Electronic Permit Submittal and Processing System (EPSAP)
Professional Engineer Signature Document

"This document is signed and sealed to secure the data in this permit application and any attached files that were submitted electronically as described in Florida Department of Business and Professional Regulation, Board of Professional Engineers, Procedures for Signing and Sealing Electronically Transmitted Plan, Specifications, Reports or other Documents, Rule 61G15-23.003., F.A.C.."

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NOV 05 2008
BUREAU OF AIR REGULATION

EPSAP Application Number: 1270-3
Facility Identification Number: 0930104
Facility Owner/Company Name: OKEECHOBEE LANDFILL, INC.

Purpose of Application:
Air construction permit.

Signature File Created: 10/29/2008 3:02:13 PM

File Description	Authentication Code
Submitted Application Data	656E147C253064343D2792334AD1E6CD4AFB922F
Uploaded Facility Documents:	
Refer to Support Documents under Facility.pdf	6768D9CB7D8B72BCC49316AF812D2C203DC2F566
10-29-08 Section I _ II PSD_AC Application 1270-3.pdf	3009164B2CA811F2C55D98A4497EAD47895677DC
Refer to Support Documents under Facility.pdf	6768D9CB7D8B72BCC49316AF812D2C203DC2F566
10-29-08 AQIA Section III PSD_AC Application 1270-3.pdf	8F661BE72C8643C55C940EDEBA9E0C646F0FB828
10-29-08 Class I AQA Section III PSD_AC Application 1270-3.pdf	EFF1A09B105751725E6D5D9DC911689A7D6C1F34
Refer to Support Documents under Facility.pdf	6768D9CB7D8B72BCC49316AF812D2C203DC2F566
10-29-08 Section II Appendices PSD_AC Application 1270-3.pdf	2C71B2042066ABE1A6E2C6F7F8713A8976EE81DD
Refer to Support Documents under Facility.pdf	6768D9CB7D8B72BCC49316AF812D2C203DC2F566
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Refer to Support Documents under Facility.pdf	6768D9CB7D8B72BCC49316AF812D2C203DC2F566
Uploaded Emissions Unit Documents:	
Refer to Support Documents under Facility.pdf	6768D9CB7D8B72BCC49316AF812D2C203DC2F566
Refer to Support Documents under Facility.pdf	6768D9CB7D8B72BCC49316AF812D2C203DC2F566
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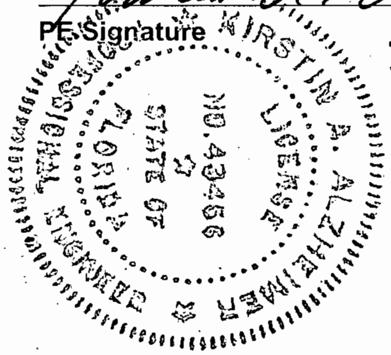
Refer to Support Documents under Facility.pdf	6768D9CB7D8B72BCC49316AF812D2C203DC2F566
Final Signature File	D778B38E2571BEE5D43F8FAB8B794A9E3D2E7365

Professional Engineer (PE): KRISTIN ALZHEIMER **License No:** 43456

(sign and affix PE seal below)

PE Signature 10/31/08
Date



Alzheimer, Kristin

From:	Oracle Account [oracle@epic30.dep.state.fl.us]
Sent:	Thursday, October 30, 2008 10:50 AM
To:	undisclosed-recipients:
Subject:	FDEP - AIR Permit PE Signature Document Required

Our records show that you are the Professional Engineer for the following EPSAP Air Permit application:

Application number: 1270-3
Submitted on: 30-OCT-08
Facility: OKEECHOBEE LANDFILL, INC.

The Responsible Official or Owner/Authorized Representative has submitted this application to the permitting authority, therefore, it is now time for you to sign, seal and mail in your PE Signature Document as specified in Rule 61G15-23.003, Florida Administrative Code.

The application will be deemed incomplete if the sealed PE Signature Document is not received during the initial completeness review time period. Only the most recently generated PE Signature Document should be mailed in to the permitting authority. If you have misplaced your most recent PE Signature Document, please note that you can re-print it from the EPSAP Main Menu if necessary.

Please send your signed and sealed PE Signature Document to the following address:

Office Name:	FDEP Bureau of Air Regulation
Office Location:	2600 Blair Stone Road MS 5505 Tallahassee, Florida 32399-2400
Office Phone:	850-921-9505
Primary Contact:	Elizabeth Walker
Primary Contact email:	Elizabeth.Walker@dep.state.fl.us
Secondary Contact:	Al Linero
Secondary Contact email:	Alvaro.Linero@dep.state.fl.us
Secondary Contact:	Barbara Friday
Secondary Contact email:	barbara.friday@dep.state.fl.us
Secondary Contact:	Jeff Koerner
Secondary Contact email:	jeff.koerner@dep.state.fl.us
Secondary Contact:	Jonathan Holtom
Secondary Contact email:	jonathan.holtom@dep.state.fl.us

The Department of Environmental

Protection values your feedback as a customer. DEP Secretary Michael W. Sole is committed to continuously assessing and

improving the level and quality of services provided to you. Please take a few minutes to comment on the quality of

service you received. Copy the url below to a web browser to complete the DEP

survey:
http://survey.dep.state.fl.us/?refemail=oracle@epic30.dep.state.fl.us
Thank you in advance for completing the survey.

Shaw™ Shaw Environmental, Inc.

Shaw Environmental, Inc.
88C Elm Street
Hopkinton, Massachusetts 01748-1656
508.435.9561
FAX: 508.435.9641

November 11, 2008

Mr. Alvaro A. Linero
Chief, Bureau of Air Regulation
Division of Air Resource Regulation
Florida Department of Environmental Protection
2600 Blairstone Road MS#5505
Tallahassee, FL 32399-2400

Subject: Prevention of Significant Deterioration (PSD) Permit Application Addenda
Document No. 1270-3
Okeechobee Landfill, Inc., Facility ID No. 0930104

Dear Mr. Linero:

On behalf of Okeechobee Landfill, Inc., Shaw Environmental, Inc. (Shaw) is pleased to provide you with hard copies of the Prevention of Significant Deterioration (PSD) Permit Application for the Okeechobee Landfill submitted through the Florida Department of Environmental Protection's EPSAP system on October 30, 2008. During the compilation of the copies, it was noted that the installation schedule for the control devices in Appendix E needed to be revised to reflect the changes in the application addenda. Attached is a copy of the revised Appendix E. Please find enclosed four (4) hard copies including the Air Quality Impact Analysis (AQIA) data and one (1) disc copy (without the AQAI data) of the permit application. These copies include the revised Appendix E.

If you have any questions or require additional information, please do not hesitate to contact David Thorley at 713.328.7404 or dthorley@wm.com. If you find any problems with the application copies we have provided, please contact me at 508.497.6172 or kelly.fagan@shawgrp.com.

Sincerely,
Shaw Environmental, Inc.

Kelly Fagan
Client Program Manager

Attachment
Enclosures

Cc: Mr. Seth Nunes, Okeechobee Landfill (2 copies, 1 disc w/o AQIA data)
Mr. John Van Gessel, Waste Management (1 disc w/o AQIA data)
Mr. David Thorley, Waste Management (1 copy, 1 disc w/o AQIA data)
Mr. Kristin Alzheimer, Shaw (1 disc w/o AQIA data)
Mr. Arijit Pakrasi, Shaw (1 copy w/o AQIA data)

Walker, Elizabeth (AIR)

From: Heron, Teresa
Sent: Friday, December 12, 2008 2:12 PM
To: Walker, Elizabeth (AIR)
Subject: FW: Okeechobee Landfill Request for Additional Information
Attachments: IncDec11-08.pdf

FYI. We sent an incompleteness letter yesterday.

From: Heron, Teresa
Sent: Thursday, December 11, 2008 3:36 PM
To: 'jvangessel@wm.com'; 'dthorley@wm.com'; 'snunes1@wm.com'; '.'; 'dunger@wm.com'; 'arijit.pakrasi@shawgrp.com'; 'leah.blinn@shawgrp.com'; 'dee_morse@nps.gov'; Long, Jack; Lurix, Joe; 'abrams.heather@epa.gov'; 'forney.kathleen@epa.gov'
Cc: Linero, Alvaro; Nelson, Deborah
Subject: Okeechobee Landfill Request for Additional Information

Attached please find the Department request for additional information.

If you have any questions, feel free to contact me.

Thanks,
Teresa Heron,
Special Programs Section
Bureau of Air Regulation
Phone 850/921-9529
teresa.heron@dep.state.fl.us

Florida Department of Environmental Protection
Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

December 11, 2008

Electronically Sent – Received Receipt Requested

jvangessel@wm.com
Mr. John Van Gessel
Vice President & Assistant Secretary
Waste Management, Inc. of Florida
2869 West Paces Ferry Road
Atlanta, Georgia 30339

Re: DEP File No. 0930104-014-AC
Berman Road and Clay Farms Landfills
Okeechobee Landfill, Inc.
Waste Management, Inc. of Florida

Dear Mr. Van Gessel:

On November 12, 2008 the Department received the revised air construction permit application for the construction of additional flares and turbines along with the Low Cat desulfurization system at the Berman Road and Clay Farms Landfills.

Pursuant to Rules 62-4.055, and 62-4.070 F.A.C., Permit Processing, the Department requests submittal of the additional information prior to processing the application. Should your response to any of the below items require new calculations, please submit the new calculations, assumptions, reference material and appropriate revised pages of the application form.

1. The application states (page 11, Section 5.2 of the PSD report) that the best available control technology (BACT) section has not been revised. The Department acknowledges that there is no need to review the BACT analyses referring to the LoCat desulphurization system. However, the BACT for the new proposed turbines needs to be addressed. Appendix B of the application lists for the primary operating scenario potential emissions of nitrogen oxides (NO_X) emissions in the order of 765.3 tons per year (TPY), sulfur dioxide (SO_2) 574.8 TPY, and carbon monoxide emissions in the order of 5,042 TPY. The individual emission rates for NO_X are 72 parts per million, by volume (ppmv) for the Titan and 42 ppmv for the Centaur. CO is listed as 100 ppmv for the Titan and 250 ppmv for the Centaur.

   The Department needs a description as to what system of continuous emissions reduction is planned and a best available control technology (BACT) proposal in accordance with Rule 62-210.200, Definitions, F.A.C and Rule 62-210.400(4)(c) Prevention of Significant Deterioration (PSD), F.A.C.

2. Section 2.4 of the addendum to the application states that for modeling purposes, more recent and averaged H_2S data were used. Please provide the time period of the data used in the modeling. Also, please explain how the new data was averaged.

3. Section 4.3.1 of the addendum to the application explains the receptor grid for the Ambient Air Quality Standard (AAQS) and Increment analyses. Please clarify or verify that a 50 km buffer was used for all analyses and that no further than 100 meter spacing of receptors were used where higher concentrations were found. Please also verify that a 50 km fence-line grid was used for the Significant Impact Analysis for PM_{10}.

4. With regards to Appendix B on disk, please explain why there are different inventories for scenario 2B and scenario 2. Also, please explain the following with regards to the excel spreadsheets: what do the terms "Deleted - Duplicate Entry" and "Deleted -No Emission Information" mean, why is the Berman Road Landfill on the NO_X list for "Deleted - No Emission Information," why do the tables show blank cells in the column for whether the source is within the Significant Impact Area, and why all of the sources inside the impact area are not shown whether or not they were modeled in the adjacent column.

Rule 62-4.050(3), F.A.C. requires that all applications for a Department permit must be certified by a professional engineer registered in the State of Florida. This requirement also applies to responses to Department requests for additional information of an engineering nature. Please note that per Rule 62-4.055(1): "The applicant shall have ninety days after the Department mails a timely request for additional information to submit that information to the Department.......... Failure of an applicant to provide the timely requested information by the applicable date shall result in denial of the application."

We will forward any comments from EPA Region IV and the National Park Service as soon as they are received. If you have any questions regarding this matter, please contact Ms. Teresa Heron at 850/921-9529 or Ms. Debbie Nelson (meteorologist) at 850/921-9537.

Sincerely,

A.A. Linero, Program Administrator
Special Projects Section

AAL/th/dn

cc: David Thorley, Waste Management, Inc. dthorley@wm.com
Seth Nunes, Waste Management, Inc. snunes1@wm.com
Jim Christiansen, Waste Management, Inc. jchristi@wm.com
David Unger, Waste Management, Inc. dunger@wm.com
Arijit Pakrasi, Shaw Environmental & Infrastructure, Inc. arijit.pakrasi@shawgrp.com
Leah Blinn, Shaw Environmental & Infrastructure, Inc. leah.blinn@shawgrp.com
Dee Morse, National Park Service, Denver CO: dee_morse@nps.gov
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Heather Abrams, U.S. EPA Region 4: abrams.heather@epa.gov
Kathleen Forney, U.S. EPA Region 4: forney.kathleen@epa.gov

Shaw® Shaw Environmental, Inc.

Shaw Environmental, Inc.
88C Elm Street
Hopkinton, MA 01748-1656
508-435-9561
FAX: 508-435-9641

December 22, 2008

A.A. Linero, P.E.
Program Administrator
Air Permitting South Section
Bob Martinez Center
2600 Blair Stone Road
Tallahassee, FL 32399-2400

RECEIVED
DEC 23 2008
BUREAU OF AIR REGULATION

RE: Response to Comments, Florida Department of Environmental Protection Letter Dated December 11, 2008 for Okeechobee Landfill DEP file No. 0930104-014-AC, Application No. 1270-3

Dear Mr. Linero:

On December 11, 2008, Waste Management, Inc. of Florida received a request for information from the Florida Department of Environmental Protection (FDEP) in response to the permit application (DEP File Number 0930104-014-AC). Attached is the response to your request for information provided by Shaw Environmental, Inc. (Shaw).

The requests made by FDEP are detailed below along with our response.

Comment 1. The application states (page 11, Section 5.2 of the PSD report) that the best available control technology (BACT) section has not been revised. The Department acknowledges that there is no need to review the BACT analyses referring to the LoCat desulphurization system. However, the BACT for the new proposed turbines needs to be addressed. Appendix B of the application lists for the primary operating scenario potential emissions of nitrogen oxides (NO_x) emissions in the order of 765.3 tons per year (TPY), sulfur dioxide (SO_2) 574.8 TPY, and carbon monoxide emissions in the order of 5,0542 TPY. The individual emission rates for NO_x are 72 parts per million, by volume (ppmv) for the Titan and 42 ppmv for the Centaur. CO is listed as 100 ppmv for the Titan and 250 ppmv for the Centaur.

The Department needs a description as to what system of continuous emissions reduction is planned and a best available control technology (BACT) proposal in accordance with Rule 62-210.200, Definitions, F.A.C and Rule 62-210.400(4)(c) Prevention of Significant Deterioration (PSD), F.A.C.

Response 1.
The proposed Titan 130 and Centaur 40 turbines operate under the same principles of combustion of LFG as the earlier proposed Mars turbines; the difference is in capacity. Therefore, the BACT analysis for the new proposed turbines, Titan 130 and Centaur 40 manufactured by Solar, remains the same as presented in Appendix D of the application 1270-2 submitted on February 27, 2007. In summary, "good combustion practices" will be the BACT for NOx, CO, and PM for these turbines. The emission rates for the proposed turbines are different than the previously proposed Mars Turbines as mentioned in the above comment.

Attachment 1 includes the revised BACT determination and the revised BACT emission rates for the proposed turbines. Please note that the BACT determination reflects our review of the RBLC database.

Comment 2. Section 2.4 of the addendum to the application states that for the modeling purposes, more recent and averaged H_2S data were used. Please provide the time period of the data used in the modeling. Also, please explain how the new data was averaged.

Response 2. In the October 2008 Addendum, there was no change in the H_2S data from the February 2008 Air Quality Analysis report. The H2S value considered for the BACT scenarios is 400 ppmv based on the estimated performance of the Lo-Cat system. The H_2S values for the interim scenarios are shown in the table below and were measured from July to November 2007. As shown in the table below, the H_2S concentration data was averaged for the enclosed flares and for the odor control (open) flare. These averages were used for the interim modeling scenarios.

2007 Month	H2S Concentration (ppmv)	
	Enclosed Flares	Odor (Θpen Flare)
July	3600	3733
August	3133	3100
September	1017	4900
October	5467	7033
November	1733	6167
Average	**2990**	**4986.6**

Comment 3. Section 4.3.1 of the addendum to the application explains the receptor grid for the Ambient Air Quality Standard (AAQS) and Increment analyses. Please clarify or verify that a 50 km buffer was used for all analyses and that no further than 100 meter spacing of receptors were used where higher concentrations were found. Please also verify that a 50 km fence-line grid was used for the Significant Impact Analysis for PM_{10}.

Response 3. The Significant Impact Analysis receptor grid for all pollutants extended to approximately 30 km from the fence-line. Shaw believes that this receptor grid is sufficient for capturing the location of the maximum impacts from the project sources. All maximum concentrations were close to the fence-line and the maximum radius of impact (ROI) was 3.2 km from the sources (for 24-hr SO_2).

No further than 100 meter spacing of receptors were used where higher concentrations were found. Once the ROI was found for each pollutant, Shaw requested the off-property inventory for sources from FDEP that are located within the ROI plus 50 km (i.e. the 50 km buffer), which were then included in NAAQS and PSD increment compliance demonstration.

Comment 4. With regards to Appendix B on disk, please explain why there are different inventories for scenario 2B and scenario2. Also, please explain the following with regards to the excel spreadsheets: what do the terms "Deleted – Duplicate Entry" and "Deleted – No Emission Information" mean, why is the Berman Road Landfill on the NO_x list for "Deleted – No Emission Information," why do the tables show blank cells in the column for whether the sources is within the Significant Impact Area, and why all of the sources inside the impact area are not shown whether or not they were modeled in the adjacent column.

Response 4. Shaw discussed this comment with Debbie Nelson on December 16, 2008. As previously discussed, there are two different inventories for scenario 2B and scenario 2 because the ROI is different for these scenarios.

Those sources in the off-property inventory provided by FDEP which had a blank for the emissions data were deleted and marked as "Deleted – No Emission Information." There were a few sources in the inventory that were duplicate entries, and were marked as "Deleted – Duplicate Entry." All Okeechobee Landfill, Inc. sources listed in the off-property inventory were deleted because these sources were already included in the model as on-site sources.

The tables show blank cells if the source is not within the criteria (ex. not within the area of impact). The final column in the spreadsheet is the final determination if the source should be included in the modeling. Appendix B was explained to and discussed with Debbie Nelson on December 16, 2008 with regards to these comments.

If there are further questions on the application, please contact the David Thorley at 713-328-7404.

Sincerely,

Kelly Fagan, P.E.
Project Manager

Seal

Kristin A. Alzheimer, P.E.

Attachment

Cc: John Van Gessel, Waste Management, Inc. of Florida: jvangessel@wm.com
Seth Nunes, Okeechobee Landfill, Inc. snunes1@wm.com
Jim Christiansen, Okeechobee Landfill, Inc.: jchristi@wm.com
David Thorley, Okeechobee Landfill, Inc.: dthorley@wm.com
Arijit Pakrasi, Shaw Environmental: arijit.pakrasi@shawgrp.com
Leah Blinn, Shaw Environmental: leah.blinn@shawgrp.com

Attachment

Addendum to
Best Available Control Technology (BACT) Analysis

Okeechobee Landfill, Inc.
Okeechobee, FL

Facility No. 0930104
AC Permit Application No. 1270-3

February 27, 2007
Revised: December 16, 2008

TABLE OF CONTENTS

1.0 INTRODUCTION

This document is an addendum to the Best Available Control Technology (BACT) analysis provided in Appendix D of the Application 1270-2 on February 27, 2007. In a letter from the Florida Department of Environmental Protection dated December 11, 2008, it was requested that a BACT analysis be addressed for the new turbines, Titan 130 and Centaur 40. The letter stated that the selected BACT for sulfur dioxide was acceptable and did not have to be revised for the new turbines. Section 2.0 of this Addendum reiterates the BACT regulation and definition. Sections 3.0, 4.0 and 5.0 address BACT analysis for the criteria pollutants, Nitrogen Dioxide (NO2), Carbon Monoxide (CO) and particulate matter (PM). These sections have been taken from the previous BACT report and revised where necessary.

2.0 Best Available Control Technology Analysis

Under Florida's Preconstruction Review Process (PCR), a PSD permit process requires a BACT analysis in order to identify the pollution control device or system that is most suitable with respect to technological and economic considerations [F.A.C. 62-212.400(4)(c)]. The code defines and provides the general approach to support a BACT analysis under Definitions [F.A.C. 62-210.200(39)].

(a) *An emission limitation, including a visible emissions standard, based on the maximum degree of reduction of each pollutant emitted which the Department, on a case by case basis, taking into account:*

1. *Energy, environmental and economic impacts, and other costs;*
2. *All scientific, engineering, and technical material and other information available to the Department; and*
3. *The emission limiting standards or BACT determinations of Florida and any other state; determines (what) is achievable through application of production processes and available methods, systems and techniques (including fuel cleaning or treatment or innovative fuel combustion techniques) for control of each such pollutant.*

(b) *If the Department determines that technological or economic limitations on the application of measurement methodology to a particular part of an emissions unit or facility would make the imposition of an emission standard infeasible, a design, equipment, work practice, operational standard or combination thereof, may be prescribed instead to satisfy the requirement for the application of BACT. Such standard shall, to the degree possible, set forth the emissions reductions achievable by implementation of such design, equipment, work practice or operation.*

(c) *Each BACT determination shall include applicable test methods or shall provide for determining compliance with the standard(s) by means which achieve equivalent results.*

(d) *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, 61, and 63.*

The definition above describes a PCR project and how BACT is developed. The construction project and other MSW landfill projects are substantially different than other PCR projects. In most PCR projects the facility has not been built or it has been built is operational but a definable expansion is proposed. In the case of an MSW landfill project, the facility has been permitted and construction is congruent to the operation. As the "community", whatever the may be relative to vicinity or waste produced, grows, the landfill must increase its disposal area. Currently, air permits are not required for the processing of permit applications for MSW facility expansions. Historically, many agencies have looked at the flares or other combustion devices as emission sources along with the landfill and each control device is permitted as they are needed. For the project, it is expected that up to a three year period will be necessary for permit approval, procurement, design and construction for the selected prior to BACT installation.

3.0 BACT: NO_2

Oxides of nitrogen (NO, NO_2 and NO_3 – jointly referred to ax NO_x) are products of thermal combustion processes. There are two components of NOx formation:

"Fuel NOx" is caused by the direct oxidation of fuel-bound-nitrogen; i.e., nitrogen that is chemically part of the fuel molecules.

"Thermal NOx" is formed at high temperatures (generally in excess of 2100°F) by the dissociation of N_2 in the combustion air and recombination with oxygen. Thermal NOx is predominantly NO, though NO converts to NO_2 in the presence of oxygen and with time. Trace amounts of NO_3 may also be formed, but the fraction is so small that it can be ignored for most practical purposes regarding NOx control.

Fuel-bound-nitrogen is a concern only in liquid and solid fuels and some refinery fuel gases. There is essentially no fuel-bound-nitrogen in gaseous fuels such as natural gas or landfill gas. Nitrogen in these gaseous fuels is free nitrogen, N_2, which acts like the N_2 in the combustion air. Combustion air is the source of 99% of the free nitrogen involved in the combustion process. Therefore, referrals to NOx in the remainder of this report are to thermal NOx.

Although NOx emissions from a combustion source are a mix of NO and NO_2, it is NO_2 that is the pollutant of concern. Stack measurements of NOx are therefore reported as NO_2.

3.1 USEPA TECHNOLOGY CLEARINGHOUSE DATABASE FOR NO_2

A review was made of the USEPA RACT BACT LAER Clearinghouse by using the USEPA web site www.epa.gov/ttn/catc/rblc. The data base was searched for process information related to landfill gas with the pollutant NOx. The results are summarized in the **Table 3-1**.

Table 3-1
USEPA TTN Database search parameters and results for NOx

Process Information	Result
Fuel Combustion	
Utility and Large Industrial Boiler/ Furnaces	
11.320 LF/ Digester/ Bio-gas	1 Facility
Industrial Size Boilers/ furnaces (> 100 mi)	
Gaseous fuel and mixtures	
12.320 LF/ Digester/ Bio-Gas	2 Facilities
Commercial/ Industrial size boilers/ furnaces	
Gaseous fuel and mixtures	
13.320 LF/ Digester/ Bio-Gas	None
Large combustion Turbines (> 25 MW)	
Simple Cycle	
15.120 LF/ Digester/ Bio-Gas	None
Combined Cycle and Co-generation	
15.220 LF/ Digester/ Bio-Gas	None
Small Combustion Turbines (<25 MW)	
Simple Cycle	

Process Information	Result
16.120 LF/ Digester/ Bio-Gas	3 Facilities
Combined Cycle and Co-generation	
16.220 LF/ Digester/ Bio-Gas	None
Internal Combustion Engine	
Large Internal Combustion Engine (> 500 HP)	
17.140 LF/ Digester/ Bio-Gas	18 Facilities
Small Internal Combustion Engine	
17.240 LF/ Digester/ Bio-Gas	1 Facility
Miscellaneous Combustion	
Flares	
19.320 Digester & LF Gas Flares	17 Facilities and 19 Processes

There are no BACT determinations for CTGs using solely landfill gas.

3.2 OVERVIEW OF NO_X CONTROL TECHNOLOGIES

Approaches to NOx control for combustion turbines burning gaseous fuels are of two types:

Combustion modifications aimed generally at reducing the effective flame temperature. Since NOx formation is temperature-sensitive, lowering the flame temperature reduces NOx formation.

3.3 NOX CONTROL TECHNOLOGY DESCRIPTIONS

Conventional CTG combustors utilize a diffusion flame, essentially mixing air with a gaseous fuel to obtain a flammable mixture and then burning it. The result is a very hot central region to the flame, cooling as it continues to diffuse more air into the combustion process. That hot zone is where most of the NOx is formed. Typical NOx emission rates from a natural gas-fired CTG with traditional diffusion burners are on the order of 150 to 250 ppm depending on other design parameters of the engines.

3.3.1 Combustion Modification

There are three general approaches to combustion modification to reduce the effective temperature of that flame, staged combustion, catalytic combustion and the addition of diluents.

3.3.1.1 Staged Combustion

In staged combustion, a limited amount of air is combined thoroughly with the fuel and combustion is started in a sub-stoichiometric mixture at low temperature. Subsequent stages add more air and complete the combustion process. In this manner, there is no hot central core to the flame; the combustion process occurs uniformly across the entire combustor. Staged combustion is known by various trade names associated with specific CTG manufacturers; e.g., Dry Low-NOx™ (General Electric), Dry-Low Emissions™ (Rolls-Royce) and SoLoNOx™ (Solar Turbines). Although there are differences in actual combustor design, the principals are the same. Staged combustors have routinely achieved NOx emission rates in the single digits in natural gas-fired CTGs. However, combustor design is highly fuel-specific. Even regional variations in natural gas composition lead to variations in combustor design.

Staged combustion is being developed for landfill gas combustion in CTGs but has not been commercially demonstrated. Additionally, staged combustion is not commercially available for the Solar Titan and Centaur 40 CTGs proposed for this project. Therefore, this technology is not considered as voable for the proposed turbines.

3.3.1.2 Catalytic Combustion

Catalytic combustion, such as Xonon™, places a catalyst within the combustion chamber of a gas-fired CTG. This is a combustion technology which combusts fuel at temperatures below that at which thermal NOx is formed. This technology, though promising, is yet to be commercialized. . Also, it has not been applied to a landfill gas-fired CTG and is not available on the selected Titan and Centaur 40 CTG.

3.3.1.3 Diluent Injection

Various diluents have been used for NOx control in fossil-fuel-fired CTGs. Water is the most common diluent and has been commonly used since the 1970s. Water is introduced into the combustion chamber, either by a finely atomized spray or by physical mixing with the fuel (limited to liquid fuels). The water absorbs heat from the combustion process as it evaporates, lowering the flame temperature while not significantly interfering with the combustion process..

With landfill gas-fired CTGs, however, the flame temperature is already considerably lower than in a natural gas-fired CTG because the gas is already diluted by about 50 percent or greater with CO_2, a natural product of landfill gas production. CO_2 operates in the flame just as water or steam would; it reduces the flame temperature that is achieved during combustion. A turbine manufacturer has indicated that natural variability in landfill gas quality and the already-diluted character of the fuel would make water injection a technical challenge, potentially leading to flame instability, which in turn can severely shorten the life of turbine components, create a safety hazard, and greatly increase CO emissions due to combustion interference, hence incomplete combustion. Water injection is therefore not recommended for low-Btu gas used with any CTG including the Titan and Centaur 40 CTGs.

The Titan 100 and the Centaur 40 are high-efficiency engines with high compression ratio and "firing temperature" (firing temperature is not the same as flame temperature – it generally refers to the gas temperature entering the power turbine section of the CTG, not the temperature in the combustion zone), its emissions are slightly higher than some of the lower efficiency models. Solar has quoted 72 and 42 ppm NOx as a guaranteed emission rate for the Titan and Centaur units respectively; actual emission rate may be somewhat lower. This is below the recent New Source Performance Standard for Stationary Combustion Turbines, 40 CFR 60 Subpart KKKK, which limits NOx for small simple-cycle CTGs burning other than natural gas or oil to 74 ppm NOx.

3.3.2 Post-Combustion Control

There are a number of processes available for NOx removal in a gas stream; however, almost all are designed to operate in the chemical manufacturing and refining industries processing streams with concentrations from hundreds to tens of thousands of ppm NOx and are not applicable to processing highly dilute gas flows. Examples include Single and Multiple Stage High Efficiency Nitrogen Oxide (NOx) Control Scrubbing Systems, similar to those produced by Duall and low temperature oxidation technology, LoTOx™ Technology, from BELCO® under license from BOC. This latter technology has strong synergy with EDV® scrubbing for refinery applications such as Fluid Catalytic Cracking Unit (FCCU), fluid cokers, heaters and boilers. Some of the common technologies used for post combustion NOx control are discussed below:

3.3.2.1 SNCR

The Wheelabrator NOxOUT™ Process and other similar selective non-catalytic reduction (SNCR) technologies that have been utilized commercially to reduce NOx emissions in boiler and applications using natural gas. Natural gas combustion provides the temperature window (namely 1600-2100 F) and the residence time required for SNCR. LFG combustion does not provide the required residence time and the required temperature window due to the dilution effect of CO2. There is no commercially available SNCR system using LFG in a combustion turbine. Thus, this technology is not considered for the proposed turbines.

3.3.2.2 SCONOX™

SCONOX is a catalytic NOx reduction technology. A mesh or honeycomb stubstrate coated with a regenerable catalyst is placed in the CTGs exhaust gas path. NOx is catalytically reacted resulting in formation of a nitrogen-based compound that remains in the coating. The catalyst is periodically taken out of service and regenerated, releasing the nitrogen that was formerly NOx as nitrogen gas. Its apparent advantage over selective catalytic reduction (SCR), which is discussed later herein, is that ammonia is not required in the process.

This technology was technically demonstrated on a 20MW natural gas-fired CTG in the mid-1990s. It was later applied commercially to a Solar Mars turbine installation in MA that was fired with natural gas and occasionally distillate oil. After several years of continuous development, that unit was reportedly recently shut down having not continuously achieved its target performance, and plans for a second identical unit have been canceled. Results are expected to be similar for any of the landfill-gas fired CTG including the Titan and the Centaur.

The technology was offered for several years for larger U.S. power plant applications under license to ABB (later Ahlstom) Environmental Systems, but was never utilized, in part because its cost was extreme.

This technology is not applicable to the proposed project. It requires gas temperatures that are much lower than those from a simple cycle combustion turbine installation. The process is also highly sensitive to sulfur in compounds in the gas stream. It has not been demonstrated burning landfill gas and is considered technically infeasible as well as commercially undemonstrated.

3.3.2.3 SCR

Selective catalytic reduction (SCR) is a catalytic NOx removal process. Ammonia is injected into the exhaust gas flow which then passes over a catalyst coated mesh or honeycomb placed in the exhaust dust. Ammonia and NOx react to N_2

and H_2O. Excess ammonia passes through unreacted and is emitted to the atmosphere.

There are two general categories of SCR systems, referred to herein as conventional and high-temperature systems. Conventional catalyst systems are limited to operation at <850°F. Even short-term excursions above that temperature can permanently damage the catalyst structure. The exhaust temperature of simple cycle CTGs varies with make, model, fuel and ambient conditions; the landfill gas-fired Titan and Centaur is 900 to 925 °F during the majority of the year (i.e., at ambient temperatures of 60°F or greater).

A few installations of conventional SCR on simple cycle CTGs have been accomplished by adding fresh air to the exhaust flow using dilution air fans, lowering the exhaust temperature to below 850°F. In those cases, the specific engines had peak exhaust temperatures in the range of 870 to 880°F. These are generally fossil-fuel-fired CTGs in utility peaking service, operated only a few hours per year. The energy penalty of adding dilution air makes the technique impractical of for continuously operated units.

High temperature SCR uses a different type of catalyst which comprises the entire catalyst structure; i.e., is not just a coating. It can be used at operating temperatures exceeding the expected exhaust temperatures of the Project's CTGs. This technology has been only rarely applied, however, because it is considerably more expensive than conventional SCRs.

Virtually all SCR experience is on fossil fuel-fired CTGs. Landfill gas contains siloxanes, a silicone-carbon compound that oxidizes to silicone dioxide, SiO2, when combusted. SiO_2 will then coat downstream components, fouling a catalyst placed in the gas path.

"There are numerous examples where SiO_2 deposits from siloxane have resulted in catalyst deactivation in hours or days. ....their rapid destructive effects makes this [use of a catalyst for emission control] a difficult application."[1]

For this reason, use of SCR is not technically feasible for use with landfill gas-fired engines.

3.4 NO_2 CONTROL TECHNOLOGY ANALYSIS

The natural diluent effects of CO_2 in landfill gas greatly reduce NOx formation that would otherwise occur from burning the methane component. Other combustion modifications, such as water injection or staged combustion, have not been applied to landfill gas-fired CTGs.

Post-combustion controls are not technically feasible for landfill gas-fired CTGs due to contaminants in the landfill gas that will coat and damage catalysts.

3.5 NO_2 BACT SELECTION

[1] "Siloxanes in Landfill and Digester Gas Update", Wheless, Ed, Los Angeles County Sanitation District and Pierce, Jeffrey, SCS Energy (date unknown)

3.5.1 Combustion Turbines

The turbines selected for the project were selected because of their ability to burn landfill gas efficiently and steadily. Good combustion practice is selected as BACT for No2 for the proposed turbines. Using the BACT, the emissions from the turbines will be limited to 72 and 42 ppm for the Titan and Centaur, respectively, which is lower than the applicable requirement of NSPS subpart KKKK.

3.5.2 Flares

The application also reviewed the literature for BACT that had been applied to flares. The project will utilize flares as back up devices for the turbines. The flares will also be the initial control devices until the turbines are installed. The RBLC was queried for control systems to be applied to flares. The flares are the control devices. The RBLC lists flares as control devices for the petroleum industry, chemical industry, waste water treatment and landfill gas. They are generally employed where waste gas would be discharged untreated to the atmosphere. That will be the application of the flares in this project.

There are two techniques which are discussed for the better operation of the flares. The techniques are steam assisted flares and air assisted flares[2]. These techniques are used to create a smokeless flare when the material being flared is difficult to combust when passively mixed with air. Flares developed for landfill gas are smokeless by design.

Smokeless design is selected as the BACT for NO2 for flares.

[2] Air and Waste Management association, Air pollution Engineering Manual, Second Edition, Davis, Wayne,ed;.2000

4.0 BACT: CO

- Carbon monoxide is a product of incomplete combustion. A combustion turbine-generator ("CTG"), as a technology, is inherently highly efficient in combusting fuel

4.1 USEPA Technology Clearinghouse Database for CO

A review was made of the USEPA RACT BACT LAER Clearinghouse at the USEPA web site www.epa.gov/ttn/catc/rblc. The data base was searched for landfills with the pollutant CO. The results are summarized in **Table 4-1**. No facilities were found in the database using landfill gas to operate a combustion turbine.

Table 4-1
USEPA TTN Database: Search Parameters And Results For CO

Process Information	Result
Fuel Combustion	
Utility and Large Industrial Boiler/ Furnaces	
11.320 LF/ Digester/ Bio-gas	1 Facility
Industrial Size Boilers/ furnaces (> 100 mi)	
Gaseous fuel and mixtures	
12.320 LF/ Digester/ Bio-Gas	2 Facilities
Commercial/ Industrial size boilers/ furnaces	
Gaseous fuel and mixtures	
13.320 LF/ Digester/ Bio-Gas	None
Large combustion Turbines (> 25 MW)	
Simple Cycle	
15.120 LF/ Digester/ Bio-Gas	None
Combined Cycle and Co-generation	
15.220 LF/ Digester/ Bio-Gas	None
Small Combustion Turbines (<25 MW)	
Simple Cycle	
16.120 LF/ Digester/ Bio-Gas	3 facilities
Combined Cycle and Co-generation	
16.220 LF/ Digester/ Bio-Gas	None
Internal Combustion Engine	
Large Internal Combustion Engine (> 500 HP)	
17.140 LF/ Digester/ Bio-Gas	18 Facilities
Small Internal Combustion Engine	
17.240 LF/ Digester/ Bio-Gas	1 Facility
Miscellaneous Combustion	
Flares	
19.320 Digester & LF Gas Flares	15 Facilities and 17 Processes

As shown above, there were no BACT determinations for CO for CTGs using landfill gas in the database.

4.2 OVERVIEW OF CO CONTROL TECHNOLOGIES

CO emissions are controlled by either combustor design or by add-on flue gas treatment.

Generation of CO is a function of the efficiency of the combustion process. Combustion turbines, as a technology, are inherently highly efficient in combusting fuel, resulting in very low CO emissions compared, for example, to conventional boilers and IC engines.

Add-on systems for CO control are comprised of oxidation catalysts placed in the hot exhaust gas flow.

4.3 CO CONTROL TECHNOLOGY DESCRIPTIONS

4.3.1 Post Combustion Catalytic Controls

Oxidation catalysts have been commonly used on natural gas-fired combustion turbines. However, this technology is not applicable to units burning landfill gas. Landfill gas contains contaminants, specifically siloxanes that convert to SiO2 in the combustion process. The SiO_2 will quickly foul downstream components, including catalysts. This is summarized in a U.S. EPA memorandum.[3]

"Oxidation Catalyst systems can be used on combustion turbines which combust all types of gaseous and liquid fuels except for landfill and digester gases, which foul the catalyst very quickly because of a compound called siloxanes contained in these fuels. Siloxanes are difficult and very costly to remove from these fuels. Therefore, the application of oxidation catalyst systems to combustion turbines that burn landfill or digester gas does not appear to be feasible. Also there are no known installations of oxidation catalysts on combustion turbines burning landfill or digester gas." Thus, this technology was not considered in the BACT analysis for CO for the proposed turbines.

4.3.2 Combustion Controls

Good combustion practices are commonly used in controlling CO for fossil fuel combustion systems. Generally, NOx and CO generation in fossil fuel combustion are interdependent; lower NOx generation leads to higher CO generation. However, with good combustion control practices, the current generation of combustion turbines is able to control both pollutants within required limits.

Because burner and combustion chamber design are the principal features ensuring high combustion efficiency in a CTG, fuels of variable quality, such as digester or landfill gas and refinery fuel gas, can affect CO emission rates. Thus manufacturers' data include higher CO emission rates than for natural gas or oil-fired CTGs. Furthermore, there are relatively few CTGs burning landfill gas, therefore, there is less confidence in the available data, further increasing the emission rates that manufacturers will guarantee.

In addition, CO emission rates can be sensitive to very slight differences in manufacturing and operation; hence CO emission rates may vary from installation to installation of the same make and model combustion turbine. As a result, combustion turbine manufacturers include significant margin in their CO emissions guarantees.

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[3] " Hazardous Air Pollutant (HAP) Emission Control Technology for New Stationary Combustion Turbines", U.S. EPA memorandum from Sims Roy, Emission Standards Division, Combustion Group, to Docket A-95-51, August 21, 2001.

4.4 CO BACT SELECTION

Good combustion control is selected the BACT for CO for the proposed turbines. Solar Turbines, the manufacturer of the proposed CTGs, has provided a guaranteed CO emission rate of 100 and 250 parts per million, by volume, dry, corrected to 15% O_2 ("ppmc") for the Titan 130 and Centaur 40, respectively, This will be considered the BACT emission rate.

5.0 BACT: PM_{10}

The primary method of controlling PM_{10} emissions from a CTG is use of clean-burning fuels. PM_{10} emissions from gas-fired CTGs are extremely low and are generally comprised of trace contaminants in the fuel and uncombusted VOCs that form condensable particulate matter in the turbine exhaust. Trace amounts of filterable PM_{10} may also occur from combustion products. PM_{10} concentrations in the exhaust of gas-fired CTGs are so small that it takes special test procedures (exceptionally large sample volumes) to measure them.

5.1 USEPA TECHNOLOGY CLEARINGHOUSE DATABASE FOR PM_{10}

A review was made of the USEPA RACT/BACT/LAER Clearinghouse at the USEPA web site www.epa.gov/ttn/catc/rblc. The data base was searched for landfills with the pollutant PM_{10}. The results are summarized in **Table 5-1**. No facilities were found in the database using landfill gas to operate a combustion turbine.

Table 5-1
USEPA TTN Database search parameters and results for PM

Process Information	Result
Fuel Combustion	
Utility and Large Industrial Boiler/ Furnaces	
11.320 LF/ Digester/ Bio-gas	None
Industrial Size Boilers/ furnaces (> 100 mi)	
Gaseous fuel and mixtures	
12.320 LF/ Digester/ Bio-Gas	None
Commercial/ Industrial size boilers/ furnaces	
Gaseous fuel and mixtures	
13.320 LF/ Digester/ Bio-Gas	None
Large combustion Turbines (> 25 MW)	
Simple Cycle	
15.120 LF/ Digester/ Bio-Gas	None
Combined Cycle and Co-generation	
15.220 LF/ Digester/ Bio-Gas	None
Small Combustion Turbines (<25 MW)	
Simple Cycle	
16.120 LF/ Digester/ Bio-Gas	3 facilities
Combined Cycle and Co-generation	
16.220 LF/ Digester/ Bio-Gas	None
Internal Combustion Engine	
Large Internal Combustion Engine (> 500 HP)	
17.140 LF/ Digester/ Bio-Gas	16 Facilities

Process Information	Result
Small Internal Combustion Engine 17.240 LF/ Digester/ Bio-Gas	1 Facility
Miscellaneous Combustion Flares, Landfill 19.320 Digester & LF Gas Flares	12 Facilities and 14 Processes

As shown above, there were no BACT determinations in the database for CTGs using LFG.

5.2 OVERVIEW OF PM_{10} CONTROL TECHNOLOGIES

PM_{10} emissions are controlled by minimizing particulate matter in the fuel, filtering the combustion air entering the engine, and insuring high efficiency combustion. There are no add-on technologies that have been applied to CTG exhaust.

5.3 PM_{10} CONTROL TECHNOLOGY DESCRIPTIONS

5.3.1 Combustion Control Using Clean Fuel

The use of clean-burning gas fuels effectively minimizes PM10 generation. Landfill gas contains some contaminants that may contribute to PM10 emissions, such as siloxane, but further control of fuel quality is impractical, particularly considering the very low PM10 emission rate.

All combustion turbines utilize high efficiency inlet air filters to remove ambient particulate matter. Although this measure is taken primarily to protect the surfaces of ther blades and rotors and to keep the compressor clean to maximize its efficiency, it also removes particles that would have otherwise contributed to PM10 emissions.

The efficient combustion control in a modern CTG maximizes the complete combustion of the fuel gas components, keeping condensable C3+ organic compounds to levels typically on the order of 1 ppm.

USEPA's AP-42 provides a PM10 emission factor for landfill gas-fired CTGs of 0.023 lb/MMBtu. This is believed to be a representative value.

5.3.2 Post-Combustion Controls

Post combustion control of PM includes cyclones, fabric filters, electrostatic precipitators, and wet scrubbers. These technologies are considered infeasible for the turbines due to very low PM emissions from burning of LFG.

5.4 PM_{10} BACT SELECTION

The use of clean burning LFG and good combustion control is selected as the BACT for PM10 for the proposed turbines. The PM10 emissions from the proposed CTGs will be 0.023 lb/MMBtu using the BACT.