# ADMINISTRATIVE RECORD

Ukiu Energy, LLC

Application No. 0912-01 for Initial Permit

Six (6) 7.48 MW (Nominal) Wartsila Engine Generators

Located At: Pulehu Road and Upper Division Road, Kahului, Island of Maui

**CSP No. 0912-01-C**

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# Public Notice

**REQUEST FOR PUBLIC COMMENTS**
**ON DRAFT AIR PERMIT**
**REGULATING THE EMISSIONS OF AIR POLLUTANTS**

**(Docket No. 25-CA-PA-19)**

Pursuant to Hawaii Revised Statutes (HRS), Chapter 342B-13 and Hawaii Administrative Rules (HAR), Chapter 11-60.1, the Department of Health, State of Hawaii (DOH), is requesting public comments on the following **DRAFT PERMIT** presently under review for:

**Covered Source Permit (CSP) No. 0912-01-C**
Application No. 0912-01 for Initial Permit
Ukiu Energy, LLC
Six (6) 7.48 MW (Nominal) Wartsila Engine Generators
Located At: Pulehu Road and Upper Division Road, Kahului, Island of Maui
UTM: Zone 4Q; 768,845 m E, 2,307,383 m N (NAD-83)

The **DRAFT PERMIT** is described as follows:

**CSP No. 0912-01-C** will grant conditional approval to Ukiu Energy, LLC to construct and operate six (6) internal combustion engine generators in Kahului, Maui. Each of the engine generators has a nominal rating of 7.48 MW and can fire both liquid fuels and gaseous fuels. The engine generators will each be equipped with a selective catalytic reduction system and an oxidation catalyst to control emissions and have continuous emissions monitoring systems for nitrogen oxide and carbon monoxide emissions. The engine generators are subject to 40 CFR Part 60, Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines and 40 CFR Part 63, Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines.

The **ADMINISTRATIVE RECORD**, consisting of the **APPLICATION** and non-confidential supporting material from the applicant, the permit review summary, and the **DRAFT PERMIT**, is available for public inspection online at: http://health.hawaii.gov/cab/public-notices/ and at the following location during regular office hours, Monday through Friday, 7:45 a.m. to 4:15 p.m.:

**Oahu:**

State of Hawaii
Clean Air Branch
2827 Waimano Home Road, #130
Pearl City, Hawaii 96782

**Maui:**

Maui District Health Office, Department of Health
54 High Street, Room 300, Wailuku, Maui

All comments on the draft permit must be in writing, addressed to the Clean Air Branch at the above address and must be postmarked or received by **December 20, 2025**.

Any person may request a public hearing by submitting a written request that explains the party's interest and the reasons why a hearing is warranted.  The request for a public hearing must be received by December 9, 2025.  If requested, a public hearing will be held at 6:00 p.m. on December 15, 2025.  Information on the public hearing will be posted on the Department of Health's website at: https://health.hawaii.gov/cab/public-notices/ at least thirty (30) days in advance of the scheduled hearing date.  If no request for a public hearing is received, a cancellation notice will be posted on the Department of Health's website on December 12, 2025.

Interested persons may obtain copies of the administrative record or parts thereof at a copying cost of five (5) cents per page.  Please send written requests to the Oahu office of the Clean Air Branch listed above or call Ms. Kori Chun at the Clean Air Branch at (808) 586-4200.

Comments on the draft permit should address, but need not be limited to, the permit conditions and the facility's compliance with federal and state air pollution laws, including:  (1) the National and State Ambient Air Quality Standards; and (2) HRS, Chapter 342B and HAR, Chapter 11-60.1.

DOH invites comments regarding Native Hawaiian traditional and customary rights that may be affected or impaired by the proposed permit.

DOH will make a final decision on the permit after considering all comments and will send notice of the final decision to each person who has submitted comments or requested such notice.

Kenneth S. Fink, MD, MGA, MPH
Director of Health

# Draft Permit

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**CERTIFIED MAIL**
**RETURN RECEIPT REQUESTED**
**(XXXX XXXX XXXX XXXX XXXX)**

25-XXXE CAB
File No. 0912

DATE

Ms. Nicole Bulgarino
Executive Vice President
Ukiu Energy, LLC
101 Constitution Avenue, N.W.
Suite 525 East
Washington, DC 20001

Dear Ms. Bulgarino:

**SUBJECT: Covered Source Permit (CSP) No. 0912-01-C**
**Application No. 0912-01 for Initial Permit**
**Ukiu Energy, LLC**
**Six (6) 7.48 MW (Nominal) Wartsila Engine Generators**
**Located At: Pulehu Road and Upper Division Road, Kahului, Island of Maui**
**UTM: Zone 4; 768,845 m E, 2,307,383 m N (NAD-83)**
**Date of Expiration: DATE**

The subject CSP is issued in accordance with Hawaii Administrative Rules (HAR), Title 11, Chapter 60.1. The issuance of this permit is based on the plans, specifications, and information that you submitted as part of your application received on August 2, 2024, and additional information from correspondence between December 12, 2024, and September 22, 2025.

This CSP is issued subject to the conditions/requirements set forth in the following attachments:

Attachment I: Standard Conditions
Attachment II: Special Conditions
Attachment II – INSIG: Special Conditions – Insignificant Activities
Attachment III: Annual Fee Requirements
Attachment IV: Annual Emissions Reporting Requirements

The following forms are enclosed for your use and submittal as required:

Compliance Certification Form
Annual Emissions Report Form: Engine Generators
Monitoring Report Form: Engine Generators
Monitoring Report Form: Opacity Exceedances
Excess Emission and Monitoring System Performance Summary Report

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The following are enclosed for your use in monitoring visible emissions:

Visible Emissions Form Requirements, State of Hawaii
Visible Emissions Form

This permit: (a) shall not in any manner affect the title of the premises upon which the equipment is to be located; (b) does not release the permittee from any liability for any loss due to personal injury or property damage caused by, resulting from or arising out of the design, installation, maintenance, or operation of the equipment; and (c) in no manner implies or suggests that the Department of Health, Clean Air Branch (herein after referred to as Department), or its officers, agents, or employees, assumes any liability, directly or indirectly, for any loss due to personal injury or property damage caused by, resulting from or arising out of the design, installation, maintenance, or operation of the equipment.

If you have any questions, please contact Ms. Kori Chun of the Clean Air Branch at (808) 586-4200.

Sincerely,

JOANNA L. SETO, P.E., CHIEF
Environmental Management Division

KC:tkg

Enclosures

**ATTACHMENT I: STANDARD CONDITIONS**
**COVERED SOURCE PERMIT NO. 0912-01**
**Issuance Date: DATE** **Expiration Date: DATE**

This permit is granted in accordance with the HAR, Title 11, Chapter 60.1, Air Pollution Control, and is subject to the following Standard Conditions:

1. Unless specifically identified, the terms and conditions contained in this permit are consistent with the applicable requirement, including form, on which each term or condition is based.

   (Auth.: HAR §11-60.1-90)

2. This permit, or a copy thereof, shall be maintained at or near the source and shall be made available for inspection upon request. The permit shall not be willfully defaced, altered, forged, counterfeited, or falsified.

   (Auth.: HAR §11-60.1-6; SIP §11-60-11)[2]

3. This permit is not transferable whether by operation of law or otherwise, from person to person, from place to place, or from one piece of equipment to another without the approval of the Department, except as provided in HAR, Section 11-60.1-91.

   (Auth.: HAR §11-60.1-7; SIP §11-60-9)[2]

4. A request for transfer from person to person shall be made on forms furnished by the Department.

   (Auth.: HAR §11-60.1-7)

5. In the event of any changes in control or ownership of the facilities to be constructed or modified, this permit shall be binding on all subsequent owners and operators. The permittee shall notify the succeeding owner and operator of the existence of this permit and its conditions by letter, copies of which will be forwarded to the Department and the U.S. Environmental Protection Agency (EPA), Region 9.

   (Auth.: HAR §11-60.1-5, §11-60.1-7, §11-60.1-94)

6. The facility covered by this permit shall be constructed and operated in accordance with the application, and any information submitted as part of the application, for the CSP. There shall be no deviation unless additional or revised plans are submitted to and approved by the Department, and the permit is amended to allow such deviation.

   (Auth.: HAR §11-60.1-2, §11-60.1-4, §11-60.1-82, §11-60.1-84, §11-60.1-90)

7. This permit (a) does not release the permittee from compliance with other applicable statutes of the State of Hawaii, or with applicable local laws, regulations, or ordinances, and (b) shall not constitute, nor be construed to be an approval of the design of the covered source.

   (Auth.: HAR §11-60.1-5, §11-60.1-82)

8. The permittee shall comply with all the terms and conditions of this permit. Any permit noncompliance constitutes a violation of HAR, Chapter 11-60.1 and the Clean Air Act and is grounds for enforcement action; for permit termination, suspension, reopening, or amendment; or for denial of a permit renewal application.

   (Auth.: HAR §11-60.1-3, §11-60.1-10, §11-60.1-19, §11-60.1-90)

9. If any term or condition of this permit becomes invalid as a result of a challenge to a portion of this permit, the other terms and conditions of this permit shall not be affected and shall remain valid.

   (Auth.: HAR §11-60.1-90)

10. The permittee shall not use as a defense in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the terms and conditions of this permit.

    (Auth.: HAR §11-60.1-90)

11. This permit may be terminated, suspended, reopened, or amended for cause pursuant to HAR, Sections 11-60.1-10 and 11-60.1-98, and Hawaii Revised Statutes (HRS), Chapter 342B-27, after affording the permittee an opportunity for a hearing in accordance with HRS, Chapter 91.

    (Auth.: HAR §11-60.1-3, §11-60.1-10, §11-60.1-90, §11-60.1-98)

12. The filing of a request by the permittee for the termination, suspension, reopening, or amendment of this permit, or of a notification of planned changes or anticipated noncompliance does not stay any permit condition.

    (Auth.: HAR §11-60.1-90)

13. This permit does not convey any property rights of any sort, or any exclusive privilege.

    (Auth.: HAR §11-60.1-90)

14. The permittee shall <u>notify</u> the Department and U.S. EPA, Region 9, in writing of the following dates:

    a. The **anticipated date of initial start-up** for each emission unit of a new source or significant modification not more than sixty (60) days or less than thirty (30) days prior to such date;

b. The **actual date of construction commencement** within fifteen (15) days after such date; and
c. The **actual date of start-up** within fifteen (15) days after such date.

(Auth.: HAR §11-60.1-90)

15. The permittee shall furnish, in a timely manner, any information or records requested in writing by the Department to determine whether cause exists for terminating, suspending, reopening, or amending this permit, or to determine compliance with this permit. Upon request, the permittee shall also furnish to the Department copies of records required to be kept by the permittee. For information claimed to be confidential, the Director of Health (Director) may require the permittee to furnish such records not only to the Department but also directly to the U.S. EPA, Region 9, along with a claim of confidentiality.

(Auth.: HAR §11-60.1-14, §11-60.1-90)

16. The permittee shall notify the Department in writing of the **intent to shut down air pollution control equipment for necessary scheduled maintenance** at least twenty-four (24) hours prior to the planned shutdown. The submittal of this notice shall not be a defense to an enforcement action. The notice shall include the following:

a. Identification of the specific equipment to be taken out of service, as well as its location and permit number;
b. The expected length of time that the air pollution control equipment will be out of service;
c. The nature and quantity of emissions of air pollutants likely to be emitted during the shutdown period;
d. Measures such as the use of off-shift labor and equipment that will be taken to minimize the length of the shutdown period; and
e. The reasons why it would be impossible or impractical to shut down the source operation during the maintenance period.

(Auth.: HAR §11-60.1-15; SIP §11-60-16)[2]

17. **In the event any emission unit, air pollution control equipment, or related equipment malfunctions or breaks down in such a manner as to cause the emission of air pollutants in violation of HAR, Chapter 11-60.1 or this permit**, the permittee shall immediately notify the Department of the malfunction or breakdown, unless the protection of personnel or public health or safety demands immediate attention to the malfunction or breakdown and makes such notification infeasible. In the latter case, the notice shall be provided as soon as practicable. Within five (5) working days of this initial notification, the permittee shall also submit, in writing, the following information:

a. Identification of each affected emission point and each emission limit exceeded;
b. Magnitude of each excess emission;

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c. Time and duration of each excess emission;
d. Identity of the process or control equipment causing the excess emission;
e. Cause and nature of each excess emission;
f. Description of the steps taken to remedy the situation, prevent a recurrence, limit the excessive emissions, and assure that the malfunction or breakdown does not interfere with the attainment and maintenance of the National Ambient Air Quality Standards and State Ambient Air Quality Standards;
g. Documentation that the equipment or process was at all times maintained and operated in a manner consistent with good practice for minimizing emissions; and
h. A statement that the excess emissions are not part of a recurring pattern indicative of inadequate design, operation, or maintenance.

The submittal of these notices shall not be a defense to an enforcement action.

(Auth.: HAR §11-60.1-16; SIP §11-60-16)[2]

18. The permittee may request confidential treatment of any records in accordance with HAR, Section 11-60.1-14.

    (Auth.: HAR §11-60.1-14, §11-60.1-90)

19. This permit shall become invalid with respect to the authorized construction if construction is not commenced as follows:

    a. Within eighteen (18) months after the permit takes effect, is discontinued for a period of eighteen (18) months or more, or is not completed within a reasonable time.
    b. For phased construction projects, each phase shall commence construction within eighteen (18) months of the projected and approved commencement dates in the permit. This provision shall be applicable only if the projected and approved commencement dates of each construction phase are defined in Attachment II, Special Conditions, of this permit.

    (Auth.: HAR §11-60.1-9, §11-60.1-90)

20. The Department may extend the time periods specified in Standard Condition No. 19 upon a satisfactory showing that an extension is justified. Requests for an extension shall be submitted in writing to the Department.

    (Auth.: HAR §11-60.1-9, §11-60.1-90)

21. The permittee shall submit fees in accordance with HAR, Chapter 11-60.1, Subchapter 6.

    (Auth.: HAR §11-60.1-90)

22. All certifications shall be in accordance with HAR, Section 11-60.1-4.

    (Auth.: HAR §11-60.1-4, §11-60.1-90)

23. The permittee shall allow the Director, the Regional Administrator for the U.S. EPA and/or an authorized representative, upon presentation of credentials or other documents required by law:

    a. To enter the premises where a source is located or emission-related activity is conducted, or where records must be kept under the conditions of this permit and inspect at reasonable times all facilities, equipment, including monitoring and air pollution control equipment, practices, operations, or records covered under the terms and conditions of this permit and request copies of records or copy records required by this permit; and
    b. To sample or monitor at reasonable times substances or parameters to ensure compliance with this permit or applicable requirements of HAR, Chapter 11-60.1.

    (Auth.: HAR §11-60.1-11, §11-60.1-90)

24. Within thirty (30) days of **permanent discontinuance of the construction, modification, relocation, or operation of a covered source covered by this permit**, the discontinuance shall be <u>reported</u> in writing to the Department by a responsible official of the source.

    (Auth.: HAR §11-60.1-8; SIP §11-60-10)[2]

25. Each permit renewal application shall be submitted to the Department and the U.S. EPA, Region 9, no less than twelve (12) months and no more than eighteen (18) months prior to the permit expiration date. The Director may allow a permit renewal application to be submitted no less than six (6) months prior to the permit expiration date, if the Director determines that there is reasonable justification.

    (Auth.: HAR §11-60.1-101; 40 CFR §70.5(a)(1)(iii))[1]

26. The terms and conditions included in this permit, including any provision designed to limit a source's potential to emit, are federally enforceable unless such terms, conditions, or requirements are specifically designated as not federally enforceable.

    (Auth.: HAR §11-60.1-93)

27. The compliance plan and compliance certification submittal requirements shall be in accordance with HAR, Sections 11-60.1-85 and 11-60.1-86. As specified in HAR, Section 11-60.1-86, the compliance certification shall be submitted to the Department and the U.S. EPA, Region 9, once per year or more frequently as set by any applicable requirement.

    (Auth.: HAR §11-60.1-90)

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28. **Any document (including reports) required to be submitted by this permit shall be certified as being true, accurate, and complete by a responsible official in accordance with HAR, Sections 11-60.1-1 and 11-60.1-4, and shall be mailed to the following address:**

**State of Hawaii**
**Clean Air Branch**
**2827 Waimano Home Road, #130**
**Pearl City, Hawaii 96782**

**Upon request and as required by this permit, all correspondence to the State of Hawaii Department of Health associated with this CSP shall have duplicate copies forwarded to:**

**Manager**
**Enforcement Division, Air Section**
**U.S. Environmental Protection Agency, Region 9**
**75 Hawthorne Street, ENF-2-1**
**San Francisco, CA 94105**

(Auth.: HAR §11-60.1-4, §11-60.1-90)

29. To determine compliance with submittal deadlines for time-sensitive documents, the postmark date of the document shall be used. If the document was hand-delivered, the date received (“stamped”) at the Clean Air Branch shall be used to determine the submittal date.

(Auth.: HAR §11-60.1-5, §11-60.1-90)

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[1] The citations to the Code of Federal Regulations (CFR) identified under a particular condition, indicate that the permit condition complies with the specified provision(s) of the CFR. Due to the integration of the preconstruction and operating permit requirements, permit conditions may incorporate more stringent requirements than those set forth in the CFR.

[2] The citations to the State Implementation Plan (SIP) identified under a particular condition, indicate that the permit condition complies with the specified provision(s) of the SIP.

**ATTACHMENT II: SPECIAL CONDITIONS**
**COVERED SOURCE PERMIT NO. 0912-01-C**

**Issuance Date: DATE** **Expiration Date: DATE**

In addition to the Standard Conditions of the CSP, the following Special Conditions shall apply to the permitted facility:

## Section A. Equipment Description

1. This permit encompasses the following equipment and associated appurtenances:

   Six (6) 7.48 MW (Nominal) Wartsila Engine Generators, Model No. 16V34DF, Serial Nos. TBD, equipped with selective catalytic reduction (SCR) and oxidation catalyst.

   (Auth.: HAR §11-60.1-3)

2. An identification tag or nameplate shall be displayed on the equipment listed above to show the manufacturer, model number, and serial number, as applicable. The identification tag or nameplate shall be permanently attached to the equipment in a conspicuous location.

   (Auth.: HAR §11-60.1-5, §11-60.1-90)

## Section B. Applicable Federal Regulations

1. The engine generators are subject to the provisions of the following federal regulations:

   a. 40 CFR Part 60, Standards of Performance for New Stationary Sources, Subpart A, General Provisions;
   b. 40 CFR Part 60, Standards of Performance for New Stationary Sources, Subpart IIII, Standards of Performance for Stationary Compression Ignition Internal Combustion Engines;
   c. 40 CFR Part 63, National Emission Standards for Hazardous Air Pollutants for Source Categories, Subpart A, General Provisions; and
   d. 40 CFR Part 63, National Emission Standards for Hazardous Air Pollutants for Source Categories, Subpart ZZZZ, National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines.

2. The permittee shall comply with all applicable requirements of these standards, including all emission and operating limits, monitoring, recordkeeping, notification, reporting, and testing requirements. The major requirements of these standards are detailed in the special conditions of this permit.

   (Auth.: HAR §11-60.1-3, §11-60.1-90, §11-60.1-161, §11-60.1-174; 40 CFR Part 60, Part 63)[1]

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**<u>Section C</u>. <u>Operational and Emissions Limitations</u>**

1. Fuel Limits

   a. The engine generators shall be fired only on the following fuels:

      i. Liquid fuels, including biodiesel (B100), renewable diesel, fuel oil #2, and any combination thereof, with a maximum sulfur content not to exceed 0.0015% by weight (15 parts per million (ppm));
      ii. Gaseous fuels, including natural gas and renewable natural gas (RNG) with a maximum sulfur content not to exceed 5 ppm by volume (ppmv); and
      iii. Alternate fuels in accordance with Attachment II, Special Condition No. C.8.

   b. Each engine generator shall be fired with an annual average of two percent (2%) or more liquid fuel of total fuel on an energy equivalent basis to comply with the definition of a compression ignition engine as defined in 40 CFR Part 60, Subpart IIII.

   (Auth.: HAR §11-60.1-3, §11-60.1-38, §11-60.1-90; 40 CFR §60.4207, §60.4219)[1]

2. Startup Periods

   a. Each startup period for each engine generator shall not exceed thirty (30) minutes.
   b. Startup shall be defined as the period starting from the time fuel use at an engine generator begins and ending thirty (30) minutes later.
   c. Upon completion of a thirty (30) minute startup period, each engine generator shall be at forty percent (40%) or more of the nominal rated load (i.e., ≥2.99 MW) based on a fifteen (15) minute average basis, and the air pollution control equipment shall be operational.
   d. Except for shutdowns and as allowed by Attachment II, Special Condition No. C.8.b, upon completion of the startup period, the permittee shall not allow the operation of the engine generators below thirty percent (30%) of the nominal rated load (i.e., < 2.24 MW) at any time. Each engine generator shall be maintained at forty percent (40%) or more of the nominal rated load (i.e., ≥2.99 MW) determined on a fifteen (15) minute average basis.

   (Auth.: HAR §11-60.1-3, §11-60.1-90)

3. Air Pollution Control Equipment

   The permittee shall install, operate, and maintain a SCR system with ammonia or urea injection and an oxidation catalyst on each engine generator to meet the emission limits as specified in Attachment II, Special Condition No. C.4.a, and C.4.c. The SCR systems and oxidation catalysts shall be in operation whenever the engine generators are in operation, excluding startup and shutdown.

   (Auth.: HAR §11-60.1-3, §11-60.1-90)

4. Emission Limits

   a. The permittee shall not discharge or cause the discharge of nitrogen oxides ($NO_x$) as nitrogen dioxide ($NO_2$), carbon monoxide (CO), particulate matter 10 micrometers and 2.5 micrometers in diameter and smaller ($PM_{10}$ and $PM_{2.5}$), volatile organic compounds (VOC) as methane ($CH_4$), and ammonia ($NH_3$) into the atmosphere from each engine generator in excess of the following limits. These mass emission limits shall apply at all times with the exception of $NO_x$, CO, $PM_{10}/PM_{2.5}$, and VOC emission limits during any three-hour (3-hour) averaging period that includes a startup, as specified in Attachment II, Special Condition No. C.4.b:

| Pollutant | Maximum Emission Limits (each generator, 3-hour average) (lb/hr) | |
|---|---|---|
| | Liquid Fuels | Gaseous Fuels |
| $NO_x$ (as $NO_2$) | 8.64 | 1.32 |
| CO | 3.01 | 2.02 |
| $PM_{10}/PM_{2.5}$ | 3.61 | 1.61 |
| VOC (as $CH_4$) | 3.44 | 2.00 |
| $NH_3$ | 0.94 | 0.82 |

   b. The permittee shall not discharge or cause the discharge of $NO_x$, CO, and $PM_{10}/PM_{2.5}$ into the atmosphere from each engine generator during any hour that includes a startup, in excess of the following limits:

| Pollutant | Maximum Emission Limit (each generator, 1-hour average) (lb/hr, any fuel) |
|---|---|
| $NO_x$ (as $NO_2$) | 57.32 |
| CO | 12.01 |
| $PM_{10}/PM_{2.5}$ | 6.81 |

   c. The permittee shall not discharge or cause the discharge of $NO_x$ (as $NO_2$), CO, $PM_{10}$, $PM_{2.5}$, VOC (as $CH_4$), and $NH_3$ into the atmosphere from each engine generator in excess of the following limits:

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| Pollutant | Load Range | Maximum Emission Limit (each generator, 3-Hour Average) | | |
|---|---|---|---|---|
| | | Liquid Fuels | Gaseous Fuels | Units |
| $NO_x$ (as $NO_2$) | 75-100% | 35 | 6 | ppmvd at 15% $O_2$ |
| | 40-74% | 40 | 9 | |
| CO | 40-100% | 20 | 15 | ppmvd at 15% $O_2$ |
| $PM_{10}/PM_{2.5}$ | 75-100% | 30 | 15 | mg/Nm$^3$ at 15% $O_2$, dry |
| | 40-74% | 40 | 20 | |
| VOC (as $CH_4$) | 75-100% | 40 | 26 | ppmvd at 15% $O_2$ |
| | 50-74% | 40 | 37 | |
| | 40-49% | 40 | 42 | |
| $NH_3$ | All | 10 | 10 | ppmvd at 15% $O_2$ |

d. The permittee shall not discharge or cause the discharge of $NO_x$ (as $NO_2$), CO, and $PM_{10}/PM_{2.5}$ into the atmosphere from all engine generators in excess of the following annual limits, on any rolling twelve-month (12-month) period:

| Pollutant | Maximum Emission Limit (Total, all engines, tons/year) |
|---|---|
| $NO_x$ (as $NO_2$) | 220.2 |
| CO | 67.6 |
| $PM_{10}/PM_{2.5}$ | 72.5 |

e. The permittee shall not discharge or cause the discharge of $NO_X$ and filterable PM into the atmosphere from each engine generator in excess of the following limits. These emission limits shall apply at all times, except during startup, shutdown, and malfunction. During periods of startup, shutdown, and malfunction, the emission limits of Attachment II, Special Condition No. C.4.a, C.4.b, and C.4.c shall apply.

| Pollutant | Maximum Emission Limit |
|---|---|
| $NO_X$ (as $NO_2$) | 1.8 g/HP-hr (2.4 g/kW-hr)* |
| PM (Filterable) | 0.11 g/HP-hr (0.15 g/kW-hr) |

*Listed rate is based on 720 RPM (6.7n$^{-0.20}$ g/HP-hr (9.0n$^{-0.20}$ g/kW-hr) where n is the maximum engine speed.

f. The permittee shall not discharge or cause the discharge of carbon dioxide equivalent ($CO_2e$) into the atmosphere from the engine generators in excess of the following rolling twelve-month (12-month) limit calculated by summing 1,416 lb $CO_2e/MW_e$-hr times the $MW_e$-hr produced using liquid fuels, and 1,318 lb $CO_2e/MW_e$-hr times the $MW_e$-hr produced using gaseous fuels, divided by the total $MW_e$-hr produced.

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g. The total $NO_x$ emissions from the facility, including periods of engine generator startups, shutdowns, testing and maintenance, and malfunction or upset conditions, shall not equal or exceed 250 tons/year, on any rolling twelve-month (12-month) period. $NO_x$ emissions from the emergency diesel engine generator (DEG) shall also be included in the $NO_x$ emissions from the facility.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90; 40 CFR §60.4204)[1]

5. Visible Emissions (VE)

For any six (6) minute averaging period, the engine generators shall not exhibit VE of twenty percent (20%) opacity or greater, except as follows: during start-up, shutdown, or equipment breakdown, the engine generators may exhibit VE not greater than sixty percent (60%) opacity for a period aggregating not more than six (6) minutes in any sixty (60) minute period.

(Auth.: HAR §11-60.1-3, §11-60.1-32, §11-60.1-90)

6. Stack Height

The exhaust stacks for the engine generators shall be at a minimum height of 115 feet (35.05 meters) above ground elevation.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

7. Operation and Maintenance

a. The engine generators shall be properly maintained and kept in good operating condition at all times with scheduled inspections and maintenance as recommended by the manufacturer, and as needed. The permittee shall do all the following:

   i. Operate and maintain each engine and control device (if any) according to the manufacturer's emission-related written instructions;
   ii. Change only those emission-related settings that are permitted by the manufacturer; and
   iii. Meet the requirements of 40 CFR Part 1068, as they apply.

b. If the permittee does not install, configure, operate and maintain each unit and control device(s), if any, according to the manufacturer's emission-related written instructions, or emission-related settings are changed in a way that is not permitted by the manufacturer, compliance shall be demonstrated by keeping a maintenance plan and shall, to the extent practicable, maintain and operate the engine in a manner consistent with good air pollution control practice for minimizing emissions.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90; 40 CFR §60.4211)[1]

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8. Alternate Operating Scenarios

   a. The permittee may replace each engine generator with a temporary replacement unit if any repair reasonably warrants the removal of the engine generator from its site (i.e., equipment failure, engine overhaul, or any major equipment problems requiring maintenance for efficient operation) and the following provisions are adhered to:

      i. A request for the replacement unit shall be submitted in accordance with Attachment II, Special Condition No. E.8.a;
      ii. The temporary replacement unit must be similar in size with equal or lesser emissions and with similar stack parameters;
      iii. The temporary replacement unit shall comply with all applicable conditions including all air pollution control equipment requirements, operating restrictions, and emission limits;
      iv. The installation and operation of the temporary replacement unit (and any approved successive replacements) shall not exceed twelve (12) consecutive months, such that the total period in which the engine generator is removed from service does not exceed twelve (12) consecutive months;
      v. The engine generator shall be repaired and returned to service at the same location in a timely manner; and
      vi. Removal and return information shall be submitted in accordance with Attachment II, Special Condition No. E.8.b.

   The Department may require an ambient air quality assessment of the temporary replacement unit, and/or provide a conditional approval to impose additional monitoring, testing, recordkeeping, and reporting requirements to ensure the temporary unit is in compliance with the applicable requirements of the permitted unit being temporarily replaced.

   b. The engine generators may operate below forty percent (40%) of the nominal rated load (i.e., < 2.99 MW) for maintenance and testing periods as approved by the Department in accordance with Attachment II, Special Condition No. E.8.c. The maintenance and testing operation shall be performed for one of the following purposes:

      i. Evaluate the ability of an engine or its supported equipment to perform during an emergency;
      ii. Facilitate the training of personnel on emergency activities; or
      iii. Perform emissions testing, maintenance and operational testing, or safety-related testing as required by any government agency or by the manufacturer as a requirement of any law, regulation, rule, ordinance, standard, or contract.

   Operation during these periods shall not result in an exceedance of the emission limits of Attachment II, Special Condition No. C.4.

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c. Upon receiving approval from the Department, the permittee may fire the engine generators on an alternate fuel. The alternate fuel shall be burned only temporarily and shall not result in an increase in emissions of any air pollutant or in the emission of any air pollutant not previously emitted, or compliance with New Source Performance Standards (NSPS) or National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements that would not otherwise apply, or compliance with a requirement that is different from those specified in this permit. Requests for burning an alternate fuel shall be in accordance with Attachment II, Special Condition No. E.8.d.

d. Records shall be maintained in accordance with Attachment II, Special Condition No. D.10.

e. The terms and conditions under each operating scenario shall meet all applicable requirements, including special conditions of this permit.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

9. This source is exempt from a Prevention of Significant Deterioration (PSD) review due to the emission limits in Attachment II, Special Condition Nos. C.4.d. Any relaxation of these limits that increases the potential to emit above the applicable PSD thresholds will require a PSD evaluation of the source as though construction had not yet commenced on the source.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90; 40 CFR §52.21(r)(4))[1]

## Section D. Monitoring and Recordkeeping Requirements

1. Records

a. All records, including support information, shall be maintained for at least five (5) years from the date of the monitoring sample, measurement, test, report, or application. Support information includes all calibration, maintenance, inspection, and repair records and copies of all reports required by this permit. These records shall be true, accurate, and maintained in a permanent form suitable for inspection and be made available to the Department or their authorized representative(s) upon request.

b. Any records required to be maintained by 40 CFR Part 60, Subpart IIII that are submitted electronically via the EPA's Compliance and Emissions Data Reporting Interface (CEDRI) may be maintained in electronic format. This ability to maintain electronic copies does not affect the requirement for facilities to make records, data, and reports available upon request to the Department or the EPA as part of an on-site compliance evaluation.

(Auth.: HAR §11-60.1-3, §11-60.1-11, §11-60.1-90; 40 CFR §60.4214)[1]

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2. Fuel Consumption and Sulfur Content

   a. For each fuel delivery, records shall be maintained for fuel type, sulfur content, gross heat content, and quantity of fuel delivered for the engine generators. For liquid fuels, records for density shall also be maintained. Fuel sulfur content, gross heat content, and density may be demonstrated by providing the supplier's fuel specification sheet for the type of fuel purchased and received.
   b. Records shall be maintained for the quantity of each type of fuel fired in each engine generator on a monthly basis.
   c. The permittee shall keep, in a satisfactory manner, fuel supplier certification records of fuel sample test data, for each delivery of liquid fuel used in the engines, demonstrating that the fuel sulfur content meets the requirement of Attachment II, Special Condition No. C.1.a, and 40 CFR §60.4207. The certification or test data shall include the name of the fuel supplier or laboratory, and the sulfur content of the fuel.

   (Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-11, §11-60.1-90; 40 CFR §60.4207)[1]

3. Startup

   For each startup event and for each engine generator, the following records shall be maintained:

   a. The date, start and end time, duration (minutes); and
   b. Fuel type.

   (Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

4. Ammonia Slip

   Records shall be maintained on the amount of ammonia slip from the operation of the SCR system. Estimates of ammonia slip shall be based on the ammonia emission rates measured during the initial and subsequent annual performance tests required by Attachment II, Section F. Back-up data, calculations, and the resulting ammonia emissions shall be maintained on a monthly basis.

   (Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

5. Greenhouse Gas Emissions

   a. The permittee shall calculate on a monthly basis the amount of $CO_2$e emitted from the engine generators in accordance with 40 CFR Part 98, Subpart C. Compliance with the limit in Attachment II, Special Condition No. C.4.f shall be evaluated on a rolling twelve-month (12-month) basis, calculated by dividing the total $CO_2$e emissions (in lbs) from the most recent twelve-months (12-months) by the total electricity produced (in $MW_e$-hr) during the same period.

b. The average limit shall be calculated on a rolling twelve-month (12-month) period by summing 1,416 lb $CO_2e/MW_e$-hr times the $MW_e$-hr produced using liquid fuels, and 1,318 lb $CO_2e/MW_e$-hr times the $MW_e$-hr produced using gaseous fuels, then dividing the result by the total $MW_e$-hr produced during the same twelve-month (12-month) period.

Detailed supporting data and calculations shall be maintained for the purpose of demonstrating compliance with the limit in Attachment II, Special Condition No. C.4.f. The supporting data shall include but is not limited to monthly fuel consumption, $MW_e$-hr production by fuel type, and emissions calculations.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

6. Continuous Monitoring System (CMS)

The permittee shall install, operate, and maintain a CMS to measure and record the following parameters or data for each engine generator. The associated date and time of the monitored data shall also be recorded.

a. Operating load

i. The operating load (gross) in megawatts;
ii. The operating load (gross) at which ammonia flow to the SCR system is initiated and terminated; and
iii. The operating load (gross) at the end of each thirty (30) minute startup period.

b. Operating Hours

A non-resetting hour meter shall be installed, operated, and maintained on each engine generator for the permanent recording of the total amount of hours operated for the purpose of the calculating the $PM_{10}/PM_{2.5}$ emissions as described in Attachment II, Special Condition No. D.12.b. The non-resetting meter shall not allow the manual resetting or other manual adjustments of the meter readings. The installation of any new non-resetting meters or the replacement of any existing non-resetting meters shall be designed to accommodate a minimum of five (5) years of equipment operation, considering any operational limitations, before the meter returns to a zero reading. The following information shall be recorded for each engine generator for each fuel type:

i. Beginning and ending meter readings for each month;
ii. Total hours of operation for each month; and
iii. Total hours of operation on a rolling twelve-month (12-month) basis.

c. Fuel consumption using a flow metering system (liquid (gallon per minute) and gas (cubic foot per minute)); and

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d. $NO_x$, CO, and $CO_2$ or oxygen ($O_2$) concentrations in the stack gases using a continuous emissions monitoring system (CEMS). The CEMS shall be in continuous operation whenever the engine generator is in operation. The system shall meet the requirements of 40 CFR §60.13 and 40 CFR Part 60, Appendix B and Appendix F. If $CO_2$ is measured with the CEMS to adjust the pollutant concentration, the $CO_2$ correction factor equations listed in 40 CFR §60.4213(d)(3) shall be used to determine compliance with the applicable emissions limit. The emissions for $NO_x$ and CO shall be recorded in ppmvd at fifteen percent (15%) $O_2$ and lb/hr. CEMS data shall be reduced to one-hour (1-hour) averages in accordance with 40 CFR §60.13(h) for all operating hours, including startup. For startup periods, emission rates shall be recorded in one-minute (1-minute) increments.

   Quarterly accuracy audits and daily calibration drift tests shall be performed in accordance with 40 CFR Part 60, Appendix F. Successive quarterly audits shall occur no closer than two (2) months. The relative accuracy test audit (RATA) must be conducted at least once every four (4) calendar quarters. The RATA reports shall be postmarked by the **60th day** after completion of the RATA.

(Auth.: HAR §11-60.1-3, §11-60.1-11, §11-60.1-90, §11-60.1-161; 40 CFR §60.13)[1]

7. Malfunctions

The permittee shall maintain records of the occurrence and duration of any malfunction in the operation of the engine generators, air pollution control equipment, or any periods during which the CMS or monitoring device is inoperative.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-11, §11-60.1-90; 40 CFR §60.7)[1]

8. Performance Tests

Performance tests shall be conducted on the engine generators pursuant to Attachment II, Section F. Test plans, summaries, and results shall be maintained in accordance with the requirements of this section.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

9. Inspection, Maintenance, and Repair Log

An inspection, maintenance, and repair log shall be maintained for the equipment covered under this permit. Inspection and replacement of parts and repairs shall be well documented. At a minimum, the following records shall be maintained:

a. The date of the inspection/maintenance/repair work;
b. A description of the part(s) inspected or repaired;

c. A description of the findings and any maintenance or repair work performed; and
d. The name and title of the personnel performing the inspection/work.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

10. Alternate Operating Scenarios

a. The permittee shall contemporaneously with making a change from one operating scenario to another, record in a log at the permitted facility, the scenario under which it is operating.
b. The permittee shall maintain all records corresponding to the implementation of an alternate operating scenario specified in Attachment II, Special Condition No. C.8.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

11. Visible Emissions

The permittee shall conduct **monthly** (calendar month) VE observations for the engine generators by a certified reader in accordance with 40 CFR Part 60, Appendix A, Method 9, or U.S. EPA approved equivalent methods or alternative methods with prior written approval from the Department. For each month, two (2) consecutive six (6) minute observations shall be taken at fifteen (15) second intervals. Records shall be completed and maintained in accordance with the *Visible Emissions Form Requirements*.

(Auth.: HAR §11-60.1-3, §11-60.1-11, §11-60.1-32, §11-60.1-90)

12. Annual Tonnage Calculations

The permittee shall calculate and record the CO, $NO_x$, and $PM_{10}/PM_{2.5}$ emissions from the facility for all periods of operation, including during periods of startups, shutdowns, testing and maintenance, and malfunction or upset conditions, on a monthly and rolling twelve-month (12-month) basis to demonstrate compliance with Attachment II, Special Condition No. C.4.d. $NO_x$ emissions from the emergency DEG shall also be included in the $NO_x$ emissions from the facility to demonstrate compliance with Attachment II, Special Condition No. C.4.g. Detailed supporting data, calculations, and the resulting emission quantities shall be maintained.

a. The permittee shall use data from each engine generator's CO and $NO_x$ CEMS required by Attachment II, Special Condition No. D.6.d, using the following procedures:

   i. The permittee shall use the data conversion procedures in 40 CFR Part 60, Appendix A, Method 19 to determine the hourly mass emission rate of CO and $NO_x$ from the engine generators during all engine generator operating hours.

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ii. **Within 180 days of the issuance of the permit**, the permittee shall submit to the Department a protocol for the substitution of missing data for $NO_x$ and CO. The protocol shall include, but is not limited to, the methodology, justification, and quality assurance procedures proposed for data substitution for both $NO_x$ and CO. The permittee shall obtain written approval from the Department prior to implementing any missing data substitution procedures. The Department reserves the right to require revision to, or additional information about, the protocol.

b. The $PM_{10}/PM_{2.5}$ emissions per engine generator shall be calculated using the following equations, and emissions from each engine generator shall be summed to calculate the total $PM_{10}/PM_{2.5}$ emissions from all engine generators:

Liquid fuel operation:

Rolling 12-Month $Emissions_{LIQ}$ (tons/year) = [ ($\#Starts_{LIQ}$ x 5.0 lbs/start) + ($OpHours_{LIQ}$ – ($\#Starts_{LIQ}$ * 0.5)) * 3.61 lbs/hr)) ] / 2000 lbs/ton

Gaseous fuel operation:

Rolling 12-Month $Emissions_{GAS}$ (tons/year) = [ ($\#Starts_{GAS}$ x 2.0 lbs/start) + ($OpHours_{GAS}$ – ($\#Starts_{GAS}$ * 0.5)) * 1.61 lbs/hr)) ] / 2000 lbs/ton

Total Per Engine Generator:

Rolling 12-Month Emissions (tons/year) = Rolling 12-Month $Emissions_{LIQ}$ + Rolling 12-Month $Emissions_{GAS}$

Where:

$\#Starts_{LIQ}$ = Number of startups per year on liquid fuel
$\#Starts_{GAS}$ = Number of startups per year on gaseous fuel

The hours per twelve-month (12-month) rolling period ($OpHours_{GAS}$ and $OpHours_{LIQ}$) shall be based on the hour meter readings for gaseous and liquid fuel, respectively.

c. The emergency DEG's $NO_x$ emissions shall be calculated using the following equation:

Power (hp) x Emission Factor (lb/hp-hr) x Hours/Rolling twelve-month (12-month) period x ton/2000 lbs

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The $NO_x$ emission factor shall be based on data from the manufacturer, AP-42, or other data. The emission factor used shall receive prior written approval by the Department. The hours per rolling twelve-month (12-month) period shall be based on the hour meter reading. The power rating shall be based on the maximum power rating as specified by the manufacturer.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-11, §11-60.1-90)

13. Liquid Fuel-to-Total Fuel Ratio

The permittee shall calculate the parts liquid fuel to one hundred (100) parts total fuel on an energy equivalent basis each calendar year for each engine generator. Detailed supporting data and monthly calculations shall be maintained for the purpose of demonstrating compliance with the fuel limit in Attachment II, Special Condition No. C.1.b.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

14. Maintenance Plan

If the permittee does not install, configure, operate and maintain each engine and control device(s), if any, according to the manufacturer's emission-related written instructions, or the emission related settings are changed in a way that is not permitted by the manufacturer, a maintenance plan and records of conducted maintenance shall be kept in accordance with 40 CFR §60.4211(g)(3).

(Auth.: HAR §11-60.1-3, §11-60.1-90; 40 CFR §60.4211)[1]

15. 40 CFR Part 60, Subpart IIII Recordkeeping

The permittee shall keep records of the following information for each engine generator:

a. All notifications submitted to comply with 40 CFR Part 60, Subpart IIII and all documentation supporting any notification.
b. Maintenance conducted on each engine. The records shall adequately demonstrate compliance with either Attachment II, Special Condition C.7.a, or C.7.b.
c. Documentation that each unit meets the emission limits in Attachment II, Special Condition No. C.4.e.

(Auth.: HAR §11-60.1-3, §11-60.1-90; 40 CFR §60.4214)[1]

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## Section E. Notification and Reporting Requirements

1. Standard Conditions Reporting

   Notification and reporting pertaining to the following events shall be done in accordance with Attachment I, Standard Condition Nos. 14, 16, 17, and 24, respectively:

   a. Anticipated date of initial start-up, actual date of construction commencement, and actual date of start-up;
   b. Intent to shut down air pollution control equipment for necessary scheduled maintenance;
   c. Emissions of air pollutants in violation of HAR, Chapter 11-60.1 or this permit; and
   d. Permanent discontinuance of construction, modification, relocation, or operation of the facility covered by this permit.

   (Auth.: HAR §11-60.1-8, §11-60.1-15, §11-60.1-16, §11-60.1-90; SIP §11-60-10, §11-60-16)[2]

2. Deviations

   The permittee shall report in writing **within five (5) working days** any deviations from the permit requirements, including those attributed to upset conditions, the probable cause of such deviations, and any corrective actions or preventative measures taken. Corrective actions may include a requirement for additional source testing, more frequent monitoring, or could trigger implementation of a corrective action plan.

   (Auth.: HAR §11-60.1-3, §11-60.1-15, §11-60.1-16, §11-60.1-90)

3. Annual Emissions Reports

   a. As required by Attachment IV, Annual Emissions Reporting Requirements, and in conjunction with the requirements of Attachment III, Annual Fee Requirements, the permittee shall report **annually** the total tons per year emitted of each regulated air pollutant, including hazardous air pollutants. The report is due **within sixty (60) days following** the end of each calendar year. The following enclosed form, or equivalent, shall be used for reporting:

      **Annual Emissions Report Form: Engine Generators**

   b. Upon the permittee's written request, the deadline for annual emissions reporting may be extended, if the Department determines that reasonable justification exists for the extension.

   (Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-11, §11-60.1-90)

4. Monitoring Reports

The permittee shall submit **semi-annually** the following reports to the Department. The reports shall be submitted within **sixty (60) days** after the end of each semi-annual calendar period (January 1 - June 30 and July 1 - December 31) and shall be signed and dated by a responsible official. The following enclosed form, or equivalent form, shall be used for reporting:

**Monitoring Report Form: Engine Generators**; and
**Monitoring Report Form: Opacity Exceedances**

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-11, §11-60.1-90)

5. Excess Emissions

The permittee shall submit **semi-annually** to the Department and U.S. EPA, Region 9, an excess emissions and monitoring systems performance report and/or summary report for the engine generators in accordance with 40 CFR §§60.7(c) and (d).

a. If the total duration of excess emissions for the reporting period is less than one percent (1%) of the total operating time for the reporting period and CMS downtime for the reporting period is less than five percent (5%) of the total operating time for the reporting period, only the summary report form shall be submitted and the excess emission report described in 40 CFR §60.7(c) need not be submitted unless requested by the Department.
b. If the total duration of excess emissions for the reporting period is one percent (1%) or greater of the total operating time for the reporting period or the total CMS downtime for the reporting period is five percent (5%) or greater of the total operating time for the reporting period, the summary report form and the excess emission report described in 40 CFR §60.7(c) shall both be submitted. The excess emissions report shall include the following information:

    i. The magnitude of excess emissions computed in accordance with 40 CFR §60.13(h), any conversion factors used, and the date and time of commencement and completion of each time period of excess emissions. The process operating time during the reporting period.
    ii. Specific identification of each period of excess emissions that occurs during startups, shutdowns, and malfunctions of the engine generators. The nature and cause of any malfunction (if known) and the corrective action taken or preventive measures adopted.
    iii. The date and time identifying each period during which the CMS was inoperative except for zero and span checks, and the nature of the system repairs or adjustments.
    iv. When no excess emissions have occurred or the CMS has not been inoperative, repaired, or adjusted, such information shall be stated in the report.

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c. Excess emissions of $NO_x$ (as $NO_2$) shall be defined as any period in which any engine generator exceeds the $NO_X$ emission limits specified in Attachment II, Special Condition No. C.4.
d. Excess emissions of PM (filterable) shall be defined as any period in which any engine generator exceeds the PM (filterable) emission limits specified in Attachment II, Special Condition No. C.4.e.
e. Excess emissions of CO shall be defined as any period in which any engine generator exceeds the CO emission limit specified in Attachment II, Special Condition No. C.4.
f. Excess emissions indicated by the CMS shall be considered violations of the applicable emission limit for the purposes of this permit.
g. All reports shall be postmarked by the **30th day** following the end of each semi-annual calendar period (January 1 - June 30 and July 1 - December 31). The enclosed **Excess Emission and Monitoring System Performance Summary Report** form or an equivalent form shall be submitted.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90, §11-60.1-161; 40 CFR §60.7)[1]

6. Performance Tests

a. At least **thirty (30) days** prior to conducting a source performance test pursuant to Attachment II, Section F, the permittee shall submit a performance test plan in accordance with Attachment II, Special Condition No. F.4.
b. Within **sixty (60) days** after completion of a source performance test, the permittee shall submit a test report in accordance with Attachment II, Special Condition No. F.6.

(Auth.: HAR §11-60.1-3, §11-60.1-11, §11-60.1-90; 40 CFR §60.8)[1]

7. Compliance Certification

During the permit term, the permittee shall submit at least **annually** to the Department and U.S. EPA, Region 9, the attached **Compliance Certification Form** pursuant to HAR, Subsection 11-60.1-86. The permittee shall indicate whether or not compliance is being met with each term or condition of this permit. The compliance certification shall include, at a minimum, the following information:

a. The identification of each term or condition of the permit that is the basis of the certification;
b. The compliance status;
c. Whether compliance was continuous or intermittent;
d. The methods used for determining the compliance status of the source currently and over the reporting period;
e. Any additional information indicating the source’s compliance status with any applicable enhanced monitoring and compliance certification, including the requirements of Section 114(a)(3) of the Clean Air Act or any applicable monitoring and analysis provisions of Section 504(b) of the Clean Air Act;

f. Brief description of any deviations including identifying as possible exceptions to compliance any periods during which compliance is required and in which the excursion or exceedances as defined in 40 CFR Part 64 occurred; and
g. Any additional information as required by the Department, including information to determine compliance.

The compliance certification shall be submitted within **sixty (60) days** after the end of each calendar year and shall be signed and dated by a responsible official.

Upon written request of the permittee, the deadline for submitting the compliance certification may be extended, if the Department determines that reasonable justification exists for the extension.

(Auth.: HAR §11-60.1-4, §11-60.1-86, §11-60.1-90)

8. Alternate Operating Scenarios

a. The permittee shall submit a written request and receive prior written approval from the Department before exchanging an engine generator with a temporary replacement unit. The written request shall identify, at a minimum, the reasons for the replacement of the engine generator from the site of operation and the estimated time period/dates for the temporary replacement, type and size of the temporary unit, emissions data, and stack parameters. The Department may require an ambient air quality assessment of the temporary unit, and/or provide a conditional approval to impose additional monitoring, testing, recordkeeping, and reporting requirements to ensure the temporary unit is in compliance with the applicable requirements of the permitted unit being temporarily replaced.
b. Prior to the removal and return of the engine generator, the permittee shall submit to the Department written documentation on the removal and return dates and on the make, size, model, and serial numbers for both the temporary replacement unit and the installed unit.
c. The permittee shall submit a written request and receive prior written approval from the Department to operate an engine generator below forty percent (40%) of the nominal rated load (i.e., < 2.99 MW) for maintenance and testing as specified in Attachment II, Special Condition No. C.8.b. The written request shall identify, at a minimum, the unit number(s), a description of the maintenance/testing being performed, including the reason for operating below forty percent (40%) of the nominal rated load (i.e., < 2.99 MW), the operating status of the SCR system during the proposed maintenance/testing period, confirmation that operation during the proposed maintenance/testing period will not result in an exceedance of the emission limits of Attachment II, Special Condition No. C.4. and the estimated time period/dates for the event.
d. The permittee shall submit a written request and receive prior written approval from the Department to fire the engine generators on an alternate fuel. The written request shall include, but not be limited to, the following:

i. The type of fuel proposed;
ii. Information on the type of fuel proposed;
iii. Reason for using the alternate fuel;
iv. Emission rates for burning the alternate fuel;
v. Stack parameters when firing the alternate fuel;
vi. The estimated start and end dates for firing the alternate fuel. If the permittee intends to add the alternate fuel as a permitted fuel under Attachment II, Special Condition No. C.1.a.i or C.1.a.ii, they shall concurrently submit an application for a minor modification. The written request must specify the proposed end date for firing the alternate fuel, which shall correspond to the date the minor modification is issued by the Department;
vii. Documentation that burning the alternate fuel will not constitute a modification that would require compliance with NSPS or NESHAP requirements that would not otherwise apply; and
viii. Documentation that burning the alternate fuel will not require compliance with an applicable requirement that is different from those specified in this permit.

Within **thirty (30) days** after discontinuing the firing of the alternate fuel, the permittee shall notify the Department of the end date, in writing. The Department may require an ambient air quality assessment for firing the alternate fuel and/or provide a conditional approval to impose additional monitoring, testing, recordkeeping, and reporting requirements.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

9. Serial Number and Stack Heights

a. The permittee shall submit to the Department written notification of the serial numbers of each of the engine generator units within **fifteen (15) days** following the initial start-up of each unit.
b. The permittee shall submit to the Department written notification of the final constructed stack heights of each of the engine generator units within **fifteen (15) days** following the initial start-up of each unit.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

10. 40 CFR Part 60, Subpart IIII Initial Notification

The permittee shall submit an initial notification as required in 40 CFR §60.7(a)(1). The permittee shall submit the notification to the U.S. EPA, Region 9 electronically in accordance with Attachment II, Special Condition No. E.12, and to the Department. The notification shall include the following information:

a. Name and address of the owner or operator;
b. The address of the affected source;

c. Engine information including make, model, engine family, serial number, model year, maximum engine power, and engine displacement;
d. Emission control equipment; and
e. Fuel used at the time of commissioning.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90; 40 CFR §60.7, §60.4214)[1]

11. $NO_x$ and PM (Filterable)

a. The permittee shall submit to the U.S. EPA, Region 9, Permitting for approval, and to the Department, a plan for complying with the requirements of 40 CFR Part 60, Subpart IIII. The plan shall be submitted within thirty (30) days after the completion of the initial performance test required under Attachment II, Special Condition No. F.a.i. The plan shall include the information described in §§60.4211(d)(2)(i) through (v) to establish operating parameters to be monitored continuously to ensure that each engine generator continues to meet the emission standards for $NO_x$ and PM (filterable) as specified in Attachment II, Special Condition No. C.4.e.
b. Prior to approval of the plan by U.S. EPA, Region 9, the permittee shall comply with all measures and operating parameters proposed in the submitted plan. U.S. EPA, Region 9 may require revisions to the plan before approval. Upon approval of the plan, the permittee shall implement and comply with all provisions of the approved plan.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90; 40 CFR §60.4211)[1]

12. Compliance and Emissions Data Reporting Interface (CEDRI)

a. For notifications or reports required to be submitted to the U.S. EPA, Region 9 via CEDRI, which can be accessed through the EPA's Central Data Exchange (CDX) (https://cdx.epa.gov/), the procedures in 40 CFR §60.4214(g) shall be followed.
b. For reports required to be electronically submitted to the U.S. EPA, Region 9 through CEDRI in the EPA's CDX, the permittee may assert a claim of EPA system outage for failure to timely comply with that reporting requirement. To assert a claim of EPA system outage, the permittee shall meet the requirements outlined in 40 CFR §60.4214(h)(1) through (7).
c. For reports required to be electronically submitted to the U.S. EPA, Region 9 through CEDRI in the EPA's CDX, the permittee may assert a claim of force majeure for failure to timely comply with that reporting requirement. To assert a claim of force majeure, the permittee shall meet the requirements outlined in 40 CFR §60.4214(i)(1) through (5).

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90; 40 CFR §60.4214)[1]

**Section F. Testing Requirements**

1. Performance Testing

   a. Initial Performance Testing

      i. For each engine generator, within **sixty (60) days** after achieving the maximum production rate at which the generator will be operated, but not later than **180 days** after initial start-up on liquid fuel, the permittee shall conduct or cause to be conducted, performance tests on each engine generator to demonstrate compliance with the emission limits specified in Attachment II, Special Condition Nos. C.4.a, and C.4.c for $PM_{10}/PM_{2.5}$, VOC, and $NH_3$, and Attachment II, Special Condition No. C.4.e.
      ii. For each engine generator, within **sixty (60) days** after achieving the maximum production rate at which the generator will be operated, but not later than **180 days** after initial start-up on gaseous fuel, the permittee shall conduct or cause to be conducted, performance tests on each engine generator to demonstrate compliance with the emission limits specified in Attachment II, Special Condition Nos. C.4.a, and C.4.c for $PM_{10}/PM_{2.5}$, VOC, and $NH_3$.

   b. Subsequent Performance Testing

      i. For each engine generator, the permittee shall conduct subsequent performance tests to demonstrate compliance with the emission limits specified in Attachment II, Special Conditions No. C.4.a, and C.4.c for $PM_{10}/PM_{2.5}$, VOC, and $NH_3$ annually using the primary fuel for each engine generator at the time of the tests or other fuels as specified by the Department.
      ii. For each engine generator, the permittee shall conduct subsequent performance tests to demonstrate compliance with the emission limits specified in Attachment II, Special Condition No. C.4.e annually using liquid fuel.

   c. The performance tests to demonstrate compliance with the emission limits specified in Attachment II, Special Condition Nos. C.4.a, and C.4.c shall be conducted at the maximum expected operating capacity of the engine generators or highest achievable load. The Department may require testing at additional loads.
   d. The performance tests to demonstrate compliance with the emission limits specified in Attachment II, Special Condition No. C.4.e shall be conducted within ten percent (10%) of 100 percent (100%) peak (or the highest achievable) load.
   e. The performance tests shall consist of three (3) separate test runs and each test run shall last at least one (1) hour. For the purpose of determining compliance with an applicable standard, the arithmetic mean of results of the three (3) runs shall apply. The performance tests shall not be conducted during periods of startup, shutdown, or malfunction.

   (Auth.: HAR §11-60.1-3, §11-60.1-11, §11-60.1-90, §11-60.1-161; 40 CFR §60.8, §60.4213)[1]

**DRAFT**

2. Performance Test Methods

   a. $PM_{10}/PM_{2.5}$, VOC, and $NH_3$

      The performance tests to demonstrate compliance with the emission limits specified in Attachment II, Special Condition Nos. C.4.a, and C.4.c for $PM_{10}/PM_{2.5}$, VOC, and $NH_3$ shall be conducted, and the results reported in accordance with the test methods and procedures set forth in 40 CFR §60.8 and 40 CFR Part 60, Appendix A. The following test methods, U.S. EPA approved equivalent methods, or alternate methods with prior written approval from the Department shall be used:

      i. For the emissions of $PM_{10}/PM_{2.5}$, EPA Methods 1–4 and 201A for the filterable portion and EPA Method 202 for the condensable portion.
      ii. For the emissions of VOC, EPA Methods 1–4 and 25A or Method 18.
      iii. For the emissions of $NH_3$, EPA Conditional Test Method 027 (CTM-027).

   b. 40 CFR Part 60, Subpart IIII

      The performance tests to demonstrate compliance with the emission limits specified in Attachment II, Special Condition No. C.4.e shall be conducted, and the results reported in accordance with the test methods and requirements set forth in 40 CFR §60.8 and specific conditions specified in §60.4213 and Table 7 of 40 CFR Part 60, Subpart IIII. Mass emission rates of $NO_x$ shall be reported on an $NO_2$ basis.

   (Auth.: HAR §11-60.1-3, §11-60.1-11, §11-60.1-90, §11-60.1-161; 40 CFR §60.8, §60.4213)[1]

3. Performance Test Expense and Monitoring

   The performance tests shall be conducted at the expense of the permittee and the Department may monitor the tests.

   (Auth.: HAR §11-60.1-3, §11-60.1-11, §11-60.1-90)

4. Performance Test Plan

   At least **thirty (30) days** prior to conducting a performance test, the permittee shall submit a written performance test plan to the Department and U.S. EPA, Region 9, that includes date(s) of the test, test duration, test locations, test methods, source operation, and other parameters that may affect the test results. Such a plan shall conform to U.S. EPA guidelines including quality assurance procedures. A test plan or quality assurance plan that does not have the approval of the Department may be grounds to invalidate any test and require a retest.

   (Auth.: HAR §11-60.1-3, §11-60.1-11, §11-60.1-90; 40 CFR §60.8)[1]

**DRAFT**

5. Deviations

Any deviations from these conditions, test methods, or procedures may be cause for rejection of the test results unless such deviations are approved by the Department before the tests.

(Auth.: HAR §11-60.1-3, §11-60.1-11, §11-60.1-90)

6. Performance Test Report

Within **sixty (60) days** after completion of a performance test, the permittee shall submit to the Department and U.S. EPA, Region 9, the test report which shall include the operating conditions of the equipment at the time of the test, summarized test results, comparative results with the permit emission limits, other pertinent support calculations, and field/laboratory data. The results of the performance test demonstrating compliance with the emission limits in Attachment II, Special Condition No. C.4.e shall be submitted to the U.S. EPA, Region 9 in accordance with the procedures specified in 40 CFR §60.4214(f)(1) and (f)(2).

(Auth.: HAR §11-60.1-3, §11-60.1-11, §11-60.1-90; 40 CFR §60.8, §60.4214)[1]

7. Performance Test Waiver

Except for performance tests to demonstrate compliance with the emission limits specified in Attachment II, Special Condition No. C.4.e, upon written request and justification, the Department may waive the requirement for, or a portion of, a specific performance test. The waiver request is to be submitted prior to the required test and must include documentation justifying such action. Documentation should include, but is not limited to, the results of the prior performance test indicating compliance by a wide margin, documentation of continuing compliance, and further that operations of the source have not changed since the previous source test.

(Auth.: HAR §11-60.1-3, §11-60.1-90)

## Section G. Agency Notification

Any document (including reports) required to be submitted by this CSP shall be done in accordance with Attachment I, Standard Condition No. 28.

(Auth.: HAR §11-60.1-4, §11-60.1-90)

[1]The citations to the CFR identified under a particular condition, indicate that the permit condition complies with the specified provision(s) of the CFR. Due to the integration of the preconstruction and operating permit requirements, permit conditions may incorporate more stringent requirements than those set forth in the CFR.
[2]The citations to the SIP identified under a particular condition, indicate that the permit condition complies with the specified provision(s) of the SIP.

**ATTACHMENT II – INSIG**
**SPECIAL CONDITIONS – INSIGNIFICANT ACTIVITIES**
**COVERED SOURCE PERMIT NO. 0912-01-C**

**Issuance Date: DATE** **Expiration Date: DATE**

In addition to the Standard Conditions of the CSP, the following Special Conditions shall apply to the permitted facility:

## Section A. Equipment Description

This attachment encompasses insignificant activities listed in HAR §11-60.1-82(f) and (g) for which provisions of this permit and HAR, Subchapter 2, General Prohibitions, apply, including the following:

One (1) 755 bhp Cummins (or equivalent) Emergency DEG, Model DFEK (or equivalent).

(Auth.: HAR §11-60.1-3)

## Section B. Operational Limitations

1. The permittee shall take measures to operate applicable insignificant activities in accordance with the provisions of HAR, Subchapter 2 for VE, fugitive dust, incineration, process industries, sulfur oxides from fuel combustion, storage of VOC, VOC water separation, pump and compressor requirements, and waste gas disposal.

   (Auth.: HAR §11-60.1-3, §11-60.1-82, §11-60.1-90)

2. The Department may at any time require the permittee to further abate emissions if an inspection indicates poor or insufficient controls.

   (Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-82, §11-60.1-90)

## Section C. Monitoring and Recordkeeping Requirements

1. Hour Meter

   A non-resetting hour meter shall be installed, operated, and maintained on the emergency DEG for the permanent recording of the total number of hours operated for the purpose of demonstrating compliance with Attachment II, Special Condition No. C.4.g. The non-resetting meter shall not allow the manual resetting or other manual adjustments of the meter readings. The installation of any new non-resetting meters or the replacement of any existing non-resetting meters shall be designed to accommodate a minimum of five (5) years of equipment operation, considering any operational limitations, before the meter returns to a zero reading. The following information shall be recorded for the emergency DEG:

i. Date of meter reading;
ii. Beginning and ending meter readings for each month;
iii. Total hours of operation for each month; and
iv. Total hours of operation on a rolling twelve-month (12-month) basis.

(Auth.: HAR §11-60.1-3, §11-60.1-5, §11-60.1-90)

2. The Department reserves the right to require monitoring, recordkeeping, or testing of any insignificant activity to determine compliance with the applicable requirements.

   (Auth.: HAR §11-60.1-3, §11-60.1-90)

3. All records shall be maintained for at least five (5) years from the date of any required monitoring, recordkeeping, testing, or reporting. These records shall be true, accurate, and maintained in a permanent form suitable for inspection and made available to the Department or its authorized representative upon request.

   (Auth.: HAR §11-60.1-3, §11-60.1-11, §11-60.1-90)

**<u>Section D</u>. <u>Notification and Reporting</u>**

1. The permittee shall submit all necessary information regarding the emergency DEG to the Department and receive written approval prior to its purchase. The required information shall include, but is not limited to, the bhp rating, manufacturer, model number, serial number, emission rates, add-on air pollution controls, and a demonstration showing that the operation of the emergency DEG will not cause facility-wide $NO_x$ emissions to exceed 250 tons per year. This information shall be submitted to the Department at least **fifteen (15) days** prior to the purchase of the emergency DEG.

   (Auth.: HAR §11-60.1-3, §11-60.1-90)

2. Compliance Certification

   During the permit term, the permittee shall submit at least **annually** to the Department and U.S. EPA, Region 9, the attached **Compliance Certification Form** pursuant to HAR §11-60.1-86. The permittee shall indicate whether compliance is being met with each term or condition of this permit. The compliance certification shall include, at a minimum, the following information:

a. The identification of each term or condition of the permit that is the basis of the certification;
b. The compliance status;
c. Whether compliance was continuous or intermittent;
d. The methods used for determining the compliance status of the source currently and over the reporting period;
e. Any additional information indicating the source's compliance status with any applicable enhanced monitoring and compliance certification including the requirements of Section 114(a)(3) of the Clean Air Act or any applicable monitoring and analysis provisions of Section 504(b) of the Clean Air Act;
f. Brief description of any deviations including identifying as possible exceptions to compliance any periods during which compliance is required and in which the excursion or exceedances as defined in 40 CFR Part 64 occurred; and
g. Any additional information as required by the Department including information to determine compliance.

The compliance certification shall be submitted **within sixty (60) days** after the end of each calendar year, and shall be signed and dated by a responsible official.

Upon written request of the permittee, the deadline for submitting the compliance certification may be extended, if the Department determines that reasonable justification exists for the extension.

In lieu of addressing each emission unit as specified in the **Compliance Certification Form**, the permittee may address insignificant activities as a single unit provided compliance is met with all applicable requirements. If compliance is not totally attained, the permittee shall identify the specific insignificant activity and provide the details associated with the noncompliance.

(Auth.: HAR §11-60.1-4, §11-60.1-86, §11-60.1-90)

## <u>Section E</u>. <u>Agency Notification</u>

Any document (including reports) required to be submitted by this CSP shall be done in accordance with Attachment I, Standard Condition No. 28.

(Auth.: HAR §11-60.1-4, §11-60.1-90)

**ATTACHMENT III: ANNUAL FEE REQUIREMENTS**
**COVERED SOURCE PERMIT NO. 0912-01-C**

**Issuance Date: DATE** **Expiration Date: DATE**

The following requirements for the submittal of annual fees are established pursuant to HAR, Title 11, Chapter 60.1, Air Pollution Control. Should HAR, Chapter 60.1 be revised such that the following requirements are in conflict with the provisions of HAR, Chapter 60.1, the permittee shall comply with the provisions of HAR, Chapter 60.1.

1. Annual fees shall be paid in full:

   a. Within **120 days** after the end of each calendar year; and
   b. Within **thirty (30) days** after the permanent discontinuance of the covered source.

2. The annual fees shall be determined and submitted in accordance with HAR, Chapter 11-60.1, Subchapter 6.

3. The annual emissions data for which the annual fees are based shall accompany the submittal of any annual fees and be submitted on forms furnished by the Department.

4. The annual fees and the emission data shall be mailed to:

**State of Hawaii**
**Clean Air Branch**
**2827 Waimano Home Road, #130**
**Pearl City, Hawaii 96782**

**ATTACHMENT IV: ANNUAL EMISSIONS REPORTING REQUIREMENTS**
**COVERED SOURCE PERMIT NO. 0912-01-C**

**Issuance Date: DATE** **Expiration Date: DATE**

In accordance with the HAR, Title 11, Chapter 60.1, Air Pollution Control, the permittee shall report to the Department of Health the nature and amounts of emissions.

1. Complete the attached form(s):

   **Annual Emissions Report Form: Engine Generators**

2. The reporting period shall be from January 1 to December 31 of each year. All reports shall be submitted to the Department within **sixty (60) days** after the end of each calendar year and shall be mailed to the following address:

   **State of Hawaii**
   **Clean Air Branch**
   **2827 Waimano Home Road, #130**
   **Pearl City, Hawaii 96782**

3. The permittee shall retain the information submitted, including all emission calculations. These records shall be in a permanent form suitable for inspection, retained for a minimum of five (5) years, and made available to the Department upon request.

4. Any information submitted to the Department without a request for confidentiality shall be considered public record.

5. In accordance with HAR, Section 11-60.1-14, the permittee may request confidential treatment of specific information, including information concerning confidential processes or methods of manufacturing, by submitting a written request to the Director and clearly identifying the specific information that is to be accorded confidential treatment.

**COMPLIANCE CERTIFICATION FORM**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(PAGE 1 OF ___)**

**Issuance Date: DATE** **Expiration Date: DATE**

In accordance with the Hawaii Administrative Rules (HAR), Title 11, Chapter 60.1, Air Pollution Control, the permittee shall report to the Department of Health the following certification at least annually, or more frequently as requested by the Department of Health.

(Make Copies for Future Use)

For Period: ______________________________ Date: ______________

Company/Facility Name: ______________________________

Responsible Official (Print): ______________________________

Title: ______________________________

Responsible Official (Signature): ______________________________

I certify that I have knowledge of the facts herein set forth, that the same are true, accurate and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by Department of Health as public record. I further state that I will assume responsibility for the construction, modification, or operation of the source in accordance with the HAR, Title 11, Chapter 60.1, Air Pollution Control, and any permit issued thereof.

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**COMPLIANCE CERTIFICATION FORM**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(CONTINUED, PAGE 2 OF ___)**

**Issuance Date: DATE** **Expiration Date: DATE**

The purpose of this form is to evaluate whether or not the facility was in compliance with the permit terms and conditions during the covered period. If there were any deviations to the permit terms and conditions during the covered period, the deviation(s) shall be certified as *intermittent compliance* for the particular permit term(s) or condition(s). Deviations include failure to monitor, record, report, or collect the minimum data required by the permit to show compliance. In the absence of any deviation, the particular permit term(s) or condition(s) may be certified as *continuous compliance*.

**Instructions:**

Please certify Sections A, B, and C below for continuous or intermittent compliance. Sections A and B are to be certified as a group of permit conditions. Section C shall be certified individually for each operational and emissions limit condition as listed in the Special Conditions section of the permit (list all applicable equipment for each condition). Any deviations shall also be listed individually and described in Section D. The facility may substitute its own generated form in verbatim for Sections C and D.

## A. Attachment I, Standard Conditions

| Permit term/condition | Equipment | Compliance |
|---|---|---|
| All standard conditions | All equipment listed in the permit | ☐ Continuous<br>☐ Intermittent |

## B. Special Conditions - Monitoring, Recordkeeping, Reporting, Testing, and INSIG

| Permit term/condition | Equipment | Compliance |
|---|---|---|
| All monitoring conditions | All equipment listed in the permit | ☐ Continuous<br>☐ Intermittent |
| All recordkeeping conditions | All equipment listed in the permit | ☐ Continuous<br>☐ Intermittent |
| All reporting conditions | All equipment listed in the permit | ☐ Continuous<br>☐ Intermittent |
| All testing conditions | All equipment listed in the permit | ☐ Continuous<br>☐ Intermittent |
| All INSIG conditions | All equipment listed in the permit | ☐ Continuous<br>☐ Intermittent |

**COMPLIANCE CERTIFICATION FORM**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(CONTINUED, PAGE ___ OF ___)**

**Issuance Date: DATE** **Expiration Date: DATE**

## C. Special Conditions - Operational and Emissions Limitations

Each permit term/condition shall be identified in chronological order using attachment and section numbers (e.g., Attachment II, B.1, Attachment IIA, Special Condition No. B.1.f, etc.). Each piece of equipment shall be identified using the description stated in Section A of the Special Conditions (e.g., unit no., model no., serial no., etc.). Check all methods (as required by permit) used to determine the compliance status of the respective permit term/condition.

| Permit Term / Condition | Equipment | Method | Compliance |
|---|---|---|---|
| | | ☐ monitoring<br>☐ recordkeeping<br>☐ reporting<br>☐ testing<br>☐ none of the above | ☐ Continuous<br>☐ Intermittent |
| | | ☐ monitoring<br>☐ recordkeeping<br>☐ reporting<br>☐ testing<br>☐ none of the above | ☐ Continuous<br>☐ Intermittent |
| | | ☐ monitoring<br>☐ recordkeeping<br>☐ reporting<br>☐ testing<br>☐ none of the above | ☐ Continuous<br>☐ Intermittent |
| | | ☐ monitoring<br>☐ recordkeeping<br>☐ reporting<br>☐ testing<br>☐ none of the above | ☐ Continuous<br>☐ Intermittent |
| | | ☐ monitoring<br>☐ recordkeeping<br>☐ reporting<br>☐ testing<br>☐ none of the above | ☐ Continuous<br>☐ Intermittent |
| | | ☐ monitoring<br>☐ recordkeeping<br>☐ reporting<br>☐ testing<br>☐ none of the above | ☐ Continuous<br>☐ Intermittent |
| | | ☐ monitoring<br>☐ recordkeeping<br>☐ reporting<br>☐ testing<br>☐ none of the above | ☐ Continuous<br>☐ Intermittent |

(Make Additional Copies if Needed)

**COMPLIANCE CERTIFICATION FORM**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(CONTINUED, PAGE ___ OF ___)**

**Issuance Date: DATE** **Expiration Date: DATE**

## D. Deviations

| **Permit Term / Condition** | **Equipment / Brief Summary of Deviation** | **Deviation Period** time (am/pm) & date (mo/day/yr) | **Date of Written Deviation Report to DOH** (mo/day/yr) |
|---|---|---|---|
| | | Beginning:<br><br>Ending: | |
| | | Beginning:<br><br>Ending: | |
| | | Beginning:<br><br>Ending: | |
| | | Beginning:<br><br>Ending: | |
| | | Beginning:<br><br>Ending: | |
| | | Beginning:<br><br>Ending: | |
| | | Beginning:<br><br>Ending: | |

*Identify as possible exceptions to compliance any periods during which compliance is required and in which an excursion or exceedance as defined under 40 CFR Part 64 occurred.

**(Make Additional Copies if Needed)**

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**ANNUAL EMISSIONS REPORT FORM**
**ENGINE GENERATORS**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(PAGE 1 OF 2)**

**Issuance Date: DATE** **Expiration Date: DATE**

In accordance with the Hawaii Administrative Rules, Title 11, Chapter 60.1, Air Pollution Control, the permittee shall report to the Department of Health the nature and amounts of emissions.

(Make Copies for Future Use)

For Reporting Period:________________________________ Date:____________________

Company/Facility Name:________________________________________________________

**I certify that I have knowledge of the facts herein set forth, that the same are true, accurate, and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by the Department of Health as public record.**

Responsible Official (Print):____________________________________________________

Title: __________________________________________________________

Phone Number: __________________________________________________

Responsible Official (Signature): ____________________________________________

1. Report the maximum design heat input rate, total fuel consumption, and maximum sulfur content of each type of fuel fired during the calendar year:

| **Unit 1** | | | |
|---|---|---|---|
| Maximum Design Heat Input Rate | Fuel Type | Fuel Use | Maximum Sulfur Content |
| | | | |
| | | | |

| **Unit 2** | | | |
|---|---|---|---|
| Maximum Design Heat Input Rate | Fuel Type | Fuel Use | Maximum Sulfur Content |
| | | | |
| | | | |

**ANNUAL EMISSIONS REPORT FORM**
**ENGINE GENERATORS**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(CONTINUED, PAGE 2 OF 2)**

**Issuance Date: DATE** **Expiration Date: DATE**

| **Unit 3** | | | |
|---|---|---|---|
| Maximum Design Heat Input Rate | Fuel Type | Fuel Use | Maximum Sulfur Content |
| | | | |
| | | | |

| **Unit 4** | | | |
|---|---|---|---|
| Maximum Design Heat Input Rate | Fuel Type | Fuel Use | Maximum Sulfur Content |
| | | | |
| | | | |

| **Unit 5** | | | |
|---|---|---|---|
| Maximum Design Heat Input Rate | Fuel Type | Fuel Use | Maximum Sulfur Content |
| | | | |
| | | | |

| **Unit 6** | | | |
|---|---|---|---|
| Maximum Design Heat Input Rate | Fuel Type | Fuel Use | Maximum Sulfur Content |
| | | | |
| | | | |

**MONITORING REPORT FORM**
**ENGINE GENERATORS**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(PAGE 1 OF 6)**

**Issuance Date: DATE** **Expiration Date: DATE**

In accordance with the Hawaii Administrative Rules, Title 11, Chapter 60.1, Air Pollution Control, the permittee shall report to the Department of Health the following information **semi-annually**:

(Make Copies for Future Use)

For Reporting Period:________________________________ Date:__________________

Company/Facility Name:______________________________________________

**I certify that I have knowledge of the facts herein set forth, that the same are true, accurate, and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by the Department of Health as public record.**

Responsible Official (Print):______________________________________________

Title:________________________________ Phone Number:__________________

Responsible Official (Signature):__________________________________________

1. Report the maximum sulfur content of each type of fuel fired in each of the engine generators:

| Equipment ID | Liquid Fuel Type | Maximum Sulfur Content Liquid Fuel Type | Gaseous Fuel Type | Maximum Sulfur Content Gaseous Fuel Type |
|---|---|---|---|---|
| Unit 1 | | | | |
| Unit 2 | | | | |
| Unit 3 | | | | |
| Unit 4 | | | | |
| Unit 5 | | | | |
| Unit 6 | | | | |

**MONITORING REPORT FORM**
**ENGINE GENERATORS**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(CONTINUED, PAGE 2 OF 6)**

**Issuance Date: DATE** **Expiration Date: DATE**

2. Report all incidents when an engine generator was not at forty percent (40%) of more of the nominal rated load (i.e., ≥ 2.99 MW) upon completion of a thirty (30) minute startup period based on a fifteen (15) minute average basis:

| Date | Time | Duration | Reason for Incident / Corrective Actions Taken |
|---|---|---|---|
| | | | |
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3. Report all incidents when an engine generator was not maintained at forty percent (40%) or more of the nominal rated load (i.e., ≥ 2.99 MW) determined on a fifteen (15) minute average basis, upon completion of a thirty (30) minute startup period, excluding shutdown and as allowed by Attachment II, Special Condition No. C.8.b:

| Date | Time | Duration | Reason for Incident / Corrective Actions Taken |
|---|---|---|---|
| | | | |
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**MONITORING REPORT FORM**
**ENGINE GENERATORS**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(CONTINUED, PAGE 3 OF 6)**

**Issuance Date: DATE** **Expiration Date: DATE**

4. Report all incidents when an engine generator was operated below thirty percent (30%) of the nominal rated load (i.e., < 2.24 MW) upon completion of a thirty (30) minute startup period, excluding shutdown and as allowed by Attachment II, Special Condition No. C.8.b

| Date | Time | Duration | Reason for Incident / Corrective Actions Taken |
|---|---|---|---|
| | | | |
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5. Report all incidents when the selective catalytic reduction systems and oxidation catalysts were not fully functional and in operation, excluding startup and shutdown periods:

| Date | Time | Duration | Reason for Incident / Corrective Actions Taken |
|---|---|---|---|
| | | | |
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**MONITORING REPORT FORM**
**ENGINE GENERATORS**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(CONTINUED, PAGE 4 OF 6)**

**Issuance Date: DATE** **Expiration Date: DATE**

6. Report the total combined emissions of carbon dioxide equivalent ($CO_2e$) from the engine generators:

| Month | $MW_e$-hr Produced by Liquid Fuels (Gross, Monthly) | $MW_e$-hr Produced by Gaseous Fuels (Gross, Monthly) | Total Combined $CO_2e$ Emissions[1] Monthly Basis (lb $CO_2e$) | Total Combined $CO_2e$ Emissions[1] Rolling 12-Month Basis (lb/$MW_e$-hr, gross) | Greenhouse Gas Limit[2] Rolling 12-Month Basis (lb/$MW_e$-hr, gross) |
|---|---|---|---|---|---|
| January | | | | | |
| February | | | | | |
| March | | | | | |
| April | | | | | |
| May | | | | | |
| June | | | | | |
| July | | | | | |
| August | | | | | |
| September | | | | | |
| October | | | | | |
| November | | | | | |
| December | | | | | |

**Notes:**
1. The combined $CO_2e$ emissions shall be calculated in accordance with the methods in Attachment II, Special Condition No. D.5.a.
2. The limit shall be calculated in accordance with the method in Attachment II, Special Condition No. D.5.b

**MONITORING REPORT FORM**
**ENGINE GENERATORS**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(CONTINUED, PAGE 5 OF 6)**

**Issuance Date: DATE** **Expiration Date: DATE**

7. Report the facility emissions of $NO_x$, CO, and $PM_{10}/PM_{2.5}$. The emissions from the facility shall include all periods of operation including during periods of startups, shutdowns, testing and maintenance, and malfunction or upset conditions.

| Month | 6 Engine Generators | | Combined 6 Engine Generators and Emergency Generator | | CO Emissions Monthly Basis (TPY) | CO Emissions Rolling 12-Month Basis (TPY) | $PM_{10}/PM_{2.5}$ Emissions Monthly Basis[2] (TPY) | $PM_{10}/PM_{2.5}$ Emissions Rolling 12-Month Basis[2] (TPY) |
|---|---|---|---|---|---|---|---|---|
| | $NO_x$ Emissions Monthly Basis (TPY) | $NO_x$ Emissions Rolling 12-Month Basis (TPY) | $NO_x$ Emissions Monthly Basis[1] (TPY) | $NO_x$ Emissions Rolling 12-Month Basis[1] (TPY) | | | | |
| January | | | | | | | | |
| February | | | | | | | | |
| March | | | | | | | | |
| April | | | | | | | | |
| May | | | | | | | | |
| June | | | | | | | | |
| July | | | | | | | | |
| August | | | | | | | | |
| September | | | | | | | | |
| October | | | | | | | | |
| November | | | | | | | | |
| December | | | | | | | | |

[1]Submit a copy of the supporting data and $NO_x$ calculations for the emergency diesel engine generator as required by Attachment II, Special Condition No. D.12.c.
[2]Submit a copy of the supporting data and $PM_{10}/PM_{2.5}$ calculations required by Attachment II, Special Condition No. D.12.b.

**MONITORING REPORT FORM**
**ENGINE GENERATORS**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(CONTINUED, PAGE 6 OF 6)**

**Issuance Date: DATE** **Expiration Date: DATE**

8. Report the total fuel consumption of liquid fuels and gaseous fuels on an energy equivalent basis for each of the engine generators for the calendar year.

| Equipment ID | Liquid Fuels (MMBtu) | Gaseous Fuels (MMBtu) | Percentage of Liquid Fuel to Total Fuel[1] |
|---|---|---|---|
| Unit 1 | | | |
| Unit 2 | | | |
| Unit 3 | | | |
| Unit 4 | | | |
| Unit 5 | | | |
| Unit 6 | | | |

[1]Submit a copy of the supporting data and liquid fuel-to-total fuel calculations required by Attachment II, Special Condition No. D.13 that includes, at a minimum, the calculations for each unit for the calendar year.

**MONITORING REPORT FORM**
**OPACITY EXCEEDANCES**
**COVERED SOURCE PERMIT NO. 0912-01-C**

**Issuance Date: DATE** **Expiration Date: DATE**

In accordance with the Hawaii Administrative Rules, Title 11, Chapter 60.1, Air Pollution Control, the permittee shall report to the Department of Health the following information **semi-annually**:

(Make Copies for Future Use)

For Period:________________________ Date:____________

Company Name:________________________________

Facility Name:________________________________

Equipment Location:________________________________

**I certify that I have knowledge of the facts herein set forth, that the same are true, accurate, and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by the Department of Health as public record.**

Responsible Official (Print):________________________________

Title:____________________ Phone Number:____________

Responsible Official (Signature):________________________________

**Visible Emissions:**

Report the following on the lines provided below: all date(s) and six (6) minute average opacity reading(s) which the opacity limit was exceeded during the monthly observations; or if there were no exceedances during the monthly observations, then write "no exceedances" in the comment column.

| EQUIPMENT or EMISSION POINT DESCRIPTION | SERIAL/ID NO. | DATE | 6 MIN. AVER. (%) | COMMENTS |
|---|---|---|---|---|
| | | | | |
| | | | | |
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**DRAFT**

**EXCESS EMISSION AND MONITORING SYSTEM PERFORMANCE SUMMARY REPORT**
**COVERED SOURCE PERMIT NO. 0912-01-C**


**Issuance Date: DATE** **Expiration Date: DATE**

In accordance with the Hawaii Administrative Rules, Title 11, Chapter 60.1, Air Pollution Control, the permittee shall report to the Department of Health the following information **semi-annually**:

(Make Copies for Future Use)

Company Name:____________________

Facility Name:____________________

Equipment Location:____________________

Equipment Description:____________________

Serial/ID Number:____________________

**Pollutant Monitored:** ____________

From: Date: ____________ Time: ____________

To: Date: ____________ Time: ____________

Emission Limitation: ____________

Date of Last CMS Certification/Audit: ____________

**Total Source Operating Time[1]:** ____________

EMISSION DATA SUMMARY[1]

1. Duration of Excess Emissions in Reporting Period Due to:
   a. Startup/Shutdown.......................................... ____________
   b. Control Equipment Failure................................ ____________
   c. Process Problems.......................................... ____________
   d. Other Known Causes...................................... ____________
   e. Unknown Causes........................................... ____________
   Number of incidents of excess emissions............. ____________
2. Total Duration of Excess Emissions...................... ____________
3. Total Duration of Excess Emissions...................... ____________
   (% of Total Source Operating Time)[2]

**EXCESS EMISSION AND MONITORING SYSTEM PERFORMANCE SUMMARY REPORT**
**COVERED SOURCE PERMIT NO. 0912-01-C**
**(CONTINUED, PAGE 2 OF 2)**

**Issuance Date: DATE** **Expiration Date: DATE**

CMS PERFORMANCE SUMMARY[1]

1. CMS Downtime in Reporting Period Due to:
   a. Monitor Equipment Malfunctions.................... ____________
   b. Non-Monitor Equipment Malfunctions............ ____________
   c. Quality Assurance Calibration........................ ____________
   d. Other Known Causes.................................... ____________
   e. Unknown Causes.......................................... ____________
   Number of incidents of monitor downtime........... ____________
2. Total CMS Downtime.......................................... ____________
3. Total CMS Downtime.......................................... ____________
   (% of Total Source Operating Time)[2]

[1]For gases, record all times in hours.
[2]For the reporting period: If the total duration of excess emissions is one percent (1%) or greater of the total operating time or the total CMS downtime is five percent (5%) of greater of the total operating time, both the summary report form and the excess emission report described in §60.7(c) shall be submitted.

CERTIFICATION by Responsible Official

**I certify that I have knowledge of the facts herein set forth, that the same are true, accurate, and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by the Department of Health as public record.**

Responsible Official (Print):____________________________________________

Title:______________________________ Phone Number:____________________

Responsible Official (Signature):_________________________________________

**VISIBLE EMISSIONS FORM REQUIREMENTS**
**STATE OF HAWAII**
**COVERED SOURCE PERMIT NO. 0912-01-C**

**Issuance Date: DATE** **Expiration Date: DATE**

The ***Visible Emissions (VE) Form*** shall be completed **monthly** (*each calendar month*) for each equipment subject to opacity limits by a certified reader in accordance with 40 CFR Part 60, Appendix A, Method 9, or U.S. EPA approved equivalent methods, or alternative methods with prior written approval from the Department of Health and U.S. EPA. The VE Form shall be completed as follows:

1. VE observations shall take place during the day only. The opacity shall be noted in five percent (5%) increments (e.g., 25%).

2. Orient the sun within a 140-degree sector to your back. Provide a source layout sketch on the VE Form using the symbols as shown.

3. For VE observations of stacks, stand at least three (3) stack heights but not more than a quarter mile from the stack.

4. For VE observations of fugitive emissions from crushing and screening plants, stand at least 4.57 meters (fifteen (15) feet) from the VE source, but not more than a quarter mile from the VE source.

5. Two (2) consecutive six (6) minute observations shall be taken at fifteen (15) second intervals for each stack or emission point.

6. The six (6) minute average opacity reading shall be calculated for each observation.

7. If possible, the observations shall be performed as follows:

   a. Read from where the line of sight is at right angles to the wind direction.
   b. The line of sight shall not include more than one (1) plume at a time.
   c. Read at the point in the plume with the greatest opacity (without condensed water vapor), ideally while the plume is no wider than the stack diameter.
   d. Read the plume at fifteen (15) second intervals only. Do not read continuously.
   e. The equipment shall be operating at the maximum permitted capacity.

8. If the equipment was shut-down for that period, briefly explain the reason for shut-down in the comment column.

The permittee shall retain the completed VE Forms for recordkeeping. These records shall be in a permanent form suitable for inspection, retained for a minimum of five (5) years, and made available to the Department of Health, or their representative upon request.

Any required initial and annual performance test performed in accordance with Method 9 by a certified reader shall satisfy the respective equipment's VE monitoring requirements for the month the performance test is performed.

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**VISIBLE EMISSIONS FORM**
**COVERED SOURCE PERMIT NO. 0912-01-C**

**Issuance Date: DATE** **Expiration Date: DATE**

(Make Copies for Future Use for Each Stack or Emission Point)

Company Name:______________________________________________

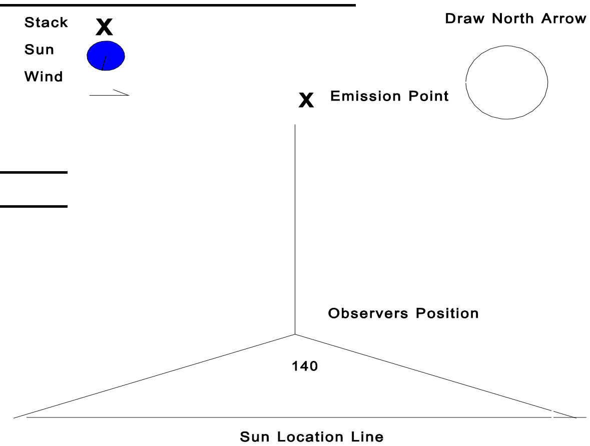
For stacks, describe equipment and fuel:_____________________________

For fugitive emissions from crushers and screens, describe:

Fugitive emission point:_________________________________________

Plant Production (tons/hr):___________

(During observation)




**Site Conditions:**

Emission point or stack height above ground (ft):_________

Emission point or stack distance from observer (ft):_______

Emission color (black or white):___________

Sky conditions (% cloud cover):___________

Wind speed (mph):____________________

Temperature (˚F):_____________________

Observer Name:______________________

Certified? (Yes/No):___________________

Observation Date and Start Time:______________________________

| | Seconds | | | | |
|---|---|---|---|---|---|
| MINUTES | 0 | 15 | 30 | 45 | COMMENTS |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| Six (6) Minute Average Opacity Reading (%): | | | | | |

Observation Date and Start Time:______________________________

| | Seconds | | | | |
|---|---|---|---|---|---|
| MINUTES | 0 | 15 | 30 | 45 | COMMENTS |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| Six (6) Minute Average Opacity Reading (%): | | | | | |

# Draft Review Summary

DRAFT

**PERMIT APPLICATION REVIEW**
**COVERED SOURCE PERMIT (CSP) NO. 0912-01-C**
**Application No. 0912-01 for Initial Permit**

| | |
|---|---|
| **APPLICANT:** | Ukiu Energy, LLC |
| **MAILING ADDRESS:** | 1001 Bishop Street, ASB Building<br>Suite 950<br>Honolulu, Hawaii 96813 |
| **FACILITY:** | Ukiu Energy, LLC<br>Six (6) 7.48 MW (Nominal)<br>Wartsila Engine Generators |
| **LOCATION:** | Pulehu Road and Upper Division Road,<br>Kahului, Island of Maui |
| **RESPONSIBLE OFFICIAL:** | Ms. Nicole Bulgarino<br>Executive Vice President, Ameresco<br>(865) 414-1341 |
| **OTHER CONTACT:** | Mr. Robert Albertini<br>Senior Director, Ameresco<br>(708) 710-5645 |
| **CONSULTANTS:** | Mr. Gary Rubenstein<br>Principal Engineer<br>Foulweather Consulting<br><br>Ms. Nancy Matthews<br>Foulweather Consulting<br>(916) 798-5665 |
| **SIC CODE:** | 4911 (Electric Services) |

**BACKGROUND:**

Ukiu Energy, LLC (Ukiu) submitted an application for an initial CSP. Ukiu is proposing to install and operate six (6) Wartsila 16V34DF generators, each rated at 7.48 MW (nominal). This new power plant project is being developed in response to a Request for Proposals from Maui Electric Company (MECO). The project is designed to interconnect to the Maui grid and to support grid stability to allow for more rooftop solar and other intermittent resources while also providing black start capacity to the island grid if needed to recover from a major grid outage.

The Wartsila generators are dual-fuel compression ignition engine generators designed to be fuel-flexible. The engines use a pilot fuel injection system to ignite the air-gas mixture in the cylinder when operating the engine in gaseous fuel mode. The engine operates in a binary mode of either liquid pilot fuel/gaseous fuel or one hundred percent (100%) liquid fuel. The calculations for gaseous fuel in this review account for pilot fuel injection. Ukiu is anticipating utilizing primarily liquid fuel (i.e., biodiesel (B100), renewable diesel, fuel oil #2, and any combination thereof) in the engine generators, with the capability of adding gaseous fuel (i.e., renewable natural gas and natural gas) in the future as it becomes available on Maui either in conjunction with the liquid fuel or solely. Per Ukiu, the values used in the application for liquid and gaseous fuel represent the worst-case values among the listed fuel types in the permit. The application used the terms "biodiesel" to represent liquid fuel and "renewable natural gas" to represent gaseous fuel, however, to avoid confusion and per the request of Ukiu, "liquid fuel" and "gaseous fuel" will be used throughout the permit and this review. For the purpose of this review, the term "liquid fuel" encompasses the proposed and accepted liquid fuels: biodiesel (B100), renewable diesel, and fuel oil #2, and any combination thereof; and the term "gaseous fuel" encompasses the proposed and accepted gaseous fuels: renewable natural gas and natural gas. Ukiu may request to temporarily fire an alternate fuel, however, they must provide adequate information for the fuel type to be approved. Details are included in the **ALTERNATE OPERATING SCENARIOS** section.

The engines operate on the lean burn principle (i.e., the mixture of air and gas in the cylinder contains more air than is needed for complete combustion). Lean combustion reduces peak temperatures and therefore $NO_x$ emissions. Additionally, each Wartsila generator (unit) will be equipped with an emission control system consisting of Selective Catalyst Reduction (SCR) for nitrogen oxide ($NO_x$) emissions control and oxidation catalysts to control carbon monoxide (CO), volatile organic compounds (VOCs) and hazardous air pollutant (HAP) emissions, continuous emissions monitoring system (CEMS) and associated support equipment.

Ukiu requested to maintain flexibility in their operations by maintaining the ability to operate any or all the engines up to twenty-four (24) hours per day, seven (7) days per week, with their annual operations limited through emission limitations. Ukiu proposed emission limits (tons per year (TPY)) based on the maximum potential to emit from their three (3) typical operating scenarios. The three (3) typical operating scenarios are detailed in the **PROJECT EMISSIONS** section. These emission limits are not dependent on the fuel being burned and will apply at all times, including startup, shutdown, maintenance and testing events, and malfunction. Ukiu also proposed pound per hour (lb/hr) limits based on a three (3) hour averaging period to remain consistent with their assumptions in their ambient air quality impact analysis. The lb/hr limits will apply at all times, with the exception of $NO_x$, CO, VOC, and $PM_{10}$/$PM_{2.5}$ emission limits during any three (3) hour averaging period that includes a startup and are based on the manufacturer's emissions data for the units. During any hour that includes a startup, Ukiu proposed maximum emission limits for $NO_x$, CO, and $PM_{10}$/$PM_{2.5}$ to remain consistent with their assumptions in their ambient air quality impact analysis and as a method to meet the Best Available Control Technology (BACT) requirements during startup. For BACT, Ukiu also proposed concentration emission limits that will apply for the load ranges that the engine generators will operate within during normal operations (i.e., forty percent (40%) – one hundred percent (100%)). The CEMS will continuously measure and record the $NO_x$ and CO emissions from each engine.

In addition to the six (6) engine generators, Ukiu is proposing to construct a 755 bhp Cummins (or equivalent) emergency diesel engine generator (DEG) adjacent to the six (6) engine generators. The new emergency DEG will provide black start capability for the engine generators in the event of complete loss of power from the grid. The proposed emergency DEG will be used solely during emergencies and is considered an insignificant activity pursuant to HAR §11-60.1-82(f)(5). Potential emissions from the emergency DEG are detailed under the **INSIGNIFICANT ACTIVITIES/ EXEMPTIONS** and accounted for in the Total Project Emissions sections.

The application for an initial CSP was received in August 2024. This review is based on the application for an initial CSP received on August 2, 2024, the Ambient Air Quality Analysis (AAQA) report by Trinity Consultants for Ukiu submitted on August 6, 2024, and subsequent emails between DOH and the consultants for Ukiu from August 7, 2024 through September 22, 2025. The application fee for an initial covered source permit (major, non-toxic) of $4,000.00 was processed.

**EQUIPMENT:**

Six (6) 7.48 MW (Nominal) Wartsila Engine Generators, Model No. 16V34DF, Serial Nos. TBD, equipped with SCR and oxidation catalyst.

**APPLICABLE REQUIREMENTS:**

Hawaii Administrative Rules (HAR)

- Title 11, Chapter 59, Ambient Air Quality Standards
- Title 11, Chapter 60.1, Air Pollution Control
  - Subchapter 1, General Requirements
  - Subchapter 2, General Prohibitions
    - 11-60.1-31, Applicability
    - 11-60.1-32, Visible Emissions
    - 11-60.1-38, Sulfur Oxides from Fuel Combustion
  - Subchapter 5, Covered Sources
  - Subchapter 6, Fees for Covered Sources, Noncovered Sources, and Agricultural Burning
    - 11-60.1-111, Definitions
    - 11-60.1-112, General Fee Provisions for Covered Sources
    - 11-60.1-113, Application Fees for Covered Sources
    - 11-60.1-114, Annual Fees for Covered Sources
  - Subchapter 8, Standards of Performance for Stationary Sources
    - 11-60.1-161, New Source Performance Standards
  - Subchapter 9, Hazardous Air Pollutant Sources
  - Subchapter 10, Field Citations

New Source Performance Standards (NSPS), 40 CFR Part 60
Subpart IIII, *Standards of Performance for Stationary Compression Ignition (CI) Internal Combustion Engines (ICE)*, is applicable to the engine generators because the engines commenced construction after July 11, 2005, and were manufactured after April 1, 2006. For purposes of Subpart IIII, the date that construction commences is the date the engine is ordered. To comply with the definition of a compression ignition engine as defined in 40 CFR Part 60, Subpart IIII, each engine generator shall be fired with an annual average of two percent (2%) or more liquid fuel of total fuel on an energy equivalent basis. The permittee shall comply with the applicable emission standards and compliance requirements for engines with a displacement of greater than or equal to thirty (30) liters per cylinder.

National Emission Standards for Hazardous Air Pollutants for Source Categories (Maximum Achievable Control Technology (MACT)), 40 CFR Part 63
Subpart ZZZZ, *National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines (RICE)*, is applicable to the engine generators because the engines are new stationary RICE. A stationary RICE located at an area source of HAP emissions is new if you commenced construction of the stationary RICE on or after June 12, 2006. A new stationary RICE located at an area source must meet the requirements of this part by meeting the requirements of 40 CFR Part 60, Subpart IIII. No further requirements apply for such engines under this part.

Air Emissions Reporting Requirements (AERR), 40 CFR Part 51, Subpart A
This source is subject to AERR since potential emissions from the facility, accounting for limits, exceed respective AERR threshold levels for Type B sources, as shown in the table below:

| Pollutant | Total Emissions (Limited) (TPY) | AERR Trigger Level 3-Year Cycle (Type B) (TPY) |
|---|---|---|
| CO | 67.6 | ≥1000 |
| $NO_x$ | 220.2 | ≥100 |
| $PM_{10}$ | 72.5 | ≥100 |
| $PM_{2.5}$ | 72.5 | ≥100 |
| $SO_2$ | 2.0 | ≥100 |
| VOC | 65.2 | ≥100 |

Best Available Control Technology (BACT)
A BACT analysis is required for new sources and significant modifications to sources that have the potential to emit or increase emissions above significant levels as defined in HAR §11-60.1-1 considering any limitations.

BACT means an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant, which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other cost, determines is achievable.

To determine BACT, available control options were ranked in descending order of effectiveness. Control technology alternatives are identified based on knowledge of the industry and previous regulatory decisions for other identical or similar sources. These alternatives are organized into a control technology hierarchy. The hierarchy is evaluated starting with the most stringent alternative, to determine economic, environmental, and energy impacts. If the most stringent alternative is not applicable, technically infeasible, or is economically infeasible, it is eliminated as BACT, and the next most stringent alternative is then considered. This process is continued until a control alternative is determined to be both technically and economically feasible, defining the emission level corresponding to BACT for the pollutant. In summary, the process consists of five steps:

1. Identify all available control options with practical potential for application to the specific emission unit for the regulated pollutant under evaluation;
2. Eliminate technically infeasible technology options;

3. Rank remaining control technologies by control effectiveness;
4. Evaluate the most effective control alternative and document results, considering energy, environmental, and economic impacts as appropriate; if the top option is not selected as BACT, evaluate the next most effective control option; and
5. Select BACT, which will be the most stringent technology not rejected based on technical, energy, environmental, and economic considerations.

| BACT Applicability | | |
|---|---|---|
| **Pollutant** | **Total Emissions (Limited) (TPY)** | **BACT Threshold Significant Amounts (TPY)** |
| CO | 67.6 | 100 |
| $NO_X$ | 220.2 | 40 |
| $SO_2$ | 2.0 | 40 |
| PM | 52.0 | 25 |
| $PM_{10}$ | 72.5 | 15 |
| $PM_{2.5}$ | 72.5 | 10 |
| VOC | 65.2 | 40 |
| GHGs | 260,090 | 40,000 |

The proposed project is subject to BACT for $NO_x$, PM, $PM_{10}$, $PM_{2.5}$, VOC, and GHGs. A BACT analysis was conducted by the applicant for the engine generators and is summarized below. Although the proposed project is not subject to BACT for CO, the applicant provided a BACT analysis for CO that is included here.

A search of the EPA RACT/BACT/LAER Clearinghouse (RBLC) in September 2025 starting with Calendar Year 2018 identified four (4) permits for similar sized, liquid-fueled compression ignition internal combustion engines (CI ICE) with a displacement of greater than or equal to thirty (30) liters per cylinder and subject to NSPS Subpart IIII: (1) Dutch Harbor Power Plant in Unalaska, Alaska; (2) Donlin Gold Project in Crooked Creek, Alaska; (3) Commonwealth LNG, LLC in Cameron Parish, Louisiana; and (4) Xcel Energy Blue Lake in Shakopee, Minnesota. Although not in the RBLC, the Humboldt Bay Repowering Project (HBRP) in Eureka, California, obtained a PSD permit in 2008. In addition, Puuloa Energy LLC (Puuloa) in Honolulu, Hawaii received a permit from the Department of Health (Department) in 2025 for similarly sized Wartsila engine generators.

- The Dutch Harbor Power Plant units were scheduled to be installed in the second phase of the project. However, the second phase was revised and different units with displacements of less than thirty (30) liters per cylinder were installed.
- The Donlin Gold Project units are twelve (12) 17 MW Wartsila 18V50DF ultra-low sulfur diesel (ULSD)/ natural gas-fired ICE. The units are equipped with oxidation catalysts and SCR.
- The Commonwealth LNG, LLC facility obtained a permit to install 4.29 MW diesel-fueled generators in Louisiana in 2023. The generators are primarily fired on diesel fuel. The facility will meet their limits through operating the engines per manufacturers’ instructions and written procedures designed to maximize combustion efficiency and minimize fuel usage.

- The Xcel Energy Blue Lake facility obtained a permit to install three (3) 9.37 MW dual-fuel engine generators in 2024. The generators are primarily fired on natural gas with ULSD as a secondary fuel. The units are equipped with oxidation catalysts and SCR.
- HBRP has ten (10) 16.3 MW Wartsila 18V50DF engines equipped with SCR and oxidation catalyst. The units are primarily fired on natural gas with ULSD as a backup fuel. The usage of diesel is limited to a maximum total of 1,000 operating hours per year for all ten (10) units combined.
- Puuloa will have eleven (11) 9.84 MW Wartsila 20V34DF engines equipped with SCR and oxidation catalyst. The units will be fired on renewable natural gas, biodiesel, and other liquid and gaseous fuels.

The table below summarizes the proposed BACT emission limits for the units. The following assumptions apply:

- Emissions based on manufacturer maximum not-to-exceed data.
- Concentration-based emission limits for $NO_x$, CO, PM/$PM_{10}$/$PM_{2.5}$, and VOC are provided for both liquid and gaseous fuels and apply to load ranges between forty percent (40%) – one hundred percent (100%) of the unit’s nominal rated load.
- The greenhouse gas (GHG) limit is based on emission rates at forty percent (40%) of the unit’s nominal rated load.

<table>
<tr><th colspan="4">BACT Summary</th></tr>
<tr><th>Pollutant/<br>Operation</th><th>Emission Limits<br>Liquid Fuel</th><th>Emission Limits<br>Gaseous Fuel</th><th>Testing and<br>Monitoring</th></tr>
<tr><td>$NO_x$</td><td>35 ppmvd @ 15% $O_2$<br>(75%-100% Load)<br><br>40 ppmvd @ 15% $O_2$<br>(40%-74% Load)<br><br>57.32 lb/hr during any hour that includes a startup</td><td>6 ppmvd @ 15% $O_2$<br>(75%-100% Load)<br><br>9 ppmvd @ 15% $O_2$<br>(40%-74% Load)<br><br>57.32 lb/hr during any hour that includes a startup</td><td>CEMS</td></tr>
<tr><td>CO</td><td>20 ppmvd @ 15% $O_2$<br>(40%-100% Load)<br><br>12.01 lb/hr during any hour that includes a startup</td><td>15 ppmvd @ 15% $O_2$<br>(40%-100% Load)<br><br>12.01 lb/hr during any hour that includes a startup</td><td>CEMS</td></tr>
<tr><td>PM<br>(Filterable)</td><td>0.15 g/kW-hr (100% Load)</td><td rowspan="2">15 $mg/Nm^3$ @ 15% $O_2$, dry<br>(75%-100% Load)<br><br>20 $mg/Nm^3$ @ 15% $O_2$, dry<br>(40%-74% Load)<br><br>6.81 lb/hr during any hour that includes a startup</td><td rowspan="2">Annual source performance testing</td></tr>
<tr><td>$PM_{10}$/$PM_{2.5}$</td><td>30 $mg/Nm^3$ @ 15% $O_2$, dry<br>(75%-100% Load)<br><br>40 $mg/Nm^3$ @ 15% $O_2$, dry<br>(40%-74% Load)<br><br>6.81 lb/hr during any hour that includes a startup</td></tr>
</table>

| BACT Summary | | | |
|---|---|---|---|
| **Pollutant/ Operation** | **Emission Limits Liquid Fuel** | **Emission Limits Gaseous Fuel** | **Testing and Monitoring** |
| VOC | 40 ppmvd @ 15% $O_2$ (40%-100% Load) | 26 ppmvd @ 15% $O_2$ (75%-100% Load)<br><br>37 ppmvd @ 15% $O_2$ (50%-74% Load)<br><br>42 ppmvd @ 15% $O_2$ (40%-49% Load) | Annual source performance testing |
| GHG | Monthly rolling twelve-month (12-month) limit calculated by summing 1,416 lb $CO_2e/MW_e$-hr times the $MW_e$-hr produced using liquid fuels, and 1,318 lb $CO_2e/MW_e$-hr times the $MW_e$-hr produced using gaseous fuels, divided by the total $MW_e$-hr produced | | Monthly emission calculations |
| Startup/ Shutdown | • Each startup period not to exceed thirty (30) minutes<br>• Excluding shutdown and previously approved maintenance and testing events, upon completion of a thirty (30) minute startup period, the permittee shall not allow the operation of the engine generators below thirty percent (30%) of the nominal rated load (i.e., <2.24 MW) at any time. Each engine generator shall be maintained at forty percent (40%) or more of the nominal rated load (i.e., ≥2.99 MW) determined on a fifteen (15) minute average basis. | | Operating Load Monitoring System |

<u>$NO_x$</u>
BACT must be at least as stringent as the applicable NSPS limits. The applicable NSPS limit for $NO_x$ and its comparison to the proposed BACT limit is as follows:

| Comparison of BACT Limits with NSPS Limits - $NO_x$ | |
|---|---|
| Subpart IIII $NO_x$ Limit | 1.8 g/HP-hr (2.4 g/kW-hr)[1] |
| BACT $NO_x$ Limit (Liquid Fuel) | 0.52 g/kW-hr (75%-100% Load)<br>0.65 g/kW-hr (40%-74% Load) |
| Percent of Subpart IIII $NO_x$ Limit | 22% (75%-100% Load)<br>27% (40%-74% Load) |

[1]Listed rate is based on 720 RPM ($6.7n^{-0.20}$ g/HP-hr ($9.0n^{-0.20}$ g/kW-hr) where n is the maximum engine speed.

The most effective and commonly used method to control $NO_x$ emissions from the proposed units is SCR. SCR is a post-combustion $NO_x$ control technology (i.e., it treats the exhaust gas downstream of the combustion source). SCR controls $NO_x$ emissions by injecting ammonia ($NH_3$) into the exhaust gas upstream of a catalyst bed. On the catalyst surface, the $NH_3$ reacts with $NO_x$ to form molecular nitrogen and water vapor.

The proposed units will be equipped with SCR to control $NO_x$ emissions to a level below the NSPS Subpart IIII $NO_x$ emission limits. Because SCR is the most effective method, no additional steps are required, and the proposed $NO_x$ controls represent BACT.

The permitted BACT $NO_x$ limits for the Donlin Gold Project, HBRP and Puuloa are as follows:

- Liquid fuel: 0.52 to 0.53 g/kW-hr
- Gaseous fuel: 0.08 g/kW-hr

The permitted BACT $NO_x$ limit for Commonwealth LNG is as follows:

- Liquid fuel: 8.46 g/kW-hr

The Xcel Energy Blue Lake units are equipped with SCR. The permitted BACT $NO_x$ limit for Xcel Energy Blue Lake is as follows:

- Gaseous fuel: 0.07 g/hp-hr (0.095 g/kW-hr)

The proposed BACT $NO_x$ limits for Ukiu are based on the manufacturer's guaranteed $NO_x$ emission rates between forty percent (40%) and one hundred percent (100%) of the unit's nominal rated load. For the seventy-five percent (75%) – one hundred percent (100%) load range, the following limits were proposed:

- Liquid fuel: 35 ppmvd @ 15% $O_2$ (0.52 g/kW-hr)
- Gaseous fuel: 6 ppmvd @ 15% $O_2$ (0.08 g/kW-hr)

Ukiu's proposed BACT $NO_x$ limits are consistent with $NO_x$ limits approved with similar units for operation at full (one hundred percent (100%)) load.

While the comparison of Ukiu's BACT limits to the limits for other similar units are based on full (one hundred percent (100%)) load performance, Ukiu is also proposing the following concentration emission limits for $NO_x$ for operation in the forty percent (40%) – seventy-four percent (74%) of the nominal rated load range:

- Liquid fuel: 40 ppmvd @ 15% $O_2$
- Gaseous fuel: 9 ppmvd @ 15% $O_2$

These proposed limits acknowledge higher concentrations during lower load operation. The higher concentration limits account for SCR performance decreases when exhaust temperatures fall below the optimal catalytic operating range, resulting in reduced $NO_x$ reduction efficiency. The proposed BACT $NO_x$ limits for liquid fuel in the load ranges that Ukiu will typically operate within (forty percent (40%) – one hundred percent (100%) load) are below the applicable NSPS $NO_x$ limits.

<u>CO and VOC</u>
The most effective and commonly used method to control CO and VOC emissions from the proposed units is catalytic oxidation using an oxidation catalyst. The catalytic oxidation is a post-combustion control technology (i.e., it treats the exhaust gas downstream of the combustion source) that reduces CO and VOC. CO emissions are oxidized to $CO_2$, and VOC emissions are oxidized to $CO_2$ and water vapor. The project will use a combination of combustion design, good combustion practices, and an oxidation catalyst as BACT for CO and VOC. Since catalytic oxidation is the most effective method, no additional steps are required, and the proposed CO and VOC controls represent BACT.

The Donlin Gold Project uses a combination of an oxidation catalyst and good combustion practices to meet their BACT limits for CO and VOC. The permitted BACT CO limits for the Donlin Gold Project are as follows:

- Diesel fuel: 0.18 g/kW-hr at full load
- Natural Gas: 0.12 g/kW-hr at full load

The permitted BACT VOC limits for the Donlin Gold Project are as follows:

- Diesel fuel: 0.21 g/kW-hr at full load
- Natural Gas: 0.09 g/kW-hr at full load

The permitted BACT CO limit for Commonwealth LNG is as follows:

- Liquid fuel: 1.21 g/kW-hr

Xcel Energy Blue Lake uses an oxidation catalyst to meet their BACT limit for CO. The permitted BACT CO limit for Xcel Energy Blue Lake is as follows:

- Gaseous fuel: 0.10 g/hp-hr (0.136 g/kW-hr)

The permitted BACT VOC limit for Commonwealth LNG is as follows:

- Liquid fuel: 0.322 g/kW-hr

Xcel Energy Blue Lake uses an oxidation catalyst to meet their BACT limit for VOC. The permitted BACT VOC limit for Xcel Energy Blue Lake is as follows:

- Gaseous fuel: 0.13 g/hp-hr (0.18 g/kW-hr)

Ukiu's proposed BACT limits for CO and VOC are based on the manufacturer's guaranteed emission rates between forty percent (40%) and one hundred percent (100%) of the unit's nominal rated load. For the 75%-100% load range, the following limits were proposed:

CO:

- Liquid fuel: 20 ppmvd @ 15% $O_2$ (0.18 g/kW-hr)
- Gaseous fuel: 15 ppmvd @ 15% $O_2$ (0.12 g/kW-hr)

VOC:

- Liquid fuel: 40 ppmvd @ 15% $O_2$ (0.21 g/kW-hr)
- Gaseous fuel: 26 ppmvd @ 15% $O_2$ (0.12 g/kW-hr)

Ukiu's proposed BACT CO and VOC limits are consistent with CO and VOC limits approved with similar units for operation at full (one hundred percent (100%)) load. Although the comparison of Ukiu's BACT limits to other similar units are based on full (one hundred percent (100%)) load performance, Ukiu is also proposing VOC concentration limits for the 50%-74% and 40-49% load ranges to ensure continued control:

- Gaseous fuel: 37 ppmvd @ 15% $O_2$ (50-74% load)
- Gaseous fuel: 42 ppmvd @ 15% $O_2$ (40-49% load)

The proposed VOC emission limit for liquid fuel and the CO limits for both fuel types are the same across the entire 40%-100% load range. The higher VOC concentration limits for gaseous fuel acknowledges the potential for higher VOC concentrations during lower load operation.

$PM/PM_{10}/PM_{2.5}$

BACT must be at least as stringent as the applicable NSPS limits. The applicable NSPS limit for PM (filterable) and a comparison to the proposed BACT limits are as follows:

| Comparison of BACT Limits with NSPS Limits - PM | |
|---|---|
| Subpart IIII PM (Filterable) Limit | 0.11 g/HP-hr (0.15 g/kW-hr) |
| BACT PM (Filterable) Limit (Liquid Fuel) | 0.15 g/kW-hr (100% Load) |

Potential methods for controlling particulate emissions from the proposed units listed in order of most to least effective and a discussion of their application to this project are:

1. Electrostatic Precipitator (ESP) – Searches of the RACT/BACT/LAER Clearinghouse in August 2022, starting with Calendar Year 2000 did not identify any application of an ESP on similar units. Supporting information contained in EPA's initial NSPS Subpart IIII docket (EPA-HQ-OAR-2005-0029) did not identify any similar stationary sources located in the United States that use an ESP to control PM emissions. However, the supporting information identified the following stationary sources outside of the United States:

    - Two (2) facilities in Korea (five (5) engines);
    - One (1) facility in India (three (3) engines); and
    - One (1) facility in Barbados (two (2) engines).

    However, no additional information was provided on the size of the units or the fuel they burned. Outside of the United States, it is not uncommon to operate similar large CI ICE on heavy fuel oil (e.g., fuel oil No. 5 and/or 6). Additionally, per the supporting information, EPA's consultant calculated an average cost of $76,880 per ton of PM removed for similar units (i.e., Wartsila 12V32 and 12V46). Therefore, ESPs do not represent BACT for this project.
2. Diesel Particulate Filter (DPF) – As part of the development of NSPS Subpart IIII, EPA concluded that it is infeasible to install a DPF on CI ICE with a displacement of greater than or equal to thirty (30) liters per cylinder (70 FR 339884, July 11, 2005). Recent vendor data shows that DPFs are limited to applications up to 4 MW. The proposed units have a displacement of greater than or equal to thirty (30) liters per cylinder and are larger than four (4) MW. Therefore, DPFs are infeasible and do not represent BACT for this project.
3. Diesel Oxidation Catalyst – Catalytic oxidation using diesel oxidation catalyst reduces the organic fraction of particulate emissions. The diesel oxidation catalyst unit contains a honeycomb-like structure or substrate with a large surface area that is coated with an active catalyst layer, such as platinum or palladium, which reduces emissions of pollutants such as PM, total hydrocarbons (THC), and CO. The diesel oxidation catalyst oxidizes CO, gaseous hydrocarbons and liquid hydrocarbon particles (unburned fuel and oil) in the exhaust gas to $CO_2$ and $H_2O$. The reduction of PM, THC, and CO varies

depending on the catalyst formulations in the diesel oxidation catalyst. The applicant will install oxidation catalysts, however, since no information is available to quantify the PM emission reduction associated with the use of the diesel oxidation catalyst in this project, it is not considered to be a control device for PM.

4. Combustion Design and Practices – The applicant will employ good combustion design and combustion practices.
5. Low Sulfur Liquid Fuels– The use of liquid fuel (i.e., biodiesel (B100), renewable diesel, fuel oil #2, or any combination thereof) with a maximum sulfur content of 15 ppm (0.0015%) will minimize sulfate ($PM_{2.5}$) formation.

The applicant is proposing a combination of good combustion design, good combustion practices and the use of liquid fuel with a maximum sulfur content of 15 ppm as BACT for $PM/PM_{10}/PM_{2.5}$.

The Donlin Gold Project uses a combination of an oxidation catalyst and good combustion practices to meet their BACT limits for $PM/PM_{10}/PM_{2.5}$. HBRP uses good combustion practices to meet their BACT limits for $PM_{10}/PM_{2.5}$. The permitted BACT $PM/PM_{10}/PM_{2.5}$ limits for the Donlin Gold Project and HBRP are as follows:

- Diesel fuel: 0.29 $g/kW_e$-hr at full load
- Natural Gas: 0.13 $g/kW_e$-hr at full load

The permitted BACT $PM_{10}/PM_{2.5}$ limit for Commonwealth LNG is as follows:

- Liquid fuel: 0.067 g/kW-hr

Xcel Energy Blue Lake uses good combustion practices to meet their $PM_{10}/PM_{2.5}$ BACT limit. The permitted BACT $PM_{10}/PM_{2.5}$ limit for Xcel Energy Blue Lake is as follows:

- Gaseous fuel: 0.07 g/hp-hr (0.095 g/kW-hr)

Additionally, although not added to the RBLC, Hawaiian Electric Company in Honolulu, Hawaii received a permit for the installation of six (6) Wartsila 16V34DF CI ICE with a displacement of greater than or equal to thirty (30) liters per cylinder and subject to NSPS Subpart IIII. Their permitted BACT limits for $PM_{10}/PM_{2.5}$ apply at all times. They proposed using a combination of catalytic oxidation, combustion design, good combustion practices and the use of diesel, biodiesel, and diesel/biodiesel blends with a maximum sulfur content of forty-two (42) ppm to meet the BACT limits. The permitted $PM_{10}/PM_{2.5}$ BACT limits when firing diesel/biodiesel are as follows:

- 0.27 $g/kW_e$-hr and 4.95 lb/hr at full load

Ukiu is proposing the following BACT PM (filterable) limit at full (one hundred percent (100%)) load:

- Liquid fuel: 0.15 g/kW-hr

The BACT PM (filterable) limit for liquid fuel is to demonstrate compliance with the applicable NSPS Subpart IIII. The proposed BACT PM (filterable) limit for liquid fuel meets the applicable NSPS PM (filterable) limit.

Ukiu is proposing the following BACT $PM_{10}$ and $PM_{2.5}$ limits at 75%-100% of the unit's nominal rated load:

- Liquid fuel:  30 mg/$Nm^3$ @ 15% $O_2$, dry (0.22 g/kW-hr);
- Gaseous fuel:  15 mg/$Nm^3$ @ 15% $O_2$, dry (0.10 g/kW-hr)

The BACT $PM_{10}$ and $PM_{2.5}$ limits are based on the manufacturer's guaranteed $PM_{10}$ and $PM_{2.5}$ emission rates at 75%-100% of a unit's nominal rated load.  All the PM emitted during gaseous fuel firing is assumed to be filterable PM.  Ukiu's proposed $PM_{10}$ and $PM_{2.5}$ limits at 75%-100% load are the same as the limits for Puuloa and are similar or lower than the previous BACT $PM_{10}$/$PM_{2.5}$ limits for similar units that were identified, with the exception of the $PM_{10}$/$PM_{2.5}$ limit for Commonwealth LNG.

While the comparison of Ukiu's BACT limits to the limits for other similar units are based on full (100%) load performance, Ukiu is also proposing $PM_{10}$/$PM_{2.5}$ concentration limits for the 40%-74% load range to demonstrate effective control across lower load ranges:

- Liquid fuel:  40 mg/$Nm^3$ @ 15% $O_2$, dry
- Gaseous fuel:  20 mg/$Nm^3$ @15% $O_2$, dry

<u>Greenhouse Gases (GHGs)</u>
EPA's 2011 guidance document "PSD and Title V Permitting Guidance for Greenhouse Gases" (EPA, 2011b) specifies that the following types of controls must be considered in determining BACT for GHGs:

- Inherently lower-emitting processes/practices/designs;
- Add-on controls; and
- Combinations of inherently lower emitting processes/practices/designs and add-on controls.

EPA's guidance recognizes that inherently lower polluting processes that fundamentally redefine the nature of the source proposed by the permit applicant can be eliminated for the list of available controls.

The applicant selected the Wartsila 16V34DF CI ICE as the best method to meet the following objectives of the needed generation:

- Quick starting;
- High efficiency;
- Firm power (available when needed);
- Fuel flexibility;
- Flexible generation capacity; and
- Flexible generation capacity to support increased penetration of intermittent renewable generating resources.

The following table summarizes the evaluation of GHG emission control options and whether it fundamentally redefines the nature of the source proposed by the applicant:

| GHG Control Option | Heat Rate Range (HHV Basis) | Fundamentally Redefines the Nature of the Source Proposed by the Permit Applicant? |
|---|---|---|
| Nuclear Generation | Not Applicable | Yes – Nuclear generation is best suited for base loaded units, while the proposed project requires load following. |
| Renewable Energy Sources (Wind, Hydro, Solar) | Not Applicable | Yes – The project requires firm generation that can help to integrate intermittent renewable resources such as wind and solar. Hydroelectric power is not a viable alternative. |
| Low Carbon Fuels (Natural Gas) | Proposed | No – This is already a project feature. The project is designed to utilize renewable natural gas as much as possible. |
| Carbon Capture and Storage (CCS) | Not Applicable | No. |
| Combined-Cycle Gas Turbines | ~7,000 to 8,000 Btu/kWh | No, however, combined-cycle gas turbines do not offer the generation flexibility of 6 RICE engines. |
| RICE | ~7,500 to 8,600 Btu/kWh | No – Currently proposed. |
| Simple-Cycle Gas Turbines | ~8,700 to 10,000 Btu/kWh | No |
| Boilers | > 10,000 Btu/kWh | Yes – Cannot meet the quick start requirements of the project. Additionally, boilers are less efficient than the proposed engines. |

As shown in the table above, the only potential GHG emissions controls for the proposed generating units, other than the selected use of RICE generators, is switching exclusively to a lower carbon fuel (i.e., natural gas) or adding carbon capture and storage (CCS). Switching to one hundred percent (100%) natural gas would reduce GHG emissions slightly; however, renewable natural gas is not currently available on Maui. For this reason, the project is designed to utilize biodiesel until renewable natural gas becomes available, when it will be utilized, to the extent possible, as the primary fuel. While alternative basic technology (simple- and combined-cycle gas turbines) would not fundamentally redefine the nature of the source, both simple-cycle and combined-cycle gas turbines are less efficient at lower loads and combined-cycle gas turbines do not meet the project's need for quick start capability.

The applicant's search of the RBLC in July 2024 identified three (3) permits for CI ICE in the proposed size range used for power generation. The BACT GHG emission limits for the Donlin Gold Project when firing on diesel fuel and on LNG are as follows:

- Diesel: 1,299,630 TPY $CO_2$e (equivalent to 657 g/kW-hr and 1,448 lb/MW-hr); and
- LNG: 869,621 TPY $CO_2$e (equivalent to 440 g/kW-hr and 969 lb/MW-hr).

The RBLC listed two (2) additional projects consisting of multiple 18.8 MW Wartsila RICE, located at the Wisconsin Public Service Weston Plant and the Arvah B. Hopkins Generating Station. The BACT GHG limit for both projects is 1,100 lb/MW-hr for one hundred percent (100%) natural gas firing.

The table below lists GHG BACT limits from similar RICE facilities located by additional research by the applicant. Due to the abundant supply of natural gas on the mainland, none of these facilities are permitted to burn diesel. Therefore, the BACT limits were scaled using the diesel to natural gas $CO_2$ ratio. This ratio is based on EPA's Mandatory GHG Reporting Rule default emission factors (40 CFR Part 98, Table C-1). These GHG BACT limits for similar facilities are consistent with the calculated equivalent GHG BACT limits for these projects. It should be noted that the Lacey Randall Generation Facility, LLC and Mid-Kansas Electric Company, LLC $CO_2$ emission limits exclude startup. The inclusion of startup emissions would result in a higher $CO_2$ emissions limit.

| Facility | Generating Units | Permitted Fuel | Permitted Rolling 12-month $CO_2$ Emissions Limit (lb/$MW_e$-hr) | Diesel to Natural Gas $CO_2$ Ratio | Diesel Equivalent Rolling 12-month $CO_2$ Emissions Limit (lb/$MW_e$-hr) |
|---|---|---|---|---|---|
| Lacey Randall Generation Facility, LLC Lacey Randall Station | Wartsila 20V34SG | Natural Gas | 1,080 | 1.394 | 1,505 |
| Mid-Kansas Electric Company, LLC Rubart Station | Caterpillar G20CM34 | Natural Gas | 1,250 | 1.394 | 1,742 |
| Wisconsin Public Service, Weston Plant and Arvah B. Hopkins Generating Station | Wartsila 18V50SG | Natural Gas | 1,100 | 1.394 | 1,533 |
| South Texas Electric Cooperative, Inc. Red Gate Power Plant | Wartsila 18V50SG | Natural Gas | 1,145 | 1.394 | 1,596 |
| | | | | Average | 1,594 |
| | | | | Average + Compliance Factor (Approx. 5%) | 1,679 |

CCS is composed of two (2) major functions: $CO_2$ capture and $CO_2$ storage. A number of methods may potentially be used for separating the $CO_2$ from the exhaust gas stream, including adsorption, physical absorption, chemical absorption, cryogenic separation, and membrane separation (Wang et al., 2011). Many of these methods are either still in development or not suitable for treating power plant flue gas due to the characteristics of the exhaust stream (Wang, 2011; IPCC, 2005). Of the potentially applicable post-combustion $CO_2$ capture options, the use of an amine solvent such as monoethanolamine (MEA) is the most mature and well-documented technology (Kvamsdal et al., 2011).

EPA generally considers post-combustion $CO_2$ capture with an amine solvent to be technically feasible for natural gas fired combined-cycle combustion turbines and coal fired power plants. However, the technology cannot yet be considered "applicable." The Interagency Task Force (ITF) on CCS found that:

> *…it is unclear how transferable the experience with natural gas processing is to separation of power plant flue gases, given the significant differences in the chemical make-up of the two gas steams. In addition, integration of these technologies with the power cycle at generating plants present significant cost and operating issues that will need to be addressed (ITF, 2010, p. 28).*

CCS has not yet reached the licensing and commercial sales stage of development. It is an emerging technology that has had limited successful applications on an industrial scale, and there have been no successful applications on a comparably sized natural gas or dual-fuel power plants. There are no CCS systems commercially available for such power plants in the United States. The Department of Energy states that "investment in and deployment of [CCS] technology lags other clean energy technologies" (DOE, 2016). Because the proposed project must go online by 2028, CCS is not commercially available for this application. The cost for implementing $CO_2$ capture with an amine solvent is estimated below.

The project's remote location imposes many additional challenges to implementing $CO_2$ storage that are not present for continental U.S. sources. The applicant is not aware of any proven $CO_2$ geological storage sites on Maui. Therefore, ocean storage – i.e., direct $CO_2$ release into the ocean water column or onto the deep seafloor – appears to be the most readily available $CO_2$ storage option.

Ocean storage potentially could be implemented in two (2) ways:

- By injecting and dissolving $CO_2$ into the water column (typically below 1,000 meters) via a fixed pipeline or a moving ship, or
- By depositing $CO_2$ via a fixed pipeline or an offshore platform onto the seafloor at depths below 3,000 meters, where $CO_2$ is denser than water and is expected to form a "lake" that would delay dissolution of $CO_2$ into the surrounding environment.

Ocean storage and its ecological impacts are still in the research phase, and the legal status of intentional ocean storage is unknown (Herzog, 2010; IPCC, 2005; Purdy, 2006).

The table below lists the estimated cost to add CCS to the proposed project based on expected operations. The estimate includes the amine absorber system cost, the onshore $CO_2$ storage cost, and the ocean injection cost. The annual estimated cost is \$192.49 per ton of $CO_2$ removed, for a total annual cost of over \$23 million based on expected operations on renewable natural gas fuel and over \$32 million based on expected operations on liquid fuel. The listed estimated total ocean $CO_2$ storage cost of \$192.49 per ton is well above the estimated total cost for geological storage (\$87.30 per ton). The costs equate to approximately 11.5 cents per kWh for liquid fuel firing and 8.4 cents per kWh for RNG firing, based on the expected operations. It should be noted that if geological storage were an option, switching to it would have little impact on the cost estimate.

**Estimated CCS Cost (\$/Ton)**

| Carbon Capture and Storage (CCS) Component | Cost (\$/ton $CO_2$ Captured) | Units 1-6 Project $CO_2$ Emissions[1] (TPY) | % Captured[2] | $CO_2$ Emissions Captured (TPY) | Total Annual Cost |
|---|---|---|---|---|---|
| **Liquid Fuel** | | | | | |
| $CO_2$ Capture and Compression[3] | 167.00 | 185,594 | 90% | 167,035 | \$27,894,845 |
| Onshore $CO_2$ Storage[4] | 3.69 | | | | \$616,359 |
| Ship transport to injection ship[4] | 8.89 | | | | \$1,484,941 |
| Injection ship, pipe and nozzle[4] | 12.91 | | | | \$2,156,422 |

| Estimated CCS Cost ($/Ton) | | | | | |
|---|---|---|---|---|---|
| **Carbon Capture and Storage (CCS) Component** | **Cost ($/ton $CO_2$ Captured)** | **Units 1-6 Project $CO_2$ Emissions[1] (TPY)** | **% Captured[2]** | **$CO_2$ Emissions Captured (TPY)** | **Total Annual Cost** |
| **Total Cost (Liquid Fuel)** | 192.49 | | | | $32,152,567 |
| **RNG** | | | | | |
| $CO_2$ Capture and Compression[3] | 167.00 | | | | $20,495,075 |
| Onshore $CO_2$ Storage[4] | 3.69 | | | | $452,855 |
| Ship transport to injection ship[4] | 8.89 | 136,361 | 90% | 122,725 | $1,091,025 |
| Injection ship, pipe and nozzle[4] | 12.91 | | | | $1,584,380 |
| **Total Cost (RNG)** | 192.49 | | | | $23,623,335 |

[1]Emissions data as provided by the applicant
[2]Typical value for amine absorber systems (ITF on CCS, 2010; NETL, 2013)
[3]The $CO_2$ capture and compression cost is based on information presented in Figure III-1 of the Report of the ITF on CCS, dated August 2010. The listed dollar per ton of $CO_2$ captured is the cost of applying post-combustion CCS to an existing natural gas fired combined cycle power plant. The listed cost ($167 per metric ton or $114 per ton in 2010 dollars) is based on the permitted operation (i.e., maximum allowable operation per unit per year at full load for each fuel type), inflated to 2025 dollars (CPI data at https://data.bls.gov/cgi-bin/cpicalc.pl).
[4]Costs are from Table 6.6 of the IPCC Special Report on Carbon Dioxide Capture and Storage, dated 2005, inflated to 2025 dollars (CPI data at https://data.bls.gov/cgi-bin/cpicalc.pl).

| Estimated CCS Cost ($/kWh) | | | | | | |
|---|---|---|---|---|---|---|
| **Load** | **Total Generation (kW)** | **Fuel Type** | **Operating Hours Per Unit (hrs/yr)** | **Total Annual Generation (kWh)** | **Total Annual Cost** | **$CO_2$ Removal Cost ($/kWh)** |
| 100% (Base) | 44,900 | Liquid Fuel | 6,250 | 280,625,000 | $32,152,567 | $0.115 |
| | | RNG | 6,250 | 280,625,000 | $23,623,335 | $0.084 |

Due to the high cost and commercial unavailability of CCS, the proposed engines are the most effective option to reduce GHG emissions and represent BACT.

Ukiu is proposing the use of the proposed dual-fuel RICE generating units as BACT for GHG and is proposing to limit $CO_2e$ emissions to a lb/$MW_e$-hr limit weighted by liquid and gaseous fuel generation during a rolling twelve (12) month period. To account for the reduced engine efficiency at lower loads required to achieve the project objective of increasing the penetration of renewable energy on Maui, the proposed limit on $CO_2e$ is based on the GHG emission rates at forty percent (40%) of rated load. The proposed limit would be the sum of 1,416 lb $CO_2e$/$MW_e$-hr times the $MW_e$-hr produced using liquid fuel, and 1,318 lb $CO_2e$/$MW_e$-hr times the $MW_e$-hr produced using gaseous fuel, divided by the total $MW_e$-hr produced, evaluated monthly on a rolling twelve (12) month basis. These $CO_2e$ limits are in the range of the previous BACT $CO_2$ and $CO_2e$ limits identified. Therefore, these limits satisfy the Clean Air Act's (CAA's) definition of BACT.

Startup/Shutdown

BACT must also be applied during the startup and shutdown periods of IC engine operation. The BACT limits discussed above apply to steady-state operation, when the engines have reached stable operations, and the emission control systems are operational.

The post-combustion controls that are used to achieve additional emissions reductions (SCR and oxidation catalyst) require that specific exhaust temperature ranges be reached to be fully effective. It is not technically feasible to use SCR to control $NO_x$ emissions when the catalyst is outside of the manufacturer's recommended operating temperature ranges. Ammonia will not react completely with $NO_x$ when catalyst temperatures are low, resulting in excess $NO_x$ emissions, excess ammonia slip, or both. The oxidation catalyst is not effective at controlling CO and VOC emissions when exhaust temperature is below the design temperature range. Therefore, exhaust gas controls used to achieve BACT for normal operations are not feasible control techniques during startups and shutdowns.

The applicant's "top-down" BACT analysis will consider the following emission limitations:

- Operating practices to minimize emissions during startup and shutdown; and
- Design features to minimize the duration of startup and shutdown.

There are basic principles of operation, or Best Management Practices that minimize emissions during startups and shutdowns. These Best Management Practices are outlined below.

- During a startup, bring the engine to the minimum load necessary to achieve compliance with the applicable $NO_x$, CO, and VOC emission limits as quickly as possible, consistent with the equipment manufacturers' recommendations and safe operating practices.
- During a startup, initiate reagent injection to the SCR system as soon as the SCR catalyst temperature and reagent vaporization system have reached their minimum operating temperatures.
- During a shutdown, once an engine reaches a load that is below the minimum load necessary to maintain compliance with the applicable $NO_x$, CO, and VOC emission limits, reduce the engine load to zero as quickly as possible, consistent with the equipment manufacturers' recommendations and safe operating practices.
- During a shutdown, maintain ammonia injection to the SCR system as long as the SCR catalyst temperature and reagent vaporization system remain above their minimum operating temperatures.

An underlying consideration of these Best Management Practices is the overall safety of the plant staff by promoting operation within the limitations of the equipment and systems and allowing for operator judgment and response times to respond to alarms and trips during a startup or shutdown sequence.

An additional technique to reduce startup emissions is to minimize the amount of time the engine spends in startup. Startup times are generally driven by the rate at which engine load can increase, and the rate at which the SCR system and oxidation catalyst come up to operating temperature.

Additionally, although BACT for $PM_{10}$/$PM_{2.5}$ is achieved through a combination of good combustion design, good combustion practices and the use of fuel with low sulfur content, the manufacturer data indicated elevated emissions during startup.

Per manufacturer's data, during any hour that includes a startup, the permittee will not emit in excess of the following from each engine generator.:

For $NO_x$: 57.32 lb/hr (Any fuel type)
For CO: 12.01 lb/hr (Any fuel type)
For $PM_{10}$/$PM_{2.5}$: 6.81 lb/hr (Any fuel type)

During startups/shutdowns the permittee will use operating systems/practices that reduce the duration of startups and shutdowns to the greatest extent feasible and use operational techniques to initiate ammonia injection as soon as possible during a startup. Ukiu will limit the startup to thirty (30) minutes, and upon completion of a thirty (30) minute startup period, each engine generator will be at forty percent (40%) or more of the nominal rated load (i.e., ≥2.99 MW) based on a fifteen (15) minute average basis and the air pollution control equipment will be operational. Excluding startup and previously approved maintenance and testing events, upon completion of startup, the permittee shall not allow the operation of the engine generators below thirty percent (30%) of the nominal rated load (i.e., < 2.24 MW) at any time. Each engine generator shall be maintained at forty percent (40%) or more of the nominal rated load (i.e., ≥2.99 MW) determined on a fifteen (15) minute average basis.

Limiting the startup time also constitutes BACT for GHG emissions during startup because the short startup times will increase the overall thermal efficiency of the facility.

Per the applicant, for these units, shutdowns occur very quickly and emissions greater than normal levels during shutdown are not expected.

Clean Air Branch (CAB) Annual Emissions Reporting
CAB in-house annual emissions reporting is required for noncovered source facilities with a potential to emit (PTE) based on permit limits (and not including emissions from exempt activities), equal to or above the CAB in-house annual emissions reporting trigger levels, and for all covered sources. Annual emissions reporting will be required because this facility is a covered source.

**NON-APPLICABLE REQUIREMENTS:**

Prevention of Significant Deterioration (PSD), 40 CFR Part 52, Subpart A, §52.21
This facility is not subject to PSD review.

A major stationary source, as defined in 40 CFR §52.21 and HAR §11-60.1-131, is any source belonging to a list of twenty-eight (28) source categories which emits, or has the PTE, one hundred (100) TPY or more of any regulated new source review (NSR) pollutant, or any other stationary source which emits, or has the PTE, 250 TPY or more of a regulated NSR pollutant. Because the facility is not listed under one of the twenty-eight (28) source categories, the trigger level is 250 TPY.

The maximum potential emissions, accounting for limits and insignificant activities, from the facility are less than 250 TPY of any regulated NSR pollutant, as shown in the Maximum Annual Project Emissions and PSD Applicability table under the **PROJECT EMISSIONS** section.

New Source Performance Standards (NSPS), 40 CFR Part 60, Subpart JJJJ, *Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (ICE)*, is not applicable to the engine generators because the engines are not considered spark ignition internal combustion engines. As defined in Subpart JJJJ:

*Spark ignition means relating to a gasoline, natural gas, or liquefied petroleum gas fueled engine or any other type of engine with a spark plug (or other sparking device) and with operating characteristics significantly similar to the theoretical Otto combustion cycle. Spark ignition engines usually use a throttle to regulate intake air flow to control power during normal operation. Dual-fuel engines in which a liquid fuel (typically diesel fuel) is used for CI and gaseous fuel (typically natural gas) is used as the primary fuel at an annual average ratio of less than 2 parts diesel fuel to 100 parts total fuel on an energy equivalent basis are spark ignition engines.*

Each engine generator will be fired with an annual average of two percent (2%) or more liquid fuel of total fuel on an energy equivalent basis.

National Emission Standards for Hazardous Air Pollutants (NESHAPs), 40 CFR Part 61
This source is not subject to NESHAPs, 40 CFR Part 61 because there are no standards applicable to this facility.

Compliance Assurance Monitoring (CAM), 40 CFR Part 64
This source is not subject to CAM. The purpose of CAM is to provide a reasonable assurance that compliance is being achieved with large emissions units that rely on air pollution control device equipment to meet an emissions limit or standard. Pursuant to 40 CFR Part 64, for CAM to be applicable, the emissions unit must:

(1) Be located at a major source;
(2) Be subject to an emissions limit or standard;
(3) Use a control device to achieve compliance;
(4) Have potential pre-control emissions that are one hundred percent (100%) of the major source level; and
(5) Not otherwise be exempt from CAM.

The engine generators have emission limits for $NO_x$, CO, PM (filterable), $PM_{10}$, $PM_{2.5}$, and VOC.

Though the engine generators have emission limits for PM (filterable), $PM_{10}$, and $PM_{2.5}$, they do not use a control device to achieve compliance, therefore, CAM does not apply to PM (filterable), $PM_{10}$, and $PM_{2.5}$.

Though the engine generators have emission limits and use a control device to achieve compliance for $NO_x$ and CO (use of SCR to control $NO_X$, and oxidation catalysts to control CO), each unit will have CEMS to monitor CO and $NO_X$. Emission limitations or standards for which a Part 70 or 71 permit specifies a continuous compliance determination method, as defined in §64.1 are exempt from the CAM requirements pursuant to 40 CFR §64.2(b). Therefore, CAM does not apply to CO and $NO_X$ for each unit because the covered source permit will specify that the emission limitations be monitored with CEMS.

Though the engine generators have emission limits and use a control device to achieve compliance for VOC (oxidation catalyst), each unit has potential pre-control emissions less than 100 TPY for VOC. Therefore, CAM does not apply to VOC for each unit because potential pre-control emissions are less than one hundred percent (100%) of major source levels.

**INSIGNIFICANT ACTIVITIES / EXEMPTIONS:**

The following equipment is considered an insignificant activity pursuant to HAR §11-60.1-82(f)(5) – standby generators used exclusively to provide electricity, standby sewage pump drives, and other emergency equipment used to protect the health and welfare of personnel and the public, all of which are used only during power outages, emergency equipment maintenance and testing, and which: (A) Are fired exclusively by natural or synthetic gas; or liquified petroleum gas; or fuel oil No. 1 or No. 2; or diesel fuel oil No. 1D or 2D; and (B) Do not trigger a PSD or covered source review, based on their PTE regulated or HAPs.

- One (1) 755 bhp Cummins (or equivalent) DEG, Model DFEK (or equivalent)

The following equipment is considered insignificant activity pursuant to HAR §11-60.1-82(f)(7) – other activities which emit less than: (A) 500 pounds per year of a HAP, except lead; (B) 300 pounds per year of lead; (C) five (5) tons per year of carbon monoxide; (D) 3,500 TPY CO2e of GHGs; and (E) two (2) tons per year of each regulated air pollutant not already identified above; and which the director determines to be insignificant on a case-by-case basis.

- Two (2) approximately 500,000 gallon fixed-roof storage tanks, which store fuel with low vapor pressure.

The emergency diesel generator will be constructed adjacent to the reciprocating engines. Per the application, the emergency DEG will provide black start capability for the Wartsila engine generators only in the event of complete loss of power from the grid. The emergency engine will operate to provide electric power only during an emergency situation – that is, when electric power from the local utility is interrupted.

| Insignificant Activities | | | |
|---|---|---|---|
| **Pollutant** | **755 BHP DEG[1] [500 hr/yr][2] (TPY)** | **Two (2) ~500,000-gallon Storage Tanks [8,760 hr/yr] (TPY)** | **Total Insignificant Emissions (TPY)** |
| CO | 0.14 | -- | 0.14 |
| $NO_X$ | 2.02 | -- | 2.02 |
| $SO_2$ | 0.002 | -- | 0.002 |
| PM | 0.02 | -- | 0.02 |
| $PM_{10}$ | 0.02 | -- | 0.02 |
| $PM_{2.5}$ | 0.02 | -- | 0.02 |
| VOC | 0.13 | 0.28[3] | 0.41 |
| HAPs | <0.01 | -- | <0.01 |

[1]The 755 BHP emergency DEG will be fired on diesel fuel No. 2 with a maximum sulfur content of 0.0015% by weight. $NO_x$, CO, and PM, emissions were based on emission factors provided by the manufacturer. The emission factors are based on the load with highest potential emissions. $SO_2$ emissions were calculated stoichiometrically. All PM was assumed to be $PM_{2.5}$ per the applicant. VOC and HAPs emissions were based on emission factors from AP-42 Section 3.4.
[2]Maximum of 500 hours per year was used to determine potential emissions from the emergency diesel engine generator per EPA 1995 guidance.
[3]Per estimate provided by email received from Ms. Matthews on May 27, 2025, each of the ~500,000-gallon storage tanks has potential VOC emissions of 0.14 tons per year.

Since the potential $NO_x$ emissions from the facility including the proposed insignificant activities are approaching the PSD threshold (250 TPY), Ukiu proposed to receive approval from the Department to confirm equivalence prior to installation. The following condition will be incorporated into the permit in **Attachment II - INSIG**:

> The permittee shall submit all necessary information regarding the emergency DEG to the Department and receive written approval prior to its purchase. The required information shall include, but is not limited to, the bhp rating, manufacturer, model number, serial number, emission rates, add-on air pollution controls, and a demonstration showing that the operation of the emergency DEG will not cause facility-wide $NO_x$ emissions to exceed 250 tons per year. This information shall be submitted to the Department at least **fifteen (15) days** prior to the purchase of the emergency DEG.

**ALTERNATE OPERATING SCENARIOS:**

The following are the proposed alternative operating scenarios:

- The ability to use a temporary replacement unit in the event of a failure or major overhaul of an installed unit. The temporary replacement unit shall comply with all applicable conditions including all air pollution control equipment requirements, operating restrictions, and emission limits for the original unit.

- The engine generators may operate below forty percent (40%) of the nominal rated load (i.e., < 2.99 MW) for the following maintenance and testing events:

    - Evaluate the ability of an engine or its supported equipment to perform during an emergency;
    - Facilitate the training of personnel on emergency activities; or
    - Perform emissions testing, maintenance and operational testing, or safety-related testing as required by any government agency or by the manufacturer as a requirement of any law, regulation, rule, ordinance, standard, or contract.

  Operation during these periods shall not result in an exceedance of the emission limits of Attachment II, Special Condition No. C.4 of the permit.
- The ability to temporarily fire the engine generators on alternate fuels. The alternate fuel shall not result in an increase in emissions of any air pollutant or in the emission of any air pollutant not previously emitted, or compliance with NSPS or NESHAP requirements that would not otherwise apply, or compliance with a requirement that is different from those specified in the permit. If the permittee intends to add the alternate fuel as a permitted fuel under Attachment II, Special Condition No. C.1.a.i or C.1.a.ii, they shall concurrently submit an application for a minor modification. The written request shall specify the proposed end date for firing the alternate fuel, which shall correspond to the date the minor modification is issued by the Department

**AIR POLLUTION CONTROLS:**

$NO_x$ emissions will be controlled through the use of low-$NO_x$ emitting equipment and add-on controls. The proposed project will use combustion technology and SCR catalyst to reduce and control $NO_x$ emissions. The design of the SCR system will limit ammonia slip to ten (10) ppmvd at fifteen percent (15%) $O_2$, three-hour (3-hour) average basis.

CO and VOC emissions are controlled by a combination of good combustion practices and an oxidation catalyst.

$PM_{10}$ and $PM_{2.5}$ emissions are controlled through good combustion practices and the use of low-sulfur fuels.

$SO_2$ emissions are controlled by limiting the fuel sulfur content to fifteen (15) ppm for liquid fuel and the use of gaseous fuel with a maximum sulfur content of five (5) ppmv.

Emissions of HAPs are controlled by the use of liquid fuels including biodiesel and renewable diesel and gaseous fuels including natural gas and renewable natural gas, the combustion system design, and an oxidation catalyst.

The exhaust from each engine will be discharged from a 115-foot-tall exhaust stack. Individual CEMS sampling probes will be located in the horizontal ducting prior to the silencer for each engine for the continuous measurement and recording of $NO_x$ and CO emissions.

**PROJECT EMISSIONS:**

The project emissions, excluding startup and shutdown emissions show potential emissions from each unit, if the unit were to operate for 8,760 hours per year. The applicant proposed emission limits based on various, typical operating scenarios. The total project emissions tables show the maximum emissions from the units reflecting the emission limits proposed by the applicant. Note, some values in the tables are derived from unrounded inputs.

Project Emissions, Excluding Startup

The tables below show the potential emissions of the six (6) generators fired on liquid fuel and gaseous fuel, excluding startup. Emission rates for CO, $NO_x$, PM, $PM_{10}$, $PM_{2.5}$, and VOC were provided by the manufacturer and the applicant for loads at one hundred percent (100%) and forty percent (40%) for firing on “biodiesel” and “renewable natural gas”. $SO_2$ emissions were based on mass balance (one hundred percent (100%) conversion of fuel sulfur), and fifteen (15) ppm and five (5) ppmv maximum sulfur fuel for “biodiesel” and “renewable natural gas”, respectively. The provided manufacturer’s guaranteed information gave emission rates for $PM_{10}$ and $PM_{2.5}$, which include filterable and condensable fractions. The manufacturer guaranteed a filterable PM emission rate of 0.15 g/kW-hr at one hundred percent (100%) load for liquid fuel, and per the applicant, all PM emitted during gaseous firing was assumed to be filterable PM. Therefore, PM was assumed to have the same emission factor as $PM_{10}$ and $PM_{2.5}$ for gaseous fuel. The maximum emission rates for all pollutants occurred at one hundred percent (100%) load fired on liquid fuel, excluding startup.

It should be noted that per the applicant, although the application and manufacturer sheets state “biodiesel” and “renewable natural gas,” the numbers and calculations represented in the application are the worst-case for the liquid and gaseous fuels proposed. Therefore, the tables and the review will reference “Liquid Fuel” and “Gaseous Fuel” to avoid confusion.

| **Project Emissions Excluding Startup (Liquid Fuel)** | | | | |
|---|---|---|---|---|
| Pollutant | Each Unit (lb/hr) | Each Unit [8,760 hr/yr] (TPY) | Six Units [8,760 hr/yr] (TPY) | Load |
| $NO_x$ | 8.64 | 37.8 | 227.1 | 100% |
| | 4.33 | 19.0 | 113.8 | 40% |
| CO | 3.01 | 13.2 | 79.1 | 100% |
| | 1.32 | 5.78 | 34.7 | 40% |
| $SO_2$ | 0.104 | 0.46 | 2.74 | 100% |
| | 0.045 | 0.20 | 1.20 | 40% |
| VOC | 3.44 | 15.1 | 90.4 | 100% |
| | 1.51 | 6.61 | 39.7 | 40% |
| PM (Filterable) | 2.47 | 10.83 | 65.0 | 100% |
| $PM_{10}$ | 3.61 | 15.8 | 94.9 | 100% |
| | 2.11 | 9.24 | 55.5 | 40% |
| $PM_{2.5}$ | 3.61 | 15.8 | 94.9 | 100% |
| | 2.11 | 9.24 | 55.5 | 40% |

| Project Emissions Excluding Startup (Gaseous Fuel) | | | | |
|---|---|---|---|---|
| Pollutant | Each Unit (lb/hr) | Each Unit [8,760 hr/yr] (TPY) | Six Units [8,760 hr/yr] (TPY) | Load |
| $NO_x$ | 1.32 | 5.78 | 34.7 | 100% |
| | 0.93 | 4.07 | 24.4 | 40% |
| CO | 2.02 | 8.85 | 53.1 | 100% |
| | 0.94 | 4.12 | 24.7 | 40% |
| $SO_2$ | 0.050 | 0.22 | 1.3 | 100% |
| | 0.024 | 0.11 | 0.66 | 40% |
| VOC | 2.00 | 8.76 | 52.6 | 100% |
| | 1.51 | 6.61 | 39.7 | 40% |
| PM (Filterable) | 1.61 | 7.05 | 42.3 | 100% |
| | 1.00 | 4.38 | 26.3 | 40% |
| $PM_{10}$ | 1.61 | 7.05 | 42.3 | 100% |
| | 1.00 | 4.38 | 26.3 | 40% |
| $PM_{2.5}$ | 1.61 | 7.05 | 42.3 | 100% |
| | 1.00 | 4.38 | 26.3 | 40% |

Startup Emissions

The tables below show the startup emissions for a generator fired on liquid fuel, gaseous fuel, and a thirty (30) minute startup on gaseous fuel followed by thirty (30) minutes of normal operations on liquid fuel. Unit shutdowns occur very quickly and emissions greater than normal levels during shutdown are not expected. Startup emission rates in the tables below are based on estimates provided by the manufacturer for cold, warm, and hot catalyst startups. $SO_2$ emissions remain the same because they are based purely on the fuel sulfur content. Per the applicant, cold, warm, and hot catalyst starts are defined as follows:

- Cold catalyst starts are when the temperature of the catalyst is close to the ambient temperature. Cold starts are expected after overhaul periods of when the unit has not been operated during the previous twenty-four (24) hours.
- Warm catalyst starts are when the catalyst temperature is above ambient but less than 100 °C. Warm starts are expected when the unit is started between six (6) and twelve (12) hours after shutdown.
- Hot catalyst starts are when the unit is started within six (6) hours of shutdown and the catalyst temperature is above 100 °C.

It should be noted that based on the definitions of cold and warm catalyst startups, a combined total of 8,760-unit cold and warm startups per year for all engines is not possible and only shown for conservatism. Hourly emission rates are based on the unit operating in cold startup for thirty (30) minutes and the worst-case load (full load) for the next thirty (30) minutes.

| Project Emissions - Startup (Liquid Fuel) | | | | |
|---|---|---|---|---|
| Pollutant | Startup Event Each Unit [0 - 30 Min] (lb) | Startup Each Unit (lb/hr) | 8,760 Unit Startups Per Year (TPY) | Type of Catalyst Startup |
| $NO_x$ | 53.0 | 57.3 | 251.1 | Cold |
| | 42.0 | 46.3 | 202.9 | Warm |
| | 34.0 | 38.3 | 167.8 | Hot |
| CO | 5.0 | 6.51 | 28.5 | Cold |
| | 4.5 | 6.01 | 26.3 | Warm |
| | 4.0 | 5.51 | 24.1 | Hot |
| $SO_2$ | 0.052 | 0.104 | 0.5 | Cold |
| | 0.052 | 0.104 | 0.5 | Warm |
| | 0.052 | 0.104 | 0.5 | Hot |
| VOC | 2.5 | 4.22 | 18.5 | Cold |
| | 2.15 | 3.87 | 17.0 | Warm |
| | 1.8 | 3.52 | 15.4 | Hot |
| $PM_{10}$ | 5.0 | 6.81 | 29.8 | Cold |
| | 5.0 | 6.81 | 29.8 | Warm |
| | 5.0 | 6.81 | 29.8 | Hot |
| $PM_{2.5}$ | 5.0 | 6.81 | 29.8 | Cold |
| | 5.0 | 6.81 | 29.8 | Warm |
| | 5.0 | 6.81 | 29.8 | Hot |

| Project Emissions - Startup (Gaseous Fuel) | | | | |
|---|---|---|---|---|
| Pollutant | Startup Event Each Unit [0 - 30 Min] (lb) | Startup Each Unit (lb/hr) | 8,760 Unit Startups Per Year (TPY) | Type of Startup |
| $NO_x$ | 14.0 | 14.7 | 64.2 | Cold |
| | 11.5 | 12.2 | 53.3 | Warm |
| | 9.0 | 9.7 | 42.3 | Hot |
| CO | 10.5 | 11.51 | 50.4 | Cold |
| | 8.8 | 9.81 | 43.0 | Warm |
| | 7.5 | 8.51 | 37.3 | Hot |
| $SO_2$ | 0.025 | 0.050 | 0.2 | Cold |
| | 0.025 | 0.050 | 0.2 | Warm |
| | 0.025 | 0.050 | 0.2 | Hot |
| VOC | 2.0 | 3.0 | 13.1 | Cold |
| | 1.7 | 2.7 | 11.8 | Warm |
| | 1.5 | 2.5 | 11.0 | Hot |
| $PM_{10}$ | 2.0 | 2.81 | 12.3 | Cold |
| | 2.0 | 2.81 | 12.3 | Warm |
| | 2.0 | 2.81 | 12.3 | Hot |
| $PM_{2.5}$ | 2.0 | 2.81 | 12.3 | Cold |
| | 2.0 | 2.81 | 12.3 | Warm |
| | 2.0 | 2.81 | 12.3 | Hot |

| Project Emissions - Startup (Startup Gaseous Fuel, Switch to Liquid Fuel) | | | | |
|---|---|---|---|---|
| **Pollutant** | **Startup Event Each Unit [0 - 30 Min] (lb)** | **Startup Each Unit (lb/hr)** | **8,760 Unit Startups Per Year (TPY)** | **Type of Startup** |
| $NO_x$ | 14.0 | 18.32 | 80.2 | Cold |
| | 11.5 | 15.82 | 69.3 | Warm |
| | 9.0 | 13.3 | 58.3 | Hot |
| CO | 10.5 | 12.01 | 52.6 | Cold |
| | 8.8 | 10.31 | 45.2 | Warm |
| | 7.5 | 9.0 | 39.5 | Hot |
| $SO_2$ | 0.025 | 0.077 | 0.3 | Cold |
| | 0.025 | 0.077 | 0.3 | Warm |
| | 0.025 | 0.077 | 0.3 | Hot |
| VOC | 2.0 | 3.72 | 16.3 | Cold |
| | 1.7 | 3.42 | 15.0 | Warm |
| | 1.5 | 3.22 | 14.1 | Hot |
| $PM_{10}$ | 2.0 | 3.81 | 16.7 | Cold |
| | 2.0 | 3.81 | 16.7 | Warm |
| | 2.0 | 3.81 | 16.7 | Hot |
| $PM_{2.5}$ | 2.0 | 3.81 | 16.7 | Cold |
| | 2.0 | 3.81 | 16.7 | Warm |
| | 2.0 | 3.81 | 16.7 | Hot |

Hazardous Air Pollutants (HAPs)
Potential HAP emissions for the engine generators firing liquid fuel and gaseous fuel at full (100%) load are shown in the tables below. The following assumptions were made:

For 100% Liquid Fuel:

- All emission factors (EF) except formaldehyde are California Air Toxics Emission Factor (CATEF) mean values for large diesel engines (SCC 20200102 or 20300101) [https://www.arb.ca.gov/app/emsinv/catef_form.html]
- Controlled emission factors are based on the forty percent (40%) control efficiency for oxidation catalysts applied for all Toxic Air Contaminants (TACs) except formaldehyde. Source: BAAQMD PDOC for Eastshore Energy Center, April 30, 2007.
- Per the applicant, the formaldehyde emission factor is the RICE NESHAP limit for diesel engines (580 ppbvd @ fifteen percent (15%) $O_2$). Although the proposed project is not a major source of HAPs, the engine generators will be equipped with oxidation catalysts just as they would be if they were subject to the RICE NESHAP limit. Therefore, the applicant used the limit as the formaldehyde emission factor for these engines. This emission factor results in a more conservative estimate of potential emissions, compared to the results using the emission factor provided in AP-42, Section 3.4, Large Stationary Diesel and All Stationary Dual-fuel Engines (10/96) for formaldehyde.
- Emissions are based on the maximum ICE firing rate of 60.5 MMBtu/hr and default fuel HHV of 138,000 Btu/gal for biodiesel fuel (0.44 Mgal/hr per engine)

- Although the application based the potential HAP emissions on the operational hours from their typical operating scenarios because the applicant was not proposing the operational hours from the operating scenarios as limits, the potential HAP emissions from the facility were evaluated at 8,760 hours per year at their maximum capacities for all six (6) engines.

For 100% Gaseous Fuel:

- All EFs except formaldehyde are CATEF mean values for a natural gas 4S/Lean/>650 hp engine [https://www.arb.ca.gov/app/emsinv/catef_form.html]
- Controlled emission factors are based on the forty percent (40%) control efficiency for oxidation catalysts applied for all TACs except formaldehyde. Source: BAAQMD PDOC for Eastshore Energy Center, April 30, 2007.
- The formaldehyde emission factor provided by the vendor reflects oxidation catalyst control (700 ppbvd @ fifteen percent (15%) $O_2$). Per email from Nancy Matthews received on December 2, 2024, although the original application listed the vendor estimate to be 1100 ppbvd @ fifteen percent (15%) $O_2$, Wartsila provided a revised emission guarantee of 700 ppbvd @ fifteen percent (15%) $O_2$ at full load in October 2023.
- Emissions are based on the maximum ICE firing rate of 0.055 MMscf/hr for renewable natural gas.
- Although the application based the potential HAP emissions on the operational hours from their typical operating scenarios because the applicant was not proposing the hours from the operating scenarios as limits, the potential HAP emissions from the facility were evaluated at 8,760 hours per year at their maximum capacities for all six (6) engines.
- The calculations for gaseous fuel account for pilot fuel injection, however, when the engine operates in gas mode, the liquid pilot fuel amounts to less than 1.5% of full-load fuel consumption. Though the one hundred percent (100%) gaseous fuel operating scenario is not technically feasible since Ukiu will be required to fire a minimum of two (2) percent liquid fuel of total fuel on an energy equivalent basis, the one hundred percent (100%) gaseous fuel operating scenario was evaluated to provide a conservative analysis. The limit was proposed in an email from Ms. Matthews, received on May 14, 2025.

| 100% Liquid Fuel | | | | | |
|---|---|---|---|---|---|
| Hazardous Air Pollutant (HAP) | EF (lb/Mgal) | Controlled EF (lb/Mgal) | Emissions (lb/hr) | Emissions (TPY) | |
| | | | | 8,760 hr/yr Per Engine | 8,760 hr/yr Per 6 Engines |
| Benzene | 1.01E-01 | 6.06E-02 | 2.66E-02 | 1.2E-01 | 6.98E-01 |
| Toluene | 3.74E-02 | 2.24E-02 | 9.84E-03 | 4.3E-02 | 0.26 |
| Xylenes | 2.68E-02 | 1.61E-02 | 7.05E-03 | 3.1E-02 | 0.19 |
| 1,3-Butadiene | -- | -- | -- | -- | -- |
| Formaldehyde | -- | 2.07E-01 | 9.07E-02 | 0.40 | 2.38 |
| Acetaldehyde | 3.47E-03 | 2.08E-03 | 9.13E-04 | 4.0E-03 | 2.40E-02 |
| Acrolein | 1.07E-03 | 6.42E-04 | 2.81E-04 | 1.2E-03 | 7.40E-03 |
| Ethylbenzene | 6.76E-03 | 4.06E-03 | 1.78E-03 | 7.8E-03 | 4.67E-02 |
| Naphthalene | 1.63E-02 | 9.78E-03 | 4.29E-03 | 1.9E-02 | 1.13E-01 |
| Total PAH | 6.21E-05 | 3.73E-05 | 1.63E-05 | 7.2E-05 | 4.29E-04 |
| Total HAPs | | | 1.41E-01 | 6.2E-01 | 3.73 |

| 100% Gaseous Fuel | | | | | |
|---|---|---|---|---|---|
| Hazardous Air Pollutant (HAP) | EF (lb/MMscf) | Controlled EF (lb/MMscf) | Emissions (lb/hr) | Emissions (TPY) | |
| | | | | 8,760 hr/yr Per Engine | 8,760 hr/yr Per 6 Engines |
| Benzene | 2.18E-01 | 1.31E-01 | 7.16E-03 | 3.13E-02 | 0.19 |
| Toluene | 2.39E-01 | 1.43E-01 | 7.85E-03 | 3.44E-02 | 0.21 |
| Xylenes | 6.46E-01 | 3.88E-01 | 2.12E-02 | 9.29E-02 | 0.56 |
| 1,3-Butadiene | 3.67E-01 | 2.20E-01 | 1.20E-02 | 5.28E-02 | 0.32 |
| Formaldehyde | -- | 1.89 | 1.01E-01 | 4.42E-01 | 2.65 |
| Acetaldehyde | 5.29E-01 | 3.17E-01 | 1.74E-02 | 7.61E-02 | 0.46 |
| Acrolein | 5.90E-02 | 3.54E-02 | 1.94E-03 | 8.48E-03 | 5.09E-02 |
| Ethylbenzene | 7.11E-02 | 4.27E-02 | 2.33E-03 | 1.02E-02 | 6.09E-02 |
| Naphthalene | 2.51E-02 | 1.51E-02 | 8.24E-04 | 3.61E-03 | 2.17E-02 |
| Total PAH | 1.71E-05 | 1.03E-05 | 5.63E-07 | 2.47E-06 | 1.48E-05 |
| Total HAPs | | | 1.72E-01 | 7.52E-01 | 4.51 |

<u>Greenhouse Gas (GHG)</u>
The total GHG emissions on a $CO_2$ equivalent ($CO_2e$) basis are summarized in the table below. The Global Warming Potentials (GWP) from 40 CFR Part 98, Subpart A, Table A-1, updated January 15, 2025. Emissions are based on emission factors from 40 CFR Part 98 Subpart C, Tables C-1, and C-2. All $CO_2e$ assumed to be non-biogenic. Although other established emission limits should indirectly limit the GHG emissions from the facility, since no operational hour limits have been proposed, the table below shows the maximum GHG emissions based on unlimited operations of 8,760 hours per year for the engines running on liquid fuel and gaseous fuel at one hundred percent (100%) (full) and forty percent (40%) (min) loads:

| Greenhouse Gas Emissions | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| GHG | GWP | Each Unit (Metric TPY) | | Six Units (Metric TPY) | | Each Unit (TPY) | | Six Units (TPY) | |
| | | GHG Mass Basis | $CO_2e$ | GHG Mass Basis | $CO_2e$ | GHG Mass Basis | $CO_2e$ | GHG Mass Basis | $CO_2e$ |
| **Liquid Fuel, 100% Load** | | | | | | | | | |
| Carbon Dioxide ($CO_2$) | 1 | 39,196 | 39,196 | 235,177 | 235,177 | 43,206 | 43,206.4 | 259,238 | 259,238 |
| Methane ($CH_4$) | 28 | 1.59 | 44.5 | 9.54 | 267.1 | 1.75 | 49.1 | 10.5 | 294.4 |
| Nitrous Oxide ($N_2O$) | 265 | 0.32 | 84.3 | 1.92 | 505.6 | 0.35 | 92.9 | 2.10 | 557.3 |
| Total Emissions | | 39,198 | 39,325 | 235,189 | 235,950 | 43,208 | 43,348 | 259,251 | 260,090 |
| **Liquid Fuel, 40% Load** | | | | | | | | | |
| $CO_2$ | 1 | 16,776 | 16,776 | 100,654 | 100,654 | 18,492 | 18,492 | 110,952 | 110,952 |
| $CH_4$ | 28 | 0.68 | 19.1 | 4.08 | 114.3 | 0.75 | 21.0 | 4.5 | 126.0 |
| $N_2O$ | 265 | 0.136 | 36.1 | 0.82 | 216.4 | 0.15 | 39.8 | 0.9 | 238.5 |
| Total Emissions | | 16,776 | 16,831 | 100,659 | 100,985 | 18,493 | 18,493 | 110,957 | 111,316 |

| Greenhouse Gas Emissions | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **GHG** | **GWP** | **Each Unit (Metric TPY)** | | **Six Units (Metric TPY)** | | **Each Unit (TPY)** | | **Six Units (TPY)** | |
| | | **GHG Mass Basis** | **$CO_2e$** | **GHG Mass Basis** | **$CO_2e$** | **GHG Mass Basis** | **$CO_2e$** | **GHG Mass Basis** | **$CO_2e$** |
| **Gaseous Fuel, 100% Load** | | | | | | | | | |
| $CO_2$ | 1 | 28,868 | 28,868 | 173,205 | 173,205 | 31,821 | 31,821 | 190,926 | 190,926 |
| $CH_4$ | 28 | 0.54 | 15.2 | 3.26 | 91.4 | 0.60 | 16.8 | 3.6 | 100.8 |
| $N_2O$ | 265 | 0.054 | 14.4 | 0.33 | 86.5 | 0.06 | 15.9 | 0.4 | 95.4 |
| Total Emissions | | 28,868 | 28,897 | 173,209 | 173,383 | 31,822 | 31,854 | 190,930 | 191,122 |
| **Gaseous Fuel, 40% Load** | | | | | | | | | |
| $CO_2$ | 1 | 13,921 | 13,921 | 83,525 | 83,525 | 15,345 | 15,345 | 92,071 | 92,071 |
| $CH_4$ | 28 | 0.26 | 7.3 | 1.57 | 44.1 | 0.29 | 8.1 | 1.7 | 48.6 |
| $N_2O$ | 265 | 0.026 | 7.0 | 0.16 | 41.7 | 0.29 | 7.7 | 0.2 | 46.0 |
| Total Emissions | | 13,921 | 13,935 | 83,527 | 83,611 | 15,345 | 15,361 | 92,072 | 92,165 |

<u>Total Project Emissions</u>
It should be noted that the potential emissions in the tables shown above are maximums that do not account for the emission limits proposed by Ukiu that are incorporated in the permit and are not representative of the proposed project's limited potential emissions.

The applicant proposed three (3) typical operating scenarios for the units and the proposed emission limits in Attachment II, Special Condition No. C.4.b and C.4.d are based on the highest emissions in lb/hr and TPY from these three (3) scenarios. It should be noted that the three (3) typical operating scenarios do not necessarily reflect the maximum capacities of the units. The operating scenarios' assumptions, as provided by Ukiu, are listed below:

*Case 1 – 100% Gaseous Fuel (when gas becomes available):*

- Pounds per hour emission rates for startup hour assumes thirty (30) minutes of cold startup on gaseous fuel and thirty (30) minutes of one hundred percent (100%) load operation on gaseous fuel.
- Tons per year emission rates assume 500 thirty (30)-minute startups on gaseous fuel for each engine, with the remaining operation at one hundred percent (100%) load on gaseous fuel.
- TPY emission rates assume two (2) starts per day, five (5) days per week (one (1) cold and nine (9) warm starts per week), fifty (50) weeks per year.
- TPY emission rates assume total baseload hours per year per unit is 5,750.
- The calculations for gaseous fuel account for pilot fuel injection, however, when the engine operates in gas mode, the liquid pilot fuel amounts to less than 1.5% of full-load fuel consumption. Though the one hundred percent (100%) gaseous fuel operating scenario is not technically feasible since Ukiu will be required to fire a minimum of two (2) percent liquid fuel of total fuel on an energy equivalent basis, the one hundred percent (100%) gaseous fuel operating scenario was evaluated to provide a conservative analysis.

*Case 2 – Gaseous Fuel Startups, Switch to Liquid Fuel (when gas becomes available):*

- Pounds per hour emission rates for startup hour assumes thirty (30) minutes of cold startup on gaseous fuel and thirty (30) minutes of one hundred percent (100%) load operation on liquid fuel.
- TPY emission rates assume 500 thirty (30)-minute startups on gaseous fuel for each engine, with the remaining operation at one hundred percent (100%) load on liquid fuel.
- TPY emission rates assume two (2) starts per day, five (5) days per week (one (1) cold and nine (9) warm starts per week), fifty (50) weeks per year.
- TPY emission rates assume total baseload hours per year per unit is 5,750.

*Case 3 – 100% Liquid Fuel:*

- Pounds per hour emission rates for startup hour assumes 30 minutes of cold startup on liquid fuel and 30 minutes of one hundred percent (100%) load operation on liquid fuel.
- TPY emission rates assume 500 thirty (30)-minute startups on liquid fuel for each engine, with the remaining operation at one hundred percent (100%) load on liquid fuel.
- TPY emission rates assume two (2) starts per day, five (5) days per week (one (1) cold and nine (9) warm starts per week), fifty (50) weeks per year.
- TPY emission rates assume total baseload hours per year per unit is 5,750.

| Case 1: 100% Gaseous Fuel | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pollutant | Per Unit | | | | | Six Units | | | | |
| | lb/hr | | TPY | | | lb/hr | | TPY | | |
| | Normal Ops | Startup | Normal Ops | Startup | Total | Normal Ops | Startup | Normal Ops | Startup | Total |
| $NO_X$ | 1.32 | 14.66 | 3.80 | 3.10 | 6.90 | 7.92 | 88.0 | 22.8 | 18.6 | 41.4 |
| CO | 2.02 | 11.51 | 5.81 | 2.50 | 8.30 | 12.1 | 69.1 | 34.8 | 15.0 | 49.8 |
| $SO_2$ | 0.050 | 0.050 | 0.14 | 0.01 | 0.15 | 0.30 | 0.30 | 0.84 | 0.06 | 0.90 |
| VOC | 2.00 | 3.00 | 5.75 | 0.68 | 6.43 | 12.0 | 18.0 | 34.5 | 4.08 | 38.6 |
| $PM_{10}$ | 1.61 | 2.81 | 4.63 | 0.70 | 5.33 | 9.66 | 16.8 | 27.8 | 4.21 | 32.0 |
| $PM_{2.5}$ | 1.61 | 2.81 | 4.63 | 0.70 | 5.33 | 9.66 | 16.8 | 27.8 | 4.21 | 32.0 |
| $NH_3$ | 0.82 | 0.41 | 2.36 | 0.10 | 2.46 | 4.92 | 2.46 | 14.2 | 0.60 | 14.8 |

| Case 2: Gaseous Fuel Startups, Liquid Fuel Operations | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pollutant | Per Unit | | | | | Six Units | | | | |
| | lb/hr | | TPY | | | lb/hr | | TPY | | |
| | Normal Ops | Startup | Normal Ops | Startup | Total | Normal Ops | Startup | Normal Ops | Startup | Total |
| $NO_X$ | 8.64 | 18.32 | 24.8 | 4.0 | 28.9 | 51.8 | 109.9 | 149.0 | 24.1 | 173.1 |
| CO | 3.01 | 12.01 | 8.7 | 2.60 | 11.3 | 18.1 | 72.1 | 51.9 | 15.7 | 67.6 |
| $SO_2$ | 0.104 | 0.077 | 0.30 | 0.02 | 0.32 | 0.62 | 0.46 | 1.8 | 0.1 | 1.9 |
| VOC | 3.44 | 3.72 | 9.9 | 0.9 | 10.8 | 20.6 | 22.3 | 59.3 | 5.2 | 64.5 |
| $PM_{10}$ | 3.61 | 3.81 | 10.4 | 0.95 | 11.3 | 21.7 | 22.8 | 62.3 | 5.7 | 68.0 |
| $PM_{2.5}$ | 3.61 | 3.81 | 10.4 | 0.95 | 11.3 | 21.7 | 22.8 | 62.3 | 5.7 | 68.0 |
| $NH_3$ | 0.94 | 0.47 | 2.70 | 0.12 | 2.82 | 5.64 | 2.82 | 16.22 | 0.71 | 16.92 |

| Case 3: 100% Liquid Fuel | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pollutant | Per Unit | | | | | Six Units | | | | |
| | lb/hr | | TPY | | | lb/hr | | TPY | | |
| | Normal Ops | Startup | Normal Ops | Startup | Total | Normal Ops | Startup | Normal Ops | Startup | Total |
| $NO_X$ | 8.64 | 57.32 | 24.8 | 11.9 | 36.7 | 51.8 | 343.9 | 149.0 | 71.1 | 220.2 |
| CO | 3.01 | 6.51 | 8.65 | 1.51 | 10.2 | 18.1 | 39.1 | 51.9 | 9.1 | 61.0 |
| $SO_2$ | 0.104 | 0.104 | 0.30 | 0.03 | 0.33 | 0.62 | 0.62 | 1.8 | 0.2 | 2.0 |
| VOC | 3.44 | 4.22 | 9.89 | 0.98 | 10.9 | 20.6 | 25.3 | 59.3 | 5.9 | 65.2 |
| $PM_{10}$ | 3.61 | 6.81 | 10.4 | 1.70 | 12.1 | 21.7 | 40.9 | 62.3 | 10.2 | 72.5 |
| $PM_{2.5}$ | 3.61 | 6.81 | 10.4 | 1.70 | 12.1 | 21.7 | 40.9 | 62.3 | 10.2 | 72.5 |
| $NH_3$ | 0.94 | 0.47 | 2.70 | 0.12 | 2.82 | 5.64 | 2.82 | 16.22 | 0.71 | 16.92 |

The highest lb/hr rates per unit per fuel type for normal operations, the highest lb/hr rates per unit regardless of fuel type for any single hour, and the combined emission rates in TPY regardless of fuel type based on the three (3) proposed typical operating scenarios are shown in the table below. The “Normal Operations” lb/hr rates are based on a three (3) hour averaging period, the “Any Hour” lb/hr rates are based on a one (1) hour averaging period. Ukiu’s proposed permit limits are based on the rates shown in the table.

| Highest Emission Rates – Typical Operating Scenarios | | | | |
|---|---|---|---|---|
| Pollutant | Individual Unit (lb/hr) | | | Six Units (TPY) |
| | Normal Operations | | Any Hour | |
| | Liquid Fuel | Gaseous Fuel | Any Fuel Type | |
| $NO_X$ | 8.64 | 1.32 | 57.32 | 220.2 |
| CO | 3.01 | 2.02 | 12.01 | 67.6 |
| $SO_2$ | 0.10 | 0.05 | 0.10 | 2.0 |
| VOC | 3.44 | 2.00 | 4.22 | 65.2 |
| $PM_{10}$ | 3.61 | 1.61 | 6.81 | 72.5 |
| $PM_{2.5}$ | 3.61 | 1.61 | 6.81 | 72.5 |
| $NH_3$ | 0.94 | 0.82 | 0.94 | 16.92 |

The maximum annual project emissions in tons per year, accounting for limits and proposed insignificant activities and compared to the PSD applicable thresholds are shown in the table below. The potential GHG emissions exceed the PSD applicability threshold of 75,000 TPY, however the potential to emit for all other pollutants are below applicability thresholds, so PSD review is not applicable.

Additionally, because the total potential $NO_x$ emissions for the facility including the potential emissions from the emergency DEG are close to PSD applicability thresholds, the following conditions will be included in the permit:

- The total $NO_x$ emissions from the facility, including periods of engine generator startups, shutdowns, maintenance and testing, and malfunction or upset conditions, shall not equal or exceed 250 TPY, on any rolling twelve-month (12-month) period. $NO_x$ emissions from the emergency diesel engine generator shall also be included in the $NO_x$ emissions from the facility.
- This source is exempt from a PSD review due to the emission limits in Attachment II, Special Condition No. C.4.d. Any relaxation of these limits that increases the potential to emit above the applicable PSD thresholds will require a PSD evaluation of the source as though construction had not yet commenced on the source.

The applicant will be required to monitor the $NO_x$ emissions from the engine generators through a CEMS and calculate the $NO_x$ emissions from the emergency DEG.

**Maximum Annual Project Emissions and PSD Applicability**

| Pollutant | Six Engine Generators (TPY) | Insignificant Activities | | Total Potential Emissions (TPY) | PSD Applicability Thresholds (TPY) |
|---|---|---|---|---|---|
| | | 755 BHP DEG (TPY) | Two (2) ~500,000-gal Storage Tanks (TPY) | | |
| $NO_X$ | 220.2 | 2.02 | -- | 222.2 | 250 |
| CO | 67.6 | 0.14 | -- | 67.7 | 250 |
| $SO_2$ | 2.0 | 0.002 | -- | 2.0 | 250 |
| VOC | 65.2 | 0.13 | 0.28 | 65.6 | 250 |
| PM (Filterable) | 52.0 | 0.02 | -- | 52.0 | 250 |
| $PM_{10}$ | 72.5 | 0.02 | -- | 72.5 | 250 |
| $PM_{2.5}$ | 72.5 | 0.02 | -- | 72.5 | 250 |
| Total HAPs | 4.51 | <0.1 | -- | 4.6 | -- |
| GHG | 260,090 | 194.2 | -- | 260,266.2 | 75,000 |

Synthetic Minor Applicability

A synthetic minor source is a facility that is potentially major, as defined in HAR §11-60.1-1 but is made non-major through federally enforceable permit conditions. This facility is a major source for $NO_x$. The facility is not a synthetic minor source for the purposes for 40 CFR Part 70, major stationary source (Title V) applicability.

The facility will be taking emission limits both per engine generator and facility wide. Unlimited operation of all six (6) engine generators would result in potential $NO_x$ emissions exceeding major stationary source levels. The facility is a synthetic minor source for the purposes of major stationary source (PSD) applicability.

**AIR QUALITY ASSESSMENT:**

An ambient air quality impact assessment (AAQIA) was required to demonstrate that the facility will comply with the State and National ambient air quality standards (SAAQS and NAAQS). Ukiu submitted an AAQIA performed by Trinity Consultants in August 2024.

<u>AAQIA Background</u>
EPA's recommended dispersion model AERMOD (v. 23132) was used in the modeling analysis to determine maximum pollutant impacts from the proposed project. AERMOD (starting with Version 11059) is capable of calculating the distribution of daily maximum one-hour (1-hour) values. The daily maximum one-hour (1-hour) values are calculated when the pollutant ID is either $SO_2$ or $NO_2$ and the only short-term averaging period specified is "1-hour." When modeling with one (1) year of site-specific meteorological data, the maximum annual average serves as an unbiased estimate of the three (3)-year average for comparison to the one-hour (1-hour) $SO_2$, one-hour (1-hour) $NO_2$, and twenty-four hour (24-hour) $PM_{2.5}$ NAAQS. Controlling modeled concentrations for the percentile based one-hour (1-hour) $SO_2$, one-hour (1-hour) $NO_2$, and twenty-four hour (24-hour) $PM_{2.5}$ NAAQS are as follows:

- The one-hour (1-hour) $SO_2$ NAAQS controlling modeled concentration is the 99$^{th}$ percentile (4$^{th}$ high) daily maximum 1-hour average $SO_2$ concentration.
- The one-hour (1-hour) $NO_2$ NAAQS controlling modeled concentration is the 98$^{th}$ percentile (8$^{th}$ high) daily maximum 1-hour average $NO_2$ concentration.
- The twenty-four hour (24-hour) $PM_{2.5}$ NAAQS controlling modeled concentration is the 98$^{th}$ percentile (8$^{th}$ high) daily $PM_{2.5}$ concentration.

Additional model assumptions used for the analysis are listed below:

1. Buildings at/near the facility were incorporated into the model to evaluate downwash effects of nearby structures. The Building Profile Input Program for PRIME (BPIPPRM V. 04274) was used to account for the building downwash effects. Trinity reviewed information from Google Earth and determined that off-site buildings do not need to be included in the modeling;
2. AERMOD's regulatory default options were used:
   - The rural dispersion option;
   - A uniform Cartesian receptor grid with spacing of one hundred (100) meters or less within one (1) kilometer of the source and finer resolution as required to identify maximum impacts; and
   - Terrain data developed through AERMAP.
3. The $NO_2$ modeling following the three (3) tier $NO_2$ modeling approach for the conversion of nitric oxide (NO) to $NO_2$ described in EPA's Guideline Section 4.2.3.4. The Tier 3 option (Ozone Limiting Method (OLM)) was used for the one-hour (1-hour) $NO_2$ impact analyses.

<u>$NO_2$ Modeling</u>
Tier 3 $NO_2$ modeling using OLM requires a source specific $NO_2/NO_x$ in-stack ratio. The applicant utilized a source specific $NO_2/NO_x$ in-stack ratio of fifteen percent (15%) for the proposed units based on the review of data for similar units from EPA's $NO_2/NO_x$ In-Stack Ratio (ISR) Database. The supporting data for the selected $NO_2/NO_x$ in-stack ratios of fifteen percent (15%) for diesel engines with a displacement of greater than thirty (30) liters per cylinder is summarized below:

- Dutch Harbor Power Plant tested a Wartsila Model 12V32C DEG. EPA's ISR Database lists an $NO_2/NO_x$ in-stack ratio of 5.52% for the fifty percent (50%) load.

- Dutch Harbor Power Plant tested a Caterpillar C-280 DEG. EPA's ISR Database lists a $NO_2/NO_x$ in-stack ratio of 4.5% for the one hundred percent (100%) load.
- Tor Viking II tested a MaK/6M32 (rated at 3,784 hp) main propulsion diesel engine equipped with SCR and diesel oxidation catalyst. EPA's Alpha ISR Database lists $NO_2/NO_x$ in-stack ratios for thirty percent (30%), forty percent (40%), sixty percent (60%), and eighty percent (80%) loads ranging from 4.24% to 15.93%. Of the seven (7) tests listed, only one had an in-stack ratio greater than fifteen percent (15%).
- Tor Viking II tested a MaK/8M32 (rated at 5,046 hp) main propulsion diesel engine equipped with SCR and diesel oxidation catalyst. EPA's Alpha ISR Database lists $NO_2/NO_x$ in-stack ratios for thirty percent (30%), forty percent (40%), and eighty percent (80%) loads ranging from 4.71% to 9.27%.
- Vladmir Ignatuk tested a Stork/8TM410 (rated at 5,720 hp) main propulsion diesel engine. EPA's Alpha ISR Database lists $NO_2/NO_x$ in-stack ratios for forty percent (40%), sixty percent (60%), and eighty percent (80%) loads ranging from 8.16% to 14.79%.

The data from these units support the use of a fifteen percent (15%) source specific $NO_2/NO_x$ in-stack ratio for the proposed units.

Tier 3 $NO_2$ OLM modeling requires concurrent hourly trioxygen ($O_3$) data. HDOH's Lauwiliwili air quality monitoring station supplied the required $O_3$ data. HDOH's Lauwiliwili Street AQM station is the state's SLAMS $O_3$ monitor and is located in Kapolei. The station location was selected by HDOH to monitor population exposure. Hourly $O_3$ data were obtained from EPA's Air Quality System (AQS) Data Mart for the twelve (12) month period of the site-specific meteorological data. Missing observations were filled by the applicant using the following three (3) step approach:

1. When one (1) or two (2) consecutive hours are missing, interpolation was used to fill these missing values;
2. When three (3) or more consecutive hours are missing, the missing values were filled with the maximum concentration from the same hour from the previous and following day; and
3. When three (3) or more consecutive hours are missing and both concentrations for the same hour from the previous and following day are missing, missing values were filled with the maximum concentration from the same hour from the entire calendar year.

Per the applicant, the use of the maximum hourly concentrations for data gaps greater than two (2) hours is not expected to result in an underestimation of the missing $O_3$ concentrations.

<u>Meteorological Data</u>
Meteorological surface data collected at the Site 251 meteorological monitoring station was used in the analysis. This meteorological data is considered site-specific data as it was collected approximately 1 mile from the project site. EPA's modeling guidance states that one (1) year of site-specific meteorological data are adequate to ensure that worst-case meteorological conditions are represented in the model results. The twelve (12) month data collection period was from February 1, 1994, through January 31, 1995.

EPA modeling guidance states that the determination of representativeness of meteorological data should include a comparison of factors like surface characteristics of the measurement site and source locations, surrounding land use, wind roses, and significant terrain features. The Site 251 meteorological data monitoring site is located approximately 1.1 miles southeast of the project site. No major geographic features impacting the surface conditions or wind patterns exist between the two (2) locations. The facility location with historical prevailing wind direction predominantly northeasterly winds is consistent with persistent trade winds and local terrain considerations. The land uses surrounding the meteorological monitoring site and the project site are similar.

Cloud cover data was not recorded. Therefore, the Bulk Richardson method was used to calculate the surface friction velocity and Monin-Obukhov length during stable conditions. During convective conditions, cloud cover data from Kahului Airport were input into AERMET.

Receptor Data and Modeling Domain

The modeling grid utilized by the applicant consists of:

- 25-meter spaced receptors along the fence line (i.e., that area to which public access is physically restricted);
- 50-meter spaced receptors centered at the project, property to 1.0 kilometer (km);
- 100-meter spaced receptors from 1.0 km to 2.5 km;
- 250-meter spaced receptors from 2.5 km to 5 km;
- 500-meter spaced receptors from 5.0 km to 7.5 km; and
- 1,000-meter spaced receptors from 5.0 km to 20 km.

EPA's AERMAP (Version 18081) program determined the receptor elevations and height scales. AERMOD uses the receptor's height scale to determine if the plume is terrain following or terrain impacting. The AERMAP User's Guide states that the domain boundary must include all terrain features that exceed a ten percent (10%) elevation slope from any given receptor. USGS National Elevation Dataset (NED) 1/3 arc-second data was used to identify all terrain features surrounding the proposed project site.

The worst-case maximum modeled project impacts are located within the fifty (50) meter or one hundred (100) meter spaced receptor grids within 2.5 km from the facility's center. Therefore, additional receptors beyond the initial twenty (20) km grid are not needed to identify the maximum impact.

Modeled Stack Locations

The proposed locations displayed as UTM coordinates and their base elevations provided by the applicant and used in the analysis are shown in the table below. The base elevations were obtained by the applicant from AERMAP.

| Model ID | Description | NAD-83, Zone 4 UTM Coordinates | | Base Elevation | |
|---|---|---|---|---|---|
| | | Easting (m) | Northing (m) | ft | m |
| 1 | Unit 1 | 768,943.30 | 2,307,363.00 | 358 | 109 |
| 2 | Unit 2 | 768,947.60 | 2,307,359.80 | 358 | 109 |
| 3 | Unit 3 | 768,951.90 | 2,307,356.50 | 358 | 109 |
| 4 | Unit 4 | 768,961.70 | 2,307,349.00 | 358 | 109 |
| 5 | Unit 5 | 768,966.00 | 2,307,345.70 | 358 | 109 |
| 6 | Unit 6 | 768,970.20 | 2,307,342.40 | 358 | 109 |

Modeled Stack Parameters and Emissions

The emission rates per unit and stack parameters provided by the permittee and used in the analysis are shown in the tables below. The stack parameters were based on the following assumptions:

- Stack parameters based on manufacturer data; and
- During startup, the units reach the one hundred percent (100%) load within five (5) minutes of the initial firing. Therefore, the stack parameters are based on the one hundred percent (100%) load. The SCR system will become fully functional once the catalyst reaches the operating temperature needed for $NO_x$ removal, not longer than thirty (30) minutes. The time for the catalyst to reach the operating temperature is dependent on how long the unit was shut down. Unit shutdowns occur very quickly and emissions greater than normal levels during shutdowns are not expected. Similar methodology and reasoning were used and accepted in HECO's Schofield Generating Station's application (CSP No. 0793-01-C) to install six (6) Wartsila engine generators.
- While the project includes a third operating scenario, where gaseous fuel is used for startup before switching over the fuel used to liquid for baseload operations, emissions on an hourly basis are expected to be less than those of the liquid fuel operation. Given that modeled stack parameters for the startup and full load scenarios are represented as identical, it is therefore assumed that the modeled liquid fuel-only scenario is conservatively representative of the operating scenario where gaseous fuel is used for startup and liquid fuel is used for the baseload operation.
- The $NO_2/NO_x$ in-stack ratios are used in $NO_2$ modeling. The justification for the in-stack ratio is detailed in the $NO_2$ Modeling section of the review.
- The use of stack heights greater than the Good Engineering Practice (GEP) stack height in the modeling is prohibited per 40 CFR §51.118 and 40 CFR §51.164. Per 40 CFR §51.100, the GEP stack height limit for this project is the greater of:

    - 65 meters, measured from the ground-level elevation at the base of the stack, or
    - The formula GEP stack height (GEP = H +1.5L), where H is the structure height, and L is the lesser dimension of the structure (height or projected width).

    The proposed stack heights of 35.05 meters (115 feet) is less than the formula GEP stack height; consequently the stack heights are within acceptable limits and the full stack heights can be used in the modeling.

    The stack parameters (i.e., the flow, velocity, temperature) were evaluated for biodiesel and renewable natural gas, per the application, however, Ukiu confirmed that the application represented the worst-case among the fuels listed in the permit.

| Stack Parameters Per Unit | | | | | | |
|---|---|---|---|---|---|---|
| **Load/ Scenario** | **Stack Diameter (m)** | **Stack Height (m)** | **Flow ($m^3/s$)** | **Velocity (m/s)** | **Temperature (°K)** | **$NO_2/NO_x$ In-Stack Ratio** |
| **Liquid Fuel** | | | | | | |
| Startup | 1.20 | 35.05 | 24.65 | 21.80 | 593.15 | 15% |
| Full (100%) | 1.20 | 35.05 | 24.65 | 21.80 | 593.15 | 15% |
| Min (40%) | 1.20 | 35.05 | 11.47 | 10.14 | 622.04 | 15% |
| **Gaseous Fuel** | | | | | | |
| Startup | 1.20 | 35.05 | 22.33 | 19.74 | 649.15 | 15% |
| Full (100%) | 1.20 | 35.05 | 22.33 | 19.74 | 649.15 | 15% |
| Min (40%) | 1.20 | 35.05 | 12.22 | 10.80 | 674.15 | 15% |

The modeled emissions were based on the following assumptions:

- Emissions were based on manufacturer data and proposed emissions limits;
- For most pollutants and scenarios (startup, one hundred percent (100%) load, forty percent (40%) load), the maximum pound per hour emission rates occurred for either one hundred percent (100%) liquid fuel or one hundred percent (100%) gaseous fuel. However, for CO, the maximum lb/hr emission rate considering startup occurred on a thirty (30) minute gaseous fuel cold startup and thirty (30) minutes of one hundred percent (100%) load operation on liquid fuel. Therefore, the liquid fuel startup emission rate for CO is based on the maximum lb/hr emission rate during a thirty (30) minute gaseous fuel startup and thirty (30) minutes of one hundred percent (100%) load operation on liquid fuel.
- The maximum hourly $SO_2$ and CO emission rates were modeled for all short-term averaging periods;
- The modeled short-term (twenty-four hour (24-hour)) $PM_{10}/PM_{2.5}$ emission rate is based on one (1) cold startup hour and twenty-three (23) hours of one hundred percent (100%) load operation;
- The modeled annual emission rates for the startup scenario are based on the proposed potential to emit limits;
- The modeled annual emission rates for the full and minimum load scenarios are based on the typical operating scenarios detailed in the <u>Total Project Emissions</u> section of the review and the maximum hourly emission rate during normal (non-startup) operations.

| Per Unit Modeled Emissions (g/s) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Load/ Scenario | $NO_x$ | | CO | | $PM_{10}/PM_{2.5}$ | | $SO_2$ | |
| | Short-Term | Annual | 1-Hour | 8-Hour | Short-Term | Annual | Short-Term | Annual |
| **Liquid Fuel** | | | | | | | | |
| Startup | 7.22 | 1.06 | 1.51 | 1.51 | 0.47 | 0.35 | 0.013 | 0.009 |
| Full (100%) | 1.09 | 0.71 | 0.38 | 0.38 | 0.44 | 0.30 | 0.013 | 0.009 |
| Min (40%) | 0.55 | 0.36 | 0.17 | 0.17 | 0.25 | 0.17 | 0.006 | 0.004 |
| **Gaseous Fuel** | | | | | | | | |
| Startup | 1.85 | 0.20 | 1.45 | 1.45 | 0.21 | 0.15 | 0.006 | 0.004 |
| Full (100%) | 0.17 | 0.11 | 0.25 | 0.25 | 0.19 | 0.13 | 0.006 | 0.004 |
| Min (40%) | 0.12 | 0.08 | 0.12 | 0.12 | 0.12 | 0.08 | 0.003 | 0.002 |

During startup, the engines reach full load within five (5) to ten (10) minutes of the initial firing. The SCR and oxidation catalyst systems become fully functional once the respective catalyst reaches the normal operating temperature, within thirty (30) minutes following the initiation of fuel flow. The time for each catalyst to reach the normal operating temperature is dependent on how long the unit was shut down. The oxidation catalysts reach their operating temperature before the SCR catalysts. The startup emissions were evaluated for cold startup, warm startup, and hot startup (as defined and further discussed in the Startup Emissions section of the Project Emissions). The short-term startup emissions are based on the worst-case startup scenario (cold catalysts). The long-term annual average startup emissions are based on worst-case expected annual operation of the proposed units. Unit shutdowns occur quickly and emissions greater than normal levels during shutdowns are not expected.

The annual emissions modeling assumes the total facility limit is evenly distributed across all engines, with each contributing an equal share. While individual engines may exceed 1/6th of the limit based on design capacity, this simplified approach effectively demonstrates compliance with annual averaging requirements for ambient air quality standards.

Results

The summary of the unit impacts from liquid fuel and gaseous fuel are shown in the tables below.

Through modeling the various scenarios (startup, full (one hundred percent (100%)), minimum (forty percent (40%))) and both fuel types, the modeled impacts from the controlling (worst-case) scenarios for each pollutant and their averaging periods were compared to the applicable SAAQS and NAAQS. The table below shows that the predicted ambient air quality impacts from the proposed project, accounting for limits, should comply with the SAAQS and NAAQS.

| Air Pollutant | Averaging Period | Controlling Scenario[7] | Modeled Impact[1,2,3,4,5] (µg/m$^3$) | Secondary $PM_{2.5}$[6] (µg/m$^3$) | Background (µg/m$^3$) | Total Impact (µg/m$^3$) | SAAQS (µg/m$^3$) | NAAQS (µg/m$^3$) | % Standard |
|---|---|---|---|---|---|---|---|---|---|
| CO | 1-hour | Startup - Liquid | 96.64 | -- | 1,375 | 1,471.64 | 10,000 | 40,000 | 14.7 |
| | 8-hour | Startup - Gaseous | 59.91 | -- | 458 | 517.91 | 5,000 | 10,000 | 10.4 |
| $NO_2$ | 1-hour | Startup - Liquid | 126.61 | -- | 50.8 | 177.4 | -- | 188 | 94.4 |
| | Annual | Startup - Liquid | 4.23 | -- | 5.6 | 9.8 | 70 | 100 | 14.0 |
| $PM_{10}$ | 24-hour | Startup - Liquid | 16.60 | -- | 48.0 | 64.6 | 150 | 150 | 43.1 |
| | Annual | Startup - Liquid | 1.56 | -- | 16.5 | 18.1 | 50 | -- | 36.2 |
| $PM_{2.5}$ | 24-hour | Startup - Liquid | 11.71 | 0.26 | 11.7 | 23.7 | -- | 35 | 67.7 |
| | Annual | Startup - Liquid | 1.56 | 0.01 | 4.2 | 5.8 | -- | 9 | 64.1 |
| $SO_2$ | 1-hour | Full Load - Liquid | 0.75 | -- | 21.0 | 21.7 | -- | 196 | 11.0 |
| | 3-hour | Full Load - Liquid | 0.59 | -- | 13.1 | 13.7 | 1,300 | 1,300 | 1.1 |
| | 24-hour | Startup - Liquid | 0.46 | -- | 7.9 | 8.36 | 365 | 365 | 2.3 |
| | Annual | Startup - Liquid | 0.04 | -- | 2.6 | 2.64 | 80 | 80 | 3.3 |

[1]The highest second high (H2H) concentrations from the model were used for all averaging periods for CO, the twenty-four (24) hour averaging period for $PM_{10}$ and the three (3) hour and twenty-four (24) hour averaging periods for $SO_2$.
[2]The one (1) hour $NO_2$ modeled impact is based on the 98th percentile daily maximum one (1) hour average (8th high).
[3]The twenty-four (24) hour $PM_{2.5}$ modeled impact is based on the 98th percentile twenty-four (24) hour concentration (8th high).
[4]The one (1) hour $SO_2$ modeled impact is based on the 99th percentile daily maximum one (1) hour average (4th high).
[5]The maximum concentration from the model was used for the annual averaging periods for $NO_2$, $SO_2$, $PM_{10}$, and $PM_{2.5}$.
[6]The total impact for all averaging periods of $PM_{2.5}$ include secondary $PM_{2.5}$. The secondary $PM_{2.5}$ concentrations are estimated using EPA's Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program (EPA-454/R-19-003), dated April 2019. The lowest (worst-case) MERPs for the West and Northwest climates zones were selected.
[7]The controlling scenario for the 1-hour CO is based on a thirty (30) minute startup of gaseous fuel followed by thirty (30) minutes of full (one hundred percent (100%)) load on liquid fuel.

Background Concentrations

The monitoring stations used to provide background data for the proposed project are listed in the table below.

| Pollutant | Monitoring Station |
|---|---|
| $NO_2$ | Kapolei |
| $SO_2$ | Kapolei |
| $O_3$ | Kapolei |
| CO | Kapolei |
| $PM_{10}$ | Kapolei/Honolulu |
| $PM_{2.5}$ | Kihei/Kapolei |

As outlined in 40 CFR 51, Appendix W, Section 8.2, the background data used to evaluate the potential air quality impacts is not required to be collected on a project site if the data is representative of the air quality in the subject area. The following three (3) criteria were used by the applicant to justify why the background data used was representative:

- Location – The measured data must be representative of the areas where the maximum concentration occurs for the proposed stationary source, existing sources, and a combination of the proposed and existing sources. Each of the monitoring stations listed has been sited to monitor population exposure and/or maximum concentration. $PM_{2.5}$ data was from Kihei for 2020 and 2021, however, $PM_{2.5}$ monitoring at Kihei was discontinued at the end of March 2022, so Kapolei monitoring station was used. All other background data was from Kapolei, with the exception of the 2021 $PM_{10}$ data. 2021 $PM_{10}$ data recovery was below minimum for third quarter, so the Honolulu station was used.
- Data Quality – Data must be collected and equipment must be operated in accordance with the requirements of 40 CFR Part 58, Appendices A and B, and PSD monitoring guidance. The HDOH and EPA ambient air quality data summaries have been used as the primary sources of data. The 2021 $PM_{10}$ data recovery from Kapolei was below minimum for the third quarter; therefore, the 2021 $PM_{10}$ dataset is from Honolulu.
- Data Currentness – The data are current if they have been collected within the preceding three (3) years and are representative of existing conditions. Because the applicant's analysis was prepared in 2023/4, the maximum ambient background concentrations from the period 2020-2022 were combined with the modeled concentrations and used for the comparison to the ambient air quality standards. Therefore, the data used by the applicant represented the three (3) most recent years of data available at the time of the analysis.

The maximum of the background $NO_2$, CO, $SO_2$, $PM_{10}$, and $PM_{2.5}$ data from the listed monitoring stations for the period between 2020-2022 were combined with the modeled concentrations for the comparison to the ambient air quality standards. The one (1) hour $NO_2$ is based on the three (3) year average 98$^{th}$ percentile value. The twenty-four (24) hour $PM_{2.5}$ is based on the three (3) year 98$^{th}$ percentile value, and the annual $PM_{2.5}$ is based on the three (3) year average. The annual $PM_{10}$ is based on the three (3) year maximum annual average. The one (1) hour $SO_2$ is based on the three (3) year average 99$^{th}$ percentile value.

<u>Other Regulated Pollutants</u>
The facility will be an area source of HAPs since emissions of any single HAP are below ten (10) tons per year and maximum total HAP emissions are below twenty-five (25) TPY Ukiu performed a health risk assessment to determine compliance with standards specified in HAR §11-60.1-179 for non-carcinogenic and carcinogenic HAPs. Although not required, Ukiu evaluated the impacts of the potential $NH_3$ emissions.

<u>Non-carcinogenic HAPs</u>:
HAR §11-60.1-179(c)(1) defines significant ambient air concentration of any non-carcinogenic HAP with a Threshold Limit Values – Time Weighted Average (TLV-TWA) as any eight-hour (8-hour) average ambient air concentration in excess of 1/100 of the TLV-TWA, and any annual average ambient air concentration in excess of 1/420 of the TLV-TWA. To be conservative, Ukiu evaluated any HAP listed in the CAA, that is anticipated to be released due to the proposed project, with a listed TLV-TWA. Ukiu's demonstration was based on the following assumptions:

- The TLV-TWA values from all pollutants except PAHs are from the worst-case concentration threshold among those listed in the “2025 TLVs and BEIs” compiled by the ACGIH.
- PAHs TLV-TWA from https://www.atsdr.cdc.gov/csem/polycyclic-aromatic-hydrocarbons/stanards_and_regulations_for_exposure.html.
- Maximum concentrations for the eight (8) hour averaging period are the total of the six (6) engine generators based on their maximum hourly emission rates.
- Maximum concentrations for the annual averaging period are the total of the six (6) engine generators based on their annual emission rates at 8,760 hours per year.

The tables below show the maximum impacts from the HAPs with listed TLV-TWAs emitted from the proposed project are below the significant levels for the eight (8) hour and annual averaging periods, respectively.

| **Comparison of 1/100 TLV-TWA to 8-Hour Concentrations** | | | |
|---|---|---|---|
| **Pollutant** | **TLV-TWA (µg/m³)** | **8-Hour Concentration (µg/m³)** | **1/100 of TLV-TWA (µg/m³)** |
| **Liquid Fuel** | | | |
| Benzene | 63.9 | 0.14 | 0.64 |
| Ethylbenzene | 86,838 | 9.5E-03 | 868.4 |
| Formaldehyde | 122.8 | 0.48 | 1.23 |
| Hexane | 176,237 | 1.9E-03 | 1,762 |
| Naphthalene | 52,429 | 2.3E-02 | 524 |
| PAHs (as B(a)P) | 2,064 | 8.7E-05 | 21 |
| Toluene | 75,370 | 5.2E-02 | 754 |
| Xylene | 86,838 | 3.8E-02 | 868.4 |
| **Gaseous Fuel** | | | |
| Benzene | 63.9 | 0.04 | 0.64 |
| 1,3-Butadiene | 4,425 | 0.07 | 44.3 |
| Ethylbenzene | 86,838 | 0.01 | 868.4 |
| Formaldehyde | 122.8 | 0.56 | 1.23 |
| Naphthalene | 52,429 | 4.6E-03 | 524 |
| PAHs (as B(a)P) | 2,064 | 3.1E-06 | 21 |
| Toluene | 75,370 | 0.04 | 754 |
| Xylene | 86,838 | 0.12 | 868.4 |

| Comparison of 1/420 TLV-TWA to Annual Concentrations | | | |
|---|---|---|---|
| **Pollutant** | **TLV-TWA ($\mu g/m^3$)** | **Annual Concentration ($\mu g/m^3$)** | **1/420 of TLV-TWA ($\mu g/m^3$)** |
| **Liquid Fuel** | | | |
| Benzene | 63.9 | 1.49E-02 | 0.152 |
| Ethylbenzene | 86,838 | 9.99E-04 | 206.8 |
| Formaldehyde | 122.8 | 5.10E-02 | 0.29 |
| Hexane | 176,237 | 2.05E-04 | 420 |
| Naphthalene | 52,429 | 2.41E-03 | 124.8 |
| PAHs (as B(a)P) | 2,064 | 9.18E-06 | 4.91 |
| Toluene | 75,370 | 5.53E-03 | 179 |
| Xylene | 86,838 | 3.96E-03 | 206.8 |
| **Gaseous Fuel** | | | |
| Benzene | 63.9 | 4.18E-03 | 0.152 |
| 1,3-Butadiene | 4,425 | 7.04E-03 | 10.53 |
| Ethylbenzene | 86,838 | 1.36E-03 | 206.8 |
| Formaldehyde | 122.8 | 5.90E-02 | 0.29 |
| Naphthalene | 52,429 | 4.82E-04 | 124.8 |
| PAHs (as B(a)P) | 2,064 | 3.29E-07 | 4.91 |
| Toluene | 75,370 | 4.59E-03 | 179 |
| Xylene | 86,838 | 1.24E-02 | 206.8 |

Carcinogenic HAPs:
HAR §11-60.1-179(c)(3) defines significant ambient air concentration of any carcinogenic HAP as any ambient air concentration that may result in an excess individual lifetime cancer risk of more than ten (10) in one million assuming continuous exposure for seventy (70) years. Ukiu conducted an evaluation of the cancer risk posed by the proposed project. EPA's Region IX Regional Screening Levels (RSLs) for ambient air were used in the evaluation. RSLs are based on EPA toxicity with "standard" exposure factors and are protective of humans, including sensitive groups, over a lifetime. The results of the maximum combined cancer risk evaluation were 0.4 in one million for liquid fuel and 1.1 in one million for gaseous fuel, which are below the significant level of ten (10) in one million.

Ammonia ($NH_3$):
Ammonia is not classified as a HAP under the CAA, and it has no NAAQS or SAAQS. To assess ammonia in similar applications (Hawaiian Electric Company's Schofield Generating Station application (CSP No. 0793-01-C) to install six (6) Wartsila engine generators), the Department used their discretion to treat $NH_3$ as a non-carcinogenic HAP and assessed the emission concentration in accordance with HAR §11-60.1-179(c), as described under the Non-carcinogenic HAPs section of the review. Ukiu's demonstration was based on the following assumptions:

- The TLV-TWA (DOH Standard) value is from the worst-case concentration threshold among those listed in the "2025 TLVs and BEIs" compiled by the ACGIH.
- The maximum concentrations are the total of the six (6) engine generators based on the maximum hourly and annual emission rate.

The table below shows the liquid fuel and gaseous fuel maximum $NH_3$ impacts from the project are below the provided thresholds.

| Short-Term and Annual $NH_3$ Analyses | | | | |
|---|---|---|---|---|
| **Pollutant** | **Averaging Period** | **Maximum Concentration ($\mu g/m^3$)** | **DOH Standard ($\mu g/m^3$)** | **Percent of Standard** |
| **Liquid Fuel** | | | | |
| Ammonia ($NH_3$) | 8-hour<br>Annual | 5.17<br>0.53 | 174<br>41.5 | 3.0%<br>1.3% |
| **Gaseous Fuel** | | | | |
| $NH_3$ | 8-hour<br>Annual | 4.69<br>0.48 | 174<br>41.5 | 2.7%<br>1.2% |

**SIGNIFICANT PERMIT CONDITIONS:**

Section C. Operational and Emissions Limitations

1. Fuel Limits

a. The engine generators shall be fired only on the following fuels:

i. Liquid fuels, including biodiesel (B100), renewable diesel, fuel oil #2, and any combination thereof, with a maximum sulfur content not to exceed 0.0015% by weight (15 parts per million (ppm));
ii. Gaseous fuels, including natural gas and renewable natural gas (RNG) with a maximum sulfur content not to exceed 5 ppm by volume (ppmv); and
iii. Alternate fuels in accordance with Attachment II, Special Condition No. C.8.

Reason: The fuel sulfur content limits were proposed by Ukiu and are used in the air quality assessment.

b. Each engine generator shall be fired with an annual average of two percent (2%) or more liquid fuel of total fuel on an energy equivalent basis to comply with the definition of a compression ignition engine as defined in 40 CFR Part 60, Subpart IIII.

Reason: To comply with the definition of a compression ignition engine as defined in 40 CFR Part 60, Subpart IIII. The limit was proposed in an email received from Ms. Matthews on May 14, 2025. The original application did not propose this limit and evaluated potential emissions from the engine generators using a "100% Gaseous Fuel" operating scenario. The evaluation for gaseous fuel account for pilot fuel injection, however, when the engine operates in gas mode, the liquid pilot fuel amounts to less than 1.5% of full-load fuel consumption. Though the one hundred percent (100%) gaseous fuel operating scenario is not technically feasible since Ukiu will be required to fire a minimum of two percent (2%) liquid fuel of total fuel on an energy equivalent basis, the one hundred percent (100%) gaseous fuel operating scenario was evaluated to provide a conservative analysis. The addition of the fuel limit will not affect the operating scenarios and emissions calculations presented in the permit application and additional supporting information Ukiu provided.

4. Emission Limits

a. The permittee shall not discharge or cause the discharge of nitrogen oxides ($NO_x$) as nitrogen dioxide ($NO_2$), carbon monoxide (CO), particulate matter 10 micrometers and 2.5 micrometers in diameter and smaller ($PM_{10}$ and $PM_{2.5}$), volatile organic compounds (VOC) as methane ($CH_4$), and ammonia ($NH_3$) into the atmosphere from each engine generator in excess of the following limits. These mass emission limits shall apply at all times with the exception of $NO_x$, CO, $PM_{10}/PM_{2.5}$, and VOC emission limits during any three-hour (3-hour) averaging period that includes a startup, as specified in Attachment II, Special Condition No. C.4.b:

| Pollutant | Maximum Emission Limits (each generator, 3-hour average) (lb/hr) | |
|---|---|---|
| | Liquid Fuels | Gaseous Fuels |
| $NO_x$ (as $NO_2$) | 8.64 | 1.32 |
| CO | 3.01 | 2.02 |
| $PM_{10}/PM_{2.5}$ | 3.61 | 1.61 |
| VOC (as $CH_4$) | 3.44 | 2.00 |
| $NH_3$ | 0.94 | 0.82 |

Reason: These emission limits were proposed by the applicant. The $NO_x$, CO and $PM_{10}/PM_{2.5}$ rates are consistent with the emission rates per unit used in the modeling assessment for full (one hundred percent (100%)) load on liquid and gaseous fuels. The design of the SCR system will limit ammonia slip. The permittee must demonstrate compliance with these limits by conducting initial and annual performance tests, except for the $NO_x$ and CO limits.

The permittee must install, operate, and maintain a CEMS for $NO_x$ and CO on each engine. The purpose of the CEMS is to provide continuous, real-time monitoring, which eliminates the need for separate performance testing to demonstrate compliance with the above emission limits. Records must also be maintained on the amount of ammonia slip from the operation of the SCR system on a monthly basis.

Additionally, the permittee expects elevated VOC emissions during startup periods. As a result, for any three-hour (3-hour) averaging period that includes a startup event, the maximum emission limit for VOC may exceed the limit specified in the table above. However, Attachment II, Special Condition No. C.4.b will not include a specific startup limit for VOC emissions, as there is no established ambient air quality standard for VOC.

b. The permittee shall not discharge or cause the discharge of $NO_x$, CO, and $PM_{10}/PM_{2.5}$ into the atmosphere from each engine generator during any hour that includes a startup, in excess of the following limits:

| Pollutant | Maximum Emission Limit (each generator, 1-hour average) (lb/hr, any fuel) |
|---|---|
| $NO_x$ (as $NO_2$) | 57.32 |
| CO | 12.01 |
| $PM_{10}/PM_{2.5}$ | 6.81 |

Reason: These emission limits are for any hour that include a startup. They reflect:

- The highest hourly NOx emission rate for any operating scenario and reflects one (1) cold startup hour on liquid fuel. This is consistent with the startup emission rate per unit used in the modeling assessment.
- The highest hourly CO emission rate for any operating scenario (one (1) cold startup on gaseous fuel, switch to liquid fuel). This is consistent with the startup emission rate per unit used for both the one-hour (1-hour) and eight-hour (8-hour) averaging periods in the model.
- Highest hourly $PM_{10}/PM_{2.5}$ emission rate for any operating scenario (liquid fuel only) and occurs during the startup hour. $PM_{10}$ and $PM_{2.5}$'s short-term averaging period in the model is twenty-four (24) hours. The maximum emission rate of 0.47 g/s per engine used in the model reflects one (1) cold startup hour on liquid fuel and twenty-three (23) baseload hours on liquid fuel.

The permittee must install, operate, and maintain a CEMS for $NO_x$ and CO on each engine. The elevated $PM_{10}/PM_{2.5}$ emission rate is a result from limited manufacturer's data during startups. While other pollutants have different emission rates for cold, warm and hot startups, the startup emission rate for $PM_{10}/PM_{2.5}$ was the same regardless of the type of startup. The limit for $PM_{10}/PM_{2.5}$ is to ensure compliance with what was modeled in the application and is retained in the permit to support annual $PM_{10}/PM_{2.5}$ calculations based on maximum potential values.

c. The permittee shall not discharge or cause the discharge of $NO_x$ (as $NO_2$), CO, $PM_{10}$, $PM_{2.5}$, VOC (as $CH_4$), and $NH_3$ into the atmosphere from each engine generator in excess of the following limits:

| Pollutant | Load Range | Maximum Emission Limit (each generator, 3-Hour Average) | | |
|---|---|---|---|---|
| | | Liquid Fuels | Gaseous Fuels | Units |
| $NO_x$ (as $NO_2$) | 75-100% | 35 | 6 | ppmvd at 15% $O_2$ |
| | 40-74% | 40 | 9 | |
| CO | 40-100% | 20 | 15 | ppmvd at 15% $O_2$ |
| $PM_{10}/PM_{2.5}$ | 75-100% | 30 | 15 | mg/Nm$^3$ at 15% $O_2$, dry |
| | 40-74% | 40 | 20 | |
| VOC (as $CH_4$) | 75-100% | 40 | 26 | ppmvd at 15% $O_2$ |
| | 50-74% | 40 | 37 | |
| | 40-49% | 40 | 42 | |
| $NH_3$ | All | 10 | 10 | ppmvd at 15% $O_2$ |

Reason: The applicant proposed concentration-based emission limits for BACT that apply during operation between forty percent (40%) and one hundred percent (100%) load, which reflects the expected range of operation. The higher load range (i.e., 75%-100%) aligns with manufacturer-guaranteed emission rates and reflects optimal control device performance. The higher load range was used to compare with any applicable NSPS limits and BACT limits from sources with similar units in the BACT analysis. The CEMS for $NO_x$ and CO monitors emission limits across the specified load ranges. For pollutants such as

$PM_{10}/PM_{2.5}$, VOC, and $NH_3$, annual performance testing is currently required only at the maximum operating capacity or highest achievable load, however, lower load range emission limits, based on the manufacturer's guaranteed rates, are included in the permit to allow for future Department-requested testing and to demonstrate expected variations in control efficiency at reduced loads.

d. The permittee shall not discharge or cause the discharge of $NO_x$ (as $NO_2$), CO, and $PM_{10}/PM_{2.5}$ into the atmosphere from all engine generators in excess of the following annual limits, on any rolling twelve-month (12-month) period:

| Pollutant | Maximum Emission Limit (Total, all engines, tons/year) |
|---|---|
| $NO_x$ (as $NO_2$) | 220.2 |
| CO | 67.6 |
| $PM_{10}/PM_{2.5}$ | 72.5 |

Reason: The annual emission limits apply to all engine generators combined and were established to demonstrate compliance with the annual averaging period for NAAQS and SAAQS. These limits, proposed by the applicant to maintain operational flexibility, are based on maximum annual emissions from three (3) typical operating scenarios and apply regardless of fuel type. The emission totals should include periods of engine generator startups, shutdowns, testing and maintenance, and malfunction or upset conditions.

The permittee must install, operate, and maintain CEMS for $NO_x$ and CO on each engine. Compliance with $PM_{10}/PM_{2.5}$ limits will be determined using calculations based on maximum hourly emission limits for startup and normal operations with liquid and gaseous fuels, and operation hours tracked via a non-resetting hour meter and startup events will be recorded.

It should be noted that the annual limits for CO and $PM_{10}/PM_{2.5}$ are not strictly required since CO has no annual ambient air quality standard, and the in-house ambient air quality impact analysis showed that even assuming the maximum lb/hr rate (thirty (30) minute liquid fuel startup followed by thirty (30) minutes of full (one hundred percent (100%)) load operations on liquid fuel), $PM_{10}$ and $PM_{2.5}$ levels met the standards. However, the applicant proposed these limits which are included in the permit to help minimize emissions from the facility.

While Ukiu proposed an $SO_2$ annual limit, it was excluded since compliance depends solely on fuel sulfur content, which is capped by the permit. Evaluations showed potential $SO_2$ concentrations are low and well below NAAQS and SAAQS even with unlimited operations.

e. The permittee shall not discharge or cause the discharge of $NO_X$ and filterable PM into the atmosphere from each engine generator in excess of the following limits. These emission limits shall apply at all times, except during startup, shutdown, and malfunction. During periods of startup, shutdown, and malfunction, the emission limits of Attachment II, Special Condition No. C.4.a, C.4.b, and C.4.c shall apply.

| Pollutant | Maximum Emission Limit |
|---|---|
| $NO_X$ (as $NO_2$) | 1.8 g/HP-hr (2.4 g/KW-hr)* |
| PM (Filterable) | 0.11 g/HP-hr (0.15 g/KW-hr) |

*Listed rate is based on 720 RPM ($6.7n^{-0.20}$ g/HP-hr ($9.0n^{-0.20}$ g/kW-hr) where n is the maximum engine speed.

Reason: The emission limits is based on the emission standards of 40 CFR Part 60, Subpart IIII. The engine generators are subject to the emission standards of Subpart IIII for engines greater than or equal to thirty (30) liters per cylinder and installed on or after January 1, 2016. The permittee must demonstrate compliance with these standards by conducting initial and annual performance tests (on liquid fuel) and submitting a plan for approval that establishes operating parameters to be monitored continuously.

f. The permittee shall not discharge or cause the discharge of carbon dioxide equivalent ($CO_2e$) into the atmosphere from the engine generators in excess of the following rolling twelve-month (12-month) limit calculated by summing 1,416 lb $CO_2e/MW_e$-hr times the $MW_e$-hr produced using liquid fuels, and 1,318 lb $CO_2e/MW_e$-hr times the $MW_e$-hr produced using gaseous fuels, divided by the total $MW_e$-hr produced:

Reason: The emission limit is based on the permittee proposed limit and the BACT analysis for GHG. The permittee must record the MW-hr produced from the engine generators from liquid fuel, the MW-hr produced from the engine generators from gaseous fuel, calculate on a monthly basis the amount of $CO_2e$ emitted from the engine generators, and calculate both the total combined $CO_2e$ per total MW-hr and their limit based on a rolling twelve-month (12-month) basis.

g. The total $NO_x$ emissions from the facility, including periods of engine generator startups, shutdowns, testing and maintenance, and malfunction or upset conditions, shall not equal or exceed 250 tons/year, on any rolling twelve-month (12-month) period. $NO_x$ emissions from the emergency diesel engine generator (DEG) shall also be included in the $NO_x$ emissions from the facility.

Reason: The above condition limiting $NO_x$ emissions from the facility, including the emissions from insignificant activities is meant to ensure that the source is below the PSD applicability threshold. $NO_x$ emissions from the engine generators will be monitored through the CEMS, and the permittee will be required to calculate the $NO_x$ emissions from the emergency diesel engine generator on a rolling twelve-month (12-month) period based on the hours indicated by the non-resetting hour meter.

The permittee will be required to report the facility's total NOx emissions for a rolling twelve-month (12-month) period semi-annually.

Section D. Monitoring and Recordkeeping Requirements

12. Annual Tonnage Calculations

The permittee shall calculate and record the CO, $NO_x$, and $PM_{10}/PM_{2.5}$ emissions from the facility for all periods of operation, including during periods of startups, shutdowns, testing and maintenance, and malfunction or upset conditions, on a monthly and rolling twelve-month (12-month) basis to demonstrate compliance with Attachment II, Special Condition No. C.4.d. $NO_x$ emissions from the emergency DEG shall also be included in the $NO_x$ emissions from the facility to demonstrate compliance with Attachment II, Special Condition No. C.4.g. Detailed supporting data, calculations, and the resulting emission quantities shall be maintained.

a. The permittee shall use data from each engine generator's CO and $NO_x$ CEMS required by Attachment II, Special Condition No. D.6.d, using the following procedures:

i. The permittee shall use the data conversion procedures in 40 CFR Part 60, Appendix A, Method 19 to determine the hourly mass emission rate of CO and NOx from the engine generators during all engine generator operating hours.

ii. **Within 180 days of the issuance of the permit**, the permittee shall submit to the Department a protocol for the substitution of missing data for $NO_x$ and CO. The protocol shall include, but is not limited to, the methodology, justification, and quality assurance procedures proposed for data substitution for both $NO_x$ and CO. The permittee shall obtain written approval from the Department prior to implementing any missing data substitution procedures. The Department reserves the right to require revision to, or additional information about, the protocol.

Reason: To demonstrate compliance with their mass emission limits and their annual tonnage emission limits, the permittee will use the data conversion procedures in 40 CFR Part 60, Appendix A, Method 19. To account for missing data substitutions, the permittee will submit a missing data substitution protocol for $NO_x$ and CO to the Department for review and written approval. The Department reserves the right to require revision or additional information of the protocol at any time.

b. The $PM_{10}/PM_{2.5}$ emissions per engine generator shall be calculated using the following equations, and emissions from each engine generator shall be summed to calculate the total $PM_{10}/PM_{2.5}$ emissions from all engine generators:

Liquid fuel operation:

$$\text{Rolling 12-Month Emissions}_{LIQ}\ (\text{tons/year}) = [\ (\#\text{Starts}_{LIQ} \times 5.0\ \text{lbs/start}) + (\text{OpHours}_{LIQ} - (\#\text{Starts}_{LIQ} * 0.5)) * 3.61\ \text{lbs/hr}))\ ] / 2000\ \text{lbs/ton}$$

Gaseous fuel operation:

Rolling 12-Month Emissions$_{GAS}$ (tons/year) = [ (#Starts$_{GAS}$ x 2.0 lbs/start)
+ (OpHours$_{GAS}$ – (#Starts$_{GAS}$ * 0.5)) * 1.61 lbs/hr)) ]
/ 2000 lbs/ton

Total Per Engine Generator:

Rolling 12-Month Emissions (tons/year) = Rolling 12-Month Emissions$_{LIQ}$ + Rolling 12-Month Emissions$_{GAS}$

Where:

#Starts$_{LIQ}$ = Number of startups per year on liquid fuel
#Starts$_{GAS}$ = Number of startups per year on gaseous fuel

The hours per twelve-month (12-month) rolling period (OpHours$_{GAS}$ and OpHours$_{LIQ}$) shall be based on the hour meter readings for gaseous and liquid fuel, respectively.

Reason: To demonstrate compliance with the annual $PM_{10}/PM_{2.5}$ emission limit, the permittee will calculate the total $PM_{10}/PM_{2.5}$ emissions per generator and then sum up the values for all the engine generators. Conservatively, the lbs/hr emission rates for liquid fuel and gaseous fuel operation are based on the maximum emission rates provided by the manufacturer during periods of startup and normal operations. During periods of maintenance and testing, and/or malfunction, the maximum emission rate for normal operation should be used.

c. The emergency diesel engine generator's $NO_x$ emissions shall be calculated using the following equation:

Power (hp) x Emission Factor (lb/hp-hr) x Hours/Rolling 12-month period x ton/2000 lbs

The $NO_x$ emission factor shall be based on data from the manufacturer, AP-42, or other data. The emission factor used shall receive prior written approval by the Department. The hours per rolling twelve-month (12-month) period shall be based on the hour meter reading. The power rating shall be based on the maximum power rating as specified by the manufacturer.

Reason: This condition is to estimate $NO_x$ emissions from the emergency DEG, so it can be evaluated with the total $NO_x$ emissions from the engine generators to ensure that the total emissions from the facility do not exceed PSD applicability thresholds.

13. Liquid Fuel-to-Total Fuel Ratio

The permittee shall calculate the parts liquid fuel to one hundred (100) parts total fuel on an energy equivalent basis each calendar year for each engine generator. Detailed supporting data and monthly calculations shall be maintained for the purpose of demonstrating compliance with the fuel limit in Attachment II, Special Condition No. C.1.b.

Reason: The permittee must calculate and keep records of the parts liquid fuel to one hundred (100) parts total fuel on an energy equivalent basis each calendar year for the purpose of demonstrating compliance with the fuel limit in Attachment II, Special Condition No. C.1.b. This calculation helps demonstrate that the engine generators are operating as compression ignition engines, making them subject to the applicable requirements of 40 CFR Part 60, Subpart IIII.

**CONCLUSION AND RECOMMENDATION:**

Ukiu Energy, LLC applied for an initial CSP to install and operate six (6) 7.48 MW Wartsila 16V34DF generators at Waena, Maui. The engine operates in a binary mode of either liquid pilot fuel/ gaseous fuel or one hundred percent (100%) liquid fuel. Each engine generator will be required to be fired with an annual average of two percent (2%) or more liquid fuel of total fuel on an energy equivalent basis to comply with the definition of a compression ignition engine as defined in 40 CFR Part 60, Subpart IIII. The engine generators will be subject to the requirements of 40 CFR Part 60, Subpart IIII for non-emergency engines with a displacement of greater than or equal to thirty (30) liters per cylinder. Each unit will be equipped with an emission control system consisting of SCR, oxidation catalysts, CEMS, and associated support equipment. The applicant proposed annual emission limits based on the maximum potential to emit from their three (3) typical operating scenarios. The three (3) typical operating scenarios are detailed in the **PROJECT EMISSIONS** section. These annual emission limits are not dependent on the fuel being burned and will apply at all times, including startup, shutdown, testing and maintenance, and malfunction or upset conditions. The applicant also proposed lb/hr limits that will apply at all times, excluding $NO_x$, CO, $PM_{10}/PM_{2.5}$, and VOC emission limits during any three-hour (3-hour) averaging period that includes a startup, and are based on the manufacturer’s emissions data for the units. During any hour that includes a startup, Ukiu proposed maximum emission limits for $NO_x$, CO, and $PM_{10}/PM_{2.5}$. The lb/hr limits were proposed to remain consistent with their assumptions in their ambient air quality impact analysis. Shutdowns occur very quickly and emissions greater than normal levels during shutdown are not expected. The applicant also proposed concentration emission limits for their normal operation load and startup specific limitations to comply with the BACT requirements. The CEMS will continuously measure and record the $NO_x$ and CO emissions.

Ukiu is proposing to construct a 755 bhp Cummins (or equivalent) emergency DEG adjacent to the six (6) engine generators, which will be considered as insignificant activity. To avoid exceeding the PSD applicability threshold for $NO_x$, Ukiu must record and calculate the $NO_x$ emissions from this insignificant activity and include them in the evaluation of the total $NO_x$ emissions from the facility on a rolling twelve-month (12-month) basis.

If operated as proposed in the application and in accordance with the permit, the facility should demonstrate compliance with Federal requirements, HAR, Chapter 11-60.1, and State and Federal ambient air quality standards.  Issuance of this initial permit is recommended, subject to the incorporation of the significant permit conditions, thirty-day (30-day) public comment period, and forty-five-day (45-day) EPA review period.

KC
October 23, 2025

# Application
# and
# Supporting Information

Foulweather Consulting
Foulweather Bluff
Hansville, WA
916.802.1375

July 29, 2024

Ms. Marianne Rossio, P.E.
Manager, Clean Air Branch
State of Hawaii Department of Health
2827 Waimano Home Road #130
Pearl City, HI 96782]

Subject: Application for an Initial Covered Source Permit
Ukiu Energy LLC
Waena, Maui

Dear Ms. Rossio:

Enclosed please find two copies of an Application for an Initial Covered Source Permit for a proposed new nominal 45 megawatt (MW) power plant, to be located near the Waena substation on the island of Maui.

Ukiu Energy LLC proposes to install and operate six Wartsila 16V34DF (dual fuel) reciprocating internal combustion engines (RICE). Each nominal 7.5 MW RICE will be equipped with a selective catalytic reduction (SCR) system to control oxides of nitrogen (NOx) emissions and an oxidation catalyst to reduce carbon monoxide (CO) and formaldehyde emissions. Auxiliary equipment will include an emergency diesel generator.

The Wärtsilä generators are four-stroke compression ignition engines that are capable of being fired on either liquid or gaseous fuel (with pilot biodiesel fuel injection). The engines are designed to be fuel flexible, and will be primarily fueled with renewable fuels, including ultra-low sulfur renewable diesel with a maximum sulfur content of 15 ppm and renewable natural gas (RNG).

The project will be a new major source under the Covered Source Permit program. The project will not be subject to Prevention of Significant Deterioration review because its potential to emit will be below applicable thresholds.

The applicant's contact information is:

Bob Albertini, Senior Director
800 Bethel Street
Queens Court, Suite 500
Honolulu, HI 96813
(708) 710-5645

If you have any questions or need additional information regarding this application, please contact Mr. Albertini at the number above or Nancy Matthews of Foulweather Consulting at (916) 798-5665.

Sincerely,

Gary Rubenstein
Principal

Enclosure

Cc: Chief (Attention: AIR-3), Permits Office, Air Division, U.S. EPA Region 9 (via email)

Bob Albertini, Ukiu Energy

Foulweather Consulting

# Application to the Hawaii Department of Health Clean Air Branch for a Covered Source Permit For a New Generating Project at Waena, Maui

prepared for:

## Ukiu Energy LLC

July 2024

prepared by:

Foulweather Consulting
Foulweather Bluff, Hansville, WA

Foulweather Consulting

# APPLICATION TO THE HAWAII DEPARTMENT OF HEALTH CLEAN AIR BRANCH FOR A COVERED SOURCE PERMIT FOR A NEW GENERATING PROJECT AT WAENA, MAUI

Prepared for:

Ukiu Energy LLC

Submitted to:

Hawaii Department of Health Clean Air Branch

July 2024

Prepared by:


Foulweather Consulting
Foulweather Bluff, Hansville, WA


Foulweather Consulting

# APPLICATION TO THE HAWAII DEPARTMENT OF HEALTH CLEAN AIR BRANCH FOR A COVERED SOURCE PERMIT FOR A NEW GENERATING PROJECT AT WAENA, MAUI

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## 1. Introduction

Ukiu Energy LLC proposes to construct and operate a new power plant at Waena on the island of Maui. The new power plant project is being developed in response to a Request for Proposals from Maui Electric Company (MECO). The project will provide capacity and energy to MECO via a Power Purchase Agreement that will support the deployment of additional renewable resources on the island. The project is designed to interconnect to the Maui grid and provide significant grid benefits, notably supporting grid stability to allow for more rooftop solar and other intermittent resources while also providing black start capacity to the island grid if needed to recover from a major grid outage. The new generating facility would consist of six Wärtsilä 16V34DF biofuel-fired reciprocating internal combustion engine generators, for a total of 44.88 MW (gross) of generating capacity.

## 2. Proposed Generating Facility

The project will consist of six Wärtsilä 16V34DF generating units. The six Wärtsilä 16V34DF generating units and auxiliary equipment are the subject of this application.

The Wärtsilä generators are dual-fuel compression ignition engine generators, each rated at 7.5 MW (gross, nominal). The generators are designed to be fuel-flexible; the primary fuels for the engine generators will be renewable natural gas and biodiesel. Each dual-fueled generator will be equipped with an emission control system consisting of Selective Catalyst Reduction (SCR) for oxides of nitrogen (NOx) emissions control and oxidation catalysts to control carbon monoxide (CO), volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions; continuous emissions monitoring system (CEMS); and associated support equipment.

Other equipment and facilities to be constructed include water treatment facilities, fire protection and emergency services, a new 46 kilovolt (kV) air-insulated switchgear switchyard, other electrical switchgear and transformers, and an operations and maintenance building.

Following completion of the Hawaii Department of Health's (HDOH) permitting activities, Ukiu Energy intends to commence construction of the Wärtsilä generators. Construction is expected to start in early to mid-2026, with a projected on-line date in late 2027.

The HDOH application forms for the project are enclosed as Appendix A.

### 2.1. Environmental Assessment

There are no Chapter 343 triggers applicable to a renewable firm generation facility on appropriately zoned land, so no Environmental Assessment is required for this project.

## 3. Existing Site Conditions

### 3.1. Geography and Topography

The project will be located in central Maui, adjacent to the Maui Electric Waena substation at the corner of Pulehu Road and Upper Division Road. The project power generation equipment will be constructed on a 10-acre site owned by Ukiu Energy. The property is a greenfield site. The approximate latitude and longitude coordinates of the generation project are 20°50'50" N and 156°24'59" W.

### 3.2. Climate and Meteorology

The Hawaiian Island chain is situated south of the large Eastern Pacific semipermanent high-pressure cell, the dominant atmospheric feature affecting air circulation in the region. Over the Hawaiian Islands, this high-pressure cell produces very persistent winds called the northeast trades, which blow from the northeast. During the winter months, cold fronts sweep across the north central Pacific Ocean, bringing rain to the Hawaiian Islands and intermittently modifying the trade wind regime. Thunderstorms also contribute to annual precipitation.

Due to the tempering influence of the Pacific Ocean and the low-latitude location, the Hawaiian Islands experience extremely small diurnal and seasonal variations in ambient temperature. Average temperatures range from about 74-75ºF in March to 79-80ºF in July. These temperature variations are quite modest compared to those experienced at inland continental locations.

Surface wind patterns on Maui result from a combination of synoptic (large-scale), mesoscale (regional), and small-scale circulations. The Hawaiian Islands lie at a tropical latitude where northeasterly trade winds prevail. This circulation is extremely persistent. Occasional hurricanes disrupt wind and rain patterns in the Hawaiian Islands.

Superimposed on the large-scale flow in and around Waena are so-called "mountain and valley" circulations. Mountain and valley winds result from differential heating or cooling between the slope of the nearby volcano and adjacent free air. Upslope, or up-valley, flow occurs during the day as air is warmed. Downslope, or down-valley, flow occurs at night due to radiational cooling.

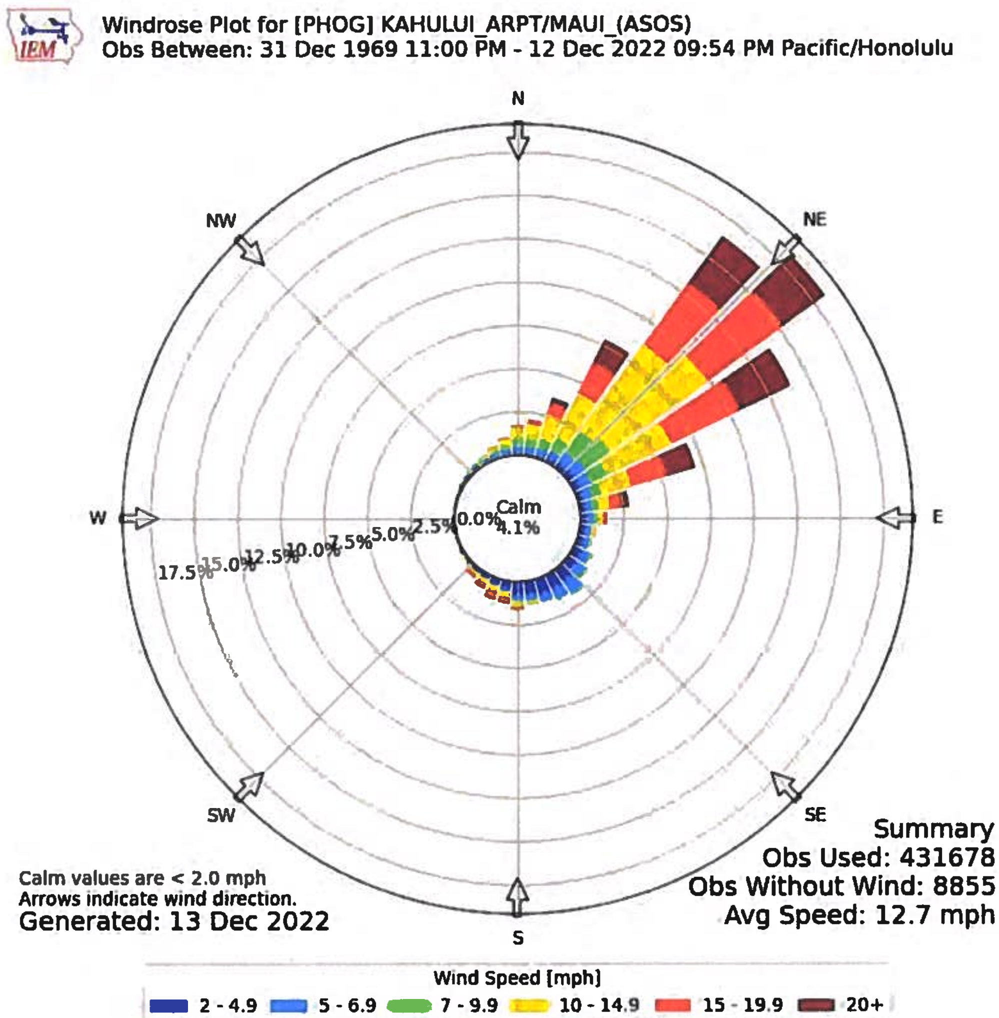
The nearest full-time meteorological monitoring station to the proposed project site is maintained at the Kahului International Airport, approximately 3.3 miles northwest of the project site. Wind patterns for the project area are presented in Figure 1, which is a wind rose for the Kahului International Airport meteorological station. The wind rose shows that at this site, the majority of winds come from the northeast and east-northeast. Calm conditions prevail only about 1% of the time.[1]

The average high temperature at the project site is 87 °F; the average annual temperature is 77°F. Temperatures of 60°F or below and of 100°F or above rarely occur at this location.

---

[1] Note that the ambient air quality modeling analysis was prepared using onsite meteorological data. The Kahului Airport wind rose is included here only for informational purposes.

**Figure 1. Kahului International Airport Wind Rose (Long-Term Averages)**




### 3.3. Overview of Air Quality Standards

The U.S. Environmental Protection Agency (EPA) has established national ambient air quality standards (NAAQS) for the following seven pollutants, termed criteria pollutants: ozone, nitrogen dioxide ($NO_2$), CO, sulfur dioxide ($SO_2$), particulate matter with aerodynamic diameter less than or equal to 10 microns ($PM_{10}$), particulate matter with aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), and airborne lead. The federal Clean Air Act (CAA) requires EPA to designate areas (counties) as attainment or non-attainment with respect to each criteria pollutant, depending on whether the areas meet the NAAQS. An area that is designated non-attainment means the area is not meeting the NAAQS and is subject to planning requirements to attain the standard.

In addition to the seven pollutants listed above, the Hawaii Department of Health (HDOH) has established state standards for CO, $PM_{10}$, ozone, $SO_2$, hydrogen sulfide and lead. The state standards were designed to protect the most sensitive members of the population, such as children, the elderly, and people who suffer from lung or heart diseases.

Both state and federal air quality standards are based on two variables: maximum concentration and an averaging time over which the concentration would be measured. Maximum concentrations are based on levels that may have an adverse effect on human health. The averaging times are based on whether the damage caused by the pollutant would occur during exposures to a high concentration for a short time (for example, 1 hour), or to a relatively lower average concentration over a longer period (8 hours, 24 hours, or 1 month). For some pollutants, there is more than one air quality standard, reflecting both short-term and long-term effects. Table 1 presents the NAAQS and HAAQS.

### 3.1. Existing Air Quality

The project site is an urban area that is in attainment for all state and federal standards. The impacts of existing sources will be represented by the existing ambient air quality data collected at nearby monitoring stations. The monitoring stations that will be used to provide background data for the proposed project are listed in Table 2.

Ambient air quality monitoring data for ozone, $PM_{10}$, $PM_{2.5}$, CO, $NO_2$ and $SO_2$ from the representative SLAMS monitoring stations for the years 2020 through 2022 are summarized in Table 3. The only pollutant monitored on the island of Maui is $PM_{2.5}$. Background concentrations for the other pollutants are taken from HDOH's SLAMS monitoring station at Kapolei, Oahu, which is sited in a suburban area for population exposure.

The ambient air quality data are based on data published by HDOH (HDOH Web site) and EPA (AIRS Web site). The maximum ambient background concentrations will be combined with the modeled concentrations and used for comparison to the AAQS.

| Table 1. Ambient Air Quality Standards | | | |
|---|---|---|---|
| Pollutant | Averaging Time | Hawaii | National |
| Ozone | 1-hour<br>8 hour | –<br>0.08 ppm | –<br>0.070 ppm |
| CO | 1-hour<br>8-hour | 9 ppm (10 mg/m³)<br>4.4 ppm | 35 ppm (40 mg/m³)<br>9 ppm (10 mg/m³) |
| $NO_2$ | 1-hour<br>Annual arithmetic mean | –<br>0.04 ppm | 100 ppb (188 µg/m³) [a]<br>53 ppb (100 µg/m³) |
| $SO_2$ | 1-hour<br>3-hour (secondary standard)<br>24-hour<br>Annual arithmetic mean | –<br>0.5 ppm<br>0.14 ppm<br>0.03 ppm | 75 ppb (196 µg/m³)<br>0.5 ppm (1,300 µg/m³)<br>–<br>– |
| Respirable Particulate Matter ($PM_{10}$) | 24-hour<br>Annual arithmetic mean | 150 µg/m³<br>50 µg/m³ | 150 µg/m3<br>– |
| Fine Particulate Matter ($PM_{2.5}$) | 24-hour<br>Annual arithmetic mean | –<br>– | 35 µg/m³ [b]<br>12 µg/m³ [c] |
| Lead | Calendar quarter<br>Rolling 3-month average | –<br>1.5 µg/m³ | 1.5 µg/m³<br>0.15 µg/m³ |
| Hydrogen sulfide ($H_2S$) | 1- hour | 0.025 ppm | – |

Note:

a. To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb.
b. The 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard.
c. 3-year average of the weighted annual mean concentrations.

µg/m³ = microgram(s) per cubic meter
ppm = parts per million
Source: HDOH, 2020

| Table 2. Monitoring Station Locations | |
|---|---|
| **Pollutant** | **Monitoring Station** |
| $NO_2$ | Kapolei, Oahu |
| $SO_2$ | Kapolei, Oahu |
| $O_3$ | Kapolei, Oahu |
| CO | Kapolei, Oahu |
| $PM_{10}$ | Kapolei, Oahu |
| $PM_{2.5}$ | Kihei, Maui |

animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion.

- Nitrous oxide ($N_2O$) is a greenhouse gas with a GWP of 298 times that of $CO_2$.[3] Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

The project impact assessment includes the impacts from emissions of $CO_2$, $CH_4$, and $N_2O$.

## 4. Environmental Analysis

The following sections describe the emission sources that have been evaluated, the results of the ambient impact analyses, and the evaluation of project compliance with the applicable air quality regulations. These analyses are designed to confirm that the proposed project's design features result in less-than-significant impacts with the following conservative analysis assumptions and procedures: maximum allowable emission rates, project operating schedules that lead to maximum emissions, worst-case meteorological conditions, and the worst-observed existing air quality added to the highest potential ground-level impact from modeling—even when all of these situations could not physically occur at the same time.

### 4.1. Process Description

As discussed above, the proposed project includes the installation of six new Wärtsilä 16V34DF reciprocating IC engines. Each new engine generator will be equipped with an inlet air filter and an intercooling system. Table 4 lists the technical specifications for the new engines. Note the specifications are for a single engine.

**Table 4. Wärtsilä 16V34DF Nominal Specifications**

| Parameter | Specifications | |
|---|---|---|
| Manufacturer | Wärtsilä | |
| Model | 16V34DF | |
| Fuel Types | Renewable natural gas (RNG) | Biodiesel |
| Fuel Higher Heating Value | 1024 Btu/scf | 19,280 Btu/lb |
| Heat Input (HHV) (peak load)[a] | 62 MMBtu/hr | 61 MMBtu/hr |
| Fuel Consumption | 54.7 Mscf/hr | 3,479 lb/hr |
| Exhaust Flow (peak load, nominal) | 42,300 dscfm | 49,050 dscfm |
| Exhaust Temperature (peak load) | 707 °F | 642 °F |
| Engine Generator Output | 7,480 kW (nominal - gross) | |

Note:
a. Represents the maximum fuel consumption of the engine, based on rated heat input and fuel heat content.

[3] IPCC, 2007, op.cit.

Manufacturer's literature is provided in Appendix E.

These compression ignition engines use a pilot fuel injection system to ignite the air-gas mixture in the cylinder when operating the engine in gaseous fuel mode.[4] The engine operates in a binary mode of either biodiesel pilot fuel/renewable natural gas or 100% biodiesel fuel. The engines are designed to operate on a wide range of liquid and gaseous fuels. References to RNG in this application are intended to represent all gaseous fuels and references to biodiesel are intended to represent all liquid fuels. The emission rates presented in this application represent worst case emissions for each fuel type (liquid or gaseous).

The Wärtsilä dual-fuel engine operates on the lean burn principle: the mixture of air and gas in the cylinder contains more air than is needed for complete combustion. Lean combustion reduces peak temperatures and therefore $NO_X$ emissions. Emissions will be further minimized through the use of post-combustion air pollution controls, which will consist of SCR for $NO_X$ control and oxidation catalysts for carbon monoxide (CO) control. Any or all of the reciprocating engines may be operated up to 24 hours per day, 7 days per week, with annual operation limited by fuel use and emissions limitations.

### 4.2. Air Pollution Control (APC) Systems

Each engine generator will utilize an SCR catalyst with ammonia or urea injection for control of NOx emissions. As a result, the NOx emissions at full load will be limited to 6 ppmv, 3-hour average, dry basis at 15% $O_2$ (ppmc), on RNG and 35 ppmc on biodiesel. The oxidation catalyst is expected to achieve CO emissions at full load of 15 ppmc, 3-hour average, on RNG and 20 ppm on biodiesel. VOC emissions at full load will be limited to 26 ppmc on RNG and 40 ppmc on biodiesel (as methane). SOx and $PM_{10}$ emissions will be minimized through the use of ultra-low sulfur fuels. Ammonia slip from the SCR system will be limited to 10 ppmc, 3-hour average basis.

The exhaust from each engine will be discharged from a 115-foot tall, 4-foot diameter exhaust stack. Individual Continuous Emission Monitoring System (CEMS) sampling probes will be located in the horizontal ducting prior to the silencer for each engine for continuous measurement and recording of NOx and CO emissions.

### 4.3. Emergency Diesel Generator

The emergency diesel generator will be constructed adjacent to the reciprocating engines. Specifications for the emergency generator are shown in Table 5. Because this unit is used solely in emergencies, it is an insignificant source and is exempt from permitting under 11-60.1-82(d)(8).

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[4] The amount of pilot fuel varies with engine load and under most operating conditions comprises less than 1% of full-load fuel consumption. The amount of pilot fuel is optimized for efficient combustion by the engine control and monitoring system. The volume/mass of pilot fuel stays more or less constant throughout the load range, so the effective percentage rises as load decreases.

Manufacturers' literature for the emergency engine is provided in Appendix E.

**Table 5. Emergency Diesel Engine Generator Specifications**

| Parameter | Value |
|---|---|
| Manufacturer | Cummins or equivalent |
| Model | DFEK or equivalent |
| EPA Emissions Certification | Tier 2 (Stationary Emergency) |
| Fuel | ULSD |
| Engine Output, kw | 563 |
| Engine Output, bhp | 755 |
| Heat Input, MMBtu/hr (HHV) | 4.75 |
| Heat Input, gal/hr | 34.4 |
| Operating hours per year[a] | 500 |

Note:
a. Operating hours per year used to determine annual emissions.

### 4.4. Criteria Pollutant Emissions from the New Generating Units

The highest hourly heat input and emission rates for the Wärtsilä 16V34DF engine generators during normal operation occur at peak load. The primary fuel for the engines will initially be biodiesel, with other fuels (including renewable natural gas and ultralow sulfur diesel) as backups. The engines may be operated under a wide variety of load conditions and may start up and/or operate on either RNG or biodiesel. The worst-case hourly emissions assume all six engines will undergo startups on biodiesel during the same hour. Worst-case hourly emissions for RNG reflect the maximum emissions on any gaseous fuel; worst-case hourly emissions for biodiesel reflect the maximum emissions on any liquid fuel. Maximum daily emissions are calculated assuming that each engine will undergo one startup/shutdown per day and will operate at full load for the remaining hours of the day. Maximum annual emissions are calculated for three operating scenarios that describe maximum potential emissions for the various combinations of fuel use: 100% RNG operation, 100% biodiesel operation, and biodiesel operation with RNG startups. However, the engines may operate in any one or a combination of these modes, depending upon operational demands and fuel availability. Details of the emissions calculations are provided in the following sections.

#### 4.4.1. Commissioning Period

Engine commissioning consists of no-load, partial-load and full-load testing performed immediately after construction for the purpose of optimizing engine operations, followed by installation of the emission control systems and optimizing and testing of the SCR systems. Several parameters—such as engine load, engine tuning, and degree of SCR control—may be varied simultaneously during testing at the discretion of the applicant and in accordance with the commissioning program laid out by the engine and control equipment manufacturers.

Emissions during the commissioning period may be higher than those during normal operations for some pollutants due to the fact that the engines may not be optimally tuned and the SCR systems may be only partially operational or not operational at all. However, operations during commissioning are episodic and short-term, and not all engines are operated simultaneously so emissions during these activities will be minimized.

The CEMS will be installed and calibrated on each engine prior to the first start of each engine, and NOx and CO emissions will be continuously monitored during the commissioning phase.

#### 4.4.2. Emissions Calculations

Criteria pollutant emission rates were calculated for various operating modes of the project: engine startup and engine operation. These operating modes are described in Table 7. Detailed emission calculations are in Appendix B.

| Table 6. Operating Modes of the Engine Generators | |
|---|---|
| **Mode** | **Description** |
| Start-up | There will be up to 6 total startups per day; the equivalent of 1 startup for each engine. Startup emissions are elevated because the control equipment has not reached optimal temperature to begin the chemical reactions needed to convert NOx to elemental nitrogen and water. Startup emissions using biodiesel fuel are evaluated as a worst case. |
| Normal Operation | Normal operation occurs after the engines and the control equipment are working optimally, as designed. Emissions may vary due to fluctuations in engine load, but mass emissions at part load are not higher than mass emissions at full load. Operating emissions on biodiesel fuel are evaluated as a worst case. |

#### 4.4.3. Start-Up Emissions

The applicant expects that there will be an average of the equivalent of 365 startups per year for each engine during normal plant operations. During a startup, there are up to 30 minutes with elevated emissions (emissions higher than during normal operation) as the emission control devices reach full effectiveness. Shutdowns occur quickly enough (within one minute, based on information provided by the manufacturer) that they are not expected to result in emissions above normal levels.

The startup emission calculations are shown in Appendix B. The applicant expects that there will be an average of one startup per day per engine; however, this is not proposed as an operational limit as daily operations will vary. During start-up operations, each engine is assumed to operate at elevated NOx and CO emission rates due to the phased-in effectiveness of the SCR systems and oxidation catalysts. Compliance with emission limits during startup will be monitored by the CEMS.

#### 4.4.4. Normal Operations

The emissions during normal operations are assumed to be fully controlled to Best Available Control Technology (BACT) levels and exclude emissions due to commissioning and startup periods. Hourly and annual averages are calculated and shown in Appendix B.

Table 8 and Table 9 show hourly and annual emissions for the six engines for three typical operating scenarios. Each operating scenario includes startup and normal (fully control) operation. Details of the hourly and annual emissions calculations for each scenario are shown in Appendix B. The engines are expected to operate in any one or a combination of these operating scenarios.

#### 4.4.5. Hourly and Annual Emissions Limits

The maximum hourly and annual emissions for all six engines, shown as the maximum of any scenario, are proposed as permit limits to ensure that the project is operated in a manner consistent with the operating assumptions used to evaluate project impacts. NOx and CO emissions will be continuously monitored at all times. No other operational limitations are proposed for the project.

### 4.5. Criteria Pollutant Emissions from the New Emergency Diesel Generator

The new Wartsila generators will be connected to the grid and would take power for startup from the grid under normal circumstances. The new emergency diesel engine generator will only be needed if there were a loss of power from the grid that resulted from a power outage. Under those circumstances, the emergency diesel generator will provide black start capability for the Wärtsilä engine generators in the event of complete loss of power from the grid. The emergency engine will operate to provide electric power only during an emergency situation—that is, when electric power from the local utility is interrupted—and therefore qualifies as emergency equipment used to protect health and welfare used during power outages. In accordance with H.A.R. 11-60.1-82(f)(5), the emergency generator is an insignificant source.

The emergency generator is expected to operate infrequently, with non-emergency operation (maintenance and testing) limited to 100 hours per year. However, its annual emissions have been evaluated to ensure compliance with H.A.R. 11-60.1-82(e). Annual emissions are calculated based on 500 hours of operation per year, based on EPA policy for emergency engines, and are included in the total project emissions shown in Table 10.

| Table 7. Maximum Mass Emission Rates, lb/hr | | | | | | |
|---|---|---|---|---|---|---|
| | NOx | SOx | CO | VOC | $PM_{10}/PM_{2.5}$ | $NH_3$ |
| **100% RNG Operation** | | | | | | |
| **Each Individual Engine** | | | | | | |
| Normal Operating Hour | 1.32 | 0.050 | 2.02 | 2.00 | 1.61 | 1.02 |
| Startup Hour[a] | 14.66 | 0.050 | 11.51 | 3.00 | 2.81 | 0.51 |
| Maximum Hour | 14.66 | 0.050 | 11.51 | 3.00 | 2.81 | 1.02 |
| **Total, Six Engines** | | | | | | |
| Normal Operating Hour | 7.92 | 0.30 | 12.12 | 12 | 9.66 | 6.1 |
| Startup Hour[a] | 88.0 | 0.30 | 69.1 | 18.0 | 16.8 | 3.1 |
| Maximum Hour | 88.0 | 0.30 | 69.1 | 18.0 | 16.8 | 6.1 |
| **RNG Startups, Biodiesel Operation** | | | | | | |
| **Each Individual Engine** | | | | | | |
| Normal Operating Hour | 8.64 | 0.104 | 3.01 | 3.44 | 3.61 | 1.15 |
| Startup Hour[a] | 18.3 | 0.104 | 12.01 | 3.72 | 3.81 | 0.58 |
| Maximum Hour | 18.3 | 0.104 | 12.01 | 3.72 | 3.81 | 1.15 |
| **Total, Six Engines** | | | | | | |
| Normal Operating Hour | 51.8 | 0.61 | 18.1 | 20.6 | 21.7 | 6.9 |
| Startup Hour[a] | 109.9 | 0.48 | 72.0 | 22.3 | 22.8 | 3.5 |
| Maximum Hour | 109.9 | 0.61 | 72.0 | 22.3 | 22.8 | 6.9 |
| **100% Biodiesel Operation** | | | | | | |
| **Each Individual Engine** | | | | | | |
| Normal Operating Hour | 8.64 | 0.104 | 3.01 | 3.44 | 3.61 | 1.15 |
| Startup Hour[a] | 57.32 | 0.104 | 6.51 | 4.22 | 6.81 | 0.58 |
| Maximum Hour | 57.32 | 0.104 | 6.51 | 4.22 | 6.81 | 1.15 |
| **Total, Six Engines** | | | | | | |
| Normal Operating Hour | 51.8 | 0.61 | 18.1 | 20.6 | 21.7 | 6.9 |
| Startup Hour[a] | 343.9 | 0.61 | 39.0 | 25.3 | 40.8 | 3.5 |
| Maximum Hour | 343.9 | 0.61 | 39.0 | 25.3 | 40.8 | 6.9 |
| **Maximum, Any Scenario** | 343.9 | 0.61 | 72.0 | 25.3 | 40.8 | 6.9 |

Note:

a. Pounds per hour emission rates for startup hour include 30 minutes of cold startup and 30 minutes of full-load operation.

| Table 8. Maximum Mass Emission Rates, tons/year | | | | | | |
|---|---|---|---|---|---|---|
| | NOx | SOx | CO | VOC | $PM_{10}/PM_{2.5}$ | $NH_3$ |
| **100% RNG Operation** | | | | | | |
| **Each Individual Engine** | | | | | | |
| Normal Operations | 3.80 | 0.14 | 5.81 | 5.75 | 4.63 | 2.93 |
| Startups[a] | 3.10 | 0.01 | 2.50 | 0.68 | 0.70 | 0.13 |
| Total[b] | 6.90 | 0.16 | 8.30 | 6.43 | 5.33 | 3.06 |
| **Total, Six Engines** | | | | | | |
| Normal Operations | 22.8 | 0.9 | 34.8 | 34.5 | 27.8 | 17.6 |
| Startups[a] | 18.6 | 0.1 | 15.0 | 4.1 | 4.2 | 0.8 |
| Total[b] | 41.4 | 0.9 | 49.8 | 38.6 | 32.0 | 18.4 |
| **RNG Startups, Biodiesel Operation** | | | | | | |
| **Each Individual Engine** | | | | | | |
| Normal Operations | 24.8 | 0.30 | 8.7 | 9.9 | 10.38 | 3.31 |
| Startups[a] | 4.0 | 0.02 | 2.6 | 0.9 | 0.95 | 0.14 |
| Total[b] | 28.9 | 0.32 | 11.3 | 10.8 | 11.33 | 3.45 |
| **Total, Six Engines** | | | | | | |
| Normal Operations | 149.0 | 1.8 | 51.9 | 59.3 | 62.3 | 19.8 |
| Startups[a] | 24.1 | 0.1 | 15.7 | 5.2 | 5.7 | 0.9 |
| Total[b] | 173.1 | 1.9 | 67.6 | 64.5 | 68.0 | 20.7 |
| **100% Biodiesel Operation** | | | | | | |
| **Each Individual Engine** | | | | | | |
| Normal Operations | 24.8 | 0.30 | 8.7 | 9.9 | 10.38 | 3.31 |
| Startups[a] | 11.9 | 0.03 | 1.5 | 1.0 | 1.70 | 0.14 |
| Total[b] | 36.7 | 0.33 | 10.2 | 10.9 | 12.08 | 3.45 |
| **Total, Six Engines** | | | | | | |
| Normal Operations | 149.0 | 1.8 | 51.9 | 59.3 | 62.3 | 19.8 |
| Startups[a] | 71.1 | 0.2 | 9.1 | 5.9 | 10.2 | 0.9 |
| Total[b] | 220.2 | 2.0 | 61.0 | 65.2 | 72.5 | 20.7 |
| **Maximum, Any Scenario** | 220.2 | 2.0 | 67.6 | 65.2 | 72.5 | 20.7 |

Note:
a. Startup emissions reflect 30 minutes of cold startup and 30 minutes of full-load operation for each hour of startup during the year.
b. Numbers may not add directly due to rounding.

| Table 9. Maximum Annual Project Emissions, tons/year | | | | | |
|---|---|---|---|---|---|
| | NOx | SOx | CO | VOC | $PM_{10}/PM_{2.5}$ |
| 6 16V34DF Engines, Maximum, Any Scenario | 220.2 | 2.0 | 67.6 | 65.2 | 72.5 |
| Emergency Generator | 1.8 | 0.002 | 0.2 | 0.01 | 0.04 |
| Total Project Emissions | 222.0 | 2.0 | 67.8 | 65.2 | 72.5 |
| Note:<br>a. Startup emissions reflect 30 minutes of cold startup and 30 minutes of full-load operation for each hour of startup during the year. | | | | | |

### 4.6. Non-Criteria Pollutant Emissions from the New Generating Units

Noncriteria pollutant emissions were estimated for the new engines. These emissions are summarized in Table 10. The detailed noncriteria pollutant emissions calculations and the associated screening-level health risk assessment are included in Appendices B and C. Because the emissions of any single HAP are below 10 tons per year and maximum total HAP emissions are below 25 tons per year, the facility will be an area source of HAPs.

| Table 10. Non-Criteria Pollutant Emissions for the New Equipment | | | |
|---|---|---|---|
| | **100% RNG Operation** | **RNG Startups/ Biodiesel Operation** | **100% Biodiesel Operation** |
| **Compound** | **Emissions (tons/yr, each engine)** | | |
| Ammonia (not a HAP) | 3.1 | 3.5 | 3.5 |
| Propylene (not a HAP) | 0.6 | 0.3 | 0.3 |
| Acetaldehyde | 0.05 | 6.7E-03 | 2.9E-03 |
| Acrolein | 0.01 | 1.3E-03 | 8.8E-04 |
| Benzene | 0.02 | 0.08 | 8.3E-02 |
| 1,3-Butadiene | 0.04 | 2.8E-03 | 5.6E-03 |
| Ethylbenzene | 0.01 | 5.9E-03 | 0.28 |
| Formaldehyde | 0.32 | 0.30 | 1.1E-03 |
| Naphthalene | 2.6E-03 | 1.1E-03 | 1.3E-02 |
| PAHs (other) | 1.8E-06 | 0.01 | 5.1E-05 |
| Toluene | 0.02 | 4.9E-05 | 3.1E-02 |
| Xylene | 0.07 | 0.03 | 2.2E-02 |
| **Total, All HAPs** | **Emissions (tons/yr, 6 engines)** | | |
| Total HAPs | 3.22 | 2.79 | 2.66 |
| See detailed calculations in Appendix B, Appendix Tables B-16, B-17 and B-18. | | | |

### 4.7. Greenhouse Gas Emission Estimates

Combustion of fossil fuels in the reciprocating engine generators would result in emissions of $CO_2$, $CH_4$, and $N_2O$. GHG emissions for normal facility operations under each of the three operating scenarios were calculated based on the maximum fuel use predicted for each scenario and emission factors contained in the EPA GHG Reporting Regulation.[5] Emissions of $CO_2$, $N_2O$, and $CH_4$ resulting from operation of the generators are presented in Table 11.

**Table 11. Greenhouse Gas Emissions from the New Generators**

| | $CO_2$, metric tons/year | $CH_4$, metric tons/year | $N_2O$, metric tons/year | $CO_2$eq, metric tons/yr[a] | $CO_2$, pounds per MWh |
|---|---|---|---|---|---|
| **100% RNG Operation** | | | | | |
| Each Engine | 20,596 | 0.39 | 0.039 | | |
| Total, 6 Engines | 123,577 | 2.33 | 0.23 | 123,704 | 978.8 |
| **RNG Startups/ Biodiesel Operation** | | | | | |
| Each Engine | 27,671 | 1.11 | 0.22 | | |
| Total, 6 Engines | 166,023 | 6.66 | 1.32 | 166,581 | 1,318.1 |
| **100% Biodiesel Operation** | | | | | |
| Each Engine | 27,965 | 1.13 | 0.23 | | |
| Total, 6 Engines | 167,792 | 6.78 | 1.38 | 168,368 | 1,332.2 |

Note:
a. Includes $CH_4$ and $N_2O$.

Detailed GHG emission calculations for the new engines are included in Appendix B.

[5] 40 CFR 98 (as revised on 12/09/2016).

### 4.8. Consistency with Laws, Ordinances, Regulations, and Standards

This section demonstrates consistency separately for federal and state requirements.

#### 4.8.1. Consistency with Federal Requirements

*PSD Program*

EPA has promulgated PSD regulations for areas that are in compliance with national ambient air quality standards (40 CFR 52.21). The PSD program allows new sources of air pollution to be constructed, or existing sources to be modified, while preserving the existing ambient air quality levels, protecting public health and welfare, and protecting Class I areas (e.g., specific national parks and wilderness areas). There are five principal aspects of the PSD program: (1) Applicability; (2) Best Available Control Technology; (3) Pre-Construction Monitoring; (4) Increments Analysis; and (5) Air Quality Impact Analysis.

Applicability. The federal PSD requirements apply on a pollutant-specific basis to any project that is a new major stationary source or a major modification to an existing stationary source. (These terms are defined in federal regulations.) (40 CFR 52.21). Since the proposed project will be a new major source, the determination of PSD applicability to the proposed project is based on evaluating the emissions increases associated with the proposed project. In Table 12, the emissions from the proposed project, based on the maximum emissions from any of the proposed operating scenarios, are compared to the regulatory significance thresholds. As shown in this table, the emissions associated with the proposed project are below these PSD applicability thresholds for all pollutants, and thus the proposed project is not subject to PSD review.

**Table 12. Project Emissions and PSD Applicability**

| Pollutant | Maximum Annual Emissions from New Equipment (tpy)[a] | PSD Applicability Thresholds (tpy) | Emissions Exceed Threshold? |
|---|---|---|---|
| NOx | 220.2 | 250 | No |
| SOx | 2.0 | 250 | No |
| CO | 67.6 | 250 | No |
| VOC | 65.2 | 250 | No |
| $PM_{10}$ | 72.5 | 250 | No |
| $PM_{2.5}$ | 72.5 | 250 | No |
| GHG | 185,788 | 75,000[b] | No |

Notes:
a. Includes emissions from the emergency generator. See Table 10.
b. GHG significance threshold is applicable only if potential to emit for one or more attainment pollutants exceed the applicable threshold. Since PTEs for all other pollutants are below the applicability thresholds, the GHG threshold does not apply.

*New Source Performance Standards: Wärtsilä Reciprocating Engines*

When fired on RNG, the proposed Wärtsilä 16V34DF units will be subject to the NSPS Subpart JJJJ requirements for non-emergency engines manufactured on or after July 1, 2010, for engines with a maximum engine power greater than or equal to 500 horsepower (hp). Although these engines utilize pilot biodiesel and not sparking devices to ignite the compressed fuel in the cylinder, they meet the definition of spark ignition in NSPS Subpart JJJJ, as follows:

> *Spark ignition means relating to either: a gasoline-fueled engine; or any type of engine with a spark plug (or other sparking device) and with operating characteristics significantly similar to the theoretical Otto combustion cycle. Spark ignition engines usually use a throttle to regulate intake air flow to control power during normal operation. Dual-fuel engines in which a liquid fuel (typically diesel fuel) is used for compression ignition and gaseous fuel (typically natural gas) is used as the primary fuel at an annual average ratio of less than 2 parts diesel fuel to 100 parts total fuel on an energy equivalent basis are spark ignition engines.*

As discussed in Section 1.3, the Wärtsilä 16V34DF engines use a biodiesel pilot fuel injection system to ignite the air-gas mixture in the cylinder when the engine operates in gas mode. The Wärtsilä units are normally started in biodiesel mode. During operation in gas mode, gas admission is activated when combustion is stable in all cylinders (usually within 1-2 minutes). When the engine operates in gas mode, the biodiesel pilot fuel amounts to less than 1.5% of full-load fuel consumption, and the engine's operating characteristics are substantially similar to the theoretical Otto combustion cycle. Therefore, the proposed Wärtsilä 16V34DF units will be regulated as spark ignition engines under NSPS Subpart JJJJ when fueled with RNG.

40 CFR Part 60 Subpart JJJJ, Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (NSPS JJJJ) applies to owners and operators of stationary spark ignition internal combustion engines (SI ICE) that commence construction after June 12, 2006. The NSPS Subpart JJJJ requirements are dependent on the following factors:

- The maximum engine power,
- When the SI ICE was manufactured, and
- The purpose of the stationary SI ICE.

Per 40 CFR §60.4233(e), the applicable NSPS Subpart JJJJ $NO_X$, CO, and VOC emission standards are those for non-emergency SI ICE with a maximum engine power greater than or equal to 500 bhp fired on natural gas and manufactured on or after July 1, 2010. The proposed permit limits are well below the applicable NSPS standards, as shown in Table 13.

| Table 13. Compliance with SI NSPS Limits | | |
|---|---|---|
| **Pollutant** | **Proposed Permit Limits[a]** | **Subpart JJJJ Limits** |
| $NO_X$ | 6 ppmvd at 15% $O_2$ | 1.0 g/hp-hr OR<br>82 ppmvd at 15% $O_2$ |
| CO | 15 ppmvd at 15% $O_2$ | 2.0 g/hp-hr OR<br>270 ppmvd at 15% $O_2$ |
| VOC<br>(excluding formaldehyde) | 26 ppmvd at 15% $O_2$ | 0.7 g/hp-hr OR<br>60 ppmvd at 15% $O_2$ |
| Note:<br>a. Exhaust concentrations vary by load; highest (full load) limits shown. See Appendix B, Table B-1. | | |

40 CFR Part 60 Subpart IIII, Standards of Performance for Stationary Compression Ignition Internal Combustion Engines (NSPS Subpart IIII) applies to owners and operators of stationary compression ignition internal combustion engines (CI) ICE that commence construction after July 11, 2005, where the stationary CI ICE is manufactured after April 1, 2006. The NSPS Subpart IIII requirements are dependent on the following factors:

- When the stationary CI ICE will be installed,
- The size (cylinder displacement) of the stationary CI ICE;
- The engine speed; and
- The purpose of the stationary CI ICE.

When the proposed Wärtsilä 16V34DF units are fired primarily or solely on biodiesel, they will be subject to the NSPS Subpart IIII requirements for non-emergency compression ignition engines with a displacement of greater than or equal to 30 liters per cylinder. Per 40 CFR §60.4204(c)(3), the applicable NSPS Subpart IIII $NO_X$ limit for non-emergency stationary CI ICE with a displacement of greater than or equal to 30 liters per cylinder installed on or after January 1, 2016, and an engine speed is between 130 and 2,000 rpm, is calculated as follows:

$$E_{NSPS} = 9.0 * n^{-0.20}$$

Where:

$E_{NSPS}$ = Applicable NSPS $NO_X$ limit ($g/kW_m$-hr)
$n$ = Maximum Engine Speed (RPM)

Based on the Wärtsilä 16V34DF's maximum rated engine speed of 720 rpm, the applicable NSPS Subpart IIII $NO_X$ limit is 2.4 $g/kW_m$-hr (1.8 g/hp-hr). The NSPS limit is based on the engine's mechanical output, not the generator's electrical output. The manufacturer's guaranteed $NO_X$ emission rate is equivalent to 0.52 $g/kW_m$-hr at full load, well below the applicable NSPS Subpart IIII $NO_X$ limit.

NSPS Subpart IIII requires non-emergency stationary CI ICE with a displacement of greater than or equal to 30 liters per cylinder to limit PM emissions to 0.15 $g/kW_m$-hr (0.11 g/hp-hr) (40 CFR §60.4204(c)(4)). The manufacturer's guaranteed PM emission rate is equivalent to 0.15 g/$kW_m$-hr at full load, in compliance with the applicable NSPS Subpart IIII PM limit.

Per 40 CFR §60.4215(b), stationary CI ICE with a displacement of greater than or equal to 30 liters per cylinder are required by 40 CFR §60.4207 to use diesel fuel with a sulfur content that does not exceed 1,000 ppm. The biodiesel fuel used in this application will have a sulfur content that does not exceed 15 ppm as BACT for $SO_2$ and $PM_{10}$/$PM_{2.5}$, as discussed previously.

*New Source Performance Standards for the Emergency Engine*

The proposed 750 kW emergency diesel engine generator will be subject to the NSPS Subpart IIII requirements for emergency CI ICE with a displacement of less than 30 liters per cylinder. Stationary CI ICE with a displacement of less than 30 liters per cylinder are required to meet the applicable emission standards in §40 C.F.R. 60.4205 for their model year.

40 CFR §60.4205 requires the emergency engine to meet the applicable standards in Table 4 to Subpart IIII of Part 60. The applicant will comply with this requirement by installing a Tier 2 certified emergency generator.

*National Emission Standards for Hazardous Air Pollutants*

40 CFR Part 63 Subpart ZZZZ, National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines (RICE NESHAP) applies to all stationary RICE. The specific applicable requirements are dependent on the following factors:

- The engine output and engine type (CI or SI),
- The engine installation date,
- Whether the source is a major or area source of HAPs, and
- The purpose of the stationary RICE.

The RICE NESHAP classifies the proposed Wärtsilä 16V34DF units as "new stationary engines >500 hp located at area source of HAP, spark ignition 4-stroke lean burn" while using RNG as they:

- Have a site rating of more than 500 brake horsepower (bhp),
- Will be constructed after June 12, 2006,
- Are four-stroke, lean burn spark ignition engines, and
- Will be located at an area source of HAP emissions (40 CFR §63.6590(a)(2)(iii)).

The RICE NESHAP classifies the proposed Wärtsilä 16V34DF units as "new stationary engines >500 hp located at area source of HAP, compression ignition" while using biodiesel fuel as they:

- Have a site rating of more than 500 brake horsepower (bhp),
- Will be constructed after June 12, 2006,
- Are compression ignition engines, and
- Will be located at an area source of HAP emissions (40 CFR §63.6590(a)(2)(iii)).

The NESHAP requires new stationary engines >500 hp located at area sources of HAP to comply with the requirements of NSPS Subparts IIII or JJJJ, as appropriate. There are no separate requirements for these engines under the NESHAP.

*Compliance Assurance Monitoring (CAM)*

The CAM regulation (40 CFR 64) applies to emission units at major stationary sources required to obtain a Title V permit, which use control equipment to achieve a specified emission limit. The rule is intended to provide "reasonable assurance" that the control systems are operating properly to maintain compliance with the emission limits. Since the project will be issued a Covered Source Permit requiring the installation and operation of continuous emissions monitoring systems, the project will qualify for this exemption from the requirements of the CAM rule. Therefore, CAM requirements do not apply to the proposed project.

*Acid Rain Requirements*

The federal Acid Rain program (40 CFR Part 72) applies to electric generating units rated at greater than 25 MW that are located within the 48 contiguous states. Because each of the Wärtsilä generating units is rated at 7.5 MW (nominal) and the project will be located in Hawaii, these units are not subject to Acid Rain program requirements.

4.8.2. Consistency with State Requirements

The proposed project is subject to State of Hawaii Administrative Rules, Chapter 11-60.1, Air Pollution Control, Subchapters 1, 2, 5, 6, 8, and 11. Each of these rules requires, in various forms, descriptions and analyses of the project, its emissions, and its impact on air quality. The data and analyses in this application support document verify that the project will comply with all applicable state and federal air quality requirements.

As discussed in Part I of this application, the facility is considered to be a "covered source" for the purposes of Chapter 11-60.1. Section 11-60.1-101 requires that every application for a covered source permit include:

A description of the compliance status of the existing covered source or proposed source with respect to all the applicable requirements . . .

"Applicable requirements" are defined in §11-60.1-61 as:

[A]ll of the following as they apply to emissions units in a covered source:

(1) Any NAAQS or state ambient air quality standard;
(2) The application of best available control technology to control those pollutants subject to any NAAQS or state ambient air quality standard, but only as best available control technology would apply to new covered sources and modifications to covered sources that have the potential to emit or increase emissions above significant amounts considering any limitations, enforceable by the director, on the covered source to emit a pollutant; and
(3) Any standard or other requirement provided for in chapter 342B, HRS; this chapter; or chapter 11-59.

Compliance with each of these requirements is discussed in the following sections.

1) Any NAAQS or state ambient air quality standard.

The source will comply with all national and state ambient air quality standards. The ambient air quality impact analysis is provided in Appendix C.

2) The application of best available control technology to control those pollutants subject to any NAAQS or state ambient air quality standard, but only as best available control technology would apply to new covered sources and modifications to covered sources that have the potential to emit or increase emissions above significant amounts considering any limitations, enforceable by the director, on the covered source to emit a pollutant.

The required BACT analyses are provided in Appendix D.

3) Any standard or other requirement provided for in chapter 342B, HRS; this chapter; or chapter 11-59.

Chapter 11-60.1 was developed to implement the requirements of chapter 342B as well as Title V of the Clean Air Act Amendments. Compliance with the requirements of chapter 11-60.1 will also ensure compliance with chapter 342B. Chapter 11-59 lists the state ambient air quality standards, which were discussed previously in this section.

The "General Requirements" of Chapter 11-60.1 Subchapter 1 that are applicable to the source are discussed below.

a. Subchapter 1, General Requirements

§ 1 Definitions. This section contains definitions that are applicable to various standards and requirements, but no actual standards or requirements. This section defines "covered source" to include any stationary source constructed, modified, or relocated after March 20, 1972, that is not a covered source. A "covered source" includes any "major source," or any source subject to NSPS, NESHAPS, or PSD. A "major source" includes all sources with a "potential to emit" in excess of 100 tons per year of any air pollutant. The proposed project is considered to be a "covered source" because it is a "major source."

§ 2 Prohibition of air pollution. This section requires any activity that causes air pollution to secure written approval from the director. The source will comply with this requirement by securing written approval from the director in the form of a permit prior to modifying the facility.

§ 3 General conditions for considering applications. This section requires that an applicant demonstrate to the satisfaction of the director that all of the applicable provisions of this chapter are complied with, including the following, before an application for covered or covered source permit can be approved: (1) NSPS, NESHAPS, and PSD requirements if applicable; and (2) the maintenance or attainment of any NAAQS or state air quality standard. This application document contains all the information necessary to make the required demonstration.

§ 4 Certification. This section requires that all information submitted in the permit application be certified by a responsible official as true, accurate, and complete. The required certification is included in this application.

§ 5 Permit Conditions. This section authorizes the director to impose permit conditions that may be more restrictive than otherwise required by regulations to protect public health, welfare, and safety. The project will comply with all permit conditions.

§ 6 Holding of permit. This section requires the permit to be maintained at the stationary source site and made available for inspection upon request. The source will comply with this requirement by keeping the permit onsite.

§ 7 Transfer of permit. This section prohibits transfer of permits between equipment and locations and requires director approval for transfer from one person to another. The source will comply with this requirement if a permit transfer is ever needed.

§ 8 Reporting discontinuance. This section requires written notification to the director of any permanent discontinuance of construction or operation. The source will supply all necessary written notifications if operation is discontinued.

§ 11 Sampling, testing, and reporting methods. This section requires that all sampling and testing be in accordance with EPA reference methods, allows the department to conduct tests of emissions from any source, and allows the director to require a source to maintain records of all operating data necessary to determine compliance with applicable emissions limitations. The source will conduct all necessary testing according to EPA methods and will maintain all appropriate records.

§ 14 Public access to information. This section allows public access to all emissions information and permit applications submitted to the department, except for information that is requested and approved for "confidential treatment." The source will comply with this requirement by following appropriate procedures when confidential treatment of information is required.

§ 15 Reporting of equipment shutdown. This section requires reporting of any scheduled shutdowns of air pollution control equipment at least 24 hours prior to the shutdown and sets out specific items that must be contained in this report. The source will comply with all applicable reporting requirements during any scheduled shutdown of air pollution control equipment.

§ 16 Prompt reporting of deviations. This section requires immediate notification of failure or breakdown of emissions units or related equipment that causes a violation of this chapter or permit. The source will comply with all applicable notification requirements during failure or breakdown.

§ 17 Prevention of air pollution emergency episodes. This section allows the director to curtail source activities during periods of excessive buildup of air contaminants. The source will comply with any curtailment orders issued under this section.

§ 18 Variances. This section requires that all variances and variance applications comply with Hawaii Revised Statutes (HRS) ' 342B-14 and prohibits any variance from interfering with the maintenance or attainment of any NAAQS. Also, it allows no variances from federal regulations or federally enforceable permit conditions. The source will comply with any applicable variance procedures.

§ 19 Penalties and remedies. This section states that any person who violates any provision in chapter 11-60.1 is subject to the penalties and remedies provided in certain sections of the HRS. The source will abide by any applicable penalties and remedies properly imposed on the source.

*Standby generators used exclusively to provide electricity, standby sewage pump drives, and other emergency equipment used to protect the health and welfare of personnel and the public, all of which are used only during power outages, emergency equipment maintenance and testing, and which:*

*(A) Are fired exclusively by natural or synthetic gas; or liquified petroleum gas; or fuel oil No. 1 or No. 2; or diesel fuel oil No. 1D or No. 2D; and*

*(B) Do not trigger a Prevention of Significant Deterioration (PSD) or covered source review, based on their potential to emit regulated or hazardous air pollutants*

The emergency engines will be fired exclusively on diesel fuel oil No. 2, and their emissions do not trigger a PSD review, as shown in Table 13.

§ 85 Compliance plan. This section requires submittal of a "compliance plan" with every application for a new covered source permit. The compliance plan must include a description of the compliance status of the existing covered source with respect to all applicable requirements. The source will comply with this requirement by identifying all applicable requirements and stating the compliance status of the source with respect to all of these requirements.

§ 86 Compliance certification. This section requires submittal of a "compliance certification" with every application for a new covered source permit. The required certification is being submitted as part of this application.

d. Subchapter 6, Fees for Covered Sources, Noncovered Sources, and Agricultural Burning

§ 11-60.1-111 through § 11-60.1-121 set out the fees required for a covered source permit application. The applicant will pay all applicable permit fees.

e. Subchapter 9. Hazardous Air Pollutants

§ 11-60.1-179 prohibits a facility owner/operator from emitting hazardous air pollutants (HAPs) "...in such quantities that result in, or contribute to, an ambient air concentration which endangers human health." Because the proposed project is not a new major source of HAPs, there is no reason to believe that the emissions of HAPs may result in an unacceptable ambient air concentration.

f. Subchapter 11. Greenhouse Gas (GHG) Emissions

§11-60.1-201 through § 11-60.1-206 outline the requirement to prepare and implement a greenhouse gas reduction plan. This requirement applies only to sources that had begun construction or operation by June 30, 2014, so is not applicable to the proposed new facility.

***Best Available Control Technology***

Section 81 of Chapter 60.1 identifies BACT as an applicable requirement for new covered sources. New covered sources must apply BACT for any pollutants whose emissions are "significant." Emissions from all sources at the facility were shown in Table 10. The new engines are subject to BACT for NOx, VOC, CO, $PM_{10}/PM_{2.5}$, and GHG.

HDOH regulations define BACT as the following:

> *...an emissions limitation...based on the maximum degree of reduction for each pollutant subject to regulation approved pursuant to the Act which would be emitted from any proposed stationary source or modification which the director, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through the application of production techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant.*

The following tasks were performed for the BACT analysis for NOx:

- Reviewed published BACT guidelines;
- Reviewed federal NSPS; and
- Reviewed EPA's RBLC database.

The detailed BACT analysis is included in Appendix D. As discussed in this analysis, the new engines will comply with BACT using the following measures. All proposed limits are expressed on a 3-hour average basis.

- BACT for NOx emissions will be the use of low-NOx emitting equipment and add-on controls. The proposed project will use combustion technology and SCR to reduce NOx emissions (as $NO_2$) to 6 ppmc while operating on RNG and 35 ppmc while operating on biodiesel.
- BACT for CO emissions will be achieved by using good combustion practices and an oxidation catalyst to achieve CO emissions of 15 ppmc while operating on RNG and 20 ppmc while operating on biodiesel.
- BACT for VOC emissions will be achieved by use of good combustion practices and an oxidation catalyst to achieve VOC emissions (as methane) of 26 ppmc while operating on RNG and 40 ppmc while operating on biodiesel.
- BACT for $PM_{10}$ and $PM_{2.5}$ is best combustion practices and the use of clean, low-sulfur renewable fuels. The proposed engines will burn exclusively renewable natural gas with a maximum sulfur content of 5 parts per million by volume (0.32 grains per 100 scf (gr/100 scf) and biodiesel with a maximum sulfur content of 15 ppm.

*Screening Health Risk Assessment*

§ 11-60.1-179(c) requires that any new major source of hazardous air pollutants (HAPs) must demonstrate that the HAP emissions from the proposed new major source will not result in or contribute to any ambient air concentration which endangers human health. In addition, per HAR 11-60.1-83(a)(14) the director can request a risk assessment of the air quality related impacts caused by a proposed project.

Calculation of noncriteria pollutant emissions from the proposed project are provided in Appendix B and summarized in Table 10 above. The calculations demonstrate that the proposed project will not be a major source of HAP, so no risk assessment is required. However, a risk assessment will be provided upon request.

# Appendix A

# HDOH Application Forms

File/Application No.: NEW

# S-1: Standard Air Pollution Control Permit Application Form
(Covered Source Permit and Noncovered Source Permit)

State of Hawaii
Department of Health
Environmental Management Division
Clean Air Branch
P.O. Box 3378 • Honolulu, HI 96801-3378 • Phone: (808) 586-4200

1. Company Name: Ukiu Energy LLC

2. Facility Name (if different from the Company): Ukiu Energy

3. Mailing Address: 800 Bethel Street Queens Court, Suite 500

   City: Honolulu State: HI Zip Code: 96813

   Phone Number: 708-710-5645

4. Name of Owner/Owner's Agent: Nicole Bulgarino

   Title: Executive Vice President Phone: 865-414-1341

   Mailing Address: 101 Constitution Avenue, N.W., Suite 525 East

   City: Washington State: DC Zip Code: 20001

5. Plant Site Manager/Other Contact: Bob Albertini

   Title: Senior Director Phone: 708-710-5645

   Mailing Address: 800 Bethel Street Queens Court, Suite 500

   City: Honolulu State: HI Zip Code: 96813

6. Permit Application Basis: (Check all applicable categories.)

   ☑ Initial Permit for a New Source ☐ Initial Permit for an Existing Source

   ☐ Renewal of Existing Permit ☐ General Permit

   ☐ Temporary Source ☐ Transfer of Permit

   ☐ Modification to a Covered Source: ➔ Is Modification? ☐ Significant ☐ Minor ☐ Uncertain

   ☐ Modification to a Noncovered Source

7. If renewal or modification, include existing permit number: ____

8. Does the Proposed Source require a County Special Management Area Permit? ☐ Yes ☑ No

9. Type of Source (Check One): ☑ Covered Source ☐ Covered and PSD Source

   ☐ Noncovered Source ☐ Uncertain

10. Standard Industrial Classification Code (SICC), if known: 4911

11. Proposed Equipment/Plant Location (e.g. street address): Pulehu Road and Upper Division Road

City: Kahului State: HI Zip Code: 96784

UTM Coordinates (meters): East: 768845 North: 2307383

UTM Zone: 4 UTM Horizontal Datum: ☐ Old Hawaiian ☐ NAD-27 ☑ NAD-83

12. General Nature of Business: Electric generation

13. Date of Planned Commencement of Construction or Modification: early to mid-2026

14. Is *any* of the equipment to be leased to another individual or entity? ☐ Yes ☑ No

15. Type of Organization: ☑ Corporation ☐ Individual Owner ☐ Partnership

☐ Government Agency (Government Facility Code: _______)

☐ Other: ______________________

*Any applicant for a permit who fails to submit any relevant facts or who has submitted incorrect information in any permit application shall, upon becoming aware of such failure or incorrect submittal, promptly submit such supplementary facts or corrected information. In addition, an applicant shall provide additional information as necessary to address any requirements that become applicable to the source after the date it filed a complete application, but prior to the issuance of the noncovered source permit or release of a draft covered source permit.* (HAR §11-60.1-64 & 11-60.1-84)

**RESPONSIBLE OFFICIAL** (as defined in HAR §11-60.1-1)

Name (Last): Bulgarino (First): Nicole (MI): ________

Title: Executive Vice President Phone: 865-414-1341

Mailing Address: 101 Constitution Avenue, N.W., Suite 525 East

City: Washington State: DC Zip Code: 20001

**Certification by Responsible Official** (pursuant to HAR §11-60.1-4)

I certify that I have knowledge of the facts herein set forth, that the same are true, accurate and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by the Department of Health as public record. I further state that I will assume responsibility for the construction, modification, or operation of the source in accordance with the Hawaii Administrative Rules (HAR), Title 11, Chapter 60.1, Air Pollution Control, and any permit issued thereof.

NAME (Print/Type): Nicole Bulgarino

(Signature): [signature] Date: 7-21-24

**FOR AGENCY USE ONLY:**

File/Application No.: ______________

Island: ______________

Date Received: ______________

Submit the following documents as part of your application:

A. The ***Emissions Units Table***, filled in as completely as possible. Use separate sheets of paper as needed. General instructions include the following:

1. Identify each **emission point** with a unique number for this plant site, consistent with emission point identification used on the location drawing and previous permits; if known, provide the SICC number. Emission points shall be identified and described in sufficient detail to establish the basis for **fees** and applicability of requirement of HAR, Chapter 11-60.1. Examples of emission point names are: heater, vent, boiler, tank, baghouse, fugitive, etc. Abbreviations may be used.
   a. For each emission point use as many lines as necessary to list regulated and hazardous air pollutant data. For hazardous air pollutants, also list the Chemical Abstracts Service number (CAS#).
   b. Indicate the emission points that discharge together for any length of time.
   c. The **Equipment Date** is the date of equipment construction, reconstruction, or modification. Provide supporting documentation.

2. State the **maximum emission rates** in terms sufficient to establish compliance with the applicable requirements and standard reference test methods. Provide all supporting emission calculations and assumptions:
   a. Include all regulated and hazardous air pollutants and air pollutants for which the source is major, as defined in HAR §11-60.1-1. Examples of regulated pollutant names are: Carbon Monoxide (CO), Nitrogen Oxides ($NO_X$), Sulfur Dioxide ($SO_2$), Volatile Organic Compounds (VOC), particulate matter (PM), and particulate less than 10 microns ($PM_{10}$). Abbreviations may be used.
   b. Include fugitive emissions.
   c. **Pounds per hour (#/HR)** is the maximum potential emission rate expected by applicant.
   d. **Tons per year** is the annual maximum potential emissions expected by the applicant, taking into account the typical operating schedule.

3. Describe ***Stack Source Parameters***:
   a. **Stack Height** is the height above the ground.
   b. **Direction** refers to the exit direction of stack emissions: up, down or horizontal.
   c. **Flow Rate** is the actual, not the calculated, flow rate.

4. Provide any additional information, if applicable, as follows:
   a. If combinations of different fuels are used that cause any of the stack source parameters to differ, complete one row for each possible set of stack parameters and identify each fuel in the **Equipment Description**.
   b. For a rectangular stack, indicate the length and width.
   c. Provide any information on stack parameters or any stack height limitations developed pursuant to Section 123 of the Clean Air Act.

B. A **process flow diagram** identifying all equipment used in the process, including the following:
   1. Identify and describe each emission point.
   2. Identify the locations of safety valves, bypasses, and other such devices which when activated may release air pollutants to the atmosphere.

C. A **facility location map**, drawn to a reasonable scale and showing the following:
   1. The property involved and all structures on it. Identify property/fence lines plainly.
   2. Layout of the facility.
   3. Location and identification of the proposed emissions unit on the property.
   4. Location of the property and equipment with respect to streets and all adjacent property. Show the location of all structures within 100 meters of the applicant's emissions unit. Provide the building dimensions (height, length, and width) of all structures that have heights greater than 40% of the stack height of the emissions unit.

D. Provide a description of any proposed modifications or permit revisions. Include any justification or supporting information for the proposed modifications or permit revisions.

File No.: NEW

# EMISSIONS UNITS

Review of applications and issuance of permits will be expedited by supplying all necessary information on this Table.

| AIR POLLUTANT DATA: EMISSION POINTS | | | AIR POLLUTANT | AIR POLLUTANT EMISSION RATE | | UTM COORDINATES OF EMISSION POINT | | | STACK SOURCE PARAMETERS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STACK NO. | UNIT NO. | EQUIPMENT NAME/DESCRIPTION and SICC Code | REGULATED or HAZARDOUS AIR POLLUTANT NAME (CAS#)[3] | #/ HR. | TONS/ YEAR | ZONE | EAST (Mtrs) | NORTH (Mtrs) | HEIGHT ABOVE GROUND (mtrs) | DIRECT. (1) | DIA. (ft.) | VEL. (m/s) | FLOW RATE ($m^3/s$) | TEMP. (°C) |
| 1 | 1 | Wärtsilä 16V34DF RICE | NOx | 57.3 | 36.7 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 1 | 1 | Wärtsilä 16V34DF RICE | $SO_2$ | 0.10 | 0.33 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 1 | 1 | Wärtsilä 16V34DF RICE | CO | 11.5 | 10.2 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 1 | 1 | Wärtsilä 16V34DF RICE | $PM_{10}$ | 6.8 | 12.1 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 1 | 1 | Wärtsilä 16V34DF RICE | HC | 4.2 | 10.9 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 2 | 2 | Wärtsilä 16V34DF RICE | NOx | 57.3 | 36.7 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 2 | 2 | Wärtsilä 16V34DF RICE | $SO_2$ | 0.10 | 0.33 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 2 | 2 | Wärtsilä 16V34DF RICE | CO | 11.5 | 10.2 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 2 | 2 | Wärtsilä 16V34DF RICE | TSP/$PM_{10}$/ $PM_{2.5}$ | 6.8 | 12.1 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 2 | 2 | Wärtsilä 16V34DF RICE | HC | 4.2 | 10.9 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 3 | 3 | Wärtsilä 16V34DF RICE | NOx | 57.3 | 36.7 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 3 | 3 | Wärtsilä 16V34DF RICE | $SO_2$ | 0.10 | 0.33 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 3 | 3 | Wärtsilä 16V34DF RICE | CO | 11.5 | 10.2 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 3 | 3 | Wärtsilä 16V34DF RICE | TSP/$PM_{10}$/ $PM_{2.5}$ | 6.8 | 12.1 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 3 | 3 | Wärtsilä 16V34DF RICE | HC | 4.2 | 10.9 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 4 | 4 | Wärtsilä 16V34DF RICE | NOx | 57.3 | 36.7 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 4 | 4 | Wärtsilä 16V34DF RICE | $SO_2$ | 0.10 | 0.33 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 4 | 4 | Wärtsilä 16V34DF RICE | CO | 11.5 | 10.2 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 4 | 4 | Wärtsilä 16V34DF RICE | $PM_{10}$ | 6.8 | 12.1 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 4 | 4 | Wärtsilä 16V34DF RICE | HC | 4.2 | 10.9 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 5 | 5 | Wärtsilä 16V34DF RICE | NOx | 57.3 | 36.7 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 5 | 5 | Wärtsilä 16V34DF RICE | $SO_2$ | 0.10 | 0.33 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 5 | 5 | Wärtsilä 16V34DF RICE | CO | 11.5 | 10.2 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 5 | 5 | Wärtsilä 16V34DF RICE | TSP/$PM_{10}$/ $PM_{2.5}$ | 6.8 | 12.1 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 5 | 5 | Wärtsilä 16V34DF RICE | HC | 4.2 | 10.9 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 6 | 6 | Wärtsilä 16V34DF RICE | NOx | 57.3 | 36.7 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 6 | 6 | Wärtsilä 16V34DF RICE | $SO_2$ | 0.10 | 0.33 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 6 | 6 | Wärtsilä 16V34DF RICE | CO | 11.5 | 10.2 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |
| 6 | 6 | Wärtsilä 16V34DF RICE | TSP/$PM_{10}$/ $PM_{2.5}$ | 6.8 | 12.1 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |

COMPANY NAME Ukiu Energy LLC.


File No.: NEW

| AIR POLLUTANT DATA: EMISSION POINTS | | | AIR POLLUTANT | AIR POLLUTANT EMISSION RATE | | UTM COORDINATES OF EMISSION POINT | | | STACK SOURCE PARAMETERS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STACK NO. | UNIT NO. | EQUIPMENT NAME/DESCRIPTION and SICC Code | REGULATED or HAZARDOUS AIR POLLUTANT NAME (CAS#)[3] | #/ HR. | TONS/ YEAR | ZONE | EAST (Mtrs) | NORTH (Mtrs) | HEIGHT ABOVE GROUND (mtrs) | DIRECT. (1) | DIA. (ft.) | VEL. (m/s) | FLOW RATE ($m^3/s$) | TEMP. (°C) |
| 6 | 6 | Wärtsilä 16V34DF RICE | HC | 4.2 | 10.9 | 4 | 768845 | 2307383 | 35.05 | up | 3.9 | varies[2] | varies[2] | varies[2] |

Notes:
1. Exit direction of stack emissions: up, down, or horizontal.
2. Exhaust gas flow rate, velocity and temperature vary with fuel type and load. See Appendix C, Table 2-2.
3. Hazardous air pollutant emission rates shown in Appendix B, Tables B-10, B-11 and B-12.

File No.: NEW

## C-1: Compliance Plan

The Responsible Official shall submit a Compliance Plan as indicated in the Instructions for Applying for an Air Pollution Control Permit and at such other times as requested by the Director of Health (hereafter, Director).

Use separate sheets of paper if necessary.

---

1. Compliance status with respect to all Applicable Requirements:

   Will your facility be in compliance, or is your facility in compliance, with all applicable requirements in effect at the time of your permit application submittal?

   ☑ YES {If YES, complete items a and c below}

   ☐ NO {If NO, complete items a, b, and c below}

   a. Identify all applicable requirement(s) for which compliance is achieved.

      Please see attached list.

      Provide a statement that the source is in compliance and will continue to comply with all such requirements.

      The source will be in compliance and will continue to comply with all applicable requirements.

   b. Identify all applicable requirement(s) for which compliance is NOT achieved.

      None known.

      Provide a detailed Schedule of Compliance Schedule and a description of how the source will achieve compliance with all such applicable requirements.

| Description of Remedial Action | Expected Date of Completion |
|---|---|
| | |
| | |
| | |
| | |

c. Identify any other applicable requirement(s) with a future compliance date that your source is subject to. These applicable requirements may take effect AFTER permit issuance:

| Applicable Requirement | Effective Date | Currently in Compliance? |
| --- | --- | --- |
| None known. | | |
| | | |
| | | |
| | | |
| | | |

If the source is not currently in compliance, provide a Schedule of Compliance and a description of how the source will achieve compliance with all such applicable requirements:

| Description of Proposed Action/Steps to Achieve Compliance | Expected Date of Achieving Compliance |
| --- | --- |
| | |
| | |
| | |
| | |
| | |

Provide a statement that the source on a timely basis will meet all these applicable requirements:

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

If the expected date of achieving compliance will NOT meet the applicable requirement's effective date, provide a more detailed description of each remedial action and the expected date of completion:

| Description of Remedial Action and Explanation | Expected Date of Completion |
| --- | --- |
| | |
| | |
| | |
| | |
| | |

2. Compliance Progress Reports:

a. If a compliance plan is being submitted to remedy a violation, complete the following information:

Frequency of Submittal: ____________________ Beginning Date: ____________________
(less than or equal to 6 months)

b. Date(s) that the Action described in (1)(b) was achieved:

| Remedial Action | Date Achieved |
|---|---|
| | |
| | |
| | |

c. Narrative description of why any date(s) in (1)(b) was not met, and any preventive or corrective measures taken in the interim:

---

## RESPONSIBLE OFFICIAL (as defined in HAR §11-60.1-1)

Name (Last): Bulgarino (First): Nicole (MI): ______

Title: Executive Vice President Phone: 865-414-1341

Mailing Address: 101 Constitution Avenue, N.W., Suite 525 East

City: Washington State: DC Zip Code: 20001

## Certification by Responsible Official (pursuant to HAR §11-60.1-4)

I certify that I have knowledge of the facts herein set forth, that the same are true, accurate and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by the Department of Health as public record. I further state that I will assume responsibility for the construction, modification, or operation of the source in accordance with the Hawaii Administrative Rules, Title 11, Chapter 60.1, Air Pollution Control, and any permit issued thereof.

Name (Print/Type): Nicole Bulgarino

(Signature): [signature] Date: 7-23-24

Facility Name: Ukiu Energy

Location: Pulehu Rd and Upper Division Rd, Kahului, HI

Permit Number: ______

FOR AGENCY USE ONLY

File/Application No.: ______

Island: ______

Date Received: ______

File No.: NEW

# C-2: Compliance Certification

The Responsible Official shall submit a Compliance Certification as indicated in the Instructions for Applying for an Air Pollution Control Permit and at such other times as requested by the Director of Health (hereafter, Director).

Complete as many copies of this form as needed. Use separate sheets of paper if necessary.

---

**RESPONSIBLE OFFICIAL** (as defined in HAR §11-60.1-1)

Name (Last): Bulgarino (First): Nicole (MI): ______

Title: Executive Vice President Phone: 865-414-1341

Mailing Address: 101 Constitution Avenue, N.W., Suite 525 East

City: Washington State: DC Zip Code: 20001

**Certification by Responsible Official** (pursuant to HAR §11-60.1-4)

I certify that I have knowledge of the facts herein set forth, that the same are true, accurate and complete to the best of my knowledge and belief, and that all information not identified by me as confidential in nature shall be treated by the Department of Health as public record. I further state that I will assume responsibility for the construction, modification, or operation of the source in accordance with the Hawaii Administrative Rules, Title 11, Chapter 60.1, Air Pollution Control, and any permit issued thereof.

Name (Print/Type): Nicole Bulgarino

(Signature): [signature] Date: 7-21-24

Facility Name: Ukiu Energy

Location: Pulehu Rd and Upper Division Rd, Kahului, HI

Permit Number: ______

FOR AGENCY USE ONLY

File/Application No.: ______

Island: ______

Date Received: ______

Complete the following information for ***each*** applicable requirement that applies to ***each*** emissions unit at the source. Also include any additional information as required by the Director. The compliance certification may reference information contained in a previous compliance certification submittal to the Director, provided such referenced information is certified as being current and still applicable.

1. Schedule for submission of Compliance Certifications during the term of the permit:

   Frequency of Submittal: annually    Beginning Date: tbd

2. Emissions Unit No./Description: Six (6) Wartsila 16V34DF reciprocating IC engine generators

3. Identify the applicable requirement(s) that is/are the basis of this certification:

   Please see attached list.

4. Compliance status:

   a. Will the emissions unit be in compliance with the identified applicable requirement(s)?

      ☑ YES ☐ NO

   b. If YES, will compliance be continuous or intermittent?

      ☑ Continuous ☐ Intermittent

   c. If NO, explain:

5. Describe the methods to be used in determining compliance of the emissions unit with the applicable requirement(s), including any monitoring, recordkeeping, reporting requirements, and/or test methods:

Please see attached list.

Provide a detailed description of the methods used to determine compliance (e.g. monitoring device type and location, test method description, or parameter being recorded, frequency of recordkeeping, etc.):

Please see attached list.

6. Statement of Compliance with Enhanced Monitoring and Compliance Certification Requirements.

a. Will the emissions unit identified in this application be in compliance with applicable enhanced monitoring and compliance certification requirements?

☑ YES ☐ NO

b. If YES, identify the requirements and the provisions being taken to achieve compliance:

Please see attached list.

c. If NO, describe below which requirements will not be met:

**Attachment to Forms C-1 and C-2**

| Applicable Requirement | Compliance Method | Description of Method(s) Used to Determine Compliance |
|---|---|---|
| 40 CFR 60 Subpart JJJJ (NSPS) | Continuous emissions monitoring (NOx and CO); periodic compliance testing (NOx, CO, VOC) | Continuous emissions monitoring of NOx, CO and diluent ($O_2$ or $CO_2$) in accordance with the requirements of 40 CFR 60 Appendix B and F; periodic compliance testing of NOx, CO, VOC and diluent ($O_2$ or $CO_2$) using EPA Methods 7E, 10, 18/323 and 3A. |
| 40 CFR 60 Subpart IIII (NSPS) | Continuous emissions monitoring (NOx); periodic compliance testing (NOx and PM); fuel sulfur analyses | Continuous emissions monitoring of NOx and diluent ($O_2$ or $CO_2$) in accordance with the requirements of 40 CFR 60 Appendix B and F; periodic compliance testing of NOx, PM and diluent ($O_2$ or $CO_2$) using EPA Methods 7E, 5/202 and 3A. |
| Annual reporting of emissions (SLEIS, e-GGRT and HDOH semiannual and annual reporting requirements) | Monitor and report fuel use; continuous emissions monitoring (NOx and CO); periodic compliance testing (NOx, CO, VOC, PM, $NH_3$); fuel sulfur analyses | Calculate and report criteria emissions using monitored data, compliance test data and fuel analysis data; calculate and report GHG emissions using monitored fuel use and fuel analysis data in accordance with EPA methods. |
| Permit conditions | Monitor and report fuel use; continuous emissions monitoring (NOx and CO); periodic compliance testing (NOx, CO, VOC, PM, $NH_3$); fuel sulfur analyses | All methods listed ablve. |
| Prompt reporting of deviations | Monitor and report fuel use; continuous emissions monitoring (NOx and CO); periodic compliance testing (NOx, CO, VOC, PM, $NH_3$); fuel sulfur analyses | Promptly report any deviations from permit limits determined from continuous monitoring, periodic testing and/or other data analysis. |

# Appendix B

# Emissions Calculations

**Table B-1**

**Typical Project Operating Scenarios and Emissions Summaries**

**Emissions Summaries**

**Case 1: RNG only**

| | Emissions, tpy | | | | | |
|---|---|---|---|---|---|---|
| | NOx | SO2 | CO | VOC | PM10 | CO2e |
| Emissions Total, 6 Engines | 41.4 | 0.9 | 49.8 | 38.6 | 32.0 | 136,361 |
| Black Start Generator | 1.8 | 0.002 | 0.2 | 0.01 | 0.04 | 194 |
| Project Total | 43.2 | 0.9 | 50.0 | 38.6 | 32.0 | 136,555 |
| PSD Threshold | 250 | 250 | 250 | 250 | 250 | n/a |

**Case 2: startup on RNG, switch to biodiesel**

| | Emissions, tpy | | | | | |
|---|---|---|---|---|---|---|
| | NOx | SO2 | CO | VOC | PM10 | CO2e |
| Emissions Total, 6 Engines | 173.1 | 1.9 | 67.6 | 64.5 | 68.0 | 183,624 |
| Black Start Generator | 1.8 | 0.002 | 0.2 | 0.01 | 0.04 | 194.2 |
| Project Total | 174.9 | 1.9 | 67.8 | 64.5 | 68.0 | 183,818 |
| PSD Threshold | 250 | 250 | 250 | 250 | 250 | n/a |

**Case 3: biodiesel only**

| | Emissions, tpy | | | | | |
|---|---|---|---|---|---|---|
| | NOx | SO2 | CO | VOC | PM10 | CO2e |
| Emissions Total, 6 Engines | 220.2 | 2.0 | 61.0 | 65.2 | 72.5 | 185,594 |
| Black Start Generator | 1.8 | 0.002 | 0.2 | 0.01 | 0.04 | 194.2 |
| Project Total | 222.0 | 2.0 | 61.2 | 65.2 | 72.5 | 185,788 |
| PSD Threshold | 250 | 250 | 250 | 250 | 250 | n/a |

**Table B-2**
**Example Operating Scenarios**

| Example Operating Scenarios | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Scenario | No. of Units | Starts per year per unit | Fuel for Startups | Total Baseload Hrs/Yr/Unit | Fuel for Baseload Operation | Annual NOx (tons/year) | Annual Capacity Factor | Annual Fuel Consumption, MMBtu | Description |
| Case 1 | 6 | 0 | Biodiesel | 0 | Diesel | 43.2 | 71% | 0 | Operating hours on RNG only |
| | | 500 | RNG | 5750 | NG | | | 2,328,998 | |
| Case 2 | 6 | 0 | Biodiesel | 5750 | Diesel | 174.9 | 71% | 2,177,937 | Startup on RNG, operation on biodiesel |
| | | 500 | RNG | 0 | NG | | | 93,160 | |
| Case 3 | 6 | 500 | Biodiesel | 5750 | Diesel | 222.0 | 71% | 2,268,684 | Operating hours on biodiesel only |
| | | 0 | RNG | 0 | NG | | | 0 | |

Notes:

1. Emissions and fuel consumption for startups calculated on a 1-hour basis: 30 minutes for the startup plus 30 minutes at baseload.
2. Capacity factor calculated based on the assumption that a startup hour includes the equivalent of 55 minutes of baseload operation.
3. Case 1: 100% operation on gaseous fuel with pilot injection; 365 30-minute startups on gaseous fuel for each engine, with the remaining operations at 100% load on gaseous fuel. Assume one start per day, seven days per week (one cold and 6 warm starts per week).
4. Case 2: 365 30-minute startups on gaseous fuel for each engine, with the remaining operations at 100% load on liquid fuel. Assume one start per day, seven days per week (one cold and 6 warm starts per week).
5. Case 3: 100% operation on liquid fuel; 365 30-minute startups on liquid fuel for each engine, with the remaining operations at 100% load on liquid fuel. Assume one start per day, seven days per week (one cold and 6 warm starts per week)

**Table B-3**
**Emissions Data Provided by Wartsila**

**Flue gas emissions on liquid fuel operation after emission control system**

Stable load as 1 hour average values (Using TYPICAL values)

| Pollutant | | Engine Load | | Units |
|---|---|---|---|---|
| | | 100% | 40% | |
| $NO_x$ | as $NO_2$ | 35 | 40 | ppm-v, 15 vol-% $O_2$, dry |
| CO | | 20 | 20 | ppm-v, 15 vol-% $O_2$, dry |
| VOC (NMNEHC) | as $CH_4$ | 40 | 40 | ppm-v, 15 vol-% $O_2$, dry |
| $PM_{10}/PM_{2.5}$ (total) | | 30 | 40 | mg/$Nm^{3*}$, 15 vol-% $O_2$, |
| $NH_3$ | | 10 | 10 | ppm-v, 15 vol-% $O_2$, dry |

**Engine performance on liquid fuels**

| Parameter | Engine Load | | Units |
|---|---|---|---|
| | 100% | 40% | |
| Engine output | 7,480 | 2992 | kWe, gross |
| Plant output | 44,880 | 17,952 | kWe, gross |
| Heat rate, gross | 8088 | 8654 | Btu/kWh, LHV |
| Fuel consumption | 3479 | 1489 | lb/hr |
| | 60.50 | 25.89 | MMBtu/hr, HHV (calculated) |
| Fuel heat content | 17,388 | 17,388 | Btu/lb, LHV |
| | 126,931 | 126,931 | Btu/gal, HHV |
| | 114,559 | 114,559 | Btu/gal, LHV |
| Fuel density | 7.3 | 7.3 | lb/gal (DOE) |
| Fuel sulfur content | 15 | 15 | ppm-w |
| | 6 | 6 | Number of Units |

**Table B-3**
**Emissions Data Provided by Wartsila**

**Flue gas emissions on gaseous fuel operation after emission control system**

Stable load as 1 hour average values (Using TYPICAL values)

| Pollutant | | Engine Load | | Units |
|---|---|---|---|---|
| | | 100% | 40% | |
| $NO_x$ | as $NO_2$ | 6 | 9 | ppm-v, 15 vol-% $O_2$, dry |
| CO | | 15 | 15 | ppm-v, 15 vol-% $O_2$, dry |
| VOC (NMNEHC) | as $CH_4$ | 26 | 42 | ppm-v, 15 vol-% $O_2$, dry |
| $PM_{10}/PM_{2.5}$ (total) | | 15 | 20 | mg/Nm$^{3*}$, 15 vol-% $O_2$, |
| CH2O | | 0.7 | 1.5 | ppm-v, 15 vol-% $O_2$, dry |
| $NH_3$ | | 10 | 10 | ppm-v, 15 vol-% $O_2$, dry |

**Engine performance on gaseous fuels**

| Parameter | Engine Load | | Units |
|---|---|---|---|
| | 100% | 40% | |
| Engine output | 7,480 | 2992 | kWe, gross |
| Plant output | 44,880 | 17,952 | kWe, gross |
| Heat rate, gross | 7491 | 9031 | Btu/kWh, LHV |
| Fuel consumption | 54,719.4 | 26,387.5 | ft3/hr |
| | 62.11 | 29.95 | MMBtu/hr, HHV (calculated) |
| | 56.03 | 27.02 | MMBtu/hr, LHV (Wärtsilä spec) |
| Fuel heat content | 1,024 | 1,024 | Btu/ft3, LHV (Wärtsilä specification) |
| Fuel sulfur content | 5 | 5 | ppm-w |
| | 6 | 6 | Number of Units |

**Table B-4**
**Emission Rate Calculations - Biodiesel**

| Parameter | Variable | Units | Wärtsilä 16V34DF Engines 100% Load Value | Wärtsilä 16V34DF Engines 40% Load Value | Data Source |
|---|---|---|---|---|---|
| | | | **Performance Data** | | |
| Mechanical Output | MO | $kW_m$ | 7,480 | 2,992 | |
| | -- | HP | 10,023 | 4,009 | Converted from $KW_m$ |
| Generation | G | $kW_e$ | 44,880 | 17,952 | |
| Heat Rate (LHV) | $HR_{LHV}$ | Btu/$kW_e$-hr | 8,088 | 8,654 | |
| Heat Input (LHV) | $HI_{LHV}$ | MMBtu/hr | 60.5 | 25.9 | $HR_{LHV}*G/10^6$ |
| Heat Input (HHV) | $HI_{HHV}$ | MMBtu/hr | 60.5 | 28.7 | $LHV*FF_{lb/hr}*1.108/10^6$ |
| Fuel Heat Content (LHV) | LHV | Btu/lb | 17,388 | 17,388 | |
| Fuel Flow | $FF_{lb/hr}$ | lb/hr | 3,479 | 1,489 | |
| | | | **Exhaust Data** | | |
| Exhaust Temp | -- | °F | 642.0 | 660.0 | Wärtsilä specs |
| | $T_{stack}$ | °R | 1,102.0 | 1,120.0 | Converted from °F |
| | -- | °C | 320 | 320 | Wärtsilä specs |
| | $T_{stack-K}$ | K | 593.15 | 593.15 | Converted from °C |
| Universal Gas Constant | R | psia-$ft^3$/lbmol-R | 10.73 | 10.73 | http://en.wikipedia.org/wiki/Gas_constant |
| Standard Pressure | $P_{std}$ | psia | 14.696 | 14.696 | 40 CFR Part 60, Appendix A, Method 5 |
| Standard Temperature | $T_{std}$ | K | 293.2 | 293.2 | 40 CFR Part 60, Appendix A, Method 5 |
| Exhaust Volumetric Flow (actual) | $Q_{m3s}$ | $m^3$/s | 24.7 | 11.5 | Converted from Nm3/min |
| | -- | acfh | 3,134,098 | 1,457,936 | Converted from $m^3$/s |
| | $Q_{acfm}$ | acfm | 52,235 | 24,299 | Converted from acfm |
| | | ft3/s | 871 | 405 | |
| Exhaust $H_2O$ Content | $\%H_2O$ | % by Vol | 6.1% | 5.7% | |
| Exhaust $O_2$ Content | $\%O_2$ | % by Vol | 11.74% | 12.26% | Calculatedfrom O2 dry and %H2O |
| Exhaust $CO_2$ Content | $\%CO_2$ | % by Vol | 5.78% | 5.3% | |
| Dry Exhaust Volumetric Flow | $Q_{dry}$ | dcf/min | 49,049 | 22,914 | $Q_{acfm}*(1-\%H_2O)$ |
| $\%O_2$ Dry Basis | $\%O_{2-Dry}$ | % | 12.5% | 13.0% | Wärtsilä spec |
| $\%CO_2$ Dry Basis | $\%CO_{2-Dry}$ | % | 6.16% | 5.64% | $\%CO_2/(1-\%H_2O)$ |
| Dry Exhaust Volumetric Flow (Std) | $Q_{dry-std}$ | dscf/min | 24,245 | 11,327 | $Q_{dry}*(T_{std}/T_{stack-K})$ |
| Dry Exhaust Volumetric Flow (32 °F) | $Q_{dry-32F}$ | $Nm^3$/min | 10.66 | 4.98 | $Q_{dry}*(273.15/T_{stack-K})*.3048^3$ |
| Stack Diameter | $D_{ft}$ | ft | 3.94 | 3.94 | Converted from meters |
| | $D_m$ | m | 1.20 | 1.20 | Provided by Chris Heck/Wartsila 4/4/24 email |
| Stack Area | $A_{m2}$ | $m^2$ | 1.13 | 1.13 | $(\pi*D_m^2)/4$ |
| Stack Velocity | $V_{m/sec}$ | m/sec | 21.80 | 10.14 | $Q_{m3s}/A_{m2}$ |
| | $V_{ft/sec}$ | ft/sec | 71.51 | 33.27 | Converted from m/s |
| | | | **Emission Rates** | | |
| Max Sulfur | $FS_{ppm}$ | ppm | 15 | 15 | |
| $SO_2$ Emission Rates | -- | g/s | 1.314E-02 | 5.620E-03 | Converted from lb/hr |
| | $M_{SO2}$ | lb/hr | 0.104 | 0.045 | $FF_{lb/hr}*(FS_{ppm}/10^6)*(MW_{SO2}/MW_S)$ (Mass Balance - 100% conversion of fuel S) |
| $SO_2$ Emission Factors | -- | lb/MMBtu | 0.00172 | 0.00156 | $M_{SO2}/HI_{HHV}$ |
| $SO_2$ Molecular Weight | $MW_{SO2}$ | lb/lbmol | 64.1 | 64.1 | http://www.webelements.com/ |
| S Molecular Weight | $MW_S$ | lb/lbmol | 32.1 | 32.1 | http://www.webelements.com/ |
| $PM_{10}/PM_{2.5}$ Stack Conc. | $C_{d15-PM10}$ | mg/$Nm^3$ @ 15% $O_2$ | 20 | 40 | Supplied by Wärtsilä |
| $PM_{10}/PM_{2.5}$ Emission Rates | $M_{PM-g/s}$ | g/s | 0.45 | 0.27 | Calculated from lb/hr |
| | $M_{PM10-lb/hr}$ | lb/hr | 3.61 | 2.11 | Supplied by Wärtsilä |
| $PM_{10}/PM_{2.5}$ Emission Factors | -- | lb/MMBtu | 0.0597 | 0.0735 | $M_{PM10-lb/hr}/HI_{HHV}$ |
| | -- | g/$kW_e$-hr | 0.15 | 0.24 | Supplied by Wärtsilä |
| $NO_X$ as $NO_2$ Stack Conc. | $C_{d15-NOX}$ | ppmvd @ 15% $O_2$ | 35 | 40 | Supplied by Wärtsilä |
| $NO_2$ Molecular Weight | $MW_{NO2}$ | lb/lbmol | 46.0 | 46.0 | http://www.webelements.com/ |
| $NO_X$ as $NO_2$ Emission Rates | $M_{NOX-lb/hr}$ | lb/hr | 8.64 | 4.33 | Supplied by Wärtsilä |
| $NO_X$ as $NO_2$ Emission Factors | -- | lb/MMBtu | 0.143 | 0.151 | $M_{NOX-lb/hr}/HI_{HHV}$ |
| | -- | g/$kW_e$-hr | 0.52 | 0.65 | Supplied by Wärtsilä |
| | | | **Emission Rates (Continued)** | | |
| CO Stack Conc. | $C_{d15-CO}$ | ppmvd @ 15% $O_2$ | 20 | 20 | Supplied by Wärtsilä |
| CO Molecular Weight | $MW_{CO}$ | lb/lbmol | 28.0 | 28.0 | http://www.webelements.com/ |
| CO Emission Rates | $M_{CO-lb/hr}$ | lb/hr | 3.01 | 1.32 | Supplied by Wärtsilä |
| CO Emission Factors | -- | lb/MMBtu | 0.0498 | 0.0460 | $M_{CO-lb/hr}/HI_{HHV}$ |
| | -- | g/$kW_e$-hr | 0.18 | 0.18 | Supplied by Wärtsilä |
| VOC (as $CH_4$) Stack Conc. | $C_{d15-VOC}$ | ppmvd @ 15% $O_2$ | 40 | 40 | Supplied by Wärtsilä |
| VOC (as $CH_4$) Molecular Weight | $MW_{CH4}$ | lb/lbmol | 16.0 | 16.0 | http://www.webelements.com/ |
| VOC (as $CH_4$) Emission Rates | $M_{VOC-lb/hr}$ | lb/hr | 3.44 | 1.51 | Supplied by Wärtsilä |
| VOC (as $CH_4$) Emission Factors | -- | lb/MMBtu | 0.0569 | 0.0526 | $M_{VOC-lb/hr}/HI_{HHV}$ |
| | -- | g/$kW_e$-hr | 0.21 | 0.23 | Supplied by Wärtsilä |
| Formaldehyde | $C_{d15-HCOH}$ | ppbvd @ 15% $O_2$ | 580 | 580 | RICE NESHAP limit for major source |
| | $C_{d-HCOH}$ | ppmvd | 0.826 | 0.777 | $C_{d15-HCOH}*((20.9-\%O_{2-Dry}*100)/(20.9-15))$ |
| | $MW_{HCOH}$ | lb/lbmol | 30.03 | 30.03 | http://www.webelements.com/ |
| | $M_{HCOH-lb/hr}$ | lb/hr | 0.091 | 0.04 | $((C_{d-HCOH}*(1-\%H_2O))*Q_{acfm}/10^6)*P_{std}*MW_{HCOH}/(R*T_{stack})*60$ |
| | $M_{HCOH-g/s}$ | g/s | 1.140E-02 | 5.000E-03 | Converted from lb/hr |
| | $EF_{HCOH}$ | lb/MMBtu | 0.0015 | 0.0014 | $M_{HCOH-lb/hr}/HI_{HHV}$ |

**Table B-5**
**Emission Rate Calculations: RNG***

| Parameter | Variable | Units | Wärtsilä 16V34DF Engines 100% Load Value | Wärtsilä 16V34DF Engines 40% Load Value | Data Source |
|---|---|---|---|---|---|
| | | | **Performance Data** | | |
| Mechanical Output | MO | $kW_m$ | 7,480 | 2,992 | Wärtsilä data |
| | -- | HP | 10,023 | 4,009 | Converted from $KW_m$ |
| Generation | G | $kW_e$ | 44,880 | 17,952 | |
| Heat Rate (LHV) | $HR_{LHV}$ | $Btu/kW_e$-hr | 7,491 | 9,031 | Wärtsilä data |
| Heat Input (LHV) | $HI_{LHV}$ | MMBtu/hr | 56.0 | 27.0 | LHV=HHV/1.1084 |
| Heat Input (HHV) | $HI_{HHV}$ | MMBtu/hr | 62.1 | 29.9 | Wärtsilä data |
| Fuel Heat Content (LHV) | LHV | Btu/ft3 | 1,024 | 1,024 | Wärtsilä data |
| Fuel Flow | $FF_{lb/hr}$ | ft3/hr | 54,719 | 26,387 | Calculated |
| Fuel Density | $F_{density}$ | $lb/ft^3$ | 0.0447 | 0.0447 | Density of $CH_4$ at 0 °C and 1 atm |
| | | | **Exhaust Data** | | |
| Exhaust Temp | -- | °F | 707.0 | 760.0 | Wärtsilä data |
| | $T_{stack}$ | °R | 1,167.0 | 1,220.0 | Converted from °F |
| | -- | °C | 376 | 401 | Wärtsilä data |
| | $T_{stack\text{-}K}$ | K | 649.15 | 674.15 | Converted from °C |
| Universal Gas Constant | R | psia-$ft^3$/lbmol-R | 10.73 | 10.73 | http://en.wikipedia.org/wiki/Gas_constant |
| Standard Pressure | $P_{std}$ | psia | 14.696 | 14.696 | 40 CFR Part 60, Appendix A, Method 5 |
| Standard Temperature | $T_{std}$ | K | 293.2 | 293.2 | 40 CFR Part 60, Appendix A, Method 5 |
| Exhaust Volumetric Flow (actual) | $Q_{m3s}$ | $m^3/s$ | 22.3 | 12.2 | Calculated from Qdry-32F, Tstack and %H2O |
| | -- | acfh | 2,838,855 | 1,553,322 | Converted from $m^3/s$ |
| | $Q_{acfm}$ | acfm | 47,314 | 25,889 | Converted from acfm |
| | | f3/s | 789 | 431 | |
| Exhaust $H_2O$ Content | $\%H_2O$ | % by Vol | 10.6% | 9.1% | |
| Exhaust $O_2$ Content | $\%O_2$ | % by Vol | | | |
| Exhaust $CO_2$ Content | $\%CO_2$ | % by Vol | 5.0% | 4.2% | |
| Dry Exhaust Volumetric Flow | $Q_{dry}$ | dcf/min | 42,299 | 23,533 | $Q_{acfm}*(1-\%H_2O)$ |
| $\%O_2$ Dry Basis | $\%O_{2\text{-}Dry}$ | % | 11.4% | 12.6% | Wärtsilä spec |
| $\%CO_2$ Dry Basis | $\%CO_{2\text{-}Dry}$ | % | 5.59% | 4.62% | $\%CO_2/(1-\%H_2O)$ |
| Dry Exhaust Volumetric Flow (Std) | $Q_{dry\text{-}std}$ | dscf/min | 19,105 | 10,235 | $Q_{dry}*(T_{std}/T_{stack\text{-}K})$ |
| Dry Exhaust Volumetric Flow (32 °F) | $Q_{dry\text{-}32F}$ | $Nm^3$/min | 8.40 | 4.50 | $Q_{dry}*(273.15/T_{stack\text{-}K})*.3048^3$ |
| Stack Diameter | $D_{ft}$ | ft | 3.94 | 3.94 | Converted from meters |
| | $D_m$ | m | 1.20 | 1.20 | Provided by Chris Heck/Wartsila 4/4/24 email |
| Stack Area | $A_{m2}$ | $m^2$ | 1.13 | 1.13 | $(\pi*D_m^2)/4$ |
| Stack Velocity | $V_{m/sec}$ | m/sec | 19.74 | 10.80 | $Q_{m3s}/A_{m2}$ |
| | $V_{ft/sec}$ | ft/sec | 64.78 | 35.44 | Converted from m/s |
| | | | **Emission Rates** | | |
| Max Sulfur | $FS_{ppm}$ | ppm | 5 | 5 | Wärtsilä max. fuel sulfur content spec |
| | FS | gr/100 SCF | 0.318 | 0.318 | converted from ppmv |
| $SO_2$ Emission Rates | -- | g/s | 6.270E-03 | 3.020E-03 | Converted from lb/hr |
| | $M_{SO2}$ | lb/hr | 0.050 | 0.024 | Calculated using mass balance (100% conversion of fuel S) |
| $SO_2$ Emission Factors | -- | lb/MMBtu | 0.00080 | 0.00080 | $M_{SO2}/HI_{HHV}$ |
| $SO_2$ Molecular Weight | $MW_{SO2}$ | lb/lbmol | 64.1 | 64.1 | http://www.webelements.com/ |
| S Molecular Weight | $MW_S$ | lb/lbmol | 32.1 | 32.1 | http://www.webelements.com/ |
| | $Q_{SO2}$ | $ft^3$/min | 0.0110 | 0.0056 | Calculated using Ideal Gas Law $[((M_{SO2}/MW_{SO2})*R*T_{stack})/(P_{std}*60)]$ |
| | $C_{d\text{-}SO2}$ | ppmvd | 0.26 | 0.24 | $(Q_{SO2}/Q_{dry})*10^6$ |
| | -- | ppmvd @ 15% $O_2$ | 0.16 | 0.17 | $C_{d\text{-}SO2}*((20.9\text{-}15)/(20.9\text{-}\%O_{2\text{-}Dry}*100))$ |
| $PM_{10}/PM_{2.5}$ Stack Conc. | $C_{d15\text{-}PM10}$ | $mg/Nm^3$ @ 15% $O_2$ | 15 | 20 | Supplied by Wärtsilä |
| $PM_{10}/PM_{2.5}$ Emission Rates | $M_{PM\text{-}g/s}$ | g/s | 2.03E-01 | 2.100E-03 | Calculated from lb/hr |
| | $M_{PM10\text{-}lb/hr}$ | lb/hr | 1.61 | 1.00 | Supplied by Wärtsilä |
| $PM_{10}/PM_{2.5}$ Emission Factors | -- | lb/MMBtu | 0.0259 | 0.0334 | $M_{PM10\text{-}lb/hr}/HI_{HHV}$ |
| | -- | $g/kW_e$-hr | 0.10 | 0.15 | Supplied by Wärtsilä |
| $NO_X$ as $NO_2$ Stack Conc. | $C_{d15\text{-}NOX}$ | ppmvd @ 15% $O_2$ | 6 | 9 | Supplied by Wärtsilä |
| $NO_2$ Molecular Weight | $MW_{NO2}$ | lb/lbmol | 46.0 | 46.0 | http://www.webelements.com/ |
| $NO_X$ as $NO_2$ Emission Rates | $M_{NOX\text{-}lb/hr}$ | lb/hr | 1.32 | 0.93 | Supplied by Wärtsilä |
| | $M_{NOX\text{-}g/s}$ | g/s | 0.166 | 0.117 | Calculated from lb/hr |
| $NO_X$ as $NO_2$ Emission Factors | -- | lb/MMBtu | 0.021 | 0.031 | $M_{NOX\text{-}lb/hr}/HI_{HHV}$ |
| | -- | $g/kW_e$-hr | 0.08 | 0.14 | Supplied by Wärtsilä |
| | | | **Emission Rates (Continued)** | | |
| CO Stack Conc. | $C_{d15\text{-}CO}$ | ppmvd @ 15% $O_2$ | 15 | 15 | Supplied by Wärtsilä |
| | $C_{d\text{-}CO}$ | ppmvd | 24.2 | 21.1 | $C_{d15\text{-}CO}*((20.9\text{-}\%O_{2\text{-}dry}*100)/(20.9\text{-}15))$ |
| CO Molecular Weight | $MW_{CO}$ | lb/lbmol | 28.0 | 28.0 | http://www.webelements.com/ |
| CO Emission Rates | $M_{CO\text{-}lb/hr}$ | lb/hr | 2.02 | 0.94 | Supplied by Wärtsilä |
| | $M_{CO\text{-}g/s}$ | g/s | 2.55E-01 | 1.184E-01 | Calculated from lb/hr |
| CO Emission Factors | -- | lb/MMBtu | 0.033 | 0.031 | $M_{CO\text{-}lb/hr}/HI_{HHV}$ |
| | -- | $g/kW_e$-hr | 0.12 | 0.14 | Supplied by Wärtsilä |
| VOC (as $CH_4$) Stack Conc. | $C_{d15\text{-}VOC}$ | ppmvd @ 15% $O_2$ | 26 | 42 | Supplied by Wärtsilä |
| VOC (as $CH_4$) Molecular Weight | $MW_{CH4}$ | lb/lbmol | 16.0 | 16.0 | http://www.webelements.com/ |
| VOC (as $CH_4$) Emission Rates | $M_{VOC\text{-}lb/hr}$ | lb/hr | 2.00 | 1.51 | Supplied by Wärtsilä |
| | $M_{VOC\text{-}g/s}$ | g/s | 2.52E-01 | 1.903E-01 | Calculated from lb/hr |
| VOC (as $CH_4$) Emission Factors | -- | lb/MMBtu | 0.032 | 0.050 | $M_{VOC\text{-}lb/hr}/HI_{HHV}$ |
| | -- | $g/kW_e$-hr | 0.12 | 0.23 | Supplied by Wärtsilä |
| Formaldehyde | $C_{d15\text{-}HCOH}$ | ppbvd @ 15% $O_2$ | 700.0 | 1700 | Supplied by Wärtsilä |
| | $C_{d\text{-}HCOH}$ | ppmvd | 1.127 | 2.392 | $C_{d15\text{-}HCOH}*((20.9\text{-}\%O_{2\text{-}Dry}*100)/(20.9\text{-}15))$ |
| | $MW_{HCOH}$ | lb/lbmol | 30.03 | 30.03 | http://www.webelements.com/ |
| | $M_{HCOH\text{-}lb/hr}$ | lb/hr | 0.101 | 0.101 | Supplied by Wärtsilä |
| | $M_{HCOH\text{-}g/s}$ | g/s | 1.270E-02 | 1.270E-02 | Converted from lb/hr |
| | $EF_{HCOH}$ | lb/MMBtu | 0.002 | 0.003 | $M_{HCOH\text{-}lb/hr}/HI_{HHV}$ |

**Table B-6**
**Startup Emission Rates - Biodiesel**

**Cold Start**[1]

| Time (min.) | Operating Mode | $NO_X$ | $SO_2$ | CO | VOC | $PM_{10}/PM_{2.5}$ | NH3 |
|---|---|---|---|---|---|---|---|
| 1 - 30 | Startup | 53.0 | 0.0521 | 5.0 | 2.5 | 5.0 | 0 |
| 31 - 60 | Normal (Full load) | 4.32 | 0.0521 | 1.51 | 1.72 | 1.81 | 0.575 |
| **Total** | **(lbs/hr)** | **57.3** | **0.1043** | **6.51** | **4.22** | **6.81** | **0.58** |

[1] A cold catalyst start is when the temperature of the catalyst is close to the ambient temperature.

**Warm Start**[2]

| Time (min.) | Operating Mode | $NO_X$ | $SO_2$ | CO | VOC | $PM_{10}/PM_{2.5}$ | NH3 |
|---|---|---|---|---|---|---|---|
| 1 - 30 | Startup | 42.0 | 0.0521 | 4.5 | 2.15 | 5.0 | 0 |
| 31 - 60 | Normal (Full load) | 4.32 | 0.0521 | 1.51 | 1.72 | 1.81 | 0.575 |
| **Total** | **(lbs/hr)** | **46.3** | **0.1043** | **6.01** | **3.87** | **6.81** | **0.58** |

[2] A warm catalyst start is when the unit is started between 6 and 12 hours after shutdown.

**Hot Start**[3]

| Time (min.) | Operating Mode | $NO_X$ | $SO_2$ | CO | VOC | $PM_{10}/PM_{2.5}$ | NH3 |
|---|---|---|---|---|---|---|---|
| 1 - 30 | Startup | 34.0 | 0.0521 | 4.0 | 1.8 | 5.0 | 0 |
| 31 - 60 | Normal (Full load) | 4.32 | 0.0521 | 1.51 | 1.72 | 1.81 | 0.575 |
| **Total** | **(lbs/hr)** | **38.3** | **0.1043** | **5.51** | **3.52** | **6.81** | **0.58** |

[3] A hot catalyst start is when the unit is started within 6 hours of shutdown and the catalyst temperature is above 100°F.

Wärtsilä Doc. ID DESA00025056, "expected start up and unloading emissions-Maui- 16V34DF," 28 Mar 2024

**Table B-7**
**Startup Emission Rates - RNG Startup, Switch to Biodiesel**

**Cold Start**[1]

| Time (min.) | Operating Mode | $NO_X$ | $SO_2$ | CO | VOC | $PM_{10}/PM_{2.5}$ | NH3 |
|---|---|---|---|---|---|---|---|
| 1 - 30 | Startup | 14.0 | 0.0521 | 10.5 | 2.0 | 2.0 | 0 |
| 31 - 60 | Normal (Full load) | 4.32 | 0.0521 | 1.51 | 1.72 | 1.81 | 0.575 |
| **Total** | **(lbs/hr)** | **18.3** | **0.1043** | **12.01** | **3.72** | **3.81** | **0.58** |

[1] A cold catalyst start is when the temperature of the catalyst is close to the ambient temperature.

**Warm Start**[2]

| Time (min.) | Operating Mode | $NO_X$ | $SO_2$ | CO | VOC | $PM_{10}/PM_{2.5}$ | NH3 |
|---|---|---|---|---|---|---|---|
| 1 - 30 | Startup | 11.5 | 0.0521 | 8.8 | 1.7 | 2.0 | 0 |
| 31 - 60 | Normal (Full load) | 4.32 | 0.0521 | 1.51 | 1.72 | 1.81 | 0.575 |
| **Total** | **(lbs/hr)** | **15.8** | **0.1043** | **10.31** | **3.42** | **3.81** | **0.58** |

[2] A warm catalyst start is when the unit is started between 6 and 12 hours after shutdown.

**Hot Start**[3]

| Time (min.) | Operating Mode | $NO_X$ | $SO_2$ | CO | VOC | $PM_{10}/PM_{2.5}$ | NH3 |
|---|---|---|---|---|---|---|---|
| 1 - 30 | Startup | 9.0 | 0.0521 | 7.5 | 1.5 | 2.0 | 0 |
| 31 - 60 | Normal (Full load) | 4.32 | 0.0521 | 1.51 | 1.72 | 1.81 | 0.575 |
| **Total** | **(lbs/hr)** | **13.3** | **0.1043** | **9.01** | **3.22** | **3.81** | **0.58** |

[3] A hot catalyst start is when the unit is started within 6 hours of shutdown and the catalyst temperature is above 100°F.

Wärtsilä Doc. ID DESA00025056, "expected start up and unloading emissions-Maui- 16V34DF," 28 Mar 2024

**Table B-8**
**Startup Emission Rates - RNG**

**Cold Start[1]**

| Time (min.) | Operating Mode | $NO_X$ | $SO_2$ | CO | VOC | $PM_{10}/PM_{2.5}$ | NH3 |
|---|---|---|---|---|---|---|---|
| 1 - 30 | Startup | 14.0 | 0.0249 | 10.5 | 2.0 | 2.0 | 0 |
| 31 - 60 | Normal (Full load) | 0.66 | 0.0249 | 1.01 | 1.00 | 0.81 | 0.51 |
| **Total** | **(lbs/hr)** | **14.7** | **0.0497** | **11.51** | **3.00** | **2.81** | **0.51** |

[1] A cold catalyst start is when the temperature of the catalyst is close to the ambient temperature.

**Warm Start[2]**

| Time (min.) | Operating Mode | $NO_X$ | $SO_2$ | CO | VOC | $PM_{10}/PM_{2.5}$ | NH3 |
|---|---|---|---|---|---|---|---|
| 1 - 30 | Startup | 11.5 | 0.0249 | 8.8 | 1.7 | 2.0 | 0 |
| 31 - 60 | Normal (Full load) | 0.66 | 0.0249 | 1.01 | 1.00 | 0.81 | 0.51 |
| **Total** | **(lbs/hr)** | **12.2** | **0.0497** | **9.81** | **2.70** | **2.81** | **0.51** |

[2] A warm catalyst start is when the unit is started between 6 and 12 hours after shutdown.

**Hot Start[3]**

| Time (min.) | Operating Mode | $NO_X$ | $SO_2$ | CO | VOC | $PM_{10}/PM_{2.5}$ | NH3 |
|---|---|---|---|---|---|---|---|
| 1 - 30 | Startup | 9.0 | 0.0249 | 7.5 | 1.5 | 2.0 | 0 |
| 31 - 60 | Normal (Full load) | 0.66 | 0.0249 | 1.01 | 1.00 | 0.81 | 0.51 |
| **Total** | **(lbs/hr)** | **9.7** | **0.0497** | **8.51** | **2.50** | **2.81** | **0.51** |

[3] A hot catalyst start is when the unit is started within 6 hours of shutdown and the catalyst temperature is above 100°F.

Wärtsilä Doc. ID DESA00025056, "expected start up and unloading emissions-Maui- 16V34DF," 28 Mar 2024

## Table B-9
## Emergency Generator Performance Data

| Parameter | Units | Full Load Value | Data Source |
|---|---|---|---|
| **Performance Data** | | | |
| Generation | kW | 563 | Cummins DFEK spec sheet |
| Engine Power | bhp | 755 | Cummins DFEK spec sheet |
| Fuel Flow | gal/hr | 34.4 | Cummins DFEK spec sheet |
| | lb/hr | 242.5 | Calculated from fuel flow and fuel density. |
| Fuel Heat Content (HHV) | Btu/gal | 138,000 | Table C-1 to Subpart C of CFR 40 Part 98 |
| Fuel Density | lb/gal | 7.05 | AP-42, Appendix A |
| Heat Input (HHV) | MMBtu/hr | 4.7472 | Calculated from fuel flow and fuel heat content. |
| Operating Hours | hr/day | 4 | Expected |
| | hr/yr | 500 | EPA default for emissions calculations** |
| **Exhaust Data** | | | |
| Exhaust Temperature | °F | 901 | Cummins DFEK spec sheet |
| | K | 755.9 | Converted from °F |
| Exhaust Volumetric Flow (actual) | acfm | 3,625 | Cummins DFEK spec sheet |
| | $m^3/s$ | 1.711 | converted from acfm |
| **Emission Rates** | | | |
| Fuel Sulfur Content | ppm | 15 | Requested permit limit |
| $SO_2$ Emissions | lb/hr | 0.0073 | Mass Balance - 100% conversion of fuel S |
| | g/s | 9.167E-04 | Converted from lb/hr |
| | tpy | 0.0018 | Calculated from lb/hr and annual operating hours |
| PM | g/bhp-hr | 0.10 | Caterpillar C27 specification sheet |
| (Filterable PM) | lb/hr | 0.17 | Calculated from g/hp-hr limit and bhp |
| | g/s | 2.097E-02 | Converted from lb/hr |
| | tpy | 0.0416 | Calculated from lb/hr and annual operating hours |
| $PM_{10}/PM_{2.5}$ | g/bhp-hr | 0.10 | Assume 100% of PM is PM2.5 |
| (Filterable plus Condensable PM) | lb/hr | 0.17 | Calculated from g/hp-hr limit and bhp |
| | g/s | 2.097E-02 | Converted from lb/hr |
| | tpy | 0.0416 | Calculated from lb/hr and annual operating hours |
| $NO_X$ | g/bhp-hr | 4.30 | Caterpillar C27 specification sheet |
| | lb/hr | 7.157 | Calculated from g/hp-hr limit and bhp |
| | g/s | 0.9018 | Converted from lb/hr |
| | tpy | 1.7893 | Calculated from lb/hr and annual operating hours |
| CO | g/bhp-hr | 0.4 | Caterpillar C27 specification sheet |
| | lb/hr | 0.666 | Calculated from g/hp-hr limit and bhp |
| | g/s | 0.0839 | Converted from lb/hr |
| | tpy | 0.1664 | Calculated from lb/hr and annual operating hours |
| VOC | g/bhp-hr | 0.03 | Caterpillar C27 specification sheet |
| | lb/hr | 0.050 | Calculated from g/hp-hr limit and bhp |
| | g/s | 0.0063 | Converted from lb/hr |
| | tpy | 0.01 | Calculated from lb/hr and annual operating hours |
| Lead | lb/MMBtu | 1.40E-05 | AP-42, Section 3.1, Table 3.1-5 |
| | lb/hr | 6.65E-05 | Calculated from lb/MMBtu and heat input |
| | g/s | 8.37E-06 | Converted from lb/hr |
| | tpy | 1.66E-05 | Calculated from lb/hr and annual operating hours |

**Table B-9**
**Emergency Generator Performance Data**

| Parameter | Units | Full Load Value | Data Source |
|---|---|---|---|
| Fluorides | lb/MMBtu | 2.49E-04 | AP-42, Section 1.3, Table 1.3-11 for No. 6 Fuel Oil |
| | lb/hr | 1.18E-03 | Calculated from lb/MMBtu and heat input |
| | g/s | 1.49E-04 | Converted from lb/hr |
| | tpy | 2.95E-04 | Calculated from lb/hr and annual operating hours |
| CO2 | kg/MMBtu | 73.96 | 40 CFR Part 98 |
| | tpy | 193.5 | Calculated from kg/MMBtu and heat input |
| CH4 | g/MMBtu | 3.0 | 40 CFR Part 98 |
| | tpy | 0.01 | Calculated from kg/MMBtu and heat input |
| N2O | g/MMBtu | 0.6 | 40 CFR Part 98 |
| | tpy | 0.002 | Calculated from kg/MMBtu and heat input |
| CO2e | tpy | 194.2 | Sum of GHGs weighted by GWP |

Notes:

** Seitz 1995 memo at www.epa.doc/files/documents/emgen

**Table B-10**
**Operating and Emissions Assumptions**
**Case 1: RNG Only**

| Equipment | NOx lb/hr | SOx (1) lb/hr | CO lb/hr | VOC lb/hr | PM10 lb/hr | NH3 lb/hr |
|---|---|---|---|---|---|---|
| Biodiesel, baseload hour | 8.64 | 0.104 | 3.01 | 3.44 | 3.61 | 1.15 |
| Biodiesel, cold startup hour | 57.32 | 0.104 | 6.51 | 4.22 | 6.81 | 0.58 |
| Biodiesel, warm startup hour | 46.32 | 0.104 | 6.01 | 3.87 | 6.81 | 0.58 |
| Biodiesel, hot startup hour | 38.32 | 0.104 | 5.51 | 3.52 | 6.81 | 0.58 |
| RNG, baseload hour | 1.32 | 0.050 | 2.02 | 2.00 | 1.61 | 1.02 |
| RNG, cold startup hour | 14.66 | 0.050 | 11.51 | 3.00 | 2.81 | 0.51 |
| RNG, warm startup hour | 12.16 | 0.050 | 9.81 | 2.70 | 2.81 | 0.51 |
| RNG, hot startup hour | 9.66 | 0.050 | 8.51 | 2.50 | 2.81 | 0.51 |
| RNG, cold startup/switch to biodiesel | 18.32 | 0.077 | 12.01 | 3.72 | 3.81 | 0.58 |
| RNG, warm startup/switch to biodiesel | 15.82 | 0.077 | 10.31 | 3.42 | 3.81 | 0.58 |

| Equipment | NOx Emissions Max lb/hr | NOx Emissions Max lb/day | NOx Emissions Total tons/yr | NH3 Emissions Max lb/hr | NH3 Emissions Max tons/yr |
|---|---|---|---|---|---|
| Biodiesel, baseload hour | 0.00 | 0.00 | 0.0 | 0.0 | 0.00 |
| Biodiesel, cold startup hour | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| Biodiesel, warm startup hour | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| RNG, baseload hour | 0.00 | 30.4 | 3.80 | 0.0 | 2.93 |
| RNG, cold startup hour | 14.7 | 0.0 | 0.37 | 0.5 | 0.01 |
| RNG, warm startup hour | 0.0 | 12.2 | 2.74 | 0.0 | 0.11 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| RNG, cold startup/switch to biodiesel | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| RNG, warm startup/switch to biodiesel | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| ICE Total, 6 engines | 88.0 lb/hr | 255.1 lb/day | 41.4 tons/yr | 3.1 lb/hr | 18.4 tons/yr |

| Equipment | SOx Emissions Max lb/hr | SOx Emissions Max lb/day | SOx Emissions Total tons/yr |
|---|---|---|---|
| Biodiesel, baseload hour | 0.00 | 0.00 | 0.00 |
| Biodiesel, cold startup hour | 0.00 | 0.00 | 0.00 |
| Biodiesel, warm startup hour | 0.00 | 0.00 | 0.00 |
| Biodiesel, hot startup hour | 0.00 | 0.00 | 0.00 |
| RNG, baseload hour | 0.00 | 1.14 | 0.14 |
| RNG, cold startup hour | 0.05 | 0.00 | 0.00 |
| RNG, warm startup hour | 0.00 | 0.05 | 0.01 |
| RNG, hot startup hour | 0.00 | 0.00 | 0.00 |
| RNG, cold startup/switch to biodiesel | 0.00 | 0.00 | 0.00 |
| RNG, warm startup/switch to biodiesel | 0.00 | 0.00 | 0.00 |
| ICE Total, all engines | 0.30 lb/hr | 7.2 lb/day | 0.9 tons/yr |

**Table B-10**
**Operating and Emissions Assumptions**
**Case 1: RNG Only**

| | CO Emissions | | |
|---|---|---|---|
| Equipment | Max lb/hr | Max lb/day | Total tons/yr |
| Biodiesel, baseload hour | 0.0 | 0.0 | 0.0 |
| Biodiesel, cold startup hour | 0.0 | 0.0 | 0.0 |
| Biodiesel, warm startup hour | 0.0 | 0.0 | 0.0 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.0 |
| RNG, baseload hour | 0.0 | 46.5 | 5.808 |
| RNG, cold startup hour | 11.5 | 0.0 | 0.288 |
| RNG, warm startup hour | 0.0 | 9.8 | 2.207 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.0 |
| RNG, cold startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| RNG, warm startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| ICE Total, all engines | 69.1 lb/hr | 337.6 lb/day | 49.8 tons/yr |

| | VOC Emissions | | |
|---|---|---|---|
| Equipment | Max lb/hr | Max lb/day | Total tons/yr |
| Biodiesel, baseload hour | 0.0 | 0.0 | 0.0 |
| Biodiesel, cold startup hour | 0.0 | 0.0 | 0.0 |
| Biodiesel, warm startup hour | 0.0 | 0.0 | 0.0 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.0 |
| RNG, baseload hour | 0.0 | 46.0 | 5.750 |
| RNG, cold startup hour | 3.0 | 0.0 | 0.075 |
| RNG, warm startup hour | 0.0 | 2.7 | 0.608 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| RNG, warm startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| ICE Total, all engines | 18.0 lb/hr | 292.2 lb/day | 38.6 tons/yr |

| | PM10 Emissions | | |
|---|---|---|---|
| Equipment | Max lb/hr | Max lb/day | Total tons/yr |
| Biodiesel, baseload hour | 0.0 | 0.0 | 0.0 |
| Biodiesel, cold startup hour | 0.0 | 0.0 | 0.0 |
| Biodiesel, warm startup hour | 0.0 | 0.0 | 0.0 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.0 |
| RNG, baseload hour | 0.0 | 37.0 | 4.629 |
| RNG, cold startup hour | 2.8 | 0.0 | 0.070 |
| RNG, warm startup hour | 0.0 | 2.8 | 0.631 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| RNG, warm startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| ICE Total, all engines | 16.8 lb/hr | 239.0 lb/day | 32.0 tons/yr |

**Table B-11**
**Operating and Emissions Assumptions**
**Case 2: Startup on RNG, Switch to Biodiesel**

| Equipment | NOx lb/hr | SOx (1) lb/hr | CO lb/hr | VOC lb/hr | PM10 lb/hr | NH3 lb/hr |
|---|---|---|---|---|---|---|
| Biodiesel, baseload hour | 8.64 | 0.104 | 3.01 | 3.44 | 3.61 | 1.15 |
| Biodiesel, cold startup hour | 57.32 | 0.104 | 6.51 | 4.22 | 6.81 | 0.58 |
| Biodiesel, warm startup hour | 46.32 | 0.104 | 6.01 | 3.87 | 6.81 | 0.58 |
| Biodiesel, hot startup hour | 38.32 | 0.104 | 5.51 | 3.52 | 6.81 | 0.58 |
| RNG, baseload hour | 1.32 | 0.050 | 2.02 | 2.00 | 1.61 | 1.02 |
| RNG, cold startup hour | 14.66 | 0.050 | 11.51 | 3.00 | 2.81 | 0.51 |
| RNG, warm startup hour | 12.16 | 0.050 | 9.81 | 2.70 | 2.81 | 0.51 |
| RNG, hot startup hour | 9.66 | 0.050 | 8.51 | 2.50 | 2.81 | 0.51 |
| RNG, cold startup/switch to biodiesel | 18.32 | 0.077 | 12.01 | 3.72 | 3.81 | 0.58 |
| RNG, warm startup/switch to biodiesel | 15.82 | 0.077 | 10.31 | 3.42 | 3.81 | 0.58 |

| | NOx Emissions | | | NH3 Emissions | |
|---|---|---|---|---|---|
| Equipment | Max lb/hr | Max lb/day | Total tons/yr | Max lb/hr | Max tons/yr |
| Biodiesel, baseload hour | 0.00 | 198.72 | 24.840 | 0.0 | 3.306 |
| Biodiesel, cold startup hour | 0.0 | 0.0 | 0.000 | 0.0 | 0.00 |
| Biodiesel, warm startup hour | 0.0 | 0.0 | 0.000 | 0.0 | 0.00 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.000 | 0.0 | 0.00 |
| RNG, baseload hour | 0.00 | 0.00 | 0.000 | 0.0 | 0.00 |
| RNG, cold startup hour | 0.0 | 0.0 | 0.000 | 0.0 | 0.00 |
| RNG, warm startup hour | 0.0 | 0.0 | 0.000 | 0.0 | 0.00 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.000 | 0.0 | 0.00 |
| RNG, cold startup/switch to biodiesel | 18.3 | 0.0 | 0.458 | 0.6 | 0.01 |
| RNG, warm startup/switch to biodiesel | 0.0 | 15.8 | 3.560 | 0.0 | 0.13 |
| ICE Total, 6 engines | 109.9 lb/hr | 1,287.2 lb/day | 173.1 tons/yr | 3.5 lb/hr | 20.7 tons/yr |

| | SOx Emissions | | |
|---|---|---|---|
| Equipment | Max lb/hr | Max lb/day | Total tons/yr |
| Biodiesel, baseload hour | 0.0 | 2.4 | 0.300 |
| Biodiesel, cold startup hour | 0.0 | 0.0 | 0.000 |
| Biodiesel, warm startup hour | 0.0 | 0.0 | 0.000 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, baseload hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup hour | 0.0 | 0.0 | 0.000 |
| RNG, warm startup hour | 0.0 | 0.0 | 0.000 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup/switch to biodiesel | 0.08 | 0.0 | 0.002 |
| RNG, warm startup/switch to biodiesel | 0.0 | 0.1 | 0.017 |
| ICE Total, all engines | 0.5 lb/hr | 14.9 lb/day | 1.914 tons/yr |

**Table B-11**
**Operating and Emissions Assumptions**
**Case 2: Startup on RNG, Switch to Biodiesel**

| Equipment | CO Emissions Max lb/hr | CO Emissions Max lb/day | CO Emissions Total tons/yr |
|---|---|---|---|
| Biodiesel, baseload hour | 0.0 | 69.2 | 8.654 |
| Biodiesel, cold startup hour | 0.0 | 0.0 | 0.000 |
| Biodiesel, warm startup hour | 0.0 | 0.0 | 0.000 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, baseload hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup hour | 0.0 | 0.0 | 0.000 |
| RNG, warm startup hour | 0.0 | 0.0 | 0.000 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup/switch to biodiesel | 12.0 | 0.0 | 0.300 |
| RNG, warm startup/switch to biodiesel | 0.0 | 10.3 | 2.319 |
| ICE Total, all engines | 72.0 lb/hr | 477.2 lb/day | 67.6 tons/yr |

| Equipment | VOC Emissions Max lb/hr | VOC Emissions Max lb/day | VOC Emissions Total tons/yr |
|---|---|---|---|
| Biodiesel, baseload hour | 0.0 | 79.1 | 9.890 |
| Biodiesel, cold startup hour | 0.0 | 0.0 | 0.000 |
| Biodiesel, warm startup hour | 0.0 | 0.0 | 0.000 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, baseload hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup hour | 0.0 | 0.0 | 0.000 |
| RNG, warm startup hour | 0.0 | 0.0 | 0.000 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup/switch to biodiesel | 3.7 | 0.0 | 0.093 |
| RNG, warm startup/switch to biodiesel | 0.0 | 3.4 | 0.770 |
| ICE Total, all engines | 22.3 lb/hr | 495.2 lb/day | 64.5 tons/yr |

| Equipment | PM10 Emissions Max lb/hr | PM10 Emissions Max lb/day | PM10 Emissions Total tons/yr |
|---|---|---|---|
| Biodiesel, baseload hour | 0.0 | 83.0 | 10.379 |
| Biodiesel, cold startup hour | 0.0 | 0.0 | 0.000 |
| Biodiesel, warm startup hour | 0.0 | 0.0 | 0.000 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, baseload hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup hour | 0.0 | 0.0 | 0.000 |
| RNG, warm startup hour | 0.0 | 0.0 | 0.000 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup/switch to biodiesel | 3.8 | 0.0 | 0.095 |
| RNG, warm startup/switch to biodiesel | 0.0 | 3.8 | 0.856 |
| ICE Total, all engines | 22.8 lb/hr | 521.0 lb/day | 68.0 tons/yr |

**Table B-12**
**Operating and Emissions Assumptions**
**Case 3: Biodiesel Only**

| Equipment | NOx lb/hr | SOx (1) lb/hr | CO lb/hr | VOC lb/hr | PM10 lb/hr | NH3 lb/hr |
|---|---|---|---|---|---|---|
| Biodiesel, baseload hour | 8.64 | 0.104 | 3.01 | 3.44 | 3.61 | 1.15 |
| Biodiesel, cold startup hour | 57.32 | 0.104 | 6.51 | 4.22 | 6.81 | 0.58 |
| Biodiesel, warm startup hour | 46.32 | 0.104 | 6.01 | 3.87 | 6.81 | 0.58 |
| Biodiesel, hot startup hour | 38.32 | 0.104 | 5.51 | 3.52 | 6.81 | 0.58 |
| RNG, baseload hour | 1.32 | 0.050 | 2.02 | 2.00 | 1.61 | 1.02 |
| RNG, cold startup hour | 14.66 | 0.050 | 11.51 | 3.00 | 2.81 | 0.51 |
| RNG, warm startup hour | 12.16 | 0.050 | 9.81 | 2.70 | 2.81 | 0.51 |
| RNG, hot startup hour | 9.66 | 0.050 | 8.51 | 2.50 | 2.81 | 0.51 |
| RNG, cold startup/switch to biodiesel | 18.32 | 0.077 | 12.01 | 3.72 | 3.81 | 0.58 |
| RNG, warm startup/switch to biodiesel | 15.82 | 0.077 | 10.31 | 3.42 | 3.81 | 0.58 |

| Equipment | NOx Emissions | | | NH3 Emissions | |
|---|---|---|---|---|---|
| | Max lb/hr | Max lb/day | Total tons/yr | Max lb/hr | Max tons/yr |
| Biodiesel, baseload hour | 0.00 | 198.72 | 24.840 | 0.00 | 3.31 |
| Biodiesel, cold startup hour | 57.3 | 0.0 | 1.433 | 0.58 | 0.01 |
| Biodiesel, warm startup hour | 0.0 | 46.3 | 10.422 | 0.0 | 0.1 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.000 | 0.0 | 0.00 |
| RNG, baseload hour | 0.00 | 0.00 | 0.000 | 0.00 | 0.00 |
| RNG, cold startup hour | 0.0 | 0.0 | 0.0 | 0.00 | 0.00 |
| RNG, warm startup hour | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| RNG, cold startup/switch to biodiesel | 0.0 | 0.0 | 0.0 | 0.00 | 0.00 |
| RNG, warm startup/switch to biodiesel | 0.0 | 0.0 | 0.0 | 0.00 | 0.00 |
| ICE Total, 6 engines | 343.9 lb/hr | 1,470.2 lb/day | 220.2 tons/yr | 3.5 lb/hr | 20.7 tons/yr |

| Equipment | SOx Emissions | | |
|---|---|---|---|
| | Max lb/hr | Max lb/day | Total tons/yr |
| Biodiesel, baseload hour | 0.0 | 2.4 | 0.300 |
| Biodiesel, cold startup hour | 0.1 | 0.0 | 0.003 |
| Biodiesel, warm startup hour | 0.0 | 0.1 | 0.023 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, baseload hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup hour | 0.0 | 0.0 | 0.000 |
| RNG, warm startup hour | 0.0 | 0.0 | 0.000 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.000 |
| RNG, cold startup/switch to biodiesel | 0.0 | 0.0 | 0.000 |
| RNG, warm startup/switch to biodiesel | 0.0 | 0.0 | 0.000 |
| ICE Total, all engines | 0.6 lb/hr | 15.0 lb/day | 1.955 tons/yr |

**Table B-12**
**Operating and Emissions Assumptions**
**Case 3: Biodiesel Only**

| Equipment | CO Emissions Max lb/hr | CO Emissions Max lb/day | CO Emissions Total tons/yr |
|---|---|---|---|
| Biodiesel, baseload hour | 0.0 | 69.2 | 8.654 |
| Biodiesel, cold startup hour | 6.5 | 0.0 | 0.163 |
| Biodiesel, warm startup hour | 0.0 | 6.0 | 1.351 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.0 |
| RNG, baseload hour | 0.0 | 0.0 | 0.0 |
| RNG, cold startup hour | 0.0 | 0.0 | 0.0 |
| RNG, warm startup hour | 0.0 | 0.0 | 0.0 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.0 |
| RNG, cold startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| RNG, warm startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| ICE Total, all engines | 39.0 lb/hr | 451.4 lb/day | 61.0 tons/yr |

| Equipment | VOC Emissions Max lb/hr | VOC Emissions Max lb/day | VOC Emissions Total tons/yr |
|---|---|---|---|
| Biodiesel, baseload hour | 0.0 | 79.1 | 9.89 |
| Biodiesel, cold startup hour | 4.2 | 0.0 | 0.11 |
| Biodiesel, warm startup hour | 0.0 | 3.9 | 0.87 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.0 |
| RNG, baseload hour | 0.0 | 0.0 | 0.0 |
| RNG, cold startup hour | 0.0 | 0.0 | 0.0 |
| RNG, warm startup hour | 0.0 | 0.0 | 0.0 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.0 |
| RNG, cold startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| RNG, warm startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| ICE Total, all engines | 25.3 lb/hr | 497.9 lb/day | 65.2 tons/yr |

| Equipment | PM10 Emissions Max lb/hr | PM10 Emissions Max lb/day | PM10 Emissions Total tons/yr |
|---|---|---|---|
| Biodiesel, baseload hour | 0.0 | 83.0 | 10.38 |
| Biodiesel, cold startup hour | 6.8 | 0.0 | 0.17 |
| Biodiesel, warm startup hour | 0.0 | 6.8 | 1.53 |
| Biodiesel, hot startup hour | 0.0 | 0.0 | 0.00 |
| RNG, baseload hour | 0.0 | 0.0 | 0.0 |
| RNG, cold startup hour | 0.0 | 0.0 | 0.0 |
| RNG, warm startup hour | 0.0 | 0.0 | 0.0 |
| RNG, hot startup hour | 0.0 | 0.0 | 0.0 |
| RNG, cold startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| RNG, warm startup/switch to biodiesel | 0.0 | 0.0 | 0.0 |
| ICE Total, all engines | 40.8 lb/hr | 539.0 lb/day | 72.5 tons/yr |

# Table B-13
# GHG Emissions
# Case 1: RNG Only

| Unit | Heat Input (MMBtu/hr) | Operating: Output (gross MW) | Operating: Hours (hrs/yr) | Annual Heat Input per Unit (MMBtu/yr) | Number of Units | Total Annual Heat Input (MMBtu/yr) | Total Annual Output MWh/yr | GHG Pollutant[1] | Emission Factor[2] (kg/MMBtu) | Max. Hourly Emissions (kg/hr) | Annual Emissions (metric tpy) | Global Warming Potential[3] | Per Unit Total GHG Emissions $CO_2e$ (lb/hr) | Per Unit Total GHG Emissions $CO_2e$ (metric tpy) | Per Unit Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ (lb/hr) | Total GHG Emissions $CO_2e$ (metric tpy) | Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ lb/MWh | g/kWh | lb/MMBtu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GHG Emissions when Firing Biodiesel, Full Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä | | | | | | | | $CO_2$ | 73.96 | 4,474 | 0 | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| 16V34DF | 60.5 | 44.9 | 0 | 0 | 6 | 0 | 0 | $N_2O$ | 6.0E-04 | 3.63E-02 | 0.000 | 298 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| Engines | | | | | | | | $CH_4$ | 3.0E-03 | 1.81E-01 | 0.00 | 25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| **GHG Emissions when Firing RNG, Full Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä | | | | | | | | $CO_2$ | 53.06 | 3,295 | 20,596 | 1 | 7,265.1 | 20,596.1 | 22,703.3 | 43,590.4 | 123,576.7 | 136,219.9 | 978 | | |
| 16V34DF | 62.1 | 44.9 | 6,250 | 388,166 | 6 | 2,328,998 | 278,630 | $N_2O$ | 1.0E-04 | 6.21E-03 | 0.039 | 298 | 0.0 | 11.6 | 12.8 | 0.0 | 69.4 | 76.5 | 1 | | |
| Engines | | | | | | | | $CH_4$ | 1.0E-03 | 6.21E-02 | 0.39 | 25 | 0.0 | 9.7 | 10.7 | 0.0 | 58.2 | 64.2 | 0 | | |
| | | | | | | | | | | | | Total $CO_2e$ = | 7,265.1 | 20,617.4 | 22,726.8 | 43,590.4 | 123,704.3 | 136,360.6 | 978.8 | 444.0 | 117.1 |
| | | | | | | | | | | | | Biogenic[4] $CO_2$ = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | | | | | | | | | | | | non-Biogenic $CO_2e$ = | 7,265.1 | 20,617.4 | 22,726.8 | 43,590.4 | 123,704.3 | 136,360.6 | | | |

| Unit | Heat Input (MMBtu/hr) | Operating: Output (gross MW) | Operating: Hours (hrs/yr) | Annual Heat Input per Unit (MMBtu/yr) | Number of Units | Total Annual Heat Input (MMBtu/yr) | Total Annual Output MWh/yr | GHG Pollutant[1] | Emission Factor[2] (kg/MMBtu) | Max. Hourly Emissions (kg/hr) | Annual Emissions (metric tpy) | Global Warming Potential[3] | Per Unit Total GHG Emissions $CO_2e$ (lb/hr) | Per Unit Total GHG Emissions $CO_2e$ (metric tpy) | Per Unit Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ (lb/hr) | Total GHG Emissions $CO_2e$ (metric tpy) | Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ lb/MWh | g/kWh | lb/MMBtu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GHG Emissions when Firing Biodiesel, Minimum Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä | | | | | | | | $CO_2$ | 73.96 | 1,915 | 0 | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| 16V34DF | 25.9 | 18.0 | 0 | 0 | 6 | 0 | 0 | $N_2O$ | 6.0E-04 | 1.55E-02 | 0.000 | 298 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| Engines | | | | | | | | $CH_4$ | 3.0E-03 | 7.77E-02 | 0.00 | 25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| **GHG Emissions when Firing RNG, Minimum Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä | | | | | | | | $CO_2$ | 53.06 | 1,589 | 9,932 | 1 | 3,503.4 | 9,932.1 | 10,948.3 | 21,020.7 | 59,592.6 | 65,689.6 | 1171 | | |
| 16V34DF | 29.9 | 18.0 | 6,250 | 187,186 | 6 | 1,123,118 | 112,200 | $N_2O$ | 1.0E-04 | 2.99E-03 | 0.019 | 298 | 0.0 | 5.6 | 6.1 | 0.0 | 33.5 | 36.9 | 1 | | |
| Engines | | | | | | | | $CH_4$ | 1.0E-03 | 2.99E-02 | 0.19 | 25 | 0.0 | 4.7 | 5.2 | 0.0 | 28.1 | 31.0 | 1 | | |
| | | | | | | | | | | | | Total $CO_2e$ = | 3,503.4 | 9,942.4 | 10,959.6 | 21,020.7 | 59,654.2 | 65,757.5 | 1,172.1 | 531.7 | 117.1 |
| | | | | | | | | | | | | Biogenic[4] $CO_2$ = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | | | | | | | | | | | | non-Biogenic $CO_2e$ = | 3,503.4 | 9,942.4 | 10,959.6 | 21,020.7 | 59,654.2 | 65,757.5 | | | |

[1] Greenhouse Gas (GHG) pollutants from the Mandatory Greenhouse Gas Reporting rule (40 CFR §98.32).

[2] Emission factors from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart C, Tables C-1 and C-2).

[3] Global Warming Potentials from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart A, Table A-1).

[4] Per 40 CFR §98.6, biogenic $CO_2$ means carbon dioxide emissions generated as the result of biomass combustion.

# Table B-14
# GHG Emissions
# Case 2: Startup on RNG, Switch to Biodiesel

| Unit | Heat Input (MMBtu/hr) | Operating Output (gross MW) | Operating Hours (hrs/yr) | Annual Heat Input per Unit (MMBtu/yr) | Number of Units | Total Annual Heat Input (MMBtu/yr) | Total Annual Output MWh/yr | GHG Pollutant[1] | Emission Factor[2] (kg/MMBtu) | Max. Hourly Emissions (kg/hr) | Annual Emissions (metric tpy) | Global Warming Potential[3] | Per Unit Total GHG Emissions $CO_2e$ (lb/hr) | Per Unit Total GHG Emissions $CO_2e$ (metric tpy) | Per Unit Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ (lb/hr) | Total GHG Emissions $CO_2e$ (metric tpy) | Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ lb/MWh | Total GHG Emissions $CO_2e$ g/kWh | Total GHG Emissions $CO_2e$ lb/MMBtu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GHG Emissions when Firing Biodiesel** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 60.5 | 44.9 | 6,000 | 362,989 | 6 | 2,177,937 | 258,060 | $CO_2$ | 73.96 | 4,474 | 26,847 | 1 | 9,864.5 | 26,846.7 | 29,593.4 | 59,186.8 | 161,080.2 | 177,560.5 | 1376 | | |
| | | | | | | | | $N_2O$ | 6.0E-04 | 3.63E-02 | 0.218 | 298 | 23.8 | 64.9 | 71.5 | 143.1 | 389.4 | 429.3 | 3 | | |
| | | | | | | | | $CH_4$ | 3.0E-03 | 1.81E-01 | 1.09 | 25 | 10.0 | 27.2 | 30.0 | 60.0 | 163.3 | 180.1 | 1 | | |
| **GHG Emissions when Firing RNG** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 62.1 | 44.9 | 250 | 15,527 | 6 | 93,160 | 20,570 | $CO_2$ | 53.06 | 3,295 | 824 | 1 | 7,265.1 | 823.8 | 908.1 | 43,590.4 | 4,943.1 | 5,448.8 | 530 | | |
| | | | | | | | | $N_2O$ | 1.0E-04 | 6.21E-03 | 0.002 | 298 | 0.0 | 0.5 | 0.5 | 0.0 | 2.8 | 3.1 | 0 | | |
| | | | | | | | | $CH_4$ | 1.0E-03 | 6.21E-02 | 0.02 | 25 | 0.0 | 0.4 | 0.4 | 0.0 | 2.3 | 2.6 | 0 | | |
| | | | | | | | | | | | | Total $CO_2e$ = | 9,898.3 | 27,763.5 | 30,604.0 | 59,389.9 | 166,581.1 | 183,624.3 | 1,318.1 | 597.9 | 161.7 |
| | | | | | | | | | | | | Biogenic[4] $CO_2$ = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | | | | | | | | | | | | non-Biogenic $CO_2e$ = | 9,898.3 | 27,763.5 | 30,604.0 | 59,389.9 | 166,581.1 | 183,624.3 | | | |

[1] Greenhouse Gas (GHG) pollutants from the Mandatory Greenhouse Gas Reporting rule (40 CFR §98.32).
[2] Emission factors from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart C, Tables C-1 and C-2).
[3] Global Warming Potentials from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart A, Table A-1).
[4] Per 40 CFR §98.6, biogenic $CO_2$ means carbon dioxide emissions generated as the result of biomass combustion.

# Table B-15
# GHG Emissions
# Case 3: Biodiesel Only

| Unit | Heat Input (MMBtu/hr) | Operating Output (gross MW) | Operating Hours (hrs/yr) | Annual Heat Input per Unit (MMBtu/yr) | Number of Units | Total Annual Heat Input (MMBtu/yr) | Total Annual Output MWh/yr | GHG Pollutant[1] | Emission Factor[2] (kg/MMBtu) | Max. Hourly Emissions (kg/hr) | Annual Emissions (metric tpy) | Global Warming Potential[3] | Per Unit Total GHG Emissions $CO_2e$ (lb/hr) | Per Unit Total GHG Emissions $CO_2e$ (metric tpy) | Per Unit Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ (lb/hr) | Total GHG Emissions $CO_2e$ (metric tpy) | Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ lb/MWh | g/kWh | lb/MMBtu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GHG Emissions when Firing Biodiesel, Full Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 60.5 | 44.9 | 6,250 | 378,114 | 6 | 2,268,684 | 278,630 | $CO_2$ | 73.96 | 4,474 | 27,965 | 1 | 9,864.5 | 27,965.3 | 30,826.5 | 59,186.8 | 167,791.9 | 184,958.9 | 1328 | | |
| | | | | | | | | $N_2O$ | 6.0E-04 | 3.63E-02 | 0.227 | 298 | 23.8 | 67.6 | 74.5 | 143.1 | 405.6 | 447.1 | 3 | | |
| | | | | | | | | $CH_4$ | 3.0E-03 | 1.81E-01 | 1.13 | 25 | 10.0 | 28.4 | 31.3 | 60.0 | 170.2 | 187.6 | 1 | | |
| **GHG Emissions when Firing RNG, Full Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 62.1 | 44.9 | 0 | 0 | 6 | 0 | 0 | $CO_2$ | 53.06 | 3,295 | 0 | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $N_2O$ | 1.0E-04 | 6.21E-03 | 0.000 | 298 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $CH_4$ | 1.0E-03 | 6.21E-02 | 0.00 | 25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | | | | | Total $CO_2e$ = | 9,898.3 | 28,061.3 | 30,932.3 | 59,389.9 | 168,367.7 | 185,593.6 | 1,332.2 | 604.3 | 163.6 |
| | | | | | | | | | | | | Biogenic[4] $CO_2$ = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | | | | | | | | | | | | non-Biogenic $CO_2e$ = | 9,898.3 | 28,061.3 | 30,932.3 | 59,389.9 | 168,367.7 | 185,593.6 | | | |

| Unit | Heat Input (MMBtu/hr) | Operating Output (gross MW) | Operating Hours (hrs/yr) | Annual Heat Input per Unit (MMBtu/yr) | Number of Units | Total Annual Heat Input (MMBtu/yr) | Total Annual Output MWh/yr | GHG Pollutant[1] | Emission Factor[2] (kg/MMBtu) | Max. Hourly Emissions (kg/hr) | Annual Emissions (metric tpy) | Global Warming Potential[3] | Per Unit Total GHG Emissions $CO_2e$ (lb/hr) | Per Unit Total GHG Emissions $CO_2e$ (metric tpy) | Per Unit Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ (lb/hr) | Total GHG Emissions $CO_2e$ (metric tpy) | Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ lb/MWh | g/kWh | lb/MMBtu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GHG Emissions when Firing Biodiesel, Minimum Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 25.9 | 18.0 | 6,250 | 161,830 | 6 | 970,979 | 112,200 | $CO_2$ | 73.96 | 1,915 | 11,969 | 1 | 4,221.9 | 11,968.9 | 13,193.5 | 25,331.5 | 71,813.6 | 79,160.9 | 1411 | | |
| | | | | | | | | $N_2O$ | 6.0E-04 | 1.55E-02 | 0.097 | 298 | 10.2 | 28.9 | 31.9 | 61.2 | 173.6 | 191.4 | 3 | | |
| | | | | | | | | $CH_4$ | 3.0E-03 | 7.77E-02 | 0.49 | 25 | 4.3 | 12.1 | 13.4 | 25.7 | 72.8 | 80.3 | 1 | | |
| **GHG Emissions when Firing RNG, Minimum Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 29.9 | 18.0 | 0 | 0 | 6 | 0 | 0 | $CO_2$ | 53.06 | 1,589 | 0 | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $N_2O$ | 1.0E-04 | 2.99E-03 | 0.000 | 298 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $CH_4$ | 1.0E-03 | 2.99E-02 | 0.00 | 25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | | | | | Total $CO_2e$ = | 4,236.4 | 12,010.0 | 13,238.8 | 25,418.4 | 72,060.0 | 79,432.6 | 1,415.9 | 642.3 | 163.6 |
| | | | | | | | | | | | | Biogenic[4] $CO_2$ = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | | | | | | | | | | | | non-Biogenic $CO_2e$ = | 4,236.4 | 12,010.0 | 13,238.8 | 25,418.4 | 72,060.0 | 79,432.6 | | | |

[1] Greenhouse Gas (GHG) pollutants from the Mandatory Greenhouse Gas Reporting rule (40 CFR §98.32).
[2] Emission factors from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart C, Tables C-1 and C-2).
[3] Global Warming Potentials from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart A, Table A-1).
[4] Per 40 CFR §98.6, biogenic $CO_2$ means carbon dioxide emissions generated as the result of biomass combustion.

**Table B-16**
**Annual and Maximum Hourly HAP Emissions**
**Case 1: RNG Only**

| Pollutant | RNG Emission Factor (1) lb/MMcf | Controlled RNG Em Factor (2) lb/MMcf | Hourly Emissions per Engine, Case 1 (4) lb/hr | Annual Emissions per Engine, Case 1 (4) tpy | Total Annual Emissions, all Engines Case 1 (5) tpy |
|---|---|---|---|---|---|
| Ammonia | (3) | n/a | 1.15 | 3.06 | 18.4 |
| Propylene | 5.38E+00 | 3.23E+00 | 0.18 | 0.55 | 3.31 |
| Hazardous Air Pollutants | | | | | |
| Acetaldehyde | 5.29E-01 | 3.17E-01 | 0.02 | 0.05 | 0.33 |
| Acrolein | 5.90E-02 | 3.54E-02 | 1.94E-03 | 0.01 | 0.04 |
| Benzene | 2.18E-01 | 1.31E-01 | 0.01 | 0.02 | 0.13 |
| 1,3-Butadiene | 3.67E-01 | 2.20E-01 | 0.01 | 0.04 | 0.23 |
| Ethylbenzene | 7.11E-02 | 4.27E-02 | 2.33E-03 | 0.01 | 0.04 |
| Formaldehyde | n/a | 1.85E+00 | 0.10 | 0.32 | 1.89 |
| Naphthalene | 2.51E-02 | 1.51E-02 | 8.24E-04 | 2.6E-03 | 0.02 |
| PAHs (as B(a)P) (6) | 1.71E-05 | 1.03E-05 | 5.63E-07 | 1.8E-06 | 0.00 |
| Toluene | 2.39E-01 | 1.43E-01 | 7.85E-03 | 0.02 | 0.15 |
| Xylene | 6.46E-01 | 3.88E-01 | 0.02 | 0.07 | 0.40 |
| Total HAPs | | | | | 3.22 |

Notes:

(1) All factors except formaldehyde are from CATEF mean emission factors for a natural gas 4S/Lean/>650Hp engine.
https://www.arb.ca.gov/app/emsinv/catef_form.html
Formaldehyde based on RICE NESHAP limit for SI engines (1.1 ppm).

(2) 40% control efficiency for oxidation catalyst applied for all TACs except formaldehyde. Source: BAAQMD PDOC for Eastshore Energy Center, April 30, 2007. Formaldehyde emission factor provided by vendor reflects ox cat control.

(3) Based on 10 ppm ammonia slip from SCR system.

(4) Based on maximum ICE firing rate of 62.1 MMBtu/hr for RNG
0.05 MMscf per engine

(5) Based on maximum ICE firing rate (from (4)) for RNG.
342 MMscf per engine

(6) Emission factors for individual PAHs weighted by cancer risk relative to B(a)P and summed to obtain overall B(a)P equivalent emission rate for HRA.

| | Mean EF NG (lb/MMscf) | PEF Equiv. | Weighted EF NG (lb/MMscf) |
|---|---|---|---|
| PAHs (as B(a)P) | | | |
| Benzo(a)anthracene | 5.88E-05 | 0.1 | 5.88E-06 |
| Benzo(a)pyrene | 2.70E-06 | 1 | 2.70E-06 |
| Benzo(b)fluoranthene | 4.09E-05 | 0.1 | 4.09E-06 |
| Benzo(k)fluoranthene | 7.83E-06 | 0.1 | 7.83E-07 |
| Chrysene | 1.43E-05 | 0.01 | 1.43E-07 |
| Dibenz(a,h)anthracene | 2.70E-06 | 1.05 | 2.84E-06 |
| Indeno(1,2,3-cd)pyrene | 7.17E-06 | 0.1 | 7.17E-07 |

**Table B-17**
**Annual and Maximum Hourly HAP Emissions**
**Case 2: Startup on RNG, Switch to Biodiesel**

| Pollutant | Biodiesel Emission Factor (1) lb/Mgal | Controlled Biodiesel Em Factor (2) lb/Mgal | Hourly Emissions per Engine, Biodiesel Firing (4) lb/hr | Total Annual Emissions, all Engines Biodiesel Firing (5) tpy | RNG Emission Factor (1) lb/MMcf | Controlled RNG Em Factor (2) lb/MMcf | Hourly Emissions per Engine, RNG Firing (6) lb/hr | Total Annual Emissions, all Engines RNG Firing (7) tpy | Maximum Hourly Emissions per Engine lb/hr | Annual Emissions per Engine, Case 2 tpy | Total Annual Emissions, all Engines tpy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ammonia | (3) | n/a | 1.15 | n/a | (3) | n/a | 1.02 | n/a | 1.2 | 3.5 | 20.7 |
| Propylene | 3.85E-01 | 2.31E-01 | 0.10 | 1.82 | 5.38E+00 | 3.23E+00 | 0.18 | 0.24 | 0.2 | 0.3 | 2.1 |
| Hazardous Air Pollutants | | | | | | | | | | | |
| Acetaldehyde | 3.47E-03 | 2.08E-03 | 9.13E-04 | 0.02 | 5.29E-01 | 3.17E-01 | 1.74E-02 | 0.02 | 1.74E-02 | 6.7E-03 | 0.04 |
| Acrolein | 1.07E-03 | 6.42E-04 | 2.81E-04 | 0.01 | 5.90E-02 | 3.54E-02 | 1.94E-03 | 2.66E-03 | 1.94E-03 | 1.3E-03 | 7.73E-03 |
| Benzene | 1.01E-01 | 6.06E-02 | 2.66E-02 | 0.48 | 2.18E-01 | 1.31E-01 | 7.16E-03 | 0.01 | 0.03 | 0.08 | 0.49 |
| 1,3-Butadiene | n/a | 0 | 0 | 0.00 | 3.67E-01 | 2.20E-01 | 1.20E-02 | 0.02 | 1.20E-02 | 2.8E-03 | 0.02 |
| Ethylbenzene | 6.76E-03 | 4.06E-03 | 1.78E-03 | 0.03 | 7.11E-02 | 4.27E-02 | 2.33E-03 | 3.21E-03 | 2.33E-03 | 5.9E-03 | 0.04 |
| Formaldehyde | n/a | 2.07E-01 | 9.07E-02 | 1.63 | n/a | 1.85E+00 | 1.01E-01 | 0.14 | 1.01E-01 | 0.30 | 1.77 |
| Hexane | 1.39E-03 | 8.34E-04 | 3.66E-04 | 0.01 | n/a | 0 | 0 | 0 | 3.66E-04 | 1.1E-03 | 6.58E-03 |
| Naphthalene | 1.63E-02 | 9.78E-03 | 4.29E-03 | 0.08 | 2.51E-02 | 1.51E-02 | 8.24E-04 | 1.13E-03 | 4.29E-03 | 0.01 | 0.08 |
| PAHs (as B(a)P) (6) | 6.21E-05 | 3.73E-05 | 1.63E-05 | 0.00 | 1.71E-05 | 1.03E-05 | 5.63E-07 | 7.74E-07 | 1.63E-05 | 4.9E-05 | 2.95E-04 |
| Toluene | 3.74E-02 | 2.24E-02 | 9.84E-03 | 0.18 | 2.39E-01 | 1.43E-01 | 7.85E-03 | 1.08E-02 | 9.84E-03 | 0.03 | 0.19 |
| Xylene | 2.68E-02 | 1.61E-02 | 7.05E-03 | 0.13 | 6.46E-01 | 3.88E-01 | 2.12E-02 | 2.92E-02 | 2.12E-02 | 0.03 | 0.16 |
| Total HAPs | | | | 2.55 | | | | 0.24 | | | 2.79 |

Notes:

(1) All factors except formaldehyde are CATEF mean values for large Diesel engines (SCC 20200102 or 20300101)
or a natural gas 4S/Lean/>650Hp engine.
https://www.arb.ca.gov/app/emsinv/catef_form.html
Formaldehyde based on RICE NESHAP limit for CI engines (580 ppb).

(2) 40% control efficiency for oxidation catalyst applied for all TACs except formaldehyde. Source: BAAQMD PDOC for Eastshore Energy Center, April 30, 2007. Formaldehyde emission factor is RICE NESHAP limit for diesel engines.

(3) Based on 10 ppm ammonia slip from SCR system.

(4) Based on maximum ICE firing rate of 67.0 MMBtu/hr and default fuel HHV of 138,000 Btu/gal for biodiesel fuel
0.44 Mgal/hr per engine

(5) Based on maximum ICE firing rate (from (4)) for 100% biodiesel fuel.
2,630 Mgal/yr per engine

(6) Based on maximum ICE firing rate of 62.1 MMBtu/hr for RNG
0.05 MMscf per engine

(7) Based on maximum ICE firing rate (from (4)) for 100% RNG.
14 MMscf per engine

(8) Emission factors for individual PAHs weighted by cancer risk relative to B(a)P and summed to obtain overall B(a)P equivalent emission rate for HRA.

| PAHs (as B(a)P) | Mean EF Diesel (lb/Mgal) | PEF Equiv. | Weighted EF Diesel (lb/Mgal) | Mean EF NG (lb/MMscf) | PEF Equiv. | Weighted EF NG (lb/MMscf) |
|---|---|---|---|---|---|---|
| Benzo(a)anthracene | 5.03E-05 | 0.1 | 5.03E-06 | 5.88E-05 | 0.1 | 5.88E-06 |
| Benzo(a)pyrene | 1.81E-05 | 1 | 1.81E-05 | 2.70E-06 | 1 | 2.70E-06 |
| Benzo(b)fluoranthene | 7.96E-05 | 0.1 | 7.96E-06 | 4.09E-05 | 0.1 | 4.09E-06 |
| Benzo(k)fluoranthene | 1.56E-05 | 0.1 | 1.56E-06 | 7.83E-06 | 0.1 | 7.83E-07 |
| Chrysene | 1.06E-04 | 0.01 | 1.06E-06 | 1.43E-05 | 0.01 | 1.43E-07 |
| Dibenz(a,h)anthracene | 2.43E-05 | 1.05 | 2.55E-05 | 2.70E-06 | 1.05 | 2.84E-06 |
| Indeno(1,2,3-cd)pyrene | 2.89E-05 | 0.1 | 2.89E-06 | 7.17E-06 | 0.1 | 7.17E-07 |

**Table B-18**
**Annual and Maximum Hourly HAP Emissions**
**Case 3: Biodiesel Only**

| Pollutant | Biodiesel Emission Factor (1) lb/Mgal | Controlled Biodiesel Em Factor (2) lb/Mgal | Hourly Emissions per Engine, Biodiesel Firing (4) lb/hr | Annual Emissions per Engine Biodiesel Firing (5) tpy | Total Annual Emissions, all Engines Biodiesel Firing (5) tpy |
|---|---|---|---|---|---|
| Ammonia | (3) | n/a | 1.15 | 3.5 | 20.7 |
| Propylene | 3.85E-01 | 2.31E-01 | 0.10 | 0.3 | 1.90 |
| Hazardous Air Pollutants | | | | | |
| Acetaldehyde | 3.47E-03 | 2.08E-03 | 9.13E-04 | 2.9E-03 | 0.02 |
| Acrolein | 1.07E-03 | 6.42E-04 | 2.81E-04 | 8.8E-04 | 0.01 |
| Benzene | 1.01E-01 | 6.06E-02 | 2.66E-02 | 8.3E-02 | 0.50 |
| Ethylbenzene | 6.76E-03 | 4.06E-03 | 1.78E-03 | 5.6E-03 | 0.03 |
| Formaldehyde | n/a | 2.07E-01 | 9.07E-02 | 0.28 | 1.70 |
| Hexane | 1.39E-03 | 8.34E-04 | 3.66E-04 | 1.1E-03 | 0.01 |
| Naphthalene | 1.63E-02 | 9.78E-03 | 4.29E-03 | 1.3E-02 | 0.08 |
| PAHs (as B(a)P) (6) | 6.21E-05 | 3.73E-05 | 1.63E-05 | 5.1E-05 | 0.00 |
| Toluene | 3.74E-02 | 2.24E-02 | 9.84E-03 | 3.1E-02 | 0.18 |
| Xylene | 2.68E-02 | 1.61E-02 | 7.05E-03 | 2.2E-02 | 0.13 |
| Total HAPs | | | | | 2.66 |

Notes:

(1) All factors except formaldehyde are CATEF mean values for large Diesel engines (SCC 20200102 or 20300101).
https://www.arb.ca.gov/app/emsinv/catef_form.html
Formaldehyde based on RICE NESHAP limit for CI engines (580 ppb).

(2) 40% control efficiency for oxidation catalyst applied for all TACs except formaldehyde. Source: BAAQMD PDOC for Eastshore Energy Center, April 30, 2007. Formaldehyde emission factor is RICE NESHAP limit for diesel engines.

(3) Based on 10 ppm ammonia slip from SCR system.

(4) Based on maximum ICE firing rate of 67.0 MMBtu/hr and default fuel HHV of 138,000 Btu/gal for biodiesel fuel
0.44 Mgal/hr per engine

(5) Based on maximum ICE firing rate (from (4)) for 100% biodiesel fuel.
2,740 Mgal/yr per engine

(6) Emission factors for individual PAHs weighted by cancer risk relative to B(a)P and summed to obtain overall B(a)P equivalent emission rate for HRA.

| | Mean EF Diesel | PEF Equiv. | Weighted EF Diesel |
|---|---|---|---|
| PAHs (as B(a)P) | | | |
| Benzo(a)anthracene | 5.03E-05 | 0.1 | 5.03E-06 |
| Benzo(a)pyrene | 1.81E-05 | 1 | 1.81E-05 |
| Benzo(b)fluoranthene | 7.96E-05 | 0.1 | 7.96E-06 |
| Benzo(k)fluoranthene | 1.56E-05 | 0.1 | 1.56E-06 |
| Chrysene | 1.06E-04 | 0.01 | 1.06E-06 |
| Dibenz(a,h)anthracene | 2.43E-05 | 1.05 | 2.55E-05 |
| Indeno(1,2,3-cd)pyrene | 2.89E-05 | 0.1 | 2.89E-06 |

# Appendix C

# Air Dispersion Modeling Report

## Summary of Modeling Results: Maximum Impacts

| Pollutant | Averaging Period | Design Concentration[a] | Modeled Concentration (μg/m³) | Total Impact (μg/m³) | SIL[b] (μg/m³) | Above SIL? |
|---|---|---|---|---|---|---|
| $PM_{10}$ | 24-hr | H1H | 17.3 | 17.3 | 5.0 | Yes |
| | Annual | H1H | 1.56 | 1.56 | 1.0 | Yes |
| $PM_{2.5}$ | 24-hr | H1H | 17.3 | 17.6 | 1.2 | Yes |
| | Annual | H1H | 1.56 | 1.58 | 0.2 | Yes |
| $SO_2$ | 1-hr | H1H | 0.92 | 0.92 | 7.8 | No |
| | 3-hr | H1H | 0.65 | 0.65 | 25.0 | No |
| | 24-hr | H1H | 0.48 | 0.48 | 5.0 | No |
| | Annual | H1H | 0.04 | 0.04 | 1.0 | No |
| $NO_2$ | 1-hr | H1H | 142 | 142 | 7.5 | Yes |
| | Annual | H1H | 4.23 | 4.2 | 1.0 | Yes |
| CO | 1-hr | H1H | 57.8 | 58 | 2000 | No |
| | 8-hr | H1H | 34.7 | 34.7 | 500 | No |

Notes:

a. H1H: highest first high
b. SIL: significant impact level

## Modeling Results – Maximum Total Impacts (Biodiesel)

| Pollutant | Averaging Period | Design Concentration[a] | Modeled Concentration (μg/m³) | Background Concentration (μg/m³) | Total Impact (μg/m³) | NAAQS (μg/m³) | Above NAAQS? | State Standard (μg/m³) | Above State Standard? |
|---|---|---|---|---|---|---|---|---|---|
| $PM_{10}$ | 24-hr | H2H | 16.60 | 48.0 | 64.6 | 150 | No | 150 | No |
| | Annual | Average | 1.56 | 16.5 | 18.1 | -- | -- | 50 | No |
| $PM_{2.5}$ | 24-hr | H8H | 11.71 | 11.7 | 23.7 | 35 | No | -- | -- |
| | Annual | Average | 1.56 | 4.2 | 5.8 | 12 | No | -- | -- |
| $SO_2$ | 1-hr | H4H | 0.74 | 21.0 | 21.7 | 196 | No | -- | -- |
| | 3-hr | H2H | 0.58 | 13.1 | 13.7 | -- | -- | 1,300 | No |
| | 24-hr | H2H | 0.46 | 7.9 | 8.3 | -- | -- | 365 | No |
| | Annual | Average | 0.04 | 2.6 | 2.7 | -- | -- | 80 | No |
| $NO_2$ | 1-hr | H8H | 126.61 | 50.8 | 177.4 | 188 | No | -- | -- |
| | Annual | Average | 4.23 | 5.6 | 9.9 | 100 | No | 70 | No |
| CO | 1-hr | H2H | 52.49 | 1,035.0 | 1087.5 | 40,000 | No | 10,000 | No |
| | 8-hr | H2H | 32.94 | 690.0 | 722.9 | 10,000 | No | 5,000 | No |

Notes:

a. H2H: highest second high
   H8H: highest eight high
   H4H: highest fourth high

**Screening HRA**
**Acute Impacts**
**Case 3: Biodiesel Only**

| | Acute Impacts, 1-hr Avg | | | Acute Impacts, 8-hr Avg | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pollutant | 1-hour modeled impact, ug/m3 | 1-Hour REL, ug/m3 (1) | 1-hour impact > REL? | 8-hour modeled impact, ug/m3 | 8-hour REL, ug/m3 (1) | 8-hour impact > REL? | MW (g/mol) | TWA-TLV (8-hour basis) (2), ppm | TWA-TLV (8-hour basis), ug/m3 | 1/100 x TWA-TLV | 8-hour impact> 1/100 x TWA/TLV? |
| Ammonia | | | | | | | | | | | |
| Propylene | | | | | | | | | | | |
| | | | | | | | | | | | |
| Acetaldehyde | 8.10E-03 | 470 | no | 4.9E-03 | 300 | no | n/a | n/a | n/a | n/a | n/a |
| Acrolein | 2.50E-03 | 2.5 | no | 1.5E-03 | 0.7 | no | n/a | n/a | n/a | n/a | n/a |
| Benzene | 0.24 | 27 | no | 1.4E-01 | 3 | no | 78.11 | 0.5 | 1,597 | 16 | no |
| Ethylbenzene | 1.58E-02 | 660 | no | 9.5E-03 | 9 | no | 106.20 | 20 | 86,869 | 869 | no |
| Formaldehyde | 0.81 | n/a | n/a | 4.8E-01 | n/a | n/a | 30.03 | 0.1 | 123 | 1 | no |
| Hexane | 3.25E-03 | 55 | no | 1.9E-03 | 9 | no | 86.18 | 50 | 176,234 | 1762.34 | no |
| Naphthalene | 3.81E-02 | n/a | n/a | 2.3E-02 | n/a | n/a | 128.17 | 10 | 52,421 | 524 | no |
| PAHs (as B(a)P) (6) | 1.45E-04 | n/a | n/a | 8.7E-05 | n/a | n/a | 252.31 | 0.2 | 2,064 | 21 | no |
| Toluene | 8.73E-02 | 5000 | no | 5.2E-02 | 830 | no | 92.13 | 20 | 75,362 | 754 | no |
| Xylene | 6.26E-02 | 22000 | no | 3.8E-02 | n/a | n/a | 106.16 | 100 | 434,192 | 4342 | no |
| Total HAPs | | | | | | | | | | | |

**Screening HRA**
**Chronic and Cancer Impacts**
**Case 3: Biodiesel Only**

| | Chronic Impacts | | | | | | Cancer Risk | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | Annual Emission Rate, g/s (all engines) | Annual impact, ug/m3 | Annual REL, ug/m3 (1) | Annual Impact > REL? | 1/420 x TWA/TLV | Annual Impact > 1/420 x TWA/TLV? | Unit Risk, per µg/m3 (3,4) | Cancer Risk x10E-6 |
| Ammonia | | | | | | | | |
| Propylene | | | | | | | | |
| | | | | | | | | |
| Acetaldehyde | 4.92E-04 | 3.68E-04 | 140 | no | n/a | n/a | 2.20E-06 | 8.10E-04 |
| Acrolein | 1.52E-04 | 1.14E-04 | 0.35 | no | n/a | n/a | n/a | n/a |
| Benzene | 1.43E-02 | 1.07E-02 | 3 | no | 4 | no | 7.80E-06 | 0.08 |
| Ethylbenzene | 9.59E-04 | 7.18E-04 | 2 | no | 207 | no | 3.50E-05 | 0.03 |
| Formaldehyde | 4.89E-02 | 3.66E-02 | 2000 | no | 0.29 | no | 2.60E-06 | 0.10 |
| Hexane | 1.97E-04 | 1.48E-04 | 9 | no | 420 | no | 1.30E-05 | 1.92E-03 |
| Naphthalene | 2.31E-03 | 1.73E-03 | 9 | no | 125 | no | 3.40E-05 | 0.06 |
| PAHs (as B(a)P) (6) | 8.81E-06 | 6.59E-06 | n/a | n/a | 5 | no | 6.40E-04 | 4.22E-03 |
| Toluene | 5.31E-03 | 3.97E-03 | 420 | no | 179 | no | n/a | n/a |
| Xylene | 3.80E-03 | 2.85E-03 | 700 | no | 1034 | no | n/a | n/a |
| Total HAPs | | | | | | | | 0.3 in one million |

# Appendix D

## Best Available Control Technology Analysis

Best Available Control Technology (BACT) is defined in HDOH regulations as follows:

> *...an emissions limitation...based on the maximum degree of reduction for each pollutant ...which the Administrator, on a case by case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable...through the application of production processes or available methods, systems, and techniques...*

In no event can the application of BACT result in emissions of any pollutant that would exceed the level allowed by an applicable NSPS or NESHAP.

The BACT analyses presented in this report are based on a "top down" approach consistent with the 1990 draft New Source Review Workshop Manual (EPA, 1990). In the top-down methodology, control technology alternatives are identified through knowledge of the industry and previous regulatory decisions for other identical or similar sources. These alternatives are then ranked by stringency into a control technology hierarchy. The hierarchy is evaluated starting with the "top," or most stringent alternative, to determine economic, environmental, and energy impacts. If the top control alternative is not applicable, technically infeasible, or is economically infeasible, it is rejected as BACT and the next most stringent alternative is then considered. This process continues until a control alternative is determined to be both technically and economically feasible, thereby defining the emission level corresponding to BACT for the pollutant. The BACT analysis for each pollutant is discussed in the following sections for the eleven proposed Wärtsilä 20V34DF units.[1]

**Steps in a Top-Down BACT Analysis**

**<u>Step 1 – Identify All Possible Control Technologies</u>**

The first step in a top-down analysis is to identify, for the emissions unit and pollutant in question, all available control options. Available control options are those air pollution control technologies or techniques, including alternate basic equipment or processes, with a practical potential for application to the emissions unit in question. The control alternatives should include not only existing controls for the source category in question, but also, through technology transfer, controls applied to similar source categories and gas streams.

BACT must be at least as stringent as what has been achieved in practice (AIP) for a category or class of source. Additionally, EPA guidelines require that a technology that is determined to be AIP for one category of source be considered for transfer to other source categories. There are two types of potentially transferable control technologies: (1) exhaust stream controls, and (2) process controls and modifications. For the first type,

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[1] Although not require by DOH regulations, the emergency generator and emergency fire pump engine are designed to meet BACT requirements as well.

technology transfer must be considered between source categories that produce similar exhaust streams; for the second type, technology transfer must be considered between source categories with similar processes.

Candidate control options that do not meet basic project requirements (i.e., alternative basic designs that "redefine the source") are eliminated at this step.

<u>Step 2 – Eliminate Technologically Infeasible Options</u>

To be considered, the candidate control option must be technologically feasible for the application being reviewed.

<u>Step 3 – Rank Remaining Control Options by Control Effectiveness</u>

All feasible options are ranked in the order of decreasing control effectiveness for the pollutant under consideration. In some cases, a given control technology may be listed more than once, representing different levels of control. Any control option less stringent than what has been already achieved in practice for the category of source under review must also be eliminated at this step.

<u>Step 4 – Evaluate Most Effective Control Technology Considering Environmental, Energy, and Cost Impacts</u>

To be required as BACT, the candidate control option must be cost effective, considering energy, environmental, economic, and other costs. The most stringent control technology for control of one pollutant may have other undesirable environmental or economic impacts. The purpose of Step 4 is to either validate the suitability of the top control option or provide a clear justification as to why that option should not be selected as BACT.

Once all of the candidate control technologies have been ranked, and other impacts have been evaluated, the most stringent candidate control technology is deemed to be BACT, unless the other impacts are unacceptable.

<u>Step 5 – Determine BACT/Present Conclusions</u>

BACT is determined to be the most effective control technology subject to evaluation, and not rejected as infeasible or having unacceptable energy, environmental, or cost impacts.

**BACT Analysis for the Wärtsilä Engine Generators: Normal Operations**

<u>$NO_X$</u>

BACT must be at least as stringent as the applicable NSPS. The applicable NSPS limits are discussed in Section 4.9.

***Identify All Possible Control Technologies***

Potential methods for controlling $NO_X$ emissions from the proposed units, listed in order of most to least effective (i.e., the top-down approach) are summarized below.

Selective Catalytic Reduction (SCR) – SCR is a post-combustion $NO_X$ control technology (i.e., it treats the exhaust gas downstream of the combustion source). SCR controls $NO_X$ emissions by injecting ammonia ($NH_3$) into the exhaust gas upstream of a catalyst bed. On the catalyst surface, the $NH_3$ reacts with $NO_X$ to form molecular nitrogen and water vapor. The general chemical reactions are as follows:

$$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$$

$$2NO_2 + 4NH_3 + O_2 \rightarrow 3N_2 + 6H_2O$$

$$NO + NO_2 + 2NH_3 \rightarrow 2N_2 + 3H_2O$$

Selective Non-Catalytic Reduction (SNCR) – SNCR is a post-combustion control technology that involves injecting ammonia or urea into regions of the exhaust with temperatures greater than 1400–1500 degrees Fahrenheit. The nitrogen oxides in the exhaust are reduced to nitrogen and water vapor. Additional fuel is required to heat the engine exhaust to the correct operating temperature. Heat recovery from the engine exhaust can limit the additional fuel requirement and concurrent additional emissions from heating exhaust gases. Temperature is the operational parameter affecting the reaction, as well as degree of contaminant mixing with reagent and residence time.

Engine Design – Engine manufactures have developed various methods to minimize the formation of $NO_X$ through the use of the following:

- Fuel injection timing retard (FITR),
- Turbocharging combined with intake air aftercooling, and
- Computerized fuel and combustion air management.

Alternative Basic Equipment:

- Gas turbines (simple cycle or combined cycle)
- Boilers
- Renewable Energy Source (e.g., solar, wind, etc.)

It should be noted that the use of any of these alternative generating technologies in lieu of the proposed reciprocating engines would "redefine the source."

Renewable energy facilities require significantly more land to construct and need to be located in areas with very specific characteristics. Wind and solar facilities have power generation profiles that cannot match demand; conventional power plants are needed in order to follow demand. The capital costs for wind or solar facilities are substantially higher than for a comparable conventional facility, making financing of such a project significantly different. Finally, one of the fundamental objectives of the proposed project is to provide baseload capacity when needed, making the use of renewable energy for the project fundamentally incompatible with the project objective. Nonetheless, these alternative generating technologies are carried forward to Step 2.

***Eliminate Technologically Infeasible Options; Rank Remaining Control Technologies by Control Effectiveness; Evaluate the Most Effective Control Technology***

Exhaust Stream Controls

SCR is the only method that can control emissions below the applicable NSPS $NO_X$ limits. The proposed units will be equipped with SCR to control $NO_X$ emissions. Since SCR is the most effective method, no additional steps in the top-down approach are required.

A search of the EPA RACT/BACT/LAER Clearinghouse (RBLC) in July 2024 starting with calendar year 2014 identified only two permits[2] for similar-sized, liquid-fueled compression ignition internal combustion engines (CI ICE) with a displacement of greater than or equal to 30 liters per cylinder and subject to NSPS Subpart IIII: one for the Dutch Harbor Power Plant and another for the Donlin Gold Project. In addition, although not in the RBLC, the Humboldt Bay Repowering Project (HBRP) in Eureka, CA, obtained a PSD permit in 2008. The Dutch Harbor Power Plant units were scheduled to be installed in the second phase of the project; however, the second phase of the project was revised and different units with displacement of less than 30 liters per cylinder were installed.[3] The Donlin Gold Project units are 12 Wärtsilä 18V50DF diesel/LNG fired ICE; HBRP consists of ten Wärtsilä 18V50DF engines fueled primarily on natural gas with diesel backup. The permitted BACT NOx limits for both projects are as follows:

Liquid fuel – 0.53 g/$kW_e$-hr, and

RNG – 0.08 g/$kW_e$-hr.

Appendix Table D-1 contains the results of the RBLC search listed in order of most to least stringent $NO_X$ limits.

Alternative Basic Technology

*Simple-Cycle and Combined-Cycle Gas Turbines*

The use of simple-cycle gas turbines instead of the proposed reciprocating IC engines would be technically feasible but less efficient. Multiple smaller fast-starting engines are needed to effectively handle variable loads and perform multiple startups/shutdowns per day. While reciprocating engines have a relatively flat heat rate curve across their load range, gas turbines experience a degradation in efficiency at lower loads. Efficiency vs. load is illustrated in Figure D-1.[4]

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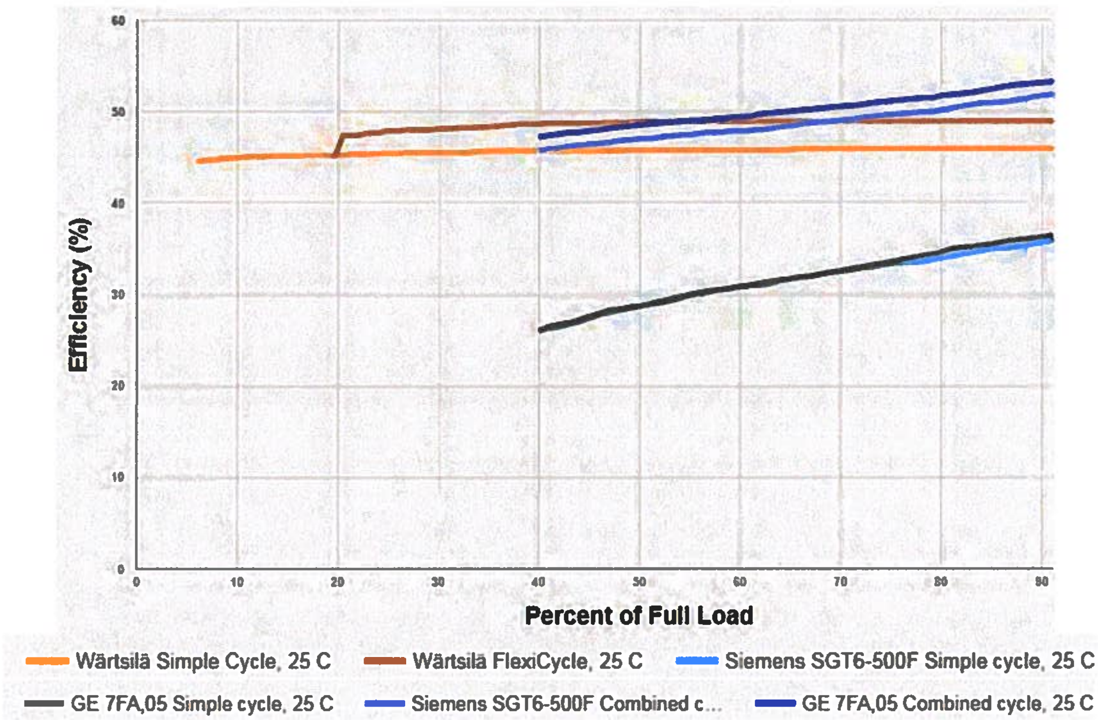
[2] Permit No. AQ0934CPT01 issued June 30, 2017 for the Donlin Gold Project, located 12 miles north of Crooked Creek, Alaska and Permit No. AQ0215CPT02 issued January 31, 2007 for the Dutch Harbor Power Plant, City of Unalaska, Alaska.

[3] Permit No. AQ0215MSS03 issued November 28, 2012 and Permit No. AQ0215MSS04 issued November 24, 2014 for the Dutch Harbor Power Plant, City of Unalaska, Alaska.

[4] Wärtsilä, Combustion Engine vs. Gas Turbine: Part Load Efficiency and Flexibility, available at https://www.wartsila.com/energy/learning-center/technical-comparisons/combustion-engine-vs-gas-

Combined-cycle turbines might be technically feasible for the project, but may not meet the project objectives. Multiple smaller fast-starting engines are needed to effectively handle variable loads and to more effectively allow the host utility to utilize more of the intermittent renewable energy from solar projects. While advanced combined-cycle turbines can start relatively quickly (within approximately 12 minutes to reach 100% rated capacity of the gas turbine generator), they may need as much as 2 hours to reach full combined-cycle output (combined output of gas turbine and steam turbine generators).[5] When operating in simple-cycle mode (while waiting for the steam system to warm up), fast-start combined-cycle units will have efficiencies that are no better than, and potentially worse than, those achieved with the Wärtsilä engines. In addition, advanced combined-cycle gas turbines require a large auxiliary steam source to achieve fast startup times. This steam must be provided by an auxiliary boiler, which is not currently part of the project and would be an additional source of emissions.

**Figure D-1. Part Load Efficiency for Gas Turbines and Reciprocating Engines**




Therefore, simple-cycle turbines are eliminated because they cannot operate through the load range without significant efficiency impacts. Combined-cycle turbines are eliminated for similar reasons.

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turbine-part-load-efficiency-and-flexibility. "25 C" refers to ambient temperature at which the comparison is made.

[5] El Segundo Energy Center LLC, 00-AFC-014C: Petition to Amend, 4/23/13, Section 2.2.7

*Solar Thermal and Solar Photovoltaic (PV)*

Solar thermal facilities collect solar radiation, then heat a working fluid (water or a hydrocarbon liquid) to create steam to power a steam turbine generator. Solar PV facilities use solar energy and arrays of photovoltaic panels to generate electricity directly. All solar thermal and utility-scale solar PV facilities require considerable land for the collection field and are best located in areas of high solar incident energy per unit area. In addition, power is generated only while the sun shines, so the units do not supply power at night or on cloudy days. The project parcel is not sufficiently large to be feasible for a commercial solar power plant. Furthermore, a solar power plant would not meet the project's objective of providing firm power that is available when needed and flexible generation capacity to support increased penetration of intermittent renewable generating resources. For these reasons, a solar thermal or solar PV power plant is rejected as BACT for this application.

*Wind*

Wind power facilities use a wind-driven rotor to turn a generator to generate electricity. Like solar thermal and utility-scale solar PV facilities, wind power facilities require considerable land area. Even in prime locations the wind does not blow continuously, so power is not always available. Due to limited available space on the project parcel, limited dependability, and relatively high cost, this technology is not feasible for this project. Furthermore, a wind power plant would not meet the project's objective of providing firm power that is available when needed and flexible generation capacity to support increased penetration of intermittent renewable generating resources. For these reasons, a wind power plant is rejected as BACT for this application.

***Determine BACT/Present Conclusions***

The proposed BACT $NO_X$ limits shown below are based on the manufacturer's guaranteed $NO_X$ emission rate at full load.

Biodiesel – 35 ppmc (0.52 g/$kW_e$-hr) at full load
RNG – 6 ppmc (0.08 g/$kW_e$-hr) at full load

These $NO_X$ limits are below the applicable NSPS $NO_X$ limits and are consistent with previous BACT $NO_X$ limits for CI ICE identified. Therefore, these limits satisfy HDOH's definition of BACT.

**PM/$PM_{10}$/$PM_{2.5}$**

BACT must be at least as stringent as the applicable NSPS. The applicable PM NSPS limit is discussed in Section 4.10.1.

*Identify All Possible Control Technologies*

Potential methods for controlling $PM/PM_{10}/PM_{2.5}$ emissions from the proposed units listed in order of most to least effective (i.e., the top-down approach) are outlined below.

Electrostatic Precipitator (ESP) – An ESP is a post-combustion control technology (i.e., it treats the exhaust gas downstream of the combustion source) that reduces PM emissions.

Diesel Particulate Filter (DPF) – A DPF is a device that removes post-combustion PM emissions from the exhaust gas.

Diesel Oxidation Catalyst – Catalytic oxidation using a diesel oxidation catalyst reduces the organic fraction of particulate emissions.

Combustion Design and Practices – Good combustion design and combustion practices are employed to minimize the formation of $PM/PM_{10}/PM_{2.5}$ emissions.

Low Sulfur Liquid Fuels – The formation of secondary $PM_{2.5}$ from sulfates is directly related to the fuel sulfur content. Therefore, lowering the fuel sulfur content reduces secondary $PM_{2.5}$ emissions from sulfates.

Alternative basic equipment—including renewable energy sources, such as solar and wind—has also been identified as a potential option for the control of $PM/PM_{10}/PM_{2.5}$ emissions. Such alternative basic equipment was already discussed above (Steps 1 and 2 for $NO_X$ BACT). For the same reasons discussed above for $NO_X$, solar, wind, and other renewable energy sources are rejected as $PM/PM_{10}/PM_{2.5}$ BACT for this application.

***Eliminate Technologically Infeasible Options; Rank Remaining Control Technologies by Control Effectiveness; Evaluate the Most Effective Control Technology Considering Environmental, Energy, and Cost Impacts***

In EPA's response to comments[6] on the initial PM NSPS Subpart IIII standards, EPA stated:

> *...EPA agrees in general with the comments regarding the proposed emission limitation for PM. The final rule has been written considering the comments received and requires 60 percent PM reduction or an emission limit of 0.15 g/kW-hr (0.11 g/ HP-hr). EPA believes the PM standard will be achievable through the use of lower sulfur fuel, on-engine controls, and aftertreatment EPA believes that the PM percent reduction requirement is feasible through application of ESP...*

However, a search of the RBLC in August 2022 starting with calendar year 2000 did not identify any application of an ESP on similar units. Appendix Table D-2 contains the results of the RBLC search listed in order of most to least stringent $PM/PM_{10}/PM_{2.5}$

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[6] 71 FR 39167, July 11, 2006

limits. Supporting information[7] contained in EPA's initial NSPS Subpart IIII docket (EPA-HQ-OAR-2005-0029) did not identify any similar stationary sources located in the U.S. that use an ESP to control PM emissions. However, this information identified the following stationary sources outside the US:

Two facilities in Korea (five engines),
One facility in India (three engines), and
One facility in Barbados (two engines).

No additional information was provided on the size of these units or the fuel they burned. Outside of the U.S., it is not uncommon to operate similar large CI ICE on heavy fuel oil (e.g., fuel oil no. 5 and/or 6).

Additionally, this supporting information contained a cost evaluation of using an ESP to control PM. EPA's consultant calculated an average cost of $76,880 per ton of PM removed for similar units (i.e., Wärtsilä 12V32 and 12V46). Therefore, an ESP is not cost effective and is rejected as BACT based on cost.

The next most effective PM control is a DPF. As part of the development of NSPS Subpart IIII, EPA concluded that it is infeasible to install a DPF on CI ICE with a displacement of greater than or equal to 30 liters per cylinder.[8] A review of more recent vendor data shows that DPFs are limited to applications up to approximately 4 MW.[9] The proposed units have a displacement of greater than or equal to 30 liters per cylinder and are larger than 4 MW. Therefore, DPFs are infeasible and do not represent BACT for this project.

The next most effective PM control is catalytic oxidation. The Donlin Gold Project received a permit in 2017 for twelve 17-MW Wärtsilä 18V50DF diesel/LNG fired ICEs; HBRP permitted ten Wärtsilä 18V50DF diesel/natural gas fired ICE. The permitted PM BACT limits for both projects are as follows:

PM, $PM_{10}$, $PM_{2.5}$ – 0.29 g/$kW_e$-hr (full load, diesel fuel) and
PM, $PM_{10}$, $PM_{2.5}$ – 0.13 g/$kW_e$-hr (full load, natural gas).

Hawaiian Electric received a permit for the installation of six Wärtsilä 20V34DF CI ICE with a displacement of greater than or equal to 30 liters per cylinder and subject to NSPS Subpart IIII. The PM/$PM_{10}$/$PM_{2.5}$ BACT determination has not been added to the RBLC. The permitted PM and $PM_{10}$/$PM_{2.5}$ BACT limits when firing diesel/biodiesel are as follows:

$PM_{10}$/$PM_{2.5}$ – 0.27 g/$kW_e$-hr and 4.95 lb/hr (full load).

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[7] Memorandum from Bradley Nelson, Alpha-Gamma Technologies, Inc. to Jaime Pagan, EPA Energy Strategies Group, dated May 22, 2006. Re: Emission Standards for Engines with a Displacement of ≥30 Liters per Cylinder (EPA-HQ-OAR-2005-0029-0274)

[8] 70 FR 39884, July 11, 2005

[9] http://www.miratechcorp.com/fa-content/uploads/2014/09/MIRATECH_LTR_9-16-14.pdf

These emissions limits apply at all times. Hawaiian Electric is using the combination of catalytic oxidation, combustion design, good combustion practices, and the use of diesel, biodiesel, and diesel/biodiesel blends with a maximum sulfur content of 42 ppm to meet the BACT limits.

As discussed above, solar, wind and other renewable energy alternatives are not considered technologically feasible for this application.

***Determine BACT/Present Conclusions***

The project will use a combination of catalytic oxidation, combustion design, good combustion practices, and the use of liquid (renewable diesel) and RNG fuels with a maximum sulfur content of 15 ppm as BACT for $PM/PM_{10}/PM_{2.5}$. Therefore, no further control analysis is required. The proposed BACT PM limits are as follows:

> 3.61 lb/hr (0.22 $g/kW_e$-hr), at full load on liquid fuel, and
> 1.61 lb/hr (0.10 $g/kW_e$-hr), at full load on RNG.

These proposed limits are based on the manufacturer's guaranteed $PM_{10}$ and $PM_{2.5}$ emission rate at full load. The proposed $PM_{10}/PM_{2.5}$ limits are lower than the previous BACT $PM_{10}/PM_{2.5}$ limits identified. Therefore, these proposed limits satisfy the CAA's definition of BACT.

<u>VOC and CO</u>

***Identify All Possible Control Technologies***

Potential methods for controlling VOC and CO emissions from the proposed units, listed in order of most to least effective (i.e., the top-down approach), are outlined below.

<u>Catalytic Oxidation</u> - Catalytic oxidation is a post-combustion control technology (i.e., it treats the exhaust gas downstream of the combustion source) that reduces VOC, CO, and PM emissions. CO emissions are oxidized to $CO_2$, and VOC emissions are oxidized to $CO_2$ and water vapor.

<u>Engine Design</u> - Engine manufactures have developed various methods to minimize the VOC emissions through the use of:

- FITR,
- Turbocharging combined with intake air aftercooling, and
- Computerized fuel and combustion air management.

Alternative basic equipment - The use of alternative basic equipment—including renewable energy sources, such as solar and wind—has also been identified as a potential option for the control of VOC and CO emissions. Such alternative basic equipment was already discussed above (Steps 1 and 2 for $NO_X$ BACT). For the same reasons discussed above for $NO_X$, solar, wind and other renewable energy sources are rejected as VOC and CO BACT for this application.

*Eliminate Technologically Infeasible Options; Rank Remaining Control Technologies by Control Effectiveness; Evaluate the Most Effective Control Technology Considering Environmental, Energy, and Cost Impacts*

Appendix Table D-3 contains the results of the VOC and CO RBLC search conducted in August 2022, starting with calendar year 2000 and listed in order of most to least stringent VOC limits. The BACT VOC and CO limits for the 17 MW Wärtsilä 18V50DF engines at Donlin Gold Project when firing on diesel fuel are as follows:

VOC – 0.21 $g/kW_e$-hr at full load, and
CO – 0.18 $g/kW_e$-hr at full load.

Listed below are the BACT VOC and CO limits for the same engines when fired on LNG fuel.

VOC – 0.09 $g/kW_e$-hr at full load
CO – 0.12 $g/kW_e$-hr at full load

The Donlin Gold Project is using the combination of an oxidation catalyst and good combustion practices to meet the BACT limits.

As discussed above, solar, wind and other renewable energy alternatives are not considered technologically feasible for this application.

*Determine BACT/Present Conclusions*

The project will use a combination of combustion design, good combustion practices, and an oxidation catalyst as BACT for VOC and CO. Since catalytic oxidation is the most effective method, no additional steps are required and the proposed VOC and CO controls represent BACT.

The proposed BACT VOC limits of 3.44 lb/hr (liquid fuel; 0.21 $g/kW_e$-hr at full load) and 2.00 lb/hr (RNG; 0.12 $g/kW_e$-hr at full load) are based on the manufacturer's guaranteed VOC emission rates at full load. The proposed BACT CO limit of 3.01 lb/hr (liquid fuel; 0.18 $g/kW_e$-hr at full load) and 2.02 lb/hr (RNG; 0.12 $g/kW_e$-hr at full load) are based on the manufacturer's guaranteed CO emission rates at full load. These limits are consistent with previous BACT CO and VOC limits identified. Therefore, these limits satisfy the CAA's definition of BACT.

<u>Greenhouse Gases (GHGs)</u>

*Identify All Possible Control Technologies*

EPA's 2011 guidance document "PSD and Title V Permitting Guidance for Greenhouse Gases" (EPA, 2011b) specifies that the following types of controls must be considered in determining BACT for GHGs:

- Inherently lower-emitting processes/practices/designs,
- Add-on controls, and

- Combinations of inherently lower emitting processes/practices/designs and add-on controls.

EPA's guidance recognizes that inherently lower polluting processes that fundamentally redefine the nature of the source proposed by the permit applicant can be eliminated for the list of available controls. EPA's guidance states:

> *In assessing whether an option would fundamentally redefine a proposed source, EPA recommends that permitting authorities apply the analytical framework recently articulated by the Environmental Appeals Board. Under this framework, a permitting authority should look first at the administrative record to see how the applicant defined its goal, objectives, purpose, or basic design for the proposed facility in its application.* (EPA, 2011b).

Ameresco selected the Wärtsilä 20V34DF CI ICE as the best method to meet the following objectives of the needed generation:

- Quick starting,
- Extremely efficient IC engine technology,
- Firm power (available when needed),
- Fuel flexibility, and
- Flexible generation capacity to support increased penetration of intermittent renewable generating resources.

Table D-1 lists the potential GHG emissions control options and discusses their feasibility and compatibility with the objectives of the proposed project.

<u>Alternative Basic Equipment:</u>

- Gas turbines (simple cycle or combined cycle)
- Boilers
- Renewable Energy Source (e.g., solar, wind, etc.)

It should be noted that the use of any of these alternative generating technologies in lieu of the proposed reciprocating engines would "redefine the source."

Renewable energy facilities require significantly more land to construct and need to be located in areas with very specific characteristics. Wind and solar facilities have power generation profiles that cannot match demand; conventional power plants are needed in order to follow demand. The capital costs for wind or solar facilities are substantially higher than for a comparable conventional facility, making financing of such a project significantly different. Lastly, one of the fundamental objectives of the proposed project is to provide baseload capacity, making the use of renewable energy for the project fundamentally incompatible with the project objective. Nonetheless, these alternative generating technologies are carried forward to Step 2.

**Table D-1. Evaluation of GHG Emissions Control Options**

| GHG Control Option | Heat Rate Range (HHV Basis) | Fundamentally Redefines the Nature of the Source Proposed by the Permit Applicant? |
|---|---|---|
| Nuclear Generation | Not Applicable | Yes – Nuclear generation is best suited for base loaded units, while the proposed project requires load following. |
| Renewable Energy Sources (Wind, Solar, Hydro) | Not Applicable | Yes – The project requires firm generation that can help to integrate intermittent renewable resources such as wind and solar. Hydroelectric power is not a viable alternative. |
| Low Carbon Fuels (Natural Gas) | Proposed | No – This is already a project feature. Project is designed to utilize RNG as much as possible. |
| Carbon Capture and Storage (CCS) | Not Applicable | No. |
| Combined-Cycle Gas Turbines | ~7,000 to 8,000 Btu/kWh | No – Combined-cycle gas turbines do not offer the generation flexibility of 11 RICE engines. |
| RICE | ~7,500 to 8,600 Btu/kWh | No – Currently proposed. |
| Simple-Cycle Gas Turbines | ~8,700 to 10,000 Btu/kWh | No. |
| Boilers | >10,000 Btu/kWh | Yes – Cannot meet the quick start requirements of the project. Also, boilers are less efficient than the proposed engines, and thus would be rejected under Step 3. |

***Eliminate Technologically Infeasible Options; Rank Remaining Control Technologies by Control Effectiveness; Evaluate the Most Effective Control Technology Considering Environmental, Energy, and Cost Impacts***

As shown in Table D-1, the only potential GHG emissions controls for the proposed generating units, other than the selected use of RICE generators, is switching exclusively to a lower carbon fuel (i.e., natural gas) or adding carbon capture and storage (CCS). Switching to 100% natural gas would reduce GHG emissions by approximately 27%; however, renewable natural gas is currently not available on Maui in the quantity needed for the proposed project. For this reason, the project is designed to utilize RNG to the extent possible, with biodiesel as an alternate fuel. While alternative basic technology (simple- and combined-cycle gas turbines) would not fundamentally redefine the nature of the project, both simple-cycle and combined-cycle gas turbines are less efficient at lower loads, and combined-cycle gas turbines do not meet the basic project requirements related to quick start capability, as discussed above.

A search of the RBLC in July 2024 identified three permits for CI ICE in the proposed size range used for power generation. The BACT GHG emission limits for the Donlin Gold Project when firing on diesel fuel and on LNG are as follows:

- Diesel – 1,299,630 tpy $CO_2e$ (equivalent to 657 g/$kW_e$-hr and 1448 lb/MW-hr), and
- LNG – 869,621 tpy $CO_2e$ (equivalent to 440 g/$kW_e$-hr and 969 lb/MW-hr).[10]

The RBLC lists two additional projects consisting of multiple 18.8 MW Wärtsilä RICE, located at the Wisconsin Public Service Weston Plant[11] and the Arvah B. Hopkins Generating Station.[12] The BACT GHG limit for both projects is 1100 lb/MW-hr for 100% natural gas firing.

Table D-2 lists GHG BACT limits from similar RICE facilities located by additional research. Due to the abundant supply of natural gas on the mainland, none of these facilities are permitted to burn diesel. Therefore, the BACT limits were scaled using the diesel to natural gas $CO_2$ ratio. This ratio is based on EPA's Mandatory Greenhouse Gas Reporting Rule default emission factors (40 CFR Part 98, Table C-1). These GHG BACT limits for similar facilities are consistent with the calculated equivalent GHG BACT limits for these projects.

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[10] Conversion based on 17,076 kW rated output and 8,760 hrs/yr of operation per engine, 12 engines.

[11] RBLC ID: WI-0314; permit issue date 03/10/2022.

[12] RBLC ID: FL-0370; permit issue date 04/03/2019.

## Table D-2. GHG BACT Limits for Similar RICE Facilities

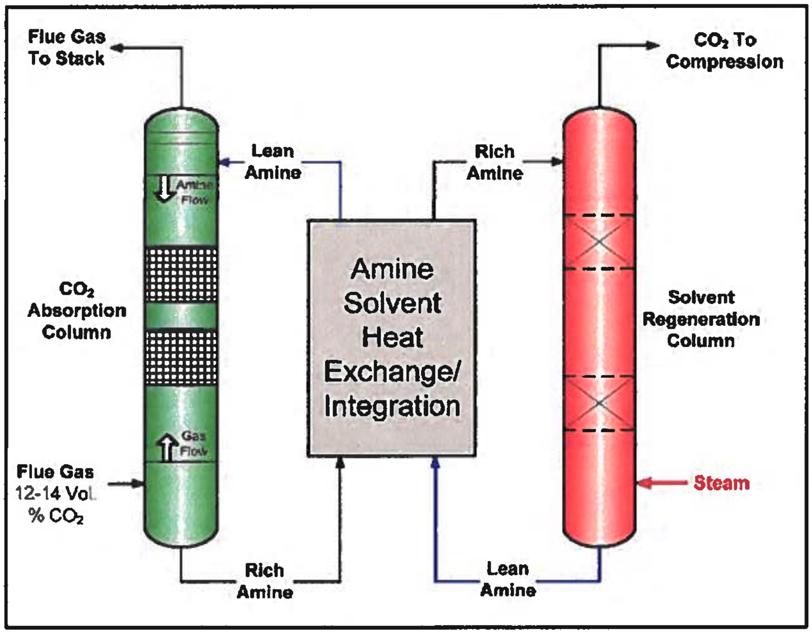
| Facility | Generating Units | Permitted Fuel | Permitted Rolling 12-month $CO_2$ Emissions Limit [A] (lb/MW$_e$-hr) | Diesel to Natural Gas $CO_2$ Ratio [B] | Diesel Equivalent Rolling 12-month $CO_2$ Emissions Limit (lb/MW$_e$-hr) |
|---|---|---|---|---|---|
| Lacey Randall Generation Facility, LLC, Lacey Randall Station | Wärtsilä 20V34SG | Natural Gas | 1,080 | 1.394 | 1,505 |
| Mid-Kansas Electric Company, LLC, Rubart Station | Caterpillar G20CM34 | Natural Gas | 1,250 | 1.394 | 1,742 |
| Wisconsin Public Service, Weston Plant and Arvah B. Hopkins Generating Station | Wärtsilä 18V50SG | Natural Gas | 1,100 | 1.394 | 1,533 |
| South Texas Electric Cooperative, Inc., Red Gate Power Plant | Wärtsilä 18V50SG | Natural Gas | 1,145 | 1.394 | 1,596 |
| Average | | | | | 1,594 |
| Average + Compliance Factor (Approx. 5%) | | | | | 1,679 |

[A] The Lacey Randall Generation Facility, LLC and Mid-Kansas Electric Company, LLC $CO_2$ emissions limits exclude startup. The inclusion of startup emissions would result in a higher $CO_2$ emissions limit.

[B] The diesel to natural gas $CO_2$ ratio is based on EPA's Mandatory Greenhouse Gas Reporting Rule default emission factors (40 CFR Part 98 Subpart C, Table C-1).

CCS is composed of two major functions: $CO_2$ capture and $CO_2$ storage. A number of methods may potentially be used for separating the $CO_2$ from the exhaust gas stream, including adsorption, physical absorption, chemical absorption, cryogenic separation, and membrane separation (Wang et al., 2011). Many of these methods are either still in development or not suitable for treating power plant flue gas due to the characteristics of the exhaust stream (Wang, 2011; IPCC, 2005). Of the potentially applicable post-combustion $CO_2$ capture options, the use of an amine solvent such as monoethanolamine (MEA) it is the most mature and well-documented technology (Kvamsdal et al., 2011). Figure D-2 illustrates the amine-based post-combustion capture process.

**Figure D-2. Schematic Diagram of Amine-based $CO_2$ Capture Process**




Source: Interagency Task Force on Carbon Capture and Storage, 2010

EPA generally considers post-combustion $CO_2$ capture with an amine solvent to be technically feasible for natural gas fired combined-cycle combustion turbines and coal fired power plants. However, the technology cannot yet be considered "applicable." The Interagency Task Force on Carbon Capture and Storage (ITF) found that

> *...it is unclear how transferable the experience with natural gas processing is to separation of power plant flue gases, given the significant differences in the chemical make-up of the two gas steams. In addition, integration of these technologies with the power cycle at generating plants present significant cost and operating issues that will need to be addressed.* (ITF, 2010, p. 28)

CCS has not yet reached the licensing and commercial sales stage of development. It is an emerging technology that has had limited successful applications on an industrial scale, and there have been no successful applications on a comparably sized natural gas or dual-fuel power plant. There are no CCS systems commercially available for such power plants in the United States. The Department of Energy states that "investment in and deployment of [CCS] technology lags other clean energy technologies." (DOE, 2016) Because the proposed project must go online by 2024, CCS is not commercially available for this application. Nonetheless, the cost for implementing $CO_2$ capture with an amine solvent is estimated below.

The project's remote location imposes many additional challenges to implementing $CO_2$ storage that are not present for continental U.S. sources. Ameresco is not aware of any proven $CO_2$ geological storage sites on Maui. Therefore, ocean storage—i.e., direct $CO_2$

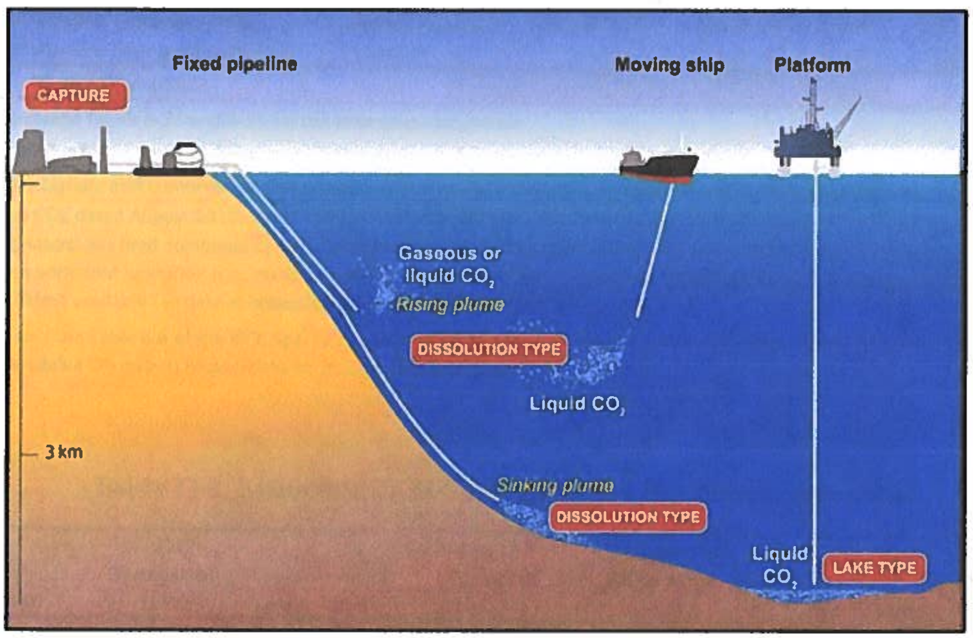
release into the ocean water column or onto the deep seafloor—appears to be the most readily available $CO_2$ storage option.

As shown in Figure D-3, $CO_2$ ocean storage potentially could be implemented in two ways:

- By injecting and dissolving $CO_2$ into the water column (typically below 1,000 meters) via a fixed pipeline or a moving ship, or
- By depositing $CO_2$ via a fixed pipeline or an offshore platform onto the sea floor at depths below 3,000 m, where $CO_2$ is denser than water and is expected to form a "lake" that would delay dissolution of $CO_2$ into the surrounding environment.

Ocean storage and its ecological impacts are still in the research phase, and the legal status of intentional ocean storage is unknown (Herzog, 2010; IPCC, 2005; Purdy, 2006).

**Figure D-3. Overview of Ocean Storage Concepts**




Source: IPCC, 2005

Table D-3 lists the estimated cost to add CCS to the proposed project based on expected operations. The estimate includes the amine absorber system cost, the onshore $CO_2$ storage cost, and the ocean injection cost. The annual estimated cost is $126 per ton of $CO_2$ removed, for a total annual cost of over $57 million based on permitted operations on RNG fuel and over $28 million based on permitted operations on liquid fuel. The listed estimated total ocean $CO_2$ storage cost of $151.37 per ton is well above the estimated total cost for geological storage ($87.30 per ton).[13]

[13] U.S. DOE, National Energy Technology Laboratory, Cost and Performance Baseline for Fossil Energy Plants, Volume 1a, Revision 3; July 6, 2015. Exhibit 4-32.

If geological storage were an option, switching to it would have little impact on the cost estimate.

**Table D-3. Estimated CCS Cost ($/Ton) – Permitted Operations**

| Carbon Capture and Storage (CCS) Component | Cost ($/ton $CO_2$ Captured) | Units 1-11 Project $CO_2$ Emissions [A] (tpy) | % Captured [B] | $CO_2$ Emissions Captured (tpy) | Total Annual Cost |
|---|---|---|---|---|---|
| | | Liquid Fuel | | | |
| $CO_2$ Capture and Compression [C] | 127.76 | 207,159 | 90% | 186,443 | $23,819,958 |
| Onshore $CO_2$ Storage [D] | 3.42 | | | | $637,635 |
| Ship transport to injection ship [D] | 8.23 | | | | $1,534,426 |
| Injection ship, pipe and nozzle [D] | 11.96 | | | | $2,229,858 |
| **Total Cost (Liquid fuel)** | 151.37 | | | | $28,221,877 |
| | | RNG | | | |
| $CO_2$ Capture and Compression [C] | 127.76 | 421,256 | 90% | 379,131 | $48,437,777 |
| Onshore CO2 Storage [D] | 3.42 | | | | $1,296,628 |
| Ship transport to injection ship [D] | 8.23 | | | | $3,120,248 |
| Injection ship, pipe and nozzle [D] | 11.96 | | | | $4,534,407 |
| **Total Cost (RNG)** | 151.37 | | | | $57,389,060 |

[A] See Appendix Tables B-13 and B-15 for the emissions calculations.

[B] Typical value for amine absorber systems (Interagency Task Force on CCS, 2010; NETL, 2013).

[C] The $CO_2$ capture and compression cost is based on information presented in Figure III-1 of the Report of the Interagency Task Force on CCS, dated August 2010. The listed dollar per ton of $CO_2$ captured is the cost of applying post-combustion CCS to an existing natural gas fired combined cycle power plant. The listed cost ($103 per metric ton or $93.44 per ton in 2010 dollars) is based on permitted operation (i.e., maximum allowable operation per unit per year at full load for each fuel type), inflated to 2022 dollars (latest available CPI data at https://data.bls.gov/cgi-bin/cpicalc.pl).

[D] Costs are from Table 6.6 of the IPCC Special Report on Carbon Dioxide Capture and Storage, dated 2005, inflated to 2022 dollars (latest available CPI data at https://data.bls.gov/cgi-bin/cpicalc.pl).

**Table D-4. Estimated CCS Cost ($/kWh) – Permitted Operations**

| Load | Total Generation (kW) | Fuel Type | Operating Hrs Per Unit (hrs/yr) | Total Annual Generation (kWh) | Total Annual Cost | $CO_2$ Removal Cost ($/kWh) |
|---|---|---|---|---|---|---|
| 100% (Base) | 103,100 | Liquid fuel | 2920 | 297,829,354 | $ 28,221,877 | $ 0.095 |
| | | RNG | 8395 | 862,137,604 | $ 57,389,060 | $ 0.067 |

As shown in Table D-4, these costs equate to 9.5¢ per kWh for liquid fuel firing and 6.7¢ per kWh for RNG firing, based on permitted operations.

Because of the high cost and commercial unavailability of CCS, the proposed engines are the most effective option to reduce GHG emissions and represent BACT.

*Determine BACT/Present Conclusions*

Ameresco proposes the use of the proposed dual-fuel RICE generating units as BACT for GHG and proposes to limit $CO_2e$ emissions to a lb/MWe-hr limit weighted by liquid and RNG fuel consumption during a rolling 12-month period. To account for the reduced engine efficiency at lower loads required to achieve the project objective of increasing the penetration of renewable energy on Maui, the proposed limit on $CO_2e$ is based on the GHG emission rates at 50% of rated load (see Tables B-13 and B-15). The proposed limit would be the sum of 1,416 lb $CO_2e$/MWe-hr times the MWe-hr produced using liquid fuel, and 1,172 lb $CO_2e$/MWe-hr times the MWe-hr produced using RNG, divided by the total MWe-hr produced, evaluated monthly on a rolling 12-month basis. These $CO_2e$ limits are in the range of the previous BACT $CO_2$ and $CO_2e$ limits identified in Table D-2. Therefore, these limits satisfy the CAA's definition of BACT.

**BACT for the Wärtsilä Engine Generators: Startup/Shutdown**

Startup and shutdown periods are a normal part of the operation of reciprocating engine generator power plants. BACT must also be applied during the startup and shutdown periods of IC engine operation. The BACT limits discussed in the previous section apply to steady-state operation, when the engines have reached stable operations and the emission control systems are fully operational.

*Identify All Possible Control Technologies*

The emission control technologies that will be effective during normal operation are discussed in the previous section. The following are additional technologies for control of emissions during startups and shutdowns:

- Fast-start technologies; and
- Operating practices to minimize the duration of startup and shutdown.

*Eliminate Technologically Infeasible Options*

The post-combustion controls that are used to achieve additional emissions reductions (SCR and oxidation catalyst) require that specific exhaust temperature ranges be reached to be fully effective. The use of SCR to control $NO_X$ is not technically feasible during the initial stages of startup, when the temperature of the SCR catalyst is below the manufacturer's recommended operating range. Ammonia will not react completely with $NO_X$ when catalyst temperatures are low, resulting in excess $NO_X$ emissions or excess ammonia slip or both. The oxidation catalyst is not effective at controlling CO and VOC emissions when exhaust temperature is below the design temperature range. Therefore, exhaust gas controls used to achieve BACT for normal operations are not feasible control techniques during startups and shutdowns.

This "top-down" BACT analysis will consider the following emission limitations:

- Operating practices to minimize emissions during startup and shutdown; and
- Design features to minimize the duration of startup and shutdown.

*Rank Remaining Control Technologies by Control Effectiveness*

Operating Practices to Minimize Emissions during Startup and Shutdown

There are basic principles of operation, or Best Management Practices, that minimize emissions during startups and shutdowns. These Best Management Practices are outlined below.

- During a startup, bring the engine to the minimum load necessary to achieve compliance with the applicable $NO_X$, CO, and VOC emission limits as quickly as possible, consistent with the equipment manufacturers' recommendations and safe operating practices.
- During a startup, initiate reagent injection to the SCR system as soon as the SCR catalyst temperature and reagent vaporization system have reached their minimum operating temperatures.
- During a shutdown, once an engine reaches a load that is below the minimum load necessary to maintain compliance with the applicable $NO_X$, CO, and VOC emission limits, reduce the engine load to zero as quickly as possible, consistent with the equipment manufacturers' recommendations and safe operating practices.
- During a shutdown, maintain ammonia injection to the SCR system as long as the SCR catalyst temperature and reagent vaporization system remain above their minimum operating temperatures.

A key underlying consideration of these Best Management Practices is the overall safety of the plant staff by promoting operation within the limitations of the equipment and systems and allowing for operator judgment and response times to respond to alarms and trips during a startup or shutdown sequence.

Design Features to Minimize the Duration of Startup and Shutdown

An additional technique to reduce startup emissions is to minimize the amount of time the engine spends in startup. Startup times are generally driven by the rate at which engine load can increase, and the rate at which the SCR system and oxidation catalyst come up to operating temperature. Having the engines at full load will, in turn, minimize the time required for emission control systems to reach operating temperature, thus minimizing the length of time during which engine emissions exceed normal controlled levels.

*Evaluate the Most Effective Control Technology Considering Environmental, Energy, and Cost Impacts*

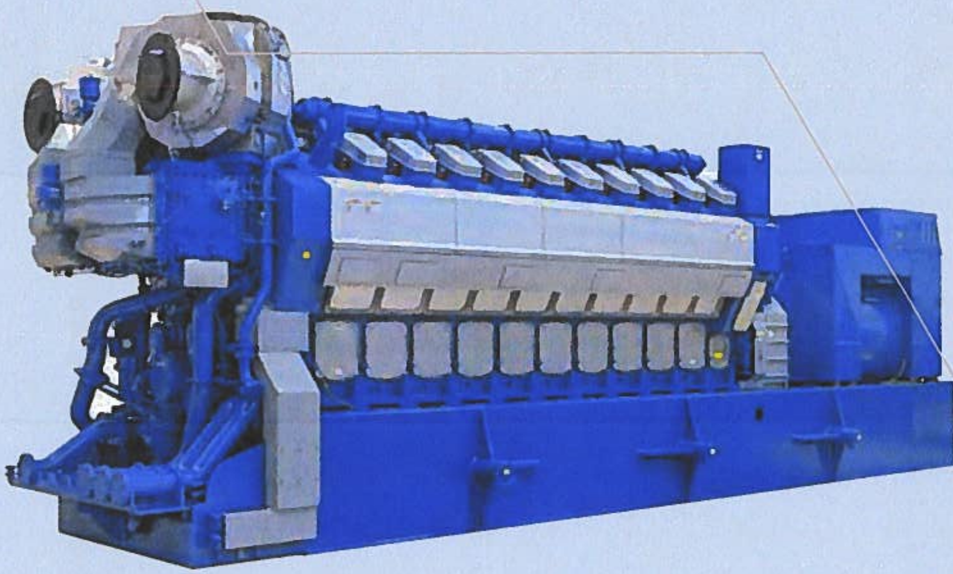
Utilizing best operating practices to minimize emissions during startups and shutdowns has no adverse environmental or energy impacts, nor does it require additional capital expenditure.

*Determine BACT/Present Conclusions*

BACT for $NO_X$, CO, VOC, and GHG during startups/shutdowns is the use of operating systems/practices that reduce the duration of startups and shutdowns to the greatest extent feasible and the use of operational techniques to initiate ammonia injection as soon as possible during a startup. Therefore, BACT is determined to be the use of reciprocating IC engine technology and the application of operating systems/practices that minimize startup and shutdown durations, in combination with the use of operational techniques to initiate ammonia injection as soon as possible during a startup.

# Appendix E

# Manufacturers' Literature



# WÄRTSILÄ 34DF

## MULTI-FUEL ENGINE GENERATING SET

The Wärtsilä 34DF is a four-stroke multi-fuel engine generating set. It allows instant switching to alternative fuels, should price instability or delivery challenges affect the use of the primary fuel. It operates on the lean burn principle, which reduces peak temperatures and lowers $NO_x$ emissions considerably.

The Wärtsilä 34DF engine generating set is extremely reliable as it is based on the well-proven Wärtsilä 32 engine, that has a track record from the mid-1990s. The Wärtsilä 34DF features a wide power output range from 5.6 to 9.8 MW, as it is available in 12V, 16V and 20V cylinder configurations.

We help our customers in decarbonisation by developing market-leading technologies such as flexible power plants that can be delivered as engineering, procurement and construction (EPC). With our full lifecycle support we ensure guaranteed performance of the plant.

**Main benefits**

- Ensures energy security in operation through fuel flexibility and seamless switching between fuels
- Can operate on natural gas or any liquid fuel, including HFO
- Low emissions in gas mode and meets even the most stringent emission limits with exhaust gas after treatment
- Optimised performance and efficiency supported by Wärtsilä Lifecycle solutions

**2**

**Minutes to full load**

**48.6**

**% Electrical efficiency**

**More than**

**1 000**

**generating sets delivered**

WÄRTSILÄ

# Main technical data

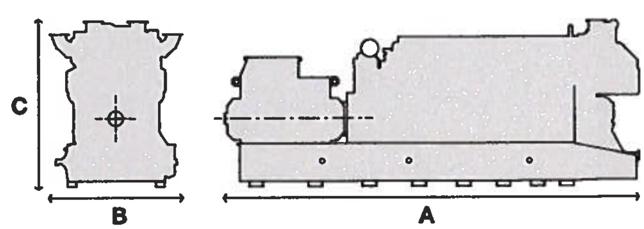
| Engine generating set | | | |
|---|---|---|---|
| Cylinder configurations | 12 V, 16 V, 20 V | | |
| Cylinder bore | 340 mm | | |
| Piston stroke | 400 mm | | |
| Engine speed | 750 rpm (50 Hz), 720 rpm (60 Hz) | | |
| **Performance [1]** | | | |
| | **20V34DF (50Hz / 60Hz)** | **16V34DF (50Hz / 60Hz)** | **12V34DF (50Hz / 60Hz)** |
| Rated electrical power (kW) | 9795 / 9388 | 7830 / 7491 | 5840 / 5580 |
| Electrical efficiency (%) | GAS: 48.6 / 48.5<br>LFO: 45.6 / 45.8<br>HFO: 45.8 / 46 | GAS: 48.6 / 48.4<br>LFO: 45.6 / 45.6<br>HFO: 45.8 / 45.8 | GAS: 48.4 / 48.1<br>LFO: 45.3 / 45.4<br>HFO: 45.6 / 45.6 |
| Heat rate at generator terminals (kJ/kWh) | GAS: 7404 / 7415<br>LFO: 7898 / 7868<br>HFO: 7856 / 7828 | GAS: 7408 / 7438<br>LFO: 7903 / 7893<br>HFO: 7861 / 7852 | GAS: 7445 / 7482<br>LFO: 7941 / 7938<br>HFO: 7899 / 7897 |
| **Loading and unloading** | | | |
| | **Connected to grid** | **Full load** | |
| Regular start time (min:sec) | 00:30 | < 5 | |
| Fast start time (min:sec) | 00:30 | < 2 | |
| Stop time (min) | 1 | | |
| Ramp rate (hot, load/min) | > 100% | | |
| **Minimum load** | | | |
| Unit level | 10% | | |
| Plant level | 1% | | |

**Maximum transportation dimensions (mm) and weights (tonnes) [2]**

| Genset type | Length (A) | Length (B) | Height (C) | Dry weight |
|---|---|---|---|---|
| 12V34DF | 10 454 | 3 350 | 4 374 | 99 |
| 16V34DF | 11 606 | 3 420 | 4 374 | 130 |
| 20V34DF | 12 971 | 3 418 | 4 429 | 141 |

1 Rated electrical power and electrical efficiencies are given at generator terminals at 100kPa ambient pressure, 25°C suction air temperature and 30% relative humidity, and without engine driven pumps. Power factor 1.0 (site). NOx emission level 90ppm @15% O2 dry. Electrical efficiency with 5% tolerance. Gas LHV >28MJ/Nm3. Gas methane number >80. Site conditions, fuel and applicable emission limits may have an impact on performance figures. Please contact Wärtsilä for project-specific performance data.

2 There are different dismantling options available to reduce weight and height for transporting. Please contact Wärtsilä for further information.






**wartsila.com/energy**

# Generator set data sheet

| | |
|---|---|
| **Model:** | **DFEK** |
| **Frequency:** | **60 Hz** |
| **Fuel type:** | **Diesel** |
| **kW rating:** | **500 Standby** |
| | **455 Prime** |
| **Emissions level:** | **EPA NSPS Stationary Emergency Tier 2** |

| | |
|---|---|
| **Exhaust emission data sheet:** | **EDS-173** |
| **Exhaust emission compliance sheet:** | **EPA-1005** |
| **Sound performance data sheet:** | **MSP-177** |
| **Cooling performance data sheet:** | **MCP-105** |
| **Prototype test summary data sheet:** | **PTS-145** |
| **Standard set-mounted radiator cooling outline:** | **0500-3326** |
| **Optional set-mounted radiator cooling outline:** | |
| **Optional heat exchanger cooling outline:** | |
| **Optional remote radiator cooling outline:** | |

## Fuel consumption

| | Standby | | | | Prime | | | | Continuous |
|---|---|---|---|---|---|---|---|---|---|
| | kW (kVA) | | | | kW (kVA) | | | | kW (kVA) |
| **Ratings** | 500 (625) | | | | 455 (569) | | | | |
| **Load** | 1/4 | 1/2 | 3/4 | Full | 1/4 | 1/2 | 3/4 | Full | Full |
| **US gph** | 11.6 | 18.8 | 25.7 | 34.4 | 10.9 | 17.6 | 23.7 | 30.4 | |
| **L/hr** | 44 | 71 | 97 | 130 | 41 | 67 | 90 | 115 | |

## Engine

| | Standby rating | Prime rating | Continuous rating |
|---|---|---|---|
| Engine manufacturer | Cummins Inc. | | |
| Engine model | QSX15-G9 | | |
| Configuration | Cast iron with replaceable wet cylinder liners, in-line 6 cylinder | | |
| Aspiration | Turbocharged with air-to-air charge air-cooling | | |
| Gross engine power output, kWm (bhp) | 563.0 (755.0) | 507.3 (680.0) | |
| BMEP at set rated load, kPa (psi) | 2433.9 (353.0) | 2213.2 (321.0) | |
| Bore, mm (in.) | 136.9 (5.39) | | |
| Stroke, mm (in.) | 168.9 (6.65) | | |
| Rated speed, rpm | 1800 | | |
| Piston speed, m/s (ft/min) | 10.1 (1995.0) | | |
| Compression ratio | 17.0:1 | | |
| Lube oil capacity, L (qt) | 83.3 (88.0) | | |
| Overspeed limit, rpm | 2150 ± 50 | | |
| Regenerative power, kW | 52.00 | | |

| Fuel flow | Standby rating | Prime rating | Continuous rating |
|---|---|---|---|
| Maximum fuel flow, L/hr (US gph) | 423.9 (112.0) | | |
| Maximum inlet restriction, mm Hg (in Hg) | 127.0 (5.0) | | |
| Maximum return restriction, mm Hg (in Hg) | 165.1 (6.5) | | |

| Air | | | |
|---|---|---|---|
| Combustion air, $m^3$/min (scfm) | 41.6 (1470.0) | 38.8 (1370.0) | |
| Maximum air cleaner restriction, kPa (in $H_2O$) | 6.2 (25.0) | | |
| Alternator cooling air, $m^3$/min (scfm) | 62.0 (1290.0) | | |

| Exhaust | | | |
|---|---|---|---|
| Exhaust flow at set rated load, $m^3$/min (cfm) | 102.6 (3625.0) | 88.7 (3135.0) | |
| Exhaust temperature, °C (°F) | 482.8 (901.0) | 466.7 (872.0) | |
| Maximum back pressure, kPa (in $H_2O$) | 10.2 (41.0) | | |

| Standard set-mounted radiator cooling | | | |
|---|---|---|---|
| Ambient design, °C (°F) | 40 (104) | | |
| Fan load, $kW_m$ (HP) | 19 (25.5) | | |
| Coolant capacity (with radiator), L (US gal) | 57.9 (15.3) | | |
| Cooling system air flow, $m^3$/min (scfm) | 707.5 (25000.0) | | |
| Total heat rejection, MJ/min (Btu/min) | 19.6 (18485.0) | 17.7 (16680.0) | |
| Maximum cooling air flow static restriction, kPa (in $H_2O$) | 0.12 (0.5) | | |

| Optional set-mounted radiator cooling | | | |
|---|---|---|---|
| Ambient design, °C (°F) | 50 (122) | | |
| Fan load, $kW_m$ (HP) | 19 (25.5) | | |
| Coolant capacity (with radiator), L (US gal) | 57.9 (15.3) | | |
| Cooling system air flow, $m^3$/min (scfm) | 707.5 (25000.0) | | |
| Total heat rejection, MJ/min (Btu/min) | 19.6 (18485.0) | 17.7 (16680.0) | |
| Maximum cooling air flow static restriction, kPa (in $H_2O$) | 0.12 (0.5) | | |

| Optional heat exchanger cooling | | | |
|---|---|---|---|
| Set coolant capacity, L (US Gal.) | | | |
| Heat rejected, jacket water circuit, MJ/min (Btu/min) | | | |
| Heat rejected, after-cooler circuit, MJ/min (Btu/min) | | | |
| Heat rejected, fuel circuit, MJ/min (Btu/min) | | | |
| Total heat radiated room, MJ/min (Btu/min) | | | |
| Maximum raw water pressure, jacket water circuit, kPa (psi) | | | |
| Maximum raw water pressure, after-cooler circuit, kPa (psi) | | | |
| Maximum raw water pressure, fuel circuit, kPa (psi) | | | |
| Maximum raw water flow, jacket water circuit, L/min (US gal/min) | | | |
| Maximum raw water flow, after-cooler circuit, L/min (US gal/min) | | | |
| Maximum raw water flow, fuel circuit, L/min (US gal/min) | | | |
| Minimum raw water flow at 27 °C (80 °F) inlet temp, jacket water circuit, L/min (US gal/min) | | | |
| Minimum raw water flow at 27 °C (80 °F) inlet temp, after-cooler circuit, L/min (US gal/min) | | | |
| Minimum raw water flow at 27 °C (80 °F) inlet temp, fuel circuit, L/min (US gal/min) | | | |

## Optional heat exchanger cooling (continued)

| | | | |
|---|---|---|---|
| Raw water delta P at min flow, jacket water circuit, kPa (psi) | | | |
| Raw water delta P at min flow, after-cooler circuit, kPa (psi) | | | |
| Raw water delta P at min flow, fuel circuit, kPa (psi) | | | |
| Maximum jacket water outlet temp, °C (°F) | | | |
| Maximum after-cooler inlet temp, °C (°F) | | | |
| Maximum after-cooler inlet temp at 25 °C (77 °F) ambient, °C ( °F) | | | |

## Optional remote radiator cooling[1]

| | |
|---|---|
| Set coolant capacity, L (US gal) | |
| Max flow rate at max friction head, jacket water circuit, L/min (US gal/min) | |
| Max flow rate at max friction head, after-cooler circuit, L/min (US gal/min) | |
| Heat rejected, jacket water circuit, MJ/min (Btu/min) | |
| Heat rejected, after-cooler circuit, MJ/min (Btu/min) | |
| Heat rejected, fuel circuit, MJ/min | |
| Total heat radiated to room, MJ/min (Btu/min) | |
| Maximum friction head, jacket water circuit, kPa (psi) | |
| Maximum friction head, after-cooler circuit, kPa (psi) | |
| Maximum static head, jacket water circuit, m (ft) | |
| Maximum static head, after-cooler circuit, m (ft) | |
| Maximum jacket water outlet temp, °C (°F) | |
| Maximum after-cooler inlet temp at 25 °C (77 °F) ambient, °C (°F) | |
| Maximum after-cooler inlet temp, °C (°F) | |
| Maximum fuel flow, L/hr (US gph) | |
| Maximum fuel return line restriction, kPa (in Hg) | |

## Weights[2]

| | |
|---|---|
| Unit dry weight kgs (lbs) | 4325 (9535) |
| Unit wet weight kgs (lbs) | 4461 (9835) |

**Notes:**

[1] For non-standard remote installations contact your local Cummins representative.

[2] Weights represent a set with standard features. See outline drawing for weights of other configurations.

## Derating factors

| | |
|---|---|
| **Standby** | Genset may be operated at up to 1400 m (4593 ft) and 40°C (104°F) without power deration. For sustained operation above these conditions, derate by 3.1% per 305 m (1000 ft), and 9% per 10°C (9% per 18°F).<br>Genset may be operated at up to 500 m (1640 ft) and 50°C (122°F) without power deration. For sustained operation above these conditions, derate by 3% per 305 m (1000 ft), and 9.5% per 10°C (9% per 18°F). |
| **Prime** | Genset may be operated at up to 2250 m (7382 ft) and 40°C (104°F) without power deration. For sustained operation above these conditions, derate by 3.2% per 305 m (1000 ft), and 16.6% per 10°C (16.6% per 18°F).<br>Genset may be operated at up to 1600 m (5249 ft) and 50°C (122°F) without power deration. For sustained operation above these conditions, derate by 3.2% per 305 m (1000 ft), and 16.6% per 10°C (16.6% per 18°F). |
| **Continuous** | |

## Ratings definitions

| **Emergency Standby Power (ESP):** | **Limited-Time Running Power (LTP):** | **Prime Power (PRP):** | **Base Load (Continuous) Power (COP):** |
|---|---|---|---|
| Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514. | Applicable for supplying power to a constant electrical load for limited hours. Limited-Time Running Power (LTP) is in accordance with ISO 8528. | Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514. | Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) is in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514. |

## Alternator data

| Three phase table[1] | | 105 °C | 105 °C | 105 °C | 125 °C | 125 °C | 125 °C | 125 °C | 125 °C | 150 °C | 150 °C | 150 °C | 150 °C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feature code | | B262 | B301 | B252 | B258 | B252 | B414 | B246 | B300 | B426 | B413 | B424 | B419 |
| Alternator data sheet number | | 308 | 307 | 307 | 308 | 307 | 308 | 306 | 306 | 307 | 307 | 305 | 306 |
| Voltage ranges | | 110/190<br>thru<br>139/240<br>220/380<br>thru<br>277/480 | 347/600 | 120/208<br>thru<br>139/240<br>240/416<br>thru<br>277/480 | 110/190<br>thru<br>139/240<br>220/380<br>thru<br>277/480 | 120/208<br>thru<br>139/240<br>240/416<br>thru<br>277/480 | 120/208<br>thru<br>139/240<br>240/416<br>thru<br>277/480 | 277/480 | 347/600 | 110/190<br>thru<br>139/240<br>220/380<br>thru<br>277/480 | 120/208<br>thru<br>139/240<br>240/416<br>thru<br>277/480 | 277/480 | 347/600 |
| Surge kW | | 514 | 517 | 514 | 514 | 514 | 516 | 515 | 515 | 512 | 514 | 512 | 515 |
| Motor starting kVA (at 90% sustained voltage) | Shunt | | | | | | | | | | | | |
| | PMG | 2429 | 2208 | 2208 | 2429 | 2208 | 2429 | 1896 | 1896 | 2208 | 2208 | 1749 | 1896 |

| Full load current - amps at Standby rating | 110/190 | 120/208 | 110/220 | 115/230 | 139/240 | 220/380 | 230/400 | 240/416 | 255/440 | 277/480 | 347/600 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1901 | 1737 | 1642 | 1571 | 1505 | 951 | 903 | 868 | 821 | 753 | 602 | |

**Note**:

[1] Single phase power can be taken from a three phase generator set at up to 40% of the generator set nameplate kW rating at unity power factor.

## Formulas for calculating full load currents:

**Three phase output**

$$\frac{kW \times 1000}{Voltage \times 1.73 \times 0.8}$$

**Single phase output**

$$\frac{kW \times SinglePhaseFactor \times 1000}{Voltage}$$

**Warning**: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

**For more information contact your local Cummins distributor or visit power.cummins.com**

**Our energy working for you.™**



D-3401 (04/20)

# AIR QUALITY IMPACT ANALYSIS

**Ameresco, Inc.**

**ʻŪkiu Energy Project**
**Waena, Maui, HI**

**TRINITY CONSULTANTS**
315 5th Avenue South
Suite 830
Seattle, WA 98104
253.867.5600

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# 1. INTRODUCTION

ʻŪkiu Energy LLC is proposing to construct and operate the ʻŪkiu Energy Project, a firm renewable generation project in response to a request for proposal from the Hawaiian Electric Company (HECO) for a new power plant to support the deployment of additional renewable electricity generation on Maui. The proposed project would be located southeast of Kahului Bay. This air quality impact analysis (AQIA) is submitted to the State of Hawaii Department of Health (HDOH) as part of the initial application for a Covered Source Permit (CSP) for the new power plant project.

The project developer is proposing to construct the power plant on 2.7 acres of land located in a 50.6-acre parcel that is currently undeveloped. The new generating facility would consist of six Wärtsilä 16V34DF Engines dual fuel reciprocating internal combustion engine generators, for a nominal total of approximately 40 MW of new generation.

The Wärtsilä engine generators are four-stroke compression ignition engines, each rated at a nominal 7.5 MW. The engine generators will be permitted to operate with a range of liquid and gaseous fuels, but principally biodiesel, renewable natural gas (RNG), or a combination of these biofuels. Each engine generator will be equipped with an emission control system consisting of a Selective Catalytic Reduction system (SCR) for oxides of nitrogen ($NO_X$) emissions control and oxidation catalysts to control carbon monoxide (CO), volatile organic compound (VOC), and hazardous air pollutant (HAP) emissions; continuous emissions monitoring system (CEMS); and associated support equipment.

The project will be permitted through the HDOH's Covered Source Permit (CSP) permitting process. As proposed, operation of the new generating facility will not result in emission rates that exceed the Prevention Significant Deterioration (PSD) major source thresholds for any regulated pollutants.

As required by HDOH rules, the application for a CSP includes a dispersion modeling analysis to demonstrate that the project will neither cause a new violation of a state or federal ambient air quality standard nor make an existing violation significantly worse for nitrogen dioxide ($NO_2$), CO, sulfur dioxide ($SO_2$), particulate matter with an aerodynamic diameter less than 10 microns ($PM_{10}$), or particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$).

# 2. MODELING METHODOLOGY

Dispersion modeling is used to determine the ambient air quality impacts of the proposed project. All modeling is consistent with HDOH and EPA guidelines, including "40 CFR Part 51, Appendix W - Guideline on Air Quality Models" (Guideline).

## 2.1 Model Selection

EPA's recommended dispersion model, AERMOD (version 23132), is used in the modeling analysis. AERMOD is a steady-state plume model capable of modeling simple, intermediate, and complex terrain receptors. In the stable boundary layer (nighttime), it assumes the concentration distribution to be Gaussian in both the vertical and horizontal. In the convective boundary layer (daytime) the probability density function describing the horizontal distribution is assumed to be Gaussian, while the vertical distribution is assumed to be bi-Gaussian. AERMOD also contains the PRIME algorithm, which incorporates the two fundamental features associated with building downwash: (1) enhanced plume dispersion coefficients due to the turbulent wake, and (2) reduced plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake. The Building Profile Input Program for PRIME (BPIPPRM version 04274) is used to account for building downwash effects.

The modeling is conducted using AERMOD's regulatory default options. These options include the following:

- The rural dispersion option;
- A uniform Cartesian receptor grid with spacing of 100 meters or less within one kilometer of the source and finer resolution as required to identify maximum impacts; and
- Terrain data developed through AERMAP.

The $NO_2$ modeling followed the three tier $NO_2$ modeling approach for the conversion of nitric oxide (NO) to $NO_2$ described in EPA's Guideline Section 4.2.3.4. The three tiers are:

- Tier 1 – Total Conversion of $NO_X$ to $NO_2$
- Tier 2 – Ambient Ratio Method 2 (ARM2)
- Tier 3 – Ozone Limiting Method (OLM) or Plume Volume Molar Ratio Method (PVMRM)

The models prepared for this application use OLM. Both OLM and PVMRM require representative source specific in-stack $NO_2/NO_X$ ratios and background $O_3$ concentrations. The source specific in-stack $NO_2/NO_X$ ratios are discussed in Section 2.2. The required representative background $O_3$ concentrations are discussed in Section 2.5. OLM was used for the 1-hour $NO_2$ project impact and full impact analyses.

AERMOD (starting with version 11059) is capable of calculating the distribution of daily maximum 1-hour values. The daily maximum 1-hour values are calculated when the pollutant ID is either "SO2" or "NO2" and the only short-term averaging period specified is "1-hour." When modeling with 5 years of National Weather Service (NWS) meteorological data, the receptor-by-receptor 5-year average serves as an unbiased estimate of the 3-year average for comparison to the 1-hour $SO_2$, 1-hour $NO_2$, and 24-hour $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS). This analysis uses one year of onsite data, so the average is not applied, but pollutant IDs are still used for consistency. Controlling modeled concentrations for the percentile based 1-hour $SO_2$, 1-hour $NO_2$, and 24-hour $PM_{2.5}$ NAAQS are as follows:

- The 1-hour $SO_2$ NAAQS controlling modeled concentration is the 99th percentile (4th high) daily maximum 1-hour average $SO_2$ concentration.
- The 1-hour $NO_2$ NAAQS controlling modeled concentration is the 98th percentile (8th high) daily maximum 1-hour average $NO_2$ concentration.
- The 24-hour $PM_{2.5}$ NAAQS controlling modeled concentration is the 98th percentile (8th high) daily $PM_{2.5}$ concentration.

For comparison to the NAAQS, the background concentrations described in Section 2.5 were added to the controlling modeled concentrations.

## 2.2 Modeled Project Emissions

The project is comprised of six Wärtsilä 16V34DF generating units. The Guideline (Section 8.2.2.d) requires changes in operating conditions that affect the physical emission parameters (e.g., release height, initial plume volume, and exit velocity) of the project sources be considered to ensure that maximum project impacts are determined. Therefore, stack parameters and emissions were developed for full load, minimum load, and startup operating conditions, for both liquid fuel and gaseous fuel operating scenarios. On an annual basis, the generating units may operate on 100% liquid fuel, 100% gaseous fuel, or a combination of the two.[1] Table 2-1 lists the modeled Universal Transverse Mercator (UTM) coordinates of the proposed units, Table 2-2 lists the modeled stack parameters, and T lists the modeled emission rates for the proposed units. Figure 2-1 shows the proposed site layout.

**Table 2-1. Modeled Stack Locations**

| Source ID | Description | X Coordinate (m) | Y Coordinate (m) | Elevation (m) |
|---|---|---|---|---|
| STACKA | 16V34DF Engine | 768,943.30 | 2,307,363.00 | 109 |
| STACKB | 16V34DF Engine | 768,947.60 | 2,307,359.80 | 109 |
| STACKC | 16V34DF Engine | 768,951.90 | 2,307,356.50 | 109 |
| STACKD | 16V34DF Engine | 768,961.70 | 2,307,349.00 | 109 |
| STACKE | 16V34DF Engine | 768,966.00 | 2,307,345.70 | 109 |
| STACKF | 16V34DF Engine | 768,970.20 | 2,307,342.40 | 109 |

[1] A third operating scenario evaluated in the application support document reflects starting up the units on RNG to minimize startup emissions, and then switching to biodiesel when RNG supplies are not adequate to support 100% RNG operation. Because the switchover to biodiesel occurs within a few minutes of startup, stack parameters for this mode of operation are the same as stack parameters for 100% biodiesel operation.

## Table 2-2. Modeled Stack Parameters

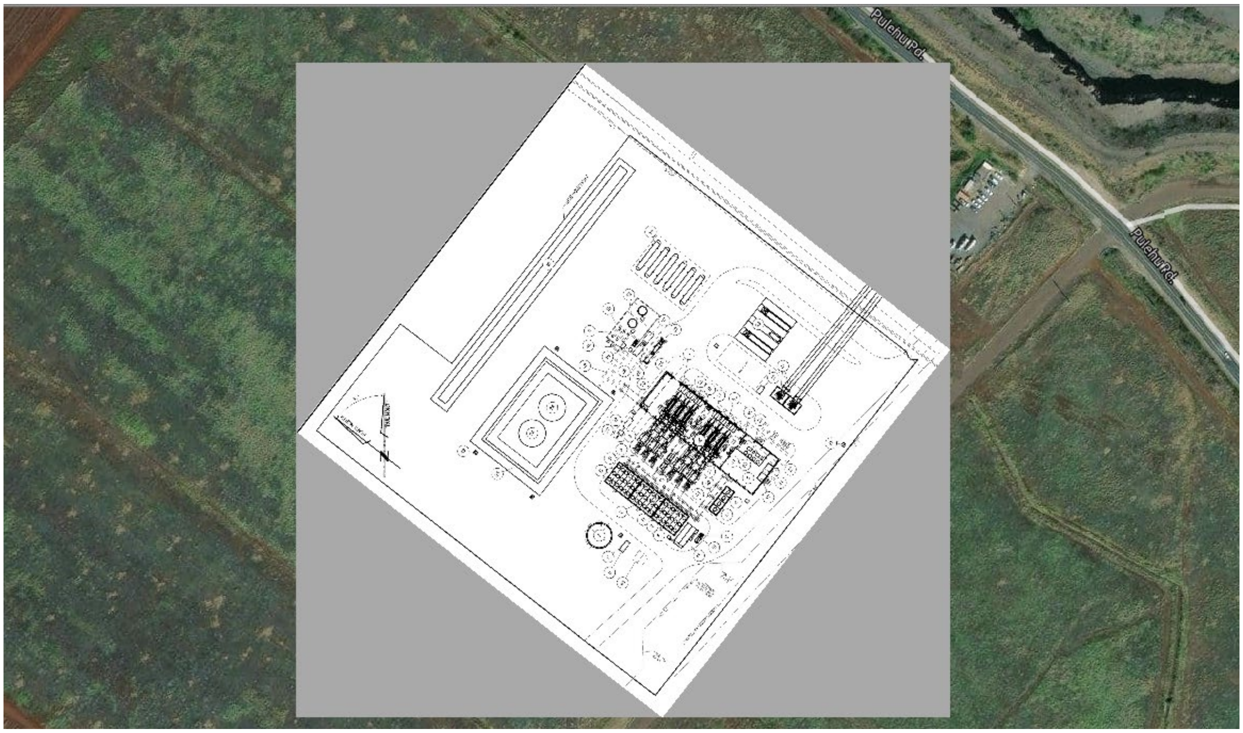
| Fuel | Operating Load/ Scenario | Source ID | Stack Parameters | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Elevation (m) | Stack Height (m) | Stack Temperature (K) | Stack Flowrate ($m^3/s$) | Stack Velocity (m/s) | Individual Stack Diameter (m) |
| Liquid Fuel | Startup / Full Load | STACKA | 109 | 35.05 | 593.15 | 24.65 | 21.80 | 1.20 |
| | | STACKB | | | 593.15 | 24.65 | 21.80 | |
| | | STACKC | | | 593.15 | 24.65 | 21.80 | |
| | | STACKD | | | 593.15 | 24.65 | 21.80 | |
| | | STACKE | | | 593.15 | 24.65 | 21.80 | |
| | | STACKF | | | 593.15 | 24.65 | 21.80 | |
| | Minimum Load | STACKA | | | 622.04 | 11.47 | 10.14 | |
| | | STACKB | | | 622.04 | 11.47 | 10.14 | |
| | | STACKC | | | 622.04 | 11.47 | 10.14 | |
| | | STACKD | | | 622.04 | 11.47 | 10.14 | |
| | | STACKE | | | 622.04 | 11.47 | 10.14 | |
| | | STACKF | | | 622.04 | 11.47 | 10.14 | |
| Gaseous Fuel | Startup / Full Load | STACKA | | | 649.15 | 22.33 | 19.74 | |
| | | STACKB | | | 649.15 | 22.33 | 19.74 | |
| | | STACKC | | | 649.15 | 22.33 | 19.74 | |
| | | STACKD | | | 649.15 | 22.33 | 19.74 | |
| | | STACKE | | | 649.15 | 22.33 | 19.74 | |
| | | STACKF | | | 649.15 | 22.33 | 19.74 | |
| | Minimum Load | STACKA | | | 674.15 | 12.22 | 10.80 | |
| | | STACKB | | | 674.15 | 12.22 | 10.80 | |
| | | STACKC | | | 674.15 | 12.22 | 10.80 | |
| | | STACKD | | | 674.15 | 12.22 | 10.80 | |
| | | STACKE | | | 674.15 | 12.22 | 10.80 | |
| | | STACKF | | | 674.15 | 12.22 | 10.80 | |

## Table 2-3. Modeled Emission Rates

| Fuel | Operating Load/ Scenario | Source ID | Emission Rate (g/s) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | $PM_{2.5}$ / $PM_{10}$ | | $NO_2$ | | $SO_2$ | | CO |
| | | | 24-hr | Annual | 1-hr | Annual | 1-, 3-, & 24-hr | Annual | 1- and 8-hr |
| Liquid Fuel | Startup | STACKA | 0.47 | 0.35 | 7.22 | 1.06 | 0.013 | 0.009 | 0.82 |
| | | STACKB | 0.47 | 0.35 | 7.22 | 1.06 | 0.013 | 0.009 | 0.82 |
| | | STACKC | 0.47 | 0.35 | 7.22 | 1.06 | 0.013 | 0.009 | 0.82 |
| | | STACKD | 0.47 | 0.35 | 7.22 | 1.06 | 0.013 | 0.009 | 0.82 |
| | | STACKE | 0.47 | 0.35 | 7.22 | 1.06 | 0.013 | 0.009 | 0.82 |
| | | STACKF | 0.47 | 0.35 | 7.22 | 1.06 | 0.013 | 0.009 | 0.82 |
| | Full Load | STACKA | 0.44 | 0.30 | 1.09 | 0.71 | 0.013 | 0.009 | 0.38 |
| | | STACKB | 0.44 | 0.30 | 1.09 | 0.71 | 0.013 | 0.009 | 0.38 |
| | | STACKC | 0.44 | 0.30 | 1.09 | 0.71 | 0.013 | 0.009 | 0.38 |
| | | STACKD | 0.44 | 0.30 | 1.09 | 0.71 | 0.013 | 0.009 | 0.38 |
| | | STACKE | 0.44 | 0.30 | 1.09 | 0.71 | 0.013 | 0.009 | 0.38 |
| | | STACKF | 0.44 | 0.30 | 1.09 | 0.71 | 0.013 | 0.009 | 0.38 |
| | Minimum Load | STACKA | 0.25 | 0.17 | 0.55 | 0.36 | 0.006 | 0.004 | 0.17 |
| | | STACKB | 0.25 | 0.17 | 0.55 | 0.36 | 0.006 | 0.004 | 0.17 |
| | | STACKC | 0.25 | 0.17 | 0.55 | 0.36 | 0.006 | 0.004 | 0.17 |
| | | STACKD | 0.25 | 0.17 | 0.55 | 0.36 | 0.006 | 0.004 | 0.17 |
| | | STACKE | 0.25 | 0.17 | 0.55 | 0.36 | 0.006 | 0.004 | 0.17 |
| | | STACKF | 0.25 | 0.17 | 0.55 | 0.36 | 0.006 | 0.004 | 0.17 |
| Gaseous Fuel | Startup | STACKA | 0.21 | 0.15 | 1.85 | 0.20 | 0.006 | 0.004 | 1.45 |
| | | STACKB | 0.21 | 0.15 | 1.85 | 0.20 | 0.006 | 0.004 | 1.45 |
| | | STACKC | 0.21 | 0.15 | 1.85 | 0.20 | 0.006 | 0.004 | 1.45 |
| | | STACKD | 0.21 | 0.15 | 1.85 | 0.20 | 0.006 | 0.004 | 1.45 |
| | | STACKE | 0.21 | 0.15 | 1.85 | 0.20 | 0.006 | 0.004 | 1.45 |
| | | STACKF | 0.21 | 0.15 | 1.85 | 0.20 | 0.006 | 0.004 | 1.45 |
| | Full Load | STACKA | 0.19 | 0.13 | 0.17 | 0.11 | 0.006 | 0.004 | 0.25 |
| | | STACKB | 0.19 | 0.13 | 0.17 | 0.11 | 0.006 | 0.004 | 0.25 |
| | | STACKC | 0.19 | 0.13 | 0.17 | 0.11 | 0.006 | 0.004 | 0.25 |
| | | STACKD | 0.19 | 0.13 | 0.17 | 0.11 | 0.006 | 0.004 | 0.25 |
| | | STACKE | 0.19 | 0.13 | 0.17 | 0.11 | 0.006 | 0.004 | 0.25 |
| | | STACKF | 0.19 | 0.13 | 0.17 | 0.11 | 0.006 | 0.004 | 0.25 |
| | Minimum Load | STACKA | 0.12 | 0.08 | 0.12 | 0.08 | 0.003 | 0.002 | 0.12 |
| | | STACKB | 0.12 | 0.08 | 0.12 | 0.08 | 0.003 | 0.002 | 0.12 |
| | | STACKC | 0.12 | 0.08 | 0.12 | 0.08 | 0.003 | 0.002 | 0.12 |
| | | STACKD | 0.12 | 0.08 | 0.12 | 0.08 | 0.003 | 0.002 | 0.12 |
| | | STACKE | 0.12 | 0.08 | 0.12 | 0.08 | 0.003 | 0.002 | 0.12 |
| | | STACKF | 0.12 | 0.08 | 0.12 | 0.08 | 0.003 | 0.002 | 0.12 |

a. Emissions in a 24-hr period on a g/s basis are expected to be less than that of a 1- or 3-hr period. In a 24-hr period, engines are not expected to operate for more than 23 hours. Therefore, the 1- and 3-hr emission rate is conservative for the 24-hr averaging period.

**Figure 2-1. Facility Layout**




During startup, each engine is expected to reach full load within 5 to 10 minutes of the initial firing. The SCR and oxidation catalyst systems become fully functional once the respective catalyst reaches the normal operating temperature, within 30 minutes following initiation of fuel flow. The time for each catalyst to reach the normal operating temperature is dependent on how long the unit is shut down. The oxidation catalysts reach their normal operating temperature before the SCR catalysts. Startup emissions were evaluated for the following scenarios:

- Cold Startup – when the catalyst temperature is close to ambient temperature. Cold starts are expected after overhaul periods or when the engine has not been operated during the last 24 hours.
- Warm Startup – when the catalyst temperature is above ambient but less than 100 °C. Warm starts are expected after the engine has been shut down for more than 12 hours but less than 24 hours.
- Hot Startup – when the catalyst temperature is greater than 100 °C. Hot starts are expected after the engine has been operated within the previous 12 hours.

The short-term startup emissions are based on the worst-case startup scenario (cold catalysts). The long-term annual average startup emissions are based on worst-case expected annual operation of the proposed units, which assumes an average of 500 start-ups per engine per year. One start-up per week (50 start-ups per year) is assumed to be a cold start. Each startup is assumed to be followed by continuous full-load operation. Unit shutdowns occur very quickly and emissions greater than normal levels during shutdowns are not expected.

Tier 3 NO2 modeling using OLM requires a source specific NO2/NOX in-stack ratio. Based on the review of data for similar units from EPA's NO2/NOX In-Stack Ratio (ISR) Database a source specific

NO2/NOX in-stack ratio of 15% is used for the proposed units. The supporting data for the selected NO2/NOX in-stack ratios of 15% for diesel engines with a displacement of greater than 30 liters per cylinder is summarizes below:

- Dutch Harbor Power Plant tested a Wärtsilä Model 12V32C DEG. EPA's ISR Database lists a NO2/NOX in-stack ratio of 5.52% for the 50% load.
- Dutch Harbor Power Plant tested a Caterpillar C-280 DEG. EPA's ISR Database lists a NO2/NOX in-stack ratio of 4.5% for the 100% load.
- Tor Viking II tested a MaK/6M32 (rated at 3,784 hp) main propulsion diesel engine equipped with SCR and diesel oxidation catalyst. EPA's Alpha ISR Database lists NO2/NOX in-stack ratios for 30%, 40%, 60%, and 80% loads ranging from 4.24% to 15.93%. Of the 7 tests listed, only one had an in-stack ratio greater than 15%.
- Tor Viking II tested a MaK/8M32 (rated at 5,046 hp) main propulsion diesel engine equipped with SCR and diesel oxidation catalyst. EPA's Alpha ISR Database lists NO2/NOX in-stack ratios for 30%, 40%, and 80% loads ranging from 4.71% to 9.27%.
- Vladimir Ignatuk tested a Stork/8TM410 (rated at 5,720 hp) main propulsion diesel engine. EPA's Alpha ISR Database lists NO2/NOX in-stack ratios for 40%, 60%, and 80% loads ranging from 8.16% to 14.79%.

The data from these units support the use of a 15% source specific NO2/NOX in-stack ratio for the proposed units.

## 2.3 AERMOD Meteorological Data

AERMOD uses several different boundary layer parameters to model how pollutants disperse in the atmosphere. Many of these parameters are not directly measured but are calculated from other variables that are more easily measured. AERMET, EPA's meteorological processor for AERMOD, uses observed near-surface wind and temperature and site-specific surface characteristics to estimate these boundary layer parameters (EPA, 2018b). The following surface characteristics are input into AERMET during stage 3 processing:

- Surface roughness length ($z_o$) – the height above the ground at which horizontal wind velocity is typically zero,
- Noon-time albedo (r) – the fraction of radiation reflected by the surface, and
- Daytime Bowen ratio ($B_o$) – the ratio of the sensible heat flux (H) to the latent heat flux ($\lambda E$).

In the AERMOD Implementation Guide, EPA recommends the following methodology to determine these surface characteristics:

1. The determination of the surface roughness length should be based on an inverse-distance weighted geometric mean for a default upwind distance of 1 km relative to the measurement site. Surface roughness length may be varied by sector to account for variations in land cover near the measurement site; however, the sector widths should be no smaller than 30 degrees.
2. The determination of the Bowen ratio should be based on a simple unweighted geometric mean (i.e., no direction or distance dependency) for a representative domain, with a default domain defined by a 10 km by 10 km region centered on the measurement site.
3. The determination of the albedo should be based on a simple unweighted arithmetic mean (i.e., no direction or distance dependency) for the same representative domain as defined for Bowen

ratio, with a default domain defined by a 10 km by 10 km region centered on the measurement site.

EPA developed AERSURFACE to calculate the surface characteristics based on this recommended methodology. AERSURFACE reads land cover, impervious surface, and tree canopy data from the United States Geological Survey (USGS) National Land Cover Dataset (NLCD). The assessment uses the newest dataset available for Hawaii and compatible with AERSURFACE. Meteorological data collected at the Kahului Airport (OGG) and the onsite data from meteorological monitoring Site 251 are used to model the ambient air quality impacts. Figure 2-2 shows the locations of the meteorological monitoring stations and the project site.

**Figure 2-2. Project Site and Meteorological Monitoring Station Locations**


EPA modeling guidance states that the determination of representativeness of meteorological data should include a comparison of factors such as surface characteristics of the measurement site and source locations, surrounding land use, wind roses and significant terrain features. The OGG meteorological data monitoring site is located approximately 3.5 miles northwest of the project site, and the Site 251 meteorological data monitoring station is located approximately 1.1 miles southeast of the project site. No major geographic features impacting the surface conditions or wind patterns exist between the two meteorological data monitoring stations and the project site location.

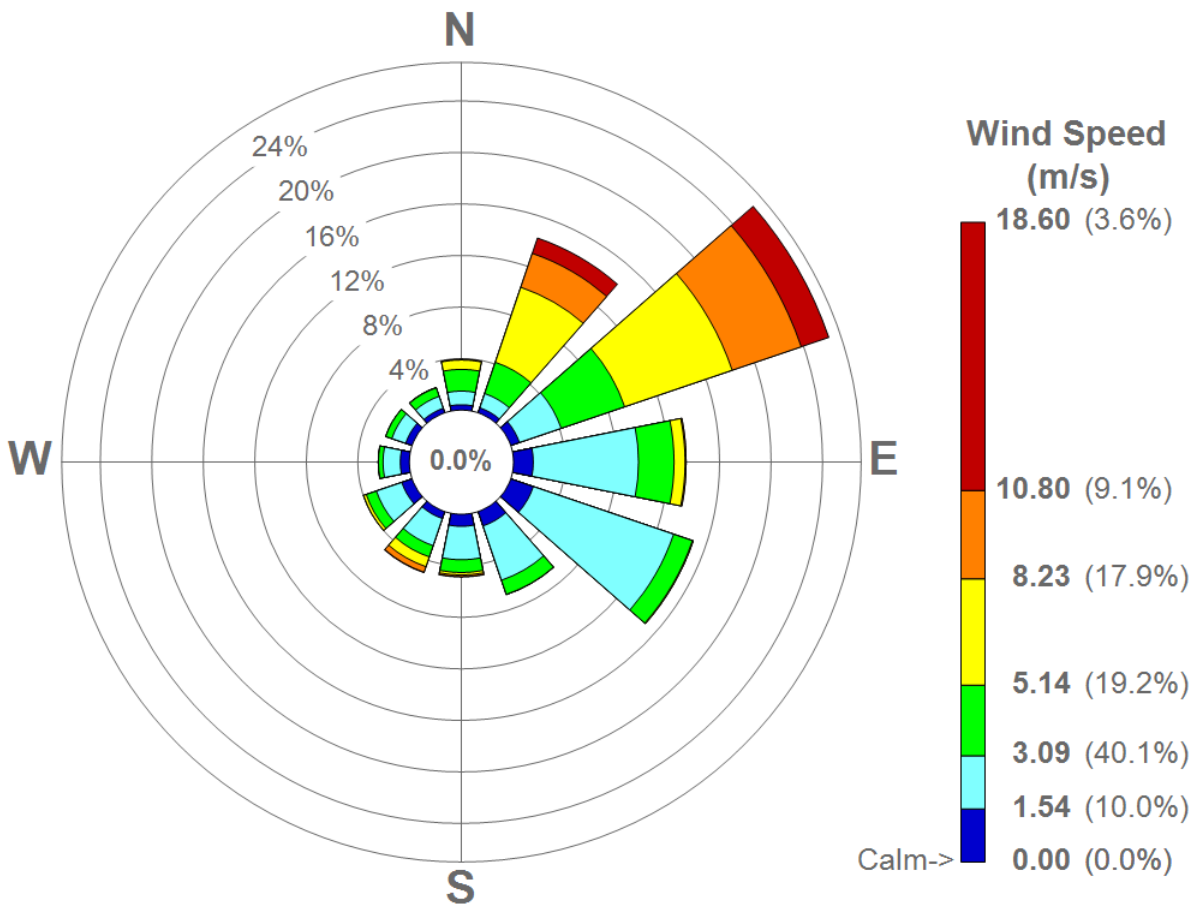
EPA's meteorological processors for AERMOD, AERMET (version 22112) and AERSURFACE (version 20060) was used to create the required meteorological input files. In the Guideline, EPA states that one (1) year of site-specific meteorological data are adequate to ensure that worst-case meteorological conditions are represented in the model results. The 12-month data collection period was from February 1, 1994, through January 31, 1995. The meteorological tower collected the following hourly data at 10 m, 37 m, and 64 m:

- Horizontal and vertical wind speed,
- Wind direction,
- Standard deviation of horizontal wind speed and direction,
- Sigma-w (standard deviation of the vertical wind speed), and
- Temperature (also measured at 2 m) and temperature differences.

Solar radiation was collected at the 64-m level. Cloud cover data was not recorded. Therefore, the Bulk Richardson method was used to calculate the surface friction velocity and Monin-Obukhov length during stable conditions. During convective conditions, cloud cover data from Kahului Airport were input into AERMET.

Figure 2-3 shows the wind rose for meteorological data collected at the Site 251 monitoring station from February 1, 1994, through January 31, 1995.

**Figure 2-3. Site 251 Wind Rose (Feb 1994-Jan 1995)**




## 2.4 AERMOD Receptor Data and Modeling Domain

The modeling grid consists of:

- 25-m spaced receptors along the fence line (i.e., that area to which public access is physically restricted),
- 50-m spaced receptors centered at the project property to 1.0 km,
- 100-m spaced receptors from 1.0 km to 2.5 km,
- 250-m spaced receptors from 2.5 km to 5 km,
- 500-m spaced receptors from 5.0 km to 7.5 km, and
- 1,000-m spaced receptors from 7.5 km to 20 km.

Past HDOH guidance specified fine grid receptor spacing of 50 meters around maximum impacts located in areas of simple terrain (terrain heights below stack top) and spacing of 30 meters or less around maximum impacts in complex terrain (receptors above stack top). The project site is located in a very flat area, and the stacks are 115 ft tall. The initial coarse grid modeling indicated that maximum project impacts occurred in simple terrain, so 50-meter spacing was used for the fine grid modeling for this project.

EPA's AERMAP (version 18081) program determined the receptor elevations and height scales. AERMOD uses the receptor's height scale to determine if the plume is terrain following or terrain impacting. The AERMAP User's Guide states that the domain boundary must include all terrain features that exceed a 10% elevation slope from any given receptor. USGS National Elevation Dataset (NED) 1/3 arc-second data is used to identify all terrain features surrounding the project site.

The worst-case maximum modeled project impacts are located within the 50-m or 100-m spaced receptor grids within 2.5 km from the facility center. Therefore, additional receptors beyond the initial 20 km grid are not needed to identify the maximum impact.

## 2.5 Background Concentrations

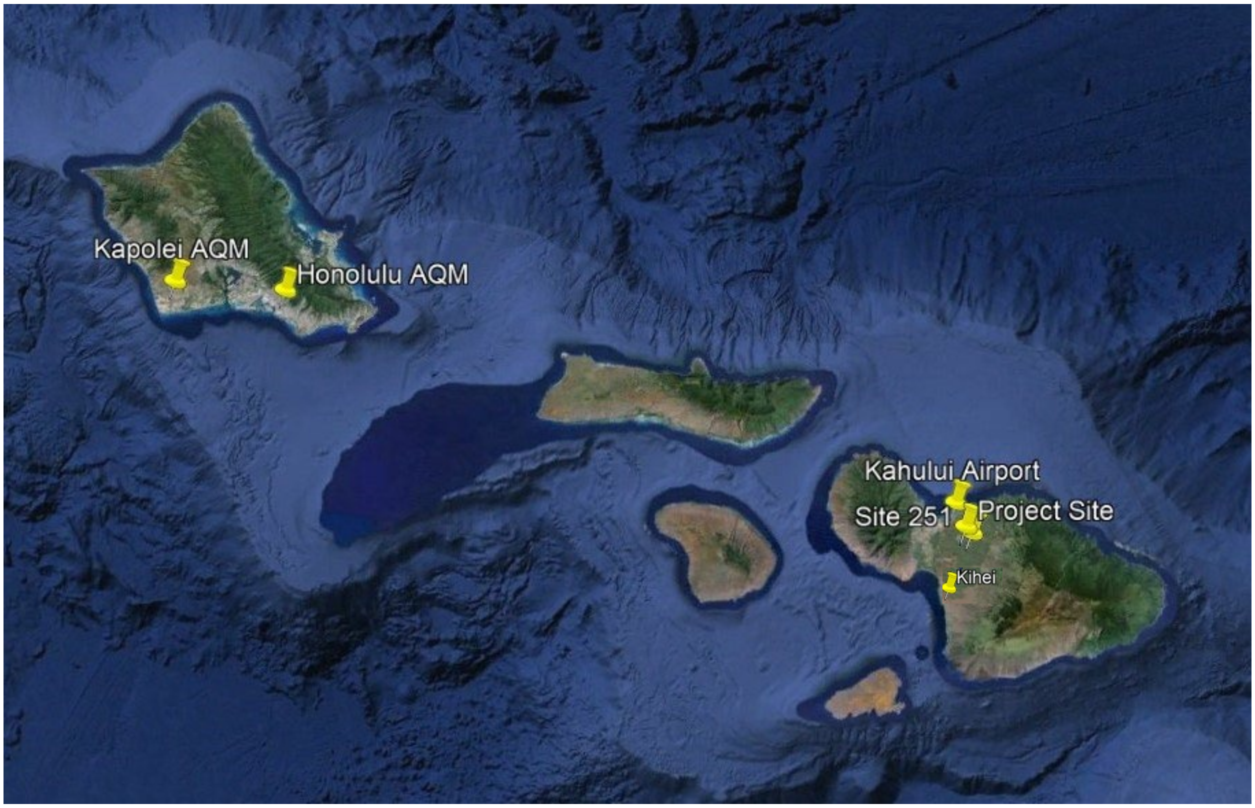
The impacts of existing sources are represented by the existing ambient air quality data collected at nearby monitoring stations. In accordance with Section 8.3.1 of Appendix W to 40 CFR Part 51, background concentrations are an essential part of the total air quality concentration to be considered in determining source impacts. Background air quality includes pollutant concentrations due to: (1) nearby sources, and (2) other sources—that is, the portion of the background attributable to natural sources, other unidentified sources in the vicinity of the project, and regional transport contributions from more distant sources (domestic and international). Typically, air quality data should be used to establish background concentrations in the vicinity of the source(s) under consideration. The Kihei monitoring station is closest and is used for pollutants and years with complete data ($PM_{2.5}$ for 2020 and 2021). $PM_{2.5}$ monitoring at Kihei was discontinued at the end of March 2022. The Kapolei monitoring station has background data available for $NO_2$, $SO_2$, $O_3$, CO, and $PM_{10}$/$PM_{2.5}$. This monitor is located second nearest to the proposed project.

As outlined in 40 CFR 51, Appendix W, Section 8.2, the background data used to evaluate the potential air quality impacts need not be collected on a project site, as long as the data are representative of the air quality in the subject area. The following three criteria were used for determining whether the background data is representative: (1) location, (2) data quality, and (3) data currentness. These criteria are defined and apply to the project as follows:

- Location: The measured data must be representative of the areas where the maximum concentration occurs for the proposed stationary source, existing sources, and a combination of the proposed and existing sources. The Kapolei monitoring station is the most representative of available stations nearest to the proposed project site, and the station has been cited by HDOH to monitor population exposure and/or maximum concentrations. Figure 2-4 shows the location of the project related to the monitoring stations.
- Data quality: Data must be collected, and equipment must be operated in accordance with the requirements of 40 CFR Part 58, Appendices A and B, and PSD monitoring guidance. The HDOH ambient air quality data summaries have been used as the primary sources of data. Therefore, the data listed in Table 2-4 meet the data quality requirements of 40 CFR Part 58, Appendices A and B, and the data align with PSD monitoring guidance. The 2021 $PM_{10}$ data recovery from Kapolei was below minimum for $3^{rd}$ quarter; therefore, the 2021 $PM_{10}$ dataset is from Honolulu.
- Data currentness: The data are current if they have been collected within the preceding 3 years and are representative of existing conditions. The maximum ambient background concentrations from the period 2020 – 2022 are combined with the modeled concentrations and used for

comparison to the ambient air quality standards. Therefore, the data listed in Table 2-4 represent the three most recent years of data available.[2]

**Figure 2-4. Locations of Background Monitoring Stations**




Based on the criteria presented above, the maximum of the three most recent years of background $NO_2$, CO, $SO_2$, $PM_{10}$ and $PM_{2.5}$ data from the listed monitoring stations are combined with the modeled concentrations and for comparison to the ambient air quality standards, as applicable. A summary of the background concentrations is presented in Table 2-4 below. Background values for state and federal standards are shown separately when necessary to reflect the form of the standard and the monitor sampling methods.

In accordance with EPA guidelines, the highest second-highest modeled concentrations are used to demonstrate compliance with the short-term federal standards (except for the statistically based federal one-hour $NO_2$ and $SO_2$, and 24-hour $PM_{2.5}$ standards, discussed in Section 2.1 above) and the highest modeled concentrations are used to demonstrate compliance with the federal annual standards and all state standards. If the predicted total ground-level concentration is below the state or federal ambient air quality standard for each pollutant and averaging period, no further analysis is required for that pollutant and averaging period.

[2] The 2023 data from the HDOH is still being processed and final data were not available when this analysis was prepared.

**Table 2-4. Background Concentrations from the Kapolei Monitoring Station in the Project Area**

| Pollutant | Averaging Period | Ambient Standard | Monitored Background Concentration | | | Maximum Concentration |
|---|---|---|---|---|---|---|
| | | | 2020 | 2021 | 2022 | |
| $NO_2$ | 1-hour [a] – federal std | 100 ppb | 27 ppb | 25 ppb | 23.4 ppb | 27 ppb |
| | Annual – state std | 40 ppb | 3 ppb | 3 ppb | 3 ppb | 3 ppb |
| $SO_2$ | 1-hour [b] – federal std | 75 ppb | 5 ppb | 8 ppb | 6 ppb | 8 ppb |
| | 3-hour – state std | 0.5 ppm | 5 ppb | 2 ppb | 1 ppb | 5 ppb |
| | 24-hour – state std | 0.14 ppm | 3 ppb | 2 ppb | 1 ppb | 3 ppb |
| | Annual – state std | 0.03 ppm | 1 ppb | 1 ppb | <1 ppb | 1 ppb |
| CO | 1-hour – state std | 9 ppm | 0.9 ppm | 0.8 ppm | 0.7 ppm | 0.9 ppm |
| | 8-hour – state std | 4.4 ppm | 0.6 ppm | 0.4 ppm | 0.4 ppm | 0.6 ppm |
| $PM_{10}$ | 24-hour – state std | 150 $\mu g/m^3$ | 43 $\mu g/m^3$ | 46 $\mu g/m^3$ | 48 $\mu g/m^3$ | 48 $\mu g/m^3$ |
| | Annual [c] – state std | 50 $\mu g/m^3$ | 12.3 $\mu g/m^3$ | 9.8 $\mu g/m^3$ | 16.5 $\mu g/m^3$ | 16.5 $\mu g/m^3$ |
| $PM_{2.5}$ | 24-hour [d] – federal std | 35 $\mu g/m^3$ | 11.7 $\mu g/m^3$ | 9.9 $\mu g/m^3$ | 6.6 $\mu g/m^3$ | 11.7 $\mu g/m^3$ |
| | Annual [e] – federal std | 12 $\mu g/m^3$ | 4.2 $\mu g/m^3$ | 3.2 $\mu g/m^3$ | 2.6 $\mu g/m^3$ | 4.2 $\mu g/m^3$ |

Source: PM2.5 from Kihei for 2020 and 2021; all other background data from Kapolei except 2021 PM10 from Honolulu. 2021 PM10 data recovery below minimum for 3rd quarter (see Table 4-1 of 2021 Air Quality Data Book). PM2.5 monitoring at Kihei was discontinued at the end of March 2022. Data from State of Hawaii Annual Summaries of Air Quality Data (https://health.hawaii.gov/cab/hawaii-air-quality-data-books).

Notes:

a. 3-year average $98^{th}$ percentile design values are listed.
b. 3-year average $99^{th}$ percentile design values are listed.
c. Three-year maximum annual average.
d. 3-year average $98^{th}$ percentile design values are listed.
e. 3-year average design values are listed.

Tier 3 $NO_2$ OLM modeling requires concurrent hourly $O_3$ data. Hourly $O_3$ data were obtained from EPA's Air Quality System (AQS) Data Mart for the 12-month period of the meteorological data. The ozone AQS Site ID 15-009-0101 located at the same site as the on-site meteorological station supplies the required $O_3$ data. Missing observations were filled using the following three step approach:

1. When one or two consecutive hours are missing, interpolation was used to fill these missing values.
2. When three or more consecutive hours are missing, the missing values were filled with the maximum concentration from the same hour from the previous and following day.
3. When three or more consecutive hours are missing and both concentrations for the same hour from the previous and following day are missing, missing values were filled with the maximum concentration from the same hour from the entire calendar year.

## 2.6 GEP Stack Height and Building Downwash

For air quality modeling purposes, the proposed new units were evaluated in terms of their proximity to nearby structures to determine whether stack effluents may be affected by downwash in the turbulent wake of such structures. AERMOD uses the following building parameters to account for downwash:

- BUILDHGT, the building height,
- BUILDWID, the projected width of the building perpendicular to the flow,
- BUILDLEN, the projected length of the building along the flow,
- XBADJ, the along-flow distance from the stack to the center of the upwind face of the projected building, and
- YBADJ, the across-flow distance from the stack to the center of the upwind face of the projected building.

Figure 2-5 shows the locations and relative dimensions of the structures included in the downwash analysis. Building parameters were obtained using EPA's Building Profile Input Program designed for AERMOD (BPIPPRM – version 04274). BPIPPRM calculates the building parameters for 36 wind directions based on the physical dimensions of the structures surrounding a source. The BPIPPRM input and output files are included with the modeling files.

The Guideline states the use of stack heights greater than the Good Engineering Practice (GEP) stack height in the modeling is prohibited (40 CFR §51.118 and 40 CFR §51.164). Per 40 CFR §51.100 the GEP stack height limit for this project is the greater of:

- 65 meters, measured from the ground-level elevation at the base of the stack, or
- The formula GEP stack height ($GEP_f = H + 1.5L$). Where, H is the structure height, and L is the lesser dimension of the structure (height or projected width).

The proposed stack height of 35.05 meters (115 ft) is less than the formula GEP stack height; consequently, the stack heights are within acceptable limits and the full stack heights can be used in the modeling.

**Figure 2-5. Site Layout**

# 3. AMBIENT IMPACT MODELING RESULTS

This section describes the modeling methodology used to demonstrate the proposed project does not cause or contribute to the violation of any NAAQS or state ambient air quality standards (SAAQS). The air quality dispersion modeling analyses is organized into two major sub-sections based on U.S. EPA modeling guidance: the Significance Analysis and the Full Impact Analysis. Per U.S. EPA guidance, the Significance Analysis considers the emissions associated only with the proposed project to determine whether they have a significant impact upon the surrounding area. The modeled ground-level concentrations of the Significance Analysis are compared to the corresponding significant impact levels (SILs) to determine whether any modeled ground-level concentrations are greater than the SIL at any receptor (defined as "significant" receptors). If the Significance Analysis indicates that modeled ground-level concentrations for a particular pollutant and averaging period exceeds the applicable SIL at any modeled receptor, a Full Impact Analysis is performed. Each analysis conducted is discussed in detail below. Appendix A contains listings of the modeling files.

## 3.1 Significance Analysis

The significant impact analysis determines the potential of the project to cause or contribute to a violation of any NAAQS/SAAQS. When screening or refined modeling indicates that the project will not cause or contribute to any potential violation of any applicable standard, then the significant impact analysis is generally sufficient for the required demonstration. Table 3-1 lists the modeling SILs that are used to determine if the project has the potential to cause or contribute to a violation.

**Table 3-1. Modeling Significant Impact Level**

| Pollutant | Averaging Period | Design Concentration | Significant Impact Level (µg/m$^3$) |
|---|---|---|---|
| $PM_{10}$ | 24-hour<br>Annual | H1H<br>-- | 5[b]<br>1[b] |
| $PM_{2.5}$ | 24-hour<br>Annual | H1H<br>-- | 1.2[d]<br>0.13[d] |
| $SO_2$ | 1-hour<br>3-hour<br>24-hour<br>Annual | H1H<br>H1H<br>H1H<br>-- | 7.8[c]<br>25[b]<br>5[b]<br>1[b] |
| $NO_2$ | 1-hour<br>Annual | H1H<br>-- | 7.5[a]<br>1[b] |
| CO | 1-hour<br>8-hour | H1H<br>H1H | 2,000[b]<br>500[b] |

a. EPA's Stephen D. Page memorandum, dated June 29, 2010, "Guidance Concerning the Implementing the 1-hr NO2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits," recommends a 1-hr $NO^2$ SIL of 4 ppb (7.5 µg/m$^3$).

b. Table C-4 (page C.28) of the October 1990 Draft New Source Review Workshop Manual.

c. EPA's Stephen D. Page memorandum, dated August 23, 2010, "Guidance Concerning the Implementation of the 1-hour $SO_2$ NAAQS for the Prevention of Significant Deterioration Program," recommends a 1-hour $SO_2$ SIL of 3 ppb (7.8 µg/m$^3$).

d. EPA's Richard Wayland memorandum, dated April 30, 2024, "Supplement to the Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program."
and
EPA's Peter Tsirigotis memorandum, dated April 17, 2018, "Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program."

As previously discussed, the project impact analysis evaluated the units while operating under full load, minimum load, and startup conditions. The following steps were followed for the project impact analysis:

1. Determine the project's maximum impact for all receptors for all averaging periods for the three operating conditions (full load, minimum load, and startup) with all units operating simultaneously.
2. Compare the project's maximum impact identified in step 1 with the SILs listed in Table 3-1.

During startup, the units are expected to reach full load within 5 to 10 minutes of the initial firing; therefore, the modeled stack parameters for the startup and full load scenarios are identical. Table 3-2 and Table 3-3 show the results of the significance analysis for all operating scenarios for RNG and biodiesel, respectively. While this project does include a third operating scenario, where RNG is used for start-up before switching over the fuel used to biodiesel for baseload operations, emissions on an hourly basis are expected to be less than those of the biodiesel operation. Given that modeled stack parameters for the startup and full load scenarios are represented as identical, it is therefore assumed that the modeled biodiesel-only scenario is conservatively representative of the operating scenario where RNG is used for start-up and biodiesel is used for the baseload operation.

The project's secondary $PM_{2.5}$ impacts were included based on EPA's worst-case Modeled Emission Rates for Precursors (MERPs)[3] for the West and Northwest climate zones. Table 3-4 shows the project's secondary $PM_{2.5}$ impact calculation.

**Table 3-2. Summary of Significance Analysis Results (RNG)**

| Pollutant | Averaging Period | Modeled Concentration (µg/m³) | | | | SIL (µg/m³) | Above SIL? |
|---|---|---|---|---|---|---|---|
| | | Start-Up | Full Load | Partial Load | Project Impacts [a] | | |
| $PM_{10}$ | 24-hr | 8.00 | 7.44 | 6.17 | 8.0 | 5.0 | **Yes** |
| | Annual | 0.71 | 0.62 | 0.56 | 0.7 | 1.0 | No |
| $PM_{2.5}$ | 24-hr | 8.00 | 7.44 | 6.17 | 8.3 | 1.2 | **Yes** |
| | Annual | 0.71 | 0.62 | 0.56 | 0.7 | 0.13 | **Yes** |
| $SO_2$ | 1-hr | 0.46 | 0.46 | 0.27 | 0.5 | 7.8 | No |
| | 3-hr | 0.32 | 0.32 | 0.16 | 0.3 | 25.0 | No |
| | 24-hr | 0.24 | 0.23 | 0.15 | 0.2 | 5.0 | No |
| | Annual | 0.02 | 0.02 | 0.01 | 0.02 | 1.0 | No |
| $NO_2$ | 1-hr | 91.11 | 10.96 | 9.44 | 91.1 | 7.5 | **Yes** |
| | Annual | 0.83 | 0.46 | 0.47 | 0.8 | 1.0 | No |
| CO | 1-hr | 106.22 | 18.64 | 10.59 | 106.2 | 2000 | No |
| | 8-hr | 63.62 | 11.17 | 6.48 | 63.6 | 500 | No |

a. Project impacts represent the maximum modeled concentration across all operating scenarios. In the case of $PM_{2.5}$, the secondary particulate matter emissions calculated using the MERPs are also included. See Table 3-4 for more details.

[3] EPA's Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program (EPA-454/R-19-003), dated April 2019

**Table 3-3. Summary of Significance Analysis Results (Biodiesel)**

| Pollutant | Averaging Period | Modeled Concentration (μg/m³) | | | | SIL (μg/m³) | Above SIL? |
|---|---|---|---|---|---|---|---|
| | | Start-Up | Full Load | Partial Load | Project Impacts [a] | | |
| $PM_{10}$ | 24-hr | 17.30 | 16.05 | 13.54 | 17.3 | 5.0 | **Yes** |
| | Annual | 1.56 | 1.33 | 1.25 | 1.6 | 1.0 | **Yes** |
| $PM_{2.5}$ | 24-hr | 17.30 | 16.05 | 13.54 | 17.6 | 1.2 | **Yes** |
| | Annual | 1.56 | 1.33 | 1.25 | 1.6 | 0.13 | **Yes** |
| $SO_2$ | 1-hr | 0.92 | 0.93 | 0.53 | 0.9 | 7.8 | No |
| | 3-hr | 0.65 | 0.65 | 0.41 | 0.7 | 25.0 | No |
| | 24-hr | 0.48 | 0.46 | 0.29 | 0.5 | 5.0 | No |
| | Annual | 0.04 | 0.04 | 0.03 | 0.0 | 1.0 | No |
| $NO_2$ | 1-hr | 142.03 | 61.26 | 46.40 | 142.0 | 7.5 | **Yes** |
| | Annual | 4.23 | 2.86 | 2.31 | 4.2 | 1.0 | **Yes** |
| CO | 1-hr | 57.78 | 26.72 | 15.71 | 57.8 | 2,000 | No |
| | 8-hr | 34.68 | 16.04 | 9.79 | 34.7 | 500 | No |

a. Project impacts represent the maximum modeled concentration across all operating scenarios. In the case of $PM_{2.5}$, the secondary particulate matter emissions calculated using the MERPs are also included. See Table 3-4 for more details. Project impact results represent the highest 1st high (H1H) for short-term averaging periods, so these results are not comparable to the NAAQS which are often in the form of 98% (8th highest day) or 99th% (4th highest day).

b. While averaging periods and emission rates are the same between $PM_{10}$ and $PM_{2.5}$, $PM_{10}$ results represent the H1H from a 5-year data set while $PM_{2.5}$ results represent the highest 5-year average of the H1H.

**Table 3-4. MERP Based Estimated Secondary $PM_{2.5}$**

| Precursor Pollutant | Precursor Project Emissions [a] (tpy) | MERP [b] | |
|---|---|---|---|
| | | $PM_{2.5}$ - Daily | $PM_{2.5}$ - Annual |
| $NO_X$ | 220.17 | 1,073 | 3,182 |
| $SO_2$ | 1.96 | 188 | 2,331 |
| **MERP Critical Threshold (μg/m³)** | | 1.2 | 0.2 |
| **Project % of MERP** | | 24% | 8% |
| **MERP Secondary $PM_{2.5}$** | | 0.259 | 0.014 |

a. The listed precursor emissions are the worst-case project emissions among all operating scenarios.

b. The listed MERPs are from EPA's Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program (EPA-454/R-19-003), dated April 2019. The lowest (worst-case) MERPs for the West and Northwest climate zones from Table 4-1 are selected. The application of the outdated SIL in this case is used to develop the ratio, consistent with the April 2024 guidance (https://www.epa.gov/sites/default/files/2020-09/documents/epa-454_r-19-003.pdf).

Based on the results of the significant impact analysis a full impact analysis is required for $NO_2$, $PM_{2.5}$, and $PM_{10}$. The results of the full impact analysis are presented in the following section.

## 3.2 Full Impact Analysis

A Full Impact Analysis is conducted for $NO_2$, $PM_{2.5}$, and $PM_{10}$ as required based on the significance analysis. While a Full Impact Analysis is not required for $SO_2$ and CO, they are included in this Full Impact Analysis as well. The NAAQS/SAAQS are maximum concentration limits in terms of the total concentration of a pollutant in the atmosphere. To ensure compliance with the NAAQS/SAAQS, the modeled project impacts at each respective design concentration are added to the representative background concentration. The representative background concentration accounts for the impact of nearby and distant sources. Table 3-5 lists the modeling NAAQS/SAAQS and respective design concentrations that are used to determine if the project has the potential to cause or contribute to a violation of the standard.

**Table 3-5. Modeling NAAQS/SAAQS**

| Pollutant | Averaging Period | Design Concentration | NAAQS ($\mu g/m^3$) | SAAQS ($\mu g/m^3$) |
|---|---|---|---|---|
| $PM_{10}$ | 24-hour<br>Annual | H2H<br>-- | 150<br>-- | 150<br>50 |
| $PM_{2.5}$ | 24-hour<br>Annual | H8H<br>-- | 35<br>9 | --<br>-- |
| $SO_2$ | 1-hour<br>3-hour<br>24-hour<br>Annual | H4H<br>H2H<br>H2H<br>-- | 196<br>--<br>--<br>-- | --<br>1,300<br>365<br>80 |
| $NO_2$ | 1-hour<br>Annual | H8H<br>-- | 188<br>100 | --<br>70 |
| CO | 1-hour<br>8-hour | H2H<br>H2H | 40,000<br>10,000 | 10,000<br>5,000 |

Table 3-6 and Table 3-7 compare the combined impact of the proposed project under startup, full load, and partial load operating conditions and ambient background concentrations to the respective NAAQS or SAAQS for the RNG and biodiesel operating scenarios, respectively. These results show the project does not cause or contribute to an exceedance for any NAAQS or SAAQS under any operating scenario, even during worst-case startup conditions.

### Table 3-6. NAAQS/SAAQS Analysis Results (RNG)

| Pollutant | Averaging Period | Modeled Concentration ($\mu g/m^3$) | | | Secondary $PM_{2.5}$ Concentration ($\mu g/m^3$) | Background Concentration ($\mu g/m^3$) | Total Impact ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) | Above NAAQS? | SAAQS ($\mu g/m^3$) | Above SAAQS? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Start-Up | Full Load | Partial Load | | | | | | | |
| $PM_{10}$ | 24-hr | 7.73 | 7.18 | 5.85 | -- | 48.0 | 55.7 | 150 | No | 150 | No |
| | Annual | 0.71 | 0.62 | 0.56 | -- | 16.5 | 17.2 | -- | -- | 50 | No |
| $PM_{2.5}$ | 24-hr | 5.41 | 5.03 | 4.70 | 0.26 | 11.7 | 17.4 | 35 | No | -- | -- |
| | Annual | 0.71 | 0.62 | 0.56 | 0.01 | 4.2 | 4.9 | 9 | No | -- | -- |
| $SO_2$ | 1-hr | 0.37 | 0.37 | 0.24 | -- | 21.0 | 21.3 | 196 | No | -- | -- |
| | 3-hr | 0.29 | 0.29 | 0.14 | -- | 13.1 | 13.4 | -- | -- | 1,300 | No |
| | 24-hr | 0.23 | 0.22 | 0.14 | -- | 7.9 | 8.1 | -- | -- | 365 | No |
| | Annual | 0.02 | 0.02 | 0.01 | -- | 2.6 | 2.6 | -- | -- | 80 | No |
| $NO_2$ | 1-hr | 76.25 | 7.87 | 7.60 | -- | 50.8 | 127.0 | 188 | No | -- | -- |
| | Annual | 0.83 | 0.46 | 0.47 | -- | 5.6 | 6.5 | 100 | No | 70 | No |
| CO | 1-hr | 95.39 | 16.74 | 10.10 | -- | 1,035 | 1,130 | 40,000 | No | 10,000 | No |
| | 8-hr | 60.83 | 10.68 | 6.44 | -- | 690 | 751 | 10,000 | No | 5,000 | No |

### Table 3-7. NAAQS/SAAQS Analysis Results (Biodiesel)

| Pollutant | Averaging Period | Modeled Concentration ($\mu g/m^3$) | | | Secondary $PM_{2.5}$ Concentration ($\mu g/m^3$) | Background Concentration ($\mu g/m^3$) | Total Impact ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) | Above NAAQS? | SAAQS ($\mu g/m^3$) | Above SAAQS? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Start-Up | Full Load | Partial Load | | | | | | | |
| $PM_{10}$ | 24-hr | 16.60 | 15.40 | 12.67 | -- | 48.0 | 64.6 | 150 | No | 150 | No |
| | Annual | 1.56 | 1.33 | 1.25 | -- | 16.5 | 18.1 | -- | -- | 50 | No |
| $PM_{2.5}$ | 24-hr | 11.71 | 10.86 | 10.59 | 0.26 | 11.7 | 23.7 | 35 | No | -- | -- |
| | Annual | 1.56 | 1.33 | 1.25 | 0.01 | 4.2 | 5.8 | 9 | No | -- | -- |
| $SO_2$ | 1-hr | 0.74 | 0.75 | 0.46 | -- | 20.96 | 21.7 | 196 | No | -- | -- |
| | 3-hr | 0.58 | 0.59 | 0.36 | -- | 13.1 | 13.7 | -- | -- | 1,300 | No |
| | 24-hr | 0.46 | 0.44 | 0.27 | -- | 7.9 | 8.3 | -- | -- | 365 | No |
| | Annual | 0.04 | 0.04 | 0.03 | -- | 2.6 | 2.7 | -- | -- | 80 | No |
| $NO_2$ | 1-hr | 126.61 | 43.59 | 35.94 | -- | 50.8 | 177.4 | 188 | No | -- | -- |
| | Annual | 4.23 | 2.86 | 2.31 | -- | 5.6 | 9.9 | 100 | No | 70 | No |
| CO | 1-hr | 52.49 | 24.28 | 14.78 | -- | 1,035.0 | 1087.5 | 40,000 | No | 10,000 | No |
| | 8-hr | 32.94 | 15.24 | 9.44 | -- | 690.0 | 722.9 | 10,000 | No | 5,000 | No |

**Appendix Table A-1. AERMOD Run Log**

| File Name[a] | Pollutant / Scenario | Averaging Period | Modeled Year(s) | Description |
|---|---|---|---|---|
| COND94_1hrand8hr_BIO_FL.ami | CO – Biodiesel Full Load | 1-hr and 8-hr | 2/1/1994 – 1/31/1995 | Project significant impact modeling – maximum (H1H) |
| COND94_1hrand8hr_BIO_LL.ami | CO – Biodiesel Low Load | | | |
| COND94_1hrand8hr_BIO_SU.ami | CO – Biodiesel Start Up | | | |
| COND94_1hrand8hr_RNG_FL.ami | CO – RNG Full Load | | | |
| COND94_1hrand8hr_RNG_LL.ami | CO – RNG Low Load | | | |
| COND94_1hrand8hr_RNG_SU.ami | CO – RNG Start Up | | | |
| SO2ND94_1hr_BIO_FL | $SO_2$ – Biodiesel Full Load | 1-hr | 2/1/1994 – 1/31/1995 | Project significant impact modeling – maximum (H1H) |
| SO2ND94_1hr_BIO_LL | $SO_2$ – Biodiesel Low Load | | | |
| SO2ND94_1hr_BIO_SU | $SO_2$ – Biodiesel Start Up | | | |
| SO2ND94_1hr_RNG_FL | $SO_2$ – RNG Full Load | | | |
| SO2ND94_1hr_RNG_LL | $SO_2$ – RNG Low Load | | | |
| SO2ND94_1hr_RNG_SU | $SO_2$ – RNG Start Up | | | |
| SO2ND94_3hr_BIO_FL | $SO_2$ – Biodiesel Full Load | 3-hr | 2/1/1994 – 1/31/1995 | Project significant impact modeling – maximum (H1H) |
| SO2ND94_3hr_BIO_LL | $SO_2$ – Biodiesel Low Load | | | |
| SO2ND94_3hr_BIO_SU | $SO_2$ – Biodiesel Start Up | | | |
| SO2ND94_3hr_RNG_FL | $SO_2$ – RNG Full Load | | | |
| SO2ND94_3hr_RNG_LL | $SO_2$ – RNG Low Load | | | |
| SO2ND94_3hr_RNG_SU | $SO_2$ – RNG Start Up | | | |
| SO2ND94_24hr_BIO_FL | $SO_2$ – Biodiesel Full Load | 24-hr | 2/1/1994 – 1/31/1995 | Project significant impact modeling – maximum (H1H) |
| SO2ND94_24hr_BIO_LL | $SO_2$ – Biodiesel Low Load | | | |
| SO2ND94_24hr_BIO_SU | $SO_2$ – Biodiesel Start Up | | | |
| SO2ND94_24hr_RNG_FL | $SO_2$ – RNG Full Load | | | |
| SO2ND94_24hr_RNG_LL | $SO_2$ – RNG Low Load | | | |
| SO2ND94_24hr_RNG_SU | $SO_2$ – RNG Start Up | | | |
| SO2ND94_Annual_BIO_FL | $SO_2$ – Biodiesel Full Load | Annual | 2/1/1994 – 1/31/1995 | Project significant impact modeling - Annaul |
| SO2ND94_ Annual _BIO_LL | $SO_2$ – Biodiesel Low Load | | | |
| SO2ND94_ Annual _BIO_SU | $SO_2$ – Biodiesel Start Up | | | |
| SO2ND94_ Annual _RNG_FL | $SO_2$ – RNG Full Load | | | |
| SO2ND94_ Annual _RNG_LL | $SO_2$ – RNG Low Load | | | |
| SO2ND94_ Annual _RNG_SU | $SO_2$ – RNG Start Up | | | |
| P25ND94_24hr_BIO_FL.ami | $PM_{2.5}$ – Biodiesel Full Load | 24-hr | 2018-2022 | Project significant impact/NAAQS modeling – maximum (H1H and H8H) |
| P25ND94_24hr_BIO_LL.ami | $PM_{2.5}$ – Biodiesel Low Load | | | |
| P25ND94_24hr_BIO_SU.ami | $PM_{2.5}$ – Biodiesel Start Up | | | |
| P25ND94_24hr_RNG_FL.ami | $PM_{2.5}$ – RNG Full Load | | | |
| P25ND94_24hr_RNG_LL.ami | $PM_{2.5}$ – RNG Low Load | | | |
| P25ND94_24hr_RNG_SU.ami | $PM_{2.5}$ – RNG Start Up | | | |
| P25ND94_Annual_BIO_FL.ami | $PM_{2.5}$ – Biodiesel Full Load | Annual | 2/1/1994 – 1/31/1995 | Project significant impact/NAAQS modeling |
| P25ND94_Annual_BIO_LL.ami | $PM_{2.5}$ – Biodiesel Low Load | | | |
| P25ND94_Annual_BIO_SU.ami | $PM_{2.5}$ – Biodiesel Start Up | | | |
| P25ND94_Annual_RNG_FL.ami | $PM_{2.5}$ – RNG Full Load | | | |
| P25ND94_Annual_RNG_LL.ami | $PM_{2.5}$ – RNG Low Load | | | |
| P25ND94_Annual_RNG_SU.ami | $PM_{2.5}$ – RNG Start Up | | | |
| P25ND94_24hr_BIO_FL.ami | $PM_{10}$ – Biodiesel Full Load | 24-hr | 2/1/1994 – 1/31/1995 | Project significant impact/NAAQS modeling – maximum (H1H and H2H) |
| P25ND94_24hr_BIO_LL.ami | $PM_{10}$ – Biodiesel Low Load | | | |
| P25ND94_24hr_BIO_SU.ami | $PM_{10}$ – Biodiesel Start Up | | | |
| P25ND94_24hr_RNG_FL.ami | $PM_{10}$ – RNG Full Load | | | |
| P25ND94_24hr_RNG_LL.ami | $PM_{10}$ – RNG Low Load | | | |

| File Name[a] | Pollutant / Scenario | Averaging Period | Modeled Year(s) | Description |
|---|---|---|---|---|
| P25ND94_24hr_RNG_SU.ami | $PM_{10}$ – RNG Start Up | | | |
| P25ND94_Annual_BIO_FL.ami<br>P25ND94_Annual_BIO_LL.ami<br>P25ND94_Annual_BIO_SU.ami<br>P25ND94_Annual_RNG_FL.ami<br>P25ND94_Annual_RNG_LL.ami<br>P25ND94_Annual_RNG_SU.ami | $PM_{10}$ – Biodiesel Full Load<br>$PM_{10}$ – Biodiesel Low Load<br>$PM_{10}$ – Biodiesel Start Up<br>$PM_{10}$ – RNG Full Load<br>$PM_{10}$ – RNG Low Load<br>$PM_{10}$ – RNG Start Up | Annual | 2/1/1994 – 1/31/1995 | Project significant impact/NAAQS modeling |
| NNF94_1hr_BIO_FL.ami<br>NNF94_1hr_BIO_LL.ami<br>NNF94_1hr_BIO_SU.ami<br>NNF94_1hr_RNG_FL.ami<br>NNF94_1hr_RNG_LL.ami<br>NNF94_1hr_RNG_SU.ami | $NO_2$ – Biodiesel Full Load<br>$NO_2$ – Biodiesel Low Load<br>$NO_2$ – Biodiesel Start Up<br>$NO_2$ – RNG Full Load<br>$NO_2$ – RNG Low Load<br>$NO_2$ – RNG Start Up | 1-hr | 2/1/1994 – 1/31/1995 | Project significant impact/NAAQS modeling – maximum (H1H and H8H) |
| NNF94_Annual_BIO_FL.ami<br>NNF94_Annual_BIO_LL.ami<br>NNF94_Annual_BIO_SU.ami<br>NNF94_Annual_RNG_FL.ami<br>NNF94_Annual_RNG_LL.ami<br>NNF94_Annual_RNG_SU.ami | $NO_2$ – Biodiesel Full Load<br>$NO_2$ – Biodiesel Low Load<br>$NO_2$ – Biodiesel Start Up<br>$NO_2$ – RNG Full Load<br>$NO_2$ – RNG Low Load<br>$NO_2$ – RNG Start Up | Annual | 2/1/1994 – 1/31/1995 | Project significant impact/NAAQS modeling |

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December 2, 2024

To: Kori Chun, HDOH Clean Air Branch

From: Nancy Matthews Nancy Matthews

Subject: Ukiu Energy Project

We are writing to provide additional technical information in support of our application for an initial Covered Source Permit for the proposed Ukiu Energy Project to be located near Pu'unene, Maui. This is similar to the supplemental information that you requested for the Pu'uloa Energy Project during your review of that permit application. Because the two projects are so similar, we expect that similar project-specific information will be needed for your review of the Ukiu project.

For convenience, we are providing a restatement of the information requested for the Pu'uloa project, followed by the project-specific information for the Ukiu project.

1. *Please provide a summary of proposed maximum hourly and daily emission limits that would effectively limit startups to ensure consistency with the startup assumptions used in the August 2024 Air Dispersion Modeling Report.*

The demonstration of compliance with ambient standards during startups was based on the following assumptions:

- Worst-case hour: the equivalent of one startup for each engine, or 6 startups per hour
- Worst-case day: the equivalent of one startup and 23 hours of full-load operation for each engine per day

Proposed hourly and annual emission limits are provided in the form of draft permit conditions in Attachment 1. Separate hourly emission limits are proposed for normal operating hours and for hours that include a startup. In addition, maximum annual impacts reflected the equivalent of 500 startups plus 5750 hours of full-load operation for each engine. Proposed annual emission limits are included in Attachment 1 to ensure that annual operations do not result in emissions in excess of those evaluated in the modeling analysis.

2. *Please provide a proposed condition to limit minimum engine loads to 40% of rated load. If an exemption from the minimum load limit is desired during maintenance and testing operations, please propose permit language for the exemption and include language describing the maintenance and testing operations during which such an alternate operating scenario would apply.*

The following permit language is proposed to limit minimum engine loads to 40% of rated load:

> Except during engine generator startup, shutdown, maintenance and testing, the minimum engine generator load shall not be less than 40% of full rated load. Compliance with this minimum load shall be determined on a fifteen-minute average basis.

The applicant proposes the following alternate operating scenario condition to allow the engine generators to operate below 40% load if necessary during maintenance and testing operations.

X. Alternate Operating Scenarios

a. The permittee may operate each engine generator below 40% of maximum rated load (2992 kW, "low-load operation") for the purpose of maintenance and testing if the following provisions are adhered to:
   i. The maintenance and testing operation is performed for one of the following purposes:
      (a) evaluate the ability of an engine or its supported equipment to perform during an emergency;
      (b) facilitate the training of personnel on emergency activities; or
      (c) perform emissions testing, maintenance and operational testing, or safety-related testing as required by any government agency or by the manufacturer as a requirement of any law, regulation, rule, ordinance, standard, or contract.
   ii. The maintenance and testing shall be conducted as efficiently as possible to minimize low-load operation.
b. The following records shall be maintained:
   i. The date of the maintenance and testing operation during which the low-load operation occurred;
   ii. A description of the maintenance and testing performed and the justification under Condition X.a.i. above;
   iii. The beginning and ending times of the low-load operation.

3. *Please describe how the applicant proposes to monitor engine loads to ensure compliance with the proposed 40% minimum load condition on a one-hour average basis.*

The applicant proposes to continuously monitor and record engine operating loads (in kW), along with the start and end times of each startup and shutdown sequence, any maintenance and/or testing, and the associated date and time of the monitored data. The load data will be averaged over 15-minute intervals. Startup, shutdown,[1] and maintenance and testing periods will be excluded from the averages.

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[1] As we have previously discussed, shutdowns occur so quickly that compliance with emissions limits is not affected. However, it has been our experience that the timing of a shutdown can affect the determination of average load. For example, if the last 30 seconds of a one-minute shutdown occur during

4. *Please indicate whether it would be acceptable for the permit to include a single set of monitoring, recordkeeping and reporting conditions related to new source performance standards that reflect the more stringent of the Subpart IIII (for compression ignition, or CI, operation) or Subpart JJJJ (for spark ignition, or SI, operation) requirements.*

It appears that the only substantive difference in applicable monitoring, recordkeeping and reporting requirements between Subpart IIII and Subpart JJJJ for these engines is the requirement in § 60.4211(d)(2). This section requires owners/operators of large CI RICE to establish operating parameters to be monitored continuously to ensure that the CI RICE continues to meet the applicable emissions standards, while there is no comparable requirement for SI RICE. Therefore, we request that the condition that enforces this applicable requirement be written so that it clearly applies only during liquid fuel operation.

5. *Although the application indicates that the facility is not a major source for HAPs, (but is still considered a major source as defined in HAR 11-60.1-1) the Clean Air Branch is requesting the resubmittal of a HAPs assessment for the project that is based on the maximum hourly and maximum annual emission rates for each HAP. Please also include a demonstration that 8-hour ammonia impacts will not exceed the regulatory threshold.*

The HAPS assessment that was submitted was based on the maximum hourly emission rates for each HAP as the analysis was performed for the engines at full rated load for each fuel. An updated assessment of 8-hour average impacts for each fuel that includes ammonia is included in Attachment 2.

An assessment of annual HAPS for each fuel based on 8760 hours per year of operation at full rated load, to reflect the maximum potential annual HAPs emissions, is included as Attachment 2.

6. *Please clarify why the formaldehyde emission factor for Case 3 -- 100% Biodiesel was based on the RICE NESHAP limit for diesel engines located at major sources for HAPs. It is the Department's understanding that the project is not a major source for HAPs.*

Although the project is not a major source of HAPs, the engines will be equipped with oxidation catalysts just as they would be if they were subject to the RICE NESHAP limit. For this reason, we believe the RICE NESHAP limit is the appropriate formaldehyde emission factor for these engines.

7. *The application specifies that the proposed emergency diesel engine generator (DEG) will be a 755 bhp Cummins DEG, Model DFEK (or equivalent). Please clarify how "equivalent" should be defined.*

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the first 30 seconds of one of the 15-minute averaging periods, the average load for that period would be recorded as ~20% and would appear to be a violation of the low load limit.

We understand that the CAB would need to review and approve any alternative engine to confirm equivalence prior to installation. We propose the following condition to provide a mechanism for CAB concurrence.

> The Permittee shall submit a written request at least 30 days in advance of the installation of any equivalent engine for the proposed emergency diesel engine generator (755 bhp Cummins DEG, Model DFEK). The Permittee's request for approval of an equivalent engine shall include the following information: engine manufacturer and model number, horsepower (hp) rating, exhaust stack information, and manufacturer's guaranteed emissions.

8. *Please provide documentation for the formaldehyde emission rate used in assessing emissions during RNG firing.*

The requested documentation is included as Attachment 3.

Thank you for the opportunity to submit this supplemental information. If you have any questions or need additional information to complete your review of our application, please do not hesitate to contact me.

Attachments

Cc: Bob Albertini, Ameresco

**Attachment 1**
**Proposed Permit Conditions**

1. Emission Limits
   a. The permittee shall not discharge or cause the discharge of nitrogen oxides ($NO_X$) as nitrogen dioxide ($NO_2$), carbon monoxide (CO), volatile organic compounds (VOC) as methane ($CH_4$), particulate matter 10 micrometers and 2.5 micrometers in diameter and smaller ($PM_{10}/PM_{2.5}$), and ammonia ($NH_3$) into the atmosphere from each engine generator in excess of the following limits. These mass emission limits shall apply at all times with the exception of NOx, CO and $PM_{10}/PM_{2.}$emission limits during any hour that includes a startup, as specified in Condition 1.b:

| Table 1 | | |
|---|---|---|
| Pollutant | Maximum Emission Limit (each engine, lb/hr, 3-hour Average) | |
| | Biodiesel | Renewable Natural Gas |
| NOx (as $NO_2$) | 8.64 | 1.32 |
| CO | 3.01 | 2.02 |
| VOC (as CH4) | 3.44 | 2.00 |
| $PM_{10}/PM_{2.5}$ | 3.61 | 1.61 |
| $NH_3$ | 0.91 | 0.82 |

   b. For NOx, CO and $PM_{10}/PM_{2.5}$ only, during any hour that includes a startup, the permittee shall not discharge or cause the discharge of emissions into the atmosphere from each engine generator in excess of the following limits:

| Table 2 | |
|---|---|
| Pollutant | Maximum Emission Limit (each engine, 1-hour Average) |
| | lb/hr, any fuel |
| NOx (as $NO_2$) | 57.32 |
| CO | 12.01 |
| $PM1_0/PM_{2.5}$ | 6.81 |

   c. The permittee shall not discharge or cause the discharge of nitrogen oxides ($NO_X$) as nitrogen dioxide ($NO_2$), carbon monoxide (CO), volatile organic compounds (VOC) as methane ($CH_4$), particulate matter 10 micrometers and 2.5 micrometers in diameter and smaller ($PM_{10}/PM_{2.5}$), and ammonia ($NH_3$) into the atmosphere from each engine generator in excess of the following limits. These emission concentration limits shall apply at all times with the exception of NOx, CO and $PM_{10}/PM_{2.}$emission limits during any hour that includes a startup, as specified in Condition 1.b:

| Table 3 | | | | |
|---|---|---|---|---|
| Pollutant | Load Range | Maximum Emission Limit (3-hour Average) | | |
| | | Biodiesel | Renewable Natural Gas | Units |
| NOx (as $NO_2$) | 75-100% | 35 | 6 | ppmc[1] |
| | 40-74% | 40 | 9 | ppmc |
| CO | all | 20 | 15 | ppmc |
| VOC (as CH4) | 75-100% | 40 | 26 | ppmc |
| | 40-74% | 40 | 42 | ppmc |
| $PM_{10}/PM_{2.5}$ | 75-100% | 30 | 15 | $mg/Nm^3$ |
| | 40-74% | 40 | 20 | $mg/Nm^3$ |
| $NH_3$ | all | 10 | 10 | ppmc |

Note:

1. ppmc: parts per million by volume, dry, corrected to 15% $O_2$

d. The permittee shall not discharge or cause the discharge of nitrogen oxides (NOx) as nitrogen dioxide ($NO_2$), carbon monoxide (CO), sulfur dioxide (SOx), and particulate matter 10 micrometers and 2.5 micrometers in diameter and smaller ($PM_{10}/PM_{2.5}$) into the atmosphere from all engine generators in excess of the following annual limits:

| Table 4 | |
|---|---|
| Pollutant | Maximum Emission Limit (Total, all engines, tons/year) |
| NOx (as $NO_2$) | 220.2 |
| SOx | 2.0 |
| CO | 67.6 |
| $PM_{10}/PM_{2.5}$ | 72.5 |

**Attachment 2**
**Supplemental HAPS Assessment**

**Waena Project**
**Wärtsilä 16V34DF Engines**
**Annual Non-Criteria Pollutant Emissions Assessment BASED ON 8760 HRS/YR OF FULL LOAD OPERATION**
**Biodiesel only**

| Pollutant | Biodiesel Emission Factor (1) lb/Mgal | Controlled Biodiesel Em Factor (2) lb/Mgal | Hourly Emissions per Engine, Biodiesel Firing lb/hr | Annual Emissions per Engine Biodiesel Firing tpy | Total Annual Emissions, all Engines Biodiesel Firing (5) tpy | Chronic Impacts: Annual Emission Rate, g/s (all engines) | Chronic Impacts: Annual impact, ug/m3 | Chronic Impacts: Annual REL, ug/m3 (1) | Chronic Impacts: Annual Impact > REL? | Chronic Impacts: 1/420 x TWA/TLV | Chronic Impacts: Annual Impact > 1/420 x TWA/TLV? | Cancer Risk: Unit Risk, per µg/m3 (3,4) | Cancer Risk: Cancer Risk x10E-6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ammonia | (3) | n/a | 0.91 | 2.7 | 16.4 | | | | | | | | |
| Propylene | 3.85E-01 | 2.31E-01 | 0.10 | 0.4 | 2.66 | | | | | | | | |
| Hazardous Air Pollutants | | | | | | | | | | | | | |
| Acetaldehyde | 3.47E-03 | 2.08E-03 | 9.13E-04 | 4.0E-03 | 2.40E-02 | 6.90E-04 | 5.13E-04 | 140 | no | n/a | n/a | 2.20E-06 | 1.13E-03 |
| Acrolein | 1.07E-03 | 6.42E-04 | 2.81E-04 | 1.2E-03 | 7.40E-03 | 2.13E-04 | 1.58E-04 | 0.35 | no | n/a | n/a | n/a | n/a |
| Benzene | 1.01E-01 | 6.06E-02 | 2.66E-02 | 1.2E-01 | 6.98E-01 | 2.01E-02 | 1.49E-02 | 3 | no | 4 | no | 7.80E-06 | 0.12 |
| Ethylbenzene | 6.76E-03 | 4.06E-03 | 1.78E-03 | 7.8E-03 | 4.67E-02 | 1.34E-03 | 9.99E-04 | 2 | no | 207 | no | 3.50E-05 | 0.03 |
| Formaldehyde | n/a | 2.07E-01 | 9.07E-02 | 0.40 | 2.38 | 6.86E-02 | 5.10E-02 | 2000 | no | 0.29 | no | 2.60E-06 | 0.13 |
| Hexane | 1.39E-03 | 8.34E-04 | 3.66E-04 | 1.6E-03 | 9.61E-03 | 2.76E-04 | 2.05E-04 | 9 | no | 420 | no | 1.30E-05 | 2.67E-03 |
| Naphthalene | 1.63E-02 | 9.78E-03 | 4.29E-03 | 1.9E-02 | 1.13E-01 | 3.24E-03 | 2.41E-03 | 9 | no | 125 | no | 3.40E-05 | 0.08 |
| PAHs (as B(a)P) (6) | 6.21E-05 | 3.73E-05 | 1.63E-05 | 7.2E-05 | 4.29E-04 | 1.24E-05 | 9.18E-06 | n/a | n/a | 5 | no | 6.40E-04 | 5.88E-03 |
| Toluene | 3.74E-02 | 2.24E-02 | 9.84E-03 | 4.3E-02 | 0.26 | 7.44E-03 | 5.53E-03 | 420 | no | 179 | no | n/a | n/a |
| Xylene | 2.68E-02 | 1.61E-02 | 7.05E-03 | 3.1E-02 | 0.19 | 5.33E-03 | 3.96E-03 | 700 | no | 1034 | no | n/a | n/a |
| Total HAPs | | | | | 3.73 | | | | | | | | 0.4 in one million |

Notes:
(1) All factors except formaldehyde are CATEF mean values for large Diesel engines (SCC 20200102 or 20300101).
https://www.arb.ca.gov/app/emsinv/catef_form.html
Formaldehyde based on RICE NESHAP limit for CI engines (580 ppb).
(2) 40% control efficiency for oxidation catalyst applied for all TACs except formaldehyde. Source: BAAQMD PDOC for Eastshore Energy Center, April 30, 2007. Formaldehyde emission factor is RICE NESHAP limit for diesel engines.
(3) Based on 10 ppm ammonia slip from SCR system.
(4) Based on maximum ICE firing rate of 67.0 MMBtu/hr and default fuel HHV of 138,000 Btu/gal for biodiesel fuel
0.44 Mgal/hr per engine
(5) Based on maximum ICE firing rate (from (4)) for 100% biodiesel fuel.
3,840 Mgal/yr per engine (based on 8760 hrs/yr)
(6) Emission factors for individual PAHs weighted by cancer risk relative to B(a)P and summed to obtain overall B(a)P equivalent emission rate for HRA.
(7) https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary
(8) ACGIH, "2019 TLVs and BEIs" except PAHs from
https://www.atsdr.cdc.gov/csem/polycyclic-aromatic-hydrocarbons/standards_and_regulations_for_exposure.html

Unit Impact Modeling Results, ug/m3 per g/s per engine:

| Averaging Period | Full Load | Minimum Load |
|---|---|---|
| 1-hr | 11.75 | 15.78 |
| 8-hr | 7.05 | 9.83 |
| Annual | 0.74 | 1.20 |

**Waena Project**
**Wärtsilä 16V34DF Engines**
**Annual Non-Criteria Pollutant Emissions Assessment BASED ON 8760 HRS/YR OF FULL LOAD OPERATION**
**RNG Only**

| | | | | | Chronic Impacts | | | | | | Cancer Risk | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **RNG Emission Factor (1), lb/MMcf** | **Controlled RNG Emission Factor (2), lb/MMcf** | **Annual Emissions per Engine, Case 1 (5), tpy** | **Total Annual Emissions, all Engines, Case 1, tpy** | **Annual Emission Rate, g/s (all engines)** | **Annual impact, ug/m3** | **Annual REL, ug/m3 (1)** | **Annual Impact > REL?** | **1/420 x TWA/TLV** | **Annual Impact > 1/420 x TWA/TLV?** | **Unit Risk, per µg/m3 (3,4)** | **Cancer Risk x10E-6** |
| Ammonia | (3) | n/a | 2.46 | 14.8 | | | | | | | | |
| Propylene | 5.38E+00 | 3.23E+00 | 0.77 | 4.64 | | | | | | | | |
| Hazardous Air Pollutants | | | | | | | | | | | | |
| Acetaldehyde | 5.29E-01 | 3.17E-01 | 0.08 | 0.46 | 1.31E-02 | 1.02E-02 | 140 | no | n/a | n/a | 2.20E-06 | 0.02 |
| Acrolein | 5.90E-02 | 3.54E-02 | 0.01 | 0.05 | 1.46E-03 | 1.13E-03 | 0.35 | no | n/a | n/a | n/a | n/a |
| Benzene | 2.18E-01 | 1.31E-01 | 0.03 | 0.19 | 5.41E-03 | 4.18E-03 | 3 | no | 4 | no | 7.80E-06 | 0.03 |
| 1,3-Butadiene | 3.67E-01 | 2.20E-01 | 0.05 | 0.32 | 9.11E-03 | 7.04E-03 | 2 | no | 11 | no | 3.50E-05 | 0.25 |
| Ethylbenzene | 7.11E-02 | 4.27E-02 | 0.01 | 0.06 | 1.76E-03 | 1.36E-03 | 2000 | no | 197 | no | *2.60E-06* | 0.00 |
| Formaldehyde | n/a | 1.85E+00 | 0.44 | 2.65 | 7.64E-02 | 5.90E-02 | 9 | no | 0 | no | 1.30E-05 | 0.77 |
| Naphthalene | 2.51E-02 | 1.51E-02 | 3.6E-03 | 0.02 | 6.23E-04 | 4.82E-04 | 9 | no | 125 | no | *3.40E-05* | 0.02 |
| PAHs (as B(a)P) (6) | 1.71E-05 | 1.03E-05 | 2.5E-06 | 0.00 | 4.26E-07 | 3.29E-07 | n/a | n/a | 5 | no | 6.40E-04 | 2.11E-04 |
| Toluene | 2.39E-01 | 1.43E-01 | 0.03 | 0.21 | 5.93E-03 | 4.59E-03 | 420 | no | 179 | no | n/a | n/a |
| Xylene | 6.46E-01 | 3.88E-01 | 0.09 | 0.56 | 1.60E-02 | 1.24E-02 | 700 | no | 1034 | no | n/a | n/a |
| Total HAPs | | | | 4.51 | | | | | | | | 1.1 in one million |

Notes:
(1) All factors except formaldehyde are from CATEF mean emission factors for a natural gas 4S/Lean/>650Hp engine.
https://www.arb.ca.gov/app/emsinv/catef_form.html
Formaldehyde based on RICE NESHAP limit for SI engines (1.1 ppm).
(2) 40% control efficiency for oxidation catalyst applied for all TACs except formaldehyde. Source: BAAQMD PDOC for Eastshore Energy Center, April 30, 2007. Formaldehyde emission factor provided by vendor reflects ox cat control.
(3) Based on 10 ppm ammonia slip from SCR system.
(4) Based on maximum ICE firing rate of 62.1 MMBtu/hr for RNG
0.055 MMscf/hr
(5) Based on maximum ICE firing rate (from (4)) for RNG.
479 MMscf/yr (based on 8760 hrs/yr)
(6) Emission factors for individual PAHs weighted by cancer risk relative to B(a)P and summed to obtain overall B(a)P equivalent emission rate for HRA.
(7) https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary
(8) ACGIH, "2019 TLVs and BEIs" except PAHs from
https://www.atsdr.cdc.gov/csem/polycyclic-aromatic-hydrocarbons/standards_and_regulations_for_exposure.html

Unit Impact Modeling Results, ug/m3 per g/s per engine:

| Averaging Period | Full Load | Min Load |
|---|---|---|
| 1-hr | 12.21 | 14.96 |
| 8-hr | 7.31 | 9.16 |
| Annual | 0.77 | 1.13 |

**Waena Project**
**Wärtsilä 16V34DF Engines**
**Annual Non-Criteria Pollutant Emissions Assessment BASED ON 8760 HRS/YR OF FULL LOAD OPERATION**
**Biodiesel only**

| | | | | Acute Impacts, 8-hr Avg | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **Biodiesel Emission Factor (1) lb/Mgal** | **Controlled Biodiesel Em Factor (2) lb/Mgal** | **Hourly Emissions per Engine, Biodiesel Firing lb/hr** | **8-hour modeled impact, ug/m3** | **8-hour REL, ug/m3 (1)** | **8-hour impact > REL?** | **MW (g/mol)** | **TWA-TLV (8-hour basis) (2), ppm** | **TWA-TLV (8-hour basis), ug/m3** | **1/100 x TWA-TLV** | **8-hour impact> 1/100 x TWA/TLV?** |
| Ammonia | (3) | n/a | 0.91 | 4.85 | n/a | n/a | 17.031 | 25 | 17,414 | 174 | no |
| Propylene | 3.85E-01 | 2.31E-01 | 0.10 | | | | | | | | |
| Hazardous Air Pollutants | | | | | | | | | | | |
| Acetaldehyde | 3.47E-03 | 2.08E-03 | 9.13E-04 | 4.9E-03 | 300 | no | n/a | n/a | n/a | n/a | n/a |
| Acrolein | 1.07E-03 | 6.42E-04 | 2.81E-04 | 1.5E-03 | 0.7 | no | n/a | n/a | n/a | n/a | n/a |
| Benzene | 1.01E-01 | 6.06E-02 | 2.66E-02 | 1.4E-01 | 3 | no | 78.11 | 0.5 | 1,597 | 16 | no |
| Ethylbenzene | 6.76E-03 | 4.06E-03 | 1.78E-03 | 9.5E-03 | 9 | no | 106.20 | 20 | 86,869 | 869 | no |
| Formaldehyde | n/a | 2.07E-01 | 9.07E-02 | 4.8E-01 | n/a | n/a | 30.03 | 0.1 | 123 | 1 | no |
| Hexane | 1.39E-03 | 8.34E-04 | 3.66E-04 | 1.9E-03 | 9 | no | 86.18 | 50 | 176,234 | 1762.34 | no |
| Naphthalene | 1.63E-02 | 9.78E-03 | 4.29E-03 | 2.3E-02 | n/a | n/a | 128.17 | 10 | 52,421 | 524 | no |
| PAHs (as B(a)P) (6) | 6.21E-05 | 3.73E-05 | 1.63E-05 | 8.7E-05 | n/a | n/a | 252.31 | 0.2 | 2,064 | 21 | no |
| Toluene | 3.74E-02 | 2.24E-02 | 9.84E-03 | 5.2E-02 | 830 | no | 92.13 | 20 | 75,362 | 754 | no |
| Xylene | 2.68E-02 | 1.61E-02 | 7.05E-03 | 3.8E-02 | n/a | n/a | 106.16 | 100 | 434,192 | 4342 | no |
| Total HAPs | | | | | | | | | | | |

Notes:
(1) All factors except formaldehyde are CATEF mean values for large Diesel engines (SCC 20200102 or 20300101).
https://www.arb.ca.gov/app/emsinv/catef_form.html
Formaldehyde based on RICE NESHAP limit for CI engines (580 ppb).
(2) 40% control efficiency for oxidation catalyst applied for all TACs except formaldehyde. Source: BAAQMD PDOC for Eastshore Energy Center, April 30, 2007. Formaldehyde emission factor is RICE NESHAP limit for diesel engines.
(3) Based on 10 ppm ammonia slip from SCR system.
(4) Based on maximum ICE firing rate of 67.0 MMBtu/hr and default fuel HHV of 138,000 Btu/gal for biodiesel fuel
0.44 Mgal/hr per engine
(5) Based on maximum ICE firing rate (from (4)) for 100% biodiesel fuel.
3,840 Mgal/yr per engine
(6) Emission factors for individual PAHs weighted by cancer risk relative to B(a)P and summed to obtain overall B(a)P equivalent emission rate for HRA.
(7) https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary
(8) ACGIH, "2019 TLVs and BEIs" except PAHs from
https://www.atsdr.cdc.gov/csem/polycyclic-aromatic-hydrocarbons/standards_and_regulations_for_exposure.html

Unit Impact Modeling Results, ug/m3 per g/s per engine:

| Averaging Period | Full Load | Minimum Load |
|---|---|---|
| 1-hr | 11.75 | 15.78 |
| 8-hr | 7.05 | 9.83 |
| Annual | 0.74 | 1.20 |

**Waena Project**
**Wärtsilä 16V34DF Engines**
**Annual Non-Criteria Pollutant Emissions Assessment BASED ON 8760 HRS/YR OF FULL LOAD OPERATION**
**RNG Only**

| | | | | Acute Impacts, 8-hr Avg | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **RNG Emission Factor (1), lb/MMcf** | **Controlled RNG Emission Factor (2), lb/MMcf** | **Full Load Hourly Emissions per Engine, Case 1 (4), lb/hr** | **8-hour modeled impact, ug/m3** | **8-hour REL, ug/m3 (1)** | **8-hour impact > REL?** | **MW (g/mol)** | **TWA-TLV (8-hour basis) (2), ppm** | **TWA-TLV (8-hour basis), ug/m3** | **1/100 x TWA-TLV** | **8-hour impact> 1/100 x TWA/TLV?** |
| Ammonia | (3) | n/a | 0.82 | 4.53 | n/a | n/a | 17.031 | 25 | 17,414 | 174 | no |
| Propylene | 5.38E+00 | 3.23E+00 | 0.18 | | | | | | | | |
| Hazardous Air Pollutants | | | | | | | | | | | |
| Acetaldehyde | 5.29E-01 | 3.17E-01 | 0.02 | 0.10 | 300 | no | n/a | n/a | n/a | n/a | n/a |
| Acrolein | 5.90E-02 | 3.54E-02 | 1.94E-03 | 0.01 | 0.7 | no | n/a | n/a | n/a | n/a | n/a |
| Benzene | 2.18E-01 | 1.31E-01 | 0.01 | 0.04 | 3 | no | 78.11 | 0.5 | 1,597 | 16 | no |
| 1,3-Butadiene | 3.67E-01 | 2.20E-01 | 0.01 | 0.07 | 9 | no | 54.09 | 2 | 4,425 | 44 | no |
| Ethylbenzene | 7.11E-02 | 4.27E-02 | 2.33E-03 | 0.01 | n/a | n/a | 101.16 | 20 | 82,748 | 827 | no |
| Formaldehyde | n/a | 1.85E+00 | 0.10 | 0.56 | 9 | no | 30.03 | 0.1 | 123 | 1.23 | no |
| Naphthalene | 2.51E-02 | 1.51E-02 | 8.24E-04 | 4.6E-03 | n/a | n/a | 128.19 | 10 | 52,429 | 524 | no |
| PAHs (as B(a)P) (6) | 1.71E-05 | 1.03E-05 | 5.63E-07 | 3.1E-06 | n/a | n/a | 252.31 | 0.2 | 2,064 | 21 | no |
| Toluene | 2.39E-01 | 1.43E-01 | 7.85E-03 | 0.04 | 830 | no | 92.13 | 20 | 75,362 | 754 | no |
| Xylene | 6.46E-01 | 3.88E-01 | 0.02 | 0.12 | n/a | n/a | 106.16 | 100 | 434,192 | 4342 | no |
| Total HAPs | | | | | | | | | | | |

Notes:
(1) All factors except formaldehyde are from CATEF mean emission factors for a natural gas 4S/Lean/>650Hp engine.
https://www.arb.ca.gov/app/emsinv/catef_form.html
Formaldehyde based on RICE NESHAP limit for SI engines (1.1 ppm).
(2) 40% control efficiency for oxidation catalyst applied for all TACs except formaldehyde. Source: BAAQMD PDOC for Eastshore Energy Center, April 30, 2007. Formaldehyde emission factor provided by vendor reflects ox cat control.
(3) Based on 10 ppm ammonia slip from SCR system.
(4) Based on maximum ICE firing rate of 62.1 MMBtu/hr for RNG
0.055 MMscf/hr per engine
(5) Based on maximum ICE firing rate (from (4)) for RNG.
479 MMscf/yr per engine
(6) Emission factors for individual PAHs weighted by cancer risk relative to B(a)P and summed to obtain overall B(a)P equivalent emission rate for HRA.
(7) https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary
(8) ACGIH, "2019 TLVs and BEIs" except PAHs from
https://www.atsdr.cdc.gov/csem/polycyclic-aromatic-hydrocarbons/standards_and_regulations_for_exposure.html

Unit Impact Modeling Results, ug/m3 per g/s per engine:

| Averaging Period | Full Load | Min Load |
|---|---|---|
| 1-hr | 12.21 | 14.96 |
| 8-hr | 7.31 | 9.16 |
| Annual | 0.77 | 1.13 |

**Attachment 3**
**Formaldehyde Emission Factor Documentation**

This document provides the estimated formaldehyde emissions levels after an efficient emission control system on gas mode operation for Ameresco Ukiu 16V34DF-C2 project. The emission control system includes a selective catalytic reduction system and an oxidation catalyst. System is designed to meet the emission levels specified in the emission data sheet DESA00021830 (rev a). Formaldehyde emissions are based on the site conditions, emission measurement averaging time and gas composition specified in the emission data sheet.

**Formaldehyde emissions after the emission control system on gas operation at steady 100% engine load 0.7 ppm-v at 15% $O_2$, dry.**

**Formaldehyde (HCHO):** USA EPA Method 323: Measurement of formaldehyde emissions from natural gas-fired stationary sources-acetyl acetone derivatization method. In case formaldehyde guarantee is exceeded or if significant interference from acetaldehyde is suspected CARB Method 430: Determination of Formaldehyde and Acetaldehyde in Emissions from stationary sources shall be used.

## Chun, Kori

**From:** Nancy Matthews <Nancy@foulweatherconsulting.com>
**Sent:** Wednesday, May 14, 2025 5:59 AM
**To:** Chun, Kori
**Cc:** Nancy Matthews
**Subject:** [EXTERNAL] draft Ukiu documents
**Attachments:** 0912-01, Ukiu Energy, LLC draft permit.FWC (051425).docx; 0912-01 Ukiu Energy LLC draft review.FWC (051425).docx; 2025-0514 Ukiu rev GHG Tables.pdf; 2025-0514 Ukiu rev CCS Cost Tables.pdf

Hi Kori—Thank you for the opportunity to prepare draft documents for the Ukiu project. The attached drafts are in the form of markups of the Puuloa documents.

We are also providing the following updates and requests for the Ukiu Energy project:

- Ukiu Energy LLC is proposing to accept a permit condition that will require each engine to be fired with an annual average of two (2) percent or more liquid fuel total fuel fired, on an energy equivalent basis, so that each engine complies with the definition of compression ignition engine in 40 CFR Part 60, Subpart IIII. The addition of this operating requirement will not affect the operating scenarios and emissions calculations presented in the permit application and additional supporting information we have provided.
- We are requesting that the Department use the terms “liquid fuel” and “gaseous fuel” in the permit as generic terms for the approved fuels.
- We are submitting revised greenhouse gas emissions calculations that incorporate the new Global Warming Potentials that took effect on January 15, 2025, so HDOH will have the most up to date calculations.
- We are providing a corrected carbon capture and storage (CCS) cost assessment, updated for Ukiu and for 2025 costs. The CCS cost assessment provided in the application was based on erroneous figures for project output.

Thanks again for the opportunity to provide these materials. Please let me know if you have any questions or need additional information to complete your review of the Ukiu project.

*Nancy Matthews*
Foulweather Consulting
916-798-5665

## Table D-3R. Estimated CCS Cost ($/ton) for PTE - Permitted Operations

| Carbon Capture and Storage (CCS) Component | Cost ($/ton $CO_2$ Captured) | Units 1-6 Project $CO_2$ Emissions [A] (tpy) | % Captured [B] | $CO_2$ Emissions Captured (tpy) | Total Annual Cost |
|---|---|---|---|---|---|
| | | Liquid Fuel | | | |
| $CO_2$ Capture and Compression [C] | 167.00 | 185,594 | 90% | 167,035 | $27,894,845 |
| Onshore $CO_2$ Storage [D] | 3.69 | | | | $616,359 |
| Ship transport to injection ship [D] | 8.89 | | | | $1,484,941 |
| Injection ship, pipe and nozzle [D] | 12.91 | | | | $2,156,422 |
| **Total Cost (Liquid fuel)** | 192.49 | | | | $32,152,567 |
| | | RNG | | | |
| $CO_2$ Capture and Compression [C] | 167.00 | 136,361 | 90% | 122,725 | $20,495,075 |
| Onshore CO2 Storage [D] | 3.69 | | | | $452,855 |
| Ship transport to injection ship [D] | 8.89 | | | | $1,091,025 |
| Injection ship, pipe and nozzle [D] | 12.91 | | | | $1,584,380 |
| **Total Cost (RNG)** | 192.49 | | | | $23,623,335 |

[A] See Appendix Tables B-13 and B-15 for the emissions calculations.

[B] Typical value for amine absorber systems (Interagency Task Force on CCS, 2010; NETL, 2013).

[C] The $CO_2$ capture and compression cost is based on information presented in Figure III-1 of the Report of the Interagency Task Force on CCS, dated August 2010. The listed dollar per ton of $CO_2$ captured is the cost of applying post-combustion CCS to an existing natural gas fired combined cycle power plant. The listed cost ($167 per metric ton or $114 per ton in 2010 dollars) is based on permitted operation (i.e., maximum allowable operation per unit per year at full load for each fuel type), inflated to 2025 dollars (latest available CPI data at https://data.bls.gov/cgi-bin/cpicalc.pl).

[D] Costs are from Table 6.6 of the IPCC Special Report on Carbon Dioxide Capture and Storage, dated 2005, inflated to 2025 dollars (latest available CPI data at https://data.bls.gov/cgi-bin/cpicalc.pl).

Table D-4R - Estimated CCS Cost ($/kWh) - Permitted Operations

| Load | Total Generation (kW) | Fuel Type | Operating Hrs Per Unit (hrs/yr) | Total Annual Generation (kWh) | Total Annual Cost | $CO_2$ Removal Cost ($/kWh) |
|---|---|---|---|---|---|---|
| 100% (Base) | 44,900 | Liquid fuel | 6250 | 280,625,000 | $ 32,152,567 | $ 0.115 |
| | | RNG | 6250 | 280,625,000 | $ 23,623,335 | $ 0.084 |

# Table B-13R
# GHG Emissions
# Case 1: RNG Only

| Unit | Heat Input (MMBtu/hr) | Operating Output (gross MW) | Operating Hours (hrs/yr) | Annual Heat Input per Unit (MMBtu/yr) | Number of Units | Total Annual Heat Input (MMBtu/yr) | Total Annual Output MWh/yr | GHG Pollutant[1] | Emission Factor[2] (kg/MMBtu) | Max. Hourly Emissions (kg/hr) | Annual Emissions (metric tpy) | Global Warming Potential[3] | Per Unit Total GHG Emissions $CO_2e$ (lb/hr) | Per Unit Total GHG Emissions $CO_2e$ (metric tpy) | Per Unit Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ (lb/hr) | Total GHG Emissions $CO_2e$ (metric tpy) | Total GHG Emissions $CO_2e$ (tpy) | lb/MWh | g/kWh | lb/MMBtu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GHG Emissions when Firing Biodiesel, Full Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 60.5 | 44.9 | 0 | 0 | 6 | 0 | 0 | $CO_2$ | 73.96 | 4,474 | 0 | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $N_2O$ | 6.0E-04 | 3.63E-02 | 0.000 | ***265*** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $CH_4$ | 3.0E-03 | 1.81E-01 | 0.00 | ***28*** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| **GHG Emissions when Firing RNG, Full Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 62.1 | 44.9 | 6,250 | 388,166 | 6 | 2,328,998 | 278,630 | $CO_2$ | 53.06 | 3,295 | 20,596 | 1 | 7,265.1 | 20,596.1 | 22,703.3 | 43,590.4 | 123,576.7 | 136,219.9 | 978 | | |
| | | | | | | | | $N_2O$ | 1.0E-04 | 6.21E-03 | 0.039 | ***265*** | 0.0 | 10.3 | 11.3 | 0.0 | 61.7 | 68.0 | 0 | | |
| | | | | | | | | $CH_4$ | 1.0E-03 | 6.21E-02 | 0.39 | ***28*** | 0.0 | 10.9 | 12.0 | 0.0 | 65.2 | 71.9 | 1 | | |
| | | | | | | | | | | | | **Total $CO_2e$ =** | **7,265.1** | **20,617.3** | **22,726.6** | **43,590.4** | **123,703.6** | **136,359.9** | **978.8** | **444.0** | **117.1** |
| | | | | | | | | | | | | **Biogenic[4] $CO_2$ =** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | | | |
| | | | | | | | | | | | | **non-Biogenic $CO_2e$ =** | **7,265.1** | **20,617.3** | **22,726.6** | **43,590.4** | **123,703.6** | **136,359.9** | | | |

| Unit | Heat Input (MMBtu/hr) | Operating Output (gross MW) | Operating Hours (hrs/yr) | Annual Heat Input per Unit (MMBtu/yr) | Number of Units | Total Annual Heat Input (MMBtu/yr) | Total Annual Output MWh/yr | GHG Pollutant[1] | Emission Factor[2] (kg/MMBtu) | Max. Hourly Emissions (kg/hr) | Annual Emissions (metric tpy) | Global Warming Potential[3] | Per Unit Total GHG Emissions $CO_2e$ (lb/hr) | Per Unit Total GHG Emissions $CO_2e$ (metric tpy) | Per Unit Total GHG Emissions $CO_2e$ (tpy) | Total GHG Emissions $CO_2e$ (lb/hr) | Total GHG Emissions $CO_2e$ (metric tpy) | Total GHG Emissions $CO_2e$ (tpy) | lb/MWh | g/kWh | lb/MMBtu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GHG Emissions when Firing Biodiesel, Minimum Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 25.9 | 18.0 | 0 | 0 | 6 | 0 | 0 | $CO_2$ | 73.96 | 1,915 | 0 | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $N_2O$ | 6.0E-04 | 1.55E-02 | 0.000 | ***265*** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $CH_4$ | 3.0E-03 | 7.77E-02 | 0.00 | ***28*** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| **GHG Emissions when Firing RNG, Minimum Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 29.9 | 18.0 | 6,250 | 187,186 | 6 | 1,123,118 | 112,200 | $CO_2$ | 53.06 | 1,589 | 9,932 | 1 | 3,503.4 | 9,932.1 | 10,948.3 | 21,020.7 | 59,592.6 | 65,689.6 | 1171 | | |
| | | | | | | | | $N_2O$ | 1.0E-04 | 2.99E-03 | 0.019 | ***265*** | 0.0 | 5.0 | 5.5 | 0.0 | 29.8 | 32.8 | 1 | | |
| | | | | | | | | $CH_4$ | 1.0E-03 | 2.99E-02 | 0.19 | ***28*** | 0.0 | 5.2 | 5.8 | 0.0 | 31.4 | 34.7 | 1 | | |
| | | | | | | | | | | | | **Total $CO_2e$ =** | **3,503.4** | **9,942.3** | **10,959.5** | **21,020.7** | **59,653.8** | **65,757.1** | **1,172.1** | **531.7** | **117.1** |
| | | | | | | | | | | | | **Biogenic[4] $CO_2$ =** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | | | |
| | | | | | | | | | | | | **non-Biogenic $CO_2e$ =** | **3,503.4** | **9,942.3** | **10,959.5** | **21,020.7** | **59,653.8** | **65,757.1** | | | |

[1] Greenhouse Gas (GHG) pollutants from the Mandatory Greenhouse Gas Reporting rule (40 CFR §98.32), ***updated January 15, 2025*** .

[2] Emission factors from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart C, Tables C-1 and C-2).

[3] Global Warming Potentials from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart A, Table A-1).

[4] Per 40 CFR §98.6, biogenic $CO_2$ means carbon dioxide emissions generated as the result of biomass combustion.

# Table B-14R
# GHG Emissions
# Case 2: Startup on RNG, Switch to Biodiesel

| Unit | Heat Input | Operating | | Annual Heat | Number | Total Annual | Total Annual | GHG | Emission | Max. Hourly | Annual | Global | Per Unit Total GHG Emissions $CO_2e$ | | | Total GHG Emissions $CO_2e$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Output | Hours | Input per Unit | of | Heat Input | Output | Pollutant[1] | Factor[2] | Emissions | Emissions | Warming | | | | | | | | | |
| | (MMBtu/hr) | (gross MW) | (hrs/yr) | (MMBtu/yr) | Units | (MMBtu/yr) | MWh/yr | | (kg/MMBtu) | (kg/hr) | (metric tpy) | Potential[3] | (lb/hr) | (metric tpy) | (tpy) | (lb/hr) | (metric tpy) | (tpy) | lb/MWh | g/kWh | lb/MMBtu |
| **GHG Emissions when Firing Biodiesel** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 60.5 | 44.9 | 6,000 | 362,989 | 6 | 2,177,937 | 258,060 | $CO_2$ | 73.96 | 4,474 | 26,847 | 1 | 9,864.5 | 26,846.7 | 29,593.4 | 59,186.8 | 161,080.2 | 177,560.5 | 1376 | | |
| | | | | | | | | $N_2O$ | 6.0E-04 | 3.63E-02 | 0.218 | ***265*** | 21.2 | 57.7 | 63.6 | 127.2 | 346.3 | 381.7 | 3 | | |
| | | | | | | | | $CH_4$ | 3.0E-03 | 1.81E-01 | 1.09 | ***28*** | 11.2 | 30.5 | 33.6 | 67.2 | 182.9 | 201.7 | 2 | | |
| **GHG Emissions when Firing RNG** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 62.1 | 44.9 | 250 | 15,527 | 6 | 93,160 | 20,570 | $CO_2$ | 53.06 | 3,295 | 824 | 1 | 7,265.1 | 823.8 | 908.1 | 43,590.4 | 4,943.1 | 5,448.8 | 530 | | |
| | | | | | | | | $N_2O$ | 1.0E-04 | 6.21E-03 | 0.002 | ***265*** | 0.0 | 0.4 | 0.5 | 0.0 | 2.5 | 2.7 | 0 | | |
| | | | | | | | | $CH_4$ | 1.0E-03 | 6.21E-02 | 0.02 | ***28*** | 0.0 | 0.4 | 0.5 | 0.0 | 2.6 | 2.9 | 0 | | |
| | | | | | | | | | | | | **Total $CO_2e$ =** | **9,896.9** | **27,759.6** | **30,599.7** | **59,381.3** | **166,557.6** | **183,598.3** | **1,317.9** | **597.8** | **161.7** |
| | | | | | | | | | | | | **Biogenic[4] $CO_2$ =** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | | | |
| | | | | | | | | | | | | **non-Biogenic $CO_2e$ =** | **9,896.9** | **27,759.6** | **30,599.7** | **59,381.3** | **166,557.6** | **183,598.3** | | | |

[1] Greenhouse Gas (GHG) pollutants from the Mandatory Greenhouse Gas Reporting rule (40 CFR §98.32), ***updated January 15, 2025*** .
[2] Emission factors from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart C, Tables C-1 and C-2).
[3] Global Warming Potentials from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart A, Table A-1).
[4] Per 40 CFR §98.6, biogenic $CO_2$ means carbon dioxide emissions generated as the result of biomass combustion.

# Table B-15R
# GHG Emissions
# Case 3: Biodiesel Only

| GHG Emissions when Firing Biodiesel, Full Load | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Operating | | Annual Heat | Number | Total Annual | Total Annual | | Emission | Max. Hourly | Annual | Global | Per Unit Total GHG Emissions | | | Total GHG Emissions | | | | | |
| | Heat Input | Output | Hours | Input per Unit | of | Heat Input | Output | GHG | Factor[2] | Emissions | Emissions | Warming | $CO_2e$ | | | $CO_2e$ | | | | | |
| Unit | (MMBtu/hr) | (gross MW) | (hrs/yr) | (MMBtu/yr) | Units | (MMBtu/yr) | MWh/yr | Pollutant[1] | (kg/MMBtu) | (kg/hr) | (metric tpy) | Potential[3] | (lb/hr) | (metric tpy) | (tpy) | (lb/hr) | (metric tpy) | (tpy) | lb/MWh | g/kWh | lb/MMBtu |
| Wärtsilä 16V34DF Engines | 60.5 | 44.9 | 6,250 | 378,114 | 6 | 2,268,684 | 278,630 | $CO_2$ | 73.96 | 4,474 | 27,965 | 1 | 9,864.5 | 27,965.3 | 30,826.5 | 59,186.8 | 167,791.9 | 184,958.9 | 1328 | | |
| | | | | | | | | $N_2O$ | 6.0E-04 | 3.63E-02 | 0.227 | ***265*** | 21.2 | 60.1 | 66.3 | 127.2 | 360.7 | 397.6 | 3 | | |
| | | | | | | | | $CH_4$ | 3.0E-03 | 1.81E-01 | 1.13 | ***28*** | 11.2 | 31.8 | 35.0 | 67.2 | 190.6 | 210.1 | 2 | | |
| **GHG Emissions when Firing RNG, Full Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 62.1 | 44.9 | 0 | 0 | 6 | 0 | 0 | $CO_2$ | 53.06 | 3,295 | 0 | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $N_2O$ | 1.0E-04 | 6.21E-03 | 0.000 | ***265*** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $CH_4$ | 1.0E-03 | 6.21E-02 | 0.00 | ***28*** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | | | | | **Total $CO_2e$ =** | **9,896.9** | **28,057.2** | **30,927.8** | **59,381.3** | **168,343.2** | **185,566.6** | **1,332.0** | **604.2** | **163.6** |
| | | | | | | | | | | | | **Biogenic[4] $CO_2$ =** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | | | |
| | | | | | | | | | | | | **non-Biogenic $CO_2e$ =** | **9,896.9** | **28,057.2** | **30,927.8** | **59,381.3** | **168,343.2** | **185,566.6** | | | |

| GHG Emissions when Firing Biodiesel, Minimum Load | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Operating | | Annual Heat | Number | Total Annual | Total Annual | | Emission | Max. Hourly | Annual | Global | Per Unit Total GHG Emissions | | | Total GHG Emissions | | | | | |
| | Heat Input | Output | Hours | Input per Unit | of | Heat Input | Output | GHG | Factor[2] | Emissions | Emissions | Warming | $CO_2e$ | | | $CO_2e$ | | | | | |
| Unit | (MMBtu/hr) | (gross MW) | (hrs/yr) | (MMBtu/yr) | Units | (MMBtu/yr) | MWh/yr | Pollutant[1] | (kg/MMBtu) | (kg/hr) | (metric tpy) | Potential[3] | (lb/hr) | (metric tpy) | (tpy) | (lb/hr) | (metric tpy) | (tpy) | lb/MWh | g/kWh | lb/MMBtu |
| Wärtsilä 16V34DF Engines | 25.9 | 18.0 | 6,250 | 161,830 | 6 | 970,979 | 112,200 | $CO_2$ | 73.96 | 1,915 | 11,969 | 1 | 4,221.9 | 11,968.9 | 13,193.5 | 25,331.5 | 71,813.6 | 79,160.9 | 1411 | | |
| | | | | | | | | $N_2O$ | 6.0E-04 | 1.55E-02 | 0.097 | ***265*** | 9.1 | 25.7 | 28.4 | 54.5 | 154.4 | 170.2 | 3 | | |
| | | | | | | | | $CH_4$ | 3.0E-03 | 7.77E-02 | 0.49 | ***28*** | 4.8 | 13.6 | 15.0 | 28.8 | 81.6 | 89.9 | 2 | | |
| **GHG Emissions when Firing RNG, Minimum Load** | | | | | | | | | | | | | | | | | | | | | |
| Wärtsilä 16V34DF Engines | 29.9 | 18.0 | 0 | 0 | 6 | 0 | 0 | $CO_2$ | 53.06 | 1,589 | 0 | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $N_2O$ | 1.0E-04 | 2.99E-03 | 0.000 | ***265*** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | $CH_4$ | 1.0E-03 | 2.99E-02 | 0.00 | *28* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | | |
| | | | | | | | | | | | | **Total $CO_2e$ =** | **4,235.8** | **12,008.3** | **13,236.8** | **25,414.7** | **72,049.5** | **79,421.0** | **1,415.7** | **642.2** | **163.6** |
| | | | | | | | | | | | | **Biogenic[4] $CO_2$ =** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | | | |
| | | | | | | | | | | | | **non-Biogenic $CO_2e$ =** | **4,235.8** | **12,008.3** | **13,236.8** | **25,414.7** | **72,049.5** | **79,421.0** | | | |

[1] Greenhouse Gas (GHG) pollutants from the Mandatory Greenhouse Gas Reporting rule (40 CFR §98.32), ***updated January 15, 2025*** .

[2] Emission factors from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart C, Tables C-1 and C-2).

[3] Global Warming Potentials from the Mandatory Greenhouse Gas Reporting rule (40 CFR Part 98 Subpart A, Table A-1).

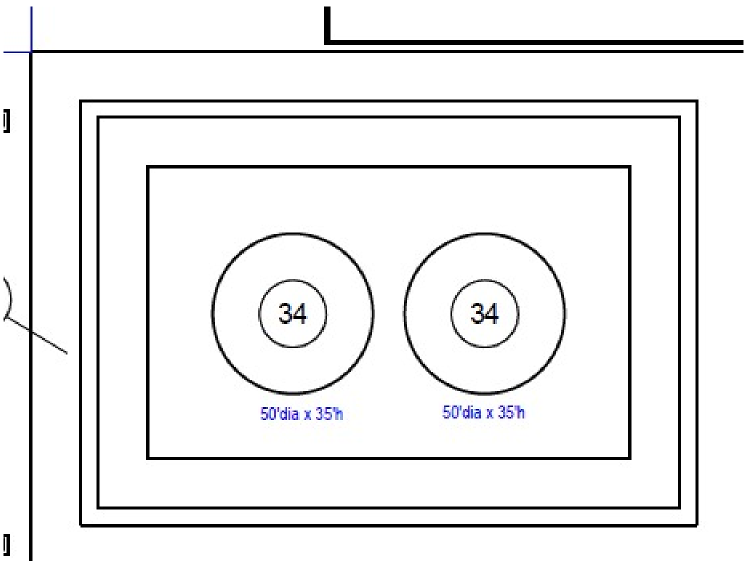
[4] Per 40 CFR §98.6, biogenic $CO_2$ means carbon dioxide emissions generated as the result of biomass combustion.

## Chun, Kori

**From:** Nancy Matthews <Nancy@foulweatherconsulting.com>
**Sent:** Tuesday, May 27, 2025 7:08 AM
**To:** Chun, Kori
**Cc:** Nancy Matthews
**Subject:** [EXTERNAL] RE: draft Ukiu documents/storage tank emissions

Hi Kori—

Ukiu will have two ~ 500,000 gallon biodiesel fuel storage tanks. The dimensions are shown on the drawing below.




Based on example operating scenario 3 in Table B-2 of the application, potential VOC emissions for each tank are 0.14 tons per year, as shown below.

**Tank information**

| | |
|---|---|
| Tank identification | 1 |
| Description | tank 1 |
| Location (city) | Waena |

| Property | Value | Units |
|---|---|---|
| Fuel type | Diesel | select one |
| Type of roof | Dome | select one |
| Actual throughput | 2,300,000 | gal/yr |
| Actual hours operated | 5750 | hours/year |
| Potential throughput | 4,555,200 | gal/yr |
| | | |
| VOC actual emissions | **0.10** | ton/yr |
| VOC potential emissions | **0.14** | ton/yr |

**Physical properties of the tank**

| Property | | Value | Units |
|---|---|---|---|
| Shell height | $H_S$ | 35 | feet |
| Shell diameter | D | 50 | feet |
| Shell radius | $R_S$ | 25 | feet |
| Maximum liquid height | $H_{LX}$ | 34.5 | feet |
| Average liquid height | $H_L$ | 17.25 | feet |
| Working volume | | 506699.6 | gallons |
| Turnovers per year (actual) | N | 4.5 | dimensionless |
| Turnovers per year (potential) | N | 9.0 | dimensionless |
| Shell color/shade | | White/NA | select one |
| Shell condition | | Average | select one |
| Paint solar absorptance | α | 0.25 | dimensionless |

Please let me know if you have any other questions.

Thank you—
Nancy

# APPENDIX A. MODELING FILES

**Appendix Table A-1. AERMOD Run Log**

| File Name[a] | Pollutant / Scenario | Averaging Period | Modeled Year(s) | Description |
|---|---|---|---|---|
| COND94_1hrand8hr_BIO_FL.ami | CO – Biodiesel Full Load | 1-hr and 8-hr | 2/1/1994 – 1/31/1995 | Project significant impact modeling – maximum (H1H) |
| COND94_1hrand8hr_BIO_LL.ami | CO – Biodiesel Low Load | | | |
| COND94_1hrand8hr_BIO_SU.ami | CO – Biodiesel Start Up | | | |
| COND94_1hrand8hr_RNG_FL.ami | CO – RNG Full Load | | | |
| COND94_1hrand8hr_RNG_LL.ami | CO – RNG Low Load | | | |
| COND94_1hrand8hr_RNG_SU.ami | CO – RNG Start Up | | | |
| SO2ND94_1hr_BIO_FL | $SO_2$ – Biodiesel Full Load | 1-hr | 2/1/1994 – 1/31/1995 | Project significant impact modeling – maximum (H1H) |
| SO2ND94_1hr_BIO_LL | $SO_2$ – Biodiesel Low Load | | | |
| SO2ND94_1hr_BIO_SU | $SO_2$ – Biodiesel Start Up | | | |
| SO2ND94_1hr_RNG_FL | $SO_2$ – RNG Full Load | | | |
| SO2ND94_1hr_RNG_LL | $SO_2$ – RNG Low Load | | | |
| SO2ND94_1hr_RNG_SU | $SO_2$ – RNG Start Up | | | |
| SO2ND94_3hr_BIO_FL | $SO_2$ – Biodiesel Full Load | 3-hr | 2/1/1994 – 1/31/1995 | Project significant impact modeling – maximum (H1H) |
| SO2ND94_3hr_BIO_LL | $SO_2$ – Biodiesel Low Load | | | |
| SO2ND94_3hr_BIO_SU | $SO_2$ – Biodiesel Start Up | | | |
| SO2ND94_3hr_RNG_FL | $SO_2$ – RNG Full Load | | | |
| SO2ND94_3hr_RNG_LL | $SO_2$ – RNG Low Load | | | |
| SO2ND94_3hr_RNG_SU | $SO_2$ – RNG Start Up | | | |
| SO2ND94_24hr_BIO_FL | $SO_2$ – Biodiesel Full Load | 24-hr | 2/1/1994 – 1/31/1995 | Project significant impact modeling – maximum (H1H) |
| SO2ND94_24hr_BIO_LL | $SO_2$ – Biodiesel Low Load | | | |
| SO2ND94_24hr_BIO_SU | $SO_2$ – Biodiesel Start Up | | | |
| SO2ND94_24hr_RNG_FL | $SO_2$ – RNG Full Load | | | |
| SO2ND94_24hr_RNG_LL | $SO_2$ – RNG Low Load | | | |
| SO2ND94_24hr_RNG_SU | $SO_2$ – RNG Start Up | | | |
| SO2ND94_Annual_BIO_FL | $SO_2$ – Biodiesel Full Load | Annual | 2/1/1994 – 1/31/1995 | Project significant impact modeling – Annual |
| SO2ND94_ Annual _BIO_LL | $SO_2$ – Biodiesel Low Load | | | |
| SO2ND94_ Annual _BIO_SU | $SO_2$ – Biodiesel Start Up | | | |
| SO2ND94_ Annual _RNG_FL | $SO_2$ – RNG Full Load | | | |
| SO2ND94_ Annual _RNG_LL | $SO_2$ – RNG Low Load | | | |
| SO2ND94_ Annual _RNG_SU | $SO_2$ – RNG Start Up | | | |
| P25ND94_24hr_BIO_FL.ami | $PM_{2.5}$ – Biodiesel Full Load | 24-hr | 2/1/1994 – 1/31/1995 | Project significant impact/NAAQS modeling – maximum (H1H and H8H) |
| P25ND94_24hr_BIO_LL.ami | $PM_{2.5}$ – Biodiesel Low Load | | | |
| P25ND94_24hr_BIO_SU.ami | $PM_{2.5}$ – Biodiesel Start Up | | | |
| P25ND94_24hr_RNG_FL.ami | $PM_{2.5}$ – RNG Full Load | | | |
| P25ND94_24hr_RNG_LL.ami | $PM_{2.5}$ – RNG Low Load | | | |
| P25ND94_24hr_RNG_SU.ami | $PM_{2.5}$ – RNG Start Up | | | |
| P25ND94_Annual_BIO_FL.ami | $PM_{2.5}$ – Biodiesel Full Load | Annual | 2/1/1994 – 1/31/1995 | Project significant impact/NAAQS modeling |
| P25ND94_Annual_BIO_LL.ami | $PM_{2.5}$ – Biodiesel Low Load | | | |
| P25ND94_Annual_BIO_SU.ami | $PM_{2.5}$ – Biodiesel Start Up | | | |
| P25ND94_Annual_RNG_FL.ami | $PM_{2.5}$ – RNG Full Load | | | |
| P25ND94_Annual_RNG_LL.ami | $PM_{2.5}$ – RNG Low Load | | | |
| P25ND94_Annual_RNG_SU.ami | $PM_{2.5}$ – RNG Start Up | | | |
| P10ND94_24hr_BIO_FL.ami | $PM_{10}$ – Biodiesel Full Load | 24-hr | 2/1/1994 – 1/31/1995 | Project significant impact/NAAQS modeling – maximum (H1H and H2H) |
| P10ND94_24hr_BIO_LL.ami | $PM_{10}$ – Biodiesel Low Load | | | |
| P10ND94_24hr_BIO_SU.ami | $PM_{10}$ – Biodiesel Start Up | | | |
| P10ND94_24hr_RNG_FL.ami | $PM_{10}$ – RNG Full Load | | | |
| P10ND94_24hr_RNG_LL.ami | $PM_{10}$ – RNG Low Load | | | |

| File Name[a] | Pollutant / Scenario | Averaging Period | Modeled Year(s) | Description |
|---|---|---|---|---|
| P10ND94_24hr_RNG_SU.ami | $PM_{10}$ – RNG Start Up | | | |
| P10ND94_Annual_BIO_FL.ami<br>P10ND94_Annual_BIO_LL.ami<br>P10ND94_Annual_BIO_SU.ami<br>P10ND94_Annual_RNG_FL.ami<br>P10ND94_Annual_RNG_LL.ami<br>P10ND94_Annual_RNG_SU.ami | $PM_{10}$ – Biodiesel Full Load<br>$PM_{10}$ – Biodiesel Low Load<br>$PM_{10}$ – Biodiesel Start Up<br>$PM_{10}$ – RNG Full Load<br>$PM_{10}$ – RNG Low Load<br>$PM_{10}$ – RNG Start Up | Annual | 2/1/1994 – 1/31/1995 | Project significant impact/NAAQS modeling |
| NNF94_1hr_BIO_FL.ami<br>NNF94_1hr_BIO_LL.ami<br>NNF94_1hr_BIO_SU.ami<br>NNF94_1hr_RNG_FL.ami<br>NNF94_1hr_RNG_LL.ami<br>NNF94_1hr_RNG_SU.ami | $NO_2$ – Biodiesel Full Load<br>$NO_2$ – Biodiesel Low Load<br>$NO_2$ – Biodiesel Start Up<br>$NO_2$ – RNG Full Load<br>$NO_2$ – RNG Low Load<br>$NO_2$ – RNG Start Up | 1-hr | 2/1/1994 – 1/31/1995 | Project significant impact/NAAQS modeling – maximum (H1H and H8H) |
| NNF94_Annual_BIO_FL.ami<br>NNF94_Annual_BIO_LL.ami<br>NNF94_Annual_BIO_SU.ami<br>NNF94_Annual_RNG_FL.ami<br>NNF94_Annual_RNG_LL.ami<br>NNF94_Annual_RNG_SU.ami | $NO_2$ – Biodiesel Full Load<br>$NO_2$ – Biodiesel Low Load<br>$NO_2$ – Biodiesel Start Up<br>$NO_2$ – RNG Full Load<br>$NO_2$ – RNG Low Load<br>$NO_2$ – RNG Start Up | Annual | 2/1/1994 – 1/31/1995 | Project significant impact/NAAQS modeling |

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September 22, 2025

To: Kori Chun, HDOH Clean Air Branch

From: Nancy Matthews *Nancy Matthews*

Subject: Ukiu Energy LLC

Thank you for your detailed and thorough review of the permit application and supporting materials. I apologize for the errors and inconsistencies you have identified in these materials. In response to your email request and our phone conversation on September 19, we are providing the following corrections and clarifications to the application, modeling analysis and markup of the technical review document. For clarity, your requests are shown below, followed by our responses.

1. *The proposed 755 bhp emergency generator is listed as a Cummins, however, Table B-9 in the application lists emission factors for a Caterpillar. Please let me know which is being proposed for the Ukiu project. If I use emissions data for the Cummins proposed I get different potential emissions than what was listed in the application and in the markup of the technical review document.*

   Response: The proposed emergency generator is a Cummins model DFEK, as shown in Table B-9, Appendix B, and in the manufacturer's literature in Appendix E of the application. The standby rating for the generator is 500 kW, while the gross engine power output is 563 kW (755 bhp). A corrected version of Table B-9 is attached, along with an emissions data sheet for the generator.

2. *Table B-4 (Biodiesel) in the application lists the $PM_{10}/PM_{2.5}$ stack concentration for 100% Load as 20 mg/Nm$^3$ @ 15% O2 and the g/kW-hr as 0.15. However, the markup of the permit and review list the 100% Load value as 30 mg/Nm$^3$ @ 15% $O_2$. The lb/hr value using an emission factor of 0.15 g/kW-hr at 100% load differs from what is used in the markup of the permit and review. Please reconcile these discrepancies.*

   Response: The 20 mg/Nm$^3$ stack concentration and 0.15 g/kW-hr mass emission rate reflect only the filterable portion of the $PM_{10}/PM_{2.5}$. The 30 mg/Nm$^3$ concentration and the 0.22 g/kW-hr mass emission rate reflect total $PM_{10}/PM_{2.5}$ and correspond to the 3.61 lb/hr full-load emission rate used in the emissions calculations and the ambient air quality modeling analysis.

3. *Similarly to item 2, the g/kW-hr rate in Table B-4 (Biodiesel) of the application for the $PM_{10}/PM_{2.5}$ stack concentration for 40% Load is 0.24 g/kW-hr. If I use this g/kW-hr rate, I get a different lb/hr value than what is listed in the review. Please clarify.*

   Response: The 0.24 g/kW-hr mass emission rate reflects only the filterable portion of the $PM_{10}/PM_{2.5}$. The total $PM_{10}/PM_{2.5}$ mass emission rate at 40% load is 0.32 g/kW-hr, which corresponds to the 2.11 lb/hr emission rate used in the emissions calculations and the ambient air quality modeling analysis.

4. *Based on the explanation of items 2 and 3, please adjust the requested limits, calculations, and modeling analysis accordingly. Provide an explanation for the discrepancy between the data that was listed in the application as "Supplied by Wartsila" and the values used in to get the numbers in the markup of the review.*

   Response: As noted in responses 2 and 3, the emissions calculations and modeling analyses are correct as they were based on the emission factors that reflect total particulate matter, so no adjustments are needed. A corrected version of Table B-4, which includes the corrected ammonia emission rates discussed in Response 5, is attached for clarity.

5. *Please clarify the ammonia values. There are discrepancies in the application, markup of the permit and markup of the review between the max lb/hr rate being 1.15 lb/hr for liquid fuel and 1.02 lb/hr for gaseous fuel, and the max being 0.91 lb/hr for liquid fuel and 0.82 lb/hr for gaseous fuel.*

   Response: The ammonia emission rates of 1.15 lb/hr for liquid fuel and 1.02 lb/hr for gaseous fuel are in error and were inadvertently carried over from data provided by Wartsila for a larger engine. The ammonia emission rate of 0.82 lb/hr for gaseous fuel and 10 ppmvd @ 15% $O_2$ for both fuel types was provided by Wartsila. The lb/hr emission rate for distillate fuel for the 16V34 engines to be used for this project is calculated as follows:

   10 ppmvd @ 15% $O_2$ = 0.0144 lb/MMBtu (based on F factor of 9,190 dscf/MMBtu for distillate fuel)
   Ammonia emission rate = 0.0144 lb/MMBtu * 65.2 MMBtu/hr = 0.94 lb/hr

   Therefore, the maximum hourly emission rate during liquid fuel firing should be 0.94 lb/hr. The markup and draft permit have been updated to reflect the correct emission rate.

6. *Please clarify how the annual micrograms per cubic meter value for ammonia was calculated (0.08 ug/m³) for both liquid fuel and gaseous fuel.*

   Response: The 0.08 μg/m³ concentration shown in the markup is not correct. The correct concentrations (calculated from the corrected ammonia hourly emission rates described in Response 5 and assuming 8760 hours per year of operation per your earlier request) are shown below. The unit impact modeling results were provided in the Supplemental HAPS Assessment that was provided as Attachment 2 to our supplemental submittal dated December 2, 2024.

   Gaseous fuel: 0.82 lb/hr * 453.6 g/lb / 3600 sec/hr * 6 engines = 0.62 g/s (total, all engines)
   0.62 g/s * 0.77 μg/m³ per g/s = 0.479 μg/m³

Liquid fuel: 0.94 lb/hr * 453.6 g/lb / 3600 sec/hr * 6 engines = 0.709 g/s (total, all engines)
0.709 g/s * 0.74 μg/m$^3$ per g/s = 0.527 μg/m$^3$

The markup has been updated to reflect the corrected concentrations.

7. *The startup CO emission rate (g/s) for gaseous fuel should have been based on a 30-minute cold start on gaseous fuel and then switching to liquid fuel for 30 minutes, which aligns with the lb/hr CO limit of 12.01 lb/hr during any hour that includes a startup. This equates to a g/s of 1.51 g/s, however, the model uses 1.45 g/s as the emission rate, which is equivalent to a 30 minute cold start on gaseous fuel and 30 minutes on gaseous fuel at 100% load. Please demonstrate compliance with the ambient air quality standards with the g/s emission rate that corresponds to the 12.01 lb/hr limit.*

   Response: The modeled one-hour average CO concentration for gaseous fuel during startup, based on a 1.45 g/s emission rate, is 52.49 μg/m$^3$ (from Table 3-6 of the August 2024 Air Dispersion Modeling Report). This is equivalent to 52.49 μg/m$^3$ / 1.45 g/s = 36.20 μg/m$^3$ per g/s. Therefore, an emission rate of 1.51 g/s would yield a modeled one-hour average concentration of 36.20 μg/m$^3$ per g/s * 1.51 g/s = 54.66 μg/m$^3$. Combined with the background concentration of 1035.0 μg/m$^3$, the total impact is 1089.7 μg/m$^3$, well below the state ambient air quality standard of 10,000 μg/m$^3$.

8. *The "SO2ND94_3hr_RNG_LL" input file shows the stack parameters for full load/startup in combination with the low load emission rate. Please demonstrate compliance with the 3-hr $SO_2$ standard at low load, on gaseous fuel with the appropriate stack parameters.*

   Response: The 3-hour average $SO_2$ concentration at minimum load on gaseous fuel will be lower than the modeled 1-hour average $SO_2$ concentration at minimum load. Even if we assume that the 3-hour average $SO_2$ concentration is equivalent to the 1-hour average $SO_2$ concentration of 0.24 μg/m$^3$ (from Table 3-6 of the Air Dispersion Modeling Report), the total impact will remain well below the state ambient air quality standard:

   0.24 μg/m$^3$ +13.1 μg/m$^3$ (background concentration)
   = 13.34 μg/m$^3$ << 365 μg/m$^3$.

9. *In the BACT analysis, some sections discuss a search of the RACT/BACT/LAER Clearinghouse in 2022. Please perform an updated search and let me know if there are any updates to the BACT analysis that should be made.*

   Response: A search of the RACT/BACT/LAER Clearinghouse database for entries since 1/1/2022 provided two additional entries for the BACT analysis. The Commonwealth LNG, LLC, facility obtained a permit to install 4.29 MW diesel-fueled generators in Louisiana in 2023 and the Xcel Energy Blue Lake facility obtained a permit to install three 9.37 MW dual-fuel engine generators in

2024. The following table compares the emission limits identified for these facilities with the emission limits proposed for the Ukiu generators.

| Pollutant | Ukiu Proposed Limit | | Commonwealth LNG BACT Limit | Xcel Energy Blue Lake BACT Limit |
|---|---|---|---|---|
| Fuel | Liquid fuel | Gaseous fuel | Liquid fuel | Gaseous fuel |
| NOx | 0.52 g/kW-hr | 0.06 g/hp-hr | 8.46 g/kW-hr | 0.07 g/hp-hr |
| CO | 0.18 g/kW-hr | 0.09 g/hp-hr | 1.21 g/kW-hr | 0.10 g/hp-hr |
| VOC | 0.21 g/kW-hr | 0.09 g/hp-hr | 0.3220 g/kW-hr | 0.13 g/hp-hr |
| $PM_{10}/PM_{2.5}$ | 0.22 g/kW-hr | 0.07 g/hp-hr | 0.0670 g/kW-hr | 0.07 g/hp-hr |
| CO2e | 604.2 g/kW-hr | 330.9 g/hp-hr | n/a | 337.00 g/hp-hr |

With the exception of $PM_{10}/PM_{2.5}$ for the Commonwealth LNG facility, the limits proposed for Ukiu are equivalent to or lower than the permitted emission rates for these recently permitted facilities. The $PM_{10}/PM_{2.5}$ emission rate shown for the Commonwealth LNG engines appears unrealistically low. The Pollutant Information page for the Commonwealth LNG facility indicates that there are no add-on controls for particulate matter, so it is likely that the units shown in the listing are in error. The addition of these two facilities to the BACT analysis does not change our proposed BACT determinations.

10. *Overall, the calculations I'm getting based on the numbers in the application are differing slightly from the numbers provided in the markup of the review. Please provide an explanation for how these differences will (or will not) impact the evaluation of the application, limits, and/or the modeling analysis.*

    Response: I apologize for the errors in the application and the markup of the review. We are providing updated versions of the markup and draft permit with the identified errors corrected. For the most part, the differences are small and have overstated impacts. Therefore, we believe the analyses provided in the application conservatively overstate potential impacts from the project.

Again, we appreciate your detailed review of the application and supporting materials, and we apologize for the confusion caused by the errors and inconsistencies. We hope that the clarifications and corrections provided here will allow you to complete your review and issue the draft permit as quickly as possible. If there are any additional questions about these issues, or any other questions regarding the project, please don't hesitate to contact me.

Attachments

Cc: Cathy Lopez, HDOH CAB
Bob Albertini, Ameresco
Richard Stuhan, Ameresco

**Table B-9R *(Rev. 9/25)***
**Emergency Generator Performance Data**

| Parameter | Units | Full Load Value | Data Source |
| --- | --- | --- | --- |
| **Performance Data** | | | |
| ***Generator Rating*** | kW | ***500*** | Cummins DFEK spec sheet |
| Engine Power | bhp | ***755*** | Cummins DFEK spec sheet |
| Fuel Flow | gal/hr | 34.4 | Cummins DFEK spec sheet |
| | lb/hr | 242.5 | Calculated from fuel flow and fuel density. |
| Fuel Heat Content (HHV) | Btu/gal | 138,000 | Table C-1 to Subpart C of CFR 40 Part 98 |
| Fuel Density | lb/gal | 7.05 | AP-42, Appendix A |
| Heat Input (HHV) | MMBtu/hr | 4.7472 | Calculated from fuel flow and fuel heat content. |
| Operating Hours | hr/day | 4 | Expected |
| | hr/yr | 500 | EPA default for emissions calculations** |
| **Exhaust Data** | | | |
| Exhaust Temperature | °F | 901 | Cummins DFEK spec sheet |
| | K | 755.9 | Converted from °F |
| Exhaust Volumetric Flow (actual) | acfm | 3,625 | Cummins DFEK spec sheet |
| | $m^3/s$ | 1.711 | converted from acfm |
| **Emission Rates** | | | |
| Fuel Sulfur Content | ppm | 15 | Requested permit limit |
| $SO_2$ Emissions | lb/hr | 0.0073 | Mass Balance - 100% conversion of fuel S |
| | g/s | 9.167E-04 | Converted from lb/hr |
| | tpy | 0.0018 | Calculated from lb/hr and annual operating hours |
| PM | g/bhp-hr | 0.05 | ***Cummins 500DFEK data sheet*** |
| (Filterable PM) | lb/hr | 0.08 | Calculated from g/hp-hr limit and bhp |
| | g/s | 1.049E-02 | Converted from lb/hr |
| | tpy | 0.0208 | Calculated from lb/hr and annual operating hours |
| $PM_{10}/PM_{2.5}$ | g/bhp-hr | 0.05 | Assume 100% of PM is PM2.5 |
| (Filterable plus Condensable PM) | lb/hr | 0.08 | Calculated from g/hp-hr limit and bhp |
| | g/s | 1.049E-02 | Converted from lb/hr |
| | tpy | 0.0208 | Calculated from lb/hr and annual operating hours |
| $NO_X$ | g/bhp-hr | ***4.85*** | ***Cummins 500DFEK data sheet*** |
| | lb/hr | ***8.07*** | Calculated from g/hp-hr limit and bhp |
| | g/s | ***1.02*** | Converted from lb/hr |
| | tpy | ***2.02*** | Calculated from lb/hr and annual operating hours |
| CO | g/bhp-hr | ***0.31*** | ***Cummins 500DFEK data sheet*** |
| | lb/hr | ***0.52*** | Calculated from g/hp-hr limit and bhp |
| | g/s | ***0.07*** | Converted from lb/hr |
| | tpy | ***0.13*** | Calculated from lb/hr and annual operating hours |
| VOC | g/bhp-hr | ***0.11*** | ***Cummins 500DFEK data sheet*** |
| | lb/hr | ***0.18*** | Calculated from g/hp-hr limit and bhp |
| | g/s | ***0.02*** | Converted from lb/hr |
| | tpy | ***0.05*** | Calculated from lb/hr and annual operating hours |
| Lead | lb/MMBtu | 1.40E-05 | AP-42, Section 3.1, Table 3.1-5 |
| | lb/hr | 6.65E-05 | Calculated from lb/MMBtu and heat input |
| | g/s | 8.37E-06 | Converted from lb/hr |
| | tpy | 1.66E-05 | Calculated from lb/hr and annual operating hours |

**Table B-9 *(Rev. 9/25)***
**Emergency Generator Performance Data**

| Parameter | Units | Full Load Value | Data Source |
|---|---|---|---|
| Fluorides | lb/MMBtu | 2.49E-04 | AP-42, Section 1.3, Table 1.3-11 for No. 6 Fuel Oil |
| | lb/hr | 1.18E-03 | Calculated from lb/MMBtu and heat input |
| | g/s | 1.49E-04 | Converted from lb/hr |
| | tpy | 2.95E-04 | Calculated from lb/hr and annual operating hours |
| CO2 | kg/MMBtu | 73.96 | 40 CFR Part 98 |
| | tpy | 193.5 | Calculated from kg/MMBtu and heat input |
| CH4 | g/MMBtu | 3.0 | 40 CFR Part 98 |
| | tpy | 0.01 | Calculated from kg/MMBtu and heat input |
| N2O | g/MMBtu | 0.6 | 40 CFR Part 98 |
| | tpy | 0.002 | Calculated from kg/MMBtu and heat input |
| CO2e | tpy | 194.2 | Sum of GHGs weighted by GWP |

Notes:

** Seitz 1995 memo at www.epa.doc/files/documents/emgen

**Table B-4R *(Rev. 9/25)***
**Emission Rate Calculations - Biodiesel**

| Parameter | Variable | Units | Wärtsilä 16V34DF Engines 100% Load Value | Wärtsilä 16V34DF Engines 40% Load Value | Data Source |
|---|---|---|---|---|---|
| | | | **Performance Data** | | |
| Mechanical Output | MO | $kW_m$ | 7,480 | 2,992 | |
| | -- | HP | 10,023 | 4,009 | Converted from $KW_m$ |
| Generation | G | $kW_e$ | 44,880 | 17,952 | |
| Heat Rate (LHV) | $HR_{LHV}$ | $Btu/kW_e$-hr | 8,088 | 8,654 | |
| Heat Input (LHV) | $HI_{LHV}$ | MMBtu/hr | 60.5 | 25.9 | $HR_{LHV}*G/10^6$ |
| Heat Input (HHV) | $HI_{HHV}$ | MMBtu/hr | 65.2 | 28.7 | $LHV*FF_{lb/hr}*1.077/10^6$ |
| Fuel Heat Content (LHV) | LHV | Btu/lb | 17,388 | 17,388 | |
| Fuel Flow | $FF_{lb/hr}$ | lb/hr | 3,479 | 1,489 | |
| | | | **Exhaust Data** | | |
| Exhaust Temp | -- | °F | 642.0 | 660.0 | Wärtsilä specs |
| | $T_{stack}$ | °R | 1,102.0 | 1,120.0 | Converted from °F |
| | -- | °C | 320 | 320 | Wärtsilä specs |
| | $T_{stack-K}$ | K | 593.15 | 593.15 | Converted from °C |
| Universal Gas Constant | R | psia-$ft^3$/lbmol-R | 10.73 | 10.73 | http://en.wikipedia.org/wiki/Gas_constant |
| Standard Pressure | $P_{std}$ | psia | 14.696 | 14.696 | 40 CFR Part 60, Appendix A, Method 5 |
| Standard Temperature | $T_{std}$ | K | 293.2 | 293.2 | 40 CFR Part 60, Appendix A, Method 5 |
| Exhaust Volumetric Flow (actual) | $Q_{m3s}$ | $m^3/s$ | 24.7 | 11.5 | Converted from Nm3/min |
| | -- | acfh | 3,134,098 | 1,457,936 | Converted from $m^3/s$ |
| | $Q_{acfm}$ | acfm | 52,235 | 24,299 | Converted from acfm |
| | | ft3/s | 871 | 405 | |
| Exhaust $H_2O$ Content | $\%H_2O$ | % by Vol | 6.1% | 5.7% | |
| Exhaust $O_2$ Content | $\%O_2$ | % by Vol | 11.74% | 12.26% | Calculatedfrom O2 dry and %H2O |
| Exhaust $CO_2$ Content | $\%CO_2$ | % by Vol | 5.78% | 5.3% | |
| Dry Exhaust Volumetric Flow | $Q_{dry}$ | dcf/min | 49,049 | 22,914 | $Q_{acfm}*(1-\%H_2O)$ |
| $\%O_2$ Dry Basis | $\%O_{2-Dry}$ | % | 12.5% | 13.0% | Wärtsilä spec |
| $\%CO_2$ Dry Basis | $\%CO_{2-Dry}$ | % | 6.16% | 5.64% | $\%CO_2/(1-\%H_2O)$ |
| Dry Exhaust Volumetric Flow (Std) | $Q_{dry-std}$ | dscf/min | 24,245 | 11,327 | $Q_{dry}*(T_{std}/T_{stack-K})$ |
| Dry Exhaust Volumetric Flow (32 °F) | $Q_{dry-32F}$ | $Nm^3$/min | 10.66 | 4.98 | $Q_{dry}*(273.15/T_{stack-K})*.3048^3$ |
| Stack Diameter | $D_{ft}$ | ft | 3.94 | 3.94 | Converted from meters |
| | $D_m$ | m | 1.20 | 1.20 | Provided by Chris Heck/Wartsila 4/4/24 email |
| Stack Area | $A_{m2}$ | $m^2$ | 1.13 | 1.13 | $(\pi*D_m^2)/4$ |
| Stack Velocity | $V_{m/sec}$ | m/sec | 21.80 | 10.14 | $Q_{m3s}/A_{m2}$ |
| | $V_{ft/sec}$ | ft/sec | 71.51 | 33.27 | Converted from m/s |
| | | | **Emission Rates** | | |
| Max Sulfur | $FS_{ppm}$ | ppm | 15 | 15 | |
| $SO_2$ Emission Rates | -- | g/s | 1.314E-02 | 5.620E-03 | Converted from lb/hr |
| | $M_{SO2}$ | lb/hr | 0.104 | 0.045 | $FF_{lb/hr}*(FS_{ppm}/10^6)*(MW_{SO2}/MW_S)$ (Mass Balance - 100% conversion of fuel S) |
| $SO_2$ Emission Factors | -- | lb/MMBtu | 0.00160 | 0.00156 | $M_{SO2}/HI_{HHV}$ |
| $SO_2$ Molecular Weight | $MW_{SO2}$ | lb/lbmol | 64.1 | 64.1 | http://www.webelements.com/ |
| S Molecular Weight | $MW_S$ | lb/lbmol | 32.1 | 32.1 | http://www.webelements.com/ |
| $PM_{10}/PM_{2.5}$ Stack Conc. | $C_{d15-PM10}$ | $mg/Nm^3$ @ 15% $O_2$ | ***30*** | 40 | Supplied by Wärtsilä |
| $PM_{10}/PM_{2.5}$ Emission Rates | $M_{PM-g/s}$ | g/s | 0.45 | 0.27 | Calculated from lb/hr |
| | $M_{PM10-lb/hr}$ | lb/hr | 3.61 | 2.11 | Supplied by Wärtsilä |
| $PM_{10}/PM_{2.5}$ Emission Factors | -- | lb/MMBtu | 0.0554 | 0.0735 | $M_{PM10-lb/hr}/HI_{HHV}$ |
| | -- | $g/kW_e$-hr | ***0.22*** | ***0.32*** | Supplied by Wärtsilä |
| $NO_X$ as $NO_2$ Stack Conc. | $C_{d15-NOX}$ | ppmvd @ 15% $O_2$ | 35 | 40 | Supplied by Wärtsilä |
| $NO_2$ Molecular Weight | $MW_{NO2}$ | lb/lbmol | 46.0 | 46.0 | http://www.webelements.com/ |
| $NO_X$ as $NO_2$ Emission Rates | $M_{NOX-lb/hr}$ | lb/hr | 8.64 | 4.33 | Supplied by Wärtsilä |
| $NO_X$ as $NO_2$ Emission Factors | -- | lb/MMBtu | 0.133 | 0.151 | $M_{NOX-lb/hr}/HI_{HHV}$ |
| | -- | $g/kW_e$-hr | 0.52 | 0.65 | Supplied by Wärtsilä |
| | | | **Emission Rates (Continued)** | | |
| CO Stack Conc. | $C_{d15-CO}$ | ppmvd @ 15% $O_2$ | 20 | 20 | Supplied by Wärtsilä |
| CO Molecular Weight | $MW_{CO}$ | lb/lbmol | 28.0 | 28.0 | http://www.webelements.com/ |
| CO Emission Rates | $M_{CO-lb/hr}$ | lb/hr | 3.01 | 1.32 | Supplied by Wärtsilä |
| CO Emission Factors | -- | lb/MMBtu | 0.0462 | 0.0460 | $M_{CO-lb/hr}/HI_{HHV}$ |
| | -- | $g/kW_e$-hr | 0.18 | 0.18 | Supplied by Wärtsilä |
| VOC (as $CH_4$) Stack Conc. | $C_{d15-VOC}$ | ppmvd @ 15% $O_2$ | 40 | 40 | Supplied by Wärtsilä |
| VOC (as $CH_4$) Molecular Weight | $MW_{CH4}$ | lb/lbmol | 16.0 | 16.0 | http://www.webelements.com/ |
| VOC (as $CH_4$) Emission Rates | $M_{VOC-lb/hr}$ | lb/hr | 3.44 | 1.51 | Supplied by Wärtsilä |
| VOC (as $CH_4$) Emission Factors | -- | lb/MMBtu | 0.0528 | 0.0526 | $M_{VOC-lb/hr}/HI_{HHV}$ |
| | -- | $g/kW_e$-hr | 0.21 | 0.23 | Supplied by Wärtsilä |
| $NH_3$ Slip | $C_{d15-NH3}$ | ppmvd @ 15% $O_2$ | 10 | 10 | Assumed |
| | $C_{d-NH3}$ | ppmvd | 14.2 | 13.4 | $C_{d15-NH3}*((20.9-\%O_{2-Dry}*100)/(20.9-15))$ |
| $NH_3$ Molecular Weight | $MW_{NH3}$ | lb/lbmol | 17.0 | 17.0 | http://www.webelements.com/ |
| $NH_3$ Emission Rate | $M_{NH3-lb/hr}$ | lb/hr | ***0.94*** | ***0.41*** | ***Calculated from ppm*** |
| | $M_{NH3-g/s}$ | g/s | 1.182E-01 | 5.210E-02 | Converted from lb/hr |
| Formaldehyde | $C_{d15-HCOH}$ | ppbvd @ 15% $O_2$ | 580 | 580 | RICE NESHAP limit for major source |
| | $C_{d-HCOH}$ | ppmvd | 0.826 | 0.777 | $C_{d15-HCOH}*((20.9-\%O_{2-Dry}*100)/(20.9-15))$ |
| | $MW_{HCOH}$ | lb/lbmol | 30.03 | 30.03 | http://www.webelements.com/ |
| | $M_{HCOH-lb/hr}$ | lb/hr | 0.091 | 0.04 | $((C_{d-HCOH}*(1-\%H_2O))*Q_{acfm}/10^6)*P_{std}*MW_{HCOH}/(R*T_{stack})*60$ |
| | $M_{HCOH-g/s}$ | g/s | 1.140E-02 | 5.000E-03 | Converted from lb/hr |
| | $EF_{HCOH}$ | lb/MMBtu | 0.0014 | 0.0014 | $M_{HCOH-lb/hr}/HI_{HHV}$ |