

US EPA ARCHIVE DOCUMENT

HILL COUNTRY ENVIRONMENTAL, INC.

June 15, 2012

RECEIVED
12 JUN 20 PM 4: 21
AIR PERMITS SECTION
6PD-R

Mr. Jeffrey Robinson
Permit Section Chief
U.S. EPA (6PD-R)
1445 Ross Ave. Ste. 1200
Dallas, Texas 75202-2733

Re: Calhoun Port Authority - ES Joslin Power Station
1002 FM 1593 South, Point Comfort, Calhoun County, Texas 77978
CN601573462
RN100226638

Initial Submittal: Prevention of Significant Deterioration Permit Application for Greenhouse Gas Emissions

Dear Mr. Robinson:

On behalf of Calhoun Port Authority (CPA), Hill Country Environmental (HCE) is submitting this application for a Prevention of Significant Deterioration (PSD) air quality permit for greenhouse gas emissions (GHGs) for the proposed repowering of the electric generating station at the CPA – ES Joslin Power Plant.

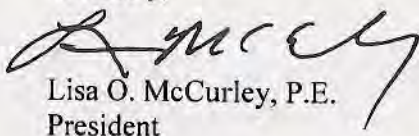
The attached application includes the TCEQ Form PI-1 – General Application for Air Preconstruction Permit and Amendments, submitted in May 2011 to the TCEQ and is pending approval to authorize non-GHG emissions under TCEQ NSR Permit No. 96336/PSD-TX-1256. The application showed the project triggered PSD review for criteria pollutants and that the project has a potential to emit GHGs in excess of 75,000 TPY CO₂e; therefore, PSD review is required for GHG emissions. The GHG permit application has been prepared per US Environmental Protection Agency (EPA) Publication No. EPA-457/B-11-001, *PSD and Title V Permitting Guidance for Greenhouse Gases*, dated March 2011.

Upon EPA's confirmation of receipt of this application, HCE will be requesting on behalf of CPA, that the EPA designate CPA and HCE as non-federal representatives, per 50 CFR §402.08, for the purposes of engaging in informal consultation and preparing a biological assessment.

CPA intends to begin construction July 2012 and is committed to working with the EPA Region 6 to answer any questions that arise during the application review.

Please contact me at 512.327.2725 or at Lisa@hillcountryenv.com with any questions or comments.

Sincerely,


Lisa O. McCurley, P.E.
President

cc: Charles R. Hausmann, Port Director, Calhoun Port Authority *(without CD)*
Mr. Mike Wilson, P.E., Director, Air Permits Division, TCEQ *(without CD)*
Ms. Melanie Magee, EPA Region 6 *(without CD)*

Attachments

List of Attachments:

Form PI-1 – General Application for Air Preconstruction Permit and Amendments
Area Map
Plot Plans
Process Description
Process Flow Diagram
Prevention of Significant Deterioration Applicability
Other Prevention of Significant Deterioration Requirements
Table 1(a)
Emission Calculations
 Carbon Dioxide Equivalent GHG Emissions Summary
 Combustion Turbine Generators
 Plant-wide Natural Gas Fugitives
 Emergency Engines
 Circuit Breakers
Best Available Control Technology (BACT) Review
GHG Applicability Flowchart – Modified sources (On or after July 1, 2011)
CD – Electronic Copy of the Application



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

Update: The TCEQ requires that a Core Data Form be submitted on all incoming applications unless a Regulated Entity and Customer Reference Number have been issued by the TCEQ and no core data information has changed. For more information regarding the Core Data Form, call (512) 239-5175 or go to the TCEQ Web site at www.tceq.state.tx.us/permitting/central_registry/guidance.html.

I. APPLICANT INFORMATION		
A. Company or Other Legal Name: Calhoun Port Authority		
Texas Secretary of State Charter/Registration Number (if applicable):		
B. Company Official Contact Name (☒ Mr. ☐ Mrs. ☐ Ms. ☐ Dr.): Charles R. Hausmann		
Title: Port Director		
Mailing Address: P.O. Box 397		
City: Point Comfort	State: Texas	ZIP Code: 77978
Telephone No: 361-987-2813	Fax No.: 361-987-2189	E-mail Address: crh@portofplpc.com
C. Technical Contact Name (☐ Mr. ☐ Mrs. ☒ Ms. ☐ Dr.): Lisa O. McCurley, P.E.		
Title: President		
Company Name: Hill Country Environmental, Inc.		
Mailing Address: 1613 S Capital of Texas Highway, Suite 201		
City: Austin	State: Texas	ZIP Code: 78746
Telephone No.: 512-327-2725	Fax No.: 512-327-2750	E-mail Address: lisa@hillcountryenv.com
D. Facility Location Information:		
Street Address: 1002 FM 1593 S		
If no street address, provide clear driving directions to the site in writing:		
City: Point Comfort	County: Calhoun	ZIP Code: 77978
E. TCEQ Account Identification Number (leave blank if new site or facility): N/A		
F. Is a TCEQ Core Data Form (TCEQ Form No. 10400) attached?		☒ YES ☐ NO
G. TCEQ Customer Reference Number (leave blank if unknown): CN601573462		
H. TCEQ Regulated Entity Number (leave blank if unknown): RN100226638		
II. IMPORTANT GENERAL INFORMATION		
A. Is confidential information submitted with this application?		☐ YES ☒ NO
If "YES," is each "confidential" page marked "CONFIDENTIAL" in large red letters?		☐ YES ☐ NO



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

II. IMPORTANT GENERAL INFORMATION (continued)		
B. Is this application in response to a TCEQ investigation or enforcement action?		☐ YES ☒ NO
If "YES", attach a copy of any correspondence from the TCEQ		
C. Number of New Jobs: 25		
D. Names of the State Senator and district number for this facility site: Glenn Hegar, District 18		
Names of State Representative and district number for this facility site: Todd A. Hunter, District 32		
E. For Concrete Batch Plants, and PSD, or Nonattainment Permits that require public notice, name of the County Judge for this facility site: Michael J. Pfeifer		
Mailing Address: 211 S. Ann Street, Suite 301		
City: Port Lavaca	State: Texas	ZIP Code: 77979
F. For Concrete Batch Plants, is the facility located in a municipality or an extraterritorial jurisdiction of a municipality?		☐ YES ☐ NO ☒ N/A
If "YES," list the name(s) of the Presiding Officer(s) for this facility site: N/A		
Mailing Address: N/A		
City: N/A	State: N/A	ZIP Code: N/A
III. FACILITY AND SOURCE INFORMATION		
A. Site Name: Calhoun Port Authority - ES Joslin Power Plant		
B. Area Name/Type of Facility: Point Comfort / Electricity Generating Unit		☒ Permanent ☐ Portable
C. Principal Company Product or Business: Electricity Generation		
Principal Standard Industrial Classification Code: 4911		
D. Projected Start of Construction Date: 07/01/12		Projected Start of Operation Date: 07/01/13
IV. TYPE OF PERMIT ACTION REQUESTED		
A. Permit Number (if existing): N/A		
B. Is this an initial permit application?		☒ YES ☐ NO
If "YES," check the type of permit requested (check <u>all</u> that apply):		
☒ State Permit	☐ Nonattainment Federal Permit	
☐ Flexible Permit	☒ Prevention of Significant Deterioration Federal Permit	
☐ Multiple Plant Permit	☐ Hazardous Air Pollutants Permit Federal Clean Air Act § 112(g)	
Other: _____		



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

IV. TYPE OF PERMIT ACTION REQUESTED <i>(continued)</i>		
C. Is this a permit amendment?		☐ YES ☒ NO
Is this a permit revision?? (SB 1126 change)		☐ YES ☒ NO
If "YES," check the type of permit requested (<i>check <u>all</u> that apply</i>): N/A		
☐ State Permit Amendment ☐ Flexible Permit Amendment ☐ Multiple Plant Permit Amendment ☐ Nonattainment Major Modification ☐ Prevention of Significant Deterioration Major Modification ☐ Hazardous Air Pollutants Permit Federal Clean Air Act § 112(g) Modification Other: _____		
D. Is a permit renewal application being submitted in conjunction with this amendment in accordance with Senate Bill 1673? [THSC 382.055(a)(2)](80 th Legislative)		☐ YES ☒ NO
E. Is this application for a change of location of previously permitted facilities?		☐ YES ☒ NO
If "YES," answer IVE. 1. - IVE. 4.		
1. Current location of facility: N/A		
Street Address (<i>If no street address, provide clear driving directions to the site in writing.</i>): N/A		
City: N/A	County: N/A	ZIP Code: N/A
2. Proposed location of facility: N/A		
Street Address (<i>If no street address, provide clear driving directions to the site in writing.</i>): N/A		
City: N/A	County: N/A	ZIP Code: N/A
3. Will the proposed facility, site, and plot plan meet all current technical requirements of the permit special conditions?		☐ YES ☐ NO ☒ N/A
If "NO," attach detailed information.		
4. Is the site where the facility is moving considered major? N/A		☐ YES ☐ NO
F. Is this a relocation?		☐ YES ☒ NO
G. Are there any standard permits, exemptions or permits by rule to be consolidated into this permit?		☐ YES ☒ NO



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

IV. TYPE OF PERMIT ACTION REQUESTED (continued)	
H. Are you permitting a facility or group of facilities that have planned maintenance, startup and shutdown emissions that cannot be authorized by a permit by rule or standard permit or that are authorized by a permit by rule or standard permit and are being rolled into this permit?	☐ YES ☒ NO
If "YES," attach information on any changes to emissions under this application as specified in Sections IX, and X.	
If "YES," answer IVH. 1 -IVH. 3.	
1. Are the activities to be included in this permit covered by any previously existing MSS authorizations?	☐ YES ☐ NO ☒ N/A
If "YES," provide a listing of all other authorizations (permit by rule or standard permit and the associated registration number if any).	
2. Have the emissions been previously submitted as part of an emissions inventory? N/A	☐ YES ☐ NO
3. List which years the MSS activities were included in emissions inventory submittals: N/A	
I. Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability)	
Is this facility located at a site required to obtain a federal operating permit under 30 TAC Chapter 122?	☒ YES ☐ NO ☐ To be Determined
1. Identify the requirements of 30 TAC Chapter 122 that will be triggered if this PI-1 application is approved. ☐ FOP Significant Revision ☐ FOP Minor ☒ Application for an FOP Revision ☐ Operational Flexibility/Off-Permit Notification ☐ Streamlined Revision for GOP ☐ To be determined ☐ None	
2. Identify the type(s) of FOP(s) issued and/or FOP application(s) submitted/pending for the site (check all that apply) ☐ GOP Issued ☐ GOP application/revision application: submitted or under APD review ☒ SOP Issued ☐ SOP application/revision application: submitted or under APD review	
V. PERMIT FEE INFORMATION	
A. Fee paid for this application:	\$ 75,000.00
1. Is a copy of the check or money order attached to the original submittal of this application?	☒ YES ☐ NO ☐ N/A
2. Is a Table 30 entitled, "Certification of estimated Capital Cost and Fee Verification," attached?	☐ YES ☐ NO ☒ N/A



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

VI. PUBLIC NOTICE APPLICABILITY		
A. Is this a new permit application or a change of location application?		☒ YES ☐ NO
B. Is this an application for a major modification of a PSD, NA or 30 TAC § 112(g) permit?		☐ YES ☒ NO
C. Is this a state permit amendment application?		☐ YES ☒ NO
If "YES," answer VIC. 1. - VIC. 3.		
1. Is there any change in character of emissions in this application? N/A		☐ YES ☐ NO
Is there a new air contaminant in this application? N/A		☐ YES ☐ NO
2. Do the facilities handle, load, unload, dry, manufacture, or process grain, seed, legumes, or vegetables fibers (agricultural facilities)?		☐ YES ☐ NO ☒ N/A
3. List the total annual emission increases associated with the application (<i>list <u>all</u> that apply</i>): N/A		
Volatile Organic Compounds (VOC):		tpy
Sulfur Dioxide (SO ₂):		tpy
Carbon Monoxide (CO):		tpy
Hazardous Air Pollutants (HAPs):		tpy
Nitrogen Oxides (NO _x):		tpy
Particulate Matter (PM):		tpy
PM ₁₀ :		tpy
PM _{2.5} :		tpy
Lead (Pb):		tpy
Other air contaminants not listed above:		tpy
VII. PUBLIC NOTICE INFORMATION (<i>complete if applicable</i>)		
A. Responsible Person:		
Name (☒ Mr. ☐ Mrs. ☐ Ms. ☐ Dr.): Charles R. Hausmann		
Title: Port Director		
Mailing Address: P.O. Box 397		
City: Point Comfort	State: Texas	ZIP Code: 77978
Telephone No.: 367-987-2813	Fax No.: 361-987-2189	E-mail Address: crh@portofplpc.com



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

VII. PUBLIC NOTICE INFORMATION <i>(complete if applicable)</i>		
B. Technical Contact:		
Company Name : Hill Country Environmental, Inc.		
Name (☐ Mr. ☐ Mrs. ☒ Ms. ☐ Dr.): Lisa O. McCurley, P.E.		
Title: President		
Mailing Address: 1613 S Capital of Texas Highway, Suite 201		
City: Austin	State: Texas	ZIP Code: 78746
Telephone No.: 512-327-2725	Fax No.: 512-327-2750	E-mail Address: lisa@hillcountryenv.com
C. Application in Public Place:		
Name of Public Place: Point Comfort Branch Library		
Physical Address: 1 Lamar Street #1, P.O. Box 382		
City: Point Comfort	County: Calhoun	
The public place has granted authorization to place the application for public viewing and copying?		☒ YES ☐ NO
The public place has internet access available for the public?		☒ YES ☐ NO ☐ N/A
Complete VII.D. 1. - VII.D. 3., as applicable.		
D.1. Name of the Mayor for this facility site:		
Pam Lambden		
Mailing Address: P.O. Box 497		
City: Point Comfort	State: Texas	ZIP Code: 77978-0497
D.2. Name of the Federal Land Manager for this facility site:		
Linda Rundell		
Mailing Address: P.O. Box 27115		
City: Santa Fe	State: New Mexico	ZIP Code: 87502-0115
D.3. Name of the Indian Governing Body for this facility site:		
Region 6 Office of Environmental Justice and Tribal Affairs		
Mailing Address: 1445 Ross Ave., Suite 1200		
City: Dallas	State: Texas	ZIP Code: 75202



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

VII. PUBLIC NOTICE INFORMATION <i>(complete if applicable)</i>				
E. Is a bilingual program required by the Texas Education Code in the School District?				☒ YES ☐ NO
Are the children who attend either the elementary school or the middle school closest to your facility eligible to be enrolled in a bilingual program provided by the district?				☒ YES ☐ NO
If "YES," which language is required by the bilingual program?			Spanish	
VIII. SMALL BUSINESS CLASSIFICATION <i>(required)</i>				
A. Does this company (including parent companies and subsidiary companies) have fewer than 100 employees or less than \$6 million in annual gross receipts?				☐ YES ☒ NO
B. Is the site a major source under 30 TAC Chapter 122, Federal Operating Permit Program?				☒ YES ☐ NO
C. Are the site emissions of any individual air contaminant greater than 50 tpy?				☒ YES ☐ NO
D. Are the site emissions of all air contaminants combined greater than 75 tpy?				☒ YES ☐ NO
IX. TECHNICAL INFORMATION				
A. Is a current area map attached?				☒ YES ☐ NO
Are any schools located within 3,000 feet of this facility?				☐ YES ☒ NO
B. Is a plot plan of the plant property attached?				☒ YES ☐ NO
C. Is a process flow diagram and a process description attached?				☒ YES ☐ NO
D. Maximum Operating Schedule:	Hours: 6000	Day(s):	Week(s):	Year(s):
Seasonal Operation?				☐ YES ☒ NO
If "YES," please describe. N/A				
E. Are worst-case emissions data and calculations attached?				☒ YES ☐ NO
1. Is a Table 1(a) entitled, "Emission Point Summary Table," attached?				☒ YES ☐ NO
2. Is a Table 2 entitled, "Material Balance Table," attached?				☒ YES ☐ NO
3. Are equipment, process, or control device tables attached?				☒ YES ☐ NO
F. Are actual emissions for the last two years (determination federal applicability) attached?				☐ YES ☒ NO



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

X. STATE REGULATORY REQUIREMENTS	
<i>Applicants must be in compliance with all applicable state regulations to obtain a permit or amendment.</i>	
A. The emissions from the proposed facility will comply with all rules and regulations of the TCEQ and details are attached?	☒ YES ☐ NO
B. The proposed facility will be able to measure emissions of significant air contaminants and details are attached?	☒ YES ☐ NO
C. A demonstration of Best Available Control Technology (BACT) is attached?	☒ YES ☐ NO
D. The proposed facilities will achieve the performance in the permit application and compliance demonstration or record keeping information is attached?	☒ YES ☐ NO
E. Is atmospheric dispersion modeling attached?	☐ YES ☒ NO
F. Does this application involve any air contaminants for which a "disaster review" is required?	☐ YES ☒ NO
If "YES," details must be attached.	
<i>Note: For a list of air contaminants for which a "disaster review" will be required, refer to the NSRPD Disaster Review Guidance Document at www.tceq.state.tx.us/permitting/air/rules/federal/63/63hmpg.html.</i>	
G. Is this facility or group of facilities located at a site within an Air Pollutant Watch List (APWL) area?	☐ YES ☒ NO
If "YES," answer X.G. 1. - X.G. 3.	
1. List the APWL Site Number: N/A	
2. Does the site emit a pollutant of concern for the APWL area in which the site is located? N/A	☐ YES ☐ NO
3. If "YES," list the pollutant(s) of concern emitted by this site: N/A	
H. Is this facility or group of facilities located at a site within the Houston/Galveston nonattainment area? (Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, or Waller Counties)	☐ YES ☒ NO X N/A
If "YES," answer X.H. 1. - X.H. 4.	
1. Does the facility or group of facilities located at this site have an uncontrolled design capacity to emit 10 tpy or more of NO _x ?	☐ YES ☐ NO X N/A
2. Is this site subject to 30 TAC Chapter 101, Subchapter H, Division 3 (Mass Emissions Cap and Trade)?	☐ YES ☐ NO X N/A
3. Does this action make the site subject to 30 TAC Chapter 101, Subchapter H, Division 3 (Mass Emissions Cap and Trade)?	☐ YES ☐ NO X N/A
4. Does this action require the site to obtain additional emission allowances? N/A	☐ YES ☐ NO



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

XI. FEDERAL REGULATORY REQUIREMENTS Applicants must be in compliance with all applicable federal regulations to obtain a permit or amendment. If any of the following questions are answered "YES, the application must contain detailed attachments addressing applicability, identify federal regulation Subparts, show how requirements are met, and include compliance information.	
A. Does a Title 40 Code of Federal Regulations Part 60, (40 CFR Part 60) New Source Performance Standard (NSPS) apply to a facility in this application?	☒ YES ☐ NO
B. Does 40 CFR Part 61, National Emissions Standard for Hazardous Air Pollutants (NESHAP) apply to a facility in this application?	☐ YES ☒ NO
C. Does a 40 CFR Part 63, Maximum Achievable Control Technology (MACT) standard apply to a facility in this application?	☐ YES ☒ NO
D. Does nonattainment permitting requirements apply to this application?	☐ YES ☒ NO
E. Does prevention of significant deterioration permitting requirements apply to this application?	☒ YES ☐ NO
F. Does Hazardous Air Pollutant Major Source [FAA § 112(g)] requirements apply to this application?	☐ YES ☒ NO
XII. COPIES OF THIS APPLICATION	
A. Has the required fee been sent separately with a copy of this Form PI-1 to the TCEQ Revenue Section? (MC 214, P.O. Box 13088, Austin, Texas 78711).	☒ YES ☐ NO ☐ NA
B. Are the Core Data Form, Form PI-1, and all attachments being sent to the TCEQ in Austin?	☒ YES ☐ NO
OPTIONAL: Has an extra copy of the Core Data Form, Form PI-1 and all attachments been sent to the TCEQ in Austin?	☐ YES ☒ NO
If "YES," please mark this application as "COPY."	
C. Is a copy of the Core Data Form, the Form PI-1, and all attachments being sent to the appropriate TCEQ regional office?	☒ YES ☐ NO
D. Is a copy of the Core Data Form, the Form PI-1, and all attachments being sent to each appropriate local air pollution control program(s)?	☐ YES ☒ NO
List all local air pollution control program(s):	
E. Is a copy of the Core Data Form, Form PI-1, and all attachments (without confidential information) being sent to the EPA Region 6 office in Dallas, Texas? (federal applications only)	☒ YES ☐ NO
F. This facility is located within 100 kilometers of the Rio Grande River and a copy of the application was sent to the International Boundary and Water Commission (IBWC):	☐ YES ☒ NO
G. This facility is located within 100 kilometers of a federally-designated Class I area and a copy of the application was sent to the appropriate Federal Land Manager:	☐ YES ☒ NO



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

XIII. PROFESSIONAL ENGINEER (P.E.) SEAL

Is the estimated capital cost of the project greater than \$2 million dollars?	Yes
If "YES," the application must be submitted under the seal of a Texas licensed Professional Engineer (P.E.).	Included

XIV. DELINQUENT FEES AND PENALTIES

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

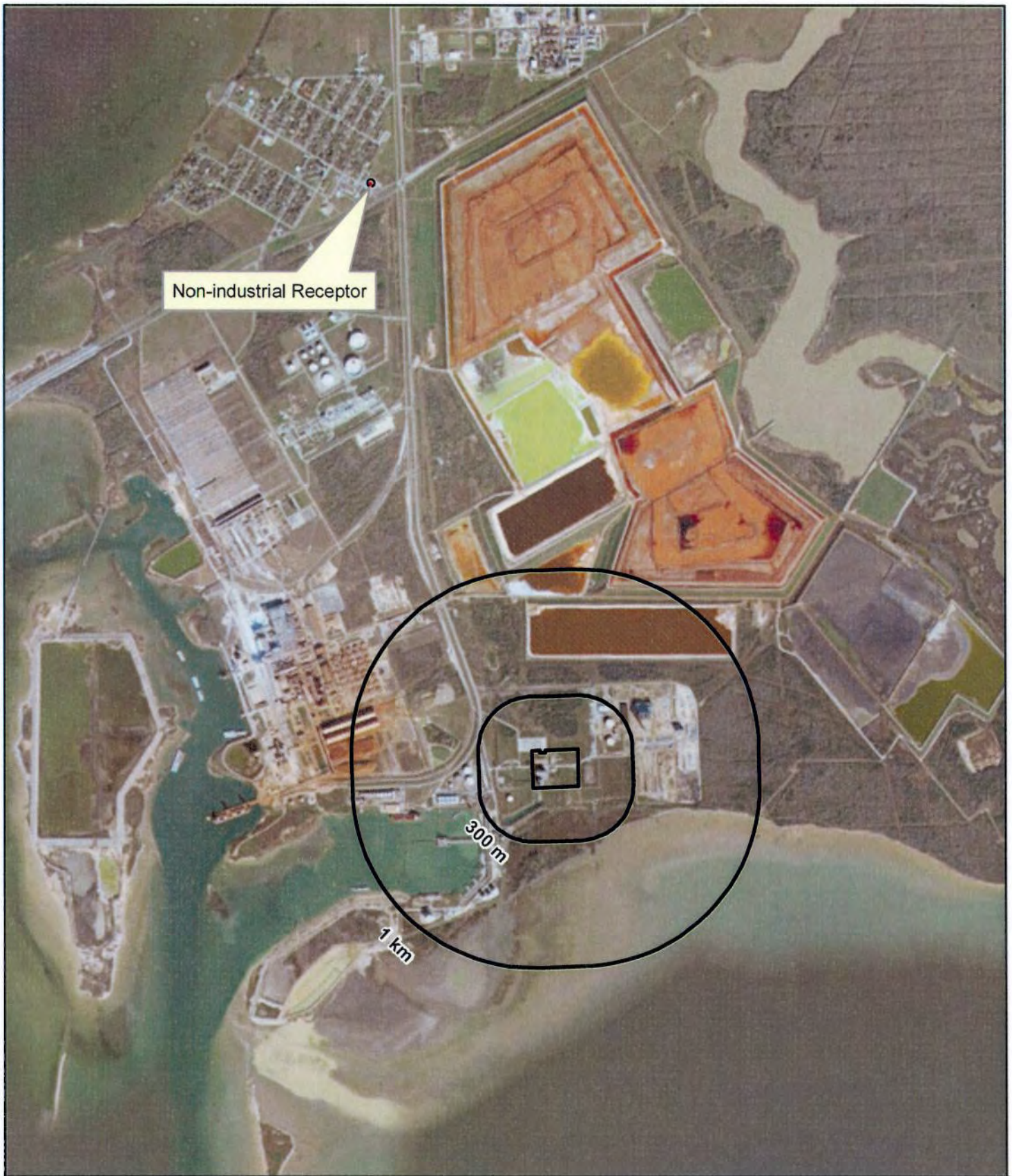
XV. SIGNATURE

The signature below confirms that I have knowledge of the facts included in this application and that these facts are true and correct to the best of my knowledge and belief. I further state that to the best of my knowledge and belief, the project for which application is made will not in any way violate any provision of the Texas Water Code (TWC), Chapter 7, Texas Clean Air Act (TCAA), as amended, or any of the air quality rules and regulations of the Texas Commission on Environmental Quality or any local governmental ordinance or resolution enacted pursuant to the TCAA. I further state that I understand my signature indicates that this application meets all applicable nonattainment, prevention of significant deterioration, or major source of hazardous air pollutant permitting requirements. I further state that I have read and understand TWC §§ 7.177-7.183, which defines CRIMINAL OFFENSES for certain violations, including intentionally or knowingly making or causing to be made false material statements or representations in this application, and TWC § 7.187, pertaining to CRIMINAL PENALTIES.

NAME: Charles R. Hausmann, Port Director

SIGNATURE: Charles Hausmann
Original Signature Required

DATE: 5-26-11



Source: State GIS - Texas Southeast 2009

Datum: NAD83

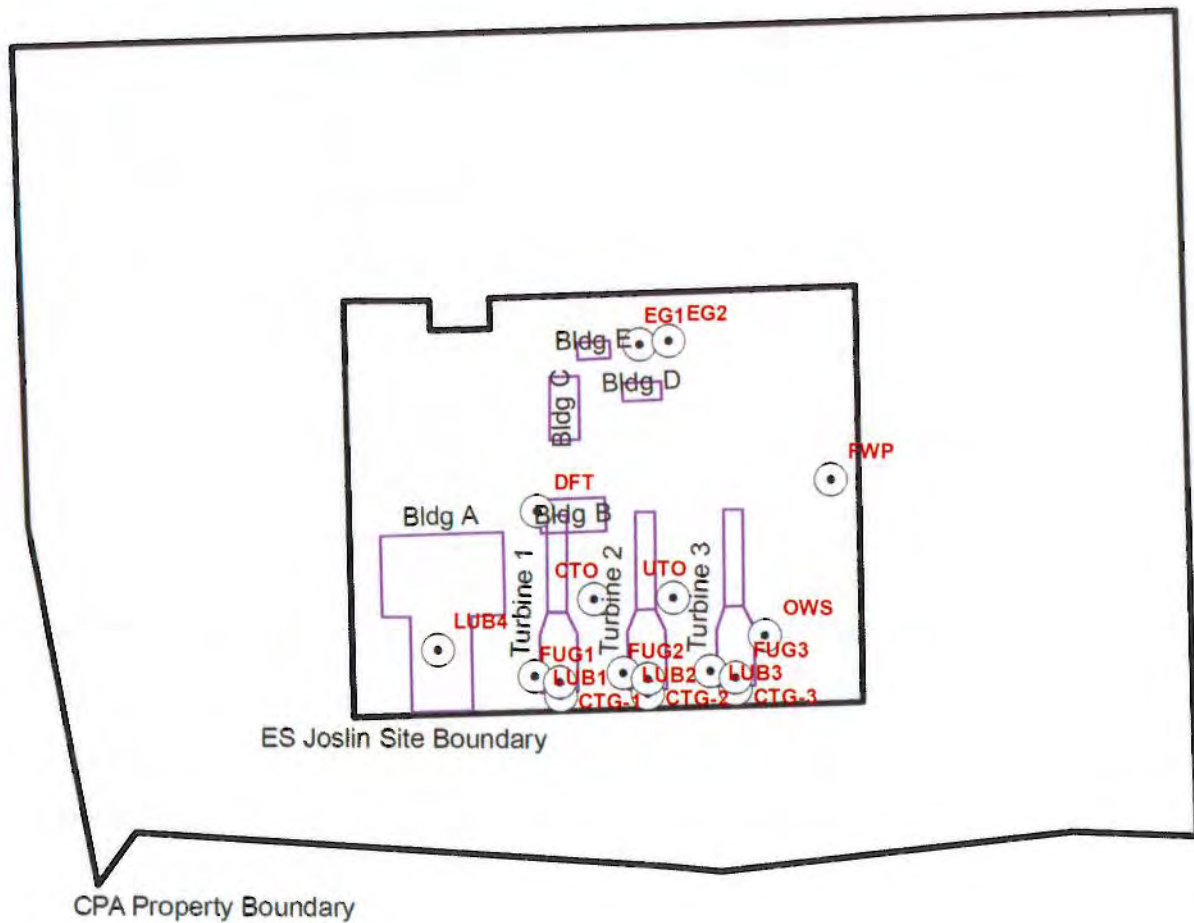
Area Map
ES Joslin Power Station
Calhoun Port Authority



Location (at center of property):
 28° 38' 50" N
 -96° 32' 43" W

Scale: 1 inch = 2,301 feet

Date: June 2012



Source: State GIS - Texas Southeast 2009
Datum: NAD83



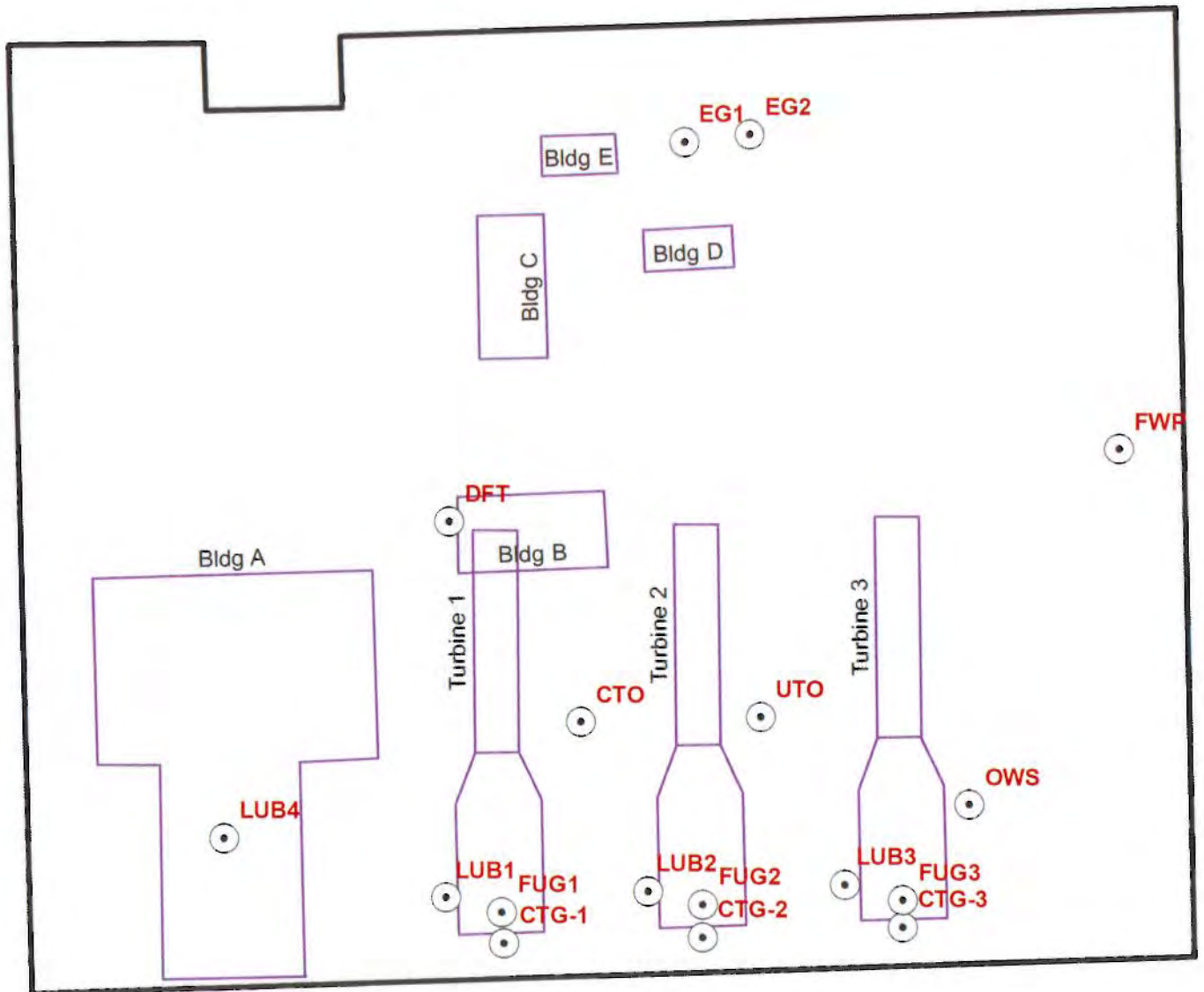
Plot Plan - 1
ES Joslin Power Station
Calhoun Port Authority



Location (at center of property):
28° 38' 50" N
96° 32' 43" W

Scale: 1 inch = 314 feet

Date: June 2012



ES Joslin Site Boundary

Source: State GIS - Texas Southeast 2009
Datum: NAD83



Plot Plan - 2 ES Joslin Power Station Calhoun Port Authority



Location (at center of property):
28° 38' 50" N
96° 32' 43" W

Scale: 1 inch = 121 feet

Date: June 2012

Calhoun Port Authority – ES Joslin Power Station Process Description

Calhoun Port Authority (CPA) owns the ES Joslin Power Station in Point Comfort, Texas. The power station is a conventional steam plant consisting of one Steam Turbine Generator (STG) rated at an output of 234,874 kW. CPA is proposing to convert the conventional steam plant to a combined cycle repowering of the ES Joslin Power Station. Repowering of the Joslin Power Station will be done by adding three General Electric (GE) Frame 7FA Combustion Turbine Generators (CTGs) and three non-fired Heat Recovery Steam Generators (HRSGs) to encompass a full 3x1 combined cycle plant.

Process Overview:

Combustion Turbine Generator (CTG)

The power generation plant configuration includes three GE Frame 7FA CTGs with evaporative coolers and dry low NO_x combustors. The CTGs are natural gas fired rotary engines that extract energy from a flow of combustion gas. Fuel is mixed with air and ignited in the combustion chamber. Resulting combustion products are forced across the turbine section blading, spinning the turbine which in turn is connected to a generator providing the electrical output. The CTGs are rated to provide an output of 208,270 kW (Gross) each at an ambient temperature of 59°F. CPA is proposing to operate the CTGs as per the following start-up/shut down (SS) schedule:

Event Type	No. of Events (events/yr)	Event Time (min/event)
Cold Start	35	< 90
Warm Start	225	< 30
Shut Down	260	< 30

A cold start is defined as a startup after the units have been out of operation in excess of forty eight hours. A warm start is defined as a startup after the units have been out of operation any duration between zero to forty-eight hours.

Heat Recovery Steam Generator (HRSG)

The configuration includes three-pressure reheat, non-fired HRSG. The exhaust gases from the CTG are routed to the HRSG. These exhaust gases are used in the Low Pressure (LP), Intermediate Pressure (IP) and High Pressure (HP) sections of the HRSG to heat water. The IP and the HP section of the HRSG produce steam to be admitted to the IP and HP sections of the STG. The flue gases from the HRSG will be directed to a Selective Catalytic Reduction (SCR) system. The SCR system uses ammonia to convert nitrogen oxides (NO_x) to diatomic nitrogen (N₂) thus reducing NO_x emissions. The flue gases from the SCR are released to the atmosphere through three stacks (EPN: CTG1, CTG2, and CTG3).

Calhoun Port Authority – ES Joslin Power Station Process Description

Steam Turbine Generator (STG)

The STG is an existing Westinghouse two cylinder turbine rated at 234,874 kW. The steam from the HRSG is used to turn the turbine in the STG which is in turn connected to a generator providing the electrical output.

Following is the summary of the individual and plant output for three different configurations:

Unit	1x1	2x1	3x1
CTG Output, kW	208,270	416,540	624,810
STG Output, kW	86,989	185,328	286,410
Plant Output, kW	285,811	584,414	887,528

The emission calculations are based on worst case scenario with most conservative configuration (i.e. 3x1). If CPA employs 2x1 or a 1x1 scenario, emissions are expected to be lower than the worst case.

Condensate System

The condensate system condenses the steam utilized in the STG and directs it to the HRSG for reuse. The steam is passed through the heat exchangers with the cold side fluid being salt water and the hot side fluid being the condensate (water) from the STG. After passing through the heat exchanger the hot steam from the STG is condensed and supplied to the HRSG. Two boiler feed water pumps are utilized to provide the condensate to the HRSG.

Boiler Feed Water System

The boiler feed water system consists of pumps and de-aerators which serve the purpose of supplying the condensate (water) to the HRSG. The HRSG is equipped with an integral de-aerator with the LP drum which eliminates the need for external de-aerator.

Circulating Water System

The circulating water system consists of circulating water pumps, travelling water screens, salt water pumps, salt water heat exchangers and cooling water pumps. The circulating water system serves the purpose of providing cooling water to the condensate system.

Water Treatment System

The water treatment system used for supplying water to the HRSG will either be a trailer-mounted demineralizer system or semi-portable demineralizer skids.

**Calhoun Port Authority – ES Joslin Power Station
Process Description**

Electrical System

The plant will be equipped with High, Medium and Low Voltage Components, generator step-up transformers, circuit breakers, and auxiliary transformers.

Control Systems

A modern Distributed Control System (DCS) will be installed at the plant to control and automate the processes involved at the power plant. The DCS will include STG and CTG control system, Water Treatment Control System, Continuous Emissions Monitoring System, Supervisory Control and Data Acquisition (SCADA) units.

Storage Tanks

Following is a summary of the tanks proposed at the facility:

EPN	Tank Description	Tank Type	Tank Contents	Tank Capacity (gal)
DFT	Fuel Storage Tank	VFRT	Diesel	3,000
Not an emission point	Blow Down Tank	VFRT	Water	12,000
Not an emission point	Cooling Water Surge Tank	VFRT	Water	12,000
Not an emission point	Potable Water Tank	VFRT	Water	12,000
Not an emission point	Demineralized Water Storage Tank	VFRT	Water	100,000
Not an emission point	Well Water Tank	VFRT	Water	100,000
Not an emission point	Water Wash Drain Tanks	VFRT	Water	100,000
CTO	Clean Turbine Oil Storage Tank	VFRT	Clean Turbine Oil	12,000
UTO	Dirty Turbine Oil Storage Tank	VFRT	Used Turbine Oil	12,000
OWS	Oil/Water Separator Tank	VFRT	Oil/Water Mix	20,000
Not an emission point	Ammonia Storage Tank	VFRT	Ammonia	12,000

The fuel storage tank (EPN: DFT) will be storing diesel fuel for the generators and the fire water pump. The fuel storage tank is expected to have no more than one turnover per year.

The clean turbine oil and used turbine oil tanks store clean and used turbine oil respectively for

Calhoun Port Authority – ES Joslin Power Station Process Description

the turbines. The turbine oil in the CTGs and the STG is expected to be changed once a year; therefore, an annual turnover of one per year is expected for the clean and used turbine oil tanks.

The oil water separator tank is used to separate oily water recovered from the turbines. A rate of one turnover a week is expected for the oil water separator tank.

An ammonia storage tank is used to store ammonia for the SCR system. The vapors from the tank and the ammonia delivery system are routed back to the storage tank. No vapors from the tank are released to the atmosphere; therefore, the ammonia storage tank is not considered as an emission point.

Fugitive Area

Volatile Fugitive Emissions (EPN: FUG) are expected from the natural gas delivery system for the combustion turbines.

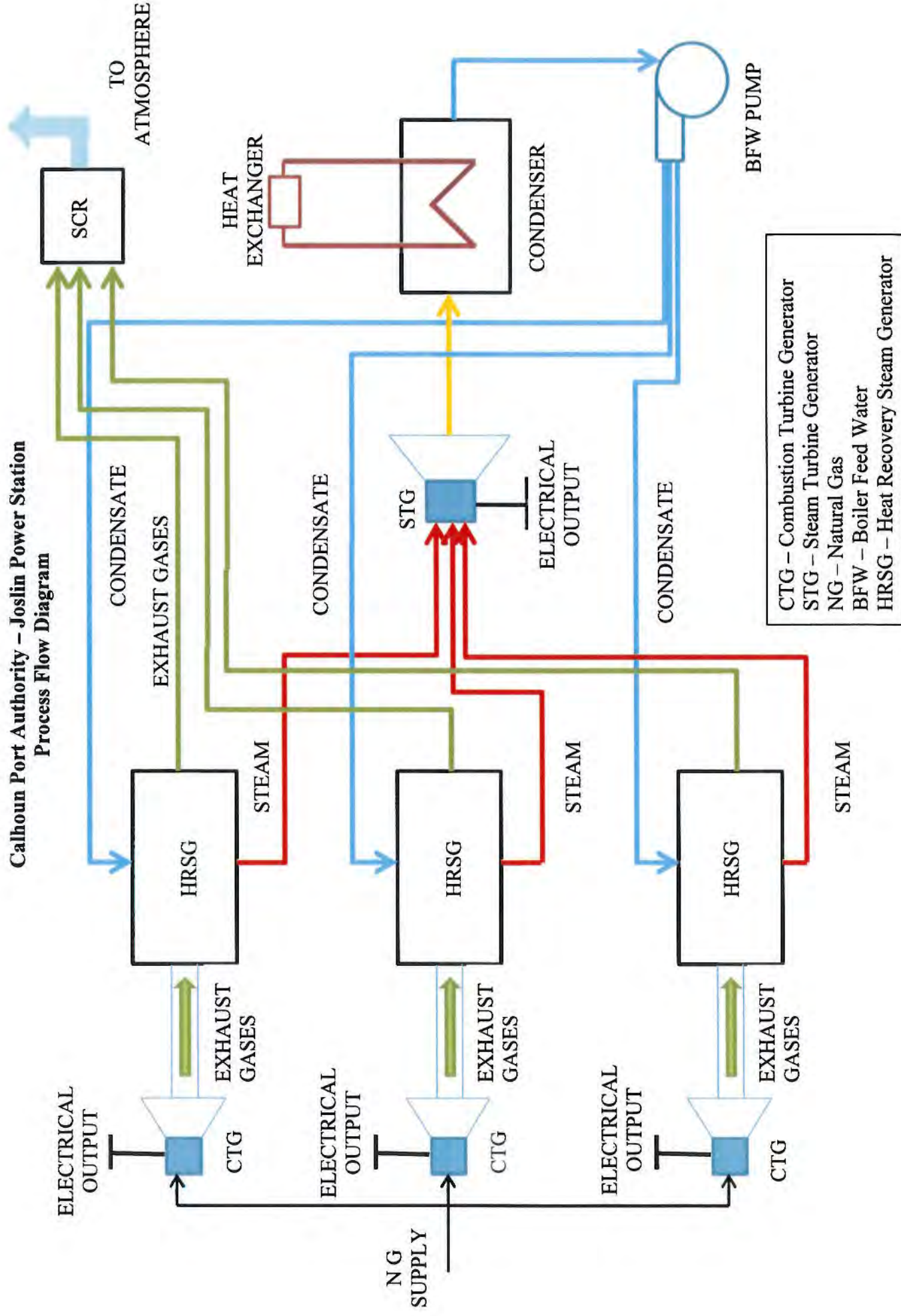
Ammonia fugitive emissions (EPN: FUG) are expected from the ammonia delivery system for SCR.

Miscellaneous Support Activities

A firewater pump (diesel, 315 hp) (EPN: FWP) is located on-site and used only for emergency purposes. Emissions have been quantified based on 50 hours per year operations.

Two 480 VAC diesel fueled emergency generators are located on-site for emergency auxiliary AC power (EPN: EG1 and EG2). Emissions have been quantified based on 50 hours per year operations for each emergency generator.

Calhoun Port Authority – Joslin Power Station Process Flow Diagram



**Calhoun Port Authority – ES Joslin Power Station
Prevention of Significant Deterioration Applicability**

According to the Environmental Protection Agency's (EPA) guidance document on Greenhouse Gases (GHGs)¹ all proposed sources after July 1, 2011 with GHG emissions equal to or greater than 100,000 tons per year (TPY) on CO₂ equivalent (CO₂e) basis and equal to or greater than the applicable major sources threshold (i.e., 100 TPY or 250 TPY, depending on the source category) are required to submit GHG PSD permit application.

Calhoun Port Authority (CPA) plans to repower the ES Joslin power plant located in Calhoun County. The CO₂e emissions associated with the three Combustion Turbine Generators (CTGs) and supporting equipment at the facility are greater than 100,000 TPY. Therefore, Prevention of Significant Deterioration (PSD) review has been performed for the GHG emissions due to the proposed facility.

¹ *PSD and Title V Permitting Guidance for Greenhouse Gases*, EPA, March 2011

**Calhoun Port Authority – ES Joslin Power Station
Other Prevention of Significant Deterioration Requirements**

Impacts Analysis

Pursuant to U.S. Environmental Protection Agency's (EPA's) recommendations in the PSD guidance document quoted below, an impacts analysis for Greenhouse Gases (GHGs) has not been included.

*"Since there are no NAAQS or PSD increments for GHGs, the requirements in sections 52.21(k) and 51.166(k) of EPA's regulations to demonstrate that a source does not cause or contribute to a violation of the NAAQS is not applicable to GHGs. Thus, we do not recommend that PSD applicants be required to model or conduct ambient monitoring for CO₂ or GHGs."*¹

GHG Preconstruction Monitoring

Pursuant to EPA's recommendations in the PSD guidance document quoted below, GHG preconstruction monitoring is not required:

*"The EPA does not consider it necessary for applicants to gather monitoring data to assess ambient air quality for GHGs under section 52.21(m)(1)(ii), section 51.166(m)(1)(ii), or similar provisions that may be contained in state rules based on EPA's rules. GHGs do not affect "ambient air quality" in the sense that EPA intended when these parts of EPA's rules were initially drafted. Considering the nature of GHG emissions and their global impacts, EPA does not believe it is practical or appropriate to expect permitting authorities to collect monitoring data for purpose of assessing ambient air impacts of GHGs."*¹

Additional Impacts Analysis

Pursuant to EPA's recommendations in the PSD guidance document quoted below, GHG additional impacts analysis is not required:

*"Furthermore, consistent with EPA's statement in the Tailoring Rule, EPA believes it is not necessary for applicants or permitting authorities to assess impacts from GHGs in the context of the additional impacts analysis or Class I area provisions of the PSD regulations for the following policy reasons. Although it is clear that GHG emissions contribute to global warming and other climate changes that result in impacts on the environment, including impacts on Class I areas and soils and vegetation due to the global scope of the problem, climate change modeling and evaluations of risks and impacts of GHG emissions is typically conducted for changes in emissions orders of magnitude larger than the emissions from individual projects that might be analyzed in PSD permit reviews. Quantifying the exact impacts attributable to a specific GHG source obtaining a permit in specific places and points would not be possible with current climate change modeling. Given these considerations, GHG emissions would serve as the more appropriate and credible proxy for assessing the impact of a given facility. Thus, EPA believes that the most practical way to address the considerations reflected in the Class I area and additional impacts analysis is to focus on reducing GHG emissions to the maximum extent. In light of these analytical challenges, compliance with the BACT analysis is the best technique that can be employed at present to satisfy the additional impacts analysis and Class I area requirements of the rules related to GHGs."*¹

¹ PSD and Title V Permitting Guidance for Greenhouse Gases, EPA, March 2011, p.47-48



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: May 2012	Permit No.: 96336 and PSDTX1256	Regulated Entity No.: RN100226638
Area Name: ES Joslin Power Plant		Customer Reference No.: CN601573462

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

AIR CONTAMINANT DATA				
1. Emission Point			2. Component or Air Contaminant Name	
(A) EPN	(B) FIN	(C) Name	3. Air Contaminant Emission Rate	
			(A) Pound Per Hour	(B) TPY
CTG1	CTG1	Combustion Turbine	Normal Operations:	
			NO _x	15.00
			CO	14.10
			PM ₁₀ /PM _{2.5}	18.00
			VOC	3.20
			SO ₂	1.10
			SO ₃	0.10
			NH ₃ (Slip)	17.13
			Cold Start:	
			NO _x	99.90
			CO	362.40
			Warm Start:	
			NO _x	33.90
			CO	92.20
			Shut Down:	
			NO _x	46.80
			CO	140.20
				65.70
				61.76
				78.84
				14.02
				4.82
				0.44
				75.03
				1.69
				6.30
				2.51
				9.59
				5.11
				18.23

CTG2	CTG2	Combustion Turbine	Normal Operations: NO _x CO PM ₁₀ /PM _{2.5} VOC SO ₂ SO ₃ NH ₃ (Slip) Cold Start: NO _x CO Warm Start: NO _x CO Shut Down: NO _x CO	15.00 14.10 18.00 3.20 1.10 0.10 17.13 99.90 362.40 33.90 92.20 46.80 140.20	65.70 61.76 78.84 14.02 4.82 0.44 75.03 1.69 6.30 2.51 9.59 5.11 18.23
CTG3	CTG3	Combustion Turbine	Normal Operations: NO _x CO PM ₁₀ /PM _{2.5} VOC SO ₂ SO ₃ NH ₃ (Slip) Cold Start: NO _x CO Warm Start: NO _x CO Shut Down: NO _x CO	15.00 14.10 18.00 3.20 1.10 0.10 17.13 99.90 362.40 33.90 92.20 46.80 140.20	65.70 61.76 78.84 14.02 4.82 0.44 75.03 1.69 6.30 2.51 9.59 5.11 18.23
LUB1	LUB1	Lube Oil Vent for CTG1	PM VOC	0.09 0.09	0.40 0.40

LUB2	LUB2	Lube Oil Vent for CTG2	PM VOC	0.09 0.09	0.40 0.40
LUB3	LUB3	Lube Oil Vent for CTG3	PM VOC	0.09 0.09	0.40 0.40
LUB4	LUB4	Lube Oil Vent for STG	PM VOC	0.09 0.09	0.40 0.40
EG1	EG1	Emergency Generator	NO _x CO PM ₁₀ /PM _{2.5} SO ₂ VOC	14.11 7.72 0.44 2.75 3.37	0.35 0.19 0.01 0.07 0.08
EG2	EG2	Emergency Generator	NO _x CO PM ₁₀ /PM _{2.5} SO ₂ VOC	14.11 7.72 0.44 2.75 3.37	0.35 0.19 0.01 0.07 0.08
FWP	FWP	Fire Water Pump	NO _x CO PM ₁₀ /PM _{2.5} SO ₂ VOC	2.08 1.82 0.10 0.65 0.79	0.05 0.05 <0.01 0.02 0.02
CTO	CTO	Clean Turbine Oil Tank	VOC	1.16	<0.01
UTO	UTO	Used Turbine Oil Tank	VOC	1.16	<0.01
DFT	DFT	Diesel Fuel Tank	VOC	0.16	<0.01

OWS	OWS	Oil Water Separator	VOC	0.01	<0.01
FUG	FUG	Fugitive Area	VOC NH ₃	0.10 0.10	0.42 0.45

EPN = Emission Point Number
FIN = Facility Identification Number



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: May 2012	Permit No.: 96336 and PSDTX1256	Regulated Entity No.: RN100226638
Area Name: ES Joslin Power Plant		Customer Reference No.: CN601573462

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

AIR CONTAMINANT DATA					EMISSION POINT DISCHARGE PARAMETERS								
1. Emission Point		4. UTM Coordinates of Emission Point			Source								
(A) EPN	(B) FIN	(C) NAME	Zone	East (Meters)	North (Meters)	5. Building Height (Ft.)	6. Height Above Ground (Ft.)	7. Stack Exit Data			8. Fugitives		
								(A) Diameter (Ft.)	(B) Velocity (FPS)	(C) Temperature (°F)	(A) Length (Ft.)	(B) Width (Ft.)	(C) Axis Degrees
CTG1	CTG1	Combustion Turbine	14	739946.71	3171300.95		190	19	Variable	272.2			
CTG2	CTG2	Combustion Turbine	14	739991.67	3171303.18		190	19	Variable	272.2			
CTG3	CTG3	Combustion Turbine	14	740035.34	3171305.14		190	19	Variable	272.2			
LUB1	LUB1	Lube Oil Vent – CTG1	14	739935.5	3171311.58		60	0.0033	0.0033	115			
LUB2	LUB2	Lube Oil Vent – CTG2	14	739979.41	3171313.32		60	0.0033	0.0033	115			
LUB3	LUB3	Lube Oil Vent – CTG3	14	740023.59	3171314.92		60	0.0033	0.0033	115			
LUB4	LUB4	Lube Oil Vent – STG	14	739887.34	3171324.44		4	0.0033	0.0033	115			

EG1	EG1	Emergency Generator 1	14	739990.41	3171475.99		20	0.83	237.70	1000			
EG2	EG2	Emergency Generator 2	14	739996.76	3171475.75		20	0.83	237.70	1000			
FWP	FWP	Fire Water Pump	14	740081.62	3171410.18		20	0.75	20	1000			
CTO	CTO	Clean Turbine Oil Tank	14	739964.69	3171350.03		17	0.0033	0.0033	ambient			
UTO	UTO	Used Turbine Oil Tank	14	740010.99	3171350.34		17	0.0033	0.0033	ambient			
DFT	DFT	Diesel Fuel Tank	14	739936.11	3171393.78		7	0.0033	0.0033	ambient			
OWS	OWS	Oil/Water Separator	14	740049.12	3171332.3		23	0.0033	0.0033	ambient			
FUG	FUG	Fugitive Area	14	739946.28 739991.40 740034.89	3171306.61 3171309.02 3171310.29		45	0.0033	0.0033	ambient			

EPN = Emission Point Number
FIN = Facility Identification Number

**Calhoun Port Authority - ES Joslin Power Station
Carbon Dioxide Equivalent GHG Emissions Summary**

Source	CO₂e Emission Rate (L_{EQ}) (Short-TPY)
Combustion Turbine Generator - 1	950,392
Combustion Turbine Generator - 2	950,392
Combustion Turbine Generator - 3	950,392
Natural Gas Fugitives	585
Emergency Engines	67
Circuit Breakers	27
Total	2,851,855

**Calhoun Port Authority - ES Joslin Power Station
Emission Calculations - Combustion Turbine Generators**

General Assumptions

Average Heat Input¹ (Q) 1854.5 MMBtu/hr
Operating Time (H) 8760 hr/yr

Source	Pollutant	GHG Emission Factor ² (E _{GHG}) (kg/MMBtu)	GHG Mass Emission Rate (L _{GHG}) (Short-TPY)	Global Warming Potential ³ (GWP)	CO ₂ e (L _{EQ}) (Short-TPY)
CTG 1	CO ₂	53.02	949461.15	1	949,461
	CH ₄	0.001	17.91	21	376
	N ₂ O	0.0001	1.79	310	555
CTG 2	CO ₂	53.02	949,461	1	949,461
	CH ₄	0.001	17.91	21	376
	N ₂ O	0.0001	1.79	310	555
CTG 3	CO ₂	53.02	949,461	1	949,461
	CH ₄	0.001	17.91	21	376
	N ₂ O	0.0001	1.79	310	555
Total					2,851,177

Calculation Methodology

$$L_{GHG} \text{ (TPY)} = Q \text{ (MMBtu/hr)} * E_{GHG} \text{ (kg/MMBtu)} * H \text{ (hr/yr)} / 907.18 \text{ (kg/(short) ton)}$$

Where:

L_{GHG} = GHG Mass Emission Rate, (Short-TPY)

Q = Average Heat Input Rate, (MMBtu/hr)

E_{GHG} = GHG Emission Factor, (kg/MMBtu/hr)

$$L_{EQ} \text{ (TPY)} = L_{GHG} * GWP$$

Where:

L_{EQ} = CO₂ Equivalent Emission Rate, (Short-TPY)

L_{GHG} = GHG Mass Emission Rate, (Short-TPY)

GWP = Global Warming Potential

Notes:

1. Average heat input rate supplied by the vendor.
2. GHG emission factors for CO₂, CH₄, and N₂O obtained from Table C-2 of 40 CFR 98 *Mandatory Greenhouse Gas Reporting*.
3. Global Warming Potential for pollutants obtained from Table A-1 of 40 CFR 98 *Mandatory Greenhouse Reporting*.

**Calhoun Port Authority - ES Joslin Power Station
Emission Calculations - Plant-wide Natural Gas Fugitives**

Equipment / Service	Gas and Oil Production Fugitive Emission Factor ¹ (E _{GOF}) (lb/hr/component)	Hours of Operation (H) (hr/yr)	Number of Components ² (N _C) (#)	CO ₂ weight fraction of Natural Gas ³ (W _C) (%)	CH ₄ weight fraction of Natural Gas ³ (W _M) (%)	CO ₂ Uncontrolled Annual Emissions Rate (L _{ANN}) (Short-TPY)	CH ₄ Uncontrolled Annual Emissions Rate (L _{ANN}) (Short-TPY)
Valves Gas/Vapor	0.00992	8,760	520	0.30%	98.50%	0.0678	22.2549
Flanges Gas/Vapor	0.00086	8,760	1460	0.30%	98.50%	0.0165	5.4170
Compressors	0.0194	8,760	2	0.30%	98.50%	0.0005	0.1674
Total						0.0848	27.8393

Source	Global Warming Potential (GWP)	CO ₂ e (L _{EQ}) (Short-TPY)
CO ₂	1	0.08
CH ₄	21	584.63
Total		585

Calculation Methodology

CO₂: L_{ANN} (TPY) = E_{GOF} (lb/hr/component) * H (hr/yr) * N_C (#) * W_C (%)

CH₄: L_{ANN} (TPY) = E_{GOF} (lb/hr/component) * H (hr/yr) * N_C (#) * W_M (%)

Where:

CO₂: L_{ANN} = CO₂ Uncontrolled Annual Emission Rate, (Short-TPY)

CH₄: L_{ANN} = CH₄ Uncontrolled Annual Emission Rate, (Short-TPY)

E_{GOF} = Gas and Oil Production Fugitive Emissions Factor, (lb/hr/component)

H = Hours of Operation, (hr/yr)

N_C = Number of Components, (#)

W_C = CO₂ Weight Percentage in Natural Gas, (%)

W_M = CH₄ Weight Percentage in Natural Gas, (%)

L_{EQ} (TPY) = L_{GHG} * GWP

Where:

L_{EQ} = CO₂ Equivalent Emission Rate, (Short-TPY)

L_{ANN} = Total Annual GHG Mass Emission Rate, (Short-TPY)

GWP = Global Warming Potential

Notes:

1. Facility/Compound Specific Fugitive Emission Factors - Oil & Gas Production Operations in TCEQ's Air Permit Guidance for Chemical Sources: Equipment Leak Fugitives.
2. The project is currently in design phase; therefore, the component counts are an estimate of the proposed equipment. Refined calculations will be submitted to EPA upon finalization of the design.
3. The Methane and CO₂ weight fractions are based on typical weight percentages for natural gas.

**Calhoun Port Authority - ES Joslin Power Station
Emission Calculations - Emergency Engines**

General Assumptions

Operating Time (H) 50 hr/yr
Diesel HHV 0.138 MMBtu/gal

Source	Pollutant	Fuel Consumption Rate ^{1,2} (FCR) (gal/hr)	Average Heat Input (Q) (MMBtu/hr)	GHG Emission Factor ³ (E _{GHG}) (kg/MMBtu)	GHG Mass Emission Rate (L _{GHG}) (Short-TPY)	Global Warming Potential ⁴ (GWP)	CO ₂ e (L _{EQ}) (Short-TPY)
EG 1	CO ₂	71.1	9.81	53.02	28.67	1	29
	CH ₄			0.001	0.0005	21	0.01
	N ₂ O			0.0001	0.0001	310	0.02
EG 2	CO ₂	71.1	9.81	53.02	29	1	29
	CH ₄			0.001	0.00	21	0.01
	N ₂ O			0.0001	0.00	310	0.02
FWP	CO ₂	22.65	3.13	53.02	9	1	9
	CH ₄			0.001	0.00	21	0.00
	N ₂ O			0.0001	0.00	310	0.01
Total							67

Calculation Methodology

$$Q \text{ (MMBtu/hr)} = \text{Diesel HHV (MMBtu/gal)} * \text{FCR (gal/hr)}$$

Where:

Q = Average Heat Input Rate, (MMBtu/hr)

FCR = Fuel Consumption Rate, (gal/hr)

$$L_{\text{GHG}} \text{ (TPY)} = Q \text{ (MMBtu/hr)} * E_{\text{GHG}} \text{ (kg/MMBtu)} * H \text{ (hr/yr)} / 907.18 \text{ (kg/(short) ton)}$$

Where:

L_{GHG} = GHG Mass Emission Rate, (Short-TPY)

Q = Average Heat Input Rate, (MMBtu/hr)

E_{GHG} = GHG Emission Factor, (kg/MMBtu/hr)

$$L_{\text{EQ}} \text{ (TPY)} = L_{\text{GHG}} * \text{GWP}$$

Where:

L_{EQ} = CO₂ Equivalent Emission Rate, (Short-TPY)

L_{GHG} = GHG Mass Emission Rate, (Short-TPY)

GWP = Global Warming Potential

Notes:

1. Diesel consumption rates are based on estimated typical consumptions rates, not on actual consumption data.
2. Fuel consumption rates are based on the engines operating at full load.
3. GHG emission factors for CO₂, CH₄, and N₂O obtained from Table C-2 of 40 CFR 98 *Mandatory Greenhouse Gas Reporting*.
4. Global Warming Potential for pollutants obtained from Table A-1 of 40 CFR 98 *Mandatory Greenhouse Reporting*.

**Calhoun Port Authority - ES Joslin Power Station
Emission Calculations - Circuit Breakers**

General Assumptions

Number of 138 kV SF ₆ insulated circuit breakers	6
Estimated SF ₆ leak rate for each 75 lb circuit breaker ^{1,2,3}	0.375 lb/year
Estimated annual mass emission rate	0.001125 short-tons/year
Global Warming Potential (GWP) ⁴	23,900
Estimated annual CO ₂ e emission rate	27 short-tons/year

Calculation Methodology

Estimated SF ₆ leak rate for each circuit breaker (lb/year)	= 0.5 (%/year) * Amount of SF ₆ in each circuit breaker at full charge (lb)
Estimated annual mass emission rate (short-tons/year)	= Estimated SF ₆ leak rate for each circuit breaker * No. of circuit breakers / 2000 (lb/short-ton)
Estimated annual CO ₂ e emission rate (short-tons/year)	= Estimated annual mass emission rate (short-ton/year) * Global Warming Potential for SF ₆

Notes

1. SF₆ leak rate obtained from EPA's paper titled *SF₆ Leak Rates from High Voltage Circuit Breakers - U.S. EPA Investigates Potential Greenhouse Gas Emission Source* by J. Blackman Program Manager, U.S. Environmental Protection Agency, M. Averyt, ICF Consulting, and Z. Taylor, ICF Consulting.
2. A worst case value of 0.5% leakage per year has been used for estimation of annual SF₆ leakage
3. As the equipment has not been finalized, quantity of SF₆ per circuit breaker has been conservatively assumed to
4. Global Warming Potential for SF₆ was obtained from Table A-1 of 40 CFR 98 *Mandatory Greenhouse Reporting*.

**Calhoun Port Authority – ES Joslin Power Station
Best Available Control Technology (BACT) Review**

Clean Air Act defines Best Available Control Technology (BACT) as:

Best available control technology means an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results.¹

Environmental Protection Agency's (EPA's) guidance on Prevention of Significant Deterioration (PSD) rules titled *PSD and Title V Permitting Guidance for Greenhouse Gases* recommends the use of a 5 step "top-down" approach to determine BACT for Greenhouse Gases (GHGs)².

The definition of BACT stated above references determining BACT for "each pollutant" individually; however, for the purposes of this project the predominant pollutant contributing to the GHGs is carbon dioxide (CO₂). CO₂ is the largest contributor towards CO₂e emissions (> 99%) and hence the most significant pollutant for reducing the impact of GHGs. Therefore, the 5 step "top down" approach outlined in this document will concentrate on determining BACT for CO₂.

The 5 steps in the "top down" approach suggested by EPA are as follows:

- Step 1: Identify all available control technologies.
- Step 2: Eliminate technically infeasible options.
- Step 3: Rank remaining control technologies.
- Step 4: Evaluate most effective controls and document results.
- Step 5: Select the BACT.

Each of the sources at the Calhoun Port Authority (CPA) – ES Joslin Power Plant contributing to GHG emissions have been analyzed for BACT according to the 5 step process. The analysis is summarized below:

¹ 40 Code of Federal Regulations §52.21(b)(12)

² *PSD and Title V Permitting Guidance for Greenhouse Gases*, EPA, March, 2011

**Calhoun Port Authority – ES Joslin Power Station
Best Available Control Technology (BACT) Review**

BACT for Combined Cycle Power Generation

Step 1: Identify all available control technologies

Combustion Controls

Combined Cycle Power Generation

The EPA's guidance document for determination of BACT for GHGs considers overall energy efficiency of the operating units to be the key factor in BACT determination.³ In general, a more energy efficient technology burns less fuel than a less energy efficient technology on a per unit of output basis. CPA proposes to employ a combined cycle electricity generation unit which reuses the heat from the exhaust gases of the combustion turbines to generate steam for the steam turbine generator. Reuse of heat to generate electricity makes the cogeneration plant energy efficient by producing more electricity for the same heat input, thus helping to reduce emissions of GHGs and other criteria pollutants. Therefore, combined cycle electric generating plants ("cogeneration") are considered to be the most energy efficient option. As single cycle generation is more energy intensive on a per unit electricity generation basis, cogeneration is considered to be the best available technology.

Use of pipeline natural gas is considered as the cleanest fuel for power generation⁴ and since CPA is proposing the cleanest fossil fuel, alternative fossil fuels have not been considered in this exercise.

Combustion Turbine Generator (CTG) Energy Efficiency

The power generation plant configuration includes three (3) GE Frame 7FA Combustion Turbine Generators (CTGs) with evaporative coolers and dry low NO_x combustors. The CTGs are natural gas fired rotary engines that extract energy from a flow of combustion gas. Fuel is mixed with air and ignited in the combustion chamber. Resulting combustion products are forced across the turbine section blading, spinning the turbine which in turn is connected to a generator providing the electrical output.

A search of the EPA's RACT/BACT/LAER clearinghouse for natural gas fired combined cycle combustion turbines was performed and no results are returned addressing BACT for GHGs. The EPA's climate change website references a GHG BACT analysis performed by Russell City Energy center for 612 Megawatt (MW) natural gas fired combined cycle power plant to be located in Hayward, California. The Russell City project includes a cogeneration unit configuration similar to the one proposed by CPA in this application. The analysis references an output based efficiency limit of seven thousand seven hundred and thirty (7,730) British Thermal Units per Kilowatt-hour (Btu/kWh) as BACT for GHG emissions.⁵

³ Parker, L., McCarthy, J., *EPA's BACT Guidance for Greenhouse Gases from Stationary Sources*, Congressional Research Service, November 22, 2010.

⁴ EPA's Natural Gas Webpage found at <http://www.epa.gov/cleanenergy/energy-and-you/affect/natural-gas.html> (last accessed on June 7, 2012)

⁵ *GHG BACT Analysis Case Study, Russell City Energy Center*, Calpine, Originally published in November 2009. Updated on February 3, 2010 found at http://www.epa.gov/oar/caaac/pdfs/RCEC_GHG_BACT_Analysis_Case_Study.pdf (last accessed on June 7, 2012)

Calhoun Port Authority – ES Joslin Power Station Best Available Control Technology (BACT) Review

The three main factors influencing the overall efficiency of a turbine are compressor, combustion, and turbine design.

Compressor⁶: The compressor technology used for the turbines has been developed from prior heavy duty gas turbine platforms and is inspired from aviation compressor technology. As such these engines are highly efficient and consist of 14 stages specifically modeled for a higher flow rate, enabling greater output. The airfoil design is based on the proven aerodynamic configuration of the GE5, GE10, 5002E and 6C platforms. The airfoils utilize a proprietary, three-dimensional aerodynamic shape for improved efficiency. The first three stages of the compressor contain variable stator vanes that provide the gas turbine with a wider operating envelope. The compressor flow path has been planned to accommodate inlet conditioning with improved leading edge erosion tolerance. The rotor is bolted steel construction with two sets of durable concentric tie bolts specifically planned to improve the aerodynamic flow path. The air is directed into the compressor through a bell mouth to reduce inlet pressure loss and improve the overall combustion turbine efficiency. The “F” type combined cycle combustion turbines typically achieve a net thermal efficiency of 53% (LHV) and the “FA” type turbine technology has a 15.5 pressure ratio⁷ which increases the overall efficiency of the combustion turbine.

Combustion: The turbines are equipped with multiple can-annular type combustors with film impingement cooling which increases the efficiency of the turbines.⁷ The 7FA model turbines are capable of efficient combustion of fuels to reduce NO_x emissions and are therefore classified as a low-NO_x emitting technology. 90% of gas fuel is injected through radial gas injection spokes in the premixer, and combustion air is mixed with the fuel in tubes the fuel nozzles.⁸ The premixer tubes are part of the cap assembly.⁸ The fuel and air are thoroughly mixed, flow out of the five tubes at high velocity and enter the burning zone where lean, low-NO_x combustion occurs⁸. The efficiency of the turbines is a function of the “Specific Power” (Power produced by the gas turbine per unit airflow). Improvements in combined-cycle thermal efficiency have developed primarily through the increases in gas turbine firing temperature, which have resulted from the development of high-temperature / high strength materials, corrosion-resistant coatings, and improved cooling technology.⁶

Turbine Section: The 7FA model turbines are designed with high-efficiency blades and advanced construction to provide efficient utilization of burned fuel. Turbine materials, coatings and cooling systems enable reliable operation at high firing temperatures resulting in higher specific power and high efficiency for combined-cycle systems. The turbines are configured with open-loop cooling of the turbine hot gas path.⁷ Hot gas path components are in large part cooled by film cooling that uses air supplied from the compressor to improve output and efficiency.⁷ Proprietary three-dimensional aerodynamic air foil shapes and more efficient stage loadings of the turbines increases the overall efficiency⁶. Improved cooling, efficiency sealing, and improved clearance further increase output of the combustion turbines.⁹

⁶ Martin, R., Forry, D., Maier, S., and Hansen, C., *GE's Next 7FA Gas Turbine "Test and Validation,"* GE Energy, July 2011.

⁷ Chase, D.L., Kehoe, P.T., *GE Combined-Cycle Product Line and Performance,* GE Power Systems, GER-3574G, October 2000.

⁸ Davis, L.B., Black, S.H., *Dry Low NO_x Combustion Systems for GE Heavy-Duty Gas Turbines,* GE Power Systems, GER-3568G, October 2000.

⁹ From GE's webpage for 7FA Heavy Duty Gas Turbines, Features and Benefits found at http://www.ge-energy.com/products_and_services/products/gas_turbines_heavy_duty/7fa_heavy_duty_gas_turbine.jsp (last accessed on June 7, 2012)

Calhoun Port Authority – ES Joslin Power Station Best Available Control Technology (BACT) Review

The combined-cycle combustion turbines are also equipped with additional features to improve the efficiency and output of the turbines. Some of the design features have been summarized below:

Evaporative Cooling: Evaporative coolers are used with gas turbines to increase the density of the combustion air, thereby increasing power output. The air density increase is accomplished by evaporating water into the inlet air, which decreases its temperature and correspondingly increases its density.¹⁰ Increased density of the combustion air increases the power output of the turbines thus increasing efficiency. Evaporative coolers are useful in increasing the power output of the turbines during warm summer months.

Insulation: The turbines have a rated firing temperature of 2420 °F / 1327 °C. As discussed earlier, higher operating temperatures provide higher efficiency for the turbines. These turbines are well insulated to prevent heat loss from the turbine casings increasing the thermal efficiency and providing safe operating environment for the personnel working around it. Efficient insulation of the casing increases the efficiency of the turbines.

Instrumentation and Controls: The turbines are equipped with distributed digital control system with a redundant data highway. The station operator consoles provide interactive color graphic displays of the overall plant, with sufficient detail to enable the operator to conveniently operate the plant.¹¹ All main components of the combined-cycle plant have individual control panels and interfaces that relay information and instructions to and from the plant operator through data highways to the operator console. The operator console will have a detailed graphic display with a high level of detail that enables convenient and informative interaction with the plant as required.¹¹

Sophisticated instrumentation and controls provide a high degree of automation and optimal operations. The automation provides maintaining systems like fuel feed and burner operations at optimal efficiency at all times.

Heat Recovery Steam Generator (HRSG) Energy Efficiency

The configuration includes three-pressure reheat, non-fired HRSGs. The exhaust gases from the CTGs are routed to the HRSGs. These exhaust gases are used in the Low Pressure (LP), Intermediate Pressure (IP) and High Pressure (HP) sections of the HRSG to heat water. The LP section of the HRSG produces steam to be admitted to the IP and HP sections of the Steam Turbine Generator (STG). The flue gases from the HRSG will be directed to a Selective Catalytic Reduction (SCR) system.

Heat Exchanger Design: The HRSG sections are made up of fine-tubed heat transfer surfaces. These surfaces are equipped with fins to provide larger contact surface area to optimize heat transfer. The HRSG takes condensate from the condensate pumps and heats it in the low pressure section of the HRSG using the exhaust gas from the CTG. The LP section of the HRSG provides

¹⁰ Johnson, R.S., Sr., P.E., *The Theory and Operation of Evaporative Coolers For Industrial Gas Turbine Installations*, THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 345 E. 47 St., New York, N.Y. 10017, 88-GT-41, June 1988.

¹¹ Chase, D.L., Kehoe, P.T., *GE Combined-Cycle Product Line and Performance*, GE Power Systems, GER-3574G, October 2000.

Calhoun Port Authority – ES Joslin Power Station Best Available Control Technology (BACT) Review

pegging steam to the integral deaerator and hot water for boiler feed pump suction. The IP and HP section of the HRSG takes boiler feed pump discharge and heats feedwater to provide hot water for fuel gas performance heating (IP section) and produces IP and HP steam for introduction to the steam turbine. Saturated HP steam travels through the HP superheater section of the HRSG where heat is added to provide a final superheated HP steam which is admitted to the HP section of the steam turbine. After the expansion of the steam through the HP turbine, it is returned to the HRSG as cold reheat steam to the HRSG where it mixes with IP steam. After mixing, the cold reheat steam travels through the reheat superheater gathering heat and is admitted to the IP turbine of the STG as hot reheat steam.

The HRSGs will be equipped with exhaust gas bypass systems and flexible tube support to enable fast startup and shutdown and flexibility of operation. Reduced startup and shutdown time decreases the overall emissions from the turbines during startup/shutdown. Efficient HRSG design enables low gas-side pressure drop facilitating optimum gas turbine performance.¹¹ The HRSG has three pressure sections for heating water to provide steam to the HP, IP, and LP sections of the turbine.

Selective Catalytic Reduction Units (SCR): The HRSGs will be equipped with SCRs to mitigate NO_x emissions. The SCR system uses ammonia to convert nitrogen oxides (NO_x) to diatomic nitrogen (N₂) thus reducing NO_x emissions.

Insulation: The key aspects of optimum utilization of heat energy from the exhaust gases is efficient transfer of heat which includes maximum contact surface area and minimal wastage of heat from surfaces that are not in contact with water/steam. The prior is achieved by utilization of fins as discussed earlier and the latter is achieved by effective insulation. The HRSG housing and panels are well insulated to prevent loss of heat to the surroundings. This increases the efficiency of the HRSG and provides more heat towards steam generation.

Fouling Reduction: Fouling occurs on the HRSG components coming in contact with the exhaust gases due to deposition of constituents of the exhaust gases. Fouling of the surfaces reduces area of contact and impedes efficient heat transfer towards steam generation. Fouling of HRSG surfaces is restricted by filtering the inlet air to the CTGs and periodic cleaning of the affected surfaces. Scheduled maintenance is done to maintain efficiency of the HRSG units.

Steam Wastage Reduction: Loss of generated steam is a crucial aspect in maintaining the efficiency of the HRSGs and the STGs. Loss of steam occurs from venting operations crucial to the system and leaks in the piping/equipment used to handle generated steam. Maximum retention of steam for power generation can be achieved by restricting the venting outlets, and identifying and repairing any leaks in the piping/equipment handling generated steam. Overall efficiency of the plant can be maintained by implementing procedures to identify steam leaks.

Steam Turbine Generator (STG) Energy Efficiency

CPA is proposing use of the exiting Westinghouse Electric Corporation 235 MW steam turbine generator. The STG is a two-cylinder, tandem-compound, double-flow, condensing reheat unit. The high pressure turbine is of the combination impulse and reaction type. The low pressure

Calhoun Port Authority – ES Joslin Power Station Best Available Control Technology (BACT) Review

turbine is a reaction, double flow turbine with steam entering at the center of the blade path and flowing toward an exhaust opening at each end.

Reheat Cycles: The steam turbine output depends on the nature of the steam entering the turbine. In order to maximize efficiency of the turbine and to ensure high steam temperature and pressure, reheat cycles are employed. The high pressure and intermediate pressure sections of this STG are carried in the high pressure turbine outer casing. Steam passes through the high pressure turbine blading and exits the high pressure turbine through two exhaust openings in the outer casing base as cold reheat steam where it is returned to the reheat section of the boiler. It returns from the reheater to the intermediate pressure turbine through the split intermediate pressure blading (part being located on each end of the HP – IP turbine rotor) and passes into the low pressure turbine through two cross-over pipes. This ensures optimum steam temperature and pressure conditions.

Exhaust Steam Condenser: The spent steam from the STG is reclaimed in condensing units. CPA is proposing the use of existing Westinghouse single pass, horizontal, deaerating, rectangular condenser with divided water box. Condensing the spent steam to a saturated state enables reducing exhaust pressure increasing the overall turbine efficiency.

Steam Turbine Generator Design: Efficient design of the generators contributes to the overall efficiency of the system. CPA is proposing the use of existing Westinghouse hydrogen inner-cooled generator to be used in the combined cycle generation configuration. Hydrogen cooling employed in the existing generator facilitates high-efficiency of the generator, enabling overall efficiency of the steam turbine.

Auxiliary Energy Efficiency Processes

Fuel Gas Preheating: Turbine performance is typically increased with the use of fuel gas at a high inlet temperature. Fuel to be introduced in the turbine can be preheated through a shell and tube “performance heater” utilizing heated IP feedwater.

Multiple Trains: Multiple combustion turbines and HRSG trains offer flexibility during part load operations. It also facilitates shutting down/operating turbines as required to operate each turbine-HRSG configuration at optimum operating conditions.

Continuous Emission Monitoring System (CEMS): CEMS monitors and records effluents from the HRSG stacks. Employing CEMS to monitor performance of the turbines provides data to optimize operations of the turbines and to keep track of the emissions from the turbines.

Operating Procedures and Practices: Vendor specified operating procedures and practices ensure efficient operation of equipment. Implementing Standard Operating Procedures (SOPs) formulated with guidance from vendor specified operating procedures and standards ensure proper maintenance of equipment and efficient operation. Maintaining records of operations and practices, employing trained and certified personnel for operation and maintenance, and scheduled periodic inspection ensures equipment efficiency, longevity, and safety.

**Calhoun Port Authority – ES Joslin Power Station
Best Available Control Technology (BACT) Review**

Post Combustion Controls

In addition to the combustion options discussed above, other add-on technologies to control GHG emissions are considered in this review. One such method is Carbon Capture and Storage/Sequestration (i.e., CCS). This method involves CO₂ capture, transport, and storage.

Carbon Capture: This method involves capturing post combustion effluent gas and separating carbon dioxide (CO₂) from the effluent stream. CO₂ capture using amine absorption is the only state-of-the-art CO₂ capture technology currently available.

This technology has been employed in some coal-fired power plants; the following is a brief summary of the currently operating CO₂ capture systems obtained from the *Report of the Interagency Task Force on Carbon Capture and Storage*¹²:

1. AES's coal-fired Warrior Run (Cumberland, Maryland) and Shady Point (Panama, Oklahoma) power plants are equipped with amine scrubbers developed by ABB/Lummus. They were designed to process a relatively small percentage of each plant's flue gas. At Warrior Run, approximately 110,000 tonnes of CO₂ per year are captured, whereas at Shady Point 66,000 tonnes of CO₂ per year are captured. The CO₂ from both plants is subsequently used in the food processing industry (Dooley et al., 2009).
2. At the Searles Valley Minerals soda ash plant in Trona, California, approximately 270,000 tonnes of CO₂ per year are captured from the flue gas of a coal power plant via amine scrubbing and used for the carbonation of brine in the process of producing soda ash (IEA, 2009a; SourceWatch, 2009).
3. In September 2009, American Electric Power Co. (AEP) began operating the Alstom post combustion chilled ammonia pilot process to capture 100,000 tonnes of CO₂ per year on the Mountaineer Plant in New Haven, West Virginia, and store it in deep geologic formations beneath the Mountaineer site.
4. A pre-combustion Rectisol® system is used for CO₂ capture at the Dakota Gasification Company's synthetic natural gas (SNG) production plant located in North Dakota, which is designed to remove approximately 1.6 million tonnes of CO₂ per year from the synthesis gas. The CO₂ is purified, transported via a 200-mile pipeline, and injected into the Weyburn oilfield in Saskatchewan, Canada. However, this experience is based on a gasification plant, not an IGCC power plant (Dakota Gasification Company, Undated).

CO₂ Transport and Storage: CO₂ capture has not been demonstrated on a commercially viable scale for a full size power plant; and therefore is not a viable option to be considered as BACT. However, CPA has included a discussion in this report evaluating the transport options for the captured CO₂. The two options for transporting the captured CO₂ are:

¹² *Report of the Interagency Task Force on Carbon Capture and Storage*, CCS Task Force, August 2010, p.31 found at <http://www.epa.gov/climatechange/downloads/CCS-Task-Force-Report-2010.pdf> (last accessed on June 7, 2012)

**Calhoun Port Authority – ES Joslin Power Station
Best Available Control Technology (BACT) Review**

- Transport of captured CO₂ to an existing pipeline; or
- Transport of captured CO₂ to the nearest sequestration site with proven potential to store CO₂.

There are several sites with recognized potential (Enhanced Oil Recovery - EOR) near the proposed site for CPA power plant (refer to “Map of CO₂ EOR Miscible Potential in the Gulf Coast”¹³ – included in this document as Attachment A) and the closest site with some demonstrated capacity for geological storage of CO₂ (i.e. SACROC site in Scurry County) is over 260 miles from the proposed site.

Step 2: Eliminate technically infeasible options

In this section, CPA evaluates the technically feasible options from the technology options covered in Step 1. Specifically, this section will be addressing the feasibility of post combustion control technology (i.e., CCS) for its suitability to the project.

Carbon Capture: Although carbon capture has been demonstrated on a smaller scale compared to the power plant applications, power plant exhausts have larger volumes and lower CO₂ concentrations (3-4% volume percent in gas-fired turbines). Carbon separation also possess additional problems like rapid degradation of sorbents due to trace impurities in exhaust gases, increased energy demand for compressing the captured CO₂ to a pressure rating which facilitates pipeline transport.

The inter-agency task force set up by the Obama administration and co-chaired by the U.S. Department of Energy (DOE) and EPA has come to the following conclusion in the report published in August 2010:

“Current technologies could be used to capture CO₂ from new and existing fossil energy power plants; however, they are not ready for widespread implementation primarily because they have not been demonstrated at the scale necessary to establish confidence for power plant application. Since the CO₂ capture capacities used in current industrial processes are generally much smaller than the capacity required for the purposes of GHG emissions mitigation at a typical power plant, there is considerable uncertainty associated with capacities at volumes necessary for commercial deployment.”¹⁴

Additionally, the energy requirement for the carbon capture process will result in significant energy penalty (up to 30%).¹⁴ This reduces the overall efficiency of the plant and requires burning of additional fuel to meet the gap, thus contributing additional GHGs.

Due to these short comings, carbon capture cannot be considered as a technically feasible option as GHG BACT.

¹³ Holtz, M. H., Núñez-López, V., and Breton, C. L., 2005, *Moving Permian Basin Technology to the Gulf Coast: The Geologic Distribution of CO₂ EOR Potential in Gulf Coast Reservoirs*, in Lufholm, Peter, and Cox, Denise, eds., *Unconventional reservoirs technology and strategies: alternative perspectives for the Permian Basin: West Texas Geological Society Fall Symposium*, October 26–27, Publication #05-115, CD-ROM [10 p.]. GCCC Digital Publication Series #05-02.

¹⁴ *Report of the Interagency Task Force on Carbon Capture and Storage*, CCS Task Force, August 2010, p.50 found at <http://www.epa.gov/climatechange/downloads/CCS-Task-Force-Report-2010.pdf> (last accessed June 7, 2012)

Calhoun Port Authority – ES Joslin Power Station Best Available Control Technology (BACT) Review

CO₂ Transport: Although there are several EOR sites available near the proposed site, none of the sites have a demonstrated potential to store CO₂ in large quantities for prolonged time periods that will be produced from the power plant. The closest sequestration site with some demonstrated CO₂ storage capability is 260 miles from the site. A long pipeline would have to be constructed to transport the captured CO₂. Additionally, the CO₂ will need to be compressed prior to transport which will increase the energy demand of the power plant and decrease its efficiency. Therefore, this option is not feasible for application as GHG BACT.

CO₂ Storage: As discussed previously, CO₂ capture and transport are not currently feasible alternatives as BACT for GHG. Still even if it could be assumed that capture and transport is economically feasible, storage of CO₂ in geological structures poses additional uncertainties and requires further study/assessment before large scale deployment.

Due to the reasons discussed above, CCS technology cannot be considered as a feasible option for GHG BACT. Therefore, CPA has eliminated CCS technology from further consideration. All other technologies discussed in this review are considered feasible and CPA intends to employ these methods as BACT.

Step 3: Rank Remaining Control Technologies

CPA intends to employ all technically feasible control technologies at the proposed power plant. Therefore, ranking of the remaining control technologies is not required.

Step 4: Evaluate Most Effective Control and Document Results

Since CPA intends to employ all technically feasible control technologies at the proposed plant, evaluation of the most effective control technology is not required.

Step 5: Select BACT

CPA is proposing the use of the following control technologies/ operating practices as BACT to mitigate GHG emissions:

- Use of Combined Cycle Power Generation
- CTG Energy Efficiency
 - Efficient compressor design
 - Efficient combustor design
 - Efficient turbine design
 - Evaporative Cooling
 - High thermal efficiency
 - Modern instrumentation, automation, and controls
 - Steam turbine bypass
- HRSG Energy Efficiency
 - Efficient heat exchanger design
 - Use of SCR to control NO_x emissions
 - Insulation to maintain efficient heat transfer

Calhoun Port Authority – ES Joslin Power Station Best Available Control Technology (BACT) Review

- Prevent steam wastage
- STG Energy Efficiency
 - Use of Reheat Cycles
 - Use of exhaust steam condenser
 - Hydrogen cooling for the generator
- Auxiliary Energy Efficiency Processes
 - Fuel Gas Preheating
 - Use of multiple turbine-HRSG configurations
 - Use of CEMS
 - Efficient operating procedures
 - Personnel training

CPA proposes an output based efficiency limit of seven thousand seven hundred and thirty (7,730) British Thermal Units per Kilowatt-hour (Btu/kWh) as BACT for GHG emissions.

BACT for Emergency Engines

CPA is proposing two diesel fired emergency generators and one diesel fired fire water pump engine for emergency purposes. These engines will be fired once a month for testing purposes and the operation time will be limited to 50 hours per year. A review of the EPA alternative control technology (ACT) suggests that add-on controls such as SCR and combustion control techniques like ignition retard to control NO_x are not cost effective for emergency diesel engines as they are expected to operate only fifty (50) hours annually. CPA is proposing good combustion practices and the use of low sulfur diesel as BACT for the emergency diesel equipment.

BACT for Circuit Breakers

A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. A sulfur hexafluoride (SF₆) circuit breaker uses contacts surrounded by SF₆ gas to quench the arc. Potential sources of SF₆ emissions include equipment leaks from SF₆ containing equipment, releases from gas cylinders used for equipment maintenance and repair operations, and SF₆ handling operations.

Step 1: Identify all available control technologies

The following available control technologies have been identified for the use of SF₆ as a circuit breaker:

1. Using gas-tight circuit breakers which require less amount of SF₆;
2. Implementing a Leak Detection and Repair (LDAR) program, repair leaks and repair/replace leaking equipment as quickly as possible; and
3. Training employees in proper handling and maintenance of equipment having potential emissions of SF₆.

Additionally use of alternative substances to SF₆ (e.g., oil) has been evaluated in this review.

Calhoun Port Authority – ES Joslin Power Station Best Available Control Technology (BACT) Review

Step 2: Eliminate Technically Infeasible Options

SF₆ is a superior dielectric gas for nearly all high voltage applications. It is easy to use, exhibits exceptional insulation and arc-interruption properties, and has proven its performance by many years of use and investigation.¹⁵

There are a number of disadvantages of using oil for applications in circuit breakers. The key disadvantages are flammability and high maintenance cost. Therefore, SF₆ is a technically superior alternative to oil.

Also, according to a report published by EPA,

“No clear alternative exists for this gas that is used extensively in circuit breakers, gas-insulated substations, and switch gear, due to its inertness and dielectric properties”¹⁶

Therefore, use of SF₆ in circuit breakers is the only available technically feasible option. Since SF₆ is the best available technology option for circuit breakers of SF₆, alternative substitutes will not be implemented. All other control technologies identified are feasible and will be implemented to reduce SF₆ fugitive emissions.

Step 3: Rank Remaining Control Technologies

Since all the identified technically feasible options will be employed to reduce fugitive SF₆ emissions, ranking of control technologies is not required.

Step 4: Evaluate Most Effective Controls and Document Results

All technically feasible control options will be implemented to reduce fugitive SF₆ emissions.

Step 5: Select BACT

Based on the top down analysis, CPA proposes following BACT for circuit breakers using SF₆ as the quenching media:

1. Using gas-tight circuit breakers which require less amount of SF₆;
2. Implementing a Leak Detection and Repair (LDAR) program, repair leaks and repair/replace leaking equipment as quickly as possible; and
3. Training employees in proper handling and maintenance of equipment having potential emissions of SF₆.

¹⁵ Christophorous, L.G., Olthoff, J.K., and Green, D.S., *Gases for Electrical Insulation and Arc Interruption: Possible Present and Future Alternatives to Pure SF₆*, NIST Technical Note 1425, November 1997

¹⁶ *SF₆ Emission Reduction Partnership for Electric Power Systems 2007 Annual Report*, U.S. Environmental Protection Agency, December 2008, available at:
http://www.epa.gov/electricpower-f6/documents/sf6_2007_ann_report.pdf (last accessed on June 7, 2012)

**Attachment A: Map of CO₂ EOR Miscible Potential in the
Gulf Coast**

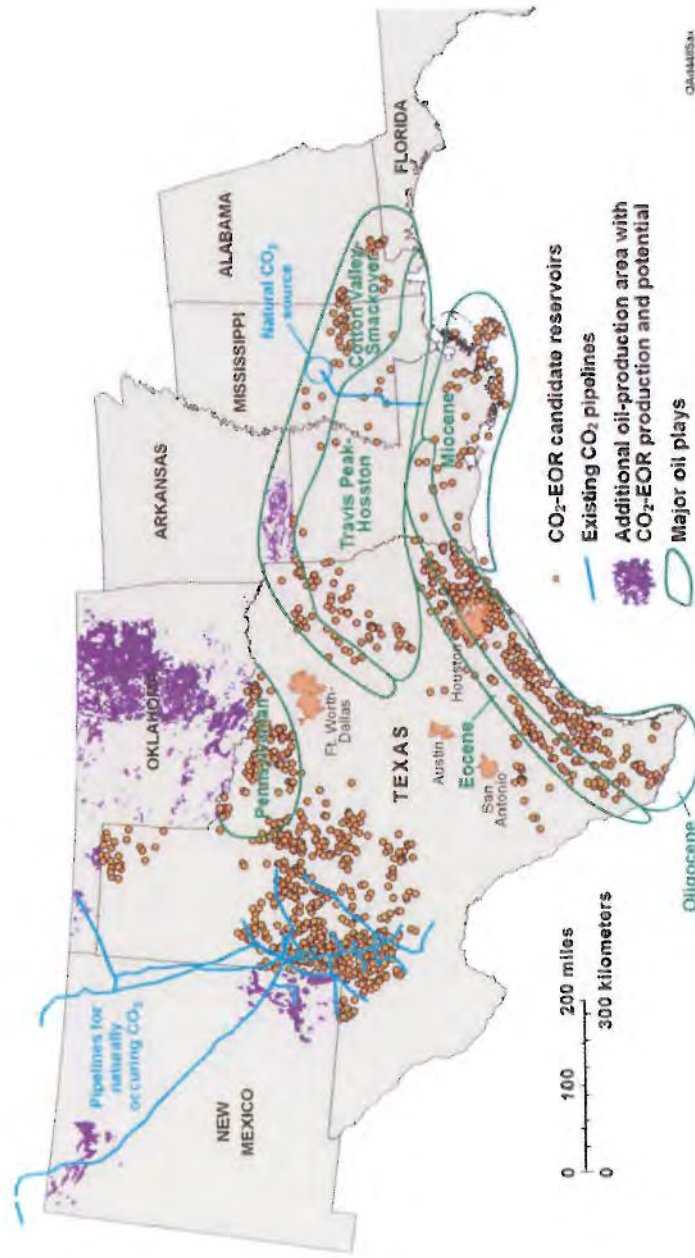


Figure 5: Map of CO₂ EOR Miscible Potential in the Gulf Coast

***GHG Applicability Flowchart – Modified Sources
(On or after July 1, 2011)***

