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WV DEP / DIV OF AIR QUALITY

REQUEST FOR EXEMPTION FROM 45CSR13 PERMITTING REQUIREMENTS

For the:

Williams Ohio Valley Midstream LLC

Anderson Dehydration Station

Submitted to:

WEST VIRGINIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF AIR QUALITY

Submitted by:

Williams Ohio Valley Midstream LLC
100 Teletech Drive, Suite 2
Moundsville, WV 26041

November 2015

REQUEST FOR EXEMPTION FROM 45CSR13 PERMITTING REQUIREMENTS

Williams Ohio Valley Midstream LLC
Anderson Dehydration Station

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Williams Ohio Valley Midstream LLC
100 Teletech Drive, Suite 2
Moundsville, WV 26041
(304) 843-3103
(304) 843-3131 fax

November 30, 2015

Beverly McKeone
New Source Review Program Manager
Division of Air Quality
West Virginia Department of Environmental Protection
601 57th Street SE
Charleston, WV 25304

Subject: Request for Exemption from 45CSR13 Permitting Requirements
Williams Ohio Valley Midstream LLC – Anderson Dehydration Station

Dear Ms. McKeone:

Williams Ohio Valley Midstream LLC (OVM) is submitting a Request for Exemption from 45CSR13 Permitting Requirements for one new Capstone C65 natural gas-fired microturbine to be constructed and operated at the Anderson Dehydration Station in Wetzel County, West Virginia. The microturbine is needed to provide on-site electrical power generation.

It is Williams OVM's position that the new microturbine is not a "stationary source" and therefore not subject to the requirements of 45CSR13 – *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*. Note that the microturbine is not subject to any substantive requirement of an emission control rule and potential emissions are below the criteria established for a "stationary source" as defined in §45-13-2, Section 2.24.

Williams OVM seeks concurrence from the WVDEP that permitting is not necessary to proceed with construction and operation of the Capstone microturbine at the Anderson Dehydration Station. If you have any questions concerning this submittal or need additional information, please contact me at (304) 843-3103 or bill.thompson@williams.com.

Sincerely,

William Thompson
Environmental Specialist

Enclosures: Completed Permit Determination Form w/ Attachments A through E

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	***PERMIT DETERMINATION FORM (PDF)*** **FOR AGENCY USE ONLY:** PLANT I.D. # _____ PDF # _____ PERMIT WRITER: _____

1. NAME OF APPLICANT (AS REGISTERED WITH THE WV SECRETARY OF STATE'S OFFICE):
Williams Ohio Valley Midstream LLC

2. NAME OF FACILITY (IF DIFFERENT FROM ABOVE):
Anderson Dehydration Station

3. NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM (**NAICS**) CODE:
213112

4A. MAILING ADDRESS: **100 Teletech Drive, Suite 2**
Moundsville, WV 26041

4B. PHYSICAL ADDRESS: **na**

5A. DIRECTIONS TO FACILITY (PLEASE PROVIDE MAP AS ATTACHMENT A): **Directions from Price Fork Rd in Smithfield: a. Head north onto WV-20 ~1.9 mi; b. Turn left onto Slab Camp Rd ~3.2 mi; c. Turn right onto Slabcamp Run Rd ~1.2 mi; d. Entrance to site is on the right.**

5B. NEAREST ROAD:	5C. NEAREST CITY OR TOWN:	5D. COUNTY:
Slab Camp Road	**Smithfield**	**Wetzel**
5E. UTM NORTHING (KM):	5F. UTM EASTING (KM):	5G. UTM ZONE:
4,367.61	**533.49**	**17**

6A. INDIVIDUAL TO CONTACT IF MORE INFORMATION IS REQUIRED:		6B. TITLE:
Bill Thompson		**Environmental Specialist**
6C. TELEPHONE:	6D. FAX:	6E. E-MAIL:
(304) 843-3103	**(304) 843-3131**	**Bill.Thompson@williams.com**

7A. DAQ PLANT I.D. NO. (FOR AN EXISTING FACILITY ONLY):
_103_ ___ - _00101__

7B. PLEASE LIST ALL CURRENT 45CSR13, 45CSR14, 45CSR19 AND/OR TITLE V (45CSR30) PERMIT NUMBERS ASSOCIATED WITH **THIS** PROCESS (FOR AN EXISTING FACILITY ONLY):
R13-3234

7C. IS THIS PDF BEING SUBMITTED AS THE RESULT OF AN ENFORCEMENT ACTION? IF YES, PLEASE LIST: **na**

8A. TYPE OF EMISSION SOURCE (CHECK ONE):
☒ **NEW SOURCE** ☐ **ADMINISTRATIVE UPDATE**
☐ **MODIFICATION** ☐ **OTHER** (PLEASE EXPLAIN IN 11B)

8B. IF ADMINISTRATIVE UPDATE, DOES DAQ HAVE THE APPLICANT'S CONSENT TO UPDATE THE EXISTING PERMIT WITH THE INFORMATION CONTAINED HEREIN?
☐ **YES** ☐ **NO**

9. IS *DEMOLITION* OR PHYSICAL *RENOVATION* AT AN EXISTING FACILITY INVOLVED? ☐ **YES** ☒ **NO**

10A. DATE OF ANTICIPATED INSTALLATION OR CHANGE:
12/01/2015

10B. DATE OF ANTICIPATED START-UP:
12/31/2015

11A. PLEASE PROVIDE A **DETAILED PROCESS FLOW DIAGRAM** SHOWING EACH PROPOSED OR MODIFIED PROCESS EMISSION POINT AS **ATTACHMENT B**.

11B. PLEASE PROVIDE A **DETAILED PROCESS DESCRIPTION** AS **ATTACHMENT C**.

12. PLEASE PROVIDE **MATERIAL SAFETY DATA SHEETS (MSDS)** FOR ALL MATERIALS PROCESSED, USED OR PRODUCED AS **ATTACHMENT D**. FOR CHEMICAL PROCESSE, PLEASE PROVIDE A MSDS FOR EACH COMPOUND EMITTED TO AIR.

13A. REGULATED AIR POLLUTANT EMISSIONS:

⇒ **FOR A NEW FACILITY,** PLEASE PROVIDE PLANT WIDE EMISSIONS BASED ON THE POTENTIAL TO EMIT (PTE) FOR THE FOLLOWING AIR POLLUTANTS INCLUDING ALL PROCESSES.

⇒ **FOR AN EXISTING FACILITY,** PLEASE PROVIDE THE PROPOSED CHANGE IN EMISSIONS BASED ON THE PTE OF ALL PROCESS CHANGES FOR THE FOLLOWING AIR POLLUTANTS.

PTE FOR A GIVEN POLLUTANT IS TYPICALLY BEFORE AIR POLLUTION CONTROL DEVICES AND IS COLLECTED BASED ON THE MAXIMUM DESIGN CAPACITY OF PROCESS EQUIPMENT.

POLLUTANT	HOURLY PTE (LB/HR)	YEARLY PTE (TON/YR) (HOURLY PTE MULTIPLIED BY 8760 HR/YR) DIVIDED BY 2000 LB/TON
PM	5.6E-03	0.02
PM_{10}	5.6E-03	0.02
VOCs	0.01	0.03
CO	0.16	0.71
NO_x	0.06	0.26
SO_2	2.9E-03	0.01
HAPs (AGGREGATE AMOUNT)	8.5E-04	3.7E-03
Benzene	1.0E-05	4.4E-05
Toluene	1.1E-04	4.8E-04
Ethylbenzene	2.7E-05	1.2E-04
Xylenes	5.4E-05	2.4E-04
n-Hexane	---	---

13B. PLEASE PROVIDE ALL **SUPPORTING CALCULATIONS** AS **ATTACHMENT E.**

CALCULATE AN HOURLY AND YEARLY PTE OF EACH PROCESS EMISSION POINT (SHOWN IN YOUR DETAILED PROCESS FLOW DIAGRAM) FOR ALL AIR POLLUTANTS LISTED ABOVE INCLUDING INDIVIDUAL HAP'S (LISTED IN SECTION 112[b] OF THE 1990 CAAA), TAP'S (LISTED IN 45CSR27), AND OTHER AIR POLLUTANTS (E.G. POLLUTANTS LISTED IN TABLE 45-13A OF 45CSR13, MINERAL ACIDS PER 45CSR7, ETC.).

14. CERTIFICATION OF DATA

I, PAUL HUNTER (*TYPE NAME*) ATTEST THAT ALL THE REPRESENTATIONS CONTAINED IN THIS APPLICATION, OR APPENDED HERETO, ARE TRUE, ACCURATE, AND COMPLETE TO THE BEST OF MY KNOWLEDGE BASED ON INFORMATION AND BELIEF AFTER REASONABLE INQUIRY, AND THAT I AM A ***RESPONSIBLE OFFICIAL**** (*PRESIDENT, VICE PRESIDENT, SECRETARY OR TREASURER, GENERAL PARTNER OR SOLE PROPRIETOR*) OF THE APPLICANT.

SIGNATURE OF RESPONSIBLE OFFICIAL: Paul Hunter

TITLE: GENERAL MANAGER OHIO RIVER SUPPLY HUB DATE: 12/01/2015

** THE DEFINITION OF THE PHRASE '***RESPONSIBLE OFFICIAL***' CAN BE FOUND AT 45CSR13, SECTION 2.23.

NOTE: PLEASE CHECK ENCLOSED ATTACHMENTS:

☒ **ATTACHMENT A** ☒ **ATTACHMENT B** ☒ **ATTACHMENT C** ☒ **ATTACHMENT D** ☒ **ATTACHMENT E**

RECORDS ON ALL CHANGES ARE REQUIRED TO BE KEPT AND MAINTAINED ON-SITE FOR TWO (2) YEARS

THE PERMIT DETERMINATION FORM WITH THE INSTRUCTIONS CAN BE FOUND ON DAQ'S PERMITTING SECTION WEB SITE

www.dep.wv.gov/daq

ATTACHMENT A

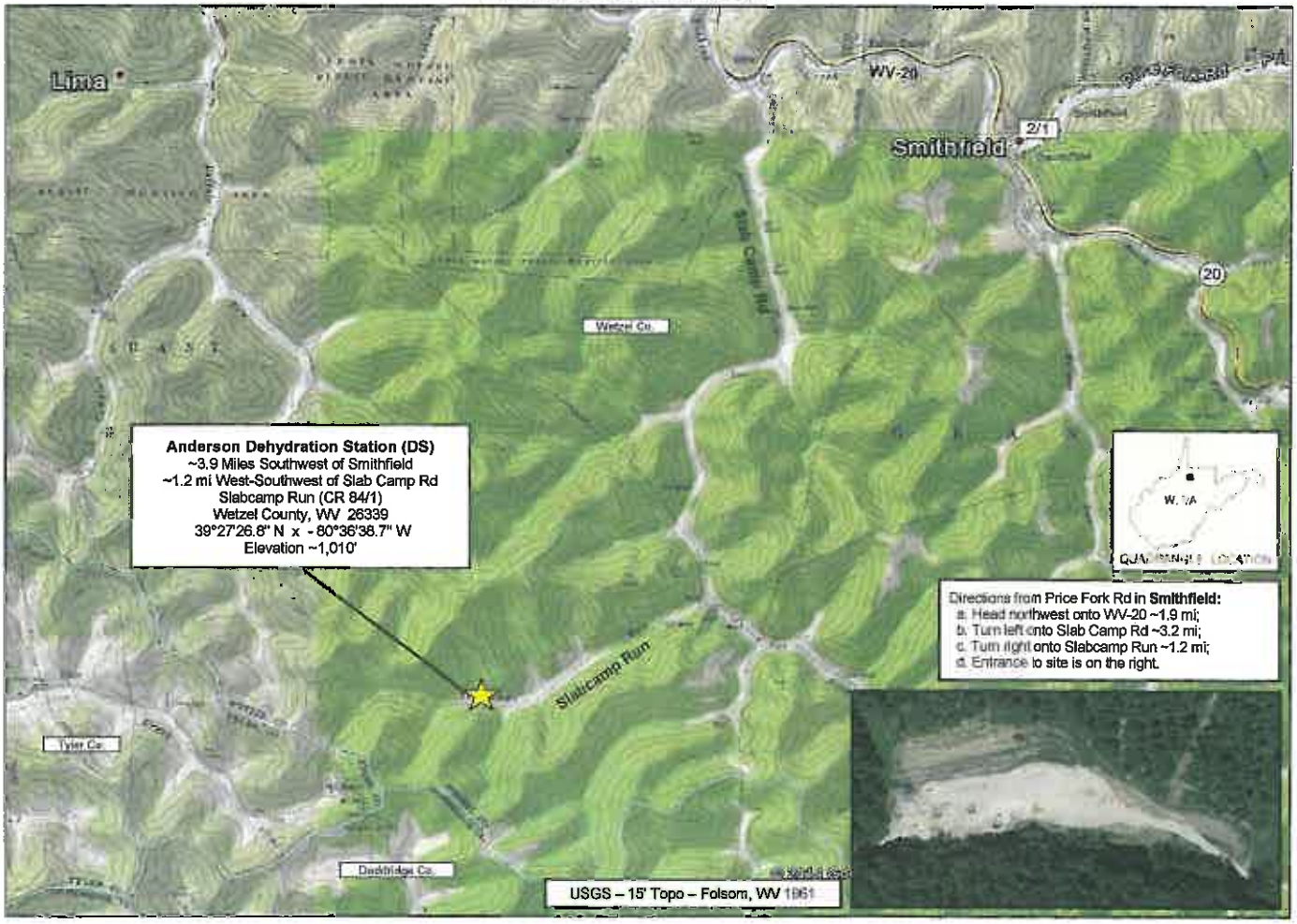
Location Map

Williams Ohio Valley Midstream LLC

ANDERSON DEHYDRATION STATION

Request for Exemption from 45CSR13 Permitting Requirements

Attachment A - Location/Topographic Map



ATTACHMENT B

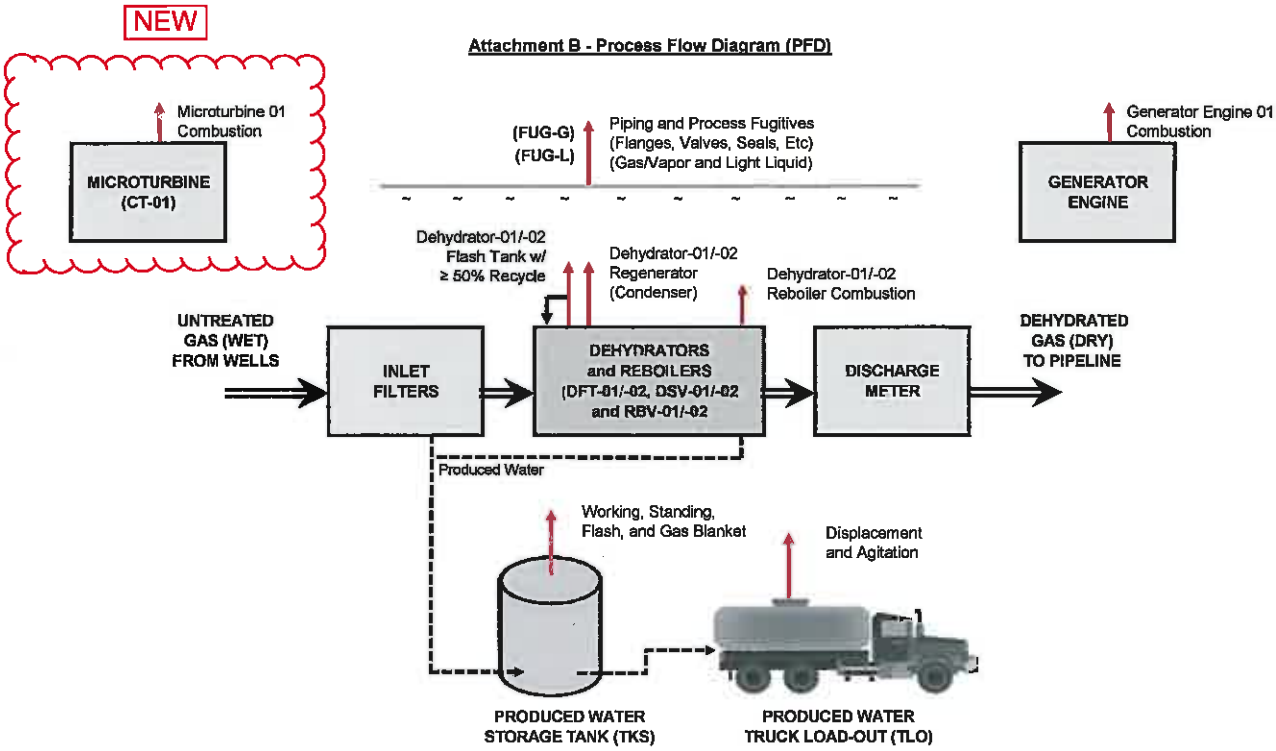
Process Flow Diagram

Williams Ohio Valley Midstream LLC (OVM)

ANDERSON DEHYDRATION STATION (DS)

Request for Exemption from 45CSR13 Permitting Requirements

Attachment B - Process Flow Diagram (PFD)



ATTACHMENT C

Process Description

ATTACHMENT C
Process Description

Williams Ohio Valley Midstream LLC
Anderson Dehydration Station
Request for Exemption from 45CSR13 Permitting Requirements

A. Project Overview

Williams Ohio Valley Midstream LLC is proposing to operate one Capstone C65 natural gas-fired microturbine for on-site electrical power generation.

B. Capstone Microturbine

One Capstone C65 microturbine will be constructed and operated at the site to produce electrical power. The Capstone microturbine has just one moving part supported by patented air bearings; there are no liquid lubricants or coolants to maintain. State-of-the-art electronics are used to convert the high frequency power from the turbogenerator into useful 50 or 60 Hz three-phase output. Capstone microturbines can operate on a variety of gaseous or liquid fuels and emit very low emissions, making Capstone a clean, green, reliable source of energy.

ATTACHMENT D

Material Safety Data Sheets (MSDS)
(i.e., Representative Gas Analysis)

- INLET GAS ANALYSIS

J-W Measurement Company
Shreveport,LA Tyler,TX Victoria,TX Midland,TX
Fairfield,TX Oklahoma City,OK Mounds,OK Tulsa,OK
WWW.JWOPERATING.COM
888-226-9110

JWMC Number:	WLMA1006	***Run Date:***	03/20/13
Customer Name:	WILLIAMS OVM		
Station Name:	ANDERSON 5-H	***Eff. Date:***	4/1/2013
Station Number:	52145-65	***Sampled by:***	MH
Producer:	197441-NXM99	***Procure Date:***	03/06/13
Field:	OVM	***Pressure (lbs.):***	1046.00
Co. or Pr.:	WETZEL	***Temperature (° F):***	92
State:	WV.	***Bottle Number:***	1004

Remarks:

Component	***Mole Percent***	***GPM @ 14.696***	***Ideal BTU @ 14.696***
Hydrogen Sulfide			
Nitrogen	0.3760		
Methane	87.2495		881.22
Carbon Dioxide	0.1261		0.00
Ethane	9.1103	2.430	161.22
Propane	2.0773	0.571	52.27
I-Butane	0.2991	0.098	9.73
N-Butane	0.4031	0.127	13.15
I-Pentane	0.1241	0.045	4.97
N-Pentane	0.0786	0.028	3.15
2,2-Dimethylbutane	0.0070	0.003	0.33
2,3-Dimethylbutane	0.0074	0.003	0.35
2-Methylpentane	0.0272	0.011	1.29
3-Methylpentane	0.0177	0.007	0.84
n-Hexane	0.0233	0.010	1.11
2,2-Dimethylpentane	0.0000	0.000	0.00
Methylcyclopentane	0.0043	0.002	0.19
Benzene	0.0009	0.000	0.03
3,3-Dimethylpentane	0.0000	0.000	0.00
Cyclohexane	0.0031	0.001	0.14
2-Methylhexane	0.0134	0.006	0.74
2,3 dimethylpentane	0.0055	0.002	0.30
3- methylhexane	0.0094	0.004	0.52
1t,2-Dimethylcyclopentane	0.0000	0.000	0.00
1c,2-Dimethycyclopentane	0.0001	0.000	0.01
n-heptane	0.0086	0.004	0.47
Methylcyclohexane	0.0068	0.003	0.35
2,5-Dimethylhexane	0.0000	0.000	0.00
2,4-Dimethyhexane	0.0000	0.000	0.00
Toluene	0.0024	0.001	0.11
2-Methylheptane	0.0038	0.002	0.24
4-Methylheptane	0.0000	0.000	0.00

We appreciate your business

J-W Measurement Company
Shreveport,LA Tyler,TX Victoria,TX Midland,TX
Fairfield,TX Oklahoma City,OK Mounds,OK Tulsa,OK
WWW.JWOPERATING.COM
888-226-9110

Customer Name:	WILLIAMS OVM				
Station Name:	ANDERSON 5-H			***Eff. Date:***	4/1/2013
Station Number:	52145-65			***Sampled by:***	MH
3-Methylheptane		0.0019	0.001	0.12	
1c,2-Dimethycyclohexane		0.0009	0.000	0.05	
N-Octane		0.0031	0.002	0.19	
1t,2-Dimethylcyclohexane		0.0000	0.000	0.00	
1t,3-Dimethylcyclohexane		0.0000	0.000	0.00	
1c,3-Dimethylcyclohexane		0.0005	0.000	0.03	
Ethylcyclohexane		0.0003	0.000	0.02	
Ethylbenzene		0.0000	0.000	0.00	
M-Xylene		0.0023	0.001	0.12	
P-Xylene		0.0013	0.001	0.07	
O-Xylene		0.0002	0.000	0.01	
N-Nonane		0.0015	0.001	0.10	
Decanes		0.0019	0.001	0.15	
Undecanes		0.0011	0.001	0.09	
TOTAL		**100.0000**	**3.366**	**1133.68**	
Ideal Gravity	0.6392		**Real Gravity**	0.6409	
Compressibility Factor (Z) @ 14.696 PSIA & 60 DEG. F =				0.9973	
Base Pressures		**14.73**	**14.65**	**15.025**	
GPM		3.374	3.355	3.441	
Ideal BTU Dry		1136.31	1130.13	1159.06	
Ideal BTU Sat.		1116.53	1110.36	1139.24	
Real BTU Dry		1139.42	1133.22	1162.30	
Real BTU Sat.		1119.60	1113.38	1142.43	

GPA METHOD 2286-95

Note: Calibration, Standards, and testing procedures are achieved pursuant to GPA regulations.

This Analysis Report is not intended for submission to Louisiana Department of Environmental Quality.

J-W ANALYST

DISTRIBUTION:

1 35

We appreciate your business

ATTACHMENT E

Emissions Unit Data Sheet(s)

- Capstone C65 Microturbine Potential to Emit Calculations
- Capstone C65 Microturbine Manufacturer's Data

Williams Ohio Valley Midstream LLC (OVM)

ANDERSON DEHYDRATION STATION

Request for Exemption from 45CSR13 Permitting Requirements

Attachment E - Supporting Emissions Calculations

Capstone C65 Microturbine Generator (65 kWe)

Unit	Description	Reference	Pollutant	Emission Factor		Pre-Control		Control Efficiency	Controlled	
				lb/MMBtu	lb/MWhe	lb/hr	tpy		lb/hr	tpy
CT-01	Capstone Turbine Corporation	Vendor	NOx	---	0.46	0.06	0.26	---	0.06	0.26
		Vendor	CO	---	1.25	0.16	0.71	---	0.16	0.71
		EPA AP-42 Table 3.1-2a	THC	0.01	---	9.3E-03	0.04	---	9.3E-03	0.04
	C65 Microturbine	EPA AP-42 Table 3.1-2a	NMHC	2.4E-03	---	2.0E-03	8.9E-03	---	2.0E-03	8.9E-03
	65 kWe	Vendor	NMNEHC	---	0.10	0.01	0.03	---	0.01	0.03
	8,760 hr/yr	Vendor	VOC	---	0.10	0.01	0.03	---	0.01	0.03
		EPA AP-42 Table 3.1-2a	SOx	3.4E-03	---	2.9E-03	0.01	---	2.9E-03	0.01
	920 Btu/scf (LHV)	EPA AP-42 Table 3.1-2a	PM10/2.5	0.01	---	5.6E-03	0.02	---	5.6E-03	0.02
	1,020 Btu/scf (HHV)	EPA AP-42 Table 3.1-3	Benzene	1.2E-05	---	1.0E-05	4.4E-05	---	1.0E-05	4.4E-05
		EPA AP-42 Table 3.1-3	Ethylbenzene	3.2E-05	---	2.7E-05	1.2E-04	---	2.7E-05	1.2E-04
	11,684 Btu/kW-hr (LHV)	EPA AP-42 Table 3.1-3	Formaldehyde	7.1E-04	---	6.0E-04	2.6E-03	---	6.0E-04	2.6E-03
	12,954 Btu/kW-hr (HHV)	EPA AP-42 Table 3.1-3	n-Hexane	---	---	---	---	---	---	---
		EPA AP-42 Table 3.1-3	Methanol	---	---	---	---	---	---	---
	0.76 MMBtu/hr (LHV)	EPA AP-42 Table 3.1-3	Toluene	1.3E-04	---	1.1E-04	4.8E-04	---	1.1E-04	4.8E-04
	0.84 MMBtu/hr (HHV)	EPA AP-42 Table 3.1-3	2,2,4-TMP	---	---	---	---	---	---	---
	6,652.79 MMBtu/yr (LHV)	EPA AP-42 Table 3.1-3	Xylenes	6.4E-05	---	5.4E-05	2.4E-04	---	5.4E-05	2.4E-04
	825.49 scf/hr (LHV)	EPA AP-42 Table 3.1-3	Other HAP	6.0E-05	---	5.0E-05	2.2E-04	---	5.0E-05	2.2E-04
		SUM	Total HAP	1.0E-03	---	8.5E-04	3.7E-03	---	8.5E-04	3.7E-03
	0.02 MMscf/day (LHV)	EPA AP-42 Table 3.1-2a	CO2	117	---	98	431	---	98	431
	0.14 MMscf/wk (LHV)	EPA AP-42 Table 3.1-2a	CH4	0.01	---	0.01	0.03	---	7.2E-03	0.03
	7.23 MMscf/yr (LHV)	EPA AP-42 Table 3.1-2a	N2O	3.0E-03	---	0.00	0.01	---	2.5E-03	0.01
		40CFR98 Table C-1	CO2e	118	---	99	435	---	99	435

Notes:
1 - Turbine generator is assumed to operate at 100% of rated load for 8,760 hrs/yr.
2 - The fuel heating value is based on 920 Btu/scf (LHV).
3 - Total PM is Filterable and Condensable Particulate Matter; including PM10 and PM2.5
4 - HCHO is Formaldehyde; Total HAP include HCHO, 1,3-Butadiene, Acetaldehyde, Acrolein, BTEX (Benzene, Toluene, Ethylbenzene, Xylene), Naphthalene, PAH and propylene oxide.
5 - A 100 percent contingency has been added to the NOx and CO mass emission rates to account for higher emissions at lower loads.

Potentially Applicable

AP-42 and GHG EMISSION FACTORS

(Preferentially use test data or vendor data where available)

	Pollutant	GAS-FIRED ENGINE			GAS-FIRED TURBINE		
		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	3.20E-01	1.30E-01	9.90E-02
	CO (≥ 90% Load)	3.86E-01	3.17E-01	3.72E+00	8.20E-02	3.00E-02	1.50E-02
	THC (TOC)	1.64E+00	1.47E+00	3.56E-01	1.10E-02	1.10E-02	1.10E-02
	NMHC (THC-CH4)	1.90E-01	2.20E-01	1.28E-01	2.40E-03	2.40E-03	2.40E-03
	NMNEHC (NMHC-C2H6)	1.19E-01	1.15E-01	5.76E-02	2.10E-03	2.10E-03	2.10E-03
	VOC	1.20E-01	1.18E-01	2.96E-02	2.10E-03	2.10E-03	2.10E-03
	SO2*** (2,000 gr-S/MMscf)	5.88E-04	5.88E-04	5.88E-04	3.40E-03	3.40E-03	3.40E-03
	PM10/2.5 (Filter+Cond)	4.83E-02	9.99E-03	1.94E-02	6.60E-03	6.60E-03	6.60E-03
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	8.10E-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	—	—	—
	Toluene	9.63E-04	4.08E-04	5.58E-04	1.30E-04	1.30E-04	1.30E-04
	TMP, 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 HAPs	1.72E-02	1.44E-02	6.36E-03	5.97E-05	1.06E-04	1.06E-04
GHG	CO2**** (GWP=1)	1.17E+02	1.17E+02	1.17E+02	1.17E+02	1.17E+02	1.17E+02
	CH4 (GWP=25)	1.45E+00	1.25E+00	2.30E-01	8.60E-03	8.60E-03	8.60E-03
	N2O (GWP=298)	2.20E-04	2.20E-04	2.20E-04	3.00E-03	3.00E-03	3.00E-03
	CO2e	1.53E+02	1.48E+02	1.23E+02	1.18E+02	1.18E+02	1.18E+02

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

	Pollutant	GAS-FIRED EXTERNAL COMBUSTION			FLARE	DIESEL ENGINE
		AP-42 Table 1.4-1, 1.4-2, 1.4-3 (<100 MMBtu/hr) 07/98			13.5-1 04/15	3.3-1, 3.3-2 10/96
		Uncontrolled lb/MMBtu	LoNOx Burners lb/MMBtu	Flue Gas Recirc lb/MMBtu	Combustion lb/MMBtu	Uncontrolled lb/MMBtu
CRITERIA	NOX	9.80E-02	4.90E-02	3.14E-02	6.80E-02	4.41E+00
	CO	8.24E-02	8.24E-02	8.24E-02	3.10E-01	9.50E-01
	THC (TOC)	1.08E-02	1.08E-02	1.08E-02	98% Destruction and Removal Efficiency	3.60E-01
	NMHC (THC-CH4)	8.53E-03	8.53E-03	8.53E-03		3.53E-01
	NMNEHC (NMHC-C2H6)	5.49E-03	5.49E-03	5.49E-03		3.50E-01
	VOC (NMNEHC+HCHO)	5.56E-03	5.56E-03	5.56E-03		3.60E-01
	SO2 (2,000 gr-S/MMscf)	5.88E-04	5.88E-04	5.88E-04	5.882E-04	2.90E-01
	PM10/2.5 (Filter+Condense)	7.45E-03	7.45E-03	7.45E-03	7.451E-03	3.10E-01
HAPs	Benzene	2.06E-06	2.06E-06	2.06E-06	98% Destruction and Removal Efficiency	9.33E-04
	Ethylbenzene	—	—	—		—
	HCHO (Formaldehyde)	7.35E-05	7.35E-05	7.35E-05		1.18E-03
	n-Hexane	1.76E-03	1.76E-03	1.76E-03		—
	Methanol (MeOH)	—	—	—		—
	Toluene	3.33E-06	3.33E-06	3.33E-06		4.09E-04
	2,2,4-TMP (i-Octane)	—	—	—		—
	Xylenes	—	—	—		2.85E-04
	Other HAPs	1.86E-06	1.86E-06	1.86E-06		1.05E-03
GHG	CO2 (GWP=1)	1.18E+02	1.18E+02	1.18E+02	1.18E+02	1.64E+02
	CH4 (GWP=25)	2.25E-03	2.25E-03	2.25E-03	98% DRE	6.61E-03
	N2O (GWP=298)	2.16E-03	6.27E-04	6.27E-04	2.16E-03	1.32E-03
	CO2e	1.18E+02	1.18E+02	1.18E+02	1.18E+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	
	Default HHV	Carbon Dioxide lb CO2/MMBtu	Methane lb CH4/MMBtu	Nitrous Oxide lb N2O/MMBtu
Fuel Oil No. 2 (Diesel)	0.138 MMBtu/gal	163.05	6.61E-03	1.32E-03
Propane	0.091 MMBtu/gal	138.60	6.61E-03	1.32E-03
Natural Gas	1,026 Btu/scf	116.98	2.20E-03	2.20E-04

Global Warming Potential (100 Yr) (GWP)		
Table A-1 to Subpart A of Part 98		
CO2	CH4*	N2O#
1.00	25.00	298.00

#Revised by EPA on 11/29/13

Conversion Factors

http://www.onlineconversion.com/

1.0 lb	=	453.592 g
1.0 kg	=	2.205 lb
1.0 hp	=	2,544.433 Btu/hr
1.0 hp	=	745.700 Watt
1.0 kW	=	3,412.142 Btu/hr
1.0 kW-hr	=	1.340 hp-hr
1.0 cf	=	7.481 gal
1.0 gal H2O	=	8.338 lb
1.0 cf H2O	=	62.371 gal
1.0 m	=	3.281 ft
1.0 km	=	0.621 mi
1.0 acre	=	43,560.174 ft2
1.0 °F	=	(°C*9/5)+32
1.0 °R	=	°F+459.67
1.0 %	=	10,000 ppm
UGC (stp)	=	379.48 scf/lb-mol

*Converted Ext Comb Emission Factors to lb/MMBtu by dividing lb/MMscf by AP-42 default HHV of 1,020 Btu/scf.

**Converted GHG Emission Factors to lb/MMBtu by multiplying kg/MMBtu by 2.2046 lb/kg.

***Assumes 100% conversion of fuel sulfur to SOX (2,000 gr/MMscf).

****Assumes 99.5% conversion of fuel carbon to CO2 for natural gas.

C65 MicroTurbine
Oil & Gas

33% smaller than equivalent generators. Offers ultra-low emissions and reliable electrical generation from raw natural gas.

- UL Class 1, Division 2 or ATEX Class 1, Zone 2 certification available
- Patented air bearing – no lubricating oil or coolant
- One moving part – minimal maintenance and downtime
- Ultra-low emissions
- Immediate service available worldwide
- Remote monitoring and diagnostic capabilities
- Multiple units easily synchronized
- Electrical protective relays mean no external switchgear required
- Small, modular design allows for easy, low-cost installation
- Reliable – tens of millions of run hours and counting
- Optional High Humidity protection available

C65 MicroTurbine

Offshore Hazardous Area

Electrical Performance[1]	
Electrical Power Output	65kW
Voltage	400–480 VAC
Electrical Service	3-Phase, 4 wire
Frequency	10–60 Hz
Maximum Output Current	100A, stand alone operation[2]
Electrical Efficiency LHV	29%

Fuel/Engine Characteristics[1]	Non-Hazardous Area Config.	Hazardous Area Config.
Natural / Wellhead Gas HHV	30.7–47.5 MJ/m³ (825–1,275 BTU/scf)	30.7–47.5 MJ/m³ (825–1,275 BTU/scf)
Inlet Pressure	517–552 kPa gauge (75–80 psig)	517–552 kPa gauge (75–80 psig)
Fuel Flow HHV	888 MJ/hr (842,000 BTU/hr)	920 MJ/hr (872,000 BTU/hr)
Net Heat Rate LHV	12.4 MJ/kWh (11,800 BTU/kWh)	12.9 MJ/kWh (12,200 BTU/kWh)

Exhaust Characteristics[1]	High Pressure Natural Gas	Hazardous Area Config.
NOx Emissions @ 15% O_2[3]	< 9 ppmvd (18 mg/m³)	< 9 ppmvd (18 mg/m³)
NOx / Electrical Output[3]	0.16 g/bhp-hr (0.46 lb/MWhe)	0.16 g/bhp-hr (0.46 lb/MWhe)
Exhaust Gas Flow	0.49 kg/s (1.08 lbm/s)	0.50 kg/s (1.09 lbm/s)
Exhaust Gas Temperature	309°C (588°F)	325°C (617°F)

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

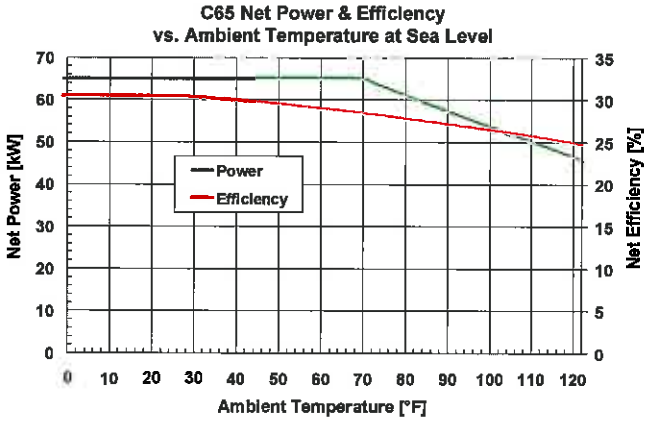
Dimensions & Weight[4]	High Pressure Natural Gas	Hazardous Area Config.
Width x Depth x Height	0.76 x 1.9 x 1.9 m (30 x 77 x 76 in)	0.87 x 3.2 x 2.3 m (35 x 128 x 90 in)
Weight	1121 kg (2,471 lb)	1666 kg (3,672 lb)

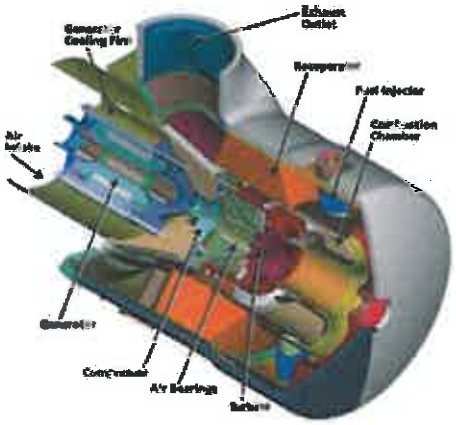
Minimum Clearance Requirements[5]	High Pressure Natural Gas	Hazardous Area Config.
Vertical Clearance	0.61 m (24 in)	0.61 m (24 in)
Horizontal Clearance		
Left & Right	0.76 m (30 in)	1.3 m (50 in)
Front[6]	1.7 m (65 in)	1.8 m (72 in)
Rear	0.91 m (36 in)	0.91 m (36 in)

Sound Levels	High Pressure Natural Gas	Hazardous Area Config.
Acoustic Emissions at Full Load Power		
Nominal at 10 m (33 ft)	70 dBA	70 dBA

Certifications

- Hazardous Area configurations certified to UL 2200 and NFPA 496
- Hazardous Area configurations certified for hazardous locations (UL file E240758) for standard natural gas
- Models available with optional equipment for CE Marking
- Hazardous Area configurations available with ATEX





(1) Nominal full power performance at ISO conditions: 59°F, 14.696 psia, 60% RH
(2) With linear load
(3) Exhaust emissions for standard natural gas at 39.4 MJ/Nm³ (1,000 BTU/scf) (HHV)
(4) Approximate dimensions and weights
(5) Clearance requirements may increase due to local code considerations
(6) Battery Removal clearance
Specifications are not warranted and are subject to change without notice.

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Technical Reference

Capstone MicroTurbine™ Systems Emissions

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_2). This CO_2 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 (5)
C30 NG	Natural Gas (1)	0.64	1.8	0.23
CR30 MBTU	Landfill Gas (2)	0.64	22.0	1.00
CR30 MBTU	Digester Gas (3)	0.64	11.0	1.00
C30 Liquid	Diesel #2 (4)	2.60	0.41	0.23
C65 NG Standard	Natural Gas (1)	0.46	1.25	0.10
C65 NG Low NOx	Natural Gas (1)	0.17	1.30	0.10
C65 NG CARB	Natural Gas (1)	0.17	0.24	0.05
CR65 Landfill	Landfill Gas (2)	0.46	4.0	0.10
CR65 Digester	Digester Gas (3)	0.46	4.0	0.10
C200 NG	Natural Gas (1)	0.40	1.10	0.10
C200 NG CARB	Natural Gas (1)	0.14	0.20	0.04
CR200 Digester	Digester Gas (3)	0.40	3.6	0.10

Notes:

(1) Emissions for standard natural gas at 1,000 BTU/scf (HHV) or 39.4 MJ/m3 (HHV)
(2) Emissions for surrogate gas containing 42% natural gas, 39% CO2, and 19% Nitrogen
(3) Emissions for surrogate gas containing 63% natural gas and 37% CO2
(4) Emissions for Diesel #2 according to ASTM D975-07b
(5) Expressed as Methane

Capstone reserves the right to change or modify, without notice, the design, specifications, and/or contents of this document without incurring any obligation either with respect to equipment previously sold or in the process of construction.