

Application Review

Issue Date: July 13, 2021

Region: Mooresville Regional Office
County: Iredell
NC Facility ID: 4900225
Inspector's Name: Karyn Kurek
Date of Last Inspection: 03/03/2021
Compliance Code: 3 / Compliance - inspection

<p align="center">Facility Data</p> <p>Applicant (Facility's Name): Transcontinental Gas Pipe Line Company, LLC - Station 150</p> <p>Facility Address: Transcontinental Gas Pipe Line Company, LLC - Station 150 236 Transco Road Mooresville, NC 28117</p> <p>SIC: 4922 / Natural Gas Transmission NAICS: 48621 / Pipeline Transportation of Natural Gas</p> <p>Facility Classification: Before: Title V After: Title V Fee Classification: Before: Title V After: Title V</p>	<p>Permit Applicability (this application only) SIP: 15A NCAC 02D .0902, .0501, .0516, .0521, .1408, .1409, .1412, .1806, .0524, .0530, and .1111, 02Q .0317 of 02D .0530 NSPS: 40 CFR 60, Subpar GG NESHAP: 40 CFR Part 63, Subpart YYYY and ZZZZ PSD: NA PSD Avoidance: 15A NCAC 02Q .0317 of 02D .0530 and .1402 NC Toxics: NA 112(r): NA Other: NA</p>
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Contact Data			Application Data
<p align="center">Facility Contact</p> <p>Jeff King Operations Manager (704) 892-7631 236 Transco Road Mooresville, NC 28117</p>	<p align="center">Authorized Contact</p> <p>Glen Jasek VP Operations, Eastern Interstates (713) 215-2134 2800 Post Oak Blvd, Suite 900 Houston, TX 77056+6147</p>	<p align="center">Technical Contact</p> <p>William Scarpinato Environmental Specialist IV (434) 964-2120 345 Greenbrier Drive Charlottesville, VA 22901+1618</p>	<p>Application Number: 4900225.21A Date Received: 04/5/2021 Application Type: Renewal/Modification Application Schedule: TV-Renewal Existing Permit Data Existing Permit Number: 08044/T17 Existing Permit Issue Date: 02/03/2017 Existing Permit Expiration Date: 01/31/2022</p>

Total Actual emissions in TONS/YEAR:

CY	SO2	NOX	VOC	CO	PM10	Total HAP	Largest HAP
2019	0.1800	231.44	99.80	200.94	14.68	64.99	45.19 [Formaldehyde]
2018	0.1700	223.97	87.87	171.12	12.47	56.84	39.52 [Formaldehyde]
2017	0.1300	199.86	82.79	147.80	10.88	53.93	37.50 [Formaldehyde]
2016	0.1800	234.39	102.19	183.99	13.53	66.44	46.21 [Formaldehyde]
2015	0.2900	314.87	131.29	250.04	18.84	86.19	59.75 [Formaldehyde]

<p>Review Engineer: Richard Simpson</p> <p>Review Engineer's Signature: _____ Date: July 13, 2021</p>	<p align="center">Comments / Recommendations:</p> <p>Issue: 08044/T18 Permit Issue Date: July 13, 2021 Permit Expiration Date: June 30, 2026</p>
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I. Purpose of Application

- A. Transcontinental Gas Pipe Line Company, LLC – Station 150 currently holds Title V Permit No. 008044T17 with an expiration date of January 31, 2022 for a natural gas pipeline compressor station located in Mooresville, Iredell County, North Carolina. The primary purpose of this application is for permit renewal and modification. The application was received on April 5, 2021, which was at least nine months prior to the expiration date, as required by General Permit Condition 3.K. Therefore, the existing permit shall not expire until the renewal permit has been issued or denied. All terms and conditions of the existing permit shall remain in effect until the renewal permit has been issued or denied.
- B. Permit application No. 4900225.21A was received on March 26, 2021 and payment was received April 5, 2021 for a Title V permit renewal which includes a modification. This permit action will address the following changes associated with modifications as outlined in the application:
- Overhaul and retrofit combustion turbine Mainline Unit No. 16 (ES-M/116) which will include a solar combustion conversion kit for a net NOx emissions reduction. There is no regulatory requirement for the emissions reduction. However the facility will take credit for the reduction in the annual emissions inventory. See Appendix 1 for specifications.
 - Update insignificant activities descriptions for ID Nos. I-23 and I-24 and delete I-32.
 - Updated ID Nos. ES-A/C1 and ES-A/C2 to ES-A/C5 and ES-A/C6.
 - Emergency engines are exempt from RACT thus eliminated the associated language for internal emergency combustion engines ID Nos. ES-AUX1 through ES-AUX3.

II. Facility Description

The following description is based on the previous compliance inspection conducted on March 3, 2021, by Karyn Kurek, DAQ-MRO Environmental Engineer. The facility operates natural gas-fired internal combustion engines and one natural gas-fired turbine to drive compressors that raise the pressure of natural gas to help move it along the pipeline. The natural gas is transported to local distribution companies and industrial firms in southern, mid-Atlantic and northeastern states.

The transmission of natural gas can now run bi-directionally. Previously, the gas could run bi-directionally via by-passing the station. The facility also has a pipeline that runs east that supplies gas to Piedmont Natural Gas. The facility consists of fifteen mainline combustion engines, one mainline combustion turbine, three auxiliary engines designated as emergency use only, and two air compressor engines designated as emergency use only. The facility operates 24 hours/day, seven days per week, and 52 weeks per year. Operations consist of one shift, four days per week (6 AM to 4:30 PM from M-Th) with a skeleton crew on Friday.

III. History/Background/Application Chronology

February 3, 2017 – Permit **08044T17** was issued.

November 4 – 23, 2020 – The facility sent an applicability determination for a proposed combustion turbine overhaul retrofit to Mainline Unit No. 16 (ES-M/116) which would include a solar combustion conversion kit. DAQ determined the turbine overhaul permit did not require a permit.

March 3, 2021 – The facility was inspected by MRO permit engineer Karyn Kurek. Based on the inspection report, “the facility appeared to be in compliance with applicable air quality regulations.”

April 5, 2021 – For the renewal and a modification, permit application 4900255.21A was submitted March 26, 2021 and application fee for \$1,002 payment was processed by DAQ’s ePay.

May 6 - 24, 2021 – Permit engineer, Richard Simpson, requested additional information from the facility which included emission estimates, spreadsheets, and zoning determination. The facility submitted the requested information promptly.

May 17 – 24, 2021 – The facility, Mooresville Regional Office, and the Stationary Source Compliance Section were requested by the Permitting Section to comment on the renewal and modification. Comments were received and included in the permit and review.

May 27, 2021 – DRAFT permit sent to public notice and EPA for review prior to issuance. The 30-day public comment period ended **June 28, 2021** with the receipt of no comments. The 45-day EPA review period ended **July 13, 2021** with the receipt of no comments.

June XX, 2021– TVEE changes were approved by Jenny Sheppard TVEE Coordinator.

July 13, 2021 – Permit **08044T18** was issued.

IV. Permit Modifications/Changes and TVEE Discussion

The following changes were made to Transcontinental Gas Pipe Line Company, LLC- Station 150 , Mooresville NC., Air Permit No. 08044T17

Page No.	Section	Description of Changes
Cover Letter	N/A	Updated cover letter with application number, permit numbers, and dates.
Attachment	Insignificant Activities	For I-23, added the word concentrate and updated the capacity from 2,500 gallons to 1,750 gallons.
Attachment	Insignificant Activities	For I-27, added to the description “L.O.C.W.”
Attachment	Insignificant Activities	Deleted I-32, “One ethylene glycol storage tank (2,045 gallons capacity; No. 0070).”
3, 12, 14	Section 1, Section 2.1 D., Section 2.1 E.	Updated ID Nos. ES-A/C1 and ES-A/C2 to ES-A/C5 and ES-A/C6.
10	Section 2.1 C.	Internal emergency combustion engines ID Nos. ES-AUX1 through ES-AUX3 are for emergencies. Emergency engines are exempt from RACT thus eliminated the associated language.
19	Section 2.2 A.2	Updated language for emergency engines per 40 CFR 63 Subpart ZZZZ.
23-33	Section 3	The General Conditions were updated to the latest version of DAQ shell.

There were changes made to the Title V Equipment Editor (TVEE) under this permit renewal.

V. Regulatory Review

The facility is currently subject to the following regulations:

15A NCAC 02D .0501, Compliance with Emission Control Standards
15A NCAC 02D .0516, Sulfur Dioxide Emissions from Combustion Sources
15A NCAC 02D .0521, Control of Visible Emissions
15A NCAC 02D .0524, New Source Performance Standards (40 CFR 60, Subpart GG)
15A NCAC 02D .0902, Applicability (Volatile Organic Compounds)
15A NCAC 02D .1111, Maximum Achievable Control Technology (40 CFR63, Subpart YYYY and Subpart ZZZZ)
15A NCAC 02D .1408, Stationary Combustion Turbines
15A NCAC 02D .1409, Seasonal Emission Rate for Large Combustion Sources
15A NCAC 02D .1412, Petition for Alternative Limitations
15A NCAC 02D .1806, Control and Prohibition of Odorous Emissions
15A NCAC 02Q .0317, Avoidance Conditions (for 15A NCAC 02D .1402, Applicability and 15A NCAC 02D .0530, Prevention of Significant Deterioration)

A regulatory review for these existing requirements will not be included in this document. Continued compliance is anticipated. No new regulations are necessary for this permit renewal and modification.

VI. NSPS, NESHAPS/MACT, PSD, 112(r), CAM

NSPS – The facility’s natural gas-fired dry low NOx combustion turbine (**ID No. ES-M/L16**) is currently the only source at the facility subject to a new source performance standard. Specifically, it is subject to a NOx limitation of 201 parts per million at 15 percent oxygen on a dry basis, and to a sulfur dioxide limitation of 150 parts per million at 15 percent oxygen on a dry basis or fuel cannot contain sulfur in excess of 0.8 percent by weight. These two limits are associated with 40 CFR 60, Standards of Performance for Stationary Gas Turbines (Subpart GG). The current permit contains appropriate monitoring/recordkeeping/reporting language. This permit renewal and modification does not affect this status.

NESHAPS/MACT – The Permittee is currently subject to the Maximum Achievable Control Technology Standards 40 CFR 63 Subpart YYYY and Subpart ZZZZ for its existing engines and turbine. The permit currently includes references to the requirements in each of the paragraphs of this Subpart.

1. 15A NCAC 2D .1111: MAXIMUM ACHIEVABLE CONTROL TECHNOLOGY

The facility is classified as a major source of hazardous air pollutants and is subject to the following Maximum Achievable Control Technology Standards:

1. 40 CFR 63, National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines (Subpart YYYY). This Subpart applies to all existing, new, or reconstructed stationary combustion turbines [40 CFR 63.6085]. The facility currently operates one natural gas-fired dry low NOx combustion turbine (rated at 14,060 hp output and 107.9 million Btu per hour heat input; **ID No. ES-M/L16**). While subject to this Subpart, the turbine has no requirements. 40 CFR 63.6090(b)(4) states that “all existing stationary combustion turbines in all subcategories do not have to meet the requirements of this Subpart and of Subpart A.” This is noted in Section 2.1.C. of the permit. This permit renewal and modification does not affect this status.
2. 40 CFR 63, National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines (Subpart ZZZZ). This Subpart is applicable to the following engines:

- one two-stroke natural gas lean-fired internal combustion engine with low emission control technology (LEC) turbochargers (rated at 2,050 maximum brake horsepower output and 16.4 million Btu per hour heat input; **ID Nos. ES-M/L1**);
- seven two-stroke natural gas lean-fired internal combustion engines with (LEC) turbochargers (each rated at 2,050 maximum brake horsepower output and 15.4 million Btu per hour heat input; **ID Nos. ES-M/L2 through ES-M/L8**);
- three two-stroke natural gas lean-fired internal combustion engines with (LEC) including high pressure fuel injection (HPFi) and high performance turbochargers (each rated at 2,100 maximum brake horsepower output and 14.0 million Btu per hour heat input; **ID Nos. ES-M/L9 through ES-M/L11**);
- two two-stroke natural gas lean-fired internal combustion engines with (LEC) including (HPFi) and high performance turbochargers (each rated at 3,400 maximum brake horsepower output and 23.3 million Btu per hour heat input; **ID Nos. ES-M/L12 and ES-M/L13**);
- two two-stroke natural gas lean-fired internal combustion engines with (LEC) including (HPFi) and high performance turbochargers (each rated at 5,500 maximum brake horsepower output and 37.7 million Btu per hour heat input; **ID Nos. ES-M/L14 and ES-M/L15**);

Per 63.6590(b)(3), there are no requirements to the referenced emission sources above. This permit renewal and modification does not affect this status.

- three four-stroke natural gas rich-fired internal combustion engines (each rated at 370 maximum brake horsepower output and 2.8 million Btu per hour heat input; **ID Nos. ES-AUX1 through ES-AUX3**);
- two four-stroke natural gas rich-fired internal combustion engine (rated at 211 and 195 maximum brake horsepower output; **ID No. ES-A/C5 and ES-A/C6**).

The existing engines are located at a major source of HAPs and 40 CFR 63 Subpart ZZZZZ applies. This permit renewal and modification does not affect this status.

RACT – The Permittee operates fifteen mainline combustion engines, one mainline combustion turbine and five auxiliary combustion engines. These units are subject to the NOx requirements as described below.

Mainline units 1-15

15A NCAC 2D .0501(e) – This regulation establishes NOx limits for each unit. Engines one through eight each have no seasonal limits while engines nine through 15 do. No monitoring, recordkeeping, and reporting requirements are required for these sources. This permit renewal and modification does not affect this status.

15A NCAC 2D .1409 – This regulation establishes seasonal NOx limits for units nine through 15 only. The current permit establishes a testing schedule for each unit as well as monitoring, recordkeeping, and reporting requirements. This permit renewal and modification does not affect this status.

15A NCAC 2D .1412 – This regulation establishes alternative NOx limits for sources subject to RACT requirements. The Permittee has requested alternative limits for units one through 11. The current permit establishes a testing schedule for each unit as well as monitoring, recordkeeping, and reporting requirements. This permit renewal and modification does not affect this status.

Mainline Unit 16

15A NCAC 2D .0501(e) – This regulation establishes seasonal NOx limits for this unit. No monitoring, recordkeeping, and reporting requirements are required for this source. This permit renewal and modification does not affect this status.

15A NCAC 2D .1408(a) – This regulation establishes NOx limits specific to stationary combustion turbines. The current permit requires annual compliance testing, monitoring, recordkeeping, and reporting. This permit renewal and modification does not affect this status.

A/C5, and A/C6

15A NCAC 2D .0501(e) – This regulation establishes NOx limits for these units. No monitoring, recordkeeping, and reporting requirements are required for these sources. This permit renewal and modification does not affect this status.

15A NCAC 2Q .0317 (Avoidance for 15A NCAC 2D .1402) – The Permittee currently operates under an hours per year limit for each of these units in order to avoid applicability of the NOx RACT requirements on these units. To ensure compliance, the Permittee shall limit the operation of A/C5 to less than 3,318.9 hours per ozone season, and A/C6 to less than 3,609.7 hours per ozone season. Monthly records and reporting requirements are also in the current permit. This permit renewal and modification does not affect this status.

Blowdown operations

15A NCAC 2D .0902 – The current permit states that per permit application review, DAQ has determined that RACT for this source is “no additional controls.” This permit renewal and modification does not affect this status.

All counties in NC were re-designated as attainment effective August 27, 2015. The RACT conditions remain unchanged since the emission sources help achieve compliance for the region. This permit renewal and modification does not affect this status.

PSD – The facility is a PSD major facility for NOx and VOCs and the Permittee currently operates under one PSD avoidance condition. For the natural gas pipeline blowdown operations (**ID No. ES-BDO**), volatile organic compounds must be less than 40 tons per year. To ensure compliance with this limit, the Permittee is required to calculate VOC emissions monthly using total amount of VOC-containing material emitted and VOC content of the material. The permit also requires semiannual reporting of these calculations. This permit renewal and modification does not affect this status.

112(r) – The facility is not subject to Section 112(r) of the Clean Air Act requirements because it does not store any of the regulated substances in quantities above the thresholds in the Rule. This permit renewal and modification does not affect this status.

CAM – 40 CFR 64 requires that a compliance assurance monitoring plan be developed for all equipment located at a major facility, that have pre-controlled emissions above the major source threshold and use a control device to meet an applicable standard. There are no permitted control devices at this facility; therefore, CAM is not applicable.

VII. Facility Wide Air Toxics

The facility is not currently subject to NC Air Toxics as never triggering a toxics review. This permit renewal and modification does not affect this status.

VIII. Facility Emissions Review

There is a NOx reduction change in Title V potential emissions for this renewal and modification due Mainline Unit No. 16 (ES-M/L16) overhaul retrofit with a solar combustion conversion kit. Actual emissions from previous years are listed on Page 1.

Below is a summary of the NOx emission reduction from ES-M/L 16. The current hourly limit of 11.70 lb/hr represents an exhaust concentration of 25 ppmvd. Following the overhaul, the guaranteed NOx emission concentration will be 15 ppmvd. There are no regulatory requirements for the

emissions reduction but the facility can take credit for the reduction with the annual emissions inventory.

Emissions Description	Permit Limit (ppmvd)	Hourly (lb/hr)	Annual Operating Hours (hr/yr)	Annual (tpy)
Permitted NO _x Emission Rate for M/L 16 ⁽¹⁾	25	11.70	8,760	51.25
Proposed NO _x Emission Rate for M/L 16 ⁽²⁾	15	7.02	8,760	30.74
Reduction in NO _x Emissions	-	-	-	20.51
Total Permitted Site-Wide NO _x Emissions	-	-	-	3,052.29
Total Proposed Site-Wide NO _x Emissions	-	-	-	3,031.78

Notes:

(1) The permitted hourly emission rate was obtained from Permit No. 08044T17, Section 2, Condition 2.1.B.

(2) The proposed hourly emission rate was obtained from Solar's Predicted Emissions Performance Summary, dated August 24, 2020.

Additional information on facility-wide potential emission spreadsheets and the solar combustion conversion kit are in Appendix 1.

IX. Compliance Status

DAQ has reviewed the compliance status of this facility. During the most recent inspection conducted on March 3, 2021, by Karyn Kurek of the MRO indicated that the facility appeared to be in compliance with all air quality regulations.

Five year compliance history

The facility has not been sent any Notice of Violations and Deficiency in the last five years.

X. Public Notice/EPA and Affected State(s) Review

A thirty-day public notice period and a forty-five-day EPA review period is required for this single step significant modification of the Title V permit. A notice of the DRAFT Title V Permit shall be made pursuant to 15A NCAC 02Q .0521. The notice will provide for a 30-day comment period, with an opportunity for a public hearing. Copies of the public notice shall be sent to persons on the Title V mailing list and EPA. Pursuant to 15A NCAC 02Q .0522, a copy of each permit application, each proposed permit, and each final permit pursuant shall be provided to the EPA. Also pursuant to 02Q .0522, a notice of the DRAFT Title V Permit shall be provided to each affected State at or before the notice is provided to the public under 02Q .0521.

EPA's 45 Day Review period

Michael Sparks (U.S. EPA, Region IV) was provided a PROPOSED permit for review on May XX, 2021. EPA 45-day review period ended on June XX, 2021. No comments were offered or received.

Public Notice

The 30-day public notice of the PROPOSED permit was posted on the NCDAQ website on May XX, 2021. No comments were offered or received.

XI. Other Regulatory Considerations

- An application fee of \$1,002 was received on April 5, 2021 by ePay for the permit modification.
- The appropriate number of application copies was received by the DAQ.
- A Professional Engineer's Seal is not required for this application.
- A zoning consistency determination was requested and provided for this application. The Town of Mooresville designated official, Danny Wilson the Planning and Development Director, approved the zoning consistency determination on August 21, 2021.
- The application was signed by Mr. Glen Jasek, VP Operations, Eastern Interstate, on March 24, 2021.
- Iredell County has triggered increment tracking under PSD for PM₁₀, NO_x, and SO₂. However, this permit renewal and modification does not consume or expand increments for any pollutants.

XII. Recommendations

The application for Transcontinental Gas Pipe Line Company, LLC-Station 150 in Mooresville, Iredell County, North Carolina has been reviewed by DAQ to determine compliance with all procedures and requirements. DAQ has determined that this facility is complying or will achieve compliance, as specified in the permit, with all requirements that are applicable to the affected sources. The DAQ recommends the issuance of Air Permit No. 08044T18.

Appendix 1

Site-Wide Potential-to-Emit Summary for Criteria Pollutants

Emission Source ID No.	Manufacturer / Model	Rated Capacity (HP)	Operating Hours (hr/yr)	Criteria Pollutant Emissions ⁽¹⁾				
				NO _x ⁽²⁾ (tpy)	VOC ⁽³⁾ (tpy)	CO (tpy)	SO ₂ (tpy)	PM _{10/2.5} (tpy)
ML 1	Clark HBA-8T	2,050	8,760	112.83	27.59	48.18	0.04	3.47
ML 2	Clark BA-8T	2,050	8,760	112.83	27.59	48.18	0.04	3.26
ML 3	Clark BA-8T	2,050	8,760	112.83	27.59	48.18	0.04	3.26
ML 4	Clark BA-8T	2,050	8,760	112.83	27.59	48.18	0.04	3.26
ML 5	Clark BA-8T	2,050	8,760	112.83	27.59	48.18	0.04	3.26
ML 6	Clark BA-8T	2,050	8,760	112.83	27.59	48.18	0.04	3.26
ML 7	Clark BA-8T	2,050	8,760	112.83	27.59	48.18	0.04	3.26
ML 8	Clark BA-8T	2,050	8,760	112.83	27.59	48.18	0.04	3.26
ML 9	Clark TLA-6	2,100	8,760	182.14	15.33	40.73	0.04	2.96
ML 10	Clark TLA-6	2,100	8,760	182.14	15.33	40.73	0.04	2.96
ML 11	Clark TLA-6	2,100	8,760	182.14	15.33	40.73	0.04	2.96
ML 12	Clark TCV-10	3,400	8,760	276.30	24.53	65.70	0.06	4.93
ML 13	Clark TCV-10	3,400	8,760	276.30	24.53	65.70	0.06	4.93
ML 14	Clark TCV-16	5,500	8,760	494.90	39.86	106.43	0.10	7.98
ML 15	Clark TCV-16	5,500	8,760	494.90	39.86	106.43	0.10	7.98
ML 16	Solar Mars 100S	15,344	8,760	30.74	3.57	31.19	2.07	4.02
AUX1	IR PVG-8	370	500	2.60	0.50	0.20	4.12E-04	0.01
AUX2	IR PVG-8	370	500	2.60	0.50	0.20	4.12E-04	0.01
AUX3	IR PVG-8	370	500	2.60	0.50	0.20	4.12E-04	0.01
A/C4	Caterpillar G3306 ⁽⁴⁾	211	500	0.91	0.01	1.49	2.35E-04	0.01
A/C5	Caterpillar G3306 ⁽⁴⁾	194	500	0.85	0.01	1.40	2.21E-04	0.01
BDO	Natural Gas Venting Emissions			-	40.00	-	-	-
Summary of Site-Wide PTE⁽⁵⁾				3,031.78	440.61	886.58	2.82	65.06

Notes:

⁽¹⁾ See attached "Notes About Criteria Pollutant Emission Calculations".

⁽²⁾ For ML Units 9 through 15, the NO_x emission rates include both Ozone and Non-Ozone season factors, as outlined in the current Title V Operating Permit. These emission sources are collectively limited to 328 tpy during the Ozone Season from May through September.

⁽³⁾ The VOC emissions for BDO are based on PSD avoidance limits outlined in the current Title V Operating Permit.

⁽⁴⁾ A/C4 was previously denoted as A/C1 and A/C5 was previously denoted as A/C2.

⁽⁵⁾ Site-wide summary excludes fugitive emissions from piping components as compressor stations are not one of the 28 listed source categories.

Notes About Criteria Pollutant Emission Calculations

Emission Source ID No.	Manufacturer / Model	NO _x Non-Ozone Season Rates ⁽¹⁾ (lb/hr)	NO _x Ozone Season Rates ⁽¹⁾ (lb/hr)	VOC ⁽²⁾ (lb/hr)	CO ⁽³⁾ (lb/hr)	SO ₂ ⁽⁴⁾ (lb/hr)	PM _{10/2.5} ⁽⁴⁾ (lb/hr)	
M/L 1	Clark HBA-8T	25.8	N/A	6.3	11.0	0.01	0.79	
M/L 2	Clark BA-8T	25.8	N/A	6.3	11.0	0.01	0.74	
M/L 3	Clark BA-8T	25.8	N/A	6.3	11.0	0.01	0.74	
M/L 4	Clark BA-8T	25.8	N/A	6.3	11.0	0.01	0.74	
M/L 5	Clark BA-8T	25.8	N/A	6.3	11.0	0.01	0.74	
M/L 6	Clark BA-8T	25.8	N/A	6.3	11.0	0.01	0.74	
M/L 7	Clark BA-8T	25.8	N/A	6.3	11.0	0.01	0.74	
M/L 8	Clark BA-8T	25.8	N/A	6.3	11.0	0.01	0.74	
M/L 9	Clark TLA-6	59.4	16.9	3.5	9.3	0.01	0.68	
M/L 10	Clark TLA-6	59.4	16.9	3.5	9.3	0.01	0.68	
M/L 11	Clark TLA-6	59.4	16.9	3.5	9.3	0.01	0.68	
M/L 12	Clark TCV-10	91.0	24.4	5.6	15.0	0.01	1.13	
M/L 13	Clark TCV-10	91.0	24.4	5.6	15.0	0.01	1.13	
M/L 14	Clark TCV-16	166.1	39.4	9.1	24.3	0.02	1.82	
M/L 15	Clark TCV-16	166.1	39.4	9.1	24.3	0.02	1.82	
M/L 16	Solar Mars 100S	See Detailed Turbine Emissions Calculations						
AUX1	IR PVG-8	10.4	N/A	2.0	0.8	1.65E-03	0.05	
AUX2	IR PVG-8	10.4	N/A	2.0	0.8	1.65E-03	0.05	
AUX3	IR PVG-8	10.4	N/A	2.0	0.8	1.65E-03	0.05	
A/C4	Caterpillar G3306	3.63	N/A	0.05	5.95	9.41E-04	0.03	
A/C5	Caterpillar G3306	3.41	N/A	0.04	5.58	8.82E-04	0.03	

Notes:

- ⁽¹⁾ NO_x emission rates based on Title V Operating Permit. Ozone season rates were applied for the months of May through September.
- ⁽²⁾ VOC emission rates based on vendor data, historical stack test results, Title V Permit, and the US EPA's AP-42, Table 3.2-3.
- ⁽³⁾ CO emission rates based on vendor data, historical stack test results, Title V Permit and the US EPA's AP-42, Table 3.2-3.
- ⁽⁴⁾ SO₂ and PM emission rates based on the US EPA's AP-42. 2SLB emission factors were obtained from 3.2-1 and 4SRB emission factors were obtained from Table 3.2-3.

Summary of Hazardous Air Pollutant Emissions⁽¹⁾

Emission Unit ID No.	Manufacturer / Model	Operating Hours (hr/yr)	VOC Emission Rate (tpy)	Hazardous Air Pollutant Emissions ^(2,3)														
				1,3-Butadiene (tpy)	2,2,4-Trimethylpentane (tpy)	Acetaldehyde (tpy)	Acrolein (tpy)	Benzene (tpy)	Ethylbenzene (tpy)	Formaldehyde (tpy)	Methanol (tpy)	n-Hexane (tpy)	Naphthalene (tpy)	PAH (tpy)	Toluene (tpy)	Xylenes (tpy)	Unspeciated HAP (tpy)	Total HAP (tpy)
ML 1	Clark HBA-8T	8,760	27.59	0.19	0.19	1.78	1.79	0.45	0.02	12.69	0.57	0.10	0.02	0.03	0.22	0.06	0.16	18.29
ML 2	Clark BA-8T	8,760	27.59	0.19	0.19	1.78	1.79	0.45	0.02	12.69	0.57	0.10	0.02	0.03	0.22	0.06	0.16	18.29
ML 3	Clark BA-8T	8,760	27.59	0.19	0.19	1.78	1.79	0.45	0.02	12.69	0.57	0.10	0.02	0.03	0.22	0.06	0.16	18.29
ML 4	Clark BA-8T	8,760	27.59	0.19	0.19	1.78	1.79	0.45	0.02	12.69	0.57	0.10	0.02	0.03	0.22	0.06	0.16	18.29
ML 5	Clark BA-8T	8,760	27.59	0.19	0.19	1.78	1.79	0.45	0.02	12.69	0.57	0.10	0.02	0.03	0.22	0.06	0.16	18.29
ML 6	Clark BA-8T	8,760	27.59	0.19	0.19	1.78	1.79	0.45	0.02	12.69	0.57	0.10	0.02	0.03	0.22	0.06	0.16	18.29
ML 7	Clark BA-8T	8,760	27.59	0.19	0.19	1.78	1.79	0.45	0.02	12.69	0.57	0.10	0.02	0.03	0.22	0.06	0.16	18.29
ML 8	Clark BA-8T	8,760	27.59	0.19	0.19	1.78	1.79	0.45	0.02	12.69	0.57	0.10	0.02	0.03	0.22	0.06	0.16	18.29
ML 9	Clark TLA-6	8,760	15.33	0.10	0.11	0.99	0.99	0.25	0.01	7.05	0.32	0.06	0.01	0.02	0.12	0.03	0.09	10.16
ML 10	Clark TLA-6	8,760	15.33	0.10	0.11	0.99	0.99	0.25	0.01	7.05	0.32	0.06	0.01	0.02	0.12	0.03	0.09	10.16
ML 11	Clark TLA-6	8,760	15.33	0.10	0.11	0.99	0.99	0.25	0.01	7.05	0.32	0.06	0.01	0.02	0.12	0.03	0.09	10.16
ML 12	Clark TCV-10	8,760	24.53	0.17	0.17	1.59	1.59	0.40	0.02	11.28	0.51	0.09	0.02	0.03	0.20	0.05	0.14	16.26
ML 13	Clark TCV-10	8,760	24.53	0.17	0.17	1.59	1.59	0.40	0.02	11.28	0.51	0.09	0.02	0.03	0.20	0.05	0.14	16.26
ML 14	Clark TCV-16	8,760	39.86	0.27	0.28	2.58	2.58	0.64	0.04	18.33	0.82	0.15	0.03	0.04	0.32	0.09	0.23	26.42
ML 15	Clark TCV-16	8,760	39.86	0.27	0.28	2.58	2.58	0.64	0.04	18.33	0.82	0.15	0.03	0.04	0.32	0.09	0.23	26.42
ML 16	Solar Mars	8,760	3.57	2.62E-04	-	0.02	3.90E-03	0.01	0.02	1.75	-	-	7.92E-04	1.34E-03	0.08	0.04	0.02	1.95
AUX1	IR PVG-8	500	0.50	1.12E-02	-	4.71E-02	4.44E-02	2.67E-02	4.19E-04	0.35	5.17E-02	-	1.64E-03	2.38E-03	9.43E-03	3.29E-03	3.03E-03	0.55
AUX2	IR PVG-8	500	0.50	1.12E-02	-	4.71E-02	4.44E-02	2.67E-02	4.19E-04	0.35	5.17E-02	-	1.64E-03	2.38E-03	9.43E-03	3.29E-03	3.03E-03	0.55
AUX3	IR PVG-8	500	0.50	1.12E-02	-	4.71E-02	4.44E-02	2.67E-02	4.19E-04	0.35	5.17E-02	-	1.64E-03	2.38E-03	9.43E-03	3.29E-03	3.03E-03	0.55
A/C4	Caterpillar G3306	500	0.01	2.65E-04	-	1.12E-03	1.05E-03	6.32E-04	9.92E-06	0.01	1.22E-03	-	3.88E-05	5.64E-05	2.23E-04	7.80E-05	7.17E-05	0.01
A/C5	Caterpillar G3306	500	0.01	2.49E-04	-	1.05E-03	9.86E-04	5.93E-04	9.30E-06	0.01	1.15E-03	-	3.64E-05	5.29E-05	2.09E-04	7.31E-05	6.72E-05	0.01
BDO	Natural Gas Venting Emissions			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Summary of Site-Wide PTE				2.74	2.79	25.74	25.78	6.48	0.38	184.75	8.33	1.47	0.32	0.45	3.28	0.93	2.32	265.76

Notes

- ⁽¹⁾ For details, see attached "Notes about Hazardous Air Pollutant Emission Factors".
- ⁽²⁾ Annual emission rates for HAPs determined based on a percentage of the annual VOC emissions, unless otherwise noted. Percentages derived from AP-42 emission factors for VOC and HAPs.
- ⁽³⁾ See the detailed turbine emissions calculations for notes on HAP emission factors.

Notes About Hazardous Air Pollutant Emission Factors

Hazardous Air Pollutant	2-Cycle Lean-Burn Engines ⁽¹⁾			4-Cycle Rich-Burn Engines ⁽¹⁾		
	Emission Factor (lb/MMBtu)	Percent of Total VOCs	Emission Factor Rating	Emission Factor (lb/MMBtu)	Percent of Total VOCs	Emission Factor Rating
Total VOC	1.20E-01	100.00%	C	2.96E-02	100%	C
1,1,2,2-Tetrachloroethane	6.63E-05	0.06%	C	2.53E-05	0.09%	C
1,1,2-Trichloroethane	5.27E-05	0.04%	C	1.53E-05	0.05%	E
1,3-Butadiene	8.20E-04	0.68%	D	6.63E-04	2.24%	E
1,3-Dichloropropene	4.38E-05	0.04%	C	1.27E-05	0.04%	E
2,2,4-Trimethylpentane	8.46E-04	0.71%	B	-	-	-
2-Methylnaphthalene	2.14E-05	0.02%	C	-	-	-
Acenaphthene	1.33E-06	0.001%	C	-	-	-
Acenaphthylene	3.17E-06	0.003%	C	-	-	-
Acetaldehyde	7.76E-03	6.47%	A	2.79E-03	9.43%	C
Acrolein	7.78E-03	6.48%	A	2.63E-03	8.89%	C
Anthracene	7.18E-07	0.001%	C	-	-	-
Benz(a)anthracene	3.36E-07	0.0003%	C	-	-	-
Benzene	1.94E-03	1.62%	A	1.58E-03	5.34%	B
Benzo(a)pyrene	5.68E-09	0.000005%	D	-	-	-
Benzo(b)fluoranthene	8.51E-09	0.00001%	D	-	-	-
Benzo(e)pyrene	2.34E-08	0.00002%	D	-	-	-
Benzo(g,h,i)perylene	2.48E-08	0.00002%	D	-	-	-
Benzo(k)fluoranthene	4.26E-09	0.000004%	D	-	-	-
Biphenyl	3.95E-06	0.003%	C	-	-	-
Carbon Tetrachloride	6.07E-05	0.05%	C	1.77E-05	0.06%	E
Chlorobenzene	4.44E-05	0.04%	C	1.29E-05	0.04%	E
Chloroform	4.71E-05	0.04%	C	1.37E-05	0.05%	E
Chrysene	6.72E-07	0.001%	C	-	-	-
Ethylbenzene	1.08E-04	0.09%	B	2.48E-05	0.08%	E
Ethylene Dibromide	7.34E-05	0.06%	C	2.13E-05	0.07%	E
Fluoranthene	3.61E-07	0.0003%	C	-	-	-
Fluorene	1.69E-06	0.001%	C	-	-	-
Formaldehyde	5.52E-02	46.00%	A	2.05E-02	69.26%	A
Indeno(1,2,3-cd)pyrene	9.93E-09	0.00001%	D	-	-	-
Methanol	2.48E-03	2.07%	A	3.06E-03	10.34%	D
Methylene Chloride	1.47E-04	0.12%	C	4.12E-05	0.14%	C
n-Hexane	4.45E-04	0.37%	C	-	-	-
Naphthalene	9.63E-05	0.08%	C	9.71E-05	0.33%	E
PAH	1.34E-04	0.11%	D	1.41E-04	0.48%	D
Perylene	4.97E-09	0.000004%	D	-	-	-
Phenanthrene	3.53E-06	0.003%	C	-	-	-
Phenol	4.21E-05	0.04%	C	-	-	-
Pyrene	5.84E-07	0.0005%	C	-	-	-
Styrene	5.48E-05	0.05%	A	1.19E-05	0.04%	E
Toluene	9.63E-04	0.80%	A	5.58E-04	1.89%	A
Vinyl Chloride	2.47E-05	0.02%	C	7.18E-06	0.02%	E
Xylenes	2.68E-04	0.22%	A	1.95E-04	0.66%	A

Notes:

⁽¹⁾ Hazardous air pollutant emission factors from EPA AP-42 Section 3.2 (July 2000).

Site-Wide Potential-to-Emit Summary for Greenhouse Gas Emissions

Emission Source ID No.	Manufacturer / Model	Operating Hours (hr/yr)	Rated Capacity (MMBtu/hr)	Greenhouse Gas Emissions ^(1,2)			
				CO ₂ (tpy)	CH ₄ (tpy)	N ₂ O (tpy)	CO ₂ e (tpy)
M/L 1	Clark HBA-8T	8,760	16.4	8,402.70	0.16	0.02	8,411.38
M/L 2	Clark BA-8T	8,760	15.4	7,890.34	0.15	0.01	7,898.49
M/L 3	Clark BA-8T	8,760	15.4	7,890.34	0.15	0.01	7,898.49
M/L 4	Clark BA-8T	8,760	15.4	7,890.34	0.15	0.01	7,898.49
M/L 5	Clark BA-8T	8,760	15.4	7,890.34	0.15	0.01	7,898.49
M/L 6	Clark BA-8T	8,760	15.4	7,890.34	0.15	0.01	7,898.49
M/L 7	Clark BA-8T	8,760	15.4	7,890.34	0.15	0.01	7,898.49
M/L 8	Clark BA-8T	8,760	15.4	7,890.34	0.15	0.01	7,898.49
M/L 9	Clark TLA-6	8,760	14.0	7,173.04	0.14	0.01	7,180.45
M/L 10	Clark TLA-6	8,760	14.0	7,173.04	0.14	0.01	7,180.45
M/L 11	Clark TLA-6	8,760	14.0	7,173.04	0.14	0.01	7,180.45
M/L 12	Clark TCV-10	8,760	23.3	11,937.98	0.22	0.02	11,950.31
M/L 13	Clark TCV-10	8,760	23.3	11,937.98	0.22	0.02	11,950.31
M/L 14	Clark TCV-16	8,760	37.7	19,315.97	0.36	0.04	19,335.92
M/L 15	Clark TCV-16	8,760	37.7	19,315.97	0.36	0.04	19,335.92
M/L 16	Solar Mars 100S	8,760	139.1	71,275.79	1.34	0.13	71,349.40
AUX1	IR PVG-8	500	2.8	81.88	1.54E-03	1.54E-04	81.97
AUX2	IR PVG-8	500	2.8	81.88	1.54E-03	1.54E-04	81.97
AUX3	IR PVG-8	500	2.8	81.88	1.54E-03	1.54E-04	81.97
A/C4	Caterpillar G3308	500	1.6	46.79	8.82E-04	8.82E-05	46.84
A/C5	Caterpillar G3308	500	1.5	43.87	8.27E-04	8.27E-05	43.91
Summary of Site-Wide PTE				219,274.21	4.13	0.41	219,500.67

Notes

⁽¹⁾ The CO₂ emission factors (lb/MMBtu/hr) were obtained from 40 CFR 98 Subpart C, Table C-1.

⁽²⁾ The CH₄ and N₂O emission factors (lb/MMBtu/hr) were obtained from 40 CFR 98 Subpart C, Table C-2.

⁽³⁾ The CO₂e emissions were determined using Global Warming Potentials obtained from 40 CFR Part 98 Subpart A.

**Solar Mars 100-14000S Natural Gas-Fired Combustion Turbine Emissions
 Normal Operating Mode (100% of Peak Load and >= 0 °F)**

Turbine Specifications

Parameter	Value	Unit of Measure
Source ID No.	M/L 16	-
Turbine Make	Solar	-
Turbine Model	Mars 100	-
ISO Horsepower ⁽¹⁾	13,264	hp
Maximum Horsepower ⁽²⁾	15,344	hp
Heat Rating ⁽²⁾	7,617	Btu/hp-hr
Fuel Type	Natural Gas	-
Fuel LHV ⁽²⁾	924.20	Btu/scf
Fuel Flowrate ⁽²⁾ (LHV)	116.88	MMBtu/hr
Fuel HHV ⁽³⁾	1,100	Btu/scf
Fuel Flowrate (HHV)	139.11	MMBtu/hr
Operating Hours	8,760	hr/yr

Emissions Data

Air Contaminant ⁽⁴⁾	Emission Factor Data			Emission Rates ⁽¹⁰⁾	
	Emission Factor Reference	Emission Factor ^(5,6,7,8,9)	Emission Factor Unit	Hourly (lb/hr)	Annual (tpy)
NO _x	Solar Data	7.02	lb/hr	7.02	30.74
CO	Solar Data	7.12	lb/hr	7.12	31.19
UHC	Solar Data	4.08	lb/hr	4.08	17.87
VOC	Solar PIL-168	0.82	lb/hr	0.82	3.57
SO ₂	AP-42	3.40E-03	lb/MMBtu	0.47	2.07
PM ₁₀ / PM _{2.5}	AP-42	6.60E-03	lb/MMBtu	0.92	4.02
1,3-Butadiene	AP-42	4.30E-07	lb/MMBtu	5.98E-05	2.62E-04
Acetaldehyde	AP-42	4.00E-05	lb/MMBtu	0.01	0.02
Acrolein	AP-42	6.40E-06	lb/MMBtu	8.90E-04	3.90E-03
Benzene	AP-42	1.20E-05	lb/MMBtu	1.67E-03	0.01
Ethylbenzene	AP-42	3.20E-05	lb/MMBtu	4.45E-03	0.02
Formaldehyde	Solar PIL-168	2.88E-03	lb/MMBtu	0.40	1.75
Naphthalene	AP-42	1.30E-06	lb/MMBtu	1.81E-04	7.92E-04
PAH	AP-42	2.20E-06	lb/MMBtu	3.06E-04	1.34E-03
Propylene Oxide	AP-42	2.90E-05	lb/MMBtu	4.03E-03	0.02
Toluene	AP-42	1.30E-04	lb/MMBtu	0.02	0.08
Xylenes	AP-42	6.40E-05	lb/MMBtu	0.01	0.04
Total HAPs	AP-42	3.20E-03	lb/MMBtu	0.44	1.95
CO ₂	40 CFR 98, Table C-1	116.98	lb/MMBtu	16,273.01	71,275.79
CH ₄	Solar PIL-168	3.26	lb/hr	3.26	14.30
N ₂ O	40 CFR 98, Table C-2	2.20E-04	lb/MMBtu	0.03	0.13
CO ₂ e	40 CFR 98, Table A-1	-	-	16,363.75	71,673.23

Notes:

- ⁽¹⁾ ISO horsepower obtained from Solar's Predicted Emission Performance Summary, dated August 24, 2020 (59 °F and 100% load).
- ⁽²⁾ Maximum horsepower, fuel consumption, fuel flowrate, and lower heating value (LHV) were obtained from Solar's Predicted Emission Performance Summary, dated August 24, 2020 (0 °F and 100% load).
- ⁽³⁾ The natural gas higher heating value (HHV) was obtained from Transco's July 2010 FERC Gas Tariff.
- ⁽⁴⁾ Solar defines UHC as unburned hydrocarbons.
- ⁽⁵⁾ Emission factors for NO_x, CO, and UHC were obtained from Solar's Predicted Emission Performance Summary, dated August 24, 2020 (0 °F and 100% load).
- ⁽⁶⁾ Emission factors for VOC, formaldehyde, and CH₄ were obtained from Solar's Product Information Letter (PIL-168), Revision 7 (03/17/2020). Per PIL-168, UHC consists of approximately 20% VOC and 80% CH₄.
- ⁽⁷⁾ Emission factors for particulate matter and SO₂ were obtained from the US EPA's AP-42, Table 3.1-2a. Emission factors for HAPs, except formaldehyde, were obtained from AP-42, Table 3.1-3.
- ⁽⁸⁾ The CH₄ emission factor was estimated based on an 80% conversion from the UHC emission factor.
- ⁽⁹⁾ The N₂O emission factor was obtained from 40 CFR Part 98 Subpart C, Table C-2.
- ⁽¹⁰⁾ Global warming potentials were obtained from 40 CFR 98 Subpart A.

Solar Turbines

A Caterpillar Company

PREDICTED EMISSION PERFORMANCE

Customer Williams Mooresville		Engine Model MARS 100-14000S	
Job ID 20-097		CS/MD 59F MATCH	
Inquiry Number		SHIPMENTS AFTER 1/95	
Run By Leslie Witherspoon	Date Run 24-Aug-20	Fuel Type CHOICE GAS	Water Injection NO
		Engine Emissions Data REV. 0.0	

	NOx EMISSIONS		CO EMISSIONS		UHC EMISSIONS	
1	15344 HP	100.0% Load	Elev. 815 ft	Rel. Humidity 60.0%	Temperature 0 Deg. F	
PPMvd at 15% O2	15.00		25.00		25.00	
ton/yr	30.74		31.19		17.87	
lbm/MMBtu (Fuel LHV)	0.060		0.061		0.035	
lbm/(MW-hr)	0.61		0.62		0.36	
(gas turbine shaft pwr) lbm/hr	7.02		7.12		4.08	
2	14270 HP	100.0% Load	Elev. 815 ft	Rel. Humidity 60.0%	Temperature 32.0 Deg. F	
PPMvd at 15% O2	15.00		25.00		25.00	
ton/yr	28.75		29.17		16.71	
lbm/MMBtu (Fuel LHV)	0.060		0.061		0.035	
lbm/(MW-hr)	0.62		0.63		0.36	
(gas turbine shaft pwr) lbm/hr	6.56		6.66		3.81	
3	13264 HP	100.0% Load	Elev. 815 ft	Rel. Humidity 60.0%	Temperature 59.0 Deg. F	
PPMvd at 15% O2	15.00		25.00		25.00	
ton/yr	26.91		27.31		15.64	
lbm/MMBtu (Fuel LHV)	0.060		0.061		0.035	
lbm/(MW-hr)	0.62		0.63		0.36	
(gas turbine shaft pwr) lbm/hr	6.14		6.24		3.57	

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg F, and between 50% and 100% load for gas fuel, and between 65% and 100% load for liquid fuel (except for the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg F and between 80% and 100% load.
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines

A Caterpillar Company

PREDICTED EMISSION PERFORMANCE

Customer Williams Mooresville	Engine Model MARS 100-14000S
Job ID 20-097	CS/MD 59F MATCH
Inquiry Number	SHIPMENTS AFTER 1/95
Run By Leslie Witherspoon	Fuel Type CHOICE GAS
Date Run 24-Aug-20	Water Injection NO
	Engine Emissions Data REV. 0.0

NOx EMISSIONS

CO EMISSIONS

UHC EMISSIONS

4	10904 HP	100.0% Load	Elev.	815 ft	Rel. Humidity	60.0%	Temperature	100.0 Deg. F
PPMvd at 15% O2			15.00		25.00		25.00	
ton/yr			23.06		23.39		13.40	
lbm/MMBtu (Fuel LHV)			0.059		0.059		0.034	
lbm/(MW-hr)			0.65		0.66		0.38	
(gas turbine shaft pwr)								
lbm/hr			5.26		5.34		3.06	

Notes

1. For short-term emission limits such as lbs/hr., Solar recommends using "worst case" anticipated operating conditions specific to the application and the site conditions. Worst case for one pollutant is not necessarily the same for another.
2. Solar's typical SoLoNOx warranty, for ppm values, is available for greater than 0 deg F or -20 deg F, and between 50% and 100% load for gas fuel, and between 65% and 100% load for liquid fuel (except for the Centaur 40). An emission warranty for non-SoLoNOx equipment is available for greater than 0 deg F or -20 deg F and between 80% and 100% load.
3. Fuel must meet Solar standard fuel specification ES 9-98. Emissions are based on the attached fuel composition, or, San Diego natural gas or equivalent.
4. If needed, Solar can provide Product Information Letters to address turbine operation outside typical warranty ranges, as well as non-warranted emissions of SO2, PM10/2.5, VOC, and formaldehyde.
5. Solar can provide factory testing in San Diego to ensure the actual unit(s) meet the above values within the tolerances quoted. Pricing and schedule impact will be provided upon request.
6. Any emissions warranty is applicable only for steady-state conditions and does not apply during start-up, shut-down, malfunction, or transient event.

Solar Turbines

A Caterpillar Company

PREDICTED ENGINE PERFORMANCE

Customer Williams Mooresville	
Job ID 20-097	
Run By Leslie Witherspoon	Date Run 24-Aug-20
Engine Performance Code REV. 4.20.1.25.13	Engine Performance Data REV. 3.0

Model MARS 100-14000S
Package Type CS/MD
Match 59F MATCH
Fuel System GAS
Fuel Type CHOICE GAS

DATA FOR NOMINAL PERFORMANCE

Elevation	feet	815			
Inlet Loss	in H2O	4.0			
Exhaust Loss	in H2O	8.0			
Accessory on GP Shaft	HP	27.8			
			1	2	3
Engine Inlet Temperature	deg F	0	32.0	59.0	100.0
Relative Humidity	%	60.0	60.0	60.0	60.0
Driven Equipment Speed	RPM	9263	9181	9100	8809
Specified Load	HP	FULL	FULL	FULL	FULL
Net Output Power	HP	15344	14270	13264	10904
Fuel Flow	mmBtu/hr	116.88	109.51	102.97	89.90
Heat Rate	Btu/HP-hr	7617	7674	7763	8244
Therm Eff	%	33.403	33.156	32.776	30.863
Engine Exhaust Flow	lbm/hr	324755	310226	296032	261489
PT Exit Temperature	deg F	910	923	937	972
Exhaust Temperature	deg F	910	923	937	972

Fuel Gas Composition (Volume Percent)	Methane (CH4)	96.11
	Ethane (C2H6)	2.84
	Propane (C3H8)	0.13
	I-Butane (C4H10)	0.0090
	N-Butane (C4H10)	0.01
	I-Pentane (C5H12)	0.0030
	N-Pentane (C5H12)	0.0020
	Hexane (C6H14)	0.0040
	Carbon Dioxide (CO2)	0.43
	Nitrogen (N2)	0.44
	Sulfur Dioxide (SO2)	0.0001

Fuel Gas Properties	LHV (Btu/Scf)	924.2	Specific Gravity	0.5754	Wobbe Index at 60F	1218.3
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This performance was calculated with a basic inlet and exhaust system. Special equipment such as low noise silencers, special filters, heat recovery systems or cooling devices will affect engine performance. Performance shown is "Expected" performance at the pressure drops stated, not guaranteed.

Volatile Organic Compound, Sulfur Dioxide, and Formaldehyde Emission Estimates

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

This Product Information Letter (PIL) summarizes emission factors commonly utilized to estimate emissions of volatile organic compounds (VOC), sulfur dioxide (SO₂), and formaldehyde from gas turbines.

INTRODUCTION

Emissions estimates of VOC, SO₂, and formaldehyde are often necessary during the air permitting process. The emissions estimates in this PIL are assumed valid at ambient temperatures >0 °F and for natural gas from 50-100% load (40-100% load for the *Titan*[™] 250 and 80-100% load for the *Saturn*[®] 20) or for liquid fuel from 65-100% load (80-100% for the *Saturn* 20 and *Centaur*[®] 40).

Volatile Organic Compounds

Permitting agencies usually require gas turbine users to include emissions of VOC, a subpart of the unburned hydrocarbon (UHC) emissions, during the air permitting process. Volatile organic compounds, non-methane hydrocarbons (NMHC), and reactive organic gases (ROG) are different ways of referring to the non-methane (and non ethane) portion of an "unburned hydrocarbon" emission estimate.

For natural gas fuel, most Solar customers use a 5 ppm VOC level to estimate emissions for the air permit. For liquid fuel, Solar's customers usually assume UHC emissions equal VOC emissions. The UHC/VOC value typically used is 25 ppm.

EPA's AP-42¹ document and WebFIRE² database also contain VOC emissions estimates for gas turbines. These sources are not commonly used by Solar's customers.

Sulfur Dioxide

Sulfur dioxide emissions are produced by conversion of sulfur in the fuel to SO₂. Solar customers usually either use a mass balance calculation or reference AP-42 to estimate SO₂ emissions. Because Solar does not control the amount of sulfur in the fuel, no SO₂ emissions warranty is available.

The mass balance method assumes that any sulfur in the fuel converts to SO₂. For reference, the typical mass balance equation is shown below.

$$\frac{\text{lb SO}_2}{\text{hr}} = \left(\frac{\text{wt\% Sulfur}}{100} \right) \left(\frac{\text{lb fuel}}{\text{Btu}} \right) \left(\frac{10^6 \text{ Btu}}{\text{MMBtu}} \right) \left(\frac{\text{MMBtu fuel}}{\text{hr}} \right) \left(\frac{\text{MW SO}_2}{\text{MW Sulfur}} \right)$$

Variables: wt % of sulfur in fuel
Btu/lb fuel (LHV)
MMBtu/hr fuel flow (LHV)

¹ AP-42 is an EPA document containing a compilation of air pollutant emission factors by source category.

² WebFIRE is an EPA electronic based repository and retrieval tool for emission factors.

As an alternative to the mass balance calculation, EPA's AP-42 document can be used. AP-42 (Table 3.1-2a, April 2000) suggests emission factors of 0.943 lb/MMBtu (HHV) (where S=sulfur % in fuel) or 0.0034 lb/MMBtu (HHV) for gas fuel and 1.01S lb/MMBtu (HHV) (where S=sulfur % in fuel) or 0.033 lb/MMBtu (HHV) for liquid fuel.

Formaldehyde

For gas turbines, formaldehyde emissions are a result of incomplete combustion. Formaldehyde in the exhaust stream is unstable and historically has been difficult to measure. In addition to turbine characteristics including combustor design, size, maintenance history, and load profile, the formaldehyde emissions level is also affected by ambient temperature, humidity, atmospheric pressure, fuel quality, formaldehyde concentration in the ambient air, test method measurement variability, and operational factors.

Since ~2003 many gas turbine users have used the emission factors found in an EPA memo *Revised HAP Emission Factors for Stationary Combustion Turbines*³ for estimating hazardous air pollutant emissions, and specifically formaldehyde, from gas turbines. The memo presents hazardous air pollutant (HAP) emission factor data in several categories. The emission factors in the memo are a compilation of the HAP data EPA collected during the Maximum Achievable Control Technology (MACT) standard development process. The emission factor documentation shows there is a high degree of variability in formaldehyde emissions from gas turbines, depending on the manufacturer, rating size of equipment, combustor design, and testing events. The most common formaldehyde emission factor used to estimate emissions for gas turbines is 0.00288 lb/MMBtu HHV (EPA Memo, Table 16).

Contact Solar Turbines Environmental Programs for a copy of the memo or for more information on estimating formaldehyde emissions.

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This information is intended as a general overview and is not intended to be, and should not be used as, a substitute for obtaining legal advice in any specific situation. This document is accurate as of the publication date. Therefore, any discussion of a particular regulatory issue may become outdated. If specific legal advice is required, the reader should consult with an attorney.

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³ Revised HAP Emission Factors for Stationary Combustion Turbines, OAR-2002-0060, IV-B-09, 8/22/03