17	---	---	---	---	---	---	---
<b>TOTAL:</b>			<b>3,200</b>	<b>237,250</b>	<b>53,931</b>			<b>95%</b>	<b>0.31</b>	<b>1.35</b>	---	---	---	---	---	---
Mgal/yr: 9,965				PRE-Control (Each): 0.77 3.37				PRE-Control (Total): 6.16 26.97								
Turnovers: 74.14																

Source ID	Tank ID	Benzene 2.00% VOC		Ethylbenzene 2.00% VOC		n-Hexane 20.00% VOC		Methanol (MeOH)		Toluene 2.00% VOC		2,2,4-TMP 2.00% VOC		Xylene 2.00% VOC		Total HAP 30.00% VOC	
		lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
		EUTK1-8	TK-01	8E-04	3E-03	8E-04	3E-03	0.01	0.03	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03
TK-02	8E-04		3E-03	8E-04	3E-03	0.01	0.03	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	0.01	0.05
TK-03	8E-04		3E-03	8E-04	3E-03	0.01	0.03	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	0.01	0.05
TK-04	8E-04		3E-03	8E-04	3E-03	0.01	0.03	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	0.01	0.05
TK-05	8E-04		3E-03	8E-04	3E-03	0.01	0.03	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	0.01	0.05
TK-06	8E-04		3E-03	8E-04	3E-03	0.01	0.03	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	0.01	0.05
TK-07	8E-04		3E-03	8E-04	3E-03	0.01	0.03	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	0.01	0.05
TK-08	8E-04		3E-03	8E-04	3E-03	0.01	0.03	---	---	8E-04	3E-03	8E-04	3E-03	8E-04	3E-03	0.01	0.05
<b>TOTAL:</b>		<b>0.01</b>	<b>0.03</b>	<b>0.01</b>	<b>0.03</b>	<b>0.06</b>	<b>0.27</b>	---	---	<b>0.01</b>	<b>0.03</b>	<b>0.01</b>	<b>0.03</b>	<b>0.01</b>	<b>0.03</b>	<b>0.09</b>	<b>0.40</b>
PRE-Control (Each):		0.02	0.07	0.02	0.07	0.15	0.67	---	---	0.02	0.07	0.02	0.07	0.02	0.07	0.23	1.01
PRE-Control (Total):		0.12	0.54	0.12	0.54	1.23	5.39	---	---	0.12	0.54	0.12	0.54	0.12	0.54	1.85	8.09

Notes: 1 - EPA TANKS 4.0.9d was used to determine working and breathing losses from each (of 2) Produced Water Storage Tank - See Supplement S6 - Emission Programs.

**TANKS 4.0.9d  
 Emissions Report - Summary Format  
 Individual Tank Emission Totals**

**Emissions Report for: Annual**

**Battle Run CF 400 bbl Stabilized Condensate Tank - Vertical Fixed Roof Tank  
 Near Dallas, West Virginia**

Losses(lbs)			
Components	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 12)	5,721.52	1,019.88	6,741.40

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Produced Water - Storage Tank (WTK-01 and WTK-02) Emissions**

Source ID	Tank ID	Material Stored	Capacity bbl	T-Put bbl/yr	PRE-CONTROL			VRU Control Efficiency	VOC		CO2 (w/o Control) --- VOC		CH4 --- VOC		CO2e CH4 GWP = 25	
					W+B	Flash	Total		lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
					lb/yr	lb/yr	lb/yr									
EPWTK	WTK-01	Produced Water	400	18,250	61	---	61	0.01	0.03	---	---	---	---	---	---	
	WTK-02	Produced Water	400	18,250	61	---	61	0.01	0.03	---	---	---	---	---	---	
			<b>800</b>	<b>36,500</b>	<b>122.00</b>			<b>TOTAL:</b>	<b>0.01</b>	<b>0.06</b>	---	---	---	---	---	
				Mgal/yr:	1,533	PRE-Control (Each):		0.01	0.03	---	---	---	---	---	---	
				Turnovers:	45.63	PRE-Control (Total):		0.01	0.06	---	---	---	---	---	---	

Source ID	Tank ID	Benzene 2.00% VOC		Ethylbenzene 2.00% VOC		n-Hexane 20.00% VOC		Methanol (MeOH)		Toluene 2.00% VOC		2,2,4-TMP 2.00% VOC		Xylene 2.00% VOC		Total HAP 30.00% VOC	
		lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
EPWTK	WTK-01	1E-04	6E-04	1E-04	6E-04	1E-03	0.01	---	---	1E-04	6E-04	1E-04	6E-04	1E-04	6E-04	2E-03	0.01
	WTK-02	1E-04	6E-04	1E-04	6E-04	1E-03	0.01	---	---	1E-04	6E-04	1E-04	6E-04	1E-04	6E-04	2E-03	0.01
<b>TOTAL:</b>		<b>3E-04</b>	<b>1E-03</b>	<b>3E-04</b>	<b>1E-03</b>	<b>3E-03</b>	<b>0.01</b>	---	---	<b>3E-04</b>	<b>1E-03</b>	<b>3E-04</b>	<b>1E-03</b>	<b>3E-04</b>	<b>1E-03</b>	<b>4E-03</b>	<b>0.02</b>
PRE-Control (Each):		1E-04	6E-04	1E-04	6E-04	1E-03	0.01	---	---	1E-04	6E-04	1E-04	6E-04	1E-04	6E-04	2E-03	0.01
PRE-Control (Total):		3E-04	1E-03	3E-04	1E-03	3E-03	0.01	---	---	3E-04	1E-03	3E-04	1E-03	3E-04	1E-03	4E-03	0.02

Notes: 1 - EPA TANKS 4.0.9d was used to determine working and breathing losses from each (of 2) Produced Water Storage Tank - See Supplement S6 - Emission Programs.

**TANKS 4.0.9d**  
**Emissions Report - Summary Format**  
**Individual Tank Emission Totals**

**Emissions Report for: Annual**

**Battle Run 400 bbl Produced Water Tank - Vertical Fixed Roof Tank**  
 Near Dallas, West Virginia

Components	Losses(lbs)		
	Working Loss	Breathing Loss	Total Emissions
Produced Water	101.51	18.57	120.08
Water	49.94	9.14	59.08
Gasoline (RVP 12)	51.57	9.44	61.00

**Stabilized Condensate (SC) - Truck Load-Out (TLO) Emissions**

Source ID	Description	S	P	M	T	CE	L <sub>L</sub>	T-Put	VOC		CO <sub>2</sub>		CH <sub>4</sub>		CO <sub>2</sub> e	
		sat. fac.	psia	lb/lb-mol	°R	%	lb/Mgal	Mgal/yr	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
TLO	Truck Load-Out - SC	0.60	5.44	64.00	510	66.5%	1.71	9,965	11.97	8.52	---	---	---	---	---	---
(See Attachment D3 - EPA TANKS 4.0.9d Emission Report)								<b>TOTAL:</b>		<b>11.97</b>	<b>8.52</b>	---	---	---	---	---
								PRE-Control:	35.72	25.4	---	---	---	---	---	---

Source ID	Benzene 2.00% VOC		Ethylbenzene 2.00% VOC		n-Hexane 20.00% VOC		Methanol (MeOH)		Toluene 2.00% VOC		2,2,4-TMP 2.00% VOC		Xylene 2.00% VOC		Total HAP 30.00% VOC	
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
TLO	0.24	0.17	0.24	0.17	2.39	1.70	---	---	0.24	0.17	0.24	0.17	0.24	0.17	3.59	2.56
<b>TOTAL:</b>	<b>0.24</b>	<b>0.17</b>	<b>0.24</b>	<b>0.17</b>	<b>2.39</b>	<b>1.70</b>	---	---	<b>0.24</b>	<b>0.17</b>	<b>0.24</b>	<b>0.17</b>	<b>0.24</b>	<b>0.17</b>	<b>3.59</b>	<b>2.56</b>

PRE-Cont: 0.71 0.51 0.71 0.51 7.14 5.09 --- --- 0.71 0.51 0.71 0.51 0.71 0.51 10.72 7.63

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<sub>L</sub> = loading loss, lb/1000 gal of liquid loaded

S = saturation factor, use 0.60 for submerged fill.

P = true vapor pressure of liquid loaded, psia.

M = molecular weight of vapors, lb/lb-mol.

T = temperature of bulk liquid loaded, °R = °F + 460

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

2 - For condensate loading, the collection efficiency is 70% for tanker trucks not subject to annual leak test.

3 - Emissions from loading of stabilized condensate will be controlled with 95% efficient carbon canisters.

4 - Stabilized condensate (SC) vapor pressure, molecular weight, and temperature are from EPA TANKS 4.0.9d output.

5 - The total stabilized condensate storage tank capacity at the facility is:

3,200 bbl = 134,400 gal.

6 - The maximum stabilized condensate throughput at the facility is:

237,250 bbl/yr = 9,964,500 gal/yr = 74.14 t-o/yr

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

8 - It is assumed each tanker truck holds 7,000 gallons and can be loaded in one hour:

1,424 hr/yr

**TANKS 4.0.9d**  
**Emissions Report - Summary Format**  
**Liquid Contents of Storage Tank**

**Battle Run CF 400 bbl Stabilized Condensate Tank - Vertical Fixed Roof Tank**  
**Near Dallas, West Virginia**

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Gasoline (RVP 12)	All	51.94	47.06	56.81	50.33	5.4430	4.9447	5.9807	64.0000			92.00	Option 4: RVP=12, ASTM Slope=3

**Produced Water (PW) - Truck Load-Out (WTLO) Emissions**

Source ID	Description	S	P	M	T	CE	L <sub>L</sub>	T-Put	VOC		CO <sub>2</sub>		CH <sub>4</sub>		CO <sub>2</sub> e CH <sub>4</sub> GWP = 25	
		sat. fac.	psia	lb/lb-mol	°R	%	lb/Mgal	Mgal/yr	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
WTLO	Truck Load-Out - PW	0.60	0.25	28.35	510	---	0.10	1,533	0.72	0.08	---	---	---	---	---	---
<b>TOTAL:</b>									<b>0.72</b>	<b>0.08</b>	---	---	---	---	---	

PRE-Control: 0.72 0.08 --- --- --- --- --- ---

Source ID	Benzene 2.00% VOC		Ethylbenzene 2.00% VOC		n-Hexane 20.00% VOC		Methanol (MeOH)		Toluene 2.00% VOC		2,2,4-TMP 2.00% VOC		Xylene 2.00% VOC		Total HAP 30.00% VOC	
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
WTLO	0.01	2E-03	0.01	2E-03	0.14	0.02	---	---	0.01	2E-03	0.01	2E-03	0.01	2E-03	0.22	0.02
<b>TOTAL:</b>	<b>0.01</b>	<b>2E-03</b>	<b>0.01</b>	<b>2E-03</b>	<b>0.14</b>	<b>0.02</b>	---	---	<b>0.01</b>	<b>2E-03</b>	<b>0.01</b>	<b>2E-03</b>	<b>0.01</b>	<b>2E-03</b>	<b>0.22</b>	<b>0.02</b>

PRE-Cont: 0.01 2E-03 0.01 2E-03 0.14 0.02 --- --- 0.01 2E-03 0.01 2E-03 0.01 2E-03 0.22 0.02

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<sub>L</sub> = loading loss, lb/1000 gal of liquid loaded

S = saturation factor, use 0.60 for submerged fill.

P = true vapor pressure of liquid loaded, psia.

M = molecular weight of vapors, lb/lb-mol.

T = temperature of bulk liquid loaded, °R = °F + 460

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

2 - Produced water vapor pressure, molecular weight, and temperature are based on operator experience and sampling data at various locations in the Marcellus Shale basin.

3 - The total produced water storage tank capacity at the facility is:

800 bbl = 33,600 gal.

4 - The maximum produced water throughput at the facility is:

36,500 bbl/yr = 1,533,000 gal/yr = 45.63 t-o/yr

5 - n-hexane,  
each RTEF

6 - It is assumed each tanker truck holds 7,000 gallons and can be loaded in one hour:

219 hr/yr

**TANKS 4.0.9d**  
**Emissions Report - Summary Format**  
**Liquid Contents of Storage Tank**

**Battle Run 400 bbl Produced Water Tank - Vertical Fixed Roof Tank**  
**Near Dallas, West Virginia**

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Produced Water	All	51.94	47.06	56.81	50.33	0.2465	0.2101	0.2893	28.3522	0.0500	0.5080	18.75	Option 4: RVP=12, ASTM Slope=3 Option 1: VP50 = .178073 VP60 = .255246
Gasoline (RVP 12)						5.4430	4.9447	5.9807	64.0000	0.9500	0.4920	92.00	
Water						0.1930	0.1614	0.2307	18.0000			18.00	

**Compressor Blowdown (CBD) / Emergency Shutdown (ESD) Emissions**

Source ID	Unit Description	Site Rating bhp	Blowdown and ESD Events/yr	Blowdown Gas scf/bhp	Total Gas Vented MMscf/yr	Control %	VOC 14,900 lb/MMscf		CO2 150 lb/MMscf		CH4 34,400 lb/MMscf		CO2e CH4 GWP = 25	
							lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
CBD/ESD	Reciprocating Compressor - 01	1,380	104	1.38	0.20	na	28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Reciprocating Compressor - 02	1,380	104	1.38	0.20		28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Reciprocating Compressor - 03	1,380	104	1.38	0.20		28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Reciprocating Compressor - 04	1,380	104	1.38	0.20		28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Reciprocating Compressor - 05	1,380	104	1.38	0.20		28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Reciprocating Compressor - 06	1,380	104	1.38	0.20		28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Reciprocating Compressor - 07	1,380	104	1.38	0.20		28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Reciprocating Compressor - 08	1,380	104	1.38	0.20		28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Reciprocating Compressor - 09	1,380	104	1.38	0.20		28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Reciprocating Compressor - 10	1,380	104	1.38	0.20		28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Reciprocating Compressor - 11	1,380	104	1.38	0.20		28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Reciprocating Compressor - 12	1,380	104	1.38	0.20		28.31	1.47	0.29	0.01	65.36	3.40	1,634	84.98
	Emergency Shutdown Testing (ESD)	16,560	1	58.93	0.98		---	7.27	---	0.07	---	16.79	---	419.71
<b>TOTAL:</b>		<b>1,249</b>	<b>TOTAL:</b>	<b>3.35</b>	<b>TOTAL:</b>	<b>28.31</b>	<b>24.94</b>	<b>TOTAL:</b>	<b>0.29</b>	<b>0.25</b>	<b>65.36</b>	<b>57.57</b>	<b>1,634</b>	<b>1,440</b>

Assumes 1 hr/CBD

Source ID	Unit Description (Compressor Blowdown - Raw Natural Gas)	Benzene 25.00 lb/MMscf		Ethylbenzene 25.00 lb/MMscf		n-Hexane 375.00 lb/MMscf		Toluene 25.00 lb/MMscf		2,2,4-TMP 25.00 lb/MMscf		Xylene 25.00 lb/MMscf		Total HAP 500.00 lb/MMscf	
		lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
CBD/ESD	Reciprocating Compressor - 01	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Reciprocating Compressor - 02	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Reciprocating Compressor - 03	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Reciprocating Compressor - 04	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Reciprocating Compressor - 05	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Reciprocating Compressor - 06	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Reciprocating Compressor - 07	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Reciprocating Compressor - 08	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Reciprocating Compressor - 09	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Reciprocating Compressor - 10	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Reciprocating Compressor - 11	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Reciprocating Compressor - 12	0.05	2E-03	0.05	2E-03	0.71	0.04	0.05	2E-03	0.05	2E-03	0.05	2E-03	0.95	0.05
	Emergency Shutdown Testing (ESD)	---	0.01	---	0.01	---	0.18	---	0.01	---	0.01	---	0.01	---	0.24
<b>TOTAL:</b>		<b>0.05</b>	<b>0.04</b>	<b>0.05</b>	<b>0.04</b>	<b>0.71</b>	<b>0.63</b>	<b>0.05</b>	<b>0.04</b>	<b>0.05</b>	<b>0.04</b>	<b>0.05</b>	<b>0.04</b>	<b>0.95</b>	<b>0.84</b>

Assumes 1 hr/CBD

Notes: 1 - The results of a representative **Wet Gas Analysis** were used to determine the following worst-case components (See Appendix A - Lab Data):

Pollutant	Wet Gas	Minimum Contingency: 10%		
		Worst Case	%Total	%VOC
CO2	101 lb/MMscf	150 lb/MMscf	0.24	0.01
Methane (CH4)	31,244 lb/MMscf	34,400 lb/MMscf	54.17	2.31
N2/Water/Ethane/Etc	12,858 lb/MMscf	14,050 lb/MMscf	22.13	0.94
VOC	13,518 lb/MMscf	14,900 lb/MMscf	23.46	1.00
TOTAL Gas	57,720 lb/MMscf	63,500 lb/MMscf	100.00	---

Pollutant	Wet Gas	Worst Case	%Total	%VOC
Benzene	4.12 lb/MMscf	25.00 lb/MMscf	0.04	0.17
Ethylbenzene	0.56 lb/MMscf	25.00 lb/MMscf	0.04	0.17
n-Hexane	322.24 lb/MMscf	375.00 lb/MMscf	0.59	2.52
Toluene	8.50 lb/MMscf	25.00 lb/MMscf	0.04	0.17
2,2,4-TMP	5.72 lb/MMscf	25.00 lb/MMscf	0.04	0.17
Xylenes	5.04 lb/MMscf	25.00 lb/MMscf	0.04	0.17
Total HAP	346.17 lb/MMscf	500.00 lb/MMscf	0.79	3.36

2 - Conversion from Actual Cubic Feet (acf) to Standard Cubic Feet (scf):  
 $scf = acf \times [(psig+ave.psia)/(std.psia)] \times [(std.oF+460)/(oF+460)]$   
 (https://www.mide.com/pages/air-pressure-at-altitude-calculator)

Description	acf	psig	oF	% Gas	scf
Emergency Shutdown Testing (ESD)	15,000	1,000	100	100	975,903

Hourly ESD Emission are Not Applicable

Ave Atmospheric pressure at: 1,210 ft elev = 14.0645 ave.psia  
 Standard Temperature and Pressure: 68.0 std.oF 14.6959 std.psia

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Process Piping and Equipment Leak (FUG-G) Emissions – Gas**

Source ID	Description	Component (Unit) Type (Gas)	Unit Count	Const'ive Multiplier 150%	Leak Factor lb/hr/Unit	LDAR Control Credit	Controlled Leaks		VOC 23.465 Wgt%		CO2 0.236 Wgt%		CH4 54.173 Wgt%		CO2e CH4 GWP = 25		
							lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	
FUG-G	Process Piping and Equipment Leaks (Gas)	Valves	960	1,440	9.92E-03	---	14.29	62.57	3.35	14.68	0.03	0.15	7.74	33.90	194	848	
		Pump Seals	---	---	5.29E-03	---	---	---	---	---	---	---	---	---	---	---	---
		Other	72	108	1.94E-02	---	2.10	9.18	0.49	2.15	5E-03	0.02	1.14	4.97	28.38	124	
		Connectors	3,132	4,699	4.41E-04	---	2.07	9.07	0.49	2.13	5E-03	0.02	1.12	4.92	28.06	123	
		Flanges	783	1,175	8.60E-04	---	1.01	4.42	0.24	1.04	2E-03	0.01	0.55	2.40	13.68	59.92	
		Open-ended Lines	34	50	4.41E-03	---	0.22	0.97	0.05	0.23	5E-04	2E-03	0.12	0.53	3.01	13.18	
<b>TOTAL:</b>			<b>4,981</b>	<b>7,472</b>			<b>TOTAL:</b>		<b>4.62</b>	<b>20.23</b>	<b>0.05</b>	<b>0.20</b>	<b>10.66</b>	<b>46.71</b>	<b>267</b>	<b>1,168</b>	
PRE-Controlled:									4.62	20.23	0.05	0.20	10.66	46.71	267	1168	

Source ID	Description	Component (Unit) Type (Gas)	Benzene 0.039 Wgt%		Ethylbenzene 0.039 Wgt%		n-Hexane 0.591 Wgt%		Toluene 0.039 Wgt%		2,2,4-TMP 0.039 Wgt%		Xylenes 0.039 Wgt%		Total HAP 0.787 Wgt%	
			lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
FUG-G	Process Piping and Equipment Leaks (Gas)	Valves	0.01	0.02	0.01	0.02	0.08	0.37	0.01	0.02	0.01	0.02	0.01	0.02	0.11	0.49
		Pump Seals	---	---	---	---	---	---	---	---	---	---	---	---	---	---
		Other	8E-04	4E-03	8E-04	4E-03	0.01	0.05	8E-04	4E-03	8E-04	4E-03	8E-04	4E-03	0.02	0.07
		Connectors	8E-04	4E-03	8E-04	4E-03	0.01	0.05	8E-04	4E-03	8E-04	4E-03	8E-04	4E-03	0.02	0.07
		Flanges	4E-04	2E-03	4E-04	2E-03	0.01	0.03	4E-04	2E-03	4E-04	2E-03	4E-04	2E-03	0.01	0.03
		Open-ended Lines	9E-05	4E-04	9E-05	4E-04	1E-03	0.01	9E-05	4E-04	9E-05	4E-04	9E-05	4E-04	2E-03	0.01
<b>TOTAL:</b>			<b>0.01</b>	<b>0.03</b>	<b>0.01</b>	<b>0.03</b>	<b>0.12</b>	<b>0.51</b>	<b>0.01</b>	<b>0.03</b>	<b>0.01</b>	<b>0.03</b>	<b>0.01</b>	<b>0.03</b>	<b>0.16</b>	<b>0.68</b>
PRE-Controlled:			0.01	0.03	0.01	0.03	0.12	0.51	0.01	0.03	0.01	0.03	0.01	0.03	0.16	0.68

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

2 - Gas/Vapor emissions calculated using EPA Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017, Nov 1995; Table 2-4, Oil and Gas Production Operations:

Equipment Type	Gas		Light Oil		Water/Oil	
	kg/hr	lb/hr/unit	kg/hr	lb/hr/unit	kg/hr	lb/hr/unit
Valves	4.5E-03	9.92E-03	2.5E-03	5.51E-03	9.8E-05	2.16E-04
Pump Seals	2.4E-03	5.29E-03	1.3E-02	2.87E-02	2.4E-05	5.29E-05
Others	8.8E-03	1.94E-02	7.5E-03	1.65E-02	1.4E-02	3.09E-02
Connectors	2.0E-04	4.41E-04	2.1E-04	4.63E-04	1.1E-04	2.43E-04
Flanges	3.9E-04	8.60E-04	1.1E-04	2.43E-04	2.9E-06	6.39E-06
Open-Ended Lines	2.0E-03	4.41E-03	1.4E-03	3.09E-03	2.5E-04	5.51E-04

3 - "Other" components include pressure relief devices (PRD), compressors, diaphragms, drains, meters, etc.

4 - Component counts based on engineering judgment plus a 50% contingency.

5 - The results of a representative **Wet Gas Analysis** were used to determine the following worst-case components (See Appendix A - Lab Data):

Pollutant	Wet Gas	Minimum Contingency: 10%	
		Worst Case	%Total %VOC
CO2	101 lb/MMscf	150 lb/MMscf	0.236 ---
Methane (CH4)	31,244 lb/MMscf	34,400 lb/MMscf	54.173 ---
N2/Water/Ethane/Etc	12,858 lb/MMscf	14,050 lb/MMscf	22.126 ---
VOC	13,518 lb/MMscf	14,900 lb/MMscf	23.465 100.000
<b>TOTAL Gas</b>	<b>57,720 lb/MMscf</b>	<b>63,500 lb/MMscf</b>	<b>100.000 ---</b>
Benzene	4 lb/MMscf	25 lb/MMscf	0.039 0.168
Ethylbenzene	1 lb/MMscf	25 lb/MMscf	0.039 0.168
n-Hexane	322 lb/MMscf	375 lb/MMscf	0.591 2.517
Toluene	8 lb/MMscf	25 lb/MMscf	0.039 0.168
2,2,4-TMP	6 lb/MMscf	25 lb/MMscf	0.039 0.168
Xylenes	5 lb/MMscf	25 lb/MMscf	0.039 0.168
<b>Total HAP</b>	<b>346 lb/MMscf</b>	<b>500 lb/MMscf</b>	<b>0.787 3.356</b>

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Process Piping and Equipment Leak (FUG-O) Emissions – Light Oil**

Source ID	Description	Component (Unit) Type (Light Liquid)	Unit Count	Cons'tive Multiplier 150%	Leak Factor lb/hr/Unit	LDAR Control Credit	Controlled Leaks		VOC 100.000 Wgt%		CO2 Wgt%		CH4 Wgt%		CO2e CH4 GWP = 25	
							lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
FUG-O	Process Piping and Equipment Leaks (Light Oil)	Valves	576	864	5.51E-03	0%	4.76	20.86	4.76	20.86	---	---	---	---	---	---
		Pump Seals	12	18	2.87E-02	0%	0.52	2.26	0.52	2.26	---	---	---	---	---	---
		Other	43	65	1.65E-02	0%	1.07	4.69	1.07	4.69	---	---	---	---	---	---
		Connectors	1,296	1,944	4.63E-04	0%	0.90	3.94	0.90	3.94	---	---	---	---	---	---
		Flanges	324	486	2.43E-04	0%	0.12	0.52	0.12	0.52	---	---	---	---	---	---
		Open-ended Lines	20	30	3.09E-03	0%	0.09	0.41	0.09	0.41	---	---	---	---	---	---
<b>TOTAL:</b>			<b>2,271</b>	<b>3,407</b>			<b>TOTAL:</b>		<b>7.46</b>	<b>32.68</b>	---	---	---	---	---	---
		PRE-Controlled:		7.46	32.68					---	---	---	---	---	---	---

Source ID	Description	Component (Unit) Type (Gas)	Benzene 0.168 %VOC		Ethylbenzene 0.168 %VOC		n-Hexane 2.517 %VOC		Toluene 0.168 %VOC		2,2,4-TMP 0.168 %VOC		Xylenes 0.168 %VOC		Total HAP 3.356 %VOC			
			lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
FUG-O	Process Piping and Equipment Leaks (Light Oil)	Valves	0.01	0.03	0.01	0.03	0.12	0.52	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.16	0.70
		Pump Seals	9E-04	4E-03	9E-04	4E-03	0.01	0.06	9E-04	4E-03	9E-04	4E-03	9E-04	4E-03	9E-04	4E-03	0.02	0.08
		Other	2E-03	0.01	2E-03	0.01	0.03	0.12	2E-03	0.01	2E-03	0.01	2E-03	0.01	2E-03	0.01	0.04	0.16
		Connectors	2E-03	0.01	2E-03	0.01	0.02	0.10	2E-03	0.01	2E-03	0.01	2E-03	0.01	2E-03	0.01	0.03	0.13
		Flanges	2E-04	9E-04	2E-04	9E-04	3E-03	0.01	2E-04	9E-04	2E-04	9E-04	2E-04	9E-04	2E-04	9E-04	4E-03	0.02
		Open-ended Lines	2E-04	7E-04	2E-04	7E-04	2E-03	0.01	2E-04	7E-04	2E-04	7E-04	2E-04	7E-04	2E-04	7E-04	3E-03	0.01
<b>TOTAL:</b>			<b>0.01</b>	<b>0.05</b>	<b>0.01</b>	<b>0.05</b>	<b>0.19</b>	<b>0.82</b>	<b>0.01</b>	<b>0.05</b>	<b>0.01</b>	<b>0.05</b>	<b>0.01</b>	<b>0.05</b>	<b>0.01</b>	<b>0.05</b>	<b>0.25</b>	<b>1.10</b>
		PRE-Controlled:		0.01	0.05	0.01	0.05	0.19	0.82	0.01	0.05	0.01	0.05	0.01	0.05	0.25	1.10	

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

5 - The results of a representative **Wet Gas Analysis** were used to determine the following worst-case components (See Appendix A - Lab Data):

2 - Light oil emissions calculated using EPA Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017, Nov 1995; Table 2-4, Oil and Gas Production Operations:

Equipment Type	Gas		Light Oil		Water/Oil	
	kg/hr	lb/hr/unit	kg/hr	lb/hr/unit	kg/hr	lb/hr/unit
Valves	4.5E-03	9.92E-03	2.5E-03	5.51E-03	9.8E-05	2.16E-04
Pump Seals	2.4E-03	5.29E-03	1.3E-02	2.87E-02	2.4E-05	5.29E-05
Others	8.8E-03	1.94E-02	7.5E-03	1.65E-02	1.4E-02	3.09E-02
Connectors	2.0E-04	4.41E-04	2.1E-04	4.63E-04	1.1E-04	2.43E-04
Flanges	3.9E-04	8.60E-04	1.1E-04	2.43E-04	2.9E-06	6.39E-06
Open-Ended Lines	2.0E-03	4.41E-03	1.4E-03	3.09E-03	2.5E-04	5.51E-04

3 - "Other" components include pressure relief devices (PRD), diaphragms, drains, meters, etc.

4 - Component counts based on engineering judgment plus a 50% contingency.

Pollutant	Wet Gas	Minimum Contingency: 10%	
		Worst Case	%Total %VOC
CO2	101 lb/MMscf	150 lb/MMscf	0.236 ---
Methane (CH4)	31,244 lb/MMscf	34,400 lb/MMscf	54.173 ---
N2/Water/Ethane/Etc	12,858 lb/MMscf	14,050 lb/MMscf	22.126 ---
VOC	13,518 lb/MMscf	14,900 lb/MMscf	23.465 100.000
<b>TOTAL Gas</b>	<b>57,720 lb/MMscf</b>	<b>63,500 lb/MMscf</b>	<b>100.000 ---</b>
Benzene	4 lb/MMscf	25 lb/MMscf	0.039 0.168
Ethylbenzene	1 lb/MMscf	25 lb/MMscf	0.039 0.168
n-Hexane	322 lb/MMscf	375 lb/MMscf	0.591 2.517
Toluene	8 lb/MMscf	25 lb/MMscf	0.039 0.168
2,2,4-TMP	6 lb/MMscf	25 lb/MMscf	0.039 0.168
Xylenes	5 lb/MMscf	25 lb/MMscf	0.039 0.168
<b>Total HAP</b>	<b>346 lb/MMscf</b>	<b>500 lb/MMscf</b>	<b>0.787 3.356</b>

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Engine Crankcase (ECC) Emissions**

Source ID	Site Rating	Operations	Leak Rate
			0.36 scf/bhp-hr MMscf/yr
CE-01	1,380 bhp	8,760 hr/yr	4.33
CE-02	1,380 bhp	8,760 hr/yr	4.33
CE-03	1,380 bhp	8,760 hr/yr	4.33
CE-04	1,380 bhp	8,760 hr/yr	4.33
CE-05	1,380 bhp	8,760 hr/yr	4.33
CE-06	1,380 bhp	8,760 hr/yr	4.33
CE-07	1,380 bhp	8,760 hr/yr	4.33
CE-08	1,380 bhp	8,760 hr/yr	4.33
CE-09	1,380 bhp	8,760 hr/yr	4.33
CE-10	1,380 bhp	8,760 hr/yr	4.33
CE-11	1,380 bhp	8,760 hr/yr	4.33
CE-12	1,380 bhp	8,760 hr/yr	4.33
GEN	805 bhp	8,760 hr/yr	2.53
<b>TOT:</b>	<b>17,365 bhp</b>	<b>113,880 hr/yr</b>	<b>54.54</b>

NOx		CO		VOC		PM		SO2		
1.52 lb/hr		9.07 lb/hr		4.62 lb/hr		0.11 lb/hr		0.01 lb/hr		
7.65 lb/MMscf		45.61 lb/MMscf		23.26 lb/MMscf		0.56 lb/MMscf		0.03 lb/MMscf		
lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
4E-03	0.02	0.02	0.10	0.01	0.05	3E-04	1E-03	2E-05	7E-05	
2E-03	0.01	0.01	0.06	0.01	0.03	2E-04	7E-04	1E-05	4E-05	
<b>TOT:</b>	<b>0.05</b>	<b>0.21</b>	<b>0.28</b>	<b>1.24</b>	<b>0.14</b>	<b>0.63</b>	<b>4E-03</b>	<b>0.02</b>	<b>2E-04</b>	<b>9E-04</b>

CO2		CH4		N2O		CO2e		
1,552 lb/hr		14.04 lb/hr		2.48E-03 lb/hr		1,903 lb/hr		
7,806 lb/MMscf		70.62 lb/MMscf		1.25E-02 lb/MMscf		9,575 lb/MMscf		
lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
3.86	16.92	0.03	0.15	6E-06	3E-05	4.74	20.75	
2.25	9.87	0.02	0.09	4E-06	2E-05	2.76	12.10	
<b>TOT:</b>	<b>48.60</b>	<b>213</b>	<b>0.44</b>	<b>1.93</b>	<b>8E-05</b>	<b>3E-04</b>	<b>59.62</b>	<b>261</b>

Source ID	Acetaldehyde		Acrolein		Benzene		Butadiene		Ethylbenzene		HCHO		n-Hexane		Methanol		POM		Toluene		TMP, 2,2,4-		Xylenes		Other/Trace		Total HAPs		
	9.39E-02 lb/hr		5.77E-02 lb/hr		4.94E-03 lb/hr		3.00E-03 lb/hr		4.46E-04 lb/hr		1.19E+00 lb/hr		1.25E-02 lb/hr		2.81E-02 lb/hr		3.89E-03 lb/hr		4.58E-03 lb/hr		3.00E-03 lb/hr		2.07E-03 lb/hr		3.60E-03 lb/hr		1.40 lb/hr		
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr
CE-01	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
CE-02	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
CE-03	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
CE-04	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
CE-05	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
CE-06	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
CE-07	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
CE-08	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
CE-09	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
CE-10	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
CE-11	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
CE-12	2E-04	1E-03	1E-04	6E-04	1E-05	5E-05	7E-06	3E-05	1E-06	5E-06	3E-03	0.01	3E-05	1E-04	7E-05	3E-04	1E-05	4E-05	1E-05	5E-05	7E-06	3E-05	5E-06	2E-05	9E-06	4E-05	3E-03	0.02	
GEN	1E-04	6E-04	8E-05	4E-04	7E-06	3E-05	4E-06	2E-05	6E-07	3E-06	2E-03	0.01	2E-05	8E-05	4E-05	2E-04	6E-06	2E-05	7E-06	3E-05	4E-06	2E-05	3E-06	1E-05	5E-06	2E-05	2E-03	0.01	
<b>TOTAL:</b>	<b>3E-03</b>	<b>0.01</b>	<b>2E-03</b>	<b>0.01</b>	<b>2E-04</b>	<b>7E-04</b>	<b>9E-05</b>	<b>4E-04</b>	<b>1E-05</b>	<b>6E-05</b>	<b>0.04</b>	<b>0.16</b>	<b>4E-04</b>	<b>2E-03</b>	<b>9E-04</b>	<b>4E-03</b>	<b>1E-04</b>	<b>5E-04</b>	<b>1E-04</b>	<b>6E-04</b>	<b>9E-05</b>	<b>4E-04</b>	<b>6E-05</b>	<b>3E-04</b>	<b>1E-04</b>	<b>5E-04</b>	<b>0.04</b>	<b>0.19</b>	

Notes: 1 - As per Caterpillar's Application & Installation Guide - Crankcase Ventilation Systems:  
 "[B]low-by on a new engine is approx. 0.5 ft3 /bhp-hr and design for a worn engine should be 1.0 ft3 /bhp-hr."  
<http://s7d2.scene7.com/is/content/Caterpillar/CM20160713-53120-62603>

2 - Blowby emission rates converted from "actual" cubic feet to "standard" cubic feet:

$$scf = acf * [(P+14.6959)/14.6959] * [527.67/(T+459.67)]$$

<b>Actual to Standard Conversions</b>	<b>1.0 acf =</b>	<b>0.36 scf</b>
(@ 1,012 oF vs. 68 oF (Ignore Δ psi):)		

3 - Engine Exhaust Flow Rates converted from "actual" cubic feet per minute to "standard" cubic feet per minute:

$$scf = acf * [(P+14.6959)/14.6959] * [527.67/(T+459.67)]$$

<b>Actual to Standard Conversions</b>	<b>9,240 acfm =</b>	<b>3,313 scfm</b>
(@ 1,012 oF vs. 68 oF (Ignore Δ psi):)		

## **Supplement S4**

### **Lab Analysis**

---

- **Wet Gas – Summary – Sand Hill Compressor Station (SHCS)**
  - **Wet Gas – Lab Analysis – Sand Hill Compressor Station (SHCS)**
-

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Wet Gas - Summary**

Sampled: **11/02/16**

GPSA-Sec 23

Component	CAS	Formula	Molecular Weight (MW)	Mole % (M% = V%)	Mole Fraction (MF)	Ib/MMscf (WS/UGC#)	Weight % Total	Weight % THC	Weight % VOC	Component Btu/scf (HHV)	Btu/scf (HHV)
Water	109-86-4	H2O	18.015	---	---	---	---	---	---	---	---
Carbon Dioxide	124-38-9	CO2	44.010	0.0869	0.038	100.78	0.1746	---	---	---	---
Hydrogen Sulfide	2148-87-8	H2S	34.086	---	---	---	---	---	---	638	---
Nitrogen	7727-37-9	N2	28.013	0.4303	0.121	317.65	0.5503	---	---	---	---
Methane*	75-82-8	CH4	16.042	73.9064	11.856	31,243.65	54.1297	54.5249	---	1,010	746.455
Ethane*	74-84-0	C2H6	30.069	15.8261	4.759	12,540.14	21.7258	21.8844	---	1,770	280.074
Propane**	74-98-6	C3H8	44.096	5.9829	2.638	6,952.10	12.0445	12.1325	51.4292	2,516	150.542
iso-Butane**	75-28-5	C4H10	58.122	0.6737	0.392	1,031.85	1.7877	1.8007	7.6333	3,252	21.909
n-Butane**	106-97-8	C4H10	58.122	1.7221	1.001	2,637.60	4.5696	4.6030	19.5121	3,262	56.182
iso-Pentane**	78-78-4	C5H12	72.149	0.3661	0.264	696.05	1.2059	1.2147	5.1491	4,001	14.647
n-Pentane**	---	C5H12	72.149	0.4834	0.349	919.06	1.5923	1.6039	6.7989	4,009	19.379
Cyclopentane**	287-92-3	C5H10	70.100	0.0182	0.013	33.62	0.0582	0.0587	0.2487	3,764	0.685
Cyclohexane**	---	C6H12	84.162	0.0303	0.026	67.20	0.1164	0.1173	0.4971	4,482	1.358
Other Hexanes**	---	C6H14	86.175	0.1545	0.133	350.85	0.6078	0.6123	2.5955	4,750	7.339
Heptanes**	142-82-5	C7H16	100.205	0.1015	0.102	268.02	0.4643	0.4677	1.9827	5,503	5.585
Methylcyclohexane**	108-87-2	C7H14	98.186	0.0246	0.024	63.65	0.1103	0.1111	0.4709	5,216	1.283
C8+ Heavies**	Various	C8+	138.00 est.	0.0417	0.058	151.64	0.2627	0.2646	1.1218	7,000	2.919
Benzene***	71-43-2	C6H6	78.112	0.0020	0.002	4.12	0.0071	0.0072	0.0305	3,742	0.075
Ethylbenzene***	100-41-4	C8H10	106.165	0.0002	0.000	0.56	0.0010	0.0010	0.0041	5,222	0.010
n-Hexane***	110-54-3	C6H14	86.175	0.1419	0.122	322.24	0.5583	0.5624	2.3838	4,756	6.749
Toluene***	108-88-3	C7H8	92.138	0.0035	0.003	8.50	0.0147	0.0148	0.0629	4,475	0.157
2,2,4-Trimethylpentane***	540-84-1	C8H18	114.229	0.0019	0.002	5.72	0.0099	0.0100	0.0423	6,214	0.118
Xylenes***	1330-20-7	C8H10	106.165	0.0018	0.002	5.04	0.0087	0.0088	0.0373	5,209	0.094

#UGC (Universal Gas Constant)  
 = 379.482 scf/lb-mol @ 60 oF and 14.6959 psia.

Ib "X"/scf =  
 (M% of "X") x (MW of "X") / #UGC

Totals:	100.0000	21.90	57,720.03
THC:	99.4828	21.74	57,301.60
Total VOC:	9.7503	5.13	13,517.81
Total HAP:	0.1513	0.13	346.17

100.0000	---	---
99.2751	100.0000	---
23.4196	23.5906	100.0000
0.5997	0.6041	2.5608

Calculated Btu/scf (HHV):	1,333
Worst-Case Btu/scf (HHV):	1,020

Component	Representative Gas Analysis		
	Mole %	Wgt %	Ib/MMscf
CO2	0.087	0.1746	100.78
Methane*	73.906	54.1297	31,243.65
Other (N2, C2, O2, CO, H2O)	16.256	22.2761	12,857.79
VOC**	9.750	23.4196	13,517.81
TOTAL GAS	100.000	100.0000	57,720.03
Benzene***	0.002	0.0071	4.12
Ethylbenzene***	2E-04	0.0010	0.56
n-Hexane***	0.142	0.5583	322.24
Toluene***	0.004	0.0147	8.50
2,2,4-Trimethylpentane***	0.002	0.0099	5.72
Xylenes***	0.002	0.0087	5.04
Total HAP***	0.151	0.5997	346.17

Assumed "Worst-Case"	
Min Margin: 10%	
Wgt %	Ib/MMscf
0.2362	150.00
54.1732	34,400.00
22.1260	14,050.00
23.4646	14,900.00
100.0000	63,500.00
0.0394	25.00
0.0394	25.00
0.5906	375.00
0.0394	25.00
0.0394	25.00
0.0394	25.00
0.7874	500.00

\* = Hydrocarbon (HC)  
 \*\* = also Volatile Organic Compound (VOC)  
 \*\*\* = also Hazardous Air Pollutant (HAP)

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Wet Gas - Lab Analysis**

**Williams Quality Control Facility  
 Extended Analysis by GPA 2186**

**Sample Information**

Sample Information	
Sample Name	SAND HILL CF DEHY INLET
Meter Number	Operational - Environmental
Effective Date	12/01/2016 10:00:00
Sample Date	11/02/2016 14:14:00
Sample Type	S
Field Remarks	None
Office Remarks	None
Sample Technician	FR
Sample Pressure, psig	940
Sample Temperature, deg F	102
Sample Bottle No.	7025
Calibration Name	GPA 2286 Ext Gas Analysis - LOW C1
Injection Date	2016-11-04 10:38:15
Report Date	2016-11-04 11:18:10
EZReporter Configuration File	Utica Gas Extended Analysis - May 2016.cfgx

**Component Results**

Component Name	Ret. Time	Peak Area	Norm Mole%
Nitrogen	3.54	4.200	0.4303
Methane	3.49	402.392	73.9064
Carbon Dioxide	4.53	1.000	0.0869
Ethane	3.63	170.776	15.8261
Propane	3.94	96.505	5.9829
iso-Butane	4.42	14.440	0.6737
n-Butane	4.83	37.122	1.7221
Neopentane	5.03	0.266	0.0096
iso-Pentane	6.20	9.936	0.3661
n-Pentane	6.84	12.912	0.4738
Hexanes Plus	0.00	0.000	0.5221
Total:			100.0000

Result	Dry
Pressure Base (psia)	14.73
Temperature Base	60.0
Gross Heating Value (BTU / Ideal cu.ft.)	1317.4
Gross Heating Value (BTU / Real cu.ft.)	1322.8
Relative Density (G), Ideal	0.7555
Relative Density (G), Real	0.7583
Compressibility (Z) Factor	0.9959
BTEX, mol%	0.0073
Ethane, GPM @ 14.73 psia	4.2472
Propane, GPM @ 14.73 psia	1.6541
i-Butane, GPM @ 14.73 psia	0.2213
n-Butane, GPM @ 14.73 psia	0.5451
i-Pentane, GPM @ 14.73 psia	0.1345
n-Pentane, GPM @ 14.73 psia	0.1723
Hexanes Plus, GPM @ 14.73 psia	0.2274
C5+, GPM @ 14.73 psia	0.5343
C5+, mol%	1.3620

Appalachia Midstream Services, LLC (AMS)  
**Sand Hill Compressor Station (SHCS)**  
 Application for 45CSR30 Title V Operating Permit (TVOP)

**Wet Gas - Lab Analysis**

**Total Component Results**

Component	Weight%	Mole%	Volume%
Nitrogen	0.5507	0.4303	0.2395
Methane	54.1672	73.9064	63.4019
Carbon Dioxide	0.1747	0.0869	0.0750
Ethane	21.7409	15.8261	21.4232
Propane	12.0529	5.9829	8.3442
iso-Butane	1.7889	0.6737	1.1155
n-Butane	4.5727	1.7221	2.7481
Neopentane	0.0316	0.0096	0.0186
iso-Pentane	1.2067	0.3661	0.6783
n-Pentane	1.5617	0.4738	0.8686
2,2-Dimethylbutane	0.0421	0.0107	0.0226
2,3-Dimethylbutane/Cyclopentane	0.0650	0.0182	0.0323
2-Methylpentane	0.3242	0.0908	0.1611
3-Methylpentane	0.2087	0.0530	0.1094
n-Hexane	0.5586	0.1419	0.2952
2,2-Dimethylpentane	0.0101	0.0022	0.0052
Methylcyclopentane/2,4-Dimethylpentane	0.0604	0.0157	0.0281
Benzene	0.0071	0.0020	0.0028
3,3-Dimethylpentane	0.0069	0.0015	0.0035
Cyclohexane	0.0561	0.0146	0.0251
2-Methylhexane	0.1108	0.0242	0.0569
2,3-Dimethylpentane	0.0261	0.0057	0.0131
3-Methylhexane	0.1190	0.0260	0.0603
trans-1,3-Dimethylcyclopentane	0.0087	0.0019	0.0044
cis-1,3-Dimethylcyclopentane	0.0069	0.0015	0.0035
2,2,4-Trimethylpentane	0.0099	0.0019	0.0050
3-Ethylpentane	0.0064	0.0014	0.0032
n-Heptane	0.1854	0.0405	0.0945
cis-1,2-Dimethylcyclopentane	0.0031	0.0006	0.0015
Methylcyclohexane/1,1,3-Trimethylcyclopentane/2,2-Dimethylhexane	0.0924	0.0206	0.0419
2,5-Dimethylhexane	0.0057	0.0011	0.0029
2,4-Dimethylhexane/Ethylcyclopentane/2,2,3-Trimethylpentane	0.0141	0.0027	0.0070
3,3-Dimethylhexane	0.0052	0.0010	0.0026
trans-1,2-cis-3-Trimethylcyclopentane	0.0016	0.0003	0.0008
Toluene	0.0147	0.0035	0.0059
1,1,2-Trimethylcyclopentane	0.0057	0.0011	0.0028
2-Methylheptane/4-Methylheptane	0.0344	0.0066	0.0172
3-Methylheptane	0.0256	0.0049	0.0126
3-Ethylhexane	0.0371	0.0071	0.0184
trans-1,2-Dimethylcyclohexane	0.0047	0.0009	0.0023
cis-1,3-Dimethylcyclohexane	0.0169	0.0033	0.0077
1,1-Dimethylcyclohexane	0.0031	0.0006	0.0015
2,2,4-Trimethylhexane	0.0016	0.0003	0.0008
n-Octane	0.0391	0.0075	0.0194
trans-1,3-Dimethylcyclohexane	0.0036	0.0007	0.0016
1-Methyl-cis-2-Ethylcyclopentane	0.0018	0.0003	0.0009
cis-1,2-Dimethylcyclohexane	0.0031	0.0006	0.0014
2,3,3-Trimethylhexane	0.0012	0.0002	0.0006
1,1,4-Trimethylcyclohexane	0.0006	0.0001	0.0003
2,3,4-Trimethylhexane	0.0006	0.0001	0.0003
Ethylbenzene	0.0010	0.0002	0.0004
2,3-Dimethylheptane	0.0012	0.0002	0.0006
m-Xylene	0.0078	0.0016	0.0031
o-Xylene	0.0010	0.0002	0.0004
1,1,2-Trimethylcyclohexane	0.0006	0.0001	0.0003
n-Nonane	0.0070	0.0012	0.0034
n-Propylcyclohexane	0.0006	0.0001	0.0003
m-Ethyltoluene	0.0007	0.0001	0.0003
p-Ethyltoluene	0.0013	0.0002	0.0006
2-Methylnonane	0.0007	0.0001	0.0003
1,2,4-Trimethylbenzene/tert-Butylbenzene/Methylcyclooctane	0.0005	0.0001	0.0002
n-Decane	0.0013	0.0002	0.0006
Total:	100.0000	100.0000	100.0000

## Supplement S5

### Vendor Data

---

- 1,380 bhp CAT G3516B w/ Emit OxCat
  - 805 bhp Capstone C600 Microturbine Generator
  - BTEX Buster (Condenser)
  - Vapor Recovery Unit (VRU)
  - Carbon Canister (CarbCan)
-

ENGINE SPEED (rpm):	1400	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8:1	RATING LEVEL:	CONTINUOUS
AFTERCOOLER TYPE:	SCAC	FUEL SYSTEM:	CAT WIDE RANGE
AFTERCOOLER - STAGE 2 INLET (°F):	130		WITH AIR FUEL RATIO CONTROL
AFTERCOOLER - STAGE 1 INLET (°F):	201		
JACKET WATER OUTLET (°F):	210	<b>SITE CONDITIONS:</b>	
ASPIRATION:	TA	FUEL:	Gas Analysis
COOLING SYSTEM:	JW+OC+1AC, 2AC	FUEL PRESSURE RANGE(psig):	7.0-40.0
CONTROL SYSTEM:	ADEM3	FUEL METHANE NUMBER:	53.6
EXHAUST MANIFOLD:	DRY	FUEL LHV (Btu/scf):	1203
COMBUSTION:	LOW EMISSION	ALTITUDE(ft):	500
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.5	MAXIMUM INLET AIR TEMPERATURE(°F):	77
SET POINT TIMING:	28	STANDARD RATED POWER:	<b>1380 bhp@1400rpm</b>

RATING	NOTES	LOAD	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE			
			100%	100%	75%	50%
ENGINE POWER (WITHOUT FAN)	(1)	bhp	1380	1380	1035	690
INLET AIR TEMPERATURE		°F	77	77	77	77

ENGINE DATA						
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	7420	7420	7947	8536
<b>FUEL CONSUMPTION (HHV)</b>	(2)	<b>Btu/bhp-hr</b>	<b>8167</b>	8167	8747	9395
AIR FLOW (@inlet air temp, 14.7 psia)	(3)(4)	ft <sup>3</sup> /min	3148	3148	2469	1726
AIR FLOW	(3)(4)	lb/hr	13958	13958	10949	7655
<b>FUEL FLOW (60°F, 14.7 psia)</b>		<b>scfm</b>	<b>142</b>	142	114	82
INLET MANIFOLD PRESSURE	(5)	in Hg(abs)	93.1	93.1	75.5	53.1
<b>EXHAUST TEMPERATURE - ENGINE OUTLET</b>	(6)	<b>°F</b>	<b>1012</b>	1012	1005	1025
<b>EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)</b>	(7)(4)	<b>ft<sup>3</sup>/min</b>	<b>9240</b>	9240	7226	5127
EXHAUST GAS MASS FLOW	(7)(4)	lb/hr	14449	14449	11343	7937

EMISSIONS DATA - ENGINE OUT						
<b>NOx (as NO2)</b>	(8)(9)	<b>g/bhp-hr</b>	<b>0.50</b>	0.50	0.50	0.50
<b>CO</b>	(8)(9)	<b>g/bhp-hr</b>	<b>2.98</b>	2.98	3.19	3.13
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	4.40	4.40	4.72	4.79
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	2.12	2.12	2.27	2.30
<b>NMNEHC (VOCs) (mol. wt. of 15.84)</b>	(8)(9)(10)	<b>g/bhp-hr</b>	<b>1.08</b>	1.08	1.16	1.18
<b>HCHO (Formaldehyde)</b>	(8)(9)	<b>g/bhp-hr</b>	<b>0.39</b>	0.39	0.38	0.38
<b>CO2</b>	(8)(9)	<b>g/bhp-hr</b>	<b>510</b>	510	545	592
EXHAUST OXYGEN	(8)(11)	% DRY	9.1	9.1	8.8	8.4

HEAT REJECTION						
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	22089	22089	20587	19228
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	6110	6110	5092	4074
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	4475	4475	3978	3363
HEAT REJ. TO A/C - STAGE 1 (1AC)	(12)(13)	Btu/min	9641	9641	7913	2550
HEAT REJ. TO A/C - STAGE 2 (2AC)	(12)(13)	Btu/min	5334	5334	5035	3317

COOLING SYSTEM SIZING CRITERIA			
TOTAL JACKET WATER CIRCUIT (JW+OC+1AC)	(13)(14)	Btu/min	39791
TOTAL AFTERCOOLER CIRCUIT (2AC)	(13)(14)	Btu/min	5601
A cooling system safety factor of 0% has been added to the cooling system sizing criteria.			

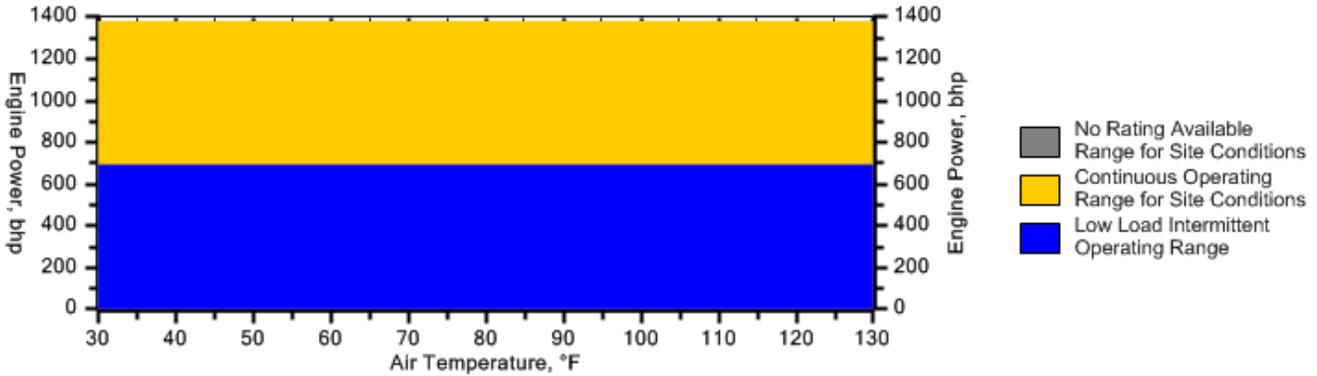
**CONDITIONS AND DEFINITIONS**

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

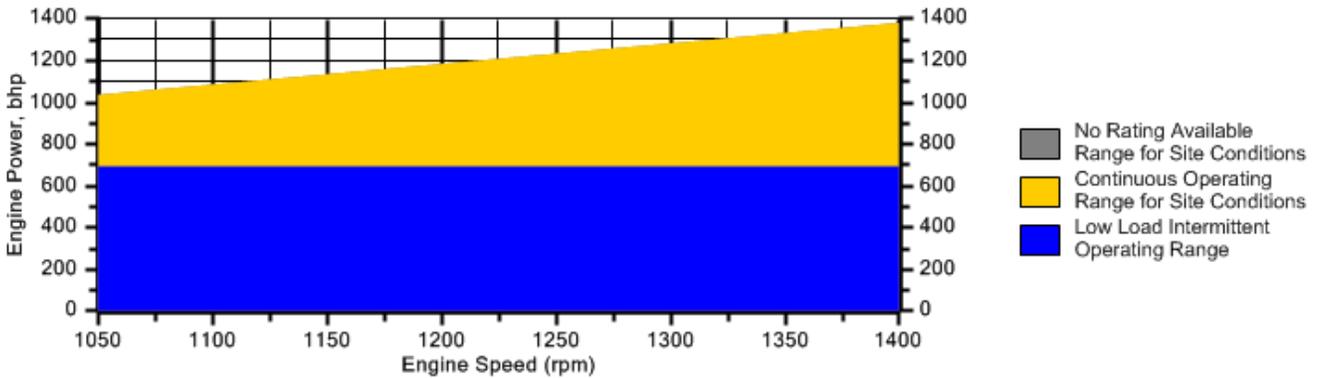
**Engine Power vs. Inlet Air Temperature**

Data represents temperature sweep at 500 ft and 1400 rpm



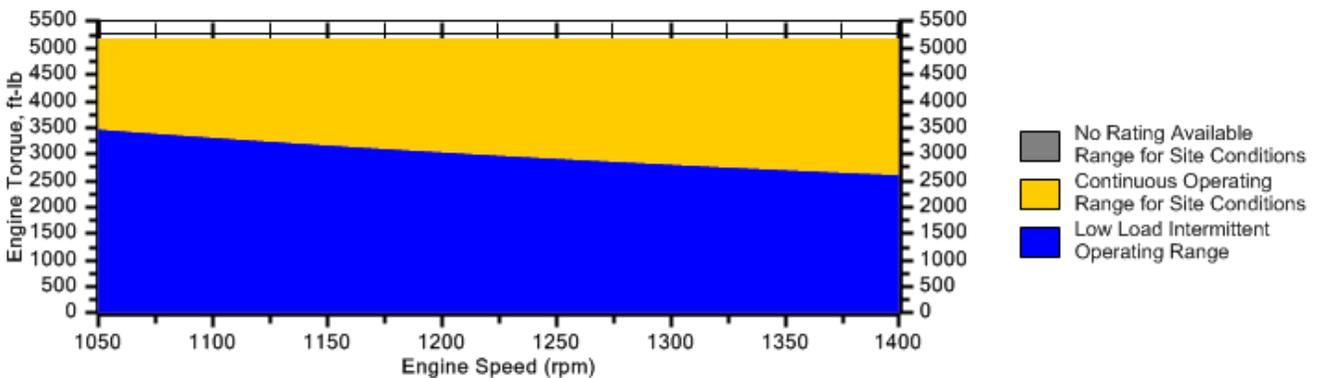
**Engine Power vs. Engine Speed**

Data represents speed sweep at 500 ft and 77 °F



**Engine Torque vs. Engine Speed**

Data represents speed sweep at 500 ft and 77 °F



Note: At site conditions of 500 ft and 77°F inlet air temp., constant torque can be maintained down to 1050 rpm. The minimum speed for loading at these conditions is 1050 rpm.

# G3516B

GAS COMPRESSION APPLICATION

## GAS ENGINE SITE SPECIFIC TECHNICAL DATA



### NOTES

1. Engine rating is with two engine driven water pumps. Tolerance is  $\pm 3\%$  of full load.
2. Fuel consumption tolerance is  $\pm 3.0\%$  of full load data.
3. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of  $\pm 5\%$ .
4. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.
5. Inlet manifold pressure is a nominal value with a tolerance of  $\pm 5\%$ .
6. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.
7. Exhaust flow value is on a "wet" basis. Flow is a nominal value with a tolerance of  $\pm 6\%$ .
8. Emissions data is at engine exhaust flange prior to any after treatment.
9. Emission values are based on engine operating at steady state conditions. Fuel methane number cannot vary more than  $\pm 3$ . Values listed are higher than nominal levels to allow for instrumentation, measurement, and engine-to-engine variations. They indicate "Not to Exceed" values. THC, NMHC, and NMNEHC do not include aldehydes. An oxidation catalyst may be required to meet Federal, State or local CO or HC requirements.
10. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ
11. Exhaust Oxygen level is the result of adjusting the engine to operate at the specified NOx level. Tolerance is  $\pm 0.5$ .
12. Heat rejection values are nominal. Tolerances, based on treated water, are  $\pm 10\%$  for jacket water circuit,  $\pm 50\%$  for radiation,  $\pm 20\%$  for lube oil circuit, and  $\pm 5\%$  for aftercooler circuit.
13. Aftercooler heat rejection includes an aftercooler heat rejection factor for the site elevation and inlet air temperature specified. Aftercooler heat rejection values at part load are for reference only. Do not use part load data for heat exchanger sizing.
14. Cooling system sizing criteria are maximum circuit heat rejection for the site, with applied tolerances.

PREPARED BY:

Data generated by Gas Engine Rating Pro Version 5.03.00  
Ref. Data Set DM8800-07-001, Printed 26Jun2015

Constituent	Abbrev	Mole %	Norm
Water Vapor	H2O	0.0000	0.0000
Methane	CH4	73.1340	73.1340
Ethane	C2H6	16.5830	16.5830
Propane	C3H8	6.2040	6.2040
Isobutane	iso-C4H10	0.6960	0.6960
Norbutane	nor-C4H10	1.7500	1.7500
Isopentane	iso-C5H12	0.3540	0.3540
Norpentane	nor-C5H12	0.4420	0.4420
Hexane	C6H14	0.3960	0.3960
Heptane	C7H16	0.0000	0.0000
Nitrogen	N2	0.3450	0.3450
Carbon Dioxide	CO2	0.0960	0.0960
Hydrogen Sulfide	H2S	0.0000	0.0000
Carbon Monoxide	CO	0.0000	0.0000
Hydrogen	H2	0.0000	0.0000
Oxygen	O2	0.0000	0.0000
Helium	HE	0.0000	0.0000
Neopentane	neo-C5H12	0.0000	0.0000
Octane	C8H18	0.0000	0.0000
Nonane	C9H20	0.0000	0.0000
Ethylene	C2H4	0.0000	0.0000
Propylene	C3H6	0.0000	0.0000
TOTAL (Volume %)		100.0000	100.0000

Fuel Makeup: Gas Analysis  
 Unit of Measure: English

**Calculated Fuel Properties**

Caterpillar Methane Number:	53.6
Lower Heating Value (Btu/scf):	1203
Higher Heating Value (Btu/scf):	1324
WOBBE Index (Btu/scf):	1382
THC: Free Inert Ratio:	225.76
Total % Inerts (% N2, CO2, He):	0.44%
RPC (%) (To 905 Btu/scf Fuel):	100%
Compressibility Factor:	0.996
Stoich A/F Ratio (Vol/Vol):	12.45
Stoich A/F Ratio (Mass/Mass):	16.44
Specific Gravity (Relative to Air):	0.757
Specific Heat Constant (K):	1.273

**CONDITIONS AND DEFINITIONS**

Caterpillar Methane Number represents the knock resistance of a gaseous fuel. It should be used with the Caterpillar Fuel Usage Guide for the engine and rating to determine the rating for the fuel specified. A Fuel Usage Guide for each rating is included on page 2 of its standard technical data sheet.

RPC always applies to naturally aspirated (NA) engines, and turbocharged (TA or LE) engines only when they are derated for altitude and ambient site conditions.

Project specific technical data sheets generated by the Caterpillar Gas Engine Rating Pro program take the Caterpillar Methane Number and RPC into account when generating a site rating.

Fuel properties for Btu/scf calculations are at 60F and 14.696 psia.

Caterpillar shall have no liability in law or equity, for damages, consequently or otherwise, arising from use of program and related material or any part thereof.

**FUEL LIQUIDS**

Field gases, well head gases, and associated gases typically contain liquid water and heavy hydrocarbons entrained in the gas. To prevent detonation and severe damage to the engine, hydrocarbon liquids must not be allowed to enter the engine fuel system. To remove liquids, a liquid separator and coalescing filter are recommended, with an automatic drain and collection tank to prevent contamination of the ground in accordance with local codes and standards.

To avoid water condensation in the engine or fuel lines, limit the relative humidity of water in the fuel to 80% at the minimum fuel operating temperature.



### INFORMATION PROVIDED BY CATERPILLAR

**Engine:** G3516B  
**Horsepower:** 1380  
**RPM:** 1400  
Compression Ratio: 8.0  
**Exhaust Flow Rate:** 9240 CFM  
**Exhaust Temperature:** 1012 °F  
Reference: DM8800-07-001  
Fuel: Natural Gas  
Annual Operating Hours: 8760

#### Uncontrolled Emissions

**g/bhp-hr**  
**NOx:** 0.50  
**CO:** 2.98  
THC: 4.40  
NMHC: 2.12  
**NMNEHC:** 1.08  
**HCHO:** 0.39  
O2: 9.00 %

#### POST CATALYST EMISSIONS

**g/bhp-hr**  
NOx: Unaffected by Oxidation Catalyst  
**CO:** <0.45  
**VOC:** <0.27  
**HCHO:** <0.02

### CONTROL EQUIPMENT

#### Catalyst Housing

Model: ELH-3550-1416F-4CE0-241  
Manufacturer: EMIT Technologies, Inc  
Element Size: Rectangle 24" x 15" x 3.5"  
Housing Type: 4 Element Capacity  
Catalyst Installation: Accessible Housing  
Construction: 10 gauge Carbon Steel  
Sample Ports: 9 (0.5" NPT)  
Inlet Connections: 14" Flat Face Flange  
Outlet Connections: 16" Flat Face Flange  
Configuration: End In / Side Out  
Silencer: Integrated  
Silencer Grade: Hospital  
Insertion Loss: 35-40 dBA

#### Catalyst Element

Model: RT-2415-H  
Catalyst Type: Oxidation, Premium Precious Group Metals  
Substrate Type: BRAZED  
Manufacturer: EMIT Technologies, Inc  
Element Quantity: 4  
Element Size: Rectangle 24" x 15" x 3.5"



## WARRANTY

EMIT Technologies, Inc. warrants that the goods supplied will be free from defects in workmanship by EMIT Technologies, Inc. for a period of two (2) years from date of shipment. EMIT Technologies, Inc. will not be responsible for any defects which result from improper use, neglect, failure to properly maintain or which are attributable to defects, errors or omissions in any drawings, specifications, plans or descriptions, whether written or oral, supplied to EMIT Technologies, Inc. by Buyer.

Catalyst performance using an EMIT Air/Fuel ratio controller is dependent upon properly defined set-points, variable with engine and fuel gas composition. Air/fuel ratio controller performance is guaranteed, but not limited, to fuel gas with a HHV content of 1400 BTU/SCF.

Catalyst performance will be guaranteed for a period of 1 year from installation, or 8760 operating hours, whichever comes first. The catalyst shall be operated with an automatic air/fuel ratio controller. The performance guarantee shall not cover the effects of excessive ash masking due to operation at low load, improper engine maintenance, or inappropriate lubrication oil. The performance guarantee shall not cover the effects of continuous engine misfires (cylinder or ignition) exposing the catalyst to excessive exothermic reaction temperatures. In most cases, excluding thermal deactivation, catalyst performance is redeemable by means of proper washing (refer to EMIT Catalyst/Silencer Housing Manual for element wash information, or contact a local EMIT Sales representative).

The exhaust temperature operating range at the converter inlet is a minimum of 600°F for oxidation catalyst and 750 °F for NSCR catalyst, and a maximum of 1250°F.

If a properly functioning, high temperature shut down switch is not installed, thermal deactivation of catalyst at sustained temperatures above 1250 °F is not covered. If excessive exposure to over oxygenation of NSCR catalyst occurs due to improperly functioning or non-existent Air/Fuel ratio control, then deactivation of catalyst is not warranted.

The catalyst conversion efficiencies (% reduction) will be guaranteed for engine loads of 50 to 100 percent. Standard Oxidation Catalyst conversion efficiencies (% reduction) will be guaranteed for fuel gas containing less than 1.5% mole fraction of non-methane, non-ethane hydrocarbons. Applications where fuel gas exceeds this level will require a Premium Oxidation Catalyst to maintain guaranteed VOC conversion efficiencies.

Engine lubrication oil shall contain less than 0.5 wt% Sulfated Ash with a maximum allowable specific oil consumption of 0.7 g/bhp-hr. The catalyst shall be limited to a maximum ash loading of 0.022 lb/ft<sup>3</sup>. Phosphorous and zinc additives are limited to 0.03 wt%. New or Reconstructed engines must operate for a minimum of 50 hours prior to catalyst installation, otherwise the warranty is void.

The catalyst must not be exposed to the following know poisoning agents, including: antimony, arsenic, chromium, copper, iron, lead, lithium, magnesium, mercury, nickel, phosphorous, potassium, silicon, sodium, sulfur, tin, and zinc. Total poison concentrations in the fuel gas must be limited to 0.25 ppm or less for catalyst to function properly.

Shipment - Promised shipping dates are approximate lead times from the point of manufacture and are not guaranteed. EMIT Technologies, Inc. will not be liable for any loss, damage or delay in manufacture or delivery resulting from any cause beyond its control including, but not limited to a period equal to the time lost by reason of that delay. All products will be crated as per best practice to prevent any damage during shipment. Unless otherwise specified, Buyer will pay for any special packing and shipping requirements. Acceptance of goods by common carrier constitutes delivery to Buyer. EMIT Technologies, Inc. shall not be responsible for goods damaged or lost in transit.

Terms: Credit is extended to purchaser for net 30 time period. If payment is not received in the net 30 timeframe, interest on the unpaid balance will accrue at a rate of 1.5% per month from the invoice date.

Order Cancellation Terms: Upon cancellation of an order once submittal of a Purchase Order has occurred, the customer will pay a 25% restocking fee for Catalyst Housings, Catalyst Elements, and Air/Fuel Ratio Controllers; 50% restocking fee for Cooler Top Solutions Exhaust System Accessories, and other Custom Built Products; 100% of all associated shipping costs incurred by EMIT; 100% of all project expenses incurred by EMIT for Field Services.



## C600 600kW Power Package High-pressure Natural Gas

World's largest air-bearing microturbine produces 600kW of clean, green, and reliable power.

- High electrical efficiency over a very wide operating range
- Low-maintenance air bearings require no lube oil or coolant
- **Ultra-low emissions**
- High availability – part load redundancy
- Proven technology with tens of millions of operating hours
- Integrated utility synchronization and protection with a modular design
- 5 and 9 year Factory Protection Plans available
- Remote monitoring and diagnostic capabilities
- Upgradable to 800kW or 1MW with field installed Capstone 200kW power modules
- Internal fuel gas compressor available for low fuel pressure natural gas applications



C600 Power Package

### Electrical Performance<sup>(1)</sup>

<b>Electrical Power Output</b>	<b>600kW</b>
Voltage	400–480 VAC
Electrical Service	3-Phase, 4 wire
Frequency	50/60 Hz, grid connect operation 10–60 Hz, stand alone operation
Maximum Output Current	870A RMS @ 400V, grid connect operation 720A RMS @ 480V, grid connect operation 930A RMS, stand alone operation <sup>(2)</sup>
<b>Electrical Efficiency LHV</b>	<b>33%</b>

### Fuel/Engine Characteristics<sup>(1)</sup>

Natural Gas HHV	30.7–47.5 MJ/m <sup>3</sup> (825–1,275 BTU/scf)
Inlet Pressure <sup>(3)</sup>	517–552 kPa gauge (75–80 psig)
<b>Fuel Flow HHV</b>	7,200 MJ/hr ( <b>6,840,000 BTU/hr</b> )
Net Heat Rate LHV	10.9 MJ/kWh (10,300 BTU/kWh)

### Exhaust Characteristics<sup>(1)</sup>

	Standard	Low-Emissions Version
NOx Emissions @ 15% O <sub>2</sub> <sup>(4)</sup>	< 9 ppmvd (18 mg/m <sup>3</sup> )	< 4 ppmvd (8 mg/m <sup>3</sup> )
NOx / Electrical Output <sup>(4)</sup>	0.14 g/bhp-hr (0.4 lb/MWhe)	0.05 g/bhp-hr (0.14 lb/MWhe)
<b>Exhaust Gas Flow</b>	4.0 kg/s ( <b>8.8 lbm/s</b> )	4.0 kg/s (8.8 lbm/s)
<b>Exhaust Gas Temperature</b>	280°C ( <b>535°F</b> )	280°C (535°F)
Exhaust Energy	4,260 MJ/hr (4,050,000 BTU/hr)	4,260 MJ/hr (4,050,000 BTU/hr)

*Reliable power when and where you need it. Clean and simple.*

## Dimensions & Weight<sup>(5)</sup>

Width x Depth x Height	2.4 x 9.1 x 2.9 m (96 x 360 x 114 in)
Weight - Grid Connect Model	12565 kg (27,700 lbs)
Weight - Dual Mode Model	15014 kg (33,100 lbs)

## Minimum Clearance Requirements<sup>(6)</sup>

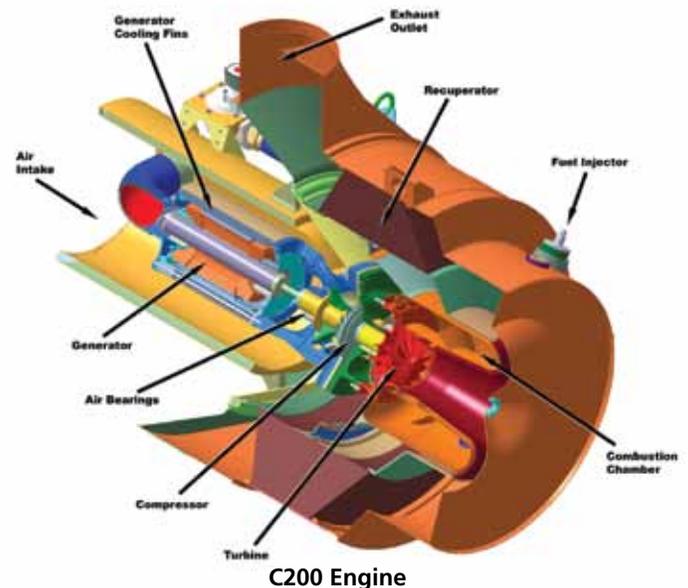
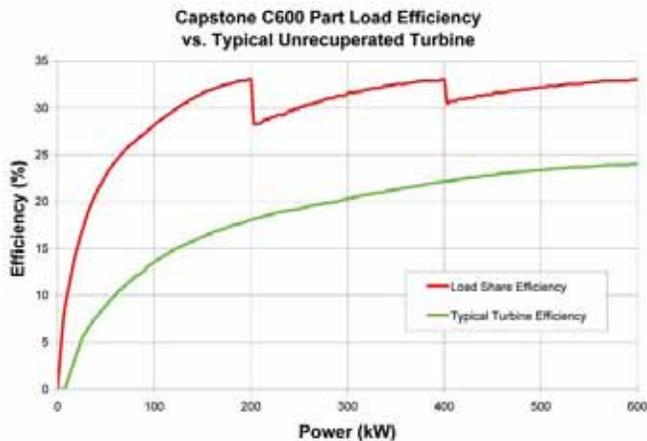
Vertical Clearance	0.6 m (24 in)
Horizontal Clearance	
Left	1.5 m (60 in)
Right	0.0 m (0 in)
Front	1.5 m (60 in)
Rear	2.0 m (80 in)

## Sound Levels

Acoustic Emissions at Full Load Power	
Nominal at 10 m (33 ft)	65 dBA

## Planned Certifications

- UL 2200 and UL 1741 for natural gas operation under existing UL files<sup>(7)</sup>
- Will comply with IEEE 1547 and will meet statewide utility interconnection requirements for California Rule 21 and the New York State Public Service Commission
- Models will be available with optional equipment for CE marking



(1) Nominal full power performance at ISO conditions: 59°F, 14.696 psia, 60% RH  
 (2) With linear load  
 (3) Inlet pressure for standard natural gas at 39.4 MJ/Nm<sup>3</sup> (1,000 BTU/scf) (HHV)  
 (4) Emissions for standard natural gas at 39.4 MJ/Nm<sup>3</sup> (1,000 BTU/scf) (HHV)  
 (5) Approximate dimensions and weights  
 (6) Clearance requirements may increase due to local code considerations  
 (7) All models are planned to be UL Listed or available with optional equipment for CE marking  
 Specifications are not warranted and are subject to change without notice.





# Technical Reference

## Capstone MicroTurbine™ Systems Emissions

The C600 Generator is comprised of Three (3) C200 Microturbine Units

### Summary

Capstone MicroTurbine™ systems are inherently clean and can meet some of the strictest emissions standards in the world. This technical reference is to provide customers with information that may be requested by local air permitting organizations or to compare air quality impacts of different technologies for a specific project. The preferred units of measure are “output based”; meaning that the quantity of a particular exhaust emission is reported relative to the useable output of the microturbine – typically in pounds per megawatt hour for electrical generating equipment. This technical reference also provides volumetric measurements in parts per million and milligrams per normal cubic meter. A conversion between several common units is also provided.

### Maximum Exhaust Emissions at ISO Conditions

Table 1 below summarizes the exhaust emissions at full power and ISO conditions for different Capstone microturbine models. Note that the fuel can have a significant impact on certain emissions. For example landfill and digester gas can be made up of a wide variety of fuel elements and impurities, and typically contains some percentage of carbon dioxide (CO<sub>2</sub>). This CO<sub>2</sub> dilutes the fuel, makes complete combustion more difficult, and results in higher carbon monoxide emissions (CO) than for pipeline-quality natural gas.

**Table 1. Emission for Different Capstone Microturbine Models in [lb/MWhe]**

Model	Fuel	NOx	CO	VOC <sup>(5)</sup>
C30 NG	Natural Gas <sup>(1)</sup>	0.64	1.8	0.23
CR30 MBTU	Landfill Gas <sup>(2)</sup>	0.64	22.0	1.00
CR30 MBTU	Digester Gas <sup>(3)</sup>	0.64	11.0	1.00
C30 Liquid	Diesel #2 <sup>(4)</sup>	2.60	0.41	0.23
C65 NG Standard	Natural Gas <sup>(1)</sup>	0.46	1.25	0.10
C65 NG Low NOx	Natural Gas <sup>(1)</sup>	0.17	1.30	0.10
C65 NG CARB	Natural Gas <sup>(1)</sup>	0.17	0.24	0.05
CR65 Landfill	Landfill Gas <sup>(2)</sup>	0.46	4.0	0.10
CR65 Digester	Digester Gas <sup>(3)</sup>	0.46	4.0	0.10
<b>C200 NG</b>	<b>Natural Gas<sup>(1)</sup></b>	<b>0.40</b>	<b>1.10</b>	<b>0.10</b>
C200 NG CARB	Natural Gas <sup>(1)</sup>	0.14	0.20	0.04
CR200 Digester	Digester Gas <sup>(3)</sup>	0.40	3.6	0.10

Notes:

Fuel Flow (HHV) = 11.4 MMBtu/1000 kW

(1) Emissions for standard natural gas at 1,000 BTU/scf (HHV) or 39.4 MJ/m<sup>3</sup> (HHV)

(2) Emissions for surrogate gas containing 42% natural gas, 39% CO<sub>2</sub>, and 19% Nitrogen

(3) Emissions for surrogate gas containing 63% natural gas and 37% CO<sub>2</sub>

(4) Emissions for Diesel #2 according to ASTM D975-07b

(5) Expressed as Methane

Table 2 provides the same output-based information shown in Table 1, but expressed in grams per horsepower hour (g/hp-hr).

**Table 2. Emission for Different Capstone Microturbine Models in [g/hp-hr]**

Model	Fuel	NOx	CO	VOC <sup>(5)</sup>
C30 NG	Natural Gas <sup>(1)</sup>	0.22	0.60	0.078
CR30 MBTU	Landfill Gas <sup>(2)</sup>	0.22	7.4	0.340
CR30 MBTU	Digester Gas <sup>(3)</sup>	0.22	3.7	0.340
C30 Liquid	Diesel #2 <sup>(4)</sup>	0.90	0.14	0.078
C65 NG Standard	Natural Gas <sup>(1)</sup>	0.16	0.42	0.034
C65 NG Low NOx	Natural Gas <sup>(1)</sup>	0.06	0.44	0.034
C65 NG CARB	Natural Gas <sup>(1)</sup>	0.06	0.08	0.017
CR65 Landfill	Landfill Gas <sup>(2)</sup>	0.16	1.4	0.034
CR65 Digester	Digester Gas <sup>(3)</sup>	0.16	1.4	0.034
<b>C200 NG</b>	<b>Natural Gas <sup>(1)</sup></b>	<b>0.14</b>	<b>0.37</b>	<b>0.034</b>
C200 NG CARB	Natural Gas <sup>(1)</sup>	0.05	0.07	0.014
CR200 Digester	Digester Gas <sup>(3)</sup>	0.14	1.3	0.034

Notes: - same as for Table 1

Emissions may also be reported on a volumetric basis, with the most common unit of measurement being parts per million. This is typically a measurement that is corrected to specific oxygen content in the exhaust and without considering moisture content. The abbreviation for this unit of measurement is “ppmvd” (parts per million by volume, dry) and is corrected to 15% oxygen for electrical generating equipment such as microturbines. The relationship between an output based measurement like pounds per MWh and a volumetric measurement like ppmvd depends on the characteristics of the generating equipment and the molecular weight of the criteria pollutant being measured. Table 3 expresses the emissions in ppmvd at 15% oxygen for the Capstone microturbine models shown in Table 1. Note that raw measurements expressed in ppmv will typically be lower than the corrected values shown in Table 3 because the microturbine exhaust has greater than 15% oxygen.

Another volumetric unit of measurement expresses the mass of a specific criteria pollutant per standard unit of volume. Table 4 expresses the emissions in milligrams per normal cubic meter at 15% oxygen. Normal conditions for this purpose are expressed as one atmosphere of pressure and zero degrees Celsius. Note that both the ppmvd and mg/m3 measurements are for specific oxygen content. A conversion can be made to adjust either unit of measurement to other reference oxygen contents, if required. Use the equation below to convert from one reference oxygen content to another:

$$\text{Emissions at New O}_2 = \frac{(20.9 - \text{New O}_2 \text{ Percent})}{(20.9 - \text{Current O}_2 \text{ Percent})} \times \text{Emissions at Current O}_2$$

For example, to express 9 ppmvd of NOx at 15% oxygen to ppmvd at 3% oxygen:

$$\text{Emissions at 3\% O}_2 = \frac{(20.9 - 3.0)}{(20.9 - 15.0)} \times 9 = 27 \text{ ppmvd}$$

**Table 3. Emission for Different Capstone Microturbine Models in [ppmvd] at 15% O<sub>2</sub>**

Model	Fuel	NOx	CO	VOC
C30 NG	Natural Gas <sup>(1)</sup>	9	40	9
CR30 MBTU	Landfill Gas <sup>(2)</sup>	9	500	40
CR30 MBTU	Digester Gas <sup>(3)</sup>	9	250	40
C30 Liquid	Diesel #2 <sup>(4)</sup>	35	9	9
C65 NG Standard	Natural Gas <sup>(1)</sup>	9	40	7
C65 NG Low NOx	Natural Gas <sup>(1)</sup>	4	40	7
C65 NG CARB	Natural Gas <sup>(1)</sup>	4	8	3
CR65 Landfill	Landfill Gas <sup>(2)</sup>	9	130	7
CR65 Digester	Digester Gas <sup>(3)</sup>	9	130	7
C200 NG	Natural Gas <sup>(1)</sup>	9	40	7
C200 NG CARB	Natural Gas <sup>(1)</sup>	4	8	3
CR200 Digester	Digester Gas <sup>(3)</sup>	9	130	7

Notes: same as Table 1

**Table 4. Emission for Different Capstone Microturbine Models in [mg/m<sup>3</sup>] at 15% O<sub>2</sub>**

Model	Fuel	NOx	CO	VOC <sup>(5)</sup>
C30 NG	Natural Gas <sup>(1)</sup>	18	50	6
CR30 MBTU	Landfill Gas <sup>(2)</sup>	18	620	30
CR30 MBTU	Digester Gas <sup>(3)</sup>	18	310	30
C30 Liquid	Diesel #2 <sup>(4)</sup>	72	11	6
C65 NG Standard	Natural Gas <sup>(1)</sup>	19	50	5
C65 NG Low NOx	Natural Gas <sup>(1)</sup>	8	50	5
C65 NG CARB	Natural Gas <sup>(1)</sup>	8	9	2
CR65 Landfill	Landfill Gas <sup>(2)</sup>	18	160	5
CR65 Digester	Digester Gas <sup>(3)</sup>	18	160	5
C200 NG	Natural Gas <sup>(1)</sup>	18	50	5
C200 NG CARB	Natural Gas <sup>(1)</sup>	8	9	2
CR200 Digester	Digester Gas <sup>(3)</sup>	18	160	5

Notes: same as Table 1

The emissions stated in Tables 1, 2, 3 and 4 are guaranteed by Capstone for new microturbines during the standard warranty period. They are also the expected emissions for a properly maintained microturbine according to manufacturer's published maintenance schedule for the useful life of the equipment.

### Emissions at Full Power but Not at ISO Conditions

The maximum emissions in Tables 1, 2, 3 and 4 are at full power under ISO conditions. These levels are also the expected values at full power operation over the published allowable ambient temperature and elevation ranges.

## Emissions at Part Power

Capstone microturbines are designed to maintain combustion stability and low emissions over a wide operating range. Capstone microturbines utilize multiple fuel injectors, which are switched on or off depending on the power output of the turbine. All injectors are typically on when maximum power is demanded, regardless of the ambient temperature or elevation. As the load requirements of the microturbine are decreased, injectors will be switched off to maintain stability and low emissions. However, the emissions relative to the lower power output may increase. This effect differs for each microturbine model.

## Emissions Calculations for Permitting

Air Permitting agencies are normally concerned with the maximum amount of a given pollutant being emitted per unit of time (for example pounds per day of NO<sub>x</sub>). The simplest way to make this calculation is to use the maximum microturbine full electrical power output (expressed in MW) multiplied by the emissions rate in pounds per MWh times the number of hours per day. For example, the C65 CARB microturbine operating on natural gas would have a NO<sub>x</sub> emissions rate of:

$$\text{NO}_x = .17 \times (65/1000) \times 24 = .27 \text{ pounds per day}$$

This would be representative of operating the equipment full time, 24 hours per day, at full power output of 65 kWe.

As a general rule, if local permitting is required, use the published agency levels as the stated emissions for the permit and make sure that this permitted level is above the calculated values in this technical reference.

## Consideration of Useful Thermal Output

Capstone microturbines are often deployed where their clean exhaust can be used to provide heating or cooling, either directly or using hot water or other heat transfer fluids. In this case, the local permitting or standards agencies will usually consider the emissions from traditional heating sources as being displaced by the useful thermal output of the microturbine exhaust energy. This increases the useful output of the microturbine, and decreases the relative emissions of the combined heat and power system. For example, the CARB version C65 ICHP system with integral heat recovery can achieve a total system efficiency of 70% or more, depending on inlet water temperatures and other installation-specific characteristics. The electric efficiency of the CARB version C65 microturbine is 28% at ISO conditions. This means that the total NO<sub>x</sub> output based emissions, including the captured thermal value, is the electric-only emissions times the ratio of electric efficiency divided by total system efficiency:

$$\text{NO}_x = .17 \times 28/70 = .068 \text{ pounds per MWh (based on total system output)}$$

This is typically much less than the emissions that would result from providing electric power using traditional central power plants, plus the emissions from a local hot water heater or boiler. In fact microturbine emissions are so low compared with traditional hot water heaters that installing a Capstone microturbine with heat recovery can actually decrease the local emissions of NO<sub>x</sub> and other criteria pollutants, without even considering the elimination of emissions from a remote power plant.

## Greenhouse Gas Emissions

Many gasses are considered “greenhouse gasses”, and agencies have ranked them based on their global warming potential (GWP) in the atmosphere compared with carbon dioxide (CO<sub>2</sub>), as well as their ability to maintain this effect over time. For example, methane is a greenhouse gas with a GWP of 21. Criteria pollutants like NO<sub>x</sub> and organic compounds like methane are monitored by local air permitting authorities, and are subject to strong emissions controls. Even though some of these criteria pollutants can be more troublesome for global warming than CO<sub>2</sub>, they are released in small quantities – especially from Capstone microturbines. So the major contributor of concern is carbon dioxide, or CO<sub>2</sub>. Emission of CO<sub>2</sub> depends on two things:

1. Carbon content in the fuel
2. Efficiency of converting fuel to useful energy

It is for these reasons that many local authorities are focused on using clean fuels (for example natural gas compared with diesel fuel), achieving high efficiency using combined heat and power systems, and displacing emissions from traditional power plants using renewable fuels like waste landfill and digester gasses.

Table 5 shows the typical CO<sub>2</sub> emissions due to combustion for different Capstone microturbine models at full power and ISO conditions. The values do not include CO<sub>2</sub> that may already exist in the fuel itself, which is typical for renewable fuels like landfill and digester gas. These values are expressed on an output basis, as is done for criteria pollutants in Table 1. The table shows the pounds per megawatt hour based on electric power output only, as well as considering total useful output in a CHP system with total 70% efficiency (LHV). As for criteria pollutants, the relative quantity of CO<sub>2</sub> released is substantially less when useful thermal output is also considered in the measurement.

**Table 5. CO<sub>2</sub> Emission for Capstone Microturbine Models in [lb/MWh]**

Model	Fuel	CO <sub>2</sub>	
		Electric Only	70% Total CHP
C30 NG	Natural Gas <sup>(1)</sup>	1,690	625
CR30 MBTU	Landfill Gas <sup>(1)</sup>	1,690	625
CR30 MBTU	Digester Gas <sup>(1)</sup>	1,690	625
C30 Liquid	Diesel #2 <sup>(2)</sup>	2,400	855
C65 NG Standard	Natural Gas <sup>(1)</sup>	1,520	625
C65 NG Low NOx	Natural Gas <sup>(1)</sup>	1,570	625
C65 NG CARB	Natural Gas <sup>(1)</sup>	1,570	625
CR65 Landfill	Landfill Gas <sup>(1)</sup>	1,520	625
CR65 Digester	Digester Gas <sup>(1)</sup>	1,520	625
C200 NG	Natural Gas <sup>(1)</sup>	1,330	625
C200 NG CARB	Natural Gas <sup>(1)</sup>	1,330	625
CR200 Digester	Digester Gas <sup>(1)</sup>	1,330	625

Notes:

(1) Emissions due to combustion, assuming natural gas with CO<sub>2</sub> content of 117 lb/MMBTU (HHV)

(2) Emissions due to combustion, assuming diesel fuel with CO<sub>2</sub> content of 160 lb/MMBTU (HHV)

## Useful Conversions

The conversions shown in Table 6 can be used to obtain other units of emissions outputs. These are approximate conversions.

**Table 6. Useful Unit Conversions**

From	Multiply By	To Get
lb/MWh	0.338	g/bhp-hr
g/bhp-hr	2.96	lb/MWh
lb	0.454	kg
kg	2.20	lb
kg	1,000	g
hp (electric)	.746	kW
kW	1.34	hp (electric)
MW	1,000	kW
kW	0.001	MW

## Definitions

- ISO conditions are defined as: 15 °C (59 °F), 60% relative humidity, and sea level pressure of 101.3 kPa (14.696 psia).
- HHV: Higher Heating Value
- LHV: Lower Heating Value
- kW<sub>th</sub>: Kilowatt (thermal)
- kW<sub>e</sub> : Kilowatt (electric)
- MWh: Megawatt-hour
- hp-hr: horsepower-hour (sometimes referred to as “electric horsepower-hour”)
- Scf: Standard cubic foot (standard references ISO temperature and pressure)
- m<sup>3</sup>: Normal cubic meter (normal references 0 °C and one atmosphere pressure)

## Capstone Contact Information

If questions arise regarding this technical reference, please contact Capstone Turbine Corporation for assistance and information:

### Capstone Applications

Toll Free Telephone: (866) 4-CAPSTONE or (866) 422-7786

Fax: (818) 734-5385

E-mail: [applications@capstoneturbine.com](mailto:applications@capstoneturbine.com)

# NATCO BTEX BUSTER

**Removes 99.7%\* of BTEX and VOC emissions from glycol reconcentrator emissions**

## The Simple and Cost-effective Answer to Your Emission Compliance Problems

Cameron's NATCO® BTEX BUSTER® provides a removal efficiency greater than 99.7%\*, helps recover and collect saleable liquid hydrocarbons and prevents the loss of expensive fuel gas from glycol reconcentrator vent emissions.

The unit is designed using the Environmental Protection Agency-approved Gri-Glycalc computer simulation program with a flash-gas separator in the glycol regeneration process. Under common operating conditions, BTEX (benzene, toluene, ethylbenzene and xylene), as well as other volatile organic compounds (VOCs), are emitted into the atmosphere during the glycol regeneration process. The rates usually are proportional to the glycol circulation rate.

The NATCO BTEX BUSTER captures those hydrocarbon emissions.

### Performance

- The cost-effective system is designed to assist operators in reducing BTEX and VOC emissions below the accepted levels and complies with federal and state environmental regulations.
- Economics of the NATCO BTEX BUSTER show that it can pay for itself by recovering saleable hydrocarbon liquids and fuel gas. By condensing troublesome glycol reconcentrator vapors and routing flash gas back to the reconcentrator fuel gas inlet for burning, the unit reduces emissions during glycol plant dehydration processing.
- The NATCO BTEX BUSTER incorporates field-proven burner accessories to help prevent sooting and backpressure on your regeneration system.
- The NATCO BTEX BUSTER also features a design to eliminate potential freeze-up problems when operating in severe cold climates.
- Cameron offers the NATCO BTEX BUSTER in standard sizes to accommodate most customer needs. Our units are backed by Cameron's replacement parts, technical assistance and service available 24 hours a day.



*The NATCO BTEX BUSTER cold-weather design eliminates freezing problems associated with cold climates.*

### How It Works

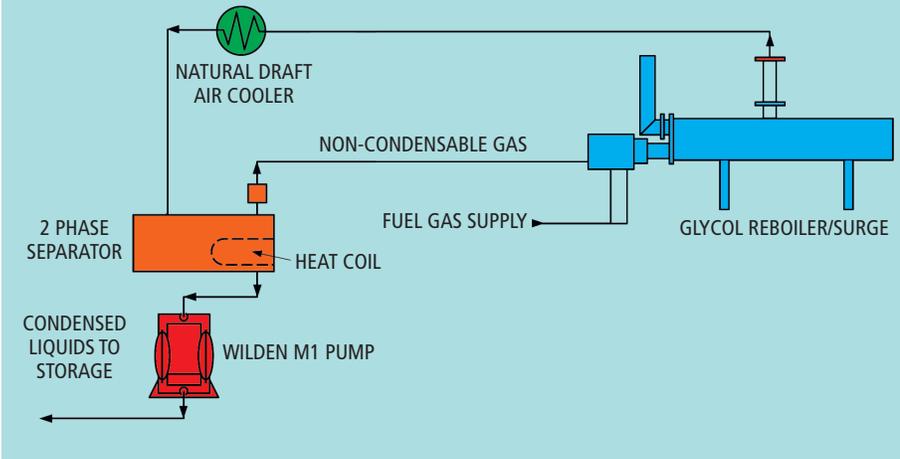
**The NATCO BTEX BUSTER is a relatively simple process that is designed to maintain greater than 99.7%\* removal of BTEX and VOC emissions.**

**The vapors emitted from the glycol still column are cooled in the natural draft air cooler to temperatures below 120° F (49° C).**

The condensed liquids are collected in a small two-phase separator and pumped to customer storage. Non-condensable gases from the separator are piped through an in-line flash arrestor and then burned in the glycol reboiler firebox to achieve an overall minimum destruction efficiency of 99.7%\* plus.

Features	Benefits
<b>Ideal for Remote Locations</b>	Natural draft self-regulating system does not require any moving pieces of equipment.
<b>Environmentally Correct</b>	Meets Federal Regulation 40 CFR part 63 and meets or exceeds most stringent state regulations LAC 111.2116 and LAC 33:111 chapter 51.
<b>Efficient</b>	<b>Removal efficiency is greater than 99.7%*.</b>
<b>Reduces Operating Costs</b>	Reduces fuel gas consumption and recovers saleable liquid hydrocarbons.
<b>Safe</b>	Features an in-line flash arrestor, high-level switch, pressure safety valve and gas shut-down valves.
<b>Designed for the Oil Field</b>	Includes field-proven burner products, and the pneumatic pump handles aromatic hydrocarbons.
<b>Designed for Cold Weather</b>	Cold-weather design eliminates freezing problems associated with cold climates.
<b>Cameron's Services</b>	Includes experienced staff and worldwide locations, 24 hours a day.

### NATCO BTEX BUSTER SKID UNIT



### Built-in Safety Features

The NATCO BTEX BUSTER is engineered with proper controls for safe operation and long in-service life. These include an in-line flash arrestor, separator high-level switch, pressure safety valve and gas shut-down valves for high reboiler bath temperatures. It also incorporates field-proven burner accessories that help to prevent typical sooting and backpressures on your regeneration system.

Field-proven, the NATCO BTEX BUSTER now is available through our sales and service locations worldwide.

Standard BTEX Size (1)	Reconcentrator Duty Btu/hr	Glycol Pump gal/hr	Max Capacity water/day (2)	Non-condensable vapor/day (3)	Cooler Duty Btu/hr (3)
150	75,000	40	273	7	30,000
150	150,000	40	273	10	30,000
250	250,000	90	1216	27	51,000
375	375,000	210	1807	45	76,000
550	550,000	210	2650	60	112,000
750	750,000	450	3615	100	152,000

#### (1) Standard BTEX

Performance of unit is based on a non-condensable vapor HHV greater than 400 Btu/cf and less than 1800 Btu/cf and a glycol circulation rate of no more than 3 gal/lb of water removed.

#### (2) Maximum Capacity of Water/day

Represents the maximum capacity of water in pounds per day for each of Cameron's standard reboiler size based on a glycol circulation rate of 2 gallons of glycol per pound of water removed.

#### (3) Non-condensable Vapor/day

Maximum non-condensable vapor rate was calculated with the Gri-Glycalc computer simulation program with a flash-gas separator used in the glycol regeneration process and a BTEX concentration in the inlet gas stream of no more than 700 ppm.

Using adiabatic combustion calculations, a minimum of 99.7%\* of these non-condensable vapors are destroyed.

#### (4) Cooler Duty Btu/hr

Cooler duty was calculated based on a prevailing windspeed of 3 mph and a maximum ambient temperature of 100° F (38° C).

Note: Cameron is not responsible for the disposal of any condensed liquids associated with its BTEX BUSTER units.

\* Certain gas streams contain more BTEX and VOCs than represented by Gri-Glycalc. Consult with Cameron's engineers for system evaluation, equipment sizing and application to ensure conversion efficiency.

### LOCATIONS

**United States of America**  
11210 Equity Dr., Suite 100  
Houston, TX 77041  
USA  
Tel 713.849.7500

**Marcellus/Utica**  
Laceyville 570.869.3104  
Nitro 304.755.9400  
  
**Midcontinent**  
Oklahoma City 405.677.8827

**Rockies**  
Casper 307.234.7183  
Bloomfield 505.634.1400  
Grand Junction 970.243.3600  
Vernal 435.789.1796  
Williston 701.774.5500

**Texas**  
Caldwell 979.272.7101  
Corpus Christi 361.289.0488  
Godley 817.389.2676  
Longview 903.759.2738  
Odessa 432.530.3600

**Canada**  
Leduc 780.986.9803

# Installing Vapor Recovery Units on Storage Tanks



## Executive Summary

There are about 500,000 crude oil storage tanks in the United States. These tanks are used to hold oil for brief periods of time in order to stabilize flow between production wells and pipeline or trucking transportation sites. In addition, the condensate liquids contained in produced gas that are captured by a mist eliminator filter/coalescer ahead of the first compressor station in transmission pipelines are often directed to a storage tank as well. During storage, light hydrocarbons dissolved in the crude oil or condensate—including methane and other volatile organic compounds (VOC), natural gas liquids (NGLs), hazardous air pollutants (HAP), and some inert gases—vaporize or "flash out" and collect in the space between the liquid and the fixed roof of the tank. As the liquid level in the tank fluctuates, these vapors are often vented to the atmosphere.

One way to prevent emissions of these light hydrocarbon vapors and yield significant economic savings is to install vapor recovery units (VRUs) on storage tanks. VRUs are relatively simple systems that can capture about 95 percent of the Btu-rich vapors for sale or for use onsite as fuel. Currently, between 7,000 and 9,000 VRUs are installed in the oil production sector, with an average of four tanks connected to each VRU.

Natural Gas STAR partners have generated significant savings from recovering and marketing these vapors while at the same time substantially reducing methane and HAP emissions. Partners have found that when the volume of vapors is sufficient, installing a VRU on one or multiple

storage tanks can save up to \$606,800 per year and payback in as little as two months. This Lessons Learned study describes how partners can identify when and where VRUs should be installed to realize these economic and environmental benefits.

## Technology Background

Underground crude oil contains many lighter hydrocarbons in solution. When the oil is brought to the surface and processed, many of the dissolved lighter hydrocarbons (as well as water) are removed through a series of high-pressure and low-pressure separators. The crude oil is then injected into a storage tank to await sale and transportation off site; the remaining hydrocarbons in the oil are emitted as vapors into the tank. The same principles apply for condensate, which accumulates as a result of the conditions within the pipelines and is removed ahead of the first compressor station. The recovered condensate, which contains dissolved light hydrocarbons, is routed to a storage tank where the dissolved light hydrocarbons are emitted as vapors. These vapors are either vented, flared, or recovered by vapor recovery units (VRUs). Losses of the remaining lighter hydrocarbons are categorized in three ways:

- ★ Flash losses occur when the separator or heater treater, operating at approximately 35 pounds per square inch (psi), dumps oil into the storage tanks, which are at atmospheric pressure.
- ★ Working losses refer to the vapor released from the

## Economic and Environmental Benefits

Method for Reducing Natural Gas Losses	Volume of Natural Gas Savings (Mcf/yr)	Value of Natural Gas Savings (\$/yr) <sup>1</sup>			Implementation Cost (\$)	Other Costs (\$)	Payback (Months)		
		\$3 per Mcf	\$5 per Mcf	\$7 per Mcf			\$3 per Mcf	\$5 per Mcf	\$7 per Mcf
Installing Vapor Recovery Units (VRUs) on Oil Production Storage Tanks	4,900—96,000	\$13,965— \$273,600	\$23,275— \$456,000	\$32,585— \$638,400	\$35,738— \$103,959	\$7,367— \$16,839	6 — 37	4 — 23	3 — 16

<sup>1</sup> Assumes 95% of the annual volume of gas lost can be recovered using a VRU.

# Installing Vapor Recovery Units on Storage Tanks

(Cont'd)

changing fluid levels and agitation of tank contents associated with the circulation of fresh oil through the storage tanks.

- ★ Standing losses occur with daily and seasonal temperature changes.

The volume of gas vapor coming off a storage tank depends on many factors. Lighter crude oils (API gravity > 36°) flash more hydrocarbon vapors than heavier crudes (API gravity < 36°). In storage tanks where the oil is frequently cycled and the overall throughput is high, more “working vapors” will be released than in tanks with low throughput and where the oil is held for longer periods and allowed to “weather.” Finally, the operating temperature and pressure of oil in the vessel dumping into the tank will affect the volume of flashed gases coming out of the oil.

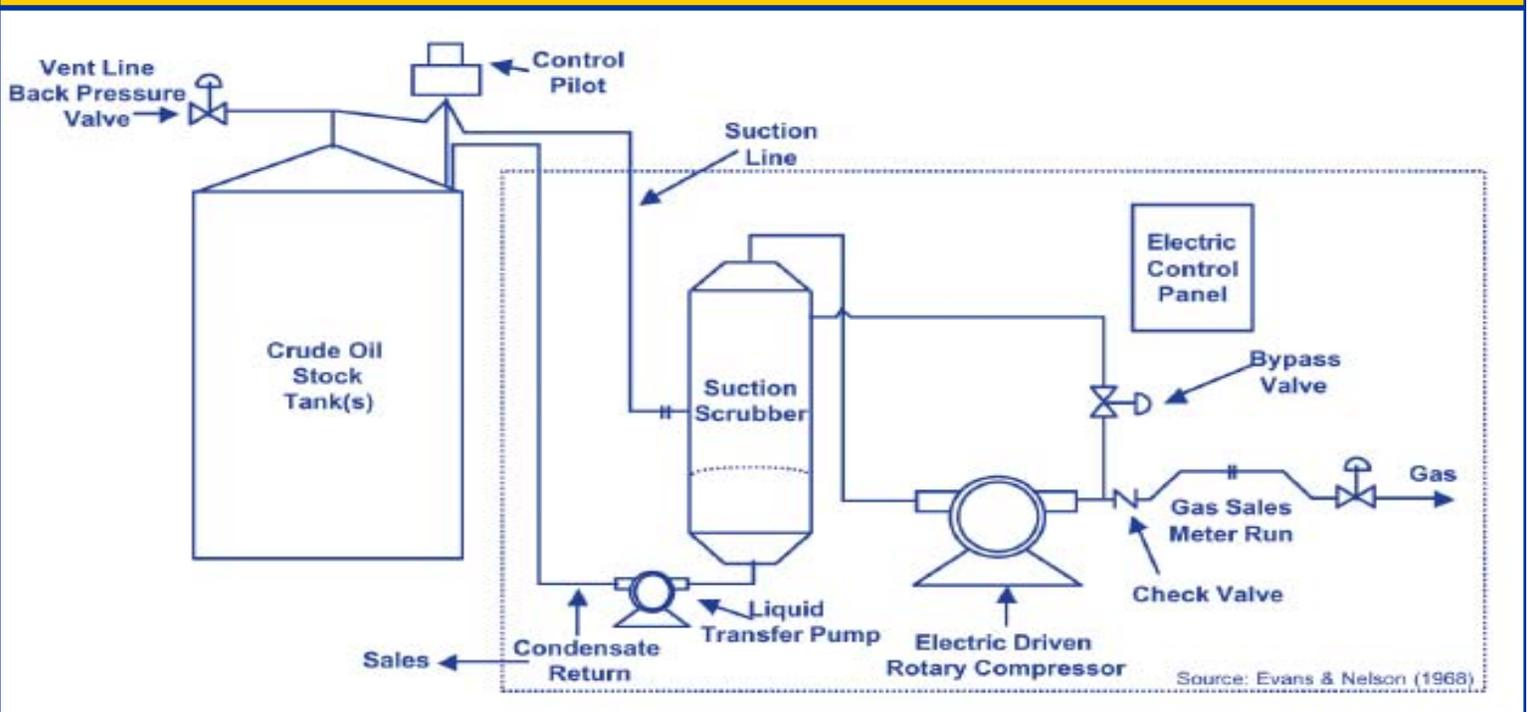
The makeup of these vapors varies, but the largest component is methane (between 40 and 60 percent). Other components include more complex hydrocarbon compounds such as propane, butane, and ethane; natural inert gases such as nitrogen and carbon dioxide; and HAP like benzene, toluene, ethyl-benzene, and xylene (collectively these four HAP are referred to as BTEX).

VRUs can recover over 95 percent of the hydrocarbon

emissions that accumulate in storage tanks. Because recovered vapors contain natural gas liquids (even after condensates have been captured by the suction scrubber), they have a Btu content that is higher than that of pipeline quality natural gas (between 950 and 1,100 Btu per standard cubic foot [scf]). Depending on the volume of NGLs in the vapors, the Btu content can reach as high as 2,000 Btu per scf. Therefore, on a volumetric basis, the recovered vapors can be more valuable than methane alone.

Exhibit 1 illustrates a VRU installed on a single crude oil storage tank (multiple tank installations are also common). Hydrocarbon vapors are drawn out of the storage (stock) tank under low-pressure, typically between four ounces and two psi, and are first piped to a separator (suction scrubber) to collect any liquids that condense out. The liquids are usually recycled back to the storage tank. From the separator, the vapors flow through a compressor that provides the low-pressure suction for the VRU system. (To prevent the creation of a vacuum in the top of a tank when oil is withdrawn and the oil level drops, VRUs are equipped with a control pilot to shut down the compressor and permit the back flow of vapors into the tank.) The vapors are then metered and removed from the VRU system for pipeline sale or onsite fuel supply.

Exhibit 1: Standard Stock Tank Vapor Recovery System



# CARBTRON<sup>®</sup>

## AIR PURIFICATION CANISTERS 140-200 LB. ACTIVATED CARBON

G-1  
G-2  
G-3



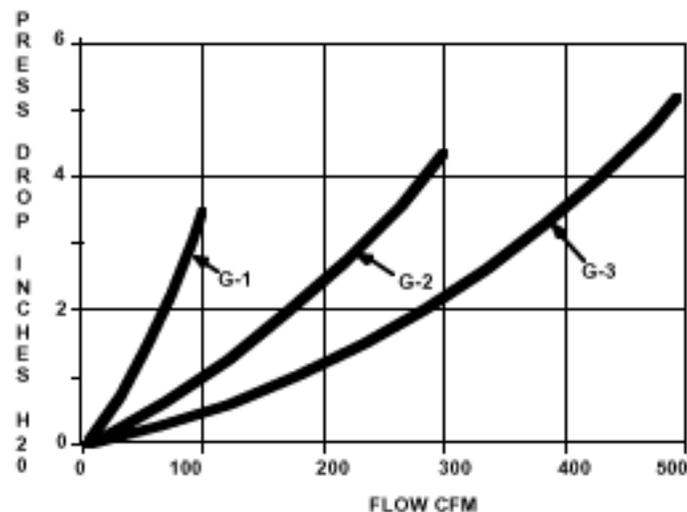
The CARBTRON "G" Canisters handles flows up to 500 CFM.

### FEATURES

- High activity carbon.
- Epoxy lined steel or polyethylene construction.
- Acceptable for transport of hazardous spent carbon.
- Side drain for removal of accumulated condensate.
- Low pressure drop.
- PVC internal piping.
- High temperature (180°F) steel units available.

### APPLICATIONS

- Soil vapor remediation
- Air stripper exhausts
- Tank vents
- Exhaust hoods
- Work area purification
- Sewage plant odor control



© Copyright 1991 Carbtronic Corporation - 10/4/02

AT-116/81

**CARBTRON<sup>®</sup>**  
CORPORATION

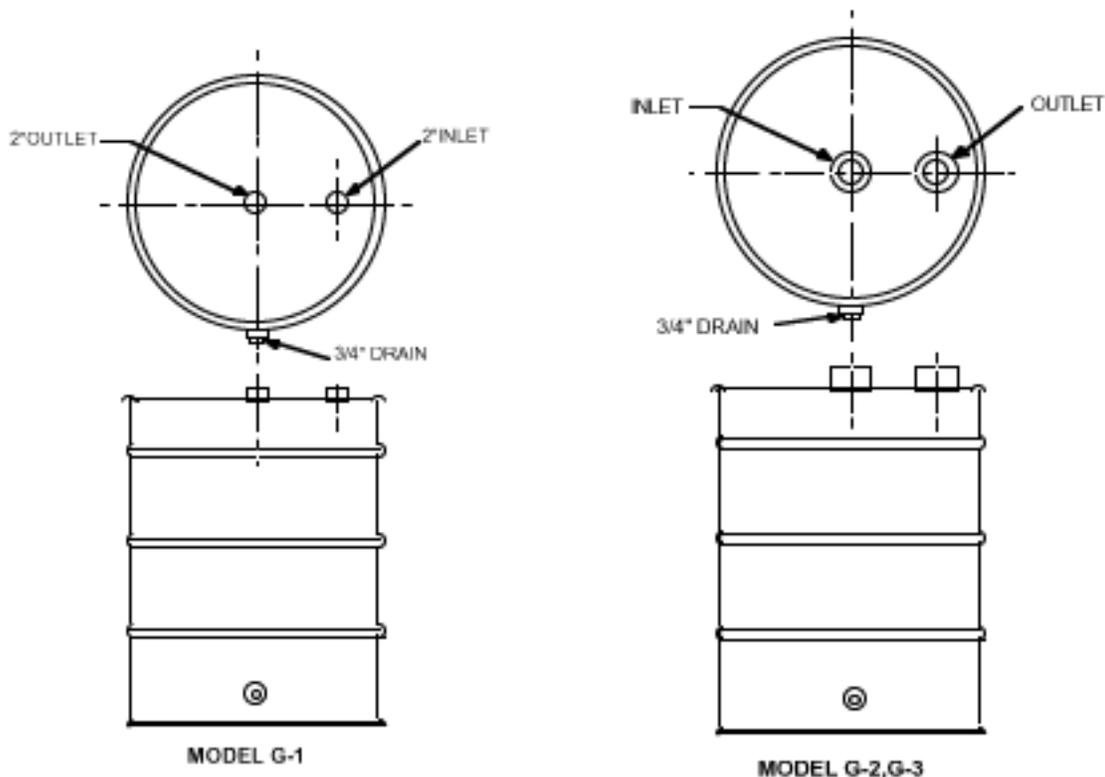
955 Connecticut Ave., Suite 5202  
Bridgeport, CT 06607

800-242-1150 Fax: 203-337-4347  
[www.carbtronic.com](http://www.carbtronic.com) [info@carbtronic.com](mailto:info@carbtronic.com)

# CARBTROL®

## AIR PURIFICATION CANISTERS 140-200 LB. ACTIVATED CARBON

G-1  
G-2  
G-3



### SPECIFICATIONS

<u>MODEL</u>	<u>DIAMETER/HEIGHT</u>	<u>CARBON WEIGHT</u>	<u>INLET/OUTLET</u>	<u>MAXIMUM RATED FLOW</u>	<u>APPROXIMATE SHIP WEIGHT</u>
G-1*	24"/36"	200 lbs.	2"/2"	100 CFM	250 lbs.
G-2*	24"/36"	170 lbs.	4"/4"	300 CFM	220 lbs.
G-3P	24"/36"	140 lbs.	6"/6"	500 CFM	190 lbs.
G-3S	24"/34"	140 lbs.	4"/4"	500 CFM	180 lbs.

\* Specify: Polyethylene (P) or Epoxy Lined Steel (S)

#### **SAFETY**

Certain chemical compounds in the presence of activated carbon may oxidize, decompose or polymerize. This could result in temperature increases sufficient to cause ignition of the activated carbon or adsorbed material. If a compounds reaction with activated carbon is unknown, appropriate tests should be considered.

**CARBTROL®**  
CORPORATION

955 Connecticut Ave., Suite 5202  
Bridgeport, CT 06607

800-242-1150 Fax: 203-337-4347  
[www.carbtrol.com](http://www.carbtrol.com) [info@carbtrol.com](mailto:info@carbtrol.com)

## **Supplement S6**

### **Emission Program Data**

---

- **EPA Tanks 4.0.9d – Stabilized Condensate (SC) – Tank Emissions**
  - **EPA Tanks 4.0.9d – Produced Water (PW) – Tank Emissions**
  - **GRI-GLYCalc – 55.0 MMscfd Dehydrator**
-

**Stabilized Condensate (SC) - Storage Tank (TK1-8)**

**TANKS 4.0.9d  
 Emissions Report - Summary Format  
 Tank Identification and Physical Characteristics**

**Identification**

User Identification: Battle Run CF 400 bbl Stabilized Condensate Tank  
 City: Near Dallas  
 State: West Virginia  
 Company: Appalachia Midstream Services  
 Type of Tank: Vertical Fixed Roof Tank  
 Description: Each of Eight 400 bbl Stabilized Condensate Tanks. Assume Gasoline RVP=12 as product stored.

**Tank Dimensions**

Shell Height (ft): 20.00  
 Diameter (ft): 12.00  
 Liquid Height (ft) : 19.00  
 Avg. Liquid Height (ft): 10.00  
 Volume (gallons): 16,074.56  
 Turnovers: 77.49  
 Net Throughput(gal/yr): 1,245,552.00  
 Is Tank Heated (y/n): N

**Paint Characteristics**

Shell Color/Shade: White/White  
 Shell Condition: Good  
 Roof Color/Shade: White/White  
 Roof Condition: Good

**Roof Characteristics**

Type: Cone  
 Height (ft): 0.00  
 Slope (ft/ft) (Cone Roof): 0.06

**Breather Vent Settings**

Vacuum Settings (psig): -0.03  
 Pressure Settings (psig): 0.03

Meteorological Data used in Emissions Calculations: Pittsburgh, Pennsylvania (Avg Atmospheric Pressure = 14.11 psia)

**TANKS 4.0.9d  
 Emissions Report - Summary Format  
 Liquid Contents of Storage Tank**

**Battle Run CF 400 bbl Stabilized Condensate Tank - Vertical Fixed Roof Tank  
 Near Dallas, West Virginia**

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Gasoline (RVP 12)	All	51.04	47.08	56.81	50.33	5.4430	4.9447	5.9807	64.0000			92.00	Option 4: RVP=12, ASTM Slope=3

**TANKS 4.0.9d  
 Emissions Report - Summary Format  
 Individual Tank Emission Totals**

**Emissions Report for: Annual**

**Battle Run CF 400 bbl Stabilized Condensate Tank - Vertical Fixed Roof Tank  
 Near Dallas, West Virginia**

Components	Losses(lbs)		
	Working Loss	Breathing Loss	Total Emissions
Gasoline (RVP 12)	5,721.52	1,019.88	6,741.40

**Produced Water (PW) - Storage Tank (WTK)**

**TANKS 4.0.9d**  
**Emissions Report - Summary Format**  
**Tank Identification and Physical Characteristics**

**Identification**

User Identification: Battle Run 400 bbl Produced Water Tank  
 City: Near Dallas  
 State: West Virginia  
 Company: Appalachia Midstream Services  
 Type of Tank: Vertical Fixed Roof Tank  
 Description: 400 bbl Produced Water Tank. Assume 95% Water + 5% Gasoline RVP=12 as product stored.

**Tank Dimensions**

Shell Height (ft): 20.00  
 Diameter (ft): 12.00  
 Liquid Height (ft) : 19.00  
 Avg. Liquid Height (ft): 10.00  
 Volume (gallons): 16,074.56  
 Turnovers: 47.68  
 Net Throughput(gal/yr): 766,500.00  
 Is Tank Heated (y/n): N

**Paint Characteristics**

Shell Color/Shade: White/White  
 Shell Condition: Good  
 Roof Color/Shade: White/White  
 Roof Condition: Good

**Roof Characteristics**

Type: Cone  
 Height (ft) 0.00  
 Slope (ft/ft) (Cone Roof) 0.06

**Breather Vent Settings**

Vacuum Settings (psig): -0.03  
 Pressure Settings (psig) 0.03

Meteorological Data used in Emissions Calculations: Pittsburgh, Pennsylvania (Avg Atmospheric Pressure = 14.11 psia)

**TANKS 4.0.9d**  
**Emissions Report - Summary Format**  
**Liquid Contents of Storage Tank**

**Battle Run 400 bbl Produced Water Tank - Vertical Fixed Roof Tank**  
**Near Dallas, West Virginia**

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Produced Water	All	51.94	47.06	56.81	50.33	0.2465	0.2101	0.2893	28.3522	0.0500	0.5080	18.75	
Gasoline (RVP 12)						5.4430	4.9447	5.9807	64.0000	0.0500	0.5080	92.00	Option 4: RVP=12, ASTM Slope=3
Water						0.1930	0.1614	0.2307	18.0000	0.9500	0.4920	18.00	Option 1: VP50 = .178073 VP60 = .255246

**TANKS 4.0.9d**  
**Emissions Report - Summary Format**  
**Individual Tank Emission Totals**

**Emissions Report for: Annual**

**Battle Run 400 bbl Produced Water Tank - Vertical Fixed Roof Tank**  
**Near Dallas, West Virginia**

Components	Losses(lbs)		
	Working Loss	Breathing Loss	Total Emissions
Produced Water	101.51	18.57	120.08
Water	49.94	9.14	59.08
Gasoline (RVP 12)	51.57	9.44	61.00

## GRI-GLYCalc VERSION 4.0 - EMISSIONS SUMMARY

Case Name: SHCS-55.0 Dehy-Electric Pump-010818

File Name: C:\Users\Clyde\Documents\Documents\04.16 - Ecologic\07 - AMS - 000-BRCS-BCS-SHCS-TVOP-122617\SHCS-TVOP-DRAFT\SHCS-TVOP-S6c-55.0 Dehy - Electric Pump.ddf

Date: January 07, 2018

## CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.0802	1.924	0.3511
Ethane	0.2803	6.728	1.2279
Propane	0.3613	8.672	1.5826
Isobutane	0.0875	2.100	0.3832
n-Butane	0.3368	8.084	1.4753
Isopentane	0.0834	2.002	0.3653
n-Pentane	0.1469	3.526	0.6434
n-Hexane	0.0821	1.970	0.3595
Cyclohexane	0.1006	2.415	0.4408
Other Hexanes	0.0755	1.813	0.3309
Heptanes	0.0958	2.299	0.4196
Methylcyclohexane	0.0726	1.743	0.3181
2,2,4-Trimethylpentane	0.0007	0.017	0.0030
Benzene	0.0566	1.358	0.2478
Toluene	0.0903	2.167	0.3954
Ethylbenzene	0.0033	0.080	0.0146
Xylenes	0.0348	0.835	0.1523
C8+ Heavies	0.0009	0.023	0.0041
Total Emissions	1.9897	47.753	8.7148
Total Hydrocarbon Emissions	1.9897	47.753	8.7148
Total VOC Emissions	1.6292	39.101	7.1359
Total HAP Emissions	0.2677	6.425	1.1726
Total BTEX Emissions	0.1850	4.439	0.8101

## UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	1.6043	38.503	7.0267
Ethane	5.6231	134.954	24.6292
Propane	7.3225	175.739	32.0724
Isobutane	1.7959	43.102	7.8661
n-Butane	6.9824	167.577	30.5829
Isopentane	1.8193	43.662	7.9684
n-Pentane	3.2803	78.728	14.3678
n-Hexane	2.0894	50.147	9.1518
Cyclohexane	2.7780	66.672	12.1677
Other Hexanes	1.8118	43.483	7.9357
Heptanes	3.3516	80.438	14.6800
Methylcyclohexane	2.5528	61.267	11.1812
2,2,4-Trimethylpentane	0.0244	0.587	0.1071
Benzene	1.5901	38.162	6.9646
Toluene	4.0164	96.393	17.5917
Ethylbenzene	0.2924	7.018	1.2809
Xylenes	3.4416	82.598	15.0742
C8+ Heavies	4.3664	104.795	19.1250

			Page: 2
Total Emissions	54.7427	1313.826	239.7732
Total Hydrocarbon Emissions	54.7427	1313.826	239.7732
Total VOC Emissions	47.5154	1140.369	208.1173
Total HAP Emissions	11.4544	274.905	50.1701
Total BTEX Emissions	9.3405	224.172	40.9113

### FLASH GAS EMISSIONS

Note: Flash Gas Emissions are zero with the Recycle/recompression control option.

### FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	34.8694	836.865	152.7278
Ethane	32.9984	791.962	144.5331
Propane	20.4362	490.469	89.5106
Isobutane	3.2273	77.456	14.1357
n-Butane	9.4919	227.805	41.5744
Isopentane	2.1155	50.772	9.2658
n-Pentane	3.0205	72.491	13.2297
n-Hexane	1.0344	24.825	4.5306
Cyclohexane	0.3321	7.970	1.4545
Other Hexanes	1.1930	28.632	5.2253
Heptanes	0.7794	18.707	3.4139
Methylcyclohexane	0.2335	5.604	1.0228
2,2,4-Trimethylpentane	0.0115	0.275	0.0502
Benzene	0.0266	0.639	0.1166
Toluene	0.0419	1.006	0.1836
Ethylbenzene	0.0017	0.041	0.0075
Xylenes	0.0140	0.335	0.0612
C8+ Heavies	0.0858	2.058	0.3756
Total Emissions	109.9130	2637.911	481.4187
Total Hydrocarbon Emissions	109.9130	2637.911	481.4187
Total VOC Emissions	42.0452	1009.084	184.1579
Total HAP Emissions	1.1300	27.121	4.9496
Total BTEX Emissions	0.0842	2.021	0.3688

### COMBINED REGENERATOR VENT/FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.0802	1.924	0.3511
Ethane	0.2803	6.728	1.2279
Propane	0.3613	8.672	1.5826
Isobutane	0.0875	2.100	0.3832
n-Butane	0.3368	8.084	1.4753
Isopentane	0.0834	2.002	0.3653
n-Pentane	0.1469	3.526	0.6434
n-Hexane	0.0821	1.970	0.3595
Cyclohexane	0.1006	2.415	0.4408
Other Hexanes	0.0755	1.813	0.3309
Heptanes	0.0958	2.299	0.4196
Methylcyclohexane	0.0726	1.743	0.3181

Page: 3

2,2,4-Trimethylpentane	0.0007	0.017	0.0030
Benzene	0.0566	1.358	0.2478
Toluene	0.0903	2.167	0.3954
Ethylbenzene	0.0033	0.080	0.0146
Xylenes	0.0348	0.835	0.1523
C8+ Heavies	0.0009	0.023	0.0041
-----			
Total Emissions	1.9897	47.753	8.7148
Total Hydrocarbon Emissions	1.9897	47.753	8.7148
Total VOC Emissions	1.6292	39.101	7.1359
Total HAP Emissions	0.2677	6.425	1.1726
Total BTEX Emissions	0.1850	4.439	0.8101

GRI-GLYCalc VERSION 4.0 - SUMMARY OF INPUT VALUES

Case Name: SHCS-55.0 Dehy-Electric Pump-010818

File Name: C:\Users\Clyde\Documents\Documents\04.16 - Ecologic\07 - AMS - 000-BRCS-BCS-SHCS-TVOP-122617\SHCS-TVOP-DRAFT\SHCS-TVOP-S6c-55.0 Dehy - Electric Pump.ddf  
 Date: January 07, 2018

DESCRIPTION:

-----  
 Description: 55MMscfd, 1.0 MMbtu/hr reboiler  
 22 gpm Electric Pump  
 Flash Tank w/ 100% Recycle  
 BTEX Buster at 120 oF w/ 95% Control

Annual Hours of Operation: 8760.0 hours/yr

WET GAS:

-----  
 Temperature: 95.00 deg. F  
 Pressure: 1100.00 psig  
 Wet Gas Water Content: Saturated

Component	Conc. (vol %)
Carbon Dioxide	0.0869
Nitrogen	0.4303
Methane	73.9064
Ethane	15.8261
Propane	5.9829
Isobutane	0.6737
n-Butane	1.7221
Isopentane	0.3757
n-Pentane	0.4738
n-Hexane	0.1419
Cyclohexane	0.0303
Other Hexanes	0.1727
Heptanes	0.1015
Methylcyclohexane	0.0246
2,2,4-Trimethylpentane	0.0019
Benzene	0.0020
Toluene	0.0035
Ethylbenzene	0.0002
Xylenes	0.0018
C8+ Heavies	0.0417

DRY GAS:

-----  
 Flow Rate: 55.0 MMSCF/day  
 Water Content: 7.0 lbs. H2O/MMSCF

LEAN GLYCOL:

-----  
 Glycol Type: TEG  
 Water Content: 1.5 wt% H2O  
 Flow Rate: 22.0 gpm

## PUMP:

---

Glycol Pump Type: Electric/Pneumatic

## FLASH TANK:

---

Flash Control: Recycle/recompression  
Temperature: 120.0 deg. F  
Pressure: 50.0 psig

## REGENERATOR OVERHEADS CONTROL DEVICE:

---

Control Device: Condenser  
Temperature: 120.0 deg. F  
Pressure: 14.1 psia

Control Device: Combustion Device  
Destruction Efficiency: 95.0 %  
Excess Oxygen: 0.0 %  
Ambient Air Temperature: 52.0 deg. F

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: SHCS-55.0 Dehy-Electric Pump-010818

File Name: C:\Users\Clyde\Documents\Documents\04.16 - Ecologic\07 - AMS - 000-BRCS-BCS-SHCS-TVOP-122617\SHCS-TVOP-DRAFT\SHCS-TVOP-S6c-55.0 Dehy - Electric Pump.ddf

Date: January 07, 2018

DESCRIPTION:

Description: 55MMscfd, 1.0 MMbtu/hr reboiler  
 22 gpm Electric Pump  
 Flash Tank w/ 100% Recycle  
 BTEX Buster at 120 oF w/ 95% Control

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.0802	1.924	0.3511
Ethane	0.2803	6.728	1.2279
Propane	0.3613	8.672	1.5826
Isobutane	0.0875	2.100	0.3832
n-Butane	0.3368	8.084	1.4753
Isopentane	0.0834	2.002	0.3653
n-Pentane	0.1469	3.526	0.6434
n-Hexane	0.0821	1.970	0.3595
Cyclohexane	0.1006	2.415	0.4408
Other Hexanes	0.0755	1.813	0.3309
Heptanes	0.0958	2.299	0.4196
Methylcyclohexane	0.0726	1.743	0.3181
2,2,4-Trimethylpentane	0.0007	0.017	0.0030
Benzene	0.0566	1.358	0.2478
Toluene	0.0903	2.167	0.3954
Ethylbenzene	0.0033	0.080	0.0146
Xylenes	0.0348	0.835	0.1523
C8+ Heavies	0.0009	0.023	0.0041
<b>Total Emissions</b>	<b>1.9897</b>	<b>47.753</b>	<b>8.7148</b>
<b>Total Hydrocarbon Emissions</b>	<b>1.9897</b>	<b>47.753</b>	<b>8.7148</b>
<b>Total VOC Emissions</b>	<b>1.6292</b>	<b>39.101</b>	<b>7.1359</b>
<b>Total HAP Emissions</b>	<b>0.2677</b>	<b>6.425</b>	<b>1.1726</b>
<b>Total BTEX Emissions</b>	<b>0.1850</b>	<b>4.439</b>	<b>0.8101</b>

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	1.6043	38.503	7.0267
Ethane	5.6231	134.954	24.6292
Propane	7.3225	175.739	32.0724
Isobutane	1.7959	43.102	7.8661
n-Butane	6.9824	167.577	30.5829
Isopentane	1.8193	43.662	7.9684
n-Pentane	3.2803	78.728	14.3678

Page: 2

n-Hexane	2.0894	50.147	9.1518
Cyclohexane	2.7780	66.672	12.1677
Other Hexanes	1.8118	43.483	7.9357
Heptanes	3.3516	80.438	14.6800
Methylcyclohexane	2.5528	61.267	11.1812
2,2,4-Trimethylpentane	0.0244	0.587	0.1071
Benzene	1.5901	38.162	6.9646
Toluene	4.0164	96.393	17.5917
Ethylbenzene	0.2924	7.018	1.2809
Xylenes	3.4416	82.598	15.0742
C8+ Heavies	4.3664	104.795	19.1250
-----			
Total Emissions	54.7427	1313.826	239.7732
Total Hydrocarbon Emissions	54.7427	1313.826	239.7732
Total VOC Emissions	47.5154	1140.369	208.1173
Total HAP Emissions	11.4544	274.905	50.1701
Total BTEX Emissions	9.3405	224.172	40.9113

FLASH GAS EMISSIONS

Note: Flash Gas Emissions are zero with the Recycle/recompression control option.

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	34.8694	836.865	152.7278
Ethane	32.9984	791.962	144.5331
Propane	20.4362	490.469	89.5106
Isobutane	3.2273	77.456	14.1357
n-Butane	9.4919	227.805	41.5744
Isopentane	2.1155	50.772	9.2658
n-Pentane	3.0205	72.491	13.2297
n-Hexane	1.0344	24.825	4.5306
Cyclohexane	0.3321	7.970	1.4545
Other Hexanes	1.1930	28.632	5.2253
Heptanes	0.7794	18.707	3.4139
Methylcyclohexane	0.2335	5.604	1.0228
2,2,4-Trimethylpentane	0.0115	0.275	0.0502
Benzene	0.0266	0.639	0.1166
Toluene	0.0419	1.006	0.1836
Ethylbenzene	0.0017	0.041	0.0075
Xylenes	0.0140	0.335	0.0612
C8+ Heavies	0.0858	2.058	0.3756
-----			
Total Emissions	109.9130	2637.911	481.4187
Total Hydrocarbon Emissions	109.9130	2637.911	481.4187
Total VOC Emissions	42.0452	1009.084	184.1579
Total HAP Emissions	1.1300	27.121	4.9496
Total BTEX Emissions	0.0842	2.021	0.3688

COMBINED REGENERATOR VENT/FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
-----			

Methane	0.0802	1.924	0.3511
Ethane	0.2803	6.728	1.2279
Propane	0.3613	8.672	1.5826
Isobutane	0.0875	2.100	0.3832
n-Butane	0.3368	8.084	1.4753
Isopentane	0.0834	2.002	0.3653
n-Pentane	0.1469	3.526	0.6434
n-Hexane	0.0821	1.970	0.3595
Cyclohexane	0.1006	2.415	0.4408
Other Hexanes	0.0755	1.813	0.3309
Heptanes	0.0958	2.299	0.4196
Methylcyclohexane	0.0726	1.743	0.3181
2,2,4-Trimethylpentane	0.0007	0.017	0.0030
Benzene	0.0566	1.358	0.2478
Toluene	0.0903	2.167	0.3954
Ethylbenzene	0.0033	0.080	0.0146
Xylenes	0.0348	0.835	0.1523
C8+ Heavies	0.0009	0.023	0.0041
-----			
Total Emissions	1.9897	47.753	8.7148
Total Hydrocarbon Emissions	1.9897	47.753	8.7148
Total VOC Emissions	1.6292	39.101	7.1359
Total HAP Emissions	0.2677	6.425	1.1726
Total BTEX Emissions	0.1850	4.439	0.8101

COMBINED REGENERATOR VENT/FLASH GAS EMISSION CONTROL REPORT:

Component	Uncontrolled tons/yr	Controlled tons/yr	% Reduction
-----			
Methane	159.7545	0.3511	99.78
Ethane	169.1622	1.2279	99.27
Propane	121.5830	1.5826	98.70
Isobutane	22.0019	0.3832	98.26
n-Butane	72.1572	1.4753	97.96
Isopentane	17.2342	0.3653	97.88
n-Pentane	27.5975	0.6434	97.67
n-Hexane	13.6824	0.3595	97.37
Cyclohexane	13.6221	0.4408	96.76
Other Hexanes	13.1610	0.3309	97.49
Heptanes	18.0939	0.4196	97.68
Methylcyclohexane	12.2040	0.3181	97.39
2,2,4-Trimethylpentane	0.1573	0.0030	98.07
Benzene	7.0812	0.2478	96.50
Toluene	17.7752	0.3954	97.78
Ethylbenzene	1.2884	0.0146	98.87
Xylenes	15.1353	0.1523	98.99
C8+ Heavies	19.5006	0.0041	99.98
-----			
Total Emissions	721.1919	8.7148	98.79
Total Hydrocarbon Emissions	721.1919	8.7148	98.79
Total VOC Emissions	392.2752	7.1359	98.18
Total HAP Emissions	55.1197	1.1726	97.87
Total BTEX Emissions	41.2801	0.8101	98.04

EQUIPMENT REPORTS:

CONDENSER AND COMBUSTION DEVICE

Condenser Outlet Temperature: 120.00 deg. F  
 Condenser Pressure: 14.08 psia  
 Condenser Duty: 1.61e-001 MM BTU/hr  
 Hydrocarbon Recovery: 1.20 bbls/day  
 Produced Water: 7.07 bbls/day  
 Ambient Temperature: 52.00 deg. F  
 Excess Oxygen: 0.00 %  
 Combustion Efficiency: 95.00 %  
 Supplemental Fuel Requirement: 1.61e-001 MM BTU/hr

Component	Emitted	Destroyed
Methane	5.00%	95.00%
Ethane	4.99%	95.01%
Propane	4.93%	95.07%
Isobutane	4.87%	95.13%
n-Butane	4.82%	95.18%
Isopentane	4.58%	95.42%
n-Pentane	4.48%	95.52%
n-Hexane	3.93%	96.07%
Cyclohexane	3.62%	96.38%
Other Hexanes	4.17%	95.83%
Heptanes	2.86%	97.14%
Methylcyclohexane	2.84%	97.16%
2,2,4-Trimethylpentane	2.84%	97.16%
Benzene	3.56%	96.44%
Toluene	2.25%	97.75%
Ethylbenzene	1.14%	98.86%
Xylenes	1.01%	98.99%
C8+ Heavies	0.02%	99.98%

ABSORBER

NOTE: Because the Calculated Absorber Stages was below the minimum allowed, GRI-GLYCalc has set the number of Absorber Stages to 1.25 and has calculated a revised Dry Gas Dew Point.

Calculated Absorber Stages: 1.25  
 Calculated Dry Gas Dew Point: 1.87 lbs. H2O/MMSCF  
 Temperature: 95.0 deg. F  
 Pressure: 1100.0 psig  
 Dry Gas Flow Rate: 55.0000 MMSCF/day  
 Glycol Losses with Dry Gas: 2.1072 lb/hr  
 Wet Gas Water Content: Saturated  
 Calculated Wet Gas Water Content: 47.69 lbs. H2O/MMSCF  
 Calculated Lean Glycol Recirc. Ratio: 12.57 gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	3.91%	96.09%
Carbon Dioxide	99.37%	0.63%
Nitrogen	99.94%	0.06%
Methane	99.95%	0.05%

Ethane	99.87%	0.13%
Propane	99.83%	0.17%
Isobutane	99.79%	0.21%
n-Butane	99.73%	0.27%
Isopentane	99.76%	0.24%
n-Pentane	99.70%	0.30%
n-Hexane	99.58%	0.42%
Cyclohexane	97.98%	2.02%
Other Hexanes	99.67%	0.33%
Heptanes	99.33%	0.67%
Methylcyclohexane	98.09%	1.91%
2,2,4-Trimethylpentane	99.73%	0.27%
Benzene	82.88%	17.12%
Toluene	79.18%	20.82%
Ethylbenzene	77.08%	22.92%
Xylenes	70.08%	29.92%
C8+ Heavies	98.96%	1.04%

FLASH TANK

Flash Control: Recycle/recompression  
 Flash Temperature: 120.0 deg. F  
 Flash Pressure: 50.0 psig

Component	Left in Glycol	Removed in Flash Gas
Water	99.96%	0.04%
Carbon Dioxide	36.36%	63.64%
Nitrogen	4.30%	95.70%
Methane	4.40%	95.60%
Ethane	14.56%	85.44%
Propane	26.38%	73.62%
Isobutane	35.75%	64.25%
n-Butane	42.38%	57.62%
Isopentane	46.50%	53.50%
n-Pentane	52.30%	47.70%
n-Hexane	67.05%	32.95%
Cyclohexane	89.66%	10.34%
Other Hexanes	60.69%	39.31%
Heptanes	81.23%	18.77%
Methylcyclohexane	91.95%	8.05%
2,2,4-Trimethylpentane	68.56%	31.44%
Benzene	98.44%	1.56%
Toluene	99.05%	0.95%
Ethylbenzene	99.48%	0.52%
Xylenes	99.65%	0.35%
C8+ Heavies	98.31%	1.69%

REGENERATOR

No Stripping Gas used in regenerator.

Component	Remaining in Glycol	Distilled Overhead
-----------	---------------------	--------------------

Water	63.87%	36.13%
Carbon Dioxide	0.00%	100.00%
Nitrogen	0.00%	100.00%
Methane	0.00%	100.00%
Ethane	0.00%	100.00%
Propane	0.00%	100.00%
Isobutane	0.00%	100.00%
n-Butane	0.00%	100.00%
Isopentane	1.07%	98.93%
n-Pentane	0.96%	99.04%
n-Hexane	0.75%	99.25%
Cyclohexane	3.57%	96.43%
Other Hexanes	1.65%	98.35%
Heptanes	0.62%	99.38%
Methylcyclohexane	4.35%	95.65%
2,2,4-Trimethylpentane	2.19%	97.81%
Benzene	5.08%	94.92%
Toluene	7.98%	92.02%
Ethylbenzene	10.46%	89.54%
Xylenes	12.96%	87.04%
C8+ Heavies	12.21%	87.79%

STREAM REPORTS:

WET GAS STREAM

Temperature: 95.00 deg. F  
 Pressure: 1114.70 psia  
 Flow Rate: 2.30e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.00e-001	1.09e+002
Carbon Dioxide	8.68e-002	2.31e+002
Nitrogen	4.30e-001	7.29e+002
Methane	7.38e+001	7.17e+004
Ethane	1.58e+001	2.88e+004
Propane	5.98e+000	1.59e+004
Isobutane	6.73e-001	2.37e+003
n-Butane	1.72e+000	6.05e+003
Isopentane	3.75e-001	1.64e+003
n-Pentane	4.73e-001	2.07e+003
n-Hexane	1.42e-001	7.39e+002
Cyclohexane	3.03e-002	1.54e+002
Other Hexanes	1.73e-001	9.00e+002
Heptanes	1.01e-001	6.15e+002
Methylcyclohexane	2.46e-002	1.46e+002
2,2,4-Trimethylpentane	1.90e-003	1.31e+001
Benzene	2.00e-003	9.44e+000
Toluene	3.50e-003	1.95e+001
Ethylbenzene	2.00e-004	1.28e+000
Xylenes	1.80e-003	1.16e+001
C8+ Heavies	4.17e-002	4.29e+002
Total Components	100.00	1.33e+005

DRY GAS STREAM

-----  
 Temperature: 95.00 deg. F  
 Pressure: 1114.70 psia  
 Flow Rate: 2.29e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	3.94e-003	4.28e+000
Carbon Dioxide	8.64e-002	2.30e+002
Nitrogen	4.30e-001	7.28e+002
Methane	7.39e+001	7.16e+004
Ethane	1.58e+001	2.87e+004
Propane	5.98e+000	1.59e+004
Isobutane	6.73e-001	2.36e+003
n-Butane	1.72e+000	6.03e+003
Isopentane	3.75e-001	1.63e+003
n-Pentane	4.73e-001	2.06e+003
n-Hexane	1.41e-001	7.36e+002
Cyclohexane	2.97e-002	1.51e+002
Other Hexanes	1.72e-001	8.97e+002
Heptanes	1.01e-001	6.11e+002
Methylcyclohexane	2.41e-002	1.43e+002
2,2,4-Trimethylpentane	1.90e-003	1.31e+001
Benzene	1.66e-003	7.83e+000
Toluene	2.77e-003	1.54e+001
Ethylbenzene	1.54e-004	9.89e-001
Xylenes	1.26e-003	8.10e+000
C8+ Heavies	4.13e-002	4.25e+002
-----		
Total Components	100.00	1.32e+005

LEAN GLYCOL STREAM

-----  
 Temperature: 95.00 deg. F  
 Flow Rate: 2.20e+001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.85e+001	1.22e+004
Water	1.50e+000	1.86e+002
Carbon Dioxide	1.17e-012	1.45e-010
Nitrogen	3.70e-013	4.58e-011
Methane	9.90e-018	1.23e-015
Ethane	1.47e-007	1.82e-005
Propane	9.12e-009	1.13e-006
Isobutane	1.22e-009	1.51e-007
n-Butane	3.30e-009	4.08e-007
Isopentane	1.60e-004	1.98e-002
n-Pentane	2.56e-004	3.17e-002
n-Hexane	1.27e-004	1.57e-002
Cyclohexane	8.30e-004	1.03e-001
Other Hexanes	2.45e-004	3.03e-002
Heptanes	1.68e-004	2.08e-002
Methylcyclohexane	9.37e-004	1.16e-001
2,2,4-Trimethylpentane	4.41e-006	5.47e-004

Benzene	6.87e-004	8.51e-002
Toluene	2.81e-003	3.48e-001
Ethylbenzene	2.76e-004	3.42e-002
Xylenes	4.14e-003	5.12e-001
C8+ Heavies	4.91e-003	6.08e-001
-----		
Total Components	100.00	1.24e+004

RICH GLYCOL STREAM

-----  
 Temperature: 95.00 deg. F  
 Pressure: 1114.70 psia  
 Flow Rate: 2.26e+001 gpm  
 NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
-----		
TEG	9.64e+001	1.22e+004
Water	2.30e+000	2.91e+002
Carbon Dioxide	1.15e-002	1.45e+000
Nitrogen	3.63e-003	4.60e-001
Methane	2.88e-001	3.65e+001
Ethane	3.05e-001	3.86e+001
Propane	2.19e-001	2.78e+001
Isobutane	3.97e-002	5.02e+000
n-Butane	1.30e-001	1.65e+001
Isopentane	3.12e-002	3.95e+000
n-Pentane	5.00e-002	6.33e+000
n-Hexane	2.48e-002	3.14e+000
Cyclohexane	2.54e-002	3.21e+000
Other Hexanes	2.40e-002	3.04e+000
Heptanes	3.28e-002	4.15e+000
Methylcyclohexane	2.29e-002	2.90e+000
2,2,4-Trimethylpentane	2.88e-004	3.65e-002
Benzene	1.34e-002	1.70e+000
Toluene	3.48e-002	4.41e+000
Ethylbenzene	2.59e-003	3.28e-001
Xylenes	3.14e-002	3.97e+000
C8+ Heavies	4.00e-002	5.06e+000
-----		
Total Components	100.00	1.27e+004

FLASH TANK OFF GAS STREAM

-----  
 Temperature: 120.00 deg. F  
 Pressure: 64.70 psia  
 Flow Rate: 1.56e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
-----		
Water	1.42e-001	1.05e-001
Carbon Dioxide	5.11e-001	9.24e-001
Nitrogen	3.82e-001	4.40e-001
Methane	5.29e+001	3.49e+001
Ethane	2.67e+001	3.30e+001
Propane	1.13e+001	2.04e+001
Isobutane	1.35e+000	3.23e+000
n-Butane	3.97e+000	9.49e+000

Isopentane	7.14e-001	2.12e+000
n-Pentane	1.02e+000	3.02e+000
n-Hexane	2.92e-001	1.03e+000
Cyclohexane	9.60e-002	3.32e-001
Other Hexanes	3.37e-001	1.19e+000
Heptanes	1.89e-001	7.79e-001
Methylcyclohexane	5.79e-002	2.34e-001
2,2,4-Trimethylpentane	2.44e-003	1.15e-002
Benzene	8.29e-003	2.66e-002
Toluene	1.11e-002	4.19e-002
Ethylbenzene	3.92e-004	1.71e-003
Xylenes	3.20e-003	1.40e-002
C8+ Heavies	1.23e-002	8.58e-002
-----		
Total Components	100.00	1.11e+002

FLASH TANK GLYCOL STREAM

Temperature: 120.00 deg. F  
 Flow Rate: 2.23e+001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.72e+001	1.22e+004
Water	2.32e+000	2.91e+002
Carbon Dioxide	4.21e-003	5.28e-001
Nitrogen	1.58e-004	1.98e-002
Methane	1.28e-002	1.60e+000
Ethane	4.48e-002	5.62e+000
Propane	5.84e-002	7.32e+000
Isobutane	1.43e-002	1.80e+000
n-Butane	5.57e-002	6.98e+000
Isopentane	1.47e-002	1.84e+000
n-Pentane	2.64e-002	3.31e+000
n-Hexane	1.68e-002	2.11e+000
Cyclohexane	2.30e-002	2.88e+000
Other Hexanes	1.47e-002	1.84e+000
Heptanes	2.69e-002	3.37e+000
Methylcyclohexane	2.13e-002	2.67e+000
2,2,4-Trimethylpentane	1.99e-004	2.50e-002
Benzene	1.34e-002	1.68e+000
Toluene	3.48e-002	4.36e+000
Ethylbenzene	2.60e-003	3.27e-001
Xylenes	3.15e-002	3.95e+000
C8+ Heavies	3.97e-002	4.97e+000
-----		
Total Components	100.00	1.25e+004

FLASH GAS EMISSIONS

Control Method: Recycle/recompression  
 Control Efficiency: 100.00

Note: Flash Gas Emissions are zero with the Recycle/recompression control option.

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F  
 Pressure: 14.70 psia  
 Flow Rate: 2.57e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	8.60e+001	1.05e+002
Carbon Dioxide	1.77e-001	5.28e-001
Nitrogen	1.04e-002	1.98e-002
Methane	1.47e+000	1.60e+000
Ethane	2.76e+000	5.62e+000
Propane	2.45e+000	7.32e+000
Isobutane	4.55e-001	1.80e+000
n-Butane	1.77e+000	6.98e+000
Isopentane	3.72e-001	1.82e+000
n-Pentane	6.70e-001	3.28e+000
n-Hexane	3.57e-001	2.09e+000
Cyclohexane	4.86e-001	2.78e+000
Other Hexanes	3.10e-001	1.81e+000
Heptanes	4.93e-001	3.35e+000
Methylcyclohexane	3.83e-001	2.55e+000
2,2,4-Trimethylpentane	3.15e-003	2.44e-002
Benzene	3.00e-001	1.59e+000
Toluene	6.42e-001	4.02e+000
Ethylbenzene	4.06e-002	2.92e-001
Xylenes	4.78e-001	3.44e+000
C8+ Heavies	3.78e-001	4.37e+000
Total Components	100.00	1.60e+002

CONDENSER PRODUCED WATER STREAM

Temperature: 120.00 deg. F  
 Flow Rate: 2.06e-001 gpm

Component	Conc. (wt%)	Loading (lb/hr)	(ppm)
Water	1.00e+002	1.03e+002	999666.
Carbon Dioxide	1.09e-003	1.13e-003	11.
Nitrogen	1.07e-006	1.11e-006	0.
Methane	1.67e-004	1.73e-004	2.
Ethane	6.65e-004	6.86e-004	7.
Propane	8.80e-004	9.07e-004	9.
Isobutane	1.16e-004	1.19e-004	1.
n-Butane	5.92e-004	6.10e-004	6.
Isopentane	1.03e-004	1.06e-004	1.
n-Pentane	1.95e-004	2.01e-004	2.
n-Hexane	9.02e-005	9.30e-005	1.
Cyclohexane	6.25e-004	6.45e-004	6.
Other Hexanes	6.69e-005	6.90e-005	1.
Heptanes	5.82e-005	6.01e-005	1.
Methylcyclohexane	2.15e-004	2.22e-004	2.
2,2,4-Trimethylpentane	2.82e-007	2.91e-007	0.
Benzene	9.93e-003	1.02e-002	99.
Toluene	1.30e-002	1.34e-002	130.
Ethylbenzene	3.60e-004	3.71e-004	4.
Xylenes	5.23e-003	5.39e-003	52.

C8+ Heavies	3.58e-007	3.70e-007	0.
-----			
Total Components	100.00	1.03e+002	1000000.

CONDENSER RECOVERED OIL STREAM

Temperature: 120.00 deg. F  
 Flow Rate: 3.51e-002 gpm

Component	Conc. (wt%)	Loading (lb/hr)
-----		
Water	3.38e-002	5.04e-003
Carbon Dioxide	4.55e-003	6.79e-004
Nitrogen	4.32e-005	6.45e-006
Methane	5.56e-003	8.29e-004
Ethane	1.05e-001	1.57e-002
Propane	6.38e-001	9.52e-002
Isobutane	3.09e-001	4.62e-002
n-Butane	1.64e+000	2.45e-001
Isopentane	1.01e+000	1.51e-001
n-Pentane	2.29e+000	3.42e-001
n-Hexane	3.00e+000	4.48e-001
Cyclohexane	5.12e+000	7.65e-001
Other Hexanes	2.02e+000	3.01e-001
Heptanes	9.62e+000	1.44e+000
Methylcyclohexane	7.37e+000	1.10e+000
2,2,4-Trimethylpentane	7.07e-002	1.06e-002
Benzene	3.00e+000	4.48e-001
Toluene	1.47e+001	2.20e+000
Ethylbenzene	1.51e+000	2.26e-001
Xylenes	1.84e+001	2.74e+000
C8+ Heavies	2.91e+001	4.35e+000
-----		
Total Components	100.00	1.49e+001

CONDENSER VENT STREAM

Temperature: 120.00 deg. F  
 Pressure: 14.08 psia  
 Flow Rate: 3.49e+002 scfh

Component	Conc. (vol%)	Loading (lb/hr)
-----		
Water	1.21e+001	2.00e+000
Carbon Dioxide	1.30e+000	5.26e-001
Nitrogen	7.67e-002	1.98e-002
Methane	1.09e+001	1.60e+000
Ethane	2.03e+001	5.61e+000
Propane	1.78e+001	7.23e+000
Isobutane	3.27e+000	1.75e+000
n-Butane	1.26e+001	6.74e+000
Isopentane	2.51e+000	1.67e+000
n-Pentane	4.43e+000	2.94e+000
n-Hexane	2.07e+000	1.64e+000
Cyclohexane	2.60e+000	2.01e+000
Other Hexanes	1.91e+000	1.51e+000
Heptanes	2.08e+000	1.92e+000

Methylcyclohexane	1.61e+000	1.45e+000
2,2,4-Trimethylpentane	1.32e-002	1.39e-002
Benzene	1.57e+000	1.13e+000
Toluene	2.13e+000	1.81e+000
Ethylbenzene	6.80e-002	6.64e-002
Xylenes	7.12e-001	6.96e-001
C8+ Heavies	1.20e-002	1.88e-002
-----		
Total Components	100.00	4.23e+001

COMBUSTION DEVICE OFF GAS STREAM

-----  
 Temperature: 1000.00 deg. F  
 Pressure: 14.70 psia  
 Flow Rate: 1.51e+001 scfh

Component	Conc. (vol%)	Loading (lb/hr)
-----		
Methane	1.26e+001	8.02e-002
Ethane	2.34e+001	2.80e-001
Propane	2.06e+001	3.61e-001
Isobutane	3.78e+000	8.75e-002
n-Butane	1.46e+001	3.37e-001
Isopentane	2.90e+000	8.34e-002
n-Pentane	5.12e+000	1.47e-001
n-Hexane	2.39e+000	8.21e-002
Cyclohexane	3.00e+000	1.01e-001
Other Hexanes	2.20e+000	7.55e-002
Heptanes	2.40e+000	9.58e-002
Methylcyclohexane	1.86e+000	7.26e-002
2,2,4-Trimethylpentane	1.53e-002	6.94e-004
Benzene	1.82e+000	5.66e-002
Toluene	2.46e+000	9.03e-002
Ethylbenzene	7.86e-002	3.32e-003
Xylenes	8.23e-001	3.48e-002
C8+ Heavies	1.39e-002	9.41e-004
-----		
Total Components	100.00	1.99e+000

**Supplement S7**  
**AP-42/EPA Emission Factors**

---

- **AP-42 – Combustion Emission Factor Summary**
  - **EPA Protocol for Equipment Leak Emission Estimates**
-

Potentially Applicable  
**AP-42 and GHG EMISSION FACTORS**  
(Preferentially use test data or vendor data where available)

Pollutant		GAS-FIRED ENGINES			GAS-FIRED TURBINES		
		AP-42 Table 3.2-1; 3.2-2; 3.2-3 07/00			AP-42 Table 3.1-1; 3.1-2a; 3.1-3 04/00		
		2SLB lb/MMBtu	4SLB lb/MMBtu	4SRB lb/MMBtu	Uncontrolled lb/MMBtu	Water Injection lb/MMBtu	Lean Pre-Mix# lb/MMBtu
CRITERIA	NOX (≥ 90% Load)	3.17E+00	4.08E+00	2.21E+00	3.23E-01	1.28E-01	9.91E-02
	CO (≥ 90% Load)	3.86E-01	3.17E-01	3.72E+00	8.23E-02	2.95E-02	1.51E-02
	VOC (NMNEHC w/o HCHO)	4.68E-02	4.92E-02	6.20E-04	2.06E-03	2.06E-03	2.06E-03
	VOC (NMNEHC w/ HCHO)	1.20E-01	1.18E-01	2.96E-02	2.82E-03	2.82E-03	2.13E-03
	PM10/2.5 (Total)	4.83E-02	9.99E-03	1.94E-02	6.63E-03	6.63E-03	6.63E-03
	SO2 (2,000 gr-S/MMscf ≈ 0.0007 W%)	5.88E-04	5.88E-04	5.88E-04	5.88E-04	5.88E-04	5.88E-04
HAPs	Acetaldehyde	7.76E-03	8.36E-03	2.79E-03	4.00E-05	4.00E-05	4.00E-05
	Acrolein	7.78E-03	5.14E-03	2.63E-03	6.40E-06	6.40E-06	6.40E-06
	Benzene	1.94E-03	4.40E-04	1.58E-03	1.20E-05	1.20E-05	9.10E-07
	Butadiene, 1,3-	8.20E-04	2.67E-04	6.63E-04	4.30E-07	4.30E-07	4.30E-07
	Ethylbenzene	1.08E-04	3.97E-05	2.48E-05	3.20E-05	3.20E-05	3.20E-05
	Formaldehyde (HCHO)	5.52E-02	5.28E-02	2.05E-02	7.10E-04	7.10E-04	2.00E-05
	n-Hexane	4.45E-04	1.11E-03	---	---	---	---
	Methanol (MeOH)	2.48E-03	2.50E-03	3.06E-03	---	---	---
	Polycyclic Organic Matter (POM/PAH)	1.34E-04	3.47E-04	9.71E-05	3.25E-05	3.25E-05	3.25E-05
	Toluene	9.63E-04	4.08E-04	5.58E-04	1.30E-04	1.30E-04	1.30E-04
	Trimethylpentane, 2,2,4- (i-Octane)	8.46E-04	2.50E-04	---	---	---	---
	Xylenes	2.68E-04	1.84E-04	1.95E-04	6.40E-05	6.40E-05	6.40E-05
	Other/Trace HAP*	6.57E-04	3.21E-04	1.79E-04	2.90E-05	2.90E-05	2.90E-05
TOTAL HAP	7.94E-02	7.22E-02	3.23E-02	1.06E-03	1.06E-03	3.55E-04	
GHG	CO2 (GWP=1)	1.10E+02	1.10E+02	1.10E+02	1.10E+02	1.10E+02	1.10E+02
	CH4 (GWP=25)	1.45E+00	1.25E+00	2.30E-01	8.64E-03	8.64E-03	8.64E-03
	N2O (GWP=298)	2.20E-04	2.20E-04	2.20E-04	3.00E-03	3.00E-03	3.00E-03
	CO2e	1.46E+02	1.41E+02	1.16E+02	1.11E+02	1.11E+02	1.11E+02

(#Lean Pre-Mix - aka: Dry Low Emissions (DLE or DLN) or SoLoNOx)

Pollutant		GAS-FIRED EXTERNAL COMBUSTION			FLARE	DIESEL ENGINES	DIESEL EMGEN
		AP-42 Table 1.4-1; 1.4-2; 1.4-3 (<100 MMBtu/hr) 07/98			13.5-1 06/17	3.3-1; 3.3-2 10/96	Tier 4 ≥ 751 bhp
		Uncontrolled lb/MMBtu	LoNOx Burners lb/MMBtu	Flue Gas Recirc lb/MMBtu	Combustion lb/MMBtu	Uncontrolled lb/MMBtu	Controlled lb/MMBtu
CRITERIA	NOX (≥ 90% Load)	9.80E-02	4.90E-02	3.14E-02	External Comb.	4.41E+00	4.18E+00
	CO (≥ 90% Load)	8.24E-02	8.24E-02	8.24E-02	3.10E-01	9.50E-01	2.35E+00
	VOC (NMNEHC w/o HCHO)	5.32E-03	5.32E-03	5.32E-03	98% Control	3.52E-01	1.27E-01
	VOC (NMNEHC w/ HCHO)	5.39E-03	5.39E-03	5.39E-03	98% Control	3.53E-01	1.28E-01
	PM10/2.5 (Total)	7.45E-03	7.45E-03	7.45E-03	External Comb.	3.10E-01	1.35E-01
	SO2 (2,000 gr-S/MMscf ≈ 0.0007 W%)	5.88E-04	5.88E-04	5.88E-04	External Comb.	2.90E-01	2.90E-01
HAPs	Acetaldehyde	---	---	---	Use External Combustion or 98% Control, As Appropriate	7.67E-04	2.77E-04
	Acrolein	---	---	---		9.25E-05	3.35E-05
	Benzene	2.06E-06	2.06E-06	2.06E-06		9.33E-04	3.38E-04
	Butadiene, 1,3-	---	---	---		3.91E-05	1.41E-05
	Ethylbenzene	---	---	---		---	---
	Formaldehyde (HCHO)	7.35E-05	7.35E-05	7.35E-05		1.18E-03	4.27E-04
	n-Hexane	1.76E-03	1.76E-03	1.76E-03		---	---
	Methanol (MeOH)	---	---	---		---	---
	Polycyclic Organic Matter (POM/PAH)	6.85E-07	6.85E-07	6.85E-07		1.68E-04	6.08E-05
	Toluene	3.33E-06	3.33E-06	3.33E-06		4.09E-04	1.48E-04
Trimethylpentane, 2,2,4- (i-Octane)	---	---	---	---	---		
Xylenes	---	---	---	2.85E-04	1.03E-04		
Other/Trace HAP*	1.18E-06	1.18E-06	1.18E-06	---	---		
TOTAL HAP	1.85E-03	1.85E-03	1.85E-03	---	---		
GHG	CO2 (GWP=1)	1.18E+02	1.18E+02	1.18E+02	---	1.64E+02	1.64E+02
	CH4 (GWP=25)	2.25E-03	2.25E-03	2.25E-03	---	6.61E-03	6.61E-03
	N2O (GWP=298)	2.16E-03	6.27E-04	6.27E-04	---	1.32E-03	1.32E-03
	CO2e	1.18E+02	1.18E+02	1.18E+02	---	1.65E+02	1.65E+02

**40 CFR 98 - DEFAULT EMISSION FACTORS**

Fuel Type	Table C-1 to Subpart C of Part 98		Table C-2 to Subpart C of Part 98		Weighted Sum
	Default HHV	Carbon Dioxide lb CO2/MMBtu	Methane lb CH4/MMBtu	Nitrous Oxide lb N2O/MMBtu	CO2e lb CO2e/MMBtu
Fuel Oil No. 2 (Diesel)	138,000 Btu/gal	1.63E+02	6.61E-03	1.32E-03	1.64E+02
Propane	91,000 Btu/gal	1.39E+02	6.61E-03	1.32E-03	1.39E+02
Natural Gas	1,026 Btu/scf	1.17E+02	2.20E-03	2.20E-04	1.17E+02

\*Other/Trace HAPs include: CarbonTetrachloride, Chlorobenzene, Chloroform, Dichloropropene, 1,3-Dichloropropene, Ethylene Dibromide, Methylene Chloride, Phenol, Propylene Oxide, Styrene, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, and Vinyl Chloride (as per AP-42).

Global Warming Potential (100 Yr) (GWP)		
Table A-1 to Subpart A of Part 98		
CO2	CH4	N2O
1	25	298



## Protocol for Equipment Leak Emission Estimates

TABLE 2-4. OIL AND GAS PRODUCTION OPERATIONS AVERAGE EMISSION FACTORS (kg/hr/source)

Equipment Type	Service <sup>a</sup>	Emission Factor (kg/hr/source) <sup>b</sup>
Valves	Gas	4.5E-03
	Heavy Oil	8.4E-06
	Light Oil	2.5E-03
	Water/Oil	9.8E-05
Pump seals	Gas	2.4E-03
	Heavy Oil	NA
	Light Oil	1.3E-02
	Water/Oil	2.4E-05
Others <sup>c</sup>	Gas	8.8E-03
	Heavy Oil	3.2E-05
	Light Oil	7.5E-03
	Water/Oil	1.4E-02
Connectors	Gas	2.0E-04
	Heavy Oil	7.5E-06
	Light Oil	2.1E-04
	Water/Oil	1.1E-04
Flanges	Gas	3.9E-04
	Heavy Oil	3.9E-07
	Light Oil	1.1E-04
	Water/Oil	2.9E-06
Open-ended lines	Gas	2.0E-03
	Heavy Oil	1.4E-04
	Light Oil	1.4E-03
	Water/Oil	2.5E-04

<sup>a</sup>Water/Oil emission factors apply to water streams in oil service with a water content greater than 50%, from the point of origin to the point where the water content reaches 99%. For water streams with a water content greater than 99%, the emission rate is considered negligible.

<sup>b</sup>These factors are for total organic compound emission rates (including non-VOC's such as methane and ethane) and apply to light crude, heavy crude, gas plant, gas production, and off shore facilities. "NA" indicates that not enough data were available to develop the indicated emission factor.

<sup>c</sup>The "other" equipment type was derived from compressors, diaphragms, drains, dump arms, hatches, instruments, meters, pressure relief valves, polished rods, relief valves, and vents. This "other" equipment type should be applied for any equipment type other than connectors, flanges, open-ended lines, pumps, or valves.

\*\*\*\* End of Application for 45CSR30 Title V Operating Permit (TVOP) \*\*\*\*