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May 1, 2014

Mr. Brad Toups
U.S. EPA Region 6, 6PD
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RE: Pinecrest Energy Center, LLC
Update to Application PSD-TX-1298-GHG
Lufkin, Angelina County, Texas

Dear Mr. Toups:

Pinecrest Energy Center is hereby submitting an update to pending greenhouse gas (GHG) Prevention of Significant Deterioration (PSD) air quality permit application PSD-TX-1298-GHG.

Included in Attachment A are updated GHG Emission Calculation Tables 3-1, 3-2, 3-3, 3-4, 3-5, 3-6, 3-7, 3-8, 3-9, 3-10, 3-11, and 3-12 which incorporate the revised Global Warming Potentials, as published in the November 29, 2013 amendment to the Mandatory Greenhouse Gas Reporting Rules, 40 CFR Part 98. Also included in Attachment A are updated Best Available Control Technology Tables 5-1, 5-2, 5-3 which incorporate the revised Global Warming Potentials.

In response to your question about why a different GE turbine model is being considered for Pinecrest Energy Center than for La Paloma Energy Center, the GE 7FA.05 combustion turbine has an approximate 12% higher generation capacity over the GE 7FA.04 model which was consistent with the business plan for the Pinecrest project.

Pinecrest Energy is providing the following supplemental information under **Section 5.1.1, Step 1: Identify All Available Control Technologies**, of the GHG application submitted February 28, 2013.

5.1.1.3 Solar Augmentation

In Concentrating Solar Power (CSP) generation, solar radiation is concentrated and the thermal energy is captured and used to heat water and generate steam. This steam can be introduced into the steam turbine and the energy converted to electricity. In the combined cycle power plant, this steam, when available, can be introduced directly into the same steam system that drives the steam turbine and generate additional electric power and contribute to the thermal efficiency of the facility.

CSP technology is currently in various stages of development, construction, and operation. The Central Receiver, or Power Tower, technology is a common application of CSP for utility scale generation. This system uses an array of mirrors, or heliostats, that track the movement of the sun to concentrate the solar radiation on a single receiver, or collector. The energy is absorbed in a heat transfer fluid that is then transferred to the feed water for steam generation. The Linear Concentrator, or Solar Trough, is another method of CSP. Similar to the power tower, an array of mirrors is constructed and tracks the sun's path to concentrate the energy, however the mirrors are a parabolic shape and arranged in a linear fashion. The parabolic shape focuses the sun's radiation onto an absorption tube that rotates with the mirror and spans the length of the mirror. As the heat transfer fluid, typically oil or molten salt, is pumped through the system of absorption tubes, the energy is delivered to the steam system and associated energy conversion equipment.

A less common CSP technology that is used in the United States is the Linear Fresnel Reflector. This system utilizes a series of smaller, flat mirrors arranged in linear fashion that pivot to focus the sun's radiation onto a stationary absorption tube. The Fresnel assemblies are also constructed in an array that is sized to achieve the required generation capacity.

Pinecrest Energy is providing the following supplemental information under **Section 5.1.2 Step 2: Eliminate Technically Infeasible Options** of the GHG application.

CSP generation has been implemented in the United States on a utility scale where the technology lends itself to use. A primary impediment to CSP technology, and solar technology in general, is the tremendous land requirements. According to a study prepared by the National Renewable Energy Laboratory (NREL), the amount of land required to generate 1 MW of capacity is approximately 10 acres. This data is gathered from installations that are primarily in the desert regions of California, Nevada and Arizona where the solar radiation intensity is the highest for any region in the United States.

Property limitations and the poor Direct Normal Solar Insolation data for east Texas eliminate solar augmentation as a feasible technology for the Pinecrest Energy Center. Included in Attachment B is a map showing Concentrating Solar Resource of the United States. As shown on the map, the Pinecrest Energy Center will be located in an area with a relatively low solar radiation intensity potential (4.0 – 4.5 $kWh/m^2/day$). The property that Pinecrest has been able to obtain for this project is 83.82 acres of which 23 acres has been restricted for area drainage use by agreement with the City of Lufkin (the area currently has drainage and detention facilities for the adjacent industrial park developed by the City of Lufkin). Of the remaining 60 acres, 10 acres will be required for the installation of the transmission interconnect facilities and approximately 40 acres will be required to construct the power generation equipment, water treatment equipment,

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and administration building. From the remaining acreage, there is less than 10 acres that could be dedicated to the construction of a thermal solar field. Based on the NREL data, solar augmentation would likely contribute less than 0.1% of than the total generation capacity of the Pinecrest Energy Center.

Should you have any questions regarding this response, please contact me by email at lmoon@zephyrenv.com or by telephone at 512-879-6619 or Ms. Kathleen Smith at ksmith@coronado-ventures.com or by telephone at 281-253-4385.

Sincerely,
ZEPHYR ENVIRONMENTAL CORPORATION

Larry A. Moon, P.E.
Principal

Enclosures

cc: Ms. Kathleen Smith, Coronado Ventures

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ATTACHMENT A

zephyr

Table 3-1
Plantwide GHG Emission Summary
Pinecrest Energy Center

Name	EPN	Normal Operation CO_2 Emissions ton/yr	Normal Operation CH_4 Emissions ton/yr	Normal Operation N_2O Emissions ton/yr	Normal Operation SF_6 Emissions ton/yr	Startup CO_2 Emissions ton/yr	Startup CH_4 Emissions ton/yr	Startup N_2O Emissions ton/yr	Total GHG Mass Emissions ton/yr	Normal Operation CO_2e ton/yr	Startup CO_2e ton/yr	Total CO_2e ton/yr
Unit 1 (GE F7FA.05)	U1-STK	1,404,550	26.0	2.6		41,636	0.77	0.077	1,446,216	1,405,975	41,678	1,447,653.13
Unit 2 (GE F7FA.05)	U2-STK	1,404,550	26.0	2.6		41,636	0.77	0.077	1,446,216	1,405,975	41,678	1,447,653.13
Unit 1 (Siemens SGT6-5000F(4))	U1-STK	1,356,622	25.1	2.5		41,805	0.78	0.078	1,398,455	1,357,998	41,847	1,399,845.33
Unit 2 (Siemens SGT6-5000F(4))	U2-STK	1,356,622	25.1	2.5		41,805	0.78	0.078	1,398,455	1,357,998	41,847	1,399,845.33
Unit 1 (Siemens SGT6-5000F(5))	U1-STK	1,526,837	28.3	2.8		42,432	0.79	0.079	1,569,300	1,528,385	42,475	1,570,860.06
Unit 2 (Siemens SGT6-5000F(5))	U2-STK	1,526,837	28.3	2.8		42,432	0.79	0.079	1,569,300	1,528,385	42,475	1,570,860.06
Auxiliary Boiler	AUXBLR	7,680	0.14	0.01					7,680	7,687		7,687.47
Natural Gas Fugitives	NG-FUG	0.81	20.27						21	508		507.51
Gas Venting	TRB-MSS	0.0043	0.1060						0.11	3		2.65
Emergency Generator	EMGEN1-STK	64.3	0.0026	0.0005					64	65		64.55
Fire Water Pump	FWP1-STK	27.7	0.0011	0.0002					28	28		27.83
SF_6 Insulated Equipment	SF6-FUG				0.001				0.001	23		22.80
Sitewide Emissions[1]		3,061,446	77.0	5.7	0.001	84,863	1.6	0.16	3,146,393	3,065,083	84,950	3,065,083

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Table 3-2

GHG Annual Emission Calculations - GE F7FA.05 Combined Cycle Combustion Turbines

Pinecrest Energy Center

GHG Emissions Contribution From Natural Gas Fired Combustion Turbines

EPN	Average Heat Input[1] (MMBtu/hr)	Annual Heat Input[2] (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[3]	GHG Mass Emissions[4] (tpy)	Global Warming Potential[5]	CO_2e (tpy)
U1-STK (GE F7FA)	2,861	23,634,263	CO_2		1,404,550.5	1	1,404,550.5
			CH_4	1.0E-03	26.0	25	649.9
			N_2O	1.0E-04	2.6	298	774.7
				Totals	**1,404,579.1**		**1,405,975.1**
U2-STK (GE F7FA)	2,861	23,634,263	CO_2		1,404,550.5	1	1,404,550.5
			CH_4	1.0E-03	26.0	25	649.9
			N_2O	1.0E-04	2.6	298	774.7
				Totals	***1,404,579.1***		**1,405,975.1**
Total for 2 Turbines					***2,809,158.1***		***2,811,950.3***

Note

1. *The average heat input for the GE F7FA scenario is based on the HHV heat input at 100% load, with maximum duct firing, at 69 ^oF ambient temperature.*
2. *Annual heat input based on 8,260 hours per year operation.*
3. *CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

4. *CO_2 emissions based on 40 CFR Part 75, Appendix G, Equation G-4*

$W_{CO2} = (Fc \times H \times U_f \times MW_{CO2})/2000$

W_{CO2} = CO_2 emitted from combustion, tons/yr

Fc = Carbon based F-factor,1040 scf/MMBtu

H = Heat Input (MMBtu/yr)

U_f = 1/385 scf CO_2/lbmole at 14.7 psia and 68 ^oF

MW_{CO2} = Molecule weight of CO_2, 44.0 lb/lbmole

5. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

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Table 3-3
Startup GHG Emission Calculations - GE F7FA.05 Turbines
Pinecrest Energy Center

Startup/Shutdown GHG Emissions From GE F7FA Turbine

EPN	Heat Input During Startup[1] (MMBtu/hr)	Annual Heat Input During Startup[2] (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[3]	GHG Mass Emissions[4] (ton/yr)	Global Warming Potential[5]	CO_2e (ton/yr)
U1-STK	1,401.2	700,600.0	CO_2		41,636	1	41,636
			CH_4	1.0E-03	0.7723	25	19.3
			N_2O	1.0E-04	0.0772	298	23.0
					41,636.5		41,678
U2-STK	1,401.2	700,600.0	CO_2		41,636	1	41,636
			CH_4	1.0E-03	0.7723	25	19.3
			N_2O	1.0E-04	0.0772	298	23.0
					41,636.5		41,678

Note

1. *The following hourly firing rates Information is from Table A-3, in Appendix A of the PSD application submitted to TCEQ on 06/22/2012.*

	Operating Mode	CTG Data Case Number	Turbine Heat Input MMBtu/hr	Duct Burner Heat Input MMBtu/hr	Total Hourly Heat Input MMBtu/hr
Maximum Hourly Heat Input During Startup	48% Load, 15 °F Ambient, no Duct Burner Firing	13	1,401.2	0	1,401.2

2. *Based on 500 hours per year of startups.*
3. *CH_4* and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.
4. *CO_2 emissions based on 40 CFR Part 75, Appendix G, Equation G-4*

W_{CO2} = (Fc x H x U_f X MW_{CO2})/2000

W_{CO2} = CO_2 emitted from combustion, tons/hr

Fc = Carbon based F-factor,1040 scf/MMBtu

H = Heat Input (MMBtu/hr)

U_f = 1/385 scf CO_2/lbmole at 14.7 psia and 68 ^oF

MW_{CO2} = Molecule weight of CO_2, 44.0 lb/lbmole

5. *Global Warming Potential factors from Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

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Table 3-4

GHG Annual Emission Calculations - Siemens SGT6-5000F(4) Combined Cycle Combustion Turbines

Pinecrest Energy Center

EPN	Average Heat Input[1] (MMBtu/hr)	Annual Heat Input[2] (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[3]	GHG Mass Emissions[4] (tpy)	Global Warming Potential[5]	CO_2e (tpy)
U1-STK (Siemens SGT6-5000F(4))	2,764	22,827,773	CO_2		1,356,622.0	1	1,356,622.0
			CH_4	1.0E-03	25.1	25	627.8
			N_2O	1.0E-04	2.5	298	748.3
				Totals	**1,356,649.6**		**1,357,998.0**
U2-STK (Siemens SGT6-5000F(4))	2,764	22,827,773	CO_2		1,356,622.0	1	1,356,622.0
			CH_4	1.0E-03	25.1	25	627.8
			N_2O	1.0E-04	2.5	298	748.3
				Totals	***1,356,649.6***		**1,357,998.0**
Total for 2 Turbines					***2,713,299.1***		***2,715,996.0***

Note

1. *The average heat input for the Siemens scenarios are based on the HHV heat input at 100% load, with maximum duct firing, at 59 °F ambient temperature.*
2. *Annual heat input based on 8,260 hours per year operation.*
3. *CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

4. *CO_2 emissions based on 40 CFR Part 75, Appendix G, Equation G-4*

W_{CO2} = (Fc x H x U_f X MW_{CO2})/2000

W_{CO2} = CO_2 emitted from combustion, tons/yr

Fc = Carbon based F-factor,1040 scf/MMBtu

H = Heat Input (MMBtu/yr)

U_f = 1/385 scf CO_2/lbmole at 14.7 psia and 68 °F

MW_{CO2} = Molecule weight of CO_2, 44.0 lb/lbmole

5. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

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Table 3-5
Startup GHG Emission Calculations - Siemens SGT6-5000F(4) Turbines
Pinecrest Energy Center

Startup/Shutdown GHG Emissions From Siemens SGT6-5000F(4)

EPN	Heat Input During Startup[1] (MMBtu/hr)	Heat Input During Startup[2] (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[3]	GHG Mass Emissions[4] (ton/hr)	Global Warming Potential[5]	CO_2e (ton/hr)
U1-STK	1,406.9	703,446.6	CO_2		41,805	1	41,805
			CH_4	1.0E-03	0.7754	25	19.3854
			N_2O	1.0E-04	0.0775	298	23.1074
				Totals	**41,806**		**41,847**
U2-STK	1,406.9	703,446.6	CO_2		41,805	1	41,805
			CH_4	1.0E-03	0.7754	25	19.3854
			N_2O	1.0E-04	0.0775	298	23.1074
				Totals	**41,806**		**41,847**

Note

1. *The following hourly firing rates Information is from Table A-3, in Appendix A of the PSD application submitted to TCEQ on 06/22/2012.*

	Operating Mode	CTG Data Case Number	Turbine Heat Input MMBtu/hr	Duct Burner Heat Input MMBtu/hr	Total Hourly Heat Input MMBtu/hr
Maximum Hourly Heat Input During Startup	50% Load, 10 °F Ambient, no Duct Burner Firing	13	1,406.9	0	1,406.9

2. *Based on 500 hours per year of startup.*
3. *CH_4* and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.
4. *CO_2 emissions based on 40 CFR Part 75, Appendix G, Equation G-4*

$W_{CO2} = (Fc \times H \times U_f \times MW_{CO2})/2000$

W_{CO2} = CO_2 emitted from combustion, tons/hr

Fc = Carbon based F-factor,1040 scf/MMBtu

H = Heat Input (MMBtu/hr)

U_f = 1/385 scf CO_2/lbmole at 14.7 psia and 68 ^oF

MW_{CO2} = Molecule weight of CO_2, 44.0 lb/lbmole

5. *Global Warming Potential factors from Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

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Table 3-6

GHG Emission Calculations - Siemens SGT6-5000F(5) Combined Cycle Combustion Turbines

Pinecrest Energy Center

EPN	Average Heat Input[1] (MMBtu/hr)	Annual Heat Input[2] (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[3]	GHG Mass Emissions[4] (tpy)	Global Warming Potential[5]	CO_2e (tpy)
U1-STK (Siemens SGT6-5000F(5))	3,110	25,691,961	CO_2		1,526,836.5	1	1,526,836.5
			CH_4	1.0E-03	28.3	25	706.5
			N_2O	1.0E-04	2.8	298	842.2
				Totals	**1,526,867.6**		**1,528,385.3**
U2-STK (Siemens SGT6-5000F(5))	3,110	25,691,961	CO_2		1,526,836.5	1	1,526,836.5
			CH_4	1.0E-03	28.3	25	706.5
			N_2O	1.0E-04	2.8	298	842.2
				Totals	***1,526,867.6***		**1,528,385.3**
Total for 2 Turbines					***3,053,735.3***		***3,056,770.5***

Note

1. *The average heat input for the Siemens scenarios are based on the HHV heat input at 100% load, with maximum duct firing, at 59 ^oF ambient temperature.*
2. *Annual heat input based on 8,260 hours per year operation.*
3. *CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

4. *CO_2 emissions based on 40 CFR Part 75, Appendix G, Equation G-4*

W_{CO2} = (Fc x H x U_f X MW_{CO2})/2000

W_{CO2} = CO_2 emitted from combustion, tons/yr

Fc = Carbon based F-factor,1040 scf/MMBtu

H = Heat Input (MMBtu/yr)

U_f = 1/385 scf CO_2/lbmole at 14.7 psia and 68 ^oF

MW_{CO2} = Molecule weight of CO_2, 44.0 lb/lbmole

5. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

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Table 3-7
Startup GHG Emission Calculations - Siemens SGT6-5000F(5) Turbines
Pinecrest Energy Center

Startup/Shutdown GHG Emissions From Siemens SGT6-5000F(5)

EPN	Heat Input During Startup[1] (MMBtu/hr)	Annual Heat Input During Startup[2] (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[3]	GHG Mass Emissions[4] (ton/hr)	Global Warming Potential[5]	CO_2e (ton/hr)
U1-STK	1,428.0	713,994.5	CO_2		42,432	1	42,432
			CH_4	1.0E-03	0.7870	25	19.6761
			N_2O	1.0E-04	0.0787	298	23.4539
				Totals	**42,433**		**42,475**
U2-STK	1,428.0	713,994.5	CO_2		42,432	1	42,432
			CH_4	1.0E-03	0.7870	25	19.6761
			N_2O	1.0E-04	0.0787	298	23.4539
				Totals	**42,433**		**42,475**

Note

1. *The following hourly firing rates Information is from Table A-3, in Appendix A of the PSD application submitted to TCEQ on 06/22/2012.*

	Operating Mode	CTG Data Case Number	Turbine Heat Input MMBtu/hr	Duct Burner Heat Input MMBtu/hr	Total Hourly Heat Input MMBtu/hr
Maximum Hourly Heat Input During Startup	50% Load, 10 °F Ambient, no Duct Burner Firing	15	1,428.0	0	1,428.0

2. *Based on 500 hours per year of startups.*
3. CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.
4. *CO_2 emissions based on 40 CFR Part 75, Appendix G, Equation G-4*

W_{CO2} = (Fc x H x U_f X MW_{CO2})/2000

W_{CO2} = CO_2 emitted from combustion, tons/hr

Fc = Carbon based F-factor,1040 scf/MMBtu

H = Heat Input (MMBtu/hr)

U_f = 1/385 scf CO_2/lbmole at 14.7 psia and 68 ^oF

MW_{CO2} = Molecule weight of CO_2, 44.0 lb/lbmole

5. *Global Warming Potential factors from Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

Table 3-8
GHG Emission Calculations - Auxilliary Boiler
Pinecrest Energy Center

GHG Potential To Emit Emissions From Natural Gas Fired Auxilliary Boiler

EPN	Maximum Heat Input[1] (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[2]	GHG Mass Emissions (tpy)	Global Warming Potential[3]	CO_2e (tpy)
AUXBLR	131,400	CO_2	53.02	7,679.53	1	7,679.5
		CH_4	1.0E-03	0.14	25	3.6
		N_2O	1.0E-04	0.01	298	4.3
			Totals	**7,679.7**		**7,687.5**

Note

1. *Annual fuel use and heating value of natural gas from Table A-10 State/PSD air permit application*
2. *Factors based on Table C-1 and C-2 of 40 CFR Part 98, Mandatory Greenhouse Gas Reporting.*
3. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

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Table 3-9
GHG Emission Calculations - Natural Gas Piping
Pinecrest Energy Center

GHG Emissions Contribution From Fugitive Natural Gas Piping Components

EPN	Source Type	Fluid State	Count	Emission Factor[1] scf/hr/comp	CO_2[2] (tpy)	Methane[3] (tpy)	Total (tpy)
NG-FUG	Valves	Gas/Vapor	600	0.121	0.51	12.73	
	Flanges	Gas/Vapor	2400	0.017	0.29	7.15	
	Relief Valves	Gas/Vapor	5	0.193	0.007	0.17	
	Sampling Connections	Gas/Vapor	10	0.031	0.0022	0.054	
	Compressors	Gas/Vapor	3	0.30	0.006332	0.1578	
GHG Mass-Based Emissions					0.81	20.27	***21.1***
Global Warming Potential[4]					1	25	
CO_2e Emissions					0.81	506.7	***507.5***

Note

1. *Emission factors from Table W-1A of 40 CFR 98 Mandatory Greenhouse Gas Reporting included in the August 3, 2012 Technical Corrections*
2. *CO_2 emissions based on vol% of CO_2 in natural gas* *1.41%*
3. *CH_4 emissions based on vol% of CH_4 in natural gas* *96.10%*
4. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

Example calculation:

600 valves	0.123 scf gas	0.0141 scf CO2	lbmole	44 lb CO_2	8760 hr	ton =	0.51 ton/yr
	hr * valve	scf gas	385 scf	lbmole	yr	2000 lb	

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TABLE 3-10

Gaseous Fuel Venting During Turbine Shutdown/Maintenance and Small Equipment and Fugitive Component Repair/Replacement Pinecrest Energy Center

	Initial Conditions			Final Conditions			CO_2[3]	CH_4[4]	Total
Location	Volume[1] (ft^3)	Press. (psig)	Temp. (°F)	Press. (psig)	Temp. (°F)	Volume[2] (scf)	Annual (tpy)	Annual (tpy)	Annual (tpy)
Turbine Fuel Line Shutdown/Maintenance	1,146	**50**	**50**	0	68	5,277	0.0042	0.11	
Small Equipment/Fugitive Component Repair/Replacement	6.7	**50**	**50**	0	68	31	0.00002	0.00061	
GHG Mass-Based Emissions							0.0043	0.1060	0.11
Global Warming Potential[5]							1	25	
CO_2e Emissions							0.0043	2.6	2.7

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. *CO_2 emissions based on vol% of CO_2 in natural gas* — 1.41% from natural gas analysis
4. *CH_4 emissions based on vol% of CH_4 in natural gas* — 96.1% from natural gas analysis
5. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

Example calculation:

5277 scf Nat Gas	0.014 scf CO2	lbmole	44 lb CO_2	ton =	=	0.0042	ton/yr CO_2
yr	scf Nat Gas	385 scf	lbmole	2000 lb			

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Table 3-11

GHG Emission Calculations - Emergency Engines

Pinecrest Energy Center

GHG Emissions Contribution From Diesel Combustion In Emergency Engines

Assumptions	**Generator**	**Fire Water Pump**	
Ann.Operating Schedule	100	100	hours/year
Power Rating	1,072	500	hp
Max Fuel Combustion	57.3	24.7	gal/hr
Heating Value of No. 2 Fuel Oil[1]	0.138	0.138	MMBtu/gal
Max Hourly Heat Input	7.9	3.4	MMBtu/hr
Annual Heat Input	790.7	340.9	MMBtu/yr

EPN	**Heat Input** (MMBtu/yr)	**Pollutant**	**Emission Factor** (kg/MMBtu)[2]	**GHG Mass Emissions** (tpy)	**Global Warming Potential**[3]	**CO_2e** (tpy)
EMGEN1-STK	790.7	CO_2	73.96	64.3	1	64.3
		CH_4	3.0E-03	0.0026	25	0.1
		N_2O	6.0E-04	0.0005	298	0.2
				64.33		**64.6**
FWP1-STK	340.9	CO_2	73.96	27.7	1	27.7
		CH_4	3.0E-03	0.0011	25	0.0
		N_2O	6.0E-04	0.0002	298	0.1
			Totals	***27.73***		**27.8**

Calculation Procedure

Annual Emission Rate = annual heat Input X Emission Factor X 2.2 lbs/kg X Global Warming Potential / 2,000 lbs/ton

Note

1. *Default high heat value based on Table C-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*
2. *GHG factors based on Tables C-1 and C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*
3. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

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Table 3-12

GHG Emission Calculations - Electrical Equipment Insulated With SF_6

Pinecrest Energy Center

Assumptions

Insulated circuit breaker SF_6 capacity	400	lb
Estimated annual SF_6 leak rate	0.5%	by weight
Estimated annual SF_6 mass emission rate	0.001	ton/yr
Global Warming Potential[1]	22,800	
Estimated annual CO_2e emission rate	22.8	ton/yr

Note

1. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

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Table 5-1
GHG Emission Calculations - Calculation of Design Heat Rate Limit for GE 7FA.05
Pinecrest Energy Center

	Net Output	Gross Output	
Base Net Heat Rate	**6,675.5**	**6534.6**	**Btu/kWH (HHV) (Without Duct Firing)**
	3.3%	**3.3%**	**Design Margin**
	6.0%	**6.0%**	**Performance Margin**
	3.0%	**3.0%**	**Degradation Margin**
Calculated Base Heat Rate with Compliance Margins	**7528.8**	**7369.9**	**Btu/kWH (HHV) (Without Duct Firing)**

Calculation of lb CO2e/MWhr Heat Rate Limit Without Duct Burner Firing

EPN	Base Heat Rate (Btu/kWhr)	Electrical Output Basis	Heat Input Required to Produce 1 MW (MMBtu/MWhr)	Pollutant	Emission Factor (kg/MMBtu)[1]	lb GHG/MWhr[2]	Global Warming Potential[3]	lb CO_2e/MWhr[4]
CTG/HRSG3	7528.8	Net	7.53	CO_2		894.852	1	894.852
				CH_4	1.0E-03	1.66E-02	25	4.15E-01
				N_2O	1.0E-04	1.66E-03	298	4.95E-01
						894.9		**895.8**
CTG/HRSG3	7369.9	Gross	7.37	CO_2		875.970	1	875.970
				CH_4	1.0E-03	1.62E-02	25	4.06E-01
				N_2O	1.0E-04	1.62E-03	298	4.84E-01
					Totals	**876.0**		**876.9**

	Net Output	Gross Output	
Base Net Heat Rate	**7,249.3**	**7026.8**	**Btu/kWH (HHV) (With Duct Firing)**
	3.3%	**3.3%**	**Design Margin**
	6.0%	**6.0%**	**Performance Margin**
	3.0%	**3.0%**	**Degradation Margin**
Calculated Base Heat Rate with Compliance Margins	**8176.0**	**7925.0**	**Btu/kWH (HHV) (With Duct Firing)**

Calculation of lb CO2e/MWhr Heat Rate Limit With Duct Burner Firing

EPN	Base Heat Rate (Btu/kWhr)	Electrical Output Basis	Heat Input Required to Produce 1 MW (MMBtu/MWhr)	Pollutant	Emission Factor (kg/MMBtu)[1]	lb GHG/MWhr[2]	Global Warming Potential[3]	lb CO_2e/MWhr[4]
CTG/HRSG3	8176.0	Net	8.18	CO_2		971.778	1	971.778
				CH_4	1.0E-03	1.80E-02	25	4.51E-01
				N_2O	1.0E-04	1.80E-03	298	5.37E-01
						971.8		**972.8**
CTG/HRSG3	7925.0	Gross	7.92	CO_2		941.942	1	941.942
				CH_4	1.0E-03	1.75E-02	25	4.37E-01
				N_2O	1.0E-04	1.75E-03	298	5.21E-01
					Totals	**942.0**		**942.9**

Note

1. *CH_4* and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.
2. *CO_2 emissions based on 40 CFR Part 75, Appendix G, Equation G-4*

W_{CO2} = (Fc x H x U_f X MW_{CO2})/2000
W_{CO2} = CO_2 emitted from combustion, tons/yr
Fc = Carbon based F-factor,1040 scf/MMBtu
H = Heat Input (MMBtu/yr)
U_f = 1/385 scf CO_2/lbmole at 14.7 psia and 68 ^oF
MW_{CO2} = Molecule weight of CO_2, 44.0 lb/lbmole

3. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*
4. *Example calculation: GHG emissions (lbs) x Global Warming Potential / 1 MW = lb CO2e/MWhr*

Table 5-2
GHG Emission Calculations - Calculation of Design Heat Rate Limit for SGT6-5000F(4)
Pinecrest Energy Center

	Net Output	Gross Output	
Base Net Heat Rate	**6,782.0**	**6615.5**	**Btu/kWH (HHV) (Without Duct Firing)**
	3.3%	**3.3%**	**Design Margin**
	6.0%	**6.0%**	**Performance Margin**
	3.0%	**3.0%**	**Degradation Margin**
Calculated Base Heat Rate with Compliance Margins	**7649.0**	**7461.2**	**Btu/kWH (HHV) (Without Duct Firing)**

Calculation of lb CO2e/MWhr Heat Rate Limit Without Duct Burner Firing

EPN	Base Heat Rate (Btu/kWhr)	Electrical Output Basis	Heat Input Required to Produce 1 MW (MMBtu/MWhr)	Pollutant	Emission Factor (kg/MMBtu)[1]	lb GHG/MWhr[2]	Global Warming Potential[3]	lb CO_2e/MWhr[4]
CTG/HRSG3	7649.0	Net	7.65	CO_2		909.136	1	909.136
				CH_4	1.0E-03	1.69E-02	25	4.22E-01
				N_2O	1.0E-04	1.69E-03	298	5.03E-01
						909.2		**910.1**
CTG/HRSG3	7461.2	Gross	7.46	CO_2		886.817	1	886.817
				CH_4	1.0E-03	1.64E-02	25	4.11E-01
				N_2O	1.0E-04	1.64E-03	298	4.90E-01
					Totals	**886.8**		**887.7**

	Net Output	Gross Output	
Base Net Heat Rate	**7,045.1**	**6782.0**	**Btu/kWH (HHV) (With Duct Firing)**
	3.3%	**3.3%**	**Design Margin**
	6.0%	**6.0%**	**Performance Margin**
	3.0%	**3.0%**	**Degradation Margin**
Calculated Base Heat Rate with Compliance Margins	**7945.7**	**7649.0**	**Btu/kWH (HHV) (With Duct Firing)**

Calculation of lb CO2e/MWhr Heat Rate Limit With Duct Burner Firing

EPN	Base Heat Rate (Btu/kWhr)	Electrical Output Basis	Heat Input Required to Produce 1 MW (MMBtu/MWhr)	Pollutant	Emission Factor (kg/MMBtu)[1]	lb GHG/MWhr[2]	Global Warming Potential[3]	lb CO_2e/MWhr[4]
CTG/HRSG3	7945.7	Net	7.95	CO_2		944.400	1	944.400
				CH_4	1.0E-03	1.75E-02	25	4.38E-01
				N_2O	1.0E-04	1.75E-03	298	5.22E-01
						944.4		**945.4**
CTG/HRSG3	7649.0	Gross	7.65	CO_2		909.136	1	909.136
				CH_4	1.0E-03	1.69E-02	25	4.22E-01
				N_2O	1.0E-04	1.69E-03	298	5.03E-01
					Totals	**909.2**		**910.1**

Note

1. CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.
2. *CO_2 emissions based on 40 CFR Part 75, Appendix G, Equation G-4*

$W_{CO2} = (Fc \times H \times U_f \times MW_{CO2})/2000$

W_{CO2} = CO_2 emitted from combustion, tons/yr

Fc = Carbon based F-factor,1040 scf/MMBtu

H = Heat Input (MMBtu/yr)

U_f = 1/385 scf CO_2/lbmole at 14.7 psia and 68 ^oF

MW_{CO2} = Molecule weight of CO_2, 44.0 lb/lbmole

3. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*
4. *Example calculation: GHG emissions (lbs) x Global Warming Potential / 1 MW = lb CO2e/MWhr*

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Table 5-3
GHG Emission Calculations - Calculation of Design Heat Rate Limit for SGT6-5000F(5)
Pinecrest Energy Center

	Net Output	Gross Output	
Base Net Heat Rate	**6,890.8**	**6582.2**	**Btu/kWH (HHV) (Without Duct Firing)**
	3.3%	**3.3%**	**Design Margin**
	6.0%	**6.0%**	**Performance Margin**
	3.0%	**3.0%**	**Degradation Margin**
Calculated Base Heat Rate with Compliance Margins	**7771.7**	**7423.6**	**Btu/kWH (HHV) (Without Duct Firing)**

Calculation of lb CO2e/MWhr Heat Rate Limit Without Duct Burner Firing

EPN	Base Heat Rate (Btu/kWhr)	Electrical Output Basis	Heat Input Required to Produce 1 MW (MMBtu/MWhr)	Pollutant	Emission Factor (kg/MMBtu)[1]	lb GHG/MWhr[2]	Global Warming Potential[3]	lb CO_2e/MWhr[4]
CTG/HRSG3	7771.7	Net	7.77	CO_2		923.718	1	923.718
				CH_4	1.0E-03	1.71E-02	25	4.28E-01
				N_2O	1.0E-04	1.71E-03	298	5.11E-01
						923.7		**924.7**
CTG/HRSG3	7423.6	Gross	7.42	CO_2		882.353	1	882.353
				CH_4	1.0E-03	1.64E-02	25	4.09E-01
				N_2O	1.0E-04	1.64E-03	298	4.88E-01
					Totals	**882.4**		**883.2**

	Net Output	Gross Output	
Base Net Heat Rate	**7,203.8**	**6808.7**	**Btu/kWH (HHV) (With Duct Firing)**
	3.3%	**3.3%**	**Design Margin**
	6.0%	**6.0%**	**Performance Margin**
	3.0%	**3.0%**	**Degradation Margin**
Calculated Base Heat Rate with Compliance Margins	**8124.7**	**7679.0**	**Btu/kWH (HHV) (With Duct Firing)**

Calculation of lb CO2e/MWhr Heat Rate Limit With Duct Burner Firing

EPN	Base Heat Rate (Btu/kWhr)	Electrical Output Basis	Heat Input Required to Produce 1 MW (MMBtu/MWhr)	Pollutant	Emission Factor (kg/MMBtu)[1]	lb GHG/MWhr[2]	Global Warming Potential[3]	lb CO_2e/MWhr[4]
CTG/HRSG3	8124.7	Net	8.12	CO_2		965.678	1	965.678
				CH_4	1.0E-03	1.79E-02	25	4.48E-01
				N_2O	1.0E-04	1.79E-03	298	5.34E-01
						965.7		**966.7**
CTG/HRSG3	7679.0	Gross	7.68	CO_2		912.707	1	912.707
				CH_4	1.0E-03	1.69E-02	25	4.23E-01
				N_2O	1.0E-04	1.69E-03	298	5.04E-01
					Totals	**912.7**		**913.6**

Note

1. CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.
2. *CO_2 emissions based on 40 CFR Part 75, Appendix G, Equation G-4*

W_{CO2} = (Fc x H x U_f X MW_{CO2})/2000

W_{CO2} = CO_2 emitted from combustion, tons/yr

Fc = Carbon based F-factor,1040 scf/MMBtu

H = Heat Input (MMBtu/yr)

U_f = 1/385 scf CO_2/lbmole at 14.7 psia and 68 ^oF

MW_{CO2} = Molecule weight of CO_2, 44.0 lb/lbmole

3. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*
4. *Example calculation: GHG emissions (lbs) x Global Warming Potential / 1 MW = lb CO2e/MWhr*

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ATTACHMENT B

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