ASRC ENERGY SERVICES
Alaska, Inc.

Alaska Methane Hydrate Project

Application for an Owner Requested Limit

Prepared for:

ASRC Energy Services Alaska, Inc.

May 2022

BOREAL

Alaska Methane Hydrate Project
Application for an Owner Requested Limit

Prepared for:

ASRC Energy Services Alaska, Inc.

3900 C Street, Suite 700
Anchorage, AK 99503

Prepared by:

Boreal Environmental Services

4300 B Street, Suite 510
Anchorage, AK 99503

Owner Requested Limit Application Elements

Requirement	Regulatory Citation	Application Section
Completed Stationary Source ID Form	18 AAC 50.225(b)(1)	SSID Form
List of all emissions units at the stationary source	18 AAC 50.225(b)(2)	Attachment A
Calculations of the stationary source's actual emissions and PTE air pollutants	18 AAC 50.225(b)(3)	Attachment A
Descriptions of each proposed limit, including for each air pollutant a calculation of the effect the limit will have on the stationary source's PTE and allowable emissions	18 AAC 50.225(b)(4)	Attachment A and Attachment B
Descriptions of a verifiable method to attain and maintain each limit, including monitoring and recordkeeping requirements	18 AAC 50.225(b)(5)	Attachment B
Citation to each requirement that the person seeks to avoid, including an explanation of why the requirement would apply in the absence of the limit and how the limit allows the person to avoid the requirement	18 AAC 50.225(b)(6)	Attachment A and Attachment B
A statement that the owner or operator of the stationary source will be able to comply with each limit	18 AAC 50.225(b)(8)	Attachment B
Signed, certification statement	18 AAC 50.225(b)(9)	SSID Form

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Alaska Department of Environmental Conservation Owner Requested Limit Application	**ADEC USE ONLY** Receiving Date: ADEC Control #: ORL :

STATIONARY SOURCE IDENTIFICATION FORM

Section 1 Stationary Source Information

Stationary Source Name: Alaska Methane Hydrate Project			
Project Name (if different):	Stationary Source Contact: Amanda Henry		
Source Physical Address: Prudhoe Bay Unit, Kuparuk State 7-11-12 Pad	City: Anchorage	State: Alaska	Zip: 99503
	Telephone: 907-339-5472		
	E-Mail Address: ahenry@asrcenergy.com		
UTM Coordinates or Latitude/Longitude: Latitude/Longitude	Northing:	Easting:	Zone:
	Latitude: 70° 19' 00" N	Longitude: 149° 12' 14" W	

Section 2 Legal Owner

Name: ASRC Energy Services Alaska, Inc.		
Mailing Address: 3900 C Street, Suite 701		
City: Anchorage	State: AK	Zip: 99503
Telephone #: 907-339-6200		
E-Mail Address:		

Section 3 Operator *(if different from owner)*

Name: ASRC Consulting & Environmental Services, LLC		
Mailing Address: 3900 C Street, Suite 601		
City: Anchorage	State: AK	Zip: 99503
Telephone #: 907-339-6341		
E-Mail Address: pramert@asrcenergy.com		

Section 4 Designated Agent *(for service of process)*

Name: Corporation Service Company		
Mailing Address: 9360 Glacier Hwy, Ste 202		
City Juneau	State: AK	Zip: 99801
Physical Address: 9360 Glacier Hwy, Ste 202		
City: Juneau	State: AK	Zip: 99801
Telephone #:		
E-Mail Address:		

Section 5 Billing Contact Person *(if different from owner)*

Name: AES - Accounts Payable		
Mailing Address: 3900 C Street, Ste 701		
City: Anchorage	State: AK	Zip: 99503
Telephone #: 907-339-6200		
E-Mail Address: AESAccountsPayable@asrcenergy.com		

Section 6 Application Contact

Name: Amanda Henry			
Mailing Address: 3900 C Street, Suite 601	City: Anchorage	State: AK	Zip: 99503
	Telephone: 907-339-5472		
	E-Mail Address: ahenry@asrcenergy.com		

Section 7 Certification

This certification applies to the Air Quality Control Owner Requested Limit Application for the: Alaska Methane Hydrate Project
(Stationary Source Name)

submitted to the department on: May 27, 2022

Type of Application

☒ Initial Application
☐ Change to Initial Application

The application is **NOT** complete unless the certification of truth, accuracy, and completeness on this form bears the **signature of a responsible official** of the firm making the application. (18 AAC 50.205)

CERTIFICATION OF TRUTH, ACCURACY, AND COMPLETENESS

"Based on information and belief formed after reasonable inquiry, I certify that the statements and information in and attached to this document are true, accurate, and complete."

Signature: 	Date: May 26, 2022
Printed Name: Paul Ramert	Title: General Manager

Section 13 Attachments

☒ Attachments Included. List attachments: Attachment A - Emissions Unit Inventory and Potential to Emit Calculations
Attachment B - Owner Request Limit

Attachment A

Emissions Unit Inventory and Potential to Emit Calculations

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Table 1. ASRC Energy Services - Alaska Methane Hydrate Project

Table 1a. Air Quality Permit Applicability Summary without an Owner Requested Limit

Pollutant	Stationary Source Potential Emissions [1]	Prevention of Significant Deterioration (PSD) Permitting Thresholds [2]	PSD Air Quality Permit Required?	Minor Air Quality Permitting Thresholds [3]	Minor Air Quality Permit Required?	Title V Operating Permit Thresholds [4]	Title V Operating Permit Required?
NO_X	54.6 tpy	250 tpy	No	40 tpy	Yes	100 tpy	No
CO	130.4 tpy	250 tpy	No	- [5]	-	100 tpy	Yes
PM	10.2 tpy	250 tpy	No	-	-	100 tpy	No
PM_{10}	10.2 tpy	250 tpy	No	15 tpy	No	100 tpy	No
$PM_{2.5}$	10.2 tpy	250 tpy	No	10 tpy	Yes	100 tpy	No
VOC	213.2 tpy	250 tpy	No	-	-	100 tpy	Yes
SO_2	56.8 tpy	250 tpy	No	40 tpy	Yes	100 tpy	No

Notes:

[1] Potential emissions from nonroad engines are not included in determining classification of a stationary source under AS 46.14.130 and 18 AAC 50.100.

[2] PSD air quality permitting thresholds for a new stationary source, per 40 CFR 52.21(b)(i)(b) and 18 AAC 50.306.

[3] Minor air quality permitting thresholds for a new stationary source under 18 AAC 50.502(c)(1).

[4] Title V air quality operating permit thresholds per 40 CFR 71 and 18 AAC 50.326.

[5] Not applicable.

Table 1b. Air Quality Permit Applicability Summary with an Owner Requested Limit

Pollutant	Stationary Source Potential Emissions [1]	Prevention of Significant Deterioration (PSD) Permitting Thresholds [2]	PSD Air Quality Permit Required?	Minor Air Quality Permitting Thresholds [3]	Minor Air Quality Permit Required?	Title V Operating Permit Thresholds [4]	Title V Operating Permit Required?
NO_X	39.7 tpy	250 tpy	No	40 tpy	No	100 tpy	No
CO	62.3 tpy	250 tpy	No	- [5]	-	100 tpy	No
PM	5.5 tpy	250 tpy	No	-	-	100 tpy	No
PM_{10}	5.5 tpy	250 tpy	No	15 tpy	No	100 tpy	No
$PM_{2.5}$	5.5 tpy	250 tpy	No	10 tpy	No	100 tpy	No
VOC	68.2 tpy	250 tpy	No	-	-	100 tpy	No
SO_2	38.2 tpy	250 tpy	No	40 tpy	No	100 tpy	No

Notes:

[1] Potential emissions from nonroad engines are not included in determining classification of a stationary source under AS 46.14.130 and 18 AAC 50.100.

[2] PSD air quality permitting thresholds for a new stationary source, per 40 CFR 52.21(b)(i)(b) and 18 AAC 50.306.

[3] Minor air quality permitting thresholds for a new stationary source under 18 AAC 50.502(c)(1).

[4] Title V air quality operating permit thresholds per 40 CFR 71 and 18 AAC 50.326.

[5] Not applicable.

Table 2. ASRC Energy Services - Alaska Methane Hydrate Project
Major Source Hazardous Air Pollutant Permit Applicability Summary without an Owner Requested Limit

Hazardous Air Pollutant	Stationary Source Potential to Emit	HAP Major Source Permit Applicability [1]	HAP Major Source Permit Required? [2]
Maximum Individual (Ethylbenzene)	0.47 tpy	10 tpy	No
Aggregate Total	1.51 tpy	25 tpy	No

Notes:

[1] A facility is a major source of HAPs if it has the potential to emit 10 tpy of a single HAP or 25 tpy of any combination of HAPs.

[2] A major source of HAPs subject to a standard under 40 CFR 63 must obtain a construction permit, per 18 AAC 50.316(a)(1).

Table 3. ASRC Energy Services - Alaska Methane Hydrate Project
Stationary Source Emissions Unit Inventory

Emissions Units					Potential Operating Hours	Potential Fuel Consumption
ID No.	Description	Classification	Rating/Size	Fuel		
1	Capstone C1000S Microturbine No. 1	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]
2	Capstone C1000S Microturbine No. 2	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]
3	Ecologix OFE-1800 Thermal Evaporator No. 1	Stationary	18.9 MMBtu/hr [4]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]
4	Ecologix OFE-1800 Thermal Evaporator No. 2	Stationary	18.9 MMBtu/hr [4]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]
5	Ecologix OFE-1800 Thermal Evaporator No. 3	Stationary	18.9 MMBtu/hr [4]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]
6	Emergency/Upset Flare	Stationary	72.88 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	641.6 MMscf/yr [6]
7	Flare Pilot	Stationary	25,500 Btu/hr [3,7]	Fuel Gas	8,760 hr/yr	0.22 MMscf/yr [7]
8	Flare Purge	Stationary	45,900 Btu/hr [3,7]	Fuel Gas	8,760 hr/yr	0.39 MMscf/yr [7]
9	(10) Portable Heaters	Stationary	7.7 MMBtu/hr, total	Diesel	8,760 hr/yr	505,334 gal/yr [8]

Notes:

[1] Each Capstone C1000S is composed of five (5) Capstone model C200 units that have a rating of 200 electric kilowatts (kWe), each.

[2] Each Capstone C1000S has a net heat rate (LHV) of 10,300 Btu per kilowatt hour, per Table 2 in Capstone Microturbine C1000 Signature Series 5-Bay Package, Product Specification (460080 Rev D (March 2020)).

[3] The potential fuel gas consumption rate is based on fuel gas with a heating value of 1,020 Btu/scf.

[4] Each Ecologix Model OFE-1800 has a heat input rate of 18.9 MMBtu/hr.

[5] The emergency/upset flare will have a maximum heat of release of 72.88 MMBtu/hr.

[6] The flared gas is assumed to have a heating value of 995 Btu/scf.

[7] The flare pilot and flare purge have respective maximum operating capacities equal to 25 scf/hr and 45 scf/hr.

[8] Diesel fuel consumption rates are based on conversions of 18,800 Btu/lb liquid fuel and 7.1 lb liquid fuel/gal.

Table 4. ASRC Energy Services - Alaska Methane Hydrate Project

Table 4a. Potential to Emit Nitrogen Oxides (NO_X) without an Owner Requested Limit

Emissions Units					Potential Operating Hours	Potential Fuel Consumption	NO_X Emission Factor		Potential Annual NO_X Emissions
ID No.	Description	Classification	Rating/Size	Fuel				Reference	
1	Capstone C1000S Microturbine No. 1	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.4 lb/MWhe	Vendor Data [4]	1.8 tpy
2	Capstone C1000S Microturbine No. 2	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.4 lb/MWhe	Vendor Data [4]	1.8 tpy
3	Ecologix OFE-1800 Thermal Evaporator No. 1	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	100 lb/MMscf	Table 1.4-1, AP-42	8.1 tpy
4	Ecologix OFE-1800 Thermal Evaporator No. 2	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	100 lb/MMscf	Table 1.4-1, AP-42	8.1 tpy
5	Ecologix OFE-1800 Thermal Evaporator No. 3	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	100 lb/MMscf	Table 1.4-1, AP-42	8.1 tpy
6	Emergency/Upset Flare	Stationary	72.88 MMBtu/hr [6]	Fuel Gas	8,760 hr/yr	642 MMscf/yr [7]	0.068 lb/MMBtu	Table 13.5-1, AP-42	21.7 tpy
7	Flare Pilot	Stationary	25,500 Btu/hr [3,8]	Fuel Gas	8,760 hr/yr	0.22 MMscf/yr [8]	0.068 lb/MMBtu	Table 13.5-1, AP-42	0.01 tpy
8	Flare Purge	Stationary	45,900 Btu/hr [3,8]	Fuel Gas	8,760 hr/yr	0.39 MMscf/yr [8]	0.068 lb/MMBtu	Table 13.5-1, AP-42	0.01 tpy
9	(10) Portable Heaters	Stationary	7.7 MMBtu/hr, total	Diesel	8,760 hr/yr	505,334 gal/yr [9]	20 lb/kgal	Table 1.3-1, AP-42	5.1 tpy
								Total	**54.6 tpy**

Notes:

[1] Each Capstone C1000S is composed of five (5) Capstone model C200 units that have a rating of 200 electric kilowatts (kWe), each.

[2] Each Capstone C1000S has a net heat rate (LHV) of 10,300 Btu per kilowatt hour, per Table 2 in Capstone Microturbine C1000 Signature Series 5-Bay Package, Product Specification (460080 Rev D (March 2020)).

[3] The potential fuel gas consumption rate is based on fuel gas with a heating value of 1,020 Btu/scf.

[4] Capstone Microturbine Systems Emissions Technical Reference (410065 Rev. B (April 2008)), Table 1.

[5] Each Ecologix Model OFE-1800 has a heat input rate of 18.9 MMBtu/hr.

[6] The emergency/upset flare will have a maximum heat of release of 72.88 MMBtu/hr.

[7] The flared gas is assumed to have a heating value of 995 Btu/scf.

[8] The flare pilot and flare purge have respective maximum operating capacities equal to 25 scf/hr and 45 scf/hr.

[9] Diesel fuel consumption rates are based on conversions of 18,800 Btu/lb liquid fuel and 7.1 lb liquid fuel/gal.

Table 4b. Potential to Emit Nitrogen Oxides (NO_X) with an Owner Requested Limit

Emissions Units					Potential Operating Hours	Potential Fuel Consumption	NO_X Emission Factor		Potential Annual NO_X Emissions
ID No.	Description	Classification	Rating/Size	Fuel				Reference	
1	Capstone C1000S Microturbine No. 1	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.4 lb/MWhe	Vendor Data [4]	1.8 tpy
2	Capstone C1000S Microturbine No. 2	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.4 lb/MWhe	Vendor Data [4]	1.8 tpy
3	Ecologix OFE-1800 Thermal Evaporator No. 1	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	100 lb/MMscf	Table 1.4-1, AP-42	8.1 tpy
4	Ecologix OFE-1800 Thermal Evaporator No. 2	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	100 lb/MMscf	Table 1.4-1, AP-42	8.1 tpy
5	Ecologix OFE-1800 Thermal Evaporator No. 3	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	100 lb/MMscf	Table 1.4-1, AP-42	8.1 tpy
6	Emergency/Upset Flare	Stationary	72.88 MMBtu/hr [6]	Fuel Gas	8,760 hr/yr	200 MMscf/yr [7]	0.068 lb/MMBtu	Table 13.5-1, AP-42	6.8 tpy [8]
7	Flare Pilot	Stationary	25,500 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.22 MMscf/yr [9]	0.068 lb/MMBtu	Table 13.5-1, AP-42	0.01 tpy
8	Flare Purge	Stationary	45,900 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.39 MMscf/yr [9]	0.068 lb/MMBtu	Table 13.5-1, AP-42	0.01 tpy
9	(10) Portable Heaters	Stationary	7.7 MMBtu/hr, total	Diesel	8,760 hr/yr	505,334 gal/yr [10]	20 lb/kgal	Table 1.3-1, AP-42	5.1 tpy
								Total	**39.7 tpy**

Notes:

[1] Each Capstone C1000S is composed of five (5) Capstone model C200 units that have a rating of 200 electric kilowatts (kWe), each.

[2] Each Capstone C1000S has a net heat rate (LHV) of 10,300 Btu per kilowatt hour, per Table 2 in Capstone Microturbine C1000 Signature Series 5-Bay Package, Product Specification (460080 Rev D (March 2020)).

[3] The potential fuel gas consumption rate is based on fuel gas with a heating value of 1,020 Btu/scf.

[4] Capstone Microturbine Systems Emissions Technical Reference (410065 Rev. B (April 2008)), Table 1.

[5] Each Ecologix Model OFE-1800 has a heat input rate of 18.9 MMBtu/hr.

[6] The emergency/upset flare will have a maximum heat of release of 72.88 MMBtu/hr.

[7] Operation of the emergency/upset flare will be limited to flare no more than 200 MMscf per consecutive 12-months.

[8] The flared gas is assumed to have a heating value of 995 Btu/scf.

[9] The flare pilot and flare purge have respective maximum operating capacities equal to 25 scf/hr and 45 scf/hr.

[10] Diesel fuel consumption rates are based on conversions of 18,800 Btu/lb liquid fuel and 7.1 lb liquid fuel/gal.

Table 5. ASRC Energy Services - Alaska Methane Hydrate Project

Table 5a. Potential to Emit Carbon Monoxide (CO) without an Owner Requested Limit

Emissions Units					Potential Operating Hours	Potential Fuel Consumption	CO Emission Factor		Potential Annual CO Emissions
ID No.	Description	Classification	Rating/Size	Fuel				Reference	
1	Capstone C1000S Microturbine No. 1	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	1.1 lb/MWhe	Vendor Data [4]	4.8 tpy
2	Capstone C1000S Microturbine No. 2	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	1.1 lb/MWhe	Vendor Data [4]	4.8 tpy
3	Ecologix OFE-1800 Thermal Evaporator No. 1	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	84 lb/MMscf	Table 1.4-1, AP-42	6.8 tpy
4	Ecologix OFE-1800 Thermal Evaporator No. 2	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	84 lb/MMscf	Table 1.4-1, AP-42	6.8 tpy
5	Ecologix OFE-1800 Thermal Evaporator No. 3	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	84 lb/MMscf	Table 1.4-1, AP-42	6.8 tpy
6	Emergency/Upset Flare	Stationary	72.88 MMBtu/hr [6]	Fuel Gas	8,760 hr/yr	642 MMscf/yr [7]	0.31 lb/MMBtu	Table 13.5-2, AP-42	99.0 tpy
7	Flare Pilot	Stationary	25,500 Btu/hr [3,8]	Fuel Gas	8,760 hr/yr	0.22 MMscf/yr [8]	0.31 lb/MMBtu	Table 13.5-2, AP-42	0.03 tpy
8	Flare Purge	Stationary	45,900 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.39 MMscf/yr [8]	0.31 lb/MMBtu	Table 13.5-2, AP-42	0.06 tpy
9	(10) Portable Heaters	Stationary	7.7 MMBtu/hr, total	Diesel	8,760 hr/yr	505,334 gal/yr [9]	5 lb/kgal	Table 1.3-1, AP-42	1.3 tpy
								Total	**130.4 tpy**

Notes:

[1] Each Capstone C1000S is composed of five (5) Capstone model C200 units that have a rating of 200 electric kilowatts (kWe), each.

[2] Each Capstone C1000S has a net heat rate (LHV) of 10,300 Btu per kilowatt hour, per Table 2 in Capstone Microturbine C1000 Signature Series 5-Bay Package, Product Specification (460080 Rev D (March 2020)).

[3] The potential fuel gas consumption rate is based on fuel gas with a heating value of 1,020 Btu/scf.

[4] Capstone Microturbine Systems Emissions Technical Reference (410065 Rev. B (April 2008)), Table 1.

[5] Each Ecologix Model OFE-1800 has a heat input rate of 18.9 MMBtu/hr.

[6] The emergency/upset flare will have a maximum heat of release of 72.88 MMBtu/hr.

[7] The flared gas is assumed to have a heating value of 995 Btu/scf.

[8] The flare pilot and flare purge have respective maximum operating capacities equal to 25 scf/hr and 45 scf/hr.

[9] Diesel fuel consumption rates are based on conversions of 18,800 Btu/lb liquid fuel and 7.1 lb liquid fuel/gal.

Table 5b. Potential to Emit Carbon Monoxide (CO) with an Owner Requested Limit

Emissions Units					Potential Operating Hours	Potential Fuel Consumption	CO Emission Factor		Potential Annual CO Emissions
ID No.	Description	Classification	Rating/Size	Fuel				Reference	
1	Capstone C1000S Microturbine No. 1	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	1.1 lb/MWhe	Vendor Data [4]	4.8 tpy
2	Capstone C1000S Microturbine No. 2	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	1.1 lb/MWhe	Vendor Data [4]	4.8 tpy
3	Ecologix OFE-1800 Thermal Evaporator No. 1	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	84 lb/MMscf	Table 1.4-1, AP-42	6.8 tpy
4	Ecologix OFE-1800 Thermal Evaporator No. 2	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	84 lb/MMscf	Table 1.4-1, AP-42	6.8 tpy
5	Ecologix OFE-1800 Thermal Evaporator No. 3	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	84 lb/MMscf	Table 1.4-1, AP-42	6.8 tpy
6	Emergency/Upset Flare	Stationary	72.88 MMBtu/hr [6]	Fuel Gas	8,760 hr/yr	200 MMscf/yr [7]	0.31 lb/MMBtu	Table 13.5-2, AP-42	30.8 tpy [8]
7	Flare Pilot	Stationary	25,500 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.22 MMscf/yr [9]	0.31 lb/MMBtu	Table 13.5-2, AP-42	0.03 tpy
8	Flare Purge	Stationary	45,900 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.39 MMscf/yr [9]	0.31 lb/MMBtu	Table 13.5-2, AP-42	0.06 tpy
9	(10) Portable Heaters	Stationary	7.7 MMBtu/hr, total	Diesel	8,760 hr/yr	505,334 gal/yr [10]	5 lb/kgal	Table 1.3-1, AP-42	1.3 tpy
								Total	**62.3 tpy**

Notes:

[1] Each Capstone C1000S is composed of five (5) Capstone model C200 units that have a rating of 200 electric kilowatts (kWe), each.

[2] Each Capstone C1000S has a net heat rate (LHV) of 10,300 Btu per kilowatt hour, per Table 2 in Capstone Microturbine C1000 Signature Series 5-Bay Package, Product Specification (460080 Rev D (March 2020)).

[3] The potential fuel gas consumption rate is based on fuel gas with a heating value of 1,020 Btu/scf.

[4] Capstone Microturbine Systems Emissions Technical Reference (410065 Rev. B (April 2008)), Table 1.

[5] Each Ecologix Model OFE-1800 has a heat input rate of 18.9 MMBtu/hr.

[6] The emergency/upset flare will have a maximum heat of release of 72.88 MMBtu/hr.

[7] The emergency/upset flare will have an owner requested limit (ORL) to limit the amount of gas flared to no more than 200 MMscf per consecutive 12-month period.

[8] The flared gas is assumed to have a heating value of 995 Btu/scf.

[9] The flare pilot and flare purge have respective maximum operating capacities equal to 25 scf/hr and 45 scf/hr.

[10] Diesel fuel consumption rates are based on conversions of 18,800 Btu/lb liquid fuel and 7.1 lb liquid fuel/gal.

Table 6. ASRC Energy Services - Alaska Methane Hydrate Project

Table 6a. Potential to Emit Particulate Matter (PM, PM_{10}, and $PM_{2.5}$) without an Owner Requested Limit

Emissions Units					Potential Operating Hours	Potential Fuel Consumption	$PM/PM_{10}/PM_{2.5}$ Emission Factor		Potential Annual $PM/PM_{10}/PM_{2.5}$ Emissions
ID No.	Description	Classification	Rating/Size	Fuel				Reference	
1	Capstone C1000S Microturbine No. 1	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.0066 lb/MMBtu	Table 3.1-2a, AP-42	0.3 tpy [2]
2	Capstone C1000S Microturbine No. 2	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.0066 lb/MMBtu	Table 3.1-2a, AP-42	0.3 tpy [2]
3	Ecologix OFE-1800 Thermal Evaporator No. 1	Stationary	18.9 MMBtu/hr [4]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	7.6 lb/MMscf	Table 1.4-2, AP-42	0.6 tpy
4	Ecologix OFE-1800 Thermal Evaporator No. 2	Stationary	18.9 MMBtu/hr [4]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	7.6 lb/MMscf	Table 1.4-2, AP-42	0.6 tpy
5	Ecologix OFE-1800 Thermal Evaporator No. 3	Stationary	18.9 MMBtu/hr [4]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	7.6 lb/MMscf	Table 1.4-2, AP-42	0.6 tpy
6	Emergency/Upset Flare	Stationary	72.88 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	642 MMscf/yr [6]	40 µg/L	Table 13.5-1, AP-42 [7]	6.9 tpy [6,8]
7	Flare Pilot	Stationary	25,500 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.22 MMscf/yr [9]	40 µg/L	Table 13.5-1, AP-42 [7]	0.002 tpy
8	Flare Purge	Stationary	45,900 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.39 MMscf/yr [9]	40 µg/L	Table 13.5-1, AP-42 [7]	0.004 tpy
9	(10) Portable Heaters	Stationary	7.7 MMBtu/hr, total	Diesel	8,760 hr/yr	505,334 gal/yr [10]	3.3 lb/kgal	Tables 1.3-1 & 1.3-2, AP-42	0.8 tpy
								Total	**10.2 tpy**

Notes:

[1] Each Capstone C1000S is composed of five (5) Capstone model C200 units that have a rating of 200 electric kilowatts (kWe), each.

[2] Each Capstone C1000S has a net heat rate (LHV) of 10,300 Btu per kilowatt hour, per Table 2 in Capstone Microturbine C1000 Signature Series 5-Bay Package, Product Specification (460080 Rev D (March 2020)).

[3] The potential fuel gas consumption rate is based on fuel gas with a heating value of 1,020 Btu/scf.

[4] Each Ecologix Model OFE-1800 has a heat input rate of 18.9 MMBtu/hr.

[5] The emergency/upset flare will have a maximum heat of release of 72.88 MMBtu/hr.

[6] The flared gas is assumed to have a heating value of 995 Btu/scf.

[7] The flare PM emission factor is based on the soot emissions value reported in Table 13.5-1, AP-42 for lightly smoking flares.

[8] Assumes an F-factor for natural gas equal to 8,710 dscf/MMBtu, per 40 CFR 60, Appendix A, Method 19.

[9] The flare pilot and flare purge have respective maximum operating capacities equal to 25 scf/hr and 45 scf/hr.

[10] Diesel fuel consumption rates are based on conversions of 18,800 Btu/lb liquid fuel and 7.1 lb liquid fuel/gal.

Table 6b. Potential to Emit Particulate Matter (PM, PM_{10}, and $PM_{2.5}$) with an Owner Requested Limit

Emissions Units					Potential Operating Hours	Potential Fuel Consumption	$PM/PM_{10}/PM_{2.5}$ Emission Factor		Potential Annual $PM/PM_{10}/PM_{2.5}$ Emissions
ID No.	Description	Classification	Rating/Size	Fuel				Reference	
1	Capstone C1000S Microturbine No. 1	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.0066 lb/MMBtu	Table 3.1-2a, AP-42	0.3 tpy [2]
2	Capstone C1000S Microturbine No. 2	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.0066 lb/MMBtu	Table 3.1-2a, AP-42	0.3 tpy [2]
3	Ecologix OFE-1800 Thermal Evaporator No. 1	Stationary	18.9 MMBtu/hr [4]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	7.6 lb/MMscf	Table 1.4-2, AP-42	0.6 tpy
4	Ecologix OFE-1800 Thermal Evaporator No. 2	Stationary	18.9 MMBtu/hr [4]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	7.6 lb/MMscf	Table 1.4-2, AP-42	0.6 tpy
5	Ecologix OFE-1800 Thermal Evaporator No. 3	Stationary	18.9 MMBtu/hr [4]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	7.6 lb/MMscf	Table 1.4-2, AP-42	0.6 tpy
6	Emergency/Upset Flare	Stationary	72.88 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	200 MMscf/yr [6]	40 µg/L	Table 13.5-1, AP-42 [7]	2.2 tpy [8,9]
7	Flare Pilot	Stationary	25,500 Btu/hr [3,10]	Fuel Gas	8,760 hr/yr	0.22 MMscf/yr [10]	40 µg/L	Table 13.5-1, AP-42 [7]	0.002 tpy
8	Flare Purge	Stationary	45,900 Btu/hr [3,10]	Fuel Gas	8,760 hr/yr	0.39 MMscf/yr [10]	40 µg/L	Table 13.5-1, AP-42 [7]	0.004 tpy
9	(10) Portable Heaters	Stationary	7.7 MMBtu/hr, total	Diesel	8,760 hr/yr	505,334 gal/yr [11]	3.3 lb/kgal	Tables 1.3-1 & 1.3-2, AP-42	0.8 tpy
								Total	**5.5 tpy**

Notes:

[1] Each Capstone C1000S is composed of five (5) Capstone model C200 units that have a rating of 200 electric kilowatts (kWe), each.

[2] Each Capstone C1000S has a net heat rate (LHV) of 10,300 Btu per kilowatt hour, per Table 2 in Capstone Microturbine C1000 Signature Series 5-Bay Package, Product Specification (460080 Rev D (March 2020)).

[3] The potential fuel gas consumption rate is based on fuel gas with a heating value of 1,020 Btu/scf.

[4] Each Ecologix Model OFE-1800 has a heat input rate of 18.9 MMBtu/hr.

[5] The emergency/upset flare will have a maximum heat of release of 72.88 MMBtu/hr.

[6] The emergency/upset flare will have an owner requested limit (ORL) to limit the amount of gas flared to no more than 200 MMscf per consecutive 12-month period.

[7] The flare PM emission factor is based on the soot emissions value reported in Table 13.5-1, AP-42 for lightly smoking flares.

[8] The flared gas is assumed to have a heating value of 995 Btu/scf.

[9] Assumes an F-factor for natural gas equal to 8,710 dscf/MMBtu, per 40 CFR 60, Appendix A, Method 19.

[10] The flare pilot and flare purge have respective maximum operating capacities equal to 25 scf/hr and 45 scf/hr.

[11] Diesel fuel consumption rates are based on conversions of 18,800 Btu/lb liquid fuel and 7.1 lb liquid fuel/gal.

Table 7. ASRC Energy Services - Alaska Methane Hydrate Project

Table 7a. Potential to Volatile Organic Compounds (VOC) without an Owner Requested Limit

Emissions Units					Potential Operating Hours	Potential Fuel Consumption	VOC Emission Factor		Potential Annual VOC Emissions
ID No.	Description	Classification	Rating/Size	Fuel				Reference	
1	Capstone C1000S Microturbine No. 1	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.1 lb/MWhe	Vendor Data [4]	0.4 tpy
2	Capstone C1000S Microturbine No. 2	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.1 lb/MWhe	Vendor Data [4]	0.4 tpy
3	Ecologix OFE-1800 Thermal Evaporator No. 1	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	5.5 lb/MMscf	Table 1.4-2, AP-42	0.4 tpy
4	Ecologix OFE-1800 Thermal Evaporator No. 2	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	5.5 lb/MMscf	Table 1.4-2, AP-42	0.4 tpy
5	Ecologix OFE-1800 Thermal Evaporator No. 3	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	5.5 lb/MMscf	Table 1.4-2, AP-42	0.4 tpy
6	Emergency/Upset Flare	Stationary	72.88 MMBtu/hr [6]	Fuel Gas	8,760 hr/yr	642 MMscf/yr [7]	0.66 lb/MMBtu	Table 13.5-2, AP-42	210.7 tpy
7	Flare Pilot	Stationary	25,500 Btu/hr [3,8]	Fuel Gas	8,760 hr/yr	0.22 MMscf/yr [8]	0.66 lb/MMBtu	Table 13.5-2, AP-42	0.07 tpy
8	Flare Purge	Stationary	45,900 Btu/hr [3,8]	Fuel Gas	8,760 hr/yr	0.39 MMscf/yr [8]	0.66 lb/MMBtu	Table 13.5-2, AP-42	0.13 tpy
9	(10) Portable Heaters	Stationary	7.7 MMBtu/hr, total	Diesel	8,760 hr/yr	505,334 gal/yr [9]	0.34 lb/kgal	Table 13.5-2, AP-42	0.1 tpy
								Total	**213.2 tpy**

Notes:

[1] Each Capstone C1000S is composed of five (5) Capstone model C200 units that have a rating of 200 electric kilowatts (kWe), each.

[2] Each Capstone C1000S has a net heat rate (LHV) of 10,300 Btu per kilowatt hour, per Table 2 in Capstone Microturbine C1000 Signature Series 5-Bay Package, Product Specification (460080 Rev D (March 2020)).

[3] The potential fuel gas consumption rate is based on fuel gas with a heating value of 1,020 Btu/scf.

[4] Capstone Microturbine Systems Emissions Technical Reference (410065 Rev. B (April 2008)), Table 1.

[5] Each Ecologix Model OFE-1800 has a heat input rate of 18.9 MMBtu/hr.

[6] The emergency/upset flare will have a maximum heat of release of 72.88 MMBtu/hr.

[7] The flared gas is assumed to have a heating value of 995 Btu/scf.

[8] The flare pilot and flare purge have respective maximum operating capacities equal to 25 scf/hr and 45 scf/hr.

[9] Diesel fuel consumption rates are based on conversions of 18,800 Btu/lb liquid fuel and 7.1 lb liquid fuel/gal.

Table 7b. Potential to Emit Volatile Organic Compounds (VOCs) with an Owner Requested Limit

Emissions Units					Potential Operating Hours	Potential Fuel Consumption	VOC Emission Factor		Potential Annual VOC Emissions
ID No.	Description	Classification	Rating/Size	Fuel				Reference	
1	Capstone C1000S Microturbine No. 1	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.1 lb/MWhe	Vendor Data [4]	0.4 tpy
2	Capstone C1000S Microturbine No. 2	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	0.1 lb/MWhe	Vendor Data [4]	0.4 tpy
3	Ecologix OFE-1800 Thermal Evaporator No. 1	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	5.5 lb/MMscf	Table 1.4-2, AP-42	0.4 tpy
4	Ecologix OFE-1800 Thermal Evaporator No. 2	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	5.5 lb/MMscf	Table 1.4-2, AP-42	0.4 tpy
5	Ecologix OFE-1800 Thermal Evaporator No. 3	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	5.5 lb/MMscf	Table 1.4-2, AP-42	0.4 tpy
6	Emergency/Upset Flare	Stationary	72.88 MMBtu/hr [6]	Fuel Gas	8,760 hr/yr	200 MMscf/yr [7]	0.66 lb/MMBtu	Table 13.5-2, AP-42	65.7 tpy [8]
7	Flare Pilot	Stationary	25,500 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.22 MMscf/yr [9]	0.66 lb/MMBtu	Table 13.5-2, AP-42	0.07 tpy
8	Flare Purge	Stationary	45,900 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.39 MMscf/yr [9]	0.66 lb/MMBtu	Table 13.5-2, AP-42	0.13 tpy
9	(10) Portable Heaters	Stationary	7.7 MMBtu/hr, total	Diesel	8,760 hr/yr	505,334 gal/yr [10]	0.34 lb/kgal	Table 13.5-2, AP-42	0.1 tpy
								Total	**68.2 tpy**

Notes:

[1] Each Capstone C1000S is composed of five (5) Capstone model C200 units that have a rating of 200 electric kilowatts (kWe), each.

[2] Each Capstone C1000S has a net heat rate (LHV) of 10,300 Btu per kilowatt hour, per Table 2 in Capstone Microturbine C1000 Signature Series 5-Bay Package, Product Specification (460080 Rev D (March 2020)).

[3] The potential fuel gas consumption rate is based on fuel gas with a heating value of 1,020 Btu/scf.

[4] Capstone Microturbine Systems Emissions Technical Reference (410065 Rev. B (April 2008)), Table 1.

[5] Each Ecologix Model OFE-1800 has a heat input rate of 18.9 MMBtu/hr.

[6] The emergency/upset flare will have a maximum heat of release of 72.88 MMBtu/hr.

[7] The emergency/upset flare will have an owner requested limit (ORL) to limit the amount of gas flared to no more than 200 MMscf per consecutive 12-month period.

[8] The flared gas is assumed to have a heating value of 995 Btu/scf.

[9] The flare pilot and flare purge have respective maximum operating capacities equal to 25 scf/hr and 45 scf/hr.

[10] Diesel fuel consumption rates are based on conversions of 18,800 Btu/lb liquid fuel and 7.1 lb liquid fuel/gal.

Table 8. ASRC Energy Services - Alaska Methane Hydrate Project

Table 8a. Potential to Sulfur Dioxide (SO_2) without an Owner Requested Limit

Emissions Units					Potential Operating Hours	Potential Fuel Consumption	SO_2 Emission Factor		Potential Annual SO_2 Emissions
ID No.	Description	Classification	Rating/Size	Fuel				Reference	
1	Capstone C1000S Microturbine No. 1	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	500 ppmv [4]	Mass Balance	3.7 tpy
2	Capstone C1000S Microturbine No. 2	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	500 ppmv [4]	Mass Balance	3.7 tpy
3	Ecologix OFE-1800 Thermal Evaporator No. 1	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	500 ppmv [4]	Mass Balance	6.8 tpy
4	Ecologix OFE-1800 Thermal Evaporator No. 2	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	500 ppmv [4]	Mass Balance	6.8 tpy
5	Ecologix OFE-1800 Thermal Evaporator No. 3	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	500 ppmv [4]	Mass Balance	6.8 tpy
6	Emergency/Upset Flare	Stationary	72.88 MMBtu/hr [6]	Fuel Gas	8,760 hr/yr	641.6 MMscf/yr [7,8]	500 ppmv [4]	Mass Balance	27.0 tpy
7	Flare Pilot	Stationary	25,500 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.22 MMscf/yr [9]	500 ppmv [4]	Mass Balance	0.01 tpy
8	Flare Purge	Stationary	45,900 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.39 MMscf/yr [9]	500 ppmv [4]	Mass Balance	0.02 tpy
9	(10) Portable Heaters	Stationary	7.7 MMBtu/hr, total	Diesel	8,760 hr/yr	505,334 gal/yr [10]	0.0071 lb/gal [11]	Mass Balance	1.79 tpy
								Total	**56.80 tpy**

Notes:

[1] Each Capstone C1000S is composed of five (5) Capstone model C200 units that have a rating of 200 electric kilowatts (kWe), each.

[2] Each Capstone C1000S has a net heat rate (LHV) of 10,300 Btu per kilowatt hour, per Table 2 in Capstone Microturbine C1000 Signature Series 5-Bay Package, Product Specification (460080 Rev D (March 2020)).

[3] The potential fuel gas consumption rate is based on fuel gas with a heating value of 1,020 Btu/scf.

[4] The fuel gas sulfur content is based on a conservative assumption that the sulfur content will not exceed 500 parts per million by volume sulfur (ppmv S).

[5] Each Ecologix Model OFE-1800 has a heat input rate of 18.9 MMBtu/hr.

[6] The emergency/upset flare will have a maximum heat of release of 72.88 MMBtu/hr.

[7] The emergency/upset flare will have an owner requested limit (ORL) to limit the amount of gas flared to no more than 200 MMscf per consecutive 12-month period.

[8] The flared gas is assumed to have a heating value of 995 Btu/scf.

[9] The flare pilot and flare purge have respective maximum operating capacities equal to 25 scf/hr and 45 scf/hr.

[10] Diesel fuel consumption rates are based on conversions of 18,800 Btu/lb liquid fuel and 7.1 lb liquid fuel/gal.

[11] Based on a conservative assumption that the diesel-fired heaters will burn low sulfur diesel (LSD) fuel with a sulfur content not to exceed 500 parts per million by weight (ppmw S).

Table 8b. Potential to Emit Sulfur Dioxide (SO_2) with an Owner Requested Limit

Emissions Units					Potential Operating Hours	Potential Fuel Consumption	SO_2 Emission Factor		Potential Annual SO_2 Emissions
ID No.	Description	Classification	Rating/Size	Fuel				Reference	
1	Capstone C1000S Microturbine No. 1	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	500 ppmv [4]	Mass Balance	3.7 tpy
2	Capstone C1000S Microturbine No. 2	Stationary	1,000 kWe [1]	Fuel Gas	8,760 hr/yr	88.5 MMscf/yr [2,3]	500 ppmv [4]	Mass Balance	3.7 tpy
3	Ecologix OFE-1800 Thermal Evaporator No. 1	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	500 ppmv [4]	Mass Balance	6.8 tpy
4	Ecologix OFE-1800 Thermal Evaporator No. 2	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	500 ppmv [4]	Mass Balance	6.8 tpy
5	Ecologix OFE-1800 Thermal Evaporator No. 3	Stationary	18.9 MMBtu/hr [5]	Fuel Gas	8,760 hr/yr	162.3 MMscf/yr [3]	500 ppmv [4]	Mass Balance	6.8 tpy
6	Emergency/Upset Flare	Stationary	72.88 MMBtu/hr [6]	Fuel Gas	2,730 hr/yr	200.0 MMscf/yr [7,8]	500 ppmv [4]	Mass Balance	8.4 tpy
7	Flare Pilot	Stationary	25,500 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.22 MMscf/yr [9]	500 ppmv [4]	Mass Balance	0.01 tpy
8	Flare Purge	Stationary	45,900 Btu/hr [3,9]	Fuel Gas	8,760 hr/yr	0.39 MMscf/yr [9]	500 ppmv [4]	Mass Balance	0.02 tpy
9	(10) Portable Heaters	Stationary	7.7 MMBtu/hr, total	Diesel	8,760 hr/yr	505,334 gal/yr [10]	0.0071 lb/gal [11]	Mass Balance	1.79 tpy
								Total	**38.20 tpy**

Notes:

[1] Each Capstone C1000S is composed of five (5) Capstone model C200 units that have a rating of 200 electric kilowatts (kWe), each.

[2] Each Capstone C1000S has a net heat rate (LHV) of 10,300 Btu per kilowatt hour, per Table 2 in Capstone Microturbine C1000 Signature Series 5-Bay Package, Product Specification (460080 Rev D (March 2020)).

[3] The potential fuel gas consumption rate is based on fuel gas with a heating value of 1,020 Btu/scf.

[4] The fuel gas sulfur content is based on a conservative assumption that the sulfur content will not exceed 500 parts per million by volume sulfur (ppmv S).

[5] Each Ecologix Model OFE-1800 has a heat input rate of 18.9 MMBtu/hr.

[6] The emergency/upset flare will have a maximum heat of release of 72.88 MMBtu/hr.

[7] The emergency/upset flare will have an owner requested limit (ORL) to limit the amount of gas flared to no more than 200 MMscf per consecutive 12-month period.

[8] The flared gas is assumed to have a heating value of 995 Btu/scf.

[9] The flare pilot and flare purge have respective maximum operating capacities equal to 25 scf/hr and 45 scf/hr.

[10] Diesel fuel consumption rates are based on conversions of 18,800 Btu/lb liquid fuel and 7.1 lb liquid fuel/gal.

[11] Based on a conservative assumption that the diesel-fired heaters will burn low sulfur diesel (LSD) fuel with a sulfur content not to exceed 500 parts per million by weight (ppmw S).

Table 9. ASRC Energy Services - Alaska Methane Hydrate Project
Hazardous Air Pollutant (HAP) Emissions Summary

Hazardous Air Pollutant (HAP)	HAP Emissions by Unit Category (tons per year)[1,2]				Total HAPs (tpy)
	Gas-fired Microturbines	Gas-fired Thermal Oxidizers	Flare	Diesel-fired Heaters	
Acetaldehyde	3.61E-03	-	1.38E-02	-	1.74E-02
Acrolein	5.77E-04	-	3.21E-03	-	3.79E-03
Benzene	1.08E-03	5.11E-04	5.11E-02	5.41E-05	5.27E-02
1,1,1-Trichloroethane	-	-	-	5.96E-05	5.96E-05
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	-	-	-	7.83E-10	7.83E-10
1,3-Butadiene	3.88E-05	-	-	-	3.88E-05
1,4-Dichlorobenzene(p)	-	2.92E-04	-	-	2.92E-04
Ethylbenzene	2.89E-03	-	4.64E-01	1.61E-05	4.67E-01
Formaldehyde	6.41E-02	1.83E-02	3.75E-01	8.34E-03	4.66E-01
n-Hexane	-	4.38E-01	9.31E-03	-	4.48E-01
Naphthalene	1.17E-04	1.49E-04	-	2.86E-04	5.51E-04
Polycyclic Organic Matter [3]	1.99E-04	2.15E-05	4.50E-03	1.53E-05	4.73E-03
Propylene Oxide	2.62E-03	-	-	-	2.62E-03
Toluene	1.17E-02	8.28E-04	1.86E-02	1.57E-03	3.27E-02
Xylenes	5.77E-03	-	9.31E-03	2.75E-05	1.51E-02
Arsenic Compounds	-	4.87E-05	-	1.35E-04	1.84E-04
Beryllium Compounds	-	2.92E-06	-	1.01E-04	1.04E-04
Cadmium Compounds	-	2.68E-04	-	1.01E-04	3.69E-04
Chromium Compounds	-	3.41E-04	-	1.01E-04	4.42E-04
Cobalt Compounds	-	2.05E-05	-	-	2.05E-05
Lead Compounds	-	-	-	3.04E-04	3.04E-04
Manganese Compounds	-	9.25E-05	-	2.02E-04	2.95E-04
Mercury Compounds	-	6.33E-05	-	1.01E-04	1.64E-04
Nickel Compounds	-	5.11E-04	-	1.01E-04	6.13E-04
Selenium Compounds	-	5.84E-06	-	5.06E-04	5.12E-04
Total - Unit Category/Source	**0.09**	**0.46**	**0.95**	**0.01**	**1.51**

Notes:

[1] Emissions from all emissions units are potential emissions based on full time operation.

[2] See individual emissions unit category emissions calculations for details on methodology and assumptions.

[3] EPA AP-42 is unclear stating whether the value for PAH includes naphthalene. The emission factor for PAH is included and listed under polycyclic organic matter.

Table 10. ASRC Energy Services - Alaska Methane Hydrate Project
Potential HAPs Emission Calculations - Fuel Gas-Fired Microturbines

Hazardous Air Pollutants		Source Category Emission Calculations	
CAS No.	**Chemical Name**	**Emission Factor [1]**	**Estimated Emissions**
106990	1,3-Butadiene	4.30E-07 lb/MMBtu	3.88E-05 tpy
75070	Acetaldehyde	4.00E-05 lb/MMBtu	3.61E-03 tpy
107028	Acrolein	6.40E-06 lb/MMBtu	5.77E-04 tpy
71432	Benzene	1.20E-05 lb/MMBtu	1.08E-03 tpy
100414	Ethylbenzene	3.20E-05 lb/MMBtu	2.89E-03 tpy
5000	Formaldehyde	7.10E-04 lb/MMBtu	6.41E-02 tpy
91203	Naphthalene	1.30E-06 lb/MMBtu	1.17E-04 tpy
N/A	Polycyclic Organic Matter [2]	2.20E-06 lb/MMBtu	1.99E-04 tpy
75569	Propylene Oxide	2.90E-05 lb/MMBtu	2.62E-03 tpy
108883	Toluene	1.30E-04 lb/MMBtu	1.17E-02 tpy
1330207	Xylenes (isomers and mixture)	6.40E-05 lb/MMBtu	5.77E-03 tpy
Notes:		**Total**	**0.09 tpy**

[1] Reference: AP-42, Table 3.1-3.

[2] AP-42, Table 3.1-3 is unclear if the value for PAH includes Naphthalene. The emission factor for PAH is included and listed under Polycyclic Organic Matter.

[3] Total heat consumption based on maximum full-time operation as noted below:

(2) 1,000 kWe Capstone C1000: 10.3 MMBtu/hr, each, maximum heat consumption

Total Potential Fuel Use: 180,456 MMBtu/yr

Table 11. ASRC Energy Services - Alaska Methane Hydrate Project
Potential HAPs Emission Calculations - Gas-Fired Thermal Evaporators

Hazardous Air Pollutants		Source Category Emission Calculations	
CAS No.	**Chemical Name**	**Emission Factor**	**Estimated Emissions**
106467	1,4-Dichlorobenzene(p)	1.20E-03 lb/MMscf	2.92E-04 tpy
N/A	Arsenic Compounds	2.00E-04 lb/MMscf	4.87E-05 tpy
71432	Benzene	2.10E-03 lb/MMscf	5.11E-04 tpy
N/A	Beryllium Compounds	1.20E-05 lb/MMscf	2.92E-06 tpy
N/A	Cadmium Compounds	1.10E-03 lb/MMscf	2.68E-04 tpy
N/A	Chromium Compounds	1.40E-03 lb/MMscf	3.41E-04 tpy
N/A	Cobalt Compounds	8.40E-05 lb/MMscf	2.05E-05 tpy
5000	Formaldehyde	7.52E-02 lb/MMscf	1.83E-02 tpy
110543	Hexane	1.80E+00 lb/MMscf	4.38E-01 tpy
N/A	Manganese Compounds	3.80E-04 lb/MMscf	9.25E-05 tpy
N/A	Mercury Compounds	2.60E-04 lb/MMscf	6.33E-05 tpy
91203	Naphthalene	6.10E-04 lb/MMscf	1.49E-04 tpy
N/A	Nickel Compounds	2.10E-03 lb/MMscf	5.11E-04 tpy
N/A	Polycyclic Organic Matter	8.82E-05 lb/MMscf	2.15E-05 tpy
N/A	Selenium Compounds	2.40E-05 lb/MMscf	5.84E-06 tpy
108883	Toluene	3.40E-03 lb/MMscf	8.28E-04 tpy
Notes:		**Total**	**0.46 tpy**

[1] Reference: AP-42, Tables 1.4-3, 1.4-4.

[2] Total fuel use based on maximum full-time operation or permit-limited operation as noted below:

(3) 18.9 MMBtu/hr Thermal Evaporators: 18,530 scf/hr, each

Total Potential Fuel Use: 487 MMscf/yr

Table 12. ASRC Energy Services - Alaska Methane Hydrate Project
Potential HAPs Emission Calculations - Emergency Flare/Pilot/Purge

Hazardous Air Pollutants		Source Category Emission Calculations	
CAS No.	Chemical Name	Emission Factor [1]	Estimated Emissions
75070	Acetaldehyde	4.30E-02 lb/MMscf	1.38E-02 tpy
107028	Acrolein	1.00E-02 lb/MMscf	3.21E-03 tpy
100414	Ethylbenzene	1.44E+00 lb/MMscf	4.64E-01 tpy
5000	Formaldehyde	1.17E+00 lb/MMscf	3.75E-01 tpy
108883	Toluene	5.80E-02 lb/MMscf	1.86E-02 tpy
1330207	Xylenes (isomers and mixture)	2.90E-02 lb/MMscf	9.31E-03 tpy
71432	Benzene	1.59E-01 lb/MMscf	5.11E-02 tpy
NA	Polycyclic Organic Matter	1.40E-02 lb/MMscf	4.50E-03 tpy
NA	n-Hexane	2.90E-02 lb/MMscf	9.31E-03 tpy
Notes:		**Total**	**0.95 tpy**

[1] Emission factors per Ventura County Air Pollution Control District, AB 2588 Combustion Emission Factors (May 17, 2001).

[2] Total heat consumption based on maximum full-time or permit-limited operation as noted below:

(1) Emergency Flare/Pilot/Purge 73.0 MMBtu/hr, combined

Total Potential Fuel Use: 642 MMscf/yr

Table 13. ASRC Energy Services - Alaska Methane Hydrate Project
Potential HAPs Emission Calculations - Diesel-Fired Portable Heaters

CAS No.	Chemical Name	Source Category Emission Calculations	
		Emission Factor [1]	Estimated Emissions
71432	Benzene	2.14E-04 lb/10^3 gal	5.4E-05 tpy
100414	Ethylbenzene	6.36E-05 lb/10^3 gal	1.6E-05 tpy
5000	Formaldehyde	3.30E-02 lb/10^3 gal	8.3E-03 tpy
91203	Naphthalene	1.13E-03 lb/10^3 gal	2.9E-04 tpy
3268879	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	3.10E-09 lb/10^3 gal	7.8E-10 tpy
N/A	Polycyclic Organic Matter	6.06E-05 lb/10^3 gal	1.5E-05 tpy
108883	Toluene	6.20E-03 lb/10^3 gal	1.6E-03 tpy
74552	1,1,1-Trichloroethane	2.36E-04 lb/10^3 gal	6.0E-05 tpy
1330207	Xylenes (isomers and mixture)	1.09E-04 lb/10^3 gal	2.8E-05 tpy
N/A	Arsenic Compounds	4 lb/10^{12} Btu	1.3E-04 tpy
N/A	Beryllium Compounds	3 lb/10^{12} Btu	1.0E-04 tpy
N/A	Cadmium Compounds	3 lb/10^{12} Btu	1.0E-04 tpy
N/A	Chromium Compounds	3 lb/10^{12} Btu	1.0E-04 tpy
N/A	Lead Compounds	9 lb/10^{12} Btu	3.0E-04 tpy
N/A	Manganese Compounds	6 lb/10^{12} Btu	2.0E-04 tpy
N/A	Mercury Compounds	3 lb/10^{12} Btu	1.0E-04 tpy
N/A	Nickel Compounds	3 lb/10^{12} Btu	1.0E-04 tpy
N/A	Selenium Compounds	15 lb/10^{12} Btu	5.1E-04 tpy
Notes:		**Total**	**1.2E-02 tpy**

[1] Reference: AP-42, Tables 1.3-9 and 1.3-10.

[2] Total heat consumption based on maximum full-time or permit-limited operation as noted below:

(10) Diesel-fired portable heaters: 67,452 MMBtu/yr, combined

Total Potential Fuel Use: 505,334 gallons/yr

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Product Specification

Capstone Microturbine®

C1000 Signature Series 5-Bay Package

(C600S, C800S & C1000S)

Capstone Turbine Corporation

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Capstone Technical Support

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3. Specifications

Table 2 summarizes the specifications for the C1000S series microturbine.

Table 2. Nominal C1000S Signature Series Microturbine Specifications

Parameter	C600S		C800S		C1000S	
	GC	DM	GC	DM	GC	DM
Performance Ratings						
Net Power Output[2] Low Pressure Natural Gas Liquid Fuel All Other C1000S Series	570 kW 570 kW 600 kW		760 kW 760 kW 800 kW		950 kW 950 kW 1000 kW	
Net Efficiency (LHV)[2] Low Pressure Natural Gas and Liquid Fuel All Other C1000S Series	31% 33%					
Net Heat Rate (LHV) Low Pressure Natural Gas & Liquid Fuel All Other C1000S Series	11.6 MJ/kWh (11,000 Btu/kWh) 10.9 MJ/kWh (10,300 Btu/kWh)					
Electrical Performance Ratings						
Voltage Operating Range	400/480 VAC					
Frequency Operating Range	50/60 Hz					
Output Voltage Connection – GC	3-phase 4 wire Wye, L1, L2, L3 (Neutral grounded with solid connection to earth ground in a single location.)					
Output Voltage Connection – SA	3-phase, 4 wire Wye, L1, L2, L3 and Neutral / 3 wire Delta, L1, L2, L3 (Neutral grounded with solid connection to earth ground in a single location.)					
Maximum Output Current[3]	900 A_{RMS}		1200 A_{RMS}		1500 A_{RMS}	
Total Harmonic Distortion (THD)	IEEE 519 compliant Grid Connect: 5% for current Dual Mode: 5% for voltage					
Exhaust Output Ratings[4]						
Exhaust Gas Temperature	280 °C (535 °F)					
Exhaust Mass Flow	3.99 kg/s (8.79 lbm/s)		5.32 kg/s (11.72 lbm/s)		6.65 kg/s (14.65 lbm/s)	
Max Allowable Back Pressure Low Emissions All Other	5 in WC 8 in WC					
Air Flow Requirements						
Engine Inlet Air Flow	220,800 slpm (7,800 scfm)		294,400 slpm (10,400 scfm)		368,000 slpm (13,000 scfm)	
Electronics Inlet Air Flow	306,000 slpm (10,800 scfm)		408,000 slpm (14,400 scfm)		510,000 slpm (18,000 scfm)	

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Technical Reference

Capstone MicroTurbine™ Systems Emissions

Summary

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

Maximum Exhaust Emissions at ISO Conditions

Table 1 below summarizes the exhaust emissions at full power and ISO conditions for different Capstone microturbine models. Note that the fuel can have a significant impact on certain emissions. For example landfill and digester gas can be made up of a wide variety of fuel elements and impurities, and typically contains some percentage of carbon dioxide (CO_2). This CO_2 dilutes the fuel, makes complete combustion more difficult, and results in higher carbon monoxide emissions (CO) than for pipeline-quality natural gas.

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

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

Notes:

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

Attachment B

Owner Requested Limit

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Attachment B
Owner Requested Limit

An application for an Owner Requested Limit (ORL) must include the information required in 18 AAC 50.225(b). The information required under 18 AAC 50.225(b) is addressed below.

18 AAC 50.225(b)(1)

Per 18 AAC 50.225(b)(1), a completed stationary source ID form is provided with this application.

18 AAC 50.225(b)(2)

Per 18 AAC 50.225(b)(2), a list of all emissions units (EUs) at the stationary source is provided in the stationary source ID form and in Attachment A of this application.

18 AAC 50.225(b)(3)

Per 18 AAC 50.225(b)(3), the calculated potential to emit air pollutants for the stationary source is provided in Attachment A of this application. The project is a proposed new stationary source, so no existing emissions units are in place at the stationary source. As a result, the actual emissions are zero.

18 AAC 50.225(b)(4)

Per 18 AAC 50.225(b)(4), a description of each proposed limit is provided in the section below. For each air pollutant, a calculation of the effect the limit will have on the stationary source's potential to emit and the allowable emissions are provided in Attachment A.

18 AAC 50.225(b)(5)

Per 18 AAC 50.225(b)(5), a description of a verifiable method to attain and maintain each limit, including monitoring and recordkeeping requirements is provided below and is proposed as a condition of the ORL.

1. Limit the cumulative volume of gas flared by the emergency/upset flare, EU ID 6, to no more than 200 million standard cubic feet (MMscf) per 12 consecutive month period.
    a. Install, maintain, and operate a non-resettable fuel gas flow meter on EU ID 6 accurate to within ± 5 percent.
    b. Record the fuel flow meter reading for EU ID 6 on the last day of each calendar month.
    c. No later than the end of each calendar month, calculate and record:

i. the total volume of gas combusted in MMscf by EU ID 6 during the previous month; and

ii. the total volume of gas combusted in MMscf by EU ID 6 during the previous 12 consecutive month period.

d. Report in each operating report required by the applicable permit issued for the source under AS 46.14.130(b) and 18 AAC 50, the volume of gas flared during each calendar month and 12 consecutive month period of the operating report period.

18 AAC 50.225(b)(6)

Per 18 AAC 50.225(b)(6), a citation to each requirement that the person seeks to avoid, including an explanation of why the requirement would apply in the absence of the limits and how the limits allow the person to avoid the requirement is provided below.

ASRC Energy Services Alaska, Inc. (AES) is requesting this ORL to allow for the installation and operation of the stationary source EUs while avoiding Title V operating permit applicability under 18 AAC 50.326 for carbon monoxide (CO) and volatile organic compounds (VOCs) and avoiding Title I air quality minor permit applicability under 18 AAC 50.502(c)(1) for nitrogen oxides (NO_X), sulfur dioxide (SO_2), and particulate matter with a diameter less than 2.5 micrometers ($PM_{2.5}$).

18 AAC 50.225(b)(8)

Per 18 AAC 50.225(b)(8), AES will comply with the proposed limit.

18 AAC 50.225(b)(9)

Per 18 AAC 50.225(b)(9), a certification, bearing the signature of the person requesting the limits, is provided in Section 7 of the Stationary Source ID form.