COOPER UNIVERSITY HOSPITAL (50078)
PCP220001

Date: 5/2/2023

New Jersey Department of Environmental Protection
Reason for Application

Permit Being Modified

Permit Class: **Number:** 0

Description of Modifications: Cooper is submitting this Preconstruction Permit Application (Application) for the following:

1. Cooper operates an existing Combined Heat and Power (CHP) unit consisting of a natural gas-fired turbine and duct burner which are permitted as E1 and E2, respectively, of emissions unit U1 under General Permit No. GEN170002 (General Permit). The General Permit is a GP-021 for CHP Combustion Turbine(s), which has been discontinued by the New Jersey Department of Environmental Protection (NJDEP) as of April 6, 2020. Cooper submitted an Application on 12/6/2022 in order to obtain an operating certificate for the CHP unit prior to the expiration of the General Permit on January 3, 2023. After receipt of the application, the permit was extended by the NJDEP for 6 months. Cooper received comments on the application on 12/27/2022, and is submitting this revised application to address those comments.

2. Cooper is proposing a federally enforceable annual fuel throughput limit of 521.74 million cubic feet per year (MMcf/yr) of natural gas for the CHP unit.

COOPER UNIVERSITY HOSPITAL (50078)
PCP220001

New Jersey Department of Environmental Protection
Facility Profile (General)

Facility Name (AIMS): Cooper University Hospital

Facility ID (AIMS): 50078

Street Address: 1 COOPER PLZ
CAMDEN, NJ 08103

Mailing Address: 1 COOPER PLZ
CAMDEN, NJ 08103

State Plane Coordinates:

X-Coordinate:	490,072
Y-Coordinate:	4,421,212
Units:	Meters
Datum:	
Source Org.:	Address Match
Source Type:	Approx. Addr. Match

County: Camden

Location Description: Take I-95 S to Market St. in Camden; take Exit 5B from I-676.

Industry:

Primary SIC:	
Secondary SIC:	
NAICS:	622110

New Jersey Department of Environmental Protection
Facility Profile (General)

Contact Type: **Air Permit Information Contact**

Organization: Cooper University Hospital
Org. Type: Hospital
Name: Frank Meade
NJ EIN:
Title: Chief Engineer
Phone: (856) 342-2000 x
Fax: ( ) - x
Other: ( ) - x
Type:
Email: meade-frank@cooperhealth.edu
Mailing Address: 1 Cooper PLZ
Camden, NJ 08103

Contact Type: **Consultant**

Organization: ALL4 LLC
Org. Type: LLC
Name: Paul Mallon
NJ EIN:
Title: Managing Consultant
Phone: (215) 391-4696 x
Fax: ( ) - x
Other: ( ) - x
Type:
Email: pmallon@all4inc.com
Mailing Address: 1601 Cherry Street
Suite 800
Philadelphia, PA 19102

Contact Type: **Fees/Billing Contact**

Organization: Cooper University Hospital
Org. Type: Hospital
Name: Frank Meade
NJ EIN:
Title: Chief Engineer
Phone: (856) 342-2000 x
Fax: ( ) - x
Other: ( ) - x
Type:
Email: meade-frank@cooperhealth.edu
Mailing Address: 1 Cooper PLZ
Camden, NJ 08103

COOPER UNIVERSITY HOSPITAL (50078)
PCP220001

New Jersey Department of Environmental Protection
Facility Profile (General)

Contact Type: **Responsible Official**

Organization: Cooper University Hospital
Org. Type: Hospital

Name: Robert Hockel
NJ EIN:

Title: SR VP Hospital Operations

Phone: (856) 342-2000 x
Fax: ( ) - x
Other: ( ) - x
Type:
Email: hockel-robert@cooperhealth.edu

Mailing Address: 1 Cooper PLZ
Camden, NJ 08103

COOPER UNIVERSITY HOSPITAL (50078) Date: 5/2/2023

PCP220001

New Jersey Department of Environmental Protection
Equipment Inventory

Equip. NJID	Facility's Designation	Equipment Description	Equipment Type	Certificate Number	Install Date	Grand-Fathered	Last Mod. (Since 1968)	Equip. Set ID
E1102	Turbine	Turbine	Combustion Turbine	GEN170002	10/1/2018	No		
E1103	Burner	Duct Burner	Duct Burner	GEN170002	10/1/2018	No		

50078 COOPER UNIVERSITY HOSPITAL PCP220001 E1102 (Combustion Turbine)
Print Date: 5/2/2023

Make:	Caterpillar		
Manufacturer:	Solar Turbines		
Model:	Mercury 50-6400R		
Maximum rated Gross Heat Input (MMBtu/hr-HHV):	48.70		
Type of Turbine:	Industrial		
Type of Cycle:	Cogeneration	Description:	
Industrial Application:	Electrical Generator	Description:	
Power Output:	4.50	Units:	Megawatts

Is the combustion turbine using (check all that apply):

A Dry Low NOx Combustor:	☐		
Steam Injection:	☐	Steam to Fuel Ratio:	
Water Injection:	☐	Water to Fuel Ratio:	
Other:	☐	Description:	

Is the turbine Equipped with a Duct Burner? ● Yes ○ No

Have you attached a diagram showing the location and/or the configuration of this equipment? ○ Yes ● No

Have you attached any manuf.'s data or specifications to aid the Dept. in its review of this application? ● Yes ○ No

Comments:

50078 COOPER UNIVERSITY HOSPITAL PCP220001 E1103 (Duct Burner)
Print Date: 5/2/2023

Make:	Caterpillar
Manufacturer:	Solar Turbines
Model:	Mercury 50-6400R
Maximum rated Gross Heat Input (MMBtu/hr-HHV):	21.30
Equipment Type Description:	Dust burner associated with E1102.

Have you attached a diagram showing the location and/or the configuration of this equipment?

- ○ Yes
- ● No

Have you attached any manuf.'s data or specifications to aid the Dept. in its review of this application?

- ● Yes
- ○ No

Comments:

Include Emission Rates on the Potential to Emit Screen for each contaminant in ppmvd @ 7%O2 in addition to lbs/hr and tons/yr.

COOPER UNIVERSITY HOSPITAL (50078)
PCP220001

Date: 5/2/2023

New Jersey Department of Environmental Protection
Emission Points Inventory

PT NJID	Facility's Designation	Description	Config.	Equiv. Diam. (in.)	Height (ft.)	Dist. to Prop. Line (ft)	Exhaust Temp. (deg. F)			Exhaust Vol. (acfm)			Discharge Direction	PT Set ID
							Avg.	Min.	Max.	Avg.	Min.	Max.		
PT35	CHP	CHP unit stack	Round	48	70	60	290.0	0.0	330.0	47,000.0	0.0	52,000.0	Up	

COOPER UNIVERSITY HOSPITAL (50078)
PCP220001

Date: 5/2/2023

New Jersey Department of Environmental Protection
Emission Unit/Batch Process Inventory

U 18 CHP unit Combustion Turbine with Duct Burner

UOS NJID	Facility's Designation	UOS Description	Operation Type	Signif. Equip.	Control Device(s)	Emission Point(s)	SCC(s)	Annual Oper. Hours		VOC Range	Flow (acfm)		Temp. (deg F)	
								Min.	Max.		Min.	Max.	Min.	Max.
OS1	Turbine/DB	Turbine operating with duct burner, duct burner not firing	Normal - Steady State	E1102		PT35	2-02-002-03	0.0	8,760.0		0.0	52,000.0	0.0	330.0
OS2	Turbine/DB	Turbine operating with duct burner, duct burner firing	Normal - Steady State	E1103		PT35	2-02-002-03	0.0	8,760.0		0.0	52,000.0	0.0	330.0

50078 COOPER UNIVERSITY HOSPITAL PCP220001 U18 OS1 (Fuel Information Table)
Print Date: 5/2/2023

Is this fuel a blend?	○ Yes ● No
Fuel Category:	Commercial
Fuel Type:	Natural gas
Description (if other):	
Amount of Sulfur in Fuel (%):	0.0001
Amount of Ash in Fuel (%):	
Fuel Heating Value:	1,020.00
Units:	BTU/scf
Estimated Maximum Amount of Fuel Burned Annually:	52.00
Units:	MMft^3/yr
Estimated Actual Amount of Fuel Burned Annually:	46
Units:	MMft^3/yr
Amount of Oxygen in Flue Gas (%):	
Amount of Moisture in Flue Gas (%):	
Comments:	

50078 COOPER UNIVERSITY HOSPITAL PCP220001 U18 OS2 (Fuel Information Table)
Print Date: 5/2/2023

Is this fuel a blend?	○ Yes ● No
Fuel Category:	Commercial
Fuel Type:	Natural gas
Description (if other):	
Amount of Sulfur in Fuel (%):	0.0001
Amount of Ash in Fuel (%):	
Fuel Heating Value:	1,020.00
Units:	BTU/scf
Estimated Maximum Amount of Fuel Burned Annually:	470.00
Units:	MMft^3/yr
Estimated Actual Amount of Fuel Burned Annually:	414
Units:	MMft^3/yr
Amount of Oxygen in Flue Gas (%):	
Amount of Moisture in Flue Gas (%):	
Comments:	

50078 COOPER UNIVERSITY HOSPITAL Date: 5/2/2023

PCP220001

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: **U18 CHP unit**

Operating Scenario: **OS0 Summary**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Acetaldehyde				0.01200000	tons/yr	No
Acrolein				0.00196000	tons/yr	No
Benzene				0.00368000	tons/yr	No
CO				12.18000000	tons/yr	No
Ethylbenzene				0.00981000	tons/yr	No
Formaldehyde				0.88000000	tons/yr	No
HAPs (Total)				0.92000000	tons/yr	No
NOx (Total)				11.34000000	tons/yr	No
PM-10 (Total)				3.07000000	tons/yr	No
PM-2.5 (Total)				3.07000000	tons/yr	No
Polynuclear aromatic hydrocarbons (PAHs)				0.00067500	tons/yr	No
Pb					tons/yr	No
Propylene oxide				0.00889000	tons/yr	No
SO2					tons/yr	No
TSP				3.07000000	tons/yr	No
VOC (Total)				1.38000000	tons/yr	No

Subject Item: **U18 CHP unit**

Operating Scenario: **OS1 Turbine/DB**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Acetaldehyde				0.00195000	lb/hr	No
Acrolein				0.00031200	lb/hr	No

50078 COOPER UNIVERSITY HOSPITAL Date: 5/2/2023

PCP220001

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: **U18 CHP unit**

Operating Scenario: **OS1 Turbine/DB**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Benzene				0.00053500	lb/hr	No
CO				1.08000000	lb/hr	No
Ethylbenzene				0.00156000	lb/hr	No
Formaldehyde				0.14000000	lb/hr	No
HAPs (Total)				0.15000000	lb/hr	No
NOx (Total)				0.88400000	lb/hr	No
PM-10 (Total)				0.48700000	lb/hr	No
PM-2.5 (Total)				0.48700000	lb/hr	No
Polynuclear aromatic hydrocarbons (PAHs)				0.00010700	lb/hr	No
Pb					lb/hr	No
Propylene oxide				0.00141000	lb/hr	No
TSP				0.48700000	lb/hr	No
VOC (Total)				0.12300000	lb/hr	No

Subject Item: **U18 CHP unit**

Operating Scenario: **OS2 Turbine/DB**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Acetaldehyde				0.00085200	lb/hr	No
Acrolein				0.00013600	lb/hr	No
Benzene				0.00025600	lb/hr	No
CO				1.70000000	lb/hr	No
Ethylbenzene				0.00068200	lb/hr	No

50078 COOPER UNIVERSITY HOSPITAL Date: 5/2/2023

PCP220001

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: **U18 CHP unit**

Operating Scenario: **OS2 Turbine/DB**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Formaldehyde				0.06000000	lb/hr	No
HAPs (Total)				0.06000000	lb/hr	No
NOx (Total)				1.71000000	lb/hr	No
PM-10 (Total)				0.21000000	lb/hr	No
PM-2.5 (Total)				0.21000000	lb/hr	No
Polynuclear aromatic hydrocarbons (PAHs)				0.00004690	lb/hr	No
Pb					lb/hr	No
Propylene oxide				0.00061800	lb/hr	No
SO2					lb/hr	No
TSP				0.21000000	lb/hr	No
VOC (Total)				0.19000000	lb/hr	No

PRECONSTRUCTION PERMIT APPLICATION

COMBINED HEAT AND POWER UNIT

COOPER UNIVERSITY HOSPITAL

SUBMITTED BY:

Cooper University Hospital

Cooper University Hospital
1 Cooper Plaza
Camden, NJ 08103

SUBMITTED TO:

New Jersey Department of Environmental Protection
Bureau of Stationary Sources, Preconstruction Permits Section
401 E. State Street, 2nd Floor, P.O. Box 420
Mail Code 401-02
Trenton, NJ 08625-0420

ALL4 Contact Information: info@all4inc.com | 610.933.5246 | www.all4inc.com

TABLE OF CONTENTS

Section Name **Page Number**

LIST OF APPENDICES

1. INTRODUCTION

Cooper University Hospital (Cooper) is located at 1 Cooper Plaza in Camden, Camden County, New Jersey (Facility) and is affiliated with Cooper Medical School of Rowan University. Cooper is submitting this Preconstruction Permit (PCP) application (Application) to the New Jersey Department of Environmental Protection (NJDEP) to seek authorization to continue to operate its existing combined heat and power (CHP) unit in accordance with New Jersey Administrative Code (N.J.A.C.) Title 7, Chapter 27, Subchapter 8. Cooper has prepared this Application using NJDEP's RADIUS software application and has submitted and certified the required submittal file electronically through NJDEP's Online Business Portal. A copy of the RADIUS forms is included with this report as an Adobe PDF in Appendix A.

Cooper understands that, upon receipt of this Application, NJDEP will invoice Cooper for the applicable permitting fees pursuant to N.J.A.C. 7:27-8.6, Table A-2.

2. FACILITY AND PROJECT DESCRIPTION

The Facility is located at 1 Cooper Plaza, Camden, Camden County, New Jersey. The Facility is a teaching hospital and biomedical research facility and is categorized under the North American Industry Classification System (NAICS) code 622110 for general medical and surgical hospitals.

The Facility operates one natural gas-fired CHP unit, two dual-fuel boilers that fire primarily natural gas and No. 2 fuel oil only during periods of natural gas curtailment, four small natural gas fired boilers, and seven diesel-fired emergency generators to generate power for the Facility and supply steam for heating. The Facility is a minor source of air emissions and operates under various general permits and PCPs issued by NJDEP.

With this Application, Cooper is seeking a new PCP for the existing CHP unit. The existing CHP unit is currently permitted under General Permit No. GEN170002 (General Permit). The General Permit is a GP-021 for CHP Combustion Turbine(s), renewals of which were discontinued by NJDEP on April 6, 2020. Cooper is seeking to obtain an operating certificate for the CHP unit prior to the expiration of the General Permit on January 3, 2023.

The unit is an existing Solar Turbines Mercury 50-6400R CHP unit (General Permit emissions unit ID U1) consisting of a 44.25-million British thermal unit per hour (MMBtu/hr) natural gas-fired turbine (General Permit equipment ID E1) and a 16.50-MMBtu/hr duct burner (General Permit equipment ID E2). Technical specifications for the CHP unit are provided in Appendix B. The CHP unit generates electricity for the Facility and produces steam for heating via an associated heat recovery steam generator (HRSG). In addition to transitioning the CHP unit from the General Permit to a PCP, Cooper is proposing a federally enforceable annual fuel throughput limit of 521.74 million cubic feet per year (MMcf/yr) of natural gas for the CHP unit.

3. EMISSIONS CALCULATIONS

Potential emissions from the CHP unit are calculated using manufacturer specifications, emissions factors from the NJDEP State of the Art (SOTA) Manual for Stationary Combustion Turbines (SOTA Manual), emissions factors from the U.S. Environmental Protection Agency (U.S. EPA) *AP-42: Compilation of Air Emissions Factors* (AP-42) Chapter 3.1 for natural gas-fired stationary combustion turbines, and emissions factors from 40 CFR Part 98, Subpart C. Potential annual emissions are calculated assuming a maximum annual natural gas throughput of 521.74 MMcf/yr for the CHP unit.

The calculated potential to emit (PTE) from proposed operations at the Facility is presented in Appendix C. The calculated PTE from the CHP unit is presented in Tables C-1 and C-2. A Facility-wide PTE summary is presented in Table C-2 to demonstrate that the Facility's total emissions from all sources remain below major facility permitting thresholds as defined in N.J.A.C. 7:27-8.1.

4. REGULATORY REVIEW

Cooper has reviewed the Federal and State of New Jersey air quality regulations to determine their applicability to the Facility.

4.1 FEDERAL REGULATIONS

For the purpose of this Application, potentially applicable Federal regulations include the following:

- New Source Review
- Standards of Performance for New Stationary Sources
- National Emission Standards for Hazardous Air Pollutants

A discussion of each potentially applicable Federal requirement is provided in the following subsections.

4.1.1 New Source Review

The New Source Review (NSR) program includes both the Nonattainment New Source Review (NNSR) regulations and Prevention of Significant Deterioration (PSD) regulations. The Facility-wide potential emissions of regulated NSR pollutants demonstrate that the Facility is not a major stationary source under either regulation. Therefore, PSD and NNSR permitting regulations do not apply.

4.1.2 Standards of Performance for New Stationary Sources

U.S. EPA has promulgated standards of performance for new, modified, or reconstructed sources of air pollution at 40 CFR Part 60, also known as the New Source Performance Standards (NSPS). Cooper has identified the following NSPS as being potentially applicable to the CHP unit:

- 40 CFR Part 60, Subpart GG (Standards of Performance for Stationary Gas Turbines)
- 40 CFR Part 60, Subpart KKKK (Standards of Performance for Stationary Combustion Turbines)

A discussion of each potentially applicable NSPS is provided in the following subsections.

4.1.2.1 40 CFR Part 60, Subpart GG

40 CFR Part 60, Subpart GG (Standards of Performance for Stationary Gas Turbines) applies to all stationary gas turbines with a heat input at peak load equal to or greater than 10 MMBtu/hr. The combustion turbine has a rated heat input of 44.25 MMBtu/hr. However, pursuant to 40 CFR §60.4305(b) of 40 CFR Part 60, Subpart KKKK, stationary combustion turbines regulated under 40 CFR Part 60, Subpart KKKK are exempt from the requirements of Subpart GG. The CHP unit is subject to Subpart KKKK; therefore, the requirements of Subpart GG do not apply.

4.1.2.2 40 CFR Part 60, Subpart KKKK

40 CFR Part 60, Subpart KKKK (Standards of Performance for Stationary Combustion Turbines) applies to stationary combustion turbines with a heat input at peak load equal to or greater than 10 MMBtu/hr which commenced construction, modification, or reconstruction after February 18, 2005. The combustion turbine has a rated heat input of 44.25 MMBtu/hr and was constructed in 2018. Therefore, the CHP unit is subject to Subpart KKKK.

The natural gas-fired CHP unit generates electricity. The peak load of the turbine is 44.25 MMBtu/hr. Per 40 CFR §60.4305(a), any additional heat input to associated heat recover steam generators (HRSG) or duct burners is not included when determining the peak heat input. Therefore, pursuant to 40 CFR §60.4320(a) and Table 1 to Subpart KKKK, NO_X emissions from the CHP unit will be less than or equal to 42 parts per million by volume, dry (ppmvd), at 15% oxygen (O_2). Pursuant to 40 CFR §60.4340(a) for units that do not use water or steam injection, Cooper will perform performance tests every two years in accordance with 40 CFR §60.4400 to demonstrate compliance with the NO_X emissions limit. Pursuant to 40 CFR §60.4375(b), a written report of the results of each performance test will be submitted to U.S. EPA within 60 days of completion of each performance test.

Pursuant to 40 CFR §60.4330(a)(2), the CHP unit will comply with the SO_2 emissions limits of Subpart KKKK by firing fuel which contains total potential sulfur emissions less than or equal to 0.060 lb SO_2/MMBtu, as demonstrated in Table C-2 of Appendix C. Pursuant to 40 CFR §60.4365, Cooper will demonstrate compliance with the sulfur emissions limit by maintaining fuel supplier records specifying that the total sulfur content for natural gas is less than or equal to 20 grains of sulfur per 100 standard cubic feet.

4.1.3 National Emission Standards for Hazardous Air Pollutants

U.S. EPA has promulgated National Emission Standards for Hazardous Air Pollutants (NESHAP) at 40 CFR Parts 61 and 63. The original NESHAP promulgated prior to the Clean Air Act Amendments (CAAA) of 1990, found in 40 CFR Part 61, apply to specific HAP. No standards in 40 CFR Part 61 have been identified as applicable to the CHP unit. NESHAP rules promulgated under 40 CFR Part 63, commonly referred to as Maximum Achievable Control Technology (MACT) standards, apply to source categories that are area or major sources of HAP. A major source of HAP is defined as a source with a facility-wide PTE of 10 tons per year (tpy) or more of any single HAP, or with a facility-wide PTE of 25 tpy of total HAP. Based on the PTE calculations included in Appendix C, the Facility is an area source of HAP. Cooper has identified the following NESHAP as being potentially applicable to the CHP unit:

- 40 CFR Part 63, Subpart YYYY (National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines)

A discussion of the potentially applicable NESHAP is provided in the following subsection.

4.1.3.1 40 CFR Part 63, Subpart YYYY

40 CFR Part 63, Subpart YYYY (National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines) applies to owners and operators of stationary combustion turbines located at major sources of HAP emissions. The Facility is an area source of HAP. Therefore, the CHP unit is not subject to Subpart YYYY.

4.2 NEW JERSEY REGULATIONS

For the purpose of this Application, potentially applicable State of New Jersey regulations include the following:

- N.J.A.C. 7:27-3 (Control and Prohibition of Smoke from Combustion of Fuel)
- N.J.A.C. 7:27-4 (Control and Prohibition of Particles from Combustion of Fuel)
- N.J.A.C. 7:27-7 (Sulfur)
- N.J.A.C. 7:27-8 (Permits and Certificates for Minor Facilities)
- N.J.A.C. 7:27-16 (Control and Prohibition of Air Pollution by Volatile Organic Compounds)
- N.J.A.C. 7:27-18 [Control and Prohibition of Air Pollution from New or Altered Sources Affecting Ambient Air Quality (Emission Offset Rules)]
- N.J.A.C. 7:27-19 (Control and Prohibition of Air Pollution from Oxides of Nitrogen)
- N.J.A.C. 7:27-22 (Operating Permits)

A discussion of each potentially applicable State of New Jersey air quality regulation is provided in the following subsections.

4.2.1 N.J.A.C. 7:27-3

N.J.A.C. 7:27-3.5 regulates smoke emissions from stationary turbine engines. Visible smoke darker than number 1 on the Ringelmann smoke chart or greater than 20% opacity will not be emitted from the CHP unit for a period of more than 10 consecutive seconds.

4.2.2 N.J.A.C. 7:27-4

N.J.A.C. 7:27-4.2(a) sets standards for PM emissions from combustion of fuel. As demonstrated in Table C-2 of Appendix C, the CHP unit will meet this standard of less than 12 pounds per hour.

4.2.3 N.J.A.C. 7:27-7

N.J.A.C. 7:27-7.2 regulates air pollution from sulfur compounds. Pursuant to N.J.A.C. 7:27-7.2(k), this subchapter does not apply to sulfur compound emissions resulting from the combustion of commercial fuel. Therefore, the CHP unit is not subject to N.J.A.C. 7:27-7.

4.2.4 N.J.A.C. 7:27-8

N.J.A.C. 7:27-8.2(c)(1) establishes the CHP unit as requiring a PCP because it is commercial fuel-burning equipment with maximum heat input of 1 MMBtu/hr or greater and, therefore, a significant source. Therefore, Cooper is submitting this Application in accordance with N.J.A.C. 7:27-8.2 and 8.4.

N.J.A.C. 7:27-8.12 establishes SOTA control requirements. The CHP unit emissions are over the SOTA threshold for NOx and CO and therefore must meet the SOTA requirements for those pollutants. Cooper complies with the SOTA requirements per N.J.A.C. 7:27-8.12(e)(5)(i). The SOTA Manual for Stationary Combustion Turbines documents that SOTA for a combined cycle turbine is 12 ppmvd for NOx and 50 ppmvd for CO, which the unit complies with.

4.2.5 N.J.A.C. 7:27-16

N.J.A.C. 7:27-16.9 regulates VOC emissions from stationary combustion turbines subject to the provisions of N.J.A.C. 7:27-19. The CHP unit is not subject to N.J.A.C. 7:27-19; therefore, it is not subject to N.J.A.C. 7:27-16.9.

4.2.6 N.J.A.C. 7:27-18

As demonstrated in Table C-2 of Appendix C, the Facility does not exceed the PTE threshold for any of the air contaminants listed in N.J.A.C. 7:27-18.2(a)(1). Therefore, the CHP unit is not subject to N.J.A.C. 7:27-18.

4.2.7 N.J.A.C. 7:27-19

Pursuant to N.J.A.C. 7:27-19.2(b)(3) and (c)(2), N.J.A.C. 7:27-19 applies to stationary combustion turbines that have a maximum gross heat input of at least 25 MMBtu/hr located at a major NO_X facility. The Facility is not a major source of NO_X. Therefore, the CHP unit is not subject to N.J.A.C. 7:27-19.

4.2.8 N.J.A.C. 7:27-22

As demonstrated in Table C-2 of Appendix C, the Facility does not exceed the applicability thresholds listed in N.J.A.C. 7:27-22.2(a). Therefore, the Facility is not subject to major source air permitting under N.J.A.C. 7:27-22.

APPENDIX A -
PDF COPY OF SUBMITTED RADIUS FILE

Cooper University Hospital (50078)

Date: 1/23/2023

New Jersey Department of Environmental Protection
Reason for Application

Permit Being Modified

Permit Class: **Number:** 0

Description of Modifications: Cooper is submitting this Preconstruction Permit Application (Application) for the following:

1. Cooper operates an existing Combined Heat and Power (CHP) unit consisting of a natural gas-fired turbine and duct burner which are permitted as E1 and E2, respectively, of emissions unit U1 under General Permit No. GEN170002 (General Permit). The General Permit is a GP-021 for CHP Combustion Turbine(s), which has been discontinued by the New Jersey Department of Environmental Protection (NJDEP) as of April 6, 2020. Cooper submitted an Application on 12/6/2022 in order to obtain an operating certificate for the CHP unit prior to the expiration of the General Permit on January 3, 2023. After receipt of the application, the permit was extended by the NJDEP for 6 months. Cooper received comments on the application on 12/27/2022, and is submitting this revised application to address those comments.

2. Cooper is proposing a federally enforceable annual fuel throughput limit of 521.74 million cubic feet per year (MMcf/yr) of natural gas for the CHP unit.

New Jersey Department of Environmental Protection
Facility Profile (General)

Facility Name (AIMS): Cooper University Hospital **Facility ID (AIMS):** 50078

Street Address: 1 COOPER PLZ
CAMDEN, NJ 08103

Mailing Address: 1 COOPER PLZ
CAMDEN, NJ 08103

State Plane Coordinates:

X-Coordinate:	490,072
Y-Coordinate:	4,421,212
Units:	Meters
Datum:	
Source Org.:	xAddress Match
Source Type:	Approx. Addr. Match

County: Camden

Location Description: Take I-95 S to Market St. in Camden; take Exit 5B from I-676.

Industry:

Primary SIC:	
Secondary SIC:	
NAICS:	622110

New Jersey Department of Environmental Protection
Facility Profile (General)

Contact Type: Air Permit Information Contact

Organization: Cooper University Hospital
Org. Type: Hospital
Name: Frank Meade
NJ EIN:
Title: Chief Engineer
Phone: (856) 342-2000 x
Fax: ( ) - x
Other: ( ) - x
Type:
Email: meade-frank@cooperhealth.edu
Mailing Address: 1 Cooper PLZ
Camden, NJ 08103

Contact Type: Consultant

Organization: ALL4 LLC
Org. Type: LLC
Name: Paul Mallon
NJ EIN:
Title: Managing Consultant
Phone: (215) 391-4696 x
Fax: ( ) - x
Other: ( ) - x
Type:
Email: pmallon@all4inc.com
Mailing Address: 1601 Cherry Street
Suite 800
Philadelphia, PA 19102

Contact Type: Fees/Billing Contact

Organization: Cooper University Hospital
Org. Type: Hospital
Name: Frank Meade
NJ EIN:
Title: Chief Engineer
Phone: (856) 342-2000 x
Fax: ( ) - x
Other: ( ) - x
Type:
Email: meade-frank@cooperhealth.edu
Mailing Address: 1 Cooper PLZ
Camden, NJ 08103

New Jersey Department of Environmental Protection
Facility Profile (General)

Contact Type: **Responsible Official**

Organization: Cooper University Hospital
Org. Type: Hospital

Name: Robert Hockel
NJ EIN:

Title: SR VP Hospital Operations

Phone: (856) 342-2000 x

Fax: ( ) - x

Other: ( ) - x

Type:

Email: hockel-robert@cooperhealth.edu

Mailing Address: 1 Cooper PLZ
Camden, NJ 08103

Cooper University Hospital (50078) Date: 1/23/2023

New Jersey Department of Environmental Protection
Facility Profile (Permitting)

1. Is this facility classified as a small business by the USEPA?	No
2. Is this facility subject to N.J.A.C. 7:27-22?	No
3. Are you voluntarily subjecting this facility to the requirements of Subchapter 22?	No
4. Has a copy of this application been sent to the USEPA?	No
5. If not, has the EPA waived the requirement?	No
6. Are you claiming any portion of this application to be confidential?	No
7. Is the facility an existing major facility?	No
8. Have you submitted a netting analysis?	No
9. Are emissions of any pollutant above the SOTA threshold?	Yes
10. Have you submitted a SOTA analysis?	Yes
11. If you answered "Yes" to Question 9 and "No" to Question 10, explain why a SOTA analysis was not required	
12. Have you provided, or are you planning to provide air contaminant modeling?	Yes

Air Contaminant(s)	
Name	**CAS Number**
Formaldehyde	00050-00-0
Polynuclear aromatic hydrocarbons (PAHs)	

Cooper University Hospital (50078) Date: 1/23/2023

New Jersey Department of Environmental Protection
Equipment Inventory

Equip. NJID	Facility's Designation	Equipment Description	Equipment Type	Certificate Number	Install Date	Grand-Fathered	Last Mod. (Since 1968)	Equip. Set ID
E1102	Turbine	Turbine	Combustion Turbine	GEN170002	10/1/2018	No		
E1103	Burner	Duct Burner	Duct Burner	GEN170002	10/1/2018	No		

000000 E1 (Combustion Turbine)
Print Date: 11/28/2022

Make:	Caterpillar
Manufacturer:	Solar Turbines
Model:	Mercury 50-6400R
Maximum rated Gross Heat Input (MMBtu/hr-HHV):	44.25
Type of Turbine:	Industrial
Type of Cycle:	Cogeneration — Description:
Industrial Application:	Electical Generator — Description:
Power Output:	4.50 — Units: Megawatts

Is the combustion turbine using (check all that apply):

A Dry Low NOx Combustor:	☐		
Steam Injection:	☐	Steam to Fuel Ratio:	
Water Injection:	☐	Water to Fuel Ratio:	
Other:	☐	Description:	

Is the turbine Equipped with a Duct Burner? ● Yes ○ No

Have you attached a diagram showing the location and/or the configuration of this equipment? ○ Yes ● No

Have you attached any manuf.'s data or specifications to aid the Dept. in its review of this application? ● Yes ○ No

Comments:

000000 E2 (Duct Burner)
Print Date: 11/28/2022

Make:	Caterpillar
Manufacturer:	Solar Turbines
Model:	Mercury 50-6400R
Maximum rated Gross Heat Input (MMBtu/hr-HHV):	16.50
Equipment Type Description:	Duct burner associated with E1.

Have you attached a diagram showing the location and/or the configuration of this equipment?

- ○ Yes
- ● No

Have you attached any manuf.'s data or specifications to aid the Dept. in its review of this application?

- ● Yes
- ○ No

Comments:

Include Emission Rates on the Potential to Emit Screen for each contaminant in ppmvd @ 7%O2 in addition to lbs/hr and tons/yr.

Cooper University Hospital (50078)

Date: 1/23/2023

New Jersey Department of Environmental Protection
Emission Points Inventory

PT NJID	Facility's Designation	Description	Config.	Equiv. Diam. (in.)	Height (ft.)	Dist. to Prop. Line (ft)	Exhaust Temp. (deg. F)			Exhaust Vol. (acfm)			Discharge Direction	PT Set ID
							Avg.	Min.	Max.	Avg.	Min.	Max.		
PT35	CHP	CHP unit stack	Round	48	70	60	290.0	0.0	330.0	47,000.0	0.0	52,000.0	Up	

Cooper University Hospital (50078)

Date: 1/23/2023

New Jersey Department of Environmental Protection
Emission Unit/Batch Process Inventory

U 18 CHP unit Combustion Turbine with Duct Burner

UOS NJID	Facility's Designation	UOS Description	Operation Type	Signif. Equip.	Control Device(s)	Emission Point(s)	SCC(s)	Annual Oper. Hours		VOC Range	Flow (acfm)		Temp. (deg F)	
								Min.	Max.		Min.	Max.	Min.	Max.
OS1	Turbine/DB	Turbine operating with duct burner, duct burner not firing	Normal - Steady State	E1102		PT35	2-02-002-03	0.0	8,760.0		0.0	52,000.0	0.0	330.0
OS2	Turbine/DB	Turbine operating with duct burner, duct burner firing	Normal - Steady State	E1103		PT35	2-02-002-03	0.0	8,760.0		0.0	52,000.0	0.0	330.0

000000 U1 OS1 (Fuel Information Table)
Print Date: 11/28/2022

Is this fuel a blend?	○ Yes ● No
Fuel Category:	Commercial
Fuel Type:	Natural gas
Description (if other):	
Amount of Sulfur in Fuel (%):	0.0001
Amount of Ash in Fuel (%):	
Fuel Heating Value:	1,020.00
Units:	BTU/scf
Estimated Maximum Amount of Fuel Burned Annually:	380.00
Units:	MMft^3/yr
Estimated Actual Amount of Fuel Burned Annually:	350.00
Units:	MMft^3/yr
Amount of Oxygen in Flue Gas (%):	
Amount of Moisture in Flue Gas (%):	
Comments:	

000000 U1 OS2 (Fuel Information Table)
Print Date: 11/28/2022

Is this fuel a blend?	○ Yes ● No
Fuel Category:	Commercial
Fuel Type:	Natural gas
Description (if other):	
Amount of Sulfur in Fuel (%):	0.0001
Amount of Ash in Fuel (%):	
Fuel Heating Value:	1,020.00
Units:	BTU/scf
Estimated Maximum Amount of Fuel Burned Annually:	142.00
Units:	MMft^3/yr
Estimated Actual Amount of Fuel Burned Annually:	110.00
Units:	MMft^3/yr
Amount of Oxygen in Flue Gas (%):	
Amount of Moisture in Flue Gas (%):	
Comments:	

Cooper University Hospital (50078) Date: 1/27/2023

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: **U18 CHP unit**

Operating Scenario: **OS0 Summary**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Acetaldehyde				0.01100000	tons/yr	No
Acrolein				0.00170000	tons/yr	No
Benzene				0.00300000	tons/yr	No
CO				12.18000000	tons/yr	No
Formaldehyde				0.77000000	tons/yr	No
HAPs (Total)				0.85000000	tons/yr	No
Methane				8.65000000	tons/yr	No
NOx (Total)				11.34000000	tons/yr	No
Pb				0.00000000	tons/yr	No
PM-10 (Total)				3.07000000	tons/yr	No
PM-2.5 (Total)				3.07000000	tons/yr	No
Propylene oxide				0.00770000	tons/yr	No
SO2					tons/yr	No
TSP				3.07000000	tons/yr	No
VOC (Total)				1.38000000	tons/yr	No

Subject Item: **U18 CHP unit**

Operating Scenario: **OS1**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Acetaldehyde				0.00180000	lb/hr	No
Acrolein				0.00028000	lb/hr	No
Benzene				0.00050000	lb/hr	No

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: **U18 CHP unit**

Operating Scenario: **OS1**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
CO				1.08000000	lb/hr	No
Formaldehyde				0.13000000	lb/hr	No
HAPs (Total)				0.14000000	lb/hr	No
Methane				0.55000000	lb/hr	No
NOx (Total)				0.88000000	lb/hr	No
Pb				0.00000000	lb/hr	No
PM-10 (Total)				0.49000000	lb/hr	No
PM-2.5 (Total)				0.49000000	lb/hr	No
Propylene oxide				0.00130000	lb/hr	No
TSP				0.49000000	lb/hr	No
VOC (Total)				0.12000000	lb/hr	No

Subject Item: **U18 CHP unit**

Operating Scenario: **OS2**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Acetaldehyde				0.00066000	lb/hr	No
Acrolein				0.00010000	lb/hr	No
Benzene				0.00019800	lb/hr	No
CO				1.70000000	lb/hr	No
Formaldehyde				0.05000000	lb/hr	No
HAPs (Total)				0.05000000	lb/hr	No
Methane				1.42000000	lb/hr	No

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: **U18 CHP unit**

Operating Scenario: **OS2**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
NOx (Total)				1.71000000	lb/hr	No
Pb				0.00000000	lb/hr	No
PM-10 (Total)				0.21000000	lb/hr	No
PM-2.5 (Total)				0.21000000	lb/hr	No
Propylene oxide				0.00048000	lb/hr	No
TSP				0.21000000	lb/hr	No
VOC (Total)				0.19000000	lb/hr	No

APPENDIX B -
CHP UNIT TECHNICAL SPECIFICATIONS

Solar Turbines
A Caterpillar Company

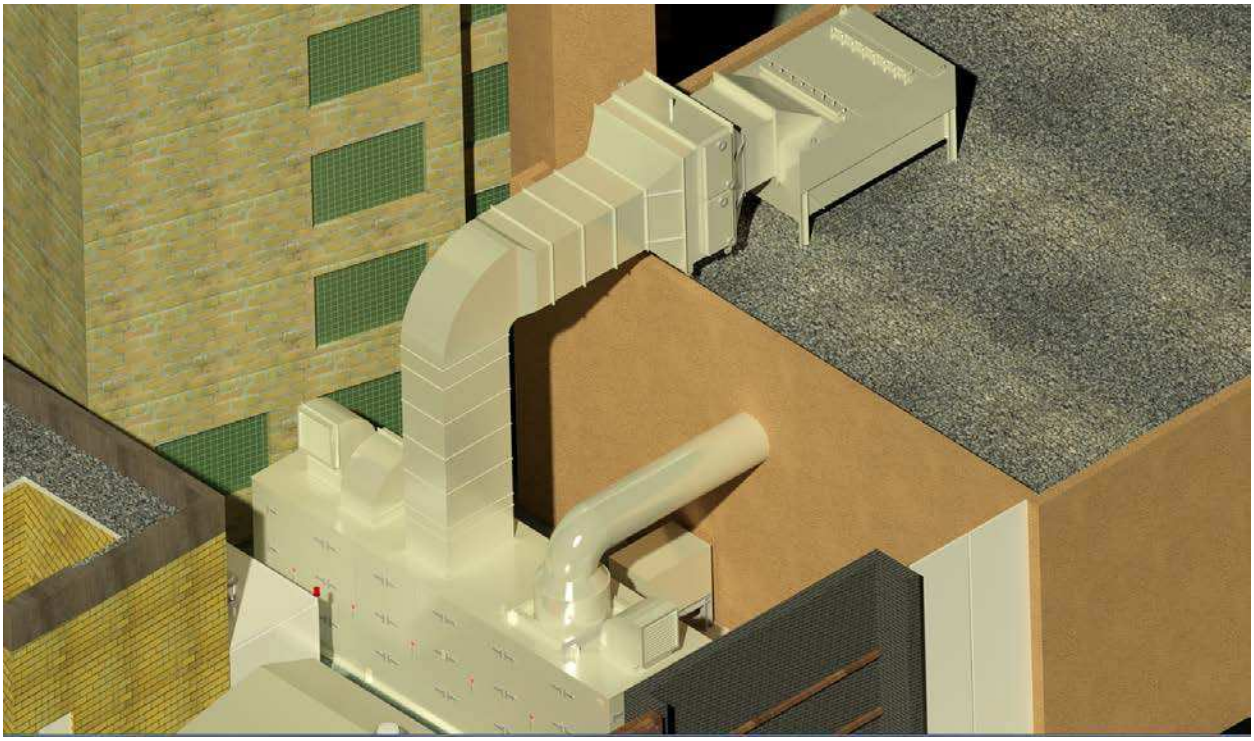
Solar Turbines Incorporated
9330 Sky Park Court
San Diego, CA 92123-5398

Tel: (858) 694-1616
Fax: (858) 694-6267

Technical Proposal

Submitted to:
Cooper University Hospital

for the:
Cooper University Hospital
Gas Turbine/4.5MW CHP SYSTEM



1 Mercury 50 Generator Set with HRSG, FGC & SWITCHGEAR
July 20, 2017: Rev 0
Solar Inquiry No: PG-NY08-02035
Sales Manager N.E USA: Bernie Pfeifer
Prepared by: Mike Cassidy

2.2 HEAT RECOVERY STEAM GENERATOR DESCRIPTION

The recommended Heat Recovery Steam Generator is an offering from Rentech, per the data sheet and technical information below.

A. Heat Recovery Steam Generator

No.	Item Description	Supplier: Rentech Boiler Systems
1.0	**Base Bid**	
1.1	Model	Rentech Crossflow HRSG
1.2	Design Pressure (PSIG)	200
1.3	Operating Pressure (PSIG)	130
1.4	Drum Pressure (PSIG)	132
1.5	Steam Flow (lb/hr)	13,098 - expected
1.6	Exhaust Gas Flow (lb/hr)	139,882
1.7	Turbine Exhaust Temperature (F)	692
1.8	Heat Loss (%)	1.3
1.9	Evap1 Temp In (F)	692
1.10	Evap2 Temp Out (F)	369
1.11	Economizer Temp In (F)	369
1.12	Economizer Temp Out (F)	327
1.13	Steam Temperature (F)	Saturated
1.14	Steam Flow (lb/hr)	13,098 - expected
1.15	Feed Water Temperature Pre Economizer (F)	240
1.16	Feed Water Temperature Post Economizer (F)	346
1.17	Blow Down (%)	2
1.18	Exhaust Gas Pressure Drop (in WC)	7.6
1.19	Total Duty (MMBTU/HR	13.11
1.20	Duty Screen (MMBTU/HR)	0.78
1.21	Duty Evap1 (MMBTU/HR)	10.85
1.22	Duty Evap 2 (MMBTU/HR)	N/A
1.23	Duty Economizer (MMBTU/HR)	1.48
2.0	**Alternate 1 – Duct Fired**	
2.1	Model	Rentech Crossflow HRSG
2.2	Design Pressure (PSIG)	200
2.3	Operating Pressure (PSIG)	130
2.4	Drum Pressure (PSIG)	138
2.5	Steam Flow (lb/hr) with CT and Duct Firing, **Limit to a maximum of 28,000 lbs/hr**	28,000
2.6	Exhaust Gas Flow (lb/hr)	139,882
2.7	Turbine Exhaust Temperature (F)	692

2.8	Heat Loss (%)	1.3
2.9	Firing Temperature (F)	1,069
2.10	LHV (BTU/SCF) from Combustion Turbine Form	922.3
2.11	Gas Input (MMBTU/HR)	14.8
2.12	Evap1 Temp In (F)	1,069
2.13	Evap2 Temp Out (F)	385
2.14	Economizer Temp In (F)	385
2.15	Economizer Temp Out (F)	318
2.16	Steam Temperature (F)	Saturated
2.17	Feed Water Temperature Pre Economizer (F)	240
2.18	Feed Water Temperature Post Economizer (F)	320
2.19	Blow Down (%)	2
2.20	Exhaust Gas Pressure Drop (in WC)	8.2
2.21	Total Duty (MMBTU/HR	28.05
2.22	Duty Screen (MMBTU/HR)	1.86
2.23	Duty Evap1 (MMBTU/HR)	23.81
2.24	Duty Evap 2 (MMBTU/HR)	N/A
2.25	Duty Economizer (MMBTU/HR)	2.38
2.26	NO_x: ppmv; lb_m/hr in	5.0
2.27	NO_x: ppmv; lb_m/hr out	9.5
2.28	CO: ppmv; lb_m/hr in	10.0
2.29	CO: ppmv; lb_m/hr out	17.0
2.30	CH_2O (formaldehyde): lb_m/hr in	Supplied after order
2.31	CH_2O (formaldehyde): lb_m/hr out	Supplied after order
2.32	PM_{10}: lb_m/hr in	Supplied after order
2.33	PM_{10}: lb_m/hr out	Supplied after order

J. Main Stack

The main stack will be provided as follows. Stack will be supported from the top of the economizer without any requirement for external support structure.

Stack Height Above Grade	70'-0"
Stack Shell Diameter	48"
Material	1/4" Thick CS Material
Exterior Surface Coating	SSPC-SP10 Surface Prep with Inorganic Zinc Primer and Top Coat
Test Ports	(4) - 4" x 150# Test Ports

K. Ladders / Platforms

Will be provided at the following locations.

- Along length of the steam drum.
- Steam drum ends.
- Economizer
- Main Stack

L. Trim and Instrumentation

Safety Relief Valves

2	Boiler	X	Drip pan elbows
0	Superheater	X	Vent stacks
1	Economizer		Silencer(s)
	Gags		Silencer supports
X	Spring covers		

Water Columns

1	**Qty.**			**Level Switches**			
X	Probe Type		Float Type	Column 1		Column 2	
	Valves			X	HI-HI		HI-HI
	Process block			X	HI		HI
X	Drain			X	LO		LO
	Vent			X	LO-LO		LO-LO

Aux. LWCO

1	Qty.		Valves
X	Probe type		Process block
	Float type	X	Drain
			Vent

Water Level Gage Glass	**Glass 1**	**Glass 2**
Prismatic	X	
Flat glass		
Bi-Color		
Illuminator	X	
Direct vision hood		
Remote viewing hood with mirrors		
Fiber optic remote		

Remote Level Indicator	
Probe Type	
Number of remote indicators	
Number of lights per indicator	
Valves	
Process block	
Drain	
Vent	

VII. Performance Guarantees

A. HRSG Performance

DESCRIPTION	UNITS	Fired	Unfired
HP Steam and Water Side			
Steam Flow *	Lbs/Hr	28,000	12,000
Steam Pressure after NRV *	psig	130	130
Steam Temperature (+/- 10°F)*	°F	Saturated	Saturated
Feedwater Water Side			
Feedwater Inlet Temperature	°F	240	240
Gas Turbine Performance			
Gas Turbine Flow	Lbs/Hr	139,882	139,882
Gas Turbine Temperature	°F	692	692
Combustion Turbine Exhaust Analysis			
CO2	(% volume)	2.39	2.39
H2O	(% volume)	5.66	5.66
N2	(% volume)	75.49	75.49
O2	(% volume)	15.55	15.55
Ar	(% volume)	0.90	0.90
Gas Side Pressure Drop *	(inches W.C.)	10	10
Duct Burner Heat Input *	MMBtu/hr LHV	16.5	--

Notes:

1. The blowdown rate is 2%.

2. Performance is calculated at site ambient pressure for guarantee point.

3. Feedwater analysis based on suggested Water Quality Limits per latest edition of ASME.

4. The steam conditions are at the RENTECH terminal points.

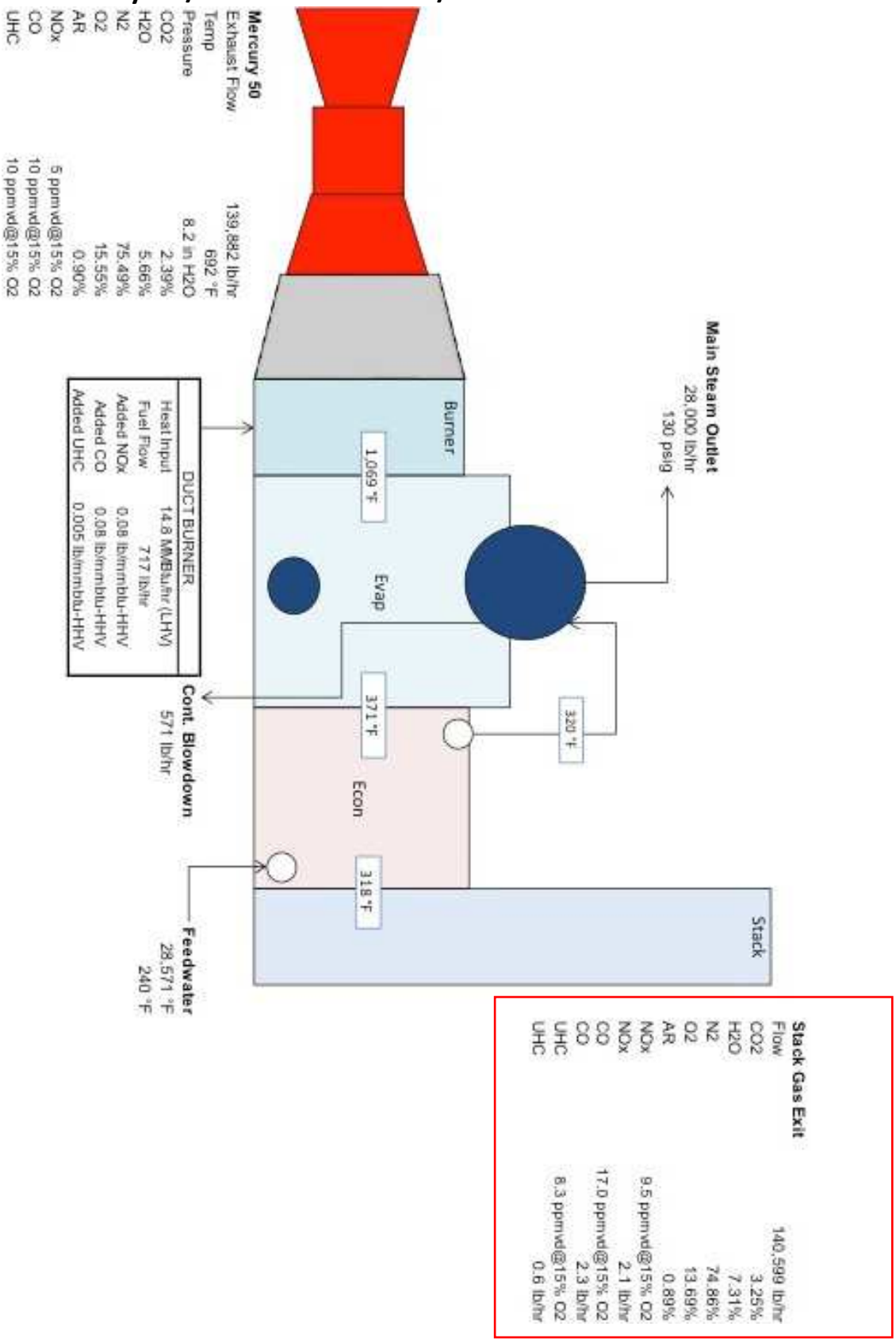
5. The RENTECH Guarantees are marked with an asterisk (*).

6. Performance Tests – By Others
   HRSG performance will be measured by a performance test based upon the principles of ASME PTC 4.4 for Heat Recovery Steam Generators. Final test procedures will need to be mutually agreed upon by both parties.

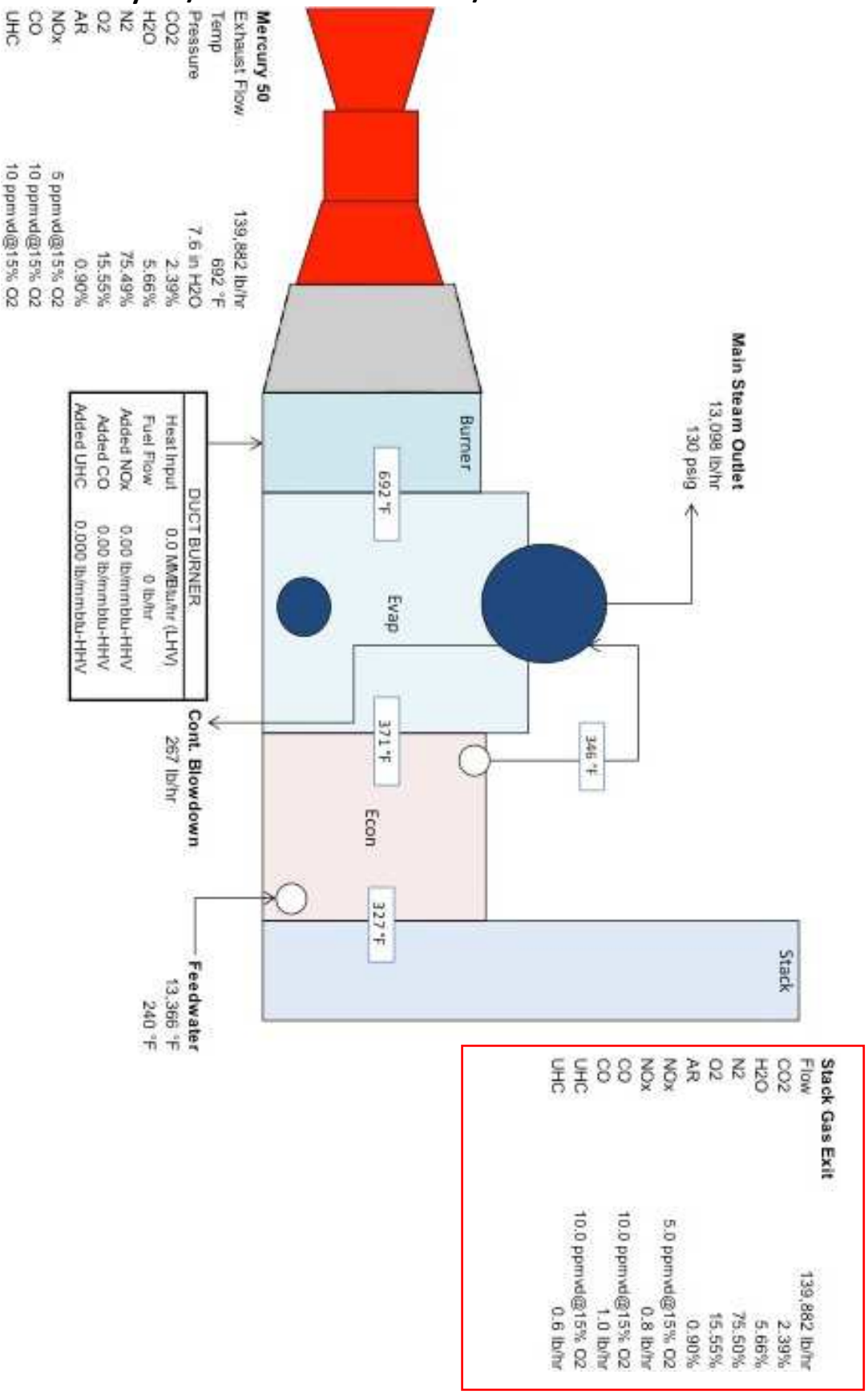
7. Steam purity based ASEM boiler water requirements.

X. Process Conditions

A. Mercury 50 / Fired Performance / 59°F



B. Mercury 50 / Unfired Performance / 59°F



Solar Turbines
A Caterpillar Company

PREDICTED ENGINE PERFORMANCE

Customer: *Cooper University Hospital*	Model: **MERCURY 50-6400R**
Job ID: **NY08-02035**	Package Type: **GSC**
Run By: **Michael Charles Cassidy** / Date Run: **18-Jul-2017**	Match: **STANDARD**
Engine Performance Code: **REV 4.54** / Engine Performance Data: **REV 1.11**	Fuel System: **GAS**
	Fuel Type: **CHOICE GAS**

DATA FOR NOMINAL PERFORMANCE

Elevation	feet	20
Inlet Loss	in H2O	5.0
Exhaust Loss	in H2O	10.0

		1	2	3	4	5
Engine Inlet Temperature	deg F	1.0	30.0	59.0	90.0	97.0
Relative Humidity	%	74.0	74.0	74.0	74.0	74.0
Specified Load*	kW	FULL	FULL	FULL	FULL	FULL
Net Output Power*	kW	5293	4990	4417	3709	3543
Fuel Flow	mmBtu/hr	44.25	43.47	39.92	35.71	34.73
Heat Rate*	Btu/kW-hr	8360	8712	9039	9630	9803
Therm Eff*	%	40.817	39.168	37.751	35.433	34.806
Inlet Air Flow	lbm/hr	149624	147928	137811	126915	124315
Engine Exhaust Flow	lbm/hr	151457	149727	139460	128319	125622
PCD	psiG	135.0	133.4	123.3	111.5	108.6
PT Exit Temp. (T7)	deg F	1177	1182	1200	1200	1200
Exhaust Temperature	deg F	621	661	692	719	725

Fuel Gas Composition (Volume Percent)

Methane (CH4)	97.55
Ethane (C2H6)	2.07
Propane (C3H8)	0.07
I-Butane (C4H10)	0.0010
N-Butane (C4H10)	0.0030
Carbon Dioxide (CO2)	0.03
Nitrogen (N2)	0.27
Sulfur Dioxide (SO2)	0.0001

Fuel Gas Properties

LHV (Btu/Scf)	922.3	Specific Gravity	0.5660	Wobbe Index at 60F	1225.9

**Electric power measured at the generator terminals.*

This performance was calculated with a basic inlet and exhaust system. Special equipment such as low noise silencers, special filters, heat recovery systems or cooling devices will affect engine performance. Performance shown is "Expected" performance at the pressure drops stated, not guaranteed.

Notes
Expected Performance

5.4 EMISSIONS OUTPUT (GAS FUEL)

The following turbine output emissions are warranted:

Gas Fuel Operation (per the Gas Fuel Component Analysis):

		With Duct Burner
NOx	5 ppmv	9.5 ppmv
CO	10 ppmv	17.0 ppmv
UHC	10 ppmv	8.3 ppmv

Operating Conditions for the above emissions are as follows:

Ambient Temperature range:	0 - 120°F (-17 -48° C)
Operating Range:	50-100%

(Emissions rates in ppmv; measured at steady state operation; and corrected to ISO conditions -- 15% O_2 dry, 59°F, 14.696 psia, 60% relative humidity)

Notes/Clarifications:

The emissions cited above are applicable only for steady-state conditions and does not apply during start-up, shutdown, malfunction, or during transient events.

5.6 GAS TURBINE DATA TABLE

GAS TURBINE POWER GENERATOR BID FORM		
Manufacturer -		
No.	**Item Description**	**Data / Item Cost**
1.0	**General Data**	
1.1	Power Generator Model Number	Mercury 50-6400R
1.2	Overall Turbine Generator Set Dimensions (L x W x H) (ft)	36.5 x 10.5 x 12.3
1.3	Power Generator Operating Weight (lb)	105,100
2.0	**Power Generator Performance Data (provide data for 0F, 59F & 90F ambient air temperatures at 13-ft elev)** (Used 20 fasl to match Section 2.03 of Specification)	
2.1	Ambient Air Conditions:	0/59/90
2.2	Site Elevation above Sea Level (ft):	20
2.3	Turbine Inlet Pressure Loss (in.wg):	5
2.4	Turbine Outlet Pressure Loss (in.wg):	10
2.5	Net Electrical Output Power (kWe) (1): (Measured at the generator terminals)	5299/4417/3709
2.6	Manufacturers ratings based on LHV of (BTU / Cu. Ft.)	922.3
2.7	Natural Gas Fuel Flow at LHV (mmbtu/hr)	44.25/39.92/35.71
2.8	Heat Rate (btu/kW-hr)	8351/9039/9630
2.9	CT Thermal Efficiency (%)	40.859/37.751/35.433
2.10	CT Thermal Recovery (mmbtu/hr) (Available Exhaust Heat)	13.092
2.11	Turbine Inlet Air Flow for Combustion (lb_m/hr)	149626/137811/126915
2.12	Turbine Exhaust Gas Mass Flow (Lb_m/hr)	151460/139460/128319
2.13	Turbine Exhaust Gas Volumetric Flow (Scfm)	33449/30920/28679
2.14	Turbine Exhaust Gas Temperature (°F)	620/692/719
2.15	Ventilation (Scfm) (Inlet Opening/Exhaust Opening)	34,000/34,000
2.16	Required minimum ventilation temperature (°F) (Standard operating range of package)	-4 to 120
3.0	**Emissions Data (at 0F ambient air, 13-ft elevation)**	
3.1	NO_x: ppmv; lb_m/hr	5/.89
3.2	CO: ppmv; lb_m/hr	10/1.1
3.4	CH_2O (formaldehyde): lb_m/hr	0.14
3.5	PM_{10}: lb_m/hr	0.5
4.0	**Natural Gas Criteria**	
	Natural Gas Pressure required at CT Entrance to the Valve Train: PSI	See Skid Edge Pressure Curve
	Natural Gas Temperature: °F	See ES 9-98
	Oil Carryover (Fuel Gas Compressor)	0.5 ppmw

PWI Engineering
Philadelphia PA

Base Loaded Firm
Cooper University Hospital

Duct Burner Efficiency 95%

Peak Cooling = Tons
Peak Cooling = KW / Ton
Seasonal Avg. = KWH / Tn - Hr

Electricity Tariff

First Tier	N/A	$ / KWH
Second Tier	N/A	$ / KWH
Third Tier	N/A	$ / KWH
Off-Peak Credit, June Thru September	$0.0000	$ / KWH
Off-Peak Credit, October Thru May	$0.0000	$ / KWH
On-Peak Charge, June Thru September	$0.0000	$ / KWH
On-Peak Charge, October Thru May	$0.0000	$ / KWH

Demand $0.00 / KW
Tax Rate 0.00%
Service Charge $0.00

Steam Turbine Chiller

Peak Demand N/A Tons
Peak Demand Lbs / Tn - Hr
NPLV Lbs / Tn - Hr
Peak Cooling = KW / Ton
Seasonal Avg. = KWH / Tn - Hr

Generation Data

Size 4,500 KW
Generation Efficiency 38.0%
Input 40.42 MMBTUH
Available Hot Water Heat Recovery 0.00 MMBTUH
Available Steam Heat Recovery 15.80 MMBTUH
Fuel Type Natural Gas
Fuel Cost $5.190 / MMBTU
Generation Cost $0.0466 / KWH
Gas Demand 39,278 CFH
CoGen Pump 250.00 KW

Electric Generation

33,726,733 Total KWH Output
115,109 MMBtu Output
341,341 MMBtu Input
33.72% Annual Electrical Efficiency

CoGen Peak Heat Recovery Efficiency

Hot Water 0.00%
Steam 39.10%

CoGen Annual Efficiency

119,269 MMBtu Recoverable Thermal Output
119,269 MMBtu Utilized Thermal Output
34.94% Annual Thermal Efficiency
4,250 KW Net Output
4,857 Full Load Hours
68.7% Annual Fuel Conversion Efficiency

	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Annual Totals	
Generator Operating Hours	753	681	382	673	688	716	744	744	718	714	376	747	7936	
Billing Days	31	28	31	30	31	30	31	31	30	31	30	31	365	
Peak Days	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	
Peak Hours	336	320	368	352	336	352	352	352	352	336	352	368	4176	
Off-Peak Hours	408	352	376	368	408	368	392	392	368	408	368	376	4584	
Hours Per Month	744	672	744	720	744	720	744	744	720	744	720	744	8760	
Demand (KW)			Maintenance								Maintenance			
Total Site On Peak Base Building	5,483	6,001	6,167	6,091	6,457	6,697	7,846	8,018	7,674	6,487	6,116	5,345	**8,018**	Peak KW, Site (bold indicates estimated values)
Estimated Chiller Plant	0	0	0	0	0	0	0	0	0	0	0	0	**0**	Peak KW, Chillers
Estimated Buildings	5,483	6,001	6,167	6,091	6,457	6,697	7,846	8,018	7,674	6,487	6,116	5,345	**8,018**	Peak KW, Buildings
CoGen Pump	250	250	250	0	250	250	250	250	250	0	250	250		
Co Gen Peak Shaving	4,500	4,500	4,500	0	4,500	4,500	4,500	4,500	4,500	0	4,500	4,500		
Steam Turbine or Absorption Chiller Credit	0	0	0	0	0	0	0	0	0	0	0	0		
Total Site From Utility	839	1,458	5,479	1,841	2,207	2,447	3,596	3,768	3,424	2,237	6,116	802	**6,116**	Peak KW, From Utility
Ratchet Peak	0	0	0	0	0	0	0	0	0	0	0	0		
On Peak Billed	839	1,458	5,479	1,841	2,207	2,447	3,596	3,768	3,424	2,237	6,116	802		
Off Peak Shaving	4,250	4,250	4,250	4,250	4,250	4,250	4,250	4,250	4,250	4,250	4,250	4,250		
Demand $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$0**	
Usage (KWH)														
On Peak Site Usage Base Building	1,551,779	1,526,246	1,725,169	1,600,053	1,584,352	1,917,342	2,243,687	2,290,291	2,027,880	1,629,563	1,742,098	1,734,990	**21,573,452**	KWH Site (bold indicates estimated monthly values)
Estimated Chiller Plant	0	0	0	0	0	0	0	0	0	0	0	0	**0**	KWH Chiller Plant
Estimated Buildings	1,551,779	1,526,246	1,725,169	1,600,053	1,584,352	1,917,342	2,243,687	2,290,291	2,027,880	1,629,563	1,742,098	1,734,990	**21,573,452**	KWH Buildings
On Peak Total	1,551,779	1,526,246	1,725,169	1,600,053	1,584,352	1,917,342	2,243,687	2,290,291	2,027,880	1,629,563	1,742,098	1,734,990	**21,573,452**	On Peak Total
Net On Peak Shaving	1,468,573	1,406,102	817,338	1,425,972	1,375,807	1,494,116	1,496,000	1,496,000	1,495,886	1,398,485	821,771	1,621,093	**16,317,143**	Net On Peak Shaving
On Peak Usage From Utility	83,206	120,145	907,831	174,081	208,546	423,226	747,687	794,291	531,994	231,078	920,327	113,897	**5,256,309**	On Peak Usage From Utility
Off Peak Site Usage Base Building	1,827,155	1,583,347	1,674,602	1,575,792	1,692,027	1,825,526	2,239,224	2,339,209	1,894,382	1,788,892	1,617,588	1,638,377	**21,696,122**	KWH Site
Estimated Chiller Plant	0	0	0	0	0	0	0	0	0	0	0	0	**0**	KWH Chiller Plant
Estimated Buildings	1,827,155	1,583,347	1,674,602	1,575,792	1,692,027	1,825,526	2,239,224	2,339,209	1,894,382	1,788,892	1,617,588	1,638,377	**21,696,122**	KWH Buildings
Off Peak Total	1,827,155	1,583,347	1,674,602	1,575,792	1,692,027	1,825,526	2,239,224	2,339,209	1,894,382	1,788,892	1,617,588	1,638,377	**21,696,122**	Off Peak Total
Net Off Peak Shaving	1,731,847	1,489,786	806,115	1,435,436	1,546,542	1,549,204	1,665,992	1,665,472	1,554,709	1,634,321	774,864	1,555,302	**17,409,590**	Net Off Peak Shaving
Off Peak Usage From Utility	95,309	93,561	868,487	140,357	145,485	276,323	573,233	673,737	339,673	154,570	842,724	83,075	**4,286,532**	Off Peak Usage From Utility
Steam Turbine or Absorption Chiller Credit	0	0	0	0	0	0	0	0	0	0	0	0	**0**	Steam Turbine or Absorption Chiller Credit KWH
Total Site KWH	3,378,934	3,109,593	3,399,771	3,175,845	3,276,379	3,742,868	4,482,911	4,629,500	3,922,263	3,418,455	3,359,686	3,373,368	**43,269,573**	Total Site KWH
NetTotal Site Generated KWH	3,200,420	2,895,888	1,623,453	2,861,408	2,922,348	3,043,319	3,161,992	3,161,472	3,050,596	3,032,807	1,596,635	3,176,396	**33,726,733**	Net Total Site Generated KWH
Total Site KWH From Utility + Credit	178,514	213,705	1,776,319	314,437	354,031	699,549	1,320,919	1,468,028	871,667	385,648	1,763,051	196,972	**9,542,840**	Total Site KWH From Utility
kwh check (HIDE)	**3,378,934**	**3,109,593**	**3,399,771**	**3,175,845**	**3,276,379**	**3,742,868**	**4,482,911**	**4,629,500**	**3,922,263**	**3,418,455**	**3,359,686**	**3,373,368**	**43,269,573**	**43,269,573**
Utility Total Firm Price Energy $ Distribution $	$18,708	$22,396	$186,158	$32,953	$37,102	$73,313	$138,432	$153,849	$91,351	$40,416	$184,768	$20,643	**$1,000,090**	
$ Total Usage & Service Charge	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
$ Total Demand, Usage & Service Charge	$18,708	$22,396	$186,158	$32,953	$37,102	$73,313	$138,432	$153,849	$91,351	$40,416	$184,768	$20,643		
Sales Tax	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	Total	
Total Electric Bill $$$	$18,708	$22,396	$186,158	$32,953	$37,102	$73,313	$138,432	$153,849	$91,351	$40,416	$184,768	$20,643	$1,000,090	Total Purchased Electric Cost
$/KWH Average	$0.1048	$0.1048	$0.1048	$0.1048	$0.1048	$0.1048	$0.1048	$0.1048	$0.1048	$0.1048	$0.1048	$0.1048	$0.1048	/ KWH
Thermal Generation Energy													$0.0000	/ Ton Hour
MM BTU	31,682	28,905	16,461	29,227	29,870	30,975	32,173	32,168	31,045	30,932	16,181	31,721	341,341	33011.73
Thermal Generation $$$	$156,194	$142,503	$81,153	$144,089	$147,260	$152,707	$158,614	$158,589	$153,052	$152,493	$79,771	$156,387	$1,771,561	
$ / KWH	$0.04880	$0.04921	$0.04999	$0.05036	$0.05039	$0.05018	$0.05016	$0.05016	$0.05017	$0.05028	$0.04996	$0.04923	$0.0525	
Heat Recovery														
Available Hot Water Heat Recovery MM BTU	0	0	0	0	0	0	0	0	0	0	0	0	0	
Available Steam Heat Recovery MM BTU	10,107	9,501	5,793	10,505	10,737	11,134	11,564	11,563	11,159	11,118	5,663	10,426	119,269	
Boiler Plant													4,246	
Boiler Input, MM Btu	22,050	18,768	19,662	27,973	24,024	22,672	22,376	23,529	22,486	24,974	19,278	21,913	269,705	Boiler Input, MM Btu
Boiler Output, MMBtu	17,860	15,202	15,926	22,658	19,460	18,364	18,125	19,059	18,213	20,229	15,615	17,750	218,461	Boiler Output, MMBtu
Average Boiler Output, MMBtuh	24.01	22.62	21.41	31.47	26.16	25.51	24.36	25.62	25.30	27.19	21.69	23.86	24.93	Average Boiler Output, MMBtuh
Domestic Hot Water MMBTU	0	0	0	0	0	0	0	0	0	0	0	0	0	Domestic Hot Water MMBTU
Domestic Hot Water MMBH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		Domestic Hot Water MMBH
Total Load Buildings, MMBtu	17,860	15,202	15,926	22,658	19,460	18,364	18,125	19,059	18,213	20,229	15,615	17,750	218,461	Total Load Buildings, MMBtu
Absorption or Steam Turbine Chiller Load, MMBtu	0	0	0	0	0	0	0	0	0	0	0	0	0	Asorption or Steam Turbine Chiller Load, MMBtu
Total Facility Load, MM Btu	17,860	15,202	15,926	22,658	19,460	18,364	18,125	19,059	18,213	20,229	15,615	17,750	218,461	Total Facility Load, MM Btu
Average Facility Load, MMBtuh	24.01	22.62	21.41	31.47	26.16	25.51	24.36	25.62	25.30	27.19	21.69	23.86	24.93	Average Facility Load, MMBtuh
% Boiler Output That Is HVAC Hot Water, MMBtu	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	% Boiler Output That Is HVAC Hot Water, MMBtu
Total Facility Hot Water Load, MM Btu	0	0	0	0	0	0	0	0	0	0	0	0	0	Facility Hot Water Load, MM Btu
Average Hot Water Load MMBtuh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	Average Hot Water Load MMBtuh
Utilized Hot Water Heat Recovery, MM Btu	0	0	0	0	0	0	0	0	0	0	0	0	0	Utilized Hot Water Heat Recovery, MM Btu
Main Facility Net Load, MM Btu	17,860	15,202	15,926	22,658	19,460	18,364	18,125	19,059	18,213	20,229	15,615	17,750	218,461	Main Facility Net Load, MM Btu
Steam Heat Recovery, MM Btu	10,107	9,501	5,793	10,505	10,737	11,134	11,564	11,563	11,159	11,118	5,663	10,426	119,269	Steam Heat Recovery, MM Btu
% OF Recoverable Heat Used	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100.0%	% OF Recoverable Heat Used
Total Boiler Net Load, MM Btu	7,753	5,701	10,133	12,153	8,723	7,231	6,561	7,496	7,055	9,111	9,952	7,324	99,191	Total Boiler Net Load, MM Btu
Total Boiler Input, MM Btu	8,161	6,001	10,666	12,792	9,182	7,611	6,906	7,891	7,426	9,590	10,475	7,709	104,412	Total Boiler Input, MM Btu
	9,187	7,480	12,007	14,880	10,336	8,854	7,774	8,883	8,638	10,796	12,185	8,678		
Total Boiler Operating Cost	$42,357	$31,147	$55,359	$66,392	$47,655	$39,502	$35,841	$40,953	$38,541	$49,774	$54,367	$40,010	$541,899	Total Boiler Operating Cost
Net Total Energy Cost $$$	$217,258.72	$196,046.19	$322,669.86	$243,434.23	$232,017.89	$265,522.47	$332,887.54	$353,391.65	$282,943.37	$242,683.65	$318,905.75	$217,039.41	**$3,224,801**	Total Energy Cost
Total Energy Cost Savings$$$													$3,091,373	Energy Cost Savings

APPENDIX C -
POTENTIAL TO EMIT CALCULATIONS

Table C-1
CHP Unit Potential to Emit - ISO Conditions
Cooper University Hospital - Camden, NJ

Pollutant	Emissions Factor	Units	Emissions Factor (lb/MMBtu)	Notes	PTE [(d)]		PTE [(e)]	
					Turbine (lb/hr)	Duct Burner (lb/hr)	(lb/hr)	(tpy)
NO_X	2.27	lb/hr	-	(a)	0.81	1.46	-	9.94
CO	2.45	lb/hr	-	(a)	0.99	1.46	-	10.73
SO_2	0.01	lb/hr	-	(a)	7.24E-03	2.96E-03	-	0.04
PM	0.60	lb/hr	-	(a)	0.45	0.15	-	2.63
PM_{10}	0.60	lb/hr	-	(a)	0.45	0.15	-	2.63
$PM_{2.5}$	0.60	lb/hr	-	(a)	0.45	0.15	-	2.63
VOC	0.28	lb/hr	-	(b)	0.11	0.17	-	1.22
CO_2	53.06	kg/MMBtu	117.00	(a)	5,176	1,930	7,106	31,132
CH_4	-	-	0.01	(d)	0.51	1.25	1.76	7.70
N_2O	-	-	2.30E-03	(a)	0.10	0.04	0.14	0.61
1,3-Butadiene	4.30E-07	lb/MMBtu	4.30E-07	(c)	1.90E-05	7.10E-06	2.61E-05	1.14E-04
Acetaldehyde	4.00E-05	lb/MMBtu	4.00E-05	(c)	1.77E-03	6.60E-04	2.43E-03	0.011
Acrolein	6.40E-06	lb/MMBtu	6.40E-06	(c)	2.83E-04	1.06E-04	3.89E-04	1.70E-03
Benzene	1.20E-05	lb/MMBtu	1.20E-05	(c)	5.31E-04	1.98E-04	7.29E-04	3.19E-03
Ethylbenzene	3.20E-05	lb/MMBtu	3.20E-05	(c)	1.42E-03	5.28E-04	1.94E-03	8.51E-03
Formaldehyde	-	-	2.88E-03	(a)	0.13	0.05	0.17	0.77
Naphthalene	1.30E-06	lb/MMBtu	1.30E-06	(c)	5.75E-05	2.15E-05	7.90E-05	3.46E-04
Polycyclic Aromatic Hydrocarbons	2.20E-06	lb/MMBtu	2.20E-06	(c)	9.74E-05	3.63E-05	1.34E-04	5.85E-04
Propylene Oxide	2.90E-05	lb/MMBtu	2.90E-05	(c)	1.28E-03	4.79E-04	1.76E-03	7.72E-03
Toluene	1.30E-04	lb/MMBtu	1.30E-04	(c)	5.75E-03	2.15E-03	7.90E-03	0.03
Xylenes	6.40E-05	lb/MMBtu	6.40E-05	(c)	2.83E-03	1.06E-03	3.89E-03	0.02
Total HAP	--	--	--	--	0.14	0.05	0.19	0.85

[(a)] Emissions factors from manufacturer specifications for a Solar Turbines Mercury 50-6400R natural gas-fired combustion turbine

[(b)] Emissions factor from manufacturer specifications for a Solar Turbines Mercury 50-6400R natural gas-fired combustion turbine. Manufacturer documentation indicates that VOC emissions are 20% of the UHC emission factor.

[(c)] Emissions factors from U.S. EPA AP-42 Chapter 3.1, Tables 3.1-2a and 3.1-3 for natural gas-fired turbines.

[(d)] Emissions factor from manufacturer specifications for a Solar Turbines Mercury 50-6400R natural gas-fired combustion turbine. Manufacturer documentation indicates that methane emissions are 90% of the UHC emission factor.

[(e)] Emissions are calculated according to the following:

Parameter	Value	Units
Turbine Heat Input	44.25	MMBtu/hr
Duct Burner Heat Input	16.50	MMBtu/hr
Proposed Annual Throughput Limit	521.74	MMcf/yr
Annual Operating Hours	8,760	hr/yr
Natural Gas Heating Value	1,020	Btu/cf
Pound to Kilogram Conversion	2.20	lb/kg
Pound to Ton Conversion	2,000	lb/ton

Table C-2
CHP Unit Potential to Emit - Zero Degree Conditions
Cooper University Hospital - Camden, NJ

Pollutant	Emissions Factor	Units	Emissions Factor (lb/MMBtu)	Notes	PTE [d]		PTE [e]	
					Turbine (lb/hr)	Duct Burner (lb/hr)	(lb/hr)	(tpy)
NO_X	2.59	lb/hr	-	(a)	0.88	1.71	-	11.34
CO	2.78	lb/hr	-	(a)	1.08	1.70	-	12.18
SO_2	0.01	lb/hr	-	(a)	7.90E-03	3.50E-03	-	0.05
PM	0.70	lb/hr	-	(a)	0.49	0.21	-	3.07
PM_{10}	0.70	lb/hr	-	(a)	0.49	0.21	-	3.07
$PM_{2.5}$	0.70	lb/hr	-	(a)	0.49	0.21	-	3.07
VOC	0.32	lb/hr	-	(b)	0.12	0.19	-	1.38
CO_2	53.06	kg/MMBtu	117.00	(a)	5,176	1,930	7,106	31,132
CH_4	-	-	0.01	(d)	0.55	1.42	1.98	8.65
N_2O	-	-	2.30E-03	(a)	0.10	0.04	0.14	0.61
1,3-Butadiene	4.30E-07	lb/MMBtu	4.30E-07	(c)	1.90E-05	7.10E-06	2.61E-05	1.14E-04
Acetaldehyde	4.00E-05	lb/MMBtu	4.00E-05	(c)	1.77E-03	6.60E-04	2.43E-03	0.011
Acrolein	6.40E-06	lb/MMBtu	6.40E-06	(c)	2.83E-04	1.06E-04	3.89E-04	1.70E-03
Benzene	1.20E-05	lb/MMBtu	1.20E-05	(c)	5.31E-04	1.98E-04	7.29E-04	3.19E-03
Ethylbenzene	3.20E-05	lb/MMBtu	3.20E-05	(c)	1.42E-03	5.28E-04	1.94E-03	8.51E-03
Formaldehyde	-	-	2.88E-03	(a)	0.13	0.05	0.17	0.77
Naphthalene	1.30E-06	lb/MMBtu	1.30E-06	(c)	5.75E-05	2.15E-05	7.90E-05	3.46E-04
Polycyclic Aromatic Hydrocarbons	2.20E-06	lb/MMBtu	2.20E-06	(c)	9.74E-05	3.63E-05	1.34E-04	5.85E-04
Propylene Oxide	2.90E-05	lb/MMBtu	2.90E-05	(c)	1.28E-03	4.79E-04	1.76E-03	7.72E-03
Toluene	1.30E-04	lb/MMBtu	1.30E-04	(c)	5.75E-03	2.15E-03	7.90E-03	0.03
Xylenes	6.40E-05	lb/MMBtu	6.40E-05	(c)	2.83E-03	1.06E-03	3.89E-03	0.02
Total HAP	--	--	--	--	0.14	0.05	0.19	0.85

[a] Emissions factors from manufacturer specifications for a Solar Turbines Mercury 50-6400R natural gas-fired combustion turbine

[b] Emissions factor from manufacturer specifications for a Solar Turbines Mercury 50-6400R natural gas-fired combustion turbine. Manufacturer documentation indicates that VOC emissions are 20% of the UHC emission factor.

[c] Emissions factors from U.S. EPA AP-42 Chapter 3.1, Tables 3.1-2a and 3.1-3 for natural gas-fired turbines.

[d] Emissions factor from manufacturer specifications for a Solar Turbines Mercury 50-6400R natural gas-fired combustion turbine. Manufacturer documentation indicates that methane emissions are 90% of the UHC emission factor.

[e] Emissions are calculated according to the following:

Parameter	Value	Units
Turbine Heat Input	44.25	MMBtu/hr
Duct Burner Heat Input	16.50	MMBtu/hr
Proposed Annual Throughput Limit	521.74	MMcf/yr
Annual Operating Hours	8,760	hr/yr
Natural Gas Heating Value	1,020	Btu/cf
Pound to Kilogram Conversion	2.20	lb/kg
Pound to Ton Conversion	2,000	lb/ton

Estimated Power Island Emissions

Cooper University Hospital

Estimated using data available as of January 26, 2023

(1) Mercury 50-6400R with fired HRSG		Plant Total
Ambient Temperature	°F	59.0
Gross Power Output	kW	4,408
Fuel Type		Natural Gas
Assumed Fuel Sulfur Content	lbm/MMBtu*	0.000162
Gas Turbine Exhaust Flow	lbm/hr	139,600
Duct Burner Fuel Flow	lbm/hr	800
Stack Exhaust Flow	lbm/hr	140,400
Flue Gas Temperature Leaving Gas Turbine	°F	696
Flue Gas Temperature Leaving Duct Burner	°F	1,116
Flue Gas Temperature At Stack	°F	347
Heat Input to Gas Turbine	MMBtu/hr*	44.6
Heat Input from Duct Firing	MMBtu/hr*	18.3
Additive NOx from Duct Firing	lbm/MMBtu*	0.08
Additive CO from Duct Firing	lbm/MMBtu*	0.08
Additive UHC as CH4 from Duct Firing	lbm/MMBtu*	0.045
PM10/PM2.5 Particulates from Gas Turbine	lbm/MMBtu*	0.01
Additive PM-10 Particulates from Duct Firing	lbm/MMBtu*	0.01
Turbine Exhaust Gas Analysis		
H2O, assumes 60% relative humidity	% vol	5.7%
N_2	% vol	75.5%
CO_2	% vol	2.4%
O_2	% vol	15.5%
SO_2	% vol	0.0%
Argon	% vol	0.9%
Flue Gas Analysis At Stack (Includes Duct Burner)		
H_2O	% vol	7.5%
N_2	% vol	74.8%
CO_2	% vol	3.4%
O_2	% vol	13.4%
SO_2	% vol	0.0%
Argon	% vol	0.9%
Gas Turbine Exhaust Emissions		
NOx	ppm@15%O2	5.0
	lbm/hr	0.81
CO	ppm@15%O2	10.0
	lbm/hr	0.987
UHC	ppm@15%O2	10.0
	lbm/hr	0.564
$PM_{10}/PM_{2.5}$	lbm/hr	0.446
SO_2	lbm/hr	0.00724
CO_2	lbm/hr	5,230

Emissions After Duct Burner		
NO_X	ppm@15%O2	9.9
	lbm/hr	2.27
CO	ppm@15%O2	17.6
	lbm/hr	2.45
UHC	ppm@15%O2	17.4
	lbm/hr	1.39
PM_{10}	lbm/hr	0.6
SO_2	lbm/hr	0.0102

Estimated Power Island Emissions

Cooper University Hospital

Estimated using data available as of January 26, 2023

(1) Mercury 50-6400R with fired HRSG		Plant Total
Ambient Temperature	°F	0.0
Gross Power Output	kW	5,190
Fuel Type		Natural Gas
Assumed Fuel Sulfur Content	lbm/MMBtu*	0.000162
Gas Turbine Exhaust Flow	lbm/hr	149,500
Duct Burner Fuel Flow	lbm/hr	930
Stack Exhaust Flow	lbm/hr	150,500
Flue Gas Temperature Leaving Gas Turbine	°F	623
Flue Gas Temperature Leaving Duct Burner	°F	1,085
Flue Gas Temperature At Stack	°F	364
Heat Input to Gas Turbine	MMBtu/hr*	48.7
Heat Input from Duct Firing	MMBtu/hr*	21.3
Additive NOx from Duct Firing	lbm/MMBtu*	0.08
Additive CO from Duct Firing	lbm/MMBtu*	0.08
Additive UHC as CH4 from Duct Firing	lbm/MMBtu*	0.045
PM10/PM2.5 Particulates from Gas Turbine	lbm/MMBtu*	0.01
Additive PM-10 Particulates from Duct Firing	lbm/MMBtu*	0.01
Turbine Exhaust Gas Analysis		
H2O, assumes 60% relative humidity	% vol	4.9%
N_2	% vol	76.2%
CO_2	% vol	2.5%
O_2	% vol	15.5%
SO_2	% vol	0.0%
Argon	% vol	0.9%
Flue Gas Analysis At Stack (Includes Duct Burner)		
H_2O	% vol	6.9%
N_2	% vol	75.4%
CO_2	% vol	3.5%
O_2	% vol	13.2%
SO_2	% vol	0.0%
Argon	% vol	0.9%
Gas Turbine Exhaust Emissions		
NOx	ppm@15%O2	5.0
	lbm/hr	0.884
CO	ppm@15%O2	10.0
	lbm/hr	1.08
UHC	ppm@15%O2	10.0
	lbm/hr	0.615
$PM_{10}/PM_{2.5}$	lbm/hr	0.487
SO_2	lbm/hr	0.0079
CO_2	lbm/hr	5,710

Emissions After Duct Burner		
NO_X	ppm@15%O2	10.2
	lbm/hr	2.59
CO	ppm@15%O2	17.9
	lbm/hr	2.78
UHC	ppm@15%O2	17.7
	lbm/hr	1.58
PM_{10}	lbm/hr	0.7
SO_2	lbm/hr	0.0114

Greenhouse Gas Emission Estimates

Leslie Witherspoon and Anthony Pocengal

PURPOSE

This Product Information Letter (PIL) summarizes emission factors commonly utilized to estimate greenhouse gas (GHG) emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) from gas turbines.

INTRODUCTION

PIL 291 addresses combustion related GHG emissions. The emission estimates in this PIL are assumed valid at ambient temperatures >-4°F (-20°C) and for natural gas from 50-100% load (40-100% for the Titan™ 250 and 80-100% load for the Saturn® 20) or for liquid fuel from 65-100% load (80-100% for the Saturn 20 and Centaur® 40).

For methane emissions estimates from centrifugal gas compressor seal systems see PIL 251 (Emissions from Centrifugal Compressor Dry Gas Seal System). Control options for these emissions are discussed in PIL 279 (Primary Vent Dry Gas Seal Recompression). Methane emissions associated with venting from start-up purging are estimated in PIL 219 (Pneumatic Start System). Recovery options for blowdown emissions are discussed in PIL 280 (Process Gas Vent Recompression).

Carbon Dioxide

Carbon dioxide represents ~99% of total CO2e for a natural gas fired turbine at full load. CO_2 emission estimates are available as an output from Solar's engine performance program. Please contact your Solar Account Manager or Environmental Programs for a CO_2 estimate. Alternatively, generic CO_2 emissions can be estimated by multiplying fuel flow in MMBtu/hr (HHV) by 117 lb CO_2/MMBtu (HHV) [50.3 kg/GJ] for natural gas fuel or by 163 lb CO_2/MMBtu (HHV) [70.1 kg/GJ] for liquid fuel (diesel #2).

Blending hydrogen with natural gas is a method of carbon reduction under consideration by gas turbine users, policy makers, and governments around the world. Table 1 summarizes the percent decrease in CO_2 emissions and the impact on the CO_2 emission factor estimated on Solar's products at various hydrogen blend concentrations. For project specific estimates submit a fuel gas analysis request. Because the molecular weight of the fuel decreases with the increase of H_2 in an H_2-NG fuel blend, the reduction of CO_2 on a fuel mass basis (lbm of fuel, kg of fuel) is less than the CO_2 reduction on a mole basis. Table 1 shows the reduction on a mass basis.

Table 1. Hydrogen Blended Fuels Impact on CO_2 Emissions Estimates – Simple Cycle Applications

	0% H2	5% H2	10% H2	15% H2	20% H2	30% H2	40% H2	50% H2	60% H2	70% H2	80% H2	90% H2	100% H2
CO_2 % Reduction Estimate		1-2%	3%	5%	7%	11%	16%	22%	30%	41%	54%	72%	100%
CO_2 Emission Factor lb/MMBtu (HHV) (kg/GJ)	117.2 (50.3)	115.3 (49.6)	113.3 (48.7)	111.1 (47.8)	108.7 (46.7)	103.4 (44.4)	97.1 (41.7)	89.4 (38.4)	79.9 (34.3)	67.9 (29.2)	52.2 (22.4)	30.8 (13.2)	

Assumptions: Full load, 59F, 60% RH, no losses, minimum performance, blended with San Diego natural gas.

Methane

Natural Gas Fired Turbines – Methane exists in the exhaust in very small quantities representing ~0.4% of total CO2e emissions at full load. Emissions of volatile organic compounds (VOC) may comprise up to 10-20% of Unburned Hydrocarbons (UHC). For a very conservative estimate of methane emissions from natural gas fired turbines, assume 90% of the UHC estimated/warranty value as methane. For a 25 ppm UHC warranty this is ~0.028 lb methane /MMBtu (HHV) [12g/GJ]. For a 15 ppm UHC warranty, methane is ~0.017 lb/MMBtu (HHV) [7 g/GJ].

An alternative to estimate methane emissions is to reference the U.S. Environmental Protection Agency (EPA) or Intergovernmental Panel on Climate Change (IPCC) default emission factor for methane of 0.0022 lb/MMBtu (HHV) [1 g/GJ]. However, please note that the default emission factor for natural gas is quite a bit lower than the Solar's recommend emission factor for permitting. The default EPA/IPCC emission factor is more representative of an expected "actual" emissions level.

Liquid Fuel Fired Turbines (Diesel #2) – To estimate methane emissions for #2 diesel fuel Solar recommends using the EPA/IPCC default methane emission factor of 0.0066 lb/MMBtu (HHV) [2.9 g/GJ].

For CO2e calculations the current Global Warming Potential (GWP) of methane value is 25.

Nitrous Oxide

Nitrous oxide (N_2O) can be produced in the combustion process in very small quantities representing ~0.6% of total CO2e emissions from a natural gas fired turbine at full load. Solar Turbines has limited test data for N_2O on natural gas. Based on the test data a conservative emission factor for N_2O emissions is 0.0023 lb/MMBtu (HHV) [1 g/GJ] from 50-100% load.

An alternative is to reference the EPA/IPCC default emission factors for N_2O. However, please note that the default emission factor for natural gas is an order of magnitude lower than the Solar estimate. The EPA/IPCC values originate in the 1996 IPCC Guidelines and are restated in the 2006 IPCC Guidelines and state, "…Since not many measurements of these types of emission factors are available, the uncertainty ranges are set at plus or minus a factor of three." For natural gas the EPA/IPCC emission factor is 0.00022 lb/MMBtu (HHV) [0.1g/GJ]. For #2 diesel the EPA/IPCC emission factor is 0.0014 lb/MMBtu (HHV) [0.6 g/GJ].

For CO2e calculations the current GWP of N_2O is 298.

Volatile Organic Compound, Sulfur Dioxide, and Formaldehyde Emission Estimates

Leslie Witherspoon

PURPOSE

This Product Information Letter (PIL) summarizes emission factors commonly utilized to estimate emissions of volatile organic compounds (VOC), sulfur dioxide (SO_2), and formaldehyde from gas turbines.

Volatile Organic Compounds

Many permitting agencies require gas turbine users to include emissions of VOC, a subpart of the unburned hydrocarbon (UHC) emissions, during the air permitting process. Volatile organic compounds, non-methane hydrocarbons (NMHC), and reactive organic gases (ROG) are different ways of referring to the non-methane (and non-ethane) portion of an "unburned hydrocarbon" emission estimate.

For natural gas fuel, Solar's customers often use 10-20% of the UHC emission rate to conservatively estimate VOC emissions. Solar can offer a 5 ppm VOC warranty level upon request. For liquid fuel, it is appropriate to estimate that 100% of the UHC estimate is VOC. The emissions estimates are assumed valid for natural gas at ambient temperatures >-4°F (-20C) from 50-100% load (80-100% load for the Saturn® 20 and >-20°F (-29C) and 40-100% for the Titan™ 250) and for liquid fuel from 65-100% load (80-100% for the Saturn 20 and Centaur® 40).

Environmental Protection Agency (EPA's) AP-42[1] document and WebFIRE[2] database also contain VOC emission estimates for gas turbines. These sources are not commonly used by Solar's customers.

Sulfur Dioxide

Sulfur dioxide emissions are produced by conversion of any sulfur in the fuel to SO_2. Solar customers usually either use a mass balance calculation or reference AP-42 to estimate SO_2 emissions. Because Solar does not control the amount of sulfur in the fuel, no SO_2 emissions warranty is available.

The mass balance method assumes that any sulfur in the fuel converts to SO_2. For reference, the typical mass balance equation is shown below.

$$\frac{\text{lb SO2}}{\text{hr}} = \left(\frac{\text{wt\% Sulfur}}{100}\right)\left(\frac{\text{lb fuel}}{\text{Btu}}\right)\left(\frac{10^6\ \text{Btu}}{\text{MMBtu}}\right)\left(\frac{\text{MMBtu fuel}}{\text{hr}}\right)\left(\frac{\text{MW SO2}}{\text{MW Sulfur}}\right)$$

Variables: wt% of sulfur in fuel
Btu/lb fuel (LHV)
MMBtu/hr fuel flow (LHV)

As an alternative to the mass balance calculation, EPA's AP-42 document can be used. AP-42 (Table 3.1-2a, April 2000) suggests emission factors of 0.94S lb/MMBtu (HHV) (where S=Sulfur % in fuel) or 0.0034 lb/MMBtu (HHV) for gas fuel and 1.01S lb/MMBtu (HHV) (where S=Sulfur% in fuel) or 0.33 lb/MMBtu (HHV) for liquid fuel.

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[1]AP-42 is an EPA document containing a compilation of air pollutant emission factors by source category.
[2] WebFIRE is an EPA electronic based repository and retrieval tool for emission factors.

Formaldehyde

For gas turbines, formaldehyde emissions are a result of incomplete combustion and are unstable in the exhaust stream. In this section, regulatory background, recommended emission factors, and testing considerations are discussed.

Regulatory Background and Emissions Factors – U.S. and EU

In 2004 the U.S. EPA published a Maximum Achievable Control Technology (MACT) standard (40 CFR 63 Subpart YYYY) for natural gas fired combustion turbines with a formaldehyde limit of 91 ppb (15% O2). The standard was stayed a few months later for the natural gas subcategories essentially rendering the regulation "on hold". The stay was lifted on March 9, 2022. After ~18 years of not having to comply with the MACT standard, natural gas fired combustion turbines located **at major sources of hazardous air pollutants** need to comply with the standard. The initial compliance date is September 4, 2022. With the lifting of the stay, four of the eight subcategories outlined in the Subpart YYYY must comply with the MACT standard. They are:

- stationary lean premix combustion turbines when firing gas and when firing oil at sites where all turbines fire oil no more than an aggregate total of 1,000 hours annually
- stationary lean premix combustion turbines when firing oil at sites where all turbines fire oil more than an aggregate total of 1,000 hours annually
- stationary diffusion flame combustion turbines when firing gas and when firing oil at sites where all turbines fire oil no more than an aggregate total of 1,000 hours annually
- stationary diffusion flame combustion turbines when firing oil at sites where all turbines fire oil more than an aggregate total of 1,000 hours annually

For U.S. customers with a combustion turbine that must comply with Subpart YYYY, an emission factor of 91 ppb @ 15% O2 (~0.00021 lb/MMBtu HHV) is recommended.

The formaldehyde emissions estimate of 91 ppb @15%O2 (~0.00021 lb/MMbtu HHV) can be used for all new, current production, SoLoNOx models and ratings when firing pipeline quality natural gas or ultra-low sulfur (ULSD) diesel fuel. The emissions estimate is valid for natural gas from 50-100% load (40-100% load for Titan 250) or for liquid fuel from 65-100% load (80-100% load for the Centaur 40) and at ambient temperatures >-4°F (-20C) [> -20 °F (-29C) for Titan 250].

Alternative emission factors for combustion turbines **not** affected by Subpart YYYY (or non-U.S. based combustion turbines) are from U.S. EPA's AP-42 document and are 0.00071 lb/MMBtu (HHV) for natural gas and 0.00028 lb/MMBtu (HHV) for distillate oil[3]. Note that both of the aforementioned formaldehyde emission factors are higher than the MACT standard. Since ~2003 many gas turbine users have used the emission factors found in an EPA memo Revised HAP Emission Factors for Stationary Combustion Turbines[4] for estimating hazardous air pollutant emissions. The memo presents hazardous air pollutant emission factor data in several categories. While the memo presents several formaldehyde emissions factors, the most common formaldehyde emission factor used to estimate emissions from gas turbines from this document is 0.00288 lb/MMBtu HHV (Table 16). Note that this emission factor is an order of magnitude higher than the MACT standard.

In the EU, Germany has established a formaldehyde limit of 5 mg/Nm3 for combustion turbines (13.BImSchV Section 33). This limit applies for operation at 70-100% load and it is anticipated that something similar will be adopted in other EU member states. The 5 mg/Nm3 limit is equivalent to ~0.0038 kg/GJ or ~3.7 ppm.

Formaldehyde Emissions Testing Considerations

Actual emissions of formaldehyde from Solar's gas turbines, in the SoLoNOx operating range, are predicted to be less than 91 ppb @15%O2. However, **the 91 ppb level can only be verified if the proper testing equipment is utilized.** To properly measure formaldehyde emissions, Fourier Transform Infrared (FTIR) instrumentation with limits of detection well below the standard must be utilized. Most "traditional" FTIR systems have formaldehyde

[3] AP-42, Table 3.1-3 for Natural Gas and Table 3.1-4 for Distillate Oil, 4/00.
[4] Revised HAP Emission Factors for Stationary Combustion Turbines, OAR-2002-0060, IV-B-09,8/22/03.

limits of detection in the 120-150 ppb range and are not suitable to measure formaldehyde from combustion turbines.

Solar recommends the MKS Multi Gas 2030 FTIR with StarBoost™ System, the Spectrum WaveRunIR-EXT or an equivalent system with similar path lengths and detection levels.

EPA Method 320 (or equivalent method for non-U.S. testing) should be used to measure formaldehyde. Testing should include three – 120-minute test runs. To ensure accurate formaldehyde measurements, the testing company, in addition to following the requirements of Method 320 (or equivalent method), should take necessary steps to optimize signal-to-noise, verify the FTIR is fully temperature stabilized and purged, ensure the FTIR signal is optimized before testing by maximizing alignment and cleanliness of optics, minimize sampling line bias by using clean sample lines at 250°F to prevent off-gassing and minimize contamination with other compounds, verify absence of sampling system bias via system zero measurements, measure a source specific moisture spectrum while at the test site using a water/N2 delivery systems at +/-10% of turbine moisture content, and use the source specific water spectrum as an interferent in the analysis.