zephyr

consulting ♦ training ♦ data systems

May 13, 2013

via Hand Delivery

Texas Commission on Environmental Quality
Air Permits Initial Review Team (APIRT)
MC-161
P.O. Box 13087
Austin, TX 78711-3087



Re: NSR Construction Permit Application
Invenergy Thermal Development LLC
Ector County Energy Center
Ector County, Texas

APIRT:

Pursuant to §116.116, Invenergy Thermal Development LLC, hereby submits a permit application for construction of the Ector County Energy Center. If you have any questions or need additional information, please contact Mr. Matthew Thornton, of Invenergy Thermal Development LLC, at 312-582-1527 or myself at 512-579-3815 or bosborne@zephyrenv.com.

Sincerely,
**Zephyr Environmental Corporation**

Bryan Osborne
Project Manager

Attachments

cc: Mr. Dan Ewan, Invenergy Thermal Development LLC
Mr. Matt Thornton, Invenergy Thermal Development LLC
Air Section Manager, TCEQ Region 7 – Midland, w/attachments
(via Certified Mail 7013 0600 0001 8324 5790)

**TEXCOM** Texas Commission on — Invenergy Thermal LLC — 4/17/2013

| Ref Nbr | Invoice Nbr | Invc Date | Invoice Amount | Description | Net Check Amt |
|---|---|---|---|---|---|
| 219975 | | 04/17/13 | 75,000.00 | | 75,000.00 |

015534

**Invenergy Thermal LLC**
Operating Account
One S. Wacker Dr., Ste 1900
Chicago, IL 60606

JPMorgan Chase Bank, N.A.
Chicago, IL

2-1/710

CHECK # 015534

| Check Date | Check Amount |
|---|---|
| 04/17/2013 | $ ******75,000.00 |

Seventy-Five Thousand and 00/100---------- Dollars

PAY TO THE ORDER OF
Texas Commission on
Environmental Quality
PO Box 13087
Austin, TX 13087
United States

Authorized Signatures

Security features. Details on back.

⑈015534⑈ ⑆071000013⑆ 7074063 93⑈

RECEIVED
MAY 13 2013
TCEQ Revenue Section

TCEQ Use Only

# TCEQ Core Data Form

For detailed instructions regarding completion of this form, please read the Core Data Form Instructions or call 512-239-5175.

## SECTION I: General Information

1. Reason for Submission *(If other is checked please describe in space provided)*

☒ New Permit, Registration or Authorization *(Core Data Form should be submitted with the program application)*

☐ Renewal *(Core Data Form should be submitted with the renewal form)* ☐ Other

2. Attachments — Describe Any Attachments: *(ex. Title V Application, Waste Transporter Application, etc.)*

☒ Yes ☐ No — Permit Application Documents

| 3. Customer Reference Number *(if issued)* | Follow this link to search for CN or RN numbers in Central Registry** | 4. Regulated Entity Reference Number *(if issued)* |
|---|---|---|
| CN | | RN |

## SECTION II: Customer Information

5. Effective Date for Customer Information Updates (mm/dd/yyyy): 4/12/2013

6. Customer Role (Proposed or Actual) – *as it relates to the Regulated Entity listed on this form. Please check only one of the following:*

☐ Owner ☐ Operator ☒ Owner & Operator
☐ Occupational Licensee ☐ Responsible Party ☐ Voluntary Cleanup Applicant ☐ Other: _____

7. General Customer Information

☒ New Customer ☐ Update to Customer Information ☐ Change in Regulated Entity Ownership
☐ Change in Legal Name (Verifiable with the Texas Secretary of State) ☐ No Change**

***If "No Change" and Section I is complete, skip to Section III – Regulated Entity Information.***

| 8. Type of Customer: | ☐ Corporation | ☐ Individual | ☐ Sole Proprietorship- D.B.A |
|---|---|---|---|
| ☐ City Government | ☐ County Government | ☐ Federal Government | ☐ State Government |
| ☐ Other Government | ☐ General Partnership | ☐ Limited Partnership | ☒ Other: LLC |

9. Customer Legal Name *(If an individual, print last name first: ex: Doe, John)* — *If new Customer, enter previous Customer below* — *End Date:*

Invenergy Thermal Development LLC

10. Mailing Address:

1 S. Wacker Dr.
Suite 1900

| City | Chicago | State | IL | ZIP | 60606 | ZIP + 4 | |
|---|---|---|---|---|---|---|---|

| 11. Country Mailing Information *(if outside USA)* | 12. E-Mail Address *(if applicable)* |
|---|---|
| | |

| 13. Telephone Number | 14. Extension or Code | 15. Fax Number *(if applicable)* |
|---|---|---|
| ( 312 ) 224-1400 | | ( ) - |

| 16. Federal Tax ID *(9 digits)* | 17. TX State Franchise Tax ID *(11 digits)* | 18. DUNS Number *(if applicable)* | 19. TX SOS Filing Number *(if applicable)* |
|---|---|---|---|
| | | | |

20. Number of Employees: ☐ 0-20 ☐ 21-100 ☐ 101-250 ☒ 251-500 ☐ 501 and higher

21. Independently Owned and Operated? ☒ Yes ☐ No

## SECTION III: Regulated Entity Information

22. General Regulated Entity Information *(If 'New Regulated Entity" is selected below this form should be accompanied by a permit application)*

☒ New Regulated Entity ☐ Update to Regulated Entity Name ☐ Update to Regulated Entity Information ☐ No Change** *(See below)*

**If "NO CHANGE" is checked and Section I is complete, skip to Section IV, Preparer Information.

23. Regulated Entity Name *(name of the site where the regulated action is taking place)*

Ector County Energy Center

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 24. Street Address of the Regulated Entity: *(No P.O. Boxes)* | | | | | | | | |
| | City | | State | | ZIP | | ZIP + 4 | |
| 25. Mailing Address: | 1 S. Wacker Dr. | | | | | | | |
| | Suite 1900 | | | | | | | |
| | City | Chicago | State | IL | ZIP | 60606 | ZIP + 4 | |
| 26. E-Mail Address: | mthornton@invenergyllc.com | | | | | | | |

| 27. Telephone Number | 28. Extension or Code | 29. Fax Number *(if applicable)* |
|---|---|---|
| ( 312 ) 582-1527 | | ( ) - |

| 30. Primary SIC Code (4 digits) | 31. Secondary SIC Code (4 digits) | 32. Primary NAICS Code (5 or 6 digits) | 33. Secondary NAICS Code (5 or 6 digits) |
|---|---|---|---|
| 4911 | | | |

34. What is the Primary Business of this entity? *(Please do not repeat the SIC or NAICS description.)*

Power Generation

Questions 34 – 37 address geographic location. Please refer to the instructions for applicability.

| 35. Description to Physical Location: | From Goldsmith, drive E on Hwy. 158. Turn N on Holt Road. Turn W on SW 3601. Facility is ~1mi on R. |
|---|---|

| 36. Nearest City | County | State | Nearest ZIP Code |
|---|---|---|---|
| Goldsmith | Ector | TX | 79741 |

| 37. Latitude (N) In Decimal: | | | 38. Longitude (W) In Decimal: | | |
|---|---|---|---|---|---|
| Degrees | Minutes | Seconds | Degrees | Minutes | Seconds |
| 30 | 04 | 10 | 102 | 35 | 08 |

39. TCEQ Programs and ID Numbers Check all Programs and write in the permits/registration numbers that will be affected by the updates submitted on this form or the updates may not be made. If your Program is not listed, check other and write it in. See the Core Data Form instructions for additional guidance.

| | | | | |
|---|---|---|---|---|
| ☐ Dam Safety | ☐ Districts | ☐ Edwards Aquifer | ☐ Industrial Hazardous Waste | ☐ Municipal Solid Waste |
| | | | | |
| ☒ New Source Review – Air | ☐ OSSF | ☐ Petroleum Storage Tank | ☐ PWS | ☐ Sludge |
| | | | | |
| ☐ Stormwater | ☐ Title V – Air | ☐ Tires | ☐ Used Oil | ☐ Utilities |
| | | | | |
| ☐ Voluntary Cleanup | ☐ Waste Water | ☐ Wastewater Agriculture | ☐ Water Rights | ☐ Other: |
| | | | | |

## SECTION IV: Preparer Information

| 40. Name: | Mr. Bryan Osborne | 41. Title: | Environmental Consultant |
|---|---|---|---|

| 42. Telephone Number | 43. Ext./Code | 44. Fax Number | 45. E-Mail Address |
|---|---|---|---|
| ( 512 ) 579-3815 | | ( 512 ) 329-8253 | bosborne@zephyrenv.com |

## SECTION V: Authorized Signature

**46.** By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 9 and/or as required for the updates to the ID numbers identified in field 39.

***(See the Core Data Form instructions for more information on who should sign this form.)***

| Company: | Invenergy Thermal Development LLC | Job Title: | Vice President, Thermal Development |
|---|---|---|---|
| Name *(In Print)* : | Mr. Jim Shield | Phone: | ( 312 ) 582-1440 |
| Signature: | | Date: | |

# APPLICATION TO AUTHORIZE SIMPLE-CYCLE COMBUSTION TURBINE UNITS AT THE ECTOR COUNTY ENERGY CENTER ECTOR COUNTY, TEXAS

*SUBMITTED TO:*
**TEXAS COMMISSION ON ENVIRONMENTAL QUALITY**
**OFFICE OF PERMITTING, REMEDIATION, AND REGISTRATION**
**AIR PERMITS DIVISION**
**P. O. BOX 13087**
**AUSTIN, TEXAS 78711-3087**

*SUBMITTED BY:*
**INVENERGY THERMAL DEVELOPMENT LLC**
**1 S. WACKER DR.**
**SUITE 1900**
**CHICAGO, IL 60606**

*PREPARED BY:*
**ZEPHYR ENVIRONMENTAL CORPORATION**
**TEXAS REGISTERED ENGINEERING FIRM F-102**
**2600 VIA FORTUNA, SUITE 450**
**AUSTIN, TEXAS 78746**

**MAY 2013**

zephyr

## TABLE OF CONTENTS



## APPENDICES

# INTRODUCTION

Invenergy Thermal Development LLC (Invenergy) is seeking authorization from the Texas Commission on Environmental Quality (TCEQ) to construct and operate two natural gas-fired, simple-cycle combustion turbine generating units (CTGs) at the Ector County Energy Center, located approximately 20 miles northwest of Odessa, Texas, in Ector County. In addition to the two CTGs to be installed at the Ector County Energy Center, the additional items include a dew-point heater for the gas supply for the combustion turbines and an emergency diesel fire-water pump.

The combustion turbines that are being considered for the proposed project are General Electric 7FA.03 or 7FA.05 models. These models have a nominal base-load electrical power output of 165-193 MW. The new CTGs will operate as peaking units and will be limited to 2500 hours per year of operation each. Dry low-$NO_X$ (DLN) technology will be used to reduce the nitrogen oxide ($NO_X$) emissions from the turbines.

The Ector County Energy Center project triggers PSD review for GHG regulated pollutants because the installation of the Ector County Energy Center will produce annual GHG emissions of more than 100,000 tons/yr and annual emissions of the combined criteria PSD pollutants of more than 250 tons/yr. Included in this application are a project scope description, emissions calculations, and a Best Available Control Technology (BACT) analysis.

# Texas Commission on Environmental Quality
# Form PI-1 General Application for
# Air Preconstruction Permit and Amendment

Important Note: The agency requires that a Core Data Form be submitted on all incoming applications unless a Regulated Entity and Customer Reference Number have been issued and no core data information has changed. For more information regarding the Core Data Form, call (512) 239-5175 or go to www.tceq.texas.gov/permitting/central_registry/guidance.html.



| I. Applicant Information | | |
|---|---|---|
| A. Company or Other Legal Name: Invenergy Thermal Development LLC | | |
| Texas Secretary of State Charter/Registration Number (if applicable): | | |
| B. Company Official Contact Name: Mr. Jim Shield | | |
| Title: Vice President, Thermal Development | | |
| Mailing Address: 1 S. Wacker Dr., Suite 1900 | | |
| City: Chicago | State: IL | ZIP Code: 60606 |
| Telephone No.: 312-582-1440 | Fax No.: 312-506-1455 | E-mail Address: jshield@invenergyllc.com |
| C. Technical Contact Name: Mr. Matthew Thornton | | |
| Title: Business Development Manager | | |
| Company Name: Invenergy Thermal Development, LLC | | |
| Mailing Address: 1 S. Wacker., Suite 1900 | | |
| City: Chicago | State: IL | ZIP Code: 60606 |
| Telephone No.: 312-582-1527 | Fax No.: 312-506-1455 | E-mail Address: mthornton@invenergyllc.com |
| D. Site Name: Ector County Energy Center | | |
| E. Area Name/Type of Facility: Electric Utility | | ☒ Permanent ☐ Portable |
| F. Principal Company Product or Business: Electric Generation | | |
| Principal Standard Industrial Classification Code (SIC): 4911 | | |
| Principal North American Industry Classification System (NAICS): 221112 | | |
| G. Projected Start of Construction Date: 1/1/2014 | | |
| Projected Start of Operation Date: 1/1/2015 | | |
| H. Facility and Site Location Information (If no street address, provide clear driving directions to the site in writing.): | | |
| Street Address: From Goldsmith, drive E on Hwy. 158. Turn N on Holt Road. Turn W on SW 3601. Facility is ~1mi on r. | | |
| City/Town: Goldsmith | County: Ector | ZIP Code: 79741 |
| Latitude (nearest second): 32° 04' 10" N | Longitude (nearest second): 102° 35' 08" W | |

**Texas Commission on Environmental Quality**
**Form PI-1 General Application for**
**Air Preconstruction Permit and Amendment**

| | | |
|---|---|---|
| **I.** | **Applicant Information (continued)** | |
| I. | Account Identification Number (leave blank if new site or facility): | |
| J. | Core Data Form. | |
| Is the Core Data Form (Form 10400) attached? If No, provide customer reference number and regulated entity number (complete K and L). | | ☒ YES ☐ NO |
| K. | Customer Reference Number (CN): TBD | |
| L. | Regulated Entity Number (RN): TBD | |
| **II.** | **General Information** | |
| A. | Is confidential information submitted with this application? If Yes, mark each confidential page confidential in large red letters at the bottom of each page. | ☐ YES ☒ NO |
| B. | Is this application in response to an investigation, notice of violation, or enforcement action? If Yes, attach a copy of any correspondence from the agency and provide the RN in section I.L. above. | ☐ YES ☒ NO |
| C. | Number of New Jobs: TBD | |
| D. | Provide the name of the State Senator and State Representative and district numbers for this facility site: | |
| State Senator: Kel Seliger | | District No.: 31 |
| State Representative: Tryon D. Lewis | | District No.: 81 |
| **III.** | **Type of Permit Action Requested** | |
| A. | Mark the appropriate box indicating what type of action is requested. | |
| ☒ Initial ☐ Amendment ☐ Revision (30 TAC 116.116(e) ☐ Change of Location ☐ Relocation | | |
| B. | Permit Number (if existing): | |
| C. | Permit Type: Mark the appropriate box indicating what type of permit is requested. *(check all that apply, skip for change of location)* | |
| ☒ Construction ☐ Flexible ☐ Multiple Plant ☐ Nonattainment ☐ Plant-Wide Applicability Limit | | |
| ☒ Prevention of Significant Deterioration ☐ Hazardous Air Pollutant Major Source | | |
| ☐ Other: | | |
| D. | Is a permit renewal application being submitted in conjunction with this amendment in accordance with 30 TAC 116.315(c). | ☐ YES ☒ NO |

**Texas Commission on Environmental Quality**
**Form PI-1 General Application for**
**Air Preconstruction Permit and Amendment**

| **III. Type of Permit Action Requested *(continued)*** | | | |
|---|---|---|---|
| E. | Is this application for a change of location of previously permitted facilities? If Yes, complete III.E.1 - III.E.4.0 | | ☐ YES ☒ NO |
| 1. | Current Location of Facility (If no street address, provide clear driving directions to the site in writing.): | | |
| Street Address: | | | |
| | | | |
| City: | County: | ZIP Code: | |
| 2. | Proposed Location of Facility (If no street address, provide clear driving directions to the site in writing.): | | |
| Street Address: | | | |
| | | | |
| City: | County: | ZIP Code: | |
| 3. | Will the proposed facility, site, and plot plan meet all current technical requirements of the permit special conditions? If "NO", attach detailed information. | | ☐ YES ☐ NO |
| 4. | Is the site where the facility is moving considered a major source of criteria pollutants or HAPs? | | ☐ YES ☐ NO |
| F. | Consolidation into this Permit: List any standard permits, exemptions or permits by rule to be consolidated into this permit including those for planned maintenance, startup, and shutdown. | | |
| List: | | | |
| | | | |
| G. | Are you permitting planned maintenance, startup, and shutdown emissions? If Yes, attach information on any changes to emissions under this application as specified in VII and VIII. | | ☒ YES ☐ NO |
| H. | Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability) Is this facility located at a site required to obtain a federal operating permit? If Yes, list all associated permit number(s), attach pages as needed). | | ☒ YES ☐ NO ☐ To be determined |
| Associated Permit No (s.): | | | |
| | | | |

1. Identify the requirements of 30 TAC Chapter 122 that will be triggered if this application is approved.

☐ FOP Significant Revision ☐ FOP Minor ☐ Application for an FOP Revision
☐ Operational Flexibility/Off-Permit Notification ☐ Streamlined Revision for GOP
☒ To be Determined ☐ None

**Texas Commission on Environmental Quality**
**Form PI-1 General Application for**
**Air Preconstruction Permit and Amendment**

| | | |
|---|---|---|
| **III.** | **Type of Permit Action Requested *(continued)*** | |
| H. | Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability) *(continued)* | |
| 2. | Identify the type(s) of FOP(s) issued and/or FOP application(s) submitted/pending for the site. ***(check all that apply)*** | |
| ☐ GOP Issued | ☐ GOP application/revision application submitted or under APD review | |
| ☐ SOP Issued | ☐ SOP application/revision application submitted or under APD review | |
| **IV.** | **Public Notice Applicability** | |
| A. | Is this a new permit application or a change of location application? | ☒ YES ☐ NO |
| B. | Is this application for a concrete batch plant? If Yes, complete V.C.1 – V.C.2. | ☐ YES ☒ NO |
| C. | Is this an application for a major modification of a PSD, nonattainment, FCAA 112(g) permit, or exceedance of a PAL permit? | ☐ YES ☒ NO |
| D. | Is this application for a PSD or major modification of a PSD located within 100 kilometers or less of an affected state or Class I Area? | ☐ YES ☒ NO |
| If Yes, list the affected state(s) and/or Class I Area(s). | | |
| List: | | |
| E. | Is this a state permit amendment application? If Yes, complete IV.E.1. – IV.E.3. | |
| 1. | Is there any change in character of emissions in this application? | ☐ YES ☐ NO |
| 2. | Is there a new air contaminant in this application? | ☐ YES ☐ NO |
| 3. | Do the facilities handle, load, unload, dry, manufacture, or process grain, seed, legumes, or vegetables fibers (agricultural facilities)? | ☐ YES ☐ NO |
| F. | List the total annual emission increases associated with the application ***(List all that apply and attach additional sheets as needed):*** | |
| Volatile Organic Compounds (VOC): 41.51 | | |
| Sulfur Dioxide (SO2): 69.8 | | |
| Carbon Monoxide (CO): 298.35 | | |
| Nitrogen Oxides (NOx): 160.88 | | |
| Particulate Matter (PM): 67.13 | | |
| PM 10 microns or less (PM10): 67.13 | | |
| PM 2.5 microns or less (PM2.5): 67.13 | | |
| Lead (Pb): | | |
| Hazardous Air Pollutants (HAPs): <10 tpy for individual HAP and <25 tpy for all HAPs | | |
| Other speciated air contaminants not listed above: (H2SO4): 31.80 | | |

**Texas Commission on Environmental Quality**
**Form PI-1 General Application for**
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| **V. Public Notice Information *(complete if applicable)*** | | |
|---|---|---|
| A. Public Notice Contact Name: Mr. Matthew Thornton | | |
| Title: Business Development Manager | | |
| Mailing Address: 1 S. Wacker Dr., Suite 1900 | | |
| City: Chicago | State: IL | ZIP Code: 60606 |
| B. Name of the Public Place: Ector County Library | | |
| Physical Address *(No P.O. Boxes)*: 321 W 5th St | | |
| City: Odessa | County: Ector | ZIP Code: 79761 |
| The public place has granted authorization to place the application for public viewing and copying. | | ☒ YES ☐ NO |
| The public place has internet access available for the public. | | ☒ YES ☐ NO |
| C. Concrete Batch Plants, PSD, and Nonattainment Permits | | |
| 1. County Judge Information (For Concrete Batch Plants and PSD and/or Nonattainment Permits) for this facility site. | | |
| The Honorable: Susan M. Redford | | |
| Mailing Address: 300 North Grant, Room 227 | | |
| City: Odessa | State: TX | ZIP Code: 79761 |
| 2. Is the facility located in a municipality or an extraterritorial jurisdiction of a municipality? ***(For Concrete Batch Plants)*** | | ☐ YES ☐ NO |
| Presiding Officers Name(s): | | |
| Title: | | |
| Mailing Address: | | |
| City: | State: | ZIP Code: |
| 3. Provide the name, mailing address of the chief executive and Indian Governing Body; and identify the Federal Land Manager(s) for the location where the facility is or will be located. | | |
| Chief Executive: Mayor David Turner | | |
| Mailing Address: P.O. Box 4398 | | |
| City: Odessa | State: TX | ZIP Code: 79760 |
| Name of the Indian Governing Body: | | |
| Mailing Address: | | |
| City: | State: | ZIP Code: |

**Texas Commission on Environmental Quality**
**Form PI-1 General Application for**
**Air Preconstruction Permit and Amendment**

| | | |
|---|---|---|
| **V.** | **Public Notice Information *(complete if applicable) (continued)*** | |
| C. | Concrete Batch Plants, PSD, and Nonattainment Permits | |
| 3. | Provide the name, mailing address of the chief executive and Indian Governing Body; and identify the Federal Land Manager(s) for the location where the facility is or will be located. *(continued)* | |
| Name of the Federal Land Manager(s): Leslie Thiess, 801 S. Fillmore Street, Suite 500, Amarillo, TX 79101 | | |
| D. | Bilingual Notice | |
| Is a bilingual program required by the Texas Education Code in the School District? | | ☒ YES ☐ NO |
| Are the children who attend either the elementary school or the middle school closest to your facility eligible to be enrolled in a bilingual program provided by the district? | | ☒ YES ☐ NO |
| If Yes, list which languages are required by the bilingual program? | Spanish | |
| **VI.** | **Small Business Classification *(Required)*** | |
| A. | Does this company (including parent companies and subsidiary companies) have fewer than 100 employees or less than $6 million in annual gross receipts? | ☐ YES ☒ NO |
| B. | Is the site a major stationary source for federal air quality permitting? | ☒ YES ☐ NO |
| C. | Are the site emissions of any regulated air pollutant greater than or equal to 50 tpy? | ☒ YES ☐ NO |
| D. | Are the site emissions of all regulated air pollutants combined less than 75 tpy? | ☐ YES ☒ NO |
| **VII.** | **Technical Information** | |
| A. | The following information must be submitted with your Form PI-1 ***(this is just a checklist to make sure you have included everything)*** | |
| 1. | ☒ Current Area Map | |
| 2. | ☒ Plot Plan | |
| 3. | ☒ Existing Authorizations | |
| 4. | ☒ Process Flow Diagram | |
| 5. | ☒ Process Description | |
| 6. | ☒ Maximum Emissions Data and Calculations | |
| 7. | ☒ Air Permit Application Tables | |
| a. | ☒ Table 1(a) (Form 10153) entitled, Emission Point Summary | |
| b. | ☐ Table 2 (Form 10155) entitled, Material Balance | |
| c. | ☒ Other equipment, process or control device tables | |
| B. | Are any schools located within 3,000 feet of this facility? | ☐ YES ☒ NO |

| | | | | |
|---|---|---|---|---|
| **VII.** | **Technical Information** | | | |
| C. | Maximum Operating Schedule: | | | |
| Hour(s): 24 | Day(s): 7 | Week(s): 52 | Year(s): | |
| Seasonal Operation? If Yes, please describe in the space provide below. | | | | ☐ YES ☒ NO |
| | | | | |
| D. | Have the planned MSS emissions been previously submitted as part of an emissions inventory? | | | ☐ YES ☒ NO |
| Provide a list of each planned MSS facility or related activity and indicate which years the MSS activities have been included in the emissions inventories. Attach pages as needed. | | | | |
| | | | | |
| | | | | |
| E. | Does this application involve any air contaminants for which a disaster review is required? | | | ☐ YES ☒ NO |
| F. | Does this application include a pollutant of concern on the Air Pollutant Watch List (APWL)? | | | ☐ YES ☒ NO |
| **VIII.** | **State Regulatory Requirements**<br>**Applicants must demonstrate compliance with all applicable state regulations to obtain a permit or amendment.** *The application must contain detailed attachments addressing applicability or non applicability; identify state regulations; show how requirements are met; and include compliance demonstrations.* | | | |
| A. | Will the emissions from the proposed facility protect public health and welfare, and comply with all rules and regulations of the TCEQ? | | | ☒ YES ☐ NO |
| B. | Will emissions of significant air contaminants from the facility be measured? | | | ☒ YES ☐ NO |
| C. | Is the Best Available Control Technology (BACT) demonstration attached? | | | ☒ YES ☐ NO |
| D. | Will the proposed facilities achieve the performance represented in the permit application as demonstrated through recordkeeping, monitoring, stack testing, or other applicable methods? | | | ☒ YES ☐ NO |
| **IX.** | **Federal Regulatory Requirements**<br>**Applicants must demonstrate compliance with all applicable federal regulations to obtain a permit or amendment.** *The application must contain detailed attachments addressing applicability or non applicability; identify federal regulation subparts; show how requirements are met; and include compliance demonstrations.* | | | |
| A. | Does Title 40 Code of Federal Regulations Part 60, (40 CFR Part 60) New Source Performance Standard (NSPS) apply to a facility in this application? | | | ☒ YES ☐ NO |
| B. | Does 40 CFR Part 61, National Emissions Standard for Hazardous Air Pollutants (NESHAP) apply to a facility in this application? | | | ☐ YES ☒ NO |

**Texas Commission on Environmental Quality**
**Form PI-1 General Application for**
**Air Preconstruction Permit and Amendment**

| | | |
|---|---|---|
| **IX.** | **Federal Regulatory Requirements**<br>**Applicants must demonstrate compliance with all applicable federal regulations to obtain a permit or amendment.** *The application must contain detailed attachments addressing applicability or non applicability; identify federal regulation subparts; show how requirements are met; and include compliance demonstrations.* | |
| C. | Does 40 CFR Part 63, Maximum Achievable Control Technology (MACT) standard apply to a facility in this application? | ☒ YES ☐ NO |
| D. | Do nonattainment permitting requirements apply to this application? | ☐ YES ☒ NO |
| E. | Do prevention of significant deterioration permitting requirements apply to this application? | ☒ YES ☐ NO |
| F. | Do Hazardous Air Pollutant Major Source [FCAA 112(g)] requirements apply to this application? | ☐ YES ☒ NO |
| G. | Is a Plant-wide Applicability Limit permit being requested? | ☐ YES ☒ NO |
| **X.** | **Professional Engineer (P.E.) Seal** | |
| Is the estimated capital cost of the project greater than $2 million dollars? | | ☒ YES ☐ NO |
| If Yes, submit the application under the seal of a Texas licensed P.E. | | |
| **XI.** | **Permit Fee Information** | |
| Check, Money Order, Transaction Number ,ePay Voucher Number: | Fee Amount: $ 75,000 | |
| Paid online? | | ☐ YES ☒ NO |
| Company name on check: Invenergy Thermal, LLC | | |
| Is a copy of the check or money order attached to the original submittal of this application? | | ☒ YES ☐ NO ☐ N/A |
| Is a Table 30 (Form 10196) entitled, Estimated Capital Cost and Fee Verification, attached? | | ☐ YES ☒ NO ☐ N/A |

## XII. Delinquent Fees and Penalties

This form will not be processed until all delinquent fees and/or penalties owed to the TCEQ or the Office of the Attorney General on behalf of the TCEQ is paid in accordance with the Delinquent Fee and Penalty Protocol. For more information regarding Delinquent Fees and Penalties, go to the TCEQ Web site at: www.tceq.texas.gov/agency/delin/index.html.

## XIII. Signature

The signature below confirms that I have knowledge of the facts included in this application and that these facts are true and correct to the best of my knowledge and belief. I further state that to the best of my knowledge and belief, the project for which application is made will not in any way violate any provision of the Texas Water Code (TWC), Chapter 7, Texas Clean Air Act (TCAA), as amended, or any of the air quality rules and regulations of the Texas Commission on Environmental Quality or any local governmental ordinance or resolution enacted pursuant to the TCAA I further state that I understand my signature indicates that this application meets all applicable nonattainment, prevention of significant deterioration, or major source of hazardous air pollutant permitting requirements. The signature further signifies awareness that intentionally or knowingly making or causing to be made false material statements or representations in the application is a criminal offense subject to criminal penalties.

Name:

Signature:_____

*Original Signature Required*

Date:

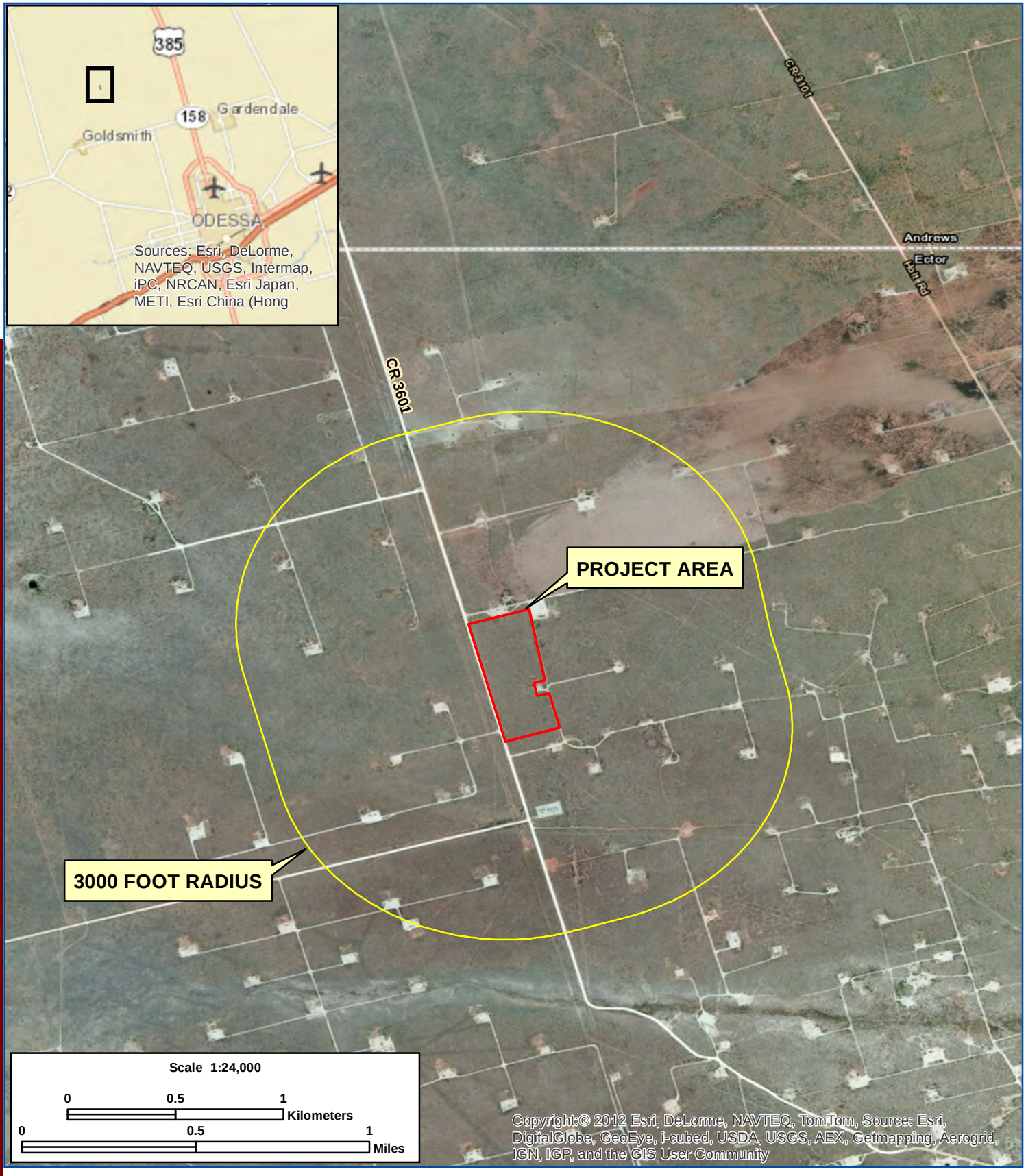
PRINT FORM RESET FORM

# VII. TECHNICAL INFORMATION
## A.1. Area Map and A.2. Plot Plan

The attached area map shows the surrounding land use and a 3,000-foot radius around the site property line.

The attached plot plan shows the scale, a north arrow, two benchmarks, and emission points associated with the proposed project.

# VII.A.1 AREA MAP




N

Datum:
GCS NAD 1983
Map Sources: ESRI
Streets & Bing Hybrid Basemap,
Invenergy LLC


zephyr

# AREA MAP

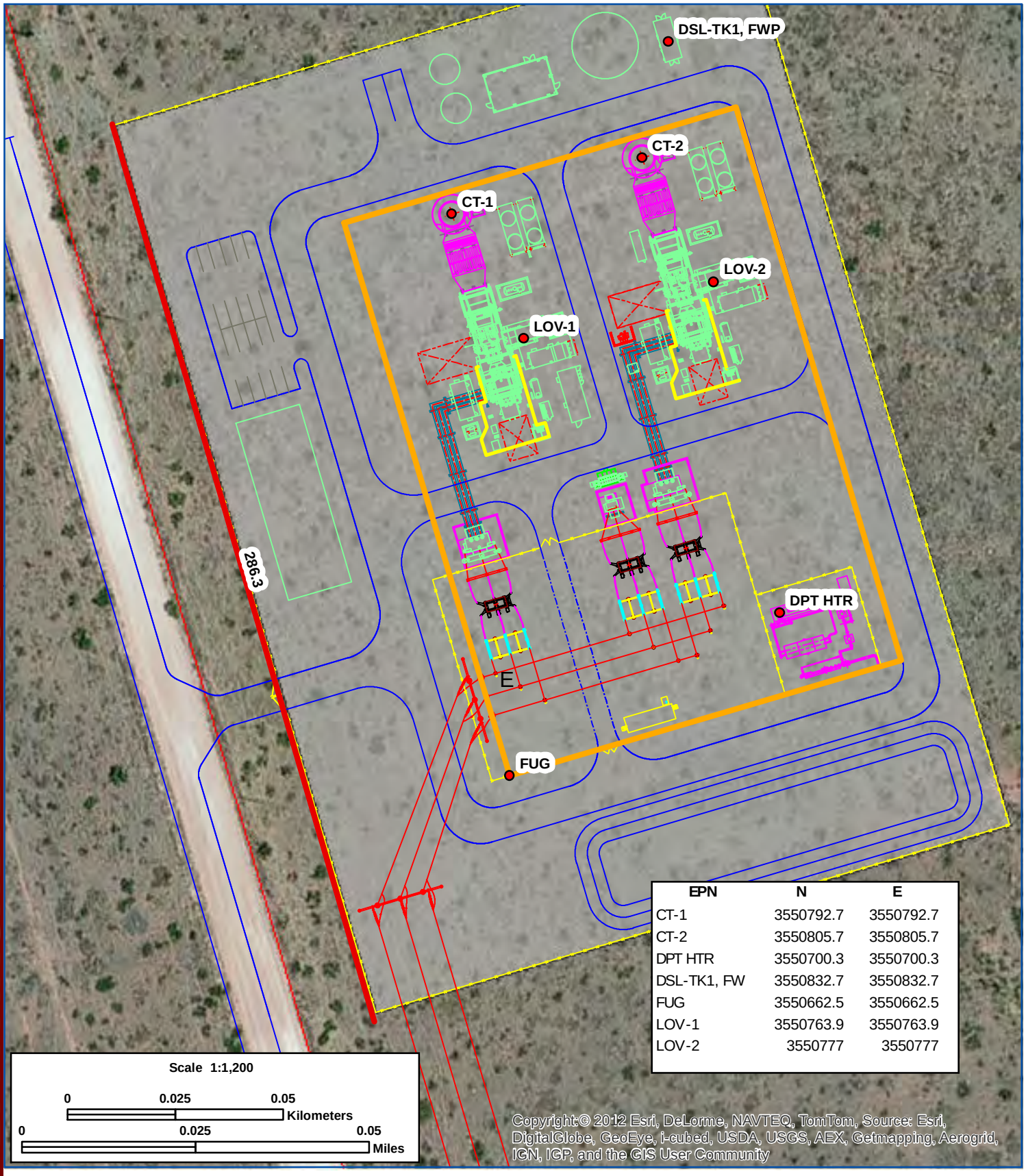
## ECTOR COUNTY ENERGY CENTER

**Invenergy LLC**
**Ector County, Texas**

H:\Invenergy, LLC\GIS\PDF

| Drafted By: | Reviewed By: | Project No.: | Date: |
|---|---|---|---|
| J. Knowles | B. Osborne | 13003.001 | 03.25.2013 |

# VII.A.2 PLOT PLAN




| EPN | N | E |
|---|---|---|
| CT-1 | 3550792.7 | 3550792.7 |
| CT-2 | 3550805.7 | 3550805.7 |
| DPT HTR | 3550700.3 | 3550700.3 |
| DSL-TK1, FW | 3550832.7 | 3550832.7 |
| FUG | 3550662.5 | 3550662.5 |
| LOV-1 | 3550763.9 | 3550763.9 |
| LOV-2 | 3550777 | 3550777 |

N

Datum:
GCS NAD 1983
Map Sources: ESRI
Streets & Bing Hybrid Basemap,
Invenergy LLC


zephyr

# AREA MAP

## Peaker Project Area

## Invenergy LLC

### Ector County, Texas

H:\Invenergy, LLC\GIS\PDF

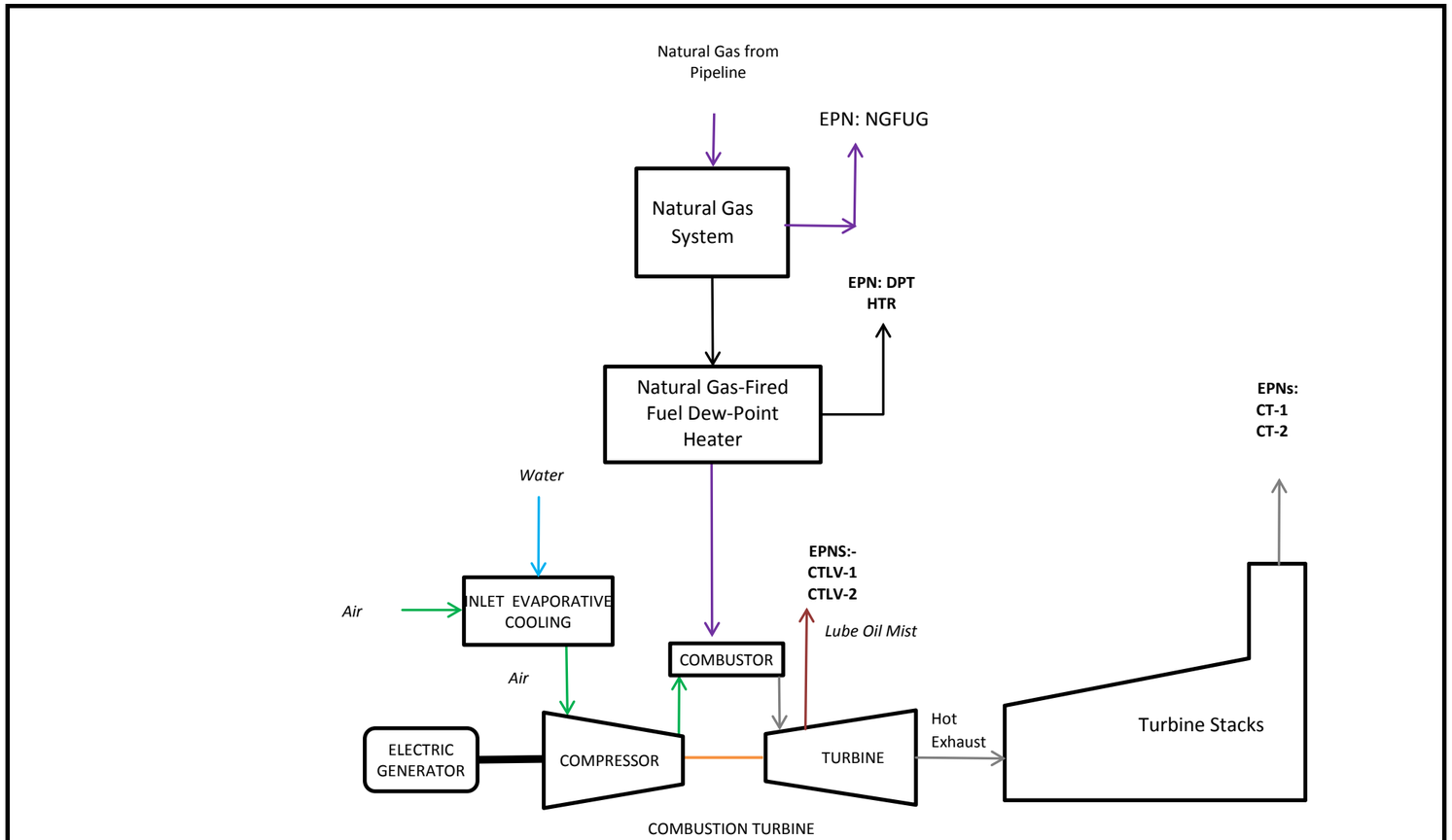
| Drafted By: | Reviewed By: | Project No.: | Date: |
|---|---|---|---|
| J. Knowles | B. Osborne | 13003.001 | 02.28.2013 |

## VII.A.3 EXISTING AUTHORIZATIONS

Since the Ector County Energy Center is a greenfield site, there are no existing authorizations.

## VII.A.4 PROCESS FLOW DIAGRAM

The process flow diagram for power generating activities associated with the new project is presented as Figure VII.A.4.




**MISC. EPNs:**
**FWP**
**MSSFUG**
**LOFUG**

| **Ector County Energy Center** | | | FIGURE VII.A.4<br>PROCESS FLOW DIAGRAM | | |
|---|---|---|---|---|---|
| Permit Application | | | Filename: ECEC PFD.xls | | |
| zephyr | Drawn by:<br>B.Breeze | Checked by:<br>B. Osborne | Project No.:<br>13003.001 | Date:<br>3/22/2013 | Sheet:<br>1 of 1 |

# VII.A.5 PROCESS DESCRIPTION

## 1.0 Introduction

Invenergy is seeking authorization to construct and operate two natural gas-fired, simple-cycle CTGs. Together, the new units will be capable of generating approximately 326-424 MW and are designed for peaking service, including daily startup and shutdown and extended periods of operation or non-operation.

The power generating equipment and ancillary equipment that will be sources of emissions at the site are listed below:

- Two identical, simple-cycle, natural gas-fired CTGs equipped with low-$NO_X$ emissions combustion technology
- Lube oil vents for the turbine lube oil recirculation systems
- Piping fugitives associated with the natural gas fuel delivery and lube oil systems

Details regarding the proposed equipment follow. A process flow diagram is included as Figure VII.A.4.

## 2.0 Combustion Turbine Generators

A typical combustion turbine generator (CTG) combusts natural gas to rotate a generator in order to produce electrical power. The main components of a CTG consist of a compressor, combustor, turbine, and generator. The compressor pressurizes combustion air to the combustor where the fuel is mixed with the combustion air and burned. Hot exhaust gases then enter the turbine where the gases expand across the turbine blades, driving a shaft to power an electric generator. The exhaust gases from the CTGs proposed for the Ector County Energy Center will be routed to their respective stacks (EPNs CT-1 and CT-2). The temperature of the inlet air to the CTGs will be lowered using evaporative cooling to increase the mass air flow through the turbines and achieve maximum turbine power output on days with warm to hot ambient conditions. In addition, there will be a natural gas-fired dew-point heater to heat the natural gas supply going to the combustion turbines.

Either the General Electric 7FA.03 or 7FA.05 combustion turbine will be selected for use at this location. Each GE 7FA.03 unit is designed to operate at a nominal 165 MW, with a 10,350 Btu/kWh higher heating value (HHV) heat rate. Each GE 7FA.05 unit is designed to operate at a nominal 193 MW, with a 9,760 Btu/kWh higher heating value (HHV) heat rate. $NO_x$ emissions are controlled via GE's DLN (dry low-$NO_x$) 2.6 combustion technology for the 7FA.03 model and with DLN9 combustion technology for the 7FA.05 model. The typical operating range of the GE units is between 48 percent and 100 percent of base load.

## 3.0 Lube Oil Recirculation System

Both of the proposed CTGs will be equipped with a lube oil recirculation system to lubricate moving parts of the turbines. Emissions of condensed lube oil droplets from the lube oil system will be exhausted through vapor extraction vents (EPNs: CTLV-1 and CTLV-2) serving the proposed CTGs, and these emissions will be controlled with mist eliminators.

Equipment and piping components in lube oil service will be sources of fugitive emissions of lube oil vapor (EPN: LOFUG).

## 4.0 Natural Gas System

Natural gas will be delivered to the site via pipeline, metered, and piped to the combustion turbines. Piping and fittings associated with the natural gas-fuel delivery system will be sources of fugitive emissions (EPN: NGFUG).

## 5.0 Startup/Shutdown Activities

Startup and shutdown of the proposed combustion turbines will be part of the routine operations at the facility. For the combustion turbine, startup is defined as the period beginning when the gas turbine receives a "turbine start" signal and an initial flame detection signal is recorded in the plant's control system and ending when the combustion turbine output reaches the lean pre-mix operating mode. The shutdown period is defined as the period beginning when the gas turbine receives a "turbine stop" command and the generator output drops below the minimum stable load and ending when a flame detection signal is no longer recorded in the plant's control system. Typically, startups and shutdowns will not exceed 60 minutes.

## 6.0 Natural Gas-Fired Dew-Point Heater

A 9 MMBtu/hr natural gas-fired, dew-point heater will be utilized for the proposed project. This heater will heat the natural gas prior to its use as fuel for the combustion turbines in order to prevent condensed liquids in the natural gas from damaging the combustor sections of the turbines. The heater will be in operation any time either of the combustion turbines is firing natural gas.

## 7.0 Emergency Fire-Water Pump

An approximate 250-horsepower diesel-fired emergency fire-water pump will be installed to be used only during emergency situations to operate the plant's fire-fighting equipment. However, the fire-water pump will be operated (typically for a few hours) on a monthly basis to maintain the integrity and operational readiness of the equipment. Annual hours of operation are anticipated to be less than 100 hours per year during non-emergency situations.

## 8.0 Maintenance Activities

Invenergy may perform the following maintenance activities at the proposed units that may generate fugitive emissions:

- Air intake filter change-out
- Inspection, repair, replacement, adjusting, testing, and calibration of analytical equipment and process instrumentation, including site glasses, meters and gauges
- CEMs calibration
- Management of sludge
- Low VOC vapor pressure equipment fugitives

These emissions are identified as EPN: MSSFUG in the application.

Invenergy may also perform the following maintenance activities at the proposed units that release emissions from the stacks serving the proposed combustion turbines:

- Combustion turbine optimization
- Off-line turbine compressor section washing

These emissions are included as part of the emissions calculated for EPNs: CT-1 and CT-2.

# VII.A.6 EMISSIONS DATA AND CALCULATIONS

## 1.0 Introduction

The methods used to calculate emissions from air pollutant emitting activities associated with the proposed project are summarized in this section, and detailed calculations are provided in Appendix A. A TCEQ Table 1(a) (Emission Point Summary), provided in Section VII.A.7, lists the maximum hourly and annual emission rates for each emission source to be authorized under the new permit. An additional summary of emission sources, with their associated facility identification, control identification, and emission point numbers (FIN/CIN/EPN), is included as Table 1(a) in Section VII.A.7.

## 2.0 Combustion Turbine Emissions

With this application, Invenergy is requesting approval to install two identical CTGs utilizing the GE 7FA.03 or 7FA.05 design. The CTGs will be fired exclusively with pipeline-quality natural gas. Products of combustion from the CTGs will include $NO_x$, carbon monoxide (CO), volatile organic compounds (VOC), sulfur dioxide ($SO_2$), particulate matter (PM) - which includes particulate matter with diameters less than 10 microns ($PM_{10}$) and particulate matter with diameters less than 2.5 microns ($PM_{2.5}$), and sulfuric acid mist ($H_2SO_4$). The products of combustion will vent to the atmosphere via the exhaust stacks serving the units (EPNs: CT-1 and CT-2).

Maximum short-term emissions during periods other than startup and shutdown (SUSD) (including during periods of full and reduced operating load operations) were calculated for each combustion turbine model as summarized in this part of Section VII.A.6. Additionally, maximum annual emissions due to the combined contributions from all modes of operation were calculated based on maximum emission rates estimated for normal and SUSD operations and the frequencies of SUSD operations.

Emission calculations were based, primarily, on data supplied by GE and on the application of BACT. Maximum emissions from the GE configuration during normal operations are projected to occur at an ambient temperature of 22ºF and at base-load.

Properties of typical natural gas to be fired in the units are summarized in Table A-7 of Appendix A.

Following is a summary of emissions performance assumptions used in calculating normal operations emissions from the turbines:

- $NO_x$ emissions were calculated using a base emission factor of 9.0 ppmvd corrected to 15 percent oxygen.
- CO emissions were calculated using the emission factor of 9.0 ppmvd, corrected to 15 percent oxygen.

- $SO_2$ emissions were calculated using a maximum natural gas sulfur content of 5.0 grains (gr) /100 scf. The sulfur content in the fuel was multiplied by the volumetric rate of fuel consumed to determine the total flow of sulfur. One hundred percent of the sulfur in the fuel was assumed to convert (stoichiometrically) to $SO_2$.

- $H_2SO_4$ emissions were calculated by conservatively assuming that 10 percent by weight of the sulfur emissions oxidize to sulfur trioxide ($SO_3$) in the CTG. It was then assumed that that 100 percent of $SO_3$ converts to $H_2SO_4$.

- PM (including $PM_{10}/PM_{2.5}$) emissions were based on data provided by the turbine vendors. The calculated $H_2SO_4$ contribution to the condensable fraction of the PM emissions was added to the vendor provided PM emission rates to estimate the total PM emission rates.

- VOC emissions were calculated using a base emission factor of 1.4 ppmv (wet).

- Hazardous air pollutant (HAP) emissions test data show that formaldehyde ($CH_2O$) is the HAP emitted in the greatest quantities from CTGs. In the development of the Subpart YYYY MACT for stationary gas turbines, the U.S. Environmental Protection Agency (EPA) evaluated emissions test data for CTGs and determined that the emissions factor for $CH_2O$ is only 0.0000978 lb/MMBtu for "lean burn" units like the GE model being considered by Invenergy.[1] Even if these formaldehyde factors were used to calculate emissions of every other HAP potentially emitted from the turbines proposed by Invenergy, maximum site-wide HAP emissions would be less than 10 tons per year for any single HAP and less than 25 tons per year for all HAPs in aggregate.

Detailed turbine emission calculations are presented in Tables A-3 and A-4 of Appendix A for multiple operating scenarios. The projected maximum emission rates are summarized in Tables A-1 and A-2 in Appendix A.

## 3.0 Emissions from Startup and Shutdown Activities

During SUSD periods, emissions may be released from the turbines at higher rates. In particular, during startup, higher $NO_X$ emissions may be produced during the transition of the combustors to full low-$NO_X$ (lean pre-mix) operation. Also, higher CO and VOC emissions during SUSD may result due to incomplete combustion as the units transition to their lean pre-mix operating modes. Finally, during startup, higher than normal opacity may be experienced.

The calculation of SUSD emissions from the CTGs was based on data supplied by GE. The maximum hourly SUSD emission rates represented in this application are the highest emission rates at any load during SUSD operations, and the annual emission rates are based on average emission rates during SUSD and frequencies of SUSD (See Part 2.0 of Section VII.A.6 for discussion of annual emissions calculations). The maximum SUSD emissions are summarized

[1] *EPA, Combustion Turbine Database, October 15, 2002*

in Table A-5 and are reflected as startup and shutdown emissions for EPNs: CT-1 and CT-2 on Table 1(a).

## 4.0 Lube Oil Recirculation System Vent Emissions

The proposed units will be equipped with dedicated lubrication systems. Lubricating oil will be circulated through the turbine machinery from the oil sump, and the heating of recirculating lube oil in the gas turbine and generator housings will create oil vapor and oil condensate droplets in the oil reservoir compartments. Emissions of the condensed droplets will be controlled by a mist eliminator serving each reservoir. The calculation of emissions from the two lube oil vents (EPNs: CTLV-1 and CTLV-2) was based on lube oil replacement rates for similar units equipped with mist eliminators and are presented as Table A-8 in Appendix A. The lube oil vent emissions are counted both as VOCs and PM for the two emission points.

When the gas turbines do not operate for extended periods such that lube oil is cooled to near-ambient temperatures, the mist eliminators may be shut down. During this time, vapor breathing and filling losses may occur from each oil reservoir. However, these latter losses will be negligible compared to the emissions during the recirculation of the hot lube oil.

## 5.0 Emissions from Natural Gas-Fired Dew-Point Heaters for Natural Gas Supply

A 9 MMBtu/hr, natural gas-fired, dew-point heater will be utilized for the proposed project. This heater will heat the natural gas prior to its use as fuel for the combustion turbines in order to prevent condensed liquids in the natural gas from damaging the combustor sections of the turbines. The heater will be in operation any time either of the combustion turbines is firing natural gas. Emissions from this unit are based on vendor specified emission rates as presented in Table A-9 in Appendix A.

## 6.0 Natural Gas Fugitive Emissions

Fugitive emissions will be generated from the natural gas feed system (NGFUG). EPA's emission factors for oil and gas production operations published on Table 2-4 of its *Protocol for Equipment Leak Emissions Estimates*[2] were applied to the various types of equipment components (valves, flanges, relief valves etc.) in natural gas service to calculate fugitive emissions from the natural gas system. Fugitive emissions from lube oil components were calculated using EPA emissions factors for components in lube oil service at refineries. These calculations, based on component counts for units similar to the ones proposed in this application, are presented on Table A-10 of Appendix A.

## 7.0 Diesel Fire-Water Pump and Related Fuel Storage

[2] *EPA, Protocol for Equipment Leak Estimates (EPA-453/R-95-017), November 1995*

A 250 horsepower diesel fire-water pump will be utilized for the proposed project. This diesel fire-water pump will be utilized for emergency purposes as well as occasional routine maintenance. Hourly emissions, as stated in Table A-11 of Appendix A, are based on the manufacturer's stated emission rates. Yearly non-emergency usage is based on 100 hours of operation per year. The emissions from the diesel fuel storage tank associated with the diesel fire-water pump have been calculated using equations listed in Table A-12 of Appendix A.

## 8.0 Emissions from Maintenance Activities

The following maintenance-related activities that are part of the project and will potentially produce emissions are listed below:

- Non-Inherently Low Emitting (ILE) Maintenance Activities
- Inherently Low Emitting (ILE) Maintenance Activities
- Turbine Compressor Section Washing
- Turbine Air Intake Filter Change-outs
- Small equipment and fugitive component repair/replacement (high VP)
- Small equipment and fugitive component repair/replacement (low VP)
- Gaseous Fuel Venting and Small Equipment and Fugitive Component Repair/Replacement
- CEMs calibration
- Diesel Storage Tank maintenance
- Lube Oil Storage Tank maintenance
- Storage Tanks for Low Reid Vapor Pressure Compounds maintenance
- Management of sludge
- Organic Chemical Usage not covered by "Manual Surface Coating or Solvent Cleaning Operations" (Gas-Fired EGU)
- Inspection, repair, replacement, adjusting, testing, and calibration of analytical equipment and process instruments, including site glasses, meters, and gauges

Maximum hourly and total annual emissions associated with combustion turbine optimization, a non-inherently low emitting (ILE) activity, and on-line turbine compressor section washing, an ILE activity, are no higher than the emission rates requested in this application for normal or SUSD emissions from the turbines and are included in the emissions estimated for EPNs: CT-1 and CT-2.

Emissions from each of the other categories of maintenance activities, all ILE activities, are summarized on Table A-14 and calculated in Tables A-15 through A-26 of Appendix A and are represented on the Table 1(a) for this application as MSSFUG. In addition, the emissions are summarized in Table A-14 of Appendix A.

# VII.A.7 TCEQ TABLES

A TCEQ Table 1(a) (Emission Point Summary), Tables 29, and Table 31 follow:

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
## Table 1(a) Emission Point Summary

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | **DD/MM/YYYY** | **Permit No.:** | **TBD** | **Regulated Entity No.:** | **TBD** |
| **Area Name:** | **Ector County Energy Center** | | | **Customer Reference No.:** | **TBD** |

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

| **AIR CONTAMINANT DATA** | | | | | |
|---|---|---|---|---|---|
| **1. Emission Point** | | | **2. Component or Air Contaminant Name** | **3. Air Contaminant Emission Rate** | |
| **(A) EPN** | **(B) FIN** | **(C) NAME** | | **(A) Pounds per Hour** | **(B) TPY** |
| CT-1 | CT-1 | Unit 1 (GE 7FA.03) | Normal Operating Emissions | | |
| (Option 1) | (Option 1) | (Option 1) | $NO_X$ | 62.34 | - - - |
| | | | CO | 37.95 | - - - |
| | | | VOC | 13.28 | - - - |
| | | | $SO_2$ | 27.40 | - - - |
| | | | $PM/PM_{10}/PM_{2.5}$ | 25.15 | - - - |
| | | | $H_2SO_4$ | 12.59 | - - - |
| | | | | | |
| | | | MSS Emissions | | |
| | | | $NO_X$ | 66.50 | - - - |
| | | | CO | 477.60 | - - - |
| | | | VOC | 36.00 | - - - |
| | | | $SO_2$ | 27.40 | - - - |
| | | | $PM/PM_{10}/PM_{2.5}$ | 25.15 | - - - |
| | | | $H_2SO_4$ | 12.59 | - - - |
| | | | | | |
| | | | Combined Normal and MSS Emissions | | |
| | | | $NO_X$ | --- | 52.68 |
| | | | CO | --- | 132.27 |
| | | | VOC | --- | 16.24 |
| | | | $SO_2$ | --- | 20.57 |
| | | | $PM/PM_{10}/PM_{2.5}$ | --- | 22.98 |
| | | | $H_2SO_4$ | --- | 9.45 |
| | | | | | |

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
## Table 1(a) Emission Point Summary

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | **DD/MM/YYYY** | **Permit No.:** | **TBD** | **Regulated Entity No.:** | **TBD** |
| **Area Name:** | **Ector County Energy Center** | | | **Customer Reference No.:** | **TBD** |

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

| **AIR CONTAMINANT DATA** | | | | | |
|---|---|---|---|---|---|
| **1. Emission Point** | | | **2. Component or Air Contaminant Name** | **3. Air Contaminant Emission Rate** | |
| **(A) EPN** | **(B) FIN** | **(C) NAME** | | **(A) Pounds per Hour** | **(B) TPY** |
| CT-2 | CT-2 | Unit 2 (GE 7FA.03) | Normal Operating Emissions | | |
| (Option 1) | (Option 1) | (Option 1) | $NO_X$ | 62.34 | - - - |
| | | | CO | 37.95 | - - - |
| | | | VOC | 13.28 | - - - |
| | | | $SO_2$ | 27.40 | - - - |
| | | | $PM/PM_{10}/PM_{2.5}$ | 25.15 | - - - |
| | | | $H_2SO_4$ | 12.59 | - - - |
| | | | | | |
| | | | MSS Emissions | | |
| | | | $NO_X$ | 66.50 | - - - |
| | | | CO | 477.60 | - - - |
| | | | VOC | 36.00 | - - - |
| | | | $SO_2$ | 27.40 | - - - |
| | | | $PM/PM_{10}/PM_{2.5}$ | 25.15 | - - - |
| | | | $H_2SO_4$ | 12.59 | - - - |
| | | | | | |
| | | | Combined Normal and MSS Emissions | | |
| | | | $NO_X$ | --- | 52.68 |
| | | | CO | --- | 132.27 |
| | | | VOC | --- | 16.24 |
| | | | $SO_2$ | --- | 20.57 |
| | | | $PM/PM_{10}/PM_{2.5}$ | --- | 22.98 |
| | | | $H_2SO_4$ | --- | 9.45 |
| | | | | | |

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
## Table 1(a) Emission Point Summary

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | **DD/MM/YYYY** | **Permit No.:** | **TBD** | **Regulated Entity No.:** | **TBD** |
| **Area Name:** | **Ector County Energy Center** | | | **Customer Reference No.:** | **TBD** |

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

| **AIR CONTAMINANT DATA** | | | | | |
|---|---|---|---|---|---|
| **1. Emission Point** | | | **2. Component or Air Contaminant Name** | **3. Air Contaminant Emission Rate** | |
| **(A) EPN** | **(B) FIN** | **(C) NAME** | | **(A) Pounds per Hour** | **(B) TPY** |
| CT-1 | CT-1 | Unit 1 (GE 7FA.05) | Normal Operating Emissions | | |
| (Option 2) | (Option 2) | (Option 2) | $NO_X$ | 63.62 | - - - |
| | | | CO | 38.73 | - - - |
| | | | VOC | 3.00 | - - - |
| | | | $SO_2$ | 28.33 | - - - |
| | | | $PM/PM_{10}/PM_{2.5}$ | 26.83 | - - - |
| | | | $H_2SO_4$ | 13.02 | - - - |
| | | | | | |
| | | | MSS Emissions | | |
| | | | $NO_X$ | 66.50 | - - - |
| | | | CO | 477.60 | - - - |
| | | | VOC | 36.00 | - - - |
| | | | $SO_2$ | 28.33 | - - - |
| | | | $PM/PM_{10}/PM_{2.5}$ | 26.83 | - - - |
| | | | $H_2SO_4$ | 13.02 | - - - |
| | | | | | |
| | | | Combined Normal and MSS Emissions | | |
| | | | $NO_X$ | --- | 78.82 |
| | | | CO | --- | 148.18 |
| | | | VOC | --- | 11.25 |
| | | | $SO_2$ | --- | 35.42 |
| | | | $PM/PM_{10}/PM_{2.5}$ | --- | 33.54 |
| | | | $H_2SO_4$ | --- | 16.27 |
| | | | | | |

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
## Table 1(a) Emission Point Summary

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | **DD/MM/YYYY** | **Permit No.:** | **TBD** | **Regulated Entity No.:** | **TBD** |
| **Area Name:** | **Ector County Energy Center** | | | **Customer Reference No.:** | **TBD** |

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

| **AIR CONTAMINANT DATA** | | | | | |
|---|---|---|---|---|---|
| **1. Emission Point** | | | **2. Component or Air Contaminant Name** | **3. Air Contaminant Emission Rate** | |
| **(A) EPN** | **(B) FIN** | **(C) NAME** | | **(A) Pounds per Hour** | **(B) TPY** |
| CT-2 | CT-2 | Unit 2 (GE 7FA.05) | Normal Operating Emissions | | |
| (Option 2) | (Option 2) | (Option 2) | $NO_X$ | 63.62 | - - - |
| | | | CO | 38.73 | - - - |
| | | | VOC | 3.00 | - - - |
| | | | $SO_2$ | 28.33 | - - - |
| | | | $PM/PM_{10}/PM_{2.5}$ | 26.83 | - - - |
| | | | $H_2SO_4$ | 13.02 | - - - |
| | | | | | |
| | | | MSS Emissions | | |
| | | | $NO_X$ | 66.50 | - - - |
| | | | CO | 477.60 | - - - |
| | | | VOC | 36.00 | - - - |
| | | | $SO_2$ | 28.33 | - - - |
| | | | $PM/PM_{10}/PM_{2.5}$ | 26.83 | - - - |
| | | | $H_2SO_4$ | 13.02 | - - - |
| | | | | | |
| | | | Combined Normal and MSS Emissions | | |
| | | | $NO_X$ | --- | 78.82 |
| | | | CO | --- | 148.18 |
| | | | VOC | --- | 11.25 |
| | | | $SO_2$ | --- | 35.42 |
| | | | $PM/PM_{10}/PM_{2.5}$ | --- | 33.54 |
| | | | $H_2SO_4$ | --- | 16.27 |
| | | | | | |

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
## Table 1(a) Emission Point Summary

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | **DD/MM/YYYY** | **Permit No.:** | **TBD** | **Regulated Entity No.:** | **TBD** |
| **Area Name:** | **Ector County Energy Center** | | | **Customer Reference No.:** | **TBD** |

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

| AIR CONTAMINANT DATA | | | | | |
|---|---|---|---|---|---|
| **1. Emission Point** | | | **2. Component or Air Contaminant Name** | **3. Air Contaminant Emission Rate** | |
| **(A) EPN** | **(B) FIN** | **(C) NAME** | | **(A) Pounds per Hour** | **(B) TPY** |
| CTLV1 | CTLV1 | Combustion Turbine 1 Lube Oil Vent | VOC | 0.09 | 0.40 |
| | | | $PM/PM_{10}/PM_{2.5}$ | 0.09 | 0.40 |
| | | | | | |
| CTLV2 | CTLV2 | Combustion Turbine 2 Lube Oil Vent | VOC | 0.09 | 0.40 |
| | | | $PM/PM_{10}/PM_{2.5}$ | 0.09 | 0.40 |
| | | | | | |
| DPT HTR | DPT HTR | Dewpoint Heater | Normal Operating Emissions | | |
| | | | NOX | 1.38 | 3.44 |
| | | | CO | 0.85 | 2.12 |
| | | | VOC | 0.05 | 0.14 |
| | | | $PM/PM_{10}/PM_{2.5}$ | 0.05 | 0.14 |
| | | | SO2 | 0.13 | 0.33 |
| | | | | | |
| | | | MSS Emissions | | |
| | | | NOX | 1.51 | - - - |
| | | | CO | 1.63 | - - - |
| | | | VOC | 0.05 | - - - |
| | | | $PM/PM_{10}/PM_{2.5}$ | 0.05 | - - - |
| | | | SO2 | 0.13 | - - - |
| | | | | | |
| NGFUG | NGFUG | Natural Gas Fugitives | VOC | 0.01 | 0.02 |
| | | | | | |
| FWP | FWP | Fire Water Pump | NOX | 1.36 | 0.07 |
| | | | CO | 0.66 | 0.03 |
| | | | VOC | 0.03 | 0.002 |
| | | | $PM/PM_{10}/PM_{2.5}$ | 0.06 | 0.003 |
| | | | SO2 | 0.03 | 0.002 |
| | | | | | |
| DSL-TK1 | DSL-TK1 | Diesel Tank 1 | VOC | 0.02 | <0.01 |
| | | | | | |

# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
## Table 1(a) Emission Point Summary

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | **DD/MM/YYYY** | **Permit No.:** | **TBD** | **Regulated Entity No.:** | **TBD** |
| **Area Name:** | **Ector County Energy Center** | | | **Customer Reference No.:** | **TBD** |

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

| AIR CONTAMINANT DATA | | | | | |
|---|---|---|---|---|---|
| **1. Emission Point** | | | **2. Component or Air Contaminant Name** | **3. Air Contaminant Emission Rate** | |
| **(A) EPN** | **(B) FIN** | **(C) NAME** | | **(A) Pounds per Hour** | **(B) TPY** |
| MSS FUG | MSS FUG | MSS Fugitives | NOX | <0.01 | <0.01 |
| | | | CO | <0.01 | <0.01 |
| | | | VOC | 4.09 | 0.78 |
| | | | $PM/PM_{10}/PM_{2.5}$ | 0.05 | 0.00 |
| | | | PM2.5 | 0.05 | 0.00 |
| | | | | | |
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# TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
## Table 1(a) Emission Point Summary

| | | | | | |
|---|---|---|---|---|---|
| **Date:** | **DD/MM/YYYY** | **Permit No.:** | **TBD** | **Regulated Entity No.:** | **TBD** |
| **Area Name:** | **Ector County Energy Center** | | | **Customer Reference No.:** | **TBD** |

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

| AIR CONTAMINANT DATA | | | EMISSION POINT DISCHARGE PARAMETERS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Emission Point | | | 4. UTM Coordinates of Emission Point | | | Source | | | | | | | |
| | | | | | | 5. Building Height (ft.) | 6. Height Above Ground (ft.) | 7. Stack Exit Data | | | 8. Fugitives | | |
| (A) EPN | (B) FIN | (C) NAME | Zone | East (Meters) | North (Meters) | | | (A) Diameter (ft.) | (B) Velocity (fps) | (C) Temperature (°F) | (A) Length (ft.) | (B) Width (ft.) | (C) Axis Degrees |
| CT-1 (Option 1) | CT-1 (Option 1) | Unit 1 (GE 7FA.03 Option) | | | | | 75 | 18.0 | 150 | 1,118 | | | |
| CT-2 (Option 1) | CT-2 (Option 1) | Unit 1 (GE 7FA.03 Option) | | | | | 75 | 18.0 | 150 | 1,118 | | | |
| CT-1 (Option 2) | CT-1 (Option 2) | Unit 1 (GE 7FA.05 Option) | | | | | 75 | 19.5 | 150 | 1,118 | | | |
| CT-2 (Option 2) | CT-2 (Option 2) | Unit 1 (GE 7FA.05 Option) | | | | | 75 | 19.5 | 150 | 1,118 | | | |
| CTLV1 | CTLV1 | Combustion Turbine 1 Lube Oil Vent | | | | | 28 | 0.1 | 0.1 | 115 | | | |
| CTLV2 | CTLV2 | Combustion Turbine 2 Lube Oil Vent | | | | | 28 | 0.1 | 0.1 | 115 | | | |
| DPT HTR | DPT HTR | Dewpoint Heater | | | | | 15 | 1.0 | 40.0 | 900 | | | |
| NGFUG | NGFUG | Plant Fugitives | | | | | | | | | | | |
| FWP | FWP | Fire Water Pump | | | | | 15 | 0.5 | 90 | 821 | | | |
| DSL-TK1 | DSL-TK1 | Diesel Tank 1 | | | | | 6 | 0.1 | 0.1 | 69 | | | |
| MSS FUG | MSS FUG | MSS Fugitives | | | | | | | | | | | |

EPN = Emission Point Number
FIN = Facility Identification Number

# Table 29
# RECIPROCATING ENGINES

## ENGINE DATA

Emission Point Number from Table 1(a): FWP

**APPLICATION**

- ____ Gas Compression
- ____ Electric Generation
- ____ Refrigeration
- X Other (Specify): Firewater pump

Manufacturer: Cummins
Model No.: CFP15E-F10
Serial No.:
Orig. Mfr. Date:
Rebuild Date(s):
No. of Cylinders: 6
Compression Ratio:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| X | 4 Stroke Cycle | ____ | Carburetted | ____ | Spark Ignited | ____ | Dual Fuel |
| ____ | 2 Stroke Cycle | ____ | Fuel Injected | X | Diesel | | |
| ____ | Naturally Aspirated | ____ | Blower/Pump Scavenged | ____ | Turbocharged and I.C. | | |
| X | Turbocharged | ____ | Intercooled (I.C.) | ____ | I.C. Water Temperature | | |

Ignition/Injection Timing: ____ Fixed ____ Variable

| | Mfg. Rating | Proposed Operating Range |
|---|---|---|
| Horsepower | 500 | |
| Speed (rpm) | | |

## FUEL DATA

| | | | | | |
|---|---|---|---|---|---|
| ____ | Field Gas | ____ | Landfill Gas | ____ | LP Gas | ____ | Other |
| ____ | Natural Gas | ____ | Digester Gas | X | Diesel | | |

| | | |
|---|---|---|
| Engine Fuel Consumption | | BTU/bhp-hr |
| Heat Value (specify units) | 18390 Btu/lb | (~~HHV~~)(LHV) |
| Fuel Sulfur Content | 0.05% | (weight percent) |

## FULL LOAD EMISSIONS DATA

**(See emission calculations for emissions data)**

| | | | | | |
|---|---|---|---|---|---|
| NOx | | lb/bhp-hr | CO | | lb/bhp-hr |
| | | ppmv | | | ppmv |
| VOC (C3+) | | lb/bhp-hr | PM/PM10 | | lb/bhp-hr |
| | | ppmv | | | ppmv |

*Attach information showing emissions versus engine speed and load.*

Method of Emissions Control:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| X | Lean Operation | ____ | Parameter Adjustment | ____ | SCR Catalyst | | |
| ____ | Stratified Charge | ____ | NSCR Catalyst | ____ | Other Specify: | ____ | |

## ADDITIONAL INFORMATION

*On separate sheets attach the following:*

A. A copy of engine manufacturer's site rating or general rating specification for the engine model.
B. Typical fuel analysis, including sulfur content and heating value. For gaseous fuels, provide mole percent of constituents.
C. Description of air/fuel ratio control system (manufacturer's information acceptable).
D. Details regarding principle of operation of emissions controls. If add-on equipment is used, provide make and model and manufacturer's information.
E. Exhaust parameter information on Table 1(a).

Note: All values are approximate and used as appropriate to calculate emission limits.

# Table 31
# COMBUSTION TURBINES

## TURBINE DATA

Emission Point Number from Table 1(a): CT-1

| | | | |
|---|---|---|---|
| X | Electric Generation | X | Simple Cycle |
| | Base Load | | Regenerative Cycle |
| X | Peaking | | Cogeneration |
| | Gas Compressions | | Combined Cycle |
| | Other (Specify) | | |

Manufacturer: GE
Model No.: 7FA.03 or 7FA.05
Serial No.:

Model represented is based on:
X Preliminary Design ____ Contract Award
____ Other (Specify)

See TCEQ Reg VI, 116.11(a)

Manufacturer's Rated Output at Baseload, ISO: 165 (.03) or 193 (.05) (MW)
Proposed Site Operating Range: (MW)
Manufacturer's Rated Heat Rate at Baseload, ISO: (Btu/k W-hr)

## FUEL DATA

Primary Fuels:

| | | | |
|---|---|---|---|
| X | Natural Gas | | Process Offgas | | Landfill/Digester Gas |
| | Fuel Oil | | Refinery Gas | | Other |

Backup Fuels:

| | | | |
|---|---|---|---|
| X | Not Provided | | Process Offgas | | Ethane |
| | Fuel Oil | | Refinery Gas | | Other (specify |

## EMISSIONS DATA

Attach manufacturer's information showing emissions of NOx, CO, VOC and PM for each proposed fuel at turbine loads and site ambient temperatures representative of the range of proposed operation. The information must be sufficient to determine maximum hourly and annual emission rates. Annual emissions may be based on a conservatively low approximation of site annual average temperature. Provide emissions in pounds per hour and except for PM, parts per million by volume at actual conditions and corrected to dry, 15% oxygen conditions.

Method of Emissions Control:

| | | | |
|---|---|---|---|
| X | Lean Premix Combustors | | Oxidation Catalyst | | Water Injection |
| | Other Low-NOx Combustor | | SCR Catalyst | | Steve Injection |
| | | | | | Other (specify) |

## ADDITIONAL INFORMATION

*On separate sheets attach the following:*

A. Details regarding principle of operation of emission controls. If add-on equipment is used, provide make and model and manufacturer's information. Example details include: controller input variables and operational algorithms for water or ammonia injection systems, combustion mode versus turbine load for variable mode combustors, etc.
B. Exhaust parameter information on Table 1(a).
C. If fired duct burners are used, information required on Table 6.

# Table 31
# COMBUSTION TURBINES

## TURBINE DATA

Emission Point Number from Table 1(a): CT-2

| | | | |
|---|---|---|---|
| X | Electric Generation | X | Simple Cycle |
| | Base Load | | Regenerative Cycle |
| X | Peaking | | Cogeneration |
| | Gas Compressions | | Combined Cycle |
| | Other (Specify) | | |

Manufacturer: GE
Model No.: 7FA.03 or 7FA.05
Serial No.:

Model represented is based on:
X Preliminary Design ____ Contract Award
____ Other (Specify) ____
See TCEQ Reg VI, 116.11(a)

Manufacturer's Rated Output at Baseload, ISO: 165 (.03) or 193 (.05) (MW)
Proposed Site Operating Range: ____ (MW)
Manufacturer's Rated Heat Rate at Baseload, ISO: ____ (Btu/k W-hr)

## FUEL DATA

Primary Fuels:

| | | | |
|---|---|---|---|
| X | Natural Gas | | Process Offgas | | Landfill/Digester Gas |
| | Fuel Oil | | Refinery Gas | | Other |

Backup Fuels:

| | | | |
|---|---|---|---|
| X | Not Provided | | Process Offgas | | Ethane |
| | Fuel Oil | | Refinery Gas | | Other (specify |

## EMISSIONS DATA

Attach manufacturer's information showing emissions of NOx, CO, VOC and PM for each proposed fuel at turbine loads and site ambient temperatures representative of the range of proposed operation. The information must be sufficient to determine maximum hourly and annual emission rates. Annual emissions may be based on a conservatively low approximation of site annual average temperature. Provide emissions in pounds per hour and except for PM, parts per million by volume at actual conditions and corrected to dry, 15% oxygen conditions.

Method of Emissions Control:

| | | | |
|---|---|---|---|
| X | Lean Premix Combustors | | Oxidation Catalyst | | Water Injection |
| | Other Low-NOx Combustor | | SCR Catalyst | | Steve Injection |
| | | | | | Other (specify) |

## ADDITIONAL INFORMATION

*On separate sheets attach the following:*

A. Details regarding principle of operation of emission controls. If add-on equipment is used, provide make and model and manufacturer's information. Example details include: controller input variables and operational algorithms for water or ammonia injection systems, combustion mode versus turbine load for variable mode combustors, etc.
B. Exhaust parameter information on Table 1(a).
C. If fired duct burners are used, information required on Table 6.

# VIII. STATE REGULATORY REQUIREMENTS
## VIII.A. Compliance with TCEQ Rules and Regulations

Emissions from the CTGs will comply with all the rules and regulations of the TCEQ and the intent of the Texas Clean Air Act, including protection of the health and physical property of the public. No schools are located within 3,000 feet of the site. Compliance with applicable rules and regulations of the Commission are discussed below.

**30 TAC Chapter 101, Subchapter A - General Rules**

*§101.2 Multiple Air Contaminant Sources or Properties* - Invenergy will demonstrate through air dispersion modeling that the sources to be permitted will not cause or contribute to violations of any TCEQ standards.

*§101.3 Circumvention* - Invenergy will not use any plan, activity, device, or contrivance that will, without resulting in an actual reduction of air contaminants, conceal or appear to minimize the effects of emissions which would otherwise constitute a violation of the Texas Clean Air Act (TCAA) or TCEQ regulations.

*§101.4 Nuisance* - Invenergy will demonstrate through air dispersion modeling that discharges to the atmosphere from the sources to be permitted will not be in such concentration and of such duration that they will or may tend to be injurious to or adversely affect human health or welfare, animal life, vegetation, or property, or interfere with the normal use and enjoyment of animal life, vegetation, or property.

*§101.5 Traffic Hazard* - No discharge of air contaminants, uncombined water or other materials from the sources to be permitted will cause or have a tendency to cause a traffic hazard or an interference with normal road use.

*§101.8 Sampling* - All stack testing and sampling will meet requirements imposed by §101.8 and data will be reported and maintained as required.

*§101.9 Sampling Ports* - Invenergy will comply with TCEQ requests for location of sampling ports in accordance with §101.9.

*§101.10 Emissions Inventory Requirements* - Invenergy will submit any necessary emissions inventories as required by §101.10.

*§101.20 Compliance with Environmental Protection Agency Standards* - As described in the sections which follow, Invenergy will comply with requirements of New Source Performance Standards (40 CFR 60) applicable to the sources to be permitted. The sources to be permitted are not subject to National Emissions Standards for Hazardous Air Pollutants under 40 CFR 61 or National Emission Standards for Hazardous Air Pollutants for Source Categories under (40 CFR 63). The project is located in a designated attainment area for all pollutants and is not subject to the federal Nonattainment New Source Review (NNSR).

*§101.24-27 Fees* - Invenergy will comply with all applicable requirements identified in this section and will pay the required fees and surcharges as specified.

**30 TAC Chapter 101, Subchapter F - Emissions Events and Scheduled Maintenance, Startup, and Shutdown Activities**

*§101.201 Emissions Event Reporting and Recordkeeping Requirements* - Invenergy will follow the notification and recordkeeping requirements in §101.201, should a reportable emissions event, as defined in §101.1, occur.

*§101.211 Scheduled Maintenance, Startup and Shutdown Reporting, and Recordkeeping Requirements* - Invenergy will comply with the provisions of §101.211 to the extent that they apply to the operation of the sources to be permitted.

*§101.221-§101.224 Operational Requirements, Demonstrations, and Excessive Emissions Events* - Invenergy will comply with these provisions to the extent that they apply to the sources to be permitted. In particular, Invenergy will maintain in good working order and properly operate all pollution emission capture and abatement equipment associated with the sources to be permitted.

**30 TAC Chapter 101, Subchapter H - Emissions Banking and Trading**

The Ector County Energy Center is not located in a county affected by the Mass Emissions Cap and Trade Program of Division 3 of this subchapter. However, Division 7 of this subchapter, which relates to the Clean Air Interstate Rule (CAIR), potentially applies to the proposed project. In January 2011, CAIR was replaced by the Cross-State Air Pollution Rule (CSPAR), but CSAPR was subsequently vacated by the U.S. Court of Appeals for the D.C. Circuit and remanded to EPA. At the time of this application, EPA had not proposed rulemaking to address the Court's issues. Therefore, at this time, Division 7 requirements that may be applicable to the Ector County Energy Center cannot be established. Invenergy will meet any applicable requirements of Division 7, as applied.

**30 TAC Chapter 111 - Control of Air Pollution from Visible Emissions and Particulate Matter**

*§111.111(a)(1) Requirements for Specified Sources: Stationary Vents* - Emissions from the combustion turbine stacks will meet the requirement of §111.111(a)(1)(C) specifying an opacity limitation of 15 percent averaged over a six-minute period. Initial stack testing will be performed using EPA Method 9. Emissions from other vents associated with the project will not exceed the six-minute opacity limit of 20 percent in §111.111(a)(1)(B).

*§111.111(a)(7)(A) Requirements for Specified Sources: Structures* - Emissions from buildings, enclosed facilities and structures associated with the project will meet the opacity limitation of 30 percent averaged over a six-minute period.

*§111.151. Allowable Emissions Limits* - Emissions of total suspended particulates from sources associated with the project with specific stack flow rates will be within the limits specified in §111.151(a), Table 1, based on calculated emission rates.

**30 TAC Chapter 112 - Control of Air Pollution from Sulfur Compounds**

*§112.2. Compliance, Reporting, and Recordkeeping* - Invenergy will maintain on site and submit any records requested by the TCEQ, to demonstrate compliance with Chapter 112 $SO_2$ limits.

*§112.3. Net Ground Level Concentrations* - The only sources of $SO_2$ associated with the proposed project will be the combustion of pipeline quality natural gas in the new combustion turbine units. Therefore, emissions from the proposed units will not affect the site's ability to comply with the net ground level property line standard for $SO_2$.

*§112.41. Sulfuric Acid Emission Limits* - The only source of $H_2SO_4$ from the proposed project will be the combustion of pipeline quality natural gas in the new combustion turbine units. Therefore, emissions from the proposed units will not affect the site's ability to comply with the net ground level property line standard for $H_2SO_4$.

No other paragraphs in Chapter 112 apply to the sources to be permitted. In particular, Invenergy will not operate a sulfuric acid plant, sulfur recovery plant, nonferrous smelter, Kraft pulp mill, or a liquid fuel-fired source as part of the proposed project. Invenergy does not anticipate the need to use higher sulfur fuels due to a temporary fuel shortage, but will comply with the requirements of §§112.15-18 should a fuel shortage occur. Invenergy does not intend to apply for an area control plan for emissions of sulfur dioxide. Additionally, no sources will produce emissions of hydrogen sulfide.

**30 TAC Chapter 113, Control of Air Pollution from Toxic Materials**

Chapter 113 incorporates by reference National Emission Standards for Hazardous Air Pollutants for Source Categories (40 CFR Part 63). As discussed in Section IX.C of this application, the sources to be permitted are not subject to any National Emission Standards for Hazardous Air Pollutants for Source Categories (40 CFR Part 63).

**30 TAC Chapter 114, Control of Air Pollution from Motor Vehicles**

Invenergy will comply with all applicable requirements of this regulation regarding inspection, maintenance and operation of air pollution control systems/devices for motor vehicles operated at the Ector County Energy Center.

**30 TAC Chapter 115, Control of Air Pollution from Volatile Organic Compounds**

The proposed simple-cycle power trains and piping equipment fugitives are not process units covered under this regulation. Therefore, these rules do not apply.

**30 TAC Chapter 116, Subchapter B. Control of Air Pollution by Permits for New Construction or Modification**

*§116.111(a)(1) - PI-1 Form, General Application* - This application provides complete information required by the TCEQ's Form PI-1, General Application Form. The completed form, signed by an authorized Invenergy representative, is included. All additional support information specified on the form is provided as part of this application or will be provided in the air dispersion modeling report, which will be submitted at a later date and after consultation with the TCEQ permit reviewer.

*§116.111(a)(2)(A) - Protection of Public Health and Welfare* - As described in this application and in the air dispersion modeling report to be submitted, emissions from the proposed facilities will comply with all the rules and regulations of the Commission and the intent of the TCAA, including protection of the health and physical property of the public. No schools are located within 3000 feet from the Ector County Energy Center.

*§116.111(a)(2)(B) - Measurement of Emissions* - In addition to compliance with applicable NSPS requirements, Invenergy will measure emissions from the proposed facilities as described in Section VIII.B of this application and will install sampling ports in accordance with guidelines in the "Texas Commission on Environmental Quality (TCEQ) Sampling Procedures Manual."

*§116.111(a)(2)(C) - Best Available Control Technology (BACT)* - As demonstrated in Section VIII.C of this application, best available control technology will be used to control emissions from the proposed facilities.

§116.111(a)(2)(D) - Federal New Source Performance Standards (NSPS) - The proposed CTG units will be subject to 40 CFR 60, Subpart KKKK. Invenergy will comply with all applicable emissions limits, monitoring, recordkeeping and reporting requirements of this subpart as discussed in Section IX.A of this application.

*§116.111(a)(2)(E) - National Emission Standards for Hazardous Air Pollutants (NESHAP)* - The Ector County Energy Center will not constitute a major source of HAPs as a result of this project. The sources to be permitted will not be subject to any NESHAP as codified in 40 CFR Part 61.

*§116.111(a)(2)(F) - NESHAP for Source Categories, MACT Standards, 40 CFR Part 63* - The Ector County Energy Center will not constitute a major source of HAPs as a result of this project and, thus, the proposed CTG units will not be subject to requirements of the only potentially applicable Part 63 rule - Subpart YYYY. The emergency diesel fire-water pump will be required to meet the requirements stated in MACT ZZZZ and NSPS IIII.

*§116.111(a)(2)(G) - Performance Demonstration* - The proposed facilities will achieve the performance specified in the representations in this application and required by the permit. Invenergy will submit any additional information as may be required by the TCEQ to demonstrate that the represented performance will be achieved.

*§116.111(a)(2)(H) - Nonattainment Review* - The proposed project will be located in Ector County which is an attainment area for all pollutants. Nonattainment new source review (NNSR) permitting procedures will not apply to this project.

*§116.111(a)(2)(I) - Prevention of Significant Deterioration (PSD) Review* - The proposed project will be considered as a major stationary source as defined in 30 TAC §116.12. Therefore, a PSD permit is required. Since the facility will be constructed at a green-field site, there will be no netting.

*§116.111(a)(2)(J) - Air Dispersion Modeling* - Invenergy will perform an air dispersion modeling study in order to demonstrate compliance with applicable standards. This study will be completed upon acceptance of emissions calculations and proposed BACT by the TCEQ.

*§116.111(a)(2)(K) - Hazardous Air Pollutants* - The proposed combustion turbines are potential sources of HAPs. However, the project does not involve the installation of a new process or production unit that in and of itself is a major source of HAPs. Additionally, EPA has promulgated a Maximum Achievable Control Technology standard for stationary combustion turbines. Therefore, the project does not involve an affected source as defined in 30 TAC §116.15(1).

*§116.111(a)(2)(L) - Mass Cap and Trade Allowances* - The new units will not be subject to the mass emission cap and trade requirements of Chapter 101, Subchapter H, Division 3 since the facility will not be located in the Houston/Galveston area.

**30 TAC Chapter 117, Control of Air Pollution from Nitrogen Compounds**

The location of this facility will be in Ector County, which is not a listed applicability county under 30 TAC 117, therefore, these regulations will not apply.

**30 TAC Chapter 118, Control of Air Pollution Episodes**

The sources to be permitted will be operated in compliance with orders of the Commission relating to generalized and localized air pollution episodes.

**30 TAC Chapter 122, Federal Operating Permits**

Invenergy will apply for a Federal Operating Permit to address Title V requirements of the new project. The application will address the required Acid Rain permitting requirements and any applicable requirements of the CAIR or CSAPR, whichever applies.

## VIII.B. MEASUREMENT OF EMISSIONS

Invenergy will measure emissions of regulated air contaminants from the CTG units through emissions performance testing and continuous emissions monitoring. 40 CFR 60 Subpart KKKK imposes testing and monitoring requirements applicable to the proposed turbines.

In addition, as discussed in Section VIII.C of this application, Invenergy will employ procedures to continuously demonstrate compliance with the requirements of the permit for those sources not subject to Subpart KKKK.

The methods which will be used to continuously demonstrate compliance are summarized in the table below:

**Table VIII.B-1 Methods of Compliance - Measurement of Emissions**

| EPN | Pollutant | Demonstration Method |
|---|---|---|
| CT-1 & CT-2 | $NO_x$ | CEMS |
| | CO | Proper operation of units |
| | $SO_2$, $H_2SO_4$ | Use of pipeline quality natural gas; fuel supplier certifications that fuel sulfur content limits are met |
| | $PM/PM_{10}$ | Proper operation of units |
| | VOC | Proper operation of units |
| Diesel-fired Equipment | Products of Combustion | Use of Subpart IIII certified engines, proper operation and maintenance of units, burning of fuel meeting federal diesel fuel specifications |

# VIII.C. BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

## 1.0 Introduction

This section presents the analysis of Best Available Control Technology (BACT) for emissions sources associated with the proposed project.

The TCAA and 30 TAC §116.111(a)(2)(C) require that new and modified facilities use BACT. BACT is determined through a 3-tier process and on a case-by-case basis for proposed facilities.

The BACT analysis for the proposed project has been prepared consistent with the TCEQ's 3-tier approach and its guidance provided in the TCEQ's April 2001 document, *Evaluating Best Available Control Technology (BACT) in Air Permit Applications* (Draft RG-383).

According to TCEQ guidance, the process begins at the first tier (i.e., emission performance levels accepted as BACT in recent permit reviews for the same process and/or industry) and continues sequentially through the second and third tiers only if BACT cannot be established through a Tier I analysis.

As stated in the TCEQ's RG-383 BACT guidance, "Tier I of the BACT evaluation involves a comparison of the applicant's BACT proposal to emission reduction performance levels accepted as BACT in recent permit reviews". RG-383 further indicates that the BACT review is complete if the Air Permits Division has not identified emission reduction options with better performance that should be evaluated. As will be presented in the following sections, BACT for the proposed project is established at the Tier I level.

## 2.0 BACT for the Natural Gas-Fired Simple-cycle Combustion Turbines

The BACT determinations for the operation of the proposed combustion turbines are based on the latest information available from the TCEQ and from EPA concerning the evaluation of BACT in permit applications for simple-cycle combustion turbine units. Additional relevant documentation that provided technical background information for the BACT assessment of the turbine units included the following:

- The TCEQ's *Air Permit Reviewer Reference Guide, Air Pollution Control, How to Conduct a Pollution Control Evaluation, APDG 6110* (Jan. 2011)
- *TCEQ Combustion Sources - Current Best Available Control Technology (BACT) Requirements* (July 2012)
- The TCEQ "gas turbine permit list" (updated September 17, 2012)
- The EPA RACT/BACT/LAER Clearinghouse (RBLC) listings for the "process type" or source category representative of Invenergy's proposed emission sources

Copies of these references are included in Appendix B to this application.

As discussed in the Process Description (Section VII.A.5.) of this application, the proposed project will consist of two natural gas-fired combustion turbines, either GE 7FA.03 or 7FA.05 units, each to be operated in a simple-cycle configuration for up to 2500 hours per year each. The emissions control methods and BACT-based emission rates proposed for these simple-cycle units are consistent with the TCEQ BACT guidance.

### *2.1 $NO_x$ Emissions*

Emissions of $NO_x$ from combustion turbines are generated through the oxidation of nitrogen in the high-temperature combustion zones and will be controlled with DLN combustors in each model of turbine. This method of $NO_X$ control is considered a combustion control as it is designed to minimize combustion temperatures by providing a lean pre-mixed air-fuel mixture, where air and fuel are combined before entering the combustor. This design minimizes fuel-rich pockets and allows the excess air to act as a heat sink, thus lowering the combustion zone temperatures to minimize thermal $NO_X$ formation. Invenergy proposes to reduce $NO_X$ emissions from the proposed simple-cycle peaking units through the use of this combustion technology.

A search of the RBLC returned 21 projects for which natural gas-fired simple-cycle units were permitted since January 1, 2007, with all 21 listing a $NO_x$ emission limit (see Appendix B). The RBLC determinations show $NO_x$ emission limits ranging from 2.5 to 25 ppmvd @15% $O_2$.

Further review of the RBLC determinations show that six simple-cycle projects were permitted with a $NO_x$ emission limit of 2.5 ppmvd, based on the use of selective catalytic reduction (SCR) control technology, but all of these projects are located in ozone nonattainment areas (three in New Jersey and three in Southern California) and their $NO_x$ emission limits are Lowest Achievable Emission Rate (LAER) - based limits and not BACT. Excluding these LAER limits, the next lowest permitted $NO_x$ limit listed in the RBLC is 5 ppmvd, for the Black Hills Power, Cheyenne Prairie Generating Station (BHP-Cheyenne) in Laramie County, Wyoming. Although the BHP-Cheyenne simple-cycle unit (a GE LM6000) was initially intended to be operated solely as a peaking unit, the issued permit authorizes BHP to also operate the turbine as a base-loaded unit (i.e., no restrictions on annual hours of operation), which is the ultimate plan for this BHP-Cheyenne unit[3]. Excluding the BHP-Cheyenne simple-cycle unit, the next lowest permitted $NO_x$ limits in the RBLC are 9 ppmvd. Review of these BACT determinations shows that the 9 ppmvd limit is achieved through use of either DLN combustion technology or the combination of low-$NO_x$ burners and water injection.

According to the TCEQ's current combustion source BACT requirements, Tier I BACT for $NO_x$ emissions from gas-fired simple-cycle combustion turbines ranges from 5.0 to 9.0 ppmvd @15% $O_2$. However, the guidance acknowledges that a higher BACT limit could be appropriate for simple cycle units used in peaking operations. This guidance is reflected in the TCEQ's recent

[3] *Teleconference between Louis Corio, Zephyr Environmental Corporation, and Timothy Rogers, Black Hills Power, October 4, 2012.*

BACT determinations for issued permits, as shown in their most recent gas turbine permit list for simple-cycle gas turbines.

A review of the information on the TCEQ's turbine list (See Appendix B), in conjunction with review of permit information available through the Agency's air permit websites, shows that $NO_x$ BACT for all but two simple cycle units for which state or PSD permits were recently issued is 9 ppmvd @15% $O_2$ on a 24-hour rolling average basis. This corresponds to the $NO_x$ emissions performance that GE represents for the dry low- $NO_x$ combustor-equipped GE 7FA.03/05 models that Invenergy is considering.

One of the two excepted simple cycle units referred to above is a GE 7EA turbine unit to be operated by NRG at its W.A. Parish Electric Generating Station. With DLN technology, the GE 7EA unit can achieve a 5 ppmvd $NO_x$ emissions rate - a lower rate than the GE 7FA unit can achieve with DLN. This is primarily due to the fact that GE offers a type of DLN for the 7EA turbines that is capable of achieving $NO_x$ emission levels below 5 ppm without the use of SCR. A similar type of DLN is not available for the 7FA turbines.

However, the GE 7EA model is not suitable for the Invenergy project as it does not meet the project design power requirements due to its maximum load limitation. The GE 7EA is a nominal 80-MW unit as opposed to the nominal 165/193-MW output of the GE 7FA.03/05 models being considered for the Invenergy project.

The other excepted units, natural gas-fired expansion turbines manufactured by Dresser Rand, authorized by the TCEQ under a Standard Permit for the Apex Bethel Energy Center (Apex), cannot meet a 9-ppmv $NO_x$ limit with DLN technology alone; this level of $NO_x$ emissions can only be achieved with the use of SCR, which reduces $NO_x$ emissions below 9 ppmvd. Although no ppmv limit has been set for $NO_x$ in the standard permit for Apex, the $NO_x$ emission rate reported in lb/MWh in the TCEQ's technical review of the application is approximately 10 times lower than the $NO_X$ emission rate for the turbine design considered for Invenergy.

However, as is the case for the GE 7EA technology, the Apex project turbines do not meet Invenergy's project requirements. Invenergy requires the use of GE 7FA or very similar technologies to meet its power production requirements, and the turbine equipment to be used by Apex is unsuitable for this application. The primary purpose of the Apex project is to function as a facility for storing bulk energy obtained during off-peak demand hours for use during peak demand hours. Quite unlike traditional power plants equipped with combustion turbines, Apex will employ two electric-powered Dresser-Rand compressors that use excess, off-peak, wind generated electrical power to compress air for storage in an underground salt cavern. This compressed air will later be recovered from the cavern and directed to two custom Dresser-Rand expansion turbine trains designed and fabricated specifically for the recovery of the stored energy to generate power. Upon entering the expansion turbine trains, the compressed air from the storage cavern will pass, in order, through the low temperature side of heat recuperation devices, topping turbines, natural gas fired combustors, high pressure expansion turbines, additional natural gas fired combustors, low pressure expansion turbines, and the high

temperature side of the heat recuperation devices. The exhaust gases from each expansion train will pass through an SCR and an oxidation catalyst prior to being exhausted to the atmosphere. Each of the expansion turbines will be connected by a shaft to a dedicated electrical generator to provide power for the grid.

Based on the information summarized above, Invenergy proposes to satisfy BACT for $NO_x$ emissions from the proposed simple-cycle units through the use of DLN combustion technology. With this type of emissions control, $NO_x$ emissions will not exceed 9 ppmvd @15% $O_2$, on a 24-hour rolling average basis, excluding periods of startup and shutdown. Invenergy's proposed $NO_x$ emissions performance is equal to the lowest BACT emission rate in recent permits issued for similar simple-cycle peaking units and technologies located in ozone attainment counties both inside and outside Texas. Therefore, the proposed emission rate satisfies TCEQ's BACT requirements at the Tier 1 level.

Invenergy will demonstrate that BACT for $NO_x$ is achieved through the initial stack testing of each combustion turbine and by the use of continuous emissions monitoring systems (CEMS) as specified under 40 CFR 75.

### *2.2 CO Emissions*

Combustion is a thermal oxidation process in which carbon and hydrogen in the fuel combine with oxygen to primarily form carbon dioxide $CO_2$ and water vapor. Emissions of CO are the result of incomplete combustion of the carbon in a fuel. The primary factors influencing the generation of CO emissions are temperature and fuel residence time within the combustion zone. Invenergy proposes to minimize CO emissions from the proposed simple-cycle peaking units through the use of operating procedures directed at the most efficient levels of operation consistent with minimizing emissions of $NO_X$, i.e., good combustion practices - controlled fuel/air mixing and sufficient temperature and gas residence time.

A search of the RBLC showed 17 permits listed as issued since January 1, 2007 with CO emission limits for natural gas-fired simple-cycle units; 15 show ppm-based emission limits (see Appendix B-3)[4]. The RBLC determinations show CO emission limits ranging from 4.0 to 63.0 ppmvd @15% $O_2$. The lowest permitted CO limits - 4.0 ppmvd @15% $O_2$ for Great River Energy Elk River Station (GRE-Elk) and 4.1 ppmvd @15% $O_2$ for the Progress Energy Florida Bartow Power Plant (PEF-Bartow) - are achieved with "good combustion practices." For the GRE-Elk units, the 4.0 ppmvd emission limit applies only to turbine loads of 70 percent or greater; for turbine loads between 60 and 70 percent, a 10-ppmvd emission limit applies. For the PEF-Bartow unit (a simple cycle Siemens SGT6-5000F turbine), PEF proposed in their permit application a similar dual emission limit approach for natural gas-firing: 4 ppmvd @15% $O_2$ for a turbine load range of 70-100% and 10 ppmvd @15% $O_2$ for a turbine load range of 60-70%.

*[4] Another RBLC listing – a permit application for the Jacksonville Electric Authority Greenland Energy Center, with a CO emissions limit of, 4.1 ppmvd @ 15% $O_2$ - was pending approval by the Florida Department of Environmental Protection when withdrawn on July 9, 2009.*

However, unlike the Minnesota Pollution Control Agency, the Florida Department of Environmental Protection ultimately permitted the project with only one emission limit: 4.1 ppmvd @15% $O_2$.

Three New Jersey projects listed in the RBLC are each permitted at 5 ppmvd @15% $O_2$ and the BHP-Cheyenne simple-cycle unit is permitted at 6 ppmvd @15% $O_2$, with all of these projects using oxidation catalyst controls to achieve these limits. As mentioned previously, unlike a true peaking unit, the BHP-Cheyenne simple-cycle unit is permitted to operate as a base-loaded unit (i.e., 8,760 hours per year), and is expected to do so in the future. Also, as mentioned previously, the three New Jersey projects are located in an ozone nonattainment area. Therefore, the concern for minimizing VOC emissions provides the impetus for oxidation catalyst controls, which reduce both VOC and CO emissions. Notwithstanding the RBLC listing for the Shady Hills Power project, the next lowest permitted CO emission limits in the RBLC are 9 ppmvd @15% $O_2$, based on good combustion practices.[5]

According to the TCEQ's current combustion source BACT requirements, Tier I BACT for CO emissions from gas-fired simple-cycle combustion turbines is 9 to 25 ppmvd @15% $O_2$. Also, TCEQ's recent BACT determinations, as shown in the agency's most recent "gas turbine permit list" for simple-cycle gas turbines, demonstrate that CO emission limits for simple-cycle units range from 8 to 29 ppmvd @15% $O_2$ (without the use of an add-on control technology, e.g., oxidation catalyst).

Based on the body of findings summarized above, Invenergy proposes to satisfy BACT for CO emissions from the proposed simple-cycle units through the use of good combustion practices - controlled fuel/air mixing and sufficient temperature and gas residence time. Given the potential variation in load and associated CO emission levels during normal operations for the combustion turbines, Invenergy is proposing to meet a CO emissions level of 9 ppmvd @15% $O_2$. This limit is expressed as 3-hour average and excludes periods of startup and shutdown. Given that Invenergy's proposed CO emission rate is less than the low end of the range of TCEQ BACT-based required emission levels; BACT is satisfied at the Tier 1 level.

Invenergy will demonstrate that BACT for CO is achieved through the initial stack testing and proper operation of the units.

### *2.3 VOC Emissions*

Similar to CO emissions generation, VOC emissions will result from the incomplete combustion of the natural gas. The primary factors influencing the generation of VOC emissions are temperature and fuel residence time within the combustion zone. Invenergy proposes to minimize VOC emissions from the proposed simple-cycle peaking units through the use of

[5] *The RBLC lists a permitted CO emission rate of 6.5 ppmvd for the Shady Hills Power project. However, in revised permitting not summarized in the RBLC, Shady Hills re-proposed, with technical justification, an emission limit of 9.0 ppmvd as BACT for its GE 7FA.05 units, which was accepted by the Florida DEP (Permit No. PSD-FL-402A).*

operating procedures directed at the most efficient levels of operation, i.e., good combustion practices - controlled fuel/air mixing and sufficient temperature and gas residence time.

A search of the RBLC showed 13 permits issued since January 1, 2007 with VOC emission limits for natural gas-fired simple-cycle units; 10 of these permits impose ppm-based emission limits (see Appendix B-3). The RBLC determinations show VOC emission limits ranging from 1.2 to 5 ppmvd @15% $O_2$. The lowest permitted VOC limit - 1.2 ppmvd @15% $O_2$ for PEF-Bartow - is achieved with "good combustion practices." For the PEF-Bartow unit (a Siemens SGT6-5000F turbine), PEF proposed in their permit application a dual emission limit approach for natural gas-firing: 1 ppmvd @15% $O_2$ for a turbine load range of 70-100% and 4 ppmvd @15% $O_2$ for a turbine load range of 60-70%. The Florida Department of Environmental Protection ultimately permitted the project with only one emission limit: 1.2 ppmvd @15% $O_2$. The next lowest permitted VOC emission limit in the RBLC is 2.0 ppmvd @15% $O_2$, based on the use of an oxidation catalyst, for the aforementioned three Southern California projects.

According to the TCEQ's current combustion source BACT requirements, Tier I BACT for VOC emissions from gas-fired simple-cycle combustion turbines is 2 ppmvd @15% $O_2$.

Based on the findings summarized above, Invenergy proposes to satisfy BACT for VOC emissions from the proposed simple-cycle units through the use of good combustion practices - controlled fuel/air mixing and sufficient temperature and gas residence time. Given the potential variation in load and associated VOC emission levels during normal operations for the combustion turbines, Invenergy is proposing to meet a VOC emissions level of 2 ppmvd @15% $O_2$. Given that the proposed VOC emission rate is nearly equal to the TCEQ BACT-based required emission level, BACT is satisfied at the Tier 1 level.

Invenergy will demonstrate that BACT for VOCs is achieved through the initial stack testing and proper operation of the combustion turbines.

### *2.4 PM/$PM_{10}$/$PM_{2.5}$ Emissions*

In general, PM is emitted from combustion processes as a result of inorganic constituents contained in the fuel, particulate matter in the inlet air, and incomplete combustion of the organic constituents in the fuel. Because the combustion turbines will fire only natural gas, PM/$PM_{10}$/$PM_{2.5}$ emissions are anticipated to be relatively low. Consistent with recent permits for simple cycle turbines, for which the TCEQ has determined that firing pipeline quality natural gas is BACT for PM, Invenergy will fire pipeline-quality natural gas and apply good combustion practices to minimize emissions of PM/$PM_{10}$/$PM_{2.5}$ from the proposed units.

Invenergy will demonstrate that BACT for PM/$PM_{10}$/$PM_{2.5}$ is achieved through the initial stack testing and proper operation of the combustion turbines.

### *2.5 Sulfur Compound Emissions*

Emissions of $SO_2$ will occur as a result of oxidation of sulfur in the natural gas fired in the combustion turbine, with the majority of the sulfur converted to $SO_2$ and a small portion to $H_2SO_4$. Consistent with recent permits for simple cycle turbines, for which the TCEQ has determined that firing pipeline quality natural gas is BACT for sulfur compounds, Invenergy will minimize the formation of $SO_2$ and $H_2SO_4$ by firing pipeline-quality natural gas with a sulfur content not exceeding 5 grains sulfur per 100 standard cubic feet in the proposed units.

Invenergy will demonstrate that BACT for $SO_2$, and $H_2SO_4$, is achieved through the maintenance of records of contractual limits on sulfur content, valid purchase contracts, tariff sheets, or transportation contracts for the fuel which show sulfur content.

### *2.6 Maintenance, Startup, and Shutdown Emissions*

Operation of the combustion turbines will result in emissions from startup and shutdown of the units. Each combustion turbine unit will be started up and shut down in a manner that minimizes the emissions during these events. BACT will be achieved by minimizing the duration of the startup and shutdown events to 60 minutes.

## 3.0 BACT for Lube Oil Mist Vent Emissions

The heating of recirculating lubrication oil in the gas turbine and steam turbine housing generates oil vapor and oil condensate droplets in the oil reservoir compartments. The venting of turbine lubrication oil is a minor source of VOC and PM emissions. These emissions will be controlled with oil mist eliminators, which are BACT for emissions from these vents.

## 4.0 BACT for Fugitive Natural Gas and Lube Oil Component Leaks

Fugitive VOC emissions were estimated for metering, compression, and piping components in natural gas and lube oil service. Invenergy proposes that the proper design of the fuel and lube oil delivery and handling systems and the use of best operating practices satisfy the requirements of BACT for fugitive emissions from components in natural gas and lube oil service.

## 5.0 BACT for Natural Gas-Fired Dew-Point Gas Heater

A 9-MMBtu/hr natural gas-fired dew point gas heater will be utilized for the proposed project. The heater will be in operation any time a combustion turbine is firing natural gas in order to ensure that the temperature of the natural gas entering the combustor sections is above the dew-point for the fuel condensate. A 9-MMBtu/hr natural gas-fired heater is a permit-by-rule combustion unit subject to 30 TAC §106.183; therefore, there are no applicable emissions standards under TCEQ rules. Invenergy is proposing that proper operation and maintenance meets the criteria for BACT for this equipment.

## 6.0 BACT for Diesel-Fired Equipment

BACT for the diesel-fired fire-water pump engine will be achieved through the installation of an engine that meets the vendor certification requirements of 40 CFR 60, Subpart IIII, through the proper operation and maintenance of the engine, and through the burning of diesel fuel meeting the sulfur requirements of 40 CFR 80.510.

## VIII.D. PERFORMANCE DEMONSTRATION

Invenergy will operate all process and emissions control equipment according to instructions and recommendations provided by the equipment vendors and in compliance with applicable regulatory requirements and the terms of any TCEQ permit. TCEQ equipment tables in Section VII.A.7 provide information about the critical design parameters for the CTGs.

# IX. FEDERAL REGULATORY REQUIREMENTS

## IX.A. New Source Performance Standards

New Source Performance Standard (NSPS) Subpart KKKK: Standards for Performance for Stationary Combustion Turbines applies to the new CTG units. Table IX.A-1 summarizes the requirements of Subpart KKKK and describes how the CTG units will comply with each applicable requirement. NSPS IIII requirements, as shown on Table IX.A-2, will apply to the Diesel Fire-Water Pump.

## Table IX.A-1
## NSPS Subpart KKKK
## Stationary Combustion Turbines
## Applicability and Compliance Analysis

| Pollutant | Requirement Type | Requirement Citation | NSPS Subpart KKKK Compliance Determination/Demonstration |
|---|---|---|---|
| $NO_X$ | Standard | §60.4320 | $NO_X$ in the exhaust gases will not exceed 15 ppm at 15 percent $O_2$, on a 4-hour basis. |
| $SO_2$ | Standard | §60.4330 | The fuel burned will not produce $SO_2$ emissions in excess of 0.06 lb/MMBtu. |
| --- | General | §60.4333 | The turbines, air pollution control equipment, and monitoring equipment will be operated and maintained in a manner consistent with good air pollution control practices for minimizing emissions at all times including during startup, shutdown, and malfunction. |
| $NO_x$ | Monitoring | §60.4340 | ECEC will install, maintain, and operate $NO_X$/diluent CEM on the turbines as required in §60.4345 |
| $NO_x$ | Monitoring | §60.4345 | $NO_X$ CEMS and all associated meters and measuring devices will be installed and certified according to the requirements of this subpart |
| $NO_X$ | Monitoring | §60.4350 | $NO_x$ CEMS data will be reduced and analyzed according to this subpart in order to demonstrate compliance with the $NO_x$ standard. |
| $NO_X$ | Testing | §60.4405 | ECEC will perform $NO_x$ performance test according to the requirements of §60.8 and this subpart |
| $SO_2$ | Testing | §60.4365 | ECEC will fire pipeline quality natural gas and will demonstrate that the fuel will not exceed the $SO_2$ standard of 0.06 lb/MMBtu by fuel quality characteristics in a current, valid purchase contract, tariff sheet or transportation contract for the fuel or annual sampling. |
| $NO_X$ | Reporting | §60.4375 | ECEC will submit reports of excess emissions and monitor downtime in accordance with §60.7(c) and §60.4380 |
| $NO_X$ | Reporting | §60.4395 | ECEC will submit all reports required by §60.7(c) postmarked by the 30$^{th}$ day following the end of each 6-month period. |

## Table IX.A-2
## NSPS Subpart IIII
## Compression Ignition Reciprocating Internal Combustion Engines
## Applicability and Compliance Analysis

| Pollutant | Requirement Type | Requirement Citation | NSPS Subpart IIII Compliance Determination/Demonstration |
|---|---|---|---|
| SO2 | Standard | §80.510(a) and (b) as referenced by §60.4207 | ECEC will meet the fuel requirements of the rule by only burning diesel fuel with a maximum sulfur content of 15 ppm. In addition, no diesel fuel with a cetane index of less than 40 or an aromatic content of greater than 35 volume percent will be used. |
| NMHC + $NO_x$ | Standard | Tables 3 and 4 as referenced by §60.4205(c) | ECEC will ensure that the purchased firewater pump engine will be of an engine class certified by the manufacturer to meet the applicable NMHC + $NO_x$ emission standard. |
| PM | Standard | §89.112(a) as referenced by §60.4202 | ECEC will ensure that the purchased emergency generator engine and firewater pump engine will be of engine classes certified by the manufacturers to meet the applicable PM emission standards. |

## IX.B. NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS

The sources to be permitted will not be subject to any National Emission Standard for Hazardous Air Pollutants (NESHAP) as codified in 40 CFR Part 61, and the ECEC will not become subject to any NESHAP as a result of the proposed project.

## IX.C. MAXIMUM ACHIEVABLE CONTROL TECHNOLOGIES FOR NESHAP SOURCE CATEGORIES

New combustion turbines are potentially subject to the Subpart YYYY National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines. However, in 2004, the EPA stayed portions of the rule regarding the effectiveness of the emissions and operating limitations in the stationary combustion turbines NESHAP for new sources in the lean premix gas-fired turbines and diffusion flame gas-fired turbines subcategories, and the stay currently remains in effect. This rule, however, applies only to major sources of HAPs. Site-wide HAP emissions at the Ector County Energy Center will be less than 10 tpy of any individual HAP and less than 25 tpy of total HAPs. Therefore, the proposed turbines will not be subject to Subpart YYYY, regardless of the outcome of the stay. MACT ZZZZ will apply to the new Diesel Fire-Water Pump.

## IX.D. NONATTAINMENT PERMITTING REQUIREMENTS

The proposed project will be located in Ector County, an attainment area for all pollutants and, therefore, nonattainment permitting will not be required.

## IX.E. Prevention of Significant Deterioration Permitting Requirements

The ECEC will be a major source for purposes of PSD review because it has the potential to emit more than 250 tons per year of all combined criteria pollutants in addition to having the potential to exceed the 100,000 ton per year threshold for greenhouse gases. Since the project will be located at a green-field site, no netting was performed for this project.

# XI. PERMIT FEE INFORMATION

As required by 30 TAC §116.141, Invenergy is remitting a fee of $75,000. Since the maximum potential amount for the permit fee is being submitted, there is no Table 30 attached. A copy of the permit fee check is included in this section.

**TEXCOM** Texas Commission on Invenergy Thermal LLC 4/17/2013

| Ref Nbr | Invoice Nbr | Invc Date | Invoice Amount | Description | Net Check Amt |
|---|---|---|---|---|---|
| 219975 | | 04/17/13 | 75,000.00 | | 75,000.00 |

015534

**Invenergy Thermal LLC**
Operating Account
One S. Wacker Dr., Ste 1900
Chicago, IL 60606

JPMorgan Chase Bank, N.A.
Chicago, IL

2-1/710

CHECK # 015534

| Check Date | Check Amount |
|---|---|
| 04/17/2013 | $ ******75,000.00 |

Seventy-Five Thousand and 00/100---------- Dollars

PAY TO THE ORDER OF
Texas Commission on
Environmental Quality
PO Box 13087
Austin, TX 13087
United States

Authorized Signatures

Security features. Details on back.

⑈015534⑈ ⑆071000013⑆ 7074063 93⑈

# APPENDIX A
# EMISSION CALCULATIONS

## Table A-1
## Gas Turbine Hourly Emission Summary
## Ector County Energy Center

### Hourly Emissions For GE 7FA.03 Scenario

| Pollutant | Max Hourly Emissions During Normal Operations (lb/hr) | Reference Case Number | Annual Avg Hourly Emissions During Normal Operations (lb/hr) | Reference Case Number |
|---|---|---|---|---|
| $NO_X$ | 62.34 | Case 8, 22 $^oF$ - 90% Load | 37.48 | Case 7, 59 $^oF$ - 100% Load |
| CO | 37.95 | Case 8, 22 $^oF$ - 90% Load | 22.82 | Case 7, 59 $^oF$ - 100% Load |
| VOC | 13.28 | Case 8, 22 $^oF$ - 90% Load | 7.99 | Case 7, 59 $^oF$ - 100% Load |
| $SO_2$ | 27.40 | Case 8, 22 $^oF$ - 90% Load, Max S | 16.46 | Case 7, 59 $^oF$ - 100% Load, Avg S |
| $PM/PM_{10}/PM_{2.5}$ | 25.15 | Case 8, 22 $^oF$ - 90% Load, Max S | 18.38 | Case 7, 59 $^oF$ - 100% Load, Avg S |
| $H_2SO_4$ | 12.59 | Case 8, 22 $^oF$ - 90% Load, Max S | 7.56 | Case 7, 59 $^oF$ - 100% Load, Avg S |

### Hourly Emissions For GE 7FA.05 Scenario

| Pollutant | Max Hourly Emissions During Normal Operations (lb/hr) | Reference Case Number | Annual Avg Hourly Emissions During Normal Operations (lb/hr) | Reference Case Number |
|---|---|---|---|---|
| $NO_X$ | 63.62 | Case 1, 22 $^oF$ - 100% Load | 63.62 | Case 5, 59 $^oF$ - 60% Load |
| CO | 38.73 | Case 1, 22 $^oF$ - 100% Load | 38.73 | Case 5, 59 $^oF$ - 60% Load |
| VOC | 3.00 | Case 1, 22 $^oF$ - 100% Load | 3.00 | Case 5, 59 $^oF$ - 60% Load |
| $SO_2$ | 28.33 | Case 1, 22 $^oF$ - 100% Load, Max S | 28.33 | Case 5, 59 $^oF$ - 60% Load, Avg S |
| $PM/PM_{10}/PM_{2.5}$ | 26.83 | Case 1, 22 $^oF$ - 100% Load, Max S | 26.83 | Case 5, 59 $^oF$ - 60% Load, Avg S |
| $H_2SO_4$ | 13.02 | Case 1, 22 $^oF$ - 100% Load, Max S | 13.02 | Case 5, 59 $^oF$ - 60% Load, Avg S |

# Table A-2
# Gas Turbine Annual Emission Summary
# Ector County Energy Center

## Annual Emissions For GE 7FA.03 Scenario

Note: emissions below are for a single combustion turbine.

| Pollutant | Annual Emissions Based on 2500 hrs/yr of Normal Operations (tons/yr) | Estimated Annual Emissions From SS Operations (tons/yr) | Estimated SS Annual Operating Hours[1] (hrs/yr) | Pro-rated Annual Emissions (tons/yr) |
|---|---|---|---|---|
| $NO_X$ | 46.85 | 15.20 | 500 | 52.68 |
| CO | 28.52 | 109.45 | 500 | 132.27 |
| VOC | 9.98 | 8.25 | 500 | 16.24 |
| $SO_2$ | 20.57 | --- | --- | 20.57 |
| $PM/PM_{10}/PM_{2.5}$ | 22.98 | --- | --- | 22.98 |
| $H_2SO_4$ | 9.45 | --- | --- | 9.45 |

## Annual Emissions For GE 7FA.05 Scenario

Note: emissions below are for a single combustion turbine.

| Pollutant | Annual Emissions Based on 2500 hrs/yr of Normal Operations (tons/yr) | Estimated Annual Emissions From SS Operations (tons/yr) | Estimated SS Annual Operating Hours[1] (hrs/yr) | Pro-rated Annual Emissions (tons/yr) |
|---|---|---|---|---|
| $NO_X$ | 79.53 | 15.20 | 500 | 78.82 |
| CO | 48.41 | 109.45 | 500 | 148.18 |
| VOC | 3.75 | 8.25 | 500 | 11.25 |
| $SO_2$ | 35.42 | --- | --- | 35.42 |
| $PM/PM_{10}/PM_{2.5}$ | 33.54 | --- | --- | 33.54 |
| $H_2SO_4$ | 16.27 | --- | --- | 16.27 |

Notes:

1. The estimated number of annual hours in startup/shutdown are based on the average duration of startup/shutdowns and the annual average number of startup/shutdowns during the year. It is not intended to be an annual limit for compliance purposes.
2. Only emissions of NOx, CO, VOC, and PM/PM10/PM2.5 are shown in the startup/shutdown columns as emissions of other pollutants are expected to be less than during normal operation.

**Table A-3**
**GE 7FA.03 Turbine Emission Calculations**
**Ector County Energy Center**

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Load Condition | | BASE | 90% | 80% | 70% | 60% | 50% | BASE | 90% | 80% | 70% | 60% | 50% | BASE | 90% | 80% | 70% | 60% | 50% | | |
| Inlet Loss | in H2O | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Exhaust Pressure Loss | in H2O | 5.66 | 5.54 | 4.62 | 3.94 | 3.44 | 2.97 | 2.51 | 6.27 | 5 | 4.25 | 3.65 | 3.18 | 2.69 | 5.23 | 4.67 | 3.98 | 3.44 | 3.06 | 2.65 | 2.29 |
| Ambient Temperature | °F | 59 | 59 | 59 | 59 | 59 | 59 | 59 | 22 | 22 | 22 | 22 | 22 | 22 | 97 | 97 | 97 | 97 | 97 | 97 | 97 |
| Ambient Relative Humidity | % | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 73.4 | 73.4 | 73.4 | 73.4 | 73.4 | 73.4 | 19.1 | 19.1 | 19.1 | 19.1 | 19.1 | 19.1 | 19.1 |
| Evap. Cooler Status | | On | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | On | Off | Off | Off | Off | Off | Off |
| Evap. Cooler Effectiveness | | 0.85 | | | | | | | | | | | | | 0.85 | | | | | | |
| Fuel Type | | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas |
| Fuel LHV | BTU/lb | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20,066 | 20066 | 20066 |
| Fuel Temperature | °F | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 |
| Output | kW | 173,040 | 170,000 | 153,060 | 136,020 | 118,980 | 102,040 | 85,000 | 184,200 | 165,790 | 147,380 | 128,970 | 110,560 | 92,150 | 163,340 | 147,480 | 132,790 | 118,000 | 103,210 | 88520 | 73740 |
| Heat Rate (LHV) | BTU/kWh | 9,300 | 9,330 | 9,490 | 9,830 | 10,370 | 11,060 | 11,980 | 9,200 | 9,270 | 9,600 | 10,070 | 10,760 | 11,640 | 9,430 | 9,660 | 9,910 | 10,300 | 10,940 | 11630 | 12570 |
| Heat Rate (HHV) | BTU/kWh | 10,320 | 10,350 | 10,530 | 10,910 | 11,510 | 12,270 | 13,290 | 10,210 | 10,290 | 10,650 | 11,180 | 11,940 | 12,920 | 10,470 | 10,720 | 11,000 | 11,430 | 12,140 | 12910 | 13950 |
| Heat Cons. (LHV) | MMBTU/hr | 1,627 | 1,604 | 1,468 | 1,352 | 1,248 | 1,141 | 1,029 | 1,714 | 1,554 | 1,431 | 1,314 | 1,204 | 1,085 | 1,558 | 1,441 | 1,330 | 1,229 | 1,142 | 1041.4 | 937.5 |
| Heat Cons. (HHV) | MMBTU/hr | 1,786 | 1,760 | 1,612 | 1,484 | 1,369 | 1,252 | 1,130 | 1,881 | 1,706 | 1,570 | 1,442 | 1,320 | 1,191 | 1,710 | 1,581 | 1,461 | 1,349 | 1,253 | | |
| Exhaust Flow | x10^3 lb/hr | 3,643 | 3,599 | 3,280 | 3,019 | 2,812 | 2,607 | 2,387 | 3,855 | 3,429 | 3,151 | 2,910 | 2,709 | 2,482 | 3,491 | 3,286 | 3,028 | 2,805 | 2,640 | 2451 | 2281 |
| Exhaust Flow | lbmol/hr | 128,456 | 126,770 | 115,534 | 106,340 | 99,049 | 91,796 | 84,049 | 135,406 | 120,485 | 110,717 | 102,249 | 95,153 | 87,179 | 123,444 | 115,786 | 106,695 | 98,837 | 92,990 | 86,303 | 80,289 |
| Exhaust Temperature | °F | 1,096 | 1,103 | 1,116 | 1,137 | 1,157 | 1,175 | 1,197 | 1,065 | 1,088 | 1,110 | 1,132 | 1,150 | 1,172 | 1,115 | 1,138 | 1,154 | 1,172 | 1,189 | 1200 | 1200 |
| Exhaust MolWt | lb/lbmol | 28.36 | 28.39 | 28.39 | 28.39 | 28.39 | 28.4 | 28.4 | 28.47 | 28.46 | 28.46 | 28.46 | 28.47 | 28.47 | 28.28 | 28.38 | 28.38 | 28.38 | 28.39 | 28.4 | 28.41 |
| Exhaust Energy | MMBTU/hr | 999.00 | 992.7 | 917 | 861.8 | 818.3 | 771.7 | 721 | 1053.5 | 959.8 | 901.6 | 850.5 | 805.1 | 752.5 | 946.7 | 907.9 | 849.7 | 801.6 | 766.5 | 719 | 668 |
| Water / Steam Flow | lb/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| EMISSIONS | | | | | | | | | | | | | | | | | | | | | |
| NOx | ppmvd, 15% O2 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | | |
| NOx Correction O2 Value | % O2 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | | |
| NOx as NO2 | lb/hr | 59.21 | 58.40 | 53.43 | 49.17 | 45.40 | 41.51 | 37.48 | 62.34 | 56.58 | 52.05 | 47.77 | 43.76 | 39.51 | 56.71 | 52.46 | 48.40 | 44.73 | 41.55 | | 62.34 |
| CO at 9 ppmvd 15% O2 | lb/hr | 36.04 | 35.55 | 32.52 | 29.93 | 27.63 | 25.27 | 22.82 | 37.95 | 34.44 | 31.68 | 29.08 | 26.64 | 24.05 | 34.52 | 31.93 | 29.46 | 27.23 | 25.29 | | 37.95 |
| VOC, 2 ppmvd as propane | lb/hr | 12.62 | 12.44 | 11.38 | 10.47 | 9.67 | 8.84 | 7.99 | 13.28 | 12.05 | 11.09 | 10.18 | 9.32 | 8.42 | 12.08 | 11.18 | 10.31 | 9.53 | 8.85 | | 13.28 |
| Fuel sulfur content (average) | gr/100 scf | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | | |
| SO2 emissions (average) | lb/hr | 26.02 | 25.63 | 23.48 | 21.62 | 19.95 | 18.24 | 16.46 | 27.40 | 24.85 | 22.87 | 21.01 | 19.23 | 17.35 | 24.92 | 23.03 | 21.28 | 19.65 | 18.25 | | |
| Fuel sulfur content (maximum) | gr/100 scf | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | | |
| SO2 emissions (maximum) | lb/hr | 26.02 | 25.63 | 23.48 | 21.62 | 19.95 | 18.24 | 16.46 | 27.40 | 24.85 | 22.87 | 21.01 | 19.23 | 17.35 | 24.92 | 23.03 | 21.28 | 19.65 | 18.25 | | 27.40 |
| SO2 to H2SO4 conversion | % | 30% | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | | |
| H2SO4 emissions (average) | lb/hr | 11.95 | 11.78 | 10.79 | 9.93 | 9.17 | 8.38 | 7.56 | 12.59 | 11.42 | 10.50 | 9.65 | 8.83 | 7.97 | 11.45 | 10.58 | 9.78 | 9.03 | 8.39 | | |
| H2SO4 emissions (maximum) | lb/hr | 11.95 | 11.78 | 10.79 | 9.93 | 9.17 | 8.38 | 7.56 | 12.59 | 11.42 | 10.50 | 9.65 | 8.83 | 7.97 | 11.45 | 10.58 | 9.78 | 9.03 | 8.39 | | 12.59 |
| PM from turbine | lb/hr | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | | |
| Total PM (average) | lb/hr | 24.30 | 24.06 | 22.73 | 21.58 | 20.55 | 19.49 | 18.38 | 25.15 | 23.58 | 22.35 | 21.20 | 20.10 | 18.93 | 23.62 | 22.45 | 21.37 | 20.36 | 19.50 | | |
| Total PM (maximum) | lb/hr | 24.30 | 24.06 | 22.73 | 21.58 | 20.55 | 19.49 | 18.38 | 25.15 | 23.58 | 22.35 | 21.20 | 20.10 | 18.93 | 23.62 | 22.45 | 21.37 | 20.36 | 19.50 | | 25.15 |
| EXHAUST ANALYSIS | | | | | | | | | | | | | | | | | | | | | |
| Argon | %vol | 0.88 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.88 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 |
| Nitrogen | %vol | 74.31 | 74.48 | 74.47 | 74.47 | 74.5 | 74.54 | 74.58 | 75.03 | 74.98 | 74.98 | 74.99 | 75.04 | 75.08 | 73.73 | 74.44 | 74.44 | 74.44 | 74.48 | 74.53 | 74.61 |
| Oxygen | %vol | 12.55 | 12.6 | 12.57 | 12.57 | 12.64 | 12.75 | 12.86 | 12.75 | 12.59 | 12.58 | 12.63 | 12.76 | 12.88 | 12.42 | 12.71 | 12.7 | 12.72 | 12.82 | 12.96 | 13.2 |
| Carbon Dioxide | %vol | 3.73 | 3.73 | 3.74 | 3.75 | 3.71 | 3.66 | 3.61 | 3.73 | 3.8 | 3.81 | 3.79 | 3.73 | 3.67 | 3.72 | 3.67 | 3.67 | 3.66 | 3.62 | 3.56 | 3.44 |
| Water | %vol | 8.52 | 8.3 | 8.32 | 8.33 | 8.27 | 8.16 | 8.06 | 7.6 | 7.74 | 7.75 | 7.71 | 7.59 | 7.47 | 9.25 | 8.29 | 8.3 | 8.28 | 8.19 | 8.07 | 7.85 |
| Argon | %vol, dry | 0.96 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | | |
| Nitrogen | %vol, dry | 81.24 | 81.22 | 81.24 | 81.23 | 81.21 | 81.16 | 81.12 | 81.20 | 81.27 | 81.27 | 81.25 | 81.19 | 81.15 | 81.25 | 81.17 | 81.18 | 81.17 | 81.12 | | |
| Oxygen | %vol, dry | 13.72 | 13.74 | 13.71 | 13.71 | 13.78 | 13.88 | 13.99 | 13.80 | 13.65 | 13.64 | 13.68 | 13.81 | 13.92 | 13.69 | 13.86 | 13.85 | 13.87 | 13.96 | | |
| Carbon Dioxide | %vol, dry | 4.08 | 4.07 | 4.08 | 4.09 | 4.04 | 3.99 | 3.93 | 4.04 | 4.12 | 4.13 | 4.11 | 4.04 | 3.97 | 4.10 | 4.00 | 4.00 | 3.99 | 3.94 | | |
| | | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | | |
| STACK PARAMETERS | | | | | | | | | | | | | | | | | | | | | |
| Stack Height | ft | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | | |
| Internal Diameter | ft | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | | |
| Flow | scfm | 825,327 | 814,497 | 742,304 | 683,236 | 636,390 | 589,788 | 540,017 | 869,982 | 774,115 | 711,355 | 656,948 | 611,357 | 560,128 | 793,129 | 743,924 | 685,514 | 635,029 | 597,464 | | |
| Temperature | oF | 1,096 | 1,103 | 1,116 | 1,137 | 1,157 | 1,175 | 1,197 | 1,065 | 1,088 | 1,110 | 1,132 | 1,150 | 1,172 | 1,115 | 1,138 | 1,154 | 1,172 | 1,189 | | |
| Flow | acfm | 2,432,214 | 2,411,097 | 2,215,664 | 2,066,531 | 1,948,943 | 1,826,332 | 1,694,712 | 2,512,731 | 2,269,566 | 2,115,205 | 1,980,799 | 1,864,175 | 1,731,305 | 2,365,866 | 2,251,496 | 2,095,493 | 1,962,817 | 1,865,943 | | |
| Exit Velocity | ft/s | 159 | 158 | 145 | 135 | 128 | 120 | 111 | 165 | 149 | 139 | 130 | 122 | 113 | 155 | 147 | 137 | 129 | 122 | | |

**Table A-4**
**GE 7FA.05 Turbine Emission Calculations**
**Ector County Energy Center**

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Load Condition | | BASE | 90% | 80% | 70% | 60% | 50% | 40% | 30% | BASE | BASE | 90% | 80% | 70% | 60% | 50% | 40% | BASE | BASE | 90% | 80% | 70% | 60% | 50% | 40% |
| Inlet Loss | in H2O | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Exhaust Pressure Loss | in H2O | 4.47 | 4.4 | 4.4 | 3.53 | 2.94 | 2.47 | 2.08 | 1.85 | 1.86 | 4.55 | 3.7 | 3.25 | 2.76 | 2.34 | 1.98 | 1.91 | 1.84 | 4.32 | 3.84 | 3.15 | 2.6 | 2.15 | 1.92 | 1.87 |
| Ambient Temperature | °F | 59 | 59 | 59 | 59 | 59 | 59 | 59 | 59 | 59 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 97 | 97 | 97 | 97 | 97 | 97 | 97 |
| Ambient Relative Humidity | % | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 73.4 | 73.4 | 73.4 | 73.4 | 73.4 | 73.4 | 73.4 | 73.4 | 19.1 | 19.1 | 19.1 | 19.1 | 19.1 | 19.1 | 19.1 |
| Evap. Cooler Status | | On | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | On | Off | Off | Off | Off | Off | Off |
| Evap. Cooler Effectiveness | | 0.85 | | | | | | | | | | | | | | | | | 0.85 | | | | | | |
| Fuel Type | | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas | Cust Gas |
| Fuel LHV | BTU/lb | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 | 20066 |
| Fuel Temperature | °F | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 | 365 |
| Output | kW | 195489 | 193112 | 193112 | 173801 | 154489 | 135178 | 115867 | 96556 | 92694 | 201558 | 181403 | 161247 | 141091 | 120935 | 100779 | 96748 | 92717 | 188392 | 170100 | 153090 | 136080 | 119070 | 102060 | 85050 |
| Heat Rate (LHV) | BTU/kWh | 8796 | 8802 | 8802 | 8878 | 9151 | 9519 | 10120 | 11109 | 11438 | 8698 | 8753 | 9092 | 9507 | 10144 | 11108 | 11341 | 11593 | 8879 | 9014 | 9196 | 9498 | 9965 | 10627 | 11933 |
| Heat Rate (HHV) | BTU/kWh | 9757 | 9764 | 9764 | 9848 | 10151 | 10559 | 11226 | 12323 | 12688 | 9649 | 9710 | 10086 | 10546 | 11253 | 12322 | 12581 | 12860 | 9849 | 9999 | 10201 | 10536 | 11054 | 11789 | 13237 |
| Heat Cons. (LHV) | MMBTU/hr | 1720 | 1700 | 1700 | 1543 | 1414 | 1287 | 1173 | 1073 | 1060 | 1753 | 1588 | 1466 | 1341 | 1227 | 1119 | 1097 | 1075 | 1673 | 1533 | 1408 | 1293 | 1187 | 1085 | 1015 |
| Heat Cons. (HHV) | MMBTU/hr | 1,908 | 1,886 | 1,886 | 1,712 | 1,568 | 1,427 | 1,301 | 1,190 | 1,176 | 1,945 | 1,761 | 1,626 | 1,488 | 1,361 | 1,242 | 1,217 | 1,192 | 1,856 | 1,701 | 1,562 | 1,434 | 1,316 | 1,203 | 1,126 |
| Exhaust Flow | x10^3 lb/hr | 3809 | 3779 | 3779 | 3372 | 3067 | 2798 | 2554 | 2403 | 2408 | 3858 | 3473 | 3251 | 2980 | 2729 | 2494 | 2445 | 2396 | 3738 | 3519 | 3173 | 2865 | 2593 | 2451 | 2418 |
| Exhaust Flow | lbmol/hr | 134,356 | 133,204 | 133,204 | 118,858 | 108,145 | 98,660 | 90,056 | 84,672 | 84,848 | 135,606 | 122,074 | 114,230 | 104,708 | 95,889 | 87,632 | 85,910 | 84,188 | 132,225 | 124,039 | 111,843 | 101,023 | 91,464 | 86,394 | 85,171 |
| Exhaust Temperature | °F | 1092 | 1096 | 1096 | 1117 | 1143 | 1164 | 1196 | 1215 | 1215 | 1071 | 1081 | 1091 | 1116 | 1150 | 1195 | 1205 | 1215 | 1101 | 1112 | 1140 | 1175 | 1215 | 1215 | 1215 |
| Exhaust MolWt | lb/lbmol | 28.35 | 28.37 | 28.37 | 28.37 | 28.36 | 28.36 | 28.36 | 28.38 | 28.38 | 28.45 | 28.45 | 28.46 | 28.46 | 28.46 | 28.46 | 28.46 | 28.46 | 28.27 | 28.37 | 28.37 | 28.36 | 28.35 | 28.37 | 28.39 |
| Exhaust Energy | MMBTU/hr | 1041.2 | 1035.6 | 1035.6 | 945.2 | 882.1 | 821.4 | 773.4 | 739.6 | 740.4 | 1062 | 965.8 | 913 | 857.3 | 811.7 | 773.4 | 765 | 756.4 | 999 | 946 | 879.1 | 822.3 | 774.8 | 731.2 | 719.7 |
| Water / Steam Flow | lb/hr | | | | | | | | | | | | | | | | | | | | | | | | |
| EMISSIONS | | | | | | | | | | | | | | | | | | | | | | | | | |
| NOx | ppmvd | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 13 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| NOx Correction O2 Value | % O2 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| NOx as NO2 | lb/hr | 62.41 | 61.71 | 61.71 | 56.02 | 51.33 | 46.72 | 42.59 | 56.25 | 38.48 | 63.62 | 57.63 | 53.21 | 48.72 | 44.56 | 40.61 | 39.82 | 39.03 | 60.71 | 55.64 | 51.15 | 46.95 | 43.08 | 39.36 | 36.80 |
| CO at 9 ppmvd 15% O2 | lb/hr | 37.99 | 37.56 | 37.56 | 34.10 | 31.24 | 28.44 | 25.93 | 23.70 | 23.42 | 38.73 | 35.08 | 32.39 | 29.65 | 27.12 | 24.72 | 24.24 | 23.76 | 36.95 | 33.87 | 31.14 | 28.58 | 26.22 | 23.96 | 22.40 |
| UHC | ppmvw | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| UHC | lb/hr | 15 | 15 | 15 | 13 | 12 | 11 | 10 | 9 | 10 | 15 | 14 | 13 | 12 | 11 | 10 | 10 | 9 | 15 | 14 | 13 | 11 | 10 | 10 | 10 |
| VOC | ppmvw | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| VOC | lb/hr | 3.00 | 2.80 | 2.60 | 2.40 | 2.20 | 2.00 | 1.80 | 1.60 | 2.90 | 3.00 | 2.60 | 2.40 | 2.20 | 2.00 | 1.90 | 1.80 | 2.80 | 2.70 | 2.50 | 2.20 | 2.10 | 2.00 | 1.90 | 1.80 |
| Fuel sulfur content (average) | gr/100 scf | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| SO2 emissions (average) | lb/hr | 27.79 | 27.47 | 27.47 | 24.94 | 22.85 | 20.79 | 18.95 | 17.33 | 17.14 | 28.33 | 25.66 | 23.69 | 21.68 | 19.83 | 18.09 | 17.73 | 17.37 | 27.03 | 24.78 | 22.75 | 20.89 | 19.18 | 17.53 | 16.40 |
| Fuel sulfur content (maximum) | gr/100 scf | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| SO2 emissions (maximum) | lb/hr | 27.79 | 27.47 | 27.47 | 24.94 | 22.85 | 20.79 | 18.95 | 17.33 | 17.14 | 28.33 | 25.66 | 23.69 | 21.68 | 19.83 | 18.09 | 17.73 | 17.37 | 27.03 | 24.78 | 22.75 | 20.89 | 19.18 | 17.53 | 16.40 |
| SO2 to H2SO4 conversion | % | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| H2SO4 emissions (average) | lb/hr | 12.77 | 12.62 | 12.62 | 11.46 | 10.50 | 9.55 | 8.71 | 7.96 | 7.87 | 13.02 | 11.79 | 10.88 | 9.96 | 9.11 | 8.31 | 8.15 | 7.98 | 12.42 | 11.38 | 10.45 | 9.60 | 8.81 | 8.05 | 7.53 |
| H2SO4 emissions (maximum) | lb/hr | 12.77 | 12.62 | 12.62 | 11.46 | 10.50 | 9.55 | 8.71 | 7.96 | 7.87 | 13.02 | 11.79 | 10.88 | 9.96 | 9.11 | 8.31 | 8.15 | 7.98 | 12.42 | 11.38 | 10.45 | 9.60 | 8.81 | 8.05 | 7.53 |
| PM from turbine | lb/hr | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 |
| Total PM (average) | lb/hr | 26.50 | 26.30 | 26.30 | 24.73 | 23.44 | 22.17 | 21.03 | 20.03 | 19.90 | 26.83 | 25.18 | 23.96 | 22.71 | 21.57 | 20.49 | 20.27 | 20.05 | 26.03 | 24.63 | 23.38 | 22.22 | 21.16 | 20.15 | 19.45 |
| Total PM (maximum) | lb/hr | 26.50 | 26.30 | 26.30 | 24.73 | 23.44 | 22.17 | 21.03 | 20.03 | 19.90 | 26.83 | 25.18 | 23.96 | 22.71 | 21.57 | 20.49 | 20.27 | 20.05 | 26.03 | 24.63 | 23.38 | 22.22 | 21.16 | 20.15 | 19.45 |
| EXHAUST ANALYSIS | | | | | | | | | | | | | | | | | | | | | | | | | |
| Argon | %vol | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.89 |
| Nitrogen | %vol | 74.19 | 74.38 | 74.38 | 74.33 | 74.31 | 74.31 | 74.32 | 74.4 | 74.44 | 74.95 | 74.94 | 74.98 | 74.98 | 74.99 | 74.99 | 74.99 | 74.99 | 73.61 | 74.37 | 74.32 | 74.27 | 74.23 | 74.33 | 74.47 |
| Oxygen | %vol | 12.46 | 12.53 | 12.53 | 12.39 | 12.33 | 12.35 | 12.36 | 12.59 | 12.7 | 12.59 | 12.54 | 12.65 | 12.66 | 12.67 | 12.69 | 12.69 | 12.69 | 12.39 | 12.76 | 12.61 | 12.48 | 12.37 | 12.64 | 13.05 |
| Carbon Dioxide | %vol | 3.76 | 3.75 | 3.75 | 3.82 | 3.84 | 3.83 | 3.83 | 3.72 | 3.68 | 3.8 | 3.82 | 3.77 | 3.77 | 3.76 | 3.76 | 3.75 | 3.75 | 3.72 | 3.64 | 3.7 | 3.76 | 3.81 | 3.69 | 3.5 |
| Water | %vol | 8.71 | 8.46 | 8.46 | 8.58 | 8.64 | 8.62 | 8.61 | 8.4 | 8.31 | 7.77 | 7.81 | 7.71 | 7.7 | 7.69 | 7.68 | 7.68 | 7.67 | 9.41 | 8.36 | 8.48 | 8.6 | 8.7 | 8.46 | 8.1 |
| Argon | %vol, dry | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.97 | 0.96 | 0.97 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.97 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.97 |
| Nitrogen | %vol, dry | 81.27 | 81.25 | 81.25 | 81.31 | 81.34 | 81.33 | 81.32 | 81.23 | 81.17 | 81.26 | 81.29 | 81.24 | 81.24 | 81.24 | 81.22 | 81.23 | 81.23 | 81.25 | 81.15 | 81.22 | 81.27 | 81.31 | 81.20 | 81.02 |
| Oxygen | %vol, dry | 13.65 | 13.69 | 13.69 | 13.55 | 13.50 | 13.52 | 13.52 | 13.75 | 13.85 | 13.65 | 13.60 | 13.71 | 13.72 | 13.73 | 13.74 | 13.75 | 13.75 | 13.68 | 13.92 | 13.78 | 13.66 | 13.55 | 13.81 | 14.20 |
| Carbon Dioxide | %vol, dry | 4.12 | 4.10 | 4.10 | 4.18 | 4.20 | 4.19 | 4.19 | 4.06 | 4.01 | 4.12 | 4.14 | 4.08 | 4.08 | 4.07 | 4.07 | 4.06 | 4.06 | 4.11 | 3.97 | 4.04 | 4.11 | 4.17 | 4.03 | 3.81 |
| | | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| STACK PARAMETERS | | | | | | | | | | | | | | | | | | | | | | | | | |
| Stack Height | ft | 75 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Internal Diameter | ft | 19.5 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Flow | scfm | 863,239 | 855,836 | 855,836 | 763,662 | 694,833 | 633,891 | 578,612 | 544,020 | 545,152 | 871,271 | 784,324 | 733,931 | 672,751 | 616,087 | 563,034 | 551,972 | 540,910 | 849,545 | 796,954 | 718,594 | 649,070 | 587,655 | 555,082 | 547,223 |
| Temperature | oF | 1,092 | 1,096 | 1,096 | 1,117 | 1,143 | 1,164 | 1,196 | 1,215 | 1,215 | 1,071 | 1,081 | 1,091 | 1,116 | 1,150 | 1,195 | 1,205 | 1,215 | 1,101 | 1,112 | 1,140 | 1,175 | 1,215 | 1,215 | 1,215 |
| Flow | acfm | 2,537,399 | 2,522,124 | 2,522,124 | 2,280,863 | 2,109,504 | 1,949,695 | 1,814,739 | 1,725,820 | 1,729,411 | 2,526,355 | 2,289,098 | 2,155,922 | 2,008,060 | 1,878,597 | 1,764,813 | 1,740,594 | 1,715,955 | 2,511,630 | 2,372,748 | 2,177,559 | 2,009,904 | 1,864,247 | 1,760,913 | 1,735,981 |
| Exit Velocity | ft/s | 142 | 134 | 134 | 121 | 112 | 103 | 96 | 92 | 92 | 134 | 121 | 114 | 107 | 100 | 94 | 92 | 91 | 133 | 126 | 116 | 107 | 99 | 93 | 92 |

# Table A-5
# Gas Turbine Startup/Shutdown Emission Calculations
# Ector County Energy Center

## Startup/Shutdown Emissions For GE 7FA.03 Scenario

| Pollutant | Estimated Duration[1] | Max Hourly Emissions | Average Hourly Emissions | Annual Emissions |
|---|---|---|---|---|
| | (hr/yr) | (lb/hr) | (lb/hr) | (tons/yr) |
| NOx | 500 | 67 | 61 | 15.2 |
| CO | | 478 | 438 | 109.5 |
| VOC | | 36 | 33 | 8.3 |

## Startup/Shutdown Emissions For GE 7FA.05 Scenario

| Pollutant | Estimated Duration[1] | Max Hourly Emissions | Average Hourly Emissions | Annual Emissions |
|---|---|---|---|---|
| | (hr/yr) | (lb/hr) | (lb/hr) | (tons/yr) |
| NOx | 500 | 67 | 61 | 15.2 |
| CO | | 478 | 438 | 109.5 |
| VOC | | 36 | 33 | 8.3 |

Notes:

1. The estimated number of annual hours in startup/shutdown are based on the average duration of startup/shutdowns and the annual average number of startup/shutdowns during the year. It is not intended to be an annual limit for compliance purposes.

# TABLE A-6

SAMPLE EMISSION CALCULATIONS - TURBINE

Ector County Energy Center

| GE 7FA.03 Unit, Case 7 | |
|---|---|
| Exhaust Flow Rate | 84,049 lbmol/hr |
| CTG Heat Input | 1,130 MMBtu / hr, HHV |
| Natural Gas | 981 Btu / scf, HHV |
| Exhaust Content | 12.86 % O2 wet |
| Exhaust Content | 8.06 % H2O |

Convert Oxygen Concentration to Dry Basis

$$O_2 = \frac{12.86\ \%\ \text{wet}}{(1 - (8.06\ /100))} = 13.99\ \%\ \text{dry}$$

Fuel Gas Usage

$$\text{CTG NG Flow} = \frac{1130\ \text{MMBtu HHV}}{\text{hr}} \left| \frac{1{,}000{,}000\ \text{Btu}}{\text{MMBtu}} \right| \frac{\text{scf}}{980.6\ \text{Btu}} = 1152055\ \text{scfh}$$

## Sample Calculation - NOx

Emission Factor 9.0 ppmvd NOx @ 15% $O_2$

$NO_2$ MW 46 lb / $lb_{mole}$

Emission Factor Corrected for Actual Oxygen Concentration - Oxides of Nitrogen

$$\text{Factor} = \frac{9\ \text{ppmvd @ 15\%}}{} \left| \frac{(\ 20.9 - 13.99\ )}{(\ 20.9 - 15\ )} \right. = 10.54\ \text{ppmvd NOx}$$

Emission Rate Calculation - Oxides of Nitrogen

$$\text{Emissions} = \frac{10.54\ \text{lbmol NOx}}{1{,}000{,}000\ \text{lbmol dry exhaust}} \left| \frac{84049\ \text{lbmol wet exhaust}}{\text{hr}} \right| \frac{(100 - 8.06)\ \%\ \text{H2O}}{} \left| \frac{46\ \text{lb NOx}}{\text{lbmole NOx}} \right. = 37.5\ \text{lb/hr NOx as NO2}$$

## Sample Calculation - CO

Emission Factor 9.0 ppmvd CO @ 15% $O_2$

CO MW 28 lb / $lb_{mole}$

Emission Factor Corrected for Actual Oxygen Concentration - CO

$$\text{Factor} = \frac{9\ \text{ppmd @ 15\%}}{} \left| \frac{(\ 20.9 - 13.99\ )}{(\ 20.9 - 15\ )} \right. = 10.54\ \text{ppmvd CO}$$

Emission Rate Calculation - CO

$$\text{ST Emissions} = \frac{10.54\ \text{lbmol CO}}{1{,}000{,}000\ \text{lbmol dry exhaust}} \left| \frac{84049\ \text{lbmol wet exhaust}}{\text{hr}} \right| \frac{(100 - 8.06)\ \%\ \text{H2O}}{} \left| \frac{28\ \text{lb CO}}{\text{lbmole CO}} \right. = 22.8\ \text{lb/hr CO}$$

## Sample Calculation - VOC

Emission Factor 2.0 ppmvd VOC @ 15% $O_2$

VOC MW 44.10 lb / $lb_{mole}$

Emission Factor Corrected for Actual Oxygen Concentration - VOC

$$\text{Factor} = \frac{2\ \text{ppmd @ 15\%}}{} \left| \frac{(\ 20.9 - 13.99\ )}{(\ 20.9 - 15\ )} \right. = 2.34\ \text{ppmvd VOC}$$

Emission Rate Calculation - VOC

$$\text{ST Emissions} = \frac{2.34\ \text{lbmol VOC}}{1{,}000{,}000\ \text{lbmol dry exhaust}} \left| \frac{84049\ \text{lbmol wet exhaust}}{\text{hr}} \right| \frac{(100 - 8.06)\ \%\ \text{H2O}}{} \left| \frac{44.1\ \text{lb VOC}}{\text{lbmole VOC}} \right. = 8\ \text{lb/hr VOC}$$

**TABLE A-6**

SAMPLE EMISSION CALCULATIONS - TURBINE

Ector County Energy Center

## Sample Calculation - SO2 and H2SO4

| | | |
|---|---|---|
| Emission Factor | 5 | grain S / 100 scf, Annual Avg Natural Gas |
| S MW | 32.06 | lb / $lb_{mole}$ |
| $SO_2$ MW | 64.06 | lb / $lb_{mole}$ |
| $H_2SO_4$ MW | 98.07 | lb / $lb_{mole}$ |
| Conversion of SO2 to SO3 | 30% | |

## Sample Calculation - Sulfur Dioxide (SO2)

$$\text{CTG Emissions} = \frac{5 \text{ grain S}}{100 \text{ scf}} \left| \frac{\text{lb}}{7000 \text{ grain}} \right| \frac{1152055 \text{ scf}}{\text{hr}} \left| \frac{64.06 \text{ lbmole SO2}}{32.06 \text{ lbmole S}} \right| = 16.44 \text{ lb/hr SO2}$$

## Sample Calculation - Sulfuric Acid (H2SO4)

Assume 30% SO2 converts to SO3

Assume 100% SO3 converts to H2SO4

$$\text{Emissions} = \frac{16.443 \text{ lb SO2}}{\text{hr}} \left| \frac{\text{lbmole SO2}}{64.06 \text{ lb SO2}} \right| \frac{0.3 \text{ lbmole H2SO4}}{\text{lbmole SO2}} \left| \frac{98.07 \text{ lb H2SO4}}{\text{lbmole H2SO4}} \right| = 7.55 \text{ lb/hr H2SO4}$$

## Sample Calculation - PM, PM10, PM2.5

| | | |
|---|---|---|
| CTG Emission Rate | 8.20 | lb/hr, front and back half, vendor supplied |

# Table A-7
# Natural Gas Analysis
# Ector County Energy Center

| Name | MW | mol fraction | MW | Wt Fraction | Gross (HHV) Btu/ft3 | Gross (HHV) Btu/lb | Avg. HHV Btu/ft3 | Avg. HHV Btu/lb |
|---|---|---|---|---|---|---|---|---|
| Nitrogen, N2 | 28.01 | 0.0323 | 0.905 | 0.054 | 0.0 | 0 | 0 | 0 |
| Carbon Dioxide, CO2 | 44.01 | 0.0046 | 0.202 | 0.012 | 0.0 | 0 | 0 | 0 |
| Carbon Monoxide, CO | 28.01 | 0.0000 | 0.000 | 0.000 | 320.5 | 4,342.2 | 0 | 0 |
| Hydrogen, H2 | 2.02 | 0.0000 | 0.000 | 0.000 | 324.2 | 61,022 | 0 | 0 |
| Methane, CH4 | 16.04 | 0.9531 | 15.291 | 0.915 | 1,010.0 | 23,891 | 963 | 21,871 |
| Ethane, C2H6 | 30.07 | 0.0097 | 0.292 | 0.017 | 1,769.7 | 22,333 | 17 | 390 |
| Propane, C3H8 | 44.10 | 0.0003 | 0.013 | 0.001 | 2,516.1 | 21,653 | 1 | 17 |
| Iso-Butane, C4H10 | 58.12 | 0.0000 | 0.000 | 0.000 | 3,251.9 | 21,232 | 0 | 0 |
| n-Butane, C4H10 | 58.12 | 0.0000 | 0.000 | 0.000 | 3,262.3 | 21,300 | 0 | 0 |
| Iso-Pentane, C5H12 | 72.15 | 0.0000 | 0.000 | 0.000 | 4,000.9 | 21,043 | 0 | 0 |
| n-Pentane, C5H12 | 72.15 | 0.0000 | 0.000 | 0.000 | 4,008.9 | 21,085 | 0 | 0 |
| n-Hexane, C6H14 | 86.18 | 0.0000 | 0.000 | 0.000 | 4,755.9 | 20,943 | 0 | 0 |
| Ethylene, C2H4 | 28.05 | 0.0000 | 0.000 | 0.000 | 1,600.0 | 21,640 | 0 | 0 |
| Propylene, C3H6 | 42.08 | 0.0000 | 0.000 | 0.000 | 2,333.0 | 21,039 | 0 | 0 |
| neo-Pentane, C5H12 | 72.15 | 0.0000 | 0.000 | 0.000 | 3,985.0 | 20,958 | 0 | 0 |
| Oxygen, O2 | 32.00 | 0.0000 | 0.000 | 0.000 | 0.0 | 0 | 0 | 0 |
| Water, H2O | 18.02 | 0.0000 | 0.000 | 0.000 | 50.312 | 1,059.8 | 0 | 0 |
| *Total* | | *1.00* | *16.70* | *1.00* | | | 981 | 22,278 |

Natural Gas MW = 16.70 lb/lbmole

Natural Gas Heating Value = 980.6 Btu/scf (HHV)
Natural Gas Heating Value = 22,278 Btu/lb (HHV)

**VOC weight fraction =** 0.0008

# Table A-8
# Lube Oil System Vent Emissions
# Ector County Energy Center

**Notes:**

1 - The heating of recirculating lube oil in the gas turbine housing generates oil vapor and oil condensate droplets in the oil reservoir compartments. Lube oil mist emissions in each reservoir are controlled by a mist eliminator.

2 - Unloading, storage, and heated recirculation of lube oil in gas turbine reservoirs will emit less than 0.3 gallon per day of oil per turbine mist eliminator vent, based on oil consumption for similar units. The calculated hourly emissions are based on the daily emission rate divided by 24 hours per day.

3 - Lube oil mist will be generated and the corresponding mist eliminator fan will be operated concurrently with turbine operation, including during startup and shutdown, plus additional time after turbine operation. When the gas turbines do not operate for extended periods such that lube oil is cooled to near-ambient temperatures, mist eliminators may be shut down. During this time, vapor breathing and filling losses may occur from each oil reservoir. These latter losses are significantly less than the emission rates calculated on this sheet.

**Example Calculation:**

Hourly ER (lb/hr) = daily volumetric emission rate (gal/day) x density (lb/gal) x (day/24 hr)

$$\text{lb/hr} = \frac{\text{X gal}}{\text{day}} \times \frac{\text{X lb}}{\text{gal}} \times \frac{\text{day}}{\text{24 hr}}$$

Annual ER (tpy) = daily volumetric emission rate (gal/day) x density (lb/gal) x days of operation (days/yr) x (ton/2000 lb)

$$\text{tpy} = \frac{\text{X gal}}{\text{day}} \times \frac{\text{X lb}}{\text{gal}} \times \frac{\text{X day}}{\text{yr}} \times \frac{\text{ton}}{\text{2000 lb}}$$

**Calculation of Emissions:**

| EPN | Description | Pollutant | Maximum Annual No. of Days of Operation (days/yr) | Daily Volumetric Emission Rate Per Mist Eliminator Vent (gal/day/vent) | Approx. Density (lb/gal) | No. of Mist Eliminator Vents (vents) | Daily Emission Rate (lb/day) | Hourly Emission Rate (lb/hr) | Annual Emission Rate (tpy) |
|---|---|---|---|---|---|---|---|---|---|
| CTLV1 | Combustion Turbine 1 Lube Oil Vent | VOC | 365 | 0.30 | 7.26 | 1 | 2.18 | 0.091 | 0.40 |
| | | PM | 365 | 0.30 | 7.26 | 1 | 2.18 | 0.091 | 0.40 |
| CTLV2 | Combustion Turbine 2 Lube Oil Vent | VOC | 365 | 0.30 | 7.26 | 1 | 2.18 | 0.091 | 0.40 |
| | | PM | 365 | 0.30 | 7.26 | 1 | 2.18 | 0.091 | 0.40 |

# Table A-9
# Natural Gas Fired Heater Emissions
# Ector County Energy Center

**Assumptions**

| | | |
|---|---|---|
| Maximum Natural Gas Firing Rate | 9 | MMBtu/hr |
| Maximum Natural Gas Firing Rate | 9,179 | scf/hr |
| Annual Operating Schedule | 5,000 | hours/year |
| Natural Gas Max Sulfur Content | 5.0 | gr/100scf |
| Natural Gas Annual Avg Sulfur Content | 5.0 | gr/100scf |

**Calculations**

| Pollutant | Emission Factor | Units | Max Hourly Emission Rate (lb/hr) | Max. Annual Emission Rate (ton/yr) |
|---|---|---|---|---|
| $NO_x$ [1] | 0.153 | lb/MMBtu | 1.38 | 3.44 |
| CO [1] | 0.094 | lb/MMBtu | 0.85 | 2.12 |
| VOC [1] | 0.006 | lb/MMBtu | 0.05 | 0.14 |
| $PM/PM_{10}/PM_{2.5}$ [1] | 0.0060 | lb/MMBtu | 0.05 | 0.14 |
| $SO_2$ [2] | | | 0.13 | 0.33 |

1. Based on manufacturer's specifications (gas heater at Invenergy Cannon Falls)
2. Calculated based on fuel sulfur content and max fuel consumption

Example Calculations

NOx = (9 MMBtu/hr) * (0.153 lb/MMBtu) = 1.38 lb/hr NOx

SO2 = (9179 scf/hr) * (5 gr S/100scf) * (lb/ 7000 gr) * (lbmole S/32 lb S) * (1 lbmole SO2/ 1 lbmole S) * (64 lb SO2/lbmole SO2) = 0.13 lb/hr SO2

| Stack Parameters [1] | | | |
|---|---|---|---|
| Stack diameter (ft) | Exhaust Flow (acfm wet) | Temperature ($^oF$) | Velocity (ft/sec) |
| 1.0 | 3,010.1 | 309 | 63.88 |

**Startup Emissions**

| Pollutant | Max Hourly Emission Rate (lb/hr) [1] |
|---|---|
| $NO_x$ | 1.51 |
| CO | 1.63 |
| VOC | 0.05 |
| $PM/PM_{10}/PM_{2.}$ | 0.05 |
| $SO_2$ | 0.13 |

1. Based on experience for similar units.

**Table A-10**

**Plantwide Natural Gas Fugitive Emissions**

**Ector County Energy Center**

| EPN | Pollutant | Source Type | Fluid State | Count | Oil & Gas Production Emission Factor | VOC (lb/hr) | VOC (tpy) |
|---|---|---|---|---|---|---|---|
| NGFUG | VOC | Valves | Gas/Vapor | 300 | 0.00992 | 0.002 | 0.01 |
| | | Flanges | Gas/Vapor | 1200 | 0.00086 | 0.001 | 0.00 |
| | | Relief Valves | Gas/Vapor | 5 | 0.414 | 0.002 | 0.01 |
| | | Sampling Connections | Gas/Vapor | 10 | 0.033 | 0.000 | 0.00 |
| | | Compressors | Gas/Vapor | 3 | 0.0194 | 0.0000 | 0.0002 |
| | | | | | ***Totals:*** | 0.01 | 0.02 |

*Calculation Procedure*

*Short-Term Emission Rate = Count X Emission Factor*

*Annual Emission Rate = Count X Emission Factor X 8,760 hours/year / 2,000 lbs/ton*

*Note*

*Based on "gas" factors for Oil & Gas Production Operations in TCEQ "Air Permit Guidance for Chemical Sources: Equipment Leak Fugitives". October, 2000. VOC emissions were estimated based on a non-methane, non-ethane weight fraction of natural gas of* *0.08%*

# Table A-11
# Diesel-Fired Equipment Emissions
# Ector County Energy Center

## Firewater Pump

### Assumptions

| | | |
|---|---|---|
| Max. Daily Operating Schedule | 1 | hours/day |
| Ann.Operating Schedule | 100 | hours/year |
| Power Rating | 250 | bhp |
| Maximum Sulfur Content (S) | 500 | ppmw |
| Max Fuel Consumption | 34 | lb/hr |

### Calculations

Emission Rate = Emission Factor * Horsepower * hours of operation / averaging period

| Pollutant | Emission Factor | Units | Max Hourly Emission Rate (lb/hr) | Max. Annual Emission Rate (ton/yr) |
|---|---|---|---|---|
| $NO_x$ [1] | 2.48 | g/hp-hr | 1.36 | 0.07 |
| CO [1] | 1.193 | g/hp-hr | 0.66 | 0.03 |
| VOC [1] | 0.062 | g/hp-hr | 0.034 | 0.0017 |
| $PM/PM_{10}$ [1] | 0.111 | g/hp-hr | 0.061 | 0.0031 |
| $SO_2$ [2] | | | 0.034 | 0.0017 |

1. Manufacturer's specifications
2. Calculated based on maximum fuel sulfur content and max fuel consumption

| Stack Parameters | | | |
|---|---|---|---|
| Stack diameter (ft) | Exhaust Flow (acfm wet) | Temperature ($^oF$) | Velocity (ft/sec) |
| 0.50 | 1061 | 821 | 90.1 |

# Table A-12
# Diesel Fuel Tank Emissions
# Ector County Energy Center

Reference: Compilation of Air Pollutant Emission Factors (AP-42)
5th Edition, January 1995, Section 7.1, Liquid Storage Tanks
Volume I: Stationary Point and Area Sources
U.S. Environmental Protection Agency Office of Air and Radiation, Office of Air Quality Planning and Standards
TNRCC Technical Guidance Package - Storage Tanks - February 2001

**Assumptions:** Firewater Pump Tank is a horizontal fixed roof tank

| | |
|---|---|
| 1 - Horizontal fixed roof tank | |
| 2 - Maximum Fill Rate (gal/hr) | 500 |
| 3 - Tank capacity (gal) | 500 |
| 4 - Maximum annual turnovers= | 10 |
| 5 - Tank diameter (ft) | 4 |
| 6 - Tank length (ft) | 6 |

**Standing Losses from a Fixed Roof Tank ($L_S$):**

**Parameter Input:**

| Tank No. | Tank Name | $M_V$ (lb/lbmol) | $P_A$ (psia) | $P_{VA}$ (psia) | D or Deff (feet) | HVO (feet) | $T_{AX}$ ($^oR$) | $T_{AN}$ ($^oR$) | alpha (unitless) | I (Btu/ft$^2$) | $P_{BP}$ (psig) | $P_{BV}$ (psig) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DSL-TK1 | Firewater Pump Fuel Tank Vent | 130 | 14.70 | 0.01 | 5.53 | 1.57 | 536.57 | 514.67 | 0.17 | 1468.00 | 0.03 | -0.03 |

Deff = effective diameter for horizontal tanks = sqrt((length x diameter)/0.785)
Hvo = One half of actual diameter for horizontal roof tanks.

**Intermediate Calculations:**

| Tank No. | Tank Name | $T_{AA}$ ($^oR$) | $T_B$ ($^oR$) | $T_{LA}$ ($^oR$) | $dT_A$ ($^oR$) | $dP_B$ (psia) | $dT_V$ ($^oR$) | $T_{LX}$ ($^oR$) | $T_{LN}$ ($^oR$) | $P_{VX}$ (psia) | $P_{VN}$ (psia) | $dP_V$ (psia) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DSL-TK1 | Firewater Pump Fuel Tank Vent | 525.62 | 525.64 | 527.6 | 21.9 | 0.06 | 22.8 | 533.3 | 521.9 | 0.0100 | 0.00690 | 0.003 |

**Average Annual Standing Losses ($L_S$):**

| Tank No. | Chemical Name | $V_V$ (ft^3) | $W_V$ (lb/ft^3) | $K_E$ (unitless) | $K_S$ (unitless) | $L_S$ (lb/yr) | $L_S$ (ton/yr) | $L_S$ (lb/hr) |
|---|---|---|---|---|---|---|---|---|
| DSL-TK1 | Diesel | 38 | 0.0002 | 0.041 | 0.999 | 0.11 | 0.00005 | 0.000012 |

**Average Annual Working Losses from a Fixed Roof Tank**

$$L_W = (0.001)(M_V)(P_{VA})(Q)(K_N)(K_P) \quad \text{(Equation 1-29)}$$

Where:

| | |
|---|---|
| $L_W$ = | Storage Tank Working Losses, lb/year |
| $M_V$ = | Molecular Weight of Vapor in Storage Tank, lb/lb-mole |
| $P_{VA}$ = | True Vapor Pressure at Daily Average Liquid Surface Temperature, psia |
| $P_{VAM}$ = | True Vapor Pressure at Daily Maximum Liquid Surface Temperature, psia (used for max. hourly calculations) |
| Q = | Annual Net Throughput, barrels/yr |
| $K_N$ = | Turnover Factor from AP-42 Figure 12.3-6, dimensionless |
| $K_P$ = | Product Factor, dimensionless. Kc equals 1.0 for liquids except crude oil. |

| Tank No. | Chemical Name | $M_V$ (lb/lb-mol) | $P_{VA}$ (psia) | $P_{VAM}$ (psia) | Q (barrels/yr) | $K_N$ (unitless) | $K_P$ (unitless) |
|---|---|---|---|---|---|---|---|
| DSL-TK1 | Diesel | 130.00 | 0.01 | 0.010 | 119 | 1.00 | 1.0 |

**Average Annual and Maximum Annual Working Losses ($L_W$ and $L_{WMAX}$):**

| Tank No. | Chemical Name | $L_W$ (lb/year) | $L_W$ (ton/year) | $L_{WMAX}$* (lb/year) |
|---|---|---|---|---|
| DSL-TK1 | Diesel | 0.13 | 0.0001 | 0.15 |

*$L_{WMAX}$ assumes a $K_N$ value of 1, per TCEQ guidance document dated February 1995.

# Table A-12
# Diesel Fuel Tank Emissions
# Ector County Energy Center

**Maximum Short-Term Working Losses calculated according to the TNRCC Guidance Document dated February 1995:**

$$L_{WMAXH} = ((L_W)(FR_m))/((TO)(TC_g))$$

Where:

| | | |
|---|---|---|
| $L_{WMAXH}$ | = | Maximum Hourly Working Loss, lb/hr |
| $L_{WMAX}$ | = | Maximum Working Losses from AP-42 , lb/year |
| $FR_m$ | = | Maximum Filling Rate, gallons/hour |
| TO | = | Turnovers per Year, dimensionless |
| TCg | = | Tank Working Capacity , gallons |

**Maximum Hourly Working Losses per tank calculated according to the TNRCC ($L_{WMAXH}$):**

| Tank No. | Chemical Name | $L_{WMAX}$ (lb/year) | $FR_m$ (gal/hr) | TO (unitless) | $TC_g$ (gal) | $L_{WMAXH}$ (lb/hr) |
|---|---|---|---|---|---|---|
| DSL-TK1 | Diesel | 0.15 | 500 | 10 | 500 | 0.015 |

**7.1.3.1 Total Losses From Fixed Roof Tanks:**

$$L_T = L_S + L_W \quad \text{(Equation 1-1)}$$

Where:

| | | |
|---|---|---|
| $L_T$ | = | Total losses, lb/yr |
| $L_S$ | = | Standing Storage Losses, lb/yr |
| $L_W$ | = | Working Losses, lb/yr |

| Tank No. | Chemical Name | Maximum Standing Loss ($L_S$) lb/hr | Average Standing Loss ($L_S$) ton/yr | Maximum Working Loss ($L_W$) lb/hr | Average Working Loss ($L_W$) tons/yr | Total Maximum Hourly Emissions ($L_T$) lb/hr | Total Average Annual Emissions ($L_T$) tons/yr |
|---|---|---|---|---|---|---|---|
| DSL-TK1 | Diesel | 0.00001 | 0.0001 | 0.015 | 0.0001 | 0.015 | 0.0001 |

## Table A-13
## NON-INHERENTLY LOW EMITTING MAINTENANCE ACTIVITIES
## Ector County Energy Center

| MSS Activity | Estimated Emissions (lb/hr) | | | | |
|---|---|---|---|---|---|
| | NOx | CO | $SO_2$ | PM | VOC |
| Combustion Turbine Optimization | --- (1) | --- (1) | --- (1) | --- (1) | --- (1) |
| **TOTAL NON-ILE MAINTENANCE EMISSIONS** | --- (1) | --- (1) | | --- (1) | --- (1) |

(1) Emissions associated with this activity are no higher than the maximum hourly emission rate occurring during Startup/Shutdown that are shown in Table A-2, and will be no higher than the annual emission limits requested in the Table 1(a).

# Table A-14
## INHERENTLY LOW EMITTING MAINTENANCE ACTIVITIES
## Ector County Energy Center

| | Calc. Table | Estimated Emissions (lb/hr) | | | | Estimated Emissions (TPY) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | NOx | CO | VOC | PM | NOx | CO | VOC | PM |
| Turbine Compressor Section Washing, Unit Off-Line | A-15 | | | | 0.046 | | | | 0.001 |
| Air Intake Filter Maintenance | A-16 | | | | 0.00048 | | | | 0.00001 |
| High VP VOC Equipment Maintenance | A-17 | | | 0.088 | | | | 0.0011 | |
| Low VP VOC Equipment Maintenance | A-18 | | | 0.070 | | | | 0.0009 | |
| Fuel Gas Venting | A-19 | | | 0.230 | | | | 0.0001 | |
| CEMS QA/QC | A-20 | 0.002 | 0.0011 | | | 0.0003 | 0.0002 | | |
| Storage Tank/Vessel Maintenance (Diesel) | A-21 | | | 1.811 | | | | 0.0009 | |
| Storage Tank/Vessel Maintenance (Lube Oil, Hydraulic Oil) | A-22 | | | | | | | | |
| Storage Tank/Vessel Maintenance (Low VP) | A-23 | | | 0.00002 | | | | 0.0000 | |
| Management of sludge | A-24 | | | 0.009 | | | | 0.002 | |
| Organic Chemical Usage | A-25 | | | 1.875 | | | | 0.770 | |
| Analytical Equipment | A-26 | | | 0.003 | | | | 0.00004 | |
| **Totals =** | | **0.002** | **0.001** | **4.086** | **0.047** | **0.0003** | **0.0002** | **0.775** | **0.001** |

# Table A-15
# Offline Compressor Washing (MSS) Calculations
# Ector County Energy Center

Activity Description:

Off-line compressor water washes are used to remove gross accumulation of air borne contaminants in-between major compressor section maintenance activities. PM emissions result from residual dust material (on the blade) being released through the unit exhaust during the wash.

| | Unit 1 | | |
|---|---|---|---|
| Total Turbine Blade Surface Area | 1700 | $ft^2$ | |
| % of blade covered by dust | 5% | --- | |
| Depth of blade dust | 2.5 | microns | 9.84E-05 in |
| Flue Dust Density | 66.16 | $lb/ft^3$ | |
| Duration of Event | 30 | minutes | |
| # of Events per year | 24 | Monthly for each unit | |
| | | | |
| Blade Dust Calculation | | | |
| Surface Area Covered by Dust | 85 | $ft^2$ | (Total Blade Surface Area) *(% of blade covered by dust) |
| Dust Volume | 6.97E-04 | $ft^3$ | (Dust Surface Area)*((Depth of Dust/12)) |
| Dust (PM) | **0.0461** | lb | (Dust Volume)*(Flue Dust Density) |
| | | | |
| Total PM | | | |
| PM hourly | **0.0461** | lb/event | |
| PM annual | **0.0006** | tpy | |

Notes: 1. Flue Dust Density based on the average of representations at:

| | | |
|---|---|---|
| http://www.powderandbulk.com/resources/bulk_density/material_bulk_density_chart_f.htm | 54 | $lb/ft^3$ |
| http://www.simetric.co.uk/si_materials.htm | 90.48 | $lb/ft^3$ |
| http://www.asiinstr.com/technical/Material_Bulk_Density_Chart_F.htm | 54 | $lb/ft^3$ |

2. Surface area of turbine blades based on assumption of 17 rows of 4' blades.
3. Calculation assumes no TDS in demineralized water.

Calculation Basis: Electric Utility MSS Workgroup.

# Table A-16
# Particulate Filter Changeout (MSS) Emission Calculations
# Ector County Energy Center

Activity description:
Particulate matter may be released to the atmosphere during planned air inlet filter changes on the combustion turbine.
Particulate collects on the filter during unit operation and may become airborne during filter handling.
The emission calculations below represent the worst case emissions that could occur on a "per filter change" basis.

| | | | |
|---|---|---|---|
| **E** | **Emission Factor (lb PM/ton)** | **0.0113** | **Source/Notes/Assumptions** |
| **E** | **Emission Factor (lb PM10/ton)** | **0.00536** | |
| **E** | **Emission Factor (lb PM2.5/ton)** | **0.000811** | |
| $E = k * (0.0032) * \frac{(U/5)^{1.3}}{(M/2)^{1.4}} (lb/ton)$ | | | Based on U.S. EPA AP-42, 13.2.4 "Aggregate Handling and Storage Piles" (Equation 1). |
| U | Mean Wind Speed (mph) | *7.90* | The mean wind speed is from the average windspeed for the Houston, Texas in TANKS 4.09d. |
| M | Material Moisture Content (%) | *1* | Estimate based on process knowledge |
| K (PM) | PM Particle Size Multiplier | *0.74* | Particle size multiplier taken from AP-42, Chapter 13.2.4. |
| K ($PM_{10}$) | $PM_{10}$ Particle Size Multiplier | *0.35* | Particle size multiplier taken from AP-42, Chapter 13.2.4. |
| K ($PM_{2.5}$) | $PM_{2.5}$ Particle Size Multiplier | *0.05* | Particle size multiplier taken from AP-42, Chapter 13.2.4. |
| CE | Control Efficiency | *0%* | Assumed control efficiency |
| - | Filter Surface Area (ft2) | 4,092 | |
| - | Assumed dust thickness before filter casing is opened (mm) | 1 | |
| - | Assumed dust thickness before filter casing is opened (ft) | *0.003281* | |
| - | Assumed dust density (lb/ft3) | 75 | |
| - | Activity Throughput (lb/activity) | 1006.89 | Throughput based on volume of accumulated dust on filter material. |
| - | Activity Throughput (ton/activity) | 0.503 | |
| - | Hourly Throughput (ton/hr) | *0.0420* | Assumed hourly throughput. |
| - | Annual Throughput (tons/yr) | *1.007* | Assumed annual throughput. |

| **Emission Summary** | | **Source/Notes/Assumptions** |
|---|---|---|
| Frequency Routine Maintenance (activity/hr) | **1** | Assume maximum = 1 activity at any time. |
| Frequency Routine Maintenance (activity/yr) | **2** | Two filter changes per gas turbine unit, per year |
| Duration Routine Maintenance (hours/activity) | **12** | Assumed length of each activity |

| | Misc Filter Changeout |
|---|---|
| PM (lb/hr) | 4.75E-04 |
| PM (tpy) | 5.70E-06 |
| PM10 (lb/hr) | 2.25E-04 |
| PM10 (tpy) | 2.70E-06 |
| PM2.5 (lb/hr) | 3.40E-05 |
| PM2.5 (tpy) | 4.08E-07 |

Calculation Basis: Electric Utility MSS Workgroup.

# Table A-17
# Small Equipment and Fugitive Component Repair/Replacement (High VP VOC Service)
# Ector County Energy Center

The emission calculations below represent the worst case emissions that could occur during routine maintenance or a unit turnaround.

**Step 1. Splash Loading Loss Calculation**

| $L_l$ | **Equipment Draining Loading Loss (lb/10$^3$ gal loaded)** | **23.63** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_l = 12.46\left(\frac{SPM_V}{T}\right)$ | | Based on U.S. EPA AP-42, 5.2 "Transportation and Marketing of Petroleum Liquids" (Equation 1). |
| S | Loading Loss Factor | *1.45* | Per U.S. EPA AP-42 Table 5.2-1, based on splash loading per TCEQ Guidance. |
| P | Vapor Pressure of Liquid Loaded (psia) | *11.00* | Based on representative material. |
| $M_V$ | Vapor molecular weight (lb/lb-mole) | *66* | Based on representative material. |
| T | Average daily temperature (ºR) | *555.00* | 95 ºF per TCEQ Guidance. |

| $L_D$ | **Equipment Draining Loading loss (lb/activity)** | **0.01768** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_D = L_l V_t$ | | |
| $L_l$ | Loading Loss (lb/10$^3$ gal loaded) | *23.634* | See calculation above. |
| $V_t$ | Volume of liquid drained (gallon/activity) | *0.75* | Assumed to be 1% of total volume (74.8 gallons) is left in the equipment and drained to pan/enclosed drain |

**Step 2. Evaporative Loss Calculation**

| $L_E$ | **Evaporation Loss (lb/activity)** | **0.00001** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_E = 7920 * A\left(\frac{P_a M_w}{RT}\right)\frac{D_{i,a}}{Z_2 - Z_1}\ln\left[\frac{1}{(1-y_{c1})}\right] * t$ | | Ajay Kumar, N.S. Vatcha, and John Schmelzle, "Estimate Emissions From Atmospheric Releases of Hazardous Substances," Environmental Engineering World, November-December 1996, pages 20-23. |
| A | Vessel opening area (m$^2$) | *0.02* | Opening on a tote (~6 in. dia.) |
| $P_a$ | Atmospheric Pressure (Pa) | *101,325* | |
| $M_W$ | Molecular weight (kg/kgmol) | *66* | Based on a representative material |
| R | Universal Gas Constant (J/°K-kgmol) | *8.314E+03* | |
| T | Temperature (ºK) | *308* | 95 ºF per TCEQ Guidance. |
| $D_{i,a}$ | Diffusivity of component through air (m$^2$/s) | *6.28E-06* | Assumed diffusivity |
| $Z_2$-$Z_1$ | Empty vapor space above liquid level in vessel (m) | *0.15* | Assumed 6 in |
| $y_{c1}$ | Volume fraction of component in air | *0.001* | |
| t | Time vessel remains open to atmosphere | *0.25* | Based on past experience. |

| **Emission Summary** | | **Source/Notes/Assumptions** |
|---|---|---|
| Total Emissions per activity (lb/activity) | **0.02** | Summation of Steps 1 through 2. |
| Frequency Routine Maintenance Activity (activity/hour) | **5** | Based on process knowledge and historical information. |
| Frequency Routine Maintenance Activity (activity/yr) | **130** | Based on process knowledge and historical information. |

| **Total Emissions** | |
|---|---|
| **(lb/hr)** | **(tpy)** |
| 0.09 | 0.00115 |

## Table A-18
## Small Equipment and Fugitive Component Repair/Replacement (Low VP VOC Service)
## Ector County Energy Center

The emission calculations below represent the worst case emissions that could occur during routine maintenance or a unit turnaround.

**Step 1. Clingage Loss Calculation**

| **Lc** | **Clingage Loss (lb/activity)** | **0.014** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_C = A_S \times T_f \times D$ | | |
| $A_s$ | Surface Area (feet) | *3.12* | Conservatively based on clingage loss from final 5 ft of pipe section being worked on. |
| $T_f$ | Clingage Film Thickness (feet) | 8.33E-05 | 95 ºF per TCEQ Guidance. |
| D | Density of Material (lb/feet$^3$) | *54.16* | Based on API Power Regression Analysis for a material with a vapor pressure of 0.5 psia. |

**Step 2. Splash Loading Loss Calculation**

| **$L_l$** | **Equipment Draining Loading Loss (lb/10$^3$ gal loaded)** | **0.04** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_l = 12.46\left(\frac{SPM_V}{T}\right)$ | | Based on U.S. EPA AP-42, 5.2 "Transportation and Marketing of Petroleum Liquids" (Equation 1). |
| S | Loading Loss Factor | *1.45* | Per U.S. EPA AP-42 Table 5.2-1, based on splash loading per TCEQ Guidance. |
| P | Vapor Pressure of Liquid Loaded (psia) | *0.01* | Based on representative material. |
| $M_V$ | Vapor molecular weight (lb/lb-mole) | *130* | Molecular Weight based on API Power Regression Analysis for a material with a vapor pressure of 0.5 psia. |
| T | Average daily temperature (ºR) | *555.00* | 95 ºF per TCEQ Guidance. |

| **$L_D$** | **Equipment Draining Loading loss (lb/activity)** | **0.00010** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_D = L_l V_t$ | | |
| $L_l$ | Loading Loss (lb/10$^3$ gal loaded) | *0.042* | See calculation above. |
| $V_t$ | Volume of liquid drained (gallon/activity) | *2.32* | Assumed to be 1% of total volume (232.4036 gallons) is left in the equipment and drained to pan/enclosed drain |

**Step 3. Evaporative Loss Calculation**

| **$L_E$** | **Evaporation Loss (lb/activity)** | **0.00002** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_E = 7920 * A\left(\frac{P_a M_w}{RT}\right)\frac{D_{i,a}}{Z_2 - Z_1}\ln\left[\frac{1}{(1-y_{c1})}\right] * t$ | | Ajay Kumar, N.S. Vatcha, and John Schmelzle, "Estimate Emissions From Atmospheric Releases of Hazardous Substances," Environmental Engineering World, November-December 1996, pages 20-23. |
| A | Vessel opening area (m$^2$) | *0.02* | Opening on a tote (~6 in. dia.) |
| $P_a$ | Atmospheric Pressure (Pa) | *101,325* | |
| $M_W$ | Molecular weight (kg/kgmol) | *130* | Molecular Weight based on API Power Regression Analysis for a material with a vapor pressure of 0.15 psia. |
| R | Universal Gas Constant (J/°K-kgmol) | *8.314E+03* | |
| T | Temperature (ºK) | *308* | 95 ºF per TCEQ Guidance. |
| $D_{i,a}$ | Diffusivity of component through air (m$^2$/s) | *6.28E-06* | Assumed diffusivity of diesel fuel |
| $Z_2$-$Z_1$ | Empty vapor space above liquid level in vessel (m) | *0.15* | Assumed 6 in |
| $y_{c1}$ | Volume fraction of component in air | *0.001* | |
| t | Time vessel remains open to atmosphere | *0.25* | Based on past experience. |

| **Emission Summary** | | **Source/Notes/Assumptions** |
|---|---|---|
| Total Emissions per activity (lb/activity) | **0.01** | Summation of Steps 1 through 3. |
| Frequency Routine Maintenance Activity (activity/hour) | **5** | Based on process knowledge and historical information. |
| Frequency Routine Maintenance Activity (activity/yr) | **130** | Based on process knowledge and historical information. |

| **Total Emissions** | |
|---|---|
| **(lb/hr)** | **(tpy)** |
| 0.07 | 0.00092 |

## Table A-19
## Gaseous Fuel Venting During Turbine Shutdown/Maintenance & Small Equipment and Fugitive Component Repair/Replacement
## Ector County Energy Center

| Piping Description | | | | Initial Conditions | | | | Final Conditions | | | | Emissions | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Diameter (in) nom. | Diameter (in) act. | Length (ft) | Max Hourly Volume[1] ($ft^3$) | Annual Volume[1] ($ft^3$) | Press. (psig) | Temp. (°F) | Press. (psig) | Temp. (°F) | Max Hourly Volume[2] (scf) | Annual Volume[2] (scf) | Hourly (lb/hr) | Annual (tpy) |
| Fuel Line | 12 | 11.25 | 200 | 138 | 138 | **600** | **50** | 0 | 68 | 6,710 | 6,710 | 0.23 | 0.000 |
| Small Equipment | --- | --- | --- | 0.7 | 6.7 | **50** | **50** | 0 | 68 | 3 | 31 | 0.000 | 5.28E-07 |
| | | | | | | | | | | | Total | 0.23 | 0.000 |

1. Initial volume is calculated by multpilying the crossectional area by the length of pipe using the following formula: $V_i$ = pi * [(diameter in inches/12)/2]$^2$ * length in feet = $ft^3$
2. Final volume calculated using ideal gas law $[(PV/ZT)_i = (PV/ZT)_f]$. $V_f = V_i (P_i/P_f) (T_f/T_i) (Z_f/Z_i)$, where Z is estimated using the following equation: $Z = 0.9994 - 0.0002P + 3E\text{-}08P^2$.
3. Additional Assumptions:

| | | |
|---|---|---|
| Nat Gas MW | 16.70 | lb/lbmol (From Natural Gas Analysis) |
| VOC Content of Nat Gas | 0.08% | by Wt (From Natural Gas Analysis) |

*Example calculation:*

| | | | | | | |
|---|---|---|---|---|---|---|
| 6710 scf / hr | lbmole / 385.5 scf | 16.7 lb Nat Gas / lbmole Nat Gas | 0.0008 lb VOC / lb Nat Gas | = | 0.23 | lb/hr |

Calculation Basis: Electric Utility MSS Workgroup.

# Table A-20
# CEMS Calibration
# Ector County Energy Center

The emission calculations below represent the worst case emissions that could occur during routine maintenance or a unit turnaround.

| Activity | Max Concentration[1] (ppm) | Flow Rate (scfm) | Duration Per Event (min) | Event Frequency (per hr) | Event Frequency (per yr) | Emissions (lb/hr) | Emissions (tpy) |
|---|---|---|---|---|---|---|---|
| $NO_x$ Cal Gas | 1000 | 1 | 15 | 1 | 370 | 0.001792 | 3.31E-04 |
| CO Cal Gas | 1000 | 1 | 15 | 1 | 370 | 0.001091 | 2.02E-04 |

Note:
1. Conservatively based on worst case max cal gas concentrations

Sample Calculation: NOx CEMS Calibration Hourly Emissions
1000 lbmol NOx/1e6 lbmol Gas * 46 lb NOx/lbmol NOx * 1bmol Gas/385.1 scf * 1 scf/min * 15 min/event * 1 events/hr = 0.001792 lb/hr

Calculation Basis: Electric Utility MSS Workgroup.

# Table A-21
# Storage Tank/Vessel Maintenance (Diesel)
# Ector County Energy Center

The emission calculations below represent the worst case emissions that could occur during routine maintenance or a unit turnaround.

**Step 1. Equipment Opening Maintenance Vapor Space Calculation**

| $L_o$ | **Opening Loss (lb/activity)** | **0.01** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_o = M_v\left(\frac{PV}{RT}\right)$ | | Based on the Ideal Gas Law with modification for VOC molecular weight. |
| P | Vapor Pressure of Material (psia) | *0.01* | Based on Vapor Pressure of Distillate Fuel Oil No.2 at Liquid Surface Temperature in TANKS4.09d. |
| V | Vapor space volume (feet$^3$) | *32.22* | Based on worst case equipment vapor space volume of 241 gallons. |
| T | Average daily temperature (ºR) | *555.00* | 95 ºF per TCEQ Guidance. |
| R | Gas constant (psia ft$^3$ per lb-mole ºR) | *10.73* | |
| $M_V$ | Vapor molecular weight (lb/lb-mole) | *130* | Molecular weight for diesel. |

**Step 2. Clingage Loss Calculation**

| Lc | **Clingage Loss (lb/activity)** | **1.81** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_C = A_S \times T_f \times D$ | | |
| $A_s$ | Surface Area (ft$^2$) | *10.39* | Based on an average size of the equipment. |
| $T_f$ | Clingage Film Thickness (feet) | 3.28E-03 | Assumed clingage factor. |
| D | Density of Material (lb/feet$^3$) | *53.12* | Based on density of 7.1 lb/gal for diesel. |

**Step 3. Splash Loading Loss Calculation**

| $L_l$ | **Equipment Draining Loading Loss (lb/10$^3$ gal loaded)** | **0.04** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_l = 12.46\left(\frac{SPM_V}{T}\right)$ | | Based on U.S. EPA AP-42, 5.2 "Transportation and Marketing of Petroleum Liquids" (Equation 1). |
| S | Loading Loss Factor | *1.45* | Per U.S. EPA AP-42 Table 5.2-1, based on splash loading per TCEQ Guidance. |
| P | Vapor Pressure of Liquid Loaded (psia) | *0.01* | Vapor pressure for diesel. |
| $M_V$ | Vapor molecular weight (lb/lb-mole) | *130* | Molecular weight for diesel. |
| T | Average daily temperature (ºR) | *555.00* | 95 ºF per TCEQ Guidance. |

| $L_D$ | **Equipment Draining Loading loss (lb/activity)** | **0.00** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_D = L_l V_t$ | | |
| $L_l$ | Loading Loss (lb/10$^3$ gal loaded) | *0.039* | See calculation above. |
| $V_t$ | Volume of liquid drained (gallon/activity) | *2.41* | Assumed to be 1% of total volume (241 gallons) is left in the equipment and drained to pan/enclosed drain. |

**Step 4. Evaporative Loss Calculation**

| $L_E$ | **Evaporation Loss (lb/activity)** | **0.06** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_E = 4.14*10^{-5} U_s^{0.78} P_v M_w^{0.67} A_p^{0.94} t$ | | Ajay Kumar, N.S. Vatcha, and John Schmelzle, "Estimate Emissions From Atmospheric Releases of Hazardous Substances," Environmental Engineering World, November-December 1996, pages 20-23. |
| $U_s$ | Surface wind speed (m/s) | *4.98* | The surface wind speed is from the average windspeed for the Waco, Texas in TANKS 4.09d. |
| $P_v$ | Vapor pressure of liquid (Pa) | *62.74* | Based on a representative material. |
| $M_W$ | Molecular weight (lb/lbmol) | *130* | Molecular weight for diesel. |
| t | Time that material sits in pan before material is moved to closed to container (hr) | *0.25* | Material is immediately placed in a closed container. |
| $A_P$ | Pool area (m$^2$) | *1.00* | The pool area is conservatively based on one of the larger pan sizes used to drain this equipment. |

| **Emission Summary** | | **Source/Notes/Assumptions** |
|---|---|---|
| Total Emissions per activity (lb/activity) | **1.88** | Summation of Steps 1 through 4. |
| Frequency Routine Maintenance Activity (activity/hour) | **1** | Based on process knowledge and historical information. |
| Frequency Routine Maintenance Activity (activity/yr) | **1** | Based on process knowledge and historical information. |

| **Total Emissions** | |
|---|---|
| **(lb/hr)** | **(tpy)** |
| 1.81 | 0.001 |

## Table A-22
## Storage Tank/Vessel Maintenance (Lube Oil, Hydraulic Oil)
## Ector County Energy Center

The emission calculations below represent the worst case emissions that could occur during routine maintenance or a unit turnaround.

**Step 1. Equipment Opening Maintenance Vapor Space Calculation**

| $L_o$ | **Opening Loss (lb/activity)** | **0.03** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_o = M_v\left(\frac{PV}{RT}\right)$ | | Based on the Ideal Gas Law with modification for VOC molecular weight. |
| P | Vapor Pressure of Material (psia) | *0.0009* | Vapor pressure of lube oil. |
| V | Vapor space volume (feet$^3$) | *1,270.05* | Based on worst case equipment vapor space volume of 9500 gallons. |
| T | Average daily temperature (ºR) | *555.00* | 95 ºF per TCEQ Guidance. |
| R | Gas constant (psia ft$^3$ per lb-mole ºR) | *10.73* | |
| $M_V$ | Vapor molecular weight (lb/lb-mole) | *170* | Molecular weight for lube oil. |

**Step 2. Clingage Loss Calculation**

| Lc | **Clingage Loss (lb/activity)** | **11.37** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_C = A_S \times T_f \times D$ | | |
| $A_s$ | Surface Area (ft$^2$) | *65.24* | Based on an average size of the equipment. |
| $T_f$ | Clingage Film Thickness (feet) | 3.28E-03 | Assumed clingage factor. |
| D | Density of Material (lb/feet$^3$) | *53.12* | Based on density of 7.1 lb/gal for lube oil. |

**Step 3. Splash Loading Loss Calculation**

| $L_l$ | **Equipment Draining Loading Loss (lb/10$^3$ gal loaded)** | **0.01** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_l = 12.46\left(\frac{SPM_V}{T}\right)$ | | Based on U.S. EPA AP-42, 5.2 "Transportation and Marketing of Petroleum Liquids" (Equation 1). |
| S | Loading Loss Factor | *1.45* | Per U.S. EPA AP-42 Table 5.2-1, based on splash loading per TCEQ Guidance. |
| P | Vapor Pressure of Liquid Loaded (psia) | *0.00* | Vapor pressure for lube oil. |
| $M_V$ | Vapor molecular weight (lb/lb-mole) | *170* | Molecular weight for lube oil. |
| T | Average daily temperature (ºR) | *555.00* | 95 ºF per TCEQ Guidance. |

| $L_D$ | **Equipment Draining Loading loss (lb/activity)** | **0.00** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_D = L_l V_t$ | | |
| $L_l$ | Loading Loss (lb/10$^3$ gal loaded) | *0.005* | See calculation above. |
| $V_t$ | Volume of liquid drained (gallon/activity) | *95* | Assumed to be 1% of total volume (9500 gallons) is left in the equipment and drained to pan/enclosed drain. |

**Step 4. Evaporative Loss Calculation**

| $L_E$ | **Evaporation Loss (lb/activity)** | **0.01** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_E = 4.14*10^{-5} U_s^{0.78} P_v M_w^{0.67} A_p^{0.94} t$ | | Ajay Kumar, N.S. Vatcha, and John Schmelzle, "Estimate Emissions From Atmospheric Releases of Hazardous Substances," Environmental Engineering World, November-December 1996, pages 20-23. |
| $U_s$ | Surface wind speed (m/s) | *4.98* | The surface wind speed is from the average windspeed for the Waco, Texas in TANKS 4.09d. |
| $P_v$ | Vapor pressure of liquid (Pa) | *6.27* | Based on a representative material. |
| $M_W$ | Molecular weight (lb/lbmol) | *170* | Molecular weight for lube oil. |
| t | Time that material sits in pan before material is moved to closed to container (hr) | *0.25* | Material is immediately placed in a closed container. |
| $A_P$ | Pool area (m$^2$) | *1.00* | The pool area is conservatively based on one of the larger pan sizes used to drain this equipment. |

| **Emission Summary** | | **Source/Notes/Assumptions** |
|---|---|---|
| Total Emissions per activity (lb/activity) | **11.41** | Summation of Steps 1 through 4. |
| Frequency Routine Maintenance Activity (activity/hour) | **1** | Based on process knowledge and historical information. |
| Frequency Routine Maintenance Activity (activity/yr) | **4** | Based on process knowledge and historical information. |

| **Total VOC Emissions** | |
|---|---|
| **(lb/hr)** | **(tpy)** |
| 11.37 | 0.02 |

# Table A-23
# Storage Tank/Vessel Maintenance (Low vapor pressure compounds)
# Ector County Energy Center

The emission calculations below represent the worst case emissions that could occur during routine maintenance or a unit turnaround. The calculations are given with 98% sulfuric acid as a worst case. Emissions of other materials (bleach, scale inhibitor, etc.) are expected to be less.

**Step 1. Equipment Opening Maintenance Vapor Space Calculation**

| $L_o$ | **Opening Loss (lb/activity)** | **0.0000** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_o = M_v\left(\frac{PV}{RT}\right)$ | | Based on the Ideal Gas Law with modification for molecular weight. |
| P | Vapor Pressure of Material (psia) | *0.000001* | Vapor pressure of sulfuric acid. |
| V | Vapor space volume (feet$^3$) | *1,336.90* | Based on worst case equipment vapor space volume of 10000 gallons. |
| T | Average daily temperature (ºR) | *555.00* | 95 ºF per TCEQ Guidance. |
| R | Gas constant (psia ft$^3$ per lb-mole ºR) | *10.73* | |
| $M_V$ | Vapor molecular weight (lb/lb-mole) | *98.00* | Molecular weight for sulfuric acid. |

**Step 2. Splash Loading Loss Calculation**

| $L_l$ | **Equipment Draining Loading Loss (lb/10$^3$ gal loaded)** | **0.0000** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_l = 12.46\left(\frac{SPM_V}{T}\right)$ | | Based on U.S. EPA AP-42, 5.2 "Transportation and Marketing of Petroleum Liquids" (Equation 1). |
| S | Loading Loss Factor | *1.45* | Per U.S. EPA AP-42 Table 5.2-1, based on splash loading per TCEQ Guidance |
| P | Vapor Pressure of Liquid Loaded (psia) | *0.000001* | Vapor pressure of sulfuric acid. |
| $M_V$ | Vapor molecular weight (lb/lb-mole) | *98.00* | Molecular weight for sulfuric acid. |
| T | Average daily temperature (ºR) | *555.00* | 95 ºF per TCEQ Guidance. |

| $L_D$ | **Equipment Draining Loading loss (lb/activity)** | **0.0000** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_D = L_l V_t$ | | |
| $L_l$ | Loading Loss (lb/10$^3$ gal loaded) | *0.00000* | See calculation above. |
| $V_t$ | Volume of liquid drained (gallon/activity) | *100.00* | Assumed to be 1% of total volume (10000 gallons) is left in the equipment and drained to pan/enclosed drain. |

**Step 3. Evaporative Loss Calculation**

| $L_E$ | **Evaporation Loss (lb/activity)** | **0.00002** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | $L_E = 4.14*10^{-5} U_s^{0.78} P_v M_w^{0.67} A_p^{0.94} t$ | | Ajay Kumar, N.S. Vatcha, and John Schmelzle, "Estimate Emissions From Atmospheric Releases of Hazardous Substances," Environmental Engineering World, November-December 1996, pages 20-23. |
| $U_s$ | Surface wind speed (m/s) | *4.98* | The surface wind speed is from the average windspeed for the Waco, Texas in TANKS 4.09d. |
| $P_v$ | Vapor pressure of liquid (Pa) | *0.007* | Based on a representative material. |
| $M_W$ | Molecular weight (lb/lbmol) | *98* | Vapor pressure of sulfuric acid. |
| t | Time that material sits in pan before material is moved to closed to container (hr) | *1.0* | Material is immediately placed in a closed container. |
| $A_P$ | Pool area (m$^2$) | *1.0* | The pool area is conservatively based on one of the larger pan sizes used to drain this equipment. |

| **Emission Summary** | | **Source/Notes/Assumptions** |
|---|---|---|
| Total Emissions per activity (lb/activity) | **0.00004** | Summation of Steps 1 through 3. |
| Frequency Routine Maintenance Activity (activity/hour) | **1** | Based on process knowledge and historical information. |
| Frequency Routine Maintenance Activity (activity/yr) | **1** | Based on process knowledge and historical information. |

| **Total VOC Emissions** | |
|---|---|
| **(lb/hr)** | **(tpy)** |
| 0.00002 | 0.000000 |

# Table A-24
# Management of sludge
# Ector County Energy Center

The emission calculations below represent the worst case emissions that could occur during routine maintenance or a unit turnaround. For calculation purposes, sludge management via vacuum truck was considered, but emissions from an open pit are provided as more conservative.

**Activity 1. Sludge/Sediment Management from pits, ponds, sumps, and water conveyances including cooling tower, plant drains lift station, and transformer pit**

| Description | Worst-Case VOC Concentration (ppmw) | Sludge Density [1] ($lb/ft^3$) | Worst-Case Annual Volume of Sludge Removed ($yd^3$) | Worst-Case Monthly Volume of Sludge Removed ($yd^3$) | Annual Total Mass of Sludge Removed (lb/yr) | Hourly Total Mass of Sludge Removed [2] (lb/hr) | VOC (lb/hr) | VOC (tpy) |
|---|---|---|---|---|---|---|---|---|
| Sludge/Sediment Management | 5.00 | 45.01 | 545.00 | 56.00 | 662,322 | 1,701 | 0.009 | 0.002 |

Notes:
1 - Engineering Estimate.
2 - Assumes worst-case monthly volume of sludge removed in one 40-hour week.

Sample Calculations:
Annual Emissions (ton/yr) = Total Mass of Sludge (lbs/yr) x VOC Concentration (ppmw) / 1,000,000 / 2000 lb/ton
= (662322.15 lbs/yr) * (5 ppmw) / 1,000,000 / 2000 lbs/ton = 0.002 tpy
Hourly Emissions (lb/hr) = Total Mass of Sludge (lbs/hr) x VOC Concentration (ppmw) / 1,000,000
= (1701.378 lbs/hr) * (5 ppmw) / 1,000,000 = 0.01 lb/hr

# Table A-25

## Organic Chemical Usage, not covered by "Manual Surface Coating or Solvent Cleaning Operations" (Gas Fired EGU)

## Ector County Energy Center

| Organic Chemical Usage [1] | |
|---|---|
| **oz/hr** | **oz/yr** |
| 30.00 | 41076.25 |

| | |
|---|---|
| **Worst-case VOC Weight %(Short-term)** | 100 |
| **Average VOC Weight % (Annual)** | 60 |

| Organic Chemical Usage Emissions | | |
|---|---|---|
| **Pollutant** | **Maximum Hourly Emission Rate (lb/hr)** | **Annual Emissions (tpy)** |
| VOC | 1.88 | 0.77 |

[1] Oz/hr is based on 150 oz averaged over 5 hours and oz/yr is based on expected usage.

# Table A-26
## Inspection, Repair, Replacement, Adjusting, Testing, and Calibration of Analytical Equipment, Process Instruments Including Sight Glasses, Meters, Gauges
## Ector County Energy Center

The emission calculations below represent the worst case emissions that could occur during routine maintenance or a unit turnaround.

**Step 1. Clingage Loss Calculation**

| **Lc** | **Clingage Loss (lb/activity)** | **0.00135** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | | | |
| $A_s$ | Surface Area (feet) | *0.31* | Based on an average size of the equipment. |
| $T_f$ | Clingage Film Thickness (feet) | 8.33E-05 | 95 ºF per TCEQ Guidance. |
| D | Density of Material (lb/feet$^3$) | *52.46* | Based on API Power Regression Analysis for a material with a vapor pressure of 0.15 psia. |

**Step 2. Splash Loading Loss Calculation**

| **$L_l$** | **Equipment Draining Loading Loss (lb/10$^3$ gal loaded)** | **0.493** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | | | Based on U.S. EPA AP-42, 5.2 "Transportation and Marketing of Petroleum Liquids" (Equation 1). |
| S | Loading Loss Factor | *1.45* | Per U.S. EPA AP-42 Table 5.2-1, based on splash loading per TCEQ Guidance. |
| P | Vapor Pressure of Liquid Loaded (psia) | *0.15* | Based on representative material. |
| $M_V$ | Vapor molecular weight (lb/lb-mole) | *103* | Molecular Weight based on API Power Regression Analysis for a material with a vapor pressure of 0.15 psia. |
| T | Average daily temperature (ºR) | *555.00* | 95 ºF per TCEQ Guidance. |

| **$L_D$** | **Equipment Draining Loading loss (lb/activity)** | **1.11E-07** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | | | |
| $L_l$ | Loading Loss (lb/10$^3$ gal loaded) | *0.493* | See calculation above. |
| $V_t$ | Volume of liquid drained (gallon/activity) | *0.0002* | Assumed to be 1% of total volume (0.02244 gallons) is left in the equipment and drained to pan/enclosed drain. |

**Step 3. Evaporative Loss Calculation**

| **$L_E$** | **Evaporation Loss (lb/activity)** | **0.000386** | **Source/Notes/Assumptions** |
|---|---|---|---|
| | | | Ajay Kumar, N.S. Vatcha, and John Schmelzle, "Estimate Emissions From Atmospheric Releases of Hazardous Substances," Environmental Engineering World, November-December 1996, pages 20-23. |
| A | Vessel opening area (m$^2$) | *0.07* | Area for a 5 gal bucket (~11.75 in. dia.) |
| $P_a$ | Atmospheric Pressure (Pa) | *101,325* | |
| $M_W$ | Molecular weight (kg/kgmol) | *103* | Molecular Weight based on API Power Regression Analysis for a material with a vapor pressure of 0.15 psia. |
| R | Universal Gas Constant (J/°K-kgmol) | *8314* | |
| T | Temperature (ºK) | *308* | 95 ºF per TCEQ Guidance. |
| $D_{i,a}$ | Diffusivity of component through air (m$^2$/s) | *6.28E-06* | Assumed diffusivity of diesel fuel |
| $Z_2$-$Z_1$ | Empty vapor space above liquid level in vessel (m) | *0.37* | Assumed 5 gal bucket (14.5 in) |
| $y_{c1}$ | Volume fraction of component in air | *0.010* | |
| t | Time that material sits in pan before removed by vacuum truck (hr) | *0.25* | Based on past experience. |

| **Emission Summary** | | **Source/Notes/Assumptions** |
|---|---|---|
| Total Emissions per activity (lb/activity) | **0.00174** | Summation of Steps 1 through 3. |
| Frequency Routine Maintenance Activity (activity/hour) | **2** | Based on process knowledge and historical information. |
| Frequency Routine Maintenance Activity (activity/yr) | **50** | Based on process knowledge and historical information. |

| **Total VOC Emissions** | |
|---|---|
| **(lb/hr)** | **(tpy)** |
| 0.00271 | 4.35E-05 |

Calculation Basis: Electric Utility MSS Workgroup.

# APPENDIX B
# BACT SUPPORT DOCUMENTS

## RBLC LISTING OF VOC EMISSION LIMITS FOR GAS-FIRED SIMPLE CYCLE COMBUSTION TURBINES

| Company-Facility | Make/Model & No. of SC Units | Unit Size (MMBtu/hr) | Allowed Operation (hr/yr) | County/ Parish | State | Permit No. | Permit Date | VOC Limit (ppmv) | VOC Limit (lb/hr) | Basis | Controls & Control Eff. | Comments Regarding Limits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black Hills Power-Cheyenne Prairie | GE LM6000 (3) | 40 MW | | Laramie | WY | CT-12636 | 8/28/12 | 3.0 | 3.0 | BACT-PSD | OC | ppmv is @15% $O_2$, 3-hr avg.; lb/hr is 3-hr avg. |
| Entergy Gulf States LA-Calcasieu | (2) | 1900 | | Calcasieu | LA | PSD-LA-746 | 12/21/2011 | 3.0 | 7.0 | BACT-PSD | DLN | ppmvd is @15% $O_2$; lb/hr is hourly max. |
| Sabine Pass LNG-Liquefaction Terminal | GE LM2500 (16) | 286 | | Cameron | LA | PSD-LA-703(M3) | 12/6/11 | - | 0.66 | BACT-PSD | GCP/NG | lb/hr is hourly max. |
| | GE LM2500 (2) | 286 | | | | | | - | 0.66 | BACT-PSD | GCP/NG | lb/hr is hourly max. |
| PSEG Fossil-Kearny | GE LM6000 (6) | 485 | 2978 | Hudson | NJ | 12200-BOP100002 | 10/27/10 | 4.0 | 2.33 | Other* | OC/GCP/NG (90%) | ppmvd is @15% $O_2$ - stack test; lb/hr - stack test |
| Southern Power-Dahlberg | (4) | 190 | | Jackson | GA | 4911-157-0034-V-04-1 | 5/14/10 | 5.0 | - | BACT-PSD | GCP | ppm is @15% $O_2$, 3-hr avg. |
| El Cajon Energy-El Cajon | | 49.95 MW | | San Diego | CA | 987824 | 12/11/09 | 2.0 | - | BACT-PSD* | OC | ppmv, 1-hr basis |
| Dayton Power & Light-Dayton | (4) | 1,115.2 | 3,755 | Montgomery | OH | P0104867 | 12/3/09 | - | 4.0 | BACT-PSD | - | - |
| Bayonne Energy Center-Bayonne | RR Trent 60WLE (8) | 603 | 4,748 (NG) | Hudson | NJ | 12863-BOP080001 | 9/24/09 | 2.5 | 1.93 | LAER* | OC/CF (90%) | ppmvd is @15% $O_2$ |
| Bosque Power-Bosque County | (2) | 170 MW | 8,760 | Bosque | TX | 40620 | 2/27/09 | 4.0 | - | BACT-PSD | GCP | ppmvd, rolling 3-hr basis |
| Orange Grove Project | | 49.8 MW | | San Diego | CA | 985708 | 12/4/08 | 2.0 | - | BACT-PSD* | OC | ppm, 1-hr basis |
| Escondido Energy Center | | 46.5 MW | | San Diego | CA | 985693 | 7/2/08 | 2.0 | - | BACT-PSD* | OC | ppmv is @15% $O_2$, 1-hr basis |
| Creole Trail LNG-Import Terminal | (4) | 290 | | Cameron | LA | PSD-LA-714 | 8/15/07 | - | 1.21 | BACT-PSD | GCP | lb/hr is hourly max. |
| Progress Energy Florida-Bartow | SGT6-5000F | 1,972 | | Pinellas | FL | PSD-FL-381 | 1/26/07 | 1.2 | - | BACT-PSD | GCP | ppmvd is @15% O2 |

** Note: Project located in an ozone nonattainment area*

**RBLC LISTING OF CO EMISSION LIMITS FOR GAS-FIRED SIMPLE CYCLE COMBUSTION TURBINES**

| Company-Facility | Make/Model & No. of SC Units | Unit Size (MMBtu/hr) | Allowed Operation (hr/yr) | County/ Parish | State | Permit No. | Permit Date | CO Limit (ppmv) | CO Limit (lb/hr) | Basis | Controls & Control Eff. | Comments Regarding Limits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black Hills Power-Cheyenne Prairie | GE LM6000 (3) | 40 MW | | Laramie | WY | CT-12636 | 8/28/12 | 6.0 | 5.6 | BACT-PSD | OC | ppmv is @15% $O_2$, 1-hr basis; lb/hr is 30-day rolling |
| Entergy Gulf States LA-Calcasieu | (2) | 1900 | | Calcasieu | LA | PSD-LA-746 | 12/21/2011 | 15.0 | 781.0 | BACT-PSD | DLN | ppmvd is @15% $O_2$; lb/hr is hourly max. |
| Sabine Pass LNG-Liquefaction Terminal | GE LM2500 (16) | 286 | | Cameron | LA | PSD-LA-703(M3) | 12/6/11 | 58.4 | 43.6 | BACT-PSD | GCP/NG | ppmv is @15% $O_2$; lb/hr is hourly max. |
| | GE LM2500 (2) | 286 | | | | | | 25.0 | 17.46 | BACT-PSD | GCP/NG | ppmv is @15% $O_2$; lb/hr is hourly max. |
| Southwestern Public Service-Cunningham | | | | Lea | NM | PSD-NM-622-M3 | 5/2/11 | - | 77.2 | BACT-PSD | GCP | lb/hr is hourly max. |
| PSEG Fossil-Kearny | GE LM6000 (6) | 485 | 2978 | Hudson | NJ | 12200-BOP100002 | 10/27/10 | 5.0 | 5.35 | Other | OC/GCP/NG (90%) | ppmvd is @15% $O_2$, 3-hr rolling avg.; lb/hr, stack test |
| Vineland Municipal EU-Howard Down | RR Trent 60 | 590 | 8,760 | Cumberland | NJ | 75507-BOP090003 | 9/16/10 | 5.0 | 6.4 | Other | CO/NG (90%) | ppmvd is @15% $O_2$, 3-hr rolling avg.; lb/hr, 3-hr rolling avg. |
| Southern Power-Dahlberg | (4) | 190 | | Jackson | GA | 4911-157-0034-V-04-1 | 5/14/10 | 9.0 | - | BACT-PSD | GCP | ppm is @15% $O_2$, 3-hr avg. |
| Dayton Power & Light-Dayton | (4) | 1,115.2 | 3,755 | Montgomery | OH | P0104867 | 12/3/09 | 20.0 | 301.0 | BACT-PSD | Eff. Comb. Tech. | ppmvd is @15% $O_2$, 1-hr basis |
| Bayonne Energy Center-Bayonne | RR Trent 60WLE (8) | 603 | 4,748 (NG) | Hudson | NJ | 12863-BOP080001 | 9/24/09 | 5.0 | - | Other | OC/CF (90%) | ppmvd is @15% $O_2$ |
| Jacksonville Electric Authority-Greenland | (2) | 1,806 | 3,500 | Duval | FL | PSD-FL-401 | 3/10/09 | 4.1 | 16.2 | BACT-PSD | GCP | ppmvd is @15% $O_2$, 24-hr block basis; lb/hr, stack test |
| Bosque Power-Bosque County | (2) | 170 MW | 8,760 | Bosque | TX | 40620 | 2/27/09 | 9.0 | - | BACT-PSD | GCP | ppmvd is @15% $O_2$, rolling 3-hr basis |
| Shady Hills Power-Shady Hills | GE 7FA (3) | 170 MW | | Pasco | FL | PSD-FL-402 | 1/12/09 | 6.5 | 21.5 | BACT-PSD | - | ppmvd is @15% $O_2$; lb/hr, stack test |
| Great River Energy-Elk River | | 2,169 | | Sherburne | MN | 14100003-004 | 7/1/08 | 4.0 | - | BACT-PSD | GCP | ppm, 4-hr rolling basis @ loads $\geq$70% |
| Western Farmers Electric Coop-Anadarko | GE LM6000 (3) | 462.7 | 2,500 | Caddo | OK | 2005-037-C(M-2) | 6/13/08 | 63.0 | 65.5 | BACT-PSD | GCP | ppmvd is @15% $O_2$ |
| Creole Trail LNG-Import Terminal | (4) | 290 | | Cameron | LA | PSD-LA-714 | 8/15/07 | 25.0 | 17.8 | BACT-PSD | DLN | ppmvd is @15% O2; lb/hr is hourly max. |
| Public Service of Oklahoma-Jenks | | | | Tulsa | OK | 2003-360-C M-1 PSD | 3/22/07 | - | 59.0 | BACT-PSD | GCP | |
| Progress Energy Florida-Bartow | SGT6-5000F | 1,972 | | Pinellas | FL | PSD-FL-381 | 1/26/07 | 4.1 | - | BACT-PSD | GCP | ppmvd is @15% O2 |

**RBLC LISTING OF NOx EMISSION LIMITS FOR GAS-FIRED SIMPLE CYCLE COMBUSTION TURBINES**

| Company-Facility | Make/Model & No. of SC Units | Unit Size (MMBtu/hr) | Allowed Operation (hr/yr) | County/ Parish | State | Permit No. | Permit Date | NOX Limit (ppmv) | NOX Limit (lb/hr) | Basis | Controls & Control Eff. | Comments Regarding Limits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black Hills Power-Cheyenne Prairie | GE LM6000 (3) | 40 MW | 8,760 | Laramie | WY | CT-12636 | 8/28/12 | 5.0 | 7.7 | BACT-PSD | SCR | ppmv is @15% $O_2$, 1-hr basis; lb/hr is 30-day rolling |
| Entergy Gulf States LA-Calcasieu | (2) | 1900 | | Calcasieu | LA | PSD-LA-746 | 12/21/11 | 17.5 | 240.0 | BACT-PSD | DLN | ppmvd is @15% $O_2$; lb/hr is hourly max. |
| Sabine Pass LNG-Liquefaction Terminal | GE LM2500 (16) | 286 | | Cameron | LA | PSD-LA-703(M3) | 12/6/11 | 20.0 | 22.9 | BACT-PSD | WI | ppmv is @15% $O_2$; lb/hr is hourly max. |
| | GE LM2500 (2) | 286 | | | | | | 25.0 | 28.68 | BACT-PSD | WI | ppmv is @15% $O_2$; lb/hr is hourly max. |
| Southwestern Public Service-Cunningham | | | | Lea | NM | PSD-NM-622-M3 | 5/2/11 | 21.0 | - | BACT-PSD | DLN/GCP | ppmvd is @15% $O_2$, 1-hr basis |
| PSEG Fossil-Kearny | GE LM6000 (6) | 485 | 2,978 | Hudson | NJ | 12200-BOP100002 | 10/27/10 | 2.5 | 4.39 | Other* | SCR/NG (90%) | ppmvd is @15% $O_2$, 3-hr rolling avg.; lb/hr, stack test |
| Vineland Municipal EU-Howard Down | Trent 60 | 590 | 8,760 | Cumberland | NJ | 75507-BOP090003 | 9/16/10 | 2.5 | 5.4 | Other* | SCR/WI/NG (90%) | ppmvd is @15% $O_2$, 3-hr rolling avg.; lb/hr, 3-hr rolling avg. |
| Southern Power-Dahlberg | (4) | 190 | | Jackson | GA | 4911-157-0034-V-04-1 | 5/14/10 | 9.0 | - | BACT-PSD | DLN | ppm is @15% $O_2$, 3-hr avg. |
| El Cajon Energy-El Cajon | | 49.95 MW | | San Diego | CA | 987824 | 12/11/09 | 2.5 | - | BACT-PSD* | SCR/WI | ppmv, 1-hr basis |
| Dayton Power & Light-Dayton | (4) | 1,115.2 | 3,755 | Montgomery | OH | P0104867 | 12/3/09 | 15.0 | 161.0 | BACT-PSD | DLN | ppmvd is @15% $O_2$, 1-hr basis |
| Bayonne Energy Center-Bayonne | RR Trent 60WLE (8) | 603 | 4,748 (NG) | Hudson | NJ | 12863-BOP080001 | 9/24/09 | 2.5 | - | LAER* | SCR/WLEC (90%) | ppmvd is @15% $O_2$ |
| Jacksonville Electric Authority-Greenland | (2) | 1,806 | 3,500 | Duval | FL | PSD-FL-401 | 3/10/09 | 9.0 | 58.5 | BACT-PSD | DLN/WI | ppmvd is @15% $O_2$, 24-hr block basis; lb/hr, stack test |
| Bosque Power-Bosque County | (2) | 170 MW | 8,760 | Bosque | TX | 40620 | 2/27/09 | 9.0 | - | BACT-PSD | DLN | ppmvd is @15% $O_2$, 24-hr basis |
| Shady Hills Power-Shady Hills | GE 7FA (3) | 170 MW | | Pasco | FL | PSD-FL-402 | 1/12/09 | 9.0 | 59.0 | BACT-PSD | DLN | ppmvd is @15% $O_2$, 24-hr block basis; lb/hr, stack test |
| Orange Grove Project | | 49.8 MW | | San Diego | CA | 985708 | 12/4/08 | 2.5 | - | BACT-PSD* | SCR/WI | ppm, 1-hr basis |
| Escondido Energy Center | | 46.5 MW | | San Diego | CA | 985693 | 7/2/08 | 2.5 | - | BACT-PSD* | SCR/WI | ppmv is @15% $O_2$, 1-hr basis |
| Great River Energy-Elk River | | 2,169 | | Sherburne | MN | 14100003-004 | 7/1/08 | 9.0 | - | BACT-PSD | DLN | ppm, 4-hr rolling basis @ loads $\geq$60% |
| Western Farmers Electric Coop-Anadarko | GE LM6000 (3) | 462.7 | 2,500 | Caddo | OK | 2005-037-C M-2 PSD | 6/13/08 | 25.0 | 42.0 | BACT-PSD | WI | ppmvd is @15% $O_2$ |
| Platte River Power Authority-Rawhide | GE 7FA | 1,400 | | Larimer | CO | 07LR0017 | 8/31/07 | 9.0 | - | BACT-PSD | DLN | ppmvd is @15% $O_2$, 3-hr rolling avg. |
| Creole Trail LNG-Import Terminal | (4) | 290 | | Cameron | LA | PSD-LA-714 | 8/15/07 | 25.0 | 29.0 | BACT-PSD | DLN | ppmvd is @15% O2; lb/hr is hourly max. |
| Public Service of Oklahoma-Jenks | | | | Tulsa | OK | 2003-360-C M-1 PSD | 3/22/07 | 9.0 | - | BACT-PSD | DLN | ppmvd is @15% $O_2$ |
| Progress Energy Florida-Bartow | SGT6-5000F | 1,972 | | Pinellas | FL | PSD-FL-381 | 1/26/07 | 15.0 | - | BACT-PSD | DLN/WI | ppmvd uncorrected, 4-hr basis |

*Project located in an ozone nonattainment area