TVA TENNESSEE VALLEY AUTHORITY

1101 Market Street, BR 2C, Chattanooga, Tennessee 37402

Submitted to dep.gateway.ky.gov/eForms

June 5, 2024

Mr. Michael Kennedy, Director
Kentucky Division for Air Quality
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601

Dear Mr. Kennedy:

TENNESSEE VALLEY AUTHORITY (TVA) – PARADISE COMBINED CYCLE PLANT (PCC) – SOURCE ID NO. 21-177-00006 – TITLE V PERMIT RENEWAL APPLICATION

Please find enclosed TVA's Title V Permit renewal application for PCC. This is a complete application based on the regulations in effect at the time of submittal and TVA requests that a permit shield under 401 KAR 52:020, Section 11 be included in the permit when it is issued.

If you have questions or need any additional information, please contact Jack Byars at (423) 751-2666 or via email at jgbyars@tva.gov.

Sincerely,

Jim E. Phelps
Plant Manager
Paradise Combined Cycle Plant

Enclosure

JGB:SMF
cc (Electronic Distribution w/ Enclosure):
Jack G. Byars
Donald L. Kachelman
Lisa C. Smallwood
Joseph B. Southerland
Emma M. Taul
Michael G. Tritapoe
ECM, ENVrecords

TITLE V PERMIT RENEWAL APPLICATION
PARADISE COMBINED CYCLE PLANT
DRAKESBORO, KENTUCKY

JUNE 2024

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INTRODUCTION

This application for a major stationary source operating permit is submitted by the Tennessee Valley Authority (TVA) for its Paradise Combined Cycle Plant (PCC), a steam electric generating facility. This application is intended to fulfill operating permit requirements promulgated under Kentucky Administrative Regulation (KAR) 401 KAR 52:020. With this submittal, TVA is requesting a major stationary source operating permit renewal for operations at PCC as well as a permit shield pursuant to 401 KAR 52:020 Section 11. The information provided reflects current and prior operations as well as any changes being made or anticipated. Emissions are calculated based on worst-case assumptions. However, because of variations in operating conditions, no individual parameter should be considered absolute.

General Facility Description

PCC is located on the western bank of the Green River in Muhlenberg County approximately 5 miles northeast of Drakesboro, Kentucky. The facility consists of three natural gas-fired combustion turbines (CTs 1, 2, 3) that can operate in either simple-cycle or combined-cycle mode. The combined-cycle combustion turbine plant includes a natural gas-fired auxiliary boiler, three natural gas-fired heaters, a sixteen-cell water cooling tower, and a diesel-fired emergency fire pump. The facility also includes three additional simple-cycle combustion turbines (CTs 5, 6, 7) with three natural gas-fired heaters.

PCC has an emergency two-way radio communication diesel generator and an emergency telecommunications propane generator. PCC has seven non-emergency diesel engines for routine operations during deconstruction.

Application Organization

This application is organized in the following sequence:

- Section 1 Introduction
- Section 2 General
- Section 3 Combined Cycle/Simple Cycle Combustion Turbines (CTs 1, 2, 3)
- Section 4 Three Simple Cycle Combustion Turbines (CTs 5, 6, 7)
- Section 5 Natural Gas-Fired Auxiliary Boiler
- Section 6 Natural Gas-Fired Gas Heaters (for CTs 1, 2, 3)
- Section 7 Natural Gas-Fired Gas Heaters (for CTs 5, 6, 7)
- Section 8 Emergency and Non-Emergency Diesel or Propane-Fired Engines
- Section 9 16 - Cell Cooling Tower
- Section 10 Compliance Certification

Division for Air Quality

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Frankfort, KY 40601
(502) 564-3999

DEP7007AI

Administrative Information

___ Section AI.1: Source Information
___ Section AI.2: Applicant Information
___ Section AI.3: Owner Information
___ Section AI.4: Type of Application
___ Section AI.5: Other Required Information
___ Section AI.6: Signature Block
___ Section AI.7: Notes, Comments, and Explanations

Additional Documentation

___ Additional Documentation attached

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21- 177-00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section AI.1: Source Information

Physical Location Address:	**Street:**	5562 Rockport Paradise Road			
	City:	Drakesboro	**County:** Muhlenburg	**Zip Code:**	42337-2345
Mailing Address:	**Street or P.O. Box:**	5562 Rockport Paradise Road			
	City:	Drakesboro	**State:** Kentucky	**Zip Code:**	42337-2345

Standard Coordinates for Source Physical Location

Longitude: -86.994167 (decimal degrees) **Latitude:** 37.263056 (decimal degrees)

Primary (NAICS) Category: Utilities **Primary NAICS #:** 221112

#

Classification (SIC) Category: Fossil Fuel Electric Power Generation **Primary SIC #:** 4911

Briefly discuss the type of business conducted at this site: Generation and transmission of electric power from burning natural gas.

Description of Area Surrounding Source:
☑ Rural Area ☑ Industrial Park ☐ Residential Area
☐ Urban Area ☐ Industrial Area ☐ Commercial Area

Is any part of the source located on federal land? ☑ Yes ☐ No

Number of Employees: 65

Approximate distance to nearest residence or commercial property: 5 miles

Property Area: Approx. 3,700 acres

Is this source portable? ☐ Yes ☑ No

What other environmental permits or registrations does this source currently hold or need to obtain in Kentucky?

NPDES/KPDES:	☑ Currently Hold	☐ Need	☐ N/A
Solid Waste:	☑ Currently Hold	☐ Need	☐ N/A
RCRA:	☑ Currently Hold	☐ Need	☐ N/A
UST:	☑ Currently Hold	☐ Need	☐ N/A

Type of Regulated Waste Activity:
☐ Mixed Waste Generator ☑ Generator ☐ Recycler ☐ Other: ______________
☐ U.S. Importer of Hazardous Waste ☐ Transporter ☐ Treatment/Storage/Disposal Facility ☐ N/A

Section AI.2: Applicant Information

Applicant Name: Tennessee Valley Authority (TVA)

Title: (if individual) N/A

Mailing Address:
Street or P.O. Box: 1101 Market Street
City: Chattanooga **State:** Tennessee **Zip Code:** 37402-2801

Email: (if individual) N/A

Phone: N/A

Technical Contact

Name: Emma Taul

Title: Environmental Scientist

Mailing Address:
Street or P.O. Box: 5562 Rockport Paradise Road
City: Drakesboro **State:** Kentucky **Zip Code:** 42337-2345

Email: emwethington@tva.gov

Phone: 270-929-3924

Air Permit Contact for Source

Name: Jack Byars

Title: Specialist, Air Permits and Compliance

Mailing Address:
Street or P.O. Box: 1101 Market Street, BR 2C-C
City: Chattanooga **State:** Tennessee **Zip Code:** 37402-2801

Email: jgbyars@tva.gov

Phone: 423-751-2666

Section AI.3: Owner Information

☐ **Owner same as applicant**

Name:	Jim E. Phelps
Title:	Plant Manager, TVA Paradise Combined Cycle Plant
Mailing Address: Street or P.O. Box:	5562 Rockport Paradise Road
City:	Drakesboro
State:	Kentucky
Zip Code:	42337-2345
Email:	jephelps@tva.gov
Phone:	270-476-4730

List names of owners and officers of the company who have an interest in the company of 5% or more.

Name	Position

Section AI.4: Type of Application

Current Status: ☑ Title V ☐ Conditional Major ☐ State-Origin ☐ General Permit ☐ Registration ☐ None

Requested Action:
(check all that apply)

☐ Name Change	☐ Initial Registration	☐ Significant Revision	☐ Administrative Permit Amendment
☑ Renewal Permit	☐ Revised Registration	☐ Minor Revision	☐ Initial Source-wide OperatingPermit
☐ 502(b)(10)Change	☐ Extension Request	☐ Addition of New Facility	☐ Portable Plant Relocation Notice
☐ Revision	☐ Off Permit Change	☐ Landfill Alternate Compliance Submittal	☐ Modification of Existing Facilities
☐ Ownership Change	☐ Closure		

Requested Status: ☑ Title V ☐ Conditional Major ☐ State-Origin ☐ PSD ☐ NSR ☐ Other: ____________

Is the source requesting a limitation of potential emissions? ☑ Yes ☐ No

Pollutant:	**Requested Limit:**	**Pollutant:**	**Requested Limit:**
☐ Particulate Matter		☐ Single HAP	
☐ Volatile Organic Compounds (VOC)		☐ Combined HAPs	
☐ Carbon Monoxide		☐ Air Toxics (40 CFR 68, Subpart F)	
☐ Nitrogen Oxides		☐ Carbon Dioxide	
☐ Sulfur Dioxide		☐ Greenhouse Gases (GHG)	
☐ Lead		☑ Other	766,000 MWh/CT-yr; EU 137-139 only

For New Construction:

Proposed Start Date of Construction: *(MM/YYYY)* ____________

Proposed Operation Start-Up Date: *(MM/YYYY)* ____________

For Modifications:

Proposed Start Date of Modification: *(MM/YYYY)* ____________

Proposed Operation Start-Up Date: *(MM/YYYY)* ____________

Applicant is seeking coverage under a permit shield. ☑ **Yes** ☐ **No**

Identify any non-applicable requirements for which permit shield is sought on a separate attachment to the application.

Section AI.5 Other Required Information

Indicate the documents attached as part of this application:

- ☑ DEP7007A Indirect Heat Exchangers and Turbines
- ☑ DEP7007B Manufacturing or Processing Operations
- ☐ DEP7007C Incinerators and Waste Burners
- ☐ DEP7007F Episode Standby Plan
- ☐ DEP7007J Volatile Liquid Storage
- ☐ DEP7007K Surface Coating or Printing Operations
- ☐ DEP7007L Mineral Processes
- ☐ DEP7007M Metal Cleaning Degreasers
- ☑ DEP7007N Source Emissions Profile
- ☐ DEP7007P Perchloroethylene Dry Cleaning Systems
- ☐ DEP7007R Emission Offset Credit
- ☐ DEP7007S Service Stations
- ☐ DEP7007T Metal Plating and Surface Treatment Operations
- ☑ DEP7007V Applicable Requirements and Compliance Activities
- ☐ DEP7007Y Good Engineering Practice and Stack Height Determination
- ☐ DEP7007AA Compliance Schedule for Non-complying Emission Units
- ☐ DEP7007BB Certified Progress Report
- ☑ DEP7007CC Compliance Certification
- ☑ DEP7007DD Insignificant Activities
- ☑ DEP7007EE Internal Combustion Engines
- ☐ DEP7007FF Secondary Aluminum Processing
- ☑ DEP7007GG Control Equipment
- ☐ DEP7007HH Haul Roads
- ☐ Confidentiality Claim
- ☐ Ownership Change Form
- ☐ Secretary of State Certificate
- ☑ Flowcharts or diagrams depicting process
- ☐ Digital Line Graphs (DLG) files of buldings, roads, etc.
- ☑ Site Map
- ☑ Map or drawing depicting location of facility
- ☑ Safety Data Sheet (SDS)
- ☐ Emergency Response Plan
- ☐ Other: ____________________

Section AI.6: Signature Block

I, the undersigned, hereby certify under penalty of law, that I am a responsible official*, and that I have personally examined, and am familiar with, the information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the information is on knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false or incomplete information, including the possibility of fine or imprisonment.

Jim E Phelps
Authorized Signature

6/5/2024
Date

Jim E. Phelps
Type or Printed Name of Signatory

Plant Manager
Title of Signatory

*Responsible official as defined by 401 KAR 52:001.

Section AI.7: Notes, Comments, and Explanations
Potential emissions for the new simple cycle CTs, Emission Units 137-139, will be limited by 40 CFR Part 60, Subpart TTTT, requirements.

FACILITY DESCRIPTION

Paradise Combined Cycle Plant (PCC) is located on the western bank of the Green River approximately 5 miles northeast of Drakesboro, Kentucky.

A site locality and a topographical map, shown in Figures 2-1 and 2-2, provide details about the location and property boundaries of PCC. Two overall facility flow diagrams show how the various operations at PCC are interconnected. Figure 2-3 is the facility wide flow diagram for the combined-cycle combustion turbine plant and Figure 2-4 is the facility wide flow diagram for the simple-cycle combustion turbine plant. The main site plan for PCC is shown in Figure 2-5, with emission point locations shown in Figures 2-6 through 2-9. The significant emission points at PCC are listed in Table 2-1, and insignificant activities are listed in Form DEP7007DD.

The combined-cycle plant consists of three natural gas-fired combustion turbines that can operate in either simple-cycle or combined-cycle mode. The combined-cycle plant also includes a natural gas-fired auxiliary boiler, three natural gas-fired heaters, a multiple-cell cooling tower, and a diesel-fired emergency fire pump.

The combined-cycle combustion turbines each have a maximum heat input capacity of 2,300 x 10^6 Btu/hr and each have duct burners rated at 400 x 10^6 Btu/hr. The generating capacity of each combustion turbine is 235 MW and the steam generator has a capacity of 470 MW.

In addition to the combined-cycle plant, there exists three additional simple-cycle combustion turbines and three natural gas-fired heaters. The simple-cycle combustion turbines each have a maximum heat input capacity of 2,257 x 10^6 Btu/hr. The generating capacity of each combustion turbine is 229 MW.

The facility also includes a diesel-fired emergency generator for two-way radio communication and an emergency propane generator for telecommunications. The facility also includes seven non-emergency diesel engines for six pumps and one generator for routine operations during deconstruction of the coal plant.

TABLE 2-1
LIST OF SIGNIFICANT EMISSION POINTS
PARADISE COMBINED CYCLE PLANT

Title V Emission Point Number	Emission Point Description	Control Device[1]
120	Combined Cycle Unit 1	LNB, SCR, CO Oxidation Catalyst
121	Combined Cycle Unit 2	LNB, SCR, CO Oxidation Catalyst
122	Combined Cycle Unit 3	LNB, SCR, CO Oxidation Catalyst
123	Simple Cycle Unit 1	LNB
124	Simple Cycle Unit 2	LNB
125	Simple Cycle Unit 3	LNB
137	Simple Cycle Unit 5	LNB
138	Simple Cycle Unit 6	LNB
139	Simple Cycle Unit 7	LNB
107	Auxiliary Boiler	LNB, FGR, OTS
108	Gas Heater 1	OTS
109	Gas Heater 2	OTS
110	Gas Heater 3	OTS
141	Gas Heater 4	OTS
142	Gas Heater 5	OTS
143	Gas Heater 6	OTS
104	Cell Phone Tower (Two-Way Radio) Emergency Diesel Engine	None
115	Emergency Diesel Engine Fire Pump	None
128	Emergency Telecommunication Propane Generator	None
147	Coal Yard Runoff Diesel Engine Pump #1	None
148	Coal Yard Runoff Diesel Engine Pump #2	None
149	Gypsum Stilling Pond Diesel Engine Pump #1	None
150	Gypsum Stilling Pond Diesel Engine Pump #2	None
151	Daniel Run Coal Fines Diesel Engine Pump #1	None
152	Daniel Run Coal Fines Diesel Engine Pump #2	None
155	GN 24 Fuel Tank Diesel Generator	None
114	16 Cell Water Cooling Tower	Drift Eliminators

[1]Air pollution control device/measure used for at least one component of the emission point. Key is as follows:

LNB = Low NOx Burners
SCR = Selective Catalytic Reduction
FGR = Flue Gas Recirculation
OTS = Oxygen Trim System

FIGURE 2-1. TVA - Paradise Combined Cycle Plant Locality Map

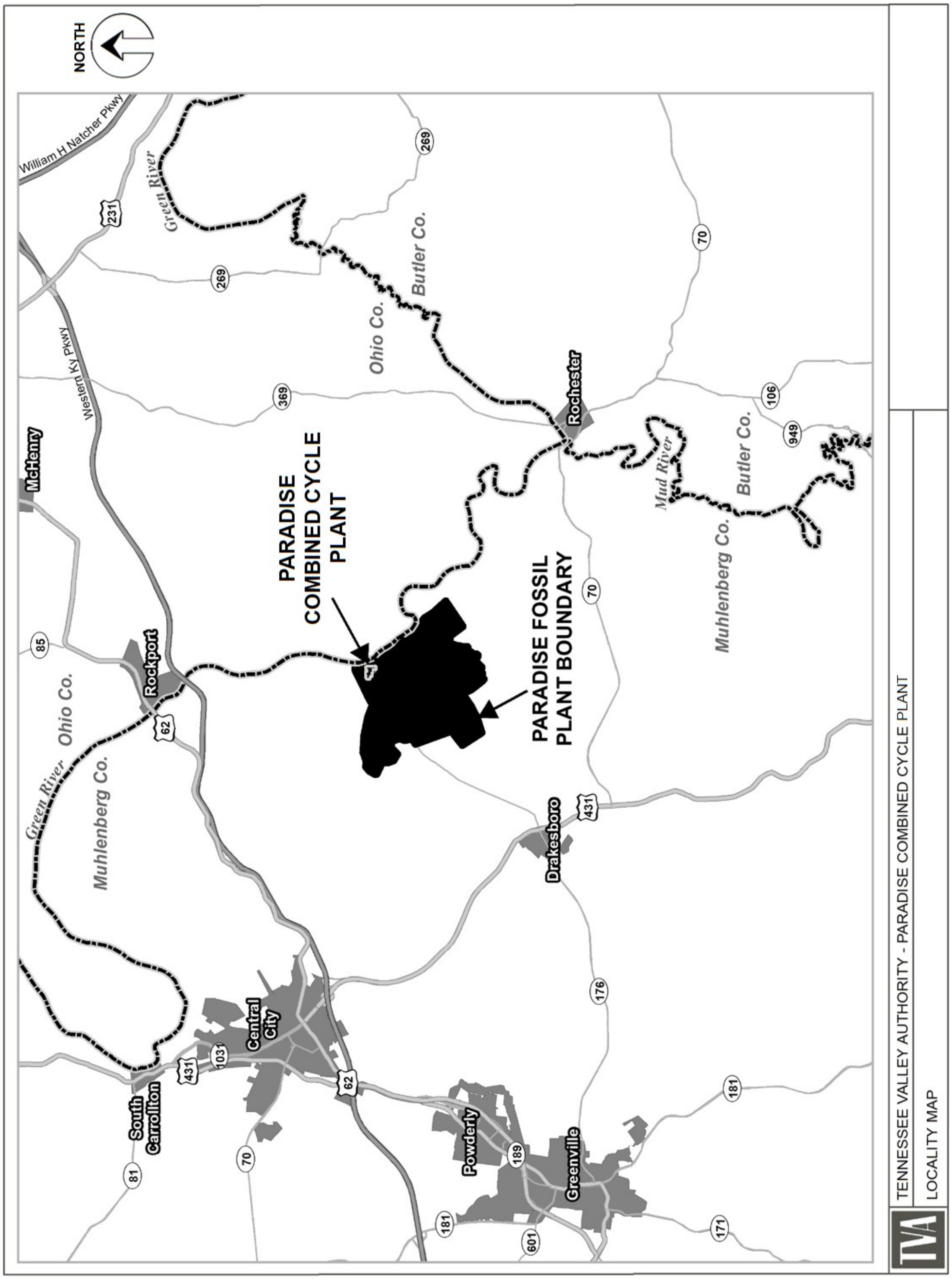


FIGURE 2-2. TVA - Paradise Combined Cycle Plant Topographic Map

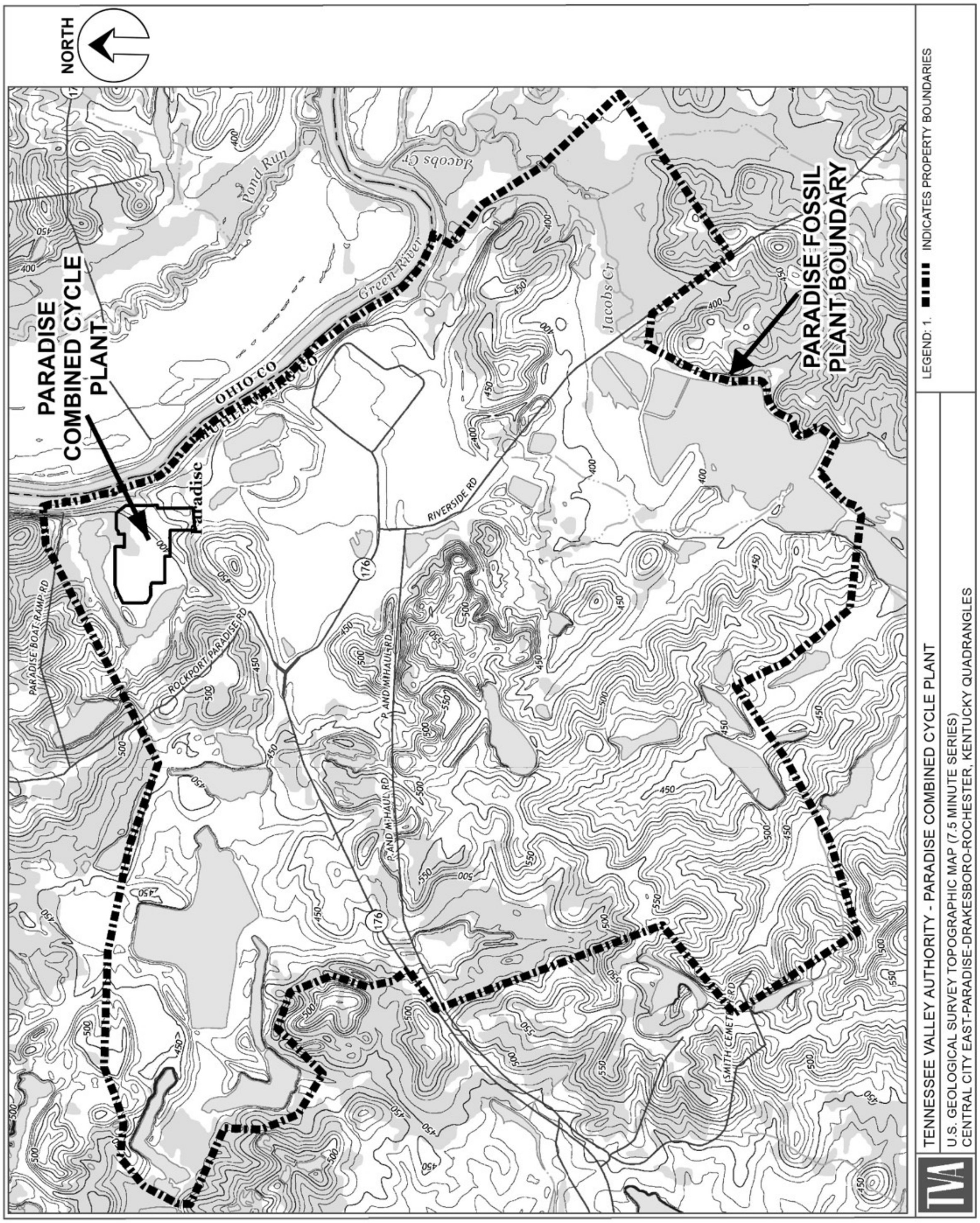


FIGURE 2-3. TVA – Paradise Combined Cycle Plant Facility Wide Flow Diagram

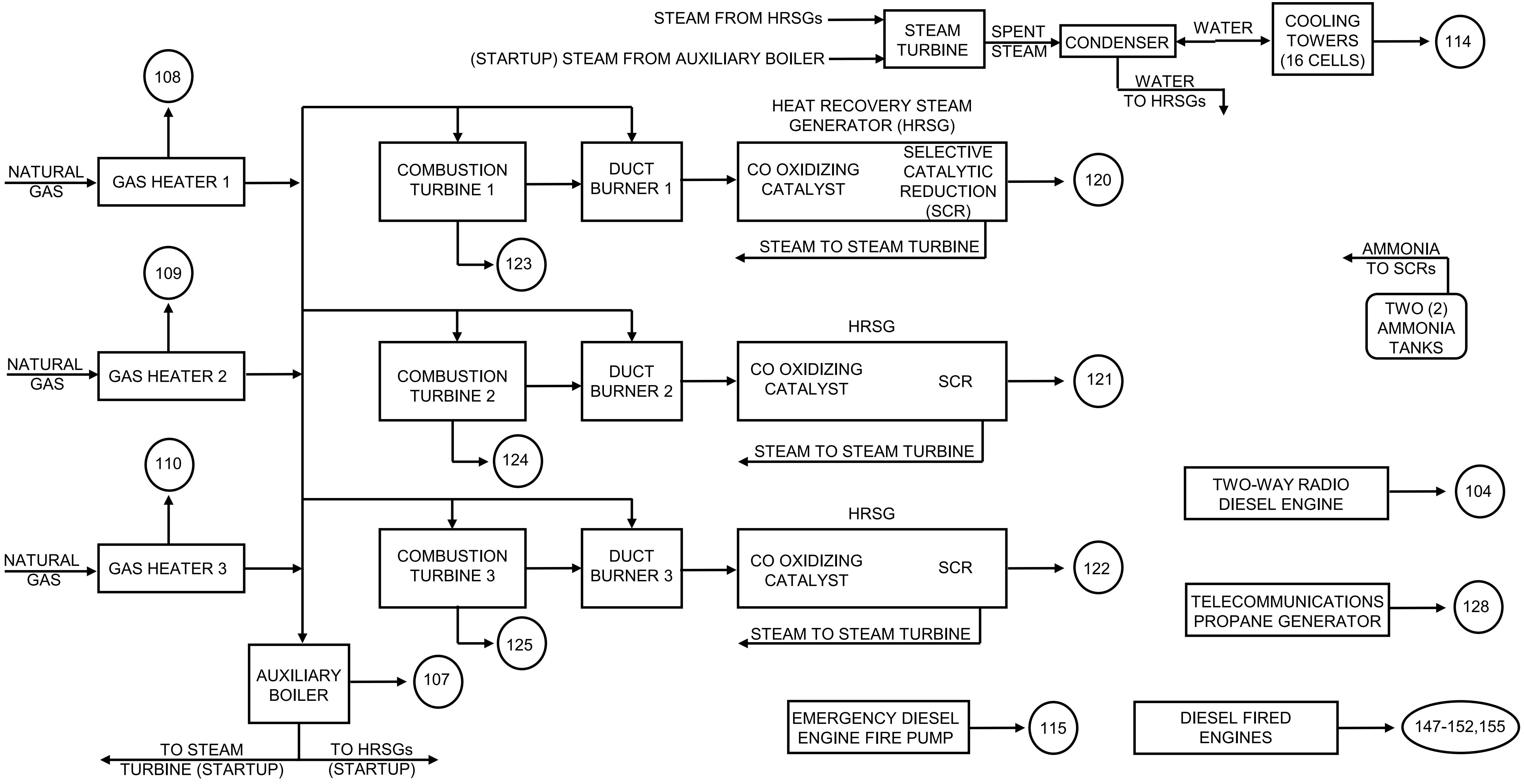


FIGURE 2-4. TVA – Paradise Simple Cycle Plant Facility Wide Flow Diagram

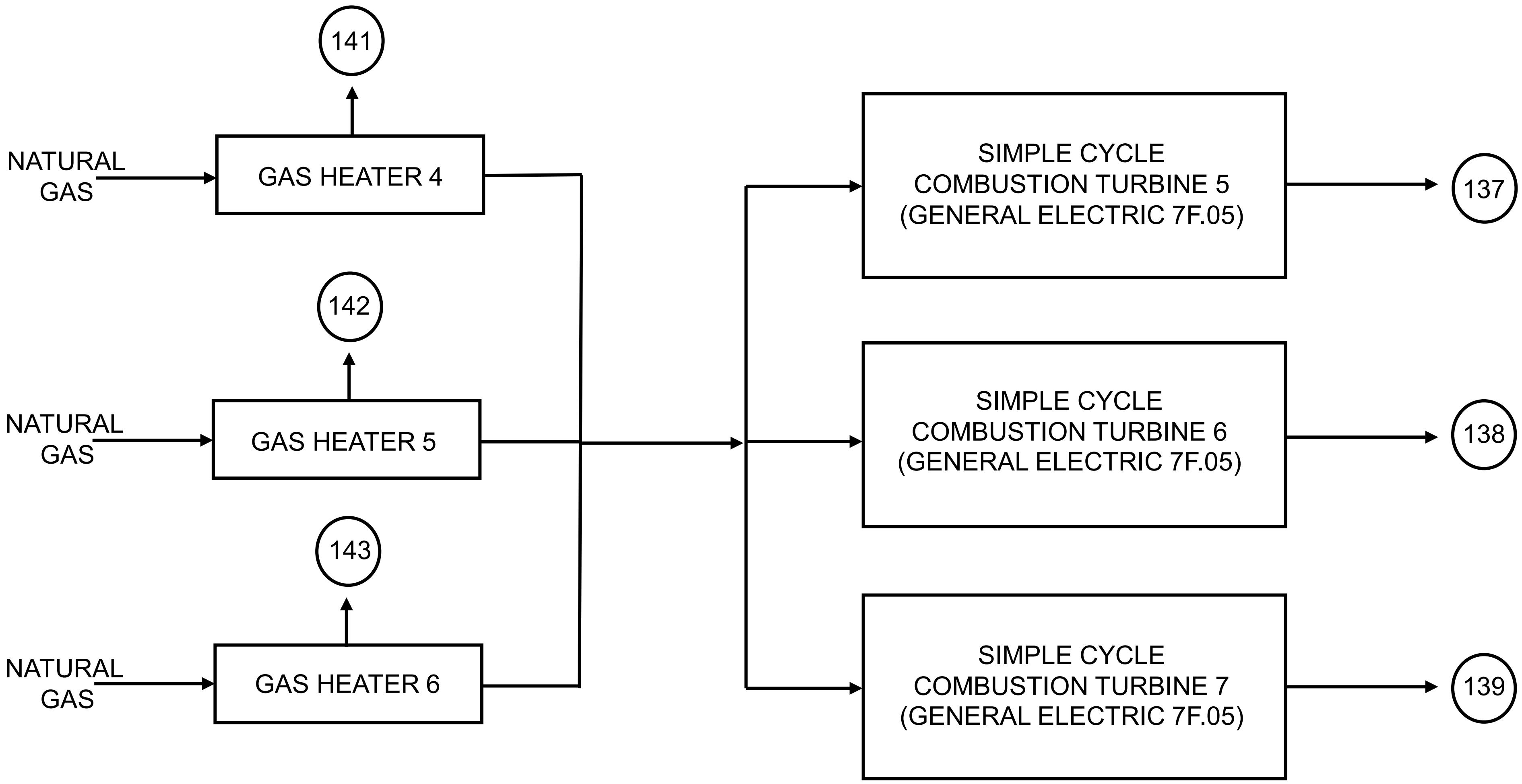
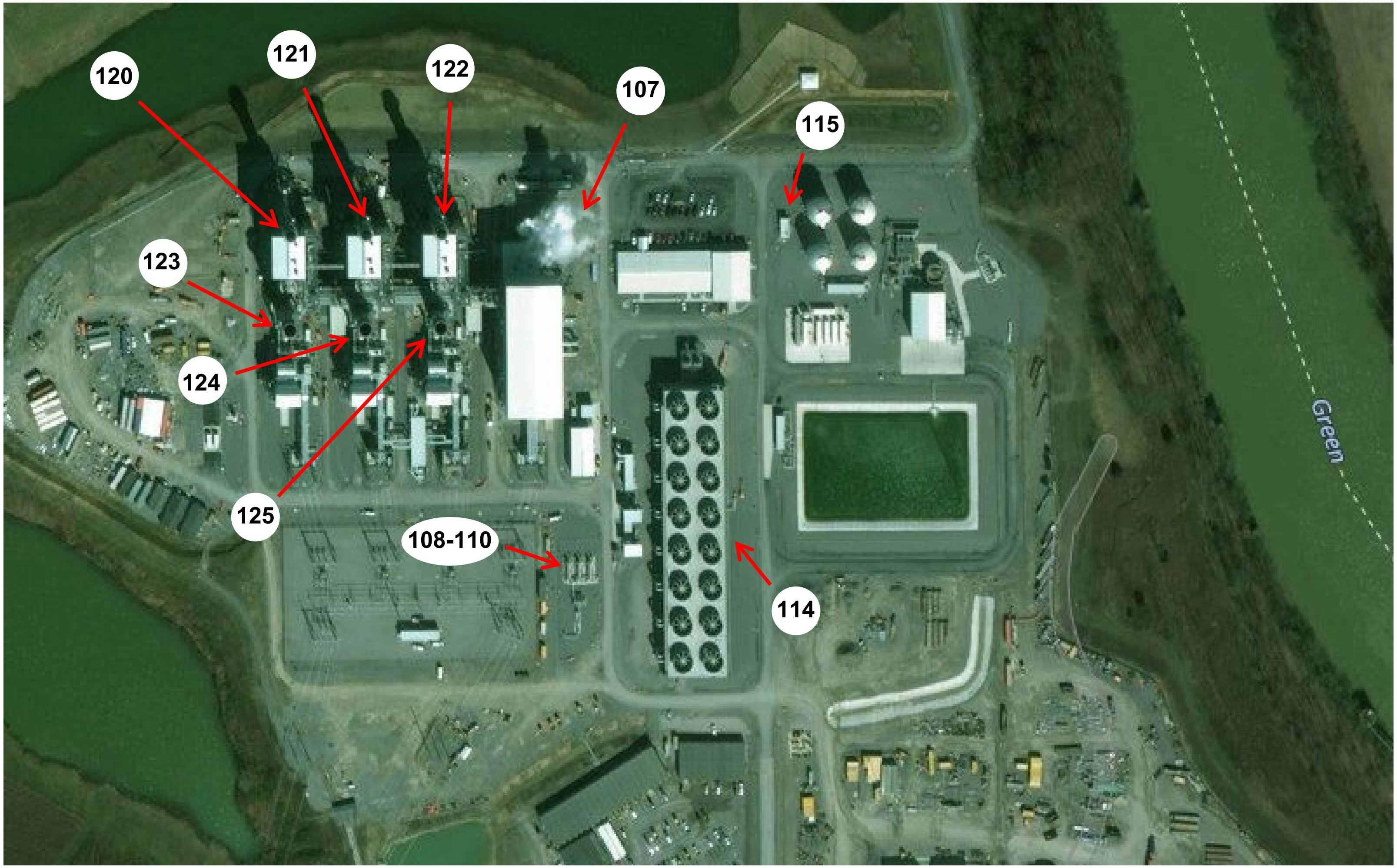


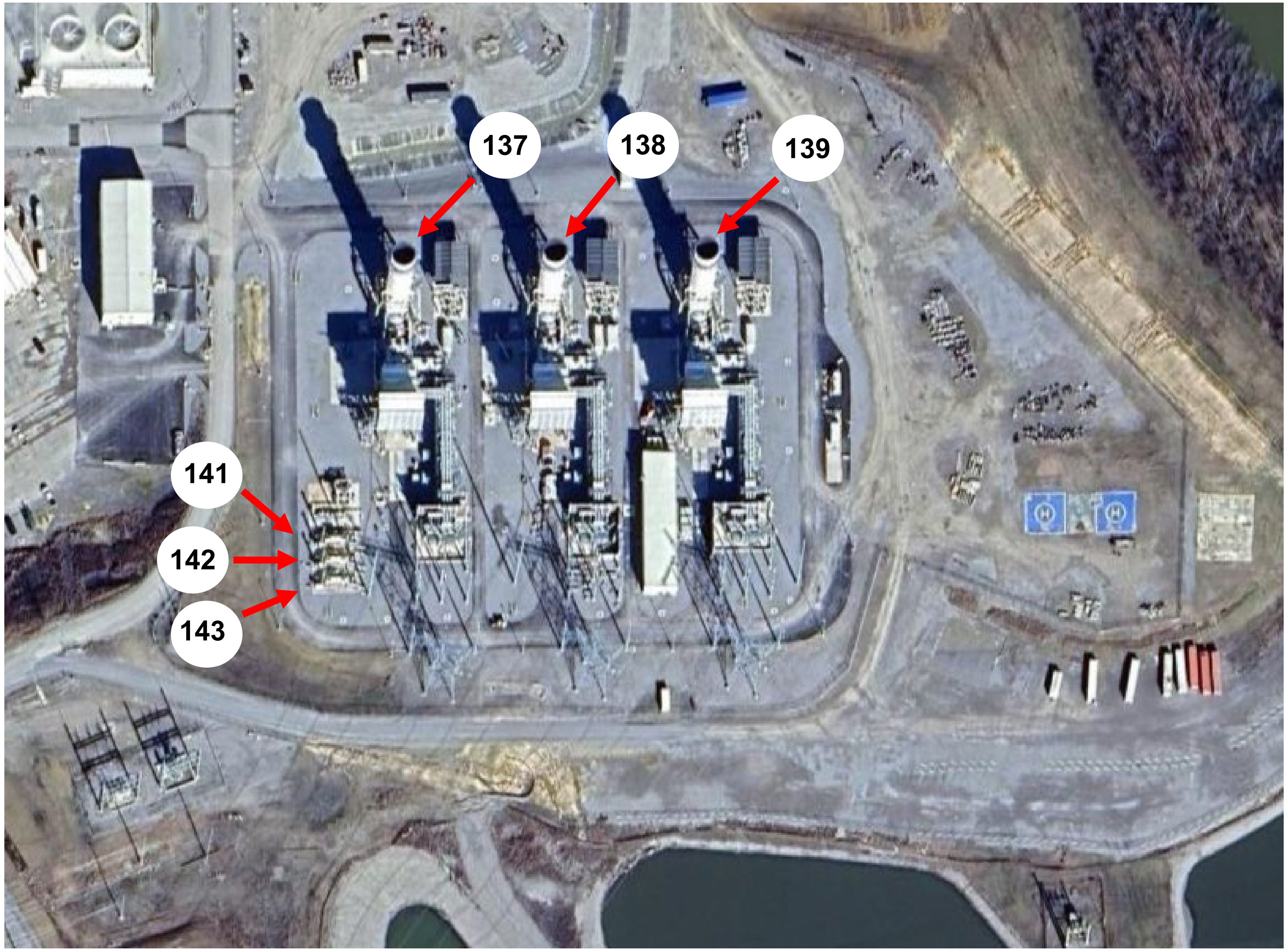
FIGURE 2-5. TVA - Paradise Combined Cycle Plant Main Site Plan

FIGURE 2-6. TVA - Paradise Combined Cycle Plant Emission Point Locations



120-122 Combined Cycle Combustion Turbines	108-110 Natural Gas Heaters
123-125 Simple Cycle Combustion Turbines	114 Sixteen Water Cooling Towers
107 Auxiliary Boiler	115 Emergency Diesel Engine Fire Pump

FIGURE 2-7. TVA - Paradise Simple Cycle Plant Emission Point Locations



137 - 139 Simple Cycle Combustion Turbines
141 - 143 Natural Gas Heaters

FIGURE 2-8. TVA - Paradise Combined Cycle Plant Emission Point Locations

104 - Cell Phone Tower (Two-Way Radio) Emergency Diesel Engine
128 - Emergency Telecommunications Propane Generator

FIGURE 2-9. TVA - Paradise Combined Cycle Plant Emission Point Locations

Location of Diesel Fired Engines

147-148 Coal Yard Runoff
149-150 Gypsum Stilling Pond
151-152 Daniel Run Coal Fines 155
GN24 Generator

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DEP7007DD

Insignificant Activities

___ Section DD.1: Table of Insignificant Activities
___ Section DD.2: Signature Block
___ Section DD.3: Notes, Comments, and Explanations

Source Name: TVA - Paradise Combined Cycle Plant

KY EIS (AFS) #: 21- **177-00006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section DD.1: Table of Insignificant Activities

*Identify each activity with a unique Insignificant Activity number (IA #); for example: 1, 2, 3… etc.

Insignificant Activity #	Description of Activity including Rated Capacity	Serial Number or Other Unique Identifier	Applicable Regulation(s)	Calculated Emissions
1	Diesel fuel oil tank at Utility Building - 10,600 gal			
2	Diesel fuel oil tank at Combined Cycle Plant - 500 gal			
3	Gasoline tank at Combined Cycle Plant - 300 gal			
4	Diesel fuel oil tank at Combined Cycle Plant for Fire Pump - 500 gal			
5	On-road diesel tank at Facilities Maintenance Base - 1,000 gal			

Insignificant Activity #	Description of Activity including Rated Capacity	Serial Number or Other Unique Identifier	Applicable Regulation(s)	Calculated Emissions
6	Gasoline tank at Facilities Maintenance Base - 300 gal			
7	Diesel fuel oil tank at Cell Tower - 147 gal			
8	Diesel fuel oil tank at Project Trailers - 3,000 gal			
9	Diesel tank at Gypsum Stack Maintenance Building - 4,000 gal			

Section DD.2: Signature Block

I, THE UNDERSIGNED, HEREBY CERTIFY UNDER PENALTY OF LAW, THAT I AM A RESPONSIBLE OFFICIAL, AND THAT I HAVE PERSONALLY EXAMINED, AND AM FAMILIAR WITH, THE INFORMATION SUBMITTED IN THIS DOCUMENT AND ALL ITS ATTACHMENTS. BASED ON MY INQUIRY OF THOSE INDIVIDUALS WITH PRIMARY RESPONSIBILITY FOR OBTAINING THE INFORMATION, I CERTIFY THAT THE INFORMATION IS ON KNOWLEDGE AND BELIEF, TRUE, ACCURATE, AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE OR INCOMPLETE INFORMATION, INCLUDING THE POSSIBILITY OF FINE OR IMPRISONMENT.

By:

Jim E. Phelps
Authorized Signature

6/5/2024
Date

Jim E. Phelps
Type/Print Name of Siguatory

Plant Manager
Title of Siguatory

COMBUSTION TURBINES AND HRSGS
PROCESS DESCRIPTION
PARADISE COMBINED CYCLE FACILITY

Three (3) identical natural-gas-fired combustion turbine (CT) electric generating units (General Electric Model 7FA.05 [GE 7FA]) have the capability to operate in either simple-cycle mode (i.e., HRSG is bypassed) or combined-cycle mode. The CTs are rated at 2,300 MMBtu/hr and have gross electrical generating capacities of 235 MW each. The one steam turbine has the electrical generating capacity of 470 MW. For nitrogen oxide (NO_X) control, the CTs are equipped with dry low-nitrogen oxide (DLN) combustors.

An evaporative cooling system is installed at the compressor inlet of each CT. Evaporative cooling is achieved when filtered air passes through a saturated media and water evaporates off the wet media. This evaporation reduces the air temperature and increases the density of the combustion air. Excess water that does not evaporate is directed downward so as not to be carried along with the cooled air. Cooled air passes through a mist eliminator where leftover water droplets are removed. Clean, cool air is then directed into the turbine inlet. The effect of this system allows for increased CT generation at ambient temperatures above 59°F.

During combined cycle operations, a HRSG is provided to recover the waste heat from the CT exhaust and generate steam. Each CT has one HRSG. An oxidizing catalyst for carbon monoxide (CO) and volatile organic compound (VOC) emissions control and a selective-catalytic-reduction (SCR) reactor for nitrogen oxide (NO_X) emissions control is installed in each HRSG.

Each HRSG contains natural gas-fired duct burners (maximum heat input of 400×10^6 Btu/hr per HRSG) to augment steam production during combined-cycle (CC) operations. The HRSG SCR utilizes aqueous ammonia (NH_3) to achieve NO_X reduction across the SCR reactor's catalyst, as needed to maintain compliance with emission limit. The facility has two (2) aqueous NH_3 tanks, each with a capacity of 20,000 gallons. The tanks are designed to operate under atmospheric pressure and store 19.5 percent aqueous NH_3.

Operational and Calculation Methodology

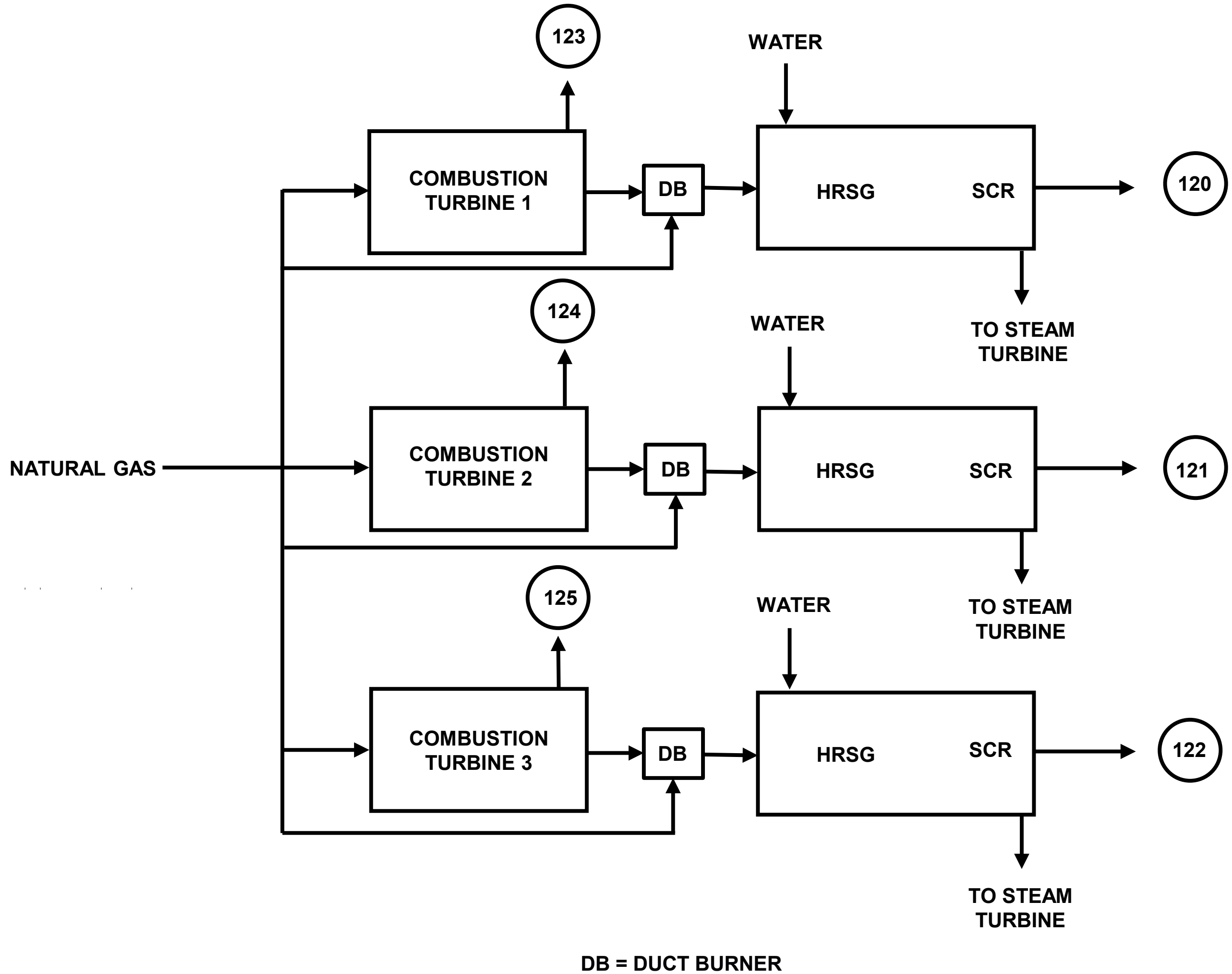
Emissions from simple-cycle operation, combined-cycle operation without duct burners, and combined-cycle operation with duct burners are determined from manufacture's data for particulate, nitrogen oxides, carbon monoxide, and volatile organic compounds. This data is shown below in Table 3-1.

The sulfur dioxide emission factor is based on a maximum 10,000 grains sulfur per million scf and 5% oxidation to sulfuric acid during fuel combustion. An additional 5% of the sulfur is oxidized in the SCR and 30% in the CO/VOC catalyst. Carbon dioxide equivalent emissions are determined from 40 CFR Part 98. Most hazardous air pollutant emission factors are from the Emission Factor Handbook, November 1995, or AP-42, Section 3.1, April 2000.

Annual emissions for simple cycle operation are based on 500 hr/yr operation for each combustion turbine. The three combustion turbines are limited to 1,500 hr/yr total. Annual emissions for combined cycle operation are based on 4,130 hr/yr without duct burner operation and 4,130 hr/yr with duct burner operation. These annual hours per year for combined cycle operation are for estimating emissions and are not a limit.

Table 3-1. Input Data for Simple-Cycle and Combined-Cycle Emission Estimates

Simple Cycle	
Filterable Particulate Matter, lb/hr	9
Condensable Particulate Matter, lb/hr	9
Nitrogen Oxides, ppmvd at 15% oxygen (lb/hr)	9.0 (72.5)
Carbon Monoxide, ppmvd at 15% oxygen (lb/hr)	9.0 (35.1)
VOC as Methane, ppmvw at 15% oxygen (lb/hr)	1.4 (3.42)
Combined Cycle without Duct Burners	
Filterable Particulate Matter, lb/hr	9
Condensable Particulate Matter, lb/hr	9
Nitrogen Oxides, ppmvd at 15% oxygen (lb/hr)	9.0 (72.5)
Carbon Monoxide, ppmvd at 15% oxygen (lb/hr)	2.5 (12.3)
VOC as Methane, ppmvd at 15% oxygen (lb/hr)	1.5 (4.22)
Combined Cycle with Duct Burners	
Filterable Particulate Matter, lb/hr	15
Condensable Particulate Matter, lb/hr	3.90
Nitrogen Oxides, ppmvd at 15% oxygen (lb/hr)	9.0 (89.1)
Carbon Monoxide, ppmvd at 15% oxygen (lb/hr)	2.5 (15.1)
VOC as Methane, ppmvd at 15% oxygen (lb/hr)	2.0 (6.90)
Maximum Sulfur Concentration in Natural Gas, grains/MMscf	10,000
Fuel Sulfur Combustion Conversion to Sulfuric Acid, %	5
Fuel Sulfur Conversion to Sulfuric Acid from SCR, %	5
Fuel Sulfur Conversion to Sulfuric Acid from CO/VOC catalyst, %	30
Ammonia Slip at SCR Outlet, ppmvd at 15% oxygen	5



TENNESSEE VALLEY AUTHORITY - PARADISE COMBINED CYCLE PLANT

FLOW DIAGRAM OF SIMPLE / COMBINED CYCLE COMBUSTION TURBINES

LEGEND: 1. XX INDICATES EMISSION POINTS
2.
3.

FIGURE 3-1

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300 Sower Boulevard

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(502) 564-3999

DEP7007A

Indirect Heat Exchangers and Turbines

___ Section A.1: General Information

___ Section A.2: Operating and Fuel Information

___ Section A.3: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG.

____ Manufacturer's specifications

Source Name: TVA - Paradise Combined Cycle Plant

KY EIS (AFS) #: **21-177-00006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section A.1: General Information

Emission Unit #	Emission Unit Name	Process ID	Process Name	Identify General Type: Indirect Heat Exchanger, Gas Turbine, or Combustion Turbine	Indirect Heat Exchanger Configuration	Manufacturer	Model No./ Serial No.	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	SCC Code	SCC Units	Control Device ID	Stack ID
120-122	Combustion Turbines 1 through 3 Combined Cycle	120-122	Combustion Turbines 1 through 3 Combined Cycle	Combustion Turbine		General Electric	7FA.05	2015	20100201	MMBTU	120-122	120-122
123-125	Combustion Turbines 1 through 3 Simple Cycle	123-125	Combustion Turbines 1 through 3 Simple Cycle	Combustion Turbine		General Electric	7FA.05	2015	20100201	MMBTU	123-125	123-125

Section A.2: Operating and Fuel Information

Emission Unit #	If multipurpose unit, identify the percentage of use by purpose				Rated Capacity Heat Input *(MMBTU/hr)*	Rated Capacity Power Output		Describe Operating Scenario (only if this unit will be used in different configurations)	Classify Fuel as Primary or Secondary	Identify Fuel Type: Coal, Natural Gas, Wood, Biomass, Landfill/Digester Gas, Fuel Oil # (specify 1-6), or Other	Heat Content (HHV)		Maximum Operating Hours	Ash Content *(%)*	Sulfur Content *(%)*
	Space Heat	Process Heat	Power	Emergency			*(Specify units: hp, MW, or lb steam/hr)*					*(Specify units: Btu/lb, Btu/gal, or Btu/scf)*			
120-122			X		2,300 CTs 400 DBs		235 MW each CT; 470 MW one steam turbine	Combined Cycle, DB, HRSG	Primary	Natural Gas	1,020	Btu/scf	8,760	0	1 grain / 100 scf
123-125			X		2,300 CTs		235 MW each CT	Simple Cycle	Primary	Natural Gas	1,020	Btu/scf	1,500 total all three CTs	0	1 grain / 100 scf

Division for Air Quality

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(502) 564-3999

DEP7007N

Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Information
__ Section N.4: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: 21- **177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity (SCC Units/hour)	Pollutant	Uncontrolled Emission Factor (lb/SCC Units)	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency (%)	Control Efficiency (%)	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential (lb/hr)	Controlled Potential (lb/hr)	Uncontrolled Potential (tons/yr)	Controlled Potential (tons/yr)
120-122	CTs 1 - 3 Combined Cycle without Duct Burners	120-122	CTs 1 - 3 without Duct Burners	low NOx burners, SCR, CatOx	120-122	120-122	2,300 MMBtu/hr	PM	3.91E-03	manufacturer's info			9.00	9.00	39.4	18.6
								PM10	3.91E-03	manufacturer's info			9.00	9.00	39.4	18.6
								PM2.5	3.91E-03	manufacturer's info			9.00	9.00	39.4	18.6
								Cond PM	3.91E-03	manufacturer's info			9.00	9.00	39.4	18.6
								SO2	1.86E-03	Eng. Estimate			4.27	4.27	18.7	8.82
								NOx	3.15E-01	manufacturer's info		90	725	72.5	3,176	150
								CO	1.78E-02	manufacturer's info		70	40.9	12.3	179	25.3
								VOC	2.62E-03	manufacturer's info		30	6.02	4.22	26.4	8.70
								CO2e	117.1	40 CFR Part 98			269,325	269,325	1,179,645	556,157
								Total HAP	4.57E-04	AP-42 & EPRI's EFH			1.05	1.05	4.60	2.17

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential *(lb/hr)*	Controlled Potential *(lb/hr)*	Uncontrolled Potential *(tons/yr)*	Controlled Potential *(tons/yr)*
120-122	CTs 1 - 3 Combined Cycle with Duct Burners	120-122	CTs 1 - 3 with Duct Burners	low NOx burners, SCR, CatOx	120-122	120-122	2,700 MMBtu/hr	PM	5.56E-03	manufacturer's info			15.0	15.0	65.7	31.0
								PM10	5.56E-03	manufacturer's info			15.0	15.0	65.7	31.0
								PM2.5	5.56E-03	manufacturer's info			15.0	15.0	65.7	31.0
								Cond PM	1.44E-03	manufacturer's info			3.90	3.90	17.1	8.05
								SO2	1.86E-03	Eng. Estimate			5.02	5.02	22.0	10.4
								NOx	3.30E-01	manufacturer's info		90	891	89.1	3,903	184
								CO	1.86E-02	manufacturer's info		70	50.2	15.1	220	31.1
								VOC	3.65E-03	manufacturer's info		30	9.86	6.90	43.2	14.3
								CO2e	117.1	40 CFR Part 98			316,164	316,164	1,384,800	652,880
								Total HAP	4.57E-04	AP-42 & EPRI's EFH			1.23	1.23	5.40	2.55

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential *(lb/hr)*	Controlled Potential *(lb/hr)*	Uncontrolled Potential *(tons/yr)*	Controlled Potential *(tons/yr)*
120-122	CTs 1 - 3 Combined Cycle startup / shutdown	120-122	CTs 1 - 3 Combined Cycle startup / shutdown	low NOx burners, SCR, CatOx	120-122	120-122		PM		manufacturer's info						1.33
								PM10		manufacturer's info						1.33
								PM2.5		manufacturer's info						1.33
								Cond PM		manufacturer's info						0.202
								SO2		manufacturer's info						0.159
								NOx		manufacturer's info						5.73
								CO		manufacturer's info						101
								VOC		manufacturer's info						3.96
								CO2e		manufacturer's info						8,739

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential *(lb/hr)*	Controlled Potential *(lb/hr)*	Uncontrolled Potential *(tons/yr)*	Controlled Potential *(tons/yr)*
123-125	CTs 1 - 3 Simple Cycle	123-125	CTs 1 - 3 Simple Cycle	low NOx burners	123-125	123-125	2,300 MMBtu/hr	PM	3.91E-03	manufacturer's info			9.00	9.00	39.4	2.25
								PM10	3.91E-03	manufacturer's info			9.00	9.00	39.4	2.25
								PM2.5	3.91E-03	manufacturer's info			9.00	9.00	39.4	2.25
								Cond PM	3.91E-03	manufacturer's info			9.00	9.00	39.4	2.25
								SO2	2.79E-03	Eng. Estimate			6.43	6.43	28.1	1.61
								NOx	1.05E-01	manufacturer's info		70	242	72.5	1,059	18.1
								CO	1.53E-02	manufacturer's info			35.1	35.1	154	8.78
								VOC	1.49E-03	manufacturer's info			3.42	3.42	15.0	0.855
								CO2e	117.1	40 CFR Part 98			269,325	269,325	1,179,645	67,331
								Total HAP	4.57E-04	AP-42 & EPRI's EFH			1.05	1.05	4.60	0.263

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential *(lb/hr)*	Controlled Potential *(lb/hr)*	Uncontrolled Potential *(tons/yr)*	Controlled Potential *(tons/yr)*
123-125	CTs 1 - 3 Simple Cycle startup / shutdown	123-125	CTs 1 - 3 Simple Cycle startup / shutdown	low NOx burners	123-125	123-125	2,300 MMBtu/hr	PM		manufacturer's info						0.568
								PM10		manufacturer's info						0.568
								PM2.5		manufacturer's info						0.568
								Cond PM		manufacturer's info						0.0491
								SO2		manufacturer's info						0.0845
								NOx		manufacturer's info						2.91
								CO		manufacturer's info						38.5
								VOC		manufacturer's info						0.846
								CO2e		manufacturer's info						3,431

Section N.2: Stack Information

UTM Zone:

Stack ID	Identify all Emission Units (with Process ID) and Control Devices that Feed to Stack	Stack Physical Data			Stack UTM Coordinates		Stack Gas Stream Data		
		Equivalent Diameter *(ft)*	Height *(ft)*	Base Elevation *(ft)*	Northing *(m)*	Easting *(m)*	Flowrate *(acfm)*	Temperature *(°F)*	Exit Velocity *(ft/sec)*
120	Combustion Turbine 1 - Combined Cycle with Duct Burner Option	18	170	418	4,124,945	500,964	1,240,000	199	81
121	Combustion Turbine 2 - Combined Cycle with Duct Burner Option	18	170	418	4,124,945	501,005	1,240,000	199	81
122	Combustion Turbine 3 - Combined Cycle with Duct Burner Option	18	170	418	4,124,946	501,046	1,240,000	199	81
123	Combustion Turbine 1 - Simple Cycle	18	131	418	4,124,893	500,965	2,990,000	1,130	196
124	Combustion Turbine 2 - Simple Cycle	18	131	418	4,124,894	501,006	2,990,000	1,130	196
125	Combustion Turbine 3 - Simple Cycle	18	131	418	4,124,894	501,047	2,990,000	1,130	196

Section N.4: Notes, Comments, and Explanations
Uncontrolled annual emissions for combined cycle mode are for 8,760 hr/yr. Controlled emissions for combined cycle mode are for 4,130 hr/yr without duct burners and 4,130 hr/yr with duct burners.
Uncontrolled annual emissions for simple cycle mode are for 8,760 hr/yr. Controlled emissions for simple cycle mode are for 500 hr/yr (total 1,500 hr/yr for all 3 CTs).

Division for Air Quality

300 Sower Boulevard

Frankfort, KY 40601

(502) 564-3999

DEP7007V
Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitation(s)
___ Section V.2: Monitoring Requirements
___ Section V.3: Recordkeeping Requirements
___ Section V.4: Reporting Requirements
___ Section V.5: Testing Requirements
___ Section V.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21- 177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section V.1: Emission and Operating Limitation(s)

Emission Unit #	Emission Unit Description	Applicable Regulation or Requirement	Pollutant	Emission Limit (if applicable)	Voluntary Emission Limit or Exemption (if applicable)	Operating Requirement or Limitation (if applicable)	Method of Determining Compliance with the Emission and Operating Requirement(s)
120-125	Combustion Turbines - Combined Cycle with Duct Burner Option and Simple Cycle Option	40 CFR Part 60 Subpart KKKK	NOx	Natural Gas Emission Limit: 15 ppm at 15 % O2			Vendor guarantees meet these limits.
120-125	Combustion Turbines - Combined Cycle with Duct Burner Option and Simple Cycle Option	40 CFR Part 60 Subpart KKKK	SO2	SO2 limit of 0.06 lb/MMBtu			Maintain good operation; burn only pipeline quality natural gas

Emission Unit #	Emission Unit Description	Applicable Regulation or Requirement	Pollutant	Emission Limit (if applicable)	Voluntary Emission Limit or Exemption (if applicable)	Operating Requirement or Limitation (if applicable)	Method of Determining Compliance with the Emission and Operating Requirement(s)
120-122	Duct Burners	401 KAR 59:015 Section 4	Opacity	20%; except a maximum of 40% shall be allowed for a maximum of 6 consecutive minutes in any 60 consecutive minutes during fire-box cleaning or soot blowing			Burn natural gas only
120-122	Duct Burners	401 KAR 59:015 Section 4	PM	PM limit of 0.1 lb/MMBtu			Burn natural gas only
120-122	Duct Burners	401 KAR 59:015 Section 5	SO2	SO2 limit of 0.8 lb/MMBtu			Burn only pipeline quality natural gas
123-125	Combustion Turbines - Simple Cycle	Permit V-18-056 R2	All Regulated Pollutants	Total operating time all 3 units is 1,500 hr/yr.			

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
120-125	Combustion Turbines - Combined Cycle with Duct Burner Option and Simple Cycle Option	NOx	40 CFR 60 Subpart KKKK	NOx	Continuous Emissions Monitoring System for each combustion turbine.

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
120-125	Combustion Turbines - Combined Cycle with Duct Burner Option and Simple Cycle Option	All Regulated Pollutants	40 CFR 60.7(b)	Startups, shutdowns, and malfunctions.	Maintain records of these events.
123-125	Combustion Turbines - Simple Cycle	All Regulated Pollutants	Permit V-18-056 R2	Hours of Operation in Simple Cycle Mode	Record hours of operation for CTs in simple cycle mode.

Section V.4: Reporting Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Reported	Description of Reporting
120-125	Combustion Turbines - Combined Cycle with Duct Burner Option and Simple Cycle Option	All Regulated Pollutants	40 CFR 60 Subpart KKKK	Fuel burned, net electrical output, CEMs for NOx, duration of startups and shutdowns, maintenance of control equipment, and current operational records. Report any excess emissions.	Report operating parameters as required.

Section V.5: Testing Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Tested	Description of Testing
120-125	Combustion Turbines - Combined Cycle with Duct Burner Option and Simple Cycle Option	SO2	40 CFR 60.8(a)	SO2	Conduct performance test as directed.

Division for Air Quality

300 Sower Boulevard

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DEP7007GG

Control Equipment

Additional Documentation
___ Complete Sections GG.1 through GG.12, as applicable
___ Attach manufacturer's specifications for each control device
___ Complete DEP7007AI

Source Name: TVA - Paradise Combined-Cycle Plant

KY EIS (AFS) #: **21- 177-00006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section GG.1: General Information - Control Equipment

Control Device ID #	Control Device Name	Cost	Manufacturer	Model Name/ Serial #	Date Installed	Inlet Gas Stream Data For All Control Devices					Inlet Gas Stream Data For Condensers, Adsorbers, Afterburners, Incinerators, Oxidizers Only			Equipment Operational Data For All Control Devices		
						Temperature (°F)	Flowrate (scfm @ 68°F)	Average Particle Diameter (μm)	Particle Density (lb/ft^3) or Specific Gravity	Gas Density (lb/ft^3)	Gas Moisture Content (%)	Gas Composition	Fan Type	Pressure Drop Range (in. H_2O)	Pollutants Collected/ Controlled	Pollutant Removal (%)
120-122	low NOx burners		General Electric		2015										NOx	see below with SCR
120-122	SCR				2015									1.0 - 1.2	NOx	90
120-122	catalytic oxidation				2015									1.7 - 1.9	CO VOC	70 30
123-125	low NOx burners		General Electric		2015										NOx	70

Section GG.10: Selective Catalytic Reduction (SCR) / Selective Non-catalytic Reduction (SNCR)

Control Device ID #	Identify all Emission Units and Control Devices that Feed to SCR/SNCR	Type (SCR/SNCR)	Gas Composition	Injection Grid Design (e.g. honeycomb)	Design Temperature Range		Reagent			Maximum Design Ammonia Slip *(ppm)*	SCR **Only**			
							Type	Injection Rate			Catalyst			
					Min *(°F)*	Max *(°F)*		Min *(lb/hr)*	Max *(lb/hr)*		Composition	Volume *(ft^3)*	Weight *(lb)*	Replacement Schedule
120-122	120-122	SCR					ammonia			5				

Section GG.11: Other Control Equipment

Control Device ID #	Identify all Emission Units and Control Devices that Feed to Control Equipment	**Type of Control Equipment** (provide description and a diagram with dimensions)
120-122	120-122	Low NOx Burners inhibit the formation of thermal NOx (i.e., NOx created by the high temperature reaction in the combustion chamber between atmospheric nitrogen and oxygen) by using a staged pre-mixed combustor where the natural gas and combustion air are combined prior to ignition.
120-122	120-122	A catalytic oxidation system provides the most stringent CO control level available. The oxidation of CO to CO2 in the heat recovery steam generator (HRSG) utilizes the excess air present in the turbine exhaust; and the activation energy required for the reaction to proceed is lowered in the presence of the catalyst. Although specifically designed to control CO, catalytic oxidation also provides collateral VOC control.
123-125	123-125	Low NOx Burners inhibit the formation of thermal NOx (i.e., NOx created by the high temperature reaction in the combustion chamber between atmospheric nitrogen and oxygen) by using a staged pre-mixed combustor where the natural gas and combustion air are combined prior to ignition.

Table 3-2. Emissions for Simple Cycle Operation (2,300 MMBtu/hr)

	Emission Factor Reference	Emission Factor lb/MMBtu	Emissions lb/hr	Emissions at 500 hr/yr ton/yr
Filterable Particulate Matter TSP	1	3.91E-03	9.00	2.25
Filterable Particulate Matter PM10	1	3.91E-03	9.00	2.25
Filterable Particulate Matter PM2.5	1	3.91E-03	9.00	2.25
Condensable PM	1	3.91E-03	9.00	2.25
Sulfur Dioxide	2	2.79E-03	6.43	1.61
Nitrogen Oxides	1	3.15E-02	72.5	18.1
Carbon Monoxide	1	1.53E-02	35.1	8.78
Volatile Organic Compnds	1	1.49E-03	3.42	0.855
Sulfuric Acid	2	2.25E-04	0.518	0.129
Carbon Dioxide	3	117	269,047	67,262
Methane	3	2.20E-03	5.07	1.27
Nitrous Oxide	3	2.20E-04	0.507	0.127
GHG (CO2 equivalent)	3	117	269,325	67,331
Antimony	4	1.80E-07	4.14E-04	1.04E-04
Arsenic	5	2.30E-07	5.29E-04	1.32E-04
Beryllium	5	1.00E-08	2.30E-05	5.75E-06
Cadmium	5	4.00E-08	9.20E-05	2.30E-05
Chromium	5	1.10E-06	2.53E-03	6.33E-04
Cobalt	5	8.00E-08	1.84E-04	4.60E-05
Lead	5	4.00E-07	9.20E-04	2.30E-04
Manganese	5	4.00E-07	9.20E-04	2.30E-04
Mercury	5	8.00E-10	1.84E-06	4.60E-07
Nickel	5	2.40E-06	5.52E-03	1.38E-03
Selenium	5	2.00E-08	4.60E-05	1.15E-05
1,3-Butadiene	6	4.30E-07	9.89E-04	2.47E-04
Acetaldehyde	6	4.00E-05	9.20E-02	2.30E-02
Acrolein	6	6.40E-06	1.47E-02	3.68E-03
Benzene	6	1.20E-05	2.76E-02	6.90E-03
Ethylbenzene	6	3.20E-05	7.36E-02	1.84E-02
Formaldehyde	7	1.35E-04	3.11E-01	7.76E-02
Naphthalene	6	1.30E-06	2.99E-03	7.48E-04
Propylene Oxide	6	2.90E-05	6.67E-02	1.67E-02
Toluene	6	1.30E-04	2.99E-01	7.48E-02
Xylenes	6	6.40E-05	1.47E-01	3.68E-02
Polycyclic Organic Matter	6	2.20E-06	5.06E-03	1.27E-03
HAP Total		4.57E-04	1.05	2.63E-01

Notes on emission factor references.

1 Manufacturer's data.
2 Based on 10,000 grains S/MMscf and 5% conversion to H2SO4.
3 Based on 40 CFR Part 98.
4 US EPA, Air Emissions from Scrap Tire Combustion, EPA-600/R-97-115, October 1997
(Emission data for a NG-fired rotary-kiln incinerator simulator)
5 Emission Factors Handbook [EFH]--Guidelines for Estimating Trace Substance Emissions from Fossil Fuel Steam Electric Plants,
Electric Power Research Institute (EPRI), Report No. EPRI TR-105611, 11-95, Table 4-1 ("Uncontrolled Gas-Fired Boiler Emission Factors")
6 US EPA, Compilation of Air Pollutant Emission Factors (AP-42), Vol. I, 5th Edition, Supplement F, Section 3.1, Stationary Gas Turbines, 4-00.
7 Access database (file "r03s01.zip") downloaded from EPA's CHIEF Website 4-16-01.

Table 3-3. Emissions for Combined Cycle Operation Without Duct Burners (2,300 MMBtu/hr)

	Emission Factor Reference	Emission Factor lb/MMBtu	Emissions lb/hr	Emissions at 4,130 hr/yr ton/yr
Filterable Particulate Matter TSP	1	3.91E-03	9.00	18.6
Filterable Particulate Matter PM10	1	3.91E-03	9.00	18.6
Filterable Particulate Matter PM2.5	1	3.91E-03	9.00	18.6
Condensable PM	1	3.91E-03	9.00	18.6
Sulfur Dioxide	2	1.86E-03	4.27	8.82
Nitrogen Oxides	1	3.15E-02	72.5	150
Carbon Monoxide	1	5.33E-03	12.3	25.3
Volatile Organic Compnds	1	1.83E-03	4.22	8.70
Sulfuric Acid	2	1.66E-03	3.81	7.88
Ammonia	8	6.49E-03	14.9	30.8
Carbon Dioxide	3	117	269,047	555,583
Methane	3	2.20E-03	5.07	10.5
Nitrous Oxide	3	2.20E-04	0.507	1.05
GHG (CO2 equivalent)	3	117	269,325	556,157
Antimony	4	1.80E-07	4.14E-04	8.55E-04
Arsenic	5	2.30E-07	5.29E-04	1.09E-03
Beryllium	5	1.00E-08	2.30E-05	4.75E-05
Cadmium	5	4.00E-08	9.20E-05	1.90E-04
Chromium	5	1.10E-06	2.53E-03	5.22E-03
Cobalt	5	8.00E-08	1.84E-04	3.80E-04
Lead	5	4.00E-07	9.20E-04	1.90E-03
Manganese	5	4.00E-07	9.20E-04	1.90E-03
Mercury	5	8.00E-10	1.84E-06	3.80E-06
Nickel	5	2.40E-06	5.52E-03	1.14E-02
Selenium	5	2.00E-08	4.60E-05	9.50E-05
1,3-Butadiene	6	4.30E-07	9.89E-04	2.04E-03
Acetaldehyde	6	4.00E-05	9.20E-02	1.90E-01
Acrolein	6	6.40E-06	1.47E-02	3.04E-02
Benzene	6	1.20E-05	2.76E-02	5.70E-02
Ethylbenzene	6	3.20E-05	7.36E-02	1.52E-01
Formaldehyde	7	1.35E-04	3.11E-01	6.41E-01
Naphthalene	6	1.30E-06	2.99E-03	6.17E-03
Propylene Oxide	6	2.90E-05	6.67E-02	1.38E-01
Toluene	6	1.30E-04	2.99E-01	6.17E-01
Xylenes	6	6.40E-05	1.47E-01	3.04E-01
Polycyclic Organic Matter	6	2.20E-06	5.06E-03	1.04E-02
HAP Total		4.57E-04	1.05	2.17

Notes on emission factor references.

1 Manufacturer's data.
2 Based on 10,000 grains S/MMscf and 5% conversion to H2SO4, 5% conversion in SCR, 30% conversion in CO/VOC catalyst.
3 Based on 40 CFR Part 98.
4 US EPA, Air Emissions from Scrap Tire Combustion, EPA-600/R-97-115, October 1997
(Emission data for a NG-fired rotary-kiln incinerator simulator)
5 Emission Factors Handbook [EFH]--Guidelines for Estimating Trace Substance Emissions from Fossil Fuel Steam Electric Plants,
Electric Power Research Institute (EPRI), Report No. EPRI TR-105611, 11-95, Table 4-1 ("Uncontrolled Gas-Fired Boiler Emission Factors")
6 US EPA, Compilation of Air Pollutant Emission Factors (AP-42), Vol. I, 5th Edition, Supplement F, Section 3.1, Stationary Gas Turbines, 4-00.
7 Access database (file "r03s01.zip") downloaded from EPA's CHIEF Website 4-16-01.
8 Ammonia emissions based on 5 ppmv ammonia slip.

Table 3-4. Emissions for Combined Cycle Operation With Duct Burners (2,700 MMBtu/hr)

	Emission Factor Reference	Emission Factor lb/MMBtu	Emissions lb/hr	Emissions at 4,130 hr/yr ton/yr
Filterable Particulate Matter TSP	1	5.56E-03	15.0	31.0
Filterable Particulate Matter PM10	1	5.56E-03	15.0	31.0
Filterable Particulate Matter PM2.5	1	5.56E-03	15.0	31.0
Condensable PM	1	1.44E-03	3.90	8.05
Sulfur Dioxide	2	1.86E-03	5.02	10.4
Nitrogen Oxides	1	3.30E-02	89.1	184
Carbon Monoxide	1	5.58E-03	15.1	31.1
Volatile Organic Compnds	1	2.56E-03	6.90	14.3
Sulfuric Acid	2	1.66E-03	4.48	9.25
Ammonia	8	6.78E-03	18.3	37.8
Carbon Dioxide	3	117	315,838	652,206
Methane	3	2.20E-03	5.95	12.3
Nitrous Oxide	3	2.20E-04	0.595	1.23
GHG (CO2 equivalent)	3	117	316,164	652,880
Antimony	4	1.80E-07	4.86E-04	1.00E-03
Arsenic	5	2.30E-07	6.21E-04	1.28E-03
Beryllium	5	1.00E-08	2.70E-05	5.58E-05
Cadmium	5	4.00E-08	1.08E-04	2.23E-04
Chromium	5	1.10E-06	2.97E-03	6.13E-03
Cobalt	5	8.00E-08	2.16E-04	4.46E-04
Lead	5	4.00E-07	1.08E-03	2.23E-03
Manganese	5	4.00E-07	1.08E-03	2.23E-03
Mercury	5	8.00E-10	2.16E-06	4.46E-06
Nickel	5	2.40E-06	6.48E-03	1.34E-02
Selenium	5	2.00E-08	5.40E-05	1.12E-04
1,3-Butadiene	6	4.30E-07	1.16E-03	2.40E-03
Acetaldehyde	6	4.00E-05	1.08E-01	2.23E-01
Acrolein	6	6.40E-06	1.73E-02	3.57E-02
Benzene	6	1.20E-05	3.24E-02	6.69E-02
Ethylbenzene	6	3.20E-05	8.64E-02	1.78E-01
Formaldehyde	7	1.35E-04	3.65E-01	7.53E-01
Naphthalene	6	1.30E-06	3.51E-03	7.25E-03
Propylene Oxide	6	2.90E-05	7.83E-02	1.62E-01
Toluene	6	1.30E-04	3.51E-01	7.25E-01
Xylenes	6	6.40E-05	1.73E-01	3.57E-01
Polycyclic Organic Matter	6	2.20E-06	5.94E-03	1.23E-02
HAP Total		4.57E-04	1.23	2.55

Notes on emission factor references.

1 Manufacturer's data.
2 Based on 10,000 grains S/MMscf and 5% conversion to H2SO4, 5% conversion in SCR, 30% conversion in CO/VOC catalyst.
3 Based on 40 CFR Part 98.
4 US EPA, Air Emissions from Scrap Tire Combustion, EPA-600/R-97-115, October 1997
(Emission data for a NG-fired rotary-kiln incinerator simulator)
5 Emission Factors Handbook [EFH]--Guidelines for Estimating Trace Substance Emissions from Fossil Fuel Steam Electric Plants,
Electric Power Research Institute (EPRI), Report No. EPRI TR-105611, 11-95, Table 4-1 ("Uncontrolled Gas-Fired Boiler Emission Factors")
6 US EPA, Compilation of Air Pollutant Emission Factors (AP-42), Vol. I, 5th Edition, Supplement F, Section 3.1, Stationary Gas Turbines, 4-00.
7 Access database (file "r03s01.zip") downloaded from EPA's CHIEF Website 4-16-01.
8 Ammonia emissions based on 5 ppmv ammonia slip.

PAC COMBUSTION-TURBINE (CT) STARTUP (SU)/SHUTDOWN (SD) EMISSION ESTIMATES

Type	Nominal # of SU/Year Combined-Cycle (CC) NG-Fired	Simple-Cycle (SC) NG-Fired
Hot SU (HSU)	190	210
Warm SU (WSU)	14	
Cold SU (CSU)	6	
SD	210	210

Required Downtime for SU to Qualify as a Given Type:

Type	Downtime Hours	
HSU	8	or less
WSU	48	(default value; between HSU & CSU)
CSU	72	or more

Table 3-5. Natural Gas CC Conventional Hot SU and SD, w/ NH3 Input to SCR as Catalyst Operating Temp Reached

Downtime = 9.25 hr/HSU-SD

Item	# Units	Duratn, min	NOX	CO	VOC	SO2	H2SO4	FPM	CPM	NH3	CO2	CH4	N2O	CO2e
Lead SU, lb/CT	1	57.0	37.1	1392	46.9	1.41	0.0224	10.4	2.37	3.97	80108	1.51	0.151	80191
Lag SU, lb/CT	2	33.0	29.7	572	20.1	0.783	0.0224	6.18	1.03	1.77	42073	0.794	0.0794	42117
Total, lb/HSU			96.6	2535	87.0	2.97	0.0671	22.8	4.42	7.52	164255	3.10	0.310	164425
SD, lb/CT	3	18.3	10.3	136	7.65	0.365	0.00794	3.56	0.390	0.909	19778	0.373	0.0373	19798
Total, lb/HSU-SD			128	2944	110	4.07	0.0910	33.4	5.59	10.2	223589	4.22	0.422	223820
Routine CC CT Emissns, lb/CT-hr														
Displaced Routine Emssn, lb/HSU-SD														
Net Emissn, lb/HSU-SD														
Gross HSU-SD Emissns, ton/yr			12.1	280	10.4	0.4	0.00864	3.18	0.531	0.973	21241	0.401	0.0401	21263
Net HSU-SD Emissns, ton/yr														

Table 3-6. Natural Gas CC Conventional Warm SU and SD, w/ NH3 Input to SCR as Catalyst Operating Temp Reached

Downtime = 49.99 hr/WSU-SD

Item	# Units	Duratn, min	NOX	CO	VOC	SO2	H2SO4	FPM	CPM	NH3	CO2	CH4	N2O	CO2e
Lead SU, lb/CT	1	101.0	138	604	35.0	2.33	0.0598	20.4	1.81	5.59	127183	2.40	0.240	127315
Lag SU, lb/CT	2	76.0	114	559	32.5	1.82	0.0598	14.9	1.68	3.78	95753	1.81	0.181	95852
Total, lb/WSU			365	1721	99.9	5.97	0.179	50.1	5.17	13.2	318689	6.01	0.601	319018
SD, lb/CT	3	18.3	10.3	136	7.65	0.365	0.00794	3.56	0.390	0.909	19778	0.373	0.0373	19798
Total, lb/WSU-SD			396	2130	123	7.06	0.203	60.8	6.34	15.9	378022	7.13	0.713	378413
Routine CC CT Emissns, lb/CT-hr														
Displaced Routine Emssn, lb/WSU-SD														
Net Emissn, lb/WSU-SD														
Gross WSU-SD Emissns, ton/yr			2.77	14.9	0.860	0.0494	0.00142	0.426	0.0444	0.111	2646	0.0499	0.00499	2649
Net WSU-SD Emissns, ton/yr														

Table 3-7. Natural Gas CC Conventional Cold SU and SD, w/ NH3 Input to SCR as Catalyst Operating Temp Reached

Downtime = 75.80 hr/CSU-SD

Item	# Units	Duratn, min	NOX	CO	VOC	SO2	H2SO4	FPM	CPM	NH3	CO2	CH4	N2O	CO2e
Lead SU, lb/CT	1	210.0	262	1013	65.0	4.78	0.0972	43.1	3.35	12.6	267036	5.04	0.504	267312
Lag SU, lb/CT	2	175.2	236	733	53.2	4.02	0.0972	35.8	2.76	9.88	220396	4.16	0.416	220623
Total, lb/CSU			735	2480	171	12.8	0.292	115	8.87	32.3	707827	13.4	1.34	708558
SD, lb/CT	3	18.3	10.3	136	7.65	0.365	0.00794	3.56	0.390	0.909	19778	0.373	0.0373	19798
Total, lb/CSU-SD			766	2888	194	13.9	0.315	125	10.0	35.0	767160	14.5	1.45	767953
Routine CC CT Emissns, lb/CT-hr														
Displaced Routine Emssn, lb/CSU-SD														
Net Emissn, lb/CSU-SD														
Gross CSU-SD Emissns, ton/yr			2.30	8.66	0.583	0.0417	0.000946	0.376	0.0301	0.105	2301	0.0434	0.00434	2304
Net CSU-SD Emissns, ton/yr														

Table 3-8. All Natural Gas Conventional CC Startups (SU) with Subsequent Shutdowns (SD)

	NOX	CO	VOC	SO2	H2SO4	FPM	CPM	NH3	CO2	CH4	N2O	CO2e
Gross SU/SD Emissns, ton/yr	17.2	303	11.9	0.477	0.0110	3.98	0.605	1.19	26189	0.494	0.0494	26216
Gross SU/SD Emissns, ton/CT-yr	5.73	101	3.96	0.159	0.00367	1.33	0.202	0.397	8730	0.165	0.0165	8739
Net SU/SD Emissns, ton/yr												

Table 3-9. Natural Gas CC Conventional Simple Cycle SU and SD

Item	# Units	Duratn, min	NOX	CO	VOC	SO2	H2SO4	FPM	CPM	NH3	CO2	CH4	N2O	CO2e
SU, lb/CT	3	15.3	13.7	190	4.36	0.408	0.0329	2.80	0.251	0.0	16565	0.312	0.0312	16583
SD, lb/CT	3	14.2	14.0	177	3.70	0.396	0.0319	2.62	0.217	0.0	16077	0.303	0.0303	16093
Total, lb/SU-SD			83.2	1101	24.2	2.41	0.195	16.2	1.40	0.0	97926	1.85	0.185	98027
Gross SU/SD Emissns, ton/yr			8.73	116	2.5	0.253	0.0204	1.71	0.147	0.0	10282	0.194	0.0194	10293
Gross SU/SD Emissns, ton/CT-yr			2.91	38.5	0.846	0.0845	0.00681	0.568	0.0491	0.00	3427	0.0646	0.00646	3431

Sample Calculations

Combined Cycle, Hot, NOx

HSU	37.1 x 1 + 29.7 x 2 = 96.6 lb NOx
SD	10.3 x 3 = 30.9 lb NOx
Total HSU + SD	96.6 + 30.9 = 128 lb NOx
Gross HSU + SD	190 x 128/2000 = 12.1 ton/yr of NOx
H + W + C	12.1 + 2.77 + 2.30 = 17.2 ton/yr of NOx
H + W + C per CT	17.2/3 = 5.73 ton/yr of NOx

Simple Cycle, CO

190 x 3 + 177 x 3 = 1101 lb CO

1101 x 210/2000 = 116 ton/yr CO

116/3 = 38.5 ton/yr CO per CT

Sample Calculations for Simple Cycle Operation

PM	manufacture's data of 9 lb/hr of filterable PM 9 lb/hr x 500 hr/yr x ton/2,000 lb = 2.25 ton/yr
NOx	manufacture's data of 72.5 lb/hr of filterable PM 72.5 lb/hr x 500 hr/yr x ton/2,000 lb = 18.1 ton/yr
SO2	2000 grains S ratioed to 10,000 grains S and 5% fuel conversion to H2SO4 0.6 lb/MMscf x 10,000 grains S/2,000 grains S x scf/1020 Btu x 0.95 = 2.79E-03 lb/MMBtu 2.79E-03 lb/MMBtu x 2,300 MMBtu /hr = 6.43 lb/hr 6.43 lb/hr x 500 hr/yr x ton/2,000 lb = 1.61 ton/yr
H2SO4	2000 grains S ratioed to 10,000 grains S and 5% conversion to H2SO4 0.6 lb/MMscf x 10,000 grains S/2,000 grains S x scf/1020 Btu x 0.05 x 98/64 = 2.25E-04 lb/MMBtu
CO2 equiv	(53.06 + 0.001 x 25 + 0.0001 x 298) x 2.20462 = 117 lb/MMBtu 117 lb/MMBtu x 2,300 MMBtu /hr = 269,325 lb/hr 269,325 lb/hr x 500 hr/yr x ton/2,000 lb = 67,331 ton/yr
Lead	4.00E-07 lb/MMBtu x 2,300 MMBtu /hr = 9.20E-04 lb/hr 9.20E-04 lb/hr x 500 hr/yr x ton/2,000 lb = 2.30E-04 ton/yr

Sample Calculations for Combined Cycle Operation Without Duct Burners

PM	manufacture's data of 9 lb/hr of filterable PM 9 lb/hr x 4,130 hr/yr x ton/2,000 lb = 18.6 ton/yr
NOx	manufacture's data of 72.5 lb/hr of filterable PM 72.5 lb/hr x 4,130 hr/yr x ton/2,000 lb = 150 ton/yr
SO2	2000 grains S ratioed to 10,000 grains S and 5% fuel conversion to H2SO4, 5% in SCR, and 30% in CO/VOC catalyst 0.6 lb/MMscf x 10,000 grains S/2,000 grains S x scf/1020 Btu x 0.95 x 0.95 x 0.7 = 1.86E-03 lb/MMBtu 1.86E-03 lb/MMBtu x 2,300 MMBtu /hr = 4.27 lb/hr 4.27 lb/hr x 4,130 hr/yr x ton/2,000 lb = 8.82 ton/yr
H2SO4	2000 grains S ratioed to 10,000 grains S and 5% fuel conversion to H2SO4, 5% in SCR, and 30% in CO/VOC catalyst 0.6 lb/MMscf x 10,000 grains S/2,000 grains S x scf/1020 Btu x (1 - 0.95 x 0.95 x 0.7) x 98/64 = 1.66E-03 lb/MMBtu
CO2 equiv	(53.06 + 0.001 x 25 + 0.0001 x 298) x 2.20462 = 117 lb/MMBtu 117 lb/MMBtu x 2,300 MMBtu /hr = 269,325 lb/hr 269,325 lb/hr x 4,130 hr/yr x ton/2,000 lb = 556,157 ton/yr
Lead	4.00E-07 lb/MMBtu x 2,300 MMBtu /hr = 9.20E-04 lb/hr 9.20E-04 lb/hr x 4,130 hr/yr x ton/2,000 lb = 1.90E-03 ton/yr

Sample Calculations for Combined Cycle Operation With Duct Burners

PM	manufacture's data of 15 lb/hr of filterable PM 15 lb/hr x 4,130 hr/yr x ton/2,000 lb = 31.0 ton/yr
CPM	manufacturer's data of FPM + CPM less than 0.007 lb/MMBtu 0.007 lb/MMBtu - 5.56E-03 lb/MMBtu (for FPM) = 1.44E-03 lb/MMBtu (for CPM) 1.44E-03 lb/MMBtu x 2,700 MMBtu/hr = 3.90 lb/hr CPM
NOx	manufacture's data of 89.1 lb/hr of filterable PM 89.1 lb/hr x 4,130 hr/yr x ton/2,000 lb = 184 ton/yr
SO2	2000 grains S ratioed to 10,000 grains S and 5% fuel conversion to H2SO4, 5% in SCR, and 30% in CO/VOC catalyst 0.6 lb/MMscf x 10,000 grains S/2,000 grains S x scf/1020 Btu x 0.95 x 0.95 x 0.7 = 1.86E-03 lb/MMBtu 1.86E-03 lb/MMBtu x 2,700 MMBtu /hr = 5.02 lb/hr 5.02 lb/hr x 4,130 hr/yr x ton/2,000 lb = 10.4 ton/yr
H2SO4	2000 grains S ratioed to 10,000 grains S and 5% fuel conversion to H2SO4, 5% in SCR, and 30% in CO/VOC catalyst 0.6 lb/MMscf x 10,000 grains S/2,000 grains S x scf/1020 Btu x (1 - 0.95 x 0.95 x 0.7) x 98/64 = 1.66E-03 lb/MMBtu
CO2 equiv	(53.06 + 0.001 x 25 + 0.0001 x 298) x 2.20462 = 117 lb/MMBtu 117 lb/MMBtu x 2,700 MMBtu /hr = 316,164 lb/hr 269,325 lb/hr x 4,130 hr/yr x ton/2,000 lb = 652,880 ton/yr
Lead	4.00E-07 lb/MMBtu x 2,700 MMBtu /hr = 1.08E-03 lb/hr 1.08E-03 lb/hr x 4,130 hr/yr x ton/2,000 lb = 2.23E-03 ton/yr

PROCESS DESCRIPTION
SIMPLE CYCLE COMBUSTION TURBINES
PARADISE COMBINED CYCLE COMBUSTION TURBINE PLANT

The new combustion turbines at Paradise consist of three simple-cycle combustion turbines (CT) installed in October 2023. These units are utilized during periods of peak power demand when sufficient generating capacity may not be available from other TVA generation assets and to maintain transmission system reliability. Annual operations are limited by 40 CFR Part 60, Subpart TTTT.

The three identical natural-gas-fired CT electric generating units (General Electric Model 7F.05) each have a gross electrical generating capacity of 229 MW at 59°F and a heat input capacity of 2,257 MMBtu per hour at 59°F. The CT units are equipped with dry low-nitrogen oxide (DLN) combustors.

An evaporative cooling system, which reduces the inlet air temperature and increases the density of the combustion air, is installed on each CT. The effect of this system allows for increased CT generation at ambient temperatures above 59°F.

The CT units require the natural gas temperature at the turbine interface to be above the dew point of any natural gas constituent. To achieve this, three dew-point natural gas heaters each rated at 10 MMBtu/hr are used. The gas heaters are indirect water-bath heaters having a shell-and-tube heat exchanger configuration. Each gas heater has an oxygen-trim system, which maintains an optimal air-to-fuel ratio.

The three turbines and three gas heaters are considered significant emission sources.

OPERATIONAL AND CALCULATION METHODOLOGY

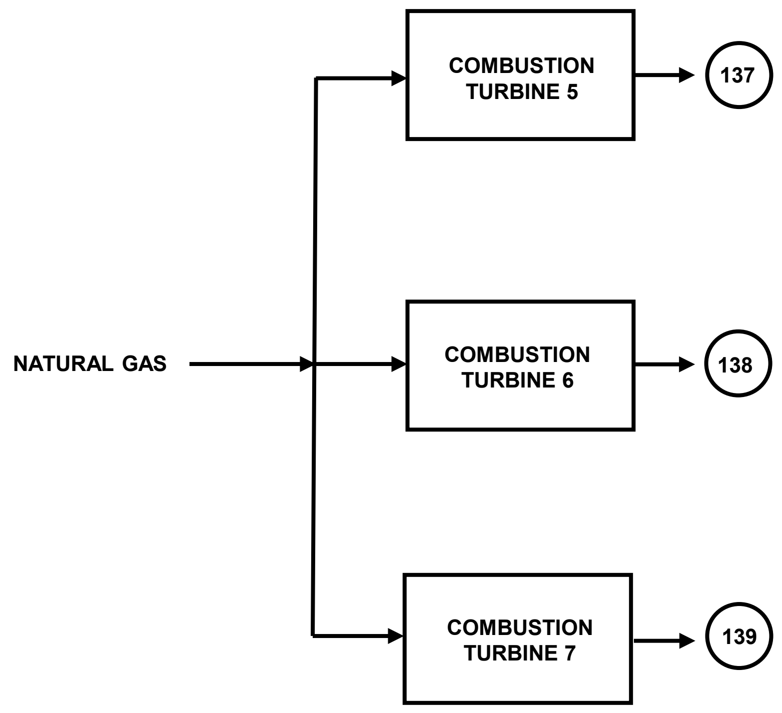
Potential emissions are calculated for the three combustion turbines containing dry low-nitrogen oxide (DLN) combustors. The potential emissions are calculated based on an annual operating limit of 766,000 MWhr/yr for each CT limited by 40 CFR Part 60, Subpart TTTT. This limit equates to a total operating time for each CT of 3,406 hr/yr (3,321 hr/yr CT operating hours and 85 hr/yr for startup and shutdown). The startup and shutdown emissions are based on a total of 150 startups and shutdowns each year for each CT with 20 minutes per startup and 14 minutes per shutdown. Particulates, carbon monoxide, and volatile organic compounds are based on manufacturer's data. Nitrogen oxides are based on 40 CFR Part 60 Subpart KKKK. Most emission factors are from AP-42, 5th Ed, Section 3.1, 4/00 or Emission Factor Handbook, 11/95. Carbon dioxide equivalent emissions are based on 40 CFR Part 60, Subpart TTTT and 40 CFR Part 98.

The combustion turbines have a heat input capacity of 2,257 MMBtu/hr at 59°F on a per unit basis.

Data used to estimate emissions from the CT units are summarized in the table below:

TABLE 4-1
INPUT DATA FOR SIMPLE CYCLE COMBUSTION TURBINES EMISSION ESTIMATES

Heat input capacity at 59°F, MMBtu/hr per CT unit	2,257
Particulate (filterable) emissions based on manufacturer's data, lb/hr	9
Particulate (filterable) emission factor based on manufacturer's data, lb/MMBtu	0.00399
Particulate (condensable) emissions based on manufacturer's data, lb/hr	9
Particulate (condensable) emission factor based on manufacturer's data, lb/MMBtu	0.00399
NO_x emissions based on 40 CFR Part 60 subpart KKKK, ppmvd at 15% O2	15
NO_x emission factor based on manufacturer's data, lb/MMBtu	0.0545
CO emissions based on manufacturer's data, ppmvd at 15% O2	9
CO emission factor based on manufacturer's data, lb/MMBtu	0.0199
VOC emissions based on manufacturer's data, ppmvw at 15% O2 wet	1.4
VOC emission factor based on manufacturer's data, lb/MMBtu	0.00259
SO2 emission factor based on 40 CFR Part 75, Appendix D, lb/MMBtu	0.0006
CO2 emission factor based 40 CFR Part 60, Subpart TTTT, lb/MMBtu	120



TENNESSEE VALLEY AUTHORITY - PARADISE COMBINED CYCLE PLANT

FLOW DIAGRAM OF SIMPLE CYCLE COMBUSTION TURBINES

LEGEND: 1. XX INDICATES EMISSION POINTS
2.
3.

FIGURE 4-1

Division for Air Quality

300 Sower Boulevard

Frankfort, KY 40601

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DEP7007A

Indirect Heat Exchangers and Turbines

___ Section A.1: General Information

___ Section A.2: Operating and Fuel Information

___ Section A.3: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG.

____ Manufacturer's specifications

Source Name: TVA - Paradise Combined Cycle Plant

KY EIS (AFS) #: **21-177-00006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section A.1: General Information

Emission Unit #	Emission Unit Name	Process ID	Process Name	Identify General Type: Indirect Heat Exchanger, Gas Turbine, or Combustion Turbine	Indirect Heat Exchanger Configuration	Manufacturer	Model No./ Serial No.	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	SCC Code	SCC Units	Control Device ID	Stack ID
137-139	Combustion Turbines 5 through 7 Simple Cycle	137-139	Combustion Turbines 5 through 7 Simple Cycle	Combustion Turbine		General Electric	7F.05	10/2023	20100201	MMBTU	137-139	137-139

Section A.2: Operating and Fuel Information

Emission Unit #	If multipurpose unit, identify the percentage of use by purpose				Rated Capacity Heat Input *(MMBTU/hr)*	Rated Capacity Power Output		Describe Operating Scenario (only if this unit will be used in different configurations)	Classify Fuel as Primary or Secondary	Identify Fuel Type: Coal, Natural Gas, Wood, Biomass, Landfill/Digester Gas, Fuel Oil # (specify 1-6), or Other	Heat Content (HHV)		Maximum Operating Hours	Ash Content *(%)*	Sulfur Content *(%)*
	Space Heat	Process Heat	Power	Emergency			*(Specify units: hp, MW, or lb steam/hr)*					*(Specify units: Btu/lb, Btu/gal, or Btu/scf)*			
137-139			X		2,257	229	MW each CT		Primary	Natural Gas	1,020	Btu/scf	40 CFR Part 60 Subpart TTTT; 766,000 MWh/CTyr	0	6.70E-04

Division for Air Quality

300 Sower Boulevard
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DEP7007N

Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Information
__ Section N.4: Notes, Comments, and Explanations

Additional Documentation
___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21- 177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity (SCC Units/hour)	Pollutant	Uncontrolled Emission Factor (lb/SCC Units)	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency (%)	Control Efficiency (%)	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential (lb/hr)	Controlled Potential (lb/hr)	Uncontrolled Potential (tons/yr)	Controlled Potential (tons/yr)
137-139	CTs 5 - 7 Simple Cycle	137-139	CTs 5 - 7	low NOx burners	137-139	137-139	2,257 MMBtu/hr	PM	3.99E-03	manufacturer's info			9.00	9.00	14.9	14.9
								PM10	3.99E-03	manufacturer's info			9.00	9.00	14.9	14.9
								PM2.5	3.99E-03	manufacturer's info			9.00	9.00	14.9	14.9
								Cond PM	3.99E-03	manufacturer's info			9.00	9.0	14.9	14.9
								SO2	6.00E-04	40 CFR Part 75 App. D			1.35	1.35	2.25	2.25
								NOx	5.45E-02	40 CFR Part 60 Subpart KKKK		70	410	123	681	204
								CO	1.99E-02	manufacturer's info			45.0	45.0	74.7	74.7
								VOC	2.59E-03	manufacturer's info			5.84	5.84	9.70	9.70
								CO2e	120.1	40 CFR Part 60 Subpart TTTT and Part 98			271,113	271,113	450,183	450,183
								Total HAP	5.38E-04	AP-42 & EPRI's EFH			1.21	1.21	2.07	2.07

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential *(lb/hr)*	Controlled Potential *(lb/hr)*	Uncontrolled Potential *(tons/yr)*	Controlled Potential *(tons/yr)*
137-139	CTs 5 - 7 Simple Cycle startup / shutdown	137-139	CTs 5 - 7 Simple Cycle startup / shutdown	low NOx burners	137-139	137-139	2,257 MMBtu/hr	PM		manufacturer's info						0.383
								PM10		manufacturer's info						0.383
								PM2.5		manufacturer's info						0.383
								Cond PM		manufacturer's info						0.383
								SO2		manufacturer's info						0.0539
								NOx		manufacturer's info						3.75
								CO		manufacturer's info						26.3
								VOC		manufacturer's info						2.23
								CO2e		manufacturer's info						3,596

Section N.2: Stack Information

UTM Zone:

Stack ID	Identify all Emission Units (with Process ID) and Control Devices that Feed to Stack	Stack Physical Data			Stack UTM Coordinates		Stack Gas Stream Data		
		Equivalent Diameter *(ft)*	Height *(ft)*	Base Elevation *(ft)*	Northing *(m)*	Easting *(m)*	Flowrate *(acfm)*	Temperature *(°F)*	Exit Velocity *(ft/sec)*
137	Combustion Turbine 5 - Simple Cycle with dry low NOx	22	131	418	4,124,644	501,277	2,918,536	1,114	128
138	Combustion Turbine 6 - Simple Cycle with dry low NOx	22	131	418	4,124,645	501,322	2,918,536	1.114	128
139	Combustion Turbine 7 - Simple Cycle with dry low NOx	22	131	418	4,124,646	501,375	2,918,536	1.114	128

Section N.4: Notes, Comments, and Explanations
The simple cycle combustion turbines are limited by 40 CFR 60 Subpart TTTT to 766,000 MWh/yr each which equates to an operating time of about 3,406 hr/yr including startup and shutdown operating time.

Division for Air Quality

300 Sower Boulevard

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DEP7007V

Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitation(s)

___ Section V.2: Monitoring Requirements

___ Section V.3: Recordkeeping Requirements

___ Section V.4: Reporting Requirements

___ Section V.5: Testing Requirements

___ Section V.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant

KY EIS (AFS) #: 21- **177-0006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section V.1: Emission and Operating Limitation(s)

Emission Unit #	Emission Unit Description	Applicable Regulation or Requirement	Pollutant	Emission Limit (if applicable)	Voluntary Emission Limit or Exemption (if applicable)	Operating Requirement or Limitation (if applicable)	Method of Determining Compliance with the Emission and Operating Requirement(s)
137-139	Combustion Turbines - Simple Cycle	40 CFR Part 60 Subpart KKKK	NOx	15 ppmvd at 15 % O2			Vendor guarantees meet these limits.
137-139	Combustion Turbines - Simple Cycle	40 CFR Part 60 Subpart KKKK	SO2	0.060 lb SO2/MMBtu			fuel analysis indicates 0.060 lb SO2/MMBtu will not be exceeded
137-139	Combustion Turbines - Simple Cycle	40 CFR 60 Subpart TTTT	Greenhouse Gases	120 lb CO2/MMBtu		766,000 MWh/CTyr	12-operating-month rolling average

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
137-139	Combustion Turbines - Simple Cycle	NOx SO2	40 CFR 60 Subpart KKKK	NOx Fuel Sulfur Content	NOx: Continuous Emissions Monitoring System for each combustion turbine. SO2: The use of a current, valid purchase contract, tariff sheet, or transportation contract for the fuel specifying the max total fuel sulfur content.

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
137-139	Combustion Turbines - Simple Cycle	N/A	40 CFR 60.7(b)	Startups, shutdowns, and malfunctions.	Maintain records of these events.
137-139	Combustion Turbines - Simple Cycle	Greenhouse Gases	40 CFR 60 Subpart TTTT	MWh	Fuel purchase records. Gross Generation (MWh) via a 12-operating-month average. Records stipulated by Subpart F of Part 75.

Section V.4: Reporting Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Reported	Description of Reporting
137-139	Combustion Turbines - Simple Cycle	NOx	40 CFR 60 Subpart KKKK	Excess Emissions and Monitor Downtime	§ 60.4375: submit reports of excess emissions and monitor downtime, in accordance with § 60.7(c). Excess emissions must be reported for all periods of unit operation, including startup, shutdown, and malfunction.
137-139	Combustion Turbines - Simple Cycle	Greenhouse Gases	40 CFR Part 60 Subpart TTTT	MWh	§ 60.5555(a)(3): the final calendar-quarter report must include (1) gross energy output over the four quarters of the calendar year and (2) the potential electric output of the EGU.
137-139	Combustion Turbines - Simple Cycle	Greenhouse Gases	40 CFR Part 60 Subpart TTTT	CO2 MWh	§ 60.5555(c)(1): EGUs that are subject to the Acid Rain Program must meet all applicable reporting requirements and submit reports as required under Subpart G of Part 75.

Section V.5: Testing Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Tested	Description of Testing
137-139	Combustion Turbines - Simple Cycle	Thermal Performance, NOx, SO2	40 CFR 60.8(a) 40 CFR Part 60 Subpart TTTT 40 CFR Part 60 Subpart KKKK	Performance test of combustion turbines	Thermal Performance: ASME PTC 22 (or equivalent) NOx: CEMs RATA SO2: Max fuel sulfur established via fuel supplier receipts.
137-139	Combustion Turbines - Simple Cycle	Thermal Performance, NOx, SO2	40 CFR 60.8(a) 40 CFR Part 60 Subpart TTTT 40 CFR Part 60 Subpart KKKK	Performance test of combustion turbines	Performance testing must occur within 60 days after achieving maximum production rate but no later than 160 days after initial startup.

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DEP7007GG
Control Equipment

Additional Documentation
___ Complete Sections GG.1 through GG.12, as applicable
___ Attach manufacturer's specifications for each control device
___ Complete DEP7007AI

Source Name: TVA - Paradise Combined-Cycle Plant

KY EIS (AFS) #: **21- 177-00006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section GG.1: General Information - Control Equipment

Control Device ID #	Control Device Name	Cost	Manufacturer	Model Name/ Serial #	Date Installed	Inlet Gas Stream Data For All Control Devices					Inlet Gas Stream Data For Condensers, Adsorbers, Afterburners, Incinerators, Oxidizers Only			Equipment Operational Data For All Control Devices		
						Temperature (°F)	Flowrate (scfm @ 68°F)	Average Particle Diameter (μm)	Particle Density (lb/ft^3) or Specific Gravity	Gas Density (lb/ft^3)	Gas Moisture Content (%)	Gas Composition	Fan Type	Pressure Drop Range (in. H_2O)	Pollutants Collected/ Controlled	Pollutant Removal (%)
137-139	low NOx burners		General Electric		2023										NOx	70

Section GG.11: Other Control Equipment

Control Device ID #	Identify all Emission Units and Control Devices that Feed to Control Equipment	**Type of Control Equipment** (provide description and a diagram with dimensions)
137-139	137-139	Low NOx Burners inhibit the formation of thermal NOx (i.e., NOx created by the high temperature reaction in the combustion chamber between atmospheric nitrogen and oxygen) by using a staged pre-mixed combustor where the natural gas and combustion air are combined prior to ignition.

Table 4-2
Emission Factors for Paradise Simple Cycle Combustion Turbines 5 Through 7

Pollutant	Emission Factor Natural Gas lb/MMBtu	Emission Factor Natural Gas Reference
PM Filterable Particulate Matter	0.00399	1
PM10 Filterable Particulate Matter	0.00399	1
PM2.5 Filterable Particulate Matter	0.00399	1
Condensable Particulate Matter	0.00399	1
Nitrogen Oxides	0.0545	2
Carbon Monoxide	0.0199	1
Volatile Organic Compounds	0.00259	1
Sulfur Dioxide	0.0006	3
Sulfuric Acid	0.0000459	3
Carbon Dioxide Equivalent	120.1	4
Antimony	1.80E-07	5
Arsenic	2.30E-07	6
Beryllium	1.00E-08	6
Cadmium	4.00E-08	6
Chromium	1.10E-06	6
Cobalt	8.00E-08	6
Lead	4.00E-07	6
Manganese	4.00E-07	6
Mercury	8.00E-10	6
Nickel	2.40E-06	6
Selenium	2.00E-08	6
1,3 Butadiene	4.30E-07	3
Acetaldehyde	4.00E-05	3
Acrolein	6.40E-06	3
Benzene	1.20E-05	3
Ethylbenzene	3.20E-05	3
Formaldehyde	2.16E-04	7
Naphthalene	1.30E-06	3
Propylene Oxide	2.90E-05	3
Toluene	1.30E-04	3
Xylenes	6.40E-05	3
Polycyclic Organic Matter (POM)	2.20E-06	3

References:

(1) Based on manufacturer's data.
PM filterable and PM condensable based on 9 lb/hr at 2,257 MMBtu/hr (rated capacity at 59 F).
CO based on 9 ppmvd at 15% O2.
VOC based on 1.4 ppmvw at 15% O2 wet.
(2) NOx based on 40 CFR 60 Subpart KKKK of 15 ppmvd at 15% O2. Manufacturer's data is 9 ppmvd at 15% O2.
(3) US EPA, AP-42, Section 3.1, Stationary Gas Turbines, 4/00.
Assume 5% of SO2 converted to sulfuric acid.
(4) 40 CFR Part 60 Subpart TTTT and 40 CFR Part 98.
(5) US EPA, Air Emissions from Scrap Tire Combustion, EPA-600/R-97-115, October 1997 (natural gas-fired rotary-kiln incinerator simulator emission data).
(6) Emission Factors Handbook [EFH] - Guidelines for Estimating Trace Substance Emissions from Fossil Fuel Steam Electric Plants, Electric Power Research Institute (EPRI), Report No. EPRI TR-105611, 11-95, Table 4-1 (Uncontrolled Gas-Fired Boiler Emission Factors).
(7) Natural gas-fired formaldehyde emission factor based upon 40 CFR 63 Subpart YYYY's "91 ppb" limit.

Table 4-3
Potential Emissions for Paradise Combustion Turbines 5 Through 7

	Natural Gas	
Number of Combustion Turbines	3	
Generation Capacity, MW/CT	229	
Heat Input per CT at 59 F, MMBtu/hr	2,257	
Total Hours per Year, hr	3,406	Used for HAPs, since no SUSD data
Total Hours per Year for SUSD, hr	85	Used for PM through CO2e, with SUSD data
Total Hours per Year for CT Operation, hr	3,321	Used for PM through CO2e, with SUSD data
Total Annual Generation Limit, MWh/yr*	2,298,000	
CT Annual Generation Limit, MWh/yr*	766,000	

*Annual generation limited by 40 CFR Part 60 Subpart TTTT.

Pollutant	Emission Factor Natural Gas lb/MMBtu	Emissions per CT 100% Natural Gas lb/hr	ton/yr	Emissions for 3 CTs 100% Natural Gas ton/yr	SU/SD, ton/yr	Total, ton/yr
PM Filterable Particulate Matter	0.00399	9.00	14.9	44.8	1.15	46.0
PM10 Filterable Particulate Matter	0.00399	9.00	14.9	44.8	1.15	46.0
PM2.5 Filterable Particulate Matter	0.00399	9.00	14.9	44.8	1.15	46.0
Condensable Particulate Matter	0.00399	9.00	14.9	44.8	1.15	46.0
Nitrogen Oxides	0.0545	123	204	613	11.3	624
Carbon Monoxide	0.0199	45.0	74.7	224	78.9	303
Volatile Organic Compounds	0.00259	5.84	9.70	29.1	6.68	35.8
Sulfur Dioxide	0.0006	1.35	2.25	6.75	0.0539	6.80
Sulfuric Acid	0.0000459	0.104	0.172	0.516	3.85E-03	0.520
Carbon Dioxide Equivalent	120.1	271,113	450,183	1,350,548	10,788	1,361,335
Antimony	1.80E-07	4.06E-04	6.92E-04	2.08E-03		2.08E-03
Arsenic	2.30E-07	5.19E-04	8.84E-04	2.65E-03		2.65E-03
Beryllium	1.00E-08	2.26E-05	3.84E-05	1.15E-04		1.15E-04
Cadmium	4.00E-08	9.03E-05	1.54E-04	4.61E-04		4.61E-04
Chromium	1.10E-06	2.48E-03	4.23E-03	1.27E-02		1.27E-02
Cobalt	8.00E-08	1.81E-04	3.07E-04	9.22E-04		9.22E-04
Lead	4.00E-07	9.03E-04	1.54E-03	4.61E-03		4.61E-03
Manganese	4.00E-07	9.03E-04	1.54E-03	4.61E-03		4.61E-03
Mercury	8.00E-10	1.81E-06	3.07E-06	9.22E-06		9.22E-06
Nickel	2.40E-06	5.42E-03	9.22E-03	2.77E-02		2.77E-02
Selenium	2.00E-08	4.51E-05	7.69E-05	2.31E-04		2.31E-04
1,3 Butadiene	4.30E-07	9.71E-04	1.65E-03	4.96E-03		4.96E-03
Acetaldehyde	4.00E-05	9.03E-02	1.54E-01	4.61E-01		4.61E-01
Acrolein	6.40E-06	1.44E-02	2.46E-02	7.38E-02		7.38E-02
Benzene	1.20E-05	2.71E-02	4.61E-02	1.38E-01		1.38E-01
Ethylbenzene	3.20E-05	7.22E-02	1.23E-01	3.69E-01		3.69E-01
Formaldehyde	2.16E-04	4.87E-01	8.30E-01	2.49		2.49
Naphthalene	1.30E-06	2.93E-03	5.00E-03	1.50E-02		1.50E-02
Propylene Oxide	2.90E-05	6.55E-02	1.11E-01	3.34E-01		3.34E-01
Toluene	1.30E-04	2.93E-01	5.00E-01	1.50		1.50
Xylenes	6.40E-05	1.44E-01	2.46E-01	7.38E-01		7.38E-01
Polycyclic Organic Matter (POM)	2.20E-06	4.97E-03	8.46E-03	2.54E-02		2.54E-02
Total HAPs	5.38E-04	1.21	2.07	6.20		6.20

Table 4-4
Startup and Shutdown Emissions for Paradise Simple Cycle Combustion Turbines 5 Through 7

Total number of combustion turbines	3
Total number of startups and shutdowns per CT	150
Duration of start ups, hr	0.333
Duration of shutdowns, hr	0.233

Startup and Shutdown Emissions, lb/CT hr

	FPM	FPM10	FPM2.5	Cond. PM	NOx	CO	VOC	SO2	H2SO4	CO2e
Startup	9	9	9	9	87.2	599	38.1	0.497	3.55E-02	99,453
Shutdown	9	9	9	9	90.0	647	72.9	0.317	2.26E-02	63,403

Startup and Shutdown Emissions, ton/yr

	FPM	FPM10	FPM2.5	Cond. PM	NOx	CO	VOC	SO2	H2SO4	CO2e
Emissions, ton/CT yr	0.383	0.383	0.383	0.383	3.75	26.3	2.23	1.80E-02	1.28E-03	3,596
Emissions for 3 CTs	1.15	1.15	1.15	1.15	11.3	78.9	6.68	5.39E-02	3.85E-03	10,788

Sample Calculation

For NOx (87.2 lb/CT hr x 0.333 hr + 90 lb/CT hr x 0.233 hr) x 150 SUSD x ton/2,000 lb = 3.75 ton/CT yr

3.75 ton/CT yr x 3 CT = 11.3 ton/yr

SAMPLE CALCULATIONS

Potential Emissions for Combustion Turbines 5 through 7.

The three new combustion turbines are fired by natural gas only. Each CT has a heat input rating of 2,257 MMBtu/hr at 59 F. Each CT has an annual generation limit of 766,000 MWhr/yr determined by 40 CFR 60 Subpart TTTT. This corresponds to 3,406 hr/yr total operating time for each CT or 3,321 hr/yr operating time with 85 hr/yr startup and shutdown time. The startup and shutdown time is based on 150 startups and shutdowns per year for each CT with durations of 20 minutes for each startup and 14 minutes for each shutdown. Other than low NOx burners, the new combustion turbines have no add-on emission control equipment.

Particulate Filterable PM = PM10 = PM2.5 = Condensable PM

Emission factor based on manufacturer's data at 2,257 MMBtu/hr heat input at 59 F. Potential annual emissions based on 3,321 hr/yr plus startup and shutdown emissions (based on 85 hr/yr).

9 lb/hr / 2,257 MMBtu/hr = 0.00399 lb/MMBtu

Hourly emissions: 0.00399 lb/MMBtu x 2,257 MMBtu/hr = 9 lb/hr

Annual emissions: 9 lb/hr x 3,321 hr/yr x ton/2,000 lb = 14.9 ton/yr

Startup and shutdown PM emissions for all three CTs (from Table 4-4) = 1.15 ton/yr

Potential annual emissions for all three CTs with emissions from startup and shutdown are:

3 x 14.9 ton/yr + 1.15 ton/yr = 46.0 ton/yr

Nitrogen Oxides

Emission factor based on 40 CFR Part 60 Subpart KKKK of 15 ppmvd at 15% O2. Potential annual emissions based on 3,321 hr/yr plus startup and shutdown emissions (based on 85 hr/yr).

15 ppmvd at 15% O2 = 0.0545 lb/MMBtu

Hourly emissions: 0.0545 lb/MMBtu x 2,257 MMBtu/hr = 123 lb/hr

Annual emissions: 123 lb/hr x 3,321 hr/yr x ton/2,000 lb = 204 ton/yr

Startup and shutdown NOx emissions for all three CTs (from Table 4-4) = 11.3 ton/yr

Potential annual emissions for all three CTs with emissions from startup and shutdown are:

3 x 204 ton/yr + 11.3 ton/yr = 624 ton/yr

Carbon Monoxide

Emission factor based on manufacturer's data with 2,257 MMBtu/hr heat input at 59 F. Potential annual emissions based on 3,321 hr/yr plus startup and shutdown emissions (based on 85 hr/yr).

9 ppmvd at 15% O_2 = 0.0199 lb/MMBtu

Hourly emissions: 0.0199 lb/MMBtu x 2,257 MMBtu/hr = 45.0 lb/hr

Annual emissions: 45.0 lb/hr x 3,321 hr/yr x ton/2,000 lb = 74.7 ton/yr

Startup and shutdown CO emissions for all three CTs (from Table 4-4) = 78.9 ton/yr

Potential annual emissions for all three CTs with emissions from startup and shutdown are:

3 x 74.7 ton/yr + 78.9 ton/yr = 303 ton/yr

VOC

Emission factor based on manufacturer's data with 2,257 MMBtu/hr heat input at 59 F. Potential annual emissions based on 3,321 hr/yr plus startup and shutdown emissions (based on 85 hr/yr).

1.4 ppmvw at 15% O_2 = 0.00259 lb/MMBtu

Hourly emissions: 0.00259 lb/MMBtu x 2,257 MMBtu/hr = 5.84 lb/hr

Annual emissions: 5.84 lb/hr x 3,321 hr/yr x ton/2,000 lb = 9.70 ton/yr

Startup and shutdown VOC emissions for all three CTs (from Table 4-4) = 6.68 ton/yr

Potential annual emissions for all three CTs with emissions from startup and shutdown are:

3 x 9.70 ton/yr + 6.68 ton/yr = 35.8 ton/yr

Sulfur Dioxide

Emission factor based on AP-42, Section 3.1, 4/00. Heat input of 2,257 MMBtu/hr at 59 F. Potential annual emissions based on 3,321 hr/yr plus startup and shutdown emissions (based on 85 hr/yr).

Emission factor = 0.0006 lb/MMBtu

Hourly emissions: 0.0006 lb/MMBtu x 2,257 MMBtu/hr = 1.35 lb/hr

Annual emissions: 1.35 lb/hr x 3,321 hr/yr x ton/2,000 lb = 2.25 ton/yr

Startup and shutdown SO_2 emissions for all three CTs (from Table 4-4) = 0.0539 ton/yr

Potential annual emissions for all three CTs with emissions from startup and shutdown are:

3 x 2.25 ton/yr + 0.0539 ton/yr = 6.80 ton/yr

Sulfuric Acid

Emission factor based on AP-42, Section 3.1, 4/00. Heat input of 2,257 MMBtu/hr at 59 F. Potential annual emissions based on 3,321 hr/yr plus startup and shutdown emissions (based on 85 hr/yr).

Assumes 5% of sulfur dioxide is converted to sulfuric acid.

Emission factor = 0.0006 lb/MMBtu x 0.05 x 98/64 = 0.0000459 lb/MMBtu

Hourly emissions: 0.0000459 lb/MMBtu x 2,257 MMBtu/hr = 0.104 lb/hr

Annual emissions: 0.104 lb/hr x 3,321 hr/yr x ton/2,000 lb = 0.172 ton/yr

Startup and shutdown H_2SO_4 emissions for all three CTs (from Table 4-4) = 3.85E-03 ton/yr

Potential annual emissions for all three CTs with emissions from startup and shutdown are:

3 x 0.172 ton/yr + 3.85E-03 ton/yr = 0.520 ton/yr

Carbon Dioxide Equivalent

Emission factor from 40 CFR 60 Subpart TTTT and 40 CFR Part 98. Heat input of 2,257 MMBtu/hr at 59 F. Potential annual emissions based on 3,321 hr/yr plus startup and shutdown emissions (based on 85 hr/yr).

120 lb/MMBtu + (0.001 kg/MMBtu x 25 + 0.0001 kg/MMBtu x 298) x 2.20462 lb/kg =

120.1 lb/MMBtu

Emission factor = 120.1 lb/MMBtu

Hourly emissions: 120.1 lb/MMBtu x 2,257 MMBtu/hr = 271,113 lb/hr

Annual emissions: 271,113 lb/hr x 3,321 hr/yr x ton/2,000 lb = 450,183 ton/yr

Startup and shutdown CO2e emissions for all three CTs (from Table 4-4) = 10,788 ton/yr

Potential annual emissions for all three CTs with emissions from startup and shutdown are:

3 x 450,183 ton/yr + 10,788 ton/yr = 1,361,335 ton/yr

Antimony

Emission factor from EPA (scrap tire combustion). Heat input of 2,257 MMBtu/hr at 59 F. With no startup and shutdown estimated emissions for HAPs, emission estimate is based on total operating time of 3,321 hr + 85 hr (startup and shutdown time) = 3,406 hr

Emission factor = 1.8E-07 lb/MMBtu

Hourly emissions: 1.8E-07 lb/MMBtu x 2,257 MMBtu/hr = 4.06E-04 lb/hr

Annual emissions: 4.06E-04 lb/hr x 3,411 hr/yr x ton/2,000 lb = 6.92E-04 ton/yr

Potential annual emissions for all three CTs are:

3 x 6.92E-04 ton/yr = 2.08E-03 ton/yr

Other HAP pollutants are calculated as above using the emission factor for each pollutant.

NATURAL GAS-FIRED AUXILIARY BOILER DESCRIPTION
PARADISE COMBINED-CYCLE PLANT

The natural gas-fired auxiliary boiler (80 MMBtu/hr maximum rated heat input capacity) supplies steam to various equipment. The steam is used to maintain turbine steam seals during startups, preheat the condenser, aid in dissolved oxygen removal during startup, and provide freeze protection. NO_X emissions are controlled by utilizing a low-NO_X burner and flue gas recirculation (FGR). Additionally, the auxiliary boiler will include an oxygen (O_2) trim system. CO emissions are controlled through good combustion practices. The auxiliary boiler is expected to operate as needed.

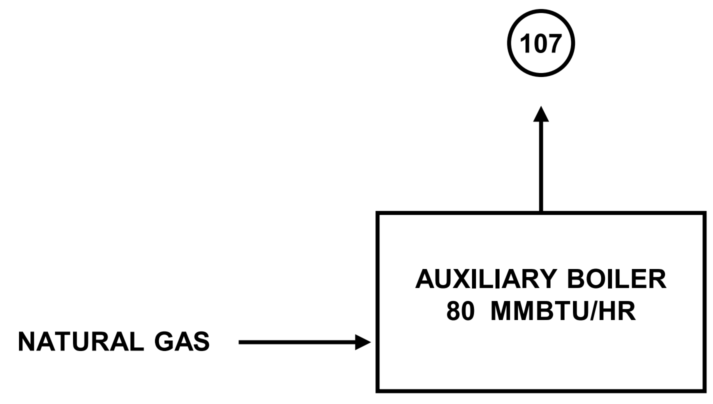
Operational and Calculation Methodology

Most of the emission factors for natural gas combustion are from AP-42, 5th Edition, Section 1.4. Emission factors for PM are based on EPA's RACT/BACT/LEAR Clearinghouse. NOx and CO are based on manufacturer's data for natural gas combustion. The sulfur dioxide emission factor is based on 10,000 grains sulfur per million scf and 95% oxidation to SO2 and 5% oxidation to sulfuric acid. Annual emissions are estimated using 8,760 hr/yr operation. Actual emissions will be much less.

TABLE 5-1

INPUT DATA FOR NATURAL GAS-FIRED AUXILIARY BOILER EMISSION ESTIMATES

Maximum Rated Heat Input Capacity of Auxiliary Boiler, MMBtu/hr	80
PM, PM10, and PM2.5 Emission Factor, lb/MMBtu	0.01
NOx Manufacturer's Data for Natural Gas, ppmvd at 3% Oxygen	30
CO Manufacturer's Data for Natural Gas, ppmvd at 3% Oxygen	150



TENNESSEE VALLEY AUTHORITY - PARADISE COMBINED-CYCLE PLANT	LEGEND: (XX) INDICATES EMISSION POINT
FLOW DIAGRAM OF NATURAL GAS-FIRED AUXILIARY BOILER	

FIGURE 5-1

Division for Air Quality

300 Sower Boulevard
Frankfort, KY 40601
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DEP7007A

Indirect Heat Exchangers and Turbines

___ Section A.1: General Information
___ Section A.2: Operating and Fuel Information
___ Section A.3: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG.

____ Manufacturer's specifications

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21-177-00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section A.1: General Information

Emission Unit #	Emission Unit Name	Process ID	Process Name	Identify General Type: Indirect Heat Exchanger, Gas Turbine, or Combustion Turbine	Indirect Heat Exchanger Configuration	Manufacturer	Model No./ Serial No.	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	SCC Code	SCC Units	Control Device ID	Stack ID
107	Natural Gas-Fired Auxiliary Boiler	107	Auxiliary Boiler	Indirect Heat Exchanger		CleaverBrooks	CBEX-E700-1800-250ST / T4608-1-1	2015	10200602	MMBTU	107	107

Section A.2: Operating and Fuel Information

Emission Unit #	If multipurpose unit, identify the percentage of use by purpose				Rated Capacity Heat Input *(MMBTU/hr)*	Rated Capacity Power Output		Describe Operating Scenario (only if this unit will be used in different configurations)	Classify Fuel as Primary or Secondary	Identify Fuel Type: Coal, Natural Gas, Wood, Biomass, Landfill/Digester Gas, Fuel Oil # (specify 1-6), or Other	Heat Content (HHV)		Maximum Operating Hours	Ash Content *(%)*	Sulfur Content *(%)*
	Space Heat	Process Heat	Power	Emergency			*(Specify units: hp, MW, or lb steam/hr)*					*(Specify units: Btu/lb, Btu/gal, or Btu/scf)*			
107		X			80				Primary	Natural Gas	1,020	Btu/scf	8,760	0	1 grain / 100 scf

Division for Air Quality

300 Sower Boulevard
Frankfort, KY 40601
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DEP7007N

Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Information
__ Section N.4: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: 21- **177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential *(lb/hr)*	Controlled Potential *(lb/hr)*	Uncontrolled Potential *(tons/yr)*	Controlled Potential *(tons/yr)*
107	Natural Gas-Fired Auxiliary Boiler	107	Natural Gas-Fired Auxiliary Boiler	low NOx burner, FGR, O2 trim	107	107	80 MMBtu/hr	PM	1.00E-02	EPA's RACT/BACT/LEAR Clearinghouse			0.800	0.800	3.50	3.50
								PM10	1.00E-02	same as above			0.800	0.800	3.50	3.50
								PM2.5	1.00E-02	same as above			0.800	0.800	3.50	3.50
								Cond PM	5.59E-03	AP-42			0.447	0.447	1.96	1.96
								SO2	2.79E-03	AP-42			0.224	0.224	0.979	0.979
								NOx	3.64E-02	manufacturer's info			2.91	2.91	12.8	12.8
								CO	1.11E-01	manufacturer's info			8.87	8.87	38.9	38.9
								VOC	5.39E-03	AP-42			0.431	0.431	1.89	1.89
								CO2e	117.1	40 CFR Part 98			9,368	9,368	41,031	41,031
								Total HAP	8.73E-05	AP-42			6.99E-03	6.99E-03	3.06E-02	3.06E-02

Section N.2: Stack Information

UTM Zone:

Stack ID	Identify all Emission Units (with Process ID) and Control Devices that Feed to Stack	Stack Physical Data			Stack UTM Coordinates		Stack Gas Stream Data		
		Equivalent Diameter *(ft)*	Height *(ft)*	Base Elevation *(ft)*	Northing *(m)*	Easting *(m)*	Flowrate *(acfm)*	Temperature *(°F)*	Exit Velocity *(ft/sec)*
107	Auxiliary Boiler with low NOx burner, flue gas recirculation, and oxygen trim system	3.25	50	418	4,124,923	501,093	18,422	418	37

Division for Air Quality

300 Sower Boulevard
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DEP7007V

Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitation(s)
___ Section V.2: Monitoring Requirements
___ Section V.3: Recordkeeping Requirements
___ Section V.4: Reporting Requirements
___ Section V.5: Testing Requirements
___ Section V.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21- 177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section V.1: Emission and Operating Limitation(s)

Emission Unit #	Emission Unit Description	Applicable Regulation or Requirement	Pollutant	Emission Limit (if applicable)	Voluntary Emission Limit or Exemption (if applicable)	Operating Requirement or Limitation (if applicable)	Method of Determining Compliance with the Emission and Operating Requirement(s)
107	Natural Gas-Fired Auxiliary Boiler	401 KAR 59:015 Section 4	PM	PM limit of 0.10 lb/MMBtu			Maintain good operation; burn only pipeline quality natural gas.
		401 KAR 59:015 Section 4	Opacity	20%; except a maximum of 27% shall be allowed for a maximum of 6 consecutive minutes in any 60 consecutive minutes			Burn only pipeline quality natural gas.
		401 KAR 59:015 Section 5	SO2	SO2 limit of 0.80 lb/MMBtu			Burn only pipeline quality natural gas.

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
107	Natural Gas-Fired Auxiliary Boiler	All regulated pollutants	401 KAR 52:020	Hours of operation. Amount of fuel (MMscf) combusted monthly.	Monitor hours of operation and natural gas combusted monthlly.
			40 CFR 60 Subpart Dc	No monitoring requirements.	

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
107	Natural Gas-Fired Auxiliary Boiler	All regulated pollutants	40 CFR 60 Subpart Dc	Hours of operation. Fuel consumption.	Record hours of operation and total monthly amount of fuel combusted; maintain for 2 years.

Section V.4: Reporting Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Reported	Description of Reporting
107	Natural Gas-Fired Auxiliary Boiler	All regulated pollutants	40 CFR 60 Subpart Dc	Hours of operation. Fuel consumption.	Submit reports every six months.

Section V.5: Testing Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Tested	Description of Testing
107	Natural Gas-Fired Auxiliary Boiler	All regulated pollutants	401 KAR 59:005 Section 2 401 KAR 50:045 Section 4	Testing conducted as requested by the Cabinet.	Testing conducted as requested by the Cabinet.

Division for Air Quality

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DEP7007GG

Control Equipment

Additional Documentation
___ Complete Sections GG.1 through GG.12, as applicable
___ Attach manufacturer's specifications for each control device
___ Complete DEP7007AI

Source Name: TVA - Paradise Combined-Cycle Plant

KY EIS (AFS) #: **21- 177-00006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section GG.1: General Information - Control Equipment

Control Device ID #	Control Device Name	Cost	Manufacturer	Model Name/ Serial #	Date Installed	Inlet Gas Stream Data For All Control Devices					Inlet Gas Stream Data For Condensers, Adsorbers, Afterburners, Incinerators, Oxidizers Only			Equipment Operational Data For All Control Devices		
						Temperature (°F)	Flowrate (scfm @ 68°F)	Average Particle Diameter (μm)	Particle Density (lb/ft^3) or Specific Gravity	Gas Density (lb/ft^3)	Gas Moisture Content (%)	Gas Composition	Fan Type	Pressure Drop Range (in. H_2O)	Pollutants Collected/ Controlled	Pollutant Removal (%)
107	low NOx burners				2015										NOx	70
107	flue gas recirculation				2015										NOx	70
107	oxygen trim system				2015											

Section GG.11: Other Control Equipment

Control Device ID #	**Identify all Emission Units and Control Devices that Feed to Control Equipment**	**Type of Control Equipment** (provide description and a diagram with dimensions)
107	107	Low NOx Burners inhibit the formation of thermal NOx (i.e., NOx created by the high temperature reaction in the combustion chamber between atmospheric nitrogen and oxygen) by using a staged pre-mixed combustor where the natural gas and combustion air are combined prior to ignition.
107	107	Flue Gas Recirculation. Flue gas is diverted from a location downstream of the boiler and is mixed with the combustion air. The recirculated flue gas takes the place of greater amounts of excess air that the boiler would normally need to keep the burning fuel cool. Boiler efficiency increases and thermal NOx decreases.
107	107	Oxygen Trim System. Boiler combustion efficiency is maintained via automatic oxygen control (i.e., oxygen trim). Flue gas composition is continuously monitored. Any deviations that occur within the monitored flue gas compostion initiates adjustment of the burner's air-supply control damper. The proper levels of combustion air are maintained.

Table 5-2. Natural Gas-Fired Inputs

Parameter		Value	Units	Comment			Note
Number of Operating Units:		1		Number of auxiliary (aux) boiler (blr) units			
Annual Operation:		8,760	hr/blr-yr	Nominal annual operating schedule for each aux boiler			
Heat Input:		80	*10^6 Btu/hr	Max heat-input (HHV) capacity for low-NOX, flue-gas recirculation aux blr			
Heat Content:		1,020	Btu/scf	Nominal higher heating value (HHV) natrl gas heat contnt (volumetric basis)			1
Fuel Sulfur Content:		10,000	gr/10^6 scf	Grains (gr); April 2011 Federal Facility Compliance Agreement, App. B			2
Filterable Particulate Matter:	FPM	0.01	lb/10^6 Btu	RACT/BACT/LEAR Clearinghouse; AP-42 ref. - all PM < 1.0 micron in dia.			1,3
Condensable Particulate Matter:	CPM	5.7	lb/10^6 scf	AP-42 ref. states all PM to be less than 1.0 micrometer in diameter			1
Sulfur Dioxide:	SO2	0.6	lb/10^6 scf	Assumed 100% fuel S convrsn; ref. fuel S basis is	2,000	gr/10^6 scf	1
Nitrogen Oxides:	NOX	30	ppmv dry	Approx. vendor guarntee; concntratn vol. basis at	3	% O2	
Carbon Monoxide	CO	150	ppmv dry	Approx. vendor guarntee; concntratn vol. basis at	3	% O2	
Volatile Organic Compounds:	VOC	5.5	lb/10^6 scf				1
Fuel-Sulfur Oxidation:		5.0	%	Aux-blr outlet fuel S conversion to SO3/H2SO4 (by analogy with CT)			

Notes:

1. EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - 4/98
2. June 2011 Federal Facilities Compliance Agreement in conjuction with the April 2011 Consent Decree "State of Alabama et al. v. TVA," US District Court, Eastern District of Tennessee at Knoxville.
3. Value based on EPA's RACT/BACT/LEAR Clearinghouse. This is a conservative approx. for natrl gas-fired blrs ranging from 60 to 95 million Btu per hour.

Table 5-3. Criteria / Non-HAP Pollutant Emission Estimates

Pollutant		Notes	Emission Factor, lb/10^6 scf	lb/10^6 Btu	Hourly, lb/blr-hr	Annual, tons/yr
Filterable Particulate Matter	FPM			0.01	0.800	3.50
PM < 10-micron	FPM10			0.01	0.800	3.50
PM < 2.5-micron	FPM2.5			0.01	0.800	3.50
Condensable Particulate Matter	CPM			5.59E-03	0.447	1.96
Sulfur Dioxide	SO2	1		2.79E-03	0.224	0.979
Nitrogen Oxides	NOX	2		3.64E-02	2.91	12.8
Carbon Monoxide	CO	2		0.111	8.87	38.9
Volatile Organic Compounds	VOC			5.39E-03	0.431	1.89
Sulfuric Acid Mist	H2SO4	1		2.25E-04	0.0180	0.0789
Carbon Dioxide	CO2	3		117	9,358	40,989
Methane	CH4	3		2.20E-03	0.176	0.772
Nitrous Oxide	N2O	3		2.20E-04	0.0176	0.0772
Greenhse Gas (GHG), as CO2 Equiv.	CO2e	3		117	9,368	41,031

Notes:

1 SO2 and SO3/H2SO4 emission estimates are based on fuel sulfur mass-bal. calculation for conversion of fuel sulfur to SO2 or SO3/H2SO4.

2 Assumed ideal gas - conversion from concentration value utilizing a molar volume of 385.3 ft^3/lbmole at 68 deg F and 1 atm and the 40 CFR Part 60 Appendix, Method 19 f-factor: 8,710 dry scf/10^6 Btu (at 68 deg F, 1 atm, and 0% O2).

3 US EPA, Code of Federal Regulations, Title 40, Part 98, Subpart A, Table A-1 and Subpart C, Tables C-1 & C-2, as amended 11-29-13 (78 FR 71904).

Table 5-4. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Emission Factor, [1] lb/10^6 scf	lb/10^6 Btu	Hourly, lb/blr-hr	Annual, tons/yr
Antimony	Sb	2	1.84E-04	1.80E-07	1.44E-05	6.31E-05
Arsenic	As		2.0E-04	1.96E-07	1.57E-05	6.87E-05
Beryllium	Be		1.2E-05	1.18E-08	9.41E-07	4.12E-06
Cadmium	Cd		1.1E-03	1.08E-06	8.63E-05	3.78E-04
Chromium	Cr		1.4E-03	1.37E-06	1.10E-04	4.81E-04
Cobalt	Co		8.4E-05	8.24E-08	6.59E-06	2.89E-05
Lead	Pb		5.0E-04	4.90E-07	3.92E-05	1.72E-04
Manganese	Mn		3.8E-04	3.73E-07	2.98E-05	1.31E-04
Nickel	Ni		2.1E-03	2.06E-06	1.65E-04	7.21E-04
Selenium	Se		2.4E-05	2.35E-08	1.88E-06	8.24E-06
Mercury	Hg		2.6E-04	2.55E-07	2.04E-05	8.93E-05

Notes:

1 Unless noted, all emission factors are from EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - 7-98.

2 US EPA, Air Emissions from Scrap Tire Combustion, EPA-600/R-97-115, Oct 1997 (natrl gas-fired rotary-kiln incinerator simulator emssn data).

Table 5-5. Organic HAP / Compounds Emission Estimates

Pollutant	(CASRN)	Note	Emission Factor, [1] lb/10^6 scf	lb/10^6 Btu	Hourly, lb/blr-hr	Annual, tons/yr
2-Methylnaphthalene	91-57-6	POM	2.4E-05	2.35E-08	1.88E-06	8.24E-06
3-Methylcholanthrene	56-49-5	POM	1.8E-06	1.76E-09	1.41E-07	6.18E-07
7,12-Dimethylbenz(a)anthracene	57-97-6	POM	1.6E-05	1.57E-08	1.25E-06	5.50E-06
Acenaphthene	83-32-9	POM	1.8E-06	1.76E-09	1.41E-07	6.18E-07
Acenaphthylene	208-96-8	POM	1.8E-06	1.76E-09	1.41E-07	6.18E-07
Anthracene	120-12-7	POM	2.4E-06	2.35E-09	1.88E-07	8.24E-07
Benzene	71-43-2		2.1E-03	2.06E-06	1.65E-04	7.21E-04
Benzo(a)anthracene	56-55-3	POM	1.8E-06	1.76E-09	1.41E-07	6.18E-07
Benzo(a)pyrene	50-32-8	POM	1.2E-06	1.18E-09	9.41E-08	4.12E-07
Benzo(b)fluoranthene	205-99-2	POM	1.8E-06	1.76E-09	1.41E-07	6.18E-07
Benzo(g,h,i)perylene	191-24-2	POM	1.2E-06	1.18E-09	9.41E-08	4.12E-07
Benzo(k)fluoranthene	207-08-9	POM	1.8E-06	1.76E-09	1.41E-07	6.18E-07
Chrysene	218-01-9	POM	1.8E-06	1.76E-09	1.41E-07	6.18E-07
Dibenzo(a,h)anthracene	53-70-3	POM	1.2E-06	1.18E-09	9.41E-08	4.12E-07
Dichlorobenzene [mixed isomers]	25321-22-6		1.2E-03	1.18E-06	9.41E-05	4.12E-04
Fluoranthene	206-44-0	POM	3.0E-06	2.94E-09	2.35E-07	1.03E-06
Fluorene	86-73-7	POM	2.8E-06	2.75E-09	2.20E-07	9.62E-07
Formaldehyde	50-00-0		7.5E-02	7.35E-05	5.88E-03	2.58E-02
Indeno(1,2,3-c,d)pyrene	193-39-5	POM	1.8E-06	1.76E-09	1.41E-07	6.18E-07
Naphthalene	91-20-3		6.1E-04	5.98E-07	4.78E-05	2.10E-04
n-Hexane	110-54-3	2	4.3E-04	4.22E-07	3.37E-05	1.48E-04
Phenanthrene	85-01-8	POM	1.7E-05	1.67E-08	1.33E-06	5.84E-06
Pyrene	129-00-0	POM	5.0E-06	4.90E-09	3.92E-07	1.72E-06
Toluene	108-88-3		3.4E-03	3.33E-06	2.67E-04	1.17E-03
Polycyclic Organic Matter	POM		8.82E-05	8.65E-08	6.92E-06	3.03E-05
Organic HAP Total	--		8.28E-02	8.12E-05	6.50E-03	2.85E-02
Total HAP	--		8.91E-02	8.73E-05	6.99E-03	3.06E-02

Notes:

1 Unless noted, all emission factors are from EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - 7-98.

2 B.T. O'Neil & D.A. Orr, "Hexane and Other Alkane Emission Estimates for Natural Gas-Fired Boilers", EPRI, 5-5-00

HAP This abbreviation denotes "Hazardous Air Pollutant."

POM This abbreviation denotes "Polycyclic Organic Matter" (POM), which is broad class of organic compounds that includes PAH and PAC. The POM group is defined as a HAP.

SAMPLE CALCULATIONS
NATURAL GAS-FIRED AUXILIARY BOILER
PARADISE COMBINED-CYCLE PLANT

Hourly emissions are determined by multiplying the natural gas emission factor (lb/MMBtu) by the maximum heat input capacity of the auxiliary boiler (80 MMBtu/hr).

PM filterable for natural gas = 0.01 lb/MMBtu x 80 MMBtu/hr = 0.800 lb/hr

Annual emissions are determined by multiplying the natural gas (lb/hr) by 8760 hr/yr and converting to ton/yr.

PM filterable for natural gas = 0.800 lb/hr x 8760 hr/yr x ton/2000 lb = 3.50 ton/yr

<u>Emission Factors for Natural Gas</u>

Condensable PM = 5.7 lb/MMscf x scf/1020 Btu = 5.59E-03 lb/MMBtu.

SO_2 for natural gas = 0.6 lb/MMscf x scf/1020 Btu x 10000 grains/2000 grains x 0.95 = 2.79E-03 lb/MMBtu
Note: 95% conversion to SO_2 and 2000 grain emission factor converted to 10000 grain concentration emission factor

NO_x for natural gas = 30 cu ft/1,000,000 cu ft x 8710 scf/MMBtu x 20.9/(20.9-3) x 46.0055 lb/lb mole/(385.3 cu ft/lbmole) = 3.64E-02 lb/MMBtu

CO for natural gas = 150 cu ft/1,000,000 cu ft x 8710 scf/MMBtu x 20.9/(20.9-3) x 28.01055 lb/lb mole/(385.3 cu ft/lbmole) = 0.111 lb/MMBtu

H_2SO_4 for natural gas = 0.6 lb/MMscf x scf/1020 Btu x 10000 grains/2000 grains x 0.05 x 98.0774/64.0628 = 2.25E-04 lb/MMBtu
Note: 5% conversion to H_2SO_4, 2000 grain emission factor converted to 10000 grain concentration emission factor, convert SO_2 to H_2SO_4

CO_2 equivalent from 40 CFR Part 98 = (53.06 kg/MMBtu x 1 + 0.001 kg/MMBtu x 25 + 0.0001 kg/MMBtu x 298) x 2.20462 lb/kg = 117 lb/MMBtu

HAP emission factors were converted from lb/MMscf to lb/MMBtu using 1020 Btu/scf.

NATURAL GAS-FIRED GAS HEATERS DESCRIPTION
PARADISE COMBINED-CYCLE PLANT

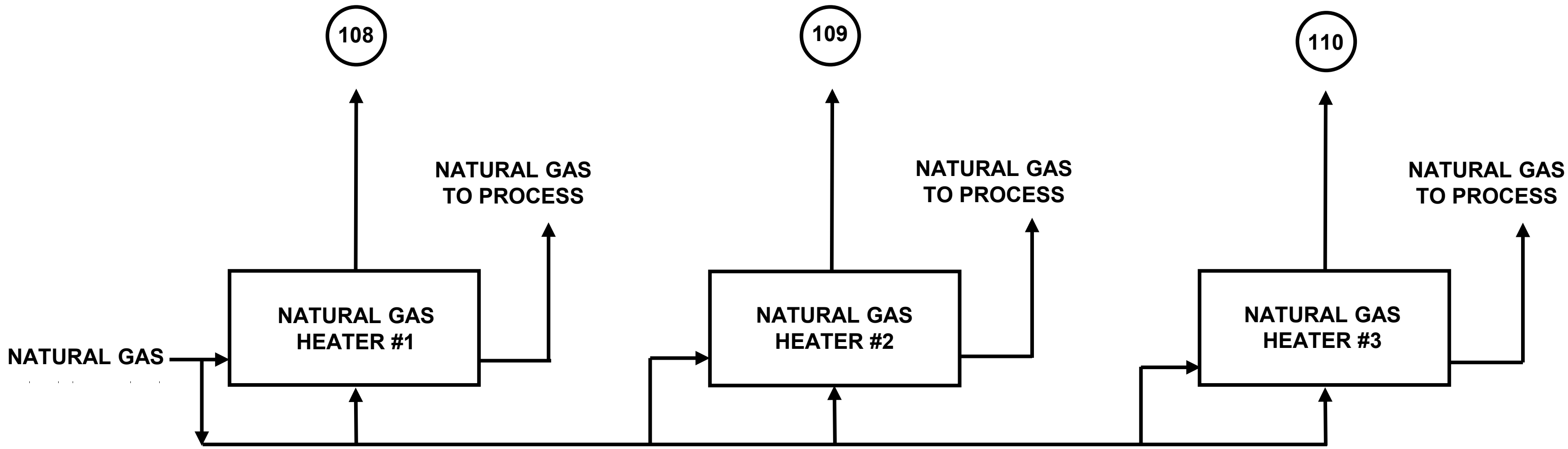
The combustion turbines require the temperature of the natural gas at the turbine interface to be above the dew point of any natural gas constituent. To achieve this, three (3) dew-point natural gas heaters are utilized. The natural gas-fired gas heaters (13.5 MMBtu/hr maximum rated heat input capacity per heater) are indirect water-bath heaters having a shell-and-tube heat exchanger configuration. CO emissions are controlled through good combustion practices. The gas heaters will include an oxygen (O_2) trim system. Each dew-point gas heater can provide 100 percent of the natural gas required for the combined-cycle facility, but each is proposed to operate year-round.

Operational and Calculation Methodology

Most of the emission factors for natural gas combustion are from AP-42, 5th Edition, Section 1.4. Emission factors for PM are based on EPA's RACT/BACT/LEAR Clearinghouse. NOx, CO, and VOC emission factors are based on manufacturer's data for natural gas combustion. The sulfur dioxide emission factor is based on 10,000 grains sulfur per million scf and 95% oxidation to SO2 and 5% oxidation to sulfuric acid. Annual emissions are estimated using 8,760 hr/yr operation.

TABLE 6-1
INPUT DATA FOR NATURAL GAS-FIRED GAS HEATERS
EMISSION ESTIMATES

Number of Natural Gas-Fired Gas Heaters	3
Maximum Rated Heat Input Capacity of Each Gas Heaters, MMBtu/hr	13.5
PM, PM10, and PM2.5 Emission Factor, lb/MMBtu	0.01
NOx Emission Factor Based on Manufacturer's Data, lb/MMBtu	0.0612
CO Emission Factor Based on Manufacturer's Data, lb/MMBtu	0.0745
VOC Emission Factor Based on Manufacturer's Data, lb/MMBtu	0.0149



TENNESSEE VALLEY AUTHORITY - PARADISE COMBINED-CYCLE PLANT

FLOW DIAGRAM OF NATURAL GAS-FIRED GAS HEATERS

LEGEND: XX **INDICATES EMISSION POINTS**

FIGURE 6-1

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DEP7007A

Indirect Heat Exchangers and Turbines

___ Section A.1: General Information
___ Section A.2: Operating and Fuel Information
___ Section A.3: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG.

____ Manufacturer's specifications

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21-177-00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section A.1: General Information

Emission Unit #	Emission Unit Name	Process ID	Process Name	Identify General Type: Indirect Heat Exchanger, Gas Turbine, or Combustion Turbine	Indirect Heat Exchanger Configuration	Manufacturer	Model No./ Serial No.	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	SCC Code	SCC Units	Control Device ID	Stack ID
108 - 110	Dew-Point Natural Gas-Fired Gas Heaters for Combined Cycle CTs	108-110	Gas Heaters for Combined Cycle CTs	Indirect Heat Exchanger	Water Bath Shell-in-Tube	Sigma Thermal	WB-7.2-244-4.0-40 / J14183-001, J14183-002, J14183-003	2015		MMBTU	108-110	108-110

Section A.2: Operating and Fuel Information

Emission Unit #	If multipurpose unit, identify the percentage of use by purpose				Rated Capacity Heat Input *(MMBTU/hr)*	Rated Capacity Power Output		Describe Operating Scenario (only if this unit will be used in different configurations)	Classify Fuel as Primary or Secondary	Identify Fuel Type: Coal, Natural Gas, Wood, Biomass, Landfill/Digester Gas, Fuel Oil # (specify 1-6), or Other	Heat Content (HHV)		Maximum Operating Hours	Ash Content *(%)*	Sulfur Content *(%)*
	Space Heat	Process Heat	Power	Emergency			*(Specify units: hp, MW, or lb steam/hr)*					*(Specify units: Btu/lb, Btu/gal, or Btu/scf)*			
108		X			13.5				Primary	Natural Gas	1,020	Btu/scf	8,760	0	1 grain / 100 scf
109		X			13.5				Primary	Natural Gas	1,020	Btu/scf	8,760	0	1 grain / 100 scf
110		X			13.5				Primary	Natural Gas	1,020	Btu/scf	8,760	0	1 grain / 100 scf

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DEP7007N

Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Informatior
__ Section N.4: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21- 177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential *(lb/hr)*	Controlled Potential *(lb/hr)*	Uncontrolled Potential *(tons/yr)*	Controlled Potential *(tons/yr)*
108 - 110	Gas Heaters for Combined Cycle CTs	108-110	Gas Heaters for Combined Cycle CTs	O2 trim system	108-110	108-110	13.5 MMBtu/hr	PM	1.00E-02	EPA's RACT/BACT/LAER Clearinghouse			1.35E-01	1.35E-01	5.91E-01	5.91E-01
								PM10	1.00E-02	same as above			1.35E-01	1.35E-01	5.91E-01	5.91E-01
								PM2.5	1.00E-02	same as above			1.35E-01	1.35E-01	5.91E-01	5.91E-01
								Cond PM	5.59E-03	AP-42			7.54E-02	7.54E-02	3.30E-01	3.30E-01
								SO2	2.79E-03	AP-42			3.77E-02	3.77E-02	1.65E-01	1.65E-01
								NOx	6.12E-02	manufacturer's info			8.26E-01	8.26E-01	3.62	3.62
								CO	7.45E-02	manufacturer's info			1.01	1.01	4.41	4.41
								VOC	1.49E-02	manufacturer's info			2.01E-01	2.01E-01	8.81E-01	8.81E-01
								CO2e	117.1	40 CFR Part 98			1,581	1,581	6,924	6,924
								Total HAPs	8.73E-05	AP-42			1.18E-03	1.18E-03	5.16E-03	5.16E-03

Section N.2: Stack Information

UTM Zone:

Stack ID	Identify all Emission Units (with Process ID) and Control Devices that Feed to Stack	Stack Physical Data			Stack UTM Coordinates		Stack Gas Stream Data		
		Equivalent Diameter *(ft)*	Height *(ft)*	Base Elevation *(ft)*	Northing *(m)*	Easting *(m)*	Flowrate *(acfm)*	Temperature *(°F)*	Exit Velocity *(ft/sec)*
108	Gas Heater with oxygen trim system	2	20	418	4,124,765	501,119	9,443	584	50.1
109	Gas Heater with oxygen trim system	2	20	418	4,124,765	501,125	9,443	584	50.1
110	Gas Heater with oxygen trim system	2	20	418	4,124,765	501,131	9,443	584	50.1

Division for Air Quality

300 Sower Boulevard

Frankfort, KY 40601

(502) 564-3999

DEP7007V

Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitation(s)

___ Section V.2: Monitoring Requirements

___ Section V.3: Recordkeeping Requirements

___ Section V.4: Reporting Requirements

___ Section V.5: Testing Requirements

___ Section V.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant

KY EIS (AFS) #: **21- 177-0006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section V.1: Emission and Operating Limitation(s)

Emission Unit #	Emission Unit Description	Applicable Regulation or Requirement	Pollutant	Emission Limit (if applicable)	Voluntary Emission Limit or Exemption (if applicable)	Operating Requirement or Limitation (if applicable)	Method of Determining Compliance with the Emission and Operating Requirement(s)
108 - 110	Dew-Point Natural Gas-Fired Gas Heaters for Combined Cycle CTs	401 KAR 59:015 Section 4	PM	PM limit of 0.10 lb/MMBtu			Maintain good operation; burn only pipeline quality natural gas.
		401 KAR 59:015 Section 4	Opacity	20%; except a maximum of 27% shall be allowed for a maximum of 6 consecutive minutes in any 60 consecutive minutes			Burn only pipeline quality natural gas.
		401 KAR 59:015 Section 5	SO2	PM limit of 0.80 lb/MMBtu			Burn only pipeline quality natural gas.

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
108 - 110	Dew-Point Natural Gas-Fired Gas Heaters for Combined Cycle CTs	All regulated pollutants	401 KAR 52:020	Hours of operation. Amount of fuel (MMscf) combusted monthly.	Monitor hours of operation and natural gas combusted monthly.
			40 CFR 60 Subpart Dc	No monitoring requirements.	

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
108 - 110	Dew-Point Natural Gas-Fired Gas Heaters for Combined Cycle CTs	All regulated pollutants	40 CFR 60 Subpart Dc	Hours of operation. Fuel consumption.	Record hours of operation and total monthly amount of fuel combusted; maintain for 2 years.

Section V.4: Reporting Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Reported	Description of Reporting
108 - 110	Dew-Point Natural Gas-Fired Gas Heaters for Combined Cycle CTs	All regulated pollutants	40 CFR 60 Subpart Dc	Hours of operation. Fuel consumption.	Submit reports every six months.

Section V.5: Testing Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Tested	Description of Testing
108 - 110	Dew-Point Natural Gas-Fired Gas Heaters for Combined Cycle CTs	All regulated pollutants	401 KAR 59:005 Section 2 401 KAR 50:045 Section 4	Testing conducted as requested by the Cabinet.	Testing conducted as requested by the Cabinet.

Division for Air Quality

300 Sower Boulevard

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DEP7007GG
Control Equipment

Additional Documentation
___ Complete Sections GG.1 through GG.12, as applicable
___ Attach manufacturer's specifications for each control device
___ Complete DEP7007AI

Source Name: TVA - Paradise Combined-Cycle Plant

KY EIS (AFS) #: 21- **177-00006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section GG.1: General Information - Control Equipment

Control Device ID #	Control Device Name	Cost	Manufacturer	Model Name/ Serial #	Date Installed	Inlet Gas Stream Data For All Control Devices					Inlet Gas Stream Data For Condensers, Adsorbers, Afterburners, Incinerators, Oxidizers Only			Equipment Operational Data For All Control Devices		
						Temperature (°F)	Flowrate (scfm @ 68°F)	Average Particle Diameter (μm)	Particle Density (lb/ft³) or Specific Gravity	Gas Density (lb/ft³)	Gas Moisture Content (%)	Gas Composition	Fan Type	Pressure Drop Range (in. H_2O)	Pollutants Collected/ Controlled	Pollutant Removal (%)
108 - 110	oxygen trim system				2015											

Section GG.11: Other Control Equipment

Control Device ID #	Identify all Emission Units and Control Devices that Feed to Control Equipment	**Type of Control Equipment** (provide description and a diagram with dimensions)
108 - 110	108 - 110	Oxygen Trim System. Burner combustion efficiency is maintained via automatic oxygen control (i.e., oxygen trim). Flue gas composition is continuously monitored. Any deviations that occur within the monitored flue gas compostion initiates adjustment of the burner's air-supply control damper. The proper levels of combustion air are maintained.

Table 6-2. Natural Gas-Fired Gas Heater Inputs

Parameter		Value	Units	Comment	Note
Number of Units:		3		Number of gas heater(s)	
Annual Operation:		8,760	hr/htr-yr	Based on a calculated capacity factor for each GH	
Heat Input:		13.5	*10^6 Btu/hr	Max capacity (HHV) for each GH; vendor specification	1
Heat Content:		1,020	Btu/scf	Nominal, higher heating value (HHV) NG heat content (volumetric basis)	2
Fuel Sulfur Content:		10,000	gr/10^6 scf	Grains (gr); April 2011 Federal Facility Compliance Agreement, App. B	3
Filterable Particulate Matter:	FPM	0.01	lb/10^6 Btu	RACT/BACT/LEAR Clearinghouse; AP-42 ref. - all PM < 1.0 micron in dia.	2,4
Condensable Particulate Matter:	CPM	5.7	lb/10^6 scf	AP-42 ref. states all PM to be less than 1.0 micrometer in diameter	2
Sulfur Dioxide:	SO2	0.6	lb/10^6 scf	Assumed 100% fuel S convrsn; ref. fuel S basis is 2,000 gr/10^6 scf	2
Nitrogen Oxides:	NOX	0.0612	lb/10^6 Btu	Emssn fctr derived from other, similar-sized TVA-project GH manufctrer data	
Carbon Monoxide	CO	0.0745	lb/10^6 Btu	Emssn fctr derived from other, similar-sized TVA-project GH manufctrer data	
Volatile Organic Compounds:	VOC	0.0149	lb/10^6 Btu	Emssn fctr derived from other, similar-sized TVA-project GH manufctrer data	
Fuel-Sulfur Oxidation:		5.0	%	GH outlet fuel S conversion to SO3/H2SO4 (by analogy with CT units)	

Notes:

1. Each gas heater will be capable of meeting 100 percent of facility requirements (redundant capacity). Mike Hoy 9-24-14 email to K. Davenport, et al.
2. EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - 4/98
3. June 2011 Federal Facilities Compliance Agreement in conjuction with the April 2011 Consent Decree "State of Alabama et al. v. TVA," US District Court, Eastern District of Tennessee at Knoxville.
4. Value based on EPA's RACT/BACT/LEAR Clearinghouse. This is a conservative approx. for natrl gas-fired blrs ranging from 7.5 to 20 million Btu per hour.

Table 6-3. Criteria / Non-HAP Pollutant Emission Estimates

Pollutant		Note	Emission Factor, lb/10^6 scf	Emission Factor, lb/10^6 Btu	Hourly, lb/htr-hr	Annual, tons/year GH-1	GH-2	GH-3	Total
Filterable Particulate Matter	FPM			0.01	0.135	0.591	0.591	0.591	1.77
PM < 10-micron	FPM10			0.01	0.135	0.591	0.591	0.591	1.77
PM < 2.5-micron	FPM2.5			0.01	0.135	0.591	0.591	0.591	1.77
Condensable Particulate Matter	CPM			5.59E-03	0.0754	0.330	0.330	0.330	0.991
Sulfur Dioxide	SO2	1		2.79E-03	0.0377	0.165	0.165	0.165	0.496
Nitrogen Oxides	NOX			0.0612	0.826	3.62	3.62	3.62	10.9
Carbon Monoxide	CO			0.0745	1.01	4.41	4.41	4.41	13.2
Volatile Organic Compounds	VOC			0.0149	0.201	0.881	0.881	0.881	2.64
Sulfuric Acid (SO3/H2SO4) as H2SO4	H2SO4	1		2.25E-04	0.00304	0.0133	0.0133	0.0133	0.0399
Carbon Dioxide	CO2	2		117	1579	6,917	6,917	6,917	20,751
Methane	CH4	2		2.20E-03	0.0298	0.130	0.130	0.130	0.391
Nitrous Oxide	N2O	2		2.20E-04	0.00298	0.0130	0.0130	0.0130	0.0391
Greenhse Gas (GHG), as CO2 Equiv.	CO2e	2		117	1,581	6,924	6,924	6,924	20,772

Notes:

1 SO2 and SO3/H2SO4 emission estimates are based on fuel sulfur mass-bal. calculation for conversion of fuel sulfur to SO2 or SO3/H2SO4.

2 US EPA, Code of Federal Regulations, Title 40, Part 98, Subpart A, Table A-1 and Subpart C, Tables C-1 & C-2, as amended 11-29-13 (78 FR 71904)

Table 6-4. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Emission Factor, [1] lb/10^6 scf	Emission Factor, [1] lb/10^6 Btu	Hourly, lb/htr-hr	Annual, tons/year GH-1	GH-2	GH-3	Total
Antimony	Sb	2	1.84E-04	1.80E-07	2.43E-06	1.06E-05	1.06E-05	1.06E-05	3.19E-05
Arsenic	As		2.0E-04	1.96E-07	2.65E-06	1.16E-05	1.16E-05	1.16E-05	3.48E-05
Beryllium	Be		1.2E-05	1.18E-08	1.59E-07	6.96E-07	6.96E-07	6.96E-07	2.09E-06
Cadmium	Cd		1.1E-03	1.08E-06	1.46E-05	6.38E-05	6.38E-05	6.38E-05	1.91E-04
Chromium	Cr		1.4E-03	1.37E-06	1.85E-05	8.12E-05	8.12E-05	8.12E-05	2.43E-04
Cobalt	Co		8.4E-05	8.24E-08	1.11E-06	4.87E-06	4.87E-06	4.87E-06	1.46E-05
Lead	Pb		5.0E-04	4.90E-07	6.62E-06	2.90E-05	2.90E-05	2.90E-05	8.70E-05
Manganese	Mn		3.8E-04	3.73E-07	5.03E-06	2.20E-05	2.20E-05	2.20E-05	6.61E-05
Nickel	Ni		2.1E-03	2.06E-06	2.78E-05	1.22E-04	1.22E-04	1.22E-04	3.65E-04
Selenium	Se		2.4E-05	2.35E-08	3.18E-07	1.39E-06	1.39E-06	1.39E-06	4.17E-06
Mercury	Hg		2.6E-04	2.55E-07	3.44E-06	1.51E-05	1.51E-05	1.51E-05	4.52E-05

Notes:

1 Unless noted, all emission factors are from EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - 7-98.

2 US EPA, Air Emissions from Scrap Tire Combustion, EPA-600/R-97-115, Oct 1997 (natrl gas-fired rotary-kiln incinerator simulator emssn data)

Table 6-5. Organic HAP / Compounds Emission Estimates

Pollutant	(CASRN)	Note	Emission Factor, [1] lb/10^6 scf	lb/10^6 Btu	Hourly, lb/htr-hr	Annual, tons/year GH-1	GH-2	GH-3	Total
2-Methylnaphthalene	91-57-6	POM	2.4E-05	2.35E-08	3.18E-07	1.39E-06	1.39E-06	1.39E-06	4.17E-06
3-Methylcholanthrene	56-49-5	POM	1.8E-06	1.76E-09	2.38E-08	1.04E-07	1.04E-07	1.04E-07	3.13E-07
7,12-Dimethylbenz(a)anthracene	57-97-6	POM	1.6E-05	1.57E-08	2.12E-07	9.28E-07	9.28E-07	9.28E-07	2.78E-06
Acenaphthene	83-32-9	POM	1.8E-06	1.76E-09	2.38E-08	1.04E-07	1.04E-07	1.04E-07	3.13E-07
Acenaphthylene	208-96-8	POM	1.8E-06	1.76E-09	2.38E-08	1.04E-07	1.04E-07	1.04E-07	3.13E-07
Anthracene	120-12-7	POM	2.4E-06	2.35E-09	3.18E-08	1.39E-07	1.39E-07	1.39E-07	4.17E-07
Benzene	71-43-2		2.1E-03	2.06E-06	2.78E-05	1.22E-04	1.22E-04	1.22E-04	3.65E-04
Benzo(a)anthracene	56-55-3	POM	1.8E-06	1.76E-09	2.38E-08	1.04E-07	1.04E-07	1.04E-07	3.13E-07
Benzo(a)pyrene	50-32-8	POM	1.2E-06	1.18E-09	1.59E-08	6.96E-08	6.96E-08	6.96E-08	2.09E-07
Benzo(b)fluoranthene	205-99-2	POM	1.8E-06	1.76E-09	2.38E-08	1.04E-07	1.04E-07	1.04E-07	3.13E-07
Benzo(g,h,i)perylene	191-24-2	POM	1.2E-06	1.18E-09	1.59E-08	6.96E-08	6.96E-08	6.96E-08	2.09E-07
Benzo(k)fluoranthene	207-08-9	POM	1.8E-06	1.76E-09	2.38E-08	1.04E-07	1.04E-07	1.04E-07	3.13E-07
Chrysene	218-01-9	POM	1.8E-06	1.76E-09	2.38E-08	1.04E-07	1.04E-07	1.04E-07	3.13E-07
Dibenzo(a,h)anthracene	53-70-3	POM	1.2E-06	1.18E-09	1.59E-08	6.96E-08	6.96E-08	6.96E-08	2.09E-07
Dichlorobenzene [mixed isomers]	25321-22-6		1.2E-03	1.18E-06	1.59E-05	6.96E-05	6.96E-05	6.96E-05	2.09E-04
Fluoranthene	206-44-0	POM	3.0E-06	2.94E-09	3.97E-08	1.74E-07	1.74E-07	1.74E-07	5.22E-07
Fluorene	86-73-7	POM	2.8E-06	2.75E-09	3.71E-08	1.62E-07	1.62E-07	1.62E-07	4.87E-07
Formaldehyde	50-00-0		7.5E-02	7.35E-05	9.93E-04	4.35E-03	4.35E-03	4.35E-03	1.30E-02
Indeno(1,2,3-c,d)pyrene	193-39-5	POM	1.8E-06	1.76E-09	2.38E-08	1.04E-07	1.04E-07	1.04E-07	3.13E-07
Naphthalene	91-20-3		6.1E-04	5.98E-07	8.07E-06	3.54E-05	3.54E-05	3.54E-05	1.06E-04
n-Hexane	110-54-3	2	4.3E-04	4.22E-07	5.69E-06	2.49E-05	2.49E-05	2.49E-05	7.48E-05
Phenanthrene	85-01-8	POM	1.7E-05	1.67E-08	2.25E-07	9.86E-07	9.86E-07	9.86E-07	2.96E-06
Pyrene	129-00-0	POM	5.0E-06	4.90E-09	6.62E-08	2.90E-07	2.90E-07	2.90E-07	8.70E-07
Toluene	108-88-3		3.4E-03	3.33E-06	4.50E-05	1.97E-04	1.97E-04	1.97E-04	5.91E-04
Polycyclic Organic Matter	POM		8.82E-05	8.65E-08	1.17E-06	5.11E-06	5.11E-06	5.11E-06	1.53E-05
Organic HAP Total	--		8.28E-02	8.12E-05	1.10E-03	4.80E-03	4.80E-03	4.80E-03	1.44E-02
Total HAP	--		8.91E-02	8.73E-05	1.18E-03	5.16E-03	5.16E-03	5.16E-03	1.55E-02

Notes:

1 Unless noted, all emission factors are from EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - 7-98.

2 B.T. O'Neil & D.A. Orr, "Hexane and Other Alkane Emission Estimates for Natural Gas-Fired Boilers", Electric Power Research Institute (EPRI), 5-5-00

HAP This abbreviation denotes "Hazardous Air Pollutant."

POM This abbreviation denotes "Polycyclic Organic Matter" (POM), which is broad class of organic compounds that includes PAH and PAC. The POM group is defined as a HAP.

SAMPLE CALCULATIONS
NATURAL GAS-FIRED GAS HEATERS
PARADISE COMBINED-CYCLE PLANT

Hourly emissions are determined by multiplying the natural gas emission factor (lb/MMBtu) by the maximum heat input capacity of the gas heater (13.5 MMBtu/hr).

PM filterable for natural gas = 0.01 lb/MMBtu x 13.5 MMBtu/hr = 0.135 lb/hr

Annual emissions are determined by multiplying the natural gas (lb/hr) by 8,760 hr/yr and converting to ton/yr.

PM filterable for natural gas = 0.135 lb/hr x 8760 hr/yr x ton/2000 lb = 0.591 ton/yr

Emission Factors for Natural Gas

Condensable PM = 5.7 lb/MMscf x scf/1020 Btu = 5.59E-03 lb/MMBtu

SO_2 for natural gas = 0.6 lb/MMscf x scf/1020 Btu x 10000 grains/2000 grains x 0.95 = 2.79E-03 lb/MMBtu
Note: 95% conversion to SO_2 and 2000 grain emission factor converted to 10000 grain concentration emission factor.

H_2SO_4 for natural gas = 0.6 lb/MMscf x scf/1020 Btu x 10000 grains/2000 grains x 0.05 x 98.0774/64.0628 = 2.25E-04 lb/MMBtu
Note: 5% conversion to H_2SO_4, 2000 grain emission factor converted to 10000 grain concentration emission factor, convert SO_2 to H_2SO_4.

CO_2 equivalent from 40 CFR Part 98 = (53.06 kg/MMBtu x 1 + 0.001 kg/MMBtu x 25 + 0.0001 kg/MMBtu x 298) x 2.20462 lb/kg = 117 lb/MMBtu

HAP emission factors were converted from lb/MMscf to lb/MMBtu using 1020 Btu/scf

NATURAL GAS-FIRED GAS HEATERS DESCRIPTION
PARADISE SIMPLE-CYCLE PLANT

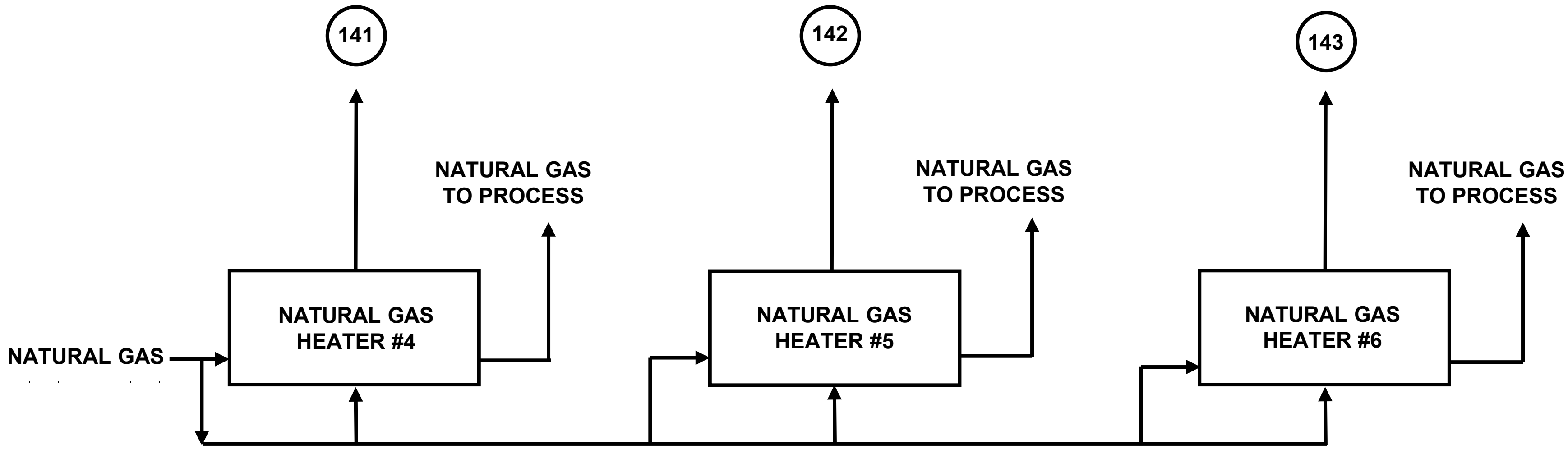
The combustion turbines require the temperature of the natural gas at the turbine interface to be above the dew point of any natural gas constituent. To achieve this, three (3) dew-point natural gas heaters are utilized. The natural gas-fired gas heaters (10 MMBtu/hr maximum rated heat input capacity per heater) are indirect water-bath heaters having a shell-and-tube heat exchanger configuration. CO emissions are controlled through good combustion practices. The gas heaters will include an oxygen (O_2) trim system.

Operational and Calculation Methodology

Most of the emission factors for natural gas combustion are from AP-42, 5th Edition, Section 1.4. Emission factors for FPM, NOx, CO, and VOCa are based on manufacturer's data for natural gas combustion for similarly-sized gas heaters. The sulfur dioxide emission factor is based on 2,000 grains sulfur per million scf and 95% oxidation to SO2 and 5% oxidation to sulfuric acid. Annual emissions are estimated using 3,406 hr/yr operation since the CTs are limited by 40 CFR Part 60 Suppart TTTT.

TABLE 7-1
INPUT DATA FOR NATURAL GAS-FIRED GAS HEATERS EMISSION ESTIMATES

Number of Natural Gas-Fired Gas Heaters	3
Maximum Rated Heat Input Capacity of Each Gas Heaters, MMBtu/hr	10
PM, PM10, and PM2.5 Emission Factor, lb/MMBtu	0.008
NOx Emission Factor Based on Manufacturer's Data, lb/MMBtu	0.0612
CO Emission Factor Based on Manufacturer's Data, lb/MMBtu	0.0745
VOC Emission Factor Based on Manufacturer's Data, lb/MMBtu	0.0149



TENNESSEE VALLEY AUTHORITY - PARADISE SIMPLE-CYCLE PLANT

FLOW DIAGRAM OF NATURAL GAS-FIRED GAS HEATERS

LEGEND: XX INDICATES EMISSION POINTS

FIGURE 7-1

Division for Air Quality

300 Sower Boulevard
Frankfort, KY 40601
(502) 564-3999

DEP7007A

Indirect Heat Exchangers and Turbines

___ Section A.1: General Information
___ Section A.2: Operating and Fuel Information
___ Section A.3: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG.

____ Manufacturer's specifications

Source Name: TVA - Paradise Combined Cycle Plant

KY EIS (AFS) #: **21-177-00006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section A.1: General Information

Emission Unit #	Emission Unit Name	Process ID	Process Name	Identify General Type: Indirect Heat Exchanger, Gas Turbine, or Combustion Turbine	Indirect Heat Exchanger Configuration	Manufacturer	Model No./ Serial No.	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	SCC Code	SCC Units	Control Device ID	Stack ID
141 - 143	Gas Heaters for Simple Cycle CTs	141-143	Gas Heaters 4, 5, and 6 for Simple Cycle CTs	Indirect Heat Exchanger	Water Bath Shell-in-Tube	Aether	Serial No. 221013-040-1 221013-040-2 221013-040-3	7/2021		MMBTU	141-143	141-143

Section A.2: Operating and Fuel Information

Emission Unit #	If multipurpose unit, identify the percentage of use by purpose				Rated Capacity Heat Input *(MMBTU/hr)*	Rated Capacity Power Output		Describe Operating Scenario (only if this unit will be used in different configurations)	Classify Fuel as Primary or Secondary	Identify Fuel Type: Coal, Natural Gas, Wood, Biomass, Landfill/Digester Gas, Fuel Oil # (specify 1-6), or Other	Heat Content (HHV)		Maximum Operating Hours	Ash Content *(%)*	Sulfur Content *(%)*
	Space Heat	Process Heat	Power	Emergency			*(Specify units: hp, MW, or lb steam/hr)*					*(Specify units: Btu/lb, Btu/gal, or Btu/scf)*			
141		X			10				Primary	Natural Gas	1,020	Btu/scf	3,406	0	6.70E-04
142		X			10				Primary	Natural Gas	1,020	Btu/scf	3,406	0	6.70E-04
143		X			10				Primary	Natural Gas	1,020	Btu/scf	3,406	0	6.70E-04

Section A.3: Notes, Comments, and Explanations
Maximum operating hours (3,406 hr/yr) are assumed and only used for emission estimates. They are not meant to represent limits on operation. The CTs are limited by 40 CFR 60 Subpart TTTT, so it is expected that the gas heaters would operate a similar amount of time as the CTs.

Division for Air Quality

300 Sower Boulevard
Frankfort, KY 40601
(502) 564-3999

DEP7007N

Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Information
__ Section N.4: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: 21- **177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential *(lb/hr)*	Controlled Potential *(lb/hr)*	Uncontrolled Potential *(tons/yr)*	Controlled Potential *(tons/yr)*
141-143	Gas Heaters for Simple Cycle CTs	141-143	Gas Heaters for Simple Cycle CTs	O2 trim system	141-143	141-143	10 MMBtu/hr	PM	8.00E-03	manufacturer's info			8.00E-02	8.00E-02	1.36E-01	1.36E-01
								PM10	8.00E-03	manufacturer's info			8.00E-02	8.00E-02	1.36E-01	1.36E-01
								PM2.5	8.00E-03	manufacturer's info			8.00E-02	8.00E-02	1.36E-01	1.36E-01
								Cond PM	5.59E-03	AP-42			5.59E-02	5.59E-02	9.52E-02	9.52E-02
								SO2	5.59E-04	AP-42			5.59E-03	5.59E-03	9.52E-03	9.52E-03
								NOx	6.12E-02	manufacturer's info			6.12E-01	6.12E-01	1.04	1.04
								CO	7.45E-02	manufacturer's info			7.45E-01	7.45E-01	1.27	1.27
								VOC	1.49E-02	manufacturer's info			1.49E-01	1.49E-01	2.54E-01	2.54E-01
								CO2e	117.1	40CFR Part 98			1,171	1,171	1,994	1,994
								Total HAPs	8.73E-05	AP-42			8.73E-04	8.73E-04	1.49E-03	1.49E-03

Section N.2: Stack Information

UTM Zone:

Stack ID	Identify all Emission Units (with Process ID) and Control Devices that Feed to Stack	Stack Physical Data			Stack UTM Coordinates		Stack Gas Stream Data		
		Equivalent Diameter *(ft)*	Height *(ft)*	Base Elevation *(ft)*	Northing *(m)*	Easting *(m)*	Flowrate *(acfm)*	Temperature *(°F)*	Exit Velocity *(ft/sec)*
141	Gas Heater with oxygen trim system	2	30	418	4,124,604.9	501,246.1	5,825	778	30.9
142	Gas Heater with oxygen trim system	2	30	418	4,124,604.9	501,251.9	5,825	778	30.9
143	Gas Heater with oxygen trim system	2	30	418	4,124,604.9	501,257.7	5,825	778	30.9

Section N.4: Notes, Comments, and Explanations
Maximum operating hours (3,406 hr/yr) are assumed and only used for emission estimates. They are not meant to represent limits on operation. The CTs are limited by 40 CFR 60 Subpart TTTT, so it is expected that the gas heaters would operate a similar amount of time as the CTs.

Division for Air Quality

300 Sower Boulevard

Frankfort, KY 40601

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DEP7007V
Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitation(s)
___ Section V.2: Monitoring Requirements
___ Section V.3: Recordkeeping Requirements
___ Section V.4: Reporting Requirements
___ Section V.5: Testing Requirements
___ Section V.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant

KY EIS (AFS) #: **21- 177-0006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section V.1: Emission and Operating Limitation(s)

Emission Unit #	**Emission Unit Description**	**Applicable Regulation or Requirement**	**Pollutant**	**Emission Limit** (if applicable)	**Voluntary Emission Limit or Exemption** (if applicable)	**Operating Requirement or Limitation** (if applicable)	**Method of Determining Compliance with the Emission and Operating Requirement(s)**
141 - 143	Dew-Point Natural Gas-Fired Gas Heaters for Simple Cycle CTs	401 KAR 59:015 Section 4	PM	PM limit of 0.01 lb/MMBtu			Maintain good operation; burn only pipeline quality natural gas
		401 KAR 59:015 Section 4	Opacity	20%; except a maximum of 40% shall be allowed for a maximum of 6 consecutive minutes in any 60 consecutive minutes during fire-box cleaning or soot blowing			Burn only pipeline quality natural gas
		401 KAR 59:015 Section 5	SO2	PM limit of 0.99 lb/MMBtu			Burn only pipeline quality natural gas

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
141 - 143	Dew-Point Natural Gas-Fired Gas Heaters for Simple Cycle CTs	All regulated pollutants	401 KAR 52:020	Hours of operation. Amount of fuel (MMscf) combusted monthly.	Monitor hours of operation and natural gas combusted monthly.
			40 CFR 60 Subpart Dc	No monitoring requirements	

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
141 - 143	Dew-Point Natural Gas-Fired Gas Heaters for Simple Cycle CTs	All regulated pollutants	40 CFR 60 Subpart Dc	Hours of operation. Fuel consumption.	Record hours of operation and total monthly amount of fuel combusted; maintain for 2 years.

Section V.4: Reporting Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Reported	Description of Reporting
141 - 143	Dew-Point Natural Gas-Fired Gas Heaters for Simple Cycle CTs	All regulated pollutants	40 CFR 60 Subpart Dc	Hours of operation. Fuel consumption.	Submit reports every six months.

Section V.5: Testing Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Tested	Description of Testing
141 - 143	Dew-Point Natural Gas-Fired Gas Heaters for Simple Cycle CTs	All regulated pollutants	401 KAR 59:005 Section 2 401 KAR 50:045 Section 4	Testing conducted as requested by the Cabinet.	Testing conducted as requested by the Cabinet.

Division for Air Quality

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DEP7007GG

Control Equipment

Additional Documentation
___ Complete Sections GG.1 through GG.12, as applicable
___ Attach manufacturer's specifications for each control device
___ Complete DEP7007AI

Source Name: TVA - Paradise Combined-Cycle Plant

KY EIS (AFS) #: **21- 177-00006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section GG.1: General Information - Control Equipment

Control Device ID #	Control Device Name	Cost	Manufacturer	Model Name/ Serial #	Date Installed	Inlet Gas Stream Data For All Control Devices					Inlet Gas Stream Data For Condensers, Adsorbers, Afterburners, Incinerators, Oxidizers Only			Equipment Operational Data For All Control Devices		
						Temperature (°F)	Flowrate (scfm @ 68°F)	Average Particle Diameter (µm)	Particle Density (lb/ft^3) or Specific Gravity	Gas Density (lb/ft^3)	Gas Moisture Content (%)	Gas Composition	Fan Type	Pressure Drop Range (in. H_2O)	Pollutants Collected/ Controlled	Pollutant Removal (%)
141-143	oxygen trim system				2021											

Section GG.11: Other Control Equipment

Control Device ID #	Identify all Emission Units and Control Devices that Feed to Control Equipment	**Type of Control Equipment** (provide description and a diagram with dimensions)
141 - 143	141 - 143	Oxygen Trim System. Burner combustion efficiency is maintained via automatic oxygen control (i.e., oxygen trim). Flue gas composition is continuously monitored. Any deviations that occur within the monitored flue gas compostion initiates adjustment of the burner's air-supply control damper. The proper levels of combustion air are maintained.

Table 7-2. Natural Gas-Fired Gas Heater Inputs

Parameter		Value	Units	Comment			Note
Number of Units:		3		Number of gas heater(s)			
Annual Operation:		3,406	hr/htr-yr	Assumed based on CT limit from 40 CFR 60 Subpart TTTT			
Heat Input:		10	*10^6 Btu/hr	Max capacity (HHV) for each GH; vendor specification			
Heat Content:		1,020	Btu/scf	Nominal, higher heating value (HHV) NG heat content (volumetric basis)			1
Fuel Sulfur Content:		2,000	gr/10^6 scf	Based on 40 CFR Part 75, Appendix D, default emission rate for natural gas			
Filterable Particulate Matter:	FPM	0.008	lb/10^6 Btu	Emssn fctr derived from other, similar-sized TVA-project GH manufctrer data			
Condensable Particulate Matter:	CPM	5.7	lb/10^6 scf	AP-42 ref. states all PM to be less than 1.0 micrometer in diameter			1
Sulfur Dioxide:	SO2	0.6	lb/10^6 scf	Assumed 100% fuel S convrsn; ref. fuel S basis is	2,000	gr/10^6 scf	1
Nitrogen Oxides:	NOX	0.0612	lb/10^6 Btu	Emssn fctr derived from other, similar-sized TVA-project GH manufctrer data			
Carbon Monoxide	CO	0.0745	lb/10^6 Btu	Emssn fctr derived from other, similar-sized TVA-project GH manufctrer data			
Volatile Organic Compounds:	VOC	0.0149	lb/10^6 Btu	Emssn fctr derived from other, similar-sized TVA-project GH manufctrer data			
Fuel-Sulfur Oxidation:		5.0	%	GH outlet fuel S conversion to SO3/H2SO4 (by analogy with CT units)			

Notes:

1 EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - 4/98

Table 7-3. Criteria / Non-HAP Pollutant Emission Estimates

Pollutant		Note	Emission Factor, lb/10^6 scf	lb/10^6 Btu	Hourly, lb/htr-hr	Annual, tons/year GH-4	GH-5	GH-6	Total
Filterable Particulate Matter	FPM			0.008	0.0800	0.136	0.136	0.136	0.409
PM < 10-micron	FPM10			0.008	0.0800	0.136	0.136	0.136	0.409
PM < 2.5-micron	FPM2.5			0.008	0.0800	0.136	0.136	0.136	0.409
Condensable Particulate Matter	CPM			0.00559	0.0559	0.0952	0.0952	0.0952	0.286
Sulfur Dioxide	SO2	1		5.59E-04	0.00559	0.00952	0.00952	0.00952	0.0286
Nitrogen Oxides	NOX			0.0612	0.612	1.04	1.04	1.04	3.13
Carbon Monoxide	CO			0.0745	0.745	1.27	1.27	1.27	3.81
Volatile Organic Compounds	VOC			0.0149	0.149	0.254	0.254	0.254	0.761
Sulfuric Acid (SO3/H2SO4) as H2SO4	H2SO4	1		4.50E-05	0.000450	0.000767	0.000767	0.000767	0.00230
Carbon Dioxide	CO2	2		117	1,170	1,992	1,992	1,992	5,976
Methane	CH4	2		2.20E-03	0.0220	0.0375	0.0375	0.0375	0.113
Nitrous Oxide	N2O	2		2.20E-04	0.00220	0.00375	0.00375	0.00375	0.0113
Greenhse Gas (GHG), as CO2 Equiv.	CO2e	2		117.1	1,171	1,994	1,994	1,994	5,983

Notes:

1 SO2 and SO3/H2SO4 emission estimates are based on fuel sulfur mass-bal. calculation for conversion of fuel sulfur to SO2 or SO3/H2SO4.

2 US EPA, Code of Federal Regulations, Title 40, Part 98, Subpart A, Table A-1 and Subpart C, Tables C-1 & C-2, as amended 11-29-13 (78 FR 71904)

Table 7-4. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Emission Factor, [1] lb/10^6 scf	lb/10^6 Btu	Hourly, lb/htr-hr	Annual, tons/year GH-4	GH-5	GH-6	Total
Antimony	Sb	2	1.84E-04	1.80E-07	1.80E-06	3.07E-06	3.07E-06	3.07E-06	9.20E-06
Arsenic	As		2.0E-04	1.96E-07	1.96E-06	3.34E-06	3.34E-06	3.34E-06	1.00E-05
Beryllium	Be		1.2E-05	1.18E-08	1.18E-07	2.00E-07	2.00E-07	2.00E-07	6.01E-07
Cadmium	Cd		1.1E-03	1.08E-06	1.08E-05	1.84E-05	1.84E-05	1.84E-05	5.51E-05
Chromium	Cr		1.4E-03	1.37E-06	1.37E-05	2.34E-05	2.34E-05	2.34E-05	7.01E-05
Cobalt	Co		8.4E-05	8.24E-08	8.24E-07	1.40E-06	1.40E-06	1.40E-06	4.21E-06
Lead	Pb		5.0E-04	4.90E-07	4.90E-06	8.35E-06	8.35E-06	8.35E-06	2.50E-05
Manganese	Mn		3.8E-04	3.73E-07	3.73E-06	6.34E-06	6.34E-06	6.34E-06	1.90E-05
Nickel	Ni		2.1E-03	2.06E-06	2.06E-05	3.51E-05	3.51E-05	3.51E-05	1.05E-04
Selenium	Se		2.4E-05	2.35E-08	2.35E-07	4.01E-07	4.01E-07	4.01E-07	1.20E-06
Mercury	Hg		2.6E-04	2.55E-07	2.55E-06	4.34E-06	4.34E-06	4.34E-06	1.30E-05

Notes:

1 Unless noted, all emission factors are from EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - 7-98.

2 US EPA, Air Emissions from Scrap Tire Combustion, EPA-600/R-97-115, Oct 1997 (natrl gas-fired rotary-kiln incinerator simulator emssn data)

Table 7-5. Organic HAP / Compounds Emission Estimates

Pollutant	(CASRN)	Note	Emission Factor, [1] lb/10^6 scf	Emission Factor, [1] lb/10^6 Btu	Hourly, lb/htr-hr	Annual, tons/year GH-4	Annual, tons/year GH-5	Annual, tons/year GH-6	Annual, tons/year Total
2-Methylnaphthalene	91-57-6	POM	2.4E-05	2.35E-08	2.35E-07	4.01E-07	4.01E-07	4.01E-07	1.20E-06
3-Methylcholanthrene	56-49-5	POM	1.8E-06	1.76E-09	1.76E-08	3.01E-08	3.01E-08	3.01E-08	9.02E-08
7,12-Dimethylbenz(a)anthracene	57-97-6	POM	1.6E-05	1.57E-08	1.57E-07	2.67E-07	2.67E-07	2.67E-07	8.01E-07
Acenaphthene	83-32-9	POM	1.8E-06	1.76E-09	1.76E-08	3.01E-08	3.01E-08	3.01E-08	9.02E-08
Acenaphthylene	208-96-8	POM	1.8E-06	1.76E-09	1.76E-08	3.01E-08	3.01E-08	3.01E-08	9.02E-08
Anthracene	120-12-7	POM	2.4E-06	2.35E-09	2.35E-08	4.01E-08	4.01E-08	4.01E-08	1.20E-07
Benzene	71-43-2		2.1E-03	2.06E-06	2.06E-05	3.51E-05	3.51E-05	3.51E-05	1.05E-04
Benzo(a)anthracene	56-55-3	POM	1.8E-06	1.76E-09	1.76E-08	3.01E-08	3.01E-08	3.01E-08	9.02E-08
Benzo(a)pyrene	50-32-8	POM	1.2E-06	1.18E-09	1.18E-08	2.00E-08	2.00E-08	2.00E-08	6.01E-08
Benzo(b)fluoranthene	205-99-2	POM	1.8E-06	1.76E-09	1.76E-08	3.01E-08	3.01E-08	3.01E-08	9.02E-08
Benzo(g,h,i)perylene	191-24-2	POM	1.2E-06	1.18E-09	1.18E-08	2.00E-08	2.00E-08	2.00E-08	6.01E-08
Benzo(k)fluoranthene	207-08-9	POM	1.8E-06	1.76E-09	1.76E-08	3.01E-08	3.01E-08	3.01E-08	9.02E-08
Chrysene	218-01-9	POM	1.8E-06	1.76E-09	1.76E-08	3.01E-08	3.01E-08	3.01E-08	9.02E-08
Dibenzo(a,h)anthracene	53-70-3	POM	1.2E-06	1.18E-09	1.18E-08	2.00E-08	2.00E-08	2.00E-08	6.01E-08
Dichlorobenzene [mixed isomers]	25321-22-6		1.2E-03	1.18E-06	1.18E-05	2.00E-05	2.00E-05	2.00E-05	6.01E-05
Fluoranthene	206-44-0	POM	3.0E-06	2.94E-09	2.94E-08	5.01E-08	5.01E-08	5.01E-08	1.50E-07
Fluorene	86-73-7	POM	2.8E-06	2.75E-09	2.75E-08	4.67E-08	4.67E-08	4.67E-08	1.40E-07
Formaldehyde	50-00-0		7.5E-02	7.35E-05	7.35E-04	1.25E-03	1.25E-03	1.25E-03	3.76E-03
Indeno(1,2,3-c,d)pyrene	193-39-5	POM	1.8E-06	1.76E-09	1.76E-08	3.01E-08	3.01E-08	3.01E-08	9.02E-08
Naphthalene	91-20-3		6.1E-04	5.98E-07	5.98E-06	1.02E-05	1.02E-05	1.02E-05	3.06E-05
n-Hexane	110-54-3	2	4.3E-04	4.22E-07	4.22E-06	7.18E-06	7.18E-06	7.18E-06	2.15E-05
Phenanthrene	85-01-8	POM	1.7E-05	1.67E-08	1.67E-07	2.84E-07	2.84E-07	2.84E-07	8.52E-07
Pyrene	129-00-0	POM	5.0E-06	4.90E-09	4.90E-08	8.35E-08	8.35E-08	8.35E-08	2.50E-07
Toluene	108-88-3		3.4E-03	3.33E-06	3.33E-05	5.68E-05	5.68E-05	5.68E-05	1.70E-04
Polycyclic Organic Matter	POM		8.82E-05	8.65E-08	8.65E-07	1.47E-06	1.47E-06	1.47E-06	4.42E-06
Organic HAP Total	--		8.28E-02	8.12E-05	8.12E-04	1.38E-03	1.38E-03	1.38E-03	4.15E-03
Total HAP	--		8.91E-02	8.73E-05	8.73E-04	1.49E-03	1.49E-03	1.49E-03	4.46E-03

Notes:

1 Unless noted, all emission factors are from EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - 7-98.

2 B.T. O'Neil & D.A. Orr, "Hexane and Other Alkane Emission Estimates for Natural Gas-Fired Boilers", Electric Power Research Institute (EPRI), 5-5-00

HAP This abbreviation denotes "Hazardous Air Pollutant."

POM This abbreviation denotes "Polycyclic Organic Matter" (POM), which is broad class of organic compounds that includes PAH and PAC. The POM group is defined as a HAP.

SAMPLE CALCULATIONS
NATURAL GAS-FIRED GAS HEATERS
PARADISE SIMPLE-CYCLE PLANT

Hourly emissions are determined by multiplying the natural gas emission factor (lb/MMBtu) by the maximum heat input capacity of the gas heater (10 MMBtu/hr).

PM filterable for natural gas = 0.008 lb/MMBtu x 10 MMBtu/hr = 0.0800 lb/hr

Annual emissions are determined by multiplying the natural gas (lb/hr) by 3,406 hr/yr and converting to ton/yr.

PM filterable for natural gas = 0.0800 lb/hr x 3,406 hr/yr x ton/2000 lb = 0.136 ton/yr

Emission Factors for Natural Gas

Condensable PM = 5.7 lb/MMscf x scf/1020 Btu = 5.59E-03 lb/MMBtu

SO_2 for natural gas = 0.6 lb/MMscf x scf/1020 Btu x 2000 grains/2000 grains x 0.95 = 5.59E-04 lb/MMBtu
Note: 95% conversion to SO_2.

H_2SO_4 for natural gas = 0.6 lb/MMscf x scf/1020 Btu x 0.05 x 98.0774/64.0628 = 4.50E-05 lb/MMBtu
Note: 5% conversion to H_2SO_4.

CO_2 equivalent from 40 CFR Part 98 = (53.06 kg/MMBtu x 1 + 0.001 kg/MMBtu x 25 + 0.0001 kg/MMBtu x 298) x 2.20462 lb/kg = 117.1 lb/MMBtu

HAP emission factors were converted from lb/MMscf to lb/MMBtu using 1020 Btu/scf

CELL PHONE TOWER (TWO-WAY RADIO)
EMERGENCY DIESEL ENGINE
PROCESS DESCRIPTION
PARADISE COMBINED CYCLE PLANT

A two-way radio system emergency diesel engine was installed in 2006. The Cummins Model DGCA-5742774 generator engine (manufactured 10/24/2005) is rated at 90 horsepower. The heat input rating for the diesel engine is 0.690 MMBtu/hr based on diesel fuel input of 4.9 gallons per hour and diesel heat content of 140,000 Btu/gallon. The engine is limited to 100 hours of operation during any twelve consecutive months for maintenance and readiness testing. Combustion gases from the engine discharge to the atmosphere through one stack.

OPERATIONAL AND CALCULATION METHODOLOGY

Potential hourly emissions for particulate, nitrogen oxides, hydrocarbons, and carbon monoxide are calculated using the Tier 2 emission standards for 2005 model year engines multiplied by a factor of 1.25 for not-to-exceed emissions. The emission factor for sulfur dioxide is based on 15 ppm sulfur and 95% of the sulfur oxidized to SO2 and 5% to H2SO4. Hazardous air pollutants are based on AP-42, 5th edition, Section 3.3. Potential annual emissions are based on 500 hours per year based on EPA's definition of hours of operation for an emergency engine.

Inputs to calculate the diesel engine emissions are shown below.

TABLE 8-1
INPUT DATA FOR TWO-WAY RADIO SYSTEM EMERGENCY DIESEL ENGINE EMISSION ESTIMATES

Parameter	Value
Diesel Engine Horsepower, hp	90
Diesel Engine Heat Input, MMBtu/hr	0.690
Diesel Fuel Consumption, gal/hr	4.9
Diesel Fuel Heat Content, Btu/gal	140,000
Diesel Fuel Sulfur Content, %	0.0015
NOx Tier 2 Standard for 2005 model year engine, g/hp-hr	5.2
PM Tier 2 Standard for 2005 model year engine, g/hp-hr	0.3
NMHC Tier 2 Standard for 2005 model year engine, g/hp-hr	0.4
CO Tier 2 Standard for 2005 model year engine, g/hp-hr	3.7
Not-To-Exceed Factor Applied to PM, HC, and CO Tier 2 Standards	1.25
Potential Hours of Operation, hr	500

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DEP7007EE

Internal Combustion Engines

___ Section EE.1: General Information
___ Section EE.2: Operating Information
___ Section EE.3: Design Information
___ Section EE.4: Fuel Information
___ Section EE.5: Emission Factor Information
___ Section EE.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG

___ Attach EPA certification of the engine

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21- 177-00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section EE.1: General Information

Emission Unit #	Emission Unit Name	Control Device ID	Stack ID	Manufacturer	Model Number	Model Year	Date of Manufacture	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	Date Reconstructed/ Modified	List Applicable Regulations
104	Two-way radio communication diesel engine	104	104	Cummins	DGCA-5742774	2005	10/24/2005	2006		40 CFR 63 Subpart ZZZZ

Section EE.2: Operating Information

Emission Unit #	**Engine Purpose** (Identify if Non-Emergency, Emergency,Fire/Water Pump, Black-start engine for combustion turbine, Engine Testing)	**Hours Operated**	**Is this engine a rental?** *(Yes/No)*	**Rental Time Period** *(hrs)*	**Alternate Operating Scenarios** (Describe any operating scenarios in which the engine may be used in a different configuration)
104	Emergency	500 assumed maximum	No		N/A

Section EE.3: Design Information

Emission Unit #	**Engine Type** (Identify all that apply: Commercial, Institutional, Stationary, Non-Road)	**Ignition Type** (Identify if either Compression or Spark Ignition)	**Engine Family** (Identify all that apply: 2-stroke, 4-stroke, Rich Burn, Lean Burn)	**Maximum Engine Power** *(bhp)*	**Maximum Engine Speed** *(rpm)*	**Total Displacement** *(L)*	**Number of Cylinders**
104	Stationary, Non-Road	Compression	4-stroke, lean burn	90	2,200		

Section EE.4: Fuel Information

Emission Unit #	Identify if Primary, Secondary, or Tertiary Fuel	Fuel Type (Identify if Diesel, Gasoline, Natural Gas, Liquefied Petroleum Gas (LPG), Landfill/Digester Gas, or Other)	Fuel Grade	Percent Time Used *(%)*	Maximum Fuel Consumption	Heat Content	Sulfur Content *(%)*	SCC Code	SCC Units
104	Primary	Diesel ultra low sulfur	No. 2 fuel oil	100	4.9 gal/hr	140,000 Btu/gal	0.0015	20200102	MMBtu

Section EE.5: Emission Factor Information

Emission factors expressed here are based on the potential to emit.

Emission Unit #	Fuel	Pollutant	Emission Factor	Emission Factor Units	Source of Emission Factor
104	Diesel	PM	0.375	g/hp-hr	Based on Not-To-Exceed (NTE) Standard by multiplying Tier 2 Emission Standards for 2005 model year engine by 1.25
		NOx	6.5	g/hp-hr	Based on Not-To-Exceed (NTE) Standard by multiplying Tier 2 Emission Standards for 2005 model year engine by 1.25
		CO	4.625	g/hp-hr	Based on Not-To-Exceed (NTE) Standard by multiplying Tier 2 Emission Standards for 2005 model year engine by 1.25
		NMHC	0.5	g/hp-hr	Based on Not-To-Exceed (NTE) Standard by multiplying Tier 2 Emission Standards for 2005 model year engine by 1.25
		CO2e	163.6	MMBtu/hr	40 CFR Part 98

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DEP7007N

Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Information
__ Section N.4: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: 21- **177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential *(lb/hr)*	Controlled Potential *(lb/hr)*	Uncontrolled Potential *(tons/yr)*	Controlled Potential *(tons/yr)*
104	Two-way radio communication diesel engine	104	Two-way radio communication diesel engine			104	0.69	PM	0.108	Tier 2 Emission Standards			0.0744	0.0744	0.0186	0.0186
								PM10	0.108	Tier 2 Emission Standards			0.0744	0.0744	0.0186	0.0186
								PM2.5	0.108	Tier 2 Emission Standards			0.0744	0.0744	0.0186	0.0186
								Cond. PM	7.30E-03	Engineering Estimate			5.04E-03	5.04E-03	1.26E-03	1.26E-03
								SO2	0.00144	AP-42			9.93E-04	9.93E-04	2.48E-04	2.48E-04
								NOx	1.87	Tier 2 Emission Standards			1.29	1.29	0.322	0.322
								CO	1.33	Tier 2 Emission Standards			0.918	0.918	0.229	0.229
								VOC	0.144	Tier 2 Emission Standards			0.0992	0.0992	0.0248	0.0248
								CO2e	163.6	40 CFR Part 98			113	113	28.2	28.2
								Total HAPs	4.26E-03	AP-42			2.94E-03	2.94E-03	7.36E-04	7.36E-04

Section N.2: Stack Information

UTM Zone:

Stack ID	Identify all Emission Units (with Process ID) and Control Devices that Feed to Stack	Stack Physical Data			Stack UTM Coordinates		Stack Gas Stream Data		
		Equivalent Diameter *(ft)*	Height *(ft)*	Base Elevation *(ft)*	Northing *(m)*	Easting *(m)*	Flowrate *(acfm)*	Temperature *(°F)*	Exit Velocity *(ft/sec)*
104	Two-way radio communication diesel engine	0.375	4	418	4,124,411	500,523	480	885	72.4

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DEP7007V
Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitation(s)
___ Section V.2: Monitoring Requirements
___ Section V.3: Recordkeeping Requirements
___ Section V.4: Reporting Requirements
___ Section V.5: Testing Requirements
___ Section V.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: 21- **177-00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section V.1: Emission and Operating Limitation(s)

Emission Unit #	**Emission Unit Description**	**Applicable Regulation or Requirement**	**Pollutant**	**Emission Limit** (if applicable)	**Voluntary Emission Limit or Exemption** (if applicable)	**Operating Requirement or Limitation** (if applicable)	**Method of Determining Compliance with the Emission and Operating Requirement(s)**
104	Two-way radio communication diesel engine	40 CFR Part 63 Subpart ZZZZ	HAPS	specifies work practices, operation, maintenance, recordkeeping			
		401 KAR 59:010, Sec 3(1)(a)	Opacity	<20 percent			

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
104	Two-way radio communication diesel engine	NOx, CO, PM, HC	40 CFR 70.6 a(3)(i)	Fuel consumption and/or hours of operation	Monitor fuel consumption and/or hours of operation and fuel sulfur content.
		All regulated pollutants	40 CFR Part 63 Subpart ZZZZ	Oil and oil filter changes, hoses and belts replaces as needed	Perform necessary maintenance as prescribed by manufacturer.

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
104	Two-way radio communication diesel engine	NOx, CO, PM, HC	40 CFR 70.6 a(3)(i) and (ii) 40 CFR 70.6 g(3) 40 CFR 51.211	Production records and operating logs	Maintain records of fuel consumption and/or hours of operation and fuel sulfur content. Retain all specified records for 5 years.
		All regulated pollutants	40 CFR Part 63 Subpart ZZZZ	Maintenance activities	Maintain records of all maintenance activities. Retain all specified records for 5 years.

Section V.4: Reporting Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Reported	Description of Reporting
104	Two-way radio communication diesel engine	All regulated pollutants	40 CFR 70.6 a(3)(iii)	Production records and operating logs	Report deviations promptly. Report annual certifcation of compliance.

Table 8-2. Cell Phone Tower (Two Way Radio) Emergency Diesel Engine Emissions

Model Year Engine				2005	
Engine Horsepower Rating, hp				90	
Diesel Fuel Use, gal/hr				4.9	
Diesel Fuel Heat Content, Btu/gal				140,000	
Diesel Engine Heat Input Rating, MMBtu/hr				0.690	
Annual Hours of Operation, hr*				500	
	Emission	Emission	AP-42		
	Factor	Factor	Emission Factor	Emissions	
	Reference	g/hp-hr	lb/MMBtu	lb/hr	ton/yr*
Particulate Matter (PM)	1	0.375		0.0744	0.0186
Nitrogen Oxides (NOx)	1	6.5		1.29	0.322
NM Hydrocarbons	1	0.5	0.144	0.0992	0.0248
Carbon Monoxide (CO)	1	4.625		0.918	0.229
Sulfur Dioxide (SO_2)	2		0.00144	9.93E-04	2.48E-04
Sulfuric Acid (H_2SO_4)	2		0.000116	8.00E-05	2.00E-05
PM Condensible	3		0.00730	5.04E-03	1.26E-03
Carbon Dioxide Equivalent	4		163.6	113	28.2
Antimony (Sb)	5		2.20E-05	1.52E-05	3.80E-06
Arsenic (As)	6		4.00E-06	2.76E-06	6.90E-07
Beryllium (Be)	6		3.00E-06	2.07E-06	5.18E-07
Cadmium (Cd)	6		3.00E-06	2.07E-06	5.18E-07
Chromium (Cr)	6		3.00E-06	2.07E-06	5.18E-07
Cobalt (Co)	6		9.10E-06	6.28E-06	1.57E-06
Lead (Pb)	6		9.00E-06	6.21E-06	1.55E-06
Manganese (Mn)	6		6.00E-06	4.14E-06	1.04E-06
Mercury (Hg)	6		3.00E-06	2.07E-06	5.18E-07
Nickel (Ni)	6		3.00E-06	2.07E-06	5.18E-07
Selenium (Se)	6		1.50E-05	1.04E-05	2.59E-06
Hydrogen Chloride (HCl)	7		3.11E-04	2.15E-04	5.36E-05
Benzene	8		9.33E-04	6.44E-04	1.61E-04
Toluene	8		4.09E-04	2.82E-04	7.06E-05
Xylenes	8		2.85E-04	1.97E-04	4.92E-05
1,3-Butadiene	8		3.91E-05	2.70E-05	6.74E-06
Formaldehyde	8		1.18E-03	8.14E-04	2.04E-04
Acetaldehyde	8		7.67E-04	5.29E-04	1.32E-04
Acrolein	8		9.25E-05	6.38E-05	1.60E-05
Total POMs	8		1.68E-04	1.16E-04	2.90E-05
Total HAPs			4.26E-03	2.94E-03	7.36E-04

* Potential annual emissions based on 500 hours per year operation. EPA definition of hours for an emergency engine.

Reference

1 PM, NMHC, and CO emission factors based on Not To Exceed (NTE) Standard by multiplying Tier 2 Emission Stds for 2005 model year engine by 1.25.
2 SO2 and H2SO4 based on 15 ppm sulfur in diesel fuel. AP-42, 5th Edition, Section 3.3, 10/96. 95% of sulfur to SO2 and 5% of sulfur to H2SO4.
3 PM Condensable emission factor based on 5% of NM Hydrocarbons emission factor plus sulfuric acid emission factor.
4 Based on 40 CFR Part 98. CO2 factor is 73.96 kg CO2/MMBtu, CH4 factor is 0.003 kg CH4/MMBtu, N2O factor is 0.0006 kg N2O/MMBtu.
CO2 equivalent factor for CO2 is 1.0, CO2 equivalent factor for CH4 is 25, CO2 equivalent factor for N2O is 298.
5 For Antimony. AP-42, Vol. I, 5th Edition, Supplement B, Section 3.1, "Stationary Gas Turbines for Electricity Generation," 10-96.
6 AP-42, 5th Edition, Supplement E, Section 1.3, "Fuel Oil Combustion," 9-98 (corrected May 2010).
7 TVA Fuel Oil Specifications.
8 AP-42, 5th Edition, Section 3.3, 10/96.

DATA AND SAMPLE EMISSION CALCULATIONS POTENTIAL EMISSIONS FOR THE TWO-WAY RADIO SYSTEM EMERGENCY DIESEL ENGINE

PARTICULATE

The emission limit for Tier 2 and 2005 model year engine is 0.3 grams/hp-hr. Applying the 1.25 Not-To-Exceed Factor yields 0.375 grams/hp-hr.

Hourly emissions are calculated from the emission limit and the horsepower rating of the engine.

$$\frac{0.375\ \mathrm{g}}{\mathrm{hp-hr}} \ \mathrm{x}\ \frac{\mathrm{lb}}{453.6\ \mathrm{g}} \ \mathrm{x}\ 90\ \mathrm{hp} = 0.0744\ \mathrm{lb/hr}$$

Potential annual emissions are calculated from 500 hours per year operation for the engine.

$$\frac{0.0744\ \mathrm{lb}}{\mathrm{hr}} \ \mathrm{x}\ \frac{500\ \mathrm{hr}}{\mathrm{yr}} \ \mathrm{x}\ \frac{\mathrm{ton}}{2000\ \mathrm{lb}} = 0.0186\ \mathrm{ton/yr}$$

NOx

The emission limit for Tier 2 and 2005 model year engine is 5.2 grams/hp-hr. Applying the 1.25 Not-to-Exceed factor yields 6.5 grams/hp-hr.

Hourly emissions are calculated from the emission limit and the horsepower rating of the engine.

$$\frac{6.5\ \mathrm{g}}{\mathrm{hp-hr}} \ \mathrm{x}\ \frac{\mathrm{lb}}{453.6\ \mathrm{g}} \ \mathrm{x}\ 90\ \mathrm{hp} = 1.29\ \mathrm{lb/hr}$$

Potential annual emissions are calculated from 500 hours per year operation for the engine.

$$\frac{1.29\ \mathrm{lb}}{\mathrm{hr}} \ \mathrm{x}\ \frac{500\ \mathrm{hr}}{\mathrm{yr}} \ \mathrm{x}\ \frac{\mathrm{ton}}{2000\ \mathrm{lb}} = 0.322\ \mathrm{ton/yr}$$

CO

The emission limit for Tier 2 and 2005 model year engine is 3.7 grams/hp-hr. Applying the 1.25 Not-To-Exceed Factor yields 4.625 grams/hp-hr.

Hourly emissions are calculated from the emission limit and the horsepower rating of the engine.

$$\frac{4.625\ \mathrm{g}}{\mathrm{hp-hr}} \ \mathrm{x}\ \frac{\mathrm{lb}}{453.6\ \mathrm{g}} \ \mathrm{x}\ 90\ \mathrm{hp} = 0.918\ \mathrm{lb/hr}$$

Potential annual emissions are calculated from 500 hours per year operation for the engine.

$$\frac{0.918\ \mathrm{lb}}{\mathrm{hr}} \ \mathrm{x}\ \frac{500\ \mathrm{hr}}{\mathrm{yr}} \ \mathrm{x}\ \frac{\mathrm{ton}}{2000\ \mathrm{lb}} = 0.229\ \mathrm{ton/yr}$$

SO2

Emission factor based on AP-42, 15 ppm sulfur in diesel fuel, and 95% of sulfur goes to SO2.

Hourly emissions are calculated from the emission factor and the diesel engine heat input rating.

$$\frac{1.01 \text{ x } 0.0015 \text{ \%S lb}}{\text{MMBtu}} \text{ x } \frac{0.690 \text{ MMBtu}}{4\text{hr}} \text{ x } 0.95 = 0.000993 \text{ lb/hr}$$

Potential annual emissions are calculated from 500 hours per year operation for the engine.

$$\frac{0.000993 \text{ lb}}{\text{hr}} \text{ x } \frac{500 \text{ hr}}{\text{yr}} \text{ x } \frac{\text{ton}}{2000 \text{ lb}} = 0.000248 \text{ ton/yr}$$

CARBON DIOXIDE EQUIVALENT

The carbon dioxide equivalent hourly emissions are from 40 CFR Part 98.

$$\left[\frac{73.96 \text{ kg } CO_2}{\text{MMBtu}} + \frac{0.003 \text{ kg } CH_4}{\text{MMBtu}} \text{ x } \frac{25 \text{ kg } CO_2\text{equiv}}{\text{kg } CH_4} + \frac{0.0006 \text{ kg } N_2O}{\text{MMBtu}} \text{ x } \frac{298 \text{ kg } CO_2\text{equiv}}{\text{kg } N_2O}\right] \text{ x } \frac{2.20462 \text{ lb}}{1 \text{ kg}} \text{ x }$$

$$\frac{0.690 \text{ MMBtu}}{\text{hr}} = 113 \frac{\text{lb } CO_2 \text{ equiv}}{hr}$$

Potential annual emissions are calculated from 500 hours per year operation for the engine.

$$\frac{113 \text{ lb}}{\text{hr}} \text{ x } \frac{500 \text{ hr}}{\text{yr}} \text{ x } \frac{\text{ton}}{2000 \text{ lb}} = 28.2 \text{ ton/yr}$$

EMERGENCY DIESEL ENGINE FIRE PUMP
PROCESS DESCRIPTION
PARADISE COMBINED CYCLE PLANT

Paradise Combined Cycle Plant installed an emergency diesel engine fire pump in 2015. The Clarke Model JU6H-UFADS8 fire pump has a John Deere Model 6068HFC48 diesel engine rated at 252 hp. The heat input rating for the diesel engine is 1.96 MMBtu/hr based on diesel fuel input of 14 gallons per hour and diesel heat content of 140,000 Btu/gallon. The engine is limited to 100 hours of operation during any twelve consecutive months for maintenance and readiness testing. Combustion gases from the engine discharge to the atmosphere through one stack.

OPERATIONAL AND CALCULATION METHODOLOGY

Potential hourly emissions for particulate, nitrogen oxides plus hydrocarbons, and carbon monoxide are calculated based on permit limits from 40 CFR 60.4205(c), Table 4. The emission factor for sulfur dioxide is based on 15 ppm sulfur and 95% of the sulfur oxidized to SO2 and 5% to H2SO4. Hazardous air pollutants are based on AP-42, 5th edition, Section 3.3. Potential annual emissions are based on 500 hours per year based on EPA's definition of hours of operation for an emergency engine.

Inputs to calculate the diesel engine emissions are shown below.

TABLE 8-3
INPUT DATA FOR EMERGENCY DIESEL ENGINE FIRE PUMP EMISSION ESTIMATES

Parameter	Value
Diesel Engine Horsepower, hp	252
Diesel Engine Heat Input, MMBtu/hr	1.96
Diesel Fuel Consumption, gal/hr	14
Diesel Fuel Heat Content, Btu/gal	140,000
Diesel Fuel Sulfur Content, %	0.0015
NOx Plus NMHC Emission Limit, g/hp-hr (lb/hr)	3 (1.67)
PM Emission Limit, g/hp-hr (lb/hr)	0.4 (0.22)
CO Emission Limit, g/hp-hr	2.6 (1.44)
Potential Hours of Operation, hr	500

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Internal Combustion Engines

___ Section EE.1: General Information
___ Section EE.2: Operating Information
___ Section EE.3: Design Information
___ Section EE.4: Fuel Information
___ Section EE.5: Emission Factor Information
___ Section EE.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG

___ Attach EPA certification of the engine

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21- 177-00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section EE.1: General Information

Emission Unit #	Emission Unit Name	Control Device ID	Stack ID	Manufacturer	Model Number	Model Year	Date of Manufacture	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	Date Reconstructed/ Modified	List Applicable Regulations
115	Emergency diesel engine fire pump	N/A	115	John Deere	6068HFC48	2015	February 2015	2015		40 CFR 60 Sbprt IIII; 40 CFR 63 Sbprt ZZZZ

Section EE.2: Operating Information

Emission Unit #	**Engine Purpose** (Identify if Non-Emergency, Emergency,Fire/Water Pump, Black-start engine for combustion turbine, Engine Testing)	**Hours Operated**	**Is this engine a rental?** *(Yes/No)*	**Rental Time Period** *(hrs)*	**Alternate Operating Scenarios** (Describe any operating scenarios in which the engine may be used in a different configuration)
115	Emergency, Fire Pump	500 assumed maximum	No		N/A

Section EE.3: Design Information

Emission Unit #	**Engine Type** (Identify all that apply: Commercial, Institutional, Stationary, Non-Road)	**Ignition Type** (Identify if either Compression or Spark Ignition)	**Engine Family** (Identify all that apply: 2-stroke, 4-stroke, Rich Burn, Lean Burn)	**Maximum Engine Power** *(bhp)*	**Maximum Engine Speed** *(rpm)*	**Total Displacement** *(L)*	**Number of Cylinders**
115	Stationary, Non-Road	Compression	4-stroke, lean burn	252	2,200		

Section EE.4: Fuel Information

Emission Unit #	Identify if Primary, Secondary, or Tertiary Fuel	Fuel Type (Identify if Diesel, Gasoline, Natural Gas, Liquefied Petroleum Gas (LPG), Landfill/Digester Gas, or Other)	Fuel Grade	Percent Time Used *(%)*	Maximum Fuel Consumption	Heat Content	Sulfur Content *(%)*	SCC Code	SCC Units
115	Primary	Diesel ultra low sulfur	No. 2 fuel oil	100	14 gal/hr	140,000 Btu/gal	0.0015	20200102	MMBtu

Section EE.5: Emission Factor Information

Emission factors expressed here are based on the potential to emit.

Emission Unit #	Fuel	Pollutant	Emission Factor	Emission Factor Units	Source of Emission Factor
115	Diesel	PM	0.15	g/hp-hr	40 CFR 60.4205(c) Table 4
		NOx	2.8	g/hp-hr	40 CFR 60.4205(c) Table 4
		CO	2.6	g/hp-hr	40 CFR 60.4205(c) Table 4
		NMHC	0.2	g/hp-hr	40 CFR 60.4205(c) Table 4
		CO2e	163.6	MMBtu/hr	40 CFR Part 98

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Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Information
__ Section N.4: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant

KY EIS (AFS) #: 21- **177-0006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions: Uncontrolled Potential *(lb/hr)*	Hourly Emissions: Controlled Potential *(lb/hr)*	Annual Emissions: Uncontrolled Potential *(tons/yr)*	Annual Emissions: Controlled Potential *(tons/yr)*
115	Emergency diesel engine fire pump	115	Emergency diesel engine fire pump			115	1.96	PM	0.0425	Tier 3 Emission Standards; 40 CFR 60 Sbprt IIII			0.0833	0.0833	0.0208	0.0208
								PM10	0.0425	Tier 3 Emission Standards; 40 CFR 60 Sbprt IIII			0.0833	0.0833	0.0208	0.0208
								PM2.5	0.0425	Tier 3 Emission Standards; 40 CFR 60 Sbprt IIII			0.0833	0.0833	0.0208	0.0208
								Cond. PM	2.95E-03	Engineering Estimate			5.78E-03	5.78E-03	1.45E-03	1.45E-03
								SO2	0.00144	AP-42			2.82E-03	2.82E-03	7.05E-04	7.05E-04
								NOx	0.794	Tier 3 Emission Standards; 40 CFR 60 Sbprt IIII			1.56	1.56	0.389	0.389
								CO	0.737	Tier 3 Emission Standards; 40 CFR 60 Sbprt IIII			1.44	1.44	0.361	0.361
								VOC	0.0567	Tier 3 Emission Standards; 40 CFR 60 Sbprt IIII			0.111	0.111	0.0278	0.0278
								CO2e	163.6	40 CFR Part 98			321	321	80.2	80.2
								Total HAPs	4.26E-03	AP-42			8.36E-03	8.36E-03	2.09E-03	2.09E-03

Section N.2: Stack Information

UTM Zone:

Stack ID	Identify all Emission Units (with Process ID) and Control Devices that Feed to Stack	Stack Physical Data			Stack UTM Coordinates		Stack Gas Stream Data		
		Equivalent Diameter *(ft)*	Height *(ft)*	Base Elevation *(ft)*	Northing *(m)*	Easting *(m)*	Flowrate *(acfm)*	Temperature *(°F)*	Exit Velocity *(ft/sec)*
115	Emergency diesel engine fire pump	0.5	12	418	4,124,935	501,238	1,351	832	115

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DEP7007V
Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitation(s)
___ Section V.2: Monitoring Requirements
___ Section V.3: Recordkeeping Requirements
___ Section V.4: Reporting Requirements
___ Section V.5: Testing Requirements
___ Section V.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: 21- **177-00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section V.1: Emission and Operating Limitation(s)

Emission Unit #	Emission Unit Description	Applicable Regulation or Requirement	Pollutant	Emission Limit (if applicable)	Voluntary Emission Limit or Exemption (if applicable)	Operating Requirement or Limitation (if applicable)	Method of Determining Compliance with the Emission and Operating Requirement(s)
115	Emergency diesel engine fire pump	40 CFR 60.4205(c), Table 4	NOx + NMHC	3.0 g/hp-hr			
		40 CFR 60.4205(c), Table 4	PM	0.15 g/hp-hr			
		40 CFR 60.4205(c), Table 4	CO	2.6 g/hp-hr			
		40 CFR 60.4207(b)	SO2	15 ppm sulfur			

Emission Unit #	**Emission Unit Description**	**Applicable Regulation or Requirement**	**Pollutant**	**Emission Limit** (if applicable)	**Voluntary Emission Limit or Exemption** (if applicable)	**Operating Requirement or Limitation** (if applicable)	**Method of Determining Compliance with the Emission and Operating Requirement(s)**
		40 CFR Part 63 Subpart ZZZZ	HAPS	specifies work practices, operation, maintenance, recordkeeping			
		401 KAR 59:010, Sec 3(1)(a)	Opacity	<20 percent			

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
115	Emergency diesel engine fire pump	NOx, CO, PM, HC	40 CFR 70.6 a(3)(i)	Fuel consumption and/or hours of operation	Monitor fuel consumption and/or hours of operation and fuel sulfur content.
		All regulated pollutants	40 CFR Part 63 Subpart ZZZZ	Oil and oil filter changes, hoses and belts replaces as needed	Perform necessary maintenance as prescribed by manufacturer.

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
115	Emergency diesel engine fire pump	NOx, CO, PM, HC	40 CFR 70.6 a(3)(i) and (ii) 40 CFR 70.6 g(3) 40 CFR 51.211	Production records and operating logs	Maintain records of fuel consumption and/or hours of operation and fuel sulfur content. Retain all specified records for 5 years.
		All regulated pollutants	40 CFR Part 63 Subpart ZZZZ	Maintenance activities	Maintain records of all maintenance activities. Retain all specified records for 5 years.

Section V.4: Reporting Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Reported	Description of Reporting
115	Emergency diesel engine fire pump	All regulated pollutants	40 CFR 70.6 a(3)(iii)	Production records and operating logs	Report deviations promptly. Report annual certifcation of compliance.

Table 8-4. Emergency Diesel Engine Fire Pump Emissions at Combined Cycle Plant

Model Year Engine				2015	
Engine Horsepower Rating, hp				252	
Diesel Fuel Use, gal/hr				14.0	
Diesel Fuel Heat Content, Btu/gal				140,000	
Diesel Engine Heat Input Rating, MMBtu/hr				1.96	
Annual Hours of Operation, hr*				500	
	Emission	Emission	AP-42		
	Factor	Factor	Emission Factor	Emissions	
	Reference	g/hp-hr	lb/MMBtu	lb/hr	ton/yr*
Particulate Matter (PM)	1	0.15	0.0425	0.0833	0.0208
Nitrogen Oxides (NOx)	1	2.8	0.794	1.56	0.389
NM Hydrocarbons	1	0.2	0.0567	0.111	0.0278
Carbon Monoxide (CO)	1	2.6	0.737	1.44	0.361
Sulfur Dioxide (SO_2)	2		0.00144	2.82E-03	7.05E-04
Sulfuric Acid (H_2SO_4)	2		0.000116	2.27E-04	5.68E-05
PM Condensible	3		0.00295	5.78E-03	1.45E-03
Carbon Dioxide Equivalent	4		163.6	321	80.2
Antimony (Sb)	5		2.20E-05	4.31E-05	1.08E-05
Arsenic (As)	6		4.00E-06	7.84E-06	1.96E-06
Beryllium (Be)	6		3.00E-06	5.88E-06	1.47E-06
Cadmium (Cd)	6		3.00E-06	5.88E-06	1.47E-06
Chromium (Cr)	6		3.00E-06	5.88E-06	1.47E-06
Cobalt (Co)	6		9.10E-06	1.78E-05	4.46E-06
Lead (Pb)	6		9.00E-06	1.76E-05	4.41E-06
Manganese (Mn)	6		6.00E-06	1.18E-05	2.94E-06
Mercury (Hg)	6		3.00E-06	5.88E-06	1.47E-06
Nickel (Ni)	6		3.00E-06	5.88E-06	1.47E-06
Selenium (Se)	6		1.50E-05	2.94E-05	7.35E-06
Hydrogen Chloride (HCl)	7		3.11E-04	6.10E-04	1.52E-04
Benzene	8		9.33E-04	1.83E-03	4.57E-04
Toluene	8		4.09E-04	8.02E-04	2.00E-04
Xylenes	8		2.85E-04	5.59E-04	1.40E-04
1,3-Butadiene	8		3.91E-05	7.66E-05	1.92E-05
Formaldehyde	8		1.18E-03	2.31E-03	5.78E-04
Acetaldehyde	8		7.67E-04	1.50E-03	3.76E-04
Acrolein	8		9.25E-05	1.81E-04	4.53E-05
Total POMs	8		1.68E-04	3.29E-04	8.23E-05
Total HAPs			4.26E-03	8.36E-03	2.09E-03

* Potential annual emissions based on 500 hours per year operation. EPA definition of hours for an emergency engine.

Reference
1 PM, NOx +NMHC, and CO emissions factors Tier 3 emission standards. 40 CFR 60.4205(c) Table 4.
2 SO2 and H2SO4 based on 15 ppm sulfur in diesel fuel. AP-42, 5th Edition, Section 3.4, 10/96. 95% of sulfur to SO2 and 5% of sulfur to H2SO4.
3 PM Condensable emission factor based on 5% of NM Hydrocarbons emission factor plus sulfuric acid emission factor.
4 Based on 40 CFR Part 98. CO2 factor is 73.96 kg CO2/MMBtu, CH4 factor is 0.003 kg CH4/MMBtu, N2O factor is 0.0006 kg N2O/MMBtu. CO2 equivalent factor for CO2 is 1.0, CO2 equivalent factor for CH4 is 25, CO2 equivalent factor for N2O is 298.
5 For Antimony. AP-42, Vol. I, 5th Edition, Supplement B, Section 3.1, "Stationary Gas Turbines for Electricity Generation," 10-96.
6 AP-42, 5th Edition, Supplement E, Section 1.3, "Fuel Oil Combustion," 9-98 (corrected May 2010).
7 TVA Fuel Oil Specifications.
8 AP-42, 5th Edition, Section 3.3, 10/96.

DATA AND SAMPLE EMISSION CALCULATIONS POTENTIAL EMISSIONS FOR THE EMERGENCY DIESEL ENGINE FIRE PUMP

PARTICULATE

The permit limit based on 40 CFR Part 60 Subpart IIII is 0.15 grams/hp-hr.

Hourly emissions are calculated from the permit limit and the horsepower rating of the engine.

$$\frac{0.15\ \text{g}}{\text{hp}-\text{hr}}\ \text{x}\ \frac{\text{lb}}{453.6\ \text{g}}\ \text{x 252 hp} = 0.0833\ \text{lb/hr}$$

Potential annual emissions are calculated from 500 hours per year operation for the engine.

$$\frac{0.0833\ \text{lb}}{\text{hr}}\ \text{x}\ \frac{500\ \text{hr}}{\text{yr}}\ \text{x}\ \frac{\text{ton}}{2000\ \text{lb}} = 0.0208\ \text{ton/yr}$$

NOx+NMHC

The permit limit based on 40 CFR Part 60 Subpart IIII is 3 grams/hp-hr.

Hourly emissions are calculated from the permit limit and the horsepower rating of the engine.

$$\frac{3\ \text{g}}{\text{hp}-\text{hr}}\ \text{x}\ \frac{\text{lb}}{453.6\ \text{g}}\ \text{x 252 hp} = 1.67\ \text{lb/hr}$$

Potential annual emissions are calculated from 500 hours per year operation for the engine.

$$\frac{1.67\ \text{lb}}{\text{hr}}\ \text{x}\ \frac{500\ \text{hr}}{\text{yr}}\ \text{x}\ \frac{\text{ton}}{2000\ \text{lb}} = 0.417\ \text{ton/yr}$$

CO

The permit limit based on 40 CFR Part 60 Subpart IIII is 2.6 grams/hp-hr.

Hourly emissions are calculated from the permit limit and the horsepower rating of the engine.

$$\frac{2.6\ \text{g}}{\text{hp}-\text{hr}}\ \text{x}\ \frac{\text{lb}}{453.6\ \text{g}}\ \text{x 252 hp} = 1.44\ \text{lb/hr}$$

Potential annual emissions are calculated from 500 hours per year operation for the engine.

$$\frac{1.44\ \text{lb}}{\text{hr}}\ \text{x}\ \frac{500\ \text{hr}}{\text{yr}}\ \text{x}\ \frac{\text{ton}}{2000\ \text{lb}} = 0.361\ \text{ton/yr}$$

SO2

Emission factor based on AP-42, 15 ppm sulfur in diesel fuel, and 95% of sulfur goes to SO2.

Hourly emissions are calculated from the emission factor and the diesel engine heat input rating.

$$\frac{1.01 \text{ x } 0.0015 \text{ \%S lb}}{\text{MMBtu}} \text{ x } \frac{1.96 \text{ MMBtu}}{4\text{hr}} \text{ x } 0.95 = 0.00282 \text{ lb/hr}$$

Potential annual emissions are calculated from 500 hours per year operation for the engine.

$$\frac{0.00282 \text{ lb}}{\text{hr}} \text{ x } \frac{500 \text{ hr}}{\text{yr}} \text{ x } \frac{\text{ton}}{2000 \text{ lb}} = 0.000705 \text{ ton/yr}$$

CARBON DIOXIDE EQUIVALENT

The carbon dioxide equivalent hourly emissions are from 40 CFR Part 98.

$$\left[\frac{73.96 \text{ kg } CO_2}{\text{MMBtu}} + \frac{0.003 \text{ kg } CH_4}{\text{MMBtu}} \text{ x } \frac{25 \text{ kg } CO_2\text{equiv}}{\text{kg } CH_4} + \frac{0.0006 \text{ kg } N_2O}{\text{MMBtu}} \text{ x } \frac{298 \text{ kg } CO_2\text{equiv}}{\text{kg } N_2O}\right] \text{ x } \frac{2.20462 \text{ lb}}{1 \text{ kg}} \text{ x }$$

$$\frac{1.96 \text{ MMBtu}}{\text{hr}} = 321 \frac{\text{lb } CO_2 \text{ equiv}}{hr}$$

Potential annual emissions are calculated from 500 hours per year operation for the engine.

$$\frac{321 \text{ lb}}{\text{hr}} \text{ x } \frac{500 \text{ hr}}{\text{yr}} \text{ x } \frac{\text{ton}}{2000 \text{ lb}} = 80.2 \text{ ton/yr}$$

EMERGENCY TELECOMMUNICATION PROPANE GENERATOR
PROCESS DESCRIPTION
PARADISE FOSSIL PLANT

Paradise Fossil Plant has an emergency telecommunication propane generator. The Generac generator, Model RG025, is rated at 25 kW electrical (42 hp). The heat input rating for the propane engine is 0.430 MMBtu/hr based on propane fuel input of 4.7 gallons per hour and propane heat content of 91,500 Btu/gallon. The engine is limited to 100 hours of operation during any twelve consecutive months for maintenance and readiness testing. Combustion gases from the engine discharge to the atmosphere through one stack.

OPERATIONAL AND CALCULATION METHODOLOGY

Potential hourly emissions are calculated using the emission factors from the San Diego Air Pollution Control District, Uncontrolled Propane-Fired Internal Combustion Engine, 6/1999. Potential annual emissions are based on 500 hours per year based on EPA's definition of hours of operation for an emergency engine.

Inputs to calculate the propane generator emissions are shown below.

TABLE 8-5
INPUT DATA FOR EMERGENCY PROPANE GENERATOR EMISSION ESTIMATES

Parameter	Value
Propane Generator Rating, kW electrical	25
Propane Engine Horsepower, hp	42
Propane Generator Heat Input, MMBtu/hr	0.430
Propane Fuel Consumption, gal/hr	4.7
Propane Fuel Heat Content, Btu/gal	91,500
PM Emission Factor, lb/1000 gal	5
NOx Emission Factor, lb/1000 gal	139
CO Emission Limit, lb/1000 gal	129
SO2 Emission Factor, lb/1000 gal	0.35
Hydrocarbon (HC) Emission Factor, lb/1000 gal	83
Potential Hours of Operation, hr	500

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DEP7007EE

Internal Combustion Engines

___ Section EE.1: General Information
___ Section EE.2: Operating Information
___ Section EE.3: Design Information
___ Section EE.4: Fuel Information
___ Section EE.5: Emission Factor Information
___ Section EE.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG

___ Attach EPA certification of the engine

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21- 177-00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section EE.1: General Information

Emission Unit #	Emission Unit Name	Control Device ID	Stack ID	Manufacturer	Model Number	Model Year	Date of Manufacture	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	Date Reconstructed/ Modified	List Applicable Regulations
128	Propane emergency telecom generator	128	128	Generac	RG025			August 2016		40 CFR 60 Subpart JJJJ, 40 CFR 63 Subpart ZZZZ

Section EE.2: Operating Information

Emission Unit #	Engine Purpose (Identify if Non-Emergency, Emergency,Fire/Water Pump, Black-start engine for combustion turbine, Engine Testing)	Hours Operated	Is this engine a rental? *(Yes/No)*	Rental Time Period *(hrs)*	Alternate Operating Scenarios (Describe any operating scenarios in which the engine may be used in a different configuration)
128	Emergency	500 assumed maximum	No		N/A

Section EE.3: Design Information

Emission Unit #	**Engine Type** (Identify all that apply: Commercial, Institutional, Stationary, Non-Road)	**Ignition Type** (Identify if either Compression or Spark Ignition)	**Engine Family** (Identify all that apply: 2-stroke, 4-stroke, Rich Burn, Lean Burn)	**Maximum Engine Power** *(bhp)*	**Maximum Engine Speed** *(rpm)*	**Total Displacement** *(L)*	**Number of Cylinders**
128	Stationary, Non-Road	Spark Ignition		42	2,200		

Section EE.4: Fuel Information

Emission Unit #	Identify if Primary, Secondary, or Tertiary Fuel	Fuel Type (Identify if Diesel, Gasoline, Natural Gas, Liquefied Petroleum Gas (LPG), Landfill/Digester Gas, or Other)	Fuel Grade	Percent Time Used *(%)*	Maximum Fuel Consumption	Heat Content	Sulfur Content *(%)*	SCC Code	SCC Units
128	Primary	Propane		100	4.7 gal/hr	91,500 Btu/gal	0.004		MMBtu

Section EE.5: Emission Factor Information

Emission factors expressed here are based on the potential to emit.

Emission Unit #	Fuel	Pollutant	Emission Factor	Emission Factor Units	Source of Emission Factor
128	Propane	PM	5	lb/1000 gal	San Diego Air Pollution Control District
		NOx	139	lb/1000 gal	San Diego Air Pollution Control District
		CO	129	lb/1000 gal	San Diego Air Pollution Control District
		SO2	0.35	lb/1000 gal	San Diego Air Pollution Control District
		HC	0.83	lb/1000 gal	San Diego Air Pollution Control District
		CO2e	139.2	lb/MMBtu	40 CFR Part 98

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DEP7007N

Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Information
__ Section N.4: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: 21- **177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions: Uncontrolled Potential *(lb/hr)*	Hourly Emissions: Controlled Potential *(lb/hr)*	Annual Emissions: Uncontrolled Potential *(tons/yr)*	Annual Emissions: Controlled Potential *(tons/yr)*
128	Propane emergency telecom generator	128				128	0.430	PM	0.0546	San Diego Air Pollution Control District			2.35E-02	2.35E-02	5.88E-03	5.88E-03
								PM10	0.0546	San Diego Air Pollution Control District			2.35E-02	2.35E-02	5.88E-03	5.88E-03
								PM2.5	0.0546	San Diego Air Pollution Control District			2.35E-02	2.35E-02	5.88E-03	5.88E-03
								NOx	1.52	San Diego Air Pollution Control District			0.653	0.653	0.163	0.163
								CO	1.41	San Diego Air Pollution Control District			0.606	0.606	0.152	0.152
								SO2	0.00383	San Diego Air Pollution Control District			1.65E-03	1.65E-03	4.11E-04	4.11E-04
								HC	0.907	San Diego Air Pollution Control District			0.390	0.390	9.75E-02	9.75E-02
								CO2e	139.2	40 CFR Part 98			59.8	59.8	15.0	15.0

Section N.2: Stack Information

UTM Zone:

Stack ID	Identify all Emission Units (with Process ID) and Control Devices that Feed to Stack	Stack Physical Data			Stack UTM Coordinates		Stack Gas Stream Data		
		Equivalent Diameter *(ft)*	Height *(ft)*	Base Elevation *(ft)*	Northing *(m)*	Easting *(m)*	Flowrate *(acfm)*	Temperature *(°F)*	Exit Velocity *(ft/sec)*
128	Propane emergency telecom generator	0.25	3	418	4,123,915	500,828	203	1,100	68.9

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DEP7007V
Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitation(s)
___ Section V.2: Monitoring Requirements
___ Section V.3: Recordkeeping Requirements
___ Section V.4: Reporting Requirements
___ Section V.5: Testing Requirements
___ Section V.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21- 177-00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section V.1: Emission and Operating Limitation(s)

Emission Unit #	**Emission Unit Description**	**Applicable Regulation or Requirement**	**Pollutant**	**Emission Limit** (if applicable)	**Voluntary Emission Limit or Exemption** (if applicable)	**Operating Requirement or Limitation** (if applicable)	**Method of Determining Compliance with the Emission and Operating Requirement(s)**
128	Propane emergency telecom generator	40 CFR Part 63 Subpart ZZZZ	HAPS	specifies work practices, operation, maintenance, recordkeeping			
		401 KAR 59:010, Sec 3 (1)(a)	Opacity	<20 percent			

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
128	Propane emergency telecom generator	PM, NOx, CO, SO2, HC	40 CFR 70.6 a(3)(i)	Fuel consumption and/or hours of operation	Monitor fuel consumption and/or hours of operation and fuel sulfur content.
		All regulated pollutants	40 CFR Part 63 Subpart ZZZZ	Oil and oil filter changes, hoses and belts replaces as needed	Perform necessary maintenance as prescribed by manufacturer.

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
128	Propane emergency telecom generator	PM, NOx, CO, SO2, HC	40 CFR 70.6 a(3)(i) and (ii) 40 CFR 70.6 g(3) 40 CFR 51.211	Production records and operating logs	Maintain records of fuel consumption and/or hours of operation. Retain all specified records for 5 years.
		All regulated pollutants	40 CFR Part 63 Subpart ZZZZ	Maintenance activities	Maintain records of all maintenance activities. Retain all specified records for 5 years.

Section V.4: Reporting Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Reported	Description of Reporting
128	Propane emergency telecom generator	All regulated pollutants	40 CFR 70.6 a(3)(iii)	Production records and operating logs	Report deviations promptly. Report annual certifcation of compliance.

Table 8-6. Propane-Fired Telecommunication Emergency Generator at Paradise Combined Cycle Plant

	PG-1 Emission Point 128 Telecommunication Generator
MMBtu/hr	0.430
Propane (91,500 Btu/gal) , gal/hr	4.7
kWe (kilowatt electrical)	25
kWm (kilowatt mechanical)	31
hp (horsepower)	42
Hours of Operation*	500

	Emission Factor**	Emissions	
	lb/1000 gal	lb/hr	ton/yr*
PM	5	0.0235	0.00588
NOx	139	0.653	0.163
CO	129	0.606	0.152
SO2	0.35	0.00165	0.000411
HC	83	0.390	0.0975
Carbon Dioxide Equivalent***		59.8	15.0

* Based on EPA's definition of 500 hr/yr operation for an emergency generator.

** Emission factors from San Diego Air Pollution Control District, Air Toxics Section (6/99), Uncontrolled Propane Fired Internal Combustion Engine.

*** CO2 factor is 62.87 kg CO2/MMBtu, CH4 factor is 0.003 kg CH4/MMBtu, N2O factor is 0.0006 kg N2O/MMBtu. CO2 equivalent factor for CO2 is 1.0, CO2 equivalent factor for CH4 is 25, CO2 equivalent factor for N2O is 298.

DATA AND SAMPLE EMISSION CALCULATIONS
POTENTIAL EMISSIONS FOR THE
EMERGENCY PROPANE GENERATOR

PARTICULATE

The particulate emission factor from the San Diego Air Pollution Control District is 5 lb/1000 gallons. The maximum propane fuel input rate is 4.7 gal/hr.

5 lb/1000 gal x 4.7 gal/hr = 0.0235 lb/hr

0.0235 lb/hr x 500 hr/yr x ton/2000 lb = 0.00588 ton/yr

NOx

The nitrogen oxides emission factor from the San Diego Air Pollution Control District is 139 lb/1000 gallons. The maximum propane fuel input rate is 4.7 gal/hr.

139 lb/1000 gal x 4.7 gal/hr = 0.653 lb/hr

0.653 lb/hr x 500 hr/yr x ton/2000 lb = 0.163 ton/yr

CO

The carbon monoxide emission factor from the San Diego Air Pollution Control District is 129 lb/1000 gallons. The maximum propane fuel input rate is 4.7 gal/hr.

129 lb/1000 gal x 4.7 gal/hr = 0.606 lb/hr

0.606 lb/hr x 500 hr/yr x ton/2000 lb = 0.152 ton/yr

SO2

The sulfur dioxide monoxide emission factor from the San Diego Air Pollution Control District is 0.35 lb/1000 gallons. The maximum propane fuel input rate is 4.7 gal/hr.

0.35 lb/1000 gal x 4.7 gal/hr = 0.00165 lb/hr

0.00165 lb/hr x 500 hr/yr x ton/2000 lb = 0.000411 ton/yr

Hydrocarbons (HC) are calculated the same as above using an emission factor from the San Diego Air Pollution Control District of 83 lb/1000 gallons.

CARBON DIOXIDE EQUIVALENT

The carbon dioxide equivalent hourly emissions are from 40 CFR Part 98.

$$\left[\frac{62.87\text{ kg }CO_2}{\text{MMBtu}} + \frac{0.003\text{ kg }CH_4}{\text{MMBtu}} \text{ x } \frac{25\text{ kg }CO_2\text{equiv}}{\text{kg }CH_4} + \frac{0.0006\text{ kg }N_2O}{\text{MMBtu}} \text{ x } \frac{298\text{ kg }CO_2\text{equiv}}{\text{kg }N_2O}\right] \text{ x } \frac{2.20462\text{ lb}}{1\text{ kg}} \text{ x}$$

$$\frac{0.430\text{ MMBtu}}{\text{hr}} = 59.8\,\frac{\text{lb }CO_2\text{ equiv}}{hr}$$

COAL YARD RUNOFF, GYPSUM STILLING POND, DANIEL RUN COAL FINES DIESEL ENGINE PUMPS AND GN24 FUEL TANK GENERATOR PROCESS DESCRIPTION
PARADISE COMBINED CYCLE PLANT

Paradise has installed six diesel engine pumps and one diesel generator for routine operations during deconstruction. List of engines installed:

- Emission Unit 147, Coal Yard Runoff Diesel Engine Pump #1, John Deere Model 4045TF285, Tier 3, 2011 model year.
- Emission Unit 148, Coal Yard Runoff Diesel Engine Pump #2, John Deere Model 4045TF285, Tier 3, 2013 model year.
- Emission Unit 149, Gypsum Stilling Pond Diesel Engine Pump #1, John Deere Model 4045DF150A, Tier 1, model year unknown.
- Emission Unit 150, Gypsum Stilling Pond Diesel Engine Pump #2, John Deere Model 4045TF285, Tier 3, 2011 model year.
- Emission Unit 151, Daniel Run Coal Fines Diesel Engine Pump #1, Deutz Model D914L04, Tier 3, model year unknown.
- Emission Unit 152, Daniel Run Coal Fines Diesel Engine Pump #2, John Deere Model 4045TF290, Tier 3, 2012 model year.
- Emission Unit 155, GN24 Fuel Tank Generator, Isuzu Model BZ-4LE2T, Tier 4, 2018 model year.

The annual emissions are calculated based on an annual operating limit of 8,760 hours for all engines.

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Internal Combustion Engines

___ Section EE.1: General Information
___ Section EE.2: Operating Information
___ Section EE.3: Design Information
___ Section EE.4: Fuel Information
___ Section EE.5: Emission Factor Information
___ Section EE.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG

___ Attach EPA certification of the engine

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: 21- **177 - 00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section EE.1: General Information

Emission Unit #	Emission Unit Name	Control Device ID	Stack ID	Manufacturer	Model Number	Model Year	Date of Manufacture	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	Date Reconstructed/ Modified	List Applicable Regulations
147	Coal Yard Runoff Diesel Engine Pump #1	N/A	147	John Deere	4045TF285	2011		01/2021		40 CFR Part 60 Subpart IIII
148	Coal Yard Runoff Diesel Engine Pump #2	N/A	148	John Deere	4045TF285	2013		01/2021		40 CFR Part 60 Subpart IIII
149	Gypsum Stilling Pond Diesel Engine Pump #1	N/A	149	John Deere	4045DF150A	Unknown		01/2021		40 CFR Part 60 Subpart IIII
150	Gypsum Stilling Pond Diesel Engine Pump #2	N/A	150	John Deere	4045TF285	2011		01/2021		40 CFR Part 60 Subpart IIII
151	Daniel Run Coal Fines Diesel Engine Pump #1	N/A	151	Deutz	D914L04	Unknown		01/2021		40 CFR Part 60 Subpart IIII

Emission Unit #	Emission Unit Name	Control Device ID	Stack ID	Manufacturer	Model Number	Model Year	Date of Manufacture	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	Date Reconstructed/ Modified	List Applicable Regulations
152	Daniel Run Coal Fines Diesel Engine Pump #2	N/A	152	John Deere	4045TF290	2012		01/2021		40 CFR Part 60 Subpart IIII
155	GN24 Fuel Tank Generator	N/A	155	Isuzu	BZ-4LE2T	2018		01/2021		40 CFR Part 60 Subpart IIII

Section EE.2: Operating Information

Emission Unit #	Engine Purpose (Identify if Non-Emergency, Emergency,Fire/Water Pump, Black-start engine for combustion turbine, Engine Testing)	Hours Operated	Is this engine a rental? *(Yes/No)*	Rental Time Period *(hrs)*	Alternate Operating Scenarios (Describe any operating scenarios in which the engine may be used in a different configuration)
147 - 152, 155	Non-Emergency	8,760	No		

Section EE.3: Design Information

Emission Unit #	**Engine Type** (Identify all that apply: Commercial, Institutional, Stationary, Non-Road)	**Ignition Type** (Identify if either Compression or Spark Ignition)	**Engine Family** (Identify all that apply: 2-stroke, 4-stroke, Rich Burn, Lean Burn)	**Maximum Engine Power** *(bhp)*	**Maximum Engine Speed** *(rpm)*	**Total Displacement** *(L)*	**Number of Cylinders**
147	Stationary, Non-Road	Compression	4-stroke, Lean Burn	99	2,400	4.5	4
148	Stationary, Non-Road	Compression	4-stroke, Lean Burn	99	2400	4.5	4
149	Stationary, Non-Road	Compression	4-stroke, Lean Burn	84	2400	4.5	4
150	Stationary, Non-Road	Compression	4-stroke, Lean Burn	99	2400	4.5	4
151	Stationary, Non-Road	Compression	4-stroke, Lean Burn	78	2300	4.3	4
152	Stationary, Non-Road	Compression	4-stroke, Lean Burn	74	1800	4.5	4
155	Stationary, Non-Road	Compression	4-stroke, Lean Burn	46	2400	2.2	4

Section EE.4: Fuel Information

Emission Unit #	Identify if Primary, Secondary, or Tertiary Fuel	Fuel Type (Identify if Diesel, Gasoline, Natural Gas, Liquefied Petroleum Gas (LPG), Landfill/Digester Gas, or Other)	Fuel Grade	Percent Time Used (%)	Maximum Fuel Consumption	Heat Content	Sulfur Content (%)	SCC Code	SCC Units
147	Primary	Diesel	No. 2	100	4.95 gal/hr	140,000	0.0015	20200102	MMBtu
148	Primary	Diesel	No. 2	100	4.95 gal/hr	140,000	0.0015	20200102	MMBtu
149	Primary	Diesel	No. 2	100	4.20 gal/hr	140,000	0.0015	20200102	MMBtu
150	Primary	Diesel	No. 2	100	4.95 gal/hr	140,000	0.0015	20200102	MMBtu
151	Primary	Diesel	No. 2	100	3.90 gal/hr	140,000	0.0015	20200102	MMBtu
152	Primary	Diesel	No. 2	100	3.70 gal/hr	140,000	0.0015	20200102	MMBtu
155	Primary	Diesel	No. 2	100	2.3 gal/hr	140,000	0.0015	20200102	MMBtu

Section EE.5: Emission Factor Information

Emission factors expressed here are based on the potential to emit.

Emission Unit #	Fuel	Pollutant	Emission Factor	Emission Factor Units	Source of Emission Factor
147, 148, 150, 151, 152	Diesel	PM	0.3	grams/hp-hr	40 CFR Part 60 Subpart IIII
149	Diesel	PM	0.31	lb/MMBtu	AP-42, Section 3.3
155	Diesel	PM	0.022	grams/hp-hr	40 CFR Part 1039
147, 148, 150, 151, 152 155	Diesel	NOx	3.3	grams/hp-hr	40 CFR Part 60 Subpart IIII; 40 CFR Part 1039
149	Diesel	NOx	6.9	grams/hp-hr	40 CFR Part 60 Subpart IIII
147, 148, 150, 151, 152,	Diesel	CO	3.7	grams/hp-hr	40 CFR Part 60 Subpart IIII
149	Diesel	CO	0.95	lb/MMBtu	AP-42, Section 3.3
155	Diesel	CO	4.1	grams/hp-hr	40 CFR Part 1039
147, 148, 150, 151, 152 155	Diesel	HC	0.2	grams/hp-hr	40 CFR Part 60 Subpart IIII; 40 CFR Part 1039
149	Diesel	HC	0.36	lb/MMBtu	AP-42, Section 3.3
147, 148, 149, 150, 151, 152, 155	Diesel	SO2	0.001515	lb/MMBtu	AP-42, Section 3.4
147, 148, 149, 150, 151, 152, 155	Diesel	CO2 Equivalent	163.6	lb/MMBtu	40 CFR Part 98

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DEP7007N

Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Information
__ Section N.4: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21- 177-00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential *(lb/hr)*	Controlled Potential *(lb/hr)*	Uncontrolled Potential *(tons/yr)*	Controlled Potential *(tons/yr)*
147, 148, 150	Coal Yard Runoff #1 and #2, Gypsum Stilling Pond #2	147, 148, 150	N/A	N/A	N/A	147, 148, 150	0.693	PM	0.0945	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.0655	0.0655	0.287	0.287
147, 148, 150	Coal Yard Runoff #1 and #2, Gypsum Stilling Pond #2	147, 148, 150	N/A	N/A	N/A	147, 148, 150	0.693	SO2	0.001515	AP-42, Section 3.4	0.00%	0.00%	0.00105	0.00105	0.00460	0.00460
147, 148, 150	Coal Yard Runoff #1 and #2, Gypsum Stilling Pond #2	147, 148, 150	N/A	N/A	N/A	147, 148, 150	0.693	NOx	1.04	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.720	0.720	3.15	3.15
147, 148, 150	Coal Yard Runoff #1 and #2, Gypsum Stilling Pond #2	147, 148, 150	N/A	N/A	N/A	147, 148, 150	0.693	CO	1.17	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.808	0.808	3.54	3.54

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity (SCC Units/hour)	Pollutant	Uncontrolled Emission Factor (lb/SCC Units)	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency (%)	Control Efficiency (%)	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential (lb/hr)	Controlled Potential (lb/hr)	Uncontrolled Potential (tons/yr)	Controlled Potential (tons/yr)
147, 148, 150	Coal Yard Runoff #1 and #2, Gypsum Stilling Pond #2	147, 148, 150	N/A	N/A	N/A	147, 148, 150	0.693	VOC	0.0630	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.0437	0.0437	0.191	0.191
147, 148, 150	Coal Yard Runoff #1 and #2, Gypsum Stilling Pond #2	147, 148, 150	N/A	N/A	N/A	147, 148, 150	0.693	CO2 equiv.	163.6	40 CFR Part 98	0.00%	0.00%	113	113	497	497
149	Gypsum Stilling Pond #1	149	N/A	N/A	N/A	149	0.588	PM	0.31	AP-42, Section 3.4	0.00%	0.00%	0.182	0.182	0.638	0.638
149	Gypsum Stilling Pond #1	149	N/A	N/A	N/A	149	0.588	SO2	0.001515	AP-42, Section 3.3	0.00%	0.00%	0.000891	0.000891	0.00312	0.00312
149	Gypsum Stilling Pond #1	149	N/A	N/A	N/A	149	0.588	NOx	2.17	40 CFR Part 60 Subpart IIII	0.00%	0.00%	1.28	1.28	4.47	4.47
149	Gypsum Stilling Pond #1	149	N/A	N/A	N/A	149	0.588	CO	0.95	AP-42, Section 3.3	0.00%	0.00%	0.559	0.559	1.96	1.96
149	Gypsum Stilling Pond #1	149	N/A	N/A	N/A	149	0.588	VOC	0.36	AP-42, Section 3.3	0.00%	0.00%	0.212	0.212	0.741	0.741
149	Gypsum Stilling Pond #1	149	N/A	N/A	N/A	149	0.588	CO2 equiv.	163.6	40 CFR Part 98	0.00%	0.00%	96.2	96.2	337	337
151	Daniel Run Coal Fines #1	151	N/A	N/A	N/A	151	0.546	PM	0.0945	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.0516	0.0516	0.226	0.226
151	Daniel Run Coal Fines #1	151	N/A	N/A	N/A	151	0.546	SO2	0.001515	AP-42, Section 3.4	0.00%	0.00%	0.000827	0.000827	0.00362	0.00362
151	Daniel Run Coal Fines #1	151	N/A	N/A	N/A	151	0.546	NOx	1.04	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.567	0.567	2.49	2.49
151	Daniel Run Coal Fines #1	151	N/A	N/A	N/A	151	0.546	CO	1.17	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.636	0.636	2.79	2.79
151	Daniel Run Coal Fines #1	151	N/A	N/A	N/A	151	0.546	VOC	0.0630	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.0344	0.0344	0.151	0.151
151	Daniel Run Coal Fines #1	151	N/A	N/A	N/A	151	0.546	CO2 equiv.	163.6	40 CFR Part 98	0.00%	0.00%	89.3	89.3	391	391
152	Daniel Run Coal Fines #2	152	N/A	N/A	N/A	152	0.518	PM	0.0945	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.0489	0.0489	0.214	0.214

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity (SCC Units/hour)	Pollutant	Uncontrolled Emission Factor (lb/SCC Units)	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency (%)	Control Efficiency (%)	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential (lb/hr)	Controlled Potential (lb/hr)	Uncontrolled Potential (tons/yr)	Controlled Potential (tons/yr)
152	Daniel Run Coal Fines #2	152	N/A	N/A	N/A	152	0.518	SO2	0.001515	AP-42, Section 3.4	0.00%	0.00%	0.000785	0.000785	0.00344	0.00344
152	Daniel Run Coal Fines #2	152	N/A	N/A	N/A	152	0.518	NOx	1.04	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.538	0.538	2.36	2.36
152	Daniel Run Coal Fines #2	152	N/A	N/A	N/A	152	0.518	CO	1.17	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.604	0.604	2.64	2.64
152	Daniel Run Coal Fines #2	152	N/A	N/A	N/A	152	0.518	VOC	0.0630	40 CFR Part 60 Subpart IIII	0.00%	0.00%	0.0326	0.0326	0.143	0.143
152	Daniel Run Coal Fines #2	152	N/A	N/A	N/A	152	0.518	CO2 equiv.	163.6	40 CFR Part 98	0.00%	0.00%	84.7	84.7	371	371
155	GN24 Fuel Tank Generator	155	N/A	N/A	N/A	155	0.322	PM	0.00693	40 CFR Part 1039	0.00%	0.00%	0.00223	0.00223	0.00977	0.00977
155	GN24 Fuel Tank Generator	155	N/A	N/A	N/A	155	0.322	SO2	0.001515	AP-42, Section 3.4	0.00%	0.00%	0.000488	0.000488	0.00214	0.00214
155	GN24 Fuel Tank Generator	155	N/A	N/A	N/A	155	0.322	NOx	1.04	40 CFR Part 1039	0.00%	0.00%	0.335	0.335	1.47	1.47
155	GN24 Fuel Tank Generator	155	N/A	N/A	N/A	155	0.322	CO	1.29	40 CFR Part 1039	0.00%	0.00%	0.416	0.416	1.82	1.82
155	GN24 Fuel Tank Generator	155	N/A	N/A	N/A	155	0.322	VOC	0.0630	40 CFR Part 1039	0.00%	0.00%	0.0203	0.0203	0.0888	0.0888
155	GN24 Fuel Tank Generator	155	N/A	N/A	N/A	155	0.322	CO2 equiv.	163.6	40 CFR Part 98	0.00%	0.00%	52.7	52.7	231	231

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DEP7007V

Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitatio
___ Section V.2: Monitoring Requirements
___ Section V.3: Recordkeeping Requirem
___ Section V.4: Reporting Requirements
___ Section V.5: Testing Requirements
___ Section V.6: Notes, Comments, and Explanatio

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: 21- **177-00006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section V.1: Emission and Operating Limitation(s)

Emission Unit #	Emission Unit Description	Applicable Regulation or Requirement	Pollutant	Emission Limit (if applicable)	Voluntary Emission Limit or Exemption (if applicable)	Operating Requirement or Limitation (if applicable)	Method of Determining Compliance with the Emission and Operating Requirement(s)
147, 148, 150, 151, 152	Coal Yard Runoff #1 & #2, Gypsum Stilling Pond #2, Daniel Run Coal Fines #1 & #2	40 CFR Part 60 IIII	NOx, HC, CO, PM	3.3, 0.2, 3.7, 0.3 g/hp hr			
149	Gypsum Stilling Pond #1	40 CFR Part 60 IIII	NOx	6.9 g/hp hr			
155	GN24 Fuel Tank Generator	40 CFR Part 1039 and Part 60 IIII	NOx, HC, CO, PM	3.3, 0.2 , 4.1, 0.022 g/hp hr			
147-152, 155	Coal Yard Runoff, Gypsum Stilling Pond, & Daniel Run Coal Fines Diesel Engine Pumps, GN24 Fuel Tank Generator	40 CFR Part 60 IIII	HAPS			work practices, operation, maintenance, recordkeeping	

Emission Unit #	Emission Unit Description	Applicable Regulation or Requirement	Pollutant	Emission Limit (if applicable)	Voluntary Emission Limit or Exemption (if applicable)	Operating Requirement or Limitation (if applicable)	Method of Determining Compliance with the Emission and Operating Requirement(s)
147-152, 155	Coal Yard Runoff, Gypsum Stilling Pond, & Daniel Run Coal Fines Diesel Engine Pumps, GN24 Fuel Tank Generator	401 KAR 59:010, Sec 3(1)(a)	Opacity	< 20 percent			

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
147 - 152, 155	Coal Yard Runoff, Gypsum Stilling Pond, & Daniel Run Coal Fines Diesel Engine Pumps, GN24 Fuel Tank Gen.	PM, SO2, NOx, CO, VOC	401 KAR 52:020, Section 10	Fuel consumption and/or hours of operation. Diesel fuel sulfur content.	Monitor fuel consumption and/or hours of operation. Monitor diesel fuel sulfur content.
147 - 152, 155	Coal Yard Runoff, Gypsum Stilling Pond, & Daniel Run Coal Fines Diesel Engine Pumps, GN24 Fuel Tank Gen.	All regulated pollutants	40 CFR Part 60 Subpart IIII	Install non-resettable hour meter.	Perform necessary maintenance as prescribed by manufacturer.

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
147 - 152, 155	Coal Yard Runoff, Gypsum Stilling Pond, & Daniel Run Coal Fines Diesel Engine Pumps, GN24 Fuel Tank Generator	PM, SO2, NOx, CO, VOC	40 CFR 70.6 (a)(3)(i) and (ii) 40 CFR 70.6 g(3) 40 CFR 51.211	Production records and operating logs	Maintain records of fuel consumption and/or hours of operation. Maintain records of diesel fuel sulfur content. Retain all specified records for 5 years.
147 - 152. 155	Coal Yard Runoff, Gypsum Stilling Pond, & Daniel Run Coal Fines Diesel Engine Pumps, GN24 Fuel Tank Generator	All regulated pollutants	40 CFR Part 60 Subpart IIII	Maintenance activities	Maintain records of all maintenance activities. Retain all specified records for 5 years.

Section V.4: Reporting Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Reported	Description of Reporting
147 - 152, 155	Coal Yard Runoff, Gypsum Stilling Pond, & Daniel Run Coal Fines Diesel Engine Pumps, GN24 Fuel Tank Generator	All regulated pollutants	40 CFR 70.6 (a)(3)(iii)	Production records and operating logs.	Report deviations promptly. Report annual certification of compliance.

Table 8-7. Emissions from Paradise Coal Yard Runoff Diesel Engine #1 (8 inch Godwin pump)

Engine Manufacturer				John Deere	
Engine Model				4045TF285	
Engine Model Year				2011	
Engine Horsepower Rating, hp				99	
Diesel Fuel Use, gal/hr				4.95	
Diesel Fuel Heat Content, Btu/gal				140,000	
Diesel Engine Heat Input Rating, MMBtu/hr				0.693	
Annual Hours of Operation, hr*				8,760	
	Emission	Emission	AP-42		
	Factor	Factor	Emission Factor	Emissions	
	Reference	g/hp-hr	lb/MMBtu	lb/hr	ton/yr*
Particulate Matter (PM)	1	0.3	0.0945	0.0655	0.287
Nitrogen Oxides (NOx)	1	3.3	1.04	0.720	3.15
NM Hydrocarbons	1	0.2	0.0630	0.0437	0.191
Carbon Monoxide (CO)	1	3.7	1.17	0.808	3.54
Sulfur Dioxide (SO_2)	2		0.001515	1.05E-03	4.60E-03
Sulfuric Acid (H_2SO_4)	2		0.000116	8.04E-05	3.52E-04
PM Condensible	3		0.00327	2.26E-03	9.91E-03
Carbon Dioxide Equivalent	4		163.6	113	497
Antimony (Sb)	5		2.20E-05	1.52E-05	6.68E-05
Arsenic (As)	6		4.00E-06	2.77E-06	1.21E-05
Beryllium (Be)	6		3.00E-06	2.08E-06	9.11E-06
Cadmium (Cd)	6		3.00E-06	2.08E-06	9.11E-06
Chromium (Cr)	6		3.00E-06	2.08E-06	9.11E-06
Cobalt (Co)	6		9.10E-06	6.31E-06	2.76E-05
Lead (Pb)	6		9.00E-06	6.24E-06	2.73E-05
Manganese (Mn)	6		6.00E-06	4.16E-06	1.82E-05
Mercury (Hg)	6		3.00E-06	2.08E-06	9.11E-06
Nickel (Ni)	6		3.00E-06	2.08E-06	9.11E-06
Selenium (Se)	6		1.50E-05	1.04E-05	4.55E-05
Hydrogen Chloride (HCl)	7		3.11E-04	2.16E-04	9.44E-04
Benzene	8		9.33E-04	6.47E-04	2.83E-03
Toluene	8		4.09E-04	2.83E-04	1.24E-03
Xylenes	8		2.85E-04	1.98E-04	8.65E-04
1,3-Butadiene	8		3.91E-05	2.71E-05	1.19E-04
Formaldehyde	8		1.18E-03	8.18E-04	3.58E-03
Acetaldehyde	8		7.67E-04	5.32E-04	2.33E-03
Acrolein	8		9.25E-05	6.41E-05	2.81E-04
Total POMs	8		1.68E-04	1.16E-04	5.10E-04
Total HAPs			4.26E-03	2.96E-03	1.29E-02

* Potential annual emissions based on 8,760 hours per year operation.

Reference
1 PM, NOx, NMHC, and CO emissions factors Tier 3 emission standards.
2 SO2 and H2SO4 based on 15 ppm sulfur in diesel fuel. AP-42, 5th Edition, Section 3.4, 10/96. 100% of sulfur to SO2 and 5% of sulfur to H2SO4.
3 PM Condensable emission factor based on 5% of NM Hydrocarbons emission factor plus sulfuric acid emission factor.
4 Based on 40 CFR Part 98. CO2 factor is 73.96 kg CO2/MMBtu, CH4 factor is 0.003 kg CH4/MMBtu, N2O factor is 0.0006 kg N2O/MMBtu. CO2 equivalent factor for CO2 is 1.0, CO2 equivalent factor for CH4 is 25, CO2 equivalent factor for N2O is 298.
5 For Antimony. AP-42, Vol. I, 5th Edition, Supplement B, Section 3.1, "Stationary Gas Turbines for Electricity Generation," 10-96.
6 AP-42, 5th Edition, Supplement E, Section 1.3, "Fuel Oil Combustion," 9-98 (corrected May 2010).
7 TVA Fuel Oil Specifications.
8 AP-42, 5th Edition, Section 3.3, 10/96.

Sample Calculations

Particulates: 0.3 g/hp-hr x 99 hp x lb/453.6 g = 0.0655 lb/hr
0.0655 lb/hr x 8,760 hr/yr x ton/2000 lb = 0.287 ton/yr

Sulfur Dioxide: 15 ppm sulfur = 0.0015 %S and 95% of sulfur goes to SO2
1.01 x 0.0015 lb/MMBtu x 0.693 MMBtu/hr = 1.05E-03 lb/hr
1.05E-03 lb/hr x 8,760 hr/yr x ton/2000 lb = 4.60E-03 ton/yr

Table 8-8. Emissions from Paradise Coal Yard Runoff Diesel Engine #2 (8 inch Godwin pump)

Engine Manufacturer				John Deere	
Engine Model				4045TF285	
Engine Model Year				2013	
Engine Horsepower Rating, hp				99	
Diesel Fuel Use, gal/hr				4.95	
Diesel Fuel Heat Content, Btu/gal				140,000	
Diesel Engine Heat Input Rating, MMBtu/hr				0.693	
Annual Hours of Operation, hr*				8,760	
	Emission	Emission	AP-42		
	Factor	Factor	Emission Factor	Emissions	
	Reference	g/hp-hr	lb/MMBtu	lb/hr	ton/yr*
Particulate Matter (PM)	1	0.3	0.0945	0.0655	0.287
Nitrogen Oxides (NOx)	1	3.3	1.04	0.720	3.15
NM Hydrocarbons	1	0.2	0.0630	0.0437	0.191
Carbon Monoxide (CO)	1	3.7	1.17	0.808	3.54
Sulfur Dioxide (SO_2)	2		0.001515	1.05E-03	4.60E-03
Sulfuric Acid (H_2SO_4)	2		0.000116	8.04E-05	3.52E-04
PM Condensible	3		0.00327	2.26E-03	9.91E-03
Carbon Dioxide Equivalent	4		163.6	113	497
Antimony (Sb)	5		2.20E-05	1.52E-05	6.68E-05
Arsenic (As)	6		4.00E-06	2.77E-06	1.21E-05
Beryllium (Be)	6		3.00E-06	2.08E-06	9.11E-06
Cadmium (Cd)	6		3.00E-06	2.08E-06	9.11E-06
Chromium (Cr)	6		3.00E-06	2.08E-06	9.11E-06
Cobalt (Co)	6		9.10E-06	6.31E-06	2.76E-05
Lead (Pb)	6		9.00E-06	6.24E-06	2.73E-05
Manganese (Mn)	6		6.00E-06	4.16E-06	1.82E-05
Mercury (Hg)	6		3.00E-06	2.08E-06	9.11E-06
Nickel (Ni)	6		3.00E-06	2.08E-06	9.11E-06
Selenium (Se)	6		1.50E-05	1.04E-05	4.55E-05
Hydrogen Chloride (HCl)	7		3.11E-04	2.16E-04	9.44E-04
Benzene	8		9.33E-04	6.47E-04	2.83E-03
Toluene	8		4.09E-04	2.83E-04	1.24E-03
Xylenes	8		2.85E-04	1.98E-04	8.65E-04
1,3-Butadiene	8		3.91E-05	2.71E-05	1.19E-04
Formaldehyde	8		1.18E-03	8.18E-04	3.58E-03
Acetaldehyde	8		7.67E-04	5.32E-04	2.33E-03
Acrolein	8		9.25E-05	6.41E-05	2.81E-04
Total POMs	8		1.68E-04	1.16E-04	5.10E-04
Total HAPs			4.26E-03	2.96E-03	1.29E-02

* Potential annual emissions based on 8,760 hours per year operation.

Reference

1 PM, NOx, NMHC, and CO emissions factors Tier 3 emission standards.
2 SO2 and H2SO4 based on 15 ppm sulfur in diesel fuel. AP-42, 5th Edition, Section 3.4, 10/96. 100% of sulfur to SO2 and 5% of sulfur to H2SO4.
3 PM Condensable emission factor based on 5% of NM Hydrocarbons emission factor plus sulfuric acid emission factor.
4 Based on 40 CFR Part 98. CO2 factor is 73.96 kg CO2/MMBtu, CH4 factor is 0.003 kg CH4/MMBtu, N2O factor is 0.0006 kg N2O/MMBtu.
CO2 equivalent factor for CO2 is 1.0, CO2 equivalent factor for CH4 is 25, CO2 equivalent factor for N2O is 298.
5 For Antimony. AP-42, Vol. I, 5th Edition, Supplement B, Section 3.1, "Stationary Gas Turbines for Electricity Generation," 10-96.
6 AP-42, 5th Edition, Supplement E, Section 1.3, "Fuel Oil Combustion," 9-98 (corrected May 2010).
7 TVA Fuel Oil Specifications.
8 AP-42, 5th Edition, Section 3.3, 10/96.

Table 8-9. Emissions from Paradise Gypsum Stilling Pond Diesel Engine Pump #1 (6 inch Gorman Rupp pump)

Engine Manufacturer				John Deere	
Engine Model				4045DF150A	
Engine Model Year				unknown	
Engine Horsepower Rating, hp				84	
Diesel Fuel Use, gal/hr				4.20	
Diesel Fuel Heat Content, Btu/gal				140,000	
Diesel Engine Heat Input Rating, MMBtu/hr				0.588	
Annual Hours of Operation, hr*				8,760	
	Emission Factor Reference	Emission Factor g/hp-hr	AP-42 Emission Factor lb/MMBtu	Emissions lb/hr	Emissions ton/yr*
Particulate Matter (PM)	1		0.31	0.182	0.798
Nitrogen Oxides (NOx)	2	6.9	2.17	1.28	5.60
NM Hydrocarbons	1		0.36	0.212	0.927
Carbon Monoxide (CO)	1		0.95	0.559	2.45
Sulfur Dioxide (SO_2)	3		0.001515	8.91E-04	3.90E-03
Sulfuric Acid (H_2SO_4)	3		0.000116	6.82E-05	2.99E-04
PM Condensible	4		0.01812	1.07E-02	4.67E-02
Carbon Dioxide Equivalent	5		163.6	96.2	421
Antimony (Sb)	6		2.20E-05	1.29E-05	5.67E-05
Arsenic (As)	7		4.00E-06	2.35E-06	1.03E-05
Beryllium (Be)	7		3.00E-06	1.76E-06	7.73E-06
Cadmium (Cd)	7		3.00E-06	1.76E-06	7.73E-06
Chromium (Cr)	7		3.00E-06	1.76E-06	7.73E-06
Cobalt (Co)	7		9.10E-06	5.35E-06	2.34E-05
Lead (Pb)	7		9.00E-06	5.29E-06	2.32E-05
Manganese (Mn)	7		6.00E-06	3.53E-06	1.55E-05
Mercury (Hg)	7		3.00E-06	1.76E-06	7.73E-06
Nickel (Ni)	7		3.00E-06	1.76E-06	7.73E-06
Selenium (Se)	7		1.50E-05	8.82E-06	3.86E-05
Hydrogen Chloride (HCl)	8		3.11E-04	1.83E-04	8.01E-04
Benzene	9		9.33E-04	5.49E-04	2.40E-03
Toluene	9		4.09E-04	2.40E-04	1.05E-03
Xylenes	9		2.85E-04	1.68E-04	7.34E-04
1,3-Butadiene	9		3.91E-05	2.30E-05	1.01E-04
Formaldehyde	9		1.18E-03	6.94E-04	3.04E-03
Acetaldehyde	9		7.67E-04	4.51E-04	1.98E-03
Acrolein	9		9.25E-05	5.44E-05	2.38E-04
Total POMs	9		1.68E-04	9.88E-05	4.33E-04
Total HAPs			4.26E-03	2.51E-03	1.10E-02

* Potential annual emissions based on 8,760 hours per year operation.

Reference
1 NOx emission factor based on Tier 1 emission standards.
2 PM, NMHC, and CO emissions factors based on AP-42, Section 3.3, 10/96.
3 SO2 and H2SO4 based on 15 ppm sulfur in diesel fuel. AP-42, 5th Edition, Section 3.4, 10/96. 100% of sulfur to SO2 and 5% of sulfur to H2SO4.
4 PM Condensable emission factor based on 5% of NM Hydrocarbons emission factor plus sulfuric acid emission factor.
5 Based on 40 CFR Part 98. CO2 factor is 73.96 kg CO2/MMBtu, CH4 factor is 0.003 kg CH4/MMBtu, N2O factor is 0.0006 kg N2O/MMBtu.
CO2 equivalent factor for CO2 is 1.0, CO2 equivalent factor for CH4 is 25, CO2 equivalent factor for N2O is 298.
6 For Antimony. AP-42, Vol. I, 5th Edition, Supplement B, Section 3.1, "Stationary Gas Turbines for Electricity Generation," 10-96.
7 AP-42, 5th Edition, Supplement E, Section 1.3, "Fuel Oil Combustion," 9-98 (corrected May 2010).
8 TVA Fuel Oil Specifications.
9 AP-42, 5th Edition, Section 3.3, 10/96.

Table 8-10. Emissions from Paradise Gypsum Stilling Pond Diesel Engine Pump #2 (8 inch Godwin pump)

Engine Manufacturer				John Deere	
Engine Model				4045TF285	
Engine Model Year				2011	
Engine Horsepower Rating, hp				99	
Diesel Fuel Use, gal/hr				4.95	
Diesel Fuel Heat Content, Btu/gal				140,000	
Diesel Engine Heat Input Rating, MMBtu/hr				0.693	
Annual Hours of Operation, hr*				8,760	
	Emission	Emission	AP-42		
	Factor	Factor	Emission Factor	Emissions	
	Reference	g/hp-hr	lb/MMBtu	lb/hr	ton/yr*
Particulate Matter (PM)	1	0.3	0.0945	0.0655	0.287
Nitrogen Oxides (NOx)	1	3.3	1.04	0.720	3.15
NM Hydrocarbons	1	0.2	0.0630	0.0437	0.191
Carbon Monoxide (CO)	1	3.7	1.17	0.808	3.54
Sulfur Dioxide (SO_2)	2		0.001515	1.05E-03	4.60E-03
Sulfuric Acid (H_2SO_4)	2		0.000116	8.04E-05	3.52E-04
PM Condensible	3		0.00327	2.26E-03	9.91E-03
Carbon Dioxide Equivalent	4		163.6	113	497
Antimony (Sb)	5		2.20E-05	1.52E-05	6.68E-05
Arsenic (As)	6		4.00E-06	2.77E-06	1.21E-05
Beryllium (Be)	6		3.00E-06	2.08E-06	9.11E-06
Cadmium (Cd)	6		3.00E-06	2.08E-06	9.11E-06
Chromium (Cr)	6		3.00E-06	2.08E-06	9.11E-06
Cobalt (Co)	6		9.10E-06	6.31E-06	2.76E-05
Lead (Pb)	6		9.00E-06	6.24E-06	2.73E-05
Manganese (Mn)	6		6.00E-06	4.16E-06	1.82E-05
Mercury (Hg)	6		3.00E-06	2.08E-06	9.11E-06
Nickel (Ni)	6		3.00E-06	2.08E-06	9.11E-06
Selenium (Se)	6		1.50E-05	1.04E-05	4.55E-05
Hydrogen Chloride (HCl)	7		3.11E-04	2.16E-04	9.44E-04
Benzene	8		9.33E-04	6.47E-04	2.83E-03
Toluene	8		4.09E-04	2.83E-04	1.24E-03
Xylenes	8		2.85E-04	1.98E-04	8.65E-04
1,3-Butadiene	8		3.91E-05	2.71E-05	1.19E-04
Formaldehyde	8		1.18E-03	8.18E-04	3.58E-03
Acetaldehyde	8		7.67E-04	5.32E-04	2.33E-03
Acrolein	8		9.25E-05	6.41E-05	2.81E-04
Total POMs	8		1.68E-04	1.16E-04	5.10E-04
Total HAPs			4.26E-03	2.96E-03	1.29E-02

* Potential annual emissions based on 8,760 hours per year operation.

Reference
1 PM, NOx, NMHC, and CO emissions factors Tier 3 emission standards.
2 SO2 and H2SO4 based on 15 ppm sulfur in diesel fuel. AP-42, 5th Edition, Section 3.4, 10/96. 100% of sulfur to SO2 and 5% of sulfur to H2SO4.
3 PM Condensable emission factor based on 5% of NM Hydrocarbons emission factor plus sulfuric acid emission factor.
4 Based on 40 CFR Part 98. CO2 factor is 73.96 kg CO2/MMBtu, CH4 factor is 0.003 kg CH4/MMBtu, N2O factor is 0.0006 kg N2O/MMBtu.
CO2 equivalent factor for CO2 is 1.0, CO2 equivalent factor for CH4 is 25, CO2 equivalent factor for N2O is 298.
5 For Antimony. AP-42, Vol. I, 5th Edition, Supplement B, Section 3.1, "Stationary Gas Turbines for Electricity Generation," 10-96.
6 AP-42, 5th Edition, Supplement E, Section 1.3, "Fuel Oil Combustion," 9-98 (corrected May 2010).
7 TVA Fuel Oil Specifications.
8 AP-42, 5th Edition, Section 3.3, 10/96.

Table 8-11. Emissions from Paradise Daniel Run Coal Fines Diesel Engine Pump #1 (6 inch Pioneer pump)

Engine Manufacturer				Deutz	
Engine Model				D914L04	
Engine Model Year				unknown	
Engine Horsepower Rating, hp				78	
Diesel Fuel Use, gal/hr				3.90	
Diesel Fuel Heat Content, Btu/gal				140,000	
Diesel Engine Heat Input Rating, MMBtu/hr				0.546	
Annual Hours of Operation, hr*				8,760	
	Emission	Emission	AP-42		
	Factor	Factor	Emission Factor	Emissions	
	Reference	g/hp-hr	lb/MMBtu	lb/hr	ton/yr*
Particulate Matter (PM)	1	0.3	0.0945	0.0516	0.226
Nitrogen Oxides (NOx)	1	3.3	1.04	0.567	2.49
NM Hydrocarbons	1	0.2	0.0630	0.0344	0.151
Carbon Monoxide (CO)	1	3.7	1.17	0.636	2.79
Sulfur Dioxide (SO_2)	2		0.001515	8.27E-04	3.62E-03
Sulfuric Acid (H_2SO_4)	2		0.000116	6.33E-05	2.77E-04
PM Condensible	3		0.00327	1.78E-03	7.81E-03
Carbon Dioxide Equivalent	4		163.6	89.3	391
Antimony (Sb)	5		2.20E-05	1.20E-05	5.26E-05
Arsenic (As)	6		4.00E-06	2.18E-06	9.57E-06
Beryllium (Be)	6		3.00E-06	1.64E-06	7.17E-06
Cadmium (Cd)	6		3.00E-06	1.64E-06	7.17E-06
Chromium (Cr)	6		3.00E-06	1.64E-06	7.17E-06
Cobalt (Co)	6		9.10E-06	4.97E-06	2.18E-05
Lead (Pb)	6		9.00E-06	4.91E-06	2.15E-05
Manganese (Mn)	6		6.00E-06	3.28E-06	1.43E-05
Mercury (Hg)	6		3.00E-06	1.64E-06	7.17E-06
Nickel (Ni)	6		3.00E-06	1.64E-06	7.17E-06
Selenium (Se)	6		1.50E-05	8.19E-06	3.59E-05
Hydrogen Chloride (HCl)	7		3.11E-04	1.70E-04	7.44E-04
Benzene	8		9.33E-04	5.09E-04	2.23E-03
Toluene	8		4.09E-04	2.23E-04	9.78E-04
Xylenes	8		2.85E-04	1.56E-04	6.82E-04
1,3-Butadiene	8		3.91E-05	2.13E-05	9.35E-05
Formaldehyde	8		1.18E-03	6.44E-04	2.82E-03
Acetaldehyde	8		7.67E-04	4.19E-04	1.83E-03
Acrolein	8		9.25E-05	5.05E-05	2.21E-04
Total POMs	8		1.68E-04	9.17E-05	4.02E-04
Total HAPs			4.26E-03	2.33E-03	1.02E-02

* Potential annual emissions based on 8,760 hours per year operation.

Reference
1 PM, NOx, NMHC, and CO emissions factors Tier 3 emission standards.
2 SO2 and H2SO4 based on 15 ppm sulfur in diesel fuel. AP-42, 5th Edition, Section 3.4, 10/96. 100% of sulfur to SO2 and 5% of sulfur to H2SO4.
3 PM Condensable emission factor based on 5% of NM Hydrocarbons emission factor plus sulfuric acid emission factor.
4 Based on 40 CFR Part 98. CO2 factor is 73.96 kg CO2/MMBtu, CH4 factor is 0.003 kg CH4/MMBtu, N2O factor is 0.0006 kg N2O/MMBtu.
CO2 equivalent factor for CO2 is 1.0, CO2 equivalent factor for CH4 is 25, CO2 equivalent factor for N2O is 298.
5 For Antimony. AP-42, Vol. I, 5th Edition, Supplement B, Section 3.1, "Stationary Gas Turbines for Electricity Generation," 10-96.
6 AP-42, 5th Edition, Supplement E, Section 1.3, "Fuel Oil Combustion," 9-98 (corrected May 2010).
7 TVA Fuel Oil Specifications.
8 AP-42, 5th Edition, Section 3.3, 10/96.

Table 8-12. Emissions from Paradise Daniel Run Coal Fines Diesel Engine Pump #2 (6 inch Godwin pump)

Engine Manufacturer				John Deere	
Engine Model				4045TF290	
Engine Model Year				2012	
Engine Horsepower Rating, hp				74	
Diesel Fuel Use, gal/hr				3.70	
Diesel Fuel Heat Content, Btu/gal				140,000	
Diesel Engine Heat Input Rating, MMBtu/hr				0.518	
Annual Hours of Operation, hr*				8,760	
	Emission Factor Reference	Emission Factor g/hp-hr	AP-42 Emission Factor lb/MMBtu	Emissions lb/hr	Emissions ton/yr*
Particulate Matter (PM)	1	0.3	0.0945	0.0489	0.214
Nitrogen Oxides (NOx)	1	3.3	1.04	0.538	2.36
NM Hydrocarbons	1	0.2	0.0630	0.0326	0.143
Carbon Monoxide (CO)	1	3.7	1.17	0.604	2.64
Sulfur Dioxide (SO_2)	2		0.001515	7.85E-04	3.44E-03
Sulfuric Acid (H_2SO_4)	2		0.000116	6.01E-05	2.63E-04
PM Condensible	3		0.00327	1.69E-03	7.41E-03
Carbon Dioxide Equivalent	4		163.6	84.8	371
Antimony (Sb)	5		2.20E-05	1.14E-05	4.99E-05
Arsenic (As)	6		4.00E-06	2.07E-06	9.08E-06
Beryllium (Be)	6		3.00E-06	1.55E-06	6.81E-06
Cadmium (Cd)	6		3.00E-06	1.55E-06	6.81E-06
Chromium (Cr)	6		3.00E-06	1.55E-06	6.81E-06
Cobalt (Co)	6		9.10E-06	4.71E-06	2.06E-05
Lead (Pb)	6		9.00E-06	4.66E-06	2.04E-05
Manganese (Mn)	6		6.00E-06	3.11E-06	1.36E-05
Mercury (Hg)	6		3.00E-06	1.55E-06	6.81E-06
Nickel (Ni)	6		3.00E-06	1.55E-06	6.81E-06
Selenium (Se)	6		1.50E-05	7.77E-06	3.40E-05
Hydrogen Chloride (HCl)	7		3.11E-04	1.61E-04	7.06E-04
Benzene	8		9.33E-04	4.83E-04	2.12E-03
Toluene	8		4.09E-04	2.12E-04	9.28E-04
Xylenes	8		2.85E-04	1.48E-04	6.47E-04
1,3-Butadiene	8		3.91E-05	2.03E-05	8.87E-05
Formaldehyde	8		1.18E-03	6.11E-04	2.68E-03
Acetaldehyde	8		7.67E-04	3.97E-04	1.74E-03
Acrolein	8		9.25E-05	4.79E-05	2.10E-04
Total POMs	8		1.68E-04	8.70E-05	3.81E-04
Total HAPs			4.26E-03	2.21E-03	9.68E-03

* Potential annual emissions based on 8,760 hours per year operation.

Reference

1 PM, NOx, NMHC, and CO emissions factors Tier 3 emission standards.
2 SO2 and H2SO4 based on 15 ppm sulfur in diesel fuel. AP-42, 5th Edition, Section 3.4, 10/96. 100% of sulfur to SO2 and 5% of sulfur to H2SO4.
3 PM Condensable emission factor based on 5% of NM Hydrocarbons emission factor plus sulfuric acid emission factor.
4 Based on 40 CFR Part 98. CO2 factor is 73.96 kg CO2/MMBtu, CH4 factor is 0.003 kg CH4/MMBtu, N2O factor is 0.0006 kg N2O/MMBtu.
CO2 equivalent factor for CO2 is 1.0, CO2 equivalent factor for CH4 is 25, CO2 equivalent factor for N2O is 298.
5 For Antimony. AP-42, Vol. I, 5th Edition, Supplement B, Section 3.1, "Stationary Gas Turbines for Electricity Generation," 10-96.
6 AP-42, 5th Edition, Supplement E, Section 1.3, "Fuel Oil Combustion," 9-98 (corrected May 2010).
7 TVA Fuel Oil Specifications.
8 AP-42, 5th Edition, Section 3.3, 10/96.

Table 8-13. Emissions from Paradise GN24 Generator for Fuel Tank

Engine Manufacturer				Isuzu	
Engine Model				BZ-4LE2T	
Engine Model Year				2018	
Engine Horsepower Rating, hp				46	
Diesel Fuel Use, gal/hr				2.30	
Diesel Fuel Heat Content, Btu/gal				140,000	
Diesel Engine Heat Input Rating, MMBtu/hr				0.322	
Annual Hours of Operation, hr*				8,760	
	Emission Factor Reference	Emission Factor g/hp-hr	AP-42 Emission Factor lb/MMBtu	Emissions lb/hr	Emissions ton/yr*
Particulate Matter (PM)	1	0.022	0.00693	0.00223	0.00977
Nitrogen Oxides (NOx)	1	3.3	1.04	0.335	1.47
NM Hydrocarbons	1	0.2	0.0630	0.0203	0.0888
Carbon Monoxide (CO)	1	4.1	1.29	0.416	1.82
Sulfur Dioxide (SO_2)	2		0.001515	4.88E-04	2.14E-03
Sulfuric Acid (H_2SO_4)	2		0.000116	3.73E-05	1.64E-04
PM Condensible	3		0.00327	1.05E-03	4.61E-03
Carbon Dioxide Equivalent	4		163.6	52.7	231
Antimony (Sb)	5		2.20E-05	7.08E-06	3.10E-05
Arsenic (As)	6		4.00E-06	1.29E-06	5.64E-06
Beryllium (Be)	6		3.00E-06	9.66E-07	4.23E-06
Cadmium (Cd)	6		3.00E-06	9.66E-07	4.23E-06
Chromium (Cr)	6		3.00E-06	9.66E-07	4.23E-06
Cobalt (Co)	6		9.10E-06	2.93E-06	1.28E-05
Lead (Pb)	6		9.00E-06	2.90E-06	1.27E-05
Manganese (Mn)	6		6.00E-06	1.93E-06	8.46E-06
Mercury (Hg)	6		3.00E-06	9.66E-07	4.23E-06
Nickel (Ni)	6		3.00E-06	9.66E-07	4.23E-06
Selenium (Se)	6		1.50E-05	4.83E-06	2.12E-05
Hydrogen Chloride (HCl)	7		3.11E-04	1.00E-04	4.39E-04
Benzene	8		9.33E-04	3.00E-04	1.32E-03
Toluene	8		4.09E-04	1.32E-04	5.77E-04
Xylenes	8		2.85E-04	9.18E-05	4.02E-04
1,3-Butadiene	8		3.91E-05	1.26E-05	5.51E-05
Formaldehyde	8		1.18E-03	3.80E-04	1.66E-03
Acetaldehyde	8		7.67E-04	2.47E-04	1.08E-03
Acrolein	8		9.25E-05	2.98E-05	1.30E-04
Total POMs	8		1.68E-04	5.41E-05	2.37E-04
Total HAPs			4.26E-03	1.37E-03	6.01E-03

* Potential annual emissions based on 8,760 hours per year operation.

Reference

1 PM, NOx, NMHC, and CO emissions factors Tier 4 emission standards.
2 SO2 and H2SO4 based on 15 ppm sulfur in diesel fuel. AP-42, 5th Edition, Section 3.4, 10/96. 100% of sulfur to SO2 and 5% of sulfur to H2SO4.
3 PM Condensable emission factor based on 5% of NM Hydrocarbons emission factor plus sulfuric acid emission factor.
4 Based on 40 CFR Part 98. CO2 factor is 73.96 kg CO2/MMBtu, CH4 factor is 0.003 kg CH4/MMBtu, N2O factor is 0.0006 kg N2O/MMBtu.
CO2 equivalent factor for CO2 is 1.0, CO2 equivalent factor for CH4 is 25, CO2 equivalent factor for N2O is 298.
5 For Antimony. AP-42, Vol. I, 5th Edition, Supplement B, Section 3.1, "Stationary Gas Turbines for Electricity Generation," 10-96.
6 AP-42, 5th Edition, Supplement E, Section 1.3, "Fuel Oil Combustion," 9-98 (corrected May 2010).
7 TVA Fuel Oil Specifications.
8 AP-42, 5th Edition, Section 3.3, 10/96.

16 CELL MECHANICAL-DRAFT COOLING TOWERS PROCESS DESCRIPTION
PARADISE COMBINED-CYCLE PLANT

Paradise Combined Cycle Plant (PCC) has a 16 cell mechanical-draft counter-flow cooling tower that provides cooling for the condensing steam turbine exhaust and the plant auxiliary equipment. It serves the design heat duty with a circulating cooling water flow rate of 289,000 gallons per minute. The drift rate will not exceed 0.0005 percent. Drift eliminators are installed to reduce the particulate emissions. A flow diagram for the cooling towers is presented in Figure 9-1.

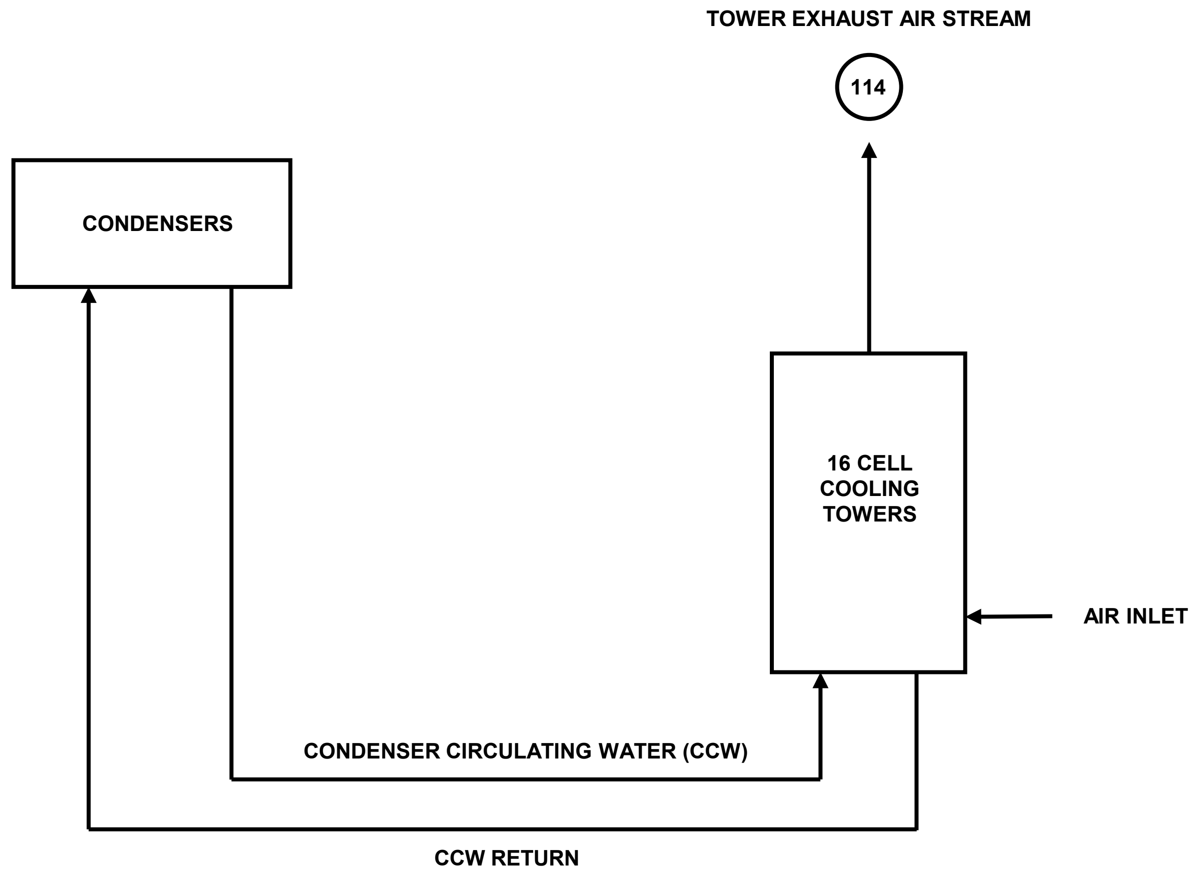
The cooling tower is complete with pumps, water chemistry control, and fire protection.

Operational and Calculation Methodology

Emissions from the cooling tower are determined from the circulating cooling water rate of 289,000 gallons per minute, design drift efficiency of 0.0005%, a concentration factor of 10, and intake water quality data. Particulate emissions are based on the total-solids content of the cooling water 1,100 ppm (350 ppm total dissolved solids + 750 ppm total suspended solids). Annual emissions are based on continuous operation of the cooling towers.

TABLE 9-1
INPUT DATA FOR COOLING TOWER EMISSION ESTIMATES
PARADISE COMBINED-CYCLE PLANT

Parameter	Value	Units
Total Circulating Cooling Water Flow	289,000	gallon / minute
Drift Loss Rate	0.0005	%
Total-Solids Content of Cooling Water	1,100	parts per million by weight (ppmw)
Concentration Factor	10	unitless
Annual Operations	8,760	hours / year



TENNESSEE VALLEY AUTHORITY - PARADISE COMBINED-CYCLE PLANT

FLOW DIAGRAM OF 16 CELL MECHANICAL-DRAFT COOLING TOWERS

LEGEND: 1. XX INDICATES EMISSION POINTS
2.
3.

FIGURE 9-1

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DEP7007B
Manufacturing or Processing Operations

___ Section B.1: Process Information
___ Section B.2: Materials and Fuel Information
___ Section B.3: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG.
___ Attach a flow diagram
___ Attach SDS

Source Name: TVA - Paradise Combined-Cycle Plant
KY EIS (AFS) #: 21- **177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section B.1: Process Information

Emission Unit #	Emission Unit Name	Describe Emission Unit	Process ID	Process Name	Manufacturer	Model No.	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	Is the Process Continuous or Batch?	Number of Batches per 24 Hours *(if applicable)*	Hours per Batch *(if applicable)*
114	16 Cell Water Cooling Tower	Counter-flow, mechanical-draft cooling tower with 16 identical exhaust points (cells)	114	16 Cell Water Cooling Tower	SPX Cooling Technologies	F454A60A4 .016B	2015	Continuous		

Section B.2: Materials and Fuel Information

**Maximum yearly fuel usage rate only applies if applicant request operating restrictions through federally enforceable limitations.*

Emission Unit #	Emission Unit Name	Name of Raw Materials Input	Maximum Quantity of Each Raw Material Input		Total Process Weight Rate for Emission Unit *(tons/hr)*	Name of Finished Materials	Maximum Quantity of Each Finished Material Output		Fuel Type	Maximum Hourly Fuel Usage Rate		Maximum Yearly Fuel Usage Rate		Sulfur Content *(%)*	Ash Content *(%)*
				(Specify Units/hr)				*(Specify Units/hr)*			*(Specify Units)*		*(Specify Units)*		
114	16 Cell Water Cooling Tower	(1) Condenser Circulating Water (CCW); (2) Corrosion/biotic inhibitors	(1) 17.34 MM	gal/hr	72,221	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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DEP7007N

Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Information
__ Section N.4: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: **21- 177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity (SCC Units/hour)	Pollutant	Uncontrolled Emission Factor (lb/SCC Units)	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency (%)	Control Efficiency (%)	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential (lb/hr)	Controlled Potential (lb/hr)	Uncontrolled Potential (tons/yr)	Controlled Potential (tons/yr)
114	16 Cell Water Cooling Tower	114	16 Cell Water Cooling Tower	Drift Eliminators	114	114	72,221 ton/hr	PM	1.10E-04	Material Balance			7.94	7.94	34.8	34.8

Section N.2: Stack Information

UTM Zone:

Stack ID	Identify all Emission Units (with Process ID) and Control Devices that Feed to Stack	Stack Physical Data			Stack UTM Coordinates		Stack Gas Stream Data		
		Equivalent Diameter *(ft)*	Height *(ft)*	Base Elevation *(ft)*	Northing *(m)*	Easting *(m)*	Flowrate *(acfm)*	Temperature *(°F)*	Exit Velocity *(ft/sec)*
114	16 Cell Water Cooling Tower with Mist Eliminators	36	47	418	4,124,718	501,180	2,271,610	97.5	37.2

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Frankfort, KY 40601
(502) 564-3999

DEP7007V
Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitation(s)
___ Section V.2: Monitoring Requirements
___ Section V.3: Recordkeeping Requirements
___ Section V.4: Reporting Requirements
___ Section V.5: Testing Requirements
___ Section V.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: 21- **177-0006**
Permit #: V-18-056 R2
Agency Interest (AI) ID: 127687
Date: 5/31/2024

Section V.1: Emission and Operating Limitation(s)

Emission Unit #	Emission Unit Description	Applicable Regulation or Requirement	Pollutant	Emission Limit (if applicable)	Voluntary Emission Limit or Exemption (if applicable)	Operating Requirement or Limitation (if applicable)	Method of Determining Compliance with the Emission and Operating Requirement(s)
114	16 Cell Water Cooling Tower	401 KAR 63:010	PM10	No visible fugitive dust beyond the property line. Reasonable precautions shall be taken to prevent PM from becoming airborne.			Drift Eliminators are utilized
114	16 Cell Water Cooling Tower	401 KAR 59:010 Section 3(1)(a)	Opacity	20%			Drift Eliminators are utilized
114	16 Cell Water Cooling Tower	401 KAR Section3(2)	PM10	E=17.31P^0.16			Drift Eliminators are utilized

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
114	16 Cell Water Cooling Tower	PM10	401 KAR 52:020	Throughput in gal/hr	Monitor amount of water processed

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
114	16 Cell Water Cooling Tower	PM10	401 KAR 52:020	Throughput in gal/hr. Maintenance and use of air pollution control equipment.	Record amount of water processed on a monthly basis and maintain as a rolling 12-month total. Maintain records of maintenance and use of air pollution control equipment. Retain records for 5 years.

Section V.4: Reporting Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Reported	Description of Reporting
114	16 Cell Water Cooling Tower	PM10	401 KAR 52:020	Production records and operating logs	Report deviations promptly. Semi-annual reports required.

Section V.5: Testing Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Tested	Description of Testing
114	16 Cell Water Cooling Tower	PM10	401 KAR 59:005 401 KAR 59:045	PM10 emissions and Throughput	Conduct testing as requested by the Cabinet.

Division for Air Quality

300 Sower Boulevard

Frankfort, KY 40601

(502) 564-3999

DEP7007GG

Control Equipment

Additional Documentation
___ Complete Sections GG.1 through GG.12, as applicable
___ Attach manufacturer's specifications for each control device
___ Complete DEP7007AI

Source Name: TVA - Paradise Combined-Cycle Plant

KY EIS (AFS) #: **21- 177-00006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section GG.1: General Information - Control Equipment

Control Device ID #	Control Device Name	Cost	Manufacturer	Model Name/ Serial #	Date Installed	Inlet Gas Stream Data For All Control Devices					Inlet Gas Stream Data For Condensers, Adsorbers, Afterburners, Incinerators, Oxidizers Only			Equipment Operational Data For All Control Devices		
						Temperature (°F)	Flowrate (scfm @ 68°F)	Average Particle Diameter (μm)	Particle Density (lb/ft^3) or Specific Gravity	Gas Density (lb/ft^3)	Gas Moisture Content (%)	Gas Composition	Fan Type	Pressure Drop Range (in. H_2O)	Pollutants Collected/ Controlled	Pollutant Removal (%)
114	Drift Eliminators		SPX Cooling Technologies	TU12C	2015										PM	

Section GG.11: Other Control Equipment

Control Device ID #	Identify all Emission Units and Control Devices that Feed to Control Equipment	**Type of Control Equipment** (provide description and a diagram with dimensions)
114	114	Drift Eliminators. To reduce the drift (particulate matter entrained in water droplets), drift eliminators are incorporated into the tower design to remove as many droplets as practical from the air stream before exiting the tower.

SAMPLE CALCULATIONS FOR THE MECHANICAL-DRAFT COOLING WATER TOWERS PARADISE COMBINED-CYCLE PLANT

PCC has one (1), 16-cell cooling water tower array. Input parameters used to calculate emission estimates are presented in the following table.

Table 9-2. Cooling Water Tower Inputs

Parameter	Value	Units
Condenser Cooling Water Vol. Flow	289,000	gallons / minute
Drift Loss Rate	0.0005	%
Makeup Water Solids	1,100	parts per million by weight (ppmw)
Concentration Factor	10	(unitless)
Density of Water	8.33	lb/gal

Cooling-tower emission estimates are based on design values. Filterable particulate matter (FPM) emissions are based on the total-solids content of the cooling water. The hourly FPM emissions are estimated by the following equation:

$$\frac{289{,}000\ gal\ Water}{array-min} \times \frac{0.0005\ gal\ Drift}{100\ gal\ Water} \times \frac{8.33\ \ lb}{gal} \times \frac{60\ min}{hr} \times \frac{1{,}100\ lb\ FPM}{10^6\ lb\ Water} \times 10 = \frac{7.94\ lb\ FPM}{array-hr}$$

Annual emissions are estimated by multiplying the hourly emission rate by 8,760 hours of operation per year. Operational hours provided are estimates and only used for emission estimations. They are not meant to represent limits on operation.

$$FPM_{Annual} = \frac{7.94\ \ lb\ FPM}{array-hr} \times \frac{8760\ hr}{yr} \times \frac{1\ ton}{2{,}000\ lb} = \frac{34.8\ ton\ FPM}{array-yr}$$

Material Safety Data Sheet
MSDS Revision Date: 2/25/13

PRODUCT: Sodium Hypochlorite Solution

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1. Product and Company Identification

Product Identity: **Sodium Hypochlorite Solution**

Chemical Formula: NaOCl
Molecular Weight: 74.45

Synonyms: Sodium Hypochlorite Solution (10-15.6%); Hypochlorite Solution; Bleach Solution, Hypochlorous acid, sodium salt, &/or AB Bleach; sodium hypochlorite/de-ionized water, Sodium Hypochlorite Solution 10%; Sno-glo Bleach; Hypochlorous acid, sodium salt

Brenntag Mid-South Inc.
1405 Hwy 136 W
Henderson, KY 42420

Technical Information: 270-830-1200
Emergency Number: 800-424-9300 (CHEMTREC)
Emergency Number: 703-5273887 (International)

2. Hazards Identification

PRECAUTIONARY STATEMENTS (Hazards to humans and domestic animals): Danger! Corrosive! May cause severe skin and eye irritation or chemical burns to broken skin. Causes eye damage. Exposure to skin may cause sensitization or other allergic responses.

INHALATION: Corrosive! Product may cause severe irritation of the nose, throat and respiratory tract. Repeated and/or prolonged exposures may cause productive cough, runny nose, bronchopneumonia, pulmonary edema (fluid build-up in lungs), and reduction of pulmonary function. Repeated inhalation exposure may cause impairment of lung function and permanent lung damage.

EYE CONTACT: Extremely corrosive! This product causes corneal scarring and clouding. Glaucoma, cataracts and permanent blindness may occur.

SKIN CONTACT: Corrosive! Concentrated solutions may cause pain and deep and severe burns to the skin. Prolonged and repeated exposure to diluted solutions often causes irritation, redness, pain and drying and cracking of the skin. Human evidence has indicated that an ingredient in this product can cause skin sensitization.

INGESTION: Corrosive! Will immediately cause severe corrosion of and damage to the gastrointestinal tract. Exposure characterized by nausea, vomiting, diarrhea, abdominal pain, bleeding, and/or tissue ulceration.

PRIMARY ROUTES OF ENTRY: Inhalation and contact.

3. Composition/Information on Ingredients

CAS NUMBER	CHEMICAL NAME(S)	*WT %
7681-52-9	Sodium hypochlorite**	10 – 15.6
1310-73-2	Sodium hydroxide	0.3 – 1.8
7647-14-5	Sodium Chloride	9 – 14.9
497-19-8	Sodium carbonate	≤ 0.5
7732-18-5	Water	Balance

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4. First Aid Measures

INHALATION: Remove victim to fresh air. Give artificial respiration if not breathing. Get medical attention.

EYE CONTACT: Wash eyes with plenty of water for at least 15 minutes while holding eyelids open. Consult an eye specialist immediately.

SKIN CONTACT: Flush skin with plenty of water while removing contaminated clothing. Get medical attention for persistent irritation. Clean clothing before reuse.

INGESTION: If swallowed drink large quantities of water. Do NOT induce vomiting. Call a poison control center or doctor immediately for treatment advice. If spontaneous vomiting occurs, have victim lean forward with head down to avoid breathing in of vomitus, rinse mouth and administer more water.

5. Fire Fighting Measures

FLASH POINT (METHOD USED): Non - flammable **FLAMMABLE LIMITS (% BY VOLUME):** n.a.

EXTINGUISHING MEDIA: Use water spray, fog, foam, dry chemicals, or carbon dioxide.

SPECIAL FIRE FIGHTING PROCEDURES: Firefighters should wear protective equipment including self contained breathing apparatus. Avoid fumes. Dilute spill with copius amounts of water, ventilate. Be prepared to use respirator.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Possible vigorous reaction upon contamination with organics or oxidizing agents. Bleach decomposes when heated, decomposition products may cause containers to rupture or explode. Many reactions can cause fire and explosion. This material will react with some metals which may cause liberation of oxygen. Toxic fumes can be liberated by contact with acid or heat. Vigorous reactions can occur with oxidizable materials and organics. Keep material cool using a water spray from a safe distance. Keep all unnecessary people away. Stay up wind and stay out of low-lying areas.

6. Accidental Release Measures

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Personnel with proper protective equipment should contain spill. Flush area with large amounts of water. Use reducing agents such as bisulfites or ferrous salt solutions to neutralize.

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7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Store this product in a cool dry area; away form direct sunlight and heat to avoid deterioration. In case of spill, flood areas with large quantities of water. Product or rinsates that cannot be used should be diluted with water before disposal in a sanitary sewer. Do not reuse container. Do not contaminate food or feed by storage, disposal or cleaning of equipment. Most metals and metal alloys are NOT suitable for use in contact with sodium hypochlorite solutions including aluminum, brass, bronze, copper, cast iron, galvanized steel, mild steel, nickel, or stainless steel, since these metals act as a catalyst which will cause rapid decomposition of the sodium hypochlorite solution through the release of oxygen.

Sodium hypochlorite solutions are basically unstable, and on exposure to heat and/or light, will slowly decompose, becoming less concentrated with time. Sodium hypochlorite solutions should never be allowed to contact or mix with acids or other low pH compounds, due to the release of chlorine gas. Do not allow sodium hypochlorite to mix with ammonia, since chloroamines may be formed.

Decomposition of sodium hypochlorite takes place within a few seconds with following salts: ammonium acetate, ammonium carbonate, ammonium nitrate, ammonium oxalate, and ammonium phosphate.

Hypochlorites react with urea to form nitrogen trichloride, which explodes spontaneously in air.

Solutions of sodium hypochlorite are corrosive to the skin, eyes, and mucous membranes. Proper safety equipment should be used when working with or in close proximity of sodium hypochlorite.

OTHER PRECAUTIONS: Use with adequate ventilation. Wash thoroughly after handling. Do not get in eyes, on skin or clothing. Do NOT breathe fumes or mist. Mixing this product with chemicals (e.g. common household cleaners, ammonia, acids, detergents, etc.) or organic matter will release chlorine gas, which is irritating to eyes, lungs, and mucous membranes.

STRONG OXIDIZING AGENT: Mix only with water according to label directions. Mixing this product with chemicals (e.g. common household cleaners, ammonia, acids, detergents, etc.) or organic matter (e.g. urine, feces, etc.) will release chlorine gas, which is irritating to eyes, lungs and mucous membranes.

8. Exposure Controls/Personal Protection

CAS NUMBER	CHEMICAL NAME(S)	*WT %	THRESHOLD LIMIT VALUES (UNITS) OSHA: PEL	OSHA: STEL	ACGIH: TLV	ACGIH: STEL
7681-52-9	Sodium hypochlorite**	10 – 15.6	— NONE ESTABLISHED —			
1310-73-2	Sodium hydroxide	0.3 – 1.8	2 mg/m^3 Ceiling	----	2 mg/m^3 Ceiling	----
7647-14-5	Sodium Chloride	9 – 14.9	— NONE ESTABLISHED —			
497-19-8	Sodium carbonate	≤ 0.5	— NONE ESTABLISHED —			
7732-18-5	Water	Balance	— NONE ESTABLISHED —			

** %(w/w) as Cl_2 9.5 to 14.9% TLV/TWA (ACGIH) 0.5ppm Cl_2; TLV/STEL (ACGIH) 1ppm Cl_2 & PEL (OSHA) 1ppm Cl_2

RESPIRATORY PROTECTION: When fumes present, use NIOSH approved respirator with acid type canister.

VENTILATION: Local exhaust preferable as required to control fumes.

PROTECTIVE GLOVES: Rubber or plastic. **EYE PROTECTION:** Chemical goggles.

OTHER PROTECTIVE EQUIPMENT: Clothing to protect skin. Safety shower and eye wash fountain.

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9. Physical and Chemical Properties

BOILING POINT °F (°C): 110 °C for 15% NaOCl

VAPOR DENSITY (AIR =1): n.a.

VAPOR PRESSURE (mmHg): Vapor pressure of water plus decomposition products.

SOLUBILITY IN WATER: Complete

SPECIFIC GRAVITY (H_2O=1): 1.08 - 1.27

EVAPORATION RATE: n.a.

PERCENT VOLATILE BY VOLUME (%): Water vapor plus decomposition products.

APPEARANCE AND ODOR: Light, yellow-green liquid

10. Stability and Reactivity

STABILITY: Unstable (Contingent upon temperature, contamination (metals), and pH.)

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Heat, light exposure, decrease in pH, and contamination with heavy metals, such as nickel, cobalt, copper and iron.

INCOMPATIBILITY (MATERIALS TO AVOID): Heavy metals, reducing agents, organics, ether, ammonia, ammonium acetate, ammonium carbonate, ammonium nitrate, ammonium oxalate, ammonium phosphate, urea and acids.

HAZARDOUS DECOMPOSITION PRODUCTS: Hypochlorous acid, chlorine, hydrochloric acid, sodium chloride, sodium chlorate, and oxygen. Decomposition of sodium hypochlorite takes place within a few seconds with following salts: ammonium acetate, ammonium carbonate, ammonium nitrate, ammonium oxalate, and ammonium phosphate. Hypochlorites react with urea to form nitrogen trichloride, which explodes spontaneously in air.

11. Toxicological Information

TOXICITY DATA:
Oral LD50: 8,910 mg/kg. (Rats)
Dermal LD 50: > 10,000mg/kg. (Rabbits)
Inhalation 0.25-hour LC 50: >10.5 mg/l (Rats)
Acute oral toxicity: IV; LD50, 192 mg/kg
Acute dermal toxicity: III; LD50, > 3,000 mg/kg
Primary eye irritation: I; Corrosive
Primary skin irritation: I; Corrosive

SUMMARY: The concentrated solution is corrosive to skin, and a 5% solution is a severe eye irritant. Solutions containing more than 5% available chlorine are classified by DOT corrosive. Toxicity described in animals from single exposures by ingestion includes muscular weakness, and hyperactivity. Repeated ingestion exposure in animals caused an increase in the relative weight of adrenal glands in one study, but no pathological change were observed in two other studies. Long-term administration of compound in drinking water of rats caused depression of the immune system. No adverse changes were observed in an eight-week dermal study of a 1% solution in guinea pigs. Tests in animals demonstrate no carcinogenic activity by either the oral or dermal routes. Tests in bacterial and mammalian cell cultures demonstrate mutagenic activity.

Material Safety Data Sheet
MSDS Revision Date: 2/25/13

PRODUCT: Sodium Hypochlorite Solution

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12. Ecological Information

ENVIRONMENTAL HAZARDS: This product is toxic to fish and aquatic organisms. Do not discharge effluents containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the sewage treatment plant authority. For guidance, contact you State Water Board or Regional Office of the EPA.

Acute oral-bobwhite quail: LD50, > 2510 mg/kg
Acute dietary-mallard duck: LC50, > 5220 ppm
Acute dietary-bobwhite quail: LC50, > 5620 ppm
Acute fish-rainbow trout: LC50, 0.18-0.22 mg/l
Acute fish-bluegill sunfish: LC50, 0.44-0.79 mg/l

Acute invertebrate-daphnia: LC50, 0.033-0.048 mg/l
Fathead minnows: 96-hour LC50, 5.9 mg/LO
Rainbow Trout: 96-hour LC50, 0.2mg/liter
Bluegill sunfish: 96-hour LC50, 0.58mg/liter

13. Disposal Considerations

WASTE DISPOSAL METHOD: Disposal is to be in accordance with all Federal, State, and Local regulations.

14. Transport Information

PROPER SHIPPING NAME: Hypochlorite Solutions

HAZARD CLASS: 8 (Corrosive) **UN/NA:** UN 1791 **PACKING GROUP:** III

D.O.T. LABEL REQUIRED: Corrosive **REPORTABLE QUANTITY OF PRODUCT:** 800 to 2,000 lbs.

15. Regulatory Information

TSCA (Toxic Substance Control Act): All components of this product are listed on the TSCA inventory.

CERCLA AND SARA REGULATIONS, 40 CFR §300-373:

Super fund Reportable Discharge = 100 pounds (100% NaOCl) CERCLA Hazardous Material: yes

SARA Extremely Hazardous substance: No SARA Toxic Chemical: No

Title III Hazard Classifications: Acute: yes Chronic: yes Fire: no Reactivity: yes Pressure: No

EPA "CLEAN AIR ACT": This product does not contain nor is it manufactured with ozone depleting substances.

OTHER REGULATIONS/LEGISLATION THAT APPLY TO THIS PRODUCT: Massachusetts, Pennsylvania, and New Jersey Right-to Know Laws.

16. Other Information

HMIS HAZARD RATING: Health 3 Flammability 0 Reactivity 2

VOC CONTENT (lbs/gal): n.a.

This MSDS is provided as an information resource only. It should not be taken as a warranty or representation for which Brenntag assumes legal liability. While Brenntag believes the information contained herein is accurate and compiled from sources believed to be reliable, it is the responsibility of the user to investigate and verify its identity. The buyer assumes all responsibility for using and handling the product in accordance with applicable international, federal, state, and local regulations.

Brenntag Mid-South Inc.
1405 Hwy 136 W
Henderson, KY 42420

PREPARED BY: ________ APPROVED BY: ________

C:\RD1\WORD\MSDS\SOD HYPOCHLORITE

SAFETY DATA SHEET
DEPOSITROL* BL5400

1. Identification

Product identifier	**DEPOSITROL BL5400**
Other means of identification	None.
Recommended use	Water based deposit control agent.
Recommended restrictions	None known.

Company/undertaking identification

SUEZ WTS USA, Inc.
4636 Somerton Road
Trevose, PA 19053
T 215 355 3300, F 215 953 5524

Emergency telephone

(800) 877 1940

2. Hazard(s) identification

Physical hazards	Corrosive to metals	Category 1
Health hazards	Skin corrosion/irritation	Category 2
	Serious eye damage/eye irritation	Category 1
OSHA defined hazards	Not classified.	

Label elements

Signal word	Danger
Hazard statement	May be corrosive to metals. Causes severe skin burns and eye damage. Causes serious eye damage.
Precautionary statement	
Prevention	Keep only in original container. Do not breathe mist or vapor. Wash thoroughly after handling. Wear protective gloves/protective clothing/eye protection/face protection.
Response	If swallowed: Rinse mouth. Do NOT induce vomiting. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center/doctor/. Specific treatment (see this label). Wash contaminated clothing before reuse. Absorb spillage to prevent material damage.
Storage	Store locked up. Store in corrosive resistant/ container with a resistant inner liner.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazard(s) not otherwise classified (HNOC)	None known.
Supplemental information	None.

3. Composition/information on ingredients

Mixtures

Components	CAS #	Percent
Phosphonic acid, (1-hydroxyethylidene)bis-	2809-21-4	60 - 80
Phosphorous acid(phosphonic acid)	13598-36-2	1 - 2.5

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

Composition comments	Information for specific product ingredients as required by the U.S. OSHA HAZARD COMMUNICATION STANDARD is listed. Refer to additional sections of this SDS for our assessment of the potential hazards of this formulation.

4. First-aid measures

Inhalation	If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. If breathing stops, provide artificial respiration. For breathing difficulties, oxygen may be necessary. Call a physician if symptoms develop or persist.
Skin contact	Take off immediately all contaminated clothing. Rinse skin with water/shower. Call a physician or poison control center immediately. Chemical burns must be treated by a physician. Wash contaminated clothing before reuse.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a physician or poison control center immediately.
Ingestion	Call a physician or poison control center immediately. Rinse mouth. Never give anything by mouth to a victim who is unconscious or is having convulsions. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.
Most important symptoms/effects, acute and delayed	Burning pain and severe corrosive skin damage. Causes serious eye damage. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Chemical burns: Flush with water immediately. While flushing, remove clothes which do not adhere to affected area. Call an ambulance. Continue flushing during transport to hospital. Keep victim under observation. Symptoms may be delayed.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Water fog. Foam. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	In case of fire and/or explosion do not breathe fumes. Use standard firefighting procedures and consider the hazards of other involved materials. Move containers from fire area if you can do so without risk. Cool containers / tanks with water spray.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep out of low areas. Wear appropriate protective equipment and clothing during clean-up. Do not breathe mist or vapor. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. See Section 8 of the SDS for Personal Protective Equipment. For personal protection, see section 8 of the SDS.

Methods and materials for containment and cleaning up	Prevent entry into waterways, sewer, basements or confined areas. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb spillage to prevent material damage. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Acidic. Do not mix with alkaline material. Do not breathe mist or vapor. Do not get this material in contact with eyes. Do not get this material in contact with skin. Avoid prolonged exposure. Do not get this material on clothing. Provide adequate ventilation. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. Use care in handling/storage.
Conditions for safe storage, including any incompatibilities	Store locked up. Do not freeze. If frozen, thaw completely and mix thoroughly prior to use. Keep away from strong bases. Store in corrosive resistant container with a resistant inner liner. Store in original tightly closed container. Do not store in steel aluminum containers. Store in a cool, dry place out of direct sunlight. Store away from incompatible materials (see Section 10 of the SDS). Store in accordance with local/regional/national/international regulation. Do not store in aluminum containers.

8. Exposure controls/personal protection

Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product. Adequate ventilation to maintain air contaminants below exposure limits. Good general ventilation should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.

Individual protection measures, such as personal protective equipment

Eye/face protection	Splash proof chemical goggles. Face shield.
Skin protection	
Hand protection	Chemical resistant gloves. The choice of an appropriate glove does not only depend on its material but also on other quality features and is different from one producer to the other. Glove selection must take into account any solvents and other hazards present.
Other	Wear appropriate chemical resistant clothing. Chemical resistant gloves. Rubber or butyl gloves. neoprene gloves Wash off after each use. Replace as necessary.
Respiratory protection	If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn. If air-purifying respirator use is appropriate, use any of the following particulate respirators: N95, N99, N100, R95, R99, R100, P95, P99 or P100. A RESPIRATORY PROTECTION PROGRAM THAT MEETS OSHA'S 29 CFR 1910.134 AND ANSI Z88.2 REQUIREMENTS MUST BE FOLLOWED WHENEVER WORKPLACE CONDITIONS WARRANT A RESPIRATOR'S USE.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary. Not applicable.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Color	Colorless to yellow
Physical state	Liquid
Odor	Mild
pH (concentrated product)	< 1 Neat

pH in aqueous solution	1.4 (5% Solution)
Initial boiling point and boiling range	219 °F (104 °C)
Flash point	> 199 °F (> 93 °C) SETA(CC)
Evaporation rate	Slower than Ether
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	18 mmHg
Vapor pressure temp.	70 °F (21 °C)
Vapor density	< 1
Relative density	1.45
Relative density temperature	70 °F (21 °C)
Solubility(ies)	
Solubility (water)	100 %
Viscosity	85 mPa.s
Viscosity temperature	70 °F (21 °C)
Other information	
Pour point	< -30 °F (< -34 °C)
Specific gravity	1.453
VOC	0 % ESTIMATED

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Protect from freezing.
Incompatible materials	Avoid contact with strong oxidizers. Avoid contact with steel, aluminium, and zinc. Avoid contact with strong bases. Contact with strong bases may cause a violent reaction releasing heat.
Hazardous decomposition products	Oxides of carbon and phosphorus evolved in fire. Oxides of phosphorus. Oxides of carbon evolved in fire.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May cause irritation to the respiratory system.
Skin contact	Causes severe skin burns.
Eye contact	Causes serious eye damage.
Ingestion	Causes digestive tract burns.
Symptoms related to the physical, chemical and toxicological characteristics	Burning pain and severe corrosive skin damage. Causes serious eye damage. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result.

Information on toxicological effects

Acute toxicity

Product	Species	Test Results
DEPOSITROL BL5400 (CAS Mixture)		
Acute		
Dermal		
LD50	Rabbit	> 5000 mg/kg, (Calculated according to GHS additivity formula)
Oral		
LD50	Rat	1878 mg/kg

Product	Species	Test Results
Chronic		
Oral		
NOEL	Rat	0.062 - 1 % diet, 2 Year, (Reversible anemia at 1%)

Components	Species	Test Results
Phosphonic acid, (1-hydroxyethylidene)bis- (CAS 2809-21-4)		
Acute		
Dermal		
LD50	Rabbit	> 7940 mg/kg
Oral		
LD50	Rat	1878 mg/kg
Phosphorous acid(phosphonic acid) (CAS 13598-36-2)		
Acute		
Oral		
LD50	Rat	1720 mg/kg

* Estimates for product may be based on additional component data not shown.

Skin corrosion/irritation Causes severe skin burns and eye damage.

Serious eye damage/eye irritation Causes serious eye damage.

Respiratory or skin sensitization

Respiratory sensitization This product is not expected to cause respiratory sensitization.

Skin sensitization This product is not expected to cause skin sensitization.

Germ cell mutagenicity No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

Carcinogenicity This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

US. National Toxicology Program (NTP) Report on Carcinogens

Not listed.

Reproductive toxicity This product is not expected to cause reproductive or developmental effects.

Specific target organ toxicity - single exposure Not classified.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard Based on available data, the classification criteria are not met. Aspiration of this product may cause the same corrosiveness/irritation impacts as if it were ingested.

Chronic effects Prolonged inhalation may be harmful.

12. Ecological information

Ecotoxicity

Product		Species	Test Results
DEPOSITROL BL5400 (CAS Mixture)			
	EC50	Selenastrum (algae)	39 mg/l, Growth Inhibition, 14 day
			3 mg/l, Growth Inhibition, 96 hour
	Growth LOEL	Fathead Minnow	60 mg/l, Chronic Bioassay, 7 day
	Growth NOEL	Fathead Minnow	30 mg/l, Chronic Bioassay, 7 day
	LC50	Bluegill Sunfish	1440 mg/l, Static Acute Bioassay, 96 hour
		Ceriodaphnia	113 mg/l, Static Renewal Bioassay, 48 hour, (pH adjusted)

Product		Species	Test Results
		Fathead Minnow	3040 mg/l, Static Renewal Bioassay, 96 hour, (pH adjusted)
		Grass Shrimp (Palaemonetes pugio)	2675 mg/l, Static Acute Bioassay, 96 hour
		Midge larvae (Chironomus tentans)	14850 mg/l, Static Acute Bioassay, 48 hour
		Mysid Shrimp	319 mg/l, Static Renewal Bioassay, 48 hour, (pH adjusted)
		Sheepshead Minnow	3630 mg/l, Static Acute Bioassay, 96 hour
	NOEL	Bluegill Sunfish	880 mg/l, Static Acute Bioassay, 96 hour
		Ceriodaphnia	31.3 mg/l, Static Renewal Bioassay, 48 hour, (pH adjusted)
		Fathead Minnow	1370 mg/l, Static Renewal Bioassay, 96 hour, (pH adjusted)
		Sheepshead Minnow	170 mg/l, Static Acute Bioassay, 96 hour
	Reproduction LOEC	Ceriodaphnia	15 mg/l, Chronic Bioassay, 7 day
	Reproduction NOEL	Ceriodaphnia	7.5 mg/l, Chronic Bioassay, 7 day
Aquatic			
Crustacea	LC50	Daphnia magna	755 mg/l, Static Renewal Bioassay, 48 hour, (pH adjusted)
	NOEL	Daphnia magna	420 mg/l, Static Renewal Bioassay, 48 hour, (pH adjusted)
Fish	LC50	Rainbow Trout	610 mg/l, Static Acute Bioassay, 96 hour
	NOEL	Rainbow Trout	250 mg/l, Static Acute Bioassay, 96 hour

Bioaccumulative potential No data available.

Mobility in soil No data available.

Other adverse effects Nutrients: P : 179,4 mg/g, N : 0 mg/g

Persistence and degradability

- COD (mgO2/g)	300
- BOD 5 (mgO2/g)	1
- BOD 28 (mgO2/g)	1
- Closed Bottle Test (% Degradation in 28 days)	0
- Zahn-Wellens Test (% Degradation in 28 days)	33
- TOC (mg C/g)	70
- Modified SCAS	90

13. Disposal considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Incinerate the material under controlled conditions in an approved incinerator. Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Dispose in accordance with all applicable regulations.

Hazardous waste code D002: Waste Corrosive material [pH <=2 or =>12.5, or corrosive to steel]
The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions). Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner.
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

UN number	UN3265
UN proper shipping name	Corrosive liquid, acidic, organic, n.o.s. (Phosphonic Acid,(1-Hydroxyethylidine)Bis- (HEDP))
Transport hazard class(es)	
Class	8
Subsidiary risk	-
Packing group	III
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
ERG number	153

Some containers may be exempt from Dangerous Goods/Hazmat Transport Regulations, please check BOL for exact container classification.

IATA

UN number	UN3265
UN proper shipping name	Corrosive liquid, acidic, organic, n.o.s. (Phosphonic Acid,(1-Hydroxyethylidine)Bis- (HEDP))
Transport hazard class(es)	
Class	8
Subsidiary risk	-
Packing group	III
Environmental hazards	No.
ERG Code	153
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number	UN3265
UN proper shipping name	CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S. (Phosphonic Acid,(1-Hydroxyethylidine)Bis- (HEDP))
Transport hazard class(es)	
Class	8
Subsidiary risk	-
Packing group	III
Environmental hazards	
Marine pollutant	No.
EmS	F-A, S-B
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

DOT

IATA; IMDG

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - Yes
Delayed Hazard - No
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Clean Water Act (CWA) Section 112(r) (40 CFR 68.130) Hazardous substance

Safe Drinking Water Act (SDWA) Not regulated.

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

US state regulations California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins.

US - California Proposition 65 - CRT: Listed date/Carcinogenic substance

No ingredient listed.

US - California Proposition 65 - CRT: Listed date/Developmental toxin

No ingredient listed.

US - California Proposition 65 - CRT: Listed date/Female reproductive toxin

No ingredient listed.

US - California Proposition 65 - CRT: Listed date/Male reproductive toxin

No ingredient listed.

US - Massachusetts RTK - Substance List

Not regulated.

US - Pennsylvania RTK - Hazardous Substances

Not regulated.

US - Rhode Island RTK

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Phosphorous acid(phosphonic acid) (CAS 13598-36-2)	Listed.

US. California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins.

16. Other information, including date of preparation or last revision

Issue date Nov-12-2014

Revision date Dec-15-2017

Version # 4.1

List of abbreviations
CAS: Chemical Abstract Service Registration Number
TWA: Time Weighted Average
STEL: Short Term Exposure Limit
LD50: Lethal Dose, 50%
LC50: Lethal Concentration, 50%
NOEL: No Observed Effect Level
COD: Chemical Oxygen Demand
BOD: Biochemical Oxygen Demand
TOC: Total Organic Carbon
IATA: International Air Transport Association
IMDG: International Maritime Dangerous Goods Code
ACGIH: American Conference of Governmental Industrial Hygienists
TSRN indicates a Trade Secret Registry Number is used in place of the CAS number.

References: No data available

Disclaimer The information in the sheet was written based on the best knowledge and experience currently available. The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Revision information
Hazard(s) identification: Prevention
Hazard(s) identification: Response
Physical & Chemical Properties: Multiple Properties
Transport Information: Material Transportation Information
Other information, including date of preparation or last revision: Prepared by

Prepared by This SDS has been prepared by SUEZ Regulatory Department (1-215-355-3300).

* Trademark of SUEZ. May be registered in one or more countries.

GE
Water & Process Technologies

Material Safety Data Sheet

Issue Date: 06-JUL-2009
Supercedes: 11-MAY-2006

SULFURIC ACID 66 BE CMD

1 Identification

Identification of substance or preparation
SULFURIC ACID 66 BE CMD

Product Application Area
Commodity chemical

Company/Undertaking Identification
GE Betz, Inc.
4636 Somerton Road
Trevose, PA 19053
T 215 355-3300, F 215 953 5524

Emergency Telephone
(800) 877-1940

Prepared by Product Stewardship Group: T 215-355-3300   Prepared on: 06-JUL-2009

2 Hazard(s) identification

****
EMERGENCY OVERVIEW

DANGER

Corrosive to skin. Corrosive to the eyes. Mists/aerosols cause irritation to the upper respiratory tract.

DOT hazard: Corrosive to skin/steel
Odor: Slight Acid; Appearance: Colorless, Liquid

Fire fighters should wear positive pressure self-contained breathing apparatus(full face-piece type). Proper fire-extinguishing media: dry chemical, carbon dioxide or foam--Avoid water if possible.
****

POTENTIAL HEALTH EFFECTS

ACUTE SKIN EFFECTS:
Primary route of exposure; Corrosive to skin.

ACUTE EYE EFFECTS:
Corrosive to the eyes.

ACUTE RESPIRATORY EFFECTS:
Mists/aerosols cause irritation to the upper respiratory tract.

INGESTION EFFECTS:

May cause severe irritation or burning of mouth, throat, and gastrointestinal tract with severe chest and abdominal pain, nausea, vomiting, diarrhea, lethargy and collapse. Possible death when ingested in very large doses.

TARGET ORGANS:
Prolonged or repeated exposures may cause tissue necrosis.

MEDICAL CONDITIONS AGGRAVATED:
Not known.

SYMPTOMS OF EXPOSURE:
Causes severe irritation, burns or tissue ulceration with subsequent scarring.

3 Composition / information on ingredients

Information for specific product ingredients as required by the U.S. OSHA HAZARD COMMUNICATION STANDARD is listed. Refer to additional sections of this MSDS for our assessment of the potential hazards of this formulation.

HAZARDOUS INGREDIENTS:

Cas#	Chemical Name	Range(w/w%)
7664-93-9	SULFURIC ACID Corrosive	60-100

4 First-aid measures

SKIN CONTACT:
URGENT! Wash thoroughly with soap and water. Remove contaminated clothing. Get immediate medical attention. Thoroughly wash clothing before reuse.

EYE CONTACT:
URGENT! Immediately flush eyes with plenty of low-pressure water for at least 20 minutes while removing contact lenses. Hold eyelids apart. Get immediate medical attention.

INHALATION:
Remove to fresh air. If breathing is difficult, give oxygen. If breathing has stopped, give artificial respiration. Get immediate medical attention.

INGESTION:
Do not feed anything by mouth to an unconscious or convulsive victim. Do not induce vomiting. Immediately contact physician. Rinse mouth with plenty of water. Dilute contents of stomach using 4-10 fluid ounces (120-300 mL) of milk or water.

NOTES TO PHYSICIANS:
Material is corrosive. It may not be advisable to induce vomiting. Possible mucosal damage may contraindicate the use of gastric lavage.

5 Fire-fighting measures

FIRE FIGHTING INSTRUCTIONS:
Fire fighters should wear positive pressure self-contained breathing apparatus (full face-piece type).
EXTINGUISHING MEDIA:
dry chemical, carbon dioxide or foam--Avoid water if possible.
HAZARDOUS DECOMPOSITION PRODUCTS:
oxides of sulfur
FLASH POINT:
> 200F   > 93C P-M(CC)
MISCELLANEOUS:
Corrosive to skin/steel
UN 1830;Emergency Response Guide #137

6 Accidental release measures

PROTECTION AND SPILL CONTAINMENT:
Ventilate area. Use specified protective equipment. Contain and absorb on absorbent material. Place in waste disposal container. Flush with water. Spread sand/grit. Neutralize with bicarbonate.
DISPOSAL INSTRUCTIONS:
Water contaminated with this product may be sent to a sanitary sewer treatment facility,in accordance with any local agreement,a permitted waste treatment facility or discharged under a permit. Product as is - Incinerate or land dispose in an approved landfill.

7 Handling and storage

HANDLING:
Acidic. Corrosive to skin and eyes. Do not breathe mist or vapor. Do not mix with alkaline material.
STORAGE:
Keep containers closed when not in use. Use approved containers only. Store in cool, well-vented area. Contact with metals may release flammable hydrogen gas.

8 Exposure controls / personal protection

EXPOSURE LIMITS

CHEMICAL NAME

SULFURIC ACID
PEL (OSHA): 1 MG/M3
TLV (ACGIH): 0.2 MG/M3

ENGINEERING CONTROLS:
Adequate ventilation to maintain air contaminants below exposure limits.
PERSONAL PROTECTIVE EQUIPMENT:
Use protective equipment in accordance with 29CFR 1910 Subpart I
RESPIRATORY PROTECTION:
A RESPIRATORY PROTECTION PROGRAM THAT MEETS OSHA'S 29 CFR 1910.134 AND ANSI Z88.2 REQUIREMENTS MUST BE FOLLOWED WHENEVER WORKPLACE CONDITIONS WARRANT A RESPIRATOR'S USE.
USE AIR PURIFYING RESPIRATORS WITHIN USE LIMITATIONS ASSOCIATED WITH THE EQUIPMENT OR ELSE USE SUPPLIED AIR-RESPIRATORS.
If air-purifying respirator use is appropriate, use a

respirator with acid gas cartridges and dust/mist prefilters.

SKIN PROTECTION:

gauntlet-type neoprene gloves, chemical resistant apron--
Wash off after each use. Replace as necessary.

EYE PROTECTION:

splash proof chemical goggles, face shield

9 Physical and chemical properties

Spec. Grav.(70F,21C)	1.829	Vapor Pressure (mmHG)	< ND
Freeze Point (F)	-17	Vapor Density (air=1)	> 1.00
Freeze Point (C)	-27		
Viscosity(cps 70F,21C)	22	% Solubility (water)	100.0

Odor		Slight Acid
Appearance		Colorless
Physical State		Liquid
Flash Point	P-M(CC)	> 200F > 93C
pH As Is (approx.)		< 1.0
Evaporation Rate (Ether=1)		< 1.00
Percent VOC:		0.0

NA = not applicable   ND = not determined

10 Stability and reactivity

CHEMICAL STABILITY:

Stable under normal storage conditions.

POSSIBILITY OF HAZARDOUS REACTIONS:

Contact with strong bases may cause a violent reaction releasing heat.

INCOMPATIBILITIES:

May react with bases or strong oxidizers.

DECOMPOSITION PRODUCTS:

oxides of sulfur

11 Toxicological information

Oral LD50 RAT:	2,140 mg/kg
Inhalation LC50 RAT:	510 mg/m3/2hr
Skin Irritation Score RABBIT:	CORROSIVE

NOTE - DOT HM181 Packing Group II: corrosive to skin at 60 minutes but not 3 minutes

Eye Irritation Score RABBIT:	CORROSIVE

NOTE - Estimated value

12 Ecological information

AQUATIC TOXICOLOGY

Daphnia magna 48 Hour Static Screen (pH adjusted)
30% Mortality= 5000; 0% Mortality= 2000 mg/L
Fathead Minnow 96 Hour Static Bioassay with 48-Hour Renewal (pH adjusted)
0% Mortality= 5000 mg/L

BIODEGRADATION

No Data Available.

13 Disposal considerations

If this undiluted product is discarded as a waste, the US RCRA hazardous waste identification number is :
D002=Corrosive(pH, steel).

Please be advised; however, that state and local requirements for waste disposal may be more restrictive or otherwise different from federal regulations. Consult state and local regulations regarding the proper disposal of this material.

14 Transport information

DOT HAZARD:	Corrosive to skin/steel
PROPER SHIPPING NAME:	SULFURIC ACID 8, UN 1830, PG II, RQ
DOT EMERGENCY RESPONSE GUIDE #:	137

Note: Some containers may be DOT exempt, please check BOL for exact container classification

15 Regulatory information

TSCA:

All components of this product are included on or are in compliance with the U.S. TSCA regulations.

CERCLA AND/OR SARA REPORTABLE QUANTITY (RQ):

71 gallons due to SULFURIC ACID;

NSF Registered and/or meets USDA (according to 1998 Guidelines):

Registration number: Not Registered

SARA SECTION 312 HAZARD CLASS:

Immediate(acute);Delayed(Chronic);Reactive

SARA SECTION 302 CHEMICALS:

CAS#	CHEMICAL NAME
7664-93-9	SULFURIC ACID

SARA SECTION 313 CHEMICALS:

CAS#	CHEMICAL NAME	RANGE
7664-93-9	SULFURIC ACID	91.0-100.0

CALIFORNIA REGULATORY INFORMATION

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65):

No regulated constituents present

MICHIGAN REGULATORY INFORMATION

No regulated constituent present at OSHA thresholds

16 Other information

HMIS vII		CODE TRANSLATION
Health	3	Serious Hazard
Fire	0	Minimal Hazard
Reactivity	2	Moderate Hazard
Special	CORR	DOT corrosive
(1) Protective Equipment	D	Goggles,Face Shield,Gloves,Apron

(1) refer to section 8 of MSDS for additional protective equipment recommendations.

CHANGE LOG

	EFFECTIVE DATE	REVISIONS TO SECTION:	SUPERCEDES
MSDS status:	18-MAY-1999		** NEW **
	31-JAN-2001	4	18-MAY-1999
	23-MAR-2001	15	31-JAN-2001
	13-DEC-2004	16	23-MAR-2001
	11-MAY-2006	8	13-DEC-2004
	06-JUL-2009	4,5,10	11-MAY-2006

Division for Air Quality Submit to the Regional Office identified in your permit	**DEP7007CC** Compliance Certification ____ Section CC.1: Source Information ____ Section CC.2: Signature Block ____ Section CC.3: Identification of Emission Units & Each Term or Condition of the Permit ____ Section CC.4: Notes, Comments, and Explanations

Section CC.1: Source Information

1) Source Name TVA - Paradise Combined Cycle Plant	**2) Agency Interest (AI) ID** 127687
3) Source Location Address (street, city, state, zip) 5562 Rockport Paradise Road, Drakesboro, KY 42337-2345	
4) Technical Contact (name, e-mail, phone #) Emma Taul, emwethington@tva.gov, 270 - 929 - 3924	

5) Permit Number(s) V-18-056 R2	**6) County** Muhlenberg	**7) KY EIS (AFS) #** 21- 177 - 00006

8) Submittal Information

Are you certifying any requirement(s) as "not in continuous compliance?" ☐ Yes ☑ No **What is the reporting period?** ____ ____ ____ TO ____ ____ ____
mm/ dd/ yy mm/ dd/ yy

Section CC.2: Signature Block

9) CERTIFICATION SIGNATURE

I, THE UNDERSIGNED, HEREBY CERTIFY UNDER PENALTY OF LAW, THAT I AM A RESPONSIBLE OFFICIAL, AND THAT I HAVE PERSONALLY EXAMINED, AND AM FAMILIAR WITH, THE INFORMATION SUBMITTED IN THIS DOCUMENT AND ALL ITS ATTACHMENTS. BASED ON MY INQUIRY OF THOSE INDIVIDUALS WITH PRIMARY RESPONSIBILITY FOR OBTAINING THE INFORMATION, I CERTIFY THAT THE STATEMENTS AND INFORMATION IS ON KNOWLEDGE AND BELIEF, TRUE, ACCURATE, AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE OR INCOMPLETE INFORMATION, INCLUDING THE POSSIBILITY OF FINE OR IMPRISONMENT.

BY: Jim E. Phelps
AUTHORIZED SIGNATURE

6/5/2024
DATE

Jim E. Phelps
TYPED OR PRINTED NAME OF SIGNATORY

Plant Manager
TITLE OF SIGNATORY

Section CC.3: Identification of Emission Units & Each Term or Condition of the Permit

Emission Units in Continuous Compliance

10a) Emission Units in Continuous Compliance. *The following emission units were in continuous compliance with each permit term or condition(s) and applicable requirements listed here, such as emission standards, emission control requirements, emission testing, court requirements, work practices, or enhanced monitoring, based on the compliance methods specified below. If additional space is required, reproduce this page as needed.*

Emission Unit/Permit ID#	Permit Term, Condition, or Applicable Regulation	Emission Unit Description	Permit Limit or requirement	Actual Emissions or status of requirement	The method used for determining compliance over the reporting period, and whether the method provided continuous or intermittent data. *(such as test methods, monitoring procedures, recordkeeping and reporting)*
120-122	40 CFR 60.4333(a)	Combined Cycle Units 1-3 with HRSG and Duct Burners	Minimize emissions at all times including startup, shutdown, and malfunction		Operate and maintain control and monitoring equipment.
120-122	40 CFR 60.4330(a)(2)	Combined Cycle Units 1-3 with HRSG and Duct Burners	0.06 lbs SO_2/MMBtu		Fuel analysis of natural gas indicates no exceedances should occur.
120-122	40 CFR 60.4320(a)	Combined Cycle Units 1-3 with HRSG and Duct Burners	15 ppm NOx at 15% O_2		Vendor guarantee meets these limits.
120-122	40 CFR 60.4335(b)	Combined Cycle Units 1-3 with HRSG and Duct Burners			Install, calibrate, maintain, and operate CEM systems for nitrogen oxides, oxygen or carbon dioxide. Record and report.
120-122	40 CFR 60.4345(c)	Combined Cycle Units 1-3 with HRSG and Duct Burners			Monitor and record fuel burned, net electrical output, duration of startups, and shutdowns, maintenance of control equipment, and current and operational records. Report any excess emissions.
123-125	Permit V-18-056 R2	Simple Cycle Units 1-3	Comply with same requirements above for combined cycle units		
123-125	401 KAR 51:017	Simple Cycle Units 1-3	1,500 hours/yr total operating time for all three units in simple cycle operation		
123-125	401 KAR 52:020	Simple Cycle Units 1-3			Monitor and record number of hours operated in simple cycle operation. Maintain weekly record of CEMs.

137-139	401 KAR 51:017	Simple Cycle Units 5-7	Limit electric generation to 766,000 MWh/CT-year		Monitor gross generation MWh/CT-year based on 12-operating month rolling average. Record startups, shutdowns, and malfunctions including the duration of each occurance.
137-139	40 CFR 60.4333(a)	Simple Cycle Units 5-7	Minimize emissions at all times including startup, shutdown, and malfunction		Operate and maintain control and monitoring equipment.
137-139	40 CFR 60.4330(a)(2)	Simple Cycle Units 5-7	0.06 lbs SO2/MMBtu		Fuel analysis of natural gas indicates no exceedances should occur.
137-139	40 CFR 60.4320(a)	Simple Cycle Units 5-7	15 ppm NOx at 15% O2		Vendor guarantee meets these limits.
137-139	40 CFR 60.4335(b)	Simple Cycle Units 5-7			Install, calibrate, maintain, and operate CEM systems for nitrogen oxides, oxygen or carbon dioxide. Record and report.
137-139	40 CFR 60.4345(c)	Simple Cycle Units 5-7			Monitor and record fuel burned, net electrical output, duration of startups, and shutdowns, maintenance of control equipment, and current and operational records. Report any excess emissions.
107	401 KAR 59:015	Natural Gas-Fired Auxiliary Boiler at CC Plant	PM<0.10 lb/MMBtu; SO2<0.80 lb/MMBtu ; <20% opacity		Burn natural gas.
107	401 KAR 52:020	Natural Gas-Fired Auxiliary Boiler at CC Plant			Monitor and record hours of operation and the amount of fuel combusted monthly.
108-110	401 KAR 59:015	Natural Gas-Fired Gas Heaters at CC Plant	PM<0.10 lb/MMBtu; SO2<0.80 lb/MMBtu ; <20% opacity		Burn natural gas.
108-110	401 KAR 52:020	Natural Gas-Fired Gas Heaters at CC Plant			Monitor and record hours of operation and the amount of fuel combusted monthly.
141-143	401 KAR 59:015	Natural Gas-Fired Gas Heaters at SC Plant	PM<0.30 lb/MMBtu; SO2<0.99 lb/MMBtu ; <20% opacity		Burn natural gas.
141-143	401 KAR 52:020	Natural Gas-Fired Gas Heaters at SC Plant			Monitor and record hours of operation and the amount of fuel combusted monthly.

104, 115, 128, 147-152, 155	40 CFR 63 Subpart ZZZZ	Emergency Two-Way Radio Diesel Engine, Emergency Fire Pump at CC Facility, Propane Emergency Telecom Generator, Coal Yard Runoff Diesels 1 and 2, Gypsum Stilling Pond Diesels 1 and 2, Daniel Run Coal Fines Diesels 1 and 2, GN24 Fuel Tank Diesel Generator	Specifies work practices, operation, maintenance, and recordkeeping for RICE.		
104, 115, 128, 147-152, 155	401 KAR 52:020	Emergency Two-Way Radio Diesel Engine, Emergency Fire Pump at CC Facility, Propane Emergency Telecom Generator, Coal Yard Runoff Diesels 1 and 2, Gypsum Stilling Pond Diesels 1 and 2, Daniel Run Coal Fines Diesels 1 and 2, GN24 Fuel Tank Diesel Generator			Monitor and record hours of operation and the amount of fuel combusted monthly.
115, 147-152, 155	40 CFR 60 Subpart IIII; 40 CFR 60.4207(b)	Emergency Fire Pump at CC Facility, Coal Yard Runoff Diesels 1 and 2, Gypsum Stilling Pond Diesels 1 and 2, Daniel Run Coal Fines Diesels 1 and 2, GN24 Fuel Tank Diesel Generator	< 15 ppm sulfur in fuel oil		
104, 115, 128, 147-152, 155	401 KAR 59:010 Sec3(1)(a)	Emergency Two-Way Radio Diesel Engine, Emergency Fire Pump at CC Facility, Propane Emergency Telecom Generator, Coal Yard Runoff Diesels 1 and 2, Gypsum Stilling Pond Diesels 1 and 2, Daniel Run Coal Fines Diesels 1 and 2, GN24 Fuel Tank Diesel Generator	< 20 percent opacity		
115	40 CFR 60 Subpart IIII; 40 CFR 60.4205(c) Table 4	Emergency Fire Pump at CC Facility	PM < 0.15 g/hp-hr; NOx + HC < 3 g/hp-hr; CO < 2.6g/hp-hr		

128	40 CFR Subpart JJJJ	Propane Emergency Telecom Generator	Comply with emission standards in 40 CFR 60.4231(c) and 40 CFR 60.4233(c)		
147, 148, 150, 151, 152	40 CFR 60 Subpart IIII	Coal Yard Runoff Diesels 1 and 2, Gypsum Stilling Pond Diesel 2, Daniel Run Coal Fines Diesels 1 and 2	PM < 0.3 g/hp-hr; NOx < 3.3 g/hp-hr; CO < 3.7 g/hp-hr; HC < 0.2 g/hp-hr		
149	40 CFR 60 Subpart IIII	Gypsum Stilling Pond Diesel 1	PM < 0.31 lb/MMBtu; NOx < 6.9 g/hp-hr; CO < 0.95 lb/MMBtu; HC < 0.31 lb/MMBtu		
155	40 CFR 60 Subpart IIII	GN24 Fuel Tank Diesel Generator	PM < 0.022 g/hp-hr; NOx < 3.3 g/hp-hr; CO < 4.1 g/hp-hr; HC < 0.2 g/hp-hr		
114	401 KAR 63:010	Mechanical Draft Cooling Towers at CC Facility	No visible fugitive dust emissions beyond property line. Reasonable precautions to prevent particulate becoming airborne.		Drift Eliminators
114	401 KAR 59:010	Mechanical Draft Cooling Towers at CC Facility	< 20 percent opacity; E = 17.31P^0.16		Drift Eliminators
114	401 KAR 52:020	Mechanical Draft Cooling Towers at CC Facility			Monitor and record amount of water processed. Maintain control equipment and record maintenance and operation of control equipment. Report deviations and semi-annual reports.

Section CC.3: Identification of Emission Units & Each Term or Condition of the Permit

Emission Units Subject to Future Compliance Dates

10b) Emission Units Subject to Future Compliance Dates. *The following emission units will achieve compliance on a timely basis and maintain compliance with future compliance dates as they become applicable during the permit term. If additional space is required, reproduce this page as needed.*

Emission Unit/Permit ID#	Future Compliance Schedule	Emission Unit Description	Reason for Future Compliance Date
N/A			

Section CC.3: Identification of Emission Units & Each Term or Condition of the Permit

Emission Units Not in Continuous Compliance

10c)(1) Emission Units Not in Continuous Compliance. *The following emission units were not in continuous compliance with each permit term or condition and applicable requirements listed here, such as emission standards, emission control requirements, emission testing, court requirements, work practices, or enhanced monitoring, based on the compliance methods specified below. If additional space is required, reproduce this page as needed.*

Emission Unit/Permit ID#	Permit Term, Condition, or Applicable Regulation	Emission Unit Description	Permit Limit or Requirement	Actual Emissions or Status of Requirement	The method used for determining compliance over the reporting period, and whether compliance was continuous or intermittent. *(such as test methods, monitoring procedures, recordkeeping and reporting)*
N/A					

Section CC.3: Identification of Emission Units & Each Term or Condition of the Permit

Emission Units Not in Continuous Compliance (continued)

10c)(2) Emission Units Not in Continuous Compliance. *For the emission units and requirements listed in 10c)(1) that were not in continuous compliance since the last reporting period, state the duration, magnitude, and reason or reasons for non-compliance. Each row of 10c)(2) must relate to the corresponding row of 10c)(1). If additional space is required, reproduce this page as needed.*

Emission Unit/Permit ID#	Description of duration, magnitude, and reason(s) for non-compliance and corrective steps taken or planned.
N/A	

TVA TENNESSEE VALLEY AUTHORITY

5562 Rockport Paradise Road, Kentucky 42337

Submitted to dep.gateway.ky.gov/eForms

May 7, 2025

Mr. Michael Kennedy, Director
Kentucky Division for Air Quality
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601

Dear Mr. Kennedy:

TENNESSEE VALLEY AUTHORITY (TVA) – PARADISE COMBINED CYCLE PLANT (PCC) – SOURCE ID NO. 21-177-00006 – TITLE V PERMIT SIGNIFICANT MODIFICATION APPLICATION – INCREASE OF ANNUAL HOURS LIMIT IN SIMPLE CYCLE OPERATIONS

Please find enclosed TVA's Title V permit significant modification application for the Paradise Combined Cycle Plant. This modification proposes to increase the allowable hours provided in Permit V-18-056 R2, Section B, Condition 8b, to be changed from 1,500 hours per year to 6,000 hours per year. The application includes a PSD applicability analysis demonstrating that the project will not exceed the significant emission rates for regulated NSR pollutants. Additionally, it includes a demonstration confirming that the PCC site will continue to qualify as a HAP area source. This is a complete application based on the regulations in effect at the time of submittal. TVA respectfully requests that a permit shield under 401 KAR 52:020, Section 11, be included in the final permit.

If you have questions or need any additional information, please contact Jack Byars at (423) 751-2666 or via email at jgbyars@tva.gov.

Sincerely,

Jim E. Phelps

Jim E. Phelps
Plant Manager
TVA Paradise Combined Cycle Plant

Enclosure

PARADISE COMBINED CYCLE PLANT

APPLICATION FOR SIGNIFICANT MODFICATION TO PERMIT V-18-056 R2

HRSG-BYPASS ANNUAL OPERATIONS

DRAKESBORO, KENTUCKY
MAY 2025

The Tennessee Valley Authority (TVA) operates a combined cycle (CC) facility at the Paradise Combined Cycle Plant (PCC) under 401 KAR 52:020 Air Quality Permit V-18-056 R2. The CC facility consists of the following equipment:

- Three combustion turbine (CT) units with inlet evaporative cooling,
- Three heat recovery steam generators (HRSGs) with duct burners, catalytic oxidation, and selective catalytic reduction (SCR),
- One reheat, condensing steam turbine (ST) generator,
- One natural gas-fired auxiliary boiler,
- Three natural gas-fired dew-point gas heaters,
- One diesel-engine-driven firewater pump, and
- One multiple cell cooling tower.

Each of the three CT units is equipped with a HRSG-bypass stack, which is used infrequently (e.g., HRSG or ST is unavailable). TVA is seeking to relax annual hours attributed to HRSG-bypass operations for each CT. Several studies are included to ensure that existing permit allowances and restrictions will not be undermined.

On October 2014, TVA submitted a significant revision application (i.e., Oct. 2014 SRA) to the TVA Paradise Fossil Plant (PAF) 401 KAR 52:020 Air Quality Permit V-12-041, which incorporated the CC facility and an auxiliary boiler. Baseline actual emissions (BAE) from retirement of the two existing PAF coal fired boilers (i.e., Unit 1 [U1] and Unit 2 [U2]) combined with the PTE from the CC facility and auxiliary boiler were used to determine project emissions. Accounting for the project's emissions was presented in Table 2-4 of the Oct. 2014 SRA and provided in the following table.

Table 1. Difference of Future Potential Emissions [New] and BAE [Retire] (tons/year)

Pollutant	PCC[1] (New)	U3 Aux Blrs (New)	PAF U1+U2[2] (Retire)	Difference (New - Retire)
Carbon Monoxide (CO)	662	343	971	34.0
Nitrogen Oxides (NO_X)	323	159	5,988	-5,505
Sulfur Dioxide (SO_2)	63.4	10.4	34,641	-34,567
Filterable Particulate Matter (FPM)	201	7.00	3,223	-3,015
Filterable PM ≤ 10 microns (FPM_{10})	201	6.75	2,192	-1,984
Filterable PM ≤ 2.5 microns ($FPM_{2.5}$)	201	6.56	1,160	-953
Condensable Particulate Matter (CPM)	82.8	23.7	4,309	-4,203
Volatile Organic Compounds (VOC)	89.6	19.5	214	-105
Lead (Pb)	0.0127	0.00576	0.995	-0.977
Sulfur Trioxide (SO_3) as Sulfuric Acid Mist (H_2SO_4)	1.03	0.781	4,129	-4,127
Carbon Dioxide Equivalent (CO_2e)	3,742,787	482,533	9,717,741	-5,492,422

Notes:
1. PCC includes the CC generation trains (HRSG and HRSG-bypass operations), CC-facility natural gas-fired auxiliary boiler, dew-point gas heaters, emergency diesel firewater pump, and cooling tower.
2. Average of the highest two-year emissions of the past five years (2008 through 2012). The year 2008 was omitted from the NO_X baseline emissions since SCRs were operated only during ozone season.

The change in project emissions (i.e., the "Difference" column in Table 1 herein and in Table 2-4 of the Oct. 2014 SRA) were compared to the Prevention of Significant Deterioration (PSD) significant emission rates (SERs). The comparison was presented in Table 3-1 of the Oct. 2014 SRA and provided in the following table.

Table 2. Project Emissions and PSD SERs (tons/year)

Pollutant	Project Emissions	PSD SER[1]
CO	34.0	100
NO_X	-5,505	40
SO_2	-34,567	40
PM (TSP)[2]	-3,015	25
PM_{10}[3]	-6,187	15
$PM_{2.5}$[3]	-5,156	10
VOC	-105	40
Pb	-0.977	0.6
H_2SO_4	-4,127	7
CO_2e	-5,492,422	75,000

Notes:
1. 401 KAR 51:001, Section 1(218)(a)
2. *TSP* denotes "Total Suspended Particulate" as defined by 401 KAR 51:001, Section 1(236). Table 3-1 of the Oct. 2014 SRA incorrectly includes CPM with the TSP. This table corrects that error.
3. PM_{10}/$PM_{2.5}$ includes filterable and condensable particulate matter as required by 401 KAR 51:001, Section 1(207)(b)e.

Increases from the proposed project were below each SER; therefore, a PSD analysis was not applicable.

The CC facility's potential emissions used in the Oct. 2014 SRA are based, in part, on predicted annual hours associated with each CT's operations via the HRSG-bypass stack. The predicted annual hours used are provided in 401 KAR 52:020 Air Quality Permit V-18-056 R2, Section B, Condition 8b, where HRSG-bypass stack operations are identified as "Simple Cycle Operations":

> The facility shall utilize the alternate operating scenario (Simple Cycle Operations) no longer than a total of 1,500 hours per year for all three units including startup and shutdown periods. The permittee is not obligated to split the total hours of operation between the three combustion turbines equally [to preclude the applicability of Sections 8 to 14 of 401 KAR 51:017].
>
> *Compliance Demonstration:* The facility shall monitor the number of hours the combustion turbines operate in simple cycle mode [401 KAR 52:020, Section 10].

Due to unexpected operational needs, TVA seeks to relax the "total of 1,500 hours per year for all three units" to allow a total of 6,000 hours per year for all three units (i.e., 22.8% of a calendar year per HRSG-bypass stack). The proposed 6,000 total hours per year for HRSG-bypass stack operations, with the balance annual hours dedicated to 100% duct-firing HRSG stack operations, produces a different emissions profile for the CC facility (see Table 3 and the "air" spreadsheet provided in Appendix A).

Table 3. Revised Table 1 to Reflect 6,000 Hours/Year of HRSG-Bypass (tons/year)

Pollutant	PCC (New)	U3 Aux Blrs (New)	PAF U1+U2 (Retire)	Difference (New - Retire)
CO	725	343	971	97.0
NO_X	464	159	5,988	-5,365
SO_2	70.5	10.4	34,641	-34,560
FPM	225	7.00	3,223	-2,991
FPM_{10}	225	6.75	2,192	-1,960
$FPM_{2.5}$	225	6.56	1,160	-928
CPM	58	23.7	4,309	-4,227
VOC	98.4	19.5	214	-96.1
Pb	0.0132	0.00576	0.995	-0.976
H_2SO_4	2.13	0.781	4,129	-4,126
CO_2e	3,882,347	482,533	9,717,741	-5,352,861

The following table compares the proposed change to each PSD SER. The proposed change to HRSG-bypass operational hours will not prompt a PSD analysis.

Table 4. Revised Project Emissions and PSD SERs (tons/year)

Pollutant	Project Emissions	PSD SER[1]
CO	97.0	100
NO_X	-5,365	40
SO_2	-34,560	40
PM (TSP)[2]	-2,991	25
PM_{10}[3]	-6,187	15
$PM_{2.5}$[3]	-5,155	10
VOC	-96.1	40
Pb	-0.976	0.6
H_2SO_4	-4,126	7
CO_2e	-5,352,861	75,000

Notes:
1. 401 KAR 51:001, Section 1(218)(a)
2. *TSP* denotes "Total Suspended Particulate" as defined by 401 KAR 51:001, Section 1(236).
3. PM_{10}/$PM_{2.5}$ includes filterable and condensable particulate matter as required by 401 KAR 51:001, Section 1(207)(b)e.

CC facility HAP emissions change with the proposed increase in HRSG-bypass operations (see Table 5 and the "air" spreadsheet provided in Appendix A). However, CC facility operations described in the Oct. 2014 SRA combined with the remaining emission units already resulted in the site being designated as a major HAP source.

Table 5. Change in CC Facility HAP Emissions (tons/year)

HAP	CAS RN	Proposed[1]	Oct. 2014 SRA[2]	Difference (Proposed - SRA)
Lead	--	1.32E-02	1.27E-02	+0.05
Formaldehyde	50-00-0	4.40E+00	4.24E+00	+0.16
Organic[3]	--	1.47E+01	1.41E+01	+0.6
Total[4]	--	1.48E+01	1.43E+01	+0.5

Notes:
1. "Proposed" HAP emissions are associated with 6,000 total hours/year of HRSG-bypass operations.
2. "Oct. 2014 SRA" HAP emissions are associated with 1,500 total hours/year of HRSG-bypass operations.
3. "Organic" is total organic HAP emissions.
4. "Total" HAP emissions based on the total organic HAP emissions and total trace-element HAP emissions (e.g., HAP metals, HCl, HF).

Regarding current emission units under 401 KAR 52:020 Air Quality Permit V-18-056 R2, the following table presents PCC site-wide HAP emissions attributed to the proposed change in HRSG-bypass stack hours (see Table 6 and the "PCC HAP PTE_2k Bypass" spreadsheet provided in Appendix A).

Table 6. PCC Site Wide HAP Emissions (tons/year): 6,000 Bypass-hours/CT-year

HAP	CAS RN	CC HAP	SC HAP	Aux HAP	PCC HAP[1]
Formaldehyde[2]	50-00-0	7.16E+00	2.49E+00	1.45E-02	9.67E+00
Total[3]	--	1.76E+01	6.12E+00	5.38E-02	2.38E+01

Notes:

1. PCC site-wide HAP emissions ("PCC HAP" column) include the following:
   a. CC facility ("CC HAP" column) with 6,000 hours/year (i.e., ~22.8% of a calendar year per unit) HRSG-bypass stack operations and the balance hours on the HRSG-stack operations with 100% duct firing and ancillary CC equipment.
   b. SC (Simple Cycle) facility ("SC HAP" column) with the three GE 7F.05 simple cycles operating via the 40 CFR 60 Subpart TTTT generation restriction and ancillary SC equipment.
   c. Auxiliary equipment ("Aux HAP") includes stationary RICE used for various site activities or site support but not tied specifically to the CC facility or SC facility. For lists of emission units, see "PCC HAP PTE_2k Bypass" spreadsheet. TVA records indicate Emission Units 144-146 (Red Water Pond diesels), Emission Unit 153 (ESS Shop Diesel Generator), and Emission Unit 154 (GN23 Generator for Scale) have been removed from service.
2. Formaldehyde is the highest individual HAP.
3. "Total" HAP emissions based on the total organic HAP emissions and total trace-element HAP emissions (e.g., HAP metals, HCl, HF).

The proposed change in HRSG-bypass stack hours does not change conclusions of the PSD SER analysis associated with the Oct. 2014 SRA and does not change PCC's HAP designation under 401 KAR 52:020 Air Quality Permit V-18-056 R2.

TVA proposes the following change to Section B, Condition 8b of the 401 KAR 52:020 Air Quality Permit V-18-056 R2:

> The facility shall utilize the alternate operating scenario (Simple Cycle Operations) no longer than a total of 6,000 hours per year (based on a 12-month rolling total) for all three units including startup and shutdown periods. The permittee is not obligated to split the total hours of operation between the three combustion turbines equally [to preclude the applicability of Sections 8 to 14 of 401 KAR 51:017].
>
> *Compliance Demonstration:* The facility shall monitor the number of hours the combustion turbines operate in simple cycle mode [401 KAR 52:020, Section 10].

To complete the HAP PTE study, CC facility emissions for 8,760 hours of only HRSG-stack operations while duct firing are considered. Continuous operations of the CC trains while duct firing along with the allowed operation of the other PCC emission units produce the most extreme operating PTE (i.e., "worst case" PTE) scenario. The "worst case" PTE does not exceed major-source HAP thresholds (see Table 7 and the "PCC HAP PTE_HRSG" spreadsheet provided in Appendix A).

Table 7. PCC Site Wide HAP Emissions (tons/year) – Worst Case PTE

HAP	CAS RN	CC HAP	SC HAP	Aux HAP	PCC HAP[1]
Formaldehyde[2]	50-00-0	7.36E+00	2.49E+00	1.45E-02	9.87E+00
Total[3]	--	1.81E+01	6.12E+00	5.38E-02	2.43E+01

Notes:

1. PCC site-wide HAP emissions ("PCC HAP" column) include the following:
   a. CC facility ("CC HAP" column) with 8,760 hours/CT-year HRSG-stack operations with 100% duct firing and ancillary CC equipment.
   b. SC (Simple Cycle) facility ("SC HAP" column) with the three GE 7F.05 simple cycles operating via the 40 CFR 60 Subpart TTTT generation restriction and ancillary SC equipment.
   c. Auxiliary equipment ("Aux HAP") includes stationary RICE used for various site activities or site support but not tied specifically to the CC facility or SC facility. For lists of emission units, see "PCC HAP PTE_2k Bypass" spreadsheet. TVA records indicate Emission Units 144-146 (Red Water Pond diesels), Emission Unit 153 (ESS Shop Diesel Generator), and Emission Unit 154 (GN23 Generator for Scale) have been removed from service.
2. Formaldehyde is the highest individual HAP.
3. "Total" HAP emissions based on the total organic HAP emissions and total trace-element HAP emissions (e.g., HAP metals, HCl, HF).

Along with the spreadsheets mentioned, changes to the applicable 401 KAR 52:020 forms are provided in Appendix B.

APPENDIX A

SPREADSHEETS

PARADISE COMBINED CYCLE PLANT
Potential-To-Emit (tons/year)

EP&C Air Programs Support
Date: 17-Oct-14
Bypass Rev: 30-Apr-25

Table 1. General

Parameter	Note	Simple-Cycle (HRSG-Bypass)				Combined-Cycle (HRSG)				Auxiliary	Gas	Fire	Cooling	CT Plant	U3 Aux	Project
		Routine	Startup/SD	SC Total	% SU/SD	Routine	Startup/SD	CC Total	% SU/SD	Boiler	Heaters	Pump	Tower	Total	Boilers	Total
Natural Gas Annual Operating Hours per Unit		2,000				6,760				8,760	8,760				7,760	
Startup / Shutdowns			210				210									
No. 2 Fuel Oil Annual Operating Hours per Unit												50			1,000	
Startup / Shutdowns																
Miscellaneous Annual Operating Hours per Unit													8,760			

Table 2. Criteria / Non-HAP Pollutants

Pollutant		Note	3 Simple-Cycle (HRSG-Bypass)				3 Combined-Cycle (HRSG)				Auxiliary	3 Gas	Fire	Cooling	CC Plant	U3 Aux	Project
	(Abbrev.)		Routine	Startup/SD	SC Total	% SU/SD	Routine	Startup/SD	CC Total	% SU/SD	Boiler	Heaters	Pump	Tower	Total	Boilers	Total
Filterable Particulate Matter	FPM		2.70E+01	1.71E+00	2.87E+01	5.94	1.52E+02	3.98E+00	1.56E+02	2.55	3.50E+00	1.20E+00	2.27E-03	3.55E+01	2.25E+02	7.00E+00	2.32E+02
FPM < 10-micrometer aero. dia.	FPM10		2.70E+01	1.71E+00	2.87E+01	5.94	1.52E+02	3.98E+00	1.56E+02	2.55	3.50E+00	1.20E+00	2.27E-03	3.55E+01	2.25E+02	6.75E+00	2.32E+02
FPM < 2.5-micrometer aero. dia.	FPM2.5		2.70E+01	1.71E+00	2.87E+01	5.94	1.52E+02	3.98E+00	1.56E+02	2.55	3.50E+00	1.20E+00	2.27E-03	3.55E+01	2.25E+02	6.56E+00	2.32E+02
Condensable Particulate Matter	CPM		2.70E+01	1.47E-01	2.71E+01	0.543	2.77E+01	6.05E-01	2.83E+01	2.14	1.96E+00	6.68E-01	8.53E-05		5.80E+01	2.37E+01	8.17E+01
Sulfur Dioxide	SO2		1.93E+01	2.53E-01	1.95E+01	1.30	4.92E+01	4.77E-01	4.97E+01	0.961	9.79E-01	3.34E-01	6.90E-05		7.05E+01	1.04E+01	8.10E+01
Nitrogen Oxides	NOX		2.18E+02	8.73E+00	2.26E+02	3.86	2.01E+02	1.72E+01	2.18E+02	7.89	1.28E+01	7.32E+00	4.39E-02		4.64E+02	1.59E+02	6.24E+02
Carbon Monoxide	CO		1.05E+02	1.16E+02	2.21E+02	52.3	1.53E+02	3.03E+02	4.56E+02	66.5	3.89E+01	8.91E+00	1.32E-02		7.25E+02	3.43E+02	1.07E+03
Volatile Organic Compounds	VOC		1.03E+01	2.54E+00	1.28E+01	19.8	7.00E+01	1.19E+01	8.19E+01	14.5	1.89E+00	1.78E+00	1.59E-03		9.83E+01	1.95E+01	1.18E+02
Sulfuric Acid	H2SO4		1.55E+00	2.04E-02	1.57E+00	1.30	4.39E-01	1.10E-02	4.50E-01	2.45	7.89E-02	2.69E-02	5.56E-06		2.13E+00	7.81E-01	2.91E+00
Ammonia	NH3		0.00E+00	0.00E+00	0.00E+00	0.00	1.86E+02	1.19E+00	1.87E+02	0.636					1.87E+02		1.87E+02
Carbon Dioxide	CO2		782,772	10,282	793,054	1.30	3,004,115	26,189	3,030,303	0.864	40,989	13,987	8		3,878,342	481,859	4,360,201
Methane	CH4		1.48E+01	1.94E-01	1.49E+01	1.30	5.66E+01	4.94E-01	5.71E+01	0.865	7.72E-01	2.64E-01	3.18E-04		7.31E+01	1.07E+01	8.38E+01
Nitrous Oxide	N2O		1.48E+00	1.94E-02	1.49E+00	1.30	5.66E+00	4.94E-02	5.71E+00	0.865	7.72E-02	2.64E-02	6.37E-05		7.31E+00	1.37E+00	8.67E+00
Greenhse Gas (GHG), as CO2 Equiv.	CO2e		783,581	10,293	793,874	1.30	3,007,218	26,216	3,033,433	0.864	41,031	14,002	8		3,882,348	482,533	4,364,880

Table 3. Trace-Element Pollutants

Pollutant		Note	3 Simple-Cycle (HRSG-Bypass)				3 Combined-Cycle (HRSG)				Auxiliary	3 Gas	Fire	Cooling	CC Plant	U3 Aux	Project
	(Symbol)		Routine	Startup/SD	SC Total	% SU/SD	Routine	Startup/SD	CC Total	% SU/SD	Boiler	Heaters	Pump	Tower	Total	Boilers	Total
Antimony	Sb	HAP	1.20E-03		1.20E-03		4.62E-03		4.62E-03		6.31E-05	2.15E-05	1.06E-06		5.91E-03	1.05E-02	1.64E-02
Arsenic	As	HAP	1.54E-03		1.54E-03		5.91E-03		5.91E-03		6.87E-05	2.34E-05	5.29E-07		7.54E-03	2.48E-03	1.00E-02
Beryllium	Be	HAP	6.69E-05		6.69E-05		2.57E-04		2.57E-04		4.12E-06	1.41E-06	1.49E-08		3.29E-04	1.39E-03	1.72E-03
Cadmium	Cd	HAP	2.68E-04		2.68E-04		1.03E-03		1.03E-03		3.78E-04	1.29E-04	2.31E-07		1.80E-03	5.12E-03	6.92E-03
Hydrogen Chloride	HCl	HAP	0.00E+00		0.00E+00		0.00E+00		0.00E+00				1.50E-05		1.50E-05	1.40E-01	1.40E-01
Chromium	Cr	HAP	7.36E-03		7.36E-03		2.82E-02		2.82E-02		4.81E-04	1.64E-04	5.29E-07		3.63E-02	6.14E-03	4.24E-02
Cobalt	Co	HAP	5.35E-04		5.35E-04		2.05E-03		2.05E-03		2.89E-05	9.85E-06	4.38E-07		2.63E-03	4.38E-03	7.01E-03
Hydrogen Fluoride	HF	HAP															
Lead	Pb	HAP	2.68E-03		2.68E-03		1.03E-02		1.03E-02		1.72E-04	5.86E-05	6.74E-07		1.32E-02	5.76E-03	1.89E-02
Manganese	Mn	HAP	2.68E-03		2.68E-03		1.03E-02		1.03E-02		1.31E-04	4.45E-05	4.85E-06		1.31E-02	4.00E-03	1.71E-02
Mercury	Hg	HAP	5.35E-06		5.35E-06		2.05E-05		2.05E-05		8.93E-05	3.05E-05	5.78E-08		1.46E-04	2.24E-03	2.39E-03
Nickel	Ni	HAP	1.61E-02		1.61E-02		6.16E-02		6.16E-02		7.21E-04	2.46E-04	2.21E-07		7.87E-02	8.54E-03	8.72E-02
Selenium	Se	HAP	1.34E-04		1.34E-04		5.14E-04		5.14E-04		8.24E-06	2.81E-06	1.20E-06		6.60E-04	6.83E-03	7.49E-03

Note:
HAP This abbreviation denotes "Hazardous Air Pollutant."

Table 4. Organic HAP / Compounds

Pollutant		Note	3 Simple-Cycle (HRSG-Bypass)				3 Combined-Cycle (HRSG)				Auxiliary	3 Gas	Fire	Cooling	CC Plant	U3 Aux	Project
	(CASRN)		Routine	Startup/SD	SC Total	% SU/SD	Routine	Startup/SD	SC Total	% SU/SD	Boiler	Heaters	Pump	Tower	Total	Boilers	Total
1,1,1-Trichloroethane	71-55-6	HAP														7.59E-04	7.59E-04
1,3-Butadiene	106-99-0	HAP	2.88E-03		2.88E-03		1.10E-02		1.10E-02				1.88E-06		1.39E-02		1.39E-02
2-Methylnaphthalene	91-57-6	POM									8.24E-06	2.81E-06			1.11E-05	8.22E-05	9.32E-05
3-Methylcholanthrene	56-49-5	PAC									6.18E-07	2.11E-07			8.29E-07	6.16E-06	6.99E-06
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC									5.50E-06	1.88E-06			7.37E-06	5.48E-05	6.21E-05
Acenaphthene	83-32-9	POM									6.18E-07	2.11E-07	6.83E-08		8.98E-07	7.40E-05	7.49E-05
Acenaphthylene	208-96-8	POM									6.18E-07	2.11E-07	2.44E-07		1.07E-06	6.98E-06	8.05E-06
Acetaldehyde	75-07-0	HAP	2.68E-01		2.68E-01		1.03E+00		1.03E+00				3.69E-05		1.29E+00		1.29E+00
Acrolein	107-02-8	HAP	4.28E-02		4.28E-02		1.64E-01		1.64E-01				4.45E-06		2.07E-01		2.07E-01
Anthracene	120-12-7	POM									8.24E-07	2.81E-07	9.00E-08		1.20E-06	1.21E-05	1.33E-05
Benzene	71-43-2	HAP	8.03E-02		8.03E-02		3.08E-01		3.08E-01		7.21E-04	2.46E-04	4.49E-05		3.89E-01	7.88E-03	3.97E-01
Benzo(a)anthracene	56-55-3	PAC									6.18E-07	2.11E-07	8.09E-08		9.10E-07	1.91E-05	2.00E-05
Benzo(a)pyrene	50-32-8	PAC									4.12E-07	1.41E-07	9.05E-09		5.62E-07	4.11E-06	4.67E-06
Benzo(b)fluoranthene	205-99-2	PAC									6.18E-07	2.11E-07	4.77E-09		8.34E-07	1.09E-05	1.18E-05
Benzo(g,h,i)perylene	191-24-2	POM									4.12E-07	1.41E-07	2.35E-08		5.76E-07	1.14E-05	1.19E-05
Benzo(k)fluoranthene	207-08-9	PAC									6.18E-07	2.11E-07	7.46E-09		8.37E-07	1.09E-05	1.18E-05
Chrysene	218-01-9	PAC									6.18E-07	2.11E-07	1.70E-08		8.46E-07	1.38E-05	1.47E-05
Dibenzo(a,h)anthracene	53-70-3	PAC									4.12E-07	1.41E-07	2.81E-08		5.81E-07	9.48E-06	1.01E-05
Dichlorobenzene [mixed isomers]	25321-22-6	HAP									4.12E-04	1.41E-04			5.53E-04	4.11E-03	4.66E-03
Ethylbenzene	100-41-4	HAP	2.14E-01		2.14E-01		8.22E-01		8.22E-01						1.04E+00	2.04E-04	1.04E+00
Fluoranthene	206-44-0	PAC									1.03E-06	3.52E-07	3.66E-07		1.75E-06	2.58E-05	2.76E-05
Fluorene	86-73-7	POM									9.62E-07	3.28E-07	1.41E-06		2.70E-06	2.40E-05	2.66E-05
Formaldehyde	50-00-0	HAP	9.03E-01		9.03E-01		3.47E+00		3.47E+00		2.58E-02	8.79E-03	5.68E-05		4.40E+00	4.53E-01	4.86E+00
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC									6.18E-07	2.11E-07	1.80E-08		8.47E-07	1.30E-05	1.39E-05
Naphthalene	91-20-3	HAP	8.70E-03		8.70E-03		3.34E-02		3.34E-02		2.10E-04	7.15E-05	4.08E-06		4.24E-02	5.72E-03	4.81E-02
n-Hexane	110-54-3	HAP									1.48E-04	5.04E-05			1.98E-04	1.47E-03	1.67E-03
Phenanthrene	85-01-8	POM									5.84E-06	1.99E-06	1.41E-06		9.25E-06	9.20E-05	1.01E-04
Propylene Oxide	75-56-9	HAP	1.94E-01		1.94E-01		7.45E-01		7.45E-01						9.39E-01		9.39E-01
Pyrene	129-00-0	POM									1.72E-06	5.86E-07	2.30E-07		2.53E-06	3.08E-05	3.33E-05
Toluene	108-88-3	HAP	8.70E-01		8.70E-01		3.34E+00		3.34E+00		1.17E-03	3.99E-04	1.97E-05		4.21E+00	3.16E-02	4.24E+00
Xylenes	1330-20-7	HAP	4.28E-01		4.28E-01		1.64E+00		1.64E+00				1.37E-05		2.07E+00	3.50E-04	2.07E+00
Polycyclic Aromatic Compounds	PAC										1.11E-05	3.77E-06	5.31E-07		1.54E-05	1.68E-04	1.83E-04
Polycyclic Organic Matter	POM	HAP	1.47E-02		1.47E-02		5.65E-02		5.65E-02		3.03E-05	1.03E-05	4.01E-06		7.13E-02	1.09E-02	8.22E-02
Organic HAP Total	--		3.03E+00		3.03E+00		1.16E+01		1.16E+01		2.85E-02	9.71E-03	1.86E-04		1.47E+01	5.16E-01	1.52E+01
Gaseous HAP Total (w/o HCl, HF)	--		3.03E+00		3.03E+00		1.16E+01		1.16E+01		2.86E-02	9.74E-03	1.88E-04		1.47E+01	5.25E-01	1.52E+01
Total HAP	--				3.06E+00				1.17E+01		3.06E-02	1.04E-02	2.11E-04		1.48E+01		

Notes:
HAP This abbreviation denotes "Hazardous Air Pollutant."
PAC This abbreviation denotes "Polycyclic Aromatic Compounds" (PAC). Although the PAC group is not identified as a Clean Air Act Section 112(b) HAP, it is reportable for Emergency Planning and Community Right-to-Know Act (EPCRA) Section 313 (i.e., Toxic Release Inventory [TRI]).
POM This abbreviation denotes "Polycyclic Organic Matter" (POM), which is broad class of organic compounds that includes Polycyclic Aromatic Hydrocarbons (PAH) and Polycyclic Aromatic Compounds (PAC). The POM group is defined as a HAP.

PARADISE HAP DETERMINATION

		Total tons/yr
Maximum Individual HAP:	Formaldehyde -	9.67E+00
Total HAP:		2.38E+01

CT Parameters	CT Note	Emission Units 120-122 CC 1-3: GE 7FA.05 (w/o Duct Brnr) Natrl Gas	No. 2 Oil	Units	Emission Units 120-122 CC 1-3: GE 7FA.05 (w/ Duct Brnr) Natrl Gas	No. 2 Oil	Units	Emission Units 123-125 CT 1-3: GE 7FA.05 (HRSG-Bypass) Natrl Gas	No. 2 Oil	Units	Emission Units 137-139 CT 5-7: GE 7F.05 (Simple Cycle) Natrl Gas	No. 2 Oil	Units
Number of Units:		3			3			3			3		
Generation Capacity:	1,2	343.3		MW/Train	380.0		MW/Train	223.3		MW/CT	229.0		MW/CT
Ht Input per CT:	1,2	2,231		10^6 Btu/hr	2,533		10^6 Btu/hr	2,231		10^6 Btu/hr	2,257		10^6 Btu/hr
Annual Capacity Limit:	1,2	0.0		%	77.2		%	22.8		%	38		%
Annual Genratn Limit:		0		MWh/yr	7,705,724		MWh/yr	1,339,800		MWh/yr	2,286,886		MWh/yr

CT Note [1]: EU 120-125 - "PAC Permit Application 20141017.pdf" performance at 59 deg. F. CT Note [2]: EU 137-139 - Permit V-18-056 R2

Table 1. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Total tons/yr	Emssn Fctr, lb/10^6 Btu Natrl Gas	No. 2 Oil	CT Note	Annual, tons/yr Natrl Gas	No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	No. 2 Oil	Max Ann., tons/yr
Antimony	Sb	HAP	7.98E-03	1.80E-07			0.00E+00		0.00E+00	4.62E-03		4.62E-03	1.20E-03		1.20E-03	2.03E-03		2.03E-03
Arsenic	As	HAP	1.03E-02	2.30E-07			0.00E+00		0.00E+00	5.91E-03		5.91E-03	1.54E-03		1.54E-03	2.59E-03		2.59E-03
Beryllium	Be	HAP	4.48E-04	1.00E-08			0.00E+00		0.00E+00	2.57E-04		2.57E-04	6.69E-05		6.69E-05	1.13E-04		1.13E-04
Cadmium	Cd	HAP	2.52E-03	4.00E-08			0.00E+00		0.00E+00	1.03E-03		1.03E-03	2.68E-04		2.68E-04	4.51E-04		4.51E-04
Chlorine as HCl	HCl	HAP	3.98E-03						0.00E+00			0.00E+00			0.00E+00			0.00E+00
Chromium	Cr	HAP	4.91E-02	1.10E-06			0.00E+00		0.00E+00	2.83E-02		2.83E-02	7.36E-03		7.36E-03	1.24E-02		1.24E-02
Cobalt	Co	HAP	3.66E-03	8.00E-08			0.00E+00		0.00E+00	2.05E-03		2.05E-03	5.35E-04		5.35E-04	9.02E-04		9.02E-04
Lead	Pb	HAP	1.80E-02	4.00E-07			0.00E+00		0.00E+00	1.03E-02		1.03E-02	2.68E-03		2.68E-03	4.51E-03		4.51E-03
Manganese	Mn	HAP	1.90E-02	4.00E-07			0.00E+00		0.00E+00	1.03E-02		1.03E-02	2.68E-03		2.68E-03	4.51E-03		4.51E-03
Mercury	Hg	HAP	2.18E-04	8.00E-10			0.00E+00		0.00E+00	2.05E-05		2.05E-05	5.35E-06		5.35E-06	9.02E-06		9.02E-06
Nickel	Ni	HAP	1.06E-01	2.40E-06			0.00E+00		0.00E+00	6.16E-02		6.16E-02	1.61E-02		1.61E-02	2.70E-02		2.70E-02
Selenium	Se	HAP	1.21E-03	2.00E-08			0.00E+00		0.00E+00	5.14E-04		5.14E-04	1.34E-04		1.34E-04	2.25E-04		2.25E-04

Table 2. Organic HAP Emission Estimates

Pollutant	(CASRN)	Note	Total tons/yr	Emssn Fctr, lb/10^6 Btu Natrl Gas	No. 2 Oil	CT Note	Annual, tons/yr Natrl Gas	No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene	106-99-0	HAP	1.93E-02	4.30E-07			0.00E+00		0.00E+00	1.10E-02		1.10E-02	2.88E-03		2.88E-03	4.85E-03		4.85E-03
2-Methylnaphthalene	91-57-6	POM	7.09E-03	1.62E-07			0.00E+00		0.00E+00	4.16E-03		4.16E-03	1.08E-03		1.08E-03	1.83E-03		1.83E-03
3-Methylcholanthrene	56-49-5	PAC	1.16E-06															
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC	1.03E-05															
Acenaphthene	83-32-9	POM	1.93E-05															
Acenaphthylene	208-96-8	POM	6.60E-05															
Acetaldehyde	75-07-0	HAP	1.76E+00	4.00E-05			0.00E+00		0.00E+00	1.03E+00		1.03E+00	2.68E-01		2.68E-01	4.51E-01		4.51E-01
Acrolein	107-02-8	HAP	2.81E-01	6.40E-06			0.00E+00		0.00E+00	1.64E-01		1.64E-01	4.28E-02		4.28E-02	7.21E-02		7.21E-02
Anthracene	120-12-7	POM	2.55E-05															
Benzene	71-43-2	HAP	5.37E-01	1.20E-05			0.00E+00		0.00E+00	3.08E-01		3.08E-01	8.03E-02		8.03E-02	1.35E-01		1.35E-01
Benzo(a)anthracene	56-55-3	PAC	2.27E-05															
Benzo(a)pyrene	50-32-8	PAC	3.18E-06															
Benzo(b)fluoranthene	205-99-2	PAC	2.43E-06															
Benzo(g,h,i)perylene	191-24-2	POM	7.04E-06															
Benzo(k)fluoranthene	207-08-9	PAC	3.15E-06															
Chrysene	218-01-9	PAC	5.68E-06															
Dibenzo(a,h)anthracene	53-70-3	PAC	8.24E-06															
Dichlorobenzene [mixed isomers]	25321-22-6	HAP	7.76E-04															
Ethylbenzene	100-41-4	HAP	1.40E+00	3.20E-05			0.00E+00		0.00E+00	8.22E-01		8.22E-01	2.14E-01		2.14E-01	3.61E-01		3.61E-01
Fluoranthene	206-44-0	PAC	9.94E-05															
Fluorene	86-73-7	POM	3.76E-04															
Formaldehyde	50-00-0	HAP	9.67E+00	2.20E-04			0.00E+00		0.00E+00	5.65E+00		5.65E+00	1.47E+00		1.47E+00	2.48E+00		2.48E+00
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC	5.96E-06															
Naphthalene	91-20-3	HAP	5.82E-02	1.30E-06			0.00E+00		0.00E+00	3.34E-02		3.34E-02	8.70E-03		8.70E-03	1.47E-02		1.47E-02
n-Hexane	110-54-3	HAP	2.78E-04															
Phenanthrene	85-01-8	POM	5.23E-03	1.11E-07			0.00E+00		0.00E+00	2.85E-03		2.85E-03	7.43E-04		7.43E-04	1.25E-03		1.25E-03
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.60E-02	2.20E-06			0.00E+00		0.00E+00	5.65E-02		5.65E-02	1.47E-02		1.47E-02	2.48E-02		2.48E-02
Propylene Oxide	75-56-9	HAP	1.27E+00	2.90E-05			0.00E+00		0.00E+00	7.45E-01		7.45E-01	1.94E-01		1.94E-01	3.27E-01		3.27E-01
Pyrene	129-00-0	POM	6.44E-05															
Toluene	108-88-3	HAP	5.68E+00	1.30E-04			0.00E+00		0.00E+00	3.34E+00		3.34E+00	8.70E-01		8.70E-01	1.47E+00		1.47E+00
Xylenes	1330-20-7	HAP	2.80E+00	6.40E-05			0.00E+00		0.00E+00	1.64E+00		1.64E+00	4.28E-01		4.28E-01	7.21E-01		7.21E-01
Polycyclic Aromatic Compounds	PAC	PAH	1.62E-04				0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00		0.00E+00
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.62E-02				0.00E+00		0.00E+00	5.65E-02		5.65E-02	1.47E-02		1.47E-02	2.48E-02		2.48E-02
Polycyclic Organic Matter	POM	HAP	1.09E-01				0.00E+00		0.00E+00	6.35E-02		6.35E-02	1.66E-02		1.66E-02	2.79E-02		2.79E-02
Organic HAP Total	--		2.36E+01				0.00E+00		0.00E+00	1.38E+01		1.38E+01	3.60E+00		3.60E+00	6.06E+00		6.06E+00

PARADISE HAP DETERMINATION

		Total tons/yr
Maximum Individual HAP:	Formaldehyde -	9.67E+00
Total HAP:		2.38E+01

Emission Unit 107

Aux Blr Parameters	AB Note	CC Auxiliary Boiler Natrl Gas	No. 2 Oil	Units
Number of Units:	1	1		
Natrl Gas Heat Content:		1,020		Btu/scf
Ht Input per Boiler:	1	80		10^6 Btu/hr
Annual Hours:	1	8,760		hr/blr-yr
No. 2 Oil Heat Content:				Btu/gal

AB Note [1]: Permit V-18-056 R1

Emission Units 108-110

GH 1-3 Parameters	GH Note	CC Gas Heaters 1-3 Natrl Gas	No. 2 Oil	Units
Number of Units:		3		
Natrl Gas Heat Content:		1,020		Btu/scf
Ht Input per Gas Htr:	1	13.5		10^6 Btu/hr
Annual Hours:	1	8,760		hr/htr-yr
Total Natrl Gas:		348		10^6 scf/yr

GH Note [1]: Permit V-18-056 R1

Emission Units 141-143

GH 5-7 Parameters	GH Note	Simple Cycle Gas Heaters 1-3 Natrl Gas	No. 2 Oil	Units
Number of Units:		3		
Natrl Gas Heat Content:		1,020		Btu/scf
Ht Input per Gas Htr:	1	10.0		10^6 Btu/hr
Annual Hours:	1	8,760		hr/htr-yr
Total Natrl Gas:		258		10^6 scf/yr

GH Note [1]: Permit V-18-056 R1

Table 1. Trace Elements Emission Estimates

Emission Unit 107

Pollutant	(Symbol)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^12 Btu	AB Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony	Sb	HAP	7.98E-03	1.84E-04			6.31E-05		6.31E-05
Arsenic	As	HAP	1.03E-02	2.00E-04			6.87E-05		6.87E-05
Beryllium	Be	HAP	4.48E-04	1.20E-05			4.12E-06		4.12E-06
Cadmium	Cd	HAP	2.52E-03	1.10E-03			3.78E-04		3.78E-04
Chlorine as HCl	HCl	HAP	3.98E-03						0.00E+00
Chromium	Cr	HAP	4.91E-02	1.40E-03			4.81E-04		4.81E-04
Cobalt	Co	HAP	3.66E-03	8.40E-05			2.89E-05		2.89E-05
Lead	Pb	HAP	1.80E-02	5.00E-04			1.72E-04		1.72E-04
Manganese	Mn	HAP	1.90E-02	3.80E-04			1.31E-04		1.31E-04
Mercury	Hg	HAP	2.18E-04	2.60E-04			8.93E-05		8.93E-05
Nickel	Ni	HAP	1.06E-01	2.10E-03			7.21E-04		7.21E-04
Selenium	Se	HAP	1.21E-03	2.40E-05			8.24E-06		8.24E-06

Emission Units 108-110

Pollutant	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^12 Btu	GH Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony	1.84E-04			3.19E-05		3.19E-05
Arsenic	2.00E-04			3.48E-05		3.48E-05
Beryllium	1.20E-05			2.09E-06		2.09E-06
Cadmium	1.10E-03			1.91E-04		1.91E-04
Chlorine as HCl						0.00E+00
Chromium	1.40E-03			2.43E-04		2.43E-04
Cobalt	8.40E-05			1.46E-05		1.46E-05
Lead	5.00E-04			8.70E-05		8.70E-05
Manganese	3.80E-04			6.61E-05		6.61E-05
Mercury	2.60E-04			4.52E-05		4.52E-05
Nickel	2.10E-03			3.65E-04		3.65E-04
Selenium	2.40E-05			4.17E-06		4.17E-06

Emission Units 141-143

Pollutant	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^12 Btu	GH Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony	1.84E-04			2.37E-05		2.37E-05
Arsenic	2.00E-04			2.58E-05		2.58E-05
Beryllium	1.20E-05			1.55E-06		1.55E-06
Cadmium	1.10E-03			1.42E-04		1.42E-04
Chlorine as HCl						0.00E+00
Chromium	1.40E-03			1.80E-04		1.80E-04
Cobalt	8.40E-05			1.08E-05		1.08E-05
Lead	5.00E-04			6.44E-05		6.44E-05
Manganese	3.80E-04			4.90E-05		4.90E-05
Mercury	2.60E-04			3.35E-05		3.35E-05
Nickel	2.10E-03			2.71E-04		2.71E-04
Selenium	2.40E-05			3.09E-06		3.09E-06

Table 2. Organic HAP Emission Estimates

Emission Unit 107

Pollutant	(CASRN)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^3 gal	AB Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene	106-99-0	HAP	1.93E-02						
2-Methylnaphthalene	91-57-6	POM	7.09E-03	2.40E-05			8.24E-06		8.24E-06
3-Methylcholanthrene	56-49-5	PAC	1.16E-06	1.80E-06			6.18E-07		6.18E-07
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC	1.03E-05	1.60E-05			5.50E-06		5.50E-06
Acenaphthene	83-32-9	POM	1.93E-05	1.80E-06			6.18E-07		6.18E-07
Acenaphthylene	208-96-8	POM	6.60E-05	1.80E-06			6.18E-07		6.18E-07
Acetaldehyde	75-07-0	HAP	1.76E+00						
Acrolein	107-02-8	HAP	2.81E-01						
Anthracene	120-12-7	POM	2.55E-05	2.40E-06			8.24E-07		8.24E-07
Benzene	71-43-2	HAP	5.37E-01	2.10E-03			7.21E-04		7.21E-04
Benzo(a)anthracene	56-55-3	PAC	2.27E-05	1.80E-06			6.18E-07		6.18E-07
Benzo(a)pyrene	50-32-8	PAC	3.18E-06	1.20E-06			4.12E-07		4.12E-07
Benzo(b)fluoranthene	205-99-2	PAC	2.43E-06	1.80E-06			6.18E-07		6.18E-07
Benzo(g,h,i)perylene	191-24-2	POM	7.04E-06	1.20E-06			4.12E-07		4.12E-07
Benzo(k)fluoranthene	207-08-9	PAC	3.15E-06	1.80E-06			6.18E-07		6.18E-07
Chrysene	218-01-9	PAC	5.68E-06	1.80E-06			6.18E-07		6.18E-07
Dibenzo(a,h)anthracene	53-70-3	PAC	8.24E-06	1.20E-06			4.12E-07		4.12E-07
Dichlorobenzene [mixed isomers]	25321-22-6	HAP	7.76E-04	1.20E-03			4.12E-04		4.12E-04
Ethylbenzene	100-41-4	HAP	1.40E+00						0.00E+00
Fluoranthene	206-44-0	PAC	9.94E-05	3.00E-06			1.03E-06		1.03E-06
Fluorene	86-73-7	POM	3.76E-04	2.80E-06			9.62E-07		9.62E-07
Formaldehyde	50-00-0	HAP	9.67E+00	7.50E-02			2.58E-02		2.58E-02
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC	5.96E-06	1.80E-06			6.18E-07		6.18E-07
Naphthalene	91-20-3	HAP	5.82E-02	6.10E-04			2.10E-04		2.10E-04
n-Hexane	110-54-3	HAP	2.78E-04	4.30E-04			1.48E-04		1.48E-04
Phenanthrene	85-01-8	POM	5.23E-03	1.70E-05			5.84E-06		5.84E-06
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.60E-02						
Propylene Oxide	75-56-9	HAP	1.27E+00						
Pyrene	129-00-0	POM	6.44E-05	5.00E-06			1.72E-06		1.72E-06
Toluene	108-88-3	HAP	5.68E+00	3.40E-03			1.17E-03		1.17E-03
Xylenes	1330-20-7	HAP	2.80E+00						
Polycyclic Aromatic Compounds	PAC	PAH	1.62E-04				1.11E-05		1.11E-05
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.62E-02				1.11E-05		1.11E-05
Polycyclic Organic Matter	POM	HAP	1.09E-01				1.92E-05		1.92E-05
Organic HAP Total	--		2.36E+01				2.85E-02		2.85E-02

Emission Units 108-110

Pollutant	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^3 gal	GH Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene						
2-Methylnaphthalene	2.40E-05			4.17E-06		4.17E-06
3-Methylcholanthrene	1.80E-06			3.13E-07		3.13E-07
7,12-Dimethylbenz(a)anthracene	1.60E-05			2.78E-06		2.78E-06
Acenaphthene	1.80E-06			3.13E-07		3.13E-07
Acenaphthylene	1.80E-06			3.13E-07		3.13E-07
Acetaldehyde						
Acrolein						
Anthracene	2.40E-06			4.17E-07		4.17E-07
Benzene	2.10E-03			3.65E-04		3.65E-04
Benzo(a)anthracene	1.80E-06			3.13E-07		3.13E-07
Benzo(a)pyrene	1.20E-06			2.09E-07		2.09E-07
Benzo(b)fluoranthene	1.80E-06			3.13E-07		3.13E-07
Benzo(g,h,i)perylene	1.20E-06			2.09E-07		2.09E-07
Benzo(k)fluoranthene	1.80E-06			3.13E-07		3.13E-07
Chrysene	1.80E-06			3.13E-07		3.13E-07
Dibenzo(a,h)anthracene	1.20E-06			2.09E-07		2.09E-07
Dichlorobenzene [mixed isomers]	1.20E-03			2.09E-04		2.09E-04
Ethylbenzene						
Fluoranthene	3.00E-06			5.22E-07		5.22E-07
Fluorene	2.80E-06			4.87E-07		4.87E-07
Formaldehyde	7.50E-02			1.30E-02		1.30E-02
Indeno(1,2,3-c,d)pyrene	1.80E-06			3.13E-07		3.13E-07
Naphthalene	6.10E-04			1.06E-04		1.06E-04
n-Hexane	4.30E-04			7.48E-05		7.48E-05
Phenanthrene	1.70E-05			2.96E-06		2.96E-06
Polycyclic Aromatic Hydrocarbons						
Propylene Oxide						
Pyrene	5.00E-06			8.70E-07		8.70E-07
Toluene	3.40E-03			5.91E-04		5.91E-04
Xylenes						
Polycyclic Aromatic Compounds				5.60E-06		5.60E-06
Polycyclic Aromatic Hydrocarbons				5.60E-06		5.60E-06
Polycyclic Organic Matter				9.74E-06		9.74E-06
Organic HAP Total				1.44E-02		1.44E-02

Emission Units 141-143

Pollutant	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^3 gal	GH Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene						
2-Methylnaphthalene	2.40E-05			3.09E-06		3.09E-06
3-Methylcholanthrene	1.80E-06			2.32E-07		2.32E-07
7,12-Dimethylbenz(a)anthracene	1.60E-05			2.06E-06		2.06E-06
Acenaphthene	1.80E-06			2.32E-07		2.32E-07
Acenaphthylene	1.80E-06			2.32E-07		2.32E-07
Acetaldehyde						
Acrolein						
Anthracene	2.40E-06			3.09E-07		3.09E-07
Benzene	2.10E-03			2.71E-04		2.71E-04
Benzo(a)anthracene	1.80E-06			2.32E-07		2.32E-07
Benzo(a)pyrene	1.20E-06			1.55E-07		1.55E-07
Benzo(b)fluoranthene	1.80E-06			2.32E-07		2.32E-07
Benzo(g,h,i)perylene	1.20E-06			1.55E-07		1.55E-07
Benzo(k)fluoranthene	1.80E-06			2.32E-07		2.32E-07
Chrysene	1.80E-06			2.32E-07		2.32E-07
Dibenzo(a,h)anthracene	1.20E-06			1.55E-07		1.55E-07
Dichlorobenzene [mixed isomers]	1.20E-03			1.55E-04		1.55E-04
Ethylbenzene						
Fluoranthene	3.00E-06			3.86E-07		3.86E-07
Fluorene	2.80E-06			3.61E-07		3.61E-07
Formaldehyde	7.50E-02			9.66E-03		9.66E-03
Indeno(1,2,3-c,d)pyrene	1.80E-06			2.32E-07		2.32E-07
Naphthalene	6.10E-04			7.86E-05		7.86E-05
n-Hexane	4.30E-04			5.54E-05		5.54E-05
Phenanthrene	1.70E-05			2.19E-06		2.19E-06
Polycyclic Aromatic Hydrocarbons						
Propylene Oxide						
Pyrene	5.00E-06			6.44E-07		6.44E-07
Toluene	3.40E-03			4.38E-04		4.38E-04
Xylenes						
Polycyclic Aromatic Compounds				4.15E-06		4.15E-06
Polycyclic Aromatic Hydrocarbons				4.15E-06		4.15E-06
Polycyclic Organic Matter				7.21E-06		7.21E-06
Organic HAP Total				1.07E-02		1.07E-02

PARADISE HAP DETERMINATION

		Total tons/yr
Maximum Individual HAP:	Formaldehyde -	9.67E+00
Total HAP:		2.38E+01

Emission Unit 104 RCG Parameters	RCG Note	Diesel Gen. for Radio Comm. Natrl Gas	No. 2 Oil	Units
Number of Units:			1	
Engine Output:			90	bhp/eng
Ht Input per Engine:			0.69	10^6 Btu/hr
Annual Hours:			500	hr/eng-yr
Heat Input Conversion:			7,000	Btu/hp-hr

RCG Note [1]: Permit V-18-056 R1; PTE annual hours via EPA guidance

Emission Unit 115 FP Parameters	FP Note	Diesel Emrgncy-Fire Water Pump Natrl Gas	No. 2 Oil	Units
Number of Units:			1	
Engine Output:	1		252	bhp/eng
Ht Input per Engine:			1.96	10^6 Btu/hr
Annual Hours:			500	hr/eng-yr
Heat Input Conversion:			7,000	Btu/hp-hr

FP Note [1]: Permit V-18-056 R1; PTE annual hours via EPA guidance

Emission Unit 128 TPG Parameters	TPG Note	Propane Gen. for Telecom. Natrl Gas	Propane	Units
Number of Units:			1	
Engine Output:	1		42	bhp/eng
Ht Input per Engine:			0.43	10^6 Btu/hr
Annual Hours:			500	hr/eng-yr
Heat Input Conversion:				Btu/hp-hr

TPG Note [1]: Permit V-18-056 R1; PTE annual hours via EPA guidance

Table 1. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	RCG Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony	Sb	HAP	7.98E-03												
Arsenic	As	HAP	1.03E-02		1.10E-05			1.90E-06	1.90E-06		1.10E-05			5.39E-06	5.39E-06
Beryllium	Be	HAP	4.48E-04		3.10E-07			5.35E-08	5.35E-08		3.10E-07			1.52E-07	1.52E-07
Cadmium	Cd	HAP	2.52E-03		4.80E-06			8.28E-07	8.28E-07		4.80E-06			2.35E-06	2.35E-06
Chlorine as HCl	HCl	HAP	3.98E-03		3.11E-04			5.36E-05	5.36E-05		3.11E-04			1.52E-04	1.52E-04
Chromium	Cr	HAP	4.91E-02		1.10E-05			1.90E-06	1.90E-06		1.10E-05			5.39E-06	5.39E-06
Cobalt	Co	HAP	3.66E-03		9.10E-06			1.57E-06	1.57E-06		9.10E-06			4.46E-06	4.46E-06
Lead	Pb	HAP	1.80E-02		1.40E-05			2.42E-06	2.42E-06		1.40E-05			6.86E-06	6.86E-06
Manganese	Mn	HAP	1.90E-02		1.01E-04			1.74E-05	1.74E-05		1.01E-04			4.94E-05	4.94E-05
Mercury	Hg	HAP	2.18E-04		1.20E-06			2.07E-07	2.07E-07		1.20E-06			5.88E-07	5.88E-07
Nickel	Ni	HAP	1.06E-01		4.60E-06			7.94E-07	7.94E-07		4.60E-06			2.25E-06	2.25E-06
Selenium	Se	HAP	1.21E-03		2.50E-05			4.31E-06	4.31E-06		2.50E-05			1.23E-05	1.23E-05

No HAP emissions identified via EPA, EPRI, etc. documentation

Table 2. Organic HAP Emission Estimates

Pollutant	(CASRN)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	RCG Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene	106-99-0	HAP	1.93E-02		3.91E-05			6.74E-06	6.74E-06		3.91E-05			1.92E-05	1.92E-05
2-Methylnaphthalene	91-57-6	POM	7.09E-03												
3-Methylcholanthrene	56-49-5	PAC	1.16E-06												
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC	1.03E-05												
Acenaphthene	83-32-9	POM	1.93E-05		1.42E-06			2.45E-07	2.45E-07		1.42E-06			6.96E-07	6.96E-07
Acenaphthylene	208-96-8	POM	6.60E-05		5.06E-06			8.73E-07	8.73E-07		5.06E-06			2.48E-06	2.48E-06
Acetaldehyde	75-07-0	HAP	1.76E+00		7.67E-04			1.32E-04	1.32E-04		7.67E-04			3.76E-04	3.76E-04
Acrolein	107-02-8	HAP	2.81E-01		9.25E-05			1.60E-05	1.60E-05		9.25E-05			4.53E-05	4.53E-05
Anthracene	120-12-7	POM	2.55E-05		1.87E-06			3.23E-07	3.23E-07		1.87E-06			9.16E-07	9.16E-07
Benzene	71-43-2	HAP	5.37E-01		9.33E-04			1.61E-04	1.61E-04		9.33E-04			4.57E-04	4.57E-04
Benzo(a)anthracene	56-55-3	PAC	2.27E-05		1.68E-06			2.90E-07	2.90E-07		1.68E-06			8.23E-07	8.23E-07
Benzo(a)pyrene	50-32-8	PAC	3.18E-06		1.88E-07			3.24E-08	3.24E-08		1.88E-07			9.21E-08	9.21E-08
Benzo(b)fluoranthene	205-99-2	PAC	2.43E-06		9.91E-08			1.71E-08	1.71E-08		9.91E-08			4.86E-08	4.86E-08
Benzo(g,h,i)perylene	191-24-2	POM	7.04E-06		4.89E-07			8.44E-08	8.44E-08		4.89E-07			2.40E-07	2.40E-07
Benzo(k)fluoranthene	207-08-9	PAC	3.15E-06		1.55E-07			2.67E-08	2.67E-08		1.55E-07			7.60E-08	7.60E-08
Chrysene	218-01-9	PAC	5.68E-06		3.53E-07			6.09E-08	6.09E-08		3.53E-07			1.73E-07	1.73E-07
Dibenzo(a,h)anthracene	53-70-3	PAC	8.24E-06		5.83E-07			1.01E-07	1.01E-07		5.83E-07			2.86E-07	2.86E-07
Dichlorobenzene [mixed isomers]	25321-22-6	HAP	7.76E-04												
Ethylbenzene	100-41-4	HAP	1.40E+00												
Fluoranthene	206-44-0	PAC	9.94E-05		7.61E-06			1.31E-06	1.31E-06		7.61E-06			3.73E-06	3.73E-06
Fluorene	86-73-7	POM	3.76E-04		2.92E-05			5.04E-06	5.04E-06		2.92E-05			1.43E-05	1.43E-05
Formaldehyde	50-00-0	HAP	9.67E+00		1.18E-03			2.04E-04	2.04E-04		1.18E-03			5.78E-04	5.78E-04
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC	5.96E-06		3.75E-07			6.47E-08	6.47E-08		3.75E-07			1.84E-07	1.84E-07
Naphthalene	91-20-3	HAP	5.82E-02		8.48E-05			1.46E-05	1.46E-05		8.48E-05			4.16E-05	4.16E-05
n-Hexane	110-54-3	HAP	2.78E-04												
Phenanthrene	85-01-8	POM	5.23E-03		2.94E-05			5.07E-06	5.07E-06		2.94E-05			1.44E-05	1.44E-05
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.60E-02												
Propylene Oxide	75-56-9	HAP	1.27E+00												
Pyrene	129-00-0	POM	6.44E-05		4.78E-06			8.25E-07	8.25E-07		4.78E-06			2.34E-06	2.34E-06
Toluene	108-88-3	HAP	5.68E+00		4.09E-04			7.06E-05	7.06E-05		4.09E-04			2.00E-04	2.00E-04
Xylenes	1330-20-7	HAP	2.80E+00		2.85E-04			4.92E-05	4.92E-05		2.85E-04			1.40E-04	1.40E-04
Polycyclic Aromatic Compounds	PAC	PAH	1.62E-04					1.90E-06	1.90E-06					5.41E-06	5.41E-06
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.62E-02					1.90E-06	1.90E-06					5.41E-06	5.41E-06
Polycyclic Organic Matter	POM	HAP	1.09E-01					1.25E-05	1.25E-05					3.54E-05	3.54E-05
Organic HAP Total	--		2.36E+01					6.68E-04	6.68E-04					1.90E-03	1.90E-03

PARADISE HAP DETERMINATION

		Total tons/yr
Maximum Individual HAP:	Formaldehyde -	9.67E+00
Total HAP:		2.38E+01

Emission Unit 147-148

CYP Parameters	CYP Note	Coal Yd. Runoff Pumps Natrl Gas	Coal Yd. Runoff Pumps No. 2 Oil	Units
Number of Units:			2	
Engine Output:	1		99	bhp/eng
Ht Input per Engine:			0.693	10^6 Btu/hr
Annual Hours:			8,760	hr/eng-yr
Heat Input Conversion:			7,000	Btu/hp-hr

CYP Note [1]: Permit V-18-056 R2; Dec. 2021 Minor Mod.

Emission Unit 151

DCP1 Parameters	DCP1 Note	Deutz DR Coal Fines Pump #1 Natrl Gas	Deutz DR Coal Fines Pump #1 No. 2 Oil	Units
Number of Units:			1	
Engine Output:	1		78	bhp/eng
Ht Input per Engine:			0.546	10^6 Btu/hr
Annual Hours:			8,760	hr/eng-yr
Heat Input Conversion:			7,000	Btu/hp-hr

DCP1 Note [1]: Permit V-18-056 R2; Dec. 2021 Minor Mod.

Emission Unit 152

DCP2 Parameters	DCP2 Note	J. Deere DR Coal Fines Pump #2 Natrl Gas	J. Deere DR Coal Fines Pump #2 No. 2 Oil	Units
Number of Units:			1	
Engine Output:	1		74	bhp/eng
Ht Input per Engine:			0.518	10^6 Btu/hr
Annual Hours:			8,760	hr/eng-yr
Heat Input Conversion:			7,000	Btu/hp-hr

DCP2 Note [1]: Permit V-18-056 R2; Dec. 2021 Minor Mod.

Table 1. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony	Sb	HAP	7.98E-03						
Arsenic	As	HAP	1.03E-02		1.10E-05			6.68E-05	6.68E-05
Beryllium	Be	HAP	4.48E-04		3.10E-07			1.88E-06	1.88E-06
Cadmium	Cd	HAP	2.52E-03		4.80E-06			2.91E-05	2.91E-05
Chlorine as HCl	HCl	HAP	3.98E-03		3.11E-04			1.89E-03	1.89E-03
Chromium	Cr	HAP	4.91E-02		1.10E-05			6.68E-05	6.68E-05
Cobalt	Co	HAP	3.66E-03		9.10E-06			5.52E-05	5.52E-05
Lead	Pb	HAP	1.80E-02		1.40E-05			8.50E-05	8.50E-05
Manganese	Mn	HAP	1.90E-02		1.01E-04			6.11E-04	6.11E-04
Mercury	Hg	HAP	2.18E-04		1.20E-06			7.28E-06	7.28E-06
Nickel	Ni	HAP	1.06E-01		4.60E-06			2.79E-05	2.79E-05
Selenium	Se	HAP	1.21E-03		2.50E-05			1.52E-04	1.52E-04

Pollutant	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony						
Arsenic		1.10E-05			2.63E-05	2.63E-05
Beryllium		3.10E-07			7.41E-07	7.41E-07
Cadmium		4.80E-06			1.15E-05	1.15E-05
Chlorine as HCl		3.11E-04			7.43E-04	7.43E-04
Chromium		1.10E-05			2.63E-05	2.63E-05
Cobalt		9.10E-06			2.18E-05	2.18E-05
Lead		1.40E-05			3.35E-05	3.35E-05
Manganese		1.01E-04			2.41E-04	2.41E-04
Mercury		1.20E-06			2.87E-06	2.87E-06
Nickel		4.60E-06			1.10E-05	1.10E-05
Selenium		2.50E-05			5.98E-05	5.98E-05

Pollutant	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony						
Arsenic		1.10E-05			2.50E-05	2.50E-05
Beryllium		3.10E-07			7.03E-07	7.03E-07
Cadmium		4.80E-06			1.09E-05	1.09E-05
Chlorine as HCl		3.11E-04			7.05E-04	7.05E-04
Chromium		1.10E-05			2.50E-05	2.50E-05
Cobalt		9.10E-06			2.06E-05	2.06E-05
Lead		1.40E-05			3.18E-05	3.18E-05
Manganese		1.01E-04			2.29E-04	2.29E-04
Mercury		1.20E-06			2.72E-06	2.72E-06
Nickel		4.60E-06			1.04E-05	1.04E-05
Selenium		2.50E-05			5.67E-05	5.67E-05

Table 2. Organic HAP Emission Estimates

Pollutant	(CASRN)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene	106-99-0	HAP	1.93E-02		3.91E-05			2.37E-04	2.37E-04
2-Methylnaphthalene	91-57-6	POM	7.09E-03						
3-Methylcholanthrene	56-49-5	PAC	1.16E-06						
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC	1.03E-05						
Acenaphthene	83-32-9	POM	1.93E-05		1.42E-06			8.62E-06	8.62E-06
Acenaphthylene	208-96-8	POM	6.60E-05		5.06E-06			3.07E-05	3.07E-05
Acetaldehyde	75-07-0	HAP	1.76E+00		7.67E-04			4.66E-03	4.66E-03
Acrolein	107-02-8	HAP	2.81E-01		9.25E-05			5.62E-04	5.62E-04
Anthracene	120-12-7	POM	2.55E-05		1.87E-06			1.14E-05	1.14E-05
Benzene	71-43-2	HAP	5.37E-01		9.33E-04			5.66E-03	5.66E-03
Benzo(a)anthracene	56-55-3	PAC	2.27E-05		1.68E-06			1.02E-05	1.02E-05
Benzo(a)pyrene	50-32-8	PAC	3.18E-06		1.88E-07			1.14E-06	1.14E-06
Benzo(b)fluoranthene	205-99-2	PAC	2.43E-06		9.91E-08			6.02E-07	6.02E-07
Benzo(g,h,i)perylene	191-24-2	POM	7.04E-06		4.89E-07			2.97E-06	2.97E-06
Benzo(k)fluoranthene	207-08-9	PAC	3.15E-06		1.55E-07			9.41E-07	9.41E-07
Chrysene	218-01-9	PAC	5.68E-06		3.53E-07			2.14E-06	2.14E-06
Dibenzo(a,h)anthracene	53-70-3	PAC	8.24E-06		5.83E-07			3.54E-06	3.54E-06
Dichlorobenzene [mixed isomers]	25321-22-6	HAP	7.76E-04						
Ethylbenzene	100-41-4	HAP	1.40E+00						
Fluoranthene	206-44-0	PAC	9.94E-05		7.61E-06			4.62E-05	4.62E-05
Fluorene	86-73-7	POM	3.76E-04		2.92E-05			1.77E-04	1.77E-04
Formaldehyde	50-00-0	HAP	9.67E+00		1.18E-03			7.16E-03	7.16E-03
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC	5.96E-06		3.75E-07			2.28E-06	2.28E-06
Naphthalene	91-20-3	HAP	5.82E-02		8.48E-05			5.15E-04	5.15E-04
n-Hexane	110-54-3	HAP	2.78E-04						
Phenanthrene	85-01-8	POM	5.23E-03		2.94E-05			1.78E-04	1.78E-04
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.60E-02						
Propylene Oxide	75-56-9	HAP	1.27E+00						
Pyrene	129-00-0	POM	6.44E-05		4.78E-06			2.90E-05	2.90E-05
Toluene	108-88-3	HAP	5.68E+00		4.09E-04			2.48E-03	2.48E-03
Xylenes	1330-20-7	HAP	2.80E+00		2.85E-04			1.73E-03	1.73E-03
Polycyclic Aromatic Compounds	PAC	PAH	1.62E-04					6.70E-05	6.70E-05
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.62E-02					6.70E-05	6.70E-05
Polycyclic Organic Matter	POM	HAP	1.09E-01					4.38E-04	4.38E-04
Organic HAP Total	--		2.36E+01					2.35E-02	2.35E-02

Pollutant	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene		3.91E-05			9.35E-05	9.35E-05
2-Methylnaphthalene						
3-Methylcholanthrene						
7,12-Dimethylbenz(a)anthracene						
Acenaphthene		1.42E-06			3.40E-06	3.40E-06
Acenaphthylene		5.06E-06			1.21E-05	1.21E-05
Acetaldehyde		7.67E-04			1.83E-03	1.83E-03
Acrolein		9.25E-05			2.21E-04	2.21E-04
Anthracene		1.87E-06			4.47E-06	4.47E-06
Benzene		9.33E-04			2.23E-03	2.23E-03
Benzo(a)anthracene		1.68E-06			4.02E-06	4.02E-06
Benzo(a)pyrene		1.88E-07			4.50E-07	4.50E-07
Benzo(b)fluoranthene		9.91E-08			2.37E-07	2.37E-07
Benzo(g,h,i)perylene		4.89E-07			1.17E-06	1.17E-06
Benzo(k)fluoranthene		1.55E-07			3.71E-07	3.71E-07
Chrysene		3.53E-07			8.44E-07	8.44E-07
Dibenzo(a,h)anthracene		5.83E-07			1.39E-06	1.39E-06
Dichlorobenzene [mixed isomers]						
Ethylbenzene						
Fluoranthene		7.61E-06			1.82E-05	1.82E-05
Fluorene		2.92E-05			6.98E-05	6.98E-05
Formaldehyde		1.18E-03			2.82E-03	2.82E-03
Indeno(1,2,3-c,d)pyrene		3.75E-07			8.97E-07	8.97E-07
Naphthalene		8.48E-05			2.03E-04	2.03E-04
n-Hexane						
Phenanthrene		2.94E-05			7.03E-05	7.03E-05
Polycyclic Aromatic Hydrocarbons						
Propylene Oxide						
Pyrene		4.78E-06			1.14E-05	1.14E-05
Toluene		4.09E-04			9.78E-04	9.78E-04
Xylenes		2.85E-04			6.82E-04	6.82E-04
Polycyclic Aromatic Compounds					2.64E-05	2.64E-05
Polycyclic Aromatic Hydrocarbons					2.64E-05	2.64E-05
Polycyclic Organic Matter					1.73E-04	1.73E-04
Organic HAP Total					9.26E-03	9.26E-03

Pollutant	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene		3.91E-05			8.87E-05	8.87E-05
2-Methylnaphthalene						
3-Methylcholanthrene						
7,12-Dimethylbenz(a)anthracene						
Acenaphthene		1.42E-06			3.22E-06	3.22E-06
Acenaphthylene		5.06E-06			1.15E-05	1.15E-05
Acetaldehyde		7.67E-04			1.74E-03	1.74E-03
Acrolein		9.25E-05			2.10E-04	2.10E-04
Anthracene		1.87E-06			4.24E-06	4.24E-06
Benzene		9.33E-04			2.12E-03	2.12E-03
Benzo(a)anthracene		1.68E-06			3.81E-06	3.81E-06
Benzo(a)pyrene		1.88E-07			4.27E-07	4.27E-07
Benzo(b)fluoranthene		9.91E-08			2.25E-07	2.25E-07
Benzo(g,h,i)perylene		4.89E-07			1.11E-06	1.11E-06
Benzo(k)fluoranthene		1.55E-07			3.52E-07	3.52E-07
Chrysene		3.53E-07			8.01E-07	8.01E-07
Dibenzo(a,h)anthracene		5.83E-07			1.32E-06	1.32E-06
Dichlorobenzene [mixed isomers]						
Ethylbenzene						
Fluoranthene		7.61E-06			1.73E-05	1.73E-05
Fluorene		2.92E-05			6.63E-05	6.63E-05
Formaldehyde		1.18E-03			2.68E-03	2.68E-03
Indeno(1,2,3-c,d)pyrene		3.75E-07			8.51E-07	8.51E-07
Naphthalene		8.48E-05			1.92E-04	1.92E-04
n-Hexane						
Phenanthrene		2.94E-05			6.67E-05	6.67E-05
Polycyclic Aromatic Hydrocarbons						
Propylene Oxide						
Pyrene		4.78E-06			1.08E-05	1.08E-05
Toluene		4.09E-04			9.28E-04	9.28E-04
Xylenes		2.85E-04			6.47E-04	6.47E-04
Polycyclic Aromatic Compounds					2.51E-05	2.51E-05
Polycyclic Aromatic Hydrocarbons					2.51E-05	2.51E-05
Polycyclic Organic Matter					1.64E-04	1.64E-04
Organic HAP Total					8.79E-03	8.79E-03

PARADISE HAP DETERMINATION

		Total			Emission Unit 155		
			GN24 Parameters	GN24 Note	Fuel Tank Generator (GN24)		
		tons/yr			Natrl Gas	No. 2 Oil	Units
Maximum Individual HAP:	Formaldehyde -	9.67E+00	Number of Units:			1	
Total HAP:		2.38E+01	Engine Output:	1		46	bhp/eng
			Ht Input per Engine:	2		0.322	10^6 Btu/hr
			Annual Hours:	2		8,760	hr/eng-yr
			Heat Input Conversion:			7,000	Btu/hp-hr

GN24 Note [1]: Permit V-18-056 R2; March 2022 Minor Mod.

Table 1. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony	Sb	HAP	7.98E-03						
Arsenic	As	HAP	1.03E-02		1.10E-05			1.55E-05	1.55E-05
Beryllium	Be	HAP	4.48E-04		3.10E-07			4.37E-07	4.37E-07
Cadmium	Cd	HAP	2.52E-03		4.80E-06			6.77E-06	6.77E-06
Chlorine as HCl	HCl	HAP	3.98E-03		3.11E-04			4.38E-04	4.38E-04
Chromium	Cr	HAP	4.91E-02		1.10E-05			1.55E-05	1.55E-05
Cobalt	Co	HAP	3.66E-03		9.10E-06			1.28E-05	1.28E-05
Lead	Pb	HAP	1.80E-02		1.40E-05			1.97E-05	1.97E-05
Manganese	Mn	HAP	1.90E-02		1.01E-04			1.42E-04	1.42E-04
Mercury	Hg	HAP	2.18E-04		1.20E-06			1.69E-06	1.69E-06
Nickel	Ni	HAP	1.06E-01		4.60E-06			6.49E-06	6.49E-06
Selenium	Se	HAP	1.21E-03		2.50E-05			3.53E-05	3.53E-05

Table 2. Organic HAP Emission Estimates

Pollutant	(CASRN)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene	106-99-0	HAP	1.93E-02		3.91E-05			5.51E-05	5.51E-05
2-Methylnaphthalene	91-57-6	POM	7.09E-03						
3-Methylcholanthrene	56-49-5	PAC	1.16E-06						
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC	1.03E-05						
Acenaphthene	83-32-9	POM	1.93E-05		1.42E-06			2.00E-06	2.00E-06
Acenaphthylene	208-96-8	POM	6.60E-05		5.06E-06			7.14E-06	7.14E-06
Acetaldehyde	75-07-0	HAP	1.76E+00		7.67E-04			1.08E-03	1.08E-03
Acrolein	107-02-8	HAP	2.81E-01		9.25E-05			1.30E-04	1.30E-04
Anthracene	120-12-7	POM	2.55E-05		1.87E-06			2.64E-06	2.64E-06
Benzene	71-43-2	HAP	5.37E-01		9.33E-04			1.32E-03	1.32E-03
Benzo(a)anthracene	56-55-3	PAC	2.27E-05		1.68E-06			2.37E-06	2.37E-06
Benzo(a)pyrene	50-32-8	PAC	3.18E-06		1.88E-07			2.65E-07	2.65E-07
Benzo(b)fluoranthene	205-99-2	PAC	2.43E-06		9.91E-08			1.40E-07	1.40E-07
Benzo(g,h,i)perylene	191-24-2	POM	7.04E-06		4.89E-07			6.90E-07	6.90E-07
Benzo(k)fluoranthene	207-08-9	PAC	3.15E-06		1.55E-07			2.19E-07	2.19E-07
Chrysene	218-01-9	PAC	5.68E-06		3.53E-07			4.98E-07	4.98E-07
Dibenzo(a,h)anthracene	53-70-3	PAC	8.24E-06		5.83E-07			8.22E-07	8.22E-07
Dichlorobenzene [mixed isomers]	25321-22-6	HAP	7.76E-04						
Ethylbenzene	100-41-4	HAP	1.40E+00						
Fluoranthene	206-44-0	PAC	9.94E-05		7.61E-06			1.07E-05	1.07E-05
Fluorene	86-73-7	POM	3.76E-04		2.92E-05			4.12E-05	4.12E-05
Formaldehyde	50-00-0	HAP	9.67E+00		1.18E-03			1.66E-03	1.66E-03
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC	5.96E-06		3.75E-07			5.29E-07	5.29E-07
Naphthalene	91-20-3	HAP	5.82E-02		8.48E-05			1.20E-04	1.20E-04
n-Hexane	110-54-3	HAP	2.78E-04						
Phenanthrene	85-01-8	POM	5.23E-03		2.94E-05			4.15E-05	4.15E-05
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.60E-02						
Propylene Oxide	75-56-9	HAP	1.27E+00						
Pyrene	129-00-0	POM	6.44E-05		4.78E-06			6.74E-06	6.74E-06
Toluene	108-88-3	HAP	5.68E+00		4.09E-04			5.77E-04	5.77E-04
Xylenes	1330-20-7	HAP	2.80E+00		2.85E-04			4.02E-04	4.02E-04
Polycyclic Aromatic Compounds	PAC	PAH	1.62E-04					1.56E-05	1.56E-05
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.62E-02					1.56E-05	1.56E-05
Polycyclic Organic Matter	POM	HAP	1.09E-01					1.02E-04	1.02E-04
Organic HAP Total	--		2.36E+01					5.46E-03	5.46E-03

HAZARDOUS AIR POLLUTANT (HAP) EMISSION FACTOR REFERENCES

Table 1. Trace Element HAP Emission Factors

Pollutant	(Symbol)	Note	Turbines, lb/10^6 Btu Gas [1]	Turbines, lb/10^6 Btu Oil [2]	Ancillary Gas Equip [3] lb/10^6 scf	Diesel Engines [4] lb/10^6 Btu
Antimony	Sb	A, HAP	1.80E-07		1.84E-04	
Arsenic	As	HAP	2.30E-07	1.10E-05	2.00E-04	1.10E-05
Barium	Ba					
Beryllium	Be	HAP	1.00E-08	3.10E-07	1.20E-05	3.10E-07
Cadmium	Cd	HAP	4.00E-08	4.80E-06	1.10E-03	4.80E-06
Chlorine as HCl	HCl	B, HAP		3.11E-04		3.11E-04
Chromium	Cr	HAP	1.10E-06	1.10E-05	1.40E-03	1.10E-05
Cobalt	Co	HAP	8.00E-08		8.40E-05	
Copper	Cu					
Lead	Pb	HAP	4.00E-07	1.40E-05	5.00E-04	1.40E-05
Manganese	Mn	A, HAP	4.00E-07	1.01E-04	3.80E-04	1.01E-04
Mercury	Hg	HAP	8.00E-10	1.20E-06	2.60E-04	1.20E-06
Nickel	Ni	HAP	2.40E-06	4.60E-06	2.10E-03	4.60E-06
Selenium	Se	HAP	2.00E-08	2.50E-05	2.40E-05	2.50E-05
Vanadium	V					
Zinc	Zn					

Notes:

1 Unless noted, combustion turbine (CT or "turbine") gas emission fctrs are from Emission Factors Handbook [EFH] - Guidelines for Estimating Trace Substance Emissions from Fossil Fuel Steam Electric Plants, Electric Power Research Institute (EPRI), Report No. EPRI TR-105611, 11-95, Table 4-1 (Uncontrolled Gas-Fired Boiler Emission Factors)[*]
[*]While EPRI cautioned against using the data in Table 4-1 for gas-fired turbines, TVA believes that the trace-element emission factors can be reasonably applicable to CT units. Fuel composition determines trace-element emissions (mass-per-unit-energy basis) whether burned in a boiler or a CT unit.

2 Unless noted, emission factors from EPA AP-42, Vol. I, 5th Ed., Sec 3.1 - Stationary Gas Turbines - Supplement F, 4/00; cited gas heat content (HHV): 1020 Btu/scf

3 Unless noted, all emission factors from EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - Supplement D, 7/98.

4 Diesel engine (e.g., fire pump) trace-element emission factors are assumed to be the same as CT oil-fired emission factors.

A CT Natrl Gas: US EPA, Air Emissions from Scrap Tire Combustion, EPA-600/R-97-115, October 1997 (natural gas-fired rotary-kiln incinerator simulator emission data). Emission factor assumed applicable for other natural gas-fired equipment.

B CT No. 2 Oil: HCl and Mn emission factors are derived from TVA CT fuel-oil specifications (#2 Distillate) Revision 5.0, 17-Jan-2001:
Chloride - 6 parts per million by weight (ppmw) Manganese - 2 ppmw

C No. 2 Oil general specifications: Density - 7.05 lb/gal [AP-42, Vol. 1, 5th Ed., Appendix A, 9/85 (re. 1/95)]
Ht Cntnt - 140,000 Btu/gal [from source in note B]

HAZARDOUS AIR POLLUTANT (HAP) EMISSION FACTOR REFERENCES

Table 2. Organic HAP Emission Factors

Pollutant	(CASRN)	Note	Turbines, lb/10^6 Btu Gas [1]	Turbines, lb/10^6 Btu Oil [1]	Ancillary Gas Equip [2] lb/10^6 scf	Diesel Engine [3] lb/10^6 Btu
1,1,2-Trichloroethane	79-00-5	HAP				
1,1,2,2-Tetrachloroethane	79-34-5	HAP				
1,3-Butadiene	106-99-0	HAP	4.30E-07	1.60E-05		3.91E-05
1,3-Dichloropropene	542-75-6	HAP				
2,2,4-Trimethylpentane	540-84-1	HAP				
2-Methylnaphthalene	91-57-6	A, POM	1.62E-07		2.40E-05	
3-Methylcholanthrene	56-49-5	PAC			1.80E-06	
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC			1.60E-05	
Acenaphthene	83-32-9	POM			1.80E-06	1.42E-06
Acenaphthylene	208-96-8	POM			1.80E-06	5.06E-06
Acetaldehyde	75-07-0	HAP	4.00E-05			7.67E-04
Acrolein	107-02-8	HAP	6.40E-06			9.25E-05
Anthracene	120-12-7	POM			2.40E-06	1.87E-06
Benzene	71-43-2	HAP	1.20E-05	5.50E-05	2.10E-03	9.33E-04
Benzo(a)anthracene	56-55-3	PAC			1.80E-06	1.68E-06
Benzo(a)pyrene	50-32-8	PAC			1.20E-06	1.88E-07
Benzo(b)fluoranthene	205-99-2	PAC			1.80E-06	9.91E-08
Benzo(e)pyrene	192-97-2	HAP				
Benzo(g,h,i)perylene	191-24-2	POM			1.20E-06	4.89E-07
Benzo(k)fluoranthene	207-08-9	PAC			1.80E-06	1.55E-07
Biphenyl	92-52-4	HAP				
Carbon Tetrachloride	56-23-5	HAP				
Chlorobenzene	108-90-7	HAP				
Chloroform	67-66-3	HAP				
Chrysene	218-01-9	PAC			1.80E-06	3.53E-07
Dibenzo(a,h)anthracene	53-70-3	PAC			1.20E-06	5.83E-07
Dichlorobenzene [mixed isomers]	25321-22-6	HAP			1.20E-03	
Ethylbenzene	100-41-4	HAP	3.20E-05			
Ethylene Dibromide	106-93-4	HAP				
Fluoranthene	206-44-0	PAC			3.00E-06	7.61E-06
Fluorene	86-73-7	POM			2.80E-06	2.92E-05
Formaldehyde	50-00-0	B, HAP	2.20E-04	2.30E-04	7.50E-02	1.18E-03
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC			1.80E-06	3.75E-07
Methanol	67-56-1	HAP				
Methylene Chloride	75-09-2	HAP				
Naphthalene	91-20-3	HAP	1.30E-06	3.50E-05	6.10E-04	8.48E-05
n-Hexane	110-54-3	C, HAP			4.30E-04	
Phenanthrene	85-01-8	POM	1.11E-07		1.70E-05	2.94E-05
Phenol	108-95-2	HAP				
Polycyclic Aromatic Hydrocarbons	PAH	POM	2.20E-06	4.00E-05		
Propylene Oxide	75-56-9	HAP	2.90E-05			
Pyrene	129-00-0	POM			5.00E-06	4.78E-06
Styrene	100-42-5	HAP				
Tetrachloroethane	630-20-6	HAP				
Toluene	108-88-3	HAP	1.30E-04		3.40E-03	4.09E-04
Vinyl Chloride	75-01-4	HAP				
Xylenes	1330-20-7	HAP	6.40E-05			2.85E-04

Notes:

1 Unless noted, all emission factors are from EPA AP-42, Vol. I, 5th Edition, Section 3.1 - Stationary Gas Turbines - Supplement F, 4/00.
2 Unless noted, all emission factors are from EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - Supplement D, 7/98.
3 EPA AP-42, Vol. 1, 5th Ed., Chapter 3.3 - Gasoline and Diesel Industrial Engines - Supplement B, 10/96.

A Turbines: Gas-Fired Boiler and Turbine Air Toxics Summary Report, EPRI, Report No. EPRI TR-105646, Table S-2, 10-96
B Turbines: natural gas-fired formaldehyde emission factor based upon 40 CFR 63 Subpart YYYY's "91 ppb" limit. Emission inventory has used a lower emission factor for decades based upon the EPA access database (r03s01.zip) downloaded from EPA's CHIEF Website, 4-16-01, and evaluating emission factors therein for comparable CT units (see "cnst" worksheet, Table 3).
C Ancillary Gas Equip.: B.T. O'Neil & D.A. Orr, "Hexane and Other Alkane Emission Estimates for Natural Gas-Fired Boilers", EPRI, 5-5-00

PARADISE HAP DETERMINATION

		Total tons/yr
Maximum Individual HAP:	Formaldehyde -	9.87E+00
Total HAP:		2.43E+01

CT Parameters	CT Note	Emission Units 120-122 CC 1-3: GE 7FA.05 (w/o Duct Brnr)			Emission Units 120-122 CC 1-3: GE 7FA.05 (w/ Duct Brnr)			Emission Units 123-125 CT 1-3: GE 7FA.05 (HRSG-Bypass)			Emission Units 137-139 CT 5-7: GE 7F.05 (Simple Cycle)		
		Natrl Gas	No. 2 Oil	Units	Natrl Gas	No. 2 Oil	Units	Natrl Gas	No. 2 Oil	Units	Natrl Gas	No. 2 Oil	Units
Number of Units:		3			3			3			3		
Generation Capacity:	1,2	343.3		MW/Train	380.0		MW/Train	223.3		MW/CT	229.0		MW/CT
Ht Input per CT:	1,2	2,231		10^6 Btu/hr	2,533		10^6 Btu/hr	2,231		10^6 Btu/hr	2,257		10^6 Btu/hr
Annual Capacity Limit:	1,2	0.0		%	100.0		%	0.0		%	38		%
Annual Genratn Limit:		0		MWh/yr	9,985,524		MWh/yr	0		MWh/yr	2,286,886		MWh/yr

CT Note [1]: EU 120-125 - "PAC Permit Application 20141017.pdf" performance at 59 deg. F. CT Note [2]: EU 137-139 - Permit V-18-056 R2

Table 1. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Total tons/yr	Emssn Fctr, lb/10^6 Btu Natrl Gas	Emssn Fctr, lb/10^6 Btu No. 2 Oil	CT Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony	Sb	HAP	8.14E-03	1.80E-07			0.00E+00		0.00E+00	5.99E-03		5.99E-03	0.00E+00		0.00E+00	2.03E-03		2.03E-03
Arsenic	As	HAP	1.05E-02	2.30E-07			0.00E+00		0.00E+00	7.66E-03		7.66E-03	0.00E+00		0.00E+00	2.59E-03		2.59E-03
Beryllium	Be	HAP	4.57E-04	1.00E-08			0.00E+00		0.00E+00	3.33E-04		3.33E-04	0.00E+00		0.00E+00	1.13E-04		1.13E-04
Cadmium	Cd	HAP	2.55E-03	4.00E-08			0.00E+00		0.00E+00	1.33E-03		1.33E-03	0.00E+00		0.00E+00	4.51E-04		4.51E-04
Chlorine as HCl	HCl	HAP	3.98E-03						0.00E+00			0.00E+00			0.00E+00			0.00E+00
Chromium	Cr	HAP	5.01E-02	1.10E-06			0.00E+00		0.00E+00	3.66E-02		3.66E-02	0.00E+00		0.00E+00	1.24E-02		1.24E-02
Cobalt	Co	HAP	3.74E-03	8.00E-08			0.00E+00		0.00E+00	2.66E-03		2.66E-03	0.00E+00		0.00E+00	9.02E-04		9.02E-04
Lead	Pb	HAP	1.83E-02	4.00E-07			0.00E+00		0.00E+00	1.33E-02		1.33E-02	0.00E+00		0.00E+00	4.51E-03		4.51E-03
Manganese	Mn	HAP	1.94E-02	4.00E-07			0.00E+00		0.00E+00	1.33E-02		1.33E-02	0.00E+00		0.00E+00	4.51E-03		4.51E-03
Mercury	Hg	HAP	2.19E-04	8.00E-10			0.00E+00		0.00E+00	2.66E-05		2.66E-05	0.00E+00		0.00E+00	9.02E-06		9.02E-06
Nickel	Ni	HAP	1.08E-01	2.40E-06			0.00E+00		0.00E+00	7.99E-02		7.99E-02	0.00E+00		0.00E+00	2.70E-02		2.70E-02
Selenium	Se	HAP	1.23E-03	2.00E-08			0.00E+00		0.00E+00	6.66E-04		6.66E-04	0.00E+00		0.00E+00	2.25E-04		2.25E-04

Table 2. Organic HAP Emission Estimates

Pollutant	(CASRN)	Note	Total tons/yr	Emssn Fctr, lb/10^6 Btu Natrl Gas	Emssn Fctr, lb/10^6 Btu No. 2 Oil	CT Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene	106-99-0	HAP	1.97E-02	4.30E-07			0.00E+00		0.00E+00	1.43E-02		1.43E-02	0.00E+00		0.00E+00	4.85E-03		4.85E-03
2-Methylnaphthalene	91-57-6	POM	7.23E-03	1.62E-07			0.00E+00		0.00E+00	5.39E-03		5.39E-03	0.00E+00		0.00E+00	1.83E-03		1.83E-03
3-Methylcholanthrene	56-49-5	PAC	1.16E-06															
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC	1.03E-05															
Acenaphthene	83-32-9	POM	1.93E-05															
Acenaphthylene	208-96-8	POM	6.60E-05															
Acetaldehyde	75-07-0	HAP	1.79E+00	4.00E-05			0.00E+00		0.00E+00	1.33E+00		1.33E+00	0.00E+00		0.00E+00	4.51E-01		4.51E-01
Acrolein	107-02-8	HAP	2.86E-01	6.40E-06			0.00E+00		0.00E+00	2.13E-01		2.13E-01	0.00E+00		0.00E+00	7.21E-02		7.21E-02
Anthracene	120-12-7	POM	2.55E-05															
Benzene	71-43-2	HAP	5.48E-01	1.20E-05			0.00E+00		0.00E+00	3.99E-01		3.99E-01	0.00E+00		0.00E+00	1.35E-01		1.35E-01
Benzo(a)anthracene	56-55-3	PAC	2.27E-05															
Benzo(a)pyrene	50-32-8	PAC	3.18E-06															
Benzo(b)fluoranthene	205-99-2	PAC	2.43E-06															
Benzo(g,h,i)perylene	191-24-2	POM	7.04E-06															
Benzo(k)fluoranthene	207-08-9	PAC	3.15E-06															
Chrysene	218-01-9	PAC	5.68E-06															
Dibenzo(a,h)anthracene	53-70-3	PAC	8.24E-06															
Dichlorobenzene [mixed isomers]	25321-22-6	HAP	7.76E-04															
Ethylbenzene	100-41-4	HAP	1.43E+00	3.20E-05			0.00E+00		0.00E+00	1.07E+00		1.07E+00	0.00E+00		0.00E+00	3.61E-01		3.61E-01
Fluoranthene	206-44-0	PAC	9.94E-05															
Fluorene	86-73-7	POM	3.76E-04															
Formaldehyde	50-00-0	HAP	9.87E+00	2.20E-04			0.00E+00		0.00E+00	7.32E+00		7.32E+00	0.00E+00		0.00E+00	2.48E+00		2.48E+00
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC	5.96E-06															
Naphthalene	91-20-3	HAP	5.94E-02	1.30E-06			0.00E+00		0.00E+00	4.33E-02		4.33E-02	0.00E+00		0.00E+00	1.47E-02		1.47E-02
n-Hexane	110-54-3	HAP	2.78E-04															
Phenanthrene	85-01-8	POM	5.33E-03	1.11E-07			0.00E+00		0.00E+00	3.69E-03		3.69E-03	0.00E+00		0.00E+00	1.25E-03		1.25E-03
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.80E-02	2.20E-06			0.00E+00		0.00E+00	7.32E-02		7.32E-02	0.00E+00		0.00E+00	2.48E-02		2.48E-02
Propylene Oxide	75-56-9	HAP	1.29E+00	2.90E-05			0.00E+00		0.00E+00	9.65E-01		9.65E-01	0.00E+00		0.00E+00	3.27E-01		3.27E-01
Pyrene	129-00-0	POM	6.44E-05															
Toluene	108-88-3	HAP	5.80E+00	1.30E-04			0.00E+00		0.00E+00	4.33E+00		4.33E+00	0.00E+00		0.00E+00	1.47E+00		1.47E+00
Xylenes	1330-20-7	HAP	2.86E+00	6.40E-05			0.00E+00		0.00E+00	2.13E+00		2.13E+00	0.00E+00		0.00E+00	7.21E-01		7.21E-01
Polycyclic Aromatic Compounds	PAC	PAH	1.62E-04				0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00		0.00E+00
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.82E-02				0.00E+00		0.00E+00	7.32E-02		7.32E-02	0.00E+00		0.00E+00	2.48E-02		2.48E-02
Polycyclic Organic Matter	POM	HAP	1.11E-01				0.00E+00		0.00E+00	8.23E-02		8.23E-02	0.00E+00		0.00E+00	2.79E-02		2.79E-02
Organic HAP Total	--		2.41E+01				0.00E+00		0.00E+00	1.79E+01		1.79E+01	0.00E+00		0.00E+00	6.06E+00		6.06E+00

PARADISE HAP DETERMINATION

		Total tons/yr
Maximum Individual HAP:	Formaldehyde -	9.87E+00
Total HAP:		2.43E+01

Emission Unit 107

Aux Blr Parameters	AB Note	CC Auxiliary Boiler Natrl Gas	CC Auxiliary Boiler No. 2 Oil	Units
Number of Units:	1	1		
Natrl Gas Heat Content:		1,020		Btu/scf
Ht Input per Boiler:	1	80		10^6 Btu/hr
Annual Hours:	1	8,760		hr/blr-yr
No. 2 Oil Heat Content:				Btu/gal

AB Note [1]: Permit V-18-056 R1

Emission Units 108-110

GH 1-3 Parameters	GH Note	CC Gas Heaters 1-3 Natrl Gas	CC Gas Heaters 1-3 No. 2 Oil	Units
Number of Units:		3		
Natrl Gas Heat Content:		1,020		Btu/scf
Ht Input per Gas Htr:	1	13.5		10^6 Btu/hr
Annual Hours:	1	8,760		hr/htr-yr
Total Natrl Gas:		348		10^6 scf/yr

GH Note [1]: Permit V-18-056 R1

Emission Units 141-143

GH 5-7 Parameters	GH Note	Simple Cycle Gas Heaters 1-3 Natrl Gas	Simple Cycle Gas Heaters 1-3 No. 2 Oil	Units
Number of Units:		3		
Natrl Gas Heat Content:		1,020		Btu/scf
Ht Input per Gas Htr:	1	10.0		10^6 Btu/hr
Annual Hours:	1	8,760		hr/htr-yr
Total Natrl Gas:		258		10^6 scf/yr

GH Note [1]: Permit V-18-056 R1

Table 1. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^12 Btu	AB Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^12 Btu	GH Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^12 Btu	GH Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony	Sb	HAP	8.14E-03	1.84E-04			6.31E-05		6.31E-05	1.84E-04			3.19E-05		3.19E-05	1.84E-04			2.37E-05		2.37E-05
Arsenic	As	HAP	1.05E-02	2.00E-04			6.87E-05		6.87E-05	2.00E-04			3.48E-05		3.48E-05	2.00E-04			2.58E-05		2.58E-05
Beryllium	Be	HAP	4.57E-04	1.20E-05			4.12E-06		4.12E-06	1.20E-05			2.09E-06		2.09E-06	1.20E-05			1.55E-06		1.55E-06
Cadmium	Cd	HAP	2.55E-03	1.10E-03			3.78E-04		3.78E-04	1.10E-03			1.91E-04		1.91E-04	1.10E-03			1.42E-04		1.42E-04
Chlorine as HCl	HCl	HAP	3.98E-03						0.00E+00						0.00E+00						0.00E+00
Chromium	Cr	HAP	5.01E-02	1.40E-03			4.81E-04		4.81E-04	1.40E-03			2.43E-04		2.43E-04	1.40E-03			1.80E-04		1.80E-04
Cobalt	Co	HAP	3.74E-03	8.40E-05			2.89E-05		2.89E-05	8.40E-05			1.46E-05		1.46E-05	8.40E-05			1.08E-05		1.08E-05
Lead	Pb	HAP	1.83E-02	5.00E-04			1.72E-04		1.72E-04	5.00E-04			8.70E-05		8.70E-05	5.00E-04			6.44E-05		6.44E-05
Manganese	Mn	HAP	1.94E-02	3.80E-04			1.31E-04		1.31E-04	3.80E-04			6.61E-05		6.61E-05	3.80E-04			4.90E-05		4.90E-05
Mercury	Hg	HAP	2.19E-04	2.60E-04			8.93E-05		8.93E-05	2.60E-04			4.52E-05		4.52E-05	2.60E-04			3.35E-05		3.35E-05
Nickel	Ni	HAP	1.08E-01	2.10E-03			7.21E-04		7.21E-04	2.10E-03			3.65E-04		3.65E-04	2.10E-03			2.71E-04		2.71E-04
Selenium	Se	HAP	1.23E-03	2.40E-05			8.24E-06		8.24E-06	2.40E-05			4.17E-06		4.17E-06	2.40E-05			3.09E-06		3.09E-06

Table 2. Organic HAP Emission Estimates

Pollutant	(CASRN)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^3 gal	AB Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^3 gal	GH Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^3 gal	GH Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene	106-99-0	HAP	1.97E-02																		
2-Methylnaphthalene	91-57-6	POM	7.23E-03	2.40E-05			8.24E-06		8.24E-06	2.40E-05			4.17E-06		4.17E-06	2.40E-05			3.09E-06		3.09E-06
3-Methylcholanthrene	56-49-5	PAC	1.16E-06	1.80E-06			6.18E-07		6.18E-07	1.80E-06			3.13E-07		3.13E-07	1.80E-06			2.32E-07		2.32E-07
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC	1.03E-05	1.60E-05			5.50E-06		5.50E-06	1.60E-05			2.78E-06		2.78E-06	1.60E-05			2.06E-06		2.06E-06
Acenaphthene	83-32-9	POM	1.93E-05	1.80E-06			6.18E-07		6.18E-07	1.80E-06			3.13E-07		3.13E-07	1.80E-06			2.32E-07		2.32E-07
Acenaphthylene	208-96-8	POM	6.60E-05	1.80E-06			6.18E-07		6.18E-07	1.80E-06			3.13E-07		3.13E-07	1.80E-06			2.32E-07		2.32E-07
Acetaldehyde	75-07-0	HAP	1.79E+00																		
Acrolein	107-02-8	HAP	2.86E-01																		
Anthracene	120-12-7	POM	2.55E-05	2.40E-06			8.24E-07		8.24E-07	2.40E-06			4.17E-07		4.17E-07	2.40E-06			3.09E-07		3.09E-07
Benzene	71-43-2	HAP	5.48E-01	2.10E-03			7.21E-04		7.21E-04	2.10E-03			3.65E-04		3.65E-04	2.10E-03			2.71E-04		2.71E-04
Benzo(a)anthracene	56-55-3	PAC	2.27E-05	1.80E-06			6.18E-07		6.18E-07	1.80E-06			3.13E-07		3.13E-07	1.80E-06			2.32E-07		2.32E-07
Benzo(a)pyrene	50-32-8	PAC	3.18E-06	1.20E-06			4.12E-07		4.12E-07	1.20E-06			2.09E-07		2.09E-07	1.20E-06			1.55E-07		1.55E-07
Benzo(b)fluoranthene	205-99-2	PAC	2.43E-06	1.80E-06			6.18E-07		6.18E-07	1.80E-06			3.13E-07		3.13E-07	1.80E-06			2.32E-07		2.32E-07
Benzo(g,h,i)perylene	191-24-2	POM	7.04E-06	1.20E-06			4.12E-07		4.12E-07	1.20E-06			2.09E-07		2.09E-07	1.20E-06			1.55E-07		1.55E-07
Benzo(k)fluoranthene	207-08-9	PAC	3.15E-06	1.80E-06			6.18E-07		6.18E-07	1.80E-06			3.13E-07		3.13E-07	1.80E-06			2.32E-07		2.32E-07
Chrysene	218-01-9	PAC	5.68E-06	1.80E-06			6.18E-07		6.18E-07	1.80E-06			3.13E-07		3.13E-07	1.80E-06			2.32E-07		2.32E-07
Dibenzo(a,h)anthracene	53-70-3	PAC	8.24E-06	1.20E-06			4.12E-07		4.12E-07	1.20E-06			2.09E-07		2.09E-07	1.20E-06			1.55E-07		1.55E-07
Dichlorobenzene [mixed isomers]	25321-22-6	HAP	7.76E-04	1.20E-03			4.12E-04		4.12E-04	1.20E-03			2.09E-04		2.09E-04	1.20E-03			1.55E-04		1.55E-04
Ethylbenzene	100-41-4	HAP	1.43E+00						0.00E+00												
Fluoranthene	206-44-0	PAC	9.94E-05	3.00E-06			1.03E-06		1.03E-06	3.00E-06			5.22E-07		5.22E-07	3.00E-06			3.86E-07		3.86E-07
Fluorene	86-73-7	POM	3.76E-04	2.80E-06			9.62E-07		9.62E-07	2.80E-06			4.87E-07		4.87E-07	2.80E-06			3.61E-07		3.61E-07
Formaldehyde	50-00-0	HAP	9.87E+00	7.50E-02			2.58E-02		2.58E-02	7.50E-02			1.30E-02		1.30E-02	7.50E-02			9.66E-03		9.66E-03
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC	5.96E-06	1.80E-06			6.18E-07		6.18E-07	1.80E-06			3.13E-07		3.13E-07	1.80E-06			2.32E-07		2.32E-07
Naphthalene	91-20-3	HAP	5.94E-02	6.10E-04			2.10E-04		2.10E-04	6.10E-04			1.06E-04		1.06E-04	6.10E-04			7.86E-05		7.86E-05
n-Hexane	110-54-3	HAP	2.78E-04	4.30E-04			1.48E-04		1.48E-04	4.30E-04			7.48E-05		7.48E-05	4.30E-04			5.54E-05		5.54E-05
Phenanthrene	85-01-8	POM	5.33E-03	1.70E-05			5.84E-06		5.84E-06	1.70E-05			2.96E-06		2.96E-06	1.70E-05			2.19E-06		2.19E-06
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.80E-02																		
Propylene Oxide	75-56-9	HAP	1.29E+00																		
Pyrene	129-00-0	POM	6.44E-05	5.00E-06			1.72E-06		1.72E-06	5.00E-06			8.70E-07		8.70E-07	5.00E-06			6.44E-07		6.44E-07
Toluene	108-88-3	HAP	5.80E+00	3.40E-03			1.17E-03		1.17E-03	3.40E-03			5.91E-04		5.91E-04	3.40E-03			4.38E-04		4.38E-04
Xylenes	1330-20-7	HAP	2.86E+00																		
Polycyclic Aromatic Compounds	PAC	PAH	1.62E-04				1.11E-05		1.11E-05				5.60E-06		5.60E-06				4.15E-06		4.15E-06
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.82E-02				1.11E-05		1.11E-05				5.60E-06		5.60E-06				4.15E-06		4.15E-06
Polycyclic Organic Matter	POM	HAP	1.11E-01				1.92E-05		1.92E-05				9.74E-06		9.74E-06				7.21E-06		7.21E-06
Organic HAP Total	--		2.41E+01				2.85E-02		2.85E-02				1.44E-02		1.44E-02				1.07E-02		1.07E-02

PARADISE HAP DETERMINATION

		Total tons/yr
Maximum Individual HAP:	Formaldehyde -	9.87E+00
Total HAP:		2.43E+01

Emission Unit 104 RCG Parameters	RCG Note	Diesel Gen. for Radio Comm. Natrl Gas	No. 2 Oil	Units
Number of Units:			1	
Engine Output:			90	bhp/eng
Ht Input per Engine:			0.69	10^6 Btu/hr
Annual Hours:			500	hr/eng-yr
Heat Input Conversion:			7,000	Btu/hp-hr

RCG Note [1]: Permit V-18-056 R1; PTE annual hours via EPA guidance

Emission Unit 115 FP Parameters	FP Note	Diesel Emrgncy-Fire Water Pump Natrl Gas	No. 2 Oil	Units
Number of Units:			1	
Engine Output:	1		252	bhp/eng
Ht Input per Engine:			1.96	10^6 Btu/hr
Annual Hours:			500	hr/eng-yr
Heat Input Conversion:			7,000	Btu/hp-hr

FP Note [1]: Permit V-18-056 R1; PTE annual hours via EPA guidance

Emission Unit 128 TPG Parameters	TPG Note	Propane Gen. for Telecom. Natrl Gas	Propane	Units
Number of Units:			1	
Engine Output:	1		42	bhp/eng
Ht Input per Engine:			0.43	10^6 Btu/hr
Annual Hours:			500	hr/eng-yr
Heat Input Conversion:				Btu/hp-hr

TPG Note [1]: Permit V-18-056 R1; PTE annual hours via EPA guidance

Table 1. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	RCG Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony	Sb	HAP	8.14E-03												
Arsenic	As	HAP	1.05E-02		1.10E-05			1.90E-06	1.90E-06		1.10E-05			5.39E-06	5.39E-06
Beryllium	Be	HAP	4.57E-04		3.10E-07			5.35E-08	5.35E-08		3.10E-07			1.52E-07	1.52E-07
Cadmium	Cd	HAP	2.55E-03		4.80E-06			8.28E-07	8.28E-07		4.80E-06			2.35E-06	2.35E-06
Chlorine as HCl	HCl	HAP	3.98E-03		3.11E-04			5.36E-05	5.36E-05		3.11E-04			1.52E-04	1.52E-04
Chromium	Cr	HAP	5.01E-02		1.10E-05			1.90E-06	1.90E-06		1.10E-05			5.39E-06	5.39E-06
Cobalt	Co	HAP	3.74E-03		9.10E-06			1.57E-06	1.57E-06		9.10E-06			4.46E-06	4.46E-06
Lead	Pb	HAP	1.83E-02		1.40E-05			2.42E-06	2.42E-06		1.40E-05			6.86E-06	6.86E-06
Manganese	Mn	HAP	1.94E-02		1.01E-04			1.74E-05	1.74E-05		1.01E-04			4.94E-05	4.94E-05
Mercury	Hg	HAP	2.19E-04		1.20E-06			2.07E-07	2.07E-07		1.20E-06			5.88E-07	5.88E-07
Nickel	Ni	HAP	1.08E-01		4.60E-06			7.94E-07	7.94E-07		4.60E-06			2.25E-06	2.25E-06
Selenium	Se	HAP	1.23E-03		2.50E-05			4.31E-06	4.31E-06		2.50E-05			1.23E-05	1.23E-05

No HAP emissions identified via EPA, EPRI, etc. documentation

Table 2. Organic HAP Emission Estimates

Pollutant	(CASRN)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	RCG Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene	106-99-0	HAP	1.97E-02		3.91E-05			6.74E-06	6.74E-06		3.91E-05			1.92E-05	1.92E-05
2-Methylnaphthalene	91-57-6	POM	7.23E-03												
3-Methylcholanthrene	56-49-5	PAC	1.16E-06												
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC	1.03E-05												
Acenaphthene	83-32-9	POM	1.93E-05		1.42E-06			2.45E-07	2.45E-07		1.42E-06			6.96E-07	6.96E-07
Acenaphthylene	208-96-8	POM	6.60E-05		5.06E-06			8.73E-07	8.73E-07		5.06E-06			2.48E-06	2.48E-06
Acetaldehyde	75-07-0	HAP	1.79E+00		7.67E-04			1.32E-04	1.32E-04		7.67E-04			3.76E-04	3.76E-04
Acrolein	107-02-8	HAP	2.86E-01		9.25E-05			1.60E-05	1.60E-05		9.25E-05			4.53E-05	4.53E-05
Anthracene	120-12-7	POM	2.55E-05		1.87E-06			3.23E-07	3.23E-07		1.87E-06			9.16E-07	9.16E-07
Benzene	71-43-2	HAP	5.48E-01		9.33E-04			1.61E-04	1.61E-04		9.33E-04			4.57E-04	4.57E-04
Benzo(a)anthracene	56-55-3	PAC	2.27E-05		1.68E-06			2.90E-07	2.90E-07		1.68E-06			8.23E-07	8.23E-07
Benzo(a)pyrene	50-32-8	PAC	3.18E-06		1.88E-07			3.24E-08	3.24E-08		1.88E-07			9.21E-08	9.21E-08
Benzo(b)fluoranthene	205-99-2	PAC	2.43E-06		9.91E-08			1.71E-08	1.71E-08		9.91E-08			4.86E-08	4.86E-08
Benzo(g,h,i)perylene	191-24-2	POM	7.04E-06		4.89E-07			8.44E-08	8.44E-08		4.89E-07			2.40E-07	2.40E-07
Benzo(k)fluoranthene	207-08-9	PAC	3.15E-06		1.55E-07			2.67E-08	2.67E-08		1.55E-07			7.60E-08	7.60E-08
Chrysene	218-01-9	PAC	5.68E-06		3.53E-07			6.09E-08	6.09E-08		3.53E-07			1.73E-07	1.73E-07
Dibenzo(a,h)anthracene	53-70-3	PAC	8.24E-06		5.83E-07			1.01E-07	1.01E-07		5.83E-07			2.86E-07	2.86E-07
Dichlorobenzene [mixed isomers]	25321-22-6	HAP	7.76E-04												
Ethylbenzene	100-41-4	HAP	1.43E+00												
Fluoranthene	206-44-0	PAC	9.94E-05		7.61E-06			1.31E-06	1.31E-06		7.61E-06			3.73E-06	3.73E-06
Fluorene	86-73-7	POM	3.76E-04		2.92E-05			5.04E-06	5.04E-06		2.92E-05			1.43E-05	1.43E-05
Formaldehyde	50-00-0	HAP	9.87E+00		1.18E-03			2.04E-04	2.04E-04		1.18E-03			5.78E-04	5.78E-04
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC	5.96E-06		3.75E-07			6.47E-08	6.47E-08		3.75E-07			1.84E-07	1.84E-07
Naphthalene	91-20-3	HAP	5.94E-02		8.48E-05			1.46E-05	1.46E-05		8.48E-05			4.16E-05	4.16E-05
n-Hexane	110-54-3	HAP	2.78E-04												
Phenanthrene	85-01-8	POM	5.33E-03		2.94E-05			5.07E-06	5.07E-06		2.94E-05			1.44E-05	1.44E-05
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.80E-02												
Propylene Oxide	75-56-9	HAP	1.29E+00												
Pyrene	129-00-0	POM	6.44E-05		4.78E-06			8.25E-07	8.25E-07		4.78E-06			2.34E-06	2.34E-06
Toluene	108-88-3	HAP	5.80E+00		4.09E-04			7.06E-05	7.06E-05		4.09E-04			2.00E-04	2.00E-04
Xylenes	1330-20-7	HAP	2.86E+00		2.85E-04			4.92E-05	4.92E-05		2.85E-04			1.40E-04	1.40E-04
Polycyclic Aromatic Compounds	PAC	PAH	1.62E-04					1.90E-06	1.90E-06					5.41E-06	5.41E-06
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.82E-02					1.90E-06	1.90E-06					5.41E-06	5.41E-06
Polycyclic Organic Matter	POM	HAP	1.11E-01					1.25E-05	1.25E-05					3.54E-05	3.54E-05
Organic HAP Total	--		2.41E+01					6.68E-04	6.68E-04					1.90E-03	1.90E-03

PARADISE HAP DETERMINATION

		Total tons/yr	Emission Unit 147-148: CYP Parameters	CYP Note	Coal Yd. Runoff Pumps: Natrl Gas	No. 2 Oil	Units	Emission Unit 151: DCP1 Parameters	DCP1 Note	Deutz DR Coal Fines Pump #1: Natrl Gas	No. 2 Oil	Units	Emission Unit 152: DCP2 Parameters	DCP2 Note	J. Deere DR Coal Fines Pump #2: Natrl Gas	No. 2 Oil	Units
Maximum Individual HAP:	Formaldehyde -	9.87E+00	Number of Units:			2		Number of Units:			1		Number of Units:			1	
Total HAP:		2.43E+01	Engine Output:	1		99	bhp/eng	Engine Output:	1		78	bhp/eng	Engine Output:	1		74	bhp/eng
			Ht Input per Engine:			0.693	10^6 Btu/hr	Ht Input per Engine:			0.546	10^6 Btu/hr	Ht Input per Engine:			0.518	10^6 Btu/hr
			Annual Hours:			8,760	hr/eng-yr	Annual Hours:			8,760	hr/eng-yr	Annual Hours:			8,760	hr/eng-yr
			Heat Input Conversion:			7,000	Btu/hp-hr	Heat Input Conversion:			7,000	Btu/hp-hr	Heat Input Conversion:			7,000	Btu/hp-hr

CYP Note [1]: Permit V-18-056 R2; Dec. 2021 Minor Mod.

DCP1 Note [1]: Permit V-18-056 R2; Dec. 2021 Minor Mod.

DCP2 Note [1]: Permit V-18-056 R2; Dec. 2021 Minor Mod.

Table 1. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Total tons/yr	CYP Natrl Gas lb/10^6 scf	CYP No. 2 Oil lb/10^6 Btu	FP Note	CYP Annual, tons/yr Natrl Gas	CYP Annual, tons/yr No. 2 Oil	CYP Max Ann., tons/yr	DCP1 Natrl Gas lb/10^6 scf	DCP1 No. 2 Oil lb/10^6 Btu	FP Note	DCP1 Annual, tons/yr Natrl Gas	DCP1 Annual, tons/yr No. 2 Oil	DCP1 Max Ann., tons/yr	DCP2 Natrl Gas lb/10^6 scf	DCP2 No. 2 Oil lb/10^6 Btu	FP Note	DCP2 Annual, tons/yr Natrl Gas	DCP2 Annual, tons/yr No. 2 Oil	DCP2 Max Ann., tons/yr
Antimony	Sb	HAP	8.14E-03																		
Arsenic	As	HAP	1.05E-02		1.10E-05			6.68E-05	6.68E-05		1.10E-05			2.63E-05	2.63E-05		1.10E-05			2.50E-05	2.50E-05
Beryllium	Be	HAP	4.57E-04		3.10E-07			1.88E-06	1.88E-06		3.10E-07			7.41E-07	7.41E-07		3.10E-07			7.03E-07	7.03E-07
Cadmium	Cd	HAP	2.55E-03		4.80E-06			2.91E-05	2.91E-05		4.80E-06			1.15E-05	1.15E-05		4.80E-06			1.09E-05	1.09E-05
Chlorine as HCl	HCl	HAP	3.98E-03		3.11E-04			1.89E-03	1.89E-03		3.11E-04			7.43E-04	7.43E-04		3.11E-04			7.05E-04	7.05E-04
Chromium	Cr	HAP	5.01E-02		1.10E-05			6.68E-05	6.68E-05		1.10E-05			2.63E-05	2.63E-05		1.10E-05			2.50E-05	2.50E-05
Cobalt	Co	HAP	3.74E-03		9.10E-06			5.52E-05	5.52E-05		9.10E-06			2.18E-05	2.18E-05		9.10E-06			2.06E-05	2.06E-05
Lead	Pb	HAP	1.83E-02		1.40E-05			8.50E-05	8.50E-05		1.40E-05			3.35E-05	3.35E-05		1.40E-05			3.18E-05	3.18E-05
Manganese	Mn	HAP	1.94E-02		1.01E-04			6.11E-04	6.11E-04		1.01E-04			2.41E-04	2.41E-04		1.01E-04			2.29E-04	2.29E-04
Mercury	Hg	HAP	2.19E-04		1.20E-06			7.28E-06	7.28E-06		1.20E-06			2.87E-06	2.87E-06		1.20E-06			2.72E-06	2.72E-06
Nickel	Ni	HAP	1.08E-01		4.60E-06			2.79E-05	2.79E-05		4.60E-06			1.10E-05	1.10E-05		4.60E-06			1.04E-05	1.04E-05
Selenium	Se	HAP	1.23E-03		2.50E-05			1.52E-04	1.52E-04		2.50E-05			5.98E-05	5.98E-05		2.50E-05			5.67E-05	5.67E-05

Table 2. Organic HAP Emission Estimates

Pollutant	(CASRN)	Note	Total tons/yr	CYP Natrl Gas lb/10^6 scf	CYP No. 2 Oil lb/10^6 Btu	FP Note	CYP Annual, tons/yr Natrl Gas	CYP Annual, tons/yr No. 2 Oil	CYP Max Ann., tons/yr	DCP1 Natrl Gas lb/10^6 scf	DCP1 No. 2 Oil lb/10^6 Btu	FP Note	DCP1 Annual, tons/yr Natrl Gas	DCP1 Annual, tons/yr No. 2 Oil	DCP1 Max Ann., tons/yr	DCP2 Natrl Gas lb/10^6 scf	DCP2 No. 2 Oil lb/10^6 Btu	FP Note	DCP2 Annual, tons/yr Natrl Gas	DCP2 Annual, tons/yr No. 2 Oil	DCP2 Max Ann., tons/yr
1,3-Butadiene	106-99-0	HAP	1.97E-02		3.91E-05			2.37E-04	2.37E-04		3.91E-05			9.35E-05	9.35E-05		3.91E-05			8.87E-05	8.87E-05
2-Methylnaphthalene	91-57-6	POM	7.23E-03																		
3-Methylcholanthrene	56-49-5	PAC	1.16E-06																		
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC	1.03E-05																		
Acenaphthene	83-32-9	POM	1.93E-05		1.42E-06			8.62E-06	8.62E-06		1.42E-06			3.40E-06	3.40E-06		1.42E-06			3.22E-06	3.22E-06
Acenaphthylene	208-96-8	POM	6.60E-05		5.06E-06			3.07E-05	3.07E-05		5.06E-06			1.21E-05	1.21E-05		5.06E-06			1.15E-05	1.15E-05
Acetaldehyde	75-07-0	HAP	1.79E+00		7.67E-04			4.66E-03	4.66E-03		7.67E-04			1.83E-03	1.83E-03		7.67E-04			1.74E-03	1.74E-03
Acrolein	107-02-8	HAP	2.86E-01		9.25E-05			5.62E-04	5.62E-04		9.25E-05			2.21E-04	2.21E-04		9.25E-05			2.10E-04	2.10E-04
Anthracene	120-12-7	POM	2.55E-05		1.87E-06			1.14E-05	1.14E-05		1.87E-06			4.47E-06	4.47E-06		1.87E-06			4.24E-06	4.24E-06
Benzene	71-43-2	HAP	5.48E-01		9.33E-04			5.66E-03	5.66E-03		9.33E-04			2.23E-03	2.23E-03		9.33E-04			2.12E-03	2.12E-03
Benzo(a)anthracene	56-55-3	PAC	2.27E-05		1.68E-06			1.02E-05	1.02E-05		1.68E-06			4.02E-06	4.02E-06		1.68E-06			3.81E-06	3.81E-06
Benzo(a)pyrene	50-32-8	PAC	3.18E-06		1.88E-07			1.14E-06	1.14E-06		1.88E-07			4.50E-07	4.50E-07		1.88E-07			4.27E-07	4.27E-07
Benzo(b)fluoranthene	205-99-2	PAC	2.43E-06		9.91E-08			6.02E-07	6.02E-07		9.91E-08			2.37E-07	2.37E-07		9.91E-08			2.25E-07	2.25E-07
Benzo(g,h,i)perylene	191-24-2	POM	7.04E-06		4.89E-07			2.97E-06	2.97E-06		4.89E-07			1.17E-06	1.17E-06		4.89E-07			1.11E-06	1.11E-06
Benzo(k)fluoranthene	207-08-9	PAC	3.15E-06		1.55E-07			9.41E-07	9.41E-07		1.55E-07			3.71E-07	3.71E-07		1.55E-07			3.52E-07	3.52E-07
Chrysene	218-01-9	PAC	5.68E-06		3.53E-07			2.14E-06	2.14E-06		3.53E-07			8.44E-07	8.44E-07		3.53E-07			8.01E-07	8.01E-07
Dibenzo(a,h)anthracene	53-70-3	PAC	8.24E-06		5.83E-07			3.54E-06	3.54E-06		5.83E-07			1.39E-06	1.39E-06		5.83E-07			1.32E-06	1.32E-06
Dichlorobenzene [mixed isomers]	25321-22-6	HAP	7.76E-04																		
Ethylbenzene	100-41-4	HAP	1.43E+00																		
Fluoranthene	206-44-0	PAC	9.94E-05		7.61E-06			4.62E-05	4.62E-05		7.61E-06			1.82E-05	1.82E-05		7.61E-06			1.73E-05	1.73E-05
Fluorene	86-73-7	POM	3.76E-04		2.92E-05			1.77E-04	1.77E-04		2.92E-05			6.98E-05	6.98E-05		2.92E-05			6.63E-05	6.63E-05
Formaldehyde	50-00-0	HAP	9.87E+00		1.18E-03			7.16E-03	7.16E-03		1.18E-03			2.82E-03	2.82E-03		1.18E-03			2.68E-03	2.68E-03
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC	5.96E-06		3.75E-07			2.28E-06	2.28E-06		3.75E-07			8.97E-07	8.97E-07		3.75E-07			8.51E-07	8.51E-07
Naphthalene	91-20-3	HAP	5.94E-02		8.48E-05			5.15E-04	5.15E-04		8.48E-05			2.03E-04	2.03E-04		8.48E-05			1.92E-04	1.92E-04
n-Hexane	110-54-3	HAP	2.78E-04																		
Phenanthrene	85-01-8	POM	5.33E-03		2.94E-05			1.78E-04	1.78E-04		2.94E-05			7.03E-05	7.03E-05		2.94E-05			6.67E-05	6.67E-05
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.80E-02																		
Propylene Oxide	75-56-9	HAP	1.29E+00																		
Pyrene	129-00-0	POM	6.44E-05		4.78E-06			2.90E-05	2.90E-05		4.78E-06			1.14E-05	1.14E-05		4.78E-06			1.08E-05	1.08E-05
Toluene	108-88-3	HAP	5.80E+00		4.09E-04			2.48E-03	2.48E-03		4.09E-04			9.78E-04	9.78E-04		4.09E-04			9.28E-04	9.28E-04
Xylenes	1330-20-7	HAP	2.86E+00		2.85E-04			1.73E-03	1.73E-03		2.85E-04			6.82E-04	6.82E-04		2.85E-04			6.47E-04	6.47E-04
Polycyclic Aromatic Compounds	PAC	PAH	1.62E-04					6.70E-05	6.70E-05					2.64E-05	2.64E-05					2.51E-05	2.51E-05
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.82E-02					6.70E-05	6.70E-05					2.64E-05	2.64E-05					2.51E-05	2.51E-05
Polycyclic Organic Matter	POM	HAP	1.11E-01					4.38E-04	4.38E-04					1.73E-04	1.73E-04					1.64E-04	1.64E-04
Organic HAP Total	--		2.41E+01					2.35E-02	2.35E-02					9.26E-03	9.26E-03					8.79E-03	8.79E-03

PARADISE HAP DETERMINATION

		Total	GN24 Parameters	GN24 Note	Emission Unit 155 Fuel Tank Generator (GN24)		
		tons/yr			Natrl Gas	No. 2 Oil	Units
Maximum Individual HAP:	Formaldehyde -	9.87E+00	Number of Units:			1	
Total HAP:		2.43E+01	Engine Output:	1		46	bhp/eng
			Ht Input per Engine:	2		0.322	10^6 Btu/hr
			Annual Hours:	2		8,760	hr/eng-yr
			Heat Input Conversion:			7,000	Btu/hp-hr

GN24 Note [1]: Permit V-18-056 R2; March 2022 Minor Mod.

Table 1. Trace Elements Emission Estimates

Pollutant	(Symbol)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
Antimony	Sb	HAP	8.14E-03						
Arsenic	As	HAP	1.05E-02		1.10E-05			1.55E-05	1.55E-05
Beryllium	Be	HAP	4.57E-04		3.10E-07			4.37E-07	4.37E-07
Cadmium	Cd	HAP	2.55E-03		4.80E-06			6.77E-06	6.77E-06
Chlorine as HCl	HCl	HAP	3.98E-03		3.11E-04			4.38E-04	4.38E-04
Chromium	Cr	HAP	5.01E-02		1.10E-05			1.55E-05	1.55E-05
Cobalt	Co	HAP	3.74E-03		9.10E-06			1.28E-05	1.28E-05
Lead	Pb	HAP	1.83E-02		1.40E-05			1.97E-05	1.97E-05
Manganese	Mn	HAP	1.94E-02		1.01E-04			1.42E-04	1.42E-04
Mercury	Hg	HAP	2.19E-04		1.20E-06			1.69E-06	1.69E-06
Nickel	Ni	HAP	1.08E-01		4.60E-06			6.49E-06	6.49E-06
Selenium	Se	HAP	1.23E-03		2.50E-05			3.53E-05	3.53E-05

Table 2. Organic HAP Emission Estimates

Pollutant	(CASRN)	Note	Total tons/yr	Natrl Gas lb/10^6 scf	No. 2 Oil lb/10^6 Btu	FP Note	Annual, tons/yr Natrl Gas	Annual, tons/yr No. 2 Oil	Max Ann., tons/yr
1,3-Butadiene	106-99-0	HAP	1.97E-02		3.91E-05			5.51E-05	5.51E-05
2-Methylnaphthalene	91-57-6	POM	7.23E-03						
3-Methylcholanthrene	56-49-5	PAC	1.16E-06						
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC	1.03E-05						
Acenaphthene	83-32-9	POM	1.93E-05		1.42E-06			2.00E-06	2.00E-06
Acenaphthylene	208-96-8	POM	6.60E-05		5.06E-06			7.14E-06	7.14E-06
Acetaldehyde	75-07-0	HAP	1.79E+00		7.67E-04			1.08E-03	1.08E-03
Acrolein	107-02-8	HAP	2.86E-01		9.25E-05			1.30E-04	1.30E-04
Anthracene	120-12-7	POM	2.55E-05		1.87E-06			2.64E-06	2.64E-06
Benzene	71-43-2	HAP	5.48E-01		9.33E-04			1.32E-03	1.32E-03
Benzo(a)anthracene	56-55-3	PAC	2.27E-05		1.68E-06			2.37E-06	2.37E-06
Benzo(a)pyrene	50-32-8	PAC	3.18E-06		1.88E-07			2.65E-07	2.65E-07
Benzo(b)fluoranthene	205-99-2	PAC	2.43E-06		9.91E-08			1.40E-07	1.40E-07
Benzo(g,h,i)perylene	191-24-2	POM	7.04E-06		4.89E-07			6.90E-07	6.90E-07
Benzo(k)fluoranthene	207-08-9	PAC	3.15E-06		1.55E-07			2.19E-07	2.19E-07
Chrysene	218-01-9	PAC	5.68E-06		3.53E-07			4.98E-07	4.98E-07
Dibenzo(a,h)anthracene	53-70-3	PAC	8.24E-06		5.83E-07			8.22E-07	8.22E-07
Dichlorobenzene [mixed isomers]	25321-22-6	HAP	7.76E-04						
Ethylbenzene	100-41-4	HAP	1.43E+00						
Fluoranthene	206-44-0	PAC	9.94E-05		7.61E-06			1.07E-05	1.07E-05
Fluorene	86-73-7	POM	3.76E-04		2.92E-05			4.12E-05	4.12E-05
Formaldehyde	50-00-0	HAP	9.87E+00		1.18E-03			1.66E-03	1.66E-03
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC	5.96E-06		3.75E-07			5.29E-07	5.29E-07
Naphthalene	91-20-3	HAP	5.94E-02		8.48E-05			1.20E-04	1.20E-04
n-Hexane	110-54-3	HAP	2.78E-04						
Phenanthrene	85-01-8	POM	5.33E-03		2.94E-05			4.15E-05	4.15E-05
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.80E-02						
Propylene Oxide	75-56-9	HAP	1.29E+00						
Pyrene	129-00-0	POM	6.44E-05		4.78E-06			6.74E-06	6.74E-06
Toluene	108-88-3	HAP	5.80E+00		4.09E-04			5.77E-04	5.77E-04
Xylenes	1330-20-7	HAP	2.86E+00		2.85E-04			4.02E-04	4.02E-04
Polycyclic Aromatic Compounds	PAC	PAH	1.62E-04					1.56E-05	1.56E-05
Polycyclic Aromatic Hydrocarbons	PAH	POM	9.82E-02					1.56E-05	1.56E-05
Polycyclic Organic Matter	POM	HAP	1.11E-01					1.02E-04	1.02E-04
Organic HAP Total	--		2.41E+01					5.46E-03	5.46E-03

HAZARDOUS AIR POLLUTANT (HAP) EMISSION FACTOR REFERENCES

Table 1. Trace Element HAP Emission Factors

Pollutant	(Symbol)	Note	Turbines, lb/10^6 Btu Gas [1]	Oil [2]	Ancillary Gas Equip [3] lb/10^6 scf	Diesel Engines [4] lb/10^6 Btu
Antimony	Sb	A, HAP	1.80E-07		1.84E-04	
Arsenic	As	HAP	2.30E-07	1.10E-05	2.00E-04	1.10E-05
Barium	Ba					
Beryllium	Be	HAP	1.00E-08	3.10E-07	1.20E-05	3.10E-07
Cadmium	Cd	HAP	4.00E-08	4.80E-06	1.10E-03	4.80E-06
Chlorine as HCl	HCl	B, HAP		3.11E-04		3.11E-04
Chromium	Cr	HAP	1.10E-06	1.10E-05	1.40E-03	1.10E-05
Cobalt	Co	HAP	8.00E-08		8.40E-05	
Copper	Cu					
Lead	Pb	HAP	4.00E-07	1.40E-05	5.00E-04	1.40E-05
Manganese	Mn	A, HAP	4.00E-07	1.01E-04	3.80E-04	1.01E-04
Mercury	Hg	HAP	8.00E-10	1.20E-06	2.60E-04	1.20E-06
Nickel	Ni	HAP	2.40E-06	4.60E-06	2.10E-03	4.60E-06
Selenium	Se	HAP	2.00E-08	2.50E-05	2.40E-05	2.50E-05
Vanadium	V					
Zinc	Zn					

Notes:

1 Unless noted, combustion turbine (CT or "turbine") gas emission fctrs are from Emission Factors Handbook [EFH] - Guidelines for Estimating Trace Substance Emissions from Fossil Fuel Steam Electric Plants, Electric Power Research Institute (EPRI), Report No. EPRI TR-105611, 11-95, Table 4-1 (Uncontrolled Gas-Fired Boiler Emission Factors)[*]
[*]While EPRI cautioned against using the data in Table 4-1 for gas-fired turbines, TVA believes that the trace-element emission factors can be reasonably applicable to CT units. Fuel composition determines trace-element emissions (mass-per-unit-energy basis) whether burned in a boiler or a CT unit.

2 Unless noted, emission factors from EPA AP-42, Vol. I, 5th Ed., Sec 3.1 - Stationary Gas Turbines - Supplement F, 4/00; cited gas heat content (HHV): 1020 Btu/scf

3 Unless noted, all emission factors from EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - Supplement D, 7/98.

4 Diesel engine (e.g., fire pump) trace-element emission factors are assumed to be the same as CT oil-fired emission factors.

A CT Natrl Gas: US EPA, Air Emissions from Scrap Tire Combustion, EPA-600/R-97-115, October 1997 (natural gas-fired rotary-kiln incinerator simulator emission data). Emission factor assumed applicable for other natural gas-fired equipment.

B CT No. 2 Oil: HCl and Mn emission factors are derived from TVA CT fuel-oil specifications (#2 Distillate) Revision 5.0, 17-Jan-2001:
Chloride - 6 parts per million by weight (ppmw) Manganese - 2 ppmw

C No. 2 Oil general specifications: Density - 7.05 lb/gal [AP-42, Vol. 1, 5th Ed., Appendix A, 9/85 (re. 1/95)]
Ht Cntnt - 140,000 Btu/gal [from source in note B]

HAZARDOUS AIR POLLUTANT (HAP) EMISSION FACTOR REFERENCES

Table 2. Organic HAP Emission Factors

Pollutant	(CASRN)	Note	Turbines, lb/10^6 Btu Gas [1]	Turbines, lb/10^6 Btu Oil [1]	Ancillary Gas Equip [2] lb/10^6 scf	Diesel Engine [3] lb/10^6 Btu
1,1,2-Trichloroethane	79-00-5	HAP				
1,1,2,2-Tetrachloroethane	79-34-5	HAP				
1,3-Butadiene	106-99-0	HAP	4.30E-07	1.60E-05		3.91E-05
1,3-Dichloropropene	542-75-6	HAP				
2,2,4-Trimethylpentane	540-84-1	HAP				
2-Methylnaphthalene	91-57-6	A, POM	1.62E-07		2.40E-05	
3-Methylcholanthrene	56-49-5	PAC			1.80E-06	
7,12-Dimethylbenz(a)anthracene	57-97-6	PAC			1.60E-05	
Acenaphthene	83-32-9	POM			1.80E-06	1.42E-06
Acenaphthylene	208-96-8	POM			1.80E-06	5.06E-06
Acetaldehyde	75-07-0	HAP	4.00E-05			7.67E-04
Acrolein	107-02-8	HAP	6.40E-06			9.25E-05
Anthracene	120-12-7	POM			2.40E-06	1.87E-06
Benzene	71-43-2	HAP	1.20E-05	5.50E-05	2.10E-03	9.33E-04
Benzo(a)anthracene	56-55-3	PAC			1.80E-06	1.68E-06
Benzo(a)pyrene	50-32-8	PAC			1.20E-06	1.88E-07
Benzo(b)fluoranthene	205-99-2	PAC			1.80E-06	9.91E-08
Benzo(e)pyrene	192-97-2	HAP				
Benzo(g,h,i)perylene	191-24-2	POM			1.20E-06	4.89E-07
Benzo(k)fluoranthene	207-08-9	PAC			1.80E-06	1.55E-07
Biphenyl	92-52-4	HAP				
Carbon Tetrachloride	56-23-5	HAP				
Chlorobenzene	108-90-7	HAP				
Chloroform	67-66-3	HAP				
Chrysene	218-01-9	PAC			1.80E-06	3.53E-07
Dibenzo(a,h)anthracene	53-70-3	PAC			1.20E-06	5.83E-07
Dichlorobenzene [mixed isomers]	25321-22-6	HAP			1.20E-03	
Ethylbenzene	100-41-4	HAP	3.20E-05			
Ethylene Dibromide	106-93-4	HAP				
Fluoranthene	206-44-0	PAC			3.00E-06	7.61E-06
Fluorene	86-73-7	POM			2.80E-06	2.92E-05
Formaldehyde	50-00-0	B, HAP	2.20E-04	2.30E-04	7.50E-02	1.18E-03
Indeno(1,2,3-c,d)pyrene	193-39-5	PAC			1.80E-06	3.75E-07
Methanol	67-56-1	HAP				
Methylene Chloride	75-09-2	HAP				
Naphthalene	91-20-3	HAP	1.30E-06	3.50E-05	6.10E-04	8.48E-05
n-Hexane	110-54-3	C, HAP			4.30E-04	
Phenanthrene	85-01-8	POM	1.11E-07		1.70E-05	2.94E-05
Phenol	108-95-2	HAP				
Polycyclic Aromatic Hydrocarbons	PAH	POM	2.20E-06	4.00E-05		
Propylene Oxide	75-56-9	HAP	2.90E-05			
Pyrene	129-00-0	POM			5.00E-06	4.78E-06
Styrene	100-42-5	HAP				
Tetrachloroethane	630-20-6	HAP				
Toluene	108-88-3	HAP	1.30E-04		3.40E-03	4.09E-04
Vinyl Chloride	75-01-4	HAP				
Xylenes	1330-20-7	HAP	6.40E-05			2.85E-04

Notes:

1 Unless noted, all emission factors are from EPA AP-42, Vol. I, 5th Edition, Section 3.1 - Stationary Gas Turbines - Supplement F, 4/00.
2 Unless noted, all emission factors are from EPA AP-42, Vol. I, 5th Ed., Section 1.4 - Natural Gas Combustion - Supplement D, 7/98.
3 EPA AP-42, Vol. 1, 5th Ed., Chapter 3.3 - Gasoline and Diesel Industrial Engines - Supplement B, 10/96.

A Turbines: Gas-Fired Boiler and Turbine Air Toxics Summary Report, EPRI, Report No. EPRI TR-105646, Table S-2, 10-96
B Turbines: natural gas-fired formaldehyde emission factor based upon 40 CFR 63 Subpart YYYY's "91 ppb" limit. Emission inventory has used a lower emission factor for decades based upon the EPA access database (r03s01.zip) downloaded from EPA's CHIEF Website, 4-16-01, and evaluating emission factors therein for comparable CT units (see "cnst" worksheet, Table 3).
C Ancillary Gas Equip.: B.T. O'Neil & D.A. Orr, "Hexane and Other Alkane Emission Estimates for Natural Gas-Fired Boilers", EPRI, 5-5-00

APPENDIX B

401 KAR 52:020 FORMS

Division for Air Quality

300 Sower Boulevard

Frankfort, KY 40601

(502) 564-3999

DEP7007AI

Administrative Information

___ Section AI.1: Source Information

___ Section AI.2: Applicant Information

___ Section AI.3: Owner Information

___ Section AI.4: Type of Application

___ Section AI.5: Other Required Information

___ Section AI.6: Signature Block

___ Section AI.7: Notes, Comments, and Explanations

Additional Documentation

___ Additional Documentation attached

Source Name:	TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #:	21-177-00006
Permit #:	V-18-056 R2
Agency Interest (AI) ID:	3239
Date:	May 2025

Section AI.1: Source Information

Physical Location Address:	**Street:**	5562 Rockport Paradise Road				
	City:	Drakesboro	**County:**	Muhlenburg	**Zip Code:**	42337-2345
Mailing Address:	**Street or P.O. Box:**	5562 Rockport Paradise Road				
	City:	Drakesboro	**State:**	Kentucky	**Zip Code:**	42337-2345

Standard Coordinates for Source Physical Location

Longitude: -86.994167 (decimal degrees) **Latitude:** 37.263056 (decimal degrees)

Primary (NAICS) Category: Utilities **Primary NAICS #:** 221112

#

Classification (SIC) Category: Fossil Fuel Electric Power Generation **Primary SIC #:** 4911

Briefly discuss the type of business conducted at this site: Generation and transmission of electric power from burning natural gas.

Description of Area Surrounding Source:
- ☑ Rural Area
- ☑ Industrial Park
- ☐ Residential Area
- ☐ Urban Area
- ☐ Industrial Area
- ☐ Commercial Area

Is any part of the source located on federal land? ☑ Yes ☐ No

Number of Employees: 65

Approximate distance to nearest residence or commercial property: Five (5) Miles

Property Area: Approx. 3,700 Acres

Is this source portable? ☐ Yes ☑ No

What other environmental permits or registrations does this source currently hold or need to obtain in Kentucky?

NPDES/KPDES:	☑ Currently Hold	☐ Need	☐ N/A
Solid Waste:	☑ Currently Hold	☐ Need	☐ N/A
RCRA:	☑ Currently Hold	☐ Need	☐ N/A
UST:	☑ Currently Hold	☐ Need	☐ N/A

Type of Regulated Waste Activity:
- ☐ Mixed Waste Generator
- ☑ Generator
- ☐ Recycler
- ☐ Other: ______________
- ☐ U.S. Importer of Hazardous Waste
- ☐ Transporter
- ☐ Treatment/Storage/Disposal Facility
- ☐ N/A

Section AI.2: Applicant Information

Applicant Name: Tennessee Valley Authority (TVA)

Title: (if individual) Not Applicable (N/A)

Mailing Address:
Street or P.O. Box: 1101 Market Street
City: Chattanooga **State:** Tennessee **Zip Code:** 37402-2801

Email: (if individual) N/A

Phone: N/A

Technical Contact

Name: Emma Taul

Title: Environmental Scientist

Mailing Address:
Street or P.O. Box: 5562 Rockport Paradise Road
City: Drakesboro **State:** Kentucky **Zip Code:** 42337-2345

Email: emwethington@tva.gov

Phone: 270-476-4366

Air Permit Contact for Source

Name: Jack Byars

Title: Specialist, Air Permits & Compliance

Mailing Address:
Street or P.O. Box: 1101 Market Street, BR 2C-C
City: Chattanooga **State:** Tennessee **Zip Code:** 37402-2801

Email: jgbyars@tva.gov

Phone: 423-751-2666

Section AI.3: Owner Information

☑ **Owner same as applicant**

Name: Jim E. Phelps

Title: Plant Manager, TVA Paradise Combined Cycle Plant

Mailing Address:
Street or P.O. Box: 5562 Rockport Paradise Road
City: Drakesboro **State:** Kentucky **Zip Code:** 42337-2345

Email: jephelps@tva.gov

Phone: 270-476-4800

List names of owners and officers of the company who have an interest in the company of 5% or more.

Name	Position

Section AI.4: Type of Application

Current Status: ☑ Title V ☐ Conditional Major ☐ State-Origin ☐ General Permit ☐ Registration ☐ None

Requested Action: *(check all that apply)*

☐ Name Change	☐ Initial Registration	☑ Significant Revision	☐ Administrative Permit Amendment
☐ Renewal Permit	☐ Revised Registration	☐ Minor Revision	☐ Initial Source-wide OperatingPermit
☐ 502(b)(10)Change	☐ Extension Request	☐ Addition of New Facility	☐ Portable Plant Relocation Notice
☐ Revision	☐ Off Permit Change	☐ Landfill Alternate Compliance Submittal	☐ Modification of Existing Facilities
☐ Ownership Change	☐ Closure		

Requested Status: ☑ Title V ☐ Conditional Major ☐ State-Origin ☐ PSD ☐ NSR ☐ Other: ____________

Is the source requesting a limitation of potential emissions? ☑ Yes ☐ No

Pollutant:	Requested Limit:	Pollutant:	Requested Limit:
☐ Particulate Matter		☐ Single HAP	
☐ Volatile Organic Compounds (VOC)		☐ Combined HAPs	
☐ Carbon Monoxide		☐ Air Toxics (40 CFR 68, Subpart F)	
☐ Nitrogen Oxides		☐ Carbon Dioxide	
☐ Sulfur Dioxide		☐ Greenhouse Gases (GHG)	
☐ Lead		☑ Other	6,000-Bypass hours/year

For New Construction:

Proposed Start Date of Construction: *(MM/YYYY)* ____________ **Proposed Operation Start-Up Date:** *(MM/YYYY)* ____________

For Modifications:

Proposed Start Date of Modification: *(MM/YYYY)* May 2025 **Proposed Operation Start-Up Date:** *(MM/YYYY)* TBD

Applicant is seeking coverage under a permit shield. ☑ **Yes** ☐ **No** **Identify any non-applicable requirements for which permit shield is sought on a separate attachment to the application.**

Section AI.5 Other Required Information

Indicate the documents attached as part of this application:

- [x] DEP7007A Indirect Heat Exchangers and Turbines
- [ ] DEP7007B Manufacturing or Processing Operations
- [ ] DEP7007C Incinerators and Waste Burners
- [ ] DEP7007F Episode Standby Plan
- [ ] DEP7007J Volatile Liquid Storage
- [ ] DEP7007K Surface Coating or Printing Operations
- [ ] DEP7007L Mineral Processes
- [ ] DEP7007M Metal Cleaning Degreasers
- [x] DEP7007N Source Emissions Profile
- [ ] DEP7007P Perchloroethylene Dry Cleaning Systems
- [ ] DEP7007R Emission Offset Credit
- [ ] DEP7007S Service Stations
- [ ] DEP7007T Metal Plating and Surface Treatment Operations
- [x] DEP7007V Applicable Requirements and Compliance Activities
- [ ] DEP7007Y Good Engineering Practice and Stack Height Determination
- [ ] DEP7007AA Compliance Schedule for Non-complying Emission Units
- [ ] DEP7007BB Certified Progress Report
- [ ] DEP7007CC Compliance Certification
- [ ] DEP7007DD Insignificant Activities
- [ ] DEP7007EE Internal Combustion Engines
- [ ] DEP7007FF Secondary Aluminum Processing
- [ ] DEP7007GG Control Equipment
- [ ] DEP7007HH Haul Roads
- [ ] Confidentiality Claim
- [ ] Ownership Change Form
- [ ] Secretary of State Certificate
- [ ] Flowcharts or diagrams depicting process
- [ ] Digital Line Graphs (DLG) files of buldings, roads, etc.
- [ ] Site Map
- [ ] Map or drawing depicting location of facility
- [ ] Safety Data Sheet (SDS)
- [ ] Emergency Response Plan
- [ ] Other: ______________________

Section AI.6: Signature Block

I, the undersigned, hereby certify under penalty of law, that I am a responsible official*, and that I have personally examined, and am familiar with, the information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the information is on knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false or incomplete information, including the possibility of fine or imprisonment.

Jim E. Phelps
Authorized Signature

7 MAY ~~2024~~ 2025 JEP
Date

Jim E. Phelps
Type or Printed Name of Signatory

Plant Manager
Title of Signatory

*Responsible official as defined by 401 KAR 52:001.

Section AI.7: Notes, Comments, and Explanations	
1	Potential emissions will be limited by 40 CFR Part 60, Subpart TTTT, requirements and by project emissions accounting.
2	"Uncontrolled/Controlled Potential (lb/hr)" per-unit emissions reflect baseload-only operations at 59 deg. F, 60% RH, and 14.484 psia (i.e., 'Maximum Design Capacity').

Division for Air Quality

300 Sower Boulevard

Frankfort, KY 40601

(502) 564-3999

DEP7007A

Indirect Heat Exchangers and Turbines

___ Section A.1: General Information

___ Section A.2: Operating and Fuel Information

___ Section A.3: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG.

____ Manufacturer's specifications

Source Name: TVA - Paradise Combined Cycle Plant

KY EIS (AFS) #: 21-177-00006

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: May 2025

Section A.1: General Information

Emission Unit #	Emission Unit Name	Process ID	Process Name	Identify General Type: Indirect Heat Exchanger, Gas Turbine, or Combustion Turbine	Indirect Heat Exchanger Configuration	Manufacturer	Model No./ Serial No.	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	SCC Code	SCC Units	Control Device ID	Stack ID
123	Simple Cycle (1) - CT(1)	123	HRSG Bypass 1	Combustion Turbine		GE	7F.05	04/2015	20100201	10^6 Btu [HHV]	01	123
124	Simple Cycle (2) - CT(2)	124	HRSG Bypass 2	Combustion Turbine		GE	7F.05	04/2015	20100201	10^6 Btu [HHV]	01	124
125	Simple Cycle (3) - CT(3)	125	HRSG Bypass 3	Combustion Turbine		GE	7F.05	04/2015	20100201	10^6 Btu [HHV]	01	125

Section A.2: Operating and Fuel Information

Emission Unit #	If multipurpose unit, identify the percentage of use by purpose				Rated Capacity Heat Input *(MMBTU/hr)*	Rated Capacity Power Output		Describe Operating Scenario (only if this unit will be used in different configurations)	Classify Fuel as Primary or Secondary	Identify Fuel Type: Coal, Natural Gas, Wood, Biomass, Landfill/Digester Gas, Fuel Oil # (specify 1-6), or Other	Heat Content (HHV)		Maximum Operating Hours	Ash Content *(%)*	Sulfur Content *(%)*
	Space Heat	Process Heat	Power	Emergency			*(Specify units: hp, MW, or lb steam/hr)*					*(Specify units: Btu/lb, Btu/gal, or Btu/scf)*			
123			X		2,231	223	MW [Gross] @ 59 F		Primary	Natural Gas	1,020	Btu/scf		Neg.	3.23E-03
124			X		2,231	223	MW [Gross] @ 59 F		Primary	Natural Gas	1,020	Btu/scf	6,000	Neg.	3.23E-03
125			X		2,231	223	MW [Gross] @ 59 F		Primary	Natural Gas	1,020	Btu/scf		Neg.	3.23E-03

Section A.3: Notes, Comments, and Explanations
1 CT rated capacity heat input and power output at/near ISO conditions.
2 Natural gas heat content from EPA AP-42, Vol. I, 5th Edition, Section 3.1 - Stationary Gas Turbines - Supplement F, 4/00.

Division for Air Quality 300 Sower Boulevard Frankfort, KY 40601 (502) 564-3999

DEP7007N

Source Emissions Profile

__ Section N.1: Emission Summary
__ Section N.2: Stack Information
__ Section N.3: Fugitive Information
__ Section N.4: Notes, Comments, and Explanations

Additional Documentation
___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant

KY EIS (AFS) #: 21-177-00006

Permit #: V-18-056 R2

Agency Interest (AI) ID: 3239

Date: May 2025

N.1: Emission Summary

Emission Unit #	Emission Unit Name	Process ID	Process Name	Control Device Name	Control Device ID	Stack ID	Maximum Design Capacity *(SCC Units/hour)*	Pollutant	Uncontrolled Emission Factor *(lb/SCC Units)*	Emission Factor Source (e.g. AP-42, Stack Test, Mass Balance)	Capture Efficiency *(%)*	Control Efficiency *(%)*	Hourly Emissions		Annual Emissions	
													Uncontrolled Potential *(lb/hr)*	Controlled Potential *(lb/hr)*	Uncontrolled Potential *(tons/yr)*	Controlled Potential *(tons/yr)*
123	Simple Cycle (1) - CT(1)	123	HRSG Bypass 1	DLN	01	123	2,231	PM (TSP)	4.03E-03	Vendor Data			9.0	9.0	39.4	27.0
124	Simple Cycle (2) - CT(2)	124	HRSG Bypass 2	DLN	01	124	2,231	TPM10 [1]	8.06E-03	AP-42 & Eng. Estimate			18.0	18.0	78.7	53.9
125	Simple Cycle (3) - CT(3)	125	HRSG Bypass 3	DLN	01	125	2,231	TPM2.5 [1]	8.06E-03	AP-42 & Eng. Estimate			18.0	18.0	78.7	53.9
								SO2	2.88E-03	Eng. Estimate			6.43	6.43	28.2	19.3
								NOX	3.25E-02	Vendor Data			72.5	72.5	318	218
								CO	1.58E-02	Vendor Data			35.1	35.1	154	105
								VOC	1.53E-03	Vendor Data			3.42	3.42	15.0	10.3
								H2SO4	2.32E-04	Eng. Estimate			0.518	0.518	2.27	1.55
[1] Combination of filterable and condensable particulate								CO2 Equiv.	117.1	40 CFR Part 98			261,194	261,194	1,144,028	783,581
[2] Denotes EPRI's Emission Factor Handbook (EFH)								Lead	4.00E-07	EPRI's EFH [2]			8.92E-04	8.92E-04	3.91E-03	2.68E-03
[3] Combination of AP-42 and EPRI's EFH								Total HAP	4.57E-04	AP-42 & EFH [3]			1.02	1.02	4.47	3.06

Section N.4: Notes, Comments, and Explanations
1 "Maximum Design Capacity" correlates baseload operations at 59 deg. F, 60% relative humidity (RH), and site barometeric pressure (14.484 psia), which is the most representative of annual average site conditions and is most appropriate to determine "Controlled Potential (tons/year)".
2 "Uncontrolled/Controlled Potential (lb/hr)" per-unit emissions reflect baseload-only operations at 59 deg. F, 60% RH, and 14.484 psia (i.e., 'Maximum Design Capacity').
3 "Uncontrolled Potential (tons/year)" and "Controlled Potential (tons/year)" consider all potential HRSG bypass annual hours.

Division for Air Quality

300 Sower Boulevard
Frankfort, KY 40601
(502) 564-3999

DEP7007V
Applicable Requirements and Compliance Activities

___ Section V.1: Emission and Operating Limitation(s)
___ Section V.2: Monitoring Requirements
___ Section V.3: Recordkeeping Requirement
___ Section V.4: Reporting Requirements
___ Section V.5: Testing Requirements
___ Section V.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI

Source Name: TVA - Paradise Combined Cycle Plant
KY EIS (AFS) #: 21-177-00006
Permit #: V-18-056 R2
Agency Interest (AI) I 3239
Date: 45778

Section V.1: Emission and Operating Limitation(s)

Emission Unit #	Emission Unit Description	Applicable Regulation or Requirement	Pollutant	Emission Limit (if applicable)	Voluntary Emission Limit or Exemption (if applicable)	Operating Requirement or Limitation (if applicable)	Method of Determining Compliance with the Emission and Operating Requirement(s)
120-125	Combustion Turbines - Combined Cycle with Duct Firing & Simple Cycle Configuration	40 CFR 60 Subpart KKKK	NOX	15 ppmvd at 15% O2			Vendor guarantee meets this limit.
120-125		40 CFR 60 Subpart KKKK	SO2	0.060 lbs. SO2/MMBtu			Maintain good operation; burn only pipeline quality natural gas
120-122	Duct Burners	401 KAR 59:015, Section 4	Opacity	20% via 6-minute avg.	401 KAR 59:015, Sec. 4(2)(a); 401 KAR 59:015, Sec. 4(2)(c)		Burn natural gas only
120-122	Duct Burners	401 KAR 59:015, Section 4	PM	PM limit of 0.1 lb/MMBtu			Burn natural gas only
120-122	Duct Burners	401 KAR 59:015, Section 5	SO2	SO2 limit of 0.8 lb/MMBtu			Burn natural gas only
123-125	Combustion Turbines - Simple Cycle Configuration	Permit V-18-056 R2	All Regulated Pollutants	6,000 hrs./year			12-month rolling total

Section V.2: Monitoring Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Monitored	Description of Monitoring
120-125	Combustion Turbines - Combined Cycle with Duct Firing & Simple Cycle Configuration	NOX SO2	40 CFR 60 Subpart KKKK	NOX Fuel Sulfur Content	NOX: Continuous Emissions Monitoring System (CEMS) SO2: The use of a current, valid purchase contract, tariff sheet, or transportation contract for the fuel specifying the max total fuel sulfur content.
120-125		Greenhouse Gases	40 CFR 60 Subpart TTTT	lbs. CO2/MWh	12-operating-month rolling average

Section V.3: Recordkeeping Requirements

Emission Unit #	Emission Unit Description	Pollutant	Applicable Regulation or Requirement	Parameter Recorded	Description of Recordkeeping
120-125	Combustion Turbines - Combined Cycle with Duct Firing & Simple Cycle Configuration	All Regulated Pollutants	40 CFR 60.7(b)	Start-ups, shutdowns, and malfunctions	Maintain records of these events
123-125	Combustion Turbines - Simple Cycle	All Regulated Pollutants	Permit V-18-056 R2	Hours of Operation in Simple Cycle Mode	Record hours of operation for CTs in simple cycle mode.

Baidy, Michael (EEC)

From:	Byars, Jack Griffith II <jgbyars@tva.gov>
Sent:	Monday, November 4, 2024 2:27 PM
To:	Baidy, Michael (EEC); Daniels, Stacie (EEC)
Cc:	Taul, Emma Marie
Subject:	Re: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Thank you, Mr. Baidy.

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From: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Sent: Monday, November 4, 2024 2:25:01 PM
To: Byars, Jack Griffith II <jgbyars@tva.gov>; Daniels, Stacie (EEC) <stacie.daniels@ky.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Hello Jack Byars,

Yes, these two engine pumps can be removed from the draft permit before the draft is submitted for public comment.
We will remove EU149 and EU150 from the permit.
I don't need any other information from TVA right now. If I have any questions during the draft review, I will email you.

Thank you,

Michael Baidy
Environmental Engineer Technologist I
Division for Air Quality
Energy and Environment Cabinet
300 Sower Blvd. Frankfort, KY 40601
502-782-2157

From: Byars, Jack Griffith II <jgbyars@tva.gov>
Sent: Wednesday, October 23, 2024 2:23 PM
To: Baidy, Michael (EEC) <michael.baidy@ky.gov>; Daniels, Stacie (EEC) <stacie.daniels@ky.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Hello, Michael and Stacie,

Below are two additional sources that have been recently removed form service at Paradise.

- EU149, Gypsum Stilling Pond Engine Pump #1, John Deere Model 4045DF150A, Tier 1, 84 HP (63 kW), Date removed – 8/15/24
- EU150, Gypsum Stilling Pond Engine Pump #2, John Deere Model 4045TF285, Tier 3, 99 HP (74 kW), Date removed – 8/15/24

Is it possible that they can be removed from the draft renewal permit before it is released? Is there any other information that you need form TVA?

Thank you.

Jack Byars
Air Permits and Compliance Specialist
Environment & Sustainability

TENNESSEE VALLEY AUTHORITY

W. 423-751-2666 **E.** jgbyars@tva.gov
1101 Market Street, BR 2C-C, Chattanooga, TN 37402-2801

From: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Sent: Wednesday, July 17, 2024 9:02 AM
To: Byars, Jack Griffith II <jgbyars@tva.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Hello Mr. Byars,

This is the information I needed, thank you!
I will let you know if/when I have more questions.

Regards,

Michael Baidy
Environmental Engineer Technologist I
Division for Air Quality
Energy and Environment Cabinet
300 Sower Blvd. Frankfort, KY 40601
502-782-2157

From: Byars, Jack Griffith II <jgbyars@tva.gov>
Sent: Tuesday, July 16, 2024 1:08 PM
To: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Mr. Baidy,

The following sources were removed from the permit application:

Significant sources removed
144-146 – 3 Red Water Pond diesel engine/pumps
153 – ESS shop generator
154 – GN23 generator for scale
130 – unpaved haul roads for dewatered gypsum to landfill
133D & 135D – fly ash and gypsum drop points unloading at landfill
133B, 134E, 135A, and 135B – paved roads for landfill transport
133C, 135C, 136A, and 136B – unpaved landfill travel
134D, 136C – landfill open storage piles

That is all the significant sources that were removed.

Insignificant removed
10,000 gallon underground gasoline storage tank

Please let me know if you have any further questions.

Jack Byars
Air Permits and Compliance Specialist
Environment & Sustainability

TENNESSEE VALLEY AUTHORITY

W. 423-751-2666 **E.** jgbyars@tva.gov
1101 Market Street, BR 2C-C, Chattanooga, TN 37402-2801

From: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Sent: Tuesday, July 16, 2024 9:39 AM
To: Byars, Jack Griffith II <jgbyars@tva.gov>; Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

You don't often get email from michael.baidy@ky.gov. Learn why this is important

This is an EXTERNAL EMAIL from outside TVA. THINK BEFORE you CLICK links or OPEN attachments. If suspicious, please click the "Report Phishing" button located on the Outlook Toolbar at the top of your screen.

Hello Mr. Byars,

Could you please tell me which sources you have removed and which sources you will not use / will be removing? I need to know which ones specifically.

Thank you,

Michael Baidy
Environmental Engineer Technologist I
Division for Air Quality
Energy and Environment Cabinet
300 Sower Blvd. Frankfort, KY 40601
502-782-2157

From: Byars, Jack Griffith II <jgbyars@tva.gov>
Sent: Monday, July 15, 2024 3:59 PM
To: Baidy, Michael (EEC) <michael.baidy@ky.gov>; Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Good afternoon, Mr. Baidy.

There are some RICE sources that have been removed from the site and we would like them removed from the permit. There are also sources related to a landfill that will not be used that we wish to also remove from the permit. If you have any further questions, please let me know.

Thank you.

Jack Byars
Air Permits and Compliance Specialist
Environment & Sustainability

TVA TENNESSEE VALLEY AUTHORITY

W. 423-751-2666 **E.** jgbyars@tva.gov
1101 Market Street, BR 2C-C, Chattanooga, TN 37402-2801

From: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Sent: Thursday, July 11, 2024 2:28 PM

To: Taul, Emma Marie <emwethington@tva.gov>; Byars, Jack Griffith II <jgbyars@tva.gov>
Subject: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Hello Emma Taul and Jack Byars,

I have a question for you today regarding the permit renewal application for Tennessee Valley Authority – Paradise Combined Cycle Plant (TVA PCC).
In reading through the application, I noticed several emission units that were added previously were not included here. Then at the beginning of the application (P.10), it reads "*The information provided reflects current and prior operations as well as any changes being made or anticipated.*"

Could you please explain what changes you are requesting?

Thank you,

Michael Baidy
Environmental Engineer Technologist I
Division for Air Quality
Energy and Environment Cabinet
300 Sower Blvd. Frankfort, KY 40601
502-782-2157

Baidy, Michael (EEC)

From:	Byars, Jack Griffith II <jgbyars@tva.gov>
Sent:	Wednesday, October 22, 2025 2:56 PM
To:	Baidy, Michael (EEC)
Cc:	Daniels, Stacie (EEC); Southerland, Joseph B; Watts, James Wesley
Subject:	RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant
Attachments:	DEP7007DD Form - Insignificant Activities_REV01.pdf; DEP7007J Form - Volatile Liquid Storage.pdf

Good afternoon, Michael.

Attached are the revised forms that you requested. If you have any questions about them, please reach out to me.

Thank you.

Jack

Jack Byars
Air Permits and Compliance Specialist
Environment Compliance Operations

TENNESSEE VALLEY AUTHORITY

W. 423-751-2666 **E.** jgbyars@tva.gov
1101 Market Street, BR 2C-C, Chattanooga, TN 37402-2801

From: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Sent: Tuesday, October 14, 2025 2:08 PM

To: Byars, Jack Griffith II <jgbyars@tva.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>; Daniels, Stacie (EEC) <stacie.daniels@ky.gov>; Southerland, Joseph B <jbsoutherland@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Hello Jack Byars,

I will update the IA description of the tank at the Facilities Maintenance Base as you outlined.

Yes, the "*300-gallon gasoline tank at the Combined Cycle Plant*" will be removed from the IA list. It will go into Section B of the permit because it dispenses gasoline and is subject to 40 CFR 63 Subpart CCCCCC. Subpart 6C's requirements are based upon monthly throughput. The Division need an estimated fuel throughput in gallons per month to add the unit to Section B.
You can add the unit to the DEP7007J form (Volatile Liquid Storage) since you're submitting a new DD form as well.

If you have any questions, please let me know.

Thank you,

Michael Baidy
Environmental Engineer Technologist II
Division for Air Quality
Energy and Environment Cabinet
300 Sower Blvd. Frankfort, KY 40601
502-782-2157

From: Byars, Jack Griffith II <jgbyars@tva.gov>
Sent: Tuesday, October 14, 2025 10:10 AM
To: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>; Daniels, Stacie (EEC) <stacie.daniels@ky.gov>; Southerland, Joseph B <jbsoutherland@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Hi, Michael.

It was good speaking to you as well.

We are preparing the revision of the DEP7007DD form to add the NH3 tanks, as you requested. In addition, we need to revise the description of the 300-gallon tank at the Facilities Maintenance Base, as it is a diesel tank and not a gasoline tank.

The 300-gallon gasoline tank at the Combined Cycle Plant does dispense into motor equipment. Do we need to remove it from the IA list? If so, what form should it be moved to?

Thank you.

Jack

Jack Byars
Air Permits and Compliance Specialist
Environment Compliance Operations

TENNESSEE VALLEY AUTHORITY

W. 423-751-2666 **E.** jgbyars@tva.gov
1101 Market Street, BR 2C-C, Chattanooga, TN 37402-2801

From: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Sent: Thursday, October 9, 2025 10:03 AM
To: Byars, Jack Griffith II <jgbyars@tva.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>; Daniels, Stacie (EEC) <stacie.daniels@ky.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Hello Jack Byars,

Thank you for speaking to me this morning on the phone.
I will write what I said over the phone here.

Yes, the Division can add the 3rd diesel engine pump to the draft permit. Since it is the same model as EU 152, I will not need additional information to add it to the permit at this time.

I asked for clarification for a few insignificant activities:

The 2024 renewal application P.31 reads *"The facility has two (2) aqueous NH3 tanks, each with a capacity of 20,000 gallons. The tanks are designed to operate under atmospheric pressure and store 19.5 percent aqueous NH3."*. I did not see any other information about these ammonia tanks in the application. I requested an updated DEP7007DD form to add the ammonia tanks to the insignificant activity list.

I asked if the two gasoline tanks in the IA list were only storage tanks or if they had gasoline dispensing facilities attached.

Gasoline Tank at Combined Cycle Plant – 300 gallons
Gasoline Tank at Facilities Maintenance Base – 300 gallons

Please let me know if you have any questions.

Thank you,

Michael Baidy
Environmental Engineer Technologist II
Division for Air Quality
Energy and Environment Cabinet
300 Sower Blvd. Frankfort, KY 40601
502-782-2157

From: Byars, Jack Griffith II <jgbyars@tva.gov>
Sent: Wednesday, October 8, 2025 4:39 PM
To: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>; Daniels, Stacie (EEC) <stacie.daniels@ky.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Good afternoon, Michael.

Paradise has a new diesel engine/pump that will soon start operating. It is a backup pump to EU 151 (Daniel Run Coal Fines Engine Pump #1). This engine is the same model and has the same date of manufacture (2012) as EU152 (Daniel Run Coal Fines Engine Pump #2). It is a John Deere Model 4045TF290, Tier 3, 74 HP (55 kW). It should be permitted to be able to operate 8760 hour per year. A description for the permit would be "Daniel Run Coal Fines Engine Pump #3". Is it possible to add it to the draft permit? Would you need anything else from us?

Thank you,

Jack
Jack Byars
Air Permits and Compliance Specialist
Environment Compliance Operations

TVA TENNESSEE VALLEY AUTHORITY

W. 423-751-2666 **E.** jgbyars@tva.gov
1101 Market Street, BR 2C-C, Chattanooga, TN 37402-2801

From: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Sent: Monday, November 4, 2024 2:25 PM

To: Byars, Jack Griffith II <jgbyars@tva.gov>; Daniels, Stacie (EEC) <stacie.daniels@ky.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

This is an EXTERNAL EMAIL from outside TVA. THINK BEFORE you CLICK links or OPEN attachments. If suspicious, please click the "Report Phishing" button located on the Outlook Toolbar at the top of your screen.

Hello Jack Byars,

Yes, these two engine pumps can be removed from the draft permit before the draft is submitted for public comment.
We will remove EU149 and EU150 from the permit.
I don't need any other information from TVA right now. If I have any questions during the draft review, I will email you.

Thank you,

Michael Baidy
Environmental Engineer Technologist I
Division for Air Quality
Energy and Environment Cabinet
300 Sower Blvd. Frankfort, KY 40601
502-782-2157

From: Byars, Jack Griffith II <jgbyars@tva.gov>
Sent: Wednesday, October 23, 2024 2:23 PM
To: Baidy, Michael (EEC) <michael.baidy@ky.gov>; Daniels, Stacie (EEC) <stacie.daniels@ky.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Hello, Michael and Stacie,

Below are two additional sources that have been recently removed form service at Paradise.

- EU149, Gypsum Stilling Pond Engine Pump #1, John Deere Model 4045DF150A, Tier 1, 84 HP (63 kW), Date removed – 8/15/24
- EU150, Gypsum Stilling Pond Engine Pump #2, John Deere Model 4045TF285, Tier 3, 99 HP (74 kW), Date removed – 8/15/24

Is it possible that they can be removed from the draft renewal permit before it is released? Is there any other information that you need form TVA?

Thank you.

Jack Byars
Air Permits and Compliance Specialist
Environment & Sustainability

TVA TENNESSEE VALLEY AUTHORITY

W. 423-751-2666 **E.** jgbyars@tva.gov
1101 Market Street, BR 2C-C, Chattanooga, TN 37402-2801

From: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Sent: Wednesday, July 17, 2024 9:02 AM
To: Byars, Jack Griffith II <jgbyars@tva.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Hello Mr. Byars,

This is the information I needed, thank you!
I will let you know if/when I have more questions.

Regards,

Michael Baidy
Environmental Engineer Technologist I
Division for Air Quality
Energy and Environment Cabinet
300 Sower Blvd. Frankfort, KY 40601
502-782-2157

From: Byars, Jack Griffith II <jgbyars@tva.gov>
Sent: Tuesday, July 16, 2024 1:08 PM
To: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Cc: Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Mr. Baidy,

The following sources were removed from the permit application:

<u>Significant sources removed</u>
144-146 – 3 Red Water Pond diesel engine/pumps
153 – ESS shop generator
154 – GN23 generator for scale
130 – unpaved haul roads for dewatered gypsum to landfill
133D & 135D – fly ash and gypsum drop points unloading at landfill
133B, 134E, 135A, and 135B – paved roads for landfill transport
133C, 135C, 136A, and 136B – unpaved landfill travel
134D, 136C – landfill open storage piles

That is all the significant sources that were removed.

Insignificant removed
10,000 gallon underground gasoline storage tank

Please let me know if you have any further questions.

Jack Byars
Air Permits and Compliance Specialist
Environment & Sustainability

TENNESSEE VALLEY AUTHORITY

W. 423-751-2666 **E.** jgbyars@tva.gov
1101 Market Street, BR 2C-C, Chattanooga, TN 37402-2801

From: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Sent: Tuesday, July 16, 2024 9:39 AM
To: Byars, Jack Griffith II <jgbyars@tva.gov>; Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Hello Mr. Byars,

Could you please tell me which sources you have removed and which sources you will not use / will be removing? I need to know which ones specifically.

Thank you,

Michael Baidy
Environmental Engineer Technologist I
Division for Air Quality
Energy and Environment Cabinet
300 Sower Blvd. Frankfort, KY 40601
502-782-2157

From: Byars, Jack Griffith II <jgbyars@tva.gov>
Sent: Monday, July 15, 2024 3:59 PM

To: Baidy, Michael (EEC) <michael.baidy@ky.gov>; Taul, Emma Marie <emwethington@tva.gov>
Subject: RE: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Good afternoon, Mr. Baidy.

There are some RICE sources that have been removed from the site and we would like them removed from the permit. There are also sources related to a landfill that will not be used that we wish to also remove from the permit. If you have any further questions, please let me know.

Thank you.

Jack Byars
Air Permits and Compliance Specialist
Environment & Sustainability

TENNESSEE
VALLEY
AUTHORITY

W. 423-751-2666 **E.** jgbyars@tva.gov
1101 Market Street, BR 2C-C, Chattanooga, TN 37402-2801

From: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Sent: Thursday, July 11, 2024 2:28 PM
To: Taul, Emma Marie <emwethington@tva.gov>; Byars, Jack Griffith II <jgbyars@tva.gov>
Subject: KY DEP DAQ - Application question - TVA Paradise Combined Cycle Plant

Hello Emma Taul and Jack Byars,

I have a question for you today regarding the permit renewal application for Tennessee Valley Authority – Paradise Combined Cycle Plant (TVA PCC).
In reading through the application, I noticed several emission units that were added previously were not included here. Then at the beginning of the application (P.10), it reads "*The information provided reflects current and prior operations as well as any changes being made or anticipated.*"

Could you please explain what changes you are requesting?

Thank you,

Michael Baidy
Environmental Engineer Technologist I
Division for Air Quality
Energy and Environment Cabinet

300 Sower Blvd. Frankfort, KY 40601
502-782-2157

Division for Air Quality
300 Sower Boulevard
Frankfort, KY 40601
(502) 564-3999

DEP7007DD

Insignificant Activities

___ Section DD.1: Table of Insignificant Activities
___ Section DD.2: Signature Block
___ Section DD.3: Notes, Comments, and Explanations

Source Name: TVA - Paradise Combined Cycle Plant

KY EIS (AFS) #: **21- 177-00006**

Permit #: V-18-056 R2

Agency Interest (AI) ID: 127687

Date: 5/31/2024

Section DD.1: Table of Insignificant Activities

*Identify each activity with a unique Insignificant Activity number (IA #); for example: 1, 2, 3… etc.

Insignificant Activity #	Description of Activity including Rated Capacity	Serial Number or Other Unique Identifier	Applicable Regulation(s)	Calculated Emissions
1	Diesel fuel oil tank at Utility Building - 10,600 gal			
2	Diesel fuel oil tank at Combined Cycle Plant - 500 gal			
3	Diesel fuel oil tank at Combined Cycle Plant for Fire Pump - 500 gal			
4	On-road diesel tank at Facilities Maintenance Base - 1,000 gal			
5	Diesel fuel oil tank at Facilities Maintenance Base - 300 gal			

Insignificant Activity #	Description of Activity including Rated Capacity	Serial Number or Other Unique Identifier	Applicable Regulation(s)	Calculated Emissions
6	Diesel fuel oil tank at Cell Tower - 147 gal			
7	Diesel fuel oil tank at Project Trailers - 3,000 gal			
8	Diesel tank at Gypsum Stack Maintenance Building - 4,000 gal			
9	Aqueous Ammonia Tank #1 - 20,000 gal			
10	Aqueous Ammonia Tank #2 - 20,000 gal			

Section DD.2: Signature Block

I, THE UNDERSIGNED, HEREBY CERTIFY UNDER PENALTY OF LAW, THAT I AM A RESPONSIBLE OFFICIAL, AND THAT I HAVE PERSONALLY EXAMINED, AND AM FAMILIAR WITH, THE INFORMATION SUBMITTED IN THIS DOCUMENT AND ALL ITS ATTACHMENTS. BASED ON MY INQUIRY OF THOSE INDIVIDUALS WITH PRIMARY RESPONSIBILITY FOR OBTAINING THE INFORMATION, I CERTIFY THAT THE INFORMATION IS ON KNOWLEDGE AND BELIEF, TRUE, ACCURATE, AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE OR INCOMPLETE INFORMATION, INCLUDING THE POSSIBILITY OF FINE OR IMPRISONMENT.

By:

Authorized Signature	**Date**
Jim E. Phelps	Plant Manager
Type/Print Name of Siguatory	**Title of Siguatory**

Division for Air Quality

300 Sower Boulevard
Frankfort, KY 40601
(502) 564-3999

DEP7007J

Volatile Liquid Storage

___ Section J.1: General Information
___ Section J.2: Tank Description
___ Section J.3: Gasoline Plants and Terminals
___ Section J.4: Loading Rack(s)
___ Section J.5: Equipment Leaks
___ Section J.6: Notes, Comments, and Explanations

Additional Documentation

___ Complete DEP7007AI, DEP7007N, DEP7007V, and DEP7007GG.

___ SDS attached

Source Name: **TVA - Paradise Combined Cycle Plant**

KY EIS (AFS) #: **21- 177-00006**

Permit #: **V-18-056 R2**

Agency Interest (AI) ID: **127687**

Date: **10/15/2025**

Section J.1: General Information

Emission Unit #	Emission Unit Name	Emission Unit Description	Proposed/Actual Date of Construction Commencement *(MM/YYYY)*	Date of modification/ reconstruction	Control Device ID	Stack ID
156	CC Plant Gasoline Tank	300 gallon Gasoline tank located at the Combined Cycle Plant				

Section J.2: Tank Description

Emission Point #: 156

Emission Point Name: CC Plant Gasoline Tank

Tank ID#: EU #156

Date Installed: May 2022

List Applicable Regulations: 40 CFR 63 Subpart CCCCCC

J.2A: Stored Liquid Data:

Single or Multi-Component Liquid Name(s)	Maximum Annual Throughput *(gal/yr)*	Liquid Density *(lb/gal)*	Molecular Weight of Single or Multi-Component Liquid	Percent Composition of Multi-Component Liquid(s)	Temperature *(°F)*		Vapor Pressure *(psia)*	
					Minimum	Maximum	Minimum	Maximum
Motor Gasoline	3000	5.6	92 lb/lb-mole		Avg Ambient Winter Temp 25F	Avg Ambient Summer Temp 90F		5.2 psia @ 60F

J.2B: Tank Data:

Tank Capacity: *(gallons)* 300 Gallons

Shell Height/ Length: *(ft)* 5.10

Shell Diameter: *(ft)* 3.17

Tank Turnovers per Year: 10

Tank Orientation: ☒ Horizontal ☐ Vertical

If Vertical, provide Maximum Liquid Height: *(ft)* ______

Average Liquid Height: *(ft)* ______

Shell Color/Shade: ☐ Red ☒ White ☐ Light Gray ☐ Medium Gray ☐ Aluminum Specular ☐ Aluminum Diffuse ☐ Other: ______

Roof Color: ☐ Slack ☒ White ☐ Light Gray ☐ Medium Gray ☐ Aluminum Specular ☐ Aluminum Diffuse ☐ Other: ______

Tank Type: ☒ Fixed Roof ☐ Internal Floating Roof ☐ External Floating Roof ☐ Pressure Tank

J.2C: For Fixed Roof Tanks:

Roof Type: ☒ Dome ☐ Flat ☐ Cone

Dome/Cone Height: ______ ft

Average Vapor Space Height: ______ ft

Is Tank Underground?: ☐ Yes ☒ No

Roof Condition: ☒ Good ☐ Poor

Vacuum Setting: ______ psig

Is Tank Heated?: ☐ Yes ☒ No

Shell Condition: ☒ Good ☐ Poor

Pressure Setting: ______ psig

J.2D: For All Internal Floating Roof Tanks:

Rim Seal Description: ☐ Vapor Mounted Primary ☐ Vapor Mounted Primary plus Secondary Seal ☐ Shoe Mounted ☐ Liquid Mounted Primary ☐ Liquid Mounted Primary plus Secondary Seal ☐ Shoe Mounted plus Secondary Seal

Secondary Seal: ☐ Rim Mounted ☐ Shoe Mounted ☐ None

Internal Shell Condition: ☐ Light Rust ☐ Dense Rust ☐ Gunite-lined

External Shell Condition: ☐ Good ☐ Poor

Roof Paint Condition: ☐ Good ☐ Poor

Self Supporting Roof? ☐ Yes ☐ No

Number of Support Columns: ______

Effective Column Diameter: ______ ft

J.2E: Deck Data for Internal Floating Roofs:

Length of Deck Seam: ____________________ ft

Deck Type: ☐ Bolted ☐ Welded

Type of Deck Fitting:
☐ Access Hatch ☐ Ladder Well ☐ Sample Pipe ☐ Sample Well ☐ Vacuum Breaker
☐ Column Well ☐ Roof Leg ☐ Hanger Well ☐ Stub Drain ☐ Automatic Gauge Float Well

Design of each deck fitting:
(diameter sizes, bolted or gasket covers, sliding cover or fabric seal, adjustable or fixed roof leg/hanger well and number)

J.2F: For All External Floating Roof Tanks:

Rim Seal Description:
☐ Vapor Mounted Primary ☐ Vapor Mounted Primary Rim Secondary Seal ☐ Vapor Mounted Prmary with Weather Shield
☐ Liquid Mounted Primary ☐ Liquid Mounted Primary Rim Secondary Seal ☐ Liquid Mounted Primary with Weather Shield
☐ Shoe Mounted Primary ☐ Shoe Mounted Primary Rim Secondary Seal ☐ Shoe Mounted Primary Shoe Secondary

Internal Shell Condition: ☐ Light Rust ☐ Dense Rust ☐ Gunite-lined

Tank Type: ☐ Riveted ☐ Welded

Roof Type: ☐ Pontoon Roof ☐ Double Deck Roof

J.2G: Deck Data for External Floating Roof Tanks:

Type of Deck Fitting:
☐ Access Hatch ☐ Gauge Hatch ☐ Sample Well ☐ Roof Leg ☐ Vacuum Breaker
☐ Guide Pole ☐ Gauge Float ☐ Roof Drain ☐ Rim Vent ☐ Other

Design of each deck fitting:
(diameter sizes, bolted or gasket covers, sliding cover, unslotted or slotted guide pole well, adjusted or fixed roof leg and number of each design)

J.2H: Emissions Data:

Attach SDS/Composition Analysis for Each Component Listed

Process ID	Component Name	Process Name (e.g. Breathing, Working, Cleaning, Flashing Loss(es))	Lost Emissions *(lb/1000 gal)*	Frequency of Occurrence	Determination Methodology for Each Type of Loss*
	CC Plant Gasoline Tank	Working Losses	8.33 lb/1000 gal	Intermittent	EPA Tanks 5.0
	CC Plant Gasoline Tank	Standing Losses	54.76 lb/1000 gal	Continuous	EPA Tanks 5.0

Section J.3: Gasoline Plants and Terminals

Indicate the percentage of one or more of the following modes of transportation for incoming liquid and outgoing liquid:

	Tank Truck	Trailer	Railcar	Pipeline	Marine Tank	Barge	Other (Specify)
Incoming Liquid Material:							
Outgoing Liquid Material:							

For Gasoline Dispensing Facilities (GDF) only:

Is the loading of gasoline storage tanks at a GDF located at an area source of hazardous air pollutants as defined in 40 CFR 63.2? ☐ Yes ☐ No

Is there the dispensing of gasoline from a fixed storage tank at a GDF into a portable tank for the on-site delivery and subsequent dispensing into gasoline-fueled equipment? ☐ Yes ☐ No

Maximum monthly throughput in gallons: 250 gal/ month

For Bulk Gasoline Plants Only:

Is the maximum calculated design throughput less than 20,000 gallons (75,700 liters) per day? ☐ Yes ☐ No

Is gasoline loaded into cargo tanks for transport to gasoline dispensing facilities? ☐ Yes ☐ No

For Bulk Gasoline Terminals Only:

Is the maximum calculated design throughput equal to or greater than 20,000 gallons (75,700 liters) per day? ☐ Yes ☐ No

Is the terminal located at an area source of hazardous air pollutants as defined in 40 CFR 63.2?	☐ Yes	☐ No
Does the facility load from marine tank vessel loading operations at all loading berths less than 1.6 billion liters (10 M barrels) of gasoline annually and of less than 32 billion liters (200 M barrels) of crude oil annually?	☐ Yes	☐ No
Does the terminal handle any reformatted or oxygenated gasoline containing methyl tertbutyl ether (MTBE), CF?	☐ Yes	☐ No

Indicate the type of vapor control device utilized: ☐ Incinerator ☐ Adsorber ☐ Other

Section J.4: Loading Rack(s)

Emission Point #: ______________________________

Emission Point Name: ______________________________

Loading Rack ID#: ______________________________

Product Type	**Number of Lanes/Rack**	**Number of risers/loading arms per rack**	**Does the petroleum storage capacity exceed 300,000 barrels?** *(Y/N)*	**Time required to load standard size tanker** *(minutes)*	**Barge/Pipeline Unloading Rate** *(barrels/hr)*	**Barge/Pipeline Unloading Rate** *(barrels/yr)*	**Maximum Loaded** *(gal/hr)*	**Maximum Loaded** *(gal/yr)*	**Stack ID**	**Control Device ID**

Section J.5: Equipment Leaks

Emission Point #: ______________________

Emission Point Name: ______________________

This section is to be completed for all components of Volatile Liquid Storage Systems that may have leaks.

Equipment Type	**Indicate the number of each type of equipment for this emission point**		**Emission Factor** *(lb/SCC units)*		**Source of Emission Factor**	**Total Emissions** *(lb/yr)*
	Gasoline	Other (diesel, kerosene, etc.)	Gasoline	Other		
Valves						
Pumps						
Connectors						
Risers/Loading-Arm Valves						
Open-ended Lines						
Other						

Section J.6: Notes, Comments, and Explanations

Baidy, Michael (EEC)

From:	Byars, Jack Griffith II <jgbyars@tva.gov>
Sent:	Wednesday, April 1, 2026 5:28 PM
To:	Baidy, Michael (EEC)
Subject:	RE: KY DAQ - Courtesy permit copy for review - Tennessee Valley Authority Paradise Combined Cycle Plant

Dear Mr. Baidy,

Thank you for the opportunity to comment on the courtesy draft. So far, the only needed change identified is that EU148 was manufactured in 2011 rather than 2013. Please let me know if you have any questions.

Thank you again.

Jack

Jack Byars
Air Permits and Compliance Specialist
Environment Compliance Operations

TVA TENNESSEE VALLEY AUTHORITY

W. 423-751-2666 **E.** jgbyars@tva.gov
1101 Market Street, BR 2C-C, Chattanooga, TN 37402-2801

From: Baidy, Michael (EEC) <michael.baidy@ky.gov>
Sent: Wednesday, March 25, 2026 7:57 AM
To: Byars, Jack Griffith II <jgbyars@tva.gov>
Cc: Daniels, Stacie (EEC) <stacie.daniels@ky.gov>; Bittner, Zachary P (EEC) <Zachary.Bittner@ky.gov>; Blair, Lori R (EEC) <Lori.Blair@ky.gov>; Taul, Emma Marie <emwethington@tva.gov>
Subject: KY DAQ - Courtesy permit copy for review - Tennessee Valley Authority Paradise Combined Cycle Plant

Dear Mr. Jack Byars,

Please find attached a courtesy copy of the Title V permit renewal for Tennessee Valley Authority (TVA) – Paradise Combined Cycle Plant. Please submit any written questions or comments no later than close of business on April 1, 2026, so that the Division may continue processing the permitting action. Any submitted questions and comments will be part of the public permitting record and considered disclosable under the Kentucky Open Records Act. Be advised that the final permit may differ from the attached even if there are no questions or comments as the permit package will undergo additional internal reviews and approvals.

Best Regards,

Michael Baidy
Environmental Engineer Technologist II
Division for Air Quality
Energy and Environment Cabinet
300 Sower Blvd. Frankfort, KY 40601
502-782-2157