OptimaBio, LLC
4441-106 Six Forks Road, Unit 379
Raleigh, North Carolina 27609

July 28, 2021

VIA MAIL and EMAIL

Heather Carter
Regional Supervisor, Fayetteville Regional Office
NCDEQ Division of Air Quality
225 Green Street, Suite 714
Fayetteville, NC 28301

RE: Optima TH, LLC
Air Permit No. 10673R00 (the "Air Permit")
Notice for Updating Information in Permit Application

Dear Mrs. Carter,

Optima TH, LLC ("Optima") is providing this notice to the North Carolina Division of Air Quality (DAQ) Regional Supervisor to update operational information in Optima's Air Permit application for the Optima TH renewable methane facility in Tar Heel, Bladen County, NC. This notice follows up earlier communications between Optima TH and the DAQ related to Optima TH's earlier expressed disagreement with the DAQ's position on the applicability of 15A NCAC 2D .0516 (2D.0516) and the necessary operational changes that have to be made if 2D.0516 is continued to be required for Optima's Air Permit, and Optima's June 18 and June 22, 2021 notices to the DAQ concerning compliance with 2D.0516. No unpermitted, new, or increased emissions are created by this operational change and no terms or conditions of the Air Permit require modification as explained further below. In fact, the operational change will result in lower SO_2 emissions. Currently, Optima is operating intermittently due to lack of biogas from Smithfield's digester. Optima anticipates its operation to consistently start up again in September 2021.

August 14, 2020 Permit Application

As described in the August 14, 2020 permit application, during Normal Operation (Operating Scenario 1 of 3), methane is recovered from an existing, permitted and operational source of digester biogas. Optima TH utilizes gas upgrading technology which separates the biogas stream into two gas streams: methane-rich renewable natural gas (RNG) and low-Btu tail gas containing the remaining biogas constituents. This is illustrated in Figure 1 below using a simplified block flow diagram. By design, the gas upgrading system (GUS) recovers for beneficial reuse an existing methane gas stream, thus removing nearly all the heating value of the biogas. The tail gas, which results from methane recovery, is delivered to the control device, a candlestick flare (CD-1), where H_2S is oxidized for odor control. It is important to note that without the use of the

control device CD-1 for odor, there would be zero SO_2 emissions from the facility. Additionally, the gas upgrading process does not add any constituents or compounds to the existing biogas stream, the methane-rich product gas RNG, or resulting tail gas. The project simply recovers methane from an existing permitted biogas source (Smithfield – Tar Heel) and separates it from the other existing biogas constituents that were already being emitted.

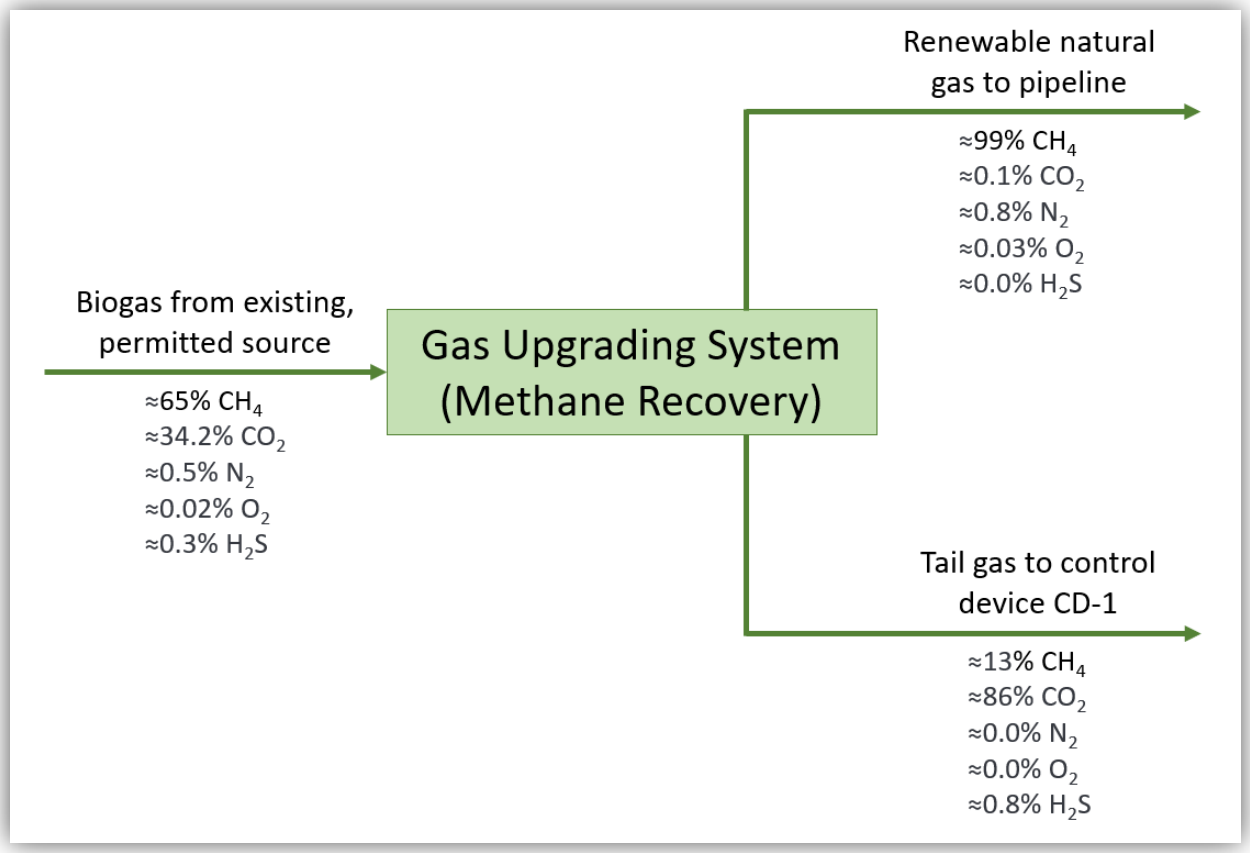

Figure 1. Block flow diagram depicting methane recovery from the biogas stream.

Optima TH's 2D .0516 compliance solution during Normal Operation, as originally presented in the permit application and subsequently approved by DAQ in our existing Air Permit, included delivering up to a 325 standard cubic feet per minute (scfm) of biogas via slip stream around the GUS to the control device simply to increase the heat input. However, as previously discussed with the DAQ, operating the facility in this manner resulted in severe damage to the GUS and therefore is no longer a viable option. After considerable investigation, the manufacturer ultimately determined it could not uphold the warranty for the system if the biogas slip stream is used. As such, the slip stream cannot be used to deliver methane to the control device for 2D .0516 compliance.

Optima TH communicated the inability to utilize a biogas slip stream to NCDAQ in a May 25, 2021 letter and during the June 3, 2021 teleconference. On the teleconference, along with prior communications to NCDAQ, Optima TH again requested relief from 2D .0516 applicability

based on the language and intent of the law. NCDAQ continues to consider the rule applicable to the Optima TH control device because the 2D .0516 regulation has consistently been applied to other flares permitted in the State. However, only one other permit for the operation of a flare at a similar biogas upgrading facility has been issued, and that facility has not yet began operating.

Updated Process Information to Comply with 2D.0516

Because use of the biogas slip stream around the GUS is not technically feasible, this is notice that Optima plans to instead use methane - natural gas delivered via the utility pipeline and likely a small amount of product gas (gas that is approximately 98-99.5% methane by volume) directly from the GUS - for the purpose of increasing the heat input to the control device to comply with 2D .0516. Accordingly, the three operating scenarios described in the Air Permit application are updated below:

1) Normal Operation. The biogas slip stream to increase the heat input to CD-1 for compliance with 2D.0516 will no longer be used. Instead, Optima will use methane delivered via the utility to increase the heat input to the control device. Optima TH may also redirect a percentage of the product gas from the GUS to the control device, instead of into the pipeline for beneficial reuse, to increase the heat input to the control device. See the attached process flow diagram.

2) By-pass Operation. The Bypass Operation (Operating Scenario 2 of 3), in which biogas was directed to the flare bypassing the GUS, will no longer be used. The valve controlling biogas flow to control device CD-1 has been permanently closed to prevent any further damage to the GUS and to satisfy the requirements to uphold the warranty from the PSA manufacturer. The bypass piping and connections still exist but are now inoperable. In the original Air Permit application, this By-pass Operation addressed the instances that facility operations were interrupted to perform necessary maintenance activities or for unpredictable events, and the biogas was either stored or was bypassed around the GUS to the flare. Since the bypassing of the GUS will no longer be used, for the instances described above, the biogas may be stored in the existing wastewater treatment facility's covered lagoon digesters for the necessary time period.

3) Off-Spec Operation. This operating scenario remains the same except there is no biogas slip stream utilized. See the attached process flow diagram. For this off-spec operation, the biogas will go through the GUS (once processed in the GUS this gas is referred to as product gas) and into the flare.

Since the biogas slip stream around the GUS can no longer be utilized, the maximum biogas flow rate processed by the facility will now equal 900 scfm. This is the rated capacity of the GUS. This results in reduced potential emissions from the facility compared to the permit application. Based on Smithfield digester operations, actual average flow rate of biogas to the facility is anticipated to be lower than 900 scfm.

For the reasons explained above, the number of operating hours for Bypass Operation are now anticipated to be 0 hours per year. The original permit application presented the number of operating hours for Bypass Operation to be 240 hours per year. The number of operating hours for Normal Operation are now anticipated to be 8,300 hours per year compared to 8,160 hours per year in the application. The number of operating hours for Off-Spec Operation are now anticipated to be 460 hours per year compared to 360 hours per year in the application. Since Normal Operation results in the lowest emission rates among all three operating scenarios, changes to the anticipated operating hours lead to lower annual emissions from Optima TH. As previously communicated to the DAQ, Optima TH does not expect to operate for 8,760 hours per year and does not expect to receive an average of 900 scfm of biogas. These values are simply used for the potential emissions calculations and provide a highly conservative estimate of emissions.

Optima's operational change does not require a permit modification as the operational change will not: (1) violate any existing regulatory requirements or add new applicable requirements; (2) cause emissions allowed under the current permit to be exceeded; (3) generate additional wastes which must be disposed of; (4) require a permit pursuant to 15A NCAC 2Q .0700, or (5) require a professional engineer's seal pursuant to Rule 15A NCAC 2Q.0112.

Further, no specific conditions or terms of the Air Permit require changes. The equations used to calculate the SO_2 emission rate in Condition A.3.b and the H_2S emission rate in Condition A.12.a are still applicable for the updated operation of the facility since all potential gas streams to the control device are already considered. Additionally, the monitoring requirements in Condition A.3.c still apply since the permit requires measurement of both product gas and natural gas, which will be used to determine the heat input to the flare. The permit issued to Optima already allows for the use of supplemental energy to increase the Btu input to the control device. The sole purpose of the biogas slip stream was simply to increase the Btu input to the flare. This operational change is just substituting methane (from the utility line and from the GUS) as the supplemental energy to increase the Btu input to the control device to comply with 2D .0516. Updated emissions are provided in the attached revised emissions calculations.

Although flaring methane delivered from the utility pipeline significantly increases the operating cost of the facility, and flaring product gas delivered from the digester significantly reduces the benefits of the project, these methods are the most economically feasible option for compliance with 2D .0516. Optima TH analyzed alternate options for 2D .0516 compliance and found that the most feasible solution, operationally and economically, continues to be the use of supplemental methane to increase the heat input at the control device. There are limited technology options for small-scale facilities, such as Optima TH, which contributed to our decision to continue to supply supplemental fuel to the control device for compliance with 02D .0516 as allowed via our existing permit. As previously discussed, increased capital and operating expenses associated with installing a hydrogen sulfide removal system to achieve compliance with 2D .0516 is not economically reasonable in this situation, particularly since supplemental Btu's can be used and have already been permitted to achieve compliance.

Regarding 2D .0516, DAQ stated in the January 17, 2021 letter to Align RNG that "the purpose of this rule is to reduce pollution" and indicates that an approach to comply with the rule that "does not reduce the mass emission rate of SO_2" is "contrary to the purpose of the rule." As discussed in our previous meetings and conversations, it is obvious that lawmakers did not, and realistically could not, due to existing technology at the time, envision renewable methane recovery facilities while enacting 2D .0516 as they did not exist. As such, the intent of the rule was to address new or additive sources of fuels high in sulfur.

For additional information for the DAQ on the impact of 2D.0516 on SO_2 emissions for this operation, Table 1 below shows the SO_2 emission rates resulting from three operation scenarios: (1) Normal Operation as presented in the August 14, 2020 permit application using biogas slipstream for 2D .0516 compliance; (2) Normal Operation as discussed in this notice using methane (primarily from utility-delivered natural gas and some product gas) for 2D .0516 compliance; and (3) Normal Operation using no product gas or natural gas to increase the Btu's in the control device (assumes 2D.0516 does not apply but the facility is still operating the flare to control potential odor).

Notably, table 1 shows that the SO_2 emission rate is lower if the facility does not use additional methane to comply with 2D.0516, or uses methane (from natural gas and/or product gas) rather than biogas slip-streamed around the GUS to increase the heat input to CD-1.

Table 1. Potential SO_2 and GHG emission rates resulting from three different modes of operation (assuming 87% methane recovery by the GUS).

	Normal Operation (original application)– Supplemental Biogas Slip Stream (not technically feasible)	Normal Operation – Supplemental Methane Gas (updated operational change for additional heat input)	Normal Operation – Tail Gas and Pilot Fuel Only (no additional methane; assumes 2D.0516 not applicable)
Biogas Flow Rate to CD-1 (scfm)	325	0	0
Tail Gas Flow Rate to CD-1 (scfm)	386	386	386
H_2S Flow Rate to CD-1 (scfm)	3.68	2.70	2.70
Tail Gas Heat Input (MMBtu/hr)	4.73	4.73	4.73
Supplemental Biogas Heat Input (MMBtu/hr)	12.90	0.00	0.00

Pilot Fuel Heat Input (MMBtu/hr)	0.10	0.10	0.10
Supplemental Methane Gas Heat Input (MMBtu/hr)	0.00	9.90	0.00
Total Heat Input to CD-1 (MMBtu/hr)	17.73	14.73	4.83
SO_2 Emission Rate (lbs/hr)	38.99	28.36	28.35
SO_2 Emission Rate (lbs/MMBtu)	2.20	1.93	5.87
CO_2 Emission Rate (short tons/yr)	21,796	16,661	11,937

As previously discussed with the DAQ, application of 2D .0516 to Optima TH's renewable energy facility is not warranted, appropriate or within the letter of the law. In addition to interpreting 2D .0516 to include a flare used as an odor control device, which is inconsistent with the regulation's plain language, the application of 2D .0516 will result in Optima TH consuming excess fuel not necessary for the facility's control device operation for emissions control. The purpose of the Optima TH facility is to recover methane from biogas produced by an existing permitted source. The facility is intended to produce renewable fuel to displace imported fossil fuels, consistent with the State's goals to reduce greenhouse gas emissions[1]. Adding supplemental Btu's to a control device to comply with 2D .0516 unnecessarily increases greenhouse gas emissions from the facility and actually increases SO_2 emission rates. Further, and important to the analysis of emissions from the facility, DAQ air dispersion modeling demonstrated the calculated, maximum potential SO_2 emission rate will result in concentrations that are only 22.2% of the restrictive 1-hour averaged SO_2 NAAQS. Thus, compliance with 2D .0516 is unnecessary as the SO_2 NAAQS is already protected.

Thank you for your assistance. Please contact me or Gus Simmons at gus.simmons@cavanaughsolutions.com with any questions.

Regards,

Mark Maloney
Manager
Optima TH, LLC

Enclosures: Revised Optima TH Emission Rate Calculations
Revised Optima TH Process Flow Diagrams

[1] State of North Carolina Executive Order No. 80, October 29, 2018.

cc: Mark J. Cuilla, Chief, Permitting Section, Raleigh Central Office

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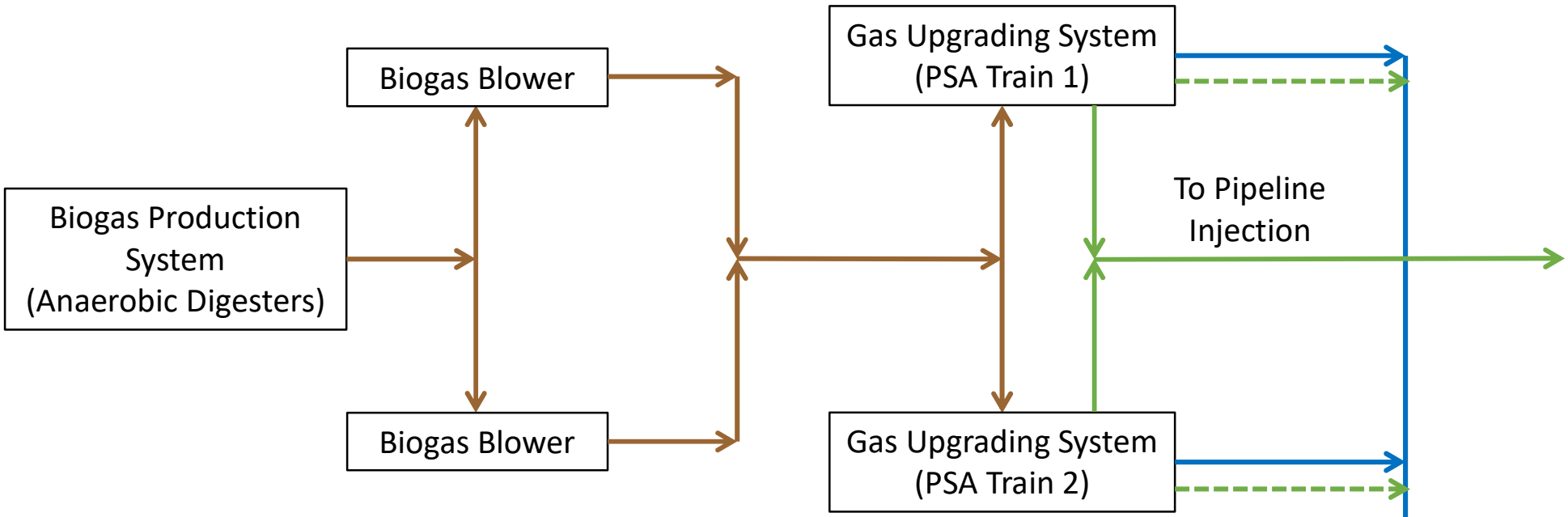
Process Flow Diagram
Operating Scenario 1 of 3: Normal Operation



Legend

- Biogas
- Tail Gas
- Product Gas (Injected)
- Product Gas (Flared for 02D .0516)
- Natural Gas

Typical Flow Rates

Biogas Inlet Flow:	900	SCFM
Product Gas (Injected)	378 - 543	SCFM
Tail Gas	357	SCFM
Natural Gas	0 - 163	SCFM
Product Gas (Flared)	0 - 166	SCFM

Typical Gas Constituents

Biogas: 65% CH_4; 34% CO_2; 0.5% N_2; 0.3% H_2S
Product Gas: 99% CH_4; 1% N_2
Tail Gas: 13% CH_4; 86% CO_2; 0.8% H_2S
Natural Gas: 96% CH_4; 2% CO_2; 2% Other

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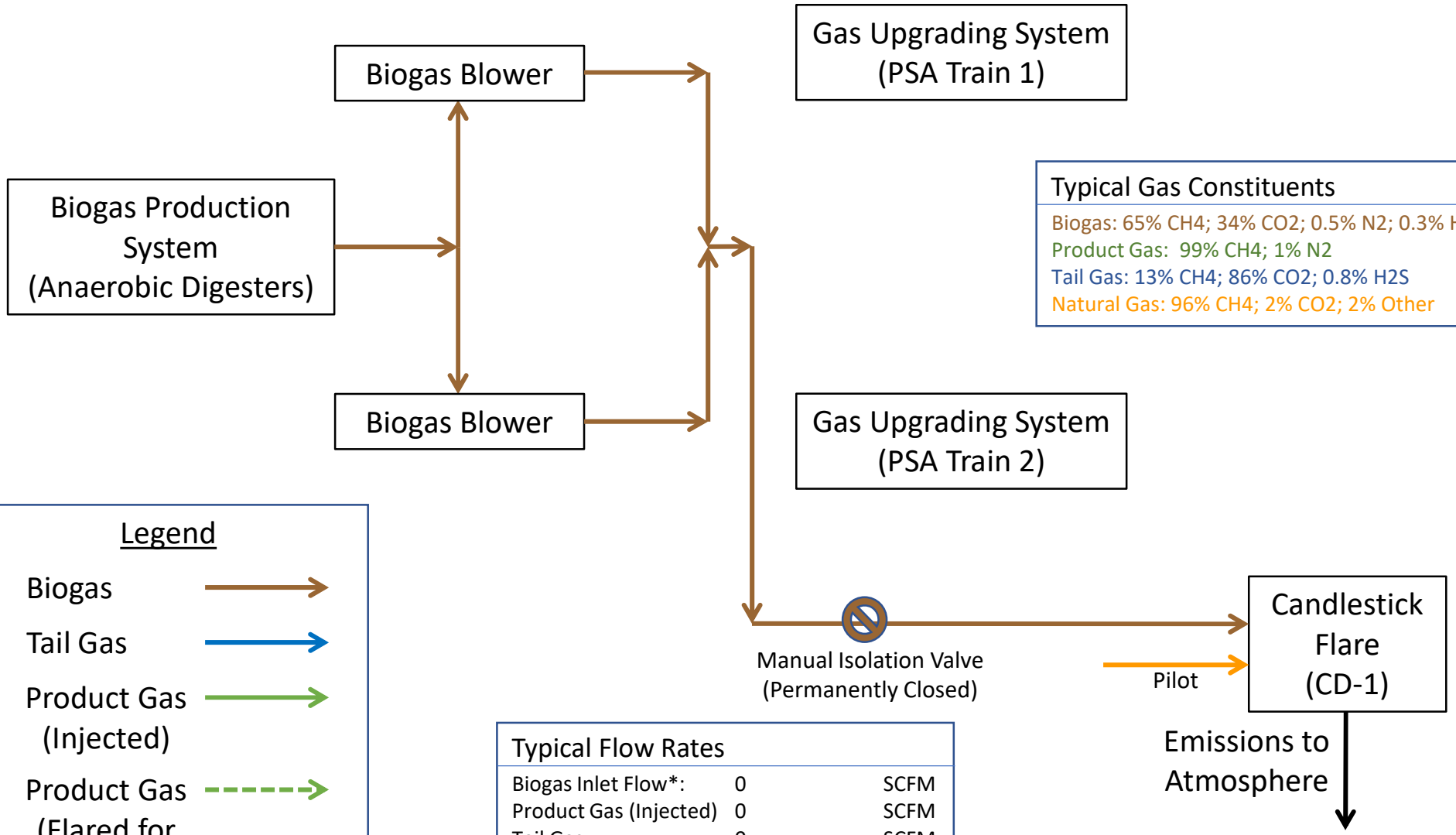
Process Flow Diagram
Operating Scenario 2 of 3: Bypass Operation



Typical Flow Rates		
Biogas Inlet Flow*:	0	SCFM
Product Gas (Injected)	0	SCFM
Tail Gas	0	SCFM
Natural Gas	2	SCFM
Product Gas (Flared)	0	SCFM

* The manual isolation valve allowing biogas flow to CD-1 has been permanently closed, however, the piping remains installed at the facility.

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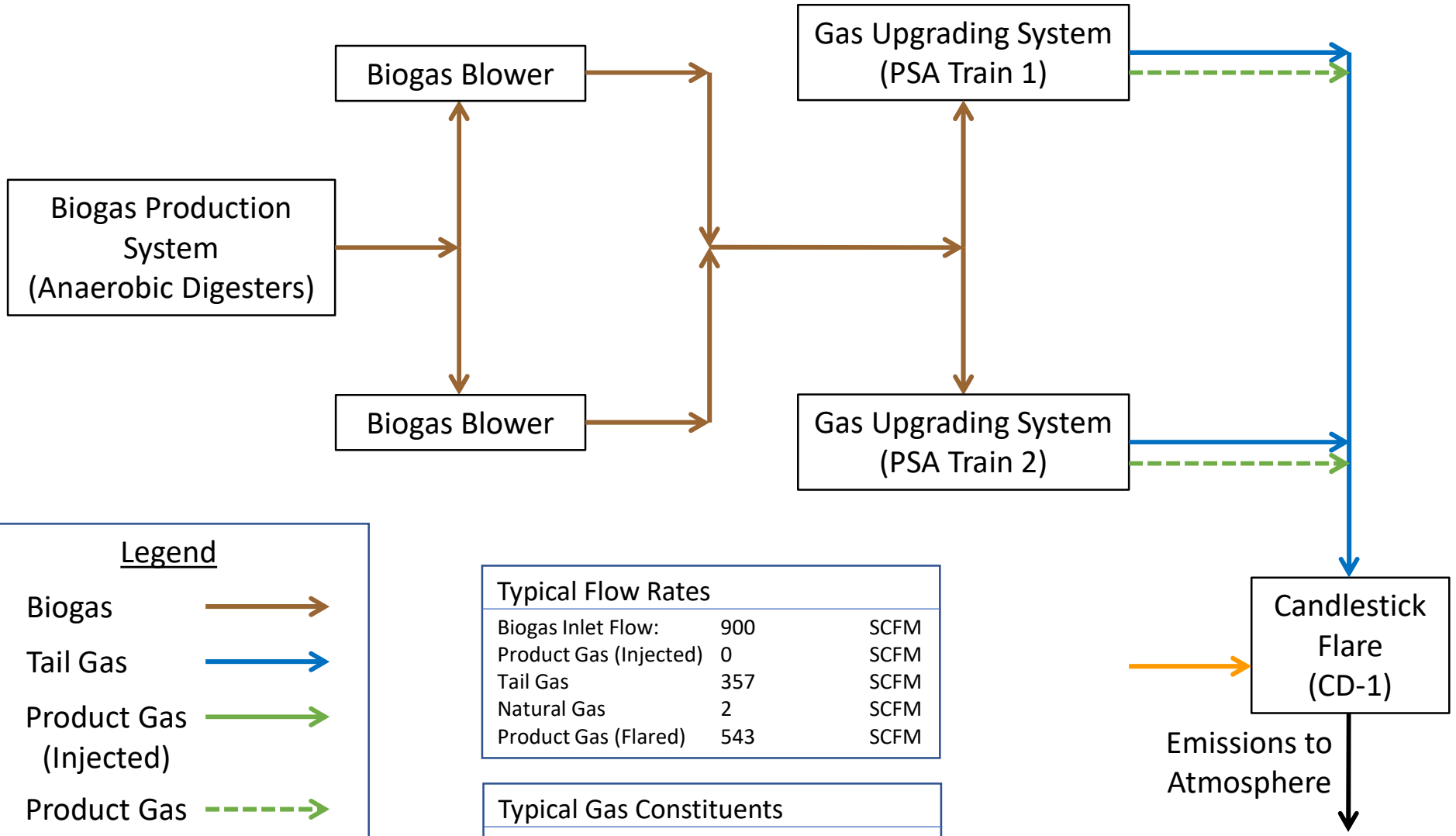
Process Flow Diagram
Operating Scenario 3 of 3: Off-Spec Operation



Legend

- Biogas
- Tail Gas
- Product Gas (Injected)
- Product Gas (Flared)
- Natural Gas

Typical Flow Rates

Biogas Inlet Flow:	900	SCFM
Product Gas (Injected)	0	SCFM
Tail Gas	357	SCFM
Natural Gas	2	SCFM
Product Gas (Flared)	543	SCFM

Typical Gas Constituents

Biogas: 65% CH_4; 34% CO_2; 0.5% N_2; 0.3% H_2S
Product Gas: 99% CH_4; 1% N_2
Tail Gas: 13% CH_4; 86% CO_2; 0.8% H_2S
Natural Gas: 96% CH_4; 2% CO_2; 2% Other

Overview

The revised emissions calculations presented below for Optima TH, LLC are provided to show the updated emission rates for the facility during Normal Operation (Operating Scenario 1 of 3) when the facility utilizes natural gas and/or product gas as supplemental fuel for control device CD-1 instead of a biogas slip stream, as previously presented in the permit application submitted for the facility. Additionally, since the biogas slip stream will no longer be utilized, the maximum flow of biogas to the facility during any of the three operating scenarios will be 900 standard cubic feet per minute (scfm), which is the rated capacity of the gas upgrading system (GUS). The air permit application presented a maximum biogas flow rate of 1,225 scfm, which was required to supply the biogas slip stream to CD-1. Since the biogas flow rate to the facility is now lower, the emissions from the facility have been reduced compared to the emission rates presented in the air permit application. The emissions calculations have also been updated to reflect the following additional process changes that have occurred at Optima TH since the permit application was submitted in August 2020:

- Bypass Operation (Operating Scenario 2 of 3) is now anticipated to occur for 0 hours per year. Bypassing biogas around the GUS caused severe damage to the GUS adsorbent beds, so the valve controlling biogas flow to CD-1 has been permanently closed. The piping and connections that allowed biogas flow to CD-1 are still installed at the facility but the valve is expected to remain closed.
- The number of operating hours for Normal Operation have been increased to 8,300 hours per year and the number of operating hours for Off-Spec Operation have been increased to 460 hours per year since Bypass Operation will no longer be used.
- The volume of natural gas and/or product gas required as supplemental fuel for CD-1 will depend on multiple factors, including the biogas flow rate, the biogas H_2S concentration, and the GUS methane recovery efficiency. For the calculations below, the rated biogas flow rate of 900 scfm, the anticipated H_2S concentration of 3,000 ppm, and a GUS methane recovery of 92% were used. Using these values, 10 MMBtu/hr of supplemental fuel is required for 15A NCAC 02D .0516 compliance. The emission rates for Normal Operation were calculated assuming 10 MMBtu/hr of natural gas is used for supplemental fuel. During Normal Operation, natural gas, product gas, or a combination of the two may be used as supplemental fuel. The same emission factors (AP-42 Section 1.4 and Section 13.5) are used for both product gas and natural gas combustion in the calculations.

The destruction efficiency for CD-1 used in the calculations below is 98%. The air permit application listed a destruction efficiency of 99% for CD-1 based on 40 CFR Part 98, Subpart II, Industrial Wastewater Treatment (U.S. EPA GHG Reporting Rule). NCDEQ Division of Air Quality informed Optima TH at the time the air permit was being drafted that a destruction efficiency of 98% must be used for the permit and emission rate calculations unless documentation for the flare can be provided showing that a destruction efficiency of 99% can be achieved. This change from a destruction efficiency of 99% to 98% for the calculations below does not constitute an increase in emissions from the facility since a destruction efficiency of 98% was used by NCDEQ Division of Air Quality at the time the air permit was issued.

Emissions Summary

The updated facility-wide potential emissions for the Optima TH facility are summarized in the table below. The potential and expected actual emission rates are lower than the emission rates submitted in the permit application for the facility. A revised Form D1 is included below for further clarification.

Air Pollutant Emitted	Expected Actual Emissions After Controls / Limitations[3] (tons/yr)	Potential Emissions Before Controls / Limitations[1] (tons/yr)	Potential Emissions After Controls / Limitations[2] (tons/yr)
Particulate Matter (PM)	0.07	0.17	0.12
Particulate Matter <10 (PM_{10})	0.07	0.17	0.12
Particulate Matter <2.5 ($PM_{2.5}$)	0.06	0.14	0.10
Sulfur Dioxide (SO_2)	124.21	124.32	124.26
Nitrogen Oxides (NO_X)	6.26	16.93	12.71
Carbon Monoxide (CO)	19.21	67.89	48.64
Volatile Organic Compounds (VOCs)	0.78	1.82	1.30
Greenhouse Gases (GHG)	17,583	38,959	31,697
Total HAPs	2.67E-01	6.22E-01	4.46E-01
Highest HAP	2.55E-01	5.95E-01	4.27E-01

Table 1. Optima TH updated potential and actual annual emissions summary.

[1]The potential emissions before controls and limitations listed above were calculated using 8,760 operating hours per year, the maximum anticipated biogas production, and the maximum rated heat input to the candlestick flare (ES-1).

[2]The potential emissions after controls and limitations listed above were calculated using 8,760 operating hours per year, the maximum anticipated biogas production, and the limited potential yearly fuel usage. The limited potential yearly fuel usage was calculated based on the actual heat input to the candlestick flare from tail gas and product gas combustion, not the maximum rated heat input for the candlestick flare.

[3]The expected actual emissions after controls and limitations listed above were calculated based on the anticipated number of operating hours for each operating scenario which total to 8,760 hours per year, the maximum anticipated biogas production, and the actual yearly fuel usage. The actual yearly fuel usage was calculated based on the actual heat input to the candlestick flare, the anticipated gas compositions, and the anticipated operating hours for each operating scenario.

It is anticipated that Normal Operation (Operating Scenario 1 of 3) will occur for 8,300 hours per year, Bypass Operation (Operating Scenario 2 of 3) will occur for 0 hours per year, and Off-Spec Operation (Operating Scenario 3 of 3) will occur for a maximum of 460 hours per year.

State Regulatory Applicability

The following sections discuss the applicability of NCDEQ Division of Air Quality regulatory requirements for the Optima TH facility based on the revised emission rates.

15A NCAC 02D .0516

As stated in 02D .0516(a), sulfur dioxide emissions from any "source of combustion" that is discharged from any "vent, stack, or chimney" shall not exceed 2.3 pounds per million Btu input (lb/MMBtu). The rate of sulfur dioxide emissions for the Optima TH facility resulting from the addition of supplemental fuel to the control device CD-1 are calculated to be 2.19 lb/MMBtu when the maximum potential tail gas flow is oxidized in the candlestick flare (Operating Scenario 1 of 3) and 0.79 lb/MMBtu when the maximum potential product gas flow and tail gas flow are combusted in the candlestick flare (Operating Scenario 3 of 3). Since these maximum emission rates are less than 2.3 lb/MMBtu, the facility will comply with rule 02D .0516(a).

15A NCAC 02D .1100

Pursuant to 15A NCAC 02D .1100 and in accordance with the NCDEQ Division of Air Quality air toxic compliance demonstration, an emission limit for hydrogen sulfide of 9.96 pounds per day (lb/day) shall not be exceeded by Optima TH. The hydrogen sulfide emission rate for the Optima TH facility is calculated to be 7.4 lb/day when the maximum potential tail gas flow is oxidized in the candlestick flare (Operating Scenario 1 of 3) and 7.4 lb/day when the maximum potential product gas flow and tail gas flow are combusted in the candlestick flare (Operating Scenario 3 of 3). Since these maximum emission rates are less than the current 9.96 lb/day hydrogen sulfide emission limit, the facility will comply with rule 02D .1100.

Optima TH Biogas Production Balance - Maximum Biogas Production

Maximum Biogas Production (scfm):	900
Average GUS Methane Recovery:	92%
GUS Uptime with Normal Operation:	95%
Maximum Biogas Flow into GUS (scfm):	900

Hours of Normal Operation:	8,300
Hours of Product Gas to the Candlestick Flare:	460
Hours of Biogas to the Candlestick Flare:	0
Total Annual Hours of Operation:	8,760

Normal Operation - Biogas from Anaerobic Digesters to Gas Upgrading System (8,760 hours per year)

Raw Biogas Constituents	Formula	Biogas Composition	Flowrate (scfm)	lb/hr	tons/yr
Methane	CH_4	65.00%	585.00	1,568.76	6,871.15
Carbon Dioxide	CO_2	34.17%	307.53	2,262.74	9,910.79
Nitrogen	N_2	0.50%	4.50	21.08	92.33
Oxygen	O_2	0.02%	0.18	0.96	4.22
Hydrogen Sulfide	H_2S	0.30%	2.70	15.38	67.38
Ammonia	NH_3	0.01%	0.09	0.26	1.12
Totals		**100.00%**	**900.00**	**3,869.18**	**16,946.99**

Normal Operation - Product Gas to Natural Gas Pipeline for Offsite Consumption (8,300 hours per year)

Product Gas Constituents	Formula	Product Gas Composition	Flowrate (scfm)	lb/hr	tons/yr
Methane	CH_4	99.04%	538.20	1,443.26	5,989.51
Carbon Dioxide	CO_2	0.10%	0.54	4.00	16.59
Nitrogen	N_2	0.83%	4.50	21.08	87.48
Oxygen	O_2	0.03%	0.18	0.96	4.00
Hydrogen Sulfide	H_2S	0.00%	0.00	0.00	0.00
Ammonia	NH_3	0.00%	0.00	0.00	0.00
Totals		**100.00%**	**543.42**	**1,469.30**	**6,097.58**

Normal Operation - Tail Gas to Candlestick Flare (8,300 hours per year)

Tail Gas Constituents	Formula	Tail Gas Composition	Flowrate (scfm)	lb/hr	tons/yr
Methane	CH_4	13.12%	46.80	125.50	549.69
Carbon Dioxide	CO_2	86.09%	306.99	2,258.74	9,893.27
Nitrogen	N_2	0.00%	0.00	0.00	0.00
Oxygen	O_2	0.00%	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.76%	2.70	15.38	67.38
Ammonia	NH_3	0.03%	0.09	0.26	1.12
Totals		**100.00%**	**356.58**	**2,399.88**	**10,511.47**

Irregular Operation - Biogas from Anaerobic Digesters to Candlestick Flare without Gas Upgrading (0 hours per year)

Raw Biogas Constituents	Formula	Biogas Composition	Flowrate (scfm)	lb/hr	tons/yr
Methane	CH_4	65.00%	0.00	0.00	0.00
Carbon Dioxide	CO_2	34.17%	0.00	0.00	0.00
Nitrogen	N_2	0.50%	0.00	0.00	0.00
Oxygen	O_2	0.02%	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.30%	0.00	0.00	0.00
Ammonia	NH_3	0.01%	0.00	0.00	0.00
Totals		**100.00%**	**0.00**	**0.00**	**0.00**

Irregular Operation - Product Gas to Candlestick Flare for Onsite Consumption (460 hours per year)

Product Gas Constituents	Formula	Product Gas Composition	Flowrate (scfm)	lb/hr	tons/yr
Methane	CH_4	99.04%	538.20	1,443.26	331.95
Carbon Dioxide	CO_2	0.10%	0.54	4.00	0.92
Nitrogen	N_2	0.83%	4.50	21.08	4.85
Oxygen	O_2	0.03%	0.18	0.96	0.22
Hydrogen Sulfide	H_2S	0.00%	0.00	0.00	0.00
Ammonia	NH_3	0.00%	0.00	0.00	0.00
Totals		**100.00%**	**543.42**	**1,469.30**	**337.94**

Normal Operation - Biogas Slip Stream to Candlestick Flare (0 hours per year)

Biogas Constituents	Formula	Biogas Composition	Flowrate (scfm)	lb/hr	tons/yr
Methane	CH_4	65.00%	0.00	0.00	0.00
Carbon Dioxide	CO_2	34.17%	0.00	0.00	0.00
Nitrogen	N_2	0.50%	0.00	0.00	0.00
Oxygen	O_2	0.02%	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.30%	0.00	0.00	0.00
Ammonia	NH_3	0.01%	0.00	0.00	0.00
Totals		**100.00%**	**0.00**	**0.00**	**0.00**

Notes:

1) The maximum rated biogas flow of 900 scfm into the GUS is shown. The maximum expected biogas production is shown. During normal operation, 900 scfm of biogas is directed to the gas upgarding system for renewable natural gas production. Biogas is not directed to the candlestick flare for combustion.
2) Normal operation consists of the gas upgrading system processing biogas to form product gas and tail gas. The product gas is utilized offsite as renewable natural gas and the tail gas is oxidized in the candlestick flare.
3) Product gas may be combusted in the candlestick flare during facility startup, which requires approximately 45 minutes. Product gas is combusted in the candlestick flare when the gas does not comply with Piedmont Natural Gas pipeline receipt specifications. The product gas composition may vary. The average composition is shown.
4) The entire flow of biogas may be combusted in the candlestick flare at times when the GUS is not operating during equipment maintenance or disrepair.

Optima TH Potential to Emit Summary Tables

Potential Annual Emissions Without Controls and Limits

Source Information		Gas Usage (scfm)				Criteria Pollutants (tons/yr)							HAPs (tons/yr)	
Emission Source	Operating Hours per Year	Tail Gas	Product Gas	Natural Gas	Biogas	PM	PM_{10}	$PM_{2.5}$	SO_2	NO_x	CO	VOC	Highest HAP	Total HAPs
Gas Upgrading System	8,760	356.6	543.4	1.6	0.0	0.17	0.17	0.14	124.32	16.93	67.89	1.82	0.60	0.62
Totals		**356.6**	**543.4**	**1.6**	**0.0**	**0.17**	**0.17**	**0.14**	**124.32**	**16.93**	**67.89**	**1.82**	**0.60**	**0.62**

Notes:
1. The candlestick flare potential emissions without controls and limits were calculated using the Product Gas to Candlestick Flare Combustion Emissions Calculator. The potential emissions were calculated using 8,760 operating hours per year and the Calculated Potential Yearly Fuel Usage.
2. The GUS Mass Balance lists 8,300 hours of normal operation per year in which biogas is processed in the gas upgrading system and product gas is injected into the natural gas pipeline for offsite consumption. Combusting the total volume of product gas results in the greatest emissions for the facility because no product gas is delivered to the natural gas pipeline. Thus, the calculations used to obtain the emisson rates above assume the maximum rated flow is combusted in the candlestick flare for 8,760 hours per year.
3. See Emission Factors for Tail Gas, Product Gas, and Biogas Combustion for the emission factors used to obtain the emission rates above.

Potential Annual Emissions With Controls and Limits

Source Information		Gas Usage (scfm)				Criteria Pollutants (tons/yr)							HAPs (tons/yr)	
Emission Source	Operating Hours per Year	Tail Gas	Product Gas	Natural Gas	Biogas	PM	PM_{10}	$PM_{2.5}$	SO_2	NO_x	CO	VOC	Highest HAP	Total HAPs
Gas Upgrading System	8,760	356.6	543.4	1.6	0.0	0.12	0.12	0.10	124.26	12.71	48.64	1.30	0.43	0.45
Totals		**356.6**	**543.4**	**1.6**	**0.0**	**0.12**	**0.12**	**0.10**	**124.26**	**12.71**	**48.64**	**1.30**	**0.43**	**0.45**

Notes:
1. The candlestick flare potential emissions without controls and limits were calculated using the Product Gas to Candlestick Flare Combustion Emissions Calculator. The potential emissions were calculated using 8,760 operating hours per year and the Limited Potential Yearly Fuel Usage.
2. The GUS Mass Balance lists 8,300 hours of normal operation per year in which biogas is processed in the gas upgrading system and product gas is injected into the natural gas pipeline for offsite consumption. Combusting the total volume of product gas in the candlestick flare without gas upgrading results in the greatest emissions for the facility because no product gas is delivered to the natural gas pipeline. Thus, the calculations used to obtain the emisson rates above assume the maximum rated flow is combusted in the candlestick flare for 8,760 hours per year.
3. See Emission Factors for Tail Gas, Product Gas, and Biogas Combustion for the emission factors used to obtain the emission rates above.

Expected Actual Annual Emissions With Controls and Limits

Source Information		Gas Usage (scfm)				Criteria Pollutants (tons/yr)							HAPs (tons/yr)	
Emission Source	Operating Hours per Year	Tail Gas	Product Gas	Natural Gas	Biogas	PM	PM_{10}	$PM_{2.5}$	SO_2	NO_x	CO	VOC	Highest HAP	Total HAPs
GUS - Normal Operation	8,300	356.6	0.0	163.4	0.0	0.07	0.07	0.06	117.68	5.59	16.66	0.71	0.23	0.24
GUS - Off-Spec Operation	460	356.6	543.4	1.6	0.0	0.01	0.01	0.01	6.53	0.67	2.55	0.07	0.02	0.02
GUS - Bypass Operation	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Totals						**0.07**	**0.07**	**0.06**	**124.21**	**6.26**	**19.21**	**0.78**	**0.26**	**0.27**

Notes:

1. The expected actual emissions for candlestick flare normal operations were calculated using the Normal Operation Emissions Calculator. The expected actual emissions with controls and limits were calculated using 8,300 normal operating hours per year.
2. The potential emissions for product gas combustion in the candlestick flare were calculated using the Product Gas to Candlestick Flare Combustion Emissions Calculator.The expected actual emissions with controls and limits were calculated for 460 off-spec operating hours per year.
3. The potential emissions for biogas combustion in the candlestick flare were calculated using the Biogas to Candlestick Flare Combustion Emissions Calculator.The expected actual emissions with controls and limits were calculated for 0 bypass operating hours per year.
4. The GUS Mass Balance lists 460 hours of operation for product gas to the candlestick flare and 0 hours of operation for the maximum biogas flow to the candlestick flare per year.
5. The calculations used to obtain the potential emissions listed above used the maximum rated capacity of the GUS (900 scfm biogas).
6. See Emission Factors for Tail Gas, Product Gas, and Biogas Combustion for the emission factors used to obtain the emission rates above.

Optima TH Potential to Emit Hazardous Air Pollutants Summary Tables

Potential to Emit Before Controls and Limits

Product Gas Combustion in the Candlestick Flare (8,760 Operating Hours per Year)		
Toxic / Hazardous Air Pollutant	CAS Number	tons/yr
Acetaldehyde (TH)	75070	5.03E-06
Acrolein (TH)	107028	5.95E-06
Ammonia (T)	7664417	1.08E+00
Arsenic unlisted compounds (TH)	ASC-other	0.00E+00
Benzene (TH)	71432	6.95E-04
Benzo(a)pyrene (TH)	50328	3.97E-07
Beryllium metal (unreacted) (TH)	7440417	0.00E+00
Cadmium metal (elemental unreacted) (TH)	7440439	0.00E+00
Chromic acid (VI) (TH)	7738945	0.00E+00
Cobalt unlisted compounds (H)	COC-other	2.78E-05
Formaldehyde (TH)	50000	2.48E-02
Hexane, n- (TH)	110543	5.95E-01
Lead unlisted compounds (H)	PBC-other	1.65E-04
Manganese unlisted compounds (TH)	MNC-other	0.00E+00
Mercury vapor (TH)	7439976	0.00E+00
Napthalene (H)	91203	2.02E-04
Nickel metal (TH)	7440020	0.00E+00
Selenium compounds (H)	SEC	7.94E-06
Toluene (TH)	108883	1.12E-03
Total HAPs		6.22E-01
Highest HAP	110543	5.95E-01

Potential to Emit After Controls and Limits

Product Gas Combustion in the Candlestick Flare (8,760 Operating Hours per Year)		
Toxic / Hazardous Air Pollutant	CAS Number	tons/yr
Acetaldehyde (TH)	75070	3.60E-06
Acrolein (TH)	107028	4.27E-06
Ammonia (T)	7664417	7.81E-01
Arsenic unlisted compounds (TH)	ASC-other	0.00E+00
Benzene (TH)	71432	4.98E-04
Benzo(a)pyrene (TH)	50328	2.84E-07
Beryllium metal (unreacted) (TH)	7440417	0.00E+00
Cadmium metal (elemental unreacted) (TH)	7440439	0.00E+00
Chromic acid (VI) (TH)	7738945	0.00E+00
Cobalt unlisted compounds (H)	COC-other	1.99E-05
Formaldehyde (TH)	50000	1.78E-02
Hexane, n- (TH)	110543	4.27E-01
Lead unlisted compounds (H)	PBC-other	1.18E-04
Manganese unlisted compounds (TH)	MNC-other	0.00E+00
Mercury vapor (TH)	7439976	0.00E+00
Napthalene (H)	91203	1.45E-04
Nickel metal (TH)	7440020	0.00E+00
Selenium compounds (H)	SEC	5.69E-06
Toluene (TH)	108883	8.06E-04
Total HAPs		4.46E-01
Highest HAP	110543	4.27E-01

Notes:

1. The candlestick flare potential HAPs emissions without controls and limits were calculated using the Product Gas to Candlestick Flare Combustion Emissions Calculator. The potential emissions were calculated using 8,760 operating hours per year and the Calculated Potential Yearly Fuel Usage.
2. The candlestick flare potential HAPs emissions with controls and limits were calculated using the Product Gas to Candlestick Flare Combustion Emissions Calculator. The potential emissions were calculated using 8,760 operating hours per year and the Limited Potential Yearly Fuel Usage.
3. The calculations used to obtain the potential emissions listed above used the maximum expected biogas production.
4. See Emission Factors for Tail Gas, Product Gas, and Biogas Combustion for the emission factors used to obtain the emission rates above.

Normal Operation
Emissions Calculator Input

Company Name:	Optima TH, LLC
Facility Name:	Optima TH
Facility ID Number:	900096
Permit Number:	10673R00
Facility City:	Tar Heel, NC
Facility County:	Bladen
Calculations Prepared By:	Ben Cauthen (Cavanaugh & Associates, P.A.)
Calculations Checked By:	
Calculations Prepared On:	7/16/2021
Calculations Checked On:	

Emission Source ID Number:	ES-1
Control Device ID Number:	CD-1
Emission Point ID Number:	EP-1
Operating Scenario:	1 of 3
Flare Maximum Heat Input (MMBtu/hr):	50.00
Date of Construction:	10/1/2019

Fuel Type:	Tail Gas, Natural Gas, Product Gas
Tail Gas Production to Flare (scfm):	356.58
Biogas Production to Flare (scfm):	0.00
Supplemental Fuel Usage (scfm):	163.40
Average Fuel Heating Value (Btu/scf):	414.99
Calculated Potential Yearly Fuel Usage (MMscf):	1,055.44
Requested Annual Limitation (MMscf):	273.30
Actual Yearly Fuel Usage (MMscf):	258.95
Calculated Potential Yearly Fuel Usage (MMBtu):	438,000
Limited Potential Yearly Fuel Usage (MMBtu):	113,417
Actual Yearly Fuel Usage (MMBtu):	107,461
Actual Heat Input (MMBtu/hr):	12.95

Daily Hours of Operation:	24
Yearly Hours of Operation:	8,300

Maximum Tail Gas Production and Composition

Tail Gas Constituents	Formula	Tail Gas Composition	Flowrate (scfm)	MW (lb/lbmol)	lb/hr	tons/yr	HHV (Btu/scf)
Methane	CH_4	13.12%	46.80	16.04	125.50	520.83	1,015.00
Carbon Dioxide	CO_2	86.09%	306.99	44.01	2,258.74	9,373.76	0.00
Nitrogen	N_2	0.00%	0.00	28.02	0.00	0.00	1.00
Oxygen	O_2	0.00%	0.00	32.00	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.76%	2.70	34.08	15.38	63.84	587.00
Ammonia	NH_3	0.03%	0.09	17.03	0.26	1.06	359.00
Totals		**100.00%**	**356.58**	**40.26**	**2,399.88**	**9,959.50**	**137.75**

Calculations Page 6

Pilot Gas & Supplemental Fuel	Flowrate (scfm)	MW (lb/lbmol)	lb/hr	MMBtu/hr	HHV (Btu/scf)
Natural Gas	163.40	19.00	519.04	10.00	1,020.00

Biogas Production and Composition to CD-1							
Biogas Constituents	Formula	Biogas Composition	Flowrate (scfm)	MW (lb/lbmol)	lb/hr	tons/yr	HHV (Btu/scf)
Methane	CH_4	65.00%	0.00	16.04	0.00	0.00	1,015.00
Carbon Dioxide	CO_2	34.17%	0.00	44.01	0.00	0.00	0.00
Nitrogen	N_2	0.50%	0.00	28.02	0.00	0.00	1.00
Oxygen	O_2	0.02%	0.00	32.00	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.30%	0.00	34.08	0.00	0.00	587.00
Ammonia	NH_3	0.01%	0.00	17.03	0.00	0.00	359.00
Totals		**100.00%**	**0.00**	**25.71**	**0.00**	**0.00**	**661.55**

Maximum Product Gas Production and Composition							
Product Gas Constituents	Formula	Product Gas Composition	Flowrate (scfm)	MW (lb/lbmol)	lb/hr	tons/yr	HHV (Btu/scf)
Methane	CH_4	99.04%	0.00	16.04	0.00	0.00	1,015.00
Carbon Dioxide	CO_2	0.10%	0.00	44.01	0.00	0.00	0.00
Nitrogen	N_2	0.83%	0.00	28.02	0.00	0.00	1.00
Oxygen	O_2	0.03%	0.00	32.00	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.00%	0.00	34.08	0.00	0.00	587.00
Ammonia	NH_3	0.00%	0.00	17.03	0.00	0.00	359.00
Totals		**100.00%**	**0.00**	**16.17**	**0.00**	**0.00**	**1,005.25**

Notes:
1. The Optima TH facility produces the lowest emissions during normal operation because some product gas is injected into the natural gas pipeline for offsite consumption.
2. Normal operation may occur for more than 8,300 hours per year.
3. Limited potential yearly fuel usage was calculated using 8,760 operating hours per year.
4. Actual yearly fuel usage was calculated using 8,300 operating hours per year.

Normal Operation
Emissions Calculator Output - Criteria Pollutants

Criteria Air Pollutant Mass Balances

Gas Constituent	MW (lb/lbmol)	Maximum Flowrate (scfm)	Maximum Molar Q (lbmol/hr)	Destruction Efficiency
Hydrogen Sulfide	34.08	2.70	0.45	98.00%
Nitrogen	28.02	0.00	0.00	98.00%
Ammonia	17.03	0.09	0.02	98.00%
Methane	16.04	46.80	7.82	98.00%

Air Pollutant Emitted	Formula	MW (lb/lbmol)
Sulfur Dioxide	SO_2	64.06
Nitric Oxide	NO	30.01
Nitrogen Dioxide	NO_2	46.01
Ammonia	NH_3	17.03
Methane	CH_4	16.04
Hydrogen Sulfide	H_2S	34.08

	Actual Emissions (After Controls/Limits)		Potential Emissions (Before Controls/Limits)		Potential Emissions (After Controls/Limits)	
Air Pollutant Emitted	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
Sulfur Dioxide	28.34	117.60	28.34	124.12	28.34	124.12
Nitric Oxide	0.40	1.65	0.40	1.74	0.40	1.74
Nitrogen Dioxide	0.07	0.28	0.07	0.30	0.07	0.30
Ammonia	0.01	0.02	0.01	0.02	0.01	0.02
Methane	2.51	10.42	2.51	10.99	2.51	10.99
Hydrogen Sulfide	0.31	1.28	0.31	1.35	0.31	1.35

Criteria Air Pollutant Emissions

	Actual Emissions (After Controls/Limits)		Potential Emissions (Before Controls/Limits)		Potential Emissions (After Controls/Limits)		Emission Factor
Air Pollutant Emitted	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/MMBtu
PM (Total)	0.02	0.07	0.02	0.07	0.02	0.07	1.25E-03
PM (Filterable)	0.01	0.03	0.01	0.03	0.01	0.03	4.82E-04
PM (Condensable)	0.01	0.04	0.01	0.04	0.01	0.04	7.71E-04
PM 2.5 (Total)	0.01	0.06	0.01	0.06	0.01	0.06	1.04E-03
PM 2.5 (Filterable)	0.00	0.01	0.00	0.02	0.00	0.02	2.65E-04
Sulfur Dioxide (SO_2)	28.36	117.68	28.36	124.20	28.36	124.20	1.45E-03
Nitrogen Oxides (NO_x)	1.35	5.59	1.35	5.90	1.35	5.90	6.80E-02
Carbon Monoxide (CO)	4.01	16.66	4.01	17.58	4.01	17.58	3.10E-01
VOCs	0.17	0.71	0.17	0.75	0.17	0.75	1.33E-02

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Notes:

1. Emission rates from criteria air pollutant mass balances were added to emission rates derived from emission factors and the maximum flare heat input in MMBtu/hr listed in the calculator input.
2. Potential Emissions (Before Controls/Limits): Calculated with no controls or limitations and 8,760 operating hours per year.
3. Potential Emissions (After Controls/Limits): Calculated using the limited yearly potential fuel usage listed in the calculator input and 8,760 operating hours per year.
4. Actual Emissions (After Controls/Limits): Calculated using the actual yearly fuel usage listed in the calculator input and 8,300 operating hours per year.

Normal Operation
Emissions Calculator Output - HAPs and TAPs

Toxic / Hazardous Air Pollutant Emissions

		Actual Emissions (After Controls/Limits)		Potential Emissions (Before Controls/Limits)		Potential Emissions (After Controls/Limits)		Emission Factor
Toxic / Hazardous Air Pollutant	CAS Number	lb/hr	lb/yr	lb/hr	lb/yr	lb/hr	lb/yr	lb/MMBtu
Acetaldehyde (TH)	75070	4.74E-07	3.94E-03	4.74E-07	4.15E-03	4.74E-07	4.15E-03	3.66E-08
Acrolein (TH)	107028	5.62E-07	4.66E-03	5.62E-07	4.92E-03	5.62E-07	4.92E-03	4.34E-08
Ammonia (T)	7664417	1.05E-01	8.71E+02	1.05E-01	9.19E+02	1.05E-01	9.19E+02	7.71E-03
Arsenic unlisted compounds (TH)	ASC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene (TH)	71432	6.55E-05	5.44E-01	6.55E-05	5.74E-01	6.55E-05	5.74E-01	5.06E-06
Benzo(a)pyrene (TH)	50328	3.74E-08	3.11E-04	3.74E-08	3.28E-04	3.74E-08	3.28E-04	2.89E-09
Beryllium metal (unreacted) (TH)	7440417	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium metal (elemental unreacted) (TH)	7440439	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chromic acid (VI) (TH)	7738945	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cobalt unlisted compounds (H)	COC-other	2.62E-06	2.18E-02	2.62E-06	2.30E-02	2.62E-06	2.30E-02	2.02E-07
Formaldehyde (TH)	50000	2.34E-03	1.94E+01	2.34E-03	2.05E+01	2.34E-03	2.05E+01	1.81E-04
Hexane, n- (TH)	110543	5.62E-02	4.66E+02	5.62E-02	4.92E+02	5.62E-02	4.92E+02	4.34E-03
Lead unlisted compounds (H)	PBC-other	1.56E-05	1.29E-01	1.56E-05	1.37E-01	1.56E-05	1.37E-01	1.20E-06
Manganese unlisted compounds (TH)	MNC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury vapor (TH)	7439976	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Napthalene (H)	91203	1.90E-05	1.58E-01	1.90E-05	1.67E-01	1.90E-05	1.67E-01	1.47E-06
Nickel metal (TH)	7440020	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Selenium compounds (H)	SEC	7.49E-07	6.21E-03	7.49E-07	6.56E-03	7.49E-07	6.56E-03	5.78E-08
Toluene (TH)	108883	1.06E-04	8.80E-01	1.06E-04	9.29E-01	1.06E-04	9.29E-01	8.19E-06
Total HAPs		5.87E-02	4.87E+02	5.87E-02	5.14E+02	5.87E-02	5.14E+02	4.53E-03
Highest HAP	110543	5.62E-02	4.66E+02	5.62E-02	4.92E+02	5.62E-02	4.92E+02	4.34E-03

Toxic Air Pollutant Emissions

		Expected Actual Emissions After Controls / Limitations			Emission Factor
Toxic Air Pollutant	CAS Number	lb/hr	lb/day	lb/yr	lb/MMBtu
Acetaldehyde (TH)	75070	4.74E-07	1.14E-05	3.94E-03	3.66E-08
Acrolein (TH)	107028	5.62E-07	1.35E-05	4.66E-03	4.34E-08
Ammonia (T)	7664417	1.05E-01	2.52E+00	8.71E+02	7.71E-03
Arsenic unlisted compounds (TH)	ASC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene (TH)	71432	6.55E-05	1.57E-03	5.44E-01	5.06E-06
Benzo(a)pyrene (TH)	50328	3.74E-08	8.99E-07	3.11E-04	2.89E-09
Beryllium metal (unreacted) (TH)	7440417	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium metal (elemental unreacted) (TH)	7440439	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Soluble chromate compounds, as chromium (VI) equivalent	7738945	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Formaldehyde (TH)	50000	2.34E-03	5.62E-02	1.94E+01	1.81E-04
Hexane, n- (TH)	110543	5.62E-02	1.35E+00	4.66E+02	4.34E-03
Hydrogen Sulfide	7783064	3.08E-01	7.38E+00	2.55E+03	
Manganese unlisted compounds (TH)	MNC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury vapor (TH)	7439976	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nickel metal (TH)	7440020	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene (TH)	108883	1.06E-04	2.55E-03	8.80E-01	8.19E-06

Normal Operation
Emissions Calculator Output - Greenhouse Gas (GHG) Emissions

Greenhouse Gas Emissions Calculations Inputs

Carbon Dioxide (CO_2) Emissions from Fuel Source (lb/hr):	2,258.74
Methane (CH_4) Emissions from Fuel Source Combustion Inefficiency (lb/hr):	2.51
Carbon Dioxide (CO_2) Emissions from Fuel Source (kg/hr):	1024.54
Methane (CH_4) Emissions from Fuel Source Combustion Inefficiency (kg/hr):	1.14
Calculated Fuel Heating Value (Btu/scf):	414.99
Calculated Potential Yearly Fuel Usage (MMscf):	1,055.44
Requested Annual Limitation Fuel Usage (MMscf):	273.30
Actual Yearly Fuel Usage (MMscf):	258.95
Calculated Potential Yearly Fuel Usage (MMBtu):	438,000
Limited Potential Yearly Fuel Usage (MMBtu):	113,417
Actual Yearly Fuel Usage (MMBtu):	107,461

Carbon Dioxide (CO_2) Emission Factor (kg/MMBtu):	53.02
Methane (CH_4) Emission Factor (kg/MMBtu):	0.001
Nitrous Oxide (N_2O) Emission Factor (kg/MMBtu):	0.0001
Carbon Dioxide (CO_2) Global Warming Potential:	1
Methane (CH_4) Global Warming Potential:	25
Nitrous Oxide (N_2O) Global Warming Potential:	298

Note: Emission factors based on Tables C-1 and C-2 of EPA Mandatory Reporting Rule, 40 CFR Part 98.

Greenhouse Gas Emissions - EPA Mandatory Reporting Rule (MRR) Calculation Method Tier 1

	Actual Emissions (After Controls and Limits)			
GHG Pollutant	metric tons/yr	CO_2e metric tons/yr	short tons/yr	CO_2e short tons/yr
Carbon Dioxide (CO_2)	14,201.29	14,201.29	15,654.23	15,654.23
Methane (CH_4)	9.45	236.24	10.42	260.41
Nitrous Oxide (NO_2)	0.01	3.20	0.01	3.53
Total CO_2e		14,440.74		15,918.17

	Potential Emissions (After Controls and Limits)			
GHG Pollutant	metric tons/yr	CO_2e metric tons/yr	short tons/yr	CO_2e short tons/yr
Carbon Dioxide (CO_2)	14,988.35	14,988.35	16,521.81	16,521.81
Methane (CH_4)	9.97	249.33	10.99	274.84
Nitrous Oxide (NO_2)	0.01	3.38	0.01	3.73
Total CO_2e		15,241.07		16,800.38

	Potential Emissions (Before Controls and Limits)			
GHG Pollutant	metric tons/yr	CO_2e metric tons/yr	short tons/yr	CO_2e short tons/yr
Carbon Dioxide (CO_2)	32,197.74	32,197.74	35,491.89	35,491.89
Methane (CH_4)	9.97	249.33	10.99	274.84
Nitrous Oxide (NO_2)	0.04	13.05	0.05	14.39
Total CO_2e		32,460.13		35,781.12

Notes:
1. Carbon dioxide emission rates calculated as the sum of fuel source cabon dioxide emissions and carbon dioxide emissions resulting from fuel combustion using the emission factor listed above.
2. Methane emission rates calculated based on fuel source and flare combustion inefficiency, not the methane emission factor listed above. Methane emission rates are calculated on the Normal Operation Emissions Calculator Output - Criteria Pollutants page.
3. Potential emissions are calculated using 8,760 operating hours per year. Actual emissions are calculated using the anticipated yearly hours of operation listed on the Calculator Input page.

Biogas to Candlestick Flare
Combustion Emissions Calculator Input

Company Name:	Optima TH, LLC
Facility Name:	Optima TH
Facility ID Number:	900096
Permit Number:	10673R00
Facility City:	Tar Heel, NC
Facility County:	Bladen
Calculations Prepared By:	Ben Cauthen (Cavanaugh & Associates, P.A.)
Calculations Checked By:	
Calculations Prepared On:	7/16/2021
Calculations Checked On:	

Emission Source ID Number:	ES-1
Control Device ID Number:	CD-1
Emission Point ID Number:	EP-1
Operating Scenario:	2 of 3
Flare Maximum Heat Input (MMBtu/hr):	50.00
Date of Construction:	10/1/2019

Fuel Type:	Biogas, Pilot Fuel
Biogas Production to CD-1 (scfm):	0.00
Fuel Heating Value (Btu/scf):	0.00
Calculated Potential Yearly Fuel Usage (MMscf):	0.00
Requested Annual Limitation (MMscf):	0.00
Actual Yearly Fuel Usage (MMscf):	0.00
Calculated Potential Yearly Fuel Usage (MMBtu):	438,000
Limited Potential Yearly Fuel Usage (MMBtu):	0
Actual Yearly Fuel Usage (MMBtu):	0
Actual Heat Input (MMBtu/hr):	0.00

Daily Hours of Operation:	24
Yearly Hours of Operation:	0

Yearly hours of operation are expected to equal 0.

Maximum Biogas Production and Composition to CD-1							
Raw Biogas Constituents	Formula	Biogas Composition	Flowrate (scfm)	MW (lb/lbmol)	lb/hr	tons/yr	HHV (Btu/scf)
Methane	CH_4	65.00%	0.00	16.04	0.00	0.00	1,015.00
Carbon Dioxide	CO_2	34.17%	0.00	44.01	0.00	0.00	0.00
Nitrogen	N_2	0.50%	0.00	28.02	0.00	0.00	1.00
Oxygen	O_2	0.02%	0.00	32.00	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.30%	0.00	34.08	0.00	0.00	587.00
Ammonia	NH_3	0.01%	0.00	17.03	0.00	0.00	359.00
Totals		**100.00%**	**0.00**	**25.71**	**0.00**	**0.00**	**661.55**

Pilot Fuel	Flowrate (scfm)	MW (lb/lbmol)	lb/hr	MMBtu/hr	HHV (Btu/scf)
Natural Gas	0.00	19.00	0.00	0.00	1,020.00

Notes:
1. The Optima TH facility produces greater emissions during biogas combustion in the candlestick flare than Normal Operation because product gas is not injected into the natural gas pipeline for offsite

Biogas to Candlestick Flare
Combustion Emissions Calculator Output - Criteria Pollutants

Criteria Air Pollutant Mass Balances

Biogas Constituent	MW (lb/lbmol)	Average Flowrate (scfm)	Average Molar Q (lbmol/hr)	Destruction Efficiency
Hydrogen Sulfide	34.08	0.00	0.00	98.00%
Nitrogen	28.02	0.00	0.00	98.00%
Ammonia	17.03	0.00	0.00	98.00%
Methane	16.04	0.00	0.00	98.00%

Air Pollutant Emitted	Formula	MW (lb/lbmol)
Sulfur Dioxide	SO_2	64.06
Nitric Oxide	NO	30.01
Nitrogen Dioxide	NO_2	46.01
Ammonia	NH_3	17.03
Methane	CH_4	16.04
Hydrogen Sulfide	H_2S	34.08

	Actual Emissions (After Controls/Limits)		Potential Emissions (Before Controls/Limits)		Potential Emissions (After Controls/Limits)	
Air Pollutant Emitted	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
Sulfur Dioxide	0.00	0.00	0.00	0.00	0.00	0.00
Nitric Oxide	0.00	0.00	0.00	0.00	0.00	0.00
Nitrogen Dioxide	0.00	0.00	0.00	0.00	0.00	0.00
Ammonia	0.00	0.00	0.00	0.00	0.00	0.00
Methane	0.00	0.00	0.00	0.00	0.00	0.00
Hydrogen Sulfide	0.00	0.00	0.00	0.00	0.00	0.00

Criteria Air Pollutant Emissions

	Actual Emissions (After Controls/Limits)		Potential Emissions (Before Controls/Limits)		Potential Emissions (After Controls/Limits)		Emission Factor
Air Pollutant Emitted	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/MMBtu
PM (Total)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00
PM (Filterable)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00
PM (Condensable)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00
PM 2.5 (Total)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00
PM 2.5 (Filterable)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00
Sulfur Dioxide (SO_2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00
Nitrogen Oxides (NO_x)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00
Carbon Monoxide (CO)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00
VOCs	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00

Notes:

1. Emission rates from criteria air pollutant mass balances were added to emission rates derived from emission factors and the maximum flare heat input in MMBtu/hr listed in the calculator input.
2. Potential Emissions (Before Controls/Limits): Calculated with no controls or limitations and 8,760 operating hours per year. Calculated using the potential yearly fuel usage listed in the calculator input.
3. Potential Emissions (After Controls/Limits): Calculated using the limited yearly potential fuel usage listed in the calculator input. Limited potential fuel usage was calculated using 8,760 operating hours per year.
4. Actual Emissions (After Controls/Limits): Calculated using the actual yearly fuel usage listed in the calculator input. Actual yearly fuel usage was calculated using 0 operating hours per year.

Biogas to Candlestick Flare
Combustion Emissions Calculator Output - HAPs and TAPs

Toxic / Hazardous Air Pollutant Emissions

		Actual Emissions (After Controls/Limits)		Potential Emissions (Before Controls/Limits)		Potential Emissions (After Controls/Limits)		Emission Factor
Toxic / Hazardous Air Pollutant	CAS Number	lb/hr	lb/yr	lb/hr	lb/yr	lb/hr	lb/yr	lb/MMBtu
Acetaldehyde (TH)	75070	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acrolein (TH)	107028	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ammonia (T)	7664417	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Arsenic unlisted compounds (TH)	ASC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene (TH)	71432	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(a)pyrene (TH)	50328	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beryllium metal (unreacted) (TH)	7440417	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium metal (elemental unreacted) (TH)	7440439	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chromic acid (VI) (TH)	7738945	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cobalt unlisted compounds (H)	COC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Formaldehyde (TH)	50000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexane, n- (TH)	110543	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Lead unlisted compounds (H)	PBC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Manganese unlisted compounds (TH)	MNC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury vapor (TH)	7439976	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Napthalene (H)	91203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nickel metal (TH)	7440020	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Selenium compounds (H)	SEC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene (TH)	108883	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HAPs		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Highest HAP	110543	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Toxic Air Pollutant Emissions

		Expected Actual Emissions After Controls / Limitations			Emission Factor
Toxic Air Pollutant	CAS Number	lb/hr	lb/day	lb/yr	lb/MMBtu
Acetaldehyde (TH)	75070	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acrolein (TH)	107028	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ammonia (T)	7664417	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Arsenic unlisted compounds (TH)	ASC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene (TH)	71432	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(a)pyrene (TH)	50328	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beryllium metal (unreacted) (TH)	7440417	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium metal (elemental unreacted) (TH)	7440439	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Soluble chromate compounds, as chromium (VI) equivalent	7738945	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Formaldehyde (TH)	50000	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexane, n- (TH)	110543	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrogen Sulfide	7783064	0.00E+00	0.00E+00	0.00E+00	
Manganese unlisted compounds (TH)	MNC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury vapor (TH)	7439976	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nickel metal (TH)	7440020	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene (TH)	108883	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Biogas to Candlestick Flare
Emissions Calculator Output - Greenhouse Gas (GHG) Emissions

Greenhouse Gas Emissions Calculations Inputs

Carbon Dioxide (CO_2) Emissions from Fuel Source (lb/hr):	0.00
Methane (CH_4) Emissions from Fuel Source Combustion Inefficiency (lb/hr):	0.00
Carbon Dioxide (CO_2) Emissions from Fuel Source (kg/hr):	0.00
Methane (CH_4) Emissions from Fuel Source Combustion Inefficiency (kg/hr):	0.00
Calculated Fuel Heating Value (Btu/scf):	0.00
Calculated Potential Yearly Fuel Usage (MMscf):	0.00
Requested Annual Limitation Fuel Usage (MMscf):	0.00
Actual Yearly Fuel Usage (MMscf):	0.00
Calculated Potential Yearly Fuel Usage (MMBtu):	438,000
Limited Potential Yearly Fuel Usage (MMBtu):	0
Actual Yearly Fuel Usage (MMBtu):	0

Carbon Dioxide (CO_2) Emission Factor (kg/MMBtu):	53.02
Methane (CH_4) Emission Factor (kg/MMBtu):	0.001
Nitrous Oxide (N_2O) Emission Factor (kg/MMBtu):	0.0001
Carbon Dioxide (CO_2) Global Warming Potential:	1
Methane (CH_4) Global Warming Potential:	25
Nitrous Oxide (N_2O) Global Warming Potential:	298

Note: Emission factors based on Tables C-1 and C-2 of EPA Mandatory Reporting Rule, 40 CFR Part 98.

Greenhouse Gas Emissions - EPA Mandatory Reporting Rule (MRR) Calculation Method Tier 1

	Actual Emissions (After Controls and Limits)			
GHG Pollutant	metric tons/yr	CO_2e metric tons/yr	short tons/yr	CO_2e short tons/yr
Carbon Dioxide (CO_2)	0.00	0.00	0.00	0.00
Methane (CH_4)	0.00	0.00	0.00	0.00
Nitrous Oxide (NO_2)	0.00	0.00	0.00	0.00
Total CO_2e		0.00		0.00

	Potential Emissions (After Controls and Limits)			
GHG Pollutant	metric tons/yr	CO_2e metric tons/yr	short tons/yr	CO_2e short tons/yr
Carbon Dioxide (CO_2)	0.00	0.00	0.00	0.00
Methane (CH_4)	0.00	0.00	0.00	0.00
Nitrous Oxide (NO_2)	0.00	0.00	0.00	0.00
Total CO_2e		0.00		0.00

	Potential Emissions (Before Controls and Limits)			
GHG Pollutant	metric tons/yr	CO_2e metric tons/yr	short tons/yr	CO_2e short tons/yr
Carbon Dioxide (CO_2)	23,222.76	23,222.76	25,598.68	25,598.68
Methane (CH_4)	0.00	0.00	0.00	0.00
Nitrous Oxide (NO_2)	0.04	13.05	0.05	14.39
Total CO_2e		23,235.81		25,613.07

Notes:
1. Carbon dioxide emission rates calculated as the sum of fuel source cabon dioxide emissions and carbon dioxide emissions resulting from fuel combustion using the emission factor listed above.
2. Methane emission rates calculated based on fuel source and flare combustion inefficiency, not the methane emission factor listed above. Methane emission rates are calculated on the Biogas to Candlestick Flare Combustion Emissions Calculator Output - Criteria Pollutants page.
3. Potential emissions are calculated using 8,760 operating hours per year. Actual emissions are calculated using the anticipated yearly hours of operation listed on the Calculator Input page.

Product Gas to Candlestick Flare
Combustion Emissions Calculator Input

Company Name:	Optima TH, LLC
Facility Name:	Optima TH
Facility ID Number:	900096
Permit Number:	10673R00
Facility City:	Tar Heel, NC
Facility County:	Bladen
Calculations Prepared By:	Ben Cauthen (Cavanaugh & Associates, P.A.)
Calculations Checked By:	
Calculations Prepared On:	7/16/2021
Calculations Checked On:	

Emission Source ID Number:	ES-1
Control Device ID Number:	CD-1
Emission Point ID Number:	EP-1
Operating Scenario:	3 of 3
Flare Maximum Heat Input (MMBtu/hr):	50.00
Date of Construction:	10/1/2019

Fuel Type:	Product Gas, Tail Gas, Pilot Fuel
Product Gas Production to Flare (scfm):	543.42
Tail Gas Production to Flare (scfm):	356.58
Biogas Production to Flare (scfm):	0.00
Fuel Heating Value (Btu/scf):	662.20
Calculated Potential Yearly Fuel Usage (MMscf):	661.43
Requested Annual Limitation (MMscf):	473.90
Actual Yearly Fuel Usage (MMscf):	24.89
Calculated Potential Yearly Fuel Usage (MMBtu):	438,000
Limited Potential Yearly Fuel Usage (MMBtu):	313,817
Actual Yearly Fuel Usage (MMBtu):	16,479
Actual Heat Input (MMBtu/hr):	35.82

Daily Hours of Operation:	24
Yearly Hours of Operation:	460

Maximum Product Gas Production and Composition

Product Gas Constituents	Formula	Product Gas Composition	Flowrate (scfm)	MW (lb/lbmol)	lb/hr	tons/yr	HHV (Btu/scf)
Methane	CH_4	99.04%	538.20	16.04	1,443.26	331.95	1,015.00
Carbon Dioxide	CO_2	0.10%	0.54	44.01	4.00	0.92	0.00
Nitrogen	N_2	0.83%	4.50	28.02	21.08	4.85	1.00
Oxygen	O_2	0.03%	0.18	32.00	0.96	0.22	0.00
Hydrogen Sulfide	H_2S	0.00%	0.00	34.08	0.00	0.00	587.00
Ammonia	NH_3	0.00%	0.00	17.03	0.00	0.00	359.00
Totals		**100.00%**	**543.42**	**16.17**	**1,469.30**	**337.94**	**1,005.25**

Pilot Fuel	Flowrate (scfm)	MW (lb/lbmol)	lb/hr	MMBtu/hr	HHV (Btu/scf)
Natural Gas	1.63	19.00	5.19	0.10	1,020.00

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Maximum Tail Gas Production and Composition							
Tail Gas Constituents	Formula	Tail Gas Composition	Flowrate (scfm)	MW (lb/lbmol)	lb/hr	tons/yr	HHV (Btu/scf)
Methane	CH_4	13.12%	46.80	16.04	125.50	28.87	1,015.00
Carbon Dioxide	CO_2	86.09%	306.99	44.01	2,258.74	519.51	0.00
Nitrogen	N_2	0.00%	0.00	28.02	0.00	0.00	1.00
Oxygen	O_2	0.00%	0.00	32.00	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.76%	2.70	34.08	15.38	3.54	587.00
Ammonia	NH_3	0.03%	0.09	17.03	0.26	0.06	359.00
Totals		**100.00%**	**356.58**	**40.26**	**2,399.88**	**551.97**	**137.75**

Biogas Production and Composition to CD-1							
Biogas Constituents	Formula	Biogas Composition	Flowrate (scfm)	MW (lb/lbmol)	lb/hr	tons/yr	HHV (Btu/scf)
Methane	CH_4	65.00%	0.00	16.04	0.00	0.00	1,015.00
Carbon Dioxide	CO_2	34.17%	0.00	44.01	0.00	0.00	0.00
Nitrogen	N_2	0.50%	0.00	28.02	0.00	0.00	1.00
Oxygen	O_2	0.02%	0.00	32.00	0.00	0.00	0.00
Hydrogen Sulfide	H_2S	0.30%	0.00	34.08	0.00	0.00	587.00
Ammonia	NH_3	0.01%	0.00	17.03	0.00	0.00	359.00
Totals		**100.00%**	**0.00**	**25.71**	**0.00**	**0.00**	**661.55**

Notes:

1. During startup and irregular operation, the Optima TH facility may combust all product gas onsite in the candlestick flare instead of injecting it into the natural gas pipeline.
2. Emissions from product gas combustion in the candlestick flare are greater than emissions from normal operation because all product gas is combusted onsite instead of being used offsite.

Product Gas to Candlestick Flare
Combustion Emissions Calculator Output - Criteria Pollutants

Criteria Air Pollutant Mass Balances

Gas Constituent	MW (lb/lbmol)	Average Flowrate (scfm)	Average Molar Q (lbmol/hr)	Destruction Efficiency
Hydrogen Sulfide	34.08	2.70	0.45	98.00%
Nitrogen	28.02	4.50	0.75	98.00%
Ammonia	17.03	0.09	0.02	98.00%
Methane	16.04	585.00	97.80	98.00%

Air Pollutant Emitted	Formula	MW (lb/lbmol)
Sulfur Dioxide	SO_2	64.06
Nitric Oxide	NO	30.01
Nitrogen Dioxide	NO_2	46.01
Ammonia	NH_3	17.03
Methane	CH_4	16.04
Hydrogen Sulfide	H_2S	34.08

	Actual Emissions (After Controls/Limits)		Potential Emissions (Before Controls/Limits)		Potential Emissions (After Controls/Limits)	
Air Pollutant Emitted	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
Sulfur Dioxide	28.34	6.52	28.34	124.12	28.34	124.12
Nitric Oxide	0.40	0.09	0.40	1.74	0.40	1.74
Nitrogen Dioxide	0.07	0.02	0.07	0.30	0.07	0.30
Ammonia	0.01	0.00	0.01	0.02	0.01	0.02
Methane	31.38	7.22	31.38	137.42	31.38	137.42
Hydrogen Sulfide	0.31	0.07	0.31	1.35	0.31	1.35

Criteria Air Pollutant Emissions

	Actual Emissions (After Controls/Limits)		Potential Emissions (Before Controls/Limits)		Potential Emissions (After Controls/Limits)		Emission Factor
Air Pollutant Emitted	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/MMBtu
PM (Total)	0.04	0.01	0.04	0.17	0.04	0.12	7.85E-04
PM (Filterable)	0.02	0.00	0.02	0.07	0.02	0.05	3.02E-04
PM (Condensable)	0.02	0.00	0.02	0.11	0.02	0.08	4.83E-04
PM 2.5 (Total)	0.03	0.01	0.03	0.14	0.03	0.10	6.49E-04
PM 2.5 (Filterable)	0.01	0.00	0.01	0.04	0.01	0.03	1.66E-04
Sulfur Dioxide (SO_2)	28.38	6.53	28.38	124.32	28.38	124.26	9.06E-04
Nitrogen Oxides (NO_x)	3.87	0.67	3.87	16.93	3.87	12.71	6.80E-02
Carbon Monoxide (CO)	15.50	2.55	15.50	67.89	15.50	48.64	3.10E-01
VOCs	0.42	0.07	0.42	1.82	0.42	1.30	8.31E-03

Notes:

1. Emission rates from criteria air pollutant mass balances were added to emission rates derived from emission factors and the maximum flare heat input in MMBtu/hr listed in the calculator input.
2. Potential Emissions (Before Controls/Limits): Calculated with no controls or limitations and 8,760 operating hours per year.
3. Potential Emissions (After Controls/Limits): Calculated using the limited yearly potential fuel usage listed in the calculator input. Limited potential fuel usage was calculated using 8,760 operating hours per year.
4. Actual Emissions (After Controls/Limits): Calculated using the actual yearly fuel usage listed in the calculator input. Actual yearly fuel usage was calculated using 460 operating hours per year.

Product Gas to Candlestick Flare
Combustion Emissions Calculator Output - HAPs and TAPs

Toxic / Hazardous Air Pollutant Emissions

		Actual Emissions (After Controls/Limits)		Potential Emissions (Before Controls/Limits)		Potential Emissions (After Controls/Limits)		Emission Factor
Toxic / Hazardous Air Pollutant	CAS Number	lb/hr	lb/yr	lb/hr	lb/yr	lb/hr	lb/yr	lb/MMBtu
Acetaldehyde (TH)	75070	1.15E-06	3.78E-04	1.15E-06	1.01E-02	1.15E-06	7.20E-03	2.30E-08
Acrolein (TH)	107028	1.36E-06	4.48E-04	1.36E-06	1.19E-02	1.36E-06	8.53E-03	2.72E-08
Ammonia (T)	7664417	2.52E-01	8.20E+01	2.47E-01	2.16E+03	2.52E-01	1.56E+03	4.83E-03
Arsenic unlisted compounds (TH)	ASC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene (TH)	71432	1.59E-04	5.23E-02	1.59E-04	1.39E+00	1.59E-04	9.95E-01	3.17E-06
Benzo(a)pyrene (TH)	50328	9.06E-08	2.99E-05	9.06E-08	7.94E-04	9.06E-08	5.69E-04	1.81E-09
Beryllium metal (unreacted) (TH)	7440417	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium metal (elemental unreacted) (TH)	7440439	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chromic acid (VI) (TH)	7738945	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cobalt unlisted compounds (H)	COC-other	6.34E-06	2.09E-03	6.34E-06	5.56E-02	6.34E-06	3.98E-02	1.27E-07
Formaldehyde (TH)	50000	5.66E-03	1.87E+00	5.66E-03	4.96E+01	5.66E-03	3.55E+01	1.13E-04
Hexane, n- (TH)	110543	1.36E-01	4.48E+01	1.36E-01	1.19E+03	1.36E-01	8.53E+02	2.72E-03
Lead unlisted compounds (H)	PBC-other	3.78E-05	1.24E-02	3.78E-05	3.31E-01	3.78E-05	2.37E-01	7.55E-07
Manganese unlisted compounds (TH)	MNC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury vapor (TH)	7439976	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Napthalene (H)	91203	4.61E-05	1.52E-02	4.61E-05	4.03E-01	4.61E-05	2.89E-01	9.21E-07
Nickel metal (TH)	7440020	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Selenium compounds (H)	SEC	1.81E-06	5.97E-04	1.81E-06	1.59E-02	1.81E-06	1.14E-02	3.62E-08
Toluene (TH)	108883	2.57E-04	8.46E-02	2.57E-04	2.25E+00	2.57E-04	1.61E+00	5.13E-06
Total HAPs		1.42E-01	4.68E+01	1.42E-01	1.24E+03	1.42E-01	8.92E+02	2.84E-03
Highest HAP	110543	1.36E-01	4.48E+01	1.36E-01	1.19E+03	1.36E-01	8.53E+02	2.72E-03

Toxic Air Pollutant Emissions

		Expected Actual Emissions After Controls / Limitations			Emission Factor
Toxic Air Pollutant	CAS Number	lb/hr	lb/day	lb/yr	lb/MMBtu
Acetaldehyde (TH)	75070	1.15E-06	2.75E-05	3.78E-04	2.30E-08
Acrolein (TH)	107028	1.36E-06	3.26E-05	4.48E-04	2.72E-08
Ammonia (T)	7664417	2.52E-01	5.92E+00	8.20E+01	4.83E-03
Arsenic unlisted compounds (TH)	ASC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene (TH)	71432	1.59E-04	3.81E-03	5.23E-02	3.17E-06
Benzo(a)pyrene (TH)	50328	9.06E-08	2.17E-06	2.99E-05	1.81E-09
Beryllium metal (unreacted) (TH)	7440417	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium metal (elemental unreacted) (TH)	7440439	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Soluble chromate compounds, as chromium (VI) equivalent	7738945	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Formaldehyde (TH)	50000	5.66E-03	1.36E-01	1.87E+00	1.13E-04
Hexane, n- (TH)	110543	1.36E-01	3.26E+00	4.48E+01	2.72E-03
Hydrogen Sulfide	7783064	3.08E-01	7.38E+00	1.42E+02	
Manganese unlisted compounds (TH)	MNC-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury vapor (TH)	7439976	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nickel metal (TH)	7440020	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene (TH)	108883	2.57E-04	6.16E-03	8.46E-02	5.13E-06

Product Gas to Candlestick Flare
Emissions Calculator Output - Greenhouse Gas (GHG) Emissions

Greenhouse Gas Emissions Calculations Inputs

Carbon Dioxide (CO_2) Emissions from Fuel Source (lb/hr):	2,262.74
Methane (CH_4) Emissions from Fuel Source Combustion Inefficiency (lb/hr):	31.38
Carbon Dioxide (CO_2) Emissions from Fuel Source (kg/hr):	1026.35
Methane (CH_4) Emissions from Fuel Source Combustion Inefficiency (kg/hr):	14.23
Calculated Fuel Heating Value (Btu/scf):	662.20
Calculated Potential Yearly Fuel Usage (MMscf):	661.43
Requested Annual Limitation Fuel Usage (MMscf):	473.90
Actual Yearly Fuel Usage (MMscf):	24.89
Calculated Potential Yearly Fuel Usage (MMBtu):	438,000
Limited Potential Yearly Fuel Usage (MMBtu):	313,817
Actual Yearly Fuel Usage (MMBtu):	16,479

Carbon Dioxide (CO_2) Emission Factor (kg/MMBtu):	53.02
Methane (CH_4) Emission Factor (kg/MMBtu):	0.001
Nitrous Oxide (N_2O) Emission Factor (kg/MMBtu):	0.0001
Carbon Dioxide (CO_2) Global Warming Potential:	1
Methane (CH_4) Global Warming Potential:	25
Nitrous Oxide (N_2O) Global Warming Potential:	298

Note: Emission factors based on Tables C-1 and C-2 of EPA Mandatory Reporting Rule, 40 CFR Part 98.

Greenhouse Gas Emissions - EPA Mandatory Reporting Rule (MRR) Calculation Method Tier 1

	Actual Emissions (After Controls and Limits)			
GHG Pollutant	metric tons/yr	CO_2e metric tons/yr	short tons/yr	CO_2e short tons/yr
Carbon Dioxide (CO_2)	1,345.84	1,345.84	1,483.53	1,483.53
Methane (CH_4)	6.55	163.66	7.22	180.41
Nitrous Oxide (NO_2)	0.00	0.49	0.00	0.54
Total CO_2e		1,509.99		1,664.48

	Potential Emissions (After Controls and Limits)			
GHG Pollutant	metric tons/yr	CO_2e metric tons/yr	short tons/yr	CO_2e short tons/yr
Carbon Dioxide (CO_2)	25,629.42	25,629.42	28,251.56	28,251.56
Methane (CH_4)	124.67	3,116.69	137.42	3,435.55
Nitrous Oxide (NO_2)	0.03	9.35	0.03	10.31
Total CO_2e		28,755.46		31,697.43

	Potential Emissions (Before Controls and Limits)			
GHG Pollutant	metric tons/yr	CO_2e metric tons/yr	short tons/yr	CO_2e short tons/yr
Carbon Dioxide (CO_2)	32,213.63	32,213.63	35,509.40	35,509.40
Methane (CH_4)	124.67	3,116.69	137.42	3,435.55
Nitrous Oxide (NO_2)	0.04	13.05	0.05	14.39
Total CO_2e		35,343.37		38,959.34

Notes:
1. Carbon dioxide emission rates calculated as the sum of fuel source cabon dioxide emissions and carbon dioxide emissions resulting from fuel combustion using the emission factor listed above.
2. Methane emission rates calculated based on fuel source and flare combustion inefficiency, not the methane emission factor listed above. Methane emission rates are calculated on the Product Gas to Candlestick Flare Combustion Emissions Calculator Output - Criteria Pollutants page.
3. Potential emissions are calculated using 8,760 operating hours per year. Actual emissions are calculated using the anticipated yearly hours of operation listed on the Calculator Input page.

Calculations Page 20

Emission Factors for Tail Gas, Product Gas, and Biogas Combustion

Criteria Pollutants	
Pollutant	Uncontrolled (lb/MMscf)
PM (Total)	0.52
PM (Filterable)	0.20
PM (Condensable)	0.32
PM 2.5 (Total)	0.43
PM 2.5 (Filterable)	0.11
Sulfur Dioxide (SO_2)	0.60
VOCs	5.50
Pollutant	Uncontrolled (lb/MMBtu)
Nitrogen Oxides (NO_x)	0.07
Carbon Monoxide (CO)	0.31

HAPs / TAPs	
Pollutant	Uncontrolled (lb/MMscf)
Acetaldehyde (H,T)	1.52E-05
Acrolein (H,T)	1.80E-05
Ammonia (T)	3.20E+00
Arsenic (H,T)	2.00E-04
Benzene (H,T)	2.10E-03
Benzo(a)pyrene (H,T)	1.20E-06
Beryllium (H,T)	1.20E-05
Cadmium (H,T)	1.10E-03
Chromium (VI) (H,T)	1.40E-03
Cobalt (H)	8.40E-05
Formaldehyde (H,T)	7.50E-02
n-Hexane (H,T)	1.80E+00
Lead (H)	5.00E-04
Manganese (H,T)	3.80E-04
Mercury (H,T)	2.60E-04
Napthalene (H)	6.10E-04
Nickel (H,T)	2.10E-03
Selenium (H)	2.40E-05
Toluene (H,T)	3.40E-03

Notes:
1. Emission factors for PM, SO_2, and VOCs were obtained from AP-42 Section 1.4.
2. Emission factors for NO_x and CO were obtained from AP-42 Section 13.5.

15A NCAC Applicability Calculations

Control of Toxic Air Pollutants (15A NCAC 02D .1100)	
Maximum H_2S Emission Rate from Candlestick Flare During Normal Operation	
Potential H_2S Emission Rate With Controls/Limits for Candlestick Flare During Normal Operation (lb/hr):	0.31
Daily Hours of Operation for Candlestick Flare During Normal Operation:	24
H_2S Emission Rate from Candlestick Flare During Normal Operation (lb/day):	7.38
Maximum H_2S Emission Rate from Candlestick Flare During Off-Spec Operation	
Potential H_2S Emission Rate With Controls/Limits for Candlestick Flare During Off-Spec Operation (lb/hr):	0.31
Daily Hours of Operation for Candlestick Flare During Off-Spec Operation:	24
H_2S Emission Rate from Candlestick Flare During Off-Spec Operation (lb/day):	7.38

Notes:

1. The potential hydrogen sulfide emission rate for the candlestick flare normal operation listed above was calculated using the maximum expected biogas production of 900 scfm and a flare destruction efficiency of 98%. Emissions were calculated using the Normal Operation Emissions Calculator and the Limited Potential Yearly Fuel Usage.
2. The potential hydrogen sulfide emission rate for the candlestick flare during irregular operation listed above was calculated using the the maximum expected biogas production of 900 scfm and a flare destruction efficiency of 98%. Emissions were calculated using the Product Gas to Candlestick Flare Emissions Calculator and the Limited Potential Yearly Fuel Usage.

Sulfur Dioxide Emissions from Combustion Sources (15A NCAC 02D .0516)	
Maximum SO_2 Emissions per MMBtu Input from Candlestick Flare Normal Operation	
Potential SO_2 Emission Rate With Controls/Limits from Candlestick Flare During Normal Operation (lb/hr):	28.36
Actual Heat Input for Candlestick Flare During Normal Operation (MMBtu/hr):	12.95
SO_2 Emissions per Million Btu Input (lb/MMBtu):	2.19
Maximum SO_2 Emissions per MMBtu Input from Candlestick Flare Off-Spec Operation	
Potential SO_2 Emission Rate With Controls/Limits from Candlestick Flare During Irregular Operation (lb/hr):	28.38
Actual Heat Input for Candlestick Flare During Irregular Operation (MMBtu/hr):	35.82
SO_2 Emissions per Million Btu Input (lb/MMBtu):	0.79

Notes:

1. The potential sulfur dioxide emission rate for the candlestick flare normal operation listed above was calculated using the maximum expected biogas production of 900 scfm. Emissions were calculated using the Normal Operation Emissions Calculator and the Limited Potential Yearly Fuel Usage.
2. The potential sulfur dioxide emission rate for the candlestick flare during irregular operation listed above was calculated using the the maximum expected biogas production of 900 scfm. Emissions were calculated using the Product Gas to Candlestick Flare Emissions Calculator and the Limited Potential Yearly Fuel Usage.

FORM D1

FACILITY-WIDE EMISSIONS SUMMARY

REVISED 09/22/16 **NCDEQ/Division of Air Quality - Application for Air Permit to Construct/Operate** **D1**

CRITERIA AIR POLLUTANT EMISSIONS INFORMATION - FACILITY-WIDE

	EXPECTED ACTUAL EMISSIONS (AFTER CONTROLS / LIMITATIONS)	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITATIONS)	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITATIONS)
AIR POLLUTANT EMITTED	tons/yr	tons/yr	tons/yr
PARTICULATE MATTER (PM)	0.07	0.17	0.12
PARTICULATE MATTER < 10 MICRONS (PM_{10})	0.07	0.17	0.12
PARTICULATE MATTER < 2.5 MICRONS ($PM_{2.5}$)	0.06	0.14	0.10
SULFUR DIOXIDE (SO_2)	124.21	124.32	124.26
NITROGEN OXIDES (NOx)	6.26	16.93	12.71
CARBON MONOXIDE (CO)	19.21	67.89	48.64
VOLATILE ORGANIC COMPOUNDS (VOC)	0.78	1.82	1.30
LEAD			
GREENHOUSE GASES (GHG) (SHORT TONS)	17,583	38,959	31,697
OTHER			

HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION - FACILITY-WIDE

		EXPECTED ACTUAL EMISSIONS (AFTER CONTROLS / LIMITATIONS)	POTENTIAL EMISSIONS (BEFORE CONTROLS / LIMITATIONS)	POTENTIAL EMISSIONS (AFTER CONTROLS / LIMITATIONS)
HAZARDOUS AIR POLLUTANT EMITTED	CAS NO.	tons/yr	tons/yr	tons/yr
Acetaldehyde (TH)	75070	2.16E-06	5.03E-06	3.60E-06
Acrolein (TH)	107028	2.55E-06	5.95E-06	4.27E-06
Ammonia (T)	7664417	4.77E-01	1.08E+00	7.81E-01
Arsenic unlisted compounds (TH)	ASC-other	0.00E+00	0.00E+00	0.00E+00
Benzene (TH)	71432	2.98E-04	6.95E-04	4.98E-04
Benzo(a)pyrene (TH)	50328	1.70E-07	3.97E-07	2.84E-07
Beryllium metal (unreacted) (TH)	7440417	0.00E+00	0.00E+00	0.00E+00
Cadmium metal (elemental unreacted) (TH)	7440439	0.00E+00	0.00E+00	0.00E+00
Chromic acid (VI) (TH)	7738945	0.00E+00	0.00E+00	0.00E+00
Cobalt unlisted compounds (H)	COC-other	1.19E-05	2.78E-05	1.99E-05
Formaldehyde (TH)	50000	1.06E-02	2.48E-02	1.78E-02
Hexane, n- (TH)	110543	2.55E-01	5.95E-01	4.27E-01
Lead unlisted compounds (H)	PBC-other	7.10E-05	1.65E-04	1.18E-04
Manganese unlisted compounds (TH)	MNC-other	0.00E+00	0.00E+00	0.00E+00
Mercury vapor (TH)	7439976	0.00E+00	0.00E+00	0.00E+00
Napthalene (H)	91203	8.66E-05	2.02E-04	1.45E-04
Nickel metal (TH)	7440020	0.00E+00	0.00E+00	0.00E+00
Selenium compounds (H)	SEC	3.41E-06	7.94E-06	5.69E-06
Toluene (TH)	108883	4.83E-04	1.12E-03	8.06E-04
Total HAPs		2.67E-01	6.22E-01	4.46E-01
Highest HAP	110543	2.55E-01	5.95E-01	4.27E-01

TOXIC AIR POLLUTANT EMISSIONS INFORMATION - FACILITY-WIDE

INDICATE REQUESTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS. EMISSIONS ABOVE THE TOXIC PERMIT EMISSION RATE (TPER) IN 15A NCAC 2Q .0711 MAY REQUIRE AIR DISPERSION MODELING. USE NETTING FORM D2 IF NECESSARY.

					Modeling Required ?	
TOXIC AIR POLLUTANT EMITTED	CAS NO.	lb/hr	lb/day	lb/year	Yes	No
Acetaldehyde (TH)	75070	1.15E-06	2.75E-05	4.31E-03		X
Acrolein (TH)	107028	1.36E-06	3.26E-05	5.11E-03		X
Ammonia (T)	7664417	2.52E-01	5.92E+00	9.53E+02		X
Arsenic unlisted compounds (TH)	ASC-other	0.00E+00	0.00E+00	0.00E+00		X
Benzene (TH)	71432	1.59E-04	3.81E-03	5.96E-01		X
Benzo(a)pyrene (TH)	50328	9.06E-08	2.17E-06	3.41E-04		X
Beryllium metal (unreacted) (TH)	7440417	0.00E+00	0.00E+00	0.00E+00		X
Cadmium metal (elemental unreacted) (TH)	7440439	0.00E+00	0.00E+00	0.00E+00		X
Soluble chromate compounds, as chromium (VI) equival	7738945	0.00E+00	0.00E+00	0.00E+00		X
Formaldehyde (TH)	50000	5.66E-03	1.36E-01	2.13E+01		X
Hexane, n- (TH)	110543	1.36E-01	3.26E+00	5.11E+02		X
Hydrogen Sulfide	7783064	3.08E-01	7.38E+00	2.70E+03	X	
Manganese unlisted compounds (TH)	MNC-other	0.00E+00	0.00E+00	0.00E+00		X
Mercury vapor (TH)	7439976	0.00E+00	0.00E+00	0.00E+00		X
Nickel metal (TH)	7440020	0.00E+00	0.00E+00	0.00E+00		X
Toluene (TH)	108883	2.57E-04	6.16E-03	9.65E-01		X

COMMENTS: The hourly and daily emission rates for the Expected Actual Emissions listed above were calculated for normal operation using the Normal Operation Emissions Calculator. The annual emission rates for the Expected Actual Emissions listed above were calculated for normal operation plus the expected duration of biogas and product gas combustion in the candlestick flare.

Attach Additional Sheets As Necessary