FLINT HILLS
resources®
Corpus Christi Refineries

CERTIFIED MAIL
RETURN RECEIPT REQUEST
7012 3050 0000 9879 4423

P.O. Box 2608
Corpus Christi, Texas 78403-2608

February 17, 2014

Ms. Kathleen Aisling
U.S. Environmental Protection Agency, Region 6
Air Permits Section (6PD-R)
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733

Re: Flint Hills Resources Corpus Christi, LLC - West Refinery
PSD Greenhouse Gas Permit Application
Domestic Crude Project
Response to Information Requests

Dear Ms. Aisling:

On behalf of Flint Hills Resources Corpus Christi, LLC (FHR), I am submitting responses to your January 14, 2014, and February 5, 2014, information requests (sent via email) regarding the greenhouse gas (GHG) prevention of significant deterioration (PSD) permit application FHR submitted to EPA Region 6 on December 12, 2012. The permit application seeks to authorize a project at FHR's West Refinery to allow the refinery to process a larger percentage of domestic crude oil (the Domestic Crude Project). Responses to your information request are provided on the following pages. Additional information associated with the responses is provided in Attachments A, B, C, and D. Responses to your January 30, 2014 information request (sent via email) will be provided at a later date.

In the event you have additional questions or would like to discuss further, please contact Daren Knowles at (361) 242-8301.

Sincerely,

Valerie Pompa
Vice President and Manufacturing Manager

VP/DK/syw
Air 14-074; W 3 N 22

Enclosure

cc: Air Section Manager, TCEQ, Region 14, Corpus Christi, w/enclosure
Mr. Kris L. Kirchner, P.E., Waid Environmental, Austin, w/enclosure
Mr. Jeff Robinson, EPA Region 6, w/enclosure (via email)
Ms. Melanie Magee, EPA Region 6, w/enclosure (via email)

RESPONSES TO JANUARY 14, 2014 INFORMATION REQUEST

__December 12, 2012, Permit Application__

1. **Because some time has passed since FHR submitted the original application, please revise the Project Overview and Description to accurately reflect the current project. If the process flow diagrams change due to these updates or any of the responses to questions below, please resubmit the diagrams.**

   __FHR's Response__

   A revised Section 2 (Project Overview and Description) is provided in Attachment A. The following changes have been made.

   1. FHR has revised the wording by removing the word expansion from the first paragraph. The objective of the Domestic Crude Project is to allow the West Refinery to process a larger percentage of domestically produced crude oil. Because the domestic crude is much lighter than foreign crude, the Project includes the construction of an additional process unit and other equipment to process more lighter-end products. The project would also modestly increase (by approximately 7%) the total crude processing capacity at the West Refinery.

   2. FHR has added wording under the "Construction of New Emission Units" and "Changes to Existing Emission Units" sections to describe controls being installed on the Sat Gas No. 3 Hot Oil Heater and the CCR Hot Oil Heater.

   3. FHR is removing the Mid Plant Cooling Tower (EPN F-S-201) from the permit application. There are no longer any modifications planned for this facility as part of the domestic crude project nor is it affected by the project. To reflect this change, the PFD for the cooling towers has been revised and is included in Attachment A.

2. **Please revise the Greenhouse Gas Emission Rate Calculations section and associated pages using EPA's recently updated global-warming potential values, where applicable. As we discussed, please resubmit the calculations using Tier 3 equations for the units that originally used Tier 1 equations. Include a discussion of the variability of fuel input parameters and how representative your refinery fuel gas baseline is. Are there past permit application representations or permit conditions for any of the units involved in this project that restrict the type of fuel that can be used?**

   __FHR's Response__

   FHR has revised the emission rate calculations using EPA's recently updated global-warming potential values. FHR has also revised the emission rate calculations for the heaters and boilers to be based on Tier 3 equations rather than the Tier 1 equations used in the original application. FHR has calculated a unique lb CO_2 /MMBtu emission factor for purchased natural gas and each refinery fuel gas stream using Equation C-5 in 40 C.F.R. Part 98, Subpart C and actual carbon content, molecular weight, and higher heating values for each fuel stream from 2011, 2012, and 2013. To account for the variable carbon content, molecular weight, and higher heating value of each fuel stream, each CO_2 factor was determined by calculating an average CO_2 factor using the carbon content, molecular weight, and higher heating value data for 2011, 2012, and 2013 and adding two standard deviations to the average. Revised calculations for the heaters and boilers reflecting the updated global warming potential values and Tier III methodology are provided in Attachment A.

In prior representations for the state NSR application, FHR has represented the firing of natural gas and the Merox Treating Unit off-gas stream in the Sat Gas No. 3 Hot Oil Heater and the firing of refinery fuel gas in the other process heaters and boilers. FHR will not fire any other types of fuels in these heaters.

In addition to the revisions above, FHR is proposing the following revisions to the emission calculations:

1. FHR is correcting the fugitive component emission rate calculations for the DHT Unit (EPN F-37), the UDEX Unit (EPN F-14-UDEX), and the West Crude Unit (EPN F-40). In the original application submitted December 2012, emission rates were shown for some of the components when the component count showed zero. (Note: these same revisions were included in the July 2013 revision submittal to EPA).
2. FHR is revising the calculation method for the incremental emissions from the API Separator Flare (EPN V-8) to be based on a more accurate estimate of the incremental vent gas flow rate. The flow rate is now based on the measured flow rate and composition of the vent gas stream routed to the flare rather than the calculated (using AP-42 emission factors) stream flow rate and composition.
3. FHR is revising the calculations for the MSSFUGS-DC to reflect a reduced number of hours per year for the controlling of maintenance, start-up, and shutdown emissions associated with the Domestic Crude Project.
4. FHR is revising the baseline emissions for the heaters and boilers based on Tier III methodology by using each heater's/boiler's actual firing rate for 2011 and 2012 as represented in the TCEQ annual emissions inventory and the average fuel carbon content, molecular weight and higher heating value for the appropriate fuel stream reported as part of the 40 CFR Part 98 GHG reporting.
5. FHR is updating the PSD applicability tables (Table 2-F) reflecting the above emissions calculation changes are included as revisions to Section 3.0 of the application in Appendix A of this submittal.

3. **Best Available Control Technology (BACT) for new heaters, Pages 67-68 (also Response to Question #4 in the May 16, 2013, letter from FHR to EPA): Please provide a discussion on why the selected product has the optimal efficiency and why the specific design is BACT. In other words, if 92% is the efficiency of the burner, is an efficiency greater than 92% possible, and if so, why was a design with the higher efficiency not selected as BACT.**

<u>FHR's Response</u>

FHR will provide a response to this question in a later submittal that addresses other questions regarding BACT.

4. **Existing Boilers--"Various Boilers" or "Utility Boilers" (also mentioned in the May, June, and July 2013, letters from FHR to EPA regarding the Domestic Crude Project): Please send the Emission Point Numbers of the existing boilers that will be affected by this project and note the location and operating scenario(s) for each boiler.**

FHR states in the PSD GHG permit application and in correspondence (for instance, on Page 3 of the May 16, 2013, letter) that the total incremental increase from all of the boilers will not be more than 96 MMBtu/hour. In addition, FHR states that these boilers each vent separately, but in the application they are grouped into one emission source. The boilers in FHR's permits and Maximum Allowable Emissions Rate Tables (MAERT) do not appear to be handled as a group, nor does the subset of boilers affected by this project appear to be under a cap as a group.

Please detail the relevant permit paragraphs and MAERTs that apply to these boilers and provide a discussion of how each individual boiler (or how these boilers as a group under a cap) will not exceed current permit limits upon implementation of the Domestic Crude Project, and the relevance of the boilers (either individually or as a group) not exceeding 96MMBtu/hour. Are there any additional operational limits on any of these boilers that will change due to the project?

Have these units been individually reported to the Texas Commission on Environmental Quality (TCEQ) on FHR's emission inventory? Have these units been registered with the TCEQ as "grandfathered sources"?

FHR's Response

The refinery has six steam generating units in the Main and Mid Plant Areas - the Cogeneration Unit Waste Heat Recovery Boiler, CO Boiler, Boiler No. 7, Boiler No. 8, Boiler No. 9 and the Mid Crude Boiler. These steam generating units produce 400 pound steam that is exported to equipment throughout the refinery via a common steam system. Because the Cogeneration Waste Heat Recovery Boiler and the CO Boiler are the most efficient steam generating units within the refinery, historically they have operated at near maximum capacity to satisfy the refinery's base steam needs while Boiler No. 7, Boiler No. 8, Boiler No. 9 and the Mid Crude Boiler have been utilized to maintain the refinery steam balance. In other words, the steam production from Boiler No. 7, Boiler No. 8, Boiler No. 9 and the Mid Crude Boiler typically fluctuates according to the refinery's fluctuating steam demand. Increases in refinery steam demand can be met by increased steam production from any combination of one or more of these boilers.

The West Domestic Crude Project will cause a 841 MMlb/yr incremental increase in the steam demand for the refinery. Boiler No. 7, Boiler No. 8, Boiler No. 9 and the Mid Crude Boiler, because they are utilized to meet increases in refinery steam demand, will provide the steam necessary to meet the incremental steam demand associated with the project. Therefore, the boilers affected by the project are:

Description	FIN	EPN
Mid Crude Boiler	43BF1	R-201
06BF657 Boiler No. 7	06BF657	R-7
06BF658 Boiler No. 8	06BF658	R-8
06BF659 Boiler No. 9	06BF659	R-9

The Mid Crude Boiler is located in the Mid Plant Utilities Area. Boilers No. 7, 8, and 9 are located in the Boiler House Area. All four boilers are permitted under TCEQ Permit No. 8803A and emissions from the boilers are included under the permit's site-wide emission rate caps. The boilers are not registered with the TCEQ as "grandfathered" sources. There are no permit conditions in TCEQ Permit No. 8803A that will require revision as a result of the incremental increase in steam demand nor are there any operational limits on any of these boilers that will change due to the project. In fact, the same incremental increase approach for the "Various Boilers" was used in the criteria pollutant PSD analysis included in the state NSR permit application for the Domestic Crude Project. The four boilers have been individually reported to the Texas Commission on Environmental Quality (TCEQ) in FHR's emission inventories.

No physical changes or changes in the method of operation to any of the four affected boilers are required to meet the incremental steam demand of the Project. An incremental increase in heat duty of 96 MMBtu/hr will be required to meet the 841 MMlb/yr incremental increase in steam production associated with the Domestic Crude Project. As shown in the table below, the four boilers can accommodate a 96 MMBtu/hr increase in overall firing rate without exceeding any boilers maximum firing capacity (used to establish TCEQ emission rate limits).

Emission Unit	Maximum Permitted Firing Capacity (MMBtu/hr)	2011-2012 Highest Monthly Average Firing Rate (MMBtu/hr)	2011-2012 Average Monthly Firing Rate (MMBtu/hr)
Boiler No. 7 (06BF657)	205	138	117
Boiler No. 8 (06BF658)	205	143	113
Boiler No. 9 (06BF659)	205	141	112
Mid Crude Boiler (43BF1)	221.5	125	97
Total	**836.5**	**547**	**439**

Because the increase in steam demand (and heat duty) from the Project could be provided by any one or more of the four affected boilers, it is impossible to determine how much of an increase in heat duty any one boiler will experience. Therefore, we have treated the affected boilers as a collective unit called "Various Boilers" for purposes of determining the incremental increase in emissions for PSD applicability purposes. Specifically, for the four affected boilers, FHR subtracted the baseline actual steam demand from the projected maximum steam demand that could occur as a result of the Domestic Crude Project to determine an incremental increase in steam demand. This incremental increase in steam demand was then used to determine an incremental increase in actual firing capacity for the boilers that would be required to generate the increase in steam demand. As explained in the emission calculations, the boiler emissions increase was based on this incremental increase in firing capacity.

The approach outlined above is consistent with EPA guidance, which provides that the appropriate test for the increased utilization of the boilers in these circumstances is the maximum incremental utilization of the boilers that could occur as a result of the Domestic Crude Project. See Letter from Sam Portanova, EPA to Steve Dunn, Wisconsin Department of Natural Resources (Feb. 24, 2005) at 4-5 ("For a situation where the existing boilers are not being modified, the emissions increase from the existing boilers that occurs as a direct result of the proposed project should be based on the maximum utilization for which the new unit will be permitted. The emissions increases should be calculated as the worst case increases that could occur at those existing units if the new units were to operate at maximum capacity."); Letter from Rebecca Weber, EPA to Bliss Higgins, Louisiana Department of Environmental Quality (July 25, 2001) at 2 ("In the case of the existing equipment not undergoing a change, but whose emission levels could be affected by the change at the facility (e.g., because of increased demand for steam and other products), emissions increases should be calculated as the worst case increases that could occur at those existing units if the new or modified units were to operate at their maximum permitted capacity.").

__General__

5. **Please provide an aerial photographic map of the facility with the location of the new units marked.**

   FHR's Response

   An aerial photographic map of the West Refinery depicting the location of the new and modified emission units associated with the Project is provided in Attachment B.

6. **Please include a final copy of the December 2013, legal agreement between the Environmental Integrity Project and FHR regarding the Domestic Crude Project with any revised permit application.**

   FHR's Response

   A copy of the executed December 2013 agreement regarding the Domestic Crude Project between the Environmental Integrity Project, the University of Texas School of Law Environmental Clinic, and FHR is provided in Attachment C.

__May 16, 2013, Letter from FHR to EPA__

7. **Please clarify the language at the end of Page 6. Does the CCR Hot Oil Heater have emissions? Where does it vent?**

   FHR's Response

   The CCR Hot Oil Heater is an existing unit that will be modified as part of the project. Emissions from the modified CCR Hot Oil Heater are presented in the application (revised calculations are included with this submittal). The emission rates include emissions from both normal, startup and shutdown, and maintenance operations. The CCR Hot Oil Heater shares a stack with the NHT Charge Heater. Accordingly, emissions from both heaters vent through the stack represented as EPN JJ-4 as shown on the process flow diagram for the NHT Unit (Page 95).

RESPONSES TO FEBRUARY 5, 2014 INFORMATION REQUEST

1. **A copy of the FHR permit application for the criteria pollutants (and any updates) submitted to the Texas Commission on Environmental Quality for the minor NSR permit associated with the Domestic Crude Project.**

   FHR's Response

   A copy of the permit application submitted to the Texas Commission on Environmental Quality for the minor NSR permit is provided in Attachment D. This copy of the application reflects the original application as supplemented throughout the TCEQ permitting process.

2. **A more detailed explanation of the changes that are planned for the CCR Hot Oil Heater as they relate to the Best Available Control Technology (BACT) discussion in FHR's December 2012 GHG permit application. The CCR Hot Oil Heater, an existing unit subject to BACT review, is evaluated in the same way as the Sat Gas #3 Hot Oil Heater, a new unit. You stated in our call yesterday that the CCR Hot Oil Heater will have add-on controls that FHR considers to be energy efficient design; however, it is not clear in the application that add-on controls will be installed (or parts changed out) nor is it clear what the add-on controls specifically will be for the existing boiler. Please add these details. This may also require a change to Page 3 of the December 2012 application where the application lists the changes to each unit.**

   FHR's Response

   As discussed in Section 5.0 of the December 2012 permit application. FHR will implement energy efficient design and operating practices as BACT for the CCR Hot Oil Heater. Specifically, FHR will be installing new, energy efficient low-NO_X burners and a new air preheat system on the CCR Hot Oil Heater. FHR has revised Page 3 of the December 2012 application to reflect these changes.

ATTACHMENT A

Revised Application Pages

Section 2.0

Project Overview and Description

Flint Hills Resources Corpus Christi, LLC (FHR) owns and operates a refinery in Corpus Christi called the West Refinery. FHR is proposing a project at the West Refinery that would allow the refinery to process a larger percentage of domestically produced crude. The domestic crude is much lighter than foreign crude. Therefore, an additional process unit and other equipment are being constructed to process more lighter-end products. The project would also modestly increase (by approximately 7%) the total crude processing capacity at the West Refinery.

Summary of Project

There are two types of changes—described in more detail below—proposed as part of this project: (1) construction of new emission units to be authorized by this permitting action; and (2) changes to existing emission units to be authorized by this permitting action.

1. Construction of New Emission Units

As part of the project, FHR is proposing to construct the following new emission units:

- A new process unit called the Saturates Gas (Sat Gas) No. 3 Unit that will include a new hot oil heater and equipment piping fugitive components. The new hot oil heater will be equipped with energy efficient, low NO_X burners and an air preheat system, selective catalytic reduction (SCR) to reduce nitrogen (NO_X) emissions, and a catalyst bed to control carbon monoxide (CO) and volatile organic compound (VOC) emissions.
- A new cooling tower in an area of the plant commonly referred to as the Mid-Plant area.
- New equipment piping fugitive components in several existing process units.

2. Changes to Existing Emission Units

As part of the project, FHR is proposing the following changes to existing emission units:

- An increase in the permitted firing duty of the CCR Hot Oil Heater. In addition, new energy efficient, low NO_X burners, a new air preheat system, SCR to reduce NO_X emissions, and a catalyst bed to control CO and VOC emissions will be installed on the CCR Hot Oil Heater.
- Conversion of the current Gas Oil Hydrotreating Unit (GOHT) to a Distillate Hydrotreating Unit (DHT).
- An increase in maintenance, startup, and shutdown (MSS) emissions as a result of new equipment being installed.

In addition, there will be increases in actual emissions for some emission units as a result of increased utilization or debottlenecking. Finally, while there will be no physical change at the marine loading area or to tanks 40FB4010 and 40FB4011 as part of this project, FHR will increase the annual marine loading throughput of naphtha and gasoline and tank crude oil throughput above existing permitted levels. Emissions increases from these actions are accounted for in this permit application. FHR has submitted a separate minor NSR permit application to TCEQ for the increased throughputs that includes a state BACT analysis for the marine loading operation and crude oil tanks. However, the increase in annual marine loading and tank crude throughput are not modifications for federal PSD, so GHG BACT is not required for the marine loading operations or tanks.

A table is provided at the end of this section showing the changes proposed for each emission unit associated with this project.

Summary of Proposed BACT Emission Limits

Based on the EPA recommended five-step, top-down process to determine BACT for GHG emissions, FHR is proposing the following as BACT emission limits:

Source	Proposed Emission Controls	Proposed Emission Limit
Sat Gas No. 3 Hot Oil Heater	Implement energy efficient design and operating practices. The heater is designed for 92% efficiency.	236,242 tons CO_2e total per 365-days (rolling)
Mid Plant Cooling Tower No. 2	Implement cooling tower monitoring program	Work practice standard
Equipment Leak Fugitives	Implement enhanced LDAR monitoring	Work practice standard
CCR Hot Oil Heater	Implement energy efficient design and operating practices. The heater is designed for 92% efficiency.	62,956 tons CO_2e total per 365-days (rolling)
Various Planned Maintenance, Start-up, and Shutdown Activities	Minimize GHG degassing emissions through good operational practices	Work practice standard

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to BACT Review?	Proposed Controls for Greenhouse Gas Pollutants
SATGASHTR	SATGASHTR	Sat Gas No. 3 Heater	New	New source as part of building new Saturates Gas Plant No. 3 Unit. Installation of SCR, CO/VOC catalyst bed, energy efficient low NOx burners, and air preheat system.	Yes	Yes	Implement energy efficient design and operating practices.
39BA3901	39BA3901	CCR Hot Oil Heater	Modified	Increase in fired duty from 90 MMBtu/hr to 123.6 MMBtu/hr (HHV). Installation of SCR, CO/VOC catalyst bed, new energy efficient low NOx burners, and air preheat system.	Yes	Yes	Implement energy efficient design and operating practices.
Various Boilers	Various Boilers	Various boilers seeing increased utilization.	Affected Downstream - increased utilization	Increase in actual emissions as a result of increased utilization due to increased steam demand. No change to permitted duty under existing TCEQ permit.	No	No	N/A
37BA2	KK-3	37BA2 DHT Stripper Reboiler	Affected Downstream - debottlenecking	Increase in actual emissions. It is not clear whether such increases should be characterized as resulting from debottlenecking or increased utilization. We assume, conservatively, that the increase is the result of debottlenecking. No change to permitted duty under existing TCEQ permit.	No	No	N/A
45BD3	V-8	API Separator Flare	Affected Downstream - increased utilization	Increase in actual emissions at Monroe API Separator controlled by the API Separator Flare as a result of increasing the amount of wastewater going to the separator. The increased amount of wastewater will not exceed the throughput limit under the existing TCEQ permit.	No	No	N/A
LW-8	VCS-1	Marine Vapor Combustor	Affected Downstream - increased utilization	Increase in annual loading rate of naphtha and gasoline.	No	No	N/A
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives	New	New fugitive piping components (i.e. valves, flanges, etc.) as part of building new Saturates Gas Plant #3.	Yes	Yes	Implement enhanced LDAR monitoring
14-UDEX	F-14-UDEX	UDEX Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	Implement enhanced LDAR monitoring
37	F-37	DHT Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	Implement enhanced LDAR monitoring
39	F-39	NHT/CCR Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	Implement enhanced LDAR monitoring
40	F-40	West Crude Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	Implement enhanced LDAR monitoring

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to BACT Review?	Proposed Controls for Greenhouse Gas Pollutants
42	F-42	Mid Crude Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	Implement enhanced LDAR monitoring
P-GB	F-GB	Gasoline Blender Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	Implement enhanced LDAR monitoring
P-VOC	F-TK-VOC	VOC Tank/Loading Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	Implement enhanced LDAR monitoring
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2	New	New cooling tower	Yes	Yes	Implement cooling tower monitoring and repair program
08FB142	FB142	Tank 08FB142	Affected Downstream - increased utilization	Increase in actual emissions as a result of increasing the throughput of crude oil in the tanks.	No	No	N/A
08FB147	FB147	Tank 08FB147					
08FB137	FB137	Tank 08FB137					
40FB4010	FB4010	Tank 40FB4010					
40FB4011	FB4011	Tank 40FB4011					
MSSFUGS-DC	MSSFUGS-DC	Miscellaneous Fugitives from Domestic Crude Project MSS Activities	New	New MSS emissions as a result of constructing new Sat Gas 3 Unit and other changes to existing equipment.	Yes	Yes	Minimize degassing through good operational practices

Section 3.0

PREVENTION OF SIGNIFICANT DETERIORATION (PSD) APPLICABILITY

Applicability

FHR's West Refinery is a petroleum refinery and an existing major source of GHG emissions because the potential to emit GHGs prior to the modifications associated with this project is greater than 100 tons/yr GHG on a mass basis and greater than 100,000 tons/yr CO_2e. As shown in the following table and in Table 2-F provided at the end of this section, the project is a major modification for GHGs because the emissions increases resulting from the project, without considering any emissions decreases, are greater than 75,000 tons/yr CO_2e and 0 tons/yr GHG on a mass basis.

This project—including construction of the new emission units, changes to existing emission units, and emissions increases from upstream and downstream affected units—will not trigger federal PSD for any non-GHG new source review (NSR)-regulated pollutants. In fact, the overall project will result in decreased emissions of non-GHG pollutants, with the exception of ammonia. Therefore, for non-GHG pollutants, construction of new emission units and changes to existing emission units are subject only to Texas minor NSR requirements. Emission information for these non-GHG NSR pollutants is set forth in the relevant Texas minor NSR permit applications, and is not provided in this GHG-only application.

Emission Calculation Methods

Existing modified sources—that is, those sources undergoing a physical change or change in method of operation—may use the actual-to-projected actual test of 40 C.F.R. § 52.21(a)(2)(iv) to determine if there will be an emission increase that triggers PSD for GHG. Nevertheless, and simply for ease of calculation, for existing modified sources the source's actual emissions for 2011 and 2012 are compared voluntarily to its future potential to emit to calculate emission increases. For new sources, the future potential to emit after the project is fully operational is used to establish the emissions increase. For those sources that are not new or modified but are affected upstream or downstream of the project due to an increase in utilization rate, an incremental increase in actual emissions is calculated based on the expected increased utilization rate. For those sources that are not new or modified but are affected upstream or downstream of the project due to debottlenecking, EPA in the *Holcim* memorandum takes the position that the 2-year actual emissions from the most recent two years and the future potential to emit after the project must be evaluated to determine each source's emissions increase.[1] For the Marine Vapor Combustor (EPN VCS-1), FHR uses the 2-year actual emissions and potential to emit based only on the loading of naphtha and gasoline and heavier materials since those are the only materials for which FHR is proposing to increase the throughput.

[1] FHR does not agree that the actual-to-potential test is mandated by the PSD regulations for all changes that can be characterized as "debottlenecking," but FHR will conservatively follow the EPA guidance in this permit application.

Pollutant	PSD Emissions Increase (tons/yr)	PSD Threshold (tons/yr)
Carbon Dioxide (CO_2)	358,647	N/A
Methane (CH_4)	29	N/A
Nitrous Oxide (N_2O)	1	N/A
Total GHG (mass basis)	358,677	0
CO_2e	359,565	75,000

TCEQ

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [1]**:** GHG (mass basis)		**Permit:**	N/A
Baseline Period: 2011	**to** 2012		

	Affected or Modified Facilities [2] FIN	EPN	Permit NO.	Actual Emissions [3] (tons/yr)	B Baseline Emissions [4] (tons/yr)	A Proposed Emissions [5] (tons/yr)	Projected Actual Emissions (ton/yr)	Difference (A-B) [5] (tons/yr)	Correction [7] (ton/yr)	Project Increase [8] (tons/yr)
1	SATGASHTR	SATGASHTR	N/A	0	0	236009	N/A	236009	N/A	236009
2	39BA3901	JJ-4	N/A	20373	20373	62891	N/A	42518	N/A	42518
3	Various Boilers	Various Boilers	N/A	N/A	N/A	50479	N/A	50479	N/A	50479
4	37BA2	KK-3	N/A	11465	11465	37281	N/A	25816	N/A	25816
5	45BD3	V-8	N/A	N/A	N/A	335	N/A	335	N/A	335
6	LW-8	VCS-1	N/A	N/A	N/A	3282	N/A	3282	N/A	3282
7	F-SATGAS3	F-SATGAS3	N/A	0.00	0.00	6.44	N/A	6.44	N/A	6.44
8	14-UDEX	F-14-UDEX	N/A	0.00	0.00	0.01	N/A	0.01	N/A	0.01
9	37	F-37	N/A	0.00	0.00	0.15	N/A	0.15	N/A	0.15
10	39	F-39	N/A	0.00	0.00	0.06	N/A	0.06	N/A	0.06
11	40	F-40	N/A	0.00	0.00	0.32	N/A	0.32	N/A	0.32
12	42	F-42	N/A	0.00	0.00	0.91	N/A	0.91	N/A	0.91
						PAGE SUBTOTAL: [9]				358,447
								Total		

TCEQ

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant (1)**:**	GHG (mass basis)	**Permit:**	N/A
Baseline Period:	2011 **to** 2012		

	Affected or Modified Facilities (2) FIN	EPN	Permit NO.	Actual EGissions (3) (tons/yr)	B Baseline Emissions (4) (ton/yr)	A Proposed Emissions (5) (tons/yr)	Projected Actual Emissions (ton/yr)	Difference (A-B) 5 (tons/yr)	Correction (7) (ton/yr)	Project Increase (8) (tons/yr)
13	P-GB	F-GB	N/A	0.00	0.00	0.04	N/A	0.04	N/A	0.04
14	P-VOC	F-TK-VOC	N/A	0.00	0.00	0.29	N/A	0.29	N/A	0.29
15	44EF2	F-S-202	N/A	0.00	0.00	0.55	N/A	0.55	N/A	0.55
16	08FB142	FB142	N/A	N/A	N/A	1.33	N/A	1.33	N/A	1.33
17	08FB147	FB147	N/A							
18	08FB137	FB137	N/A							
19	40FB4010	FB4010	N/A							
20	40FB4011	FB4011	N/A							
21	MSSFUGS-DC	MSSFUGS-DC	N/A	0.00	0.00	228	N/A	228	N/A	228
22										
23										
24										
							PAGE SUBTOTAL: (9)			230
								Total		358,677

TCEQ-20470 (Revised 10/08) Table 2F
These forms are for use by facilities subject to air quality permit requirements and may be revised periodically. (APDG 5915v1)

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [(1)]:	CO_2e		**Permit:**	N/A
Baseline Period:	2011	**to**	2012	

	Affected or Modified Facilities [(2)] FIN	Affected or Modified Facilities [(2)] EPN	Permit NO.	Actual Emissions [(3)] (tons/yr)	B Baseline Emissions [(4)] (tons/yr)	A Proposed Emissions [(5)] (tons/yr)	Projected Actual Emissions (ton/yr)	Difference (A-B) [5] (tons/yr)	Correction [(7)] (ton/yr)	Project Increase [(8)] (tons/yr)
1	SATGASHTR	SATGASHTR	N/A	0	0	236242	N/A	236242	N/A	236242
2	39BA3901	JJ-4	N/A	20397	20397	62956	N/A	42559	N/A	42559
3	Various Boilers	Various Boilers	N/A	N/A	N/A	50528	N/A	50528	N/A	50528
4	37BA2	KK-3	N/A	11477	11477	37317	N/A	25840	N/A	25840
5	45BD3	V-8	N/A	N/A	N/A	362	N/A	362	N/A	362
6	LW-8	VCS-1	N/A	N/A	N/A	3551	N/A	3551	N/A	3551
7	F-SATGAS3	F-SATGAS3	N/A	0	0	161	N/A	161	N/A	161
8	14-UDEX	F-14-UDEX	N/A	0	0	0.2	N/A	0.2	N/A	0.2
9	37	F-37	N/A	0	0	4	N/A	4	N/A	4
10	39	F-39	N/A	0	0	1	N/A	1	N/A	1
11	40	F-40	N/A	0	0	8	N/A	8	N/A	8
12	42	F-42	N/A	0	0	23	N/A	23	N/A	23
						PAGE SUBTOTAL: [(9)]				359281
								Total		

TCEQ

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [1]:	CO_2e	**Permit:**	N/A
Baseline Period:	2011 **to** 2012		

	Affected or Modified Facilities [2] FIN	EPN	Permit NO.	Actual Emissions [3] (tons/yr)	B Baseline Emissions [4] (ton/yr)	A Proposed Emissions [5] (tons/yr)	Projected Actual Emissions (ton/yr)	Difference (A-B) [5] (tons/yr)	Correction [7] (ton/yr)	Project Increase [8] (tons/yr)
13	P-GB	F-GB	N/A	0	0	1	N/A	1	N/A	1
14	P-VOC	F-TK-VOC	N/A	0	0	7	N/A	7	N/A	7
15	44EF2	F-S-202	N/A	0	0	14	N/A	14	N/A	14
16	08FB142	FB142	N/A	N/A	N/A	33	N/A	33	N/A	33
17	08FB147	FB147	N/A							
18	08FB137	FB137	N/A							
19	40FB4010	FB4010	N/A							
20	40FB4011	FB4011	N/A							
21	MSSFUGS-DC	MSSFUGS-DC	N/A	0	0	229	N/A	229	N/A	229
22										
23										
24										
							PAGE SUBTOTAL: [9]			285
								Total		359565

TABLE 2F
PROJECT EMISSION INCREASE

All emissions must be listed in tons per year (tpy). The same baseline period must apply for all facilities for a given NSR pollutant.

1. Individual Table 2F=s should be used to summarize the project emission increase for each criteria pollutant.
2. Emission Point Number as designated in NSR Permit or Emissions Inventory.
3. All records and calculations for these values must be available upon request.
4. Correct actual emissions for currently applicable rule or permit requirements, and periods of non-compliance. These corrections, as well as any MSS previously demonstrated under 30 TAC 101, should be explained in the Table 2F supplement.
5. If projected actual emission is used it must be noted in the next column and the basis for the projection identified in the Table 2F supplement.
6. Proposed Emissions (column B) Baseline Emissions (column A).
7. Correction made to emission increase for what portion could have been accommodated during the baseline period. The justification and basis for this estimate must be provided in the Table 2F supplement.
8. Obtained by subtracting the correction from the difference. Must be a positive number.
9. Sum all values for this page.

Pollutant :		Line		Type(1)	
Explanation:					

1 Type of note. Generally would be baseline adjustment, basis for projected actual, or basis for correction (what could have been accommodated).

Section 4.0

PROCESS DESCRIPTION AND EMISSIONS DATA

Process descriptions for each of the process units affected by the project are provided below. A table (Table 1a) summarizing the proposed emission rates is provided in this section along with the emission rate calculations for the emission units affected by this project.

The table below shows the carbon dioxide (CO_2), Methane (CH_4), and nitrous oxide (N_2O) emission factors for natural gas and the refinery fuel gas systems that were used in the emission rates calculations for process heaters and boilers. Each CO_2 emission factor was calculated using Tier III methodology (Equation C-5) in 40 C.F.R. Part 98, Subpart C and actual carbon content, molecular weight, and higher heating values for purchased natural gas and the CCR, 90#, and Mid Plant refinery fuel gas systems from 2011, 2012, and 2013. To account for variability in the carbon content, molecular weight, and higher heating values of each of the different fuel gases, the CO_2 factor for each was determined by calculating an average lb CO_2/MMBtu factor using the carbon content, molecular weight, and higher heating value data for 2011, 2012, and 2013 and adding two standard deviations to the average. CH_4 and N_2O emission factors are from Table C-2 from 40 C.F.R. Part 98, Subpart C, and for all fuel gas systems other than purchased natural gas, the emission factor for "Petroleum" is used.

Fuel Gas System	CO_2 Emission Factor (lb/MMBtu)	CH_4 Emission Factor (kg/MMBtu)	N_2O Emission Factor (kg/MMBtu)
Purchased Natural Gas	119.74	1.0×10^{-3}	1.0×10^{-4}
CCR Refinery Fuel Gas System	116.17	3.0×10^{-3}	6.0×10^{-4}
90# Refinery Fuel Gas System	119.29	3.0×10^{-3}	6.0×10^{-4}
Mid Plant Refinery Fuel Gas System	120.05	3.0×10^{-3}	6.0×10^{-4}

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	**December 2012; Revised February 2014**	**Permit No.:**	**N/A**	**Regulated Entity No.:**	**RN100235266**
Area Name:	**Corpus Christi West Refinery**			**Customer Reference No.:**	**CN603741463**

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**	**3. Air Contaminant Emission Rate**
EPN (A)	**FIN (B)**	**NAME (C)**		**TPY (B)**
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater	Carbon Dioxide (CO2)	236004.1
			Methane (CH4)	4.3
			Nitrous Oxide (N2O)	0.43
			Carbon Dioxide Equivalent (CO2e)	236242.2
JJ-4	39BA3901	CCR Hot Oil Heater	Carbon Dioxide (CO2)	62890.1
			Methane (CH4)	1.19
			Nitrous Oxide (N2O)	0.12
			Carbon Dioxide Equivalent (CO2e)	62955.5

EPN = Emission Point Number
FIN = Facility Identification Number

TCEQ-10153 (Revised 0408)
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permit requirements and may be revised periodically. [APDG 5178v4]

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	**December 2012; Revised February 2014**	**Permit No.:** N/A	**Regulated Entity No.:** RN100235266
Area Name:	**Corpus Christi West Refinery**		**Customer Reference No.:** CN603741463

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**	**3. Air Contaminant Emission Rate**
EPN (A)	**FIN (B)**	**NAME (C)**		**TPY (B)**
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives	Methane (CH4)	Work Practice Standard
			Carbon Dioxide Equivalent (CO2e)	Work Practice Standard
14-UDEX	F-14-UDEX	Udex Fugitives	Methane (CH4)	Work Practice Standard
			Carbon Dioxide Equivalent (CO2e)	Work Practice Standard
37	F-37	DHT Fugitives	Methane (CH4)	Work Practice Standard
			Carbon Dioxide Equivalent (CO2e)	Work Practice Standard
39	F-39	NHT/CCR Fugitives	Methane (CH4)	Work Practice Standard
			Carbon Dioxide Equivalent (CO2e)	Work Practice Standard
40	F-40	West Crude Fugitives	Methane (CH4)	Work Practice Standard
			Carbon Dioxide Equivalent (CO2e)	Work Practice Standard

EPN = Emission Point Number
FIN = Facility Identification Number

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012; Revised February 2014	**Permit No.:** N/A	**Regulated Entity No.:** RN100235266
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463

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	3. Air Contaminant Emission Rate
EPN (A)	FIN (B)	NAME (C)		TPY (B)
F-42	42	Mid Crude Fugitives	Methane (CH4)	Work Practice Standard
			Carbon Dioxide Equivalent (CO2e)	Work Practice Standard
P-GB	F-GB	Gasoline Blender Fugitives	Methane (CH4)	Work Practice Standard
			Carbon Dioxide Equivalent (CO2e)	Work Practice Standard
P-VOC	F-TK-VOC	VOC Tank/Loading Fugitives	Methane (CH4)	Work Practice Standard
			Carbon Dioxide Equivalent (CO2e)	Work Practice Standard
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2	Methane (CH4)	Work Practice Standard
			Carbon Dioxide Equivalent (CO2e)	Work Practice Standard

EPN = Emission Point Number
FIN = Facility Identification Number

TCEQ-10153 (Revised 0408)
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	**December 2012; Revised February 2014**	**Permit No.:** N/A	**Regulated Entity No.:** RN100235266
Area Name:	**Corpus Christi West Refinery**		**Customer Reference No.:** CN603741463

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**	**3. Air Contaminant Emission Rate**
EPN (A)	**FIN (B)**	**NAME (C)**		**TPY (B)**
MSSFUGS-DC	MSSFUGS-DC	Miscellaneous Fugitives from MSS Activities from Domestic Crude Project	Carbon Dioxide (CO2)	Work Practice Standard
			Methane (CH4)	Work Practice Standard
			Nitrous Oxide (N2O)	Work Practice Standard
			Carbon Dioxide Equivalent (CO2e)	Work Practice Standard

EPN = Emission Point Number
FIN = Facility Identification Number

TCEQ-10153 (Revised 0408)
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permit requirements and may be revised periodically. [APDG 5178v4]

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CCR/NHT UNITS

The Continuous Catalytic Regeneration (CCR) and Naphtha Hydrotreater (NHT) Units are existing process units at the West Refinery. FHR is proposing to install new equipment piping components and make process changes at the CCR and NHT Units which require an increase in the firing duty of the CCR Hot Oil Heater (39BA3901) from 90 MMBtu/hr (HHV) to 123.6 MMBtu/hr (HHV).

General Process Description

The purpose of the NHT Unit is to catalytically remove sulfur, nitrogen and saturate olefins from the naphtha feed to the CCR unit. Hydrotreating removes impurities from a petroleum fraction by contacting the stream with hydrogen in the presence of a catalyst at high temperatures and pressures. The CCR Unit converts naphtha to aromatics consisting primarily of benzene, toluene, and xylene. Aromatics are produced by the dehydrogenation of naphthenes and cyclization of paraffins. The dehydrogenation process also produces a hydrogen by-product. The aromatic compounds are then separated and further processed in other units. Hydrogen is consumed as fuel gas or used as feed to other units.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
39BA3901	JJ-4	39BA3901 CCR Hot Oil Heater
39	F-39	NHT/CCR Fugitives

The CCR Hot Oil Heater fires refinery fuel gas supplied by the CCR refinery fuel gas system. For the CCR Hot Oil Heater, CO_2 emission rates are estimated using the CO_2 emission factor derived from Equation C-5 in 40 C.F.R. Part 98, Subpart C and actual fuel gas carbon content, molecular weight, and higher heating value data for the CCR refinery fuel gas system. CH_4 and N_2O emission rates are estimated using Equation C-8b and the emission factors for “Petroleum” in Table C-2 in 40 C.F.R. Part 98, Subpart C and converting from metric tons to short tons.

Calculations are provided to estimate GHG emissions from just the new equipment piping components for PSD applicability purposes. CH_4 emission rates from the new equipment piping components are estimated based on the VOC emission rate and the estimated weight percent methane. The VOC emission rate is estimated based on the number of each type of component and the emission factors from the TCEQ’s Fugitive Guidance Document dated October 2000 (Appendix A).

CO_2e emissions are defined as the sum of the mass emissions of each individual greenhouse gas (GHG) adjusted for its global warming potential (GWP). CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

Greenhouse Gas Emission Rate Calculations

INPUT DATA

Combustion Unit Description:	39BA3901 CCR Hot Oil Heater
Facility Identification Number (FIN):	39BA3901
Emission Point Number (EPN):	JJ-4

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, HHV:	123.6	MMBtu/hr, HHV
Operating Hours	8760	hrs/yr

EMISSION FACTORS

Pollutant	Emission Factor (kg/MMBtu) *	Emission Factor (lb/MMBtu) *	Global Warming Potentials **
Carbon Dioxide (CO_2)	N/A	116.17	1
Methane (CH_4)	0.001	0.0022	25
Nitrous Oxide (N_2O)	0.0001	0.00022	298

* The heater fires refinery fuel gas. The CO2 emission factor is derived from Equation C-5 in 40 C.F.R. Part 98, Subpart C and actual fuel gas data for the CCR fuel gas system. The CH_4 and N_2O factors are from 40 CFR 98, Table C-2 for petroleum.

** Global warming potentials are from Table A-1 in 40 CFR 98, Subpart A.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	CO_2e Annual Emissions (tons/yr)
Carbon Dioxide (CO_2)	62890	62890
Methane (CH_4)	1.19	29.84
Nitrous Oxide (N_2O)	0.12	35.57
Total	62891	62956

Emission rates are calculated using equations C-5 and C-8b and converting from metric tons/yr.

Equation C-5 from 40 CFR 98, Subpart C

$$CO_2 = \frac{44}{12} * Fuel * CC * \frac{MW}{MVC} * 0.001 \qquad \text{(Eq. C-5)}$$

CO_2 = Annual CO_2 mass emissions from combustion of the specific gaseous fuel (metric tons).
Fuel = Annual volume of the gaseous fuel combusted (scf). The volume of fuel combusted must be measured directly, using fuel flow meters calibrated according to §98.3(i). Fuel billing meters may be used for this purpose.
CC = Annual average carbon content of the gaseous fuel (kg C per kg of fuel). The annual average carbon content shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.
MW = Annual average molecular weight of the gaseous fuel (kg/kg-mole). The annual average molecular weight shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.
MVC = Molar volume conversion factor at standard conditions, as defined in §98.6. Use 849.5 scf per kg mole if you select 68 °F as standard temperature and 836.6 scf per kg mole if you select 60 °F as standard temperature.
44/12 = Ratio of molecular weights, CO_2 to carbon.
0.001 = Conversion factor from kg to metric tons.

Equation C-8b from 40 CFR 98, Subpart C
CH_4 or N_2O (metric tons/yr) = 0.001 x Gas x EF
where
Gas = Annual natural gas usage (MMBtu)
EF = Fuel specific default CH_4 or N_2O emission factor for natural gas from Table C-2 (kg/MMBtu)

1 metric ton = 1.1023 short tons

Greenhouse Gas Fugitive Emission Rate Estimates
CCR-NHT
New Components

FIN:	39
EPN:	F-39
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	63	0.059	97%	0.112
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	7	0.024	97%	0.00504
Valves - Light Liquid (DM)	0	0.024	75%	0
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	0	0.251	93%	0
Pumps - Light Liquid (sealess)	2	0.251	100%	0
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	99	0.00055	75%	0.0136
Flanges - Light Liquid	11	0.00055	75%	0.00151
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	0	1.399	95%	0
Pressure Relief Valves [3]	5	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.132**
Total Annual Emissions				**0.578**

Sample Calculations:

Valve Emissions = (63 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0.112 lb/hr

Annual Emissions = (0.132 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 0.578 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Methane	60000	10.00%	0.013	0.058

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Difficult to monitor (DM) sources are monitored annually. Light liquid pumps and compressors are monitored at a 500 ppmv leak definition instead of 2000 ppmv, which is equivalent to the 28MID program. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	Global Warming Potentials *	CO_2e Annual Emissions (tons/yr)
Methane (CH_4)	0.06	25	1.45
Total	0.06		1.45

DHT UNIT (PREVIOUSLY GOHT UNIT)

The Gas Oil Hydrotreater (GOHT) Unit is an existing unit at the West Refinery. FHR is converting the existing GOHT Unit to the Distillate Hydrotreater (DHT) Unit. The project will require installation of new equipment piping components. There are no proposed physical changes or changes in the method of operation for the DHT Charge Heater (37BA1) and the DHT Stripper Reboiler (37BA2). However, as a result of this project, the reboiler will experience an increase in actual emissions. It is not clear that the DHT Stripper Reboiler will realize an increase as a result of debottlenecking or increased utilization. As a result, an actual to potential analysis is conservatively used for this emissions unit to assess PSD applicability. Calculations are provided for the DHT stripper reboiler at its currently authorized maximum duty of 70.9 MMBtu/hr (HHV) to represent the potential to emit of GHG emissions.

General Process Description

The DHT Unit removes sulfur from a mixed distillate feed consisting of naphtha, gas oil, light cycle oil, and diesel to produce a diesel fuel product meeting the EPA requirements for sulfur content.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
37BA2	KK-3	37BA2 DHT Stripper Reboiler
37	F-37	DHT Fugitives

Calculations are provided for the DHT Stripper reboiler to estimate GHG emissions at its currently authorized maximum duty of 70.9 MMBtu/hr (HHV). The DHT Stripper Reboiler fires refinery fuel gas supplied by the Mid Plant refinery fuel gas system. CO_2 emission rates are estimated using the CO_2 emission factor derived from Equation C-5 in 40 C.F.R. Part 98, Subpart C and actual fuel gas carbon content, molecular weight, and higher heating value data for the Mid Plant refinery fuel gas system. CH_4 and N_2O are estimated using Equation C-8b and the emission factors for “Petroleum” in Table C-2 in 40 C.F.R. Part 98, Subpart C and converting from metric tons to short tons.

Calculations are provided to estimate GHG emissions from just the new equipment piping components for PSD applicability purposes. CH_4 emission rates from the new equipment piping components are estimated based on the VOC emission rate and the estimated weight percent methane. The VOC emission rate is estimated based on the number of each type of component and the emission factors from the TCEQ’s Fugitive Guidance Document dated October 2000 (Appendix A).

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its GWP. CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

Greenhouse Gas Emission Rate Calculations

INPUT DATA

Combustion Unit Description:	37BA2 DHT Stripper Reboiler (Potential to Emit)
Facility Identification Number (FIN):	37BA2
Emission Point Number (EPN):	KK-3

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, HHV:	70.9	MMBtu/hr, HHV
Operating Hours	8760	hrs/yr

EMISSION FACTORS

Pollutant	Emission Factor (kg/MMBtu) *	Emission Factor (lb/MMBtu)	Global Warming Potentials **
Carbon Dioxide (CO_2)	N/A	120.05	1
Methane (CH_4)	0.003	0.0022	25
Nitrous Oxide (N_2O)	0.0006	0.00022	298

* The heater fires refinery fuel gas. The CO2 emission factor is derived from Equation C-5 in 40 C.F.R. Part 98, Subpart C and actual fuel gas data for the Mid Plant fuel gas system. The CH_4 and N_2O factors are from 40 CFR 98, Table C-2 for petroleum.

** Global warming potentials are from Table A-1 in 40 CFR 98, Subpart A.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	CO_2e Annual Emissions (tons/yr)
Carbon Dioxide (CO_2)	37280	37280
Methane (CH_4)	0.68	17.12
Nitrous Oxide (N_2O)	0.07	20.40
Total	37281	37317

Emission rates are calculated using equations C-5 and C-8b and converting from metric tons/yr.

Equation C-5 from 40 CFR 98, Subpart C

$$CO_2 = \frac{44}{12} * Fuel * CC * \frac{MW}{MVC} * 0.001 \qquad \text{(Eq. C-5)}$$

CO_2 = Annual CO_2 mass emissions from combustion of the specific gaseous fuel (metric tons).
Fuel = Annual volume of the gaseous fuel combusted (scf). The volume of fuel combusted must be measured directly, using fuel flow meters calibrated according to §98.3(i). Fuel billing meters may be used for this purpose.
CC = Annual average carbon content of the gaseous fuel (kg C per kg of fuel). The annual average carbon content shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.
MW = Annual average molecular weight of the gaseous fuel (kg/kg-mole). The annual average molecular weight shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.
MVC = Molar volume conversion factor at standard conditions, as defined in §98.6. Use 849.5 scf per kg mole if you select 68 °F as standard temperature and 836.6 scf per kg mole if you select 60 °F as standard temperature.
44/12 = Ratio of molecular weights, CO_2 to carbon.
0.001 = Conversion factor from kg to metric tons.

Equation C-8b from 40 CFR 98, Subpart C
CH_4 or N_2O (metric tons/yr) = 0.001 x Gas x EF
where
Gas = Annual natural gas usage (MMBtu)
EF = Fuel specific default CH_4 or N_2O emission factor for natural gas from Table C-2 (kg/MMBtu)

1 metric ton = 1.1023 short tons

Greenhouse Gas Fugitive Emission Rate Estimates
DHT (Previously GOHT)
New Components

FIN:	37
EPN:	F-37
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	29	0.059	97%	0.0513
Valves - Gas (DM)	1	0.059	75%	0.0148
Valves - Light Liquid	20	0.024	97%	0.0144
Valves - Light Liquid (DM)	1	0.024	75%	0.006
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	1	0.251	85%	0.0377
Pumps - Light Liquid	0	0.251	100%	0
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	74	0.00055	75%	0.0102
Flanges - Light Liquid	49	0.00055	75%	0.00674
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	1	1.399	85%	0.21
Pressure Relief Valves [3]	1	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.351**
Total Annual Emissions				**1.54**

Sample Calculations:

Valve Emissions = (29 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0.0513 lb/hr

Annual Emissions = (0.351 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 1.54 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Methane	60000	10.00%	0.035	0.154

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	Global Warming Potentials *	CO_2e Annual Emissions (tons/yr)
Methane (CH_4)	0.15	25	3.84
Total	0.15		3.84

MID CRUDE UNIT

The Mid Crude Unit is an existing unit at the West Refinery. FHR is proposing to install new equipment piping components as a result of this project.

General Process Description

The Mid Crude separates crude oil into fractions by distillation and steam stripping using the differences in boiling ranges to effect the separation. Distillate fractions produced by the crude unit include light ends, naphtha, jet fuel, diesel fuel or No. 2 fuel oil, gas oil, and residual oil. Pressures range from atmospheric to near full vacuum.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
42	F-42	Mid Crude Fugitives

Calculations are provided to estimate GHG emissions from just the new equipment piping components for PSD applicability purposes. CH_4 emission rates from the new equipment piping components are estimated based on the VOC emission rate and the estimated weight percent methane. The VOC emission rate is estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000 (Appendix A).

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its GWP. CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

Greenhouse Gas Fugitive Emission Rate Estimates
Mid Crude (No. 4 Crude)
New Components

FIN:	42
EPN:	F-42
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	292	0.059	97%	0.517
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	747	0.024	97%	0.538
Valves - Light Liquid (DM)	4	0.024	75%	0.024
Valves - Heavy Liquid	180	0.00051	0%	0.0918
Pumps - Light Liquid	7	0.251	93%	0.123
Pumps - Light Liquid (sealess)	1	0.251	100%	0
Pumps - Heavy Liquid	4	0.046	0%	0.184
Flanges - Gas	731	0.00055	75%	0.101
Flanges - Light Liquid	1,878	0.00055	75%	0.258
Flanges - Heavy Liquid	450	0.00055	30%	0.173
Compressors	1	1.399	95%	0.07
Pressure Relief Valves [3]	5	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**2.08**
Total Annual Emissions				**9.11**

Sample Calculations:

Valve Emissions = (292 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0.517 lb/hr

Annual Emissions = (2.08 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 9.11 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Methane	60000	10.00%	0.208	0.911

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Difficult to monitor (DM) sources are monitored annually. Light liquid pumps and compressors are monitored at a 500 ppmv leak definition instead of 2000 ppmv, which is equivalent to the 28MID program. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	Global Warming Potentials *	CO_2e Annual Emissions (tons/yr)
Methane (CH_4)	0.91	25	22.78
Total	0.91		22.78

SATURATES GAS NO. 3

FHR is proposing to construct a new Saturates Gas (Sat Gas) No. 3 Unit. The new unit will include the Sat Gas No. 3 Hot Oil Heater and new equipment piping components. The hot oil heater will have a maximum fired duty of 450 MMBtu/hr (HHV).

General Process Description

The Saturates Gas Plant No. 3 will operate to recover propane and heavier hydrocarbons from a number of refinery streams and to fractionate the recovered hydrocarbons into various product streams. Hydrocarbon recovery will be via absorption by a combination of internally produced "lean oil" for propane recovery and by externally fed sponge oil(s) for heavy-ends recovery.

The unit will produce a fuel gas which is lean in C_3+ hydrocarbons, a propane liquid product, an isobutene product, a normal butane product, a C_5+ liquid product, a rich sponge oil return liquid and a sour water waste stream. Each of these streams will be sent out of the unit for further treating, sales or as feedstocks.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives

The heater will fire mainly natural gas. Accordingly, for the Sat Gas No. 3 Hot Oil Heater, CO_2 emission rates are estimated using the CO_2 emission factor derived from Equation C-5 in 40 C.F.R. Part 98, Subpart C and actual fuel gas carbon content, molecular weight, and higher heating value data for the purchased natural gas system. CH_4 and N_2O are estimated using Equation C-8b and the emission factors in Table C-2 in 40 C.F.R. Part 98, Subpart C and converting from metric tons to short tons. The heater will also burn an off-gas stream from the Merox Treating Unit. The flow rate of this stream will be so small compared to the natural gas stream that it is not expected to significantly impact the GHG emissions from the heater. Therefore, emission rates are estimated using the emission factors for natural gas.

Calculations are provided to estimate GHG emissions from the new equipment piping components for PSD applicability purposes. CH_4 emission rates from the new equipment piping components are estimated based on the VOC emission rate and the estimated weight percent methane. The VOC emission rate is estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000 (Appendix A).

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its GWP. CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

Greenhouse Gas Emission Rate Calculations

INPUT DATA

Combustion Unit Description:	Sat Gas No. 3 Hot Oil Heater
Facility Identification Number (FIN):	SATGASHTR
Emission Point Number (EPN):	SATGASHTR

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, HHV:	450	MMBtu/hr, HHV
Operating Hours	8760	hrs/yr

EMISSION FACTORS

Pollutant	Emission Factor (kg/MMBtu) *	Emission Factor (lb/MMBtu) *	Global Warming Potentials **
Carbon Dioxide (CO_2)	N/A	119.74	1
Methane (CH_4)	0.001	0.0022	25
Nitrous Oxide (N_2O)	0.0001	0.00022	298

* The heater will fire natural gas. The CO2 emission factor is derived from Equation C-5 in 40 C.F.R. Part 98, Subpart C and actual fuel gas data for the purchased natural gas system. The CH_4 and N_2O factors are from 40 CFR 98, Table C-2 for natural gas.

** Global warming potentials are from Table A-1 in 40 CFR 98, Subpart A.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	CO_2e Annual Emissions (tons/yr)
Carbon Dioxide (CO_2)	236004	236004
Methane (CH_4)	4.35	108.63
Nitrous Oxide (N_2O)	0.43	129.49
Total	236009	236242

Emission rates are calculated using equations C-5 and C-8b and converting from metric tons/yr.

Equation C-5 from 40 CFR 98, Subpart C

$$CO_2 = \frac{44}{12} * Fuel * CC * \frac{MW}{MVC} * 0.001 \qquad \text{(Eq. C-5)}$$

CO_2 = Annual CO_2 mass emissions from combustion of the specific gaseous fuel (metric tons).
Fuel = Annual volume of the gaseous fuel combusted (scf). The volume of fuel combusted must be measured directly, using fuel flow meters calibrated according to §98.3(i). Fuel billing meters may be used for this purpose.
CC = Annual average carbon content of the gaseous fuel (kg C per kg of fuel). The annual average carbon content shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.
MW = Annual average molecular weight of the gaseous fuel (kg/kg-mole). The annual average molecular weight shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.
MVC = Molar volume conversion factor at standard conditions, as defined in §98.6. Use 849.5 scf per kg mole if you select 68 °F as standard temperature and 836.6 scf per kg mole if you select 60 °F as standard temperature.
44/12 = Ratio of molecular weights, CO_2 to carbon.
0.001 = Conversion factor from kg to metric tons.

Equation C-8b from 40 CFR 98, Subpart C
CH_4 or N_2O (metric tons/yr) = 0.001 x Gas x EF
where
Gas = Annual natural gas usage (MMBtu)
EF = Fuel specific default CH_4 or N_2O emission factor for natural gas from Table C-2 (kg/MMBtu)

1 metric ton = 1.1023 short tons

Greenhouse Gas Fugitive Emission Rate Estimates
Sat Gas No. 3 Fugitives
New Components

FIN:	F-SATGAS3
EPN:	F-SATGAS3
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	0	0.059	97%	0
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	2,535	0.024	97%	1.83
Valves - Light Liquid (DM)	6	0.024	75%	0.036
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	0	0.251	93%	0
Pumps - Light Liquid (sealess)	29	0.251	100%	0
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	1,555	0.00055	75%	0.214
Flanges - Light Liquid	6,253	0.00055	75%	0.86
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	0	1.399	95%	0
Pressure Relief Valves [3]	16	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**2.94**
Total Annual Emissions				**12.9**

Sample Calculations:

Valve Emissions = (0 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0 lb/hr

Annual Emissions = (2.94 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 12.9 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Methane	60000	50.00%	1.470	6.439

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Difficult to monitor (DM) sources are monitored annually. Light liquid pumps and compressors are monitored at a 500 ppmv leak definition instead of 2000 ppmv, which is equivalent to the 28MID program. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	Global Warming Potentials *	CO_2e Annual Emissions (tons/yr)
Methane (CH_4)	6.44	25	160.97
Total	6.44		160.97

* Global warming potentials are from Table A-1 in 40 CFR 98, Subpart A.

UDEX UNIT

The Universal Dow Extraction (UDEX) Unit is an existing unit at the West Refinery. The project will require installation of new equipment piping components.

General Process Description

The UDEX Unit removes aromatics from a feed stream composed of toluene, mixed xylenes, benzene and heavy aromatics. The aromatics are removed from the feed stream using glycol and liquid-liquid extraction and exit the unit as extract product which is further separated in downstream fractionation columns. The non-aromatics along with some aromatics end up in the raffinate product stream.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
14-UDEX	F-14-UDEX	Udex Fugitives

Calculations are provided to estimate GHG emissions from just the new equipment piping components for PSD applicability purposes. CH_4 emission rates from the new equipment piping components are estimated based on the VOC emission rate and the estimated weight percent methane. The VOC emission rate is estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000 (Appendix A).

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its GWP. CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

Greenhouse Gas Fugitive Emission Rate Estimates
UDEX
New Components

FIN:	14-UDEX
EPN:	F-14-UDEX
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	0	0.0089	97%	0
Valves - Gas (DM)	0	0.0089	75%	0
Valves - Light Liquid	60	0.0035	97%	0.0063
Valves - Light Liquid (DM)	0	0.0035	75%	0
Valves - Heavy Liquid	0	0.0007	0%	0
Pumps - Light Liquid	0	0.0386	85%	0
Pumps - Light Liquid	2	0.0386	100%	0
Pumps - Heavy Liquid	0	0.0161	0%	0.00177
Flanges - Gas	0	0.0029	75%	0
Flanges - Light Liquid	80	0.0005	75%	0.01
Flanges - Heavy Liquid	0	0.00007	30%	0
Compressors	0	0.5027	85%	0
Pressure Relief Valves [3]	0	0.23	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.0181**
Total Annual Emissions				**0.0793**

Sample Calculations:

Valve Emissions = (0 valves)(0.0089 lb/hr-source)(1 - 0.97)
= 0 lb/hr

Annual Emissions = (0.0181 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 0.0793 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Methane	60000	10.00%	0.002	0.008

NOTES:

(1) The emission factors used are SOCMI w/out ethylene factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	Global Warming Potentials *	CO_2e Annual Emissions (tons/yr)
Methane (CH_4)	0.01	25	0.20
Total	0.01		0.20

* Global warming potentials are from Table A-1 in 40 CFR 98, Subpart A.

WEST CRUDE

The West Crude Unit is an existing unit at the West Refinery. FHR is proposing process changes in the West Crude Unit which require installation of new equipment piping components.

General Process Description

The West Crude separates crude oil into fractions by distillation and steam stripping using the differences in boiling ranges to affect the separation. Distillate fractions produced by the crude unit include light ends, naphtha, jet fuel, diesel fuel or No. 2 fuel oil, gas oil, and residual oil. Pressures range from atmospheric to near full vacuum.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section:

FIN	EPN	Source Name
40	F-40	West Crude Fugitives

Calculations are provided to estimate GHG emissions from just the new equipment piping components for PSD applicability purposes. CH_4 emission rates from the new equipment piping components are estimated based on the VOC emission rate and the estimated weight percent methane. The VOC emission rate is estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000 (Appendix A).

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its GWP. CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

Greenhouse Gas Fugitive Emission Rate Estimates
West Crude
New Components

FIN:	40
EPN:	F-40
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	120	0.059	97%	0.212
Valves - Gas (DM)	3	0.059	75%	0.0443
Valves - Light Liquid	268	0.024	97%	0.193
Valves - Light Liquid (DM)	3	0.024	75%	0.018
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	1	0.251	85%	0.0377
Pumps - Light Liquid (Sealess)	4	0.251	100%	0
Pumps - Heavy Liquid	2	0.046	0%	0.092
Flanges - Gas	308	0.00055	75%	0.0424
Flanges - Light Liquid	678	0.00055	75%	0.0932
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	0	1.399	85%	0
Pressure Relief Valves [3]	2	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.733**
Total Annual Emissions				**3.21**

Sample Calculations:

Valve Emissions = (120 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0.212 lb/hr

Annual Emissions = (0.733 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 3.21 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Methane	60000	10.00%	0.073	0.321

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.

EMISSION RATES

Pollutant	GHG Annual	Global Warming	CO_2e Annual
Methane (CH_4)	0.32	25	8.03
Total	0.32		8.03

UTILITIES

The utilities area at the West Refinery consists of 6 existing boilers that supply steam to the refinery. There are no proposed physical changes or changes in method of operation to any of these boilers. However, as a result of this project, there will be an increase in steam demand that will be supplied by one or more of the following utility area boilers: the Mid Crude Boiler (43BF1), Boiler No. 7 (06BF657), Boiler No. 8 (06BF658), and Boiler No. 9 (06BF659). Accordingly, because each of these four boilers is potentially affected by the project, the increase in actual boiler emissions resulting from the increased steam demand is included in the PSD applicability assessment.

The incremental increase in actual emissions resulting from the project increase in steam demand is calculated based on an incremental increase in boiler duty of 96 MMBtu/hr (HHV). Because any of the four boilers could potentially supply the additional steam and, therefore, see an increase in utilization as a result of the project, the four boilers have been grouped together into a single emission source called “Various Boilers”.

General Process Description

The boilers provide steam to various processes within the refinery.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
Various Boilers	Various Boilers	Various boilers seeing increased utilization.

Calculations are provided to estimate GHG emissions from the boilers for the incremental increase in duty. The Mid Crude Boiler fires fuel gas from the Mid Plant refinery fuel gas system, and Boilers No. 7, No. 8, and No. 9 fire fuel gas from the 90# refinery fuel gas system. CO_2 emission rates for the incremental increase in duty are estimated using the CO_2 emission factor derived from Equation C-5 in 40 C.F.R. Part 98, Subpart C and actual fuel gas carbon content, molecular weight, and higher heating value data for the Mid Plant refinery fuel gas system because the CO_2 emission factor for the Mid Plant refinery fuel gas system is higher than the factor for the 90# refinery fuel gas system. CH_4 and N_2O are estimated using Equation C-8b and the emission factors for “Petroleum” in Table C-2 in 40 C.F.R. Part 98, Subpart C and converting from metric tons to short tons.

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its GWP. CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

Greenhouse Gas Emission Rate Calculations

INPUT DATA

Combustion Unit Description:	Boilers (Incremental Increase)
Facility Identification Number (FIN):	Various Boilers
Emission Point Number (EPN):	Various Boilers

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, HHV:	96	MMBtu/hr, HHV
Operating Hours	8760	hrs/yr

EMISSION FACTORS

Pollutant	Emission Factor (kg/MMBtu) *	Emission Factor (lb/MMBtu) *	Global Warming Potentials **
Carbon Dioxide (CO_2)	N/A	120.05	1
Methane (CH_4)	0.003	0.0022	25
Nitrous Oxide (N_2O)	0.0006	0.00022	298

* The boilers fire refinery fuel gas. The CO2 emission factor is derived from Equation C-5 in 40 C.F.R. Part 98, Subpart C and actual fuel gas data for the Mid Plant fuel gas system. The CH_4 and N_2O factors are from 40 CFR 98, Table C-2 for petroleum.

** Global warming potentials are from Table A-1 in 40 CFR 98, Subpart A.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	CO_2e Annual Emissions (tons/yr)
Carbon Dioxide (CO_2)	50478	50478
Methane (CH_4)	0.93	23.17
Nitrous Oxide (N_2O)	0.09	27.62
Total	50479	50528

Emission rates are calculated using equations C-5 and C-8b and converting from metric tons/yr.

Equation C-5 from 40 CFR 98, Subpart C

$$CO_2 = \frac{44}{12} * Fuel * CC * \frac{MW}{MVC} * 0.001 \qquad \text{(Eq. C-5)}$$

CO_2 = Annual CO_2 mass emissions from combustion of the specific gaseous fuel (metric tons).
Fuel = Annual volume of the gaseous fuel combusted (scf). The volume of fuel combusted must be measured directly, using fuel flow meters calibrated according to §98.3(i). Fuel billing meters may be used for this purpose.
CC = Annual average carbon content of the gaseous fuel (kg C per kg of fuel). The annual average carbon content shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.
MW = Annual average molecular weight of the gaseous fuel (kg/kg-mole). The annual average molecular weight shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.
MVC = Molar volume conversion factor at standard conditions, as defined in §98.6. Use 849.5 scf per kg mole if you select 68 °F as standard temperature and 836.6 scf per kg mole if you select 60 °F as standard temperature.
44/12 = Ratio of molecular weights, CO_2 to carbon.
0.001 = Conversion factor from kg to metric tons.

Equation C-8b from 40 CFR 98, Subpart C
CH_4 or N_2O (metric tons/yr) = 0.001 x Gas x EF
where
Gas = Annual natural gas usage (MMBtu)
EF = Fuel specific default CH_4 or N_2O emission factor for natural gas from Table C-2 (kg/MMBtu)

1 metric ton = 1.1023 short tons

WASTEWATER TREATMENT

There are no proposed physical changes or changes in the method of operation for the API Separator Flare (EPN V-8). However, as a result of this project, the flare will experience an increase in actual emissions. Because the flare is an affected emission unit downstream of the project, these changes in actual emissions are included in the PSD applicability assessment. The incremental increase in actual emissions as a result of the project is calculated based on an incremental increase of 4.73 MMscf/yr of vent gas routed to the API Separator Flare.

General Process Description

The wastewater streams affected by this project enter the Monroe API Separator where slop oil and sludge are removed and sent to storage. Emissions from the Monroe API Separator are controlled by the API Separator Flare (EPN V-8). FHR operates a caustic scrubber on the Monroe API Separator to reduce sulfur in the waste gas stream routed to the API Separator Flare. The API Separator Flare meets the requirements of 40 C.F.R. 60.18 and provides a minimum destruction efficiency of 98% based on TCEQ guidance.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section:

FIN	EPN	Source Name
45BD3	V8	API Separator Flare

For the API Separator Flare (EPN V-8), CO_2, CH_4, and N_2O emission rates are estimated using Equations Y-3, Y-4, and Y-5, respectively, in 40 C.F.R. Part 98, Subpart Y and converting from metric tons to short tons.

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its GWP. CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

Greenhouse Gas Emission Rate Calculations

INPUT DATA

Combustion Unit Description:	API Separator Flare (Incremental Increase)
Facility Identification Number (FIN):	45BD3
Emission Point Number (EPN):	V-8

FLARE DATA

Volume of Flare Gas Combusted:	4.73	MMscf/yr
Higher Heating Value of Flare Gas:	1,088	Btu/scf

GHG EMISSION FACTORS

Pollutant	Emission Factor (kg/MMBtu) *	Global Warming Potentials **
Carbon Dioxide (CO_2)	60	1
Methane (CH_4)	0.003	25
Nitrous Oxide (N_2O)	0.0006	298

* CO_2 emission factors are from 40 CFR 98, Subpart Y. CH_4 and N_2O emission factors are from Table C-2 in 40 CFR 98, Subpart C for Petrolem Products.

** Global warming potentials are from Table A-1 in 40 CFR 98, Subpart A.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	CO_2-e Annual Emissions (tons/yr)
Carbon Dioxide (CO_2)	333.62	333.62
Methane (CH_4)	1.11	27.75
Nitrous Oxide (N_2O)	0.0037	1.10
Total	334.73	362.47

Emission rates are calculated using equations Y-3, Y-4, and Y-5 from 40 CFR 98, Subpart Y.

Equation Y-3 from 40 CFR 98, Subpart Y

$CO_2 = 0.98 \times 0.001 \times (Flare_{NORM} \times HHV \times E_mF)$

where

$Flare_{NORM}$ = Annual Volume of flare gas combusted during normal operations in MMscf/yr

HHV = Higher Heating Value for fuel gas or flare gas in Btu/scf

E_mF = Default CO_2 emission factor for flare gas of 60 kg CO_2/MMBtu (HHV basis)

Equations Y-4 from 40 CFR 98, Subpart Y

$CH_4 = CO_2 \times E_mF_{CH4} / E_mF + CO_2 \times 0.02/0.98 \times 16/44 \times f_{CH4}$

where

CO_2 = Emission rates calculated from Equation Y-3.

E_mF_{CH4} = Default CH_4 emission factor for "Petroleum Products from Table C-2 of Subpart C.

E_mF = Default CO_2 emission factor for flare gas of 60 kg CO_2/MMBtu (HHV basis)

f_{CH4} = Weight fraction of carbon in the flare gas prior to combustion that is contributed by methane, default 0.4

$N_2O = CO_2 \times E_mF_{N2O} / E_mF$

where

CO_2 = Emission rates calculated from Equation Y-3.

E_mF_{N2O} = Default N_2O emission factor for "Petroleum Products from Table C-2 of Subpart C.

E_mF = Default CO_2 emission factor for flare gas of 60 kg CO_2/MMBtu (HHV basis)

1 metric ton = 1.023 short tons

MARINE LOADING

The Marine Vapor Combustor is an existing source at the West Refinery. FHR is proposing to increase the annual loading rate of naphtha and gasoline at the marine loading terminal. Emissions generated by the naphtha and gasoline marine loading operations are controlled by the Marine Vapor Combustor. Because the proposed change is limited to the increased loading of naphtha and gasoline and not the other products controlled by the Marine Vapor Combustor, calculations are provided estimating GHG emissions for the incremental increase in the loading rate of naphtha and gasoline. These emission rates are used in the PSD applicability assessment.

General Process Description

FHR's West Refinery uses three docks (No. 8, 9, and 10) for marine loading of both ships and barges. When loading toluene, benzene, xylene (all isomers), gasoline and blend stocks, naphthas, cumene, pseudocumene, and penexate, emissions are controlled by a vacuum-assisted loading operation that captures virtually all of the vapors and vents them to the Marine Vapor Combustor (VCS-1). The Marine Vapor Combustor is an enclosed flare with a minimum destruction efficiency of 99.5% for VOC based on stack testing.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section:

FIN	EPN	Source Name
LW-8	VCS-1	Marine Vapor Combustor

For the Marine Vapor Combustor (EPN VCS-1), CO_2, CH_4, and N_2O emission rates are estimated using Equations Y-3, Y-4, and Y-5, respectively, in 40 C.F.R. Part 98, Subpart Y and converting from metric tons to short tons. Because the Marine Vapor Combustor combusts natural gas and other petroleum vapors, the CO_2 emission factor for crude oil from 40 C.F.R. 98, Table C-1 is used rather than the default factor specified in Subpart Y because this is the highest factor from all product vapors being combusted and is the most conservative emission estimate. The CH_4 and N_2O factors are from 40 C.F.R. 98, Table C-2 for petroleum.

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its GWP. CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

Greenhouse Gas Emission Rate Calculations
Incremental Increase in Emissions (Naphtha and Gasoline Loading Only)

Because FHR is only proposing an incremental increase in the naphtha and gasoline loading rates, incremental emission rates for only naphtha and gasoline loading are calculated for PSD purposes.

INPUT DATA

Combustion Unit Description:	Marine Vapor Combustor (Proposed Increase)
Facility Identification Number (FIN):	VCS-1
Emission Point Number (EPN):	VCS-1

FLARE DATA

Volume of Gas Combusted:	9.49	MMscf/yr
Annual Higher Heating Value of Gas:	4,286	Btu/scf

EMISSION FACTORS

Pollutant	Emission Factor (kg/MMBtu) *	Global Warming Potentials **
Carbon Dioxide (CO_2)	74.49	1
Methane (CH_4)	0.003	25
Nitrous Oxide (N_2O)	0.0006	298

* The control device combusts natural gas and other petroleum vapors. Therefore, the CO_2 emission factor for crude oil from 40 CFR 98, Table C-1 is used rather than the default factor specified in Subpart Y because this is the highest factor from all product vapors being combusted and is the most conservative emission estimate. The CH4 and N2O factors are from 40 CFR 98, Table C-2 for petroleum.
** Global warming potentials are from Table A-1 in 40 CFR 98, Subpart A.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	CO_2-e Annual Emissions (tons/yr)
Carbon Dioxide (CO_2)	3271.39	3271.39
Methane (CH_4)	10.8496	271.2411
Nitrous Oxide (N_2O)	0.0290	8.6557
Total	3282.27	3551.28

Emission rates are calculated using equations Y-3, Y-4, and Y-5 from 40 CFR 98, Subpart Y.

Equation Y-3 from 40 CFR 98, Subpart Y
CO_2 (metric tons/yr) = 0.98 x 0.001 x ($Flare_{NORM}$ x HHV x E_mF)
where
$Flare_{NORM}$ = Annual Volume of flare gas combusted during normal operations in MMscf/yr
HHV = Higher Heating Value for fuel gas or flare gas in Btu/scf
E_mF = Default CO_2 emission factor for flare gas of 60 kg CO_2/MMBtu (HHV basis) - see note above

Equation Y-4 from 40 CFR 98, Subpart Y
CH_4 (metric tons/yr) = CO_2 x E_mF_{CH4} / E_mF + CO_2 x 0.02/0.98 x 16/44 x f_{CH4}
where
CO_2 = Emission rates calculated from Equation Y-3.
E_mF_{CH4} = Default CH_4 emission factor for petroleum products from Table C-2 of Subpart C.
E_mF = Default CO_2 emission factor for flare gas of 60 kg CO_2/MMBtu (HHV basis) - see note above
f_{CH4} = Weight fraction of carbon in the flare gas prior to combustion that is contributed by methane, default 0.4

Equation Y-5 from 40 CFR 98, Subpart Y
N_2O = CO_2 x E_mF_{N2O} / E_mF
where
CO_2 (metric tons/yr) = Emission rates calculated from Equation Y-3.
E_mF_{N2O} = Default N_2O emission factor for petroleum products from Table C-2 of Subpart C.
E_mF = Default CO_2 emission factor for flare gas of 60 kg CO_2/MMBtu (HHV basis) - see note above

1 metric ton = 1.1023 short tons

TANK FARM

Storage tanks 08FB137, 08FB142, 08FB147, 40FB1010, and 40FB4011 are existing sources at the West Refinery.[2] There are no proposed physical changes or changes in the method of operation for the storage tanks. However, as a result of this project, the storage tanks will experience an increase in actual emissions as a result of an increase in crude oil throughput. Because the storage tanks are affected emission units downstream of the project, these changes in actual emissions are included in the PSD applicability assessment.

The project will require installation of new equipment piping components.

<u>Emissions Data</u>

Emission rate calculations for the following sources listed below are provided at the end of this section:

FIN	EPN	Source Name
08FB137	FB137	Tank 08FB137
08FB142	FB142	Tank 08FB142
08FB147	FB147	Tank 08FB147
40FB4010	FB4010	Tank 40FB4010
40FB4011	FB4011	Tank 40FB4011
P-VOC	F-TK-VOC	VOC Tank & Loading Fugitives
P-GB	F-GB	Gasoline Blender Fugitives

As required by EPA guidance, GHG emissions are estimated only from storage tanks associated with crude oil storage because of the potential for methane emissions. For storage tanks, CH_4 emission rates are estimated using Equation Y-22 in 40 C.F.R. Part 98, Subpart Y and converting from metric tons to short tons.

Calculations are provided to estimate GHG emissions from just the new equipment piping components for PSD applicability purposes. CH_4 emission rates from the new equipment piping components are estimated based on the VOC emission rate and the weight percent methane. The VOC emission rate is estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000 (Appendix A).

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its GWP. CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

2 Tanks 40FB1010 and 40FB1011 are not experiencing a physical change or change in the method of operation. They will be considered a minor modification for the state minor NSR permitting and subject to state BACT review, but are not considered a major modification for federal PSD.

Greenhouse Gas Emission Rate Calculations
Incremental Increase in Emissions (Crude Oil Only)

Tank FIN	Tank EPN	Pollutant	Crude Oil Throughput (MMbbl/yr)	GHG Mass Emissions (tons/yr)	Global Warming Potential	CO_2e (tons/yr)
08FB137	FB137	Methane (CH_4)	12	1.33	25	33.25
08FB142	FB142					
08FB147	FB147					
40FB4010	FB4010					
40FB4011	FB4011					

Emission rates are estimated using Equation Y-22 from 40 CFR 98, Subpart Y

Equation Y-22
CH_4 (metric tons/yr) = 0.1 x Q_{REF}
where
Q_{Ref} = Quantity of crude oil plus the quantity of intermediate products received from off site that are processed at the facility (MMbbl/year).

1 metric ton = 1.1023 short tons

Greenhouse Gas Fugitive Emission Rate Estimates
Tank Farm - VOC Tank and Terminal 2
New Components

FIN:	P-VOC
EPN:	F-TK-VOC
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	0	0.059	97%	0
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	500	0.024	97%	0.36
Valves - Light Liquid (DM)	0	0.024	75%	0
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	0	0.251	85%	0
Pumps - Light Liquid	4	0.251	100%	0
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	0	0.00055	30%	0
Flanges - Light Liquid	800	0.00055	30%	0.308
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	0	1.399	85%	0
Pressure Relief Valves [3]	0	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.668**
Total Annual Emissions				**2.93**

Sample Calculations:

Valve Emissions = (0 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0 lb/hr

Annual Emissions = (0.668 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 2.93 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Methane	60000	10.00%	0.067	0.293

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	Global Warming Potentials *	CO_2e Annual Emissions (tons/yr)
Methane (CH_4)	0.29	25	7.31
Total	0.29		7.31

Greenhouse Gas Fugitive Emission Rate Estimates
Gasoline Blending System
New Components

FIN:	P-GB
EPN:	F-GB
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Current Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	0	0.059	97%	0
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	100	0.024	97%	0.072
Valves - Light Liquid (DM)	0	0.024	75%	0
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	0	0.251	85%	0
Pumps - Light Liquid (sealess)	4	0.251	100%	0
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	0	0.00055	75%	0
Flanges - Light Liquid	150	0.00055	75%	0.0206
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	0	1.399	85%	0
Pressure Relief Valves [3]	7	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.0926**
Total Annual Emissions				**0.406**

Sample Calculations:

Valve Emissions = (0 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0 lb/hr

Annual Emissions = (0.0926 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 0.406 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Methane	60000	10.00%	0.009	0.041

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.

EMISSION RATES

Pollutant	GHG Annual Emissions (tons/yr)	Global Warming Potentials *	CO_2e Annual Emissions (tons/yr)
Methane (CH_4)	0.04	25	1.01
Total	0.04		1.01

COOLING TOWERS

FHR is proposing to construct a new Mid Plant Cooling Tower No. 2 (44EF2) in the Mid-Plant area.

General Process Description

The West Refinery is provided cooling water from a number of cooling towers throughout the refinery. The cooling towers are equipped with an air-stripping system and are monitored monthly.

Emissions Data

Emission rate calculations for the following sources listed below are provided at the end of this section.

FIN	EPN	Source Name
44EF2	F-S-202	Mid Plant Cooling Tower No. 2

CH_4 emission rates from the new cooling tower is estimated based on the VOC emission rate and assumed maximum estimated weight percent methane of 10%. The cooling tower VOC emission rate is estimated based on an emissions factor of 0.7 lb/MMgal from AP-42 Table 5.1-2 and the water circulating flow rate.

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its GWP. CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

COOLING TOWER GREENHOUSE GAS EMISSIONS
Potential to Emit

Cooling Tower	EPN	FIN	Flowrate (gpm)	VOC Emission Factor * (lb/MMgal)	VOC Emission Rate * (tons/yr)	Weight % Methane (CH_4) (%)	GHG Emissions (tons/yr)	Global Warming Potential **	CO_2e Emissions (tons/yr)
Mid Plant Cooling Tower No. 2	F-S-202	44EF2	30000	0.7	5.52	10	0.55	25	13.80

* Cooling tower VOC emissions are estimated with an emissions factor of 0.7 lb/MMgal from AP-42 Table 5.1-2, dated January 1995. The cooling water is monitored for VOC.
** Global warming potentials are from Table A-1 in 40 CFR 98, Subpart A.

PLANNED MAINTENANCE, START-UP, AND SHUTDOWN EMISSIONS

Increased GHG emissions are expected from planned maintenance, start up, and shutdown (MSS) activities associated with the construction of the new Sat Gas No. 3 Unit and for new storage tanks, which are not sources of GHG emissions during normal operations, but can emit GHGs during maintenance activities.

<u>General Process Description</u>

Various maintenance activities have fugitive emissions associated with them.

Vessel and Equipment Openings after Decommissioning

Once equipment has been cleaned, blinds for maintenance are installed. This requires opening the equipment to atmosphere releasing any residual VOC/methane to the atmosphere.

Controlling Fugitive Emissions from MSS Activities

The fugitive emissions from some MSS activities are routed to a control device which generates GHG emissions from combustion. Below is a table summarizing these activities and the control device used for each activity.

Activity	Control Device Used
Vacuum Truck Loading	Carbon Canister, Engine, Thermal Oxidizer
Tank Degassing	Engine, Thermal Oxidizer
Tank Refilling after Degassing or Product Change	Engine, Thermal Oxidizer

<u>Emissions Data</u>

Emission rate calculations for the following sources listed below are provided at the end of this section

FIN	EPN	Source Name
MSSFUGS-DC	MSSFUGS-DC	Miscellaneous MSS Fugitive Emissions For Domestic Crude Project

MSS emission rates are calculated from vessel and equipment openings and from the combustion emissions as a result of controlling the fugitive emissions from various activities. The MSS emissions from these categories are summed to get a total emission rate from miscellaneous MSS fugitive emissions for the domestic crude project.

MSS Fugitive Emissions from Process Vessel and Equipment Openings to Atmosphere

GHG emission rates from process vessel and equipment openings are estimated based on the volume released to the atmosphere and the GHG content. Volume and GHG content represented in the calculations are used to estimate annual emission rates conservatively and may vary.

Combustion Emissions from Controlling MSS Fugitive Emissions

CO_2 emission rates are estimated using Equation C-1b and the emission factor for “Crude Oil” in Table C-1 in 40 C.F.R. Part 98, Subpart C and converting from metric tons to short tons. CH_4 and N_2O are estimated using Equation C-8b and the emission factors for “Petroleum” in Table C-2 in 40 C.F.R. Part 98, Subpart C and converting from metric tons to short tons. The factors for “Crude Oil” and “Petroleum” from Tables C-1 and C-2 are used rather than factors for natural gas because they result in more conservative emission rate estimates.

CO_2e emissions are defined as the sum of the mass emissions of each individual GHG adjusted for its GWP. CO_2e emission rates for each GHG are estimated by multiplying the emission rates for each GHG by its GWP value provided in Table A-1 of 40 C.F.R. Part 98, Subpart A.

Start-up/Shutdown/Maintenance Fugitive Emissions
Emissions Summary
EPN MSSFUGS-DC

Event	CO_2 Emission Rates (ton/yr)	CH_4 Emission Rates (ton/yr)	N_2O Emission Rates (ton/yr)	GHG Emission Rates (ton/yr)	CO_2e Emission Rates (ton/yr)
Equipment Openings		0.05		0.05	1.25
Controlling MSS Activities	228	0.003	0.0003	228	228
Total	**228**	**0.05**	**0.0003**	**228**	**229**

Start-up/Shutdown/Maintenance Fugitive Emissions
GHG Emissions from Vessel and Associated Piping/Equipment Openings to Atmsophere
EPN MMSFUGS-DC

Total Annual Flow Rate to the Atmosphere:	120,000	scf/yr
Maximum VOC Conent in the Vent Gas:	10000	ppmv
Assumed Molecular Weight of VOC to the Atmosphere:	62	lb/lb-mole
Methane Weight % in VOC:	50	%

VOC Emissions

$$\text{Annual VOC} = \frac{120000\ \text{scf vent gas}}{\text{yr}} \left| \frac{0.01\ \text{scf VOC}}{\text{scf vent gas}} \right| \frac{\text{lb-mol VOC}}{379.5\ \text{scf VOC}} \left| \frac{62\ \text{lb VOC}}{\text{lb-mol VOC}} \right| \frac{\text{ton VOC}}{2000\ \text{lb VOC}} = 0.10\ \text{tons/yr}$$

GHG Emissions

$$\text{Annual Methane} = \frac{0.1\ \text{tons VOC}}{\text{yr}} \left| \frac{50\ \text{tons Methane}}{100\ \text{tons VOC}} \right. = 0.05\ \text{tons Methane/yr}$$

Pollutant	GHG Annual Emissions (tons/yr)	Global Warming Potentials *	CO_2e Annual Emissions (tons/yr)
Methane (CH_4)	0.05	25	1.25
Total	0.05		1.25

Start-up/Shutdown/Maintenance Fugitive Emissions
GHG Emissions from Controlling MSS Activities
EPN MSSFUGS-DC

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, HHV:	10	MMBtu/hr, HHV
Operating Hours	278	hrs/yr

EMISSION FACTORS

Pollutant	Emission Factor (kg/MMBtu) *	Emission Factor (lb/MMBtu)	Global Warming Potentials **
Carbon Dioxide (CO_2)	74.49	164.22	1
Methane (CH_4)	0.003	0.0022	25
Nitrous Oxide (N_2O)	0.0006	0.00022	298

* The control device combusts propane and other petroleum vapors. The CO_2 emission factor is from 40 CFR 98, Table C-1 for crude oil, which is the highest factor for all types of vapors combusted. The CH4 and N2O factors are from 40 CFR 98, Table C-2 for petroleum.

** Global warming potentials are from Table A-1 in 40 CFR 98, Subpart A.

EMISSION RATES

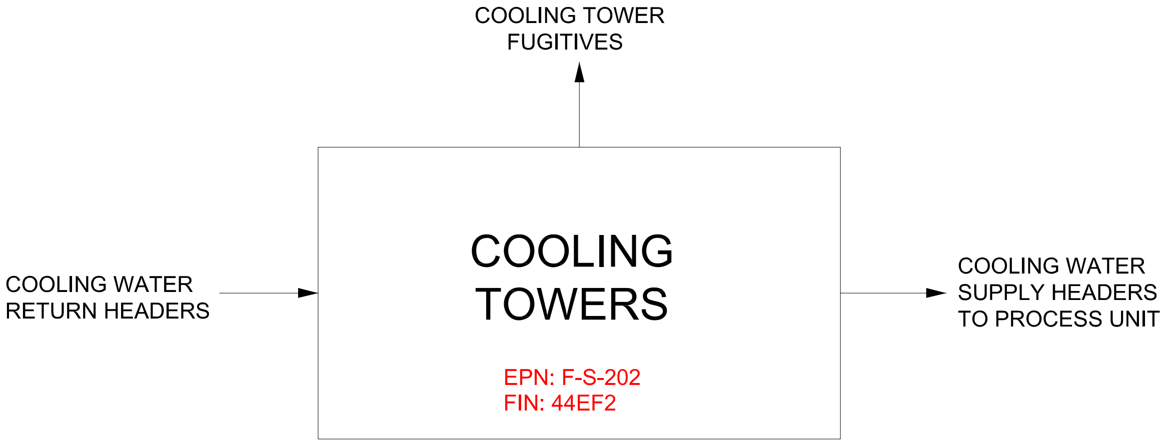
Pollutant	GHG Annual Emissions (tons/yr)	CO_2-e Annual Emissions (tons/yr)
Carbon Dioxide (CO_2)	228	228
Methane (CH_4)	0.003	0.075
Nitrous Oxide (N_2O)	0.0003	0.089
Total	228	228

Emission rates are calculated using equations C-1b and C-8b and converting from metric tons/yr.

Equation C-1b from 40 CFR 98, Subpart C
CO_2 (metric tons/yr) = 0.001 x Gas x EF
where
Gas = Annual propane/petroleum vapor usage (MMBtu)
EF = Fuel specific default CO_2 emission factor for crude oil from Table C-1 (kg/MMBtu)

Equation C-8b from 40 CFR 98, Subpart C
CH_4 or N_2O (metric tons/yr) = 0.001 x Gas x EF
where
Gas = Annual propane/petroleum vapor usage (MMBtu)
EF = Fuel specific default CH_4 or N_2O emission factor for petroleum from Table C-2 (kg/MMBtu)

1 metric ton = 1.1023 short tons



PROCESS FLOW DIAGRAM
COOLING TOWERS

WAID ENVIRONMENTAL

FLINT HILLS RESOURCES CORPUS CHRISTI, LLC

COOLING TOWERS PROCESS FLOW DIAGRAM

Drawn By	Start Date	Rev. Date	DWG Name	Rev. No.
DWW	7/9/08	1/15/14	COOLTWRS	4

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ATTACHMENT B

Aerial Photographic Map


N
Marvin Berry Rd
MSSFUGS-DC
F-TK-VOC
F-TK-VOC
F-S-202
F-GB
Mc Kinzie Ln
F-17
F-42
56
SATGASHTR
F-SATGAS3
MSSFUGS-DC
55
Up River Rd
53A
53B
F-14-UDEX
JJ-4
F-39
N Clarkwood Rd
I-37 Frontage Rd
37
1561 ft
© 2013 Google
53
Google earth
Tour Guide
1950
Imagery Date: 11/22/2011
14 R 644796.68 m E 3079898.25 m N elev 50 ft eye alt 6816 ft

ATTACHMENT C

December 2013 Legal Agreement between FHR, Environmental Integrity Project, and the University of Texas School of Law Environmental Clinic

SETTLEMENT AGREEMENT AND RELEASE

This Settlement Agreement and Release (Agreement) is entered into by and between Flint Hills Resources Corpus Christi, LLC (FHR), Citizens for Environmental Justice (CFEJ), James and Roberta Miller ("the Millers"), and Environmental Integrity Project (EIP) (collectively referred to as the Parties).

RECITALS

A. FHR is proposing changes to its Corpus Christi West Refinery located in Corpus Christi, Nueces County, Texas (Domestic Crude Project). Some of the proposed changes require an air permit under the federal Clean Air Act's (CAA) Prevention of Significant Deterioration (PSD) program from the U.S. Environmental Protection Agency (USEPA) and a state air pre-construction permit from the Texas Commission for Environmental Quality (TCEQ). The requirements for construction issued by USEPA and TCEQ will ultimately be made a part of the Corpus Christi West Refinery's Title V air operating permit. In addition, FHR will be performing voluntary emission reduction projects, which will be authorized by TCEQ through other state permit authorizations.

B. In December 2012, FHR submitted a PSD construction permit application to the USEPA and a state pre-construction permit application to TCEQ for the Domestic Crude Project.

C. In March 2013, CFEJ and EIP filed comments and a request for a contested case hearing with the TCEQ regarding the state pre-construction permit application.

D. FHR, the University of Texas School of Law Environmental Clinic ("Environmental Clinic") on behalf of the Millers and CFEJ, and EIP engaged in settlement discussions regarding the Domestic Crude Project.

E. CFEJ is a nonprofit organization dedicated to protecting and improving environmental quality in Corpus Christi, Texas.

F. The Millers are members of CFEJ. The Millers reside at 1906 Tuloso Road, Corpus Christi, TX, 78409.

G. The Environmental Clinic is a law school clinic at the University of Texas School of Law in which second and third year law students work under faculty supervision on cases and projects that will improve public health and environmental quality for low-income communities. The Environmental Clinic is representing CFEJ and the Millers.

H. EIP is a nonpartisan, nonprofit organization dedicated to effective enforcement of environmental laws. EIP has offices in Washington, D.C. and Austin, Texas.

I. FHR is a Delaware limited liability company and operates two petroleum refineries in Texas.

J. The Parties have engaged in arms-length discussions to address and resolve the issues raised by CFEJ and EIP, and they have come to a mutual agreement with respect to certain permit application content, proposed permit terms and conditions, and other voluntary commitments to be undertaken by FHR that are beneficial to public welfare and the environment. The Parties recognize that USEPA and TCEQ are the permitting authorities and nothing in this Agreement does or is intended to bind USEPA or TCEQ or require them to deviate from their normal processes. The

Parties believe that their Agreement will facilitate USEPA's and TCEQ's processing of the permit applications.

K. The Parties wish to enter into this Agreement to memorialize the terms of their mutual agreement and so that the Domestic Crude Project may move forward without delay.

AGREEMENT AND RELEASE

NOW, THEREFORE, for the good and sufficient consideration set forth below, the Parties agree as follows:

1. Permit Terms and Conditions.

   a. FHR will use commercially reasonable efforts to include the substance of the permit terms and conditions set forth in this paragraph 1 in the Domestic Crude Project PSD construction permit to be issued by USEPA, the state pre-construction permit to be issued by TCEQ, or other state permit authorizations as appropriate. To the extent USEPA or TCEQ decline to include any term or condition set forth in this paragraph 1, FHR agrees to comply with the excluded terms and conditions set forth in this paragraph 1 as a condition of this Agreement.

   b. Unless lower limits are established in any final permit issued by USEPA or TCEQ, FHR agrees to the ton per year CO_2 limits on each new and modified heater, not to exceed:

      i. Saturated Gas #3 Hot Oil Heater (SATGASHTR): 230,610 tons CO_2e per 365-days (rolling)

ii. CCR Hot Oil Heater (39BA3901, EPN JJ-4): 70,478 tons CO_2e total per 365-days (rolling)

c. In order to demonstrate compliance with the Saturated Gas #3 Hot Oil Heater and CCR Hot Oil Heater 365-day CO_2e limits, FHR agrees to use either Tier 3 or Tier 4 calculation methodologies, as described by 40 C.F.R. § 98.33, to calculate the CO_2 emissions and the appropriate methodologies as described by 40 C.F.R. § 98.33(c) to calculate the CH_4 and N_2O emissions.

d. FHR shall report, in its Quarterly Excess Emissions and CEMS Report, any exceedances of the rolling 365-day average of CO_2e emissions for the Saturated Gas #3 Hot Oil Heater and CCR Hot Oil Heater.

e. FHR agrees to limit the stack gas exit temperature on the Saturated Gas #3 Hot Oil Heater and the CCR Hot Oil Heater to 350 degrees F on a 365-day rolling average basis, excluding periods of heater start-up, shutdown, and low firing rates (<60% of maximum design capacity).

f. In order to demonstrate compliance with the Saturated Gas #3 Hot Oil Heater and the CCR Hot Oil Heater stack gas exit temperature limit, FHR agrees as follows:

i. FHR will continuously monitor each heater's stack exit temperature. Stack exit temperatures recorded during periods of monitoring instrumentation malfunction and maintenance shall be excluded from consideration provided monitoring operation downtime does not exceed 5% of any 365-day rolling period.

ii. Monitoring operation downtime in excess of 5% of any 365-day period shall be reported in FHR's Quarterly Excess Emissions and CEMs Report.

iii. A stack exit temperature above 350 degrees F on a 24 hour average basis, excluding periods of heater start-up, shutdown, and low firing rates (<60% of maximum design capacity), is an excursion that requires corrective action. The 24 hour average stack exit temperature for each heater shall be determined using the following formula:

$$24\ hour\ Average\ Temperature = \frac{Sum\ of\ Valid\ Temperature\ Readings\ in\ a\ 24\text{-}hour\ Period}{Quantity\ of\ Valid\ Temperature\ Readings\ in\ a\ 24\text{-}hour\ Period}$$

iv. Upon detecting an excursion, FHR will restore operation of the heater to its normal or usual manner of operation as expeditiously as practicable in accordance with good air pollution control practices for minimizing the period of any excursion and taking any necessary corrective actions to restore normal operation. Such actions may include heater adjustments or equipment maintenance.

v. FHR will report excursions and a summary of response actions in FHR's Quarterly Excess Emissions and CEMS Report.

vi. Excursions are events that require a response. Excursions shall not be considered out of compliance with the limit unless the stack gas exit temperature is above 350 degrees F on a 365-day rolling average basis, excluding periods of heater start-up, shutdown, and low firing rates (<60% of maximum design capacity). The 365-day rolling average stack exit temperature for each heater shall be determined using the following formula:

$$365\ day\ Average\ Tempertature = \frac{Sum\ of\ Valid\ Temperature\ Readings\ in\ a\ 365\ day\ Period}{Quantity\ of\ of\ Valid\ Temperature\ Readings\ in\ a\ 365\ day\ Period}$$

vii. FHR will limit excess O_2 in the Saturated Gas #3 Hot Oil Heater and the CCR Hot Oil Heater exhaust to 4% or less on a 365-day rolling average basis, excluding periods of heater start-up, shutdown, and low firing rates (<60% of maximum design capacity). The 365-day rolling average excess O_2 level in each heater's exhaust shall be determined using the following formula:

$$365\ day\ average\ excess\ O2\ level = \frac{Sum\ of\ Valid\ excess\ O2\ readings\ in\ a\ 365\ day\ Period}{Quantity\ of\ of\ Valid\ excess\ O2\ Readings\ in\ a\ 365\ day\ Period}$$

g. FHR will limit NOx to 0.0075 lbs/mmBtu on a 365-day rolling average, for the Saturated Gas #3 Hot Oil Heater and the CCR Hot Oil Heater, and will limit ammonia slip from the heater SCR systems to 10 ppm on an hourly average.

h. FHR will install and operate CEMS to monitor NOx, CO, and O_2 on the CCR Hot Oil Heater and the Saturated Gas #3 Hot Oil Heater and SCR systems for those heaters.

i. FHR will limit allowable emissions for the following tanks to: 08FB136 – 6.85 tpy VOC; 08FB118 – 12.36 tpy VOC; 15FB620 – 10.81 tpy VOC.

j. FHR will submit an alteration request for Flexible Permit No. 8803A, requesting the removal of existing allowables for tanks 08FB102, 08FB117 and 08FB401 and reduction of the existing VOC allowable for tank 08FB18 in Flexible Permit No. 8803A from 22.35 tpy to 4.57 tpy. FHR will limit VOC emissions from tank 08FB18 to 4.57 tpy. The total amount of additional emissions reductions and associated reductions in the VOC emissions cap in Permit No. 8803A from these proposed changes is 154 TPY.

k. To the extent these are not less stringent than any enforceable requirements as a result of a Consent Decree with EPA, FHR agrees to the following limits:

   i. Individual hourly and annual unit specific limits for criteria pollutants for all new, modified, and affected sources addressed in the West Domestic Crude project state PSD permit application, which are outlined in Attachment A, "Proposed West Permit Allowables." There are grouped limits applicable to specific tanks.

   ii. VOC emission limit of 7.36 tpy for the existing Mid Plant Cooling Tower (EPN F-S-201). For the new Mid Plant Cooling Tower No. 2 (EPN F-S-202), FHR will agree to a VOC emission limit of 5.52 tpy. FHR shall be presumed to be in compliance with this limit if actual emissions as calculated using the El Paso Method and calculation basis from MACT CC and length of time to repair from the time of sampling are at or below this limit. Samples shall be taken at least monthly.

i. FHR shall comply with the recordkeeping requirements established by 40 C.F.R. § 63.655(i)(4)(iii), and maintain such records for at least five years.

ii. FHR shall report, in the first Quarterly Excess Emissions Report following submittal of its annual emissions inventory, any exceedance of the annual tons/year VOC emissions limit.

iii. Fuel gas sulfur limits:

Unit	Source	Limit (gr/100 scf on annual basis)
	39BA3901 CCR Hot Oil Heater (JJ-4)	2
	37BA1 DHT Charge Heater (KK-3)	
	37BA2 DHT Stripper Reboiler (KK-3)	0.6
Mid Crude Unit	Crude Heater 42BA1 (A-203)	
	Vacuum Heater 42BA3 (A-204)	
Utilities	Mid Crude Boiler 43BF1 (R-201)	0.6
	Utility Boilers 06BF657 (R-7), 06BF658 (R-8), and 06BF659 (R-9)	5
Other Sources	LSG Hot Oil Heater 47BA1 (LSGHTR)	
	MX Unit Hot Oil Heater (MX-1)	
	DDS Charge Heater 56BA1 (DDS-HTRSTK)	0.6
	DDS Fractionator Reboiler 56BA2 (DDS-HTRSTK)	

iv. FHR will continuously measure the total sulfur content at each representative mix drum, namely the Mid-Plant fuel mix drum, 90# fuel gas mix drum and the CCR fuel system.

v. Sat Gas No. 3 Hot Oil Heater (SATGASHTR) will fire purchased natural gas and LPG treating off-gas with an annual sulfur content limit of 0.5 gr/100 scf.

vi. Limits and monitoring for the FCCU as set out below.

i. PM limit: 1 lb/1000 lbs of coke burn.

ii. FHR will conduct an annual PM performance test per the applicable test methods in 40 CFR 60.106. FHR will conduct the first annual PM performance test within 180 days following issuance of the state and federal construction permits for the West Domestic Crude Project. Following the initial PM performance test, subsequent PM performance tests will be performed within 12 calendar months of the prior PM performance test, or sooner if FHR wishes to do so. FHR will operate at a coke burn rate within 5% plus or minus of the coke burn rate during the prior PM performance test.

iii. SO_2 limit: 50 ppm on a 7 day average, and 25 ppm on a 365 day average.

iv. CO limit: 500 ppm on an hourly average, and 50 ppm on a 365 day average.

2. Other Agreements and Definitions.

a. FHR will engage a third party to perform an energy efficiency audit of the Mid-Crude and West Crude Units. The audit will commence within 180 days of startup of the Domestic Crude Project. FHR will provide a copy of the audit report to EIP and the Environmental Clinic. The audits will identify projects that have a seven (7) year payback or better and the potential GHG reductions associated with projects identified. FHR will use commercially reasonable efforts to evaluate projects against expected economic returns. In its sole judgment, FHR may pursue projects that meet its normal expected economic return.

b. FHR will design to an ammonia slip of 7.5 ppm on a 365-day rolling average for the Saturated Gas #3 Hot Oil Heater (EPN SATGASHTR) and use its good faith commercial efforts to design to 7.5 ppm ammonia slip on a 365-day rolling average for the CCR Hot Oil Heater (EPN JJ-4).

c. FHR agrees to fund a discrete PM and/or VOC monitoring project, not to exceed $40,000. The funds will be provided to EIP within 30 days following the execution of this Agreement, to be used solely for the purpose of procuring equipment and providing staffing to conduct ambient air monitoring.

d. FHR will perform the tank control projects listed in Attachment B such that no new or modified facility begins operation as part of the Domestic Crude Project until the VOC emissions increase associated with the new or modified facility has been offset by one or more of the tank control projects. The VOC emissions reductions attributable to these controls is approximately 84.36 tons per year.

e. A change in the Domestic Crude Project will not be considered material (hereafter a "Material Change") unless:

    i. The change results in a significant relaxation of the terms and conditions the Parties have agreed to in paragraph 1 of this Agreement;

    ii. FHR is unable to meet the agreed upon terms and conditions in this Agreement as a result of the change; or

iii. The change causes the Domestic Crude Project, including related emission reduction projects, to result in an overall increase in emissions of one or more criteria pollutants.

3. Release.

a. Unless there is a Material Change in the Domestic Crude Project, CFEJ and EIP shall formally withdraw their objections, comments, and contested case hearing request from TCEQ within five (5) days of execution of this Agreement.

b. Unless there is a Material Change in the Domestic Crude Project, the Millers, the Environmental Clinic, CFEJ, and EIP shall not file negative comments with the USEPA or TCEQ during the public comment periods or file any petitions objecting to, appealing, or requesting a contested case hearing regarding the final PSD permit for the Domestic Crude Project issued by USEPA or the final state pre-construction permit issued by TCEQ, pursuant to federal law under 40 C.F.R. Part 124 or other federal regulations or provisions under the federal Clean Air Act, pursuant to 30 T.A.C. Chapter 55 or any other state law or regulations under the Texas Clean Air Act, or under common law in any administrative or judicial venue.

c. Unless there is a Material Change in the Domestic Crude Project, the Millers, the Environmental Clinic, CFEJ, and EIP shall not file any petitions objecting to, appealing, or requesting that USEPA object to the action to include the final PSD permit for the Domestic Crude Project issued by USEPA, the final state pre-construction permit issued by TCEQ, and the terms set out in this Agreement in the Corpus Christi West Refinery's Title V air operating permit, solely with respect to the inclusion of the terms contained in the final PSD permit for the Domestic Crude Project issued by USEPA, the final state pre-construction permit issued by TCEQ, and the terms set out in the Agreement. The Parties are not restricted from challenging any other terms that may be part of a future permit action to include the final PSD permit for Domestic Crude Project issued by USEPA, the final state pre-construction permit issued by TCEQ, and the terms set out in this Agreement, pursuant to federal law under 40 C.F.R. Part 70 or other federal regulations or provisions under the federal Clean Air Act, pursuant to 30 T.A.C. Chapter 122 or any other state law or regulations under the Texas Clean Air Act, or under common law in any administrative or judicial venue.

d. Unless there is a Material Change in the Domestic Crude Project, the Millers, the Environmental Clinic, CFEJ, and EIP shall not provide funding, technical support, legal support, or other assistance to any individual or organization, whether or not such individual or organization is a member of CFEJ or EIP, for the purpose of filing negative comments with the USEPA or TCEQ regarding the Domestic Crude Project.

4. Termination.

a. If, prior to construction, FHR decides not to pursue the Domestic Crude Project, any Party shall have the option, at its sole discretion, to terminate this Agreement, in which case all provisions of the Agreement shall be rendered null and void, except for the provision in paragraph 2(c). Any Party electing to terminate the Agreement under this provision shall give 30 days notice to all other Parties prior to the termination becoming effective.

b. The Millers, CFEJ, or EIP shall have the option, at their sole discretion, to terminate this Agreement in the event there is a Material Change in the Domestic Crude Project. Prior to exercising such right to terminate, the Millers, the Environmental Clinic, CFEJ, and EIP shall consult with each other regarding whether there has been a Material Change. A Party electing to terminate the Agreement under this provision shall give 30 days notice to FHR prior to the termination becoming effective.

5. Entire Agreement. This Agreement contains the entire agreement among the Parties with respect to the subject matter hereof, and no oral statements or prior written materials not specifically incorporated herein shall be effective. No variation, modification, or changes hereof shall be binding on any party unless set forth in a document executed by all of the Parties.

6. Successors. This Agreement shall be binding upon and shall inure to the benefit of all of the Parties and their respective successors.

7. Governing Law. The validity, interpretation, performance, and enforcement of this Agreement shall be governed and construed by the laws of the state of Texas.

8. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original.

9. Assignment. The rights and/or obligations under this Agreement of any party hereto may not be assigned except with the express written consent of the other Parties hereto. Any assignment in violation of this provision shall be void.

12-4-13

Flint Hills Resources Corpus Christi, LLC
2825 Suntide Road
Corpus Christi, TX 78403

12-9-13

Environmental Integrity Project
1303 San Antonio Street, Suite 200
Austin, TX 78701

12-9-13

Environmental Clinic
University of Texas School of Law
727 East Dean Keeton
Austin, TX 78705
For: Citizens for Environmental Justice and James and Roberta Miller

Attachment A

West Domestic Crude Project

Proposed West Permit Allowables

			NO_X		CO		SO_2		PM		PM_{10}	
			Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project	
FIN	EPN	Description	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater	4.50	14.78	3.29	14.43	6.06	2.65	4.60	15.23	4.60	15.23
39BA3900	JJ-4	NHT Charge Heater	0.38	1.25	1.25	5.48	1.16	1.42	0.43	1.12	0.43	1.12
39BA3901	JJ-4	CCR Hot Oil Heater	1.24	4.06	4.07	17.81	3.79	4.61	1.40	3.66	1.40	3.66
43BF1	R-201	43BF1 Boiler	15.99	70.05	22.15	24.25	0.63	1.66	1.00	4.38	1.00	4.38
37BA1	KK-3	37BA1 DHT Charge Heater	3.84	16.80	3.20	14.01	0.20	0.53	0.64	2.80	0.64	2.80
37BA2	KK-3	37BA2 DHT Stripper Reboiler	3.84	16.80	3.20	14.01	0.20	0.53	0.64	2.80	0.64	2.80
56BA1	DDS-HTRSTK	DDS Charge Heater (combined stack)	1.80	7.88	2.00	8.76	0.11	0.30	0.30	1.31	0.30	1.31
56BA2	DDS-HTRSTK	DDS Fractionator Reboiler (combined stack)	1.80	7.88	2.00	8.76	0.11	0.30	0.30	1.31	0.30	1.31
42BA1	A-203	42BA1 Crude Heater	33.23	145.57	23.75	104.04	1.51	3.96	2.38	10.40	2.38	10.40
42BA3	A-204	42BA3 Vacuum Heater	11.99	52.53	7.49	32.81	0.48	1.25	0.75	3.28	0.75	3.28
47BA1	LSGHTR	LSG Hot Oil Heater	10.01	43.84	11.12	48.71	0.64	1.67	1.65	7.24	1.65	7.24
54BA1	MX-1	54BA1 MX Unit Hot Oil Heater	5.59	24.49	4.00	17.50	0.25	0.67	0.66	2.89	0.66	2.89
01BF102	AA-4	FCCU CO Boiler/Scrubber	586.55	467.11	358.92	157.21	370.94	162.47	58.30	235.70	58.30	235.70
LW-8	VCS-1	Marine Vapor Combustor	2.65	2.25	6.44	5.47	2.80	2.03	0.60	0.51	0.60	0.51
SRU NO. 1	H-15A	SRU No. 1 Incinerator	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45BD3	V-8	API Separator Flare	0.26	1.13	2.20	9.64	0.12	0.50				
MSSFUGS*	MSSFUGS	Miscellaneous MSS Fugitives	228.04	16.58	262.28	28.95	1726.99	56.97	27.44	1.32	23.91	0.67
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives										
14-UDEX	F-14-UDEX	UDEX Fugitives										
37	F-37	DHT Fugitives										
39	F-39	NHT/CCR Fugitives										
40	F-40	West Crude Fugitives										
42	F-42	Mid Crude Fugitives										
P-GB	F-GB	Gasoline Blender Fugitives										
P-VOC	F-TK-VOC	VOC Tank/Loading Fugitives										
01	F-01	FCCU Fugitives										
26	F-26	Hydrocracker Fugitives										
SITENH3FUG	SITENH3FUG	Site-wide Ammonia Fugitive Emissions										
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2							0.15	0.66	0.12	0.53
IFRTK1	IFRTK1	100,000 bbl IFR Tank										
IFRTK2	IFRTK2	75,000 bbl IFR Tank										
08FB108R1	FB108R1	Tank 08FB108R1										
08FB109R	FB109R	Tank 08FB109R										
08FB142	FB142	Tank 08FB142										
08FB147	FB147	Tank 08FB147										
08FB137	FB137	Tank 08FB137										
11FB402	FB402	Tank 11FB402										
11FB403	FB403	Tank 11FB403										
11FB408	FB408	Tank 11FB408										
11FB409	FB409	Tank 11FB409										
11FB410	FB410	Tank 11FB410										
Combined Limit for 11FB408, 11FB409, 11FB410												
15FB507	FB507	Tank 15FB507										
15FB508	FB508	Tank 15FB508										
15FB510	FB510	Tank 15FB510										
Combined Limit for 15FB508, 15FB510												
40FB3041	FB3041	Tank 40FB3041										

*Allowable for all permitted MSS activities at the facility

Attachment A
West Domestic Crude Project
Proposed West Permit Allowables

FIN	EPN	Description	NO_x		CO		SO_2		PM		PM_{10}	
			Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project	
			lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
40FB3043	FB3043	Tank 40FB3043										
40FB3044	FB3044	Tank 40FB3044										
Combined Limit for 40FB3043 and 40FB3044												
40FB4010	FB4010	Tank 40FB4010										
40FB4011	FB4011	Tank 40FB4011										
Combined Limit for 40FB4010 and 40FB4011												
40FB4012	FB4012	Tank 40FB4012										
40FB4013	FB4013	Tank 40FB4013										
40FB4014	FB4014	Tank 40FB4014										
40FB4015	FB4015	Tank 40FB4015										
40FB4016	FB4016	Tank 40FB4016										
15FB509	FB509	Tank 15FB509										
Combined Limit for 40FB4016, 15FB509												

*Allowable for all permitted MSS activities at the facility

Attachment A
West Domestic Crude Project
Proposed West Permit Allowables

			$PM_{2.5}$		VOC		NH_3		H2S	
			Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project	
FIN	EPN	Description	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater	4.60	15.23	0.28	1.22	1.89	8.28		
39BA3900	JJ-4	NHT Charge Heater	0.43	1.12	0.20	0.90	0.16	0.70		
39BA3901	JJ-4	CCR Hot Oil Heater	1.40	3.66	0.67	2.92	0.52	2.27		
43BF1	R-201	43BF1 Boiler	1.00	4.38	1.20	5.24				
37BA1	KK-3	37BA1 DHT Charge Heater	0.64	2.80	0.38	1.67				
37BA2	KK-3	37BA2 DHT Stripper Reboiler	0.64	2.80	0.38	1.67				
56BA1	DDS-HTRSTK	DDS Charge Heater (combined stack)	0.30	1.31	0.22	0.95				
56BA2	DDS-HTRSTK	DDS Fractionator Reboiler (combined stack)	0.30	1.31	0.22	0.95				
42BA1	A-203	42BA1 Crude Heater	2.38	10.40	2.84	12.43				
42BA3	A-204	42BA3 Vacuum Heater	0.75	3.28	0.89	3.92				
47BA1	LSGHTR	LSG Hot Oil Heater	1.65	7.24	1.20	5.24				
54BA1	MX-1	54BA1 MX Unit Hot Oil Heater	0.66	2.89	0.48	2.09				
01BF102	AA-4	FCCU CO Boiler/Scrubber	58.30	235.70	1.68	7.35	10.90	28.63		
LW-8	VCS-1	Marine Vapor Combustor	0.60	0.51	16.05	17.06			0.03	0.02
SRU NO. 1	H-15A	SRU No. 1 Incinerator	0.00	0.00	0.00	0.00			0.00	0.00
45BD3	V-8	API Separator Flare			1.07	4.68			0.0012	0.0050
MSSFUGS*	MSSFUGS	Miscellaneous MSS Fugitives	23.91	0.67	1069.14	30.77			6.69	0.46
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives			2.66	11.66				
14-UDEX	F-14-UDEX	UDEX Fugitives			0.02	0.07				
37	F-37	DHT Fugitives			4.06	17.78				
39	F-39	NHT/CCR Fugitives			2.77	12.13				
40	F-40	West Crude Fugitives			5.07	22.23				
42	F-42	Mid Crude Fugitives			8.82	38.63				
P-GB	F-GB	Gasoline Blender Fugitives			1.16	5.08				
P-VOC	F-TK-VOC	VOC Tank/Loading Fugitives			0.67	2.93				
01	F-01	FCCU Fugitives			17.81	77.99				
26	F-26	Hydrocracker Fugitives			5.66	24.78				
SITENH3FUG	SITENH3FUG	Site-wide Ammonia Fugitive Emissions					0.07	0.29		
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2	0.02	0.01	1.26	5.52			0.0001	0.0003
IFRTK1	IFRTK1	100,000 bbl IFR Tank			0.54	1.99				
IFRTK2	IFRTK2	75,000 bbl IFR Tank			0.47	1.76				
08FB108R1	FB108R1	Tank 08FB108R1			5.09	19.01				
08FB109R	FB109R	Tank 08FB109R			4.16	15.30				
08FB142	FB142	Tank 08FB142			8.39	32.83			0.32	0.21
08FB147	FB147	Tank 08FB147			10.01	38.10			0.33	0.21
08FB137	FB137	Tank 08FB137			4.44	16.15			0.16	0.10
11FB402	FB402	Tank 11FB402			4.34	17.63				
11FB403	FB403	Tank 11FB403			3.95	15.91				
11FB408	FB408	Tank 11FB408			0.96	N/A				
11FB409	FB409	Tank 11FB409			0.89	N/A				
11FB410	FB410	Tank 11FB410			0.88	N/A				
Combined Limit for 11FB408, 11FB409, 11FB410					N/A	2.35				
15FB507	FB507	Tank 15FB507			4.21	18.66				
15FB508	FB508	Tank 15FB508			1.25	N/A				
15FB510	FB510	Tank 15FB510			1.14	N/A				
Combined Limit for 15FB508, 15FB510					N/A	2.67				
40FB3041	FB3041	Tank 40FB3041			54.60	2.81				

*Allowable for all permitted MSS activities at the facility

Attachment A
West Domestic Crude Project
Proposed West Permit Allowables

FIN	EPN	Description	$PM_{2.5}$		VOC		NH_3		H2S	
			Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project		Proposed Emission Rates for Domestic Crude Project	
			lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
40FB3043	FB3043	Tank 40FB3043			0.60	N/A				
40FB3044	FB3044	Tank 40FB3044			0.60	N/A				
Combined Limit for 40FB3043 and 40FB3044					N/A	1.03				
40FB4010	FB4010	Tank 40FB4010			3.69	N/A			0.14	N/A
40FB4011	FB4011	Tank 40FB4011			3.60	N/A			0.13	N/A
Combined Limit for 40FB4010 and 40FB4011					N/A	19.73			N/A	0.17
40FB4012	FB4012	Tank 40FB4012			3.09	12.08				
40FB4013	FB4013	Tank 40FB4013			3.04	11.85				
40FB4014	FB4014	Tank 40FB4014			0.66	0.88				
40FB4015	FB4015	Tank 40FB4015			0.66	0.63				
40FB4016	FB4016	Tank 40FB4016			0.58	N/A				
15FB509	FB509	Tank 15FB509			0.80	N/A				
Combined Limit for 40FB4016, 15FB509					N/A	1.67				

*Allowable for all permitted MSS activities at the facility

Attachment B

West Domestic Crude Project

Tank Emission Reduction Projects

FIN	EPN	Description	Current Controls	Proposed Controls
40FB3043	FB3043	Tank 40FB3043	Tank is currently a fixed-roof tank painted white.	Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal which reduces VOC emissions.
40FB3044	FB3044	Tank 40FB3044	Tank is currently a fixed-roof tank painted white.	Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal which reduces VOC emissions.
40FB4014	FB4014	Tank 40FB4014	Tank is currently a fixed-roof tank painted white.	Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal which reduces VOC emissions.
40FB4015	FB4015	Tank 40FB4015	Tank is currently a fixed-roof tank painted white.	Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal for VOC control.
40FB4016	FB4016	Tank 40FB4016	Tank is currently a fixed-roof tank painted white.	Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal for VOC control.
15FB509	FB509	Tank 15FB509	Tank is currently a fixed-roof tank painted white.	Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal for VOC control.
08FB160	FB160	Tank 08FB160	Tank currently painted white and has a internal floating roof with a mechanical shoe primary seal and a bolted deck with a welded deck.	Install suspended internal floating roof and replacement of bolted deck with a welded deck to reduce VOC emissions.
08FB161	FB161	Tank 08FB161	Tank currently painted white and has a internal floating roof with a mechanical shoe primary seal and a bolted deck with a welded deck.	Install suspended internal floating roof and replacement of bolted deck with a welded deck to reduce VOC emissions.

Attachment B

West Domestic Crude Project

Tank Emission Reduction Projects

15FB501[1]	FB501	Tank 15FB501	Tank currently painted white and has a internal floating roof with a mechanical shoe primary seal and a bolted deck with a welded deck.	Install suspended internal floating roof and replacement of bolted deck with a welded deck to reduce VOC emissions.
15FB510	FB510	Tank 15FB510	Tank currently painted white and has a internal floating roof with a mechanical shoe primary seal and a bolted deck with a welded deck.	Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal which reduces VOC emissions.

[1]Tank control options may change based on technical feasibility but the same emissions reduction will be achieved with any alternative technologies.

ATTACHMENT D

Copy of Minor NSR Permit Application Submitted to TCEQ

FLINT HILLS
resources®
Corpus Christi Refineries

P.O. Box 2608
Corpus Christi, Texas 78403-2608

HAND DELIVERED

December 12, 2012

Air Initial Review Team (APIRT), MC-161
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

RECEIVED
DEC 13 2012
AIR PERMITS DIVISION

Re: Flint Hills Resources Corpus Christi, LLC - West Refinery
Amendment Application – Permit No. 6819A
Domestic Crude Project
Corpus Christi, Nueces County
Customer Reference No. CN603741463
Regulated Entity No. RN100235266

Attn: APIRT:

On behalf of Flint Hills Resources Corpus Christi, LLC (FHR), I am submitting the enclosed non-confidential portion of a permit amendment application to authorize a project at FHR's West Refinery to allow the refinery to process a larger percentage of domestic crude oil. The project will also modestly increase the total crude processing capacity at the West Refinery. Most of the existing emission units affected by this project are currently authorized by NSR Permit No. 8803A. With this amendment application, FHR is requesting to transfer those units into Permit No. 6819A.

Enclosed is a form PI-1 and supporting documentation. A $75,000 permit fee is enclosed. The confidential portion of the permit amendment application is being submitted under a separate cover letter. Please call Daren Knowles at (361) 242-8301 if you have any questions or need additional information.

Sincerely,

Valerie Pompa
Vice President and Manufacturing Manager

VP/DK/syw
Air 12-351; W 3 N 10

Enclosures

cc: Air Section Manager, TCEQ, Region 14, Corpus Christi, w/enclosure
Mr. Kris L. Kirchner, P.E., Waid Environmental, Austin, w/enclosure

FLINT HILLS resources

FLINT HILLS RESOURCES CORPUS CHRISTI, LLC
PO Box 2917
Wichita, KS 67201
1-800-577-2703

No. 2426

DATE 27-NOV-12 CUST. ACCT. NO. VENDOR NAME STATE OF TEXAS VENDOR NO. 42599

INVOICE NO	INVOICE DATE	DESCRIPTION	DISCOUNT AMOUNT	NET AMOUNT
13NOV12	13-NOV-12	CV711762	0.00	75,000.00
			0.00	75,000.00

RECEIVED
DEC 13 2012
AIR PERMITS DIVISION

RECEIVED
DEC 13 2012
TCEQ Revenue Section

PLEASE DETACH AND RETAIN THIS STATEMENT AS YOUR RECORD OF PAYMENT. Thank You

THIS IS WATERMARKED PAPER - DO NOT ACCEPT WITHOUT NOTING WATERMARK - HOLD TO LIGHT TO VERIFY WATERMARK.

FLINT HILLS resources

FLINT HILLS RESOURCES CORPUS CHRISTI, LLC
PO Box 2917
Wichita, KS 67201
1-800-577-2703

JPMorgan Chase Bank, N.A.
SYRACUSE, NY

50-937
213

No. 2426

VOID 120 DAYS AFTER DATE OF CHECK

CHECK DATE	CHECK NUMBER	CHECK AMOUNT
27-NOV-12	2426	$ *****75,000.00

PAY Seventy-Five Thousand Dollars And 00 Cents*************************

PAY TO THE ORDER OF
STATE OF TEXAS
COMMISSION ON ENVIRONMENTAL QUALITY
PO BOX 13089
AUSTIN, TX 78711-3089

AUTHORIZED SIGNATURE

⑈000002426⑈ ⑆021309379⑆ 709374524⑈

Texas Commission on Environmental Quality
Permit No. 6819A Amendment Application
Domestic Crude Project

Flint Hills Resources Corpus Christi, LLC
West Refinery

Corpus Christi, Nueces County
Air Quality Account ID No. NE-0122-D
Regulated Entity No. RN100235266
Customer No. CN603741463

STATE OF TEXAS
KRIS L. KIRCHNER
89354
LICENSED
PROFESSIONAL ENGINEER

Approved by:

Kris L. Kirchner

12-12-2012

Kris L. Kirchner

Kris L. Kirchner, P.E.
Senior Consulting Engineer

Waid Corporation dba Waid Environmental
Certificate of Registration No. F-58

www.waid.com

Austin Office
10800 Pecan Park Blvd., Suite 300
Austin, Texas 78750
512.255.9999 • 512.255.8780 FAX

Houston Office
2600 South Shore Blvd., Suite 300
League City, Texas 77573
281.333.9990 • 512.255.8780 FAX

Midland Office
24 Smith Road, Suite 304
Midland, Texas 79705
432.682.9999 • 432.682.7774 FAX

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

Important Note: The agency requires that a Core Data Form be submitted on all incoming applications unless a Regulated Entity and Customer Reference Number have been issued and no core data information has changed. For more information regarding the Core Data Form, call (512) 239-5175 or go to www.tceq.texas.gov/permitting/central_registry/guidance.html.

I. Applicant Information		
A. Company or Other Legal Name: Flint Hills Resources Corpus Christi, LLC		
Texas Secretary of State Charter/Registration Number (if applicable):		
B. Company Official Contact Name: Valerie Pompa		
Title: Vice President and Manufacturing Manager		
Mailing Address: P.O. Box 2608		
City: Corpus Christi	State: TX	ZIP Code: 78403
Telephone No.: 361.242.8358	Fax No.: 361.242.4840	E-mail Address: valerie.pompa@fhr.com
C. Technical Contact Name: Daren Knowles		
Title: Strategic Permitting Projects Manager		
Company Name: Flint Hills Resources Corpus Christi, LLC		
Mailing Address: P.O. Box 2608		
City: Corpus Christi	State: TX	ZIP Code: 78403
Telephone No.: 361.242.8301	Fax No.: 361.242.8743	E-mail Address: daren.knowles@fhr.com
D. Site Name: Corpus Christi West Refinery		
E. Area Name/Type of Facility: West Refinery		☒ Permanent ☐ Portable
F. Principal Company Product or Business: Petroleum Refining		
Principal Standard Industrial Classification Code (SIC): 2911		
Principal North American Industry Classification System (NAICS): 324110		
G. Projected Start of Construction Date: 09/2015		
Projected Start of Operation Date: 09/2016		
H. Facility and Site Location Information (If no street address, provide clear driving directions to the site in writing.):		
Street Address: 2825 Suntide Road		
City/Town: Corpus Christi	County: Nueces	ZIP Code: 78409
Latitude (nearest second): 27° 49' 38"	Longitude (nearest second): - 97° 31' 32"	

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

TCEQ

I.	**Applicant Information (continued)**	
I.	Account Identification Number (leave blank if new site or facility): NE-0122-D	
J.	Core Data Form.	
Is the Core Data Form (Form 10400) attached? If No, provide customer reference number and regulated entity number (complete K and L).		☐ YES ☒ NO
K.	Customer Reference Number (CN): CN603741463	
L.	Regulated Entity Number (RN): RN100235266	
II.	**General Information**	
A.	Is confidential information submitted with this application? If Yes, mark each confidential page confidential in large red letters at the bottom of each page.	☒ YES ☐ NO
B.	Is this application in response to an investigation, notice of violation, or enforcement action? If Yes, attach a copy of any correspondence from the agency and provide the RN in section I.L. above.	☐ YES ☒ NO
C.	Number of New Jobs: ~ 1000 temporary jobs; < 50 permanent jobs	
D.	Provide the name of the State Senator and State Representative and district numbers for this facility site:	
State Senator: Juan "Chuy" Hinojosa		District No.: 20
State Representative: Connie Scott		District No.: 34
III.	**Type of Permit Action Requested**	
A.	Mark the appropriate box indicating what type of action is requested. ☐ Initial ☒ Amendment ☐ Revision (30 TAC 116.116(e) ☐ Change of Location ☐ Relocation	
B.	Permit Number (if existing):	
C.	Permit Type: Mark the appropriate box indicating what type of permit is requested. *(check all that apply, skip for change of location)* ☒ Construction ☐ Flexible ☐ Multiple Plant ☐ Nonattainment ☐ Plant-Wide Applicability Limit ☐ Prevention of Significant Deterioration ☐ Hazardous Air Pollutant Major Source ☐ Other:	
D.	Is a permit renewal application being submitted in conjunction with this amendment in accordance with 30 TAC 116.315(c).	☐ YES ☒ NO

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

III.	Type of Permit Action Requested *(continued)*	
E.	Is this application for a change of location of previously permitted facilities? If Yes, complete III.E.1 - III.E.4.0	☐ YES ☒ NO
1.	Current Location of Facility (If no street address, provide clear driving directions to the site in writing.):	
Street Address:		
City:	County:	ZIP Code:
2.	Proposed Location of Facility (If no street address, provide clear driving directions to the site in writing.):	
Street Address:		
City:	County:	ZIP Code:
3.	Will the proposed facility, site, and plot plan meet all current technical requirements of the permit special conditions? If "NO", attach detailed information.	☐ YES ☐ NO
4.	Is the site where the facility is moving considered a major source of criteria pollutants or HAPs?	☐ YES ☐ NO
F.	Consolidation into this Permit: List any standard permits, exemptions or permits by rule to be consolidated into this permit including those for planned maintenance, startup, and shutdown.	
List:		
G.	Are you permitting planned maintenance, startup, and shutdown emissions? If Yes, attach information on any changes to emissions under this application as specified in VII and VIII.	☒ YES ☐ NO
H.	Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability) Is this facility located at a site required to obtain a federal operating permit? If Yes, list all associated permit number(s), attach pages as needed).	☒ YES ☐ NO ☐ To be determined
Associated Permit No (s.): O1272		
1.	Identify the requirements of 30 TAC Chapter 122 that will be triggered if this 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

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

III. Type of Permit Action Requested *(continued)*	
H. Federal Operating Permit Requirements (30 TAC Chapter 122 Applicability) *(continued)*	
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

IV. Public Notice Applicability	
A. Is this a new permit application or a change of location application?	☐ YES ☒ NO
B. Is this application for a concrete batch plant? If Yes, complete V.C.1 – V.C.2.	☐ YES ☒ NO
C. Is this an application for a major modification of a PSD, nonattainment, FCAA 112(g) permit, or exceedance of a PAL permit?	☐ YES ☒ NO
D. Is this application for a PSD or major modification of a PSD located within 100 kilometers or less of an affected state or Class I Area?	☐ YES ☒ NO
If Yes, list the affected state(s) and/or Class I Area(s).	
List:	
E. Is this a state permit amendment application? If Yes, complete IV.E.1. – IV.E.3.	
1. Is there any change in character of emissions in this application?	☐ YES ☒ NO
2. Is there a new air contaminant in this application?	☒ YES ☐ NO
3. Do the facilities handle, load, unload, dry, manufacture, or process grain, seed, legumes, or vegetables fibers (agricultural facilities)?	☐ YES ☒ NO
F. List the total annual emission increases associated with the application ***(List all that apply and attach additional sheets as needed):*** (1)	
Volatile Organic Compounds (VOC): -158.69 tpy	
Sulfur Dioxide (SO2): -156.36 tpy	
Carbon Monoxide (CO): -801.45 tpy	
Nitrogen Oxides (NOx): -31.42 tpy	
Particulate Matter (PM): 18.59 tpy	
PM 10 microns or less (PM10): 17.82 tpy	
PM 2.5 microns or less (PM2.5): 17.21	
Lead (Pb): 0	
Hazardous Air Pollutants (HAPs): 0	
Other speciated air contaminants not listed above: 11.54 tpy (NH3); -1.44 tpy (H2S)	

(1) The total emissions increases and decreases listed here reflect the net changes in annual allowable emissions rates resulting from the proposed project changes addressed in this permit application. As described in the attachments to this form, the proposed project, along with proposed emission reduction projects that will be authorized through separate permitting actions, will result in an overall decrease in emissions of VOC, SO2, CO, NOx, PM, PM10, PM2.5, H2S, and Cl2.

V. Public Notice Information ***(complete if applicable)***		
A. Public Notice Contact Name: Darcy Jones		
Title: Regional Manager, Public Affairs		
Mailing Address: P.O. Box 2608		
City: Corpus Christi	State: Texas	ZIP Code: 78403
B. Name of the Public Place: Corpus Christi Public Library- Main Branch		
Physical Address *(No P.O. Boxes)*: 805 Comanche St		
City: Corpus Christi	County: Nueces	ZIP Code: 78401
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
C. Concrete Batch Plants, PSD, and Nonattainment Permits		
1. County Judge Information (For Concrete Batch Plants and PSD and/or Nonattainment Permits) for this facility site.		
The Honorable:		
Mailing Address:		
City:	State:	ZIP Code:
2. Is the facility located in a municipality or an extraterritorial jurisdiction of a municipality? ***(For Concrete Batch Plants)***		☐ YES ☐ NO
Presiding Officers Name(s):		
Title:		
Mailing Address:		
City:	State:	ZIP Code:
3. Provide the name, mailing address of the chief executive and Indian Governing Body; and identify the Federal Land Manager(s) for the location where the facility is or will be located.		
Chief Executive:		
Mailing Address:		
City:	State:	ZIP Code:
Name of the Indian Governing Body:		
Mailing Address:		
City:	State:	ZIP Code:

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

V. Public Notice Information *(complete if applicable) (continued)*		
C. Concrete Batch Plants, PSD, and Nonattainment Permits		
3. Provide the name, mailing address of the chief executive and Indian Governing Body; and identify the Federal Land Manager(s) for the location where the facility is or will be located. *(continued)*		
Name of the Federal Land Manager(s):		
D. Bilingual Notice		
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, list which languages are required by the bilingual program?	Spanish	
VI. Small Business Classification *(Required)*		
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 stationary source for federal air quality permitting?		☒ YES ☐ NO
C. Are the site emissions of any regulated air pollutant greater than or equal to 50 tpy?		☒ YES ☐ NO
D. Are the site emissions of all regulated air pollutants combined less than 75 tpy?		☐ YES ☒ NO
VII. Technical Information		
A. The following information must be submitted with your Form PI-1 ***(this is just a checklist to make sure you have included everything)***		
1. ☒ Current Area Map		
2. ☒ Plot Plan		
3. ☒ Existing Authorizations		
4. ☒ Process Flow Diagram		
5. ☒ Process Description		
6. ☒ Maximum Emissions Data and Calculations		
7. ☒ Air Permit Application Tables		
a. ☒ Table 1(a) (Form 10153) entitled, Emission Point Summary		
b. ☒ Table 2 (Form 10155) entitled, Material Balance		
c. ☒ Other equipment, process or control device tables		
B. Are any schools located within 3,000 feet of this facility?		☒ YES ☐ NO

VII.	**Technical Information**			
C.	Maximum Operating Schedule:			
Hour(s): 24	Day(s): 365	Week(s): 52	Year(s):	
Seasonal Operation? If Yes, please describe in the space provide below.				☐ YES ☒ NO
D.	Have the planned MSS emissions been previously submitted as part of an emissions inventory?			☐ YES ☒ NO
Provide a list of each planned MSS facility or related activity and indicate which years the MSS activities have been included in the emissions inventories. Attach pages as needed.				
Planned MSS emissions in this application are from new activities only and therefore have not been included in the past				
emissions inventories.				
E.	Does this application involve any air contaminants for which a disaster review is required?			☐ YES ☒ NO
F.	Does this application include a pollutant of concern on the Air Pollutant Watch List (APWL)?			☐ YES ☒ NO
VIII.	**State Regulatory Requirements** **Applicants must demonstrate compliance with all applicable state regulations to obtain a permit or amendment.** *The application must contain detailed attachments addressing applicability or non applicability; identify state regulations; show how requirements are met; and include compliance demonstrations.*			
A.	Will the emissions from the proposed facility protect public health and welfare, and comply with all rules and regulations of the TCEQ?			☒ YES ☐ NO
B.	Will emissions of significant air contaminants from the facility be measured?			☒ YES ☐ NO
C.	Is the Best Available Control Technology (BACT) demonstration attached?			☒ YES ☐ NO
D.	Will the proposed facilities achieve the performance represented in the permit application as demonstrated through recordkeeping, monitoring, stack testing, or other applicable methods?			☒ YES ☐ NO
IX.	**Federal Regulatory Requirements** **Applicants must demonstrate compliance with all applicable federal regulations to obtain a permit or amendment.** *The application must contain detailed attachments addressing applicability or non applicability; identify federal regulation subparts; show how requirements are met; and include compliance demonstrations.*			
A.	Does 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

IX.	**Federal Regulatory Requirements** **Applicants must demonstrate compliance with all applicable federal regulations to obtain a permit or amendment.** *The application must contain detailed attachments addressing applicability or non applicability; identify federal regulation subparts; show how requirements are met; and include compliance demonstrations.*	
C.	Does 40 CFR Part 63, Maximum Achievable Control Technology (MACT) standard apply to a facility in this application?	☒ YES ☐ NO
D.	Do nonattainment permitting requirements apply to this application?	☐ YES ☒ NO
E.	Do prevention of significant deterioration permitting requirements apply to this application?	☐ YES ☒ NO
F.	Do Hazardous Air Pollutant Major Source [FCAA 112(g)] requirements apply to this application?	☐ YES ☒ NO
G.	Is a Plant-wide Applicability Limit permit being requested?	☐ YES ☒ NO

X. Professional Engineer (P.E.) Seal	
Is the estimated capital cost of the project greater than $2 million dollars?	☒ YES ☐ NO
If Yes, submit the application under the seal of a Texas licensed P.E.	

XI. Permit Fee Information	
Check, Money Order, Transaction Number ,ePay Voucher Number:	Fee Amount: $ 75,000
Paid online?	☐ YES ☒ NO
Company name on check: Flint Hills Resources Corpus Christi, LLC	
Is a copy of the check or money order attached to the original submittal of this application?	☒ YES ☐ NO ☐ N/A
Is a Table 30 (Form 10196) entitled, 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 Amendment

XII. Delinquent Fees and Penalties
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.texas.gov/agency/delin/index.html.
XIII. 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. The signature further signifies awareness that intentionally or knowingly making or causing to be made false material statements or representations in the application is a criminal offense subject to criminal penalties.
Name: Valerie Pompa
Signature: *Original Signature Required*
Date: 12-12-12

PRINT FORM RESET FORM

TABLE OF CONTENTS

Executive Summary

Flint Hills Resources Corpus Christi, LLC (FHR) owns and operates a refinery in Corpus Christi called the West Refinery. FHR is proposing a project at the West Refinery to allow the refinery to process a larger percentage of domestic crude oil. The project would also modestly increase the total crude processing capacity at the West Refinery.

Overview of Project

There are three types of changes—described in more detail below—proposed as part of this project: (1) construction of new emission units to be authorized by this permitting action; (2) changes to existing emission units to be authorized by this permitting action; and (3) other changes to existing emission units that will be authorized under separate permitting actions to achieve emission reductions for purposes of netting.

1. Construction of New Emission Units

As part of the project, FHR is proposing to construct the following new emission units:

- A new process unit called the Saturates Gas (Sat Gas) Plant No. 3 that will include a new hot oil heater and equipment piping fugitive components. The new hot oil heater will be equipped with selective catalytic reduction (SCR) to reduce NO_X emissions and a catalyst bed to reduce CO and VOC emissions.
- A new cooling tower in the Mid-Plant area.
- New equipment piping fugitive components in several existing process units.
- Two new internal floating roof tanks.

2. Changes to Existing Emission Units

As part of the project, FHR is proposing the following changes to existing emission units:

<u>Changes To CCR Hot Oil Heater and NHT Charge Heater</u>
- An increase in permitted firing duty of the CCR Hot Oil Heater.
- Installation of SCR on the CCR Hot Oil Heater and NHT Charge Heater to reduce NO_X emissions from the heaters.
- A decrease in the maximum hourly SO_2 allowable emission rate for the CCR Hot Oil Heater and the NHT Charge Heater as a result of decreasing the maximum sulfur content in the fuel gas from 10 gr/100 dscf to 7.2 gr/100 scf based on fuel gas sampling.

<u>Changes to Marine Terminal/Marine Vapor Combustor</u>
- An increase in permitted annual loading rate of naphtha and gasoline into ships and barges at the marine terminal.
- Incorporation of PBR Registration Nos. 103051 and 103706, which were associated with the Marine Vapor Combustor (EPN VCS-1).
- Decrease in the annual benzene loading rate from 18,250,000 bbl/yr to 4,000,000 bbl/yr.
- A decrease in the permitted hourly loading rate of several of the materials loaded at the marine terminal where emissions are controlled by the Marine Vapor Combustor.
- Removal of "Penexate" as an authorized material loaded at the marine terminal since this material is no longer produced at the refinery.

- Revising the method for calculating the NO_x and CO allowable emission limits for the Marine Vapor Combustor to be based on the firing capacity of the Marine Vapor Combustor rather than the heat content of the vapors routed to the combustor
- Revising the method for calculating the hourly VOC emission rate from the Marine Vapor Combustor based on the maximum emission rate from any one material rather than the summation of multiple materials.
- A decrease in the fuel sulfur content of the natural gas combusted in the Marine Vapor Combustor to more accurately reflect supplier specifications and sampling. The hourly sulfur content is being decreased from 6 gr/100 scf to 5 gr/100 dscf based on supplier specifications, and the annual sulfur content is being decreased from 10 gr/100 dscf to 0.5 gr/100 dscf based on sampling.
- Revising the method for calculating crude oil emissions from the marine vapor combustor to be based on AP-42, Equation 5.2-1 rather than AP-42, Equations 5.2-2 and 5.2-3.
- An increase in the control efficiency and a decrease in the NO_X and CO emission factors at the Marine Vapor Combustor based on recent stack test data.
- Inclusion for the first time PM, PM_{10}, $PM_{2.5}$, and H_2S emission rate limits applicable to the Marine Vapor Combustor.

<u>Changes to Other Existing Emission Units</u>

- Implementation of annual flange/connector monitoring in some of the process units to reduce VOC emissions.
- An increase in permitted throughputs for some storage tanks and increase in true vapor pressures of materials stored in some tanks.
- Inclusion for the first time H_2S emission rates limits applicable to crude oil storage tanks.
- Revising the calculation method for all pollutants for the API Separator Flare (EPN V-8) based on the measured flow rate and composition of the vent gas stream routed to the flare rather than the calculated (using AP-42 emission factors) stream flow rate and composition.
- Conversion of the current Gas Oil Hydrotreating Unit (GOHT) to a Distillate Hydrotreating Unit (DHT).
- An increase in annual MSS emissions as a result of new equipment being installed.
- Physical changes to the Sulfur Recovery Complex to reduce its processing rate. As part of this, FHR is proposing to shut down Sulfur Recovery Unit (SRU) No. 1.
- Operation of the FCCU Catalyst Regenerator in full burn to reduce CO emissions.
- Treatment of the Mid-Plant fuel gas system to reduce the amount of sulfur in the fuel gas prior to the combustion in the heaters utilizing this fuel gas system. This change will reduce SO_2 emissions from the heaters.

In addition to these changes, there will be increases in emissions at some existing upstream and downstream units as a result of increased utilization or debottlenecking of these units. These emission units will not be modified and the increased emissions will be below the currently authorized allowable emission rates for each emission unit.

3. Other Changes under Separate Authorizations

FHR is proposing additional changes to existing emission units that will decrease emissions and hence “net” against the significant project emission increases in NO_X, PM, and VOCs resulting from construction of new emission units and changes to existing emission units. The emission reductions achieved by these additional emission reduction changes are accounted for in the PSD netting analysis provided in Attachment IX.E because they will occur during the contemporaneous period.

These additional emission reduction changes will be permitted under TCEQ authorizations separate from this permit application to allow enough time to construct and implement the changes prior to operating the newly constructed and changed existing emission units addressed in this application. The emission reduction changes that will be authorized separately are:

- Replacement of burners in the cogeneration turbine to reduce $NO_{X,}$ PM, PM_{10}, and $PM_{2.5}$ emissions.
- Installation of a drift eliminator on the Mid Plant Cooling Tower to reduce particulate matter emissions.
- Conversion of fixed-roof tanks 15FB509, 15FB510, 40FB3043, 40FB3044, 40FB4014, 40FB4015, and 40FB4016 to internal floating roof tanks to reduce VOC emissions.
- Replacement of current internal floating roofs in Tanks 08FB160, 08FB161, and 15FB501 with suspended internal floating roofs to reduce VOC emissions.

Overview of Requested Permitting Action

FHR is requesting to amend Permit No. 6819A to authorize the construction of new emission units and changes to existing emission units. With the exception of the Marine Vapor Combustor (EPN VCS-1) which is currently authorized by Permit No. 6819A, all of the existing emission units affected by this project are currently authorized under NSR Permit No. 8803A. An amendment application for Permit No. 8803A was submitted to the TCEQ on February 17, 2012, to convert the permit from a flexible permit to a subchapter B permit (deflex). As part of this application, FHR requests to transfer those existing emission units that are currently authorized by Permit No. 8803A and that will be affected by this project from Permit No. 8803A into Permit No. 6819A. FHR is also requesting that the maintenance, start-up, and shutdown (MSS) activities currently authorized by Permit No. 8803A be transferred to Permit No. 6819A. Sources at the West Refinery not affected by this project will continue to be authorized under Permit No. 8803A. The emission limits proposed in the pending deflex application for each existing emission unit authorized by Permit No. 8803A are used as the allowable emissions prior to this project.

This project, including construction of the new emission units and changes to existing emission units, will not trigger federal prevention of significant deterioration (PSD) for any non-greenhouse gas (GHG) new source review (NSR)-regulated pollutants. Construction of the new emission units and changes to existing emission units will not result in a significant project emissions increase for carbon monoxide (CO), particulate matter (PM), sulfur dioxide (SO_2), or hydrogen sulfide (H_2S). Construction of the new emission units and changes to existing emission units will, however, result in a significant project emissions increase for nitrogen oxide (NO_X), certain species of particulate matter (PM_{10} and $PM_{2.5}$), and volatile organic compounds (VOC). However, considering contemporaneous increases and decreases under the second step of the PSD applicability analysis—particularly as a result of the emission reduction changes under separate authorizations—the project will not cause a significant *net* emissions increase for NO_X, PM_{10}, $PM_{2.5}$, or VOC. In fact, the overall project, including the emission reduction changes under separate authorizations, will result in decreased emissions of non-GHG pollutants, with the exception of non-federal PSD pollutant ammonia. Therefore, the construction of new emission units and changes to existing emission units as part of this project are subject to Texas minor NSR requirements. Through this application, FHR demonstrates that emissions associated with the proposed project will comply with all applicable TCEQ minor NSR rules and regulations and will be protective of public health and welfare.

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to Texas State BACT Review?	Proposed Controls for Primary Pollutants
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater	New	New source as part of building new Saturates Gas Plant No. 3 Unit.	Yes	Yes	Installation of Selective Catalytic Reduction (SCR) with ammonia injection for NOx control. Installation of catalyst bed for CO and VOC control.
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives	New	New fugitive piping components (i.e. valves, flanges, etc.) as part of building new Saturates Gas Plant #3.	Yes	Yes	28VHP Leak Detection and Repair (LDAR) monitoring program; annual flange/connector monitoring; sealless pumps where service allows for VOC control.
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2	New	New cooling tower	Yes	Yes	Installation of drift eliminator achieving a drift loss of no more than 0.0005% for PM control.
IFRTK1	IFRTK1	100,000 bbl IFR Tank	New	New storage tank	Yes	Yes	Storage tank with suspended internal floating roof; mechanical-shoe primary seal, rim-mounted secondary seal; painted white for VOC control.
IFRTK2	IFRTK2	75,000 bbl IFR Tank	New	New storage tank	Yes	Yes	Storage tank with suspended internal floating roof; mechanical-shoe primary seal, rim-mounted secondary seal; painted white for VOC control.
MSS	MSS	New Maintenance, Start Up, and Shutdown (MSS) Emissions	New	New MSS emissions as a result of constructing new Sat Gas 3 Unit and new storage tanks.	Yes	Yes	Purged/degassed maintenance, startup and shutdown emissions from the new Sat Gas 3 Unit will be controlled by the existing Flare Gas Recovery Unit and/or will comply with the existing MSS permit requirements to minimize VOC emissions. Controlling vacuum truck loading, frac tank, tank degassing, and tank refilling emissions after degassing and product changes using a thermal oxidizer, carbon adsorption system, or engine.
39BA3900	JJ-4	NHT Charge Heater	Contemporaneous Emissions Reduction	Installation of Selective Catalytic Reduction (SCR) with ammonia injection for NOx control. Although not a contemporaneous reduction, decrease in hourly SO2 allowable emission rate limit as a result of decreasing maximum hourly sulfur content based on fuel sampling. Decrease in CO allowable emission rate limit by reflecting a concentration limit of 50 ppmv in the exhaust consistent with the CCR Hot Oil Heater.	No	No	Installation of Selective Catalytic Reduction (SCR) with ammonia injection for NOx control.

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to Texas State BACT Review?	Proposed Controls for Primary Pollutants
39BA3901	JJ-4	CCR Hot Oil Heater	Modified	Increase in fired duty from 90 MMBtu/hr to 123.6 MMBtu/hr (HHV). Installation of Selective Catalytic Reduction (SCR) with ammonia injection for NOx control. Decrease in hourly SO2 allowable emission rate limit as a result of decreasing maximum hourly sulfur content based on fuel sampling. Decrease in CO allowable emission rate limit by reflecting a concentration limit of 50 ppmv in the exhaust	Yes	Yes	Installation of Selective Catalytic Reduction (SCR) with ammonia injection for NOx control.
Various Boilers	Various Boilers	Boilers with Potential Increased Utilization	Affected Upstream - increased utilization	Increase in actual emissions above past actual emissions as a result of increased steam demand. No change to permitted duty.	No	No	N/A
37BA1	KK-3	37BA1 DHT Charge Heater	Contemporaneous Emissions Reduction	Decrease in hourly and annual SO2 allowable emission rate limit as a result of treating sulfur in the fuel gas. No change to permitted duty.	No	No	Treat fuel gas to reduce sulfur concentration in the fuel gas which reduces SO_2 emissions.
37BA2	KK-3	37BA2 DHT Stripper Reboiler	Affected Downstream - debottlenecking	Increase in actual emissions above past actual emissions. It is not clear whether such increases should be characterized as resulting from debottlenecking or increased utilization. We assume, conservatively, that the increases are the result of debottlenecking. Decrease in hourly and annual SO2 allowable emission rate limit as a result of treating sulfur in the fuel gas. No change to permitted duty.	No	No	Treat fuel gas to reduce sulfur concentration in the fuel gas which reduces SO_2 emissions.
42BA1	A-203	42BA1 Crude Heater	Contemporaneous Emissions Reduction	Decrease in hourly and annual SO2 allowable emission rate limit as a result of treating sulfur in the fuel gas. No change to permitted duty.	No	No	Treat fuel gas to reduce sulfur concentration in the fuel gas which reduces SO_2 emissions.
42BA3	A-204	42BA3 Vacuum Heater	Contemporaneous Emissions Reduction	Decrease in hourly and annual SO2 allowable emission rate limit as a result of treating sulfur in the fuel gas. No change to permitted duty.	No	No	Treat fuel gas to reduce sulfur concentration in the fuel gas which reduces SO_2 emissions.
43BF1	R-201	43BF1 Boiler	Contemporaneous Emissions Reduction	Decrease in hourly and annual SO2 allowable emission rate limit as a result of treating sulfur in the fuel gas. Decrease in CO allowable emission rate limit for the boiler by updating the emission factor to more accurately reflect emissions measured by the continuous emissions monitor.	No	No	Treat fuel gas to reduce sulfur concentration in the fuel gas which reduces SO_2 emissions.
47BA1	LSGHTR	LSG Hot Oil Heater	Contemporaneous Emissions Reduction	Decrease in hourly and annual SO2 allowable emission rate limit as a result of treating sulfur in the fuel gas. No change to permitted duty.	No	No	Treat fuel gas to reduce sulfur concentration in the fuel gas which reduces SO_2 emissions.
54BA1	MX-1	54BA1 MX Unit Hot Oil Heater	Contemporaneous Emissions Reduction	Decrease in hourly and annual SO2 allowable emission rate limit as a result of treating sulfur in the fuel gas. No change to permitted duty.	No	No	Treat fuel gas to reduce sulfur concentration in the fuel gas which reduces SO_2 emissions.

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to Texas State BACT Review?	Proposed Controls for Primary Pollutants
56BA1	DDS-HTRSTK	DDS Charge Heater (combined stack)	Contemporaneous Emissions Reduction	Decrease in hourly and annual SO2 allowable emission rate limit as a result of treating sulfur in the fuel gas. No change to permitted duty.	No	No	Treat fuel gas to reduce sulfur concentration in the fuel gas which reduces SO_2 emissions.
56BA2	DDS-HTRSTK	DDS Fractionator Reboiler (combined stack)	Contemporaneous Emissions Reduction	Decrease in hourly and annual SO2 allowable emission rate limit as a result of treating sulfur in the fuel gas. No change to permitted duty.	No	No	Treat fuel gas to reduce sulfur concentration in the fuel gas which reduces SO_2 emissions.
01BF102	AA-4	FCCU CO Boiler/Scrubber	Contemporaneous Emissions Reduction	Decrease in annual CO allowable emission rate limit as a result of FCCU catalyst regenerator operating at full burn.	No	No	Operating the FCCU catalyst regenerator in full burn which reduced CO emissions.
LW-8	VCS-1	Marine Vapor Combustor	Modified	Increase in currently permitted naphtha and gasoline throughput. Therefore, considered modified for minor NSR purposes. Decrease in hourly loading rates of most materials. Decrease in NO_x and CO allowable emission rate limits as a result of updating the NOx and CO emission factors based on recent stack testing. Decrease in the VOC allowable emission rate limit as a result of updating the control device efficiency based on recent stack testing. Add particulate and H_2S emission rate allowables. Incorporate PBR Registration Nos. 103051 and 103706. Change in calculation method for NOx and CO based on firing capacity. Change in calculation method for hourly VOC based on highest emission rate of any one material. Change in calculation method for crude oil emissions. Decrease in fuel sulfur content. Removal of penexate as an authorized material.	Yes	Yes	Route emissions from the loading of materials with a true vapor pressure greater than 0.5 psia and cumeme/pseudocumene to a vapor combustor with a collection efficiency of 100% and control these emissions with a vapor combustor achieving a control efficiency of 99.5%. Convert H2S emissions to SO2 at a minimum efficiency of 98%.
SRU NO. 1	H-15A	SRU No. 1 Incinerator	Contemporaneous Emissions Reduction	Shut down the emission unit.	No	No	N/A
45BD3	V-8	API Separator Flare	Affected downstream - increased utilization	Increase in actual emissions above past actual emissions at Monroe API Separator controlled by the API Separator Flare as a result of increasing the amount of wastewater going to the separator. The increased amount of wastewater will not exceed the permitted amount. Revising the calculation method for permit allowables of all pollutants based on flow rate and composition of the vent gas.	No	No	N/A
14-UDEX	F-14-UDEX	UDEX Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	28VHP Leak Detection and Repair (LDAR) monitoring program; annual flange/connector monitoring for new and existing components as required by 40 CFR 63, Subpart H; any new pumps will be sealless where service allows for VOC control.

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to Texas State BACT Review?	Proposed Controls for Primary Pollutants
37	F-37	DHT Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	28VHP Leak Detection and Repair (LDAR) monitoring program; annual flange/connector monitoring for new components; any new pumps will be sealless where service allows for VOC control.
37	F-37	DHT Fugitives	Contemporaneous Emissions Reduction	Increase in monitoring frequency for existing connectors to reduce VOC emissions.	No	No	Annual flange/connector monitoring for existing components.
39	F-39	NHT/CCR Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	28VHP Leak Detection and Repair (LDAR) monitoring program; annual flange/connector monitoring for new components; any new pumps will be sealless where service allows for VOC control.
39	F-39	NHT/CCR Fugitives	Contemporaneous Emissions Reduction	Increase in monitoring frequency for existing connectors to reduce emissions.	No	No	Annual flange/connector monitoring for existing components.
40	F-40	West Crude Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	28VHP Leak Detection and Repair (LDAR) monitoring program; annual flange/connector monitoring for new components; any new pumps will be sealless where service allows for VOC control.
40	F-40	West Crude Fugitives	Contemporaneous Emissions Reduction	Increase in monitoring frequency for existing connectors to reduce emissions.	No	No	Annual flange/connector monitoring for existing components.
42	F-42	Mid Crude Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of process changes.	Yes	Yes	28VHP Leak Detection and Repair (LDAR) monitoring program; annual flange/connector monitoring for new components; any new pumps will be sealless where service allows for VOC control.
42	F-42	Mid Crude Fugitives	Contemporaneous Emissions Reduction	Increase in monitoring frequency for existing connectors to reduce emissions.	No	No	Annual flange/connector monitoring for existing components.
P-GB	F-GB	Gasoline Blender Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) to upgrade the gasoline blending system.	Yes	Yes	28VHP Leak Detection and Repair (LDAR) monitoring program; annual flange/connector monitoring for new components; any new pumps will be sealless where service allows for VOC control.
P-GB	F-GB	Gasoline Blender Fugitives	Contemporaneous Emissions Reduction	Increase in monitoring frequency for existing connectors to reduce emissions.	No	No	Annual flange/connector monitoring for existing components.
P-VOC	F-TK-VOC	VOC Tank/Loading Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of constructing two new storage tanks.	Yes	Yes	28VHP Leak Detection and Repair (LDAR) monitoring program.

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to Texas State BACT Review?	Proposed Controls for Primary Pollutants
01	F-01	FCCU Fugitives	Contemporaneous Emissions Reduction	Decrease in VOC allowable emission rate limits as a result of increasing the monitoring frequency for existing connectors to reduce VOC emissions.	No	No	Annual flange/connector monitoring for existing components for VOC control.
26	F-26	Hydrocracker Fugitives	Contemporaneous Emissions Reduction	Decrease in VOC allowable emission rate limits as a result of increasing the monitoring frequency for existing connectors to reduce VOC emissions.	No	No	Annual flange/connector monitoring for existing components for VOC control.
SCRNH3FUG	SCRNH3FUG	SCR Ammonia Fugitives	New	Addition of new fugitive piping components (i.e. valves, flanges, etc.) in ammonia service as part of process changes necessary to install SCR systems.	Yes	Yes	Audio, Visual, and Olfactory (AVO) LDAR monitoring program for ammonia control.
44EF1	F-S-201	Mid-Plant Cooling Tower	Contemporaneous Emissions Reduction	Installation of drift eliminator achieving a drift loss of no more than 0.0005% for PM control.	No	No	Installation of drift eliminator achieving a drift loss of no more than 0.0005% for PM control.
08FB108R1	FB108R1	Tank 08FB108R1	Affected downstream - increased utilization	Increase in actual emissions above past actual emissions as a result of increase in actual throughput. No change in permitted throughput. No increase in permit allowable emission rates.	No	No	N/A - no additional control required. Tank is an internal floating roof tank with a mechanical-shoe primary seal. Painted white for VOC control.
08FB109R	FB109R	Tank 08FB109R	Affected downstream - increased utilization	Increase in actual emissions above past actual emissions as a result of increase in actual throughput. No change in permitted throughput. No increase in permit allowable emission rates.	No	No	N/A - no additional control required. Tank is an internal floating roof tank with a mechanical-shoe primary seal. Painted white for VOC control.
08FB142	FB142	Tank 08FB142	Affected downstream - increased utilization	Increase in VOC actual emissions above past actual emissions as a result of increase in actual throughput. No increase in VOC permitted allowable emission rates. Inclusion of H_2S emissions for the first time from crude oil storage.	No	Yes (H_2S)	N/A - no additional control required. Tank is an external floating roof tank with a mechanical-shoe primary seal and rim-mounted secondary seal. Painted white.
08FB147	FB147	Tank 08FB147	Affected downstream - increased utilization	Increase in VOC actual emissions above past actual emissions as a result of increase in actual throughput. No increase in VOC permitted allowable emission rates. Inclusion of H_2S emissions for the first time from crude oil storage.	No	Yes (H_2S)	N/A - no additional control required. Tank is an internal floating roof tank with a mechanical-shoe primary seal. Painted white for VOC control.
08FB137	FB137	Tank 08FB137	Affected downstream - increased utilization	Increase in VOC actual emissions above past actual emissions as a result of increase in actual throughput. Increase in VOC permitted allowable emission rates due to revising the primary and secondary seal representations (no actual change in seal type). Inclusion of H_2S emission for the first time from crude oil storage.	No	Yes (H_2S)	N/A - no additional control required. Tank is an internal floating roof tank with a mechanical-shoe primary seal. Painted white for VOC control.
11FB402	FB402	Tank 11FB402	Affected downstream - increased utilization	Increase in actual emissions above past actual emissions as a result of increase in actual throughput. Decrease in VOC permitted allowable emission rates due to revising the primary and secondary seal representations (no actual change in seal type).	No	No	N/A - no additional control required. Tank is an internal floating roof tank with a mechanical-shoe primary seal and rim-mounted secondary seal. Painted white for VOC control.

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to Texas State BACT Review?	Proposed Controls for Primary Pollutants
11FB403	FB403	Tank 11FB403	Affected downstream - increased utilization	Increase in actual emissions above past actual emissions as a result of increase in actual throughput. Decrease in VOC permitted allowable emission rates due to revising the primary and secondary seal representations (no actual change in seal type).	No	No	N/A - no additional control required. Tank is an internal floating roof tank with a mechanical-shoe primary seal and rim-mounted secondary seal. Painted white for VOC control.
11FB408	FB408	Tank 11FB408	Modified	Increase in annual throughput and decrease in true vapor pressure of material stored. A grouped ton/yr emission limit is being formed from 11FB408, 11FB409, and 11FB410 based on a total throughput going through any of these tanks. This results in an overall decrease in permit allowable emissions. All tanks within the group have throughput increase above permitted throughput levels, so tank is considered modified for minor NSR purposes.	Yes	Yes	N/A - no additional control required. Tank is an external floating roof tank with a mechanical-shoe primary seal and rim-mounted secondary seal. Painted white for VOC control.
11FB409	FB409	Tank 11FB409	Modified	Increase in annual throughput and decrease in true vapor pressure of material stored. A grouped ton/yr emission limit is being formed from 11FB408, 11FB409, and 11FB410 based on a total throughput going through any of these tanks. This results in an overall decrease in permit allowable emissions. All tanks within the group have throughput increase above permitted throughput levels, so tank is considered modified for minor NSR purposes.	Yes	Yes	N/A - no additional control required. Tank is an external floating roof tank with a mechanical-shoe primary seal and rim-mounted secondary seal. Painted white for VOC control.
11FB410	FB410	Tank 11FB410	Modified	Increase in annual throughput and decrease in true vapor pressure of material stored. A grouped ton/yr emission limit is being formed from 11FB408, 11FB409, and 11FB410 based on a total throughput going through any of these tanks. This results in an overall decrease in permit allowable emissions. All tanks within the group have throughput increase above permitted throughput levels, so tank is considered modified for minor NSR purposes.	Yes	Yes	N/A - no additional control required. Tank is an external floating roof tank with a mechanical-shoe primary seal and rim-mounted secondary seal. Painted white for VOC control.
15FB507	FB507	Tank 15FB507	Affected downstream - increased utilization	Increase in actual emissions above past actual emissions as a result of increase in actual throughput. No change to permitted throughput. No increase in permit allowable emission rates.	No	No	N/A - no additional control required. Tank is an external floating roof tank with a mechanical-shoe primary seal and rim-mounted secondary seal. Painted white for VOC control.

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to Texas State BACT Review?	Proposed Controls for Primary Pollutants
15FB508	FB508	Tank 15FB508	Modified	Decrease in true vapor pressure of the material stored in the tank. A grouped ton/yr emission limit is being formed from 15FB508 and 15FB510 based on a total throughput going through any of these tanks. This results in a decrease in permit allowable emissions. Although there are no physical changes or changes in the method of operation proposed for Tank 15FB508, the tank is considered modified for minor NSR purposes because it is being included in a group with Tank 15FB510, which is considered modified because of the increase in permitted throughput and vapor pressure.	No	Yes	N/A - no additional control required. Tank is an external floating roof tank with a mechanical-shoe primary seal and rim-mounted secondary seal. Painted white for VOC control.
15FB510	FB510	Tank 15FB510	Contemporaneous Emissions Reduction	Tank is currently a fixed-roof tank painted white. A suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal are being installed. This emission reduction project will be authorized outside of this application in order to ensure adequate time to install the control prior to operating the changes proposed in this application.	No	No	Tank is currently a fixed-roof tank painted white. Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal which reduces VOC emissions.
15FB510	FB510	Tank 15FB510	Modified	Increase in annual throughput and true vapor pressure of the material stored in the tank after improving controls. Tank has throughput increase above permitted throughput levels, so considered modified. A grouped ton/yr emission limit is being formed from 15FB508 and 15FB510 based on a total throughput going through any of these tanks. This results in an overall decrease in permitted emissions.	Yes	Yes	At time of increase in annual throughput and true vapor pressure, Tank 15FB510 will already have additional VOC controls installed.
40FB3041	FB3041	Tank 40FB3041	Affected downstream - increased utilization	Increase in actual emissions above past actual emissions as a result of increase in actual throughput. No change to permitted throughput. Decrease in annual permit allowable emission rate due to change in annual temperature.	No	No	N/A - no additional control required. Tank is a fixed-roof tank with a submerged-fill pipe and is painted white.
40FB3043	FB3043	Tank 40FB3043	Contemporaneous Emissions Reduction	Tank is currently a fixed-roof tank painted white. A suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal are being installed. This emission reduction project will be authorized outside of this application in order to ensure adequate time to install the control prior to operating the changes proposed in this application.	No	No	Tank is currently a fixed-roof tank painted white. Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal which reduces VOC emissions.

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to Texas State BACT Review?	Proposed Controls for Primary Pollutants
40FB3043	FB3043	Tank 40FB3043	Modified	Increase in annual throughput and true vapor pressure of material stored in the tank above permitted levels. A grouped ton/yr emission limit is being formed from 40FB3043 and 40FB3044 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	Yes	Yes	At time of increase in annual throughput and true vapor pressure, Tanks 40FB3043 and 40FB3044 will already have additional VOC controls installed.
40FB3044	FB3044	Tank 40FB3044	Contemporaneous Emissions Reduction	Tank is currently a fixed-roof tank painted white. A suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal are being installed. This emission reduction project will be authorized outside of this application in order to ensure adequate time to install the control prior to operating the changes proposed in this application.	No	No	Tank is currently a fixed-roof tank painted white. Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal which reduces VOC emissions.
40FB3044	FB3044	Tank 40FB3044	Modified	Increase in annual throughput and true vapor pressure of material stored in the tank above permitted levels. A grouped ton/yr emission limit is being formed from 40FB3043 and 40FB3044 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	Yes	Yes	At time of increase in annual throughput and true vapor pressure, Tanks 40FB3043 and 40FB3044 will already have additional VOC controls installed.
40FB4010	FB4010	Tank 40FB4010	Modified	Increase in annual throughput and decrease in annual true vapor pressure of the material stored in the tank. One or both tanks within the group has throughput increase above permitted throughput levels, so considered modified for minor NSR purposes. Inclusion of H2S emissions for the first time from crude oil storage. Grouped ton/yr VOC and H_2S emission limits are being formed for 40FB4010 and 40FB4011 based on a total throughput going through any of these tanks. This results in a decrease in VOC permitted emissions.	Yes	Yes	N/A - no additional control required. Tank is an external floating roof tank with a mechanical-shoe primary seal and rim-mounted secondary seal. Painted white for VOC control.
40FB4011	FB4011	Tank 40FB4011	Modified	Increase in annual throughput and decrease in annual true vapor pressure of the material stored in the tank. One or both tanks within the group has throughput increase above permitted throughput levels, so considered modified for minor NSR purposes. Inclusion of H2S emissions for the first time from crude oil storage. Grouped ton/yr VOC and H_2S emission limits are being formed for 40FB4010 and 40FB4011 based on a total throughput going through any of these tanks. This results in a decrease in VOC permitted emissions.	Yes	Yes	N/A - no additional control required. Tank is an external floating roof tank with a mechanical-shoe primary seal and rim-mounted secondary seal. Painted white for VOC control.

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to Texas State BACT Review?	Proposed Controls for Primary Pollutants
40FB4012	FB4012	Tank 40FB4012	Affected downstream - increased utilization	Increase in actual emissions above past actual emissions due to increase in throughput. No change to permitted throughput. Decrease in VOC permitted allowable emission rates due to revising the primary and secondary seal representations (no actual change in seal type).	No	No	N/A - no additional control required. Tank is an internal floating roof tank with a mechanical-shoe primary seal and rim-mounted secondary seal. Painted white for VOC control.
40FB4013	FB4013	Tank 40FB4013	Affected downstream - increased utilization	Increase in actual emissions above past actual emissions due to increase in throughput. No change to permitted throughput. No increase in permit allowable emission rates.	No	No	N/A - no additional control required. Tank is an internal floating roof tank with a mechanical-shoe primary seal. Painted white for VOC control.
40FB4014	FB4014	Tank 40FB4014	Contemporaneous Emissions Reduction	Tank is currently a fixed-roof tank painted white. A suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal are being installed. This emission reduction project will be authorized outside of this application in order to ensure adequate time to install the control prior to operating the changes proposed in this application.	No	No	Tank is currently a fixed-roof tank painted white. Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal which reduces VOC emissions.
40FB4014	FB4014	Tank 40FB4014	Modified	Increase in the true vapor pressure of the material stored in the tank above permitted levels, so considered modified for minor NSR purposes. This results in an increase in permit allowable emissions.	Yes	Yes	At time of increase in true vapor pressure, Tanks 40FB4014 will already have additional VOC controls installed.
40FB4015	FB4015	Tank 40FB4015	Contemporaneous Emissions Reduction	Tank is currently a fixed-roof tank painted white. A suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal are being installed. This emission reduction project will be authorized outside of this application in order to ensure adequate time to install the control prior to operating the changes proposed in this application.	No	No	Tank is currently a fixed-roof tank painted white. Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal for VOC control.
40FB4015	FB4015	Tank 40FB4015	Modified	Increase in the true vapor pressure of the material stored in the tank above permitted levels, so considered modified for minor NSR purposes. This results in an increase in permit allowable emissions.	Yes	Yes	At time of increase in true vapor pressure, Tank 40FB4015 will already have additional VOC controls installed.
40FB4016	FB4016	Tank 40FB4016	Contemporaneous Emissions Reduction	Tank is currently a fixed-roof tank painted white. A suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal are being installed. This emission reduction project will be authorized outside of this application in order to ensure adequate time to install the control prior to operating the changes proposed in this application.	No	No	Tank is currently a fixed-roof tank painted white. Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal for VOC control.

FIN	EPN	Description	PSD Source Type	Proposal	Is there a Physical Change or Change in Method of Operation Causing an Emission Increase?	Is the Source Subject to Texas State BACT Review?	Proposed Controls for Primary Pollutants
40FB4016	FB4016	Tank 40FB4016	Modified	Increase in the true vapor pressure of the material stored in the tank above permitted levels, so considered modified for minor NSR purposes. A grouped ton/yr emission limit is being formed from 40FB4016 and 15FB509 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	Yes	Yes	At time of increase in true vapor pressure, Tanks 40FB4016 and 15FB509 will already have additional VOC controls installed.
15FB509	FB509	Tank 15FB509	Contemporaneous Emissions Reduction	Tank is currently a fixed-roof tank painted white. A suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal are being installed. This emission reduction project will be authorized outside of this application in order to ensure adequate time to install the control prior to operating the changes proposed in this application.	No	No	Tank is currently a fixed-roof tank painted white. Installing a suspended internal floating roof, mechanical-shoe primary seal, and rim-mounted secondary seal for VOC control.
15FB509	FB509	Tank 15FB509	Modified	Increase in the true vapor pressure of the material stored in the tank above permitted levels, so considered modified for minor NSR purposes. A grouped ton/yr emission limit is being formed from 40FB4016 and 15FB509 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	Yes	Yes	At time of increase in true vapor pressure, Tanks 40FB4016 and 15FB509 will already have additional VOC controls installed.
08FB160	FB160	Tank 08FB160	Contemporaneous Emissions Reduction	Replacement of current internal floating roof with a suspended internal floating roof and replacement of bolted deck with a welded deck to reduce VOC emissions.	No	No	N/A - no additional control required. Tank is an internal floating roof tank with a mechanical-shoe primary seal. Painted white. FHR will be upgrading the floating roof to further reduce VOC emissions.
08FB161	FB161	Tank 08FB161	Contemporaneous Emissions Reduction	Replacement of current internal floating roof with a suspended internal floating roof and replacement of bolted deck with a welded deck to reduce VOC emissions.	No	No	N/A - no additional control required. Tank is an internal floating roof tank with a mechanical-shoe primary seal. Painted white. FHR will be upgrading the floating roof to further reduce VOC emissions.
15FB501	FB501	Tank 15FB501	Contemporaneous Emissions Reduction	Replacement of current internal floating roof with a suspended internal floating roof to reduce VOC emissions.	No	No	N/A - no additional control required. Tank is an internal floating roof tank with a mechanical-shoe primary seal. Painted white. FHR will be upgrading the floating roof to further reduce VOC emissions.
29TA2903	Z-4	Cogeneration Turbine	Contemporaneous Emissions Reduction	Reworking the combustion section of the cogeneration turbine to reduce NOX, PM, PM10, and PM2.5 emissions.	No	No	Reworking the combustion section of the cogeneration turbine including installing low NO_X burners.

ATTACHMENT III.F

EXEMPTIONS OR PERMITS BY RULE

FHR requests incorporation of PBR Registration Nos. 103051 and 103706, which are associated with the Marine Vapor Combustor (EPN VCS-1), into Permit No. 6819A. PBR Registration No. 103051 authorized the loading of Light Straight Run or Mixed Pentanes (referred to as natural gasoline in the PBR). PBR Registration No. 103706 authorized an increase in the annual gasoline loading rate from 1,900,000 bbl/yr to 4,000,000 bbl/yr (Note: this amendment proposes to increase the gasoline loading rate to 6,935,000 bbl/yr). FHR is also requesting to transfer those existing emission units that are currently authorized by Permit No. 8803A and that will be affected by this project from Permit No. 8803A into Permit No. 6819A.

ATTACHMENT III.G

PLANNED MAINTENANCE, STARTUP, AND SHUTDOWN EMISSIONS

Planned maintenance, startup, and shutdown (MSS) activities are currently authorized in Permit No. 8803A and are subject to a grouped emission limit. FHR is proposing to transfer those planned MSS activities and their grouped emission limit over to Permit No. 6819A and to include additional MSS emissions resulting from this project in the annual grouped emission limit. FHR is not proposing any changes to the hourly grouped emission limit. The increase in annual MSS emissions is included in the PSD applicability assessment. Descriptions of the additional MSS activities resulting from this project and the emission rate calculations for those activities are provided in Attachments VII.A.5 and VII.A.6.

ATTACHMENT VII.A.1

AREA MAP

ATTACHMENT VII.A.2

PLOT PLAN

ATTACHMENT VII.A.3

EXISTING AUTHORIZATIONS

With the exception of the Marine Vapor Combustor (EPN VCS-1), the emission points identified on the Table 1(a) in Attachment VII.A.7 are currently authorized by Permit No. 8803A/PSD-TX-413M9. The Marine Vapor Combustor is currently authorized under Permit No. 6819A and PBR Registration Nos. 103051 and 103706. FHR requests to incorporate PBR Registration Nos. 103051 and 103706 into Permit No. 6819A and to transfer those existing emission units that are currently authorized by Permit No. 8803A and that will be affected by this project from Permit No. 8803A into Permit No. 6819A.

ATTACHMENT VII.A.4

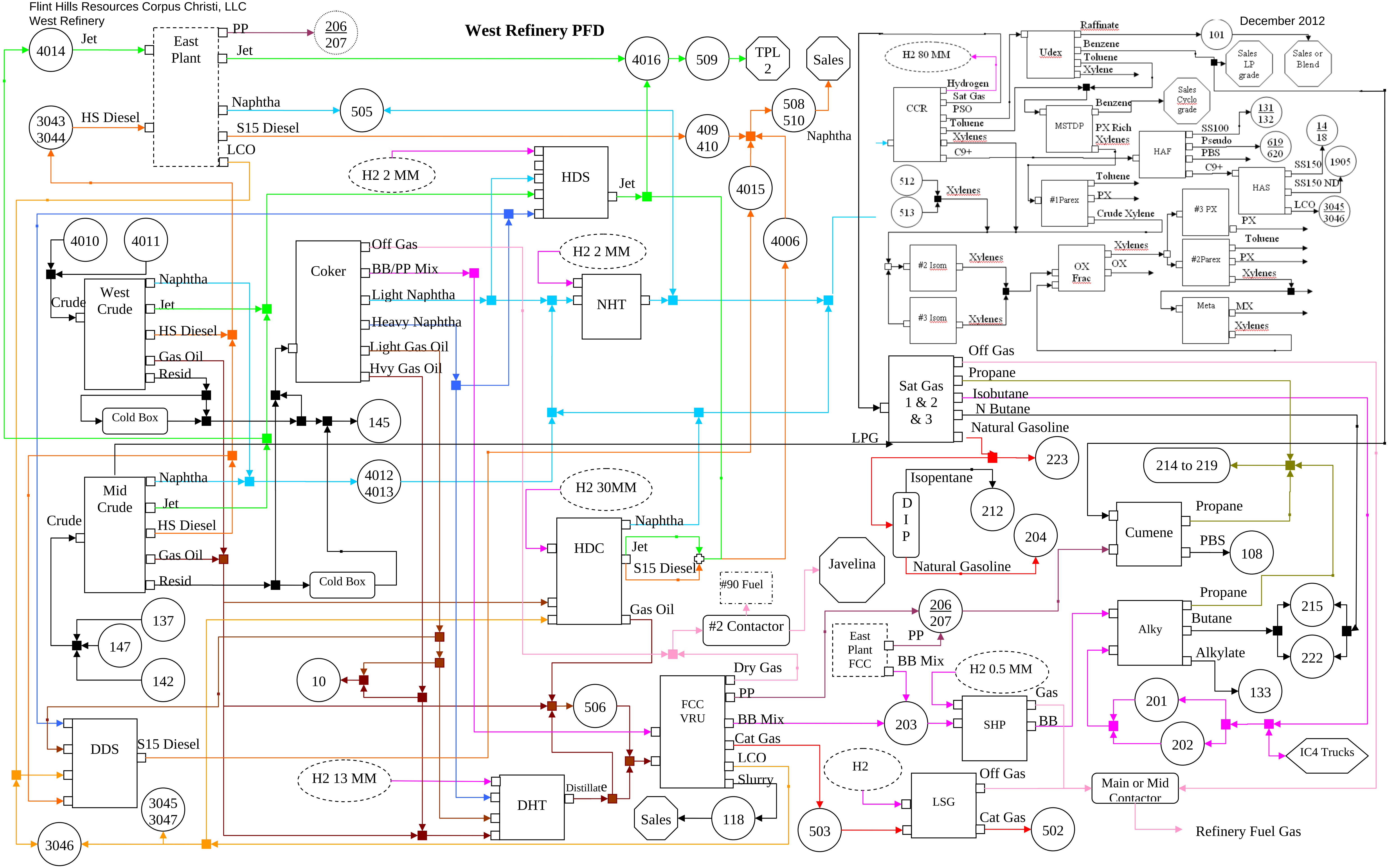
PROCESS FLOW DIAGRAM

In addition to the attached non-confidential process flow diagram, confidential process flow diagrams are provided in the confidential portion of this permit application.

Flint Hills Resources Corpus Christi, LLC
West Refinery

West Refinery PFD

December 2012



ATTACHMENTS VII.A.5 and VII.A.6

PROCESS DESCRIPTION AND EMISSIONS DATA

A general process description for each of the process units affected by this project is provided in this section. Detailed and confidential unit process descriptions and process flow diagrams for these process units are provided in the separate confidential portion of this application. A table summarizing the changes in permit allowables resulting from this project is provided in this section along with the emission rate calculations for the emission units affected by this project.

			NO_X						CO					
			Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates		Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates	
FIN	EPN	Description	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater	0.00	0.00	4.50	14.78	4.50	14.78	0.00	0.00	3.29	14.43	3.29	14.43
39BA3900	JJ-4	NHT Charge Heater	3.84	16.80	0.38	1.25	-3.46	-15.55	3.12	13.67	1.25	5.48	-1.87	-8.19
39BA3901	JJ-4	CCR Hot Oil Heater	4.05	17.74	1.24	4.06	-2.81	-13.68	4.50	19.71	4.07	17.81	-0.43	-1.90
43BF1	R-201	43BF1 Boiler	16.00	70.00	15.99	70.05	-0.01	0.05	39.90	175.00	22.15	24.25	-17.75	-150.75
37BA1	KK-3	37BA1 DHT Charge Heater	3.84	16.80	3.84	16.80	0.00	0.00	3.20	14.00	3.20	14.01	0.00	0.01
37BA2	KK-3	37BA2 DHT Stripper Reboiler	3.84	16.80	3.84	16.80	0.00	0.00	3.20	14.00	3.20	14.01	0.00	0.01
56BA1	DDS-HTRSTK	DDS Charge Heater (combined stack)	1.80	7.88	1.80	7.88	0.00	0.00	2.00	8.76	2.00	8.76	0.00	0.00
56BA2	DDS-HTRSTK	DDS Fractionator Reboiler (combined stack)	1.80	7.88	1.80	7.88	0.00	0.00	2.00	8.76	2.00	8.76	0.00	0.00
42BA1 *	A-203 *	42BA1 Crude Heater *	33.20	146.00	33.23	145.57	0.03	-0.43	23.80	104.00	23.75	104.04	-0.05	0.04
42BA3 *	A-204 *	42BA3 Vacuum Heater *	12.00	52.50	11.99	52.53	-0.01	0.03	7.49	32.80	7.49	32.81	0.00	0.01
47BA1 *	LSGHTR *	LSG Hot Oil Heater *	10.00	43.80	10.01	43.84	0.01	0.04	11.10	48.70	11.12	48.71	0.02	0.01
54BA1 *	MX-1 *	54BA1 MX Unit Hot Oil Heater *	5.59	24.50	5.59	24.49	0.00	-0.01	4.00	17.50	4.00	17.50	0.00	0.00
01BF102	AA-4	FCCU CO Boiler/Scrubber	586.55	467.11	586.55	467.11	0.00	0.00	358.92	786.04	358.92	157.21	0.00	-628.83
LW-8 **	VCS-1**	Marine Vapor Combustor **	19.19	5.68	2.65	2.25	-16.54	-3.43	76.41	22.64	6.44	5.47	-69.97	-17.17
SRU NO. 1	H-15A	SRU No. 1 Incinerator	3.45	15.10	0.00	0.00	-3.45	-15.10	4.20	18.40	0.00	0.00	-4.20	-18.40
45BD3	V-8	API Separator Flare	0.02	0.11	0.26	1.13	0.24	1.02	0.21	0.92	2.20	9.64	1.99	8.72
MSSFUGS	MSSFUGS	Miscellaneous MSS Fugitives	0.00	0.00	0.00	0.87	0.00	0.87	0.00	0.00	0.00	0.57	0.00	0.57
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives												
14-UDEX	F-14-UDEX	UDEX Fugitives												
37	F-37	DHT Fugitives												
39	F-39	NHT/CCR Fugitives												
40	F-40	West Crude Fugitives												
42	F-42	Mid Crude Fugitives												
P-GB	F-GB	Gasoline Blender Fugitives												
P-VOC	F-TK-VOC	VOC Tank/Loading Fugitives												
01	F-01	FCCU Fugitives												
26	F-26	Hydrocracker Fugitives												
SCRNH3FUG	SCRNH3FUG	SCR Ammonia Fugitives												
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2												
IFRTK1	IFRTK1	100,000 bbl IFR Tank												
IFRTK2	IFRTK2	75,000 bbl IFR Tank												
08FB108R1	FB108R1	Tank 08FB108R1												
08FB109R	FB109R	Tank 08FB109R												
08FB142	FB142	Tank 08FB142												
08FB147	FB147	Tank 08FB147												
08FB137	FB137	Tank 08FB137												
11FB402	FB402	Tank 11FB402												
11FB403	FB403	Tank 11FB403												
11FB408	FB408	Tank 11FB408												
11FB409	FB409	Tank 11FB409												
11FB410	FB410	Tank 11FB410												
Combined Limit for 11FB408, 11FB409, 11FB410														
15FB507	FB507	Tank 15FB507												
15FB508	FB508	Tank 15FB508												
15FB510	FB510	Tank 15FB510												
Combined Limit for 15FB508, 15FB510														

			NO_X						CO					
			Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates		Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates	
FIN	EPN	Description	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
40FB3041	FB3041	Tank 40FB3041												
40FB3043	FB3043	Tank 40FB3043												
40FB3044	FB3044	Tank 40FB3044												
Combined Limit for 40FB3043 and 40FB3044														
40FB4010	FB4010	Tank 40FB4010												
40FB4011	FB4011	Tank 40FB4011												
Combined Limit for 40FB4010 and 40FB4011														
40FB4012	FB4012	Tank 40FB4012												
40FB4013	FB4013	Tank 40FB4013												
40FB4014	FB4014	Tank 40FB4014												
40FB4015	FB4015	Tank 40FB4015												
40FB4016	FB4016	Tank 40FB4016												
15FB509	FB509	Tank 15FB509												
Combined Limit for 40FB4016, 15FB509														
Total							**-21.51**	**-31.42**					**-88.97**	**-801.45**

* Permit allowables for some pollutants are slightly changing due to rounding in the calculations.

			SO_2						PM					
			Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates		Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates	
FIN	EPN	Description	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater	0.00	0.00	6.06	2.65	6.06	2.65	0.00	0.00	4.60	15.23	4.60	15.23
39BA3900	JJ-4	NHT Charge Heater	1.62	1.42	1.16	1.42	-0.46	0.00	0.19	0.83	0.43	1.12	0.24	0.29
39BA3901	JJ-4	CCR Hot Oil Heater	3.83	3.36	3.79	4.61	-0.04	1.25	0.45	1.97	1.40	3.66	0.95	1.69
43BF1	R-201	43BF1 Boiler	6.33	16.60	0.63	1.66	-5.70	-14.94	1.00	4.37	1.00	4.38	0.00	0.01
37BA1	KK-3	37BA1 DHT Charge Heater	2.03	5.33	0.20	0.53	-1.83	-4.80	0.64	2.79	0.64	2.80	0.00	0.01
37BA2	KK-3	37BA2 DHT Stripper Reboiler	2.03	5.33	0.20	0.53	-1.83	-4.80	0.64	2.79	0.64	2.80	0.00	0.01
56BA1	DDS-HTRSTK	DDS Charge Heater (combined stack)	1.14	1.85	0.11	0.30	-1.03	-1.55	0.30	1.31	0.30	1.31	0.00	0.00
56BA2	DDS-HTRSTK	DDS Fractionator Reboiler (combined stack)	1.14	1.85	0.11	0.30	-1.03	-1.55	0.30	1.31	0.30	1.31	0.00	0.00
42BA1 *	A-203 *	42BA1 Crude Heater *	9.04	39.60	1.51	3.96	-7.53	-35.64	2.37	10.40	2.38	10.40	0.01	0.00
42BA3 *	A-204 *	42BA3 Vacuum Heater *	4.75	12.50	0.48	1.25	-4.27	-11.25	0.75	3.27	0.75	3.28	0.00	0.01
47BA1 *	LSGHTR *	LSG Hot Oil Heater *	6.36	16.70	0.64	1.67	-5.72	-15.03	1.65	7.24	1.65	7.24	0.00	0.00
54BA1 *	MX-1 *	54BA1 MX Unit Hot Oil Heater *	2.53	6.66	0.25	0.67	-2.28	-5.99	0.66	2.89	0.66	2.89	0.00	0.00
01BF102	AA-4	FCCU CO Boiler/Scrubber	370.94	162.47	370.94	162.47	0.00	0.00	58.30	235.70	58.30	235.70	0.00	0.00
LW-8 **	VCS-1**	Marine Vapor Combustor **	3.20	1.58	2.80	2.03	-0.40	0.45	0.00	0.00	0.60	0.51	0.60	0.51
SRU NO. 1	H-15A	SRU No. 1 Incinerator	15.00	65.70	0.00	0.00	-15.00	-65.70	0.15	0.70	0.00	0.00	-0.15	-0.70
45BD3	V-8	API Separator Flare	0.01	0.04	0.12	0.50	0.11	0.46						
MSSFUGS	MSSFUGS	Miscellaneous MSS Fugitives	0.00	0.00	0.00	0.07	0.00	0.07	0.00	0.00	0.00	0.02	0.00	0.02
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives												
14-UDEX	F-14-UDEX	UDEX Fugitives												
37	F-37	DHT Fugitives												
39	F-39	NHT/CCR Fugitives												
40	F-40	West Crude Fugitives												
42	F-42	Mid Crude Fugitives												
P-GB	F-GB	Gasoline Blender Fugitives												
P-VOC	F-TK-VOC	VOC Tank/Loading Fugitives												
01	F-01	FCCU Fugitives												
26	F-26	Hydrocracker Fugitives												
SCRNH3FUG	SCRNH3FUG	SCR Ammonia Fugitives												
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2							0.00	0.00	0.39	1.51	0.39	1.51
IFRTK1	IFRTK1	100,000 bbl IFR Tank												
IFRTK2	IFRTK2	75,000 bbl IFR Tank												
08FB108R1	FB108R1	Tank 08FB108R1												
08FB109R	FB109R	Tank 08FB109R												
08FB142	FB142	Tank 08FB142												
08FB147	FB147	Tank 08FB147												
08FB137	FB137	Tank 08FB137												
11FB402	FB402	Tank 11FB402												
11FB403	FB403	Tank 11FB403												
11FB408	FB408	Tank 11FB408												
11FB409	FB409	Tank 11FB409												
11FB410	FB410	Tank 11FB410												
Combined Limit for 11FB408, 11FB409, 11FB410														
15FB507	FB507	Tank 15FB507												
15FB508	FB508	Tank 15FB508												
15FB510	FB510	Tank 15FB510												
Combined Limit for 15FB508, 15FB510														

			SO_2						PM					
			Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates		Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates	
FIN	EPN	Description	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
40FB3041	FB3041	Tank 40FB3041												
40FB3043	FB3043	Tank 40FB3043												
40FB3044	FB3044	Tank 40FB3044												
Combined Limit for 40FB3043 and 40FB3044														
40FB4010	FB4010	Tank 40FB4010												
40FB4011	FB4011	Tank 40FB4011												
Combined Limit for 40FB4010 and 40FB4011														
40FB4012	FB4012	Tank 40FB4012												
40FB4013	FB4013	Tank 40FB4013												
40FB4014	FB4014	Tank 40FB4014												
40FB4015	FB4015	Tank 40FB4015												
40FB4016	FB4016	Tank 40FB4016												
15FB509	FB509	Tank 15FB509												
Combined Limit for 40FB4016, 15FB509														
Total							**-40.94**	**-156.36**					**6.63**	**18.59**

* Permit allowables for some pollutants are slightly changing due to rounding in the calculations.

			PM_{10}						$PM_{2.5}$					
			Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates		Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates	
FIN	EPN	Description	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater	0.00	0.00	4.60	15.23	4.60	15.23	0.00	0.00	4.60	15.23	4.60	15.23
39BA3900	JJ-4	NHT Charge Heater	0.19	0.83	0.43	1.12	0.24	0.29	0.19	0.83	0.43	1.12	0.24	0.29
39BA3901	JJ-4	CCR Hot Oil Heater	0.45	1.97	1.40	3.66	0.95	1.69	0.45	1.97	1.40	3.66	0.95	1.69
43BF1	R-201	43BF1 Boiler	1.00	4.37	1.00	4.38	-0.001	0.01	1.00	4.37	1.00	4.38	-0.001	0.01
37BA1	KK-3	37BA1 DHT Charge Heater	0.64	2.79	0.64	2.80	0.000	0.01	0.64	2.79	0.64	2.80	0.00	0.01
37BA2	KK-3	37BA2 DHT Stripper Reboiler	0.64	2.79	0.64	2.80	0.000	0.01	0.64	2.79	0.64	2.80	0.00	0.01
56BA1	DDS-HTRSTK	DDS Charge Heater (combined stack)	0.30	1.31	0.30	1.31	-0.001	0.00	0.30	1.31	0.30	1.31	0.00	0.00
56BA2	DDS-HTRSTK	DDS Fractionator Reboiler (combined stack)	0.30	1.31	0.30	1.31	-0.001	0.00	0.30	1.31	0.30	1.31	0.00	0.00
42BA1 *	A-203 *	42BA1 Crude Heater *	2.37	10.40	2.38	10.40	0.005	0.00	2.37	10.40	2.38	10.40	0.01	0.00
42BA3 *	A-204 *	42BA3 Vacuum Heater *	0.75	3.27	0.75	3.28	-0.001	0.01	0.75	3.27	0.75	3.28	0.00	0.01
47BA1 *	LSGHTR *	LSG Hot Oil Heater *	1.65	7.24	1.65	7.24	0.002	0.00	1.65	7.24	1.65	7.24	0.00	0.00
54BA1 *	MX-1 *	54BA1 MX Unit Hot Oil Heater *	0.66	2.89	0.66	2.89	0.000	0.00	0.66	2.89	0.66	2.89	0.00	0.00
01BF102	AA-4	FCCU CO Boiler/Scrubber	58.30	235.70	58.30	235.70	0.000	0.00	58.30	235.70	58.30	235.70	0.00	0.00
LW-8 **	VCS-1**	Marine Vapor Combustor **	0.00	0.00	0.60	0.51	0.60	0.51	0.00	0.00	0.60	0.51	0.60	0.51
SRU NO. 1	H-15A	SRU No. 1 Incinerator	0.15	0.70	0.00	0.00	-0.15	-0.70	0.15	0.70	0.00	0.00	-0.15	-0.70
45BD3	V-8	API Separator Flare												
MSSFUGS	MSSFUGS	Miscellaneous MSS Fugitives	0.00	0.00	0.00	0.0001	0.000	0.0001	0.00	0.00	0.00	0.0001	0.00	0.0001
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives												
14-UDEX	F-14-UDEX	UDEX Fugitives												
37	F-37	DHT Fugitives												
39	F-39	NHT/CCR Fugitives												
40	F-40	West Crude Fugitives												
42	F-42	Mid Crude Fugitives												
P-GB	F-GB	Gasoline Blender Fugitives												
P-VOC	F-TK-VOC	VOC Tank/Loading Fugitives												
01	F-01	FCCU Fugitives												
26	F-26	Hydrocracker Fugitives												
SCRNH3FUG	SCRNH3FUG	SCR Ammonia Fugitives												
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2	0.00	0.00	0.20	0.76	0.20	0.76	0.00	0.00	0.04	0.15	0.04	0.15
IFRTK1	IFRTK1	100,000 bbl IFR Tank												
IFRTK2	IFRTK2	75,000 bbl IFR Tank												
08FB108R1	FB108R1	Tank 08FB108R1												
08FB109R	FB109R	Tank 08FB109R												
08FB142	FB142	Tank 08FB142												
08FB147	FB147	Tank 08FB147												
08FB137	FB137	Tank 08FB137												
11FB402	FB402	Tank 11FB402												
11FB403	FB403	Tank 11FB403												
11FB408	FB408	Tank 11FB408												
11FB409	FB409	Tank 11FB409												
11FB410	FB410	Tank 11FB410												
Combined Limit for 11FB408, 11FB409, 11FB410														
15FB507	FB507	Tank 15FB507												
15FB508	FB508	Tank 15FB508												
15FB510	FB510	Tank 15FB510												
Combined Limit for 15FB508, 15FB510														

			PM_{10}						$PM_{2.5}$					
			Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates		Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates	
FIN	EPN	Description	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
40FB3041	FB3041	Tank 40FB3041												
40FB3043	FB3043	Tank 40FB3043												
40FB3044	FB3044	Tank 40FB3044												
Combined Limit for 40FB3043 and 40FB3044														
40FB4010	FB4010	Tank 40FB4010												
40FB4011	FB4011	Tank 40FB4011												
Combined Limit for 40FB4010 and 40FB4011														
40FB4012	FB4012	Tank 40FB4012												
40FB4013	FB4013	Tank 40FB4013												
40FB4014	FB4014	Tank 40FB4014												
40FB4015	FB4015	Tank 40FB4015												
40FB4016	FB4016	Tank 40FB4016												
15FB509	FB509	Tank 15FB509												
Combined Limit for 40FB4016, 15FB509														
Total							**6.44**	**17.82**					**6.28**	**17.21**

* Permit allowables for some pollutants are slightly changing due to rounding in the calculations.

			VOC						NH_3					
			Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates		Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates	
FIN	EPN	Description	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater	0.00	0.00	0.28	1.22	0.28	1.22	0.00	0.00	1.89	8.28	1.89	8.28
39BA3900	JJ-4	NHT Charge Heater	0.20	0.90	0.20	0.90	0.00	0.00	0.00	0.00	0.16	0.70	0.16	0.70
39BA3901	JJ-4	CCR Hot Oil Heater	0.48	2.12	0.67	2.92	0.19	0.80	0.00	0.00	0.52	2.27	0.52	2.27
43BF1	R-201	43BF1 Boiler	1.20	5.24	1.20	5.24	0.00	0.00						
37BA1	KK-3	37BA1 DHT Charge Heater	0.38	1.67	0.38	1.67	0.00	0.00						
37BA2	KK-3	37BA2 DHT Stripper Reboiler	0.38	1.67	0.38	1.67	0.00	0.00						
56BA1	DDS-HTRSTK	DDS Charge Heater (combined stack)	0.22	0.95	0.22	0.95	0.00	0.00						
56BA2	DDS-HTRSTK	DDS Fractionator Reboiler (combined stack)	0.22	0.95	0.22	0.95	0.00	0.00						
42BA1 *	A-203 *	42BA1 Crude Heater *	2.84	12.40	2.84	12.43	0.00	0.03						
42BA3 *	A-204 *	42BA3 Vacuum Heater *	0.89	3.92	0.89	3.92	0.00	0.00						
47BA1 *	LSGHTR *	LSG Hot Oil Heater *	1.20	5.24	1.20	5.24	0.00	0.00						
54BA1 *	MX-1 *	54BA1 MX Unit Hot Oil Heater *	0.48	2.09	0.48	2.09	0.00	0.00						
01BF102	AA-4	FCCU CO Boiler/Scrubber	1.68	7.35	1.68	7.35	0.00	0.00	10.90	28.63	10.90	28.63	0.00	0.00
LW-8 **	VCS-1**	Marine Vapor Combustor **	62.55	20.28	16.05	17.06	-46.50	-3.22						
SRU NO. 1	H-15A	SRU No. 1 Incinerator	0.03	0.14	0.00	0.00	-0.03	-0.14						
45BD3	V-8	API Separator Flare	0.31	1.37	1.07	4.68	0.76	3.31						
MSSFUGS	MSSFUGS	Miscellaneous MSS Fugitives	0.00	0.00	0.00	3.64	0.00	3.64						
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives	0.00	0.00	2.66	11.66	2.66	11.66						
14-UDEX	F-14-UDEX	UDEX Fugitives	0.00	0.00	0.02	0.07	0.02	0.07						
37	F-37	DHT Fugitives	4.86	21.29	4.06	17.78	-0.80	-3.51						
39	F-39	NHT/CCR Fugitives	4.06	17.78	2.77	12.13	-1.29	-5.65						
40	F-40	West Crude Fugitives	5.71	25.01	5.07	22.23	-0.64	-2.78						
42	F-42	Mid Crude Fugitives	9.13	39.98	8.82	38.63	-0.31	-1.35						
P-GB	F-GB	Gasoline Blender Fugitives	1.56	6.83	1.16	5.08	-0.40	-1.75						
P-VOC	F-TK-VOC	VOC Tank/Loading Fugitives	0.00	0.00	0.67	2.93	0.67	2.93						
01	F-01	FCCU Fugitives	19.90	87.16	17.81	77.99	-2.09	-9.17						
26	F-26	Hydrocracker Fugitives	7.22	31.62	5.66	24.78	-1.56	-6.84						
SCRNH3FUG	SCRNH3FUG	SCR Ammonia Fugitives							0.00	0.00	0.07	0.29	0.07	0.29
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2	0.00	0.00	1.26	5.52	1.26	5.52						
IFRTK1	IFRTK1	100,000 bbl IFR Tank	0.00	0.00	0.54	1.99	0.54	1.99						
IFRTK2	IFRTK2	75,000 bbl IFR Tank	0.00	0.00	0.47	1.76	0.47	1.76						
08FB108R1	FB108R1	Tank 08FB108R1	5.09	19.01	5.09	19.01	0.00	0.00						
08FB109R	FB109R	Tank 08FB109R	4.16	15.30	4.16	15.30	0.00	0.00						
08FB142	FB142	Tank 08FB142	8.39	32.83	8.39	32.83	0.00	0.00						
08FB147	FB147	Tank 08FB147	10.01	38.10	10.01	38.10	0.00	0.00						
08FB137	FB137	Tank 08FB137	4.44	16.15	5.53	20.93	1.09	4.78						
11FB402	FB402	Tank 11FB402	4.34	17.63	3.03	11.88	-1.31	-5.75						
11FB403	FB403	Tank 11FB403	3.95	15.91	3.55	14.14	-0.40	-1.77						
11FB408	FB408	Tank 11FB408	3.02	10.58	0.96	N/A	-2.06	N/A						
11FB409	FB409	Tank 11FB409	3.44	12.68	0.89	N/A	-2.55	N/A						
11FB410	FB410	Tank 11FB410	3.14	11.40	0.88	N/A	-2.26	N/A						
Combined Limit for 11FB408, 11FB409, 11FB410			N/A	34.66	N/A	2.35	N/A	-32.31						
15FB507	FB507	Tank 15FB507	4.21	18.66	4.21	18.66	0.00	0.00						
15FB508	FB508	Tank 15FB508	4.60	17.66	1.25	N/A	-3.35	N/A						
15FB510	FB510	Tank 15FB510	182.00	20.00	1.14	N/A	-180.86	N/A						
Combined Limit for 15FB508, 15FB510			N/A	37.66	N/A	2.67	N/A	-34.99						

			VOC						NH_3					
			Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates		Individual Emission Rates Proposed in Deflex Application		Proposed Emission Rates for Domestic Crude Project		Change in Permitted Emission Rates	
FIN	EPN	Description	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr
40FB3041	FB3041	Tank 40FB3041	54.60	2.81	54.60	2.76	0.00	-0.05						
40FB3043	FB3043	Tank 40FB3043	54.60	8.52	0.60	N/A	-54.00	N/A						
40FB3044	FB3044	Tank 40FB3044	54.60	4.48	0.60	N/A	-54.00	N/A						
Combined Limit for 40FB3043 and 40FB3044			N/A	13.00	N/A	1.03	N/A	-11.97						
40FB4010	FB4010	Tank 40FB4010	3.69	13.89	3.69	N/A	0.00	N/A						
40FB4011	FB4011	Tank 40FB4011	3.60	13.32	3.60	N/A	0.00	N/A						
Combined Limit for 40FB4010 and 40FB4011			N/A	27.21	N/A	19.73	N/A	-7.48						
40FB4012	FB4012	Tank 40FB4012	3.09	12.08	1.62	5.63	-1.47	-6.45						
40FB4013	FB4013	Tank 40FB4013	3.04	11.85	3.04	11.85	0.00	0.00						
40FB4014	FB4014	Tank 40FB4014	72.80	14.69	0.66	0.88	-72.14	-13.81						
40FB4015	FB4015	Tank 40FB4015	72.80	12.61	0.66	0.63	-72.14	-11.98						
40FB4016	FB4016	Tank 40FB4016	72.80	17.53	0.58	N/A	-72.22	N/A						
15FB509	FB509	Tank 15FB509	136.50	19.55	0.80	N/A	-135.70	N/A						
Combined Limit for 40FB4016, 15FB509			N/A	37.08	N/A	1.67	N/A	-35.41						
Total							**-700.13**	**-158.69**					**2.63**	**11.54**

* Permit allowables for some pollutants are slightly changing due to rounding in the calculations.

FIN	EPN	Description	H_2S Individual Emission Rates Proposed in Deflex Application lb/hr	tons/yr	Proposed Emission Rates for Domestic Crude Project lb/hr	tons/yr	Change in Permitted Emission Rates lb/hr	tons/yr
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater						
39BA3900	JJ-4	NHT Charge Heater						
39BA3901	JJ-4	CCR Hot Oil Heater						
43BF1	R-201	43BF1 Boiler						
37BA1	KK-3	37BA1 DHT Charge Heater						
37BA2	KK-3	37BA2 DHT Stripper Reboiler						
56BA1	DDS-HTRSTK	DDS Charge Heater (combined stack)						
56BA2	DDS-HTRSTK	DDS Fractionator Reboiler (combined stack)						
42BA1 *	A-203 *	42BA1 Crude Heater *						
42BA3 *	A-204 *	42BA3 Vacuum Heater *						
47BA1 *	LSGHTR *	LSG Hot Oil Heater *						
54BA1 *	MX-1 *	54BA1 MX Unit Hot Oil Heater *						
01BF102	AA-4	FCCU CO Boiler/Scrubber						
LW-8 **	VCS-1**	Marine Vapor Combustor **	0.00	0.00	0.03	0.02	0.03	0.02
SRU NO. 1	H-15A	SRU No. 1 Incinerator	0.51	2.20	0.00	0.00	-0.51	-2.20
45BD3	V-8	API Separator Flare	0.0001	0.0004	0.0012	0.0050	0.0011	0.0046
MSSFUGS	MSSFUGS	Miscellaneous MSS Fugitives	0.00	0.00	0.00	0.001	0.00	0.001
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives						
14-UDEX	F-14-UDEX	UDEX Fugitives						
37	F-37	DHT Fugitives						
39	F-39	NHT/CCR Fugitives						
40	F-40	West Crude Fugitives						
42	F-42	Mid Crude Fugitives						
P-GB	F-GB	Gasoline Blender Fugitives						
P-VOC	F-TK-VOC	VOC Tank/Loading Fugitives						
01	F-01	FCCU Fugitives						
26	F-26	Hydrocracker Fugitives						
SCRNH3FUG	SCRNH3FUG	SCR Ammonia Fugitives						
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2	0.00E+00	0.00E+00	7.51E-05	3.29E-04	7.51E-05	3.29E-04
IFRTK1	IFRTK1	100,000 bbl IFR Tank						
IFRTK2	IFRTK2	75,000 bbl IFR Tank						
08FB108R1	FB108R1	Tank 08FB108R1						
08FB109R	FB109R	Tank 08FB109R						
08FB142	FB142	Tank 08FB142	0.00	0.00	0.32	0.21	0.32	0.21
08FB147	FB147	Tank 08FB147	0.00	0.00	0.33	0.21	0.33	0.21
08FB137	FB137	Tank 08FB137	0.00	0.00	0.21	0.13	0.21	0.13
11FB402	FB402	Tank 11FB402						
11FB403	FB403	Tank 11FB403						
11FB408	FB408	Tank 11FB408						
11FB409	FB409	Tank 11FB409						
11FB410	FB410	Tank 11FB410						
Combined Limit for 11FB408, 11FB409, 11FB410								
15FB507	FB507	Tank 15FB507						
15FB508	FB508	Tank 15FB508						
15FB510	FB510	Tank 15FB510						
Combined Limit for 15FB508, 15FB510								

FIN	EPN	Description	H_2S Individual Emission Rates Proposed in Deflex Application lb/hr	tons/yr	Proposed Emission Rates for Domestic Crude Project lb/hr	tons/yr	Change in Permitted Emission Rates lb/hr	tons/yr
40FB3041	FB3041	Tank 40FB3041						
40FB3043	FB3043	Tank 40FB3043						
40FB3044	FB3044	Tank 40FB3044						
Combined Limit for 40FB3043 and 40FB3044								
40FB4010	FB4010	Tank 40FB4010	0.00	N/A	0.14	N/A	0.14	N/A
40FB4011	FB4011	Tank 40FB4011	0.00	N/A	0.13	N/A	0.13	N/A
Combined Limit for 40FB4010 and 40FB4011			N/A	0.00	N/A	0.17	N/A	0.17
40FB4012	FB4012	Tank 40FB4012						
40FB4013	FB4013	Tank 40FB4013						
40FB4014	FB4014	Tank 40FB4014						
40FB4015	FB4015	Tank 40FB4015						
40FB4016	FB4016	Tank 40FB4016						
15FB509	FB509	Tank 15FB509						
Combined Limit for 40FB4016, 15FB509								
Total							**0.65**	**-1.44**

* Permit allowables for some pollutants are slightly changing due to rounding in the calculations.

CCR/NHT UNITS

The Continuous Catalytic Regeneration (CCR) and Naphtha Hydrotreater (NHT) Units are existing process units at the West Refinery currently authorized by Permit No. 8803A. FHR is proposing process changes in the CCR and NHT Units that require an increase in the firing duty of the CCR Hot Oil Heater (39BA3901) from 90 MMBtu/hr (HHV) to 123.6 MMBtu/hr (HHV) and the installation of new equipment piping components in the CCR and NHT Units. FHR is installing a SCR system to reduce NO_X emissions from the NHT Charge Heater (39BA3900) and the CCR Hot Oil Heater. These two heaters share a common stack (EPN JJ-4), and the SCR system will be installed after the emissions from the two heaters are combined.

FHR is reducing the CCR Hot Oil Heater's CO allowable emission limit based on 50 ppmv (at 3% O_2) in the exhaust. FHR is reducing the hourly SO_2 allowable emission limit for both heaters as a result of decreasing the maximum sulfur content in the fuel gas from 10 gr/100 dscf to 7.2 gr/100 scf based on fuel gas sampling. FHR is proposing an LDAR program to reduce fugitive emissions of VOC from new equipment piping components at these units. Last, FHR is proposing annual instrument monitoring for all new and existing gas/vapor and light liquid flanges/connectors at these units.

General Process Description

The purpose of the NHT Unit is to remove sulfur, nitrogen and saturate olefins catalytically from the naphtha feed to the CCR unit. Hydrotreating removes impurities from a petroleum fraction by contacting the stream with hydrogen in the presence of a catalyst at high temperatures and pressures. The CCR Unit converts naphtha to aromatics consisting primarily of benzene, toluene, and xylene. Aromatics are produced by the dehydrogenation of naphthenes and cyclization of paraffins. The dehydrogenation process also produces a hydrogen by-product. The aromatic compounds are then separated and further processed in other units. Hydrogen is consumed as fuel gas or used as feed to other units.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
39BA3900	JJ-4	39BA3900 NHT Charge Heater
39BA3901	JJ-4	39BA3901 CCR Hot Oil Heater
39	F-39	NHT/CCR Fugitives

NO_X emission rates from the CCR Hot Oil Heater are based on the proposed fired duty of 123.6 MMBtu/hr (HHV) and the BACT limit of 0.01 lb/MMBtu (HHV) for hourly and an annual limit of 0.0075 lb/MMBtu (HHV). NO_X emission rates from the NHT Charge Heater are based on the heater's fired duty of 38 MMBtu/hr (HHV) and the same NO_X limits of 0.01 lb/MMBtu (HHV) for hourly and 0.0075 lb/MMBtu (HHV) for annual. CO emission rates from the CCR Hot Oil Heater are based on the BACT limit of 50 ppmv (at 3% O_2) in the exhaust. CO emission rates from the NHT Charge Heater are based on the same CO limit of 50 ppmv (at 3% O_2) in the exhaust. The hourly SO_2 emission rates for both heaters are based on a sulfur concentration of 7.2 gr/100 scf from fuel gas sampling. The annual SO_2 emission rates are based on a sulfur concentration permit limit of 2 gr/100 scf in the fuel gas system. PM, PM_{10}, and $PM_{2.5}$ emission rates from both heaters are based on a vendor estimate of 0.005 lb/MMBtu. Due to SCR control, ammonium sulfate PM forms when SO_2 in the stack gas oxidizes to SO_3 and reacts with excess ammonia. Based on previous applications reviewed and permits issued by TCEQ, 10% of the SO_2 is oxidized and resulting ammonium sulfate emission rates are equivalent to approximately 20% of the SO_2 emissions. These additional particulate matter emissions are added to the particulate matter emissions estimated using the vendor estimate. VOC emission rates from both heaters are based on emission factors from AP-42 (5th Edition), Section 1.4, Table 1.4-2 for natural gas combustion. The heaters burn refinery fuel gas, so the AP-42 emission factor is adjusted based on the heating value of the fuel gas (671 Btu/scf) and the baseline heating value of the AP-42 emission factor (1,020 Btu/scf). Ammonia (NH_3) emission rates from SCR control are based on the BACT limit of 10 ppmv in the exhaust gas.

VOC emission rates from the new equipment piping components are estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000. Control efficiencies are based on a 28 VHP Leak Detection and Repair (LDAR) monitoring program. FHR is committing to annual instrument monitoring for all new and existing gas/vapor and light liquid flanges/connectors. Therefore, a 75% control efficiency is applied to new and existing gas/vapor and light liquid flanges/connectors. VOC emission rates from existing equipment piping components are included to reflect the application of the 75% control efficiency to the existing gas/vapor and light liquid flanges/connectors that will be monitored annually. Where the service will allow, any new pumps will be seal-less pumps to prevent emissions to the atmosphere. New pumps with seals will be monitored to control VOC emissions.

Gas Combustion Emissions Calculator

39BA3900 NHT Charge Heater (Potential to Emit), EPN JJ-4

INPUT DATA

Combustion Unit Description:	39BA3900 NHT Charge Heater (Potential to Emit
Facility Identification Number (FIN):	39BA3900
Emission Point Number (EPN):	JJ-4
Control Identification Number (CIN)	N/A
UTM Zone:	14
UTM Easting (m):	645340
UTM Northing (m):	3079330

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	38
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	10
Stack Exit Temperature, °F:	325
Stack Diameter, ft:	11
Stack Height, ft:	152.9
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM
If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 3 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 671 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					7.2			
Nitrogen Oxides	NOx	0.01							
Particulate Matter	PM	0.005							
Carbon Monoxide	CO			50					
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 3 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 671 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					2			
Nitrogen Oxides	NOx	0.0075							
Particulate Matter	PM	0.005							
Carbon Monoxide	CO			50					
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 for nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note that the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculations

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Sampling	Permit Limit
Nitrogen Oxides	NOx	Consistent with 39BA3901	Consistent with 39BA3901
Particulate Matter	PM	Vendor estimate	Vendor estimate
Carbon Monoxide	CO	Consistent with 39BA3901	Consistent with 39BA3901
Total Organics	TOC	AP-42, Table 1.4-2, July 1998	AP-42, Table 1.4-2, July 1998
Volatile Organics	VOC	AP-42, Table 1.4-2, July 1998	AP-42, Table 1.4-2, July 1998

Volatile Organics Calculated-As Basis

Compound:	C3H8	(CH4, C2H6, C3H8, etc.)
Molecular Weight	44.09	(lb / lb-mol)

INPUT DATA CONTINUED (39BA3900 NHT Charge Heater (Potential to Emit), EPN JJ-4

FUEL DATA

Fuel Gas Composition				Pure Component Data			Fuel Gas Component Data		
			(A)	(B)	(C)	(D)	(A) X (B)	(A) X (C)	(A) X (D)
			Mole	Molecular Weight	HHV *	LHV *	lb/lb-mol	Btu (HHV) per scf	Btu (LHV) per scf
Formula	Name	Mole %	Fraction	(lb/lb-mol)	(Btu/scf)	(Btu/scf)	Fuel Gas	Fuel Gas	Fuel Gas
CH4	Methane	18.60	0.1860	16.04	1012	911	2.98	188.23	169.45
C2H6	Ethane	4.87	0.0487	30.07	1773	1622	1.46	86.35	78.99
C3H8	Propane	4.31	0.0431	44.09	2524	2322	1.90	108.78	100.08
C4H10	n-Butane	0.43	0.0043	58.12	3271	3018	0.25	14.07	12.98
i-C4H10	Isobutane	0.73	0.0073	58.12	3261	3009	0.42	23.81	21.97
n-C5H12	n-Pentane	0.08	0.0008	72.15	4020	3717	0.06	3.22	2.97
i-C5H12	Isopentane	0.18	0.0018	72.15	4011	3708	0.13	7.22	6.67
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.24	0.0024	86.17	4768	4415	0.21	11.44	10.60
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.11	0.0011	28.05	1604	1503	0.03	1.76	1.65
C3H6	Propylene	0.13	0.0013	42.08	2340	2188	0.05	3.04	2.84
C4H8	n-Butene	0.04	0.0004	56.10	3084	2885	0.02	1.23	1.15
i-C4H8	Isobutene	0.01	0.0001	56.10	3069	2868	0.01	0.31	0.29
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide	0.01	0.0001	34.08	646	595	0.00	0.06	0.06
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	68.12	0.6812	2.02	325	275	1.38	221.39	187.33
O2	Oxygen	0.12	0.0012	32.00	0	0	0.04	0.00	0.00
N2	Nitrogen	1.81	0.0181	28.01	0	0	0.51	0.00	0.00
CO	Carbon Monoxide		0.0000	28.01	321	321	0.00	0.00	0.00
CO2	Carbon Dioxide	0.15	0.0015	44.01	0	0	0.07	0.00	0.00
TOTAL		99.94	0.9994				9.52	671.	597.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

CCR #1 fuel gas system

GAS COMBUSTION CALCULATIONS (39BA3900 NHT Charge Heater (Potential to Emit), EPN JJ-4)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	38	33.8

(38 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/671 Btu) (lb-mol/379 scf) = 149 lb-mol/hr
(149 lb-mol/hr) (9.52 lb/lb-mol) = 1420 lb/hr
(149 lb-mol/hr) (379 scf/lb-mol) = 56500 scfh @ 60°F
(56500 scfh) (hr/60 min) = 942 scfm @ 60°F
(56500 scfh) (100% - 0% dscf) / (100% scf) = 56500 dscfh @ 60°F
(149 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 57700 scfh @ 70°F
(57700 scfh) (hr/60 min) = 962 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
Formula	Mole %	(A) Mole Fraction	(B)* Flow Rate lb-mol/hr	(C) lb-mol/ lb-mol fuel	(B) X (C) lb-mol/hr	(D) lb-mol/ lb-mol fuel	(B) X (D) lb-mol/hr	(E) lb-mol/ lb-mol fuel	(B) X (E) lb-mol/hr
CH4	18.60	0.1860	27.714	2.0	55.428	1.0	27.714	2.0	55.428
C2H6	4.87	0.0487	7.256	3.5	25.396	2.0	14.512	3.0	21.768
C3H8	4.31	0.0431	6.422	5.0	32.110	3.0	19.266	4.0	25.688
C4H10	0.43	0.0043	0.641	6.5	4.167	4.0	2.564	5.0	3.205
i-C4H10	0.73	0.0073	1.088	6.5	7.072	4.0	4.352	5.0	5.440
n-C5H12	0.08	0.0008	0.119	8.0	0.952	5.0	0.595	6.0	0.714
i-C5H12	0.18	0.0018	0.268	8.0	2.144	5.0	1.340	6.0	1.608
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.24	0.0024	0.358	9.5	3.401	6.0	2.148	7.0	2.506
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.11	0.0011	0.164	3.0	0.492	2.0	0.328	2.0	0.328
C3H6	0.13	0.0013	0.194	4.5	0.873	3.0	0.582	3.0	0.582
C4H8	0.04	0.0004	0.060	6.0	0.360	4.0	0.240	4.0	0.240
i-C4H8	0.01	0.0001	0.015	6.0	0.090	4.0	0.060	4.0	0.060
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.01	0.0001	0.015	1.5	0.023	1.0 (SO2)	0.015	1.0	0.015
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	68.12	0.6812	101.499	0.5	50.750	0.0	0.000	1.0	101.499
O2	0.12	0.0012	0.179	- 1.0	- 0.179	0.0	0.000	0.0	0.000
N2	1.81	0.0181	2.697	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.00	0.0000	0.000	0.5	0.000	1.0	0.000	0.0	0.000
CO2	0.15	0.0015	0.224	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.94	0.9994	149.		183.		73.7		219.

* (B) = (A) X (149 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (39BA3900 NHT Charge Heater (Potential to Emit), EPN JJ-4)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (183 lb-mol stoichiometric O2/hr) (1.1) = 201 lb-mol total O2/hr
= (201 lb-mol O2/hr) (32.00 lb/lb-mol) = 6430 lb O2/hr

Nitrogen in Supplied Air: (201 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 756 lb-mol total N2/hr
= (756 lb-mol N2/hr) (28.01 lb/lb-mol) = 21200 lb N2/hr

Bone-dry (BD) Supplied Air: (201 lb-mol O2/hr) + (756 lb-mol N2/hr) = 957 lb-mol BD air/hr
= (6430 lb O2/hr) + (21200 lb N2/hr) = 27600 lb BD air/hr

Moisture in Supplied Air: (27600 lb BD air/hr) (0.0132 lb water/lb BD air) = 364 lb water/hr
= (364 lb water/hr) (lb-mol water/18.02 lb water) = 20.2 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (201 lb-mol O2/hr) + (756 lb-mol N2/hr) + (20.2 lb-mol water/hr) = 977 lb-mol/hr
= (6430 lb O2/hr) + (21200 lb N2/hr) + (364 lb water/hr) = 28000 lb/hr
= (977 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 6170 scfm @ 60°F
= (977 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 6300 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	756.00	2.697	0.000	758.70	0.696	28.01	19.49	0.892
Oxygen	201.00	0.179	-183.000	18.18	0.017	32.00	0.54	0.021
Carbon Dioxide	0.00	0.224	73.700	73.92	0.068	44.01	2.99	0.087
Water	20.20	0.000	219.000	239.20	0.219	18.02	3.95	0.000
TOTAL				1090.	1.000		26.97	1.000

Exhaust gas flow rate = 1090 lb-mol/hr
= (1090 lb-mol/hr) (26.97 lb/lb-mol) = 29400 lb/hr
= (1090 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 6890 scfm @ 60°F
= (1090 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 7030 scfm @ 70°F
= (6890 scfm) [(325 + 460)°R] acf / [(60 + 460)°R] scf = 10400 acfm @ 325°F
= (1090 total lb-mol/hr) - (239.2 water lb-mol/hr) = 851 lb-mol/hr dry
= (851 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 5380 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (11 ft)^2 / 4 = 95 ft^2

Stack Exit Velocity = (10400 acfm) (min/60 sec) / (95 ft^2) = 1.82 ft/sec
= (1.82 ft/sec) (0.3048 m/ft) = 0.555 m/sec

GAS COMBUSTION CALCULATIONS (39BA3900 NHT Charge Heater (Potential to Emit), EPN JJ-4)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (7.2 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/671 Btu) (38 MM Btu/hr) = 1.16499893549074 lb/hr

NOx: (38 MM Btu/hr) (0.01 lb/MM Btu) = 0.38 lb/hr (HHV Calculation Basis)

PM: (38 MM Btu/hr) (0.005 lb/MM Btu) = 0.19 lb/hr (HHV Calculation Basis)

CO: (50 lb-mol CO/MMlb-mol dry exh. gas @ 3% O2) [(20.9% - 2.1%) act. ppmvd] / [(20.9% - 3%) ppmvd @ 3% O2]
(851 lb-mol dry exhaust gas/hr) (28 lb CO/lb-mol CO) = 1.25130279329609 lb/hr

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (671 Btu/scf fuel) (56500 scf fuel/hr) = 0.204424754901961 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (2 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/671 Btu) (38 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 1.41741537151373 tons/yr

NOx: (38 MM Btu/hr) (0.0075 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 1.2483 tons/yr (HHV Calculation Basis)

PM: (38 MM Btu/hr) (0.005 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 0.8322 tons/yr (HHV Calculation Basis)

CO: (50 lb-mol CO/MMlb-mol dry exh. gas @ 3% O2) ((20.9% - 2.1%) act. ppmvd) / ((20.9% - 3%) ppmvd @ 3% O2)
(851 lb-mol dry exhaust gas/hr) (28 lb CO/lb-mol CO) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 5.48070623463687 tons/yr

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (671 Btu/scf fuel) (56500 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 0.895380426470588 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	1.165	64.06	0.0182	0.00167	0.00214	16.7	21.4
NOx	0.38	46.01	0.00826	0.000758	0.000971	7.58	9.71
PM	0.19	NA	NA	NA	NA	NA	NA
CO	1.2513	28.01	0.0447	0.0041	0.00525	41.	52.5
VOC	0.20442	44.09	0.00464	0.000426	0.000545	4.26	5.45

Sample Calculations for NOx: (0.38 lb/hr) / (46.01 lb/lb-mol) = 0.00826 lb-mol/hr
(0.00826 lb-mol/hr) / (1090 lb-mol/hr exhaust gas) (100%) = 0.000758% mole composition
(0.00826 lb-mol/hr) / (851 lb-mol/hr dry exhaust gas) (100%) = 0.000971% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (39BA3900 NHT Charge Heater (Potential to Emit), EPN JJ-4)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

	Short-term Emission Rate		Long-term Emission Rate	
Pollutant	(lb/hr)	(g/sec)	(tons/yr)	(g/sec)
SO2	1.1649989	0.147	1.4174154	0.0408
NOx	0.38	0.0479	1.2483	0.0359
PM	0.19	0.024	0.8322	0.024
CO	1.2513028	0.158	5.4807062	0.158
VOC	0.2044248	0.0258	0.8953804	0.0258

Sample Calculations for NOx: (0.38 lb/hr) (454 g/lb) (hr/3600 sec) = 0.0479 g/sec
(1.2483 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 0.0359 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 152.9 ft = (152.9 ft) (0.3048 m/ft) = 46.6 m

Stack Diameter = 11 ft = (11 ft) (0.3048 m/ft) = 3.35 m

Stack Exit Velocity = (1.82 ft/sec) (0.3048 m/ft) = 0.555 m/sec

Stack Exit Temperature = 325°F = (325 - 32) / 1.8 = 163°C = 163 + 273.16 = 436 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (56500 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 495 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

39BA3900 NHT Charge Heater (Potential to Emit), EPN JJ-4

COMBUSTION UNIT DATA

Combustion Unit Description:	39BA3900 NHT Charge Heater (Potential to Emit)	
Facility Identification Number (FIN):	39BA3900	
Emission Point Number (EPN):	JJ-4	
Control Identification Number (CIN):	N/A	
Fuel Gas Firing Capacity, MM Btu/hr:	38	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	671	
Excess Air, % (default to 10% if unknown):	10	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	645340	
UTM Northing (m):	3079330	
Stack Diameter:	11 ft	(3.35 m)
Stack Height:	152.9 ft	(46.6 m)
Stack Exit Temperature:	325° F	(436 K)
Stack Exit Velocity:	1.82 ft/sec	(0.555 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	7.2 Grains Sulfur per 100 dscf Fuel Gas @ 671 Btu/scf (HHV)	Sampling	1.16	0.147
NOx	0.01 lb/MM Btu (HHV)	Consistent with 39BA3901	0.38	0.0479
PM	0.005 lb/MM Btu (HHV)	Vendor estimate	0.19	0.024
CO	50 ppmvd in Stack Gas @ 3 % O2	Consistent with 39BA3901	1.25	0.158
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	0.20	0.0258

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	2 Grains Sulfur per 100 dscf Fuel Gas @ 671 Btu/scf (HHV)	Permit Limit	1.42	0.0408
NOx	0.0075 lb/MM Btu (HHV)	Consistent with 39BA3901	1.25	0.0359
PM	0.005 lb/MM Btu (HHV)	Vendor estimate	0.83	0.024
CO	50 ppmvd in Stack Gas @ 3 % O2	Consistent with 39BA3901	5.48	0.158
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	0.90	0.0258

Gas Combustion Emissions Calculator

39BA3901 CCR Hot Oil Heater, EPN JJ-4

INPUT DATA

Combustion Unit Description:	39BA3901 CCR Hot Oil Heater
Facility Identification Number (FIN):	39BA3901
Emission Point Number (EPN):	JJ-4
Control Identification Number (CIN)	N/A
UTM Zone:	14
UTM Easting (m):	645340
UTM Northing (m):	3079330

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	123.6
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	15
Stack Exit Temperature, °F:	325
Stack Diameter, ft:	14
Stack Height, ft:	201
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM

If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 3 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 671 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					7.2			
Nitrogen Oxides	NOx	0.01							
Particulate Matter	PM	0.005							
Carbon Monoxide	CO			50					
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 3 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 671 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					2			
Nitrogen Oxides	NOx	0.0075							
Particulate Matter	PM	0.005							
Carbon Monoxide	CO			50					
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 for nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note that the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculations

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Sampling	Permit Limit
Nitrogen Oxides	NOx	BACT	Vendor estimate
Particulate Matter	PM	Vendor estimate	Vendor estimate
Carbon Monoxide	CO	BACT	BACT
Total Organics	TOC	AP-42, Table 1.4-2, July 1998	AP-42, Table 1.4-2, July 1998
Volatile Organics	VOC	AP-42, Table 1.4-2, July 1998	AP-42, Table 1.4-2, July 1998

Volatile Organics Calculated-As Basis

Compound:	C3H8	(CH4, C2H6, C3H8, etc.)
Molecular Weight	44.09	(lb / lb-mol)

INPUT DATA CONTINUED (39BA3901 CCR Hot Oil Heater, EPN JJ-4

FUEL DATA

Fuel Gas Composition				Pure Component Data			Fuel Gas Component Data		
Formula	Name	Mole %	(A) Mole Fraction	(B) Molecular Weight (lb/lb-mol)	(C) HHV * (Btu/scf)	(D) LHV * (Btu/scf)	(A) X (B) lb/lb-mol Fuel Gas	(A) X (C) Btu (HHV) per scf Fuel Gas	(A) X (D) Btu (LHV) per scf Fuel Gas
CH4	Methane	18.60	0.1860	16.04	1012	911	2.98	188.23	169.45
C2H6	Ethane	4.87	0.0487	30.07	1773	1622	1.46	86.35	78.99
C3H8	Propane	4.31	0.0431	44.09	2524	2322	1.90	108.78	100.08
C4H10	n-Butane	0.43	0.0043	58.12	3271	3018	0.25	14.07	12.98
i-C4H10	Isobutane	0.73	0.0073	58.12	3261	3009	0.42	23.81	21.97
n-C5H12	n-Pentane	0.08	0.0008	72.15	4020	3717	0.06	3.22	2.97
i-C5H12	Isopentane	0.18	0.0018	72.15	4011	3708	0.13	7.22	6.67
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.24	0.0024	86.17	4768	4415	0.21	11.44	10.60
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.11	0.0011	28.05	1604	1503	0.03	1.76	1.65
C3H6	Propylene	0.13	0.0013	42.08	2340	2188	0.05	3.04	2.84
C4H8	n-Butene	0.04	0.0004	56.10	3084	2885	0.02	1.23	1.15
i-C4H8	Isobutene	0.01	0.0001	56.10	3069	2868	0.01	0.31	0.29
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide	0.01	0.0001	34.08	646	595	0.00	0.06	0.06
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	68.12	0.6812	2.02	325	275	1.38	221.39	187.33
O2	Oxygen	0.12	0.0012	32.00	0	0	0.04	0.00	0.00
N2	Nitrogen	1.81	0.0181	28.01	0	0	0.51	0.00	0.00
CO	Carbon Monoxide		0.0000	28.01	321	321	0.00	0.00	0.00
CO2	Carbon Dioxide	0.15	0.0015	44.01	0	0	0.07	0.00	0.00
TOTAL		99.94	0.9994				9.52	671.	597.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

CCR #1 fuel gas system

GAS COMBUSTION CALCULATIONS (39BA3901 CCR Hot Oil Heater, EPN JJ-4)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	123.6	110.0

(123.6 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/671 Btu) (lb-mol/379 scf) = 486 lb-mol/hr
(486 lb-mol/hr) (9.52 lb/lb-mol) = 4630 lb/hr
(486 lb-mol/hr) (379 scf/lb-mol) = 184000 scfh @ 60°F
(184000 scfh) (hr/60 min) = 3070 scfm @ 60°F
(184000 scfh) (100% - 0% dscf) / (100% scf) = 184000 dscfh @ 60°F
(486 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 188000 scfh @ 70°F
(188000 scfh) (hr/60 min) = 3130 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
Formula	Mole %	(A) Mole Fraction	(B)* Flow Rate lb-mol/hr	(C) lb-mol/ lb-mol fuel	(B) X (C) lb-mol/hr	(D) lb-mol/ lb-mol fuel	(B) X (D) lb-mol/hr	(E) lb-mol/ lb-mol fuel	(B) X (E) lb-mol/hr
CH4	18.60	0.1860	90.396	2.0	180.792	1.0	90.396	2.0	180.792
C2H6	4.87	0.0487	23.668	3.5	82.838	2.0	47.336	3.0	71.004
C3H8	4.31	0.0431	20.947	5.0	104.735	3.0	62.841	4.0	83.788
C4H10	0.43	0.0043	2.090	6.5	13.585	4.0	8.360	5.0	10.450
i-C4H10	0.73	0.0073	3.548	6.5	23.062	4.0	14.192	5.0	17.740
n-C5H12	0.08	0.0008	0.389	8.0	3.112	5.0	1.945	6.0	2.334
i-C5H12	0.18	0.0018	0.875	8.0	7.000	5.0	4.375	6.0	5.250
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.24	0.0024	1.166	9.5	11.077	6.0	6.996	7.0	8.162
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.11	0.0011	0.535	3.0	1.605	2.0	1.070	2.0	1.070
C3H6	0.13	0.0013	0.632	4.5	2.844	3.0	1.896	3.0	1.896
C4H8	0.04	0.0004	0.194	6.0	1.164	4.0	0.776	4.0	0.776
i-C4H8	0.01	0.0001	0.049	6.0	0.294	4.0	0.196	4.0	0.196
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.01	0.0001	0.049	1.5	0.074	1.0 (SO2)	0.049	1.0	0.049
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	68.12	0.6812	331.063	0.5	165.532	0.0	0.000	1.0	331.063
O2	0.12	0.0012	0.583	- 1.0	- 0.583	0.0	0.000	0.0	0.000
N2	1.81	0.0181	8.797	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.00	0.0000	0.000	0.5	0.000	1.0	0.000	0.0	0.000
CO2	0.15	0.0015	0.729	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.94	0.9994	486.		597.		240.		715.

* (B) = (A) X (486 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (39BA3901 CCR Hot Oil Heater, EPN JJ-4)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (597 lb-mol stoichiometric O2/hr) (1.15) = 687 lb-mol total O2/hr
= (687 lb-mol O2/hr) (32.00 lb/lb-mol) = 22000 lb O2/hr

Nitrogen in Supplied Air: (687 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 2580 lb-mol total N2/hr
= (2580 lb-mol N2/hr) (28.01 lb/lb-mol) = 72300 lb N2/hr

Bone-dry (BD) Supplied Air: (687 lb-mol O2/hr) + (2580 lb-mol N2/hr) = 3270 lb-mol BD air/hr
= (22000 lb O2/hr) + (72300 lb N2/hr) = 94300 lb BD air/hr

Moisture in Supplied Air: (94300 lb BD air/hr) (0.0132 lb water/lb BD air) = 1240 lb water/hr
= (1240 lb water/hr) (lb-mol water/18.02 lb water) = 68.8 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (687 lb-mol O2/hr) + (2580 lb-mol N2/hr) + (68.8 lb-mol water/hr) = 3340 lb-mol/hr
= (22000 lb O2/hr) + (72300 lb N2/hr) + (1240 lb water/hr) = 95500 lb/hr
= (3340 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 21100 scfm @ 60°F
= (3340 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 21500 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	2580.00	8.797	0.000	2588.80	0.700	28.01	19.61	0.888
Oxygen	687.00	0.583	-597.000	90.58	0.024	32.00	0.77	0.031
Carbon Dioxide	0.00	0.729	240.000	240.73	0.065	44.01	2.86	0.083
Water	68.80	0.000	715.000	783.80	0.212	18.02	3.82	0.000
TOTAL				3700.	1.001		27.06	1.002

Exhaust gas flow rate = 3700 lb-mol/hr
= (3700 lb-mol/hr) (27.06 lb/lb-mol) = 100000 lb/hr
= (3700 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 23400 scfm @ 60°F
= (3700 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 23900 scfm @ 70°F
= (23400 scfm) [(325 + 460)°R] acf / [(60 + 460)°R] scf = 35300 acfm @ 325°F
= (3700 total lb-mol/hr) - (783.8 water lb-mol/hr) = 2920 lb-mol/hr dry
= (2920 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 18400 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (14 ft)^2 / 4 = 154 ft^2

Stack Exit Velocity = (35300 acfm) (min/60 sec) / (154 ft^2) = 3.82 ft/sec
= (3.82 ft/sec) (0.3048 m/ft) = 1.16 m/sec

GAS COMBUSTION CALCULATIONS (39BA3901 CCR Hot Oil Heater, EPN JJ-4)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (7.2 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/671 Btu) (123.6 MM Btu/hr) = 3.78931232701725 lb/hr

NOx: (123.6 MM Btu/hr) (0.01 lb/MM Btu) = 1.236 lb/hr (HHV Calculation Basis)

PM: (123.6 MM Btu/hr) (0.005 lb/MM Btu) = 0.618 lb/hr (HHV Calculation Basis)

CO: (50 lb-mol CO/MMlb-mol dry exh. gas @ 3% O2) [(20.9% - 3.1%) act. ppmvd] / [(20.9% - 3%) ppmvd @ 3% O2]
(2920 lb-mol dry exhaust gas/hr) (28 lb CO/lb-mol CO) = 4.06516201117318 lb/hr

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (671 Btu/scf fuel) (184000 scf fuel/hr) = 0.665737254901961 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (2 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/671 Btu) (123.6 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 4.61032999787098 tons/yr

NOx: (123.6 MM Btu/hr) (0.0075 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 4.06026 tons/yr (HHV Calculation Basis)

PM: (123.6 MM Btu/hr) (0.005 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 2.70684 tons/yr (HHV Calculation Basis)

CO: (50 lb-mol CO/MMlb-mol dry exh. gas @ 3% O2) ((20.9% - 3.1%) act. ppmvd) / ((20.9% - 3%) ppmvd @ 3% O2)
(2920 lb-mol dry exhaust gas/hr) (28 lb CO/lb-mol CO) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 17.8054096089385 tons/yr

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (671 Btu/scf fuel) (184000 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 2.91592917647059 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration: Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	3.78931	64.06	0.0592	0.0016	0.00203	16.	20.3
NOx	1.236	46.01	0.0269	0.000727	0.000921	7.27	9.21
PM	0.618	NA	NA	NA	NA	NA	NA
CO	4.06516	28.01	0.145	0.00392	0.00497	39.2	49.7
VOC	0.66574	44.09	0.0151	0.000408	0.000517	4.08	5.17

Sample Calculations for NOx: (1.236 lb/hr) / (46.01 lb/lb-mol) = 0.0269 lb-mol/hr
(0.0269 lb-mol/hr) / (3700 lb-mol/hr exhaust gas) (100%) = 0.000727% mole composition
(0.0269 lb-mol/hr) / (2920 lb-mol/hr dry exhaust gas) (100%) = 0.000921% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (39BA3901 CCR Hot Oil Heater, EPN JJ-4)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

Pollutant	Short-term Emission Rate (lb/hr)	Short-term Emission Rate (g/sec)	Long-term Emission Rate (tons/yr)	Long-term Emission Rate (g/sec)
SO2	3.7893123	0.478	4.61033	0.133
NOx	1.236	0.156	4.06026	0.117
PM	0.618	0.0779	2.70684	0.0779
CO	4.065162	0.513	17.8054096	0.513
VOC	0.6657373	0.084	2.9159292	0.084

Sample Calculations for NOx: (1.236 lb/hr) (454 g/lb) (hr/3600 sec) = 0.156 g/sec
(4.06026 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 0.117 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 201 ft = (201 ft) (0.3048 m/ft) = 61.3 m

Stack Diameter = 14 ft = (14 ft) (0.3048 m/ft) = 4.27 m

Stack Exit Velocity = (3.82 ft/sec) (0.3048 m/ft) = 1.16 m/sec

Stack Exit Temperature = 325°F = (325 - 32) / 1.8 = 163°C = 163 + 273.16 = 436 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (184000 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 1610 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

39BA3901 CCR Hot Oil Heater, EPN JJ-4

COMBUSTION UNIT DATA

Combustion Unit Description:	39BA3901 CCR Hot Oil Heater	
Facility Identification Number (FIN):	39BA3901	
Emission Point Number (EPN):	JJ-4	
Control Identification Number (CIN):	N/A	
Fuel Gas Firing Capacity, MM Btu/hr:	123.6	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	671	
Excess Air, % (default to 10% if unknown):	15	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	645340	
UTM Northing (m):	3079330	
Stack Diameter:	14 ft	(4.27 m)
Stack Height:	201 ft	(61.3 m)
Stack Exit Temperature:	325° F	(436 K)
Stack Exit Velocity:	3.82 ft/sec	(1.16 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	7.2 Grains Sulfur per 100 dscf Fuel Gas @ 671 Btu/scf (HHV)	Sampling	3.79	0.478
NOx	0.01 lb/MM Btu (HHV)	BACT	1.236	0.156
PM	0.005 lb/MM Btu (HHV)	Vendor estimate	0.618	0.0779
CO	50 ppmvd in Stack Gas @ 3 % O2	BACT	4.065162011	0.513
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	0.67	0.084

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	2 Grains Sulfur per 100 dscf Fuel Gas @ 671 Btu/scf (HHV)	Permit Limit	4.61	0.133
NOx	0.0075 lb/MM Btu (HHV)	Vendor estimate	4.06026	0.117
PM	0.005 lb/MM Btu (HHV)	Vendor estimate	2.70684	0.0779
CO	50 ppmvd in Stack Gas @ 3 % O2	BACT	17.80540961	0.513
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	2.92	0.084

Additional Emission Rate Calculations for SCR

INPUT DATA

Combustion Unit Description:	39BA3901 CCR Hot Oil Heater
Facility Identification Number (FIN):	39BA3901
Emission Point Number (EPN):	JJ-4

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity:	123.6	MMBtu/hr, HHV
Operating Hours	8760	hrs/yr

EMISSION FACTORS

Ammonia Emission Factor: *	0.0042	lb/MM Btu
Ammonium Sulfate PM Hourly Factor: **	0.00632	lb/MM Btu
Ammonium Sulfate PM Annual Factor: **	0.00175	lb/MM Btu

* Ammonia emissions are based on a maximum of 10 ppmv ammonia slip in the flue gas.

** Ammonium Sulfate PM forms when SO2 in the stack gas oxidizes to SO3 and reacts with excess ammonia. Presuming that 10% of the SO2 is oxidized, resulting emissions would be equivalent to approximately 20% of the SO2 emissions.

EMISSION RATES

Pollutant	Hourly Emissions (lb/hr)	Annual Emissions (tons/yr)
NH3	0.52	2.27
Ammonium Sulfate PM	0.78	0.95

Fugitive Emission Rate Estimates
CCR-NHT
New Components

FIN:	39
EPN:	F-39
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	63	0.059	97%	0.112
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	7	0.024	97%	0.00504
Valves - Light Liquid (DM)	0	0.024	75%	0
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	0	0.251	93%	0
Pumps - Light Liquid (sealess)	2	0.251	100%	0
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	99	0.00055	75%	0.0136
Flanges - Light Liquid	11	0.00055	75%	0.00151
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	0	1.399	95%	0
Pressure Relief Valves [3]	5	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.132**
Total Annual Emissions				**0.578**

Sample Calculations: Valve Emissions = (63 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0.112 lb/hr

Annual Emissions = (0.132 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 0.578 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	5.10%	0.007	0.029
Biphenyl	52475	0.15%	0.0002	0.001
Butadiene 1,3	55150	0.14%	0.000	0.001
Cresols	51535	0.00%	0.000	0.000
Cumene	52440	0.23%	0.000	0.001
Ethylbenzene	52450	2.81%	0.004	0.016
Hexane	56600	11.50%	0.015	0.066
Naphthalene	52460	0.30%	0.000	0.002
Propylene	55600	0.44%	0.001	0.003
Styrene	52480	0.51%	0.001	0.003
TMB 1,2,4	52416	3.70%	0.005	0.021
Toluene	52490	16.56%	0.022	0.096
Xylene	52510	17.46%	0.023	0.101
VOC-U	50001	41.10%	0.054	0.238
Total VOC	***59999***	***100%***	***0.13***	***0.58***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Difficult to monitor (DM) sources are monitored annually. Light liquid pumps and compressors are monitored at a 500 ppmv leak definition instead of 2000 ppmv, which is equivalent to the 28MID program. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

Fugitive Emission Rate Estimates
CCR-NHT
Total Components

FIN:	39
EPN:	F-39
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	420	0.059	97%	0.743
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	1,123	0.024	97%	0.809
Valves - Light Liquid (DM)	0	0.024	75%	0
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	14	0.251	85%	0.527
Pumps - Light Liquid	2	0.251	93%	0.0351
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	999	0.00055	75%	0.137
Flanges - Light Liquid	3,294	0.00055	75%	0.453
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	1	1.399	95%	0.07
Pressure Relief Valves [3]	18	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**2.77**
Total Annual Emissions				**12.1**

Sample Calculations:

Valve Emissions = (420 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0.743 lb/hr

Annual Emissions = (2.77 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 12.1 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	5.10%	0.141	0.619
Biphenyl	52475	0.15%	0.0042	0.018
Butadiene 1,3	55150	0.14%	0.004	0.017
Cresols	51535	0.00%	0.000	0.000
Cumene	52440	0.23%	0.006	0.028
Ethylbenzene	52450	2.81%	0.078	0.341
Hexane	56600	11.50%	0.319	1.395
Naphthalene	52460	0.30%	0.008	0.036
Propylene	55600	0.44%	0.012	0.053
Styrene	52480	0.51%	0.014	0.062
TMB 1,2,4	52416	3.70%	0.102	0.449
Toluene	52490	16.56%	0.459	2.009
Xylene	52510	17.46%	0.484	2.118
VOC-U	50001	41.10%	1.138	4.986
Total VOC	***59999***	***100%***	***2.77***	***12.13***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Difficult to monitor (DM) sources are monitored annually. Light liquid pumps and compressors are monitored at a 500 ppmv leak definition instead of 2000 ppmv, which is equivalent to the 28MID program. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

DHT UNIT (PREVIOUSLY GOHT UNIT)

The Gas Oil Hydrotreater (GOHT) Unit is an existing unit at the West Refinery currently authorized by Permit No. 8803A. FHR is converting the existing GOHT Unit to the Distillate Hydrotreater (DHT) Unit. The proposed project will require installation of new equipment piping components in the DHT Unit. There are no proposed physical changes or changes in method of operation for the DHT Stripper Reboiler (37BA2). However, as a result of this project, the reboiler could potentially run at a higher duty and experience an increase in actual emissions of all pollutants except SO_2 above past actual emissions. It is not clear if the DHT Stripper Reboiler will realize this increase in actual emissions as a result of debottlenecking or increased utilization. As a result, an actual to potential analysis is conservatively used for this emissions unit within the PSD applicability assessment. The increased actual emissions will be below the currently authorized allowable emission rates. Therefore, FHR is not proposing any increases in the current allowable emission rates.

FHR is proposing an LDAR program to reduce fugitive emissions of VOC from new equipment piping components at the DHT Unit. FHR is proposing annual instrument monitoring for all new and existing gas/vapor and light liquid flanges/connectors at the DHT Unit. FHR is also proposing an emission reduction project that will reduce the sulfur content of the fuel gas prior to combustion in the DHT Charge Heater (37BA1) and the DHT Stripper Reboiler (37BA2). Therefore, these two heaters will see a reduction in actual SO_2 emissions from past actual emission levels. FHR is proposing to decrease the SO_2 allowable emission limit for these two heaters to reflect the emission reduction project.

Calculations are provided for the DHT Stripper Reboiler at its currently authorized maximum duty of 70.9 MMBtu/hr (HHV) for purposes of the PSD applicability assessment and to establish the new SO_2 allowable emission limit. Calculations are provided for the DHT Charge Heater at its currently authorized maximum duty of 70.9 MMBtu/hr (HHV) to establish the new SO_2 allowable emission limit.

General Process Description

The DHT Unit removes sulfur from a mixed distillate feed consisting of naphtha, gas oil, light cycle oil, and diesel to produce a diesel fuel product meeting the EPA requirements for sulfur content.

Emissions Data
Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
37BA1	KK-3	37BA1 DHT Charge Heater
37BA2	KK-3	37BA2 DHT Stripper Reboiler
37	F-37	DHT Fugitives

There are no changes in the currently authorized NO_X, CO, PM, PM_{10}, $PM_{2.5}$, and VOC emission rates for the DHT Charge Heater or the DHT Stripper Reboiler. FHR is proposing to revise the SO_2 emission rates based on the SO_2 reduction project. The hourly SO_2 emission rate is based on an estimated maximum fuel gas sulfur content of 1 gr/100 scf and the annual SO_2 emission rate is based on an estimated average fuel gas sulfur content of 0.6 gr/100 scf.

VOC emission rates from the new equipment piping components are estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000. Control efficiencies are based on a 28 VHP LDAR monitoring program. FHR is committing to annual instrument monitoring for all new and existing gas/vapor and light liquid flanges/connectors. Therefore, a 75% control efficiency is applied to new and existing gas/vapor and light liquid flanges/connectors. VOC emission rates from existing equipment piping components are included to reflect the application of the 75% control efficiency to the existing gas/vapor and light liquid flanges/connectors that will be monitored annually. Where the service will allow, any new pumps will be seal-less pumps to prevent emissions to the atmosphere. New pumps with seals will be monitored to control VOC emissions.

Gas Combustion Emissions Calculator

37BA1 DHT Charge Heater (Potential to Emit), EPN KK-3

INPUT DATA

Combustion Unit Description:	37BA1 DHT Charge Heater (Potential to Emit)
Facility Identification Number (FIN):	37BA1
Emission Point Number (EPN):	KK-3
Control Identification Number (CIN)	N/A
UTM Zone:	14
UTM Easting (m):	644206
UTM Northing (m):	3079681

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	70.9
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	10
Stack Exit Temperature, °F:	450
Stack Diameter, ft:	7.21
Stack Height, ft:	134.39
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM
If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					1		0	
Nitrogen Oxides	NOx	0.0541							
Particulate Matter	PM	0.0090							
Carbon Monoxide	CO	0.0451							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					0.6		0	
Nitrogen Oxides	NOx	0.0541							
Particulate Matter	PM	0.0090							
Carbon Monoxide	CO	0.0451							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note th the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculatio

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Engineering estimate-fuel gas treating	Engineering estimate-fuel gas treating
Nitrogen Oxides	NOx	Permit Emission Limit	Permit Emission Limit
Particulate Matter	PM	Vendor Estimate	Vendor Estimate
Carbon Monoxide	CO	Vendor Estimate	Vendor Estimate
Total Organics	TOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Volatile Organics	VOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98

Volatile Organics Calculated-As Basis

Compound:	C3H8	(CH4, C2H6, C3H8, etc.)
Molecular Weight	44.09	(lb / lb-mol)

INPUT DATA CONTINUED (37BA1 DHT Charge Heater (Potential to Emit), EPN KK-3

FUEL DATA

Fuel Gas Composition				Pure Component Data			Fuel Gas Component Data		
Formula	Name	Mole %	(A) Mole Fraction	(B) Molecular Weight (lb/lb-mol)	(C) HHV * (Btu/scf)	(D) LHV * (Btu/scf)	(A) X (B) lb/lb-mol Fuel Gas	(A) X (C) Btu (HHV) per scf Fuel Gas	(A) X (D) Btu (LHV) per scf Fuel Gas
CH4	Methane	55.10	0.5510	16.04	1012	911	8.84	557.61	501.96
C2H6	Ethane	9.07	0.0907	30.07	1773	1622	2.73	160.81	147.12
C3H8	Propane	4.38	0.0438	44.09	2524	2322	1.93	110.55	101.70
C4H10	n-Butane	0.59	0.0059	58.12	3271	3018	0.34	19.30	17.81
i-C4H10	Isobutane	0.53	0.0053	58.12	3261	3009	0.31	17.28	15.95
n-C5H12	n-Pentane	0.13	0.0013	72.15	4020	3717	0.09	5.23	4.83
i-C5H12	Isopentane	0.19	0.0019	72.15	4011	3708	0.14	7.62	7.05
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.33	0.0033	86.17	4768	4415	0.28	15.73	14.57
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.28	0.0028	28.05	1604	1503	0.08	4.49	4.21
C3H6	Propylene	0.40	0.0040	42.08	2340	2188	0.17	9.36	8.75
C4H8	n-Butene	0.05	0.0005	56.10	3084	2885	0.03	1.54	1.44
i-C4H8	Isobutene	0.02	0.0002	56.10	3069	2868	0.01	0.61	0.57
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide		0.0000	34.08	646	595	0.00	0.00	0.00
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	27.33	0.2733	2.02	325	275	0.55	88.82	75.16
O2	Oxygen	0.10	0.0010	32.00	0	0	0.03	0.00	0.00
N2	Nitrogen	1.08	0.0108	28.01	0	0	0.30	0.00	0.00
CO	Carbon Monoxide	0.05	0.0005	28.01	321	321	0.01	0.16	0.16
CO2	Carbon Dioxide	0.32	0.0032	44.01	0	0	0.14	0.00	0.00
TOTAL		99.95	0.9995				16.0	999.	901.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from
Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

Midplant fuel gas sytsem

GAS COMBUSTION CALCULATIONS (37BA1 DHT Charge Heater (Potential to Emit), EPN KK-3)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	70.9	63.9

(70.9 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/999 Btu) (lb-mol/379 scf) = 187 lb-mol/hr
(187 lb-mol/hr) (16 lb/lb-mol) = 2990 lb/hr
(187 lb-mol/hr) (379 scf/lb-mol) = 70900 scfh @ 60°F
(70900 scfh) (hr/60 min) = 1180 scfm @ 60°F
(70900 scfh) (100% - 0% dscf) / (100% scf) = 70900 dscfh @ 60°F
(187 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 72400 scfh @ 70°F
(72400 scfh) (hr/60 min) = 1210 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
Formula	Mole %	(A) Mole Fraction	(B)* Flow Rate lb-mol/hr	(C) lb-mol/ lb-mol fuel	(B) X (C) lb-mol/hr	(D) lb-mol/ lb-mol fuel	(B) X (D) lb-mol/hr	(E) lb-mol/ lb-mol fuel	(B) X (E) lb-mol/hr
CH4	55.10	0.5510	103.037	2.0	206.074	1.0	103.037	2.0	206.074
C2H6	9.07	0.0907	16.961	3.5	59.364	2.0	33.922	3.0	50.883
C3H8	4.38	0.0438	8.191	5.0	40.955	3.0	24.573	4.0	32.764
C4H10	0.59	0.0059	1.103	6.5	7.170	4.0	4.412	5.0	5.515
i-C4H10	0.53	0.0053	0.991	6.5	6.442	4.0	3.964	5.0	4.955
n-C5H12	0.13	0.0013	0.243	8.0	1.944	5.0	1.215	6.0	1.458
i-C5H12	0.19	0.0019	0.355	8.0	2.840	5.0	1.775	6.0	2.130
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.33	0.0033	0.617	9.5	5.862	6.0	3.702	7.0	4.319
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.28	0.0028	0.524	3.0	1.572	2.0	1.048	2.0	1.048
C3H6	0.40	0.0040	0.748	4.5	3.366	3.0	2.244	3.0	2.244
C4H8	0.05	0.0005	0.094	6.0	0.564	4.0	0.376	4.0	0.376
i-C4H8	0.02	0.0002	0.037	6.0	0.222	4.0	0.148	4.0	0.148
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.00	0.0000	0.000	1.5	0.000	1.0 (SO2)	0.000	1.0	0.000
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	27.33	0.2733	51.107	0.5	25.554	0.0	0.000	1.0	51.107
O2	0.10	0.0010	0.187	- 1.0	- 0.187	0.0	0.000	0.0	0.000
N2	1.08	0.0108	2.020	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.05	0.0005	0.094	0.5	0.047	1.0	0.094	0.0	0.000
CO2	0.32	0.0032	0.598	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.95	0.9995	187.		362.		181.		363.

* (B) = (A) X (187 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (37BA1 DHT Charge Heater (Potential to Emit), EPN KK-3)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (362 lb-mol stoichiometric O2/hr) (1.1) = 398 lb-mol total O2/hr
= (398 lb-mol O2/hr) (32.00 lb/lb-mol) = 12700 lb O2/hr

Nitrogen in Supplied Air: (398 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 1500 lb-mol total N2/hr
= (1500 lb-mol N2/hr) (28.01 lb/lb-mol) = 42000 lb N2/hr

Bone-dry (BD) Supplied Air: (398 lb-mol O2/hr) + (1500 lb-mol N2/hr) = 1900 lb-mol BD air/hr
= (12700 lb O2/hr) + (42000 lb N2/hr) = 54700 lb BD air/hr

Moisture in Supplied Air: (54700 lb BD air/hr) (0.0132 lb water/lb BD air) = 722 lb water/hr
= (722 lb water/hr) (lb-mol water/18.02 lb water) = 40.1 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (398 lb-mol O2/hr) + (1500 lb-mol N2/hr) + (40.1 lb-mol water/hr) = 1940 lb-mol/hr
= (12700 lb O2/hr) + (42000 lb N2/hr) + (722 lb water/hr) = 55400 lb/hr
= (1940 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 12300 scfm @ 60°F
= (1940 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 12500 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	1500.00	2.020	0.000	1502.02	0.709	28.01	19.86	0.875
Oxygen	398.00	0.187	-362.000	36.19	0.017	32.00	0.54	0.021
Carbon Dioxide	0.00	0.598	181.000	181.60	0.086	44.01	3.78	0.106
Water	40.10	0.000	363.000	403.10	0.190	18.02	3.42	0.000
TOTAL				2120.	1.002		27.6	1.002

Exhaust gas flow rate = 2120 lb-mol/hr
= (2120 lb-mol/hr) (27.6 lb/lb-mol) = 58500 lb/hr
= (2120 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 13400 scfm @ 60°F
= (2120 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 13700 scfm @ 70°F
= (13400 scfm) [(450 + 460)°R] acf / [(60 + 460)°R] scf = 23500 acfm @ 450°F
= (2120 total lb-mol/hr) - (403.1 water lb-mol/hr) = 1720 lb-mol/hr dry
= (1720 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 10900 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (7.21 ft)^2 / 4 = 40.8 ft^2

Stack Exit Velocity = (23500 acfm) (min/60 sec) / (40.8 ft^2) = 9.6 ft/sec
= (9.6 ft/sec) (0.3048 m/ft) = 2.93 m/sec

GAS COMBUSTION CALCULATIONS (37BA1 DHT Charge Heater (Potential to Emit), EPN KK-3)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (1 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (70.9 MM Btu/hr) = 0.202774202774203 lb/hr

NOx: (70.9 MM Btu/hr) (0.0541 lb/MM Btu) = 3.83569 lb/hr (HHV Calculation Basis)

PM: (70.9 MM Btu/hr) (0.00902 lb/MM Btu) = 0.639518 lb/hr (HHV Calculation Basis)

CO: (70.9 MM Btu/hr) (0.0451 lb/MM Btu) = 3.19759 lb/hr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (70900 scf fuel/hr) = 0.381921617647059 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (0.6 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (70.9 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 0.532890604890605 tons/yr

NOx: (70.9 MM Btu/hr) (0.0541 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 16.8003222 tons/yr (HHV Calculation Basis)

PM: (70.9 MM Btu/hr) (0.00902 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 2.80108884 tons/yr (HHV Calculation Basis)

CO: (70.9 MM Btu/hr) (0.0451 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 14.0054442 tons/yr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (70900 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 1.67281668529412 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	0.20277	64.06	0.00317	0.00015	0.000184	1.5	1.84
NOx	3.83569	46.01	0.0834	0.00393	0.00485	39.3	48.5
PM	0.63952	NA	NA	NA	NA	NA	NA
CO	3.19759	28.01	0.114	0.00538	0.00663	53.8	66.3
VOC	0.38192	44.09	0.00866	0.000408	0.000503	4.08	5.03

Sample Calculations for NOx: (3.83569 lb/hr) / (46.01 lb/lb-mol) = 0.0834 lb-mol/hr
(0.0834 lb-mol/hr) / (2120 lb-mol/hr exhaust gas) (100%) = 0.00393% mole composition
(0.0834 lb-mol/hr) / (1720 lb-mol/hr dry exhaust gas) (100%) = 0.00485% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (37BA1 DHT Charge Heater (Potential to Emit), EPN KK-3)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

Pollutant	Short-term Emission Rate (lb/hr)	Short-term Emission Rate (g/sec)	Long-term Emission Rate (tons/yr)	Long-term Emission Rate (g/sec)
SO2	0.2027742	0.0256	0.5328906	0.0153
NOx	3.83569	0.484	16.8003222	0.484
PM	0.639518	0.0807	2.8010888	0.0807
CO	3.19759	0.403	14.0054442	0.403
VOC	0.3819216	0.0482	1.6728167	0.0482

Sample Calculations for NOx: (3.83569 lb/hr) (454 g/lb) (hr/3600 sec) = 0.484 g/sec
(16.8003222 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 0.484 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 134.39 ft = (134.39 ft) (0.3048 m/ft) = 41 m

Stack Diameter = 7.21 ft = (7.21 ft) (0.3048 m/ft) = 2.2 m

Stack Exit Velocity = (9.6 ft/sec) (0.3048 m/ft) = 2.93 m/sec

Stack Exit Temperature = 450°F = (450 - 32) / 1.8 = 232°C = 232 + 273.16 = 505 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (70900 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 621 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

37BA1 DHT Charge Heater (Potential to Emit), EPN KK-3

COMBUSTION UNIT DATA

Combustion Unit Description:	37BA1 DHT Charge Heater (Potential to Emit)	
Facility Identification Number (FIN):	37BA1	
Emission Point Number (EPN):	KK-3	
Control Identification Number (CIN):	N/A	
Fuel Gas Firing Capacity, MM Btu/hr:	70.9	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	999	
Excess Air, % (default to 10% if unknown):	10	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	644206	
UTM Northing (m):	3079681	
Stack Diameter:	7.21 ft	(2.2 m)
Stack Height:	134.39 ft	(41 m)
Stack Exit Temperature:	450° F	(505 K)
Stack Exit Velocity:	9.6 ft/sec	(2.93 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	1 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.202774203	0.0256
NOx	0.0541 lb/MM Btu (HHV)	Permit Emission Limit	3.83569	0.484
PM	0.00902 lb/MM Btu (HHV)	Vendor Estimate	0.639518	0.0807
CO	0.0451 lb/MM Btu (HHV)	Vendor Estimate	3.19759	0.403
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.381921618	0.0482

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	0.6 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.532890605	0.0153
NOx	0.0541 lb/MM Btu (HHV)	Permit Emission Limit	16.8003222	0.484
PM	0.00902 lb/MM Btu (HHV)	Vendor Estimate	2.80108884	0.0807
CO	0.0451 lb/MM Btu (HHV)	Vendor Estimate	14.0054442	0.403
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	1.672816685	0.0482

Gas Combustion Emissions Calculator

37BA2 DHT Stripper Reboiler (Potential to Emit), EPN KK-3

INPUT DATA

Combustion Unit Description:	37BA2 DHT Stripper Reboiler (Potential to Emit)
Facility Identification Number (FIN):	37BA2
Emission Point Number (EPN):	KK-3
Control Identification Number (CIN)	N/A
UTM Zone:	14
UTM Easting (m):	644206
UTM Northing (m):	3079681

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	70.9
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	10
Stack Exit Temperature, °F:	450
Stack Diameter, ft:	7.21
Stack Height, ft:	134.39
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM
If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					1		0	
Nitrogen Oxides	NOx	0.0541							
Particulate Matter	PM	0.0090							
Carbon Monoxide	CO	0.0451							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					0.6		0	
Nitrogen Oxides	NOx	0.0541							
Particulate Matter	PM	0.0090							
Carbon Monoxide	CO	0.0451							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note th the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculatio

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Engineering estimate-fuel gas treating	Engineering estimate-fuel gas treating
Nitrogen Oxides	NOx	Permit Emission Limit	Permit Emission Limit
Particulate Matter	PM	Vendor Estimate	Vendor Estimate
Carbon Monoxide	CO	Vendor Estimate	Vendor Estimate
Total Organics	TOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Volatile Organics	VOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98

Volatile Organics Calculated-As Basis

Compound: C3H8 (CH4, C2H6, C3H8, etc.)
Molecular Weight 44.09 (lb / lb-mol)

INPUT DATA CONTINUED (37BA2 DHT Stripper Reboiler (Potential to Emit), EPN KK-3

FUEL DATA

Fuel Gas Composition				Pure Component Data			Fuel Gas Component Data		
Formula	Name	Mole %	(A) Mole Fraction	(B) Molecular Weight (lb/lb-mol)	(C) HHV * (Btu/scf)	(D) LHV * (Btu/scf)	(A) X (B) lb/lb-mol Fuel Gas	(A) X (C) Btu (HHV) per scf Fuel Gas	(A) X (D) Btu (LHV) per scf Fuel Gas
CH4	Methane	55.10	0.5510	16.04	1012	911	8.84	557.61	501.96
C2H6	Ethane	9.07	0.0907	30.07	1773	1622	2.73	160.81	147.12
C3H8	Propane	4.38	0.0438	44.09	2524	2322	1.93	110.55	101.70
C4H10	n-Butane	0.59	0.0059	58.12	3271	3018	0.34	19.30	17.81
i-C4H10	Isobutane	0.53	0.0053	58.12	3261	3009	0.31	17.28	15.95
n-C5H12	n-Pentane	0.13	0.0013	72.15	4020	3717	0.09	5.23	4.83
i-C5H12	Isopentane	0.19	0.0019	72.15	4011	3708	0.14	7.62	7.05
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.33	0.0033	86.17	4768	4415	0.28	15.73	14.57
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.28	0.0028	28.05	1604	1503	0.08	4.49	4.21
C3H6	Propylene	0.40	0.0040	42.08	2340	2188	0.17	9.36	8.75
C4H8	n-Butene	0.05	0.0005	56.10	3084	2885	0.03	1.54	1.44
i-C4H8	Isobutene	0.02	0.0002	56.10	3069	2868	0.01	0.61	0.57
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide		0.0000	34.08	646	595	0.00	0.00	0.00
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	27.33	0.2733	2.02	325	275	0.55	88.82	75.16
O2	Oxygen	0.10	0.0010	32.00	0	0	0.03	0.00	0.00
N2	Nitrogen	1.08	0.0108	28.01	0	0	0.30	0.00	0.00
CO	Carbon Monoxide	0.05	0.0005	28.01	321	321	0.01	0.16	0.16
CO2	Carbon Dioxide	0.32	0.0032	44.01	0	0	0.14	0.00	0.00
TOTAL		99.95	0.9995				16.0	999.	901.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

Midplant fuel gas sytsem

GAS COMBUSTION CALCULATIONS (37BA2 DHT Stripper Reboiler (Potential to Emit), EPN KK-3)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	70.9	63.9

(70.9 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/999 Btu) (lb-mol/379 scf) = 187 lb-mol/hr
(187 lb-mol/hr) (16 lb/lb-mol) = 2990 lb/hr
(187 lb-mol/hr) (379 scf/lb-mol) = 70900 scfh @ 60°F
(70900 scfh) (hr/60 min) = 1180 scfm @ 60°F
(70900 scfh) (100% - 0% dscf) / (100% scf) = 70900 dscfh @ 60°F
(187 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 72400 scfh @ 70°F
(72400 scfh) (hr/60 min) = 1210 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
		(A) Mole	(B)* Flow Rate	(C) lb-mol/	(B) X (C)	(D) lb-mol/	(B) X (D)	(E) lb-mol/	(B) X (E)
Formula	Mole %	Fraction	lb-mol/hr	lb-mol fuel	lb-mol/hr	lb-mol fuel	lb-mol/hr	lb-mol fuel	lb-mol/hr
CH4	55.10	0.5510	103.037	2.0	206.074	1.0	103.037	2.0	206.074
C2H6	9.07	0.0907	16.961	3.5	59.364	2.0	33.922	3.0	50.883
C3H8	4.38	0.0438	8.191	5.0	40.955	3.0	24.573	4.0	32.764
C4H10	0.59	0.0059	1.103	6.5	7.170	4.0	4.412	5.0	5.515
i-C4H10	0.53	0.0053	0.991	6.5	6.442	4.0	3.964	5.0	4.955
n-C5H12	0.13	0.0013	0.243	8.0	1.944	5.0	1.215	6.0	1.458
i-C5H12	0.19	0.0019	0.355	8.0	2.840	5.0	1.775	6.0	2.130
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.33	0.0033	0.617	9.5	5.862	6.0	3.702	7.0	4.319
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.28	0.0028	0.524	3.0	1.572	2.0	1.048	2.0	1.048
C3H6	0.40	0.0040	0.748	4.5	3.366	3.0	2.244	3.0	2.244
C4H8	0.05	0.0005	0.094	6.0	0.564	4.0	0.376	4.0	0.376
i-C4H8	0.02	0.0002	0.037	6.0	0.222	4.0	0.148	4.0	0.148
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.00	0.0000	0.000	1.5	0.000	1.0 (SO2)	0.000	1.0	0.000
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	27.33	0.2733	51.107	0.5	25.554	0.0	0.000	1.0	51.107
O2	0.10	0.0010	0.187	- 1.0	- 0.187	0.0	0.000	0.0	0.000
N2	1.08	0.0108	2.020	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.05	0.0005	0.094	0.5	0.047	1.0	0.094	0.0	0.000
CO2	0.32	0.0032	0.598	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.95	0.9995	187.		362.		181.		363.

* (B) = (A) X (187 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (37BA2 DHT Stripper Reboiler (Potential to Emit), EPN KK-3)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (362 lb-mol stoichiometric O2/hr) (1.1) = 398 lb-mol total O2/hr
= (398 lb-mol O2/hr) (32.00 lb/lb-mol) = 12700 lb O2/hr

Nitrogen in Supplied Air: (398 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 1500 lb-mol total N2/hr
= (1500 lb-mol N2/hr) (28.01 lb/lb-mol) = 42000 lb N2/hr

Bone-dry (BD) Supplied Air: (398 lb-mol O2/hr) + (1500 lb-mol N2/hr) = 1900 lb-mol BD air/hr
= (12700 lb O2/hr) + (42000 lb N2/hr) = 54700 lb BD air/hr

Moisture in Supplied Air: (54700 lb BD air/hr) (0.0132 lb water/lb BD air) = 722 lb water/hr
= (722 lb water/hr) (lb-mol water/18.02 lb water) = 40.1 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (398 lb-mol O2/hr) + (1500 lb-mol N2/hr) + (40.1 lb-mol water/hr) = 1940 lb-mol/hr
= (12700 lb O2/hr) + (42000 lb N2/hr) + (722 lb water/hr) = 55400 lb/hr
= (1940 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 12300 scfm @ 60°F
= (1940 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 12500 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	1500.00	2.020	0.000	1502.02	0.709	28.01	19.86	0.875
Oxygen	398.00	0.187	-362.000	36.19	0.017	32.00	0.54	0.021
Carbon Dioxide	0.00	0.598	181.000	181.60	0.086	44.01	3.78	0.106
Water	40.10	0.000	363.000	403.10	0.190	18.02	3.42	0.000
TOTAL				2120.	1.002		27.6	1.002

Exhaust gas flow rate = 2120 lb-mol/hr
= (2120 lb-mol/hr) (27.6 lb/lb-mol) = 58500 lb/hr
= (2120 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 13400 scfm @ 60°F
= (2120 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 13700 scfm @ 70°F
= (13400 scfm) [(450 + 460)°R] acf / [(60 + 460)°R] scf = 23500 acfm @ 450°F
= (2120 total lb-mol/hr) - (403.1 water lb-mol/hr) = 1720 lb-mol/hr dry
= (1720 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 10900 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (7.21 ft)^2 / 4 = 40.8 ft^2

Stack Exit Velocity = (23500 acfm) (min/60 sec) / (40.8 ft^2) = 9.6 ft/sec
= (9.6 ft/sec) (0.3048 m/ft) = 2.93 m/sec

GAS COMBUSTION CALCULATIONS (37BA2 DHT Stripper Reboiler (Potential to Emit), EPN KK-3)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (1 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (70.9 MM Btu/hr) = 0.202774202774203 lb/hr

NOx: (70.9 MM Btu/hr) (0.0541 lb/MM Btu) = 3.83569 lb/hr (HHV Calculation Basis)

PM: (70.9 MM Btu/hr) (0.00902 lb/MM Btu) = 0.639518 lb/hr (HHV Calculation Basis)

CO: (70.9 MM Btu/hr) (0.0451 lb/MM Btu) = 3.19759 lb/hr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (70900 scf fuel/hr) = 0.381921617647059 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (0.6 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (70.9 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 0.532890604890605 tons/yr

NOx: (70.9 MM Btu/hr) (0.0541 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 16.8003222 tons/yr (HHV Calculation Basis)

PM: (70.9 MM Btu/hr) (0.00902 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 2.80108884 tons/yr (HHV Calculation Basis)

CO: (70.9 MM Btu/hr) (0.0451 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 14.0054442 tons/yr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (70900 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 1.67281668529412 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	0.20277	64.06	0.00317	0.00015	0.000184	1.5	1.84
NOx	3.83569	46.01	0.0834	0.00393	0.00485	39.3	48.5
PM	0.63952	NA	NA	NA	NA	NA	NA
CO	3.19759	28.01	0.114	0.00538	0.00663	53.8	66.3
VOC	0.38192	44.09	0.00866	0.000408	0.000503	4.08	5.03

Sample Calculations for NOx: (3.83569 lb/hr) / (46.01 lb/lb-mol) = 0.0834 lb-mol/hr
(0.0834 lb-mol/hr) / (2120 lb-mol/hr exhaust gas) (100%) = 0.00393% mole composition
(0.0834 lb-mol/hr) / (1720 lb-mol/hr dry exhaust gas) (100%) = 0.00485% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (37BA2 DHT Stripper Reboiler (Potential to Emit), EPN KK-3)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

Pollutant	Short-term Emission Rate (lb/hr)	Short-term Emission Rate (g/sec)	Long-term Emission Rate (tons/yr)	Long-term Emission Rate (g/sec)
SO2	0.2027742	0.0256	0.5328906	0.0153
NOx	3.83569	0.484	16.8003222	0.484
PM	0.639518	0.0807	2.8010888	0.0807
CO	3.19759	0.403	14.0054442	0.403
VOC	0.3819216	0.0482	1.6728167	0.0482

Sample Calculations for NOx: (3.83569 lb/hr) (454 g/lb) (hr/3600 sec) = 0.484 g/sec
(16.8003222 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 0.484 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 134.39 ft = (134.39 ft) (0.3048 m/ft) = 41 m

Stack Diameter = 7.21 ft = (7.21 ft) (0.3048 m/ft) = 2.2 m

Stack Exit Velocity = (9.6 ft/sec) (0.3048 m/ft) = 2.93 m/sec

Stack Exit Temperature = 450°F = (450 - 32) / 1.8 = 232°C = 232 + 273.16 = 505 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (70900 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 621 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

37BA2 DHT Stripper Reboiler (Potential to Emit), EPN KK-3

COMBUSTION UNIT DATA

Combustion Unit Description:	37BA2 DHT Stripper Reboiler (Potential to Emit)	
Facility Identification Number (FIN):	37BA2	
Emission Point Number (EPN):	KK-3	
Control Identification Number (CIN):	N/A	
Fuel Gas Firing Capacity, MM Btu/hr:	70.9	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	999	
Excess Air, % (default to 10% if unknown):	10	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	644206	
UTM Northing (m):	3079681	
Stack Diameter:	7.21 ft	(2.2 m)
Stack Height:	134.39 ft	(41 m)
Stack Exit Temperature:	450° F	(505 K)
Stack Exit Velocity:	9.6 ft/sec	(2.93 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	1 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.202774203	0.0256
NOx	0.0541 lb/MM Btu (HHV)	Permit Emission Limit	3.83569	0.484
PM	0.00902 lb/MM Btu (HHV)	Vendor Estimate	0.639518	0.0807
CO	0.0451 lb/MM Btu (HHV)	Vendor Estimate	3.19759	0.403
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.381921618	0.0482

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	0.6 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.532890605	0.0153
NOx	0.0541 lb/MM Btu (HHV)	Permit Emission Limit	16.8003222	0.484
PM	0.00902 lb/MM Btu (HHV)	Vendor Estimate	2.80108884	0.0807
CO	0.0451 lb/MM Btu (HHV)	Vendor Estimate	14.0054442	0.403
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	1.672816685	0.0482

Fugitive Emission Rate Estimates
DHT (Previously GOHT)
New Components

FIN:	37
EPN:	F-37
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	29	0.059	97%	0.0513
Valves - Gas (DM)	1	0.059	75%	0.0148
Valves - Light Liquid	20	0.024	97%	0.0144
Valves - Light Liquid (DM)	1	0.024	75%	0.006
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	1	0.251	85%	0.0377
Pumps - Light Liquid	0	0.251	100%	0
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	74	0.00055	75%	0.0102
Flanges - Light Liquid	49	0.00055	75%	0.00674
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	1	1.399	85%	0.21
Pressure Relief Valves [3]	1	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.351**
Total Annual Emissions				**1.54**

Sample Calculations: Valve Emissions = (29 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0.0513 lb/hr

Annual Emissions = (0.351 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 1.54 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Biphenyl	52475	0.26%	0.0009	0.004
Cresols	51535	0.05%	0.000	0.001
Cumene	52440	0.07%	0.000	0.001
Ethylbenzene	52450	0.19%	0.001	0.003
Hexane	56600	0.03%	0.000	0.000
Naphthalene	52460	0.32%	0.001	0.005
Phenol	51550	0.15%	0.001	0.002
Propylene	55600	0.12%	0.000	0.002
Styrene	52480	0.00%	0.000	0.000
TMB 1,2,4	52416	0.59%	0.002	0.009
Toluene	52490	0.24%	0.001	0.004
Xylene	52510	0.66%	0.002	0.010
VOC-U	50001	97.32%	0.342	1.496
Total VOC	***59999***	***100%***	***0.35***	***1.54***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

Fugitive Emission Rate Estimates
DHT (Previously GOHT)
Total Components

FIN:	37
EPN:	F-37
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	960	0.059	97%	1.7
Valves - Gas (DM)	1	0.059	75%	0.0148
Valves - Light Liquid	471	0.024	97%	0.339
Valves - Light Liquid (DM)	1	0.024	75%	0.006
Valves - Heavy Liquid	75	0.00051	0%	0.0383
Pumps - Light Liquid	5	0.251	85%	0.188
Pumps - Light Liquid	0	0.251	100%	0
Pumps - Heavy Liquid	1	0.046	0%	0.046
Flanges - Gas	2,866	0.00055	75%	0.394
Flanges - Light Liquid	1,402	0.00055	75%	0.193
Flanges - Heavy Liquid	225	0.00055	30%	0.0866
Compressors	5	1.399	85%	1.05
Pressure Relief Valves [3]	27	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**4.06**
Total Annual Emissions				**17.8**

Sample Calculations:

Valve Emissions = (960 valves)(0.059 lb/hr-source)(1 - 0.97)
= 1.7 lb/hr

Annual Emissions = (4.06 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 17.8 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	0.00%	0.000	0.000
Biphenyl	52475	0.26%	0.0106	0.046
Cresols	51535	0.05%	0.002	0.009
Cumene	52440	0.07%	0.003	0.012
Ethylbenzene	52450	0.19%	0.008	0.034
Hexane	56600	0.03%	0.001	0.005
Naphthalene	52460	0.32%	0.013	0.057
Phenol	51550	0.15%	0.006	0.027
Propylene	55600	0.12%	0.005	0.021
TMB 1,2,4	52416	0.59%	0.024	0.105
Toluene	52490	0.24%	0.010	0.043
Xylene	52510	0.66%	0.027	0.117
VOC-U	50001	97.32%	3.951	17.306
Total VOC	***59999***	***100%***	***4.06***	***17.78***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

MID CRUDE UNIT

The Mid Crude Unit is an existing unit at the West Refinery currently authorized by Permit No. 8803A. The project will require the installation of new equipment piping components in the Mid Crude Unit. FHR is not proposing any physical changes or changes in the method of operation for the Mid Crude Charge Heater or the Mid Crude Vacuum Heater and, based on a process engineering analysis, these emission units are not considered downstream or upstream sources affected by the project.

FHR is proposing an LDAR program to reduce fugitive emissions of VOC from new equipment piping components. FHR is proposing annual instrument monitoring for all new and existing gas/vapor and light liquid flanges/connectors. FHR is also proposing an emission reduction project which will reduce the sulfur content of the fuel gas prior to combustion in the Mid Crude Charge Heater (42BA1) and the Mid Crude Vacuum Heater (42BA3). Therefore, these two emission units will see a reduction in actual SO_2 emissions from past actual emission levels. FHR is proposing to decrease the SO_2 allowable emission limit for these two emission units to reflect the emission reduction project.

Calculations are provided for the Mid Crude Charge Heater and the Mid Crude Vacuum Heater at their currently authorized maximum duties of 526.7 MMBtu/hr (HHV) and 166.1 MMBtu/hr (HHV), respectively, to establish the new SO_2 allowable emission limits.

General Process Description

The Mid Crude separates crude oil into fractions by distillation and steam stripping using the differences in boiling ranges to effect the separation. Distillate fractions produced by the crude unit include light ends, naphtha, jet fuel, diesel fuel or No. 2 fuel oil, gas oil, and residual oil. Pressures range from atmospheric to near full vacuum.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
42BA1	A-203	42BA1 Crude Heater
42BA3	A-204	42BA3 Vacuum Heater
42	F-42	Mid Crude Fugitives

There are no changes in the NO_X, CO, PM, PM_{10}, $PM_{2.5}$, and VOC emission rates for either the Mid Crude Charge Heater or the Mid Crude Vacuum Heater. FHR is proposing to revise the SO_2 emission rates based on the SO_2 reduction project. The hourly SO_2 emission rate is based on an estimated maximum fuel gas sulfur content of 1 gr/100 scf and the annual SO_2 emission rate is based on an estimated average fuel gas sulfur content of 0.6 gr/100 scf.

VOC emission rates from the new equipment piping components are estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000. Control efficiencies are based on a 28 VHP LDAR monitoring program. FHR is committing to annual instrument monitoring for all new and existing gas/vapor and light liquid flanges/connectors. Therefore, a 75% control efficiency is applied to new and existing gas/vapor and light liquid flanges/connectors. VOC emission rates from existing equipment piping components are included to reflect the application of the 75% control efficiency to the existing gas/vapor and light liquid flanges/connectors that will be monitored annually. Where the service will allow, any new pumps will be seal-less pumps to prevent emissions to the atmosphere. New pumps with seals will be monitored to control VOC emissions.

Gas Combustion Emissions Calculator

42BA1 Crude Heater (Potential to Emit), EPN A-203

INPUT DATA

Combustion Unit Description:	42BA1 Crude Heater (Potential to Emit)
Facility Identification Number (FIN):	42BA1
Emission Point Number (EPN):	A-203
Control Identification Number (CIN)	N/A
UTM Zone:	14
UTM Easting (m):	644499
UTM Northing (m):	3079667

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	526.7
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	15
Stack Exit Temperature, °F:	620
Stack Diameter, ft:	11
Stack Height, ft:	210
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM
If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					1		0	
Nitrogen Oxides	NOx	0.0631							
Particulate Matter	PM	0.0045							
Carbon Monoxide	CO	0.0451							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					0.6		0	
Nitrogen Oxides	NOx	0.0631							
Particulate Matter	PM	0.0045							
Carbon Monoxide	CO	0.0451							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note tl the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculatio

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Engineering estimate-fuel gas treating	Engineering estimate-fuel gas treating
Nitrogen Oxides	NOx	Permit Emission Limit	Permit Emission Limit
Particulate Matter	PM	Vendor Estimate	Vendor Estimate
Carbon Monoxide	CO	Vendor Estimate	Vendor Estimate
Total Organics	TOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Volatile Organics	VOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98

Volatile Organics Calculated-As Basis

Compound: C3H8 (CH4, C2H6, C3H8, etc.)
Molecular Weight 44.09 (lb / lb-mol)

INPUT DATA CONTINUED (42BA1 Crude Heater (Potential to Emit), EPN A-203

FUEL DATA

Fuel Gas Composition				Pure Component Data			Fuel Gas Component Data		
Formula	Name	Mole %	(A) Mole Fraction	(B) Molecular Weight (lb/lb-mol)	(C) HHV * (Btu/scf)	(D) LHV * (Btu/scf)	(A) X (B) lb/lb-mol Fuel Gas	(A) X (C) Btu (HHV) per scf Fuel Gas	(A) X (D) Btu (LHV) per scf Fuel Gas
CH4	Methane	55.10	0.5510	16.04	1012	911	8.84	557.61	501.96
C2H6	Ethane	9.07	0.0907	30.07	1773	1622	2.73	160.81	147.12
C3H8	Propane	4.38	0.0438	44.09	2524	2322	1.93	110.55	101.70
C4H10	n-Butane	0.59	0.0059	58.12	3271	3018	0.34	19.30	17.81
i-C4H10	Isobutane	0.53	0.0053	58.12	3261	3009	0.31	17.28	15.95
n-C5H12	n-Pentane	0.13	0.0013	72.15	4020	3717	0.09	5.23	4.83
i-C5H12	Isopentane	0.19	0.0019	72.15	4011	3708	0.14	7.62	7.05
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.33	0.0033	86.17	4768	4415	0.28	15.73	14.57
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.28	0.0028	28.05	1604	1503	0.08	4.49	4.21
C3H6	Propylene	0.40	0.0040	42.08	2340	2188	0.17	9.36	8.75
C4H8	n-Butene	0.05	0.0005	56.10	3084	2885	0.03	1.54	1.44
i-C4H8	Isobutene	0.02	0.0002	56.10	3069	2868	0.01	0.61	0.57
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide		0.0000	34.08	646	595	0.00	0.00	0.00
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	27.33	0.2733	2.02	325	275	0.55	88.82	75.16
O2	Oxygen	0.10	0.0010	32.00	0	0	0.03	0.00	0.00
N2	Nitrogen	1.08	0.0108	28.01	0	0	0.30	0.00	0.00
CO	Carbon Monoxide	0.05	0.0005	28.01	321	321	0.01	0.16	0.16
CO2	Carbon Dioxide	0.32	0.0032	44.01	0	0	0.14	0.00	0.00
TOTAL		99.95	0.9995				16.0	999.	901.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

Midplant fuel gas sytsem

GAS COMBUSTION CALCULATIONS (42BA1 Crude Heater (Potential to Emit), EPN A-203)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	526.7	475.0

(526.7 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/999 Btu) (lb-mol/379 scf) = 1390 lb-mol/hr
(1390 lb-mol/hr) (16 lb/lb-mol) = 22200 lb/hr
(1390 lb-mol/hr) (379 scf/lb-mol) = 527000 scfh @ 60°F
(527000 scfh) (hr/60 min) = 8780 scfm @ 60°F
(527000 scfh) (100% - 0% dscf) / (100% scf) = 527000 dscfh @ 60°F
(1390 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 538000 scfh @ 70°F
(538000 scfh) (hr/60 min) = 8970 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
Formula	Mole %	(A) Mole Fraction	(B)* Flow Rate lb-mol/hr	(C) lb-mol/ lb-mol fuel	(B) X (C) lb-mol/hr	(D) lb-mol/ lb-mol fuel	(B) X (D) lb-mol/hr	(E) lb-mol/ lb-mol fuel	(B) X (E) lb-mol/hr
CH4	55.10	0.5510	765.890	2.0	1531.780	1.0	765.890	2.0	1531.780
C2H6	9.07	0.0907	126.073	3.5	441.256	2.0	252.146	3.0	378.219
C3H8	4.38	0.0438	60.882	5.0	304.410	3.0	182.646	4.0	243.528
C4H10	0.59	0.0059	8.201	6.5	53.307	4.0	32.804	5.0	41.005
i-C4H10	0.53	0.0053	7.367	6.5	47.886	4.0	29.468	5.0	36.835
n-C5H12	0.13	0.0013	1.807	8.0	14.456	5.0	9.035	6.0	10.842
i-C5H12	0.19	0.0019	2.641	8.0	21.128	5.0	13.205	6.0	15.846
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.33	0.0033	4.587	9.5	43.577	6.0	27.522	7.0	32.109
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.28	0.0028	3.892	3.0	11.676	2.0	7.784	2.0	7.784
C3H6	0.40	0.0040	5.560	4.5	25.020	3.0	16.680	3.0	16.680
C4H8	0.05	0.0005	0.695	6.0	4.170	4.0	2.780	4.0	2.780
i-C4H8	0.02	0.0002	0.278	6.0	1.668	4.0	1.112	4.0	1.112
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.00	0.0000	0.000	1.5	0.000	1.0 (SO2)	0.000	1.0	0.000
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	27.33	0.2733	379.887	0.5	189.944	0.0	0.000	1.0	379.887
O2	0.10	0.0010	1.390	- 1.0	- 1.390	0.0	0.000	0.0	0.000
N2	1.08	0.0108	15.012	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.05	0.0005	0.695	0.5	0.348	1.0	0.695	0.0	0.000
CO2	0.32	0.0032	4.448	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.95	0.9995	1390.		2690.		1340.		2700.

* (B) = (A) X (1390 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (42BA1 Crude Heater (Potential to Emit), EPN A-203)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (2690 lb-mol stoichiometric O2/hr) (1.15) = 3090 lb-mol total O2/hr
= (3090 lb-mol O2/hr) (32.00 lb/lb-mol) = 98900 lb O2/hr

Nitrogen in Supplied Air: (3090 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 11600 lb-mol total N2/hr
= (11600 lb-mol N2/hr) (28.01 lb/lb-mol) = 325000 lb N2/hr

Bone-dry (BD) Supplied Air: (3090 lb-mol O2/hr) + (11600 lb-mol N2/hr) = 14700 lb-mol BD air/hr
= (98900 lb O2/hr) + (325000 lb N2/hr) = 424000 lb BD air/hr

Moisture in Supplied Air: (424000 lb BD air/hr) (0.0132 lb water/lb BD air) = 5600 lb water/hr
= (5600 lb water/hr) (lb-mol water/18.02 lb water) = 311 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (3090 lb-mol O2/hr) + (11600 lb-mol N2/hr) + (311 lb-mol water/hr) = 15000 lb-mol/hr
= (98900 lb O2/hr) + (325000 lb N2/hr) + (5600 lb water/hr) = 430000 lb/hr
= (15000 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 94800 scfm @ 60°F
= (15000 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 96800 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	11600.00	15.012	0.000	11615.01	0.708	28.01	19.83	0.868
Oxygen	3090.00	1.390	-2690.000	401.39	0.024	32.00	0.77	0.030
Carbon Dioxide	0.00	4.448	1340.000	1344.45	0.082	44.01	3.61	0.100
Water	311.00	0.000	2700.000	3011.00	0.184	18.02	3.32	0.000
TOTAL				16400.	0.998		27.53	0.998

Exhaust gas flow rate = 16400 lb-mol/hr
= (16400 lb-mol/hr) (27.53 lb/lb-mol) = 451000 lb/hr
= (16400 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 104000 scfm @ 60°F
= (16400 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 106000 scfm @ 70°F
= (104000 scfm) [(620 + 460)°R] acf / [(60 + 460)°R] scf = 216000 acfm @ 620°F
= (16400 total lb-mol/hr) - (3011 water lb-mol/hr) = 13400 lb-mol/hr dry
= (13400 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 84600 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (11 ft)^2 / 4 = 95 ft^2

Stack Exit Velocity = (216000 acfm) (min/60 sec) / (95 ft^2) = 37.9 ft/sec
= (37.9 ft/sec) (0.3048 m/ft) = 11.6 m/sec

GAS COMBUSTION CALCULATIONS (42BA1 Crude Heater (Potential to Emit), EPN A-203)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (1 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (526.7 MM Btu/hr) = 1.50636350636351 lb/hr

NOx: (526.7 MM Btu/hr) (0.0631 lb/MM Btu) = 33.23477 lb/hr (HHV Calculation Basis)

PM: (526.7 MM Btu/hr) (0.00451 lb/MM Btu) = 2.375417 lb/hr (HHV Calculation Basis)

CO: (526.7 MM Btu/hr) (0.0451 lb/MM Btu) = 23.75417 lb/hr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (527000 scf fuel/hr) = 2.838825 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (0.6 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (526.7 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 3.9587232947233 tons/yr

NOx: (526.7 MM Btu/hr) (0.0631 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 145.5682926 tons/yr (HHV Calculation Basis)

PM: (526.7 MM Btu/hr) (0.00451 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 10.40432646 tons/yr (HHV Calculation Basis)

CO: (526.7 MM Btu/hr) (0.0451 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 104.0432646 tons/yr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (527000 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 12.4340535 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	1.50636	64.06	0.0235	0.000143	0.000175	1.43	1.75
NOx	33.23477	46.01	0.722	0.0044	0.00539	44.	53.9
PM	2.37542	NA	NA	NA	NA	NA	NA
CO	23.75417	28.01	0.848	0.00517	0.00633	51.7	63.3
VOC	2.83883	44.09	0.0644	0.000393	0.000481	3.93	4.81

Sample Calculations for NOx: (33.23477 lb/hr) / (46.01 lb/lb-mol) = 0.722 lb-mol/hr
(0.722 lb-mol/hr) / (16400 lb-mol/hr exhaust gas) (100%) = 0.0044% mole composition
(0.722 lb-mol/hr) / (13400 lb-mol/hr dry exhaust gas) (100%) = 0.00539% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (42BA1 Crude Heater (Potential to Emit), EPN A-203)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

	Short-term Emission Rate		Long-term Emission Rate	
Pollutant	(lb/hr)	(g/sec)	(tons/yr)	(g/sec)
SO2	1.5063635	0.19	3.9587233	0.114
NOx	33.23477	4.19	145.5682926	4.19
PM	2.375417	0.3	10.4043265	0.3
CO	23.75417	3.	104.0432646	3.
VOC	2.838825	0.358	12.4340535	0.358

Sample Calculations for NOx: (33.23477 lb/hr) (454 g/lb) (hr/3600 sec) = 4.19 g/sec
(145.5682926 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 4.19 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 210 ft = (210 ft) (0.3048 m/ft) = 64 m

Stack Diameter = 11 ft = (11 ft) (0.3048 m/ft) = 3.35 m

Stack Exit Velocity = (37.9 ft/sec) (0.3048 m/ft) = 11.6 m/sec

Stack Exit Temperature = 620°F = (620 - 32) / 1.8 = 327°C = 327 + 273.16 = 600 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (527000 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 4620 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

42BA1 Crude Heater (Potential to Emit), EPN A-203

COMBUSTION UNIT DATA

Combustion Unit Description:	42BA1 Crude Heater (Potential to Emit)	
Facility Identification Number (FIN):	42BA1	
Emission Point Number (EPN):	A-203	
Control Identification Number (CIN):	N/A	
Fuel Gas Firing Capacity, MM Btu/hr:	526.7	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	999	
Excess Air, % (default to 10% if unknown):	15	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	644499	
UTM Northing (m):	3079667	
Stack Diameter:	11 ft	(3.35 m)
Stack Height:	210 ft	(64 m)
Stack Exit Temperature:	620° F	(600 K)
Stack Exit Velocity:	37.9 ft/sec	(11.6 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	1 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	1.506363506	0.19
NOx	0.0631 lb/MM Btu (HHV)	Permit Emission Limit	33.23477	4.19
PM	0.00451 lb/MM Btu (HHV)	Vendor Estimate	2.375417	0.3
CO	0.0451 lb/MM Btu (HHV)	Vendor Estimate	23.75417	3
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	2.838825	0.358

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	0.6 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	3.958723295	0.114
NOx	0.0631 lb/MM Btu (HHV)	Permit Emission Limit	145.5682926	4.19
PM	0.00451 lb/MM Btu (HHV)	Vendor Estimate	10.40432646	0.3
CO	0.0451 lb/MM Btu (HHV)	Vendor Estimate	104.0432646	3
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	12.4340535	0.358

Gas Combustion Emissions Calculator

42BA3 Vacuum Heater (Potential to Emit), EPN A-204

INPUT DATA

Combustion Unit Description:	42BA3 Vacuum Heater (Potential to Emit)
Facility Identification Number (FIN):	42BA3
Emission Point Number (EPN):	A-204
Control Identification Number (CIN)	N/A
UTM Zone:	14
UTM Easting (m):	644500
UTM Northing (m):	3079720

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	166.1
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	15
Stack Exit Temperature, °F:	835
Stack Diameter, ft:	6
Stack Height, ft:	179
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM
If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					1		0	
Nitrogen Oxides	NOx	0.0722							
Particulate Matter	PM	0.0045							
Carbon Monoxide	CO	0.0451							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					0.6		0	
Nitrogen Oxides	NOx	0.0722							
Particulate Matter	PM	0.0045							
Carbon Monoxide	CO	0.0451							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note tł the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculatio

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Engineering estimate-fuel gas treating	Engineering estimate-fuel gas treating
Nitrogen Oxides	NOx	Permit Emission Limit	Permit Emission Limit
Particulate Matter	PM	Vendor Estimate	Vendor Estimate
Carbon Monoxide	CO	Vendor Estimate	Vendor Estimate
Total Organics	TOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Volatile Organics	VOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98

Volatile Organics Calculated-As Basis

Compound:	C3H8	(CH4, C2H6, C3H8, etc.)
Molecular Weight	44.09	(lb / lb-mol)

INPUT DATA CONTINUED (42BA3 Vacuum Heater (Potential to Emit), EPN A-204

FUEL DATA

Fuel Gas Compositior				Pure Component Data			Fuel Gas Component Data		
Formula	Name	Mole %	(A) Mole Fraction	(B) Molecular Weight (lb/lb-mol)	(C) HHV * (Btu/scf)	(D) LHV * (Btu/scf)	(A) X (B) lb/lb-mol Fuel Gas	(A) X (C) Btu (HHV) per scf Fuel Gas	(A) X (D) Btu (LHV) per scf Fuel Gas
CH4	Methane	55.10	0.5510	16.04	1012	911	8.84	557.61	501.96
C2H6	Ethane	9.07	0.0907	30.07	1773	1622	2.73	160.81	147.12
C3H8	Propane	4.38	0.0438	44.09	2524	2322	1.93	110.55	101.70
C4H10	n-Butane	0.59	0.0059	58.12	3271	3018	0.34	19.30	17.81
i-C4H10	Isobutane	0.53	0.0053	58.12	3261	3009	0.31	17.28	15.95
n-C5H12	n-Pentane	0.13	0.0013	72.15	4020	3717	0.09	5.23	4.83
i-C5H12	Isopentane	0.19	0.0019	72.15	4011	3708	0.14	7.62	7.05
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.33	0.0033	86.17	4768	4415	0.28	15.73	14.57
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.28	0.0028	28.05	1604	1503	0.08	4.49	4.21
C3H6	Propylene	0.40	0.0040	42.08	2340	2188	0.17	9.36	8.75
C4H8	n-Butene	0.05	0.0005	56.10	3084	2885	0.03	1.54	1.44
i-C4H8	Isobutene	0.02	0.0002	56.10	3069	2868	0.01	0.61	0.57
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide		0.0000	34.08	646	595	0.00	0.00	0.00
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	27.33	0.2733	2.02	325	275	0.55	88.82	75.16
O2	Oxygen	0.10	0.0010	32.00	0	0	0.03	0.00	0.00
N2	Nitrogen	1.08	0.0108	28.01	0	0	0.30	0.00	0.00
CO	Carbon Monoxide	0.05	0.0005	28.01	321	321	0.01	0.16	0.16
CO2	Carbon Dioxide	0.32	0.0032	44.01	0	0	0.14	0.00	0.00
TOTAL		99.95	0.9995				16.0	999.	901.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from
Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

Midplant fuel gas sytsem

GAS COMBUSTION CALCULATIONS (42BA3 Vacuum Heater (Potential to Emit), EPN A-204)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	166.1	149.8

(166.1 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/999 Btu) (lb-mol/379 scf) = 439 lb-mol/hr
(439 lb-mol/hr) (16 lb/lb-mol) = 7020 lb/hr
(439 lb-mol/hr) (379 scf/lb-mol) = 166000 scfh @ 60°F
(166000 scfh) (hr/60 min) = 2770 scfm @ 60°F
(166000 scfh) (100% - 0% dscf) / (100% scf) = 166000 dscfh @ 60°F
(439 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 170000 scfh @ 70°F
(170000 scfh) (hr/60 min) = 2830 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
Formula	Mole %	(A) Mole Fraction	(B)* Flow Rate lb-mol/hr	(C) lb-mol/ lb-mol fuel	(B) X (C) lb-mol/hr	(D) lb-mol/ lb-mol fuel	(B) X (D) lb-mol/hr	(E) lb-mol/ lb-mol fuel	(B) X (E) lb-mol/hr
CH4	55.10	0.5510	241.889	2.0	483.778	1.0	241.889	2.0	483.778
C2H6	9.07	0.0907	39.817	3.5	139.360	2.0	79.634	3.0	119.451
C3H8	4.38	0.0438	19.228	5.0	96.140	3.0	57.684	4.0	76.912
C4H10	0.59	0.0059	2.590	6.5	16.835	4.0	10.360	5.0	12.950
i-C4H10	0.53	0.0053	2.327	6.5	15.126	4.0	9.308	5.0	11.635
n-C5H12	0.13	0.0013	0.571	8.0	4.568	5.0	2.855	6.0	3.426
i-C5H12	0.19	0.0019	0.834	8.0	6.672	5.0	4.170	6.0	5.004
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.33	0.0033	1.449	9.5	13.766	6.0	8.694	7.0	10.143
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.28	0.0028	1.229	3.0	3.687	2.0	2.458	2.0	2.458
C3H6	0.40	0.0040	1.756	4.5	7.902	3.0	5.268	3.0	5.268
C4H8	0.05	0.0005	0.220	6.0	1.320	4.0	0.880	4.0	0.880
i-C4H8	0.02	0.0002	0.088	6.0	0.528	4.0	0.352	4.0	0.352
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.00	0.0000	0.000	1.5	0.000	1.0 (SO2)	0.000	1.0	0.000
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	27.33	0.2733	119.979	0.5	59.990	0.0	0.000	1.0	119.979
O2	0.10	0.0010	0.439	- 1.0	- 0.439	0.0	0.000	0.0	0.000
N2	1.08	0.0108	4.741	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.05	0.0005	0.220	0.5	0.110	1.0	0.220	0.0	0.000
CO2	0.32	0.0032	1.405	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.95	0.9995	439.		849.		424.		852.

* (B) = (A) X (439 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (42BA3 Vacuum Heater (Potential to Emit), EPN A-204)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (849 lb-mol stoichiometric O2/hr) (1.15) = 976 lb-mol total O2/hr
= (976 lb-mol O2/hr) (32.00 lb/lb-mol) = 31200 lb O2/hr

Nitrogen in Supplied Air: (976 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 3670 lb-mol total N2/hr
= (3670 lb-mol N2/hr) (28.01 lb/lb-mol) = 103000 lb N2/hr

Bone-dry (BD) Supplied Air: (976 lb-mol O2/hr) + (3670 lb-mol N2/hr) = 4650 lb-mol BD air/hr
= (31200 lb O2/hr) + (103000 lb N2/hr) = 134000 lb BD air/hr

Moisture in Supplied Air: (134000 lb BD air/hr) (0.0132 lb water/lb BD air) = 1770 lb water/hr
= (1770 lb water/hr) (lb-mol water/18.02 lb water) = 98.2 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (976 lb-mol O2/hr) + (3670 lb-mol N2/hr) + (98.2 lb-mol water/hr) = 4740 lb-mol/hr
= (31200 lb O2/hr) + (103000 lb N2/hr) + (1770 lb water/hr) = 136000 lb/hr
= (4740 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 29900 scfm @ 60°F
= (4740 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 30600 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	3670.00	4.741	0.000	3674.74	0.709	28.01	19.86	0.869
Oxygen	976.00	0.439	-849.000	127.44	0.025	32.00	0.8	0.030
Carbon Dioxide	0.00	1.405	424.000	425.41	0.082	44.01	3.61	0.101
Water	98.20	0.000	852.000	950.20	0.183	18.02	3.3	0.000
TOTAL				5180.	0.999		27.57	1.000

Exhaust gas flow rate = 5180 lb-mol/hr
= (5180 lb-mol/hr) (27.57 lb/lb-mol) = 143000 lb/hr
= (5180 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 32700 scfm @ 60°F
= (5180 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 33400 scfm @ 70°F
= (32700 scfm) [(835 + 460)°R] acf / [(60 + 460)°R] scf = 81400 acfm @ 835°F
= (5180 total lb-mol/hr) - (950.2 water lb-mol/hr) = 4230 lb-mol/hr dry
= (4230 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 26700 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (6 ft)^2 / 4 = 28.3 ft^2

Stack Exit Velocity = (81400 acfm) (min/60 sec) / (28.3 ft^2) = 47.9 ft/sec
= (47.9 ft/sec) (0.3048 m/ft) = 14.6 m/sec

GAS COMBUSTION CALCULATIONS (42BA3 Vacuum Heater (Potential to Emit), EPN A-204)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (1 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (166.1 MM Btu/hr) = 0.475046475046475 lb/hr

NOx: (166.1 MM Btu/hr) (0.0722 lb/MM Btu) = 11.99242 lb/hr (HHV Calculation Basis)

PM: (166.1 MM Btu/hr) (0.00451 lb/MM Btu) = 0.749111 lb/hr (HHV Calculation Basis)

CO: (166.1 MM Btu/hr) (0.0451 lb/MM Btu) = 7.49111 lb/hr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (166000 scf fuel/hr) = 0.894202941176471 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (0.6 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (166.1 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 1.24842213642214 tons/yr

NOx: (166.1 MM Btu/hr) (0.0722 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 52.5267996 tons/yr (HHV Calculation Basis)

PM: (166.1 MM Btu/hr) (0.00451 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 3.28110618 tons/yr (HHV Calculation Basis)

CO: (166.1 MM Btu/hr) (0.0451 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 32.8110618 tons/yr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (166000 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 3.91660888235294 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	0.47505	64.06	0.00742	0.000143	0.000175	1.43	1.75
NOx	11.99242	46.01	0.261	0.00504	0.00617	50.4	61.7
PM	0.74911	NA	NA	NA	NA	NA	NA
CO	7.49111	28.01	0.267	0.00515	0.00631	51.5	63.1
VOC	0.8942	44.09	0.0203	0.000392	0.00048	3.92	4.8

Sample Calculations for NOx: (11.99242 lb/hr) / (46.01 lb/lb-mol) = 0.261 lb-mol/hr
(0.261 lb-mol/hr) / (5180 lb-mol/hr exhaust gas) (100%) = 0.00504% mole composition
(0.261 lb-mol/hr) / (4230 lb-mol/hr dry exhaust gas) (100%) = 0.00617% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (42BA3 Vacuum Heater (Potential to Emit), EPN A-204)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

Pollutant	Short-term Emission Rate (lb/hr)	Short-term Emission Rate (g/sec)	Long-term Emission Rate (tons/yr)	Long-term Emission Rate (g/sec)
SO2	0.4750465	0.0599	1.2484221	0.0359
NOx	11.99242	1.51	52.5267996	1.51
PM	0.749111	0.0945	3.2811062	0.0945
CO	7.49111	0.945	32.8110618	0.945
VOC	0.8942029	0.113	3.9166089	0.113

Sample Calculations for NOx: (11.99242 lb/hr) (454 g/lb) (hr/3600 sec) = 1.51 g/sec
(52.5267996 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 1.51 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 179 ft = (179 ft) (0.3048 m/ft) = 54.6 m

Stack Diameter = 6 ft = (6 ft) (0.3048 m/ft) = 1.83 m

Stack Exit Velocity = (47.9 ft/sec) (0.3048 m/ft) = 14.6 m/sec

Stack Exit Temperature = 835°F = (835 - 32) / 1.8 = 446°C = 446 + 273.16 = 719 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (166000 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 1450 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

42BA3 Vacuum Heater (Potential to Emit), EPN A-204

COMBUSTION UNIT DATA

Combustion Unit Description:	42BA3 Vacuum Heater (Potential to Emit)	
Facility Identification Number (FIN):	42BA3	
Emission Point Number (EPN):	A-204	
Control Identification Number (CIN):	N/A	
Fuel Gas Firing Capacity, MM Btu/hr:	166.1	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	999	
Excess Air, % (default to 10% if unknown):	15	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	644500	
UTM Northing (m):	3079720	
Stack Diameter:	6 ft	(1.83 m)
Stack Height:	179 ft	(54.6 m)
Stack Exit Temperature:	835° F	(719 K)
Stack Exit Velocity:	47.9 ft/sec	(14.6 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	1 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.475046475	0.0599
NOx	0.0722 lb/MM Btu (HHV)	Permit Emission Limit	11.99242	1.51
PM	0.00451 lb/MM Btu (HHV)	Vendor Estimate	0.749111	0.0945
CO	0.0451 lb/MM Btu (HHV)	Vendor Estimate	7.49111	0.945
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.894202941	0.113

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	0.6 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	1.248422136	0.0359
NOx	0.0722 lb/MM Btu (HHV)	Permit Emission Limit	52.5267996	1.51
PM	0.00451 lb/MM Btu (HHV)	Vendor Estimate	3.28110618	0.0945
CO	0.0451 lb/MM Btu (HHV)	Vendor Estimate	32.8110618	0.945
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	3.916608882	0.113

Fugitive Emission Rate Estimates
Mid Crude (No. 4 Crude)
New Components

FIN:	42
EPN:	F-42
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	292	0.059	97%	0.517
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	747	0.024	97%	0.538
Valves - Light Liquid (DM)	4	0.024	75%	0.024
Valves - Heavy Liquid	180	0.00051	0%	0.0918
Pumps - Light Liquid	1	0.251	93%	0.0176
Pumps - Light Liquid (sealess)	7	0.251	100%	0
Pumps - Heavy Liquid	4	0.046	0%	0.184
Flanges - Gas	731	0.00055	75%	0.101
Flanges - Light Liquid	1,878	0.00055	75%	0.258
Flanges - Heavy Liquid	450	0.00055	30%	0.173
Compressors	1	1.399	95%	0.07
Pressure Relief Valves [3]	5	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**1.97**
Total Annual Emissions				**8.63**

Sample Calculations: Valve Emissions = (292 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0.517 lb/hr

Annual Emissions = (1.97 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 8.63 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	0.67%	0.013	0.058
Biphenyl	52475	0.12%	0.0024	0.010
Butadiene 1,3	55150	0.09%	0.002	0.008
Cresols	51535	0.14%	0.003	0.012
Cumene	52440	0.11%	0.002	0.009
Ethylbenzene	52450	0.65%	0.013	0.056
Ethylene	55300	1.08%	0.021	0.093
Hexane	56600	3.35%	0.066	0.289
Naphthalene	52460	0.94%	0.019	0.081
Phenol	51550	0.01%	0.000	0.001
Propylene	55600	0.33%	0.007	0.028
TMB 1,2,4	52416	0.55%	0.011	0.047
Toluene	52490	2.12%	0.042	0.183
Xylene	52510	2.71%	0.053	0.234
n-Butane	56725	4.78%	0.094	0.412
Propane	56775	5.88%	0.116	0.507
Ethane	56550	3.19%	0.063	0.275
VOC-U	50001	73.28%	1.444	6.323
Total VOC	***59999***	***97%***	***1.91***	***8.35***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Difficult to monitor (DM) sources are monitored annually. Light liquid pumps and compressors are monitored at a 500 ppmv leak definition instead of 2000 ppmv, which is equivalent to the 28MID program. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

Fugitive Emission Rate Estimates
Mid Crude (No. 4 Crude)
Total Components

FIN:	42
EPN:	F-42
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	1,429	0.059	97%	2.53
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	2,381	0.024	97%	1.71
Valves - Light Liquid (DM)	4	0.024	75%	0.024
Valves - Heavy Liquid	999	0.00051	0%	0.509
Pumps - Light Liquid	1	0.251	93%	0.0176
Pumps - Light Liquid	27	0.251	100%	0
Pumps - Heavy Liquid	21	0.046	0%	0.966
Flanges - Gas	4,299	0.00055	30%	1.66
Flanges - Light Liquid	6,768	0.00055	75%	0.931
Flanges - Heavy Liquid	2,498	0.00055	75%	0.343
Compressors	6	1.399	95%	0.42
Pressure Relief Valves [3]	112	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**9.11**
Total Annual Emissions				**39.9**

Sample Calculations:

Valve Emissions = (1,429 valves)(0.059 lb/hr-source)(1 - 0.97)
= 2.53 lb/hr

Annual Emissions = (9.11 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 39.9 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	0.67%	0.061	0.267
Biphenyl	52475	0.12%	0.0109	0.048
Butadiene 1,3	55150	0.09%	0.008	0.036
Cresols	51535	0.14%	0.013	0.056
Cumene	52440	0.11%	0.010	0.044
Ethylbenzene	52450	0.65%	0.059	0.259
Ethylene	55300	1.08%	0.098	0.431
Hexane	56600	3.35%	0.305	1.337
Naphthalene	52460	0.94%	0.086	0.375
Phenol	51550	0.01%	0.001	0.004
Propylene	55600	0.33%	0.030	0.132
TMB 1,2,4	52416	0.55%	0.050	0.219
Toluene	52490	2.12%	0.193	0.846
Xylene	52510	2.71%	0.247	1.081
n-Butane	56725	4.78%	0.435	1.907
Propane	56775	5.88%	0.536	2.346
Ethane	56550	3.19%	0.291	1.273
VOC-U	50001	73.28%	6.676	29.240
Total VOC	***59999***	***97%***	***8.82***	***38.63***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Difficult to monitor (DM) sources are monitored annually. Light liquid pumps and compressors are monitored at a 500 ppmv leak definition instead of 2000 ppmv, which is equivalent to the 28MID program. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

SATURATES GAS PLANT NO. 3

FHR is proposing to construct a new Saturates Gas (Sat Gas) Plant No. 3 Unit. The new unit will include the Sat Gas No. 3 Hot Oil Heater and new equipment piping components. FHR will install an SCR system on the Sat Gas No. 3 Hot Oil Heater to reduce NO_X emissions and a catalyst bed to reduce CO and VOC emissions. The hot oil heater will have a maximum fired duty of 450 MMBtu/hr (HHV). FHR is proposing an LDAR program to reduce fugitive emissions of VOC from new equipment piping components, including annual instrument monitoring for all new gas/vapor and light liquid flanges/connectors.

General Process Description

The Saturates Gas Plant No. 3 will operate to recover propane and heavier hydrocarbons from a number of refinery streams and to fractionate the recovered hydrocarbons into various product streams. Hydrocarbon recovery will be via absorption by a combination of internally produced "lean oil" for propane recovery and by externally fed sponge oil(s) for heavy-ends recovery.

The unit will produce a fuel gas that is lean in C_3+ hydrocarbons, a propane liquid product, a isobutene product, a normal butane product, a C_5+ liquid product, a rich sponge oil return liquid and a sour water waste stream. Each of these streams will be sent out of the unit for further treating, sales or as feedstocks.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives

NO_X emission rates from the Sat Gas No. 3 Hot Oil Heater are based on the proposed fired duty of 450 MMBtu/hr (HHV) and the BACT limit of 0.01 lb/MMBtu (HHV) for hourly and an an annual limit of 0.0075 lb/MMBtu (HHV). CO emission rates are based on a concentration of 10 ppmv, which is the expected concentration from the catalyst bed. The heater will fire natural gas. The hourly SO_2 emission rate is based on a maximum sulfur concentration of 5 gr/100 scf from fuel specifications. The annual SO_2 emission rate is based on an average sulfur concentration of 0.5 gr/100 scf from fuel gas sampling. PM, PM_{10}, $PM_{2.5}$, and VOC emission rates are based on emission factors from AP-42 (5th Edition), Section 1.4, Table 1.4-2 for natural gas combustion. The AP-42 emission factor is adjusted based on the expected heating value of the natural gas (1,061 Btu/scf) and the baseline heating value of the AP-42 emission factor (1,020 Btu/scf). Due to SCR control, ammonium sulfate PM forms when SO_2 in the stack gas oxidizes to SO_3 and reacts with excess ammonia. Based on previous applications reviewed and permits issued by TCEQ, 10% of the SO_2 is oxidized and resulting ammonium sulfate emission rates are equivalent to approximately 20% of the SO_2 emissions. These additional particulate matter emissions are added to the particulate matter emissions estimated using AP-42 emission factors. A 90% control efficiency is applied to the VOC emission rates estimated using AP-42 emission factors to account for the control from the catalyst bed. Ammonia (NH_3) emission rates from SCR control are based on the BACT limit of 10 ppmv in the exhaust gas.

The heater also burns an off-gas stream from the Merox Treating Unit. This fuel displaces some of the natural gas fuel and the NOx and CO emission factors are the same as for natural gas. Therefore, the combustion of Merox Treating Unit off-gas does not result in any additional NOx or CO emissions compared to natural gas firing. Although the off-gas displaces natural gas, additional VOC emissions from burning the off-gas stream are conservatively estimated based on the VOC contaminants in the off-gas stream, a 99% control efficiency for these VOC contaminants in the heater, and an additional 90% control efficiency to account for the control from the catalyst bed. Additional SO_2 emissions are estimated based on the sulfur concentration in the off-gas stream and 100% conversion of the sulfur to SO_2.

VOC emission rates from the new equipment piping components are estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000. Control efficiencies are based on a 28 VHP LDAR monitoring program. FHR is committing to annual instrument monitoring for all new gas/vapor and light liquid flanges/connectors. Therefore, a 75% control efficiency is applied to new and existing gas/vapor and light liquid flanges/connectors. Where the service will allow, any new pumps will be seal-less pumps to prevent emissions to the atmosphere. New pumps with seals will be monitored to control VOC emissions.

Gas Combustion Emissions Calculator

Sat Gas #3 Hot Oil Heater, EPN SATGAS3HTR

INPUT DATA

Combustion Unit Description:	Sat Gas #3 Hot Oil Heater
Facility Identification Number (FIN):	SATGAS3HTR
Emission Point Number (EPN):	SATGAS3HTR
Control Identification Number (CIN)	
UTM Zone:	14
UTM Easting (m):	644412
UTM Northing (m):	3079480

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	450
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	10
Stack Exit Temperature, °F:	300
Stack Diameter, ft:	11.5
Stack Height, ft:	213
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM
If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 3 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 1061 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					5			
Nitrogen Oxides	NOx	0.01							
Particulate Matter	PM							7.6	
Carbon Monoxide	CO			10					
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 3 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 1061 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					0.5			
Nitrogen Oxides	NOx	0.0075							
Particulate Matter	PM							7.6	
Carbon Monoxide	CO			10					
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 for nitrogen oxides (NO2) and 16.04 for volatile organics (CH4). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note that the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculations

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Supplier specifications	Sampling
Nitrogen Oxides	NOx	BACT	Vendor Estimate
Particulate Matter	PM	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Carbon Monoxide	CO	Vendor Guarantee	Vendor Guarantee
Total Organics	TOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Volatile Organics	VOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98

Volitile Organics Calculated-As Basis

Compound: CH4 (CH4, C2H6, C3H8, etc.)
Molecular Weight 16.04 (lb / lb-mol)

INPUT DATA CONTINUED (Sat Gas #3 Hot Oil Heater, EPN SATGAS3HTR

FUEL DATA

Fuel Gas Compositior				Pure Component Data			Fuel Gas Component Data		
Formula	Name	Mole %	(A) Mole Fraction	(B) Molecular Weight (lb/lb-mol)	(C) HHV * (Btu/scf)	(D) LHV * (Btu/scf)	(A) X (B) lb/lb-mol Fuel Gas	(A) X (C) Btu (HHV) per scf Fuel Gas	(A) X (D) Btu (LHV) per scf Fuel Gas
CH4	Methane	92.30	0.9230	16.04	1012	911	14.80	934.08	840.85
C2H6	Ethane	1.99	0.0199	30.07	1773	1622	0.60	35.28	32.28
C3H8	Propane	1.06	0.0106	44.09	2524	2322	0.47	26.75	24.61
C4H10	n-Butane	0.62	0.0062	58.12	3271	3018	0.36	20.28	18.71
i-C4H10	Isobutane	0.33	0.0033	58.12	3261	3009	0.19	10.76	9.93
n-C5H12	n-Pentane	0.18	0.0018	72.15	4020	3717	0.13	7.24	6.69
i-C5H12	Isopentane	0.20	0.0020	72.15	4011	3708	0.14	8.02	7.42
C5H12	Neopentane	0.00	0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.26	0.0026	86.17	4768	4415	0.22	12.40	11.48
C7H16	n-Heptane	0.00	0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.02	0.0002	28.05	1604	1503	0.01	0.32	0.30
C3H6	Propylene	0.03	0.0003	42.08	2340	2188	0.01	0.70	0.66
C4H8	n-Butene	0.00	0.0000	56.10	3084	2885	0.00	0.00	0.00
i-C4H8	Isobutene	0.00	0.0000	56.10	3069	2868	0.00	0.00	0.00
C5H10	n-Pentene	0.00	0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene	0.00	0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene	0.00	0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene	0.00	0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene	0.00	0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene	0.00	0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol	0.00	0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol	0.00	0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide	0.00	0.0000	34.08	646	595	0.00	0.00	0.00
H2O	Water Vapor	0.00	0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	1.69	0.0169	2.02	325	275	0.03	5.49	4.65
O2	Oxygen	0.04	0.0004	32.00	0	0	0.01	0.00	0.00
N2	Nitrogen	0.38	0.0038	28.01	0	0	0.11	0.00	0.00
CO	Carbon Monoxide	0.00	0.0000	28.01	321	321	0.00	0.00	0.00
CO2	Carbon Dioxide	0.88	0.0088	44.01	0	0	0.39	0.00	0.00
TOTAL		99.98	0.9998				17.5	1061.	958.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

Natural Gas

GAS COMBUSTION CALCULATIONS (Sat Gas #3 Hot Oil Heater, EPN SATGAS3HTR)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	450	406.3

(450 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/1061 Btu) (lb-mol/379 scf) = 1120 lb-mol/hr
(1120 lb-mol/hr) (17.5 lb/lb-mol) = 19600 lb/hr
(1120 lb-mol/hr) (379 scf/lb-mol) = 424000 scfh @ 60°F
(424000 scfh) (hr/60 min) = 7070 scfm @ 60°F
(424000 scfh) (100% - 0% dscf) / (100% scf) = 424000 dscfh @ 60°F
(1120 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 433000 scfh @ 70°F
(433000 scfh) (hr/60 min) = 7220 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
		(A)	(B)*	(C)	(B) X (C)	(D)	(B) X (D)	(E)	(B) X (E)
		Mole	Flow Rate	lb-mol/		lb-mol/		lb-mol/	
Formula	Mole %	Fraction	lb-mol/hr	lb-mol fuel	lb-mol/hr	lb-mol fuel	lb-mol/hr	lb-mol fuel	lb-mol/hr
CH4	92.30	0.9230	1033.760	2.0	2067.520	1.0	1033.760	2.0	2067.520
C2H6	1.99	0.0199	22.288	3.5	78.008	2.0	44.576	3.0	66.864
C3H8	1.06	0.0106	11.872	5.0	59.360	3.0	35.616	4.0	47.488
C4H10	0.62	0.0062	6.944	6.5	45.136	4.0	27.776	5.0	34.720
i-C4H10	0.33	0.0033	3.696	6.5	24.024	4.0	14.784	5.0	18.480
n-C5H12	0.18	0.0018	2.016	8.0	16.128	5.0	10.080	6.0	12.096
i-C5H12	0.20	0.0020	2.240	8.0	17.920	5.0	11.200	6.0	13.440
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.26	0.0026	2.912	9.5	27.664	6.0	17.472	7.0	20.384
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.02	0.0002	0.224	3.0	0.672	2.0	0.448	2.0	0.448
C3H6	0.03	0.0003	0.336	4.5	1.512	3.0	1.008	3.0	1.008
C4H8	0.00	0.0000	0.000	6.0	0.000	4.0	0.000	4.0	0.000
i-C4H8	0.00	0.0000	0.000	6.0	0.000	4.0	0.000	4.0	0.000
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.00	0.0000	0.000	1.5	0.000	1.0 (SO2)	0.000	1.0	0.000
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	1.69	0.0169	18.928	0.5	9.464	0.0	0.000	1.0	18.928
O2	0.04	0.0004	0.448	- 1.0	- 0.448	0.0	0.000	0.0	0.000
N2	0.38	0.0038	4.256	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.00	0.0000	0.000	0.5	0.000	1.0	0.000	0.0	0.000
CO2	0.88	0.0088	9.856	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.98	0.9998	1120.		2350.		1200.		2300.

* (B) = (A) X (1120 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (Sat Gas #3 Hot Oil Heater, EPN SATGAS3HTR)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (2350 lb-mol stoichiometric O2/hr) (1.1) = 2590 lb-mol total O2/hr
= (2590 lb-mol O2/hr) (32.00 lb/lb-mol) = 82900 lb O2/hr

Nitrogen in Supplied Air: (2590 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 9740 lb-mol total N2/hr
= (9740 lb-mol N2/hr) (28.01 lb/lb-mol) = 273000 lb N2/hr

Bone-dry (BD) Supplied Air: (2590 lb-mol O2/hr) + (9740 lb-mol N2/hr) = 12300 lb-mol BD air/hr
= (82900 lb O2/hr) + (273000 lb N2/hr) = 356000 lb BD air/hr

Moisture in Supplied Air: (356000 lb BD air/hr) (0.0132 lb water/lb BD air) = 4700 lb water/hr
= (4700 lb water/hr) (lb-mol water/18.02 lb water) = 261 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (2590 lb-mol O2/hr) + (9740 lb-mol N2/hr) + (261 lb-mol water/hr) = 12600 lb-mol/hr
= (82900 lb O2/hr) + (273000 lb N2/hr) + (4700 lb water/hr) = 361000 lb/hr
= (12600 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 79600 scfm @ 60°F
= (12600 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 81300 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	9740.00	4.256	0.000	9744.26	0.706	28.01	19.78	0.867
Oxygen	2590.00	0.448	-2350.000	240.45	0.017	32.00	0.54	0.021
Carbon Dioxide	0.00	9.856	1200.000	1209.86	0.088	44.01	3.87	0.108
Water	261.00	0.000	2300.000	2561.00	0.186	18.02	3.35	0.000
TOTAL				13800.	0.997		27.54	0.996

Exhaust gas flow rate = 13800 lb-mol/hr
= (13800 lb-mol/hr) (27.54 lb/lb-mol) = 380000 lb/hr
= (13800 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 87200 scfm @ 60°F
= (13800 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 89000 scfm @ 70°F
= (87200 scfm) [(300 + 460)°R] acf / [(60 + 460)°R] scf = 127000 acfm @ 300°F
= (13800 total lb-mol/hr) - (2561 water lb-mol/hr) = 11200 lb-mol/hr dry
= (11200 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 70700 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D² / 4 = (3.1416) (11.5 ft)² / 4 = 104 ft²

Stack Exit Velocity = (127000 acfm) (min/60 sec) / (104 ft²) = 20.4 ft/sec
= (20.4 ft/sec) (0.3048 m/ft) = 6.22 m/sec

GAS COMBUSTION CALCULATIONS (Sat Gas #3 Hot Oil Heater, EPN SATGAS3HTR)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (5 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/1061 Btu) (450 MM Btu/hr) = 6.05897401373367 lb/hr

NOx: (450 MM Btu/hr) (0.01 lb/MM Btu) = 4.5 lb/hr (HHV Calculation Basis)

PM: (7.6 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (1061 Btu/scf fuel) (424000 scf fuel/hr) = 3.35192784313725 lb/hr

CO: (10 lb-mol CO/MMlb-mol dry exh. gas @ 3% O2) [(20.9% - 2.1%) act. ppmvd] / [(20.9% - 3%) ppmvd @ 3% O2]
(11200 lb-mol dry exhaust gas/hr) (28 lb CO/lb-mol CO) = 3.29367597765363 lb/hr

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (1061 Btu/scf fuel) (424000 scf fuel/hr) = 2.42573725490196 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (0.5 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/1061 Btu) (450 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 2.65383061801535 tons/yr

NOx: (450 MM Btu/hr) (0.0075 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 14.7825 tons/yr (HHV Calculation Basis)

PM: (7.6 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (1061 Btu/scf fuel) (424000 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 14.6814439529412 tons/yr

CO: (10 lb-mol CO/MMlb-mol dry exh. gas @ 3% O2) ((20.9% - 2.1%) act. ppmvd) / ((20.9% - 3%) ppmvd @ 3% O2)
(11200 lb-mol dry exhaust gas/hr) (28 lb CO/lb-mol CO) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 14.4263007821229 tons/yr

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (1061 Btu/scf fuel) (424000 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 10.6247291764706 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	6.05897	64.06	0.0946	0.000686	0.000845	6.86	8.45
NOx	4.5	46.01	0.0978	0.000709	0.000873	7.09	8.73
PM	3.35193	NA	NA	NA	NA	NA	NA
CO	3.29368	28.01	0.118	0.000855	0.00105	8.55	10.5
VOC	2.42574	16.04	0.151	0.00109	0.00135	10.9	13.5

Sample Calculations for NOx: (4.5 lb/hr) / (46.01 lb/lb-mol) = 0.0978 lb-mol/hr
(0.0978 lb-mol/hr) / (13800 lb-mol/hr exhaust gas) (100%) = 0.000709% mole composition
(0.0978 lb-mol/hr) / (11200 lb-mol/hr dry exhaust gas) (100%) = 0.000873% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of CH4. The resultant compositions are thus in terms of NOx as NO2 and VOC as CH4.

GAS COMBUSTION CALCULATIONS (Sat Gas #3 Hot Oil Heater, EPN SATGAS3HTR)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

Pollutant	Short-term Emission Rate (lb/hr)	Short-term Emission Rate (g/sec)	Long-term Emission Rate (tons/yr)	Long-term Emission Rate (g/sec)
SO2	6.058974	0.764	2.6538306	0.0764
NOx	4.5	0.568	14.7825	0.426
PM	3.3519278	0.423	14.681444	0.423
CO	3.293676	0.415	14.4263008	0.415
VOC	2.4257373	0.306	10.6247292	0.306

Sample Calculations for NOx: (4.5 lb/hr) (454 g/lb) (hr/3600 sec) = 0.568 g/sec
(14.7825 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 0.426 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 213 ft = (213 ft) (0.3048 m/ft) = 64.9 m

Stack Diameter = 11.5 ft = (11.5 ft) (0.3048 m/ft) = 3.51 m

Stack Exit Velocity = (20.4 ft/sec) (0.3048 m/ft) = 6.22 m/sec

Stack Exit Temperature = 300°F = (300 - 32) / 1.8 = 149°C = 149 + 273.16 = 422 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (424000 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 3710 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

Sat Gas #3 Hot Oil Heater, EPN SATGAS3HTR

COMBUSTION UNIT DATA

Combustion Unit Description:	Sat Gas #3 Hot Oil Heater	
Facility Identification Number (FIN):	SATGAS3HTR	
Emission Point Number (EPN):	SATGAS3HTR	
Control Identification Number (CIN):		
Fuel Gas Firing Capacity, MM Btu/hr:	450	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	1061	
Excess Air, % (default to 10% if unknown):	10	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	644412	
UTM Northing (m):	3079480	
Stack Diameter:	11.5 ft	(3.51 m)
Stack Height:	213 ft	(64.9 m)
Stack Exit Temperature:	300° F	(422 K)
Stack Exit Velocity:	20.4 ft/sec	(6.22 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	5 Grains Sulfur per 100 dscf Fuel Gas @ 1061 Btu/scf (HHV)	Supplier specifications	6.058974014	0.764
NOx	0.01 lb/MM Btu (HHV)	BACT	4.5	0.568
PM	7.6 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	3.351927843	0.423
CO	10 ppmvd in Stack Gas @ 3 % O2	Vendor Guarantee	3.293675978	0.415
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	2.425737255	0.306

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	0.5 Grains Sulfur per 100 dscf Fuel Gas @ 1061 Btu/scf (HHV)	Sampling	2.653830618	0.0764
NOx	0.0075 lb/MM Btu (HHV)	Vendor Estimate	14.7825	0.426
PM	7.6 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	14.68144395	0.423
CO	10 ppmvd in Stack Gas @ 3 % O2	Vendor Guarantee	14.42630078	0.415
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	10.62472918	0.306

Additional Emissions from Combusting Merox Off-gas Stream

INPUT DATA

Combustion Unit Description:	Sat Gas #3 Hot Oil Heater	
Facility Identification Number (FIN):	SATGAS3HTR	
Emission Point Number (EPN):	SATGAS3HTR	
Conversion Factor:	385	scf/lbmol
Hours of Operation:	8760	hr/yr

Chemical	Mol. Wt.	Merox Treating Unit Off-gas	Destruction Efficiency	VOC	SO_2	VOC	SO_2
(---)	(lb/lbmol)	(lbmol/hr)	%	(lb/hr)	(lb/hr)	(ton/yr)	(ton/yr)
Nitrogen	28.014	5.84	---	---	---	---	---
Water	18.02	0.55	---	---	---	---	---
Hydrogen	2.02	0.62	---	---	---	---	---
Oxygen	32.00	1.08					
Methane	16.04	1.4	99	---	---	---	---
Ethane	30.07	0.081	---	---	---	---	---
Propane	44.10	0.00668	99	0.003	---	0.013	---
Isobutane	58.12	0.000146971	99	9E-05	---	0.0004	---
n-Butane	58.12	3.10216E-05	99	2E-05	---	8E-05	---
2-methyl-butane	72.15	4.28499E-05	99	3E-05	---	0.0001	---
Cyclopentane	70.13	0.000256542	99	2E-04	---	0.0008	---
n-Pentane	72.15	0.000337859	99	2E-04	---	0.0011	---
2,2-dimethyl-butane	86.18	0.000893058	99	8E-04	---	0.0034	---
2,3-dimethyl-butane	86.18	0.00553515	99	0.005	---	0.021	---
2-methyl-pentane	86.18	0.039809	99	0.034	---	0.15	---
3-methyl-pentane	86.18	0.032561	99	0.028	---	0.12	---
n-Hexane	86.18	0.0962235	99	0.083	---	0.36	---
Methylcyclopentane	84.16	0.0175679	99	0.015	---	0.065	---
Cyclohexane	84.16	0.0191641	99	0.016	---	0.071	---
2,2-dimethylpentane	100.20	0.00259744	99	0.003	---	0.011	---
Benzene	78.11	0.00889301	99	0.007	---	0.03	---
2,4-dimethylpentane	100.20	0.00405649	99	0.004	---	0.018	---
2,2,3-trimethylbutane	100.20	0.000886139	99	9E-04	---	0.0039	---
3,3-dimethylpentane	100.20	0.00145312	99	0.001	---	0.0064	---
1,1-dimethylcyclopentane	98.19	0.00191485	99	0.002	---	0.0082	---
2,3-dimethylpentane	100.20	0.00553898	99	0.006	---	0.024	---
2-methylhexane	100.20	0.0172776	99	0.017	---	0.076	---
trans-1,3-dimethylcyclopentane	98.19	0.00169771	99	0.002	---	0.0073	---
cis-1,3-dimethylcyclopentane	98.19	0.00213851	99	0.002	---	0.0092	---
3-methylhexane	100.20	0.0174317	99	0.018	---	0.077	---
trans-1,2-dimethylcyclopentane	98.19	0.00130265	99	0.001	---	0.0056	---
3-ethylpentane	100.20	0.00108796	99	0.001	---	0.0048	---
n-Heptane	100.20	0.0303512	99	0.03	---	0.13	---
cis-1,2-dimethylcyclopentane	98.19	0.0010044	99	1E-03	---	0.0043	---
Methylcyclohexane	98.19	0.0191677	99	0.019	---	0.082	---
Ethylcyclopentane	98.19	0.000585862	99	6E-04	---	0.0025	---
Toluene	92.14	0.014479	99	0.013	---	0.058	---
2,2,3-trimethylpentane	114.23	0.0249551	99	0.029	---	0.12	---
1-methyl-1-ethylcyclopentane	112.21	0.00328528	99	0.004	---	0.016	---
n-Octane	114.23	0.00768778	99	0.009	---	0.038	---
trans-1,2-dimethylcyclohexane	112.21	0.00372717	99	0.004	---	0.018	---
Ethylbenzene	106.17	0.000434651	99	5E-04	---	0.002	---
2,2-dimethylheptane	100.20	0.00690198	99	0.007	---	0.03	---
p-Xylene	106.17	0.00107932	99	0.001	---	0.005	---
m-Xylene	106.17	0.00296561	99	0.003	---	0.014	---
n-Butylcyclopentane	126.24	0.000261354	99	3E-04	---	0.0014	---
Dimethyl Disulfide	94.20	4.1488E-10	99	---	2.7E-08	---	1E-07
Diethyl Disulfide	122.25	1.0306E-14	99	---	6.6E-13	---	3E-12
Total	**---**	**10**	---	**0.371**	**2.7E-08**	**1.6**	**1E-07**

Sample Calculation:

Hourly Propane Emissions = (Total Flow to Fuel Gas) (Mol. Wt.) (100 % - Destruction Efficiency %)
= (0.00668 lbmol/hr) (44.097 lb/lbmol) (100 % - 99 %)
= 0.0029

Annual Propane Emissions = (Total Flow to Fuel Gas) (Mol. Wt.) (100 % - Destruction Efficiency %) (8760 hr/yr) (2000 lb/ton)
= (0.00668 lbmol/hr) (44.097 lb/lbmol) (100 % - 99 %) (8760 hr/yr) (2000 lb/ton)
= 0.013

Additional Emission Rate Calculations for SCR and VOC Control

INPUT DATA

Combustion Unit Description:	Sat Gas #3 Hot Oil Heater
Facility Identification Number (FIN):	SATGAS3HTR
Emission Point Number (EPN):	SATGAS3HTR

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity:	450	MMBtu/hr, HHV
Operating Hours	8760	hrs/yr

EMISSION FACTORS AND CONTROL EFFICIENCIES

Ammonia Emission Factor: *	0.0042	lb/MM Btu
Ammonium Sulfate PM Hourly Factor: **	0.00277	lb/MM Btu
Ammonium Sulfate PM Annual Factor: **	0.00028	lb/MM Btu
VOC Control Efficiency	90	%

* Ammonia emissions are based on a maximum of 10 ppmv ammonia slip in the flue gas.

** Ammonium Sulfate PM forms when SO2 in the stack gas oxidizes to SO3 and reacts with excess ammonia. Presuming that 10% of the SO2 is oxidized, resulting emissions would be equivalent to approximately 20% of the SO2 emissions.

EMISSION RATES

Pollutant	Hourly Emissions (lb/hr)	Annual Emissions (tons/yr)
NH3	1.89	8.28
Ammonium Sulfate PM	1.25	0.55
VOC	0.28	1.22

Fugitive Emission Rate Estimates
Sat Gas Plant No. 3
New Components

FIN:	F-SATGAS3
EPN:	F-SATGAS3
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	0	0.059	97%	0
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	2,535	0.024	97%	1.83
Valves - Light Liquid (DM)	6	0.024	75%	0.036
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	0	0.251	93%	0
Pumps - Light Liquid (sealess)	29	0.251	100%	0
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	1,555	0.00055	75%	0.214
Flanges - Light Liquid	6,253	0.00055	75%	0.86
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	0	1.399	95%	0
Pressure Relief Valves [3]	16	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**2.94**
Total Annual Emissions				**12.9**

Sample Calculations:

Valve Emissions = (0 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0 lb/hr

Annual Emissions = (2.94 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 12.9 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	4.00%	0.118	0.515
Butadiene 1,3	55150	0.02%	0.001	0.003
Ethylbenzene	52450	0.30%	0.009	0.039
Ethylene	55300	0.05%	0.001	0.006
Hexane	56600	0.62%	0.018	0.080
Propylene	55600	1.71%	0.050	0.220
TMP 2,2,4	56610	0.00%	0.000	0.000
Toluene	52490	1.84%	0.054	0.237
Xylene	52510	1.84%	0.054	0.237
n-Butane	56725	13.61%	0.400	1.753
Propane	56775	19.78%	0.582	2.547
Ethane	56550	9.42%	0.277	1.213
VOC-U	50001	46.81%	1.376	6.028
Total VOC	***59999***	***91%***	***2.66***	***11.66***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Difficult to monitor (DM) sources are monitored annually. Light liquid pumps and compressors are monitored at a 500 ppmv leak definition instead of 2000 ppmv, which is equivalent to the 28MID program. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

UDEX UNIT

The Universal Dow Extraction (UDEX) Unit is an existing unit at the West Refinery currently authorized by Permit No. 8803A. The proposed project will require installation of new equipment piping components in the UDEX Unit. FHR is proposing an LDAR program to reduce fugitive emissions of VOC from new equipment piping components, including annual instrument monitoring for all new gas/vapor and light liquid flanges/connectors.

General Process Description

The UDEX Unit removes aromatics from a feed stream composed of toluene, mixed xylenes, benzene and heavy aromatics. The aromatics are removed from the feed stream through using glycol and liquid-liquid extraction and exit the unit as extract product that is further separated in downstream fractionation columns. The non-aromatics along with some aromatics end up in the raffinate product stream.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
14-UDEX	F-14-UDEX	UDEX Fugitives

VOC emission rates from the new equipment piping components are estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000. Control efficiencies are based on a 28 VHP LDAR monitoring program. FHR already performs annual instrument monitoring for all existing gas/vapor and light liquid flanges/connectors in the UDEX Unit. Because FHR is committing to this same monitoring for all new gas/vapor and light liquid flanges/connectors, a 75% control efficiency is applied to new gas/vapor and light liquid flanges/connectors. Where the service will allow, any new pumps will be seal-less pumps to prevent emissions to the atmosphere. New pumps with seals will be monitored to control VOC emissions.

Fugitive Emission Rate Estimates
UDEX
New Components

FIN:	14-UDEX
EPN:	F-14-UDEX
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	0	0.0089	97%	0
Valves - Gas (DM)	0	0.0089	75%	0
Valves - Light Liquid	60	0.0035	97%	0.0063
Valves - Light Liquid (DM)	0	0.0035	75%	0
Valves - Heavy Liquid	0	0.0007	0%	0
Pumps - Light Liquid	0	0.0386	85%	0
Pumps - Light Liquid	2	0.0386	100%	0
Pumps - Heavy Liquid	0	0.0161	0%	0
Flanges - Gas	0	0.0029	75%	0
Flanges - Light Liquid	80	0.0005	75%	0.01
Flanges - Heavy Liquid	0	0.00007	30%	0
Compressors	0	0.5027	85%	0
Pressure Relief Valves [3]	0	0.23	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.0163**
Total Annual Emissions				**0.0714**

Sample Calculations:

Valve Emissions = (0 valves)(0.0089 lb/hr-source)(1 - 0.97)
= 0 lb/hr

Annual Emissions = (0.0163 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 0.0714 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	55.37%	0.009	0.040
Biphenyl	52475	0.68%	0.000	0.000
Cumene	52440	0.08%	0.000	0.000
Hexane	56600	1.37%	0.000	0.001
Toluene	52490	20.64%	0.003	0.015
Xylene	52510	9.57%	0.002	0.007
VOC-U	50001	12.29%	0.002	0.009
Total VOC	***59999***	***100%***	***0.02***	***0.07***

NOTES:

(1) The emission factors used are SOCMI w/out ethylene factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

WEST CRUDE

The West Crude Unit is an existing unit at the West Refinery currently authorized by Permit No. 8803A. The proposed project will require installation of new equipment piping components in the West Crude Unit. FHR is proposing an LDAR program to reduce fugitive emissions of VOC from new equipment piping components. FHR is also proposing annual instrument monitoring for all new and existing gas/vapor and light liquid flanges/connectors.

General Process Description

The West Crude separates crude oil into fractions by distillation and steam stripping using the differences in boiling ranges to affect the separation. Distillate fractions produced by the crude unit include light ends, naphtha, jet fuel, diesel fuel or No. 2 fuel oil, gas oil, and residual oil. Pressures range from atmospheric to near full vacuum.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section:

FIN	EPN	Source Name
40	F-40	West Crude Fugitives

VOC emission rates from the new equipment piping components are estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000. Control efficiencies are based on a 28 VHP LDAR monitoring program. FHR is committing to annual instrument monitoring for all new and existing gas/vapor and light liquid flanges/connectors. Therefore, a 75% control efficiency is applied to new and existing gas/vapor and light liquid flanges/connectors. VOC emission rates from existing equipment piping components are included to reflect the application of the 75% control efficiency to the existing gas/vapor and light liquid flanges/connectors that will be monitored annually. Where the service will allow, any new pumps will be seal-less pumps to prevent emissions to the atmosphere. New pumps with seals will be monitored to control VOC emissions.

Fugitive Emission Rate Estimates
West Crude
New Components

FIN:	40
EPN:	F-40
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	120	0.059	97%	0.212
Valves - Gas (DM)	3	0.059	75%	0.0443
Valves - Light Liquid	268	0.024	97%	0.193
Valves - Light Liquid (DM)	3	0.024	75%	0.018
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	1	0.251	85%	0.0377
Pumps - Light Liquid (Sealess)	4	0.251	100%	0
Pumps - Heavy Liquid	2	0.046	0%	0.092
Flanges - Gas	308	0.00055	75%	0.0424
Flanges - Light Liquid	678	0.00055	75%	0.0932
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	0	1.399	85%	0
Pressure Relief Valves [3]	2	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.733**
Total Annual Emissions				**3.21**

Sample Calculations:

Valve Emissions = (120 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0.212 lb/hr

Annual Emissions = (0.733 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 3.21 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	0.67%	0.005	0.022
Biphenyl	52475	0.12%	0.0009	0.004
Butadiene 1,3	55150	0.09%	0.001	0.003
Cresols	51535	0.14%	0.001	0.004
Cumene	52440	0.10%	0.001	0.003
Ethylbenzene	52450	0.64%	0.005	0.021
Ethylene	55300	1.07%	0.008	0.034
Hexane	56600	3.30%	0.024	0.106
Naphthalene	52460	0.95%	0.007	0.031
Phenol	51550	0.01%	0.000	0.000
Propylene	55600	0.33%	0.002	0.011
TMB 1,2,4	52416	0.54%	0.004	0.017
Toluene	52490	2.09%	0.015	0.067
Xylene	52510	2.68%	0.020	0.086
n-Butane	56725	4.72%	0.035	0.152
Propane	56775	5.81%	0.043	0.187
Ethane	56550	3.15%	0.023	0.101
VOC-U	50001	73.59%	0.539	2.363
Total VOC	***59999***	***97%***	***0.71***	***3.11***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

Fugitive Emission Rate Estimates
West Crude
Total Components

FIN:	40
EPN:	F-40
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	725	0.059	97%	1.28
Valves - Gas (DM)	3	0.059	75%	0.0443
Valves - Light Liquid	735	0.024	97%	0.529
Valves - Light Liquid (DM)	3	0.024	75%	0.018
Valves - Heavy Liquid	800	0.00051	0%	0.408
Pumps - Light Liquid	14	0.251	85%	0.527
Pumps - Light Liquid	4	0.251	100%	0
Pumps - Heavy Liquid	16	0.046	0%	0.736
Flanges - Gas	1,820	0.00055	75%	0.25
Flanges - Light Liquid	1,845	0.00055	75%	0.254
Flanges - Heavy Liquid	2,000	0.00055	30%	0.77
Compressors	2	1.399	85%	0.42
Pressure Relief Valves [3]	13	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**5.24**
Total Annual Emissions				**23**

Sample Calculations:

Valve Emissions = (725 valves)(0.059 lb/hr-source)(1 - 0.97)
= 1.28 lb/hr

Annual Emissions = (5.24 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 23 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	0.67%	0.035	0.154
Biphenyl	52475	0.12%	0.0063	0.028
Butadiene 1,3	55150	0.09%	0.005	0.021
Cresols	51535	0.14%	0.007	0.032
Cumene	52440	0.10%	0.005	0.023
Ethylbenzene	52450	0.64%	0.034	0.147
Ethylene	55300	1.07%	0.056	0.246
Hexane	56600	3.30%	0.173	0.757
Naphthalene	52460	0.95%	0.050	0.218
Phenol	51550	0.01%	0.001	0.002
Propylene	55600	0.33%	0.017	0.076
TMB 1,2,4	52416	0.54%	0.028	0.124
Toluene	52490	2.09%	0.110	0.480
Xylene	52510	2.68%	0.140	0.615
n-Butane	56725	4.72%	0.247	1.083
Propane	56775	5.81%	0.304	1.333
Ethane	56550	3.15%	0.165	0.723
VOC-U	50001	73.59%	3.856	16.890
Total VOC	***59999***	***97%***	***5.07***	***22.23***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

UTILITIES

The utilities area at the West Refinery consists of six existing boilers. There are no proposed physical changes or changes in method of operation to any of these boilers. However, as a result of this project, there will be an increase in steam demand so the boilers could potentially run at a higher duty and experience an increase in actual emissions above past actual emissions as a result of increased utilization. Because the boilers are affected emission units upstream of the project, these changes in actual emissions are included in the PSD applicability assessment. The incremental increase in actual emissions as a result of the project is conservatively calculated based on an incremental increase in actual duty of 96 MMBtu/hr (HHV) and the highest emission factor for each pollutant for any of the six boilers. The increased actual emissions will be below the currently authorized allowable emission rates. Therefore, FHR is not proposing any increases in any of the boilers' current permit allowable emission rates or authorized maximum duty rates.

FHR is also proposing an emission reduction project which will reduce the sulfur content of the fuel gas prior to combustion in the Mid Crude Boiler. Therefore, the Mid Crude Boiler will see a reduction in actual SO_2 emissions from past actual emission levels. FHR is proposing to decrease the SO_2 allowable emission limit for the boiler to reflect the emission reduction project. Lastly, FHR is decreasing the CO allowable emission rate limit for the Mid Crude Boiler by updating the emission factor to more accurately reflect emissions measured by the continuous emissions monitor (CEM).

For purposes of the PSD applicability assessment, calculations are provided for the boilers based on the incremental increase in duty of 96 MMBtu/hr (HHV) and the highest emission factor for each pollutant for any of the six boilers. Calculations are also provided for the Mid Crude Boiler at the currently authorized maximum duty—unchanged by this application—of 221.5 MMBtu/hr (HHV) to establish the new CO and SO_2 allowable emission limits.

<u>General Process Description</u>

The Boilers provide steam for use throughout several process units.

<u>Emissions Data</u>

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
Various Boilers	Various Boilers	Various Boilers
43BF1	R-201	43BF1 Crude Boiler

NO_X, CO, PM, PM_{10}, and $PM_{2.5}$ emission rates from the Mid Crude Boiler are based on a NO_x permit limit of 0.0722 lb/MMBtu (HHV), an hourly CO factor of 0.1 lb/MMBtu (HHV) based on CEM data, an annual CO factor of 0.025 lb/MMBtu (HHV) based on CEM data, and a PM, PM_{10}, $PM_{2.5}$ vendor estimate of 0.0045 lb/MMBtu (HHV). The SO_2 emission rates are being revised to reflect the SO_2 reduction project. The hourly SO_2 emission rate is based on an estimated maximum fuel gas sulfur content of of 1 gr/100 scf and the annual SO_2 emission rate is based on an estimated average fuel gas sulfur content of 0.6 gr/100 scf. VOC emission rates are based on emission factors from AP-42 (5^{th} Edition), Section 1.4, Table 1.4-2 for natural gas combustion. The boiler burns refinery fuel gas, so the AP-42 emission factor is adjusted based on the heating value of the fuel gas (999 Btu/scf) and the baseline heating value of the AP-42 emission factor (1,020 Btu/scf).

Gas Combustion Emissions Calculator

Boilers (Incremental Increase), EPN Various Boilers

INPUT DATA

Combustion Unit Description:	Boilers (Incremental Increase
Facility Identification Number (FIN):	Various Boilers
Emission Point Number (EPN):	Various Boilers
Control Identification Number (CIN)	N/A
UTM Zone:	14
UTM Easting (m):	N/A
UTM Northing (m):	N/A

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	96
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	15
Stack Exit Temperature, °F:	
Stack Diameter, ft:	
Stack Height, ft:	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM

If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					10			
Nitrogen Oxides	NOx	0.0722							
Particulate Matter	PM	0.0050							
Carbon Monoxide	CO	0.1000							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					5			
Nitrogen Oxides	NOx	0.0722							
Particulate Matter	PM	0.0050							
Carbon Monoxide	CO	0.0350							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note th the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculatio

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Engineering estimate-fuel gas treating	Engineering estimate-fuel gas treating
Nitrogen Oxides	NOx	Permit Emission Limit	Permit Emission Limit
Particulate Matter	PM	Vendor Estimate	Vendor Estimate
Carbon Monoxide	CO	CEMS data	CEMS data
Total Organics	TOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Volatile Organics	VOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98

Volatile Organics Calculated-As Basis

Compound: C3H8 (CH4, C2H6, C3H8, etc.)

Molecular Weight 44.09 (lb / lb-mol)

INPUT DATA CONTINUED (Boilers (Incremental Increase), EPN Various Boilers

FUEL DATA

Fuel Gas Composition				Pure Component Data			Fuel Gas Component Data		
Formula	Name	Mole %	(A) Mole Fraction	(B) Molecular Weight (lb/lb-mol)	(C) HHV * (Btu/scf)	(D) LHV * (Btu/scf)	(A) X (B) lb/lb-mol Fuel Gas	(A) X (C) Btu (HHV) per scf Fuel Gas	(A) X (D) Btu (LHV) per scf Fuel Gas
CH4	Methane	55.10	0.5510	16.04	1012	911	8.84	557.61	501.96
C2H6	Ethane	9.07	0.0907	30.07	1773	1622	2.73	160.81	147.12
C3H8	Propane	4.38	0.0438	44.09	2524	2322	1.93	110.55	101.70
C4H10	n-Butane	0.59	0.0059	58.12	3271	3018	0.34	19.30	17.81
i-C4H10	Isobutane	0.53	0.0053	58.12	3261	3009	0.31	17.28	15.95
n-C5H12	n-Pentane	0.13	0.0013	72.15	4020	3717	0.09	5.23	4.83
i-C5H12	Isopentane	0.19	0.0019	72.15	4011	3708	0.14	7.62	7.05
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.33	0.0033	86.17	4768	4415	0.28	15.73	14.57
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.28	0.0028	28.05	1604	1503	0.08	4.49	4.21
C3H6	Propylene	0.40	0.0040	42.08	2340	2188	0.17	9.36	8.75
C4H8	n-Butene	0.05	0.0005	56.10	3084	2885	0.03	1.54	1.44
i-C4H8	Isobutene	0.02	0.0002	56.10	3069	2868	0.01	0.61	0.57
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide		0.0000	34.08	646	595	0.00	0.00	0.00
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	27.33	0.2733	2.02	325	275	0.55	88.82	75.16
O2	Oxygen	0.10	0.0010	32.00	0	0	0.03	0.00	0.00
N2	Nitrogen	1.08	0.0108	28.01	0	0	0.30	0.00	0.00
CO	Carbon Monoxide	0.05	0.0005	28.01	321	321	0.01	0.16	0.16
CO2	Carbon Dioxide	0.32	0.0032	44.01	0	0	0.14	0.00	0.00
TOTAL		99.95	0.9995				16.0	999.	901.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

Midplant fuel gas sytsem

GAS COMBUSTION CALCULATIONS (Boilers (Incremental Increase), EPN Various Boilers)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	96	86.6

(96 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/999 Btu) (lb-mol/379 scf) = 254 lb-mol/hr
(254 lb-mol/hr) (16 lb/lb-mol) = 4060 lb/hr
(254 lb-mol/hr) (379 scf/lb-mol) = 96300 scfh @ 60°F
(96300 scfh) (hr/60 min) = 1610 scfm @ 60°F
(96300 scfh) (100% - 0% dscf) / (100% scf) = 96300 dscfh @ 60°F
(254 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 98300 scfh @ 70°F
(98300 scfh) (hr/60 min) = 1640 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
Formula	Mole %	(A) Mole Fraction	(B)* Flow Rate lb-mol/hr	(C) lb-mol/ lb-mol fuel	(B) X (C) lb-mol/hr	(D) lb-mol/ lb-mol fuel	(B) X (D) lb-mol/hr	(E) lb-mol/ lb-mol fuel	(B) X (E) lb-mol/hr
CH4	55.10	0.5510	139.954	2.0	279.908	1.0	139.954	2.0	279.908
C2H6	9.07	0.0907	23.038	3.5	80.633	2.0	46.076	3.0	69.114
C3H8	4.38	0.0438	11.125	5.0	55.625	3.0	33.375	4.0	44.500
C4H10	0.59	0.0059	1.499	6.5	9.744	4.0	5.996	5.0	7.495
i-C4H10	0.53	0.0053	1.346	6.5	8.749	4.0	5.384	5.0	6.730
n-C5H12	0.13	0.0013	0.330	8.0	2.640	5.0	1.650	6.0	1.980
i-C5H12	0.19	0.0019	0.483	8.0	3.864	5.0	2.415	6.0	2.898
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.33	0.0033	0.838	9.5	7.961	6.0	5.028	7.0	5.866
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.28	0.0028	0.711	3.0	2.133	2.0	1.422	2.0	1.422
C3H6	0.40	0.0040	1.016	4.5	4.572	3.0	3.048	3.0	3.048
C4H8	0.05	0.0005	0.127	6.0	0.762	4.0	0.508	4.0	0.508
i-C4H8	0.02	0.0002	0.051	6.0	0.306	4.0	0.204	4.0	0.204
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.00	0.0000	0.000	1.5	0.000	1.0 (SO2)	0.000	1.0	0.000
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	27.33	0.2733	69.418	0.5	34.709	0.0	0.000	1.0	69.418
O2	0.10	0.0010	0.254	- 1.0	- 0.254	0.0	0.000	0.0	0.000
N2	1.08	0.0108	2.743	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.05	0.0005	0.127	0.5	0.064	1.0	0.127	0.0	0.000
CO2	0.32	0.0032	0.813	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.95	0.9995	254.		491.		245.		493.

* (B) = (A) X (254 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (Boilers (Incremental Increase), EPN Various Boilers)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (491 lb-mol stoichiometric O2/hr) (1.15) = 565 lb-mol total O2/hr
= (565 lb-mol O2/hr) (32.00 lb/lb-mol) = 18100 lb O2/hr

Nitrogen in Supplied Air: (565 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 2120 lb-mol total N2/hr
= (2120 lb-mol N2/hr) (28.01 lb/lb-mol) = 59400 lb N2/hr

Bone-dry (BD) Supplied Air: (565 lb-mol O2/hr) + (2120 lb-mol N2/hr) = 2690 lb-mol BD air/hr
= (18100 lb O2/hr) + (59400 lb N2/hr) = 77500 lb BD air/hr

Moisture in Supplied Air: (77500 lb BD air/hr) (0.0132 lb water/lb BD air) = 1020 lb water/hr
= (1020 lb water/hr) (lb-mol water/18.02 lb water) = 56.6 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (565 lb-mol O2/hr) + (2120 lb-mol N2/hr) + (56.6 lb-mol water/hr) = 2740 lb-mol/hr
= (18100 lb O2/hr) + (59400 lb N2/hr) + (1020 lb water/hr) = 78500 lb/hr
= (2740 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 17300 scfm @ 60°F
= (2740 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 17700 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	2120.00	2.743	0.000	2122.74	0.710	28.01	19.89	0.870
Oxygen	565.00	0.254	-491.000	74.25	0.025	32.00	0.8	0.030
Carbon Dioxide	0.00	0.813	245.000	245.81	0.082	44.01	3.61	0.101
Water	56.60	0.000	493.000	549.60	0.184	18.02	3.32	0.000
TOTAL				2990.	1.001		27.62	1.001

Exhaust gas flow rate = 2990 lb-mol/hr
= (2990 lb-mol/hr) (27.62 lb/lb-mol) = 82600 lb/hr
= (2990 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 18900 scfm @ 60°F
= (2990 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 19300 scfm @ 70°F
= (18900 scfm) [(+ 460)°R] acf / [(60 + 460)°R] scf = 16700 acfm @ °F
= (2990 total lb-mol/hr) - (549.6 water lb-mol/hr) = 2440 lb-mol/hr dry
= (2440 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 15400 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (ft)^2 / 4 = 0 ft^2

#DIV/0!
#DIV/0!

GAS COMBUSTION CALCULATIONS (Boilers (Incremental Increase), EPN Various Boilers)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (10 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel) (scf fuel/999 Btu) (96 MM Btu/hr) = 2.74560274560275 lb/hr

NOx: (96 MM Btu/hr) (0.0722 lb/MM Btu) = 6.9312 lb/hr (HHV Calculation Basis)

PM: (96 MM Btu/hr) (0.005 lb/MM Btu) = 0.48 lb/hr (HHV Calculation Basis)

CO: (96 MM Btu/hr) (0.1 lb/MM Btu) = 9.6 lb/hr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (96300 scf fuel/hr) = 0.51874544117647 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (5 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel) (scf fuel/999 Btu) (96 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 6.01287001287001 tons/yr

NOx: (96 MM Btu/hr) (0.0722 lb/MM Btu) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 30.358656 tons/yr (HHV Calculation Basis)

PM: (96 MM Btu/hr) (0.005 lb/MM Btu) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 2.1024 tons/yr (HHV Calculation Basis)

CO: (96 MM Btu/hr) (0.035 lb/MM Btu) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 14.7168 tons/yr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (96300 scf fuel/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 2.27210503235294 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	2.7456	64.06	0.0429	0.00143	0.00176	14.3	17.6
NOx	6.9312	46.01	0.151	0.00505	0.00619	50.5	61.9
PM	0.48	NA	NA	NA	NA	NA	NA
CO	9.6	28.01	0.343	0.0115	0.0141	115.	141.
VOC	0.51875	44.09	0.0118	0.000395	0.000484	3.95	4.84

Sample Calculations for NOx: (6.9312 lb/hr) / (46.01 lb/lb-mol) = 0.151 lb-mol/hr
(0.151 lb-mol/hr) / (2990 lb-mol/hr exhaust gas) (100%) = 0.00505% mole composition
(0.151 lb-mol/hr) / (2440 lb-mol/hr dry exhaust gas) (100%) = 0.00619% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (Boilers (Incremental Increase), EPN Various Boilers)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

Pollutant	Short-term Emission Rate (lb/hr)	Short-term Emission Rate (g/sec)	Long-term Emission Rate (tons/yr)	Long-term Emission Rate (g/sec)
SO2	2.7456027	0.346	6.01287	0.173
NOx	6.9312	0.874	30.358656	0.874
PM	0.48	0.0605	2.1024	0.0605
CO	9.6	1.21	14.7168	0.424
VOC	0.5187454	0.0654	2.272105	0.0654

Sample Calculations for NOx: (6.9312 lb/hr) (454 g/lb) (hr/3600 sec) = 0.874 g/sec
(30.358656 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 0.874 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height was not specified.

Stack Diameter = ft = (ft) (0.3048 m/ft) = 0 m

#DIV/0!

Stack Exit Temperature = °F = (- 32) / 1.8 = -17.8°C = -17.8 + 273.16 = 255 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (96300 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 844 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

Boilers (Incremental Increase), EPN Various Boilers

COMBUSTION UNIT DATA

Combustion Unit Description:	Boilers (Incremental Increase)
Facility Identification Number (FIN):	Various Boilers
Emission Point Number (EPN):	Various Boilers
Control Identification Number (CIN):	N/A
Fuel Gas Firing Capacity, MM Btu/hr:	96
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV
Average Fuel Heating Value (HHV):	999
Excess Air, % (default to 10% if unknown):	15
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100
Ambient Temperature, °F (default to 80°F if unknown):	80
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7
Relative Humidity, % (default to 60% if unknown):	60
UTM Zone:	14
UTM Easting (m):	N/A
UTM Northing (m):	N/A
Stack Diameter:	
Stack Height:	
Stack Exit Temperature:	
Stack Exit Velocity:	

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	10 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	2.745602746	0.346
NOx	0.0722 lb/MM Btu (HHV)	Permit Emission Limit	6.9312	0.874
PM	0.005 lb/MM Btu (HHV)	Vendor Estimate	0.48	0.0605
CO	0.1 lb/MM Btu (HHV)	CEMS data	9.6	1.21
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.518745441	0.0654

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	5 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	6.012870013	0.173
NOx	0.0722 lb/MM Btu (HHV)	Permit Emission Limit	30.358656	0.874
PM	0.005 lb/MM Btu (HHV)	Vendor Estimate	2.1024	0.0605
CO	0.035 lb/MM Btu (HHV)	CEMS data	14.7168	0.424
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	2.272105032	0.0654

Gas Combustion Emissions Calculator

43BF1 Crude Boiler (Potential to Emit), EPN R-201

INPUT DATA

Combustion Unit Description:	43BF1 Crude Boiler (Potential to Emit)
Facility Identification Number (FIN):	43BF1
Emission Point Number (EPN):	R-201
Control Identification Number (CIN)	N/A
UTM Zone:	14
UTM Easting (m):	644319
UTM Northing (m):	3079608

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	221.5
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	15
Stack Exit Temperature, °F:	100
Stack Diameter, ft:	11
Stack Height, ft:	175
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM
If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					1			
Nitrogen Oxides	NOx	0.0722							
Particulate Matter	PM	0.0045							
Carbon Monoxide	CO	0.1000							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					0.6			
Nitrogen Oxides	NOx	0.0722							
Particulate Matter	PM	0.0045							
Carbon Monoxide	CO	0.0250							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note th the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculatio

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Engineering estimate-fuel gas treating	Engineering estimate-fuel gas treating
Nitrogen Oxides	NOx	Permit Emission Limit	Permit Emission Limit
Particulate Matter	PM	Vendor Estimate	Vendor Estimate
Carbon Monoxide	CO	CEMS Data	CEMS data
Total Organics	TOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Volatile Organics	VOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98

Volatile Organics Calculated-As Basis

Compound:	C3H8	(CH4, C2H6, C3H8, etc.)
Molecular Weight	44.09	(lb / lb-mol)

INPUT DATA CONTINUED (43BF1 Crude Boiler (Potential to Emit), EPN R-201

FUEL DATA

Fuel Gas Composition				Pure Component Data			Fuel Gas Component Data		
Formula	Name	Mole %	(A) Mole Fraction	(B) Molecular Weight (lb/lb-mol)	(C) HHV * (Btu/scf)	(D) LHV * (Btu/scf)	(A) X (B) lb/lb-mol Fuel Gas	(A) X (C) Btu (HHV) per scf Fuel Gas	(A) X (D) Btu (LHV) per scf Fuel Gas
CH4	Methane	55.10	0.5510	16.04	1012	911	8.84	557.61	501.96
C2H6	Ethane	9.07	0.0907	30.07	1773	1622	2.73	160.81	147.12
C3H8	Propane	4.38	0.0438	44.09	2524	2322	1.93	110.55	101.70
C4H10	n-Butane	0.59	0.0059	58.12	3271	3018	0.34	19.30	17.81
i-C4H10	Isobutane	0.53	0.0053	58.12	3261	3009	0.31	17.28	15.95
n-C5H12	n-Pentane	0.13	0.0013	72.15	4020	3717	0.09	5.23	4.83
i-C5H12	Isopentane	0.19	0.0019	72.15	4011	3708	0.14	7.62	7.05
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.33	0.0033	86.17	4768	4415	0.28	15.73	14.57
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.28	0.0028	28.05	1604	1503	0.08	4.49	4.21
C3H6	Propylene	0.40	0.0040	42.08	2340	2188	0.17	9.36	8.75
C4H8	n-Butene	0.05	0.0005	56.10	3084	2885	0.03	1.54	1.44
i-C4H8	Isobutene	0.02	0.0002	56.10	3069	2868	0.01	0.61	0.57
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide		0.0000	34.08	646	595	0.00	0.00	0.00
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	27.33	0.2733	2.02	325	275	0.55	88.82	75.16
O2	Oxygen	0.10	0.0010	32.00	0	0	0.03	0.00	0.00
N2	Nitrogen	1.08	0.0108	28.01	0	0	0.30	0.00	0.00
CO	Carbon Monoxide	0.05	0.0005	28.01	321	321	0.01	0.16	0.16
CO2	Carbon Dioxide	0.32	0.0032	44.01	0	0	0.14	0.00	0.00
TOTAL		99.95	0.9995				16.0	999.	901.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

Midplant fuel gas sytsem

GAS COMBUSTION CALCULATIONS (43BF1 Crude Boiler (Potential to Emit), EPN R-201)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	221.5	199.8

(221.5 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/999 Btu) (lb-mol/379 scf) = 585 lb-mol/hr
(585 lb-mol/hr) (16 lb/lb-mol) = 9360 lb/hr
(585 lb-mol/hr) (379 scf/lb-mol) = 222000 scfh @ 60°F
(222000 scfh) (hr/60 min) = 3700 scfm @ 60°F
(222000 scfh) (100% - 0% dscf) / (100% scf) = 222000 dscfh @ 60°F
(585 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 226000 scfh @ 70°F
(226000 scfh) (hr/60 min) = 3770 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
Formula	Mole %	(A) Mole Fraction	(B)* Flow Rate lb-mol/hr	(C) lb-mol/ lb-mol fuel	(B) X (C) lb-mol/hr	(D) lb-mol/ lb-mol fuel	(B) X (D) lb-mol/hr	(E) lb-mol/ lb-mol fuel	(B) X (E) lb-mol/hr
CH4	55.10	0.5510	322.335	2.0	644.670	1.0	322.335	2.0	644.670
C2H6	9.07	0.0907	53.060	3.5	185.710	2.0	106.120	3.0	159.180
C3H8	4.38	0.0438	25.623	5.0	128.115	3.0	76.869	4.0	102.492
C4H10	0.59	0.0059	3.452	6.5	22.438	4.0	13.808	5.0	17.260
i-C4H10	0.53	0.0053	3.101	6.5	20.157	4.0	12.404	5.0	15.505
n-C5H12	0.13	0.0013	0.761	8.0	6.088	5.0	3.805	6.0	4.566
i-C5H12	0.19	0.0019	1.112	8.0	8.896	5.0	5.560	6.0	6.672
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.33	0.0033	1.931	9.5	18.345	6.0	11.586	7.0	13.517
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.28	0.0028	1.638	3.0	4.914	2.0	3.276	2.0	3.276
C3H6	0.40	0.0040	2.340	4.5	10.530	3.0	7.020	3.0	7.020
C4H8	0.05	0.0005	0.293	6.0	1.758	4.0	1.172	4.0	1.172
i-C4H8	0.02	0.0002	0.117	6.0	0.702	4.0	0.468	4.0	0.468
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.00	0.0000	0.000	1.5	0.000	1.0 (SO2)	0.000	1.0	0.000
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	27.33	0.2733	159.881	0.5	79.941	0.0	0.000	1.0	159.881
O2	0.10	0.0010	0.585	- 1.0	- 0.585	0.0	0.000	0.0	0.000
N2	1.08	0.0108	6.318	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.05	0.0005	0.293	0.5	0.147	1.0	0.293	0.0	0.000
CO2	0.32	0.0032	1.872	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.95	0.9995	585.		1130.		565.		1140.

* (B) = (A) X (585 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (43BF1 Crude Boiler (Potential to Emit), EPN R-201)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (1130 lb-mol stoichiometric O2/hr) (1.15) = 1300 lb-mol total O2/hr
= (1300 lb-mol O2/hr) (32.00 lb/lb-mol) = 41600 lb O2/hr

Nitrogen in Supplied Air: (1300 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 4890 lb-mol total N2/hr
= (4890 lb-mol N2/hr) (28.01 lb/lb-mol) = 137000 lb N2/hr

Bone-dry (BD) Supplied Air: (1300 lb-mol O2/hr) + (4890 lb-mol N2/hr) = 6190 lb-mol BD air/hr
= (41600 lb O2/hr) + (137000 lb N2/hr) = 179000 lb BD air/hr

Moisture in Supplied Air: (179000 lb BD air/hr) (0.0132 lb water/lb BD air) = 2360 lb water/hr
= (2360 lb water/hr) (lb-mol water/18.02 lb water) = 131 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (1300 lb-mol O2/hr) + (4890 lb-mol N2/hr) + (131 lb-mol water/hr) = 6320 lb-mol/hr
= (41600 lb O2/hr) + (137000 lb N2/hr) + (2360 lb water/hr) = 181000 lb/hr
= (6320 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 39900 scfm @ 60°F
= (6320 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 40800 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	4890.00	6.318	0.000	4896.32	0.710	28.01	19.89	0.870
Oxygen	1300.00	0.585	-1130.000	170.59	0.025	32.00	0.8	0.030
Carbon Dioxide	0.00	1.872	565.000	566.87	0.082	44.01	3.61	0.101
Water	131.00	0.000	1140.000	1271.00	0.184	18.02	3.32	0.000
TOTAL				6900.	1.001		27.62	1.001

Exhaust gas flow rate = 6900 lb-mol/hr
= (6900 lb-mol/hr) (27.62 lb/lb-mol) = 191000 lb/hr
= (6900 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 43600 scfm @ 60°F
= (6900 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 44500 scfm @ 70°F
= (43600 scfm) [(100 + 460)°R] acf / [(60 + 460)°R] scf = 47000 acfm @ 100°F
= (6900 total lb-mol/hr) - (1271 water lb-mol/hr) = 5630 lb-mol/hr dry
= (5630 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 35600 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (11 ft)^2 / 4 = 95 ft^2

Stack Exit Velocity = (47000 acfm) (min/60 sec) / (95 ft^2) = 8.25 ft/sec
= (8.25 ft/sec) (0.3048 m/ft) = 2.51 m/sec

GAS COMBUSTION CALCULATIONS (43BF1 Crude Boiler (Potential to Emit), EPN R-201)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (1 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (221.5 MM Btu/hr) = 0.633490633490634 lb/hr

NOx: (221.5 MM Btu/hr) (0.0722 lb/MM Btu) = 15.9923 lb/hr (HHV Calculation Basis)

PM: (221.5 MM Btu/hr) (0.00451 lb/MM Btu) = 0.998965 lb/hr (HHV Calculation Basis)

CO: (221.5 MM Btu/hr) (0.1 lb/MM Btu) = 22.15 lb/hr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (222000 scf fuel/hr) = 1.19586176470588 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (0.6 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (221.5 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 1.66481338481338 tons/yr

NOx: (221.5 MM Btu/hr) (0.0722 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 70.046274 tons/yr (HHV Calculation Basis)

PM: (221.5 MM Btu/hr) (0.00451 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 4.3754667 tons/yr (HHV Calculation Basis)

CO: (221.5 MM Btu/hr) (0.025 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 24.25425 tons/yr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (222000 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 5.23787452941177 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	0.63349	64.06	0.00989	0.000143	0.000176	1.43	1.76
NOx	15.9923	46.01	0.348	0.00504	0.00618	50.4	61.8
PM	0.99897	NA	NA	NA	NA	NA	NA
CO	22.15	28.01	0.791	0.0115	0.014	115.	140.
VOC	1.19586	44.09	0.0271	0.000393	0.000481	3.93	4.81

Sample Calculations for NOx: (15.9923 lb/hr) / (46.01 lb/lb-mol) = 0.348 lb-mol/hr
(0.348 lb-mol/hr) / (6900 lb-mol/hr exhaust gas) (100%) = 0.00504% mole composition
(0.348 lb-mol/hr) / (5630 lb-mol/hr dry exhaust gas) (100%) = 0.00618% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (43BF1 Crude Boiler (Potential to Emit), EPN R-201)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

	Short-term Emission Rate		Long-term Emission Rate	
Pollutant	(lb/hr)	(g/sec)	(tons/yr)	(g/sec)
SO2	0.6334906	0.0799	1.6648134	0.0479
NOx	15.9923	2.02	70.046274	2.02
PM	0.998965	0.126	4.3754667	0.126
CO	22.15	2.79	24.25425	0.698
VOC	1.1958618	0.151	5.2378745	0.151

Sample Calculations for NOx: (15.9923 lb/hr) (454 g/lb) (hr/3600 sec) = 2.02 g/sec
(70.046274 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 2.02 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 175 ft = (175 ft) (0.3048 m/ft) = 53.3 m

Stack Diameter = 11 ft = (11 ft) (0.3048 m/ft) = 3.35 m

Stack Exit Velocity = (8.25 ft/sec) (0.3048 m/ft) = 2.51 m/sec

Stack Exit Temperature = 100°F = (100 - 32) / 1.8 = 37.8°C = 37.8 + 273.16 = 311 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (222000 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 1940 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

43BF1 Crude Boiler (Potential to Emit), EPN R-201

COMBUSTION UNIT DATA

Combustion Unit Description:	43BF1 Crude Boiler (Potential to Emit)	
Facility Identification Number (FIN):	43BF1	
Emission Point Number (EPN):	R-201	
Control Identification Number (CIN):	N/A	
Fuel Gas Firing Capacity, MM Btu/hr:	221.5	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	999	
Excess Air, % (default to 10% if unknown):	15	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	644319	
UTM Northing (m):	3079608	
Stack Diameter:	11 ft	(3.35 m)
Stack Height:	175 ft	(53.3 m)
Stack Exit Temperature:	100° F	(311 K)
Stack Exit Velocity:	8.25 ft/sec	(2.51 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	1 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.633490633	0.0799
NOx	0.0722 lb/MM Btu (HHV)	Permit Emission Limit	15.9923	2.02
PM	0.00451 lb/MM Btu (HHV)	Vendor Estimate	0.998965	0.126
CO	0.1 lb/MM Btu (HHV)	CEMS Data	22.15	2.79
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	1.195861765	0.151

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	0.6 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	1.664813385	0.0479
NOx	0.0722 lb/MM Btu (HHV)	Permit Emission Limit	70.046274	2.02
PM	0.00451 lb/MM Btu (HHV)	Vendor Estimate	4.3754667	0.126
CO	0.025 lb/MM Btu (HHV)	CEMS data	24.25425	0.698
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	5.237874529	0.151

WASTEWATER TREATMENT

There are no proposed physical changes or changes in the method of operation for the API Separator Flare (EPN V-8). However, as a result of this project, the flare could potentially be used to control more emissions from increased flow through the Monroe API Separator. Through this increased utilization, the flare could see an increase in actual emissions above past actual emissions. The increased actual emissions will be below the currently authorized allowable emission rates. Because the flare is an affected emission unit downstream of the project, these changes in actual emissions are included in the PSD applicability assessment. The incremental increase in actual emissions as a result of the project is calculated based on an incremental increase of 540 scf/hr of vent gas into the API Separator Flare.

FHR is revising the calculation method for the potential to emit of all pollutants based on the flow rate and composition of the vent gas stream.

General Process Description

The wastewater streams affected by this project enter the Monroe API Separator where slop oil and sludge are removed and sent to storage. Emissions from the Monroe API Separator are controlled by the API Separator Flare (EPN V-8). FHR operates a caustic scrubber on the Monroe API Separator to reduce sulfur in the waste gas stream routed to the API Separator Flare. The API Separator Flare meets the requirements of 40 C.F.R. 60.18 based on historical performance tests and provides a minimum VOC destruction efficiency of 98% based on TCEQ guidance.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section:

FIN	EPN	Source Name
45BD3	V8	API Separator Flare

NO_X and CO emission rates from the API Separator Flare are based on emission factors from TCEQ's guidance document for flares and vapor oxidizers dated October 2000. SO_2 emission rates for the vent gas stream are based on a sulfur concentration of 10 gr/100 scf in the off-gas from the caustic scrubber. SO_2 emission rates for the pilot gas are based on a maximum hourly sulfur concentration of 5 gr/100 scf based on suppliers' specifications and an annual sulfur content of 0.5 gr/100 scf based on sampling. VOC emission rates are based on a vent gas flow rate to the flare and vent gas composition data derived from sampling. A 98% control efficiency is applied to all VOC species with the exception of ethylene, propane, and propylene in which a 99% control efficiency was applied per TCEQ Flare Guidance Document dated October 2000.

Monroe Separator Flare (EPN V-8)
Incremental Increase
Vent Gas Emissions

Release Data:		
Volume of Material Flared =	540	scfh
Operating Hours =	8760	hours
Flare Assist (Steam, Air, or Unassisted) =		air

Material Destructed By Flare

Component	Estimated vol% or mole%	Material Flared scf/hr [1]	MW lb/lb-mole	lb/hr	Heating Value LHV Btu/scf [2]	LHV*mole% Btu/scf	MMBtu/hr	Destruction Efficiency [3]	Released from Flare lb/hr	Released from Flare ton/yr
				VOCs						
Ethylene (C2H4)	0.170	0.9	28.05	0.07	1503	2.6	0.00	99.0	**0.0007**	**0.0030**
Acetylene (C2H6)	0.000	0.0	26.04	0.00	1426	0	0.00	98.0	**0.0000**	**0.0000**
Propane (C3H8)	8.410	45.4	44.09	5.28	2322	195.3	0.11	99.0	**0.0528**	**0.2311**
Propylene (C3H6)	0.320	1.7	42.08	0.19	2188	7	0.00	99.0	**0.0019**	**0.0084**
n-Butane (C4H10)	2.160	11.7	58.12	1.79	3018	65.2	0.04	98.0	**0.0357**	**0.1565**
Isobutane (i-C4H10)	1.570	8.5	58.12	1.30	3009	47.2	0.03	98.0	**0.0260**	**0.1137**
Butenes (C4H8)	0.070	0.4	56.10	0.06	2869	2	0.00	98.0	**0.0011**	**0.0049**
1,3 Butadiene (C4H6)	0.000	0.0	54.09	0.00	2729	0	0.00	98.0	**0.0000**	**0.0000**
n-Pentane (n-C5H12)	0.270	1.5	72.14	0.28	3717	10	0.01	98.0	**0.0055**	**0.0243**
Isopentane (i-C5H12)	0.440	2.4	72.14	0.45	3708	16.3	0.01	98.0	**0.0090**	**0.0396**
n-Pentene (C5H10)	0.000	0.0	70.13	0.00	3585	0	0.00	98.0	**0.0000**	**0.0000**
n-Hexane plus (C6H14 +)	0.464	2.5	86.17	0.57	4415	20.5	0.01	98.0	**0.0114**	**0.0498**
Total VOC	**13.874**	**74.9**		**9.97**		**366.10**	**0.20**		**0.1441**	**0.6312**
			Non VOCs							
Hydrogen (H2)	16.480	89.0	2.02	0.47	275	45.3	0.02	98.0	**0.0095**	**0.0414**
Oxygen (O2)	0.000	0.0	32.00	0.00	0	0	0.00	100.0	**0.0000**	**0.0000**
Nitrogen (N2)	10.570	57.1	28.02	4.21	0	0	0.00		**4.2137**	**18.4560**
Carbon Monoxide (CO)	0.000	0.0	28.01	0.00	0	0	0.00	98.0	**0.0000**	**0.0000**
Carbon Dioxide (CO2)	1.380	7.5	44.01	0.86	0	0	0.00		**0.8642**	**3.7852**
Methane (CH4)	50.390	272.1	16.04	11.50	911	459.1	0.25	98.0	**0.2300**	**1.0075**
Ethane (C2H6)	7.310	39.5	30.07	3.13	1622	118.6	0.06	99.0	**0.0313**	**0.1370**
Hydrogen Sulfide (H2S)	0.016	0.1	34.08	0.01	595	0.1	0.00	98.0	**0.0002**	**0.0007**
Total Non VOC	**86.15**	**465**		**20.19**		**623.10**	**0.34**		**5.3488**	**23.4278**
TOTAL	**100.02**	**540**		**30.16**		**989.20**	**0.53**		**5.4929**	**24.0590**
						Heat Input	**4,678.96**	**MMBtu**		

Maximum Hourly Sulfur Content:	**10.0**	**gr/100 dscf**
Annual Average Sulfur Content:	**10.0**	**gr/100 dscf**

Material Created By Flaring The Gas Stream

Pollutant	Emission Factor	units	Released from Flare lb/hr	Released from Flare tons/yr	Basis
NO_X	0.0641	lb/MM Btu (LHV)	0.034	0.149	TCEQ Flare Guidance Manual
CO	0.5496	lb/MM Btu (LHV)	0.294	1.288	TCEQ Flare Guidance Manual
SO2 (Hourly)	28.57	lb/MM scf gas	0.015	N/A	mass balance (S -->SO2)
SO2 (Annual)	28.57	lb/MM scf gas	N/A	0.0676	mass balance (S -->SO2)

Notes

(1) A scf is based on 60 ° F, 14.7 psia (379.5 scf/lb-mole).

(2) LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); LHV data for C7H16 are from *Engineering Data Book* (Gas Processors Suppliers Association, Ninth Edition, 1979).

(3) Destruction efficiencies taken from TCEQ Flare Guidance Manual dated October 2000.

Monroe Separator Flare (EPN V-8
Potential to Emit
Vent Gas Emissions

Release Data:		
Volume of Material Flared =	4,000	scfh
Operating Hours =	8760	hours
Flare Assist (Steam, Air, or Unassisted) =		air

Material Destructed By Flare

Component	Estimated vol% or mole%	Material Flared scf/hr (1)	MW lb/lb-mole	lb/hr	Heating Value LHV Btu/scf (2)	LHV*mole% Btu/scf	MMBtu/hr	Destruction Efficiency (3)	Released from Flare lb/hr	Released from Flare ton/yr
VOCs										
Ethylene (C2H4)	0.170	6.8	28.05	0.50	1503	2.6	0.01	99.0	**0.0050**	**0.0220**
Acetylene (C2H6)	0.000	0.0	26.04	0.00	1426	0	0.00	98.0	**0.0000**	**0.0000**
Propane (C3H8)	8.410	336.4	44.09	39.08	2322	195.3	0.78	99.0	**0.3908**	**1.7119**
Propylene (C3H6)	0.320	12.8	42.08	1.42	2188	7	0.03	99.0	**0.0142**	**0.0622**
n-Butane (C4H10)	2.160	86.4	58.12	13.23	3018	65.2	0.26	98.0	**0.2646**	**1.1591**
Isobutane (i-C4H10)	1.570	62.8	58.12	9.62	3009	47.2	0.19	98.0	**0.1923**	**0.8425**
Butenes (C4H8)	0.070	2.8	56.10	0.41	2869	2	0.01	98.0	**0.0083**	**0.0363**
1,3 Butadiene (C4H6)	0.000	0.0	54.09	0.00	2729	0	0.00	98.0	**0.0000**	**0.0000**
n-Pentane (n-C5H12)	0.270	10.8	72.14	2.05	3717	10	0.04	98.0	**0.0411**	**0.1799**
Isopentane (i-C5H12)	0.440	17.6	72.14	3.35	3708	16.3	0.07	98.0	**0.0669**	**0.2931**
n-Pentene (C5H10)	0.000	0.0	70.13	0.00	3585	0	0.00	98.0	**0.0000**	**0.0000**
n-Hexane plus (C6H14 +)	0.464	18.5	86.17	4.21	4415	20.5	0.08	98.0	**0.0842**	**0.3688**
Total VOC	**13.874**	**554.9**		**73.88**		**366.10**	**1.46**		**1.0675**	**4.6756**
Non VOCs										
Hydrogen (H2)	16.480	659.2	2.02	3.50	275	45.3	0.18	98.0	**0.0700**	**0.3068**
Oxygen (O2)	0.000	0.0	32.00	0.00	0	0	0.00	100.0	**0.0000**	**0.0000**
Nitrogen (N2)	10.570	422.8	28.02	31.21	0	0	0.00		**31.2126**	**136.7112**
Carbon Monoxide (CO)	0.000	0.0	28.01	0.00	0	0	0.00	98.0	**0.0000**	**0.0000**
Carbon Dioxide (CO2)	1.380	55.2	44.01	6.40	0	0	0.00		**6.4015**	**28.0386**
Methane (CH4)	50.390	2,015.6	16.04	85.20	911	459.1	1.84	98.0	**1.7039**	**7.4632**
Ethane (C2H6)	7.310	292.4	30.07	23.17	1622	118.6	0.47	99.0	**0.2317**	**1.0147**
Hydrogen Sulfide (H2S)	0.016	0.6	34.08	0.06	595	0.1	0.00	98.0	**0.0012**	**0.0050**
Total Non VOC	**86.15**	**3446**		**149.54**		**623.10**	**2.49**		**39.6209**	**173.5395**
TOTAL	**100.02**	**4,001**		**223.41**		**989.20**	**3.96**		**40.6884**	**178.2151**
						Heat Input	**34,658.98**	**MMBtu**		

Maximum Hourly Sulfur Content:	**10.0**	**gr/100 dscf**
Annual Average Sulfur Content:	**10.0**	**gr/100 dscf**

Material Created By Flaring The Gas Stream

Pollutant	Emission Factor	units	Released from Flare lb/hr	Released from Flare tons/yr	Basis
NO_X	0.0641	lb/MM Btu (LHV)	0.254	1.113	TCEQ Flare Guidance Manual
CO	0.5496	lb/MM Btu (LHV)	2.174	9.522	TCEQ Flare Guidance Manual
SO2 (Hourly)	28.57	lb/MM scf gas	0.114	N/A	mass balance (S -->SO2)
SO2 (Annual)	28.57	lb/MM scf gas	N/A	0.5006	mass balance (S -->SO2)

Notes

(1) A scf is based on 60 ° F, 14.7 psia (379.5 scf/lb-mole).

(2) LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); LHV data for C7H16 are from *Engineering Data Book* (Gas Processors Suppliers Association, Ninth Edition, 1979).

(3) Destruction efficiencies taken from TCEQ Flare Guidance Manual dated October 2000.

Monroe Separator Flare (EPN V-8
Potential to Emit
Pilot Gas Emissions

Release Data:		
Volume of Material Flared =	51	scfh (actual annual flow)
Operating Hours =	8760	hours
Flare Assist (Steam, Air, or Unassisted) =		air

Material Destructed By Flare

Component	Estimated vol% or mole%	Material Flared scf/hr (1)	MW lb/lb-mole	lb/hr	Heating Value LHV Btu/scf (2)	LHV*mole% Btu/scf	MMBtu/hr	Destruction Efficiency (3)	Released from Flare lb/hr	Released from Flare ton/yr
VOCs										
Ethylene (C2H4)	0.000	0.0	28.05	0.00	1503	0	0.00	99.0	**0.0000**	**0.0000**
Acetylene (C2H6)	0.000	0.0	26.04	0.00	1426	0	0.00	98.0	**0.0000**	**0.0000**
Propane (C3H8)	0.388	0.2	44.09	0.02	2322	9	0.00	99.0	**0.0002**	**0.0010**
Propylene (C3H6)	0.005	0.0	42.08	0.00	2188	0.1	0.00	99.0	**0.0000**	**0.0000**
n-Butane (C4H10)	0.037	0.0	58.12	0.00	3018	1.1	0.00	98.0	**0.0001**	**0.0003**
Isobutane (i-C4H10)	0.044	0.0	58.12	0.00	3009	1.3	0.00	98.0	**0.0001**	**0.0003**
Butenes (C4H8)	0.000	0.0	56.10	0.00	2869	0	0.00	98.0	**0.0000**	**0.0000**
1,3 Butadiene (C4H6)	0.001	0.0	54.09	0.00	2729	0	0.00	98.0	**0.0000**	**0.0000**
n-Pentane (n-C5H12)	0.025	0.0	72.14	0.00	3717	0.9	0.00	98.0	**0.0000**	**0.0002**
Isopentane (i-C5H12)	0.021	0.0	72.14	0.00	3708	0.8	0.00	98.0	**0.0000**	**0.0002**
n-Pentene (C5H10)	0.000	0.0	70.13	0.00	3585	0	0.00	98.0	**0.0000**	**0.0000**
n-Hexane plus (C6H14 +)	0.137	0.1	86.17	0.02	4415	6	0.00	98.0	**0.0003**	**0.0014**
Total VOC	**0.658**	**0.3**		**0.05**		**19.20**	**0.00**		**0.0008**	**0.0034**
Non VOCs										
Hydrogen (H2)	0.118	0.1	2.02	0.00	275	0.3	0.00	98.0	**0.0000**	**0.0000**
Oxygen (O2)	0.142	0.1	32.00	0.01	0	0	0.00	100.0	**0.0000**	**0.0000**
Nitrogen (N2)	0.475	0.2	28.02	0.02	0	0	0.00		**0.0179**	**0.0784**
Carbon Monoxide (CO)	0.008	0.0	28.01	0.00	0	0	0.00	98.0	**0.0000**	**0.0000**
Carbon Dioxide (CO2)	0.967	0.5	44.01	0.06	0	0	0.00		**0.0572**	**0.2505**
Methane (CH4)	91.728	46.8	16.04	1.98	911	835.6	0.04	98.0	**0.0395**	**0.1732**
Ethane (C2H6)	5.874	3.0	30.07	0.24	1622	95.3	0.00	99.0	**0.0024**	**0.0104**
Hydrogen Sulfide (H2S)	0.0004	0.0002	34.08	0.00002	595	0.002	0.0000001	98.0	**0.0000004**	**0.000002**
Total Non VOC	**99.31**	**51**		**2.30**		**931.20**	**0.05**		**0.1170**	**0.5126**
TOTAL	**99.97**	**51**		**2.35**		**950.40**	**0.05**		**0.1178**	**0.5160**
						Heat Input	**424.68**	**MMBtu**		

Maximum Hourly Sulfur Content:	**5.00**	**gr/100 dscf**
Annual Average Sulfur Content:	**0.5**	**gr/100 dscf**

Material Created By Flaring The Gas Stream

Pollutant	Emission Factor	units	Released from Flare lb/hr	Released from Flare tons/yr	Basis
NO_X	0.0641	lb/MM Btu (LHV)	0.003	0.013	TCEQ Flare Guidance Manual
CO	0.5496	lb/MM Btu (LHV)	0.027	0.118	TCEQ Flare Guidance Manual
SO2 (Hourly)	14.29	lb/MM scf gas	0.001	N/A	mass balance (S -->SO2)
SO2 (Annual)	1.43	lb/MM scf gas	N/A	0.0003	mass balance (S -->SO2)

Notes

(1) A scf is based on 60 ° F, 14.7 psia (379.5 scf/lb-mole).

(2) LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); LHV data for C7H16 are from *Engineering Data Book* (Gas Processors Suppliers Association, Ninth Edition, 1979).

(3) Destruction efficiencies taken from TCEQ Flare Guidance Manual dated October 2000.

TANK FARMS

FHR is proposing to construct two new internal floating roof (IFR) tanks and increase the throughput for and/or change the vapor pressure of the materials stored in other existing tanks. FHR is also proposing to establish grouped annual emission rate limits for some of the tanks while maintaining an hourly emission rate limit for each individual tank in the group.

The two new IFR tanks will have capacities of 100,000 bbl and 75,000 bbl, respectively, and will have internal floating roofs. The new IFR tanks will be equipped with a suspended floating roof to minimize emissions from fittings and a primary and secondary seal to minimize emissions from rim seals. These tanks will store materials with a true vapor pressure less than 10.9 psia.

Tanks 08FB108R1, 08FB109R, 40FB4012, and 40FB4013 are existing internal floating roof tanks authorized to store materials with a true vapor pressure less than 10.9 psia. Tank 15FB507 is an existing external floating roof tank authorized to store materials with a true vapor pressure less than 10.9 psia. Tank 40FB3041 is an existing fixed-roof tank authorized to store materials with an annual true vapor pressure less than 0.02 psia and a maximum true vapor pressure less than 0.07 psia. There are no physical changes or changes in method of operation proposed for storage tanks 08FB108R1, 08FB109R, 15FB507, 40FB3041, 40FB4012, and 40FB4013. However, as a result of this project, the tanks will experience an increase in emissions of VOCs above past actual emissions. The incremental increase in actual emissions as a result of the project is calculated based on an incremental increase in withdrawal loss through increased utilization. Because these tanks are affected emission units downstream of the project, these changes in actual emissions are included in the PSD applicability assessment. The increased actual emissions will be below the currently authorized allowable emission rates. Therefore, for these tanks, FHR is not proposing any increases in the current permit allowable emission rates.

Tanks 08FB137 and 08FB147 are existing internal floating roof tanks and Tank 08FB142 is an existing external floating roof tank. All three tanks are authorized to store materials with a true vapor pressure less than 10.9 psia. There are no physical changes or changes in the method of operation proposed for storage tanks 08FB137, 08FB142, and 08FB147. However, as a result of this project, the tanks will experience an increase in emissions of VOCs above past actual emissions. The incremental increase in actual VOC emissions as a result of the project is calculated based on an incremental increase in the withdrawal loss through increased utilization. Because these tanks are affected emission units downstream of the project, these changes in actual VOC emissions are included in the PSD applicability assessment. The increased actual emissions will be below the currently authorized allowable emission rates. Therefore, FHR is not proposing any increases in the current permit allowable VOC emission rates. FHR is also proposing for the first time H_2S emission limits for storage tanks 08FB137, 08FB142, and 08FB147. The H_2S emissions are not new emissions resulting from a physical change or change in the method of operation, but are now being estimated consistent with TCEQ practices. To be conservative, the full H_2S potential-to-emit is included as the project increase in the PSD applicability assessment.

Tanks 11FB402 and 11FB403 are existing internal floating roof tanks and are authorized to store materials with a true vapor pressure less than 10.9 psia. There are no physical changes or changes in the method of operation proposed for storage tanks 11FB402 and 11FB403. However, as a result of this project, the tanks will experience an increase in actual emissions of VOCs above past actual emissions. The incremental increase in actual emissions as a result of the project is calculated based on an incremental increase in the withdrawal loss through increased utilization. Because these tanks are affected emission units downstream of the project, these changes in actual emissions are included in the PSD applicability assessment.

Tanks 11FB408, 11FB409, and 11FB410 are existing external floating roof tanks. FHR is proposing to increase the currently permitted annual throughput for Tanks 11FB408, 11FB409, and 11FB410 and to decrease the currently permitted true vapor pressure of the materials stored in the tanks to 0.5 psia, which result in an overall decrease in allowable emission rates. FHR is also proposing an annual grouped emission limit for these three tanks and an individual hourly emission limit for each of the tanks. Because the permitted annual throughput is increasing, these tanks are considered modified for minor NSR purposes, and FHR has included an actual to potential analysis for the tanks in the PSD applicability assessment. The tanks' future potential emissions are based on the proposed allowable throughput and vapor pressure.

Tank 15FB508 is an existing external floating roof tank, and Tank 15FB510 is an existing fixed-roof tank. There are no physical changes or changes in the method of operation proposed for existing storage tank 15FB508. FHR is proposing to decrease the true vapor pressure of the materials stored in Tank 15FB508 to 0.5 psia. FHR is proposing to increase the currently permitted annual throughput for Tank 15fB510 and increase the true vapor pressure of the materials stored in the tank to 0.5 psia, which is higher than prior permit representations. Therefore, Tank 15FB510 is considered a modified source for minor NSR purposes. FHR will be installing an internal floating roof in Tank 15FB510 as part of a pollution control project separate from the project proposed in this application. This pollution control project will be completed prior to operating the changes proposed in this application. FHR is also proposing an annual grouped emission limit for these two tanks and an individual hourly emission limit for each of the tanks. There is an overall decrease in emissions as a result of the pollution control project and proposed changes for these tanks. Although there are no physical changes or changes in the method of operation proposed for Tank 15FB508, the tank is considered modified for minor NSR purposes because it is being included in a group with Tank 15FB510, which is considered modified because of the increase in permitted throughput and vapor pressure. FHR has included an actual to potential analysis for the tanks in the PSD applicability assessment. The tanks' future potential emissions are based on the proposed allowable throughput and vapor pressure.

Tanks 40FB3043 and 40FB3044 are existing fixed-roof tanks. FHR is proposing to increase the currently permitted annual throughput for Tanks 40FB3043 and 40FB3044 and increase the true vapor pressure of the materials stored in the tanks to 0.5 psia, which is higher than prior permit representations. Because the annual throughput and true vapor pressure of the tanks will be increasing above permitted rates as a result of this project, the tanks are considered modified sources for minor NSR purposes. FHR will be installing an internal floating roof in both tanks as part of a pollution control project separate from the project proposed as part of this application. The pollution control project will be completed prior to operating the changes proposed in this application. FHR is also proposing an annual grouped emission limit for these two tanks and an individual hourly emission limit for each of the tanks. There is an overall decrease in emissions as a result of the pollution control project and proposed changes for these tanks. FHR has included an actual to potential analysis for the tanks in the PSD applicability assessment. The tanks' future potential emissions are based on the proposed allowable throughput and vapor pressure.

Tanks 40FB4010 and 40FB4011 are existing external floating roof tanks. FHR is proposing to increase the currently authorized annual throughput for Tanks 40FB4010 and 40FB4011 and limit the annual and hourly true vapor pressure of the materials stored in the tanks to 9 psia and

10.9 psia, respectively. Because the permitted annual throughputs are increasing as a result of this project, these tanks are considered modified sources for minor NSR purposes. FHR is also proposing an annual grouped VOC emission limit for these tanks and an individual hourly VOC emission limit for each of the tanks. There is an overall decrease in VOC emissions as a result of the proposed changes for these tanks. FHR has included an actual to potential analysis for the tanks in the VOC PSD applicability assessment. The tanks' future potential emissions are based on the proposed allowable throughput and vapor pressure. FHR is also proposing for the first time H_2S emission limits for storage tanks 40FB4010 and 40FB4011. The H_2S emissions are not new emissions resulting from a physical change or change in the method of operation, but are now being estimated consistent with TCEQ practices. FHR is proposing an annual grouped H_2S emission limit for these tanks and an individual hourly H_2S emission limit for each of the tanks. To be conservative, the full H_2S potential-to-emit is included as the project increase in the PSD applicability assessment.

Tanks 40FB4014 and 40FB4015 are existing fixed-roof tanks. FHR is proposing to increase the true vapor pressure of the materials stored in Tanks 40FB4014 and 40FB4015 to 0.5 psia, which is higher than prior permit representations. Therefore, these tanks are considered modified sources for minor NSR purposes. FHR will be installing an internal floating roof in the tanks as part of a pollution control project separate from the project proposed in this application. This pollution control project will be completed prior to operating the changes proposed in this application. There is an overall decrease in emissions as a result of the pollution control project and proposed changes for these tanks. FHR has included an actual to potential analysis for the tanks in the VOC PSD applicability assessment. The tanks' future potential emissions are based on the proposed allowable vapor pressure.

Tanks 40FB4016 and 15FB509 are existing fixed-roof tanks. FHR is proposing to increase the true vapor pressure of the materials stored in Tanks 40FB4016 and 15FB509 to 0.5 psia, which is higher than prior permit representations. Therefore, these tanks are considered modified sources for minor NSR purposes. FHR will be installing an internal floating roof in the tanks as part of a pollution control project separate from the project proposed in this application. This pollution control project will be completed prior to operating the changes proposed in this application. FHR also is proposing an annual grouped emission limit for these tanks and an individual hourly emission limit for each of the tanks. There is an overall decrease in emissions as a result of the pollution control projects and proposed changes for these tanks. FHR has included an actual to potential analysis for the tanks in the VOC PSD applicability assessment. The tanks' future potential emissions are based on the proposed allowable vapor pressure.

FHR is proposing the installation of new equipment piping components (EPN F-TK-VOC) as part of constructing two new storage tanks. FHR also is proposing the installation of new equipment piping components (EPN F-GB) to upgrade the gasoline blending system. FHR is proposing an LDAR program to reduce fugitive emissions of VOC from new equipment piping components. FHR also is proposing annual instrument monitoring for all new and existing gas/vapor and light liquid flanges/connectors associated with the gasoline blender system.

Emissions Data

Emission rate calculations for storage tanks and the following sources listed below are provided at the end of this section:

FIN	EPN	Source Name
P-VOC	F-TK-VOC	VOC Tank & Loading Fugitives
P-GB	F-GB	Gasoline Blender Fugitives

Annual emission rates from storage tanks are estimated using AP-42, Chapter 7 methodology. Hourly emission rates are estimated using TCEQ guidance. For internal and external floating roof tanks that are part of a combined annual limit, the grouped annual emission limit is based on a maximum total throughput going through any of the tanks in the group. Emission rates are calculated for each tank at this maximum total throughput. The grouped annual VOC emission limit is calculated by adding the rim seal losses, deck fitting losses, and deck seam losses from each tank to the maximum withdrawal loss from any one tank at the maximum total throughput.

H_2S emission rate estimates from the storage of crude oil are based on a maximum hourly concentration of 500 ppmv H_2S in the liquid and an annual average concentration of 100 ppmw H_2S in the liquid. The K factor method from "Using K Factors to Estimate Quantities of Individual Vapor Species Emitted During the Storage and Transfer of Hydrocarbon Liquids" by Jeffrey Meling, Karen Horne, and Jay Hoover is used for the calculations. VOC emissions from storage of crude oil at an RVP of 5 are used to conservatively estimate the highest H_2S emission rates from the tanks. H_2S emissions are calculated from withdrawal losses by multiplying the calculated VOC withdrawal losses by the concentration of H_2S in the liquid. H_2S emissions from breathing losses are calculated using the K factors and the VOC rim seal losses, VOC deck fitting losses, and VOC deck seam losses while storing crude oil at an RVP of 5. Total H_2S emissions from tanks are calculated by adding the H_2S emissions from withdrawal losses and the H_2S emissions from breathing losses. The grouped annual H_2S emission limit for Tanks 40FB4010 and 40FB4011 is calculated by adding the rim seal losses, deck fitting losses, and deck seam losses from each tank to the maximum withdrawal loss from any one tank at the maximum total throughput.

VOC emission rates from the new equipment piping components are estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000. Control efficiencies are based on a 28 VHP LDAR monitoring program.

FHR is committing to annual instrument monitoring for all new and existing gas/vapor and light liquid flanges/connectors associated with the Gasoline Blender Fugitives (EPN F-GB). Therefore, a 75% control efficiency is applied to the new and existing gas/vapor and light liquid flanges/connectors associated with the gasoline blender system. VOC emission rates from existing equipment piping components associated with the gasoline blender system are included to reflect the application of the 75% control efficiency to the existing gas/vapor and light liquid flanges/connectors that will be monitored annually. Where the service will allow, any new pumps will be seal-less pumps to prevent emissions to the atmosphere. New pumps with seals will be monitored to control VOC emissions.

Calculation of Grouped Annual VOC VOC Emission Limits for Storage Tanks

A grouped annual VOC emission limit is proposed for the storage tanks below. The grouped annual VOC emission limit is based on a maximum total throughput going through any of the tanks in the group. Emission rates are calculated for each tank at this maximum total throughput. The Grouped Annual VOC emission limit is calculated by adding the rim seal losses, deck fitting losses, and deck seam losses from each tank plus the maximum withdrawal loss from any one tank at the maximum total throughput. Values used to determine the grouped emission limit are in bold font.

Grouped Annual VOC Emission Limit for Tanks 11FB402 and 11FB403

Tank	Proposed Throughput (bbl/yr)	Rim Seal Loss at Proposed Total Throughput (tons/yr)	Deck Fitting Loss at Proposed Total Throughput (tons/yr)	Deck Seam Loss at Proposed Total Throughput (tons/yr)	Withdrawal Loss at Proposed Total Throughput (tons/yr)	Contribution of Emission Rates to Proposed Grouped Limit (tons/yr)
11FB402	10,037,500	**6.42**	**10.80**	**0.00**	**0.42**	**17.63**
11FB403		**2.43**	**10.80**	**2.26**	0.42	**15.49**
Proposed Totals	**10,037,500**					**33.13**

Grouped Annual VOC Emission Limit for Tanks 11FB408, 11FB409, 11FB410

Tank	Proposed Throughput (bbl/yr)	Rim Seal Loss at Proposed Total Throughput (tons/yr)	Deck Fitting Loss at Proposed Total Throughput (tons/yr)	Deck Seam Loss at Proposed Total Throughput (tons/yr)	Withdrawal Loss at Proposed Total Throughput (tons/yr)	Contribution of Emission Rates to Proposed Grouped Limit (tons/yr)
11FB408	15,000,000	**0.36**	**0.16**	N/A	**0.63**	**1.15**
11FB409		**0.41**	**0.23**	N/A	0.56	**0.63**
11FB410		**0.41**	**0.16**	N/A	0.56	**0.57**
Proposed Totals	**15,000,000**					**2.35**

Grouped Annual VOC Emission Limit for Tanks 15FB508 and 15FB510

Tank	Proposed Throughput (bbl/yr)	Rim Seal Loss at Proposed Total Throughput (tons/yr)	Deck Fitting Loss at Proposed Total Throughput (tons/yr)	Deck Seam Loss at Proposed Total Throughput (tons/yr)	Withdrawal Loss at Proposed Total Throughput (tons/yr)	Contribution of Emission Rates to Proposed Grouped Limit (tons/yr)
15FB508	54,750,000	**0.58**	**0.26**	N/A	1.45	**0.84**
15FB510		**0.07**	**0.31**	**0.00**	**1.45**	**1.83**
Proposed Totals	**54,750,000**					**2.67**

Grouped Annual VOC Emission Limit for Tanks 40FB3043 and 40FB3044

Tank	Proposed Throughput (bbl/yr)	Rim Seal Loss at Proposed Total Throughput (tons/yr)	Deck Fitting Loss at Proposed Total Throughput (tons/yr)	Deck Seam Loss at Proposed Total Throughput (tons/yr)	Withdrawal Loss at Proposed Total Throughput (tons/yr)	Contribution of Emission Rates to Proposed Grouped Limit (tons/yr)
40FB3043	15,622,000	**0.04**	**0.11**	**0.00**	**0.75**	**0.89**
40FB3044		**0.04**	**0.11**	**0.00**	0.75	**0.14**
Proposed Totals	**15,622,000**					**1.03**

Grouped Annual VOC Emission Limit for Tanks 40FB4010 and 40FB4011

Tank	Proposed Throughput (bbl/yr)	Rim Seal Loss at Proposed Total Throughput (tons/yr)	Deck Fitting Loss at Proposed Total Throughput (tons/yr)	Deck Seam Loss at Proposed Total Throughput (tons/yr)	Withdrawal Loss at Proposed Total Throughput (tons/yr)	Contribution of Emission Rates to Proposed Grouped Limit (tons/yr)
40FB4010	21,900,000	**5.84**	**3.89**	**N/A**	0.63	**9.73**
40FB4011		**5.42**	**3.89**	**N/A**	**0.68**	**9.99**
Proposed Totals	**21,900,000**					**19.73**

Grouped Annual VOC Emission Limit for Tanks 40FB4016 and 15FB509

Tank	Proposed Throughput (bbl/yr)	Rim Seal Loss at Proposed Total Throughput (tons/yr)	Deck Fitting Loss at Proposed Total Throughput (tons/yr)	Deck Seam Loss at Proposed Total Throughput (tons/yr)	Withdrawal Loss at Proposed Total Throughput (tons/yr)	Contribution of Emission Rates to Proposed Grouped Limit (tons/yr)
40FB4016	30,000,000	**0.06**	**0.27**	**0.00**	0.95	**1.29**
15FB509		**0.07**	**0.31**	**0.00**	0.79	**0.39**
Proposed Totals	**30,000,000**					**1.67**

H_2S Emission Estimates
Tanks 08FB137, 08FB142, and 08FB147

Background:
H_2S emissions are calculated by applying the K factor method of Meling, Horne, and Hoover[1] to tank losses. The H_2S mole fraction in the vapor phase of the crude oil is used to calculate H_2S emissions from the working and breathing losses from the fixed-roof tanks. The withdrawal loss (or working loss) from floating-roof tanks, however, assumes 100% volatilization. Therefore, for floating-roof tanks the weight fraction in the liquid phase of the crude oil is used to calculate the H_2S emissions from the working loss (withdrawal loss) contribution. The breathing loss contribution is the same for any type of tank.
K factors are used to calculate H_2S emissions from loading losses.

K = y/x, where

y = mole fraction of a component in the vapor phase
x = mole fraction of a component in the liquid phase

If x is known, y = Kx

Assume an annual temperature of 85°F, and an hourly temperature of 100°F.

Liquid	H_2S, liquid WF	x	K[2]	y	Vapor Pressure, psia	P*	MR lbs H_2S/ lb VOC
Crude Oil	1.00E-04	0.000609	24	0.014612	4	0.2721	0.0365
(RVP 5)	5.00E-04	0.003044	30	0.091324	5.7	0.3878	0.1602

a = annual emisions
h = hourly emissions
x = (WF H_2S)(MW oil)/MW H_2S
WF = Weight Fraction
MW oil = 207

P* = VOC partial pressure = vapor pressure/14.7 psia
MR = mass ratio = (y)(MW H_2S)/(P)(MW oil vapor)
MW = molecular weight
MW H_2S = 34
MW crude oil vapor = 50

EPN	Liquid	VOC Withdrawal Loss Emissions lbs/hr	VOC Withdrawal Loss Emissions tons/yr	Other VOC Emissions (Rim Seal, Deck Fitting, Deck Seam Losses) lbs/hr	Other VOC Emissions (Rim Seal, Deck Fitting, Deck Seam Losses) tons/yr	H_2S Emissions lbs/hr	H_2S Emissions tons/yr
FB137	Crude Oil	1.048	0.399	1.297	3.688	0.21	0.13
FB142	Crude Oil	1.391	1.128	2.009	5.713	0.32	0.21
FB147	Crude Oil	1.970	1.348	2.028	5.769	0.33	0.21
							0.55

Sample Calculations:

EPN FB137
H_2S Emissions = (WF)(withdrawal loss) + (MR)(rim seal loss + deck fitting loss)
H2S Emissions, lbs/hr = (0.0005)(1.048) + (0.1602)(1.297) = 0.21
H2S Emissions, tons/yr = (0.0001)(0.399) + (0.0365)(3.688) = 0.13

Footnotes:
1 "Using K Factors To Estimate Quantities of Individual Vapor Species Emitted During the Storage and Transfer of Hydrocarbon Liquids," by Jeffrey Meling, Karen Horne, and Jay Hoover

2 K values are taken from H_2S K equilibrium factor graph published in Natural Gas Processors Suppliers Association, Engineering Data Book, Ninth Edition, 1972

H_2S Emission Estimates
Tanks 40FB4010 and 40FB4011

A grouped annual H_2S emission limit is proposed for the storage tanks below. The grouped annual emission limit is based on a maximum total throughput going through any of the tanks in the group. Emission rates are calculated for each tank at this maximum total throughput. The Grouped Annual VOC emission limit is calculated by adding the rim seal losses, deck fitting losses, and deck seam losses from each tank plus the maximum withdrawal loss from any one tank at the maximum total throughput. Values used to determine the grouped emission limit are in bold font.

Background:
H_2S emissions are calculated by applying the K factor method of Meling, Horne, and Hoover[1] to tank losses. The H_2S mole fraction in the vapor phase of the crude oil is used to calculate H_2S emissions from the working and breathing losses from the fixed-roof tanks. The withdrawal loss (or working loss) from floating-roof tanks, however, assumes 100% volatilization. Therefore, for floating-roof tanks the weight fraction in the liquid phase of the crude oil is used to calculate the H_2S emissions from the working loss (withdrawal loss) contribution. The breathing loss contribution is the same for any type of tank.
K factors are used to calculate H_2S emissions from breathing losses.

K = y/x, where

y = mole fraction of a component in the vapor phase
x = mole fraction of a component in the liquid phase

If x is known, y = Kx

Assume an annual temperature of 85°F, and an hourly temperature of 100°F.

Liquid		H_2S, liquid WF	x	K[2]	y	Vapor Pressure, psia	P*	MR lbs H_2S/ lb VOC
Crude Oil	Annual	1.00E-04	0.000609	24	0.014612	4	0.2721	0.0365
(RVP 5)	Hourly	5.00E-04	0.003044	30	0.091324	5.7	0.3878	0.1602

a = annual emisions
h = hourly emissions
x = (WF H_2S)(MW oil)/MW H_2S
WF = Weight Fraction
MW oil = 207

P* = VOC partial pressure = vapor pressure/14.7 psia
MR = mass ratio = (y)(MW H_2S)/(P)(MW oil vapor)
MW = molecular weight
MW H_2S = 34
MW crude oil vapor = 50

EPN	Liquid	VOC Withdrawal Loss Emissions lbs/hr	VOC Withdrawal Loss Emissions tons/yr	Other VOC Emissions (Rim Seal, Deck Fitting, Deck Seam Losses) lbs/hr	Other VOC Emissions (Rim Seal, Deck Fitting, Deck Seam Losses) tons/yr	H_2S Withdrawal Loss Emissions lbs/hr	H_2S Withdrawal Loss Emissions tons/yr	Other H_2S Emissions (Rim Seal, Deck Fitting, Deck Seam Losses) lbs/hr	Other H_2S Emissions (Rim Seal, Deck Fitting, Deck Seam Losses) tons/yr	Proposed H_2S Emission Rates lbs/hr	Proposed H_2S Emission Rates tons/yr
FB4010	Crude Oil	0.733	0.803	0.858	2.440	0.0004	**0.0001**	0.14	**0.09**	0.14	N/A
FB4011	Crude Oil	0.791	0.866	0.820	2.333	0.0004	0.0001	0.13	**0.09**	0.13	N/A
Grouped Annual Emission Limit											0.17

Sample Calculations:

EPN FB4010
H_2S Emissions = (WF)(withdrawal loss) + (MR)(rim seal loss + deck fitting loss)
H2S Emissions, lbs/hr = (0.0005)(0.733) + (0.1602)(0.858) = 0.14

Footnotes:
1 "Using K Factors To Estimate Quantities of Individual Vapor Species Emitted During the Storage and Transfer of Hydrocarbon Liquids," by Jeffrey Meling, Karen Horne, and Jay Hoover

2 K values are taken from H_2S K equilibrium factor graph published in Natural Gas Processors Suppliers Association, Engineering Data Book, Ninth Edition, 1972

FIXED ROOF TANKS
VOC

Tank calculations are based on AP-42, Section 7.1 (Nov. 2006).

FIN	EPN	Tank Name	Stored Material Name	Tank Type (FX / HZ)	Tank Dia. (ft)	Tank Height/Length (ft)	Tank Capacity (gal)	Annual Tank Throughput (bbl/yr)	Maximum Tank Throughput (gal/hr)	Average Liquid Height (ft)	Vapor Molecular Weight MWv (lb/lbmol)	Annual Average Ambient Temp. T (°F)	Maximum Ambient Temp. T (°F)	Average True Vapor Pressure P_{VA} (psia)	Maximum True Vapor Pressure P (psia)	Average Daily Ambient Maximum Temperature T_{AX} (°F)	Average Daily Ambient Minimum Temperature T_{AN} (°F)	Pressure at Daily Ambient Maximum Temperature P_{VX} (psia)	Pressure at Daily Ambient Minimum Temperature P_{VN} (psia)	Breather Vent Pressure Setting P_{BP} (psia)	Breather Vent Vacuum Setting P_{BV} (psig)	Roof Construction (Cone/Dome)	Alpha (α)
40FB3041	FB3041	Tank 40FB3041	Material with an Annual TVP <= 0.02 psia	FX	95.5	48.2	2,520,000	1,750,000	252,000	24.1	130	110	130	0.02	0.07	81.6	62.5	0.07	0.02	0.03	-0.03	Cone	0.17
40FB3041 (Incremental Increase)	FB3041 (Incremental Increase)	Tank 40FB3041 (Incremental Increase)	Material with an Annual TVP <= 0.02 psia	FX	95.5	48.2	2,520,000	876,000	N/A	24.1	130	110	130	0.02	0.07	81.6	62.5	0.07	0.02	0.03	-0.03	Cone	0.17
08FB18	FB18	Tank 08FB18	Material with an Annual TVP <= 0.05 psia	FX	43	39	415,800	10,000,000	8,400	19.5	90	74.1	100	0.05	0.1	81.6	62.5	0.1	0.05	0.03	-0.03	Cone	0.17
08FB118	FB118	Tank 08FB118	Material with an Annual TVP <= 0.1 psia	FX	129	40	3,910,772	1,862,272	42,000	20.0	90	74.1	100	0.1	0.4	81.6	62.5	0.4	0.1	0.03	-0.03	Cone	0.17
15FB620	FB620	Tank 15FB620	Material with an Annual TVP <= 0.2 psia	FX	67	40	1,050,000	1,440,000	84,000	20.0	90	74.1	100	0.2	0.5	81.6	62.5	0.5	0.2	0.03	-0.03	Cone	0.17

FIXED ROOF TANKS
VOC

Tank calculations are based on AP-42, Section 7.1 (Nov. 2006).

FIN	EPN	Tank Name	Stored Material Name	Daily Total Solar Insulation Factor (Btu/ft^2-d)	Average Pressure at Tank Location Pa (psia)	Daily Ambient Temperature Range dT_A (^oF)	Daily Vapor Pressure Range dP_V (^oF)	Tank Roof Outage H_{RO} (ft)	Vapor Space Outage H_{vo} (ft)	Vapor Space Volume V_v (ft^3)	Vapor Density W_V (lb/ft^3)	Daily Vapor Temperature Range dT_V (^oR)	Vapor Expansion Factor K_E	Vented Vapor Saturation Factor K_S	Fixed Roof Standing Storage Loss L_S (tons/yr)	Number of Turnovers per year N	Annual Turnover Factor K_n	Short-term Turnover Factor K_n	Working Loss Product Factor K_p	Fixed Roof Working Loss Calculation L_w (tons/yr)	Total Fixed Roof Losses L_b+L_w (tons/yr)	Maximum Fixed Roof Losses L_w (lb/hr)
40FB3041	FB3041	Tank 40FB3041	Material with an Annual TVP <= 0.02 psia	1521	14.71	19.1	0.05	0.9948	25.095	179,755.11	0.000424	21.0	0.03602	0.97409	0.4874	29.17	1.00	1.00	1	2.2750	2.7624	54.6000
40FB3041 (Incremental Increase)	FB3041 (Incremental Increase)	Tank 40FB3041 (Incremental Increase)	Material with an Annual TVP <= 0.02 psia	1521	14.71	19.1	0.05	0.9948	25.095	179,755.11	0.000424	21.0	0.03602	0.97409	N/A	14.60	1.00	1.00	1	1.1388	1.1388	N/A
08FB18	FB18	Tank 08FB18	Material with an Annual TVP <= 0.05 psia	1521	14.71	19.1	0.05	0.4479	19.948	28,968.46	0.000782	21.0	0.03847	0.94979	0.1511	1010.10	0.20	1.00	1	4.4183	4.5693	1.8000
08FB118	FB118	Tank 08FB118	Material with an Annual TVP <= 0.1 psia	1521	14.71	19.1	0.3	1.3438	21.344	278,959.43	0.001564	21.0	0.05558	0.89837	3.9764	20.00	1.00	1.00	1	8.3802	12.3566	36.0000
15FB620	FB620	Tank 15FB620	Material with an Annual TVP <= 0.2 psia	1521	14.71	19.1	0.3	0.6979	20.698	72,973.83	0.003129	21.0	0.05569	0.82008	1.9030	57.60	0.69	1.00	1	8.9100	10.8130	90.0000

Lt = (0.4874) + (2.2750)
Lt = 2.7624 ton

Ls =365 (Vv) (Wv) (Ke) (Ks) / (2000) / (89)
Ls = 365 (179,755) (0.0004) (0.036) (0.974) / (2000)
Ls = 0.4874 ton

Lw = 0.001 (Mv) (Pva) (V) (N) (Kn) (Kp)
Lw = 365 (130) (0.0200) (29.167) (1.000) (1) / (2000)
Lw = 2.2750 ton

INTERNAL FLOATING ROOF TANKS
VOC

Tank calculations are based on AP-42, Section 7.1 (Nov. 2006).

FIN	EPN	Tank Name	Representative Material	Tank Diameter (ft)	Tank Height (ft)	Tank Capacity (gal)	Annual Tank Throughput (bbl/yr)	Maximum Tank Throughput (bbl/hr)	Tank Construction (Welded/ Riveted)	Shell Condition (Light Rust/ Dense Rust/ Gunite Lining)	Deck Seam Construction (Welded/ Bolted)	Primary Seal (MS/LM/ VM)	Secondary Seal (None/SM/ RM/WS)	Vapor Molecular Weight MWv (lb/lbmol)	Average Liquid Density WL (lb/gal)	Annual Average Temperature T (oF)	Maximum Temperature T (oF)	Annual Average True Vapor Pressure P (psia)	Maximum True Vapor Pressure P (psia)
IFRTK1	IFRTK1	100,000 bbl IFR Tank	Material with a TVP <= 10.9 psia	135	48	4,200,000	4,000,000	2,000	Welded	Light Rust	Welded	MS	RM	68	5.6	110	130	10.90	10.90
IFRTK2	IFRTK2	75,000 bbl IFR Tank	Material with a TVP <= 10.9 psia	115	48	3,150,000	4,000,000	1,500	Welded	Light Rust	Welded	MS	RM	68	5.6	110	130	10.90	10.90
08FB109R	FB109R	Tank 08FB109R	Material with a TVP <= 10.9 psia	120	50	4,200,000	3,650,000	10,000	Welded	Light Rust	Welded	MS	None	68	5.6	110	130	10.90	10.90
08FB137	FB137	Tank 08FB137	Material with a TVP <= 10.9 psia	120	40	3,360,000	9,125,000	12,000	Welded	Light Rust	Bolted	MS	None	68	5.6	110	130	10.90	10.90
08FB137	FB137	Tank 08FB137	Crude Oil (H2S Emission Basis)	120	40	3,360,000	9,125,000	12,000	Welded	Light Rust	Bolted	MS	None	50	7.1	110	130	4.00	5.70
08FB137 (Incremental Increase)	FB137 (Incremental Increase)	Tank 08FB137 (Incremental Increase)	Material with a TVP <= 10.9 psia	120	40	3,360,000	7,665,000	N/A	Welded	Light Rust	Bolted	MS	None	68	5.6	110	130	10.90	10.90
08FB147	FB147	Tank 08FB147	Material with a TVP <= 10.9 psia	225	42	11,340,000	54,750,000	40,000	Welded	Light Rust	Bolted	MS	None	68	5.6	110	130	10.90	10.90
08FB147	FB147	Tank 08FB147	Crude Oil (H2S Emission Basis)	225	42	11,340,000	54,750,000	40,000	Welded	Light Rust	Bolted	MS	None	50	7.1	110	130	4.00	5.70
08FB147 (Incremental Increase)	FB147 (Incremental Increase)	Tank 08FB147 (Incremental Increase)	Material with a TVP <= 10.9 psia	225	42	11,340,000	7,665,000	N/A	Welded	Light Rust	Bolted	MS	None	68	5.6	110	130	10.90	10.90
11FB402	FB402	Tank FB402	Material with a TVP <= 10.9 psia	100	40	2,310,000	10,037,500	5,000	Welded	Light Rust	Welded	MS	RM	68	5.6	110	130	10.90	10.90
11FB402 (Incremental Increase)	FB402 (Incremental Increase)	Tank FB402 (Incremental Increase)	Material with a TVP <= 10.9 psia	100	40	2,310,000	9,125,000	N/A	Welded	Light Rust	Welded	MS	RM	68	5.6	110	130	10.90	10.90
11FB403	FB403	Tank FB403	Material with a TVP <= 10.9 psia	100	40	2,310,000	10,037,500	5,000	Welded	Light Rust	Bolted	MS	RM	68	5.6	110	130	10.90	10.90
11FB403 (Incremental Increase)	FB403 (Incremental Increase)	Tank FB403 (Incremental Increase)	Material with a TVP <= 10.9 psia	100	40	2,310,000	9,125,000	N/A	Welded	Light Rust	Bolted	MS	RM	68	5.6	110	130	10.90	10.90
15FB509 (Proposed Increases)	FB509 (Proposed Increases)	Tank 15FB509 (Proposed Increases)	Material with a TVP <= 0.5 psia	210	40	9,954,000	30,000,000	15,000	Welded	Light Rust	Welded	MS	RM	130	7.1	110	130	0.50	0.50
15FB510 (Proposed Increases)	FB510 (Proposed Increases)	Tank 15FB510 (Proposed Increases)	Material with a TVP <= 0.5 psia	210	40	9,954,000	54,750,000	20,000	Welded	Light Rust	Welded	MS	RM	130	7.1	110	130	0.50	0.50
40FB3043 (Proposed Increase)	FB3043 (Proposed Increases)	Tank 40FB3043 (Proposed Increases)	Material with a TVP <= 0.5 psia	110.3	48.2	3,318,000	15,622,000	6,000	Welded	Light Rust	Welded	MS	RM	130	7.1	110	130	0.50	0.50
40FB3044 (Proposed Increases)	FB3044 (Proposed Increases)	Tank 40FB3044 (Proposed Increases)	Material with a TVP <= 0.5 psia	110.3	48.2	3,318,000	15,622,000	6,000	Welded	Light Rust	Welded	MS	RM	130	7.1	110	130	0.50	0.50
40FB4012	FB4012	Tank 40FB4012	Material with a TVP <= 10.9 psia	112	51	3,360,000	13,140,000	6,000	Welded	Light Rust	Welded	MS	RM	68	5.6	110	130	10.90	10.90
40FB4012 (Incremental Increase)	FB4012 (Incremental Increase)	Tank 40FB4012 (Incremental Increase)	Material with a TVP <= 10.9 psia	112	51	3,360,000	1,150,000	N/A	Welded	Light Rust	Welded	MS	RM	68	5.6	110	130	10.90	10.90
40FB4013	FB4013	Tank 40FB4013	Material with a TVP <= 10.9 psia	112	51	3,360,000	13,140,000	6,000	Welded	Light Rust	Welded	MS	None	68	5.6	110	130	10.90	10.90
40FB4013 (Incremental Increase)	FB4013 (Incremental Increase)	Tank 40FB4013 (Incremental Increase)	Material with a TVP <= 10.9 psia	112	51	3,360,000	1,150,000	N/A	Welded	Light Rust	Welded	MS	None	68	5.6	110	130	10.90	10.90
40FB4014 (Proposed Increases)	FB4014 (Proposed Increases)	Tank 40FB4014 (Proposed Increases)	Material with a TVP <= 0.5 psia	138.2	48	5,208,000	18,000,000	8,000	Welded	Light Rust	Welded	MS	RM	130	7.1	110	130	0.50	0.50
40FB4015 (Proposed Increases)	FB4015 (Proposed Increases)	Tank 40FB4015 (Proposed Increases)	Material with a TVP <= 0.5 psia	138.2	48	5,208,000	11,600,000	8,000	Welded	Light Rust	Welded	MS	RM	130	7.1	110	130	0.50	0.50
40FB4016 (Proposed Increases)	FB4016 (Proposed Increases)	Tank 40FB4016 (Proposed Increases)	Material with a TVP <= 0.5 psia	175	48	8,400,000	30,000,000	8,000	Welded	Light Rust	Welded	MS	RM	130	7.1	110	130	0.50	0.50

INTERNAL FLOATING ROOF TANKS
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Tank calculations are based on AP-42, Section 7.1 (Nov. 2006).

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								Rim Seal Losses						Withdrawal Losses					Deck Fitting Losses		
FIN	EPN	Tank Name	Representative Material	Average Pressure at Tank Location Pa (psia)	Vapor Pressure Function at average Temperature P*	Vapor Pressure Function at maximum Temperature P*	Wind Speed V (mi/hr)	Zero Wind Speed Rim Seal Loss Factor Kra	Wind Speed Dependent Rim Seal Loss Factor Krb	Seal related Wind Speed Exponent n	Product Factor Kc	Internal Floating Roof Rim Seal Losses Lr (ton/yr)	Maximum Internal Floating Roof Rim Seal Losses Lr (lb/hr)	Shell Clingage Factor C (bbl/1000 ft^2)	Number of Columns Nc	Effective Column Diameter Fc	Internal Floating Roof Withdrawal Losses Lw (ton/yr)	Maximum Internal Floating Roof Withdrawal Losses Lw (lb/hr)	Deck Fitting Loss Factor Ff (lb-mol/yr)	Internal Floating Deck Fitting Losses Lf (ton/yr)	Maximum Internal Floating Deck Fitting Losses Lf (lb/hr)
IFRTK1	IFRTK1	100,000 bbl IFR Tank	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	0.6	0.4	1	1.0	0.8963	0.2046	0.0015	0	1.00	0.1174	0.1174	87.80	0.9715	0.2218
IFRTK2	IFRTK2	75,000 bbl IFR Tank	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	0.6	0.4	1	1.0	0.7635	0.1743	0.0015	0	1.00	0.1378	0.1033	77.80	0.8609	0.1965
08FB109R	FB109R	Tank 08FB109R	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	5.8	0.3	2.1	1.0	7.7013	1.7583	0.0015	7	1.00	0.1275	0.6986	674.81	7.4668	1.7048
08FB137	FB137	Tank 08FB137	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	5.8	0.3	2.1	1.0	7.7013	1.7583	0.0015	7	0.75	0.3143	0.8268	873.00	9.6598	2.2054
08FB137	FB137	Tank 08FB137	Crude Oil (H2S Emission Basis)	14.71	0.0792	0.1219	0	5.8	0.3	2.1	1.0	1.3776	0.4844	0.0015	7	0.75	0.3985	1.0482	873.00	1.7279	0.6076
08FB137 (Incremental Increase)	FB137 (Incremental Increase)	Tank 08FB137 (Incremental Increase)	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	5.8	0.3	2.1	1.0	N//A	N//A	0.0015	7	0.75	0.2641	N//A	873.00	N//A	N//A
08FB147	FB147	Tank 08FB147	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	5.8	0.3	2.1	1.0	14.4400	3.2968	0.0015	31	0.75	1.0633	1.5537	575.40	6.3669	1.4536
08FB147	FB147	Tank 08FB147	Crude Oil (H2S Emission Basis)	14.71	0.0792	0.1219	0	5.8	0.3	2.1	1.0	2.5830	0.9083	0.0015	31	0.75	1.3482	1.9699	575.40	1.1389	0.4005
08FB147 (Incremental Increase)	FB147 (Incremental Increase)	Tank 08FB147 (Incremental Increase)	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	5.8	0.3	2.1	1.0	N/A	N/A	0.0015	31	0.75	0.1489	N/A	575.40	N/A	N/A
11FB402	FB402	Tank FB402	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	0.6	0.4	1	1.0	0.6639	0.1516	0.0015	6	0.75	0.4154	0.4139	976.00	10.7995	2.4657
11FB402 (Incremental Increase)	FB402 (Incremental Increase)	Tank FB402 (Incremental Increase)	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	0.6	0.4	1	1.0	N/A	N/A	0.0015	6	0.75	0.3777	N/A	976.00	N/A	N/A
11FB403	FB403	Tank FB403	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	0.6	0.4	1	1.0	0.6639	0.1516	0.0015	6	0.75	0.4154	0.4139	976.00	10.7995	2.4657
11FB403 (Incremental Increase)	FB403 (Incremental Increase)	Tank FB403 (Incremental Increase)	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	0.6	0.4	1	1.0	N/A	N/A	0.0015	6	0.75	0.3777	N/A	976.00	N/A	N/A
15FB509 (Proposed Increases)	FB509 (Proposed Increases)	Tank 15FB509 (Proposed Increases)	Material with a TVP <= 0.5 psia	14.71	0.0086	0.0086	0	0.6	0.4	1	1.0	0.0708	0.0162	0.0015	22	1.00	0.7925	0.7925	559.40	0.3143	0.0718
15FB510 (Proposed Increases)	FB510 (Proposed Increases)	Tank 15FB510 (Proposed Increases)	Material with a TVP <= 0.5 psia	14.71	0.0086	0.0086	0	0.6	0.4	1	1.0	0.0708	0.0162	0.0015	22	1.00	1.4463	1.0567	559.40	0.3143	0.0718
40FB3043 (Proposed Increase)	FB3043 (Proposed Increases)	Tank 40FB3043 (Proposed Increases)	Material with a TVP <= 0.5 psia	14.71	0.0086	0.0086	0	0.6	0.4	1	1.0	0.0372	0.0085	0.0015	7	0.75	0.7451	0.5723	187.60	0.1054	0.0241
40FB3044 (Proposed Increases)	FB3044 (Proposed Increases)	Tank 40FB3044 (Proposed Increases)	Material with a TVP <= 0.5 psia	14.71	0.0086	0.0086	0	0.6	0.4	1	1.0	0.0372	0.0085	0.0015	7	0.75	0.7451	0.5723	187.60	0.1054	0.0241
40FB4012	FB4012	Tank 40FB4012	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	0.6	0.4	1	1.0	0.7436	0.1698	0.0015	7	0.75	0.4864	0.4442	397.80	4.4017	1.0050
40FB4012 (Incremental Increase)	FB4012 (Incremental Increase)	Tank 40FB4012 (Incremental Increase)	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	0.6	0.4	1	1.0	N/A	N/A	0.0015	7	0.75	0.0426	N/A	397.80	N/A	N/A
40FB4013	FB4013	Tank 40FB4013	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	5.8	0.3	2.1	1.0	7.1879	1.6411	0.0015	7	0.75	0.4864	0.4442	377.80	4.1804	0.9544
40FB4013 (Incremental Increase)	FB4013 (Incremental Increase)	Tank 40FB4013 (Incremental Increase)	Material with a TVP <= 10.9 psia	14.71	0.3254	0.3254	0	5.8	0.3	2.1	1.0	N/A	N/A	0.0015	7	0.75	0.0426	N/A	377.80	N/A	N/A
40FB4014 (Proposed Increases)	FB4014 (Proposed Increases)	Tank 40FB4014 (Proposed Increases)	Material with a TVP <= 0.5 psia	14.71	0.0086	0.0086	0	0.6	0.4	1	1.0	0.0466	0.0106	0.0015	9	1.00	0.6966	0.6192	237.60	0.1335	0.0305
40FB4015 (Proposed Increases)	FB4015 (Proposed Increases)	Tank 40FB4015 (Proposed Increases)	Material with a TVP <= 0.5 psia	14.71	0.0086	0.0086	0	0.6	0.4	1	1.0	0.0466	0.0106	0.0015	9	1.00	0.4489	0.6192	237.60	0.1335	0.0305
40FB4016 (Proposed Increases)	FB4016 (Proposed Increases)	Tank 40FB4016 (Proposed Increases)	Material with a TVP <= 0.5 psia	14.71	0.0086	0.0086	0	0.6	0.4	1	1.0	0.0590	0.0135	0.0015	19	1.00	0.9543	0.5090	487.60	0.2740	0.0626

Lt = Lr + Lw + Lf + Ld
Lt = (0.8963) + (0.1174) + (0.9715) + (0.0000)
Lt = 1.9851 ton/yr

Lr = (Kra + (Krb) (V^n)) (P*) (D) (Mv) (Kc) / (2000)
Lr = (0.6 + (0.4) (0)) (0.3254) (135) (68) (1) / (2000)
Lr = 0.8963 ton/yr

Lw = (0.943) * (Q) (C) (Wl) (1 + ((Nc) (Fc)/ (D))) / (D)
Lw = (0.943) (4,000,000) (0.0015) (5.60) (1 + ((0) (1.0) / (135))) / (135) / (2000)
Lw = 0.1174 ton/yr

Lf = (Ff) (P*) (Mv) (Kc)
Lf = (87.80) (0.3254) (68) (1) / (2000)
Lf = 0.9715 ton/yr

Ld = (Kd) (Sd) (D^2) (P*) (MW) (Kc)
Ld = 0.00 ton/yr

INTERNAL FLOATING ROOF TANKS
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Tank calculations are based on AP-42, Section 7.1 (Nov. 2006).

FIN	EPN	Tank Name	Representative Material	Deck Seam Losses: Deck Seam Loss Factor Kd (lb-mol/ft-yr)	Deck Seam Length Factor Sd (ft/ft^2)	Internal Floating Deck Seam Losses Ld (ton/yr)	Maximum Internal Floating Deck Seam Losses Ld (lb/hr)	ANNUAL TOTAL INTERNAL FLOATING ROOF LOSSES Lr+Lw+Lf+Ld (ton/yr)	MAXIMUM TOTAL INTERNAL FLOATING ROOF LOSSES Lr+Lw+Lf+Ld (lb/hr)
IFRTK1	IFRTK1	100,000 bbl IFR Tank	Material with a TVP <= 10.9 psia	0	N/A	0.0000	0.0000	1.9851	0.5438
IFRTK2	IFRTK2	75,000 bbl IFR Tank	Material with a TVP <= 10.9 psia	0	N/A	0.0000	0.0000	1.7621	0.4742
08FB109R	FB109R	Tank 08FB109R	Material with a TVP <= 10.9 psia	0	N/A	0.0000	0.0000	15.2957	4.1617
08FB137	FB137	Tank 08FB137	Material with a TVP <= 10.9 psia	0.14	0.146	3.2546	0.7430	20.9301	5.5336
08FB137	FB137	Tank 08FB137	Crude OIl (H2S Emission Basis)	0.14	0.146	0.5822	0.2047	4.0862	2.3450
08FB137 (Incremental Increase)	FB137 (Incremental Increase)	Tank 08FB137 (Incremental Increase)	Material with a TVP <= 10.9 psia	0.14	0.146	N//A	N//A	0.2641	N//A
08FB147	FB147	Tank 08FB147	Material with a TVP <= 10.9 psia	0.14	0.207	16.2257	3.7045	38.0958	10.0086
08FB147	FB147	Tank 08FB147	Crude OIl (H2S Emission Basis)	0.14	0.146	2.0467	0.7197	7.1167	3.9983
08FB147 (Incremental Increase)	FB147 (Incremental Increase)	Tank 08FB147 (Incremental Increase)	Material with a TVP <= 10.9 psia	0.14	0.146	N/A	N/A	0.1489	N/A
11FB402	FB402	Tank FB402	Material with a TVP <= 10.9 psia	0	N/A	0.0000	0.0000	11.8789	3.0311
11FB402 (Incremental Increase)	FB402 (Incremental Increase)	Tank FB402 (Incremental Increase)	Material with a TVP <= 10.9 psia	N/A	N/A	N/A	N/A	0.3777	N/A
11FB403	FB403	Tank FB403	Material with a TVP <= 10.9 psia	0.14	0.146	2.2601	0.5160	14.1390	3.5471
11FB403 (Incremental Increase)	FB403 (Incremental Increase)	Tank FB403 (Incremental Increase)	Material with a TVP <= 10.9 psia	N/A	N/A	N/A	N/A	0.3777	N/A
15FB509 (Proposed Increases)	FB509 (Proposed Increases)	Tank 15FB509 (Proposed Increases)	Material with a TVP <= 0.5 psia	0.00	N/A	0.0000	0.0000	1.1777	0.8804
15FB510 (Proposed Increases)	FB510 (Proposed Increases)	Tank 15FB510 (Proposed Increases)	Material with a TVP <= 0.5 psia	559.40	N/A	0.0000	0.0000	1.8315	1.1446
40FB3043 (Proposed Increase)	FB3043 (Proposed Increases)	Tank 40FB3043 (Proposed Increases)	Material with a TVP <= 0.5 psia	0	N/A	0.0000	0.0000	0.8877	0.6049
40FB3044 (Proposed Increases)	FB3044 (Proposed Increases)	Tank 40FB3044 (Proposed Increases)	Material with a TVP <= 0.5 psia	0	N/A	0.0000	0.0000	0.8877	0.6049
40FB4012	FB4012	Tank 40FB4012	Material with a TVP <= 10.9 psia	0	N/A	0.0000	0.0000	5.6317	1.6190
40FB4012 (Incremental Increase)	FB4012 (Incremental Increase)	Tank 40FB4012 (Incremental Increase)	Material with a TVP <= 10.9 psia	0	N/A	0.0000	0.0000	0.0426	N/A
40FB4013	FB4013	Tank 40FB4013	Material with a TVP <= 10.9 psia	0	N/A	0.0000	0.0000	11.8547	3.0397
40FB4013 (Incremental Increase)	FB4013 (Incremental Increase)	Tank 40FB4013 (Incremental Increase)	Material with a TVP <= 10.9 psia	0	N/A	0.0000	0.0000	0.0426	N/A
40FB4014 (Proposed Increases)	FB4014 (Proposed Increases)	Tank 40FB4014 (Proposed Increases)	Material with a TVP <= 0.5 psia	0	N/A	0.0000	0.0000	0.8767	0.6603
40FB4015 (Proposed Increases)	FB4015 (Proposed Increases)	Tank 40FB4015 (Proposed Increases)	Material with a TVP <= 0.5 psia	0	N/A	0.0000	0.0000	0.6290	0.6603
40FB4016 (Proposed Increases)	FB4016 (Proposed Increases)	Tank 40FB4016 (Proposed Increases)	Material with a TVP <= 0.5 psia	0	N/A	0.0000	0.0000	1.2873	0.5850

EXTERNAL FLOATING ROOF TANKS
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Tank calculations are based on AP-42, Section 7.1 (Nov. 2006).

FIN	EPN	Tank Name	Representative Material	Tank Diameter (ft)	Tank Height (ft)	Tank Capacity (gal)	Annual Tank Throughput (bbl/yr)	Maximum Tank Throughput (bbl/hr)	Tank Construction (Welded/ Bolted)	Shell Condition (Light Rust/ Dense Rust/ Gunite Lining)	Primary Seal (MS/LM/ VM)	Secondary Seal (None/SM/ RM)	Vapor Molecular Weight MWv (lb/lbmol)	Average Liquid Density W_L (lb/gal)	Annual Average Temperature T (^oF)	Maximum Temperature T (^oF)	Annual Average True Vapor Pressure P (psia)	Maximum True Vapor Pressure P (psia)	Average Pressure at Tank Location Pa (psia)
08FB108R1	FB108R1	Tank 08FB108R1	Material with TVP <= 10.9 psia	120	56	4,737,400	6,000,000	12,000	Welded	Light Rust	MS	RM	68	5.6	110	130	10.90	10.90	14.71
08FB108R1 (Incremental Increase)	FB108R1 (Incremental Increase)	Tank 08FB108R1 (Incremental Increase)	Material with TVP <= 10.9 psia	120	56	4,737,400	365,000	N/A	Welded	Light Rust	MS	RM	68	5.6	110	130	10.90	10.90	14.71
08FB142	FB142	Tank 08FB142	Material with TVP <= 10.9 psia	325	42	22,050,000	73,000,000	45,000	Welded	Light Rust	MS	RM	68	5.6	110	130	10.90	10.90	14.71
08FB142	FB142	Tank 08FB142	Crude Oil (H2S Emission Basis)	325	42	22,050,000	73,000,000	45,000	Welded	Light Rust	MS	RM	50	7.1	110	130	4.00	5.70	14.71
08FB142 (Incremental Increase)	FB142 (Incremental Increase)	Tank 08FB142 (Incremental Increase)	Material with TVP <= 10.9 psia	325	42	22,050,000	7,665,000	N/A	Welded	Light Rust	MS	RM	68	5.6	110	130	10.90	10.90	14.71
11FB408	FB408	Tank 11FB408	Material with TVP <= 0.5 psia	120	40	3,360,000	15,000,000	10,000	Welded	Light Rust	MS	RM	130	7.1	110	130	0.50	0.50	14.71
11FB409	FB409	Tank 11FB409	Material with TVP <= 0.5 psia	134	48	5,040,000	15,000,000	10,000	Welded	Light Rust	MS	RM	130	7.1	110	130	0.50	0.50	14.71
11FB410	FB410	Tank 11FB410	Material with TVP <= 0.5 psia	134	48	5,040,000	15,000,000	10,000	Welded	Light Rust	MS	RM	130	7.1	110	130	0.50	0.50	14.71
15FB507	FB507	Tank 15FB507	Material with TVP <= 10.9 psia	190	40	8,484,000	54,750,000	5,000	Welded	Light Rust	MS	RM	68	5.6	110	130	10.90	10.90	14.71
15FB507 (Incremental Increase)	FB507 (Incremental Increase)	Tank 15FB507 (Incremental Increase)	Material with TVP <= 10.9 psia	190	40	8,484,000	4,380,000	N/A	Welded	Light Rust	MS	RM	68	5.6	110	130	10.90	10.90	14.71
15FB508	FB508	Tank 15FB508	Material with TVP <= 0.5 psia	190	40	8,484,000	54,750,000	20,000	Welded	Light Rust	MS	RM	130	7.1	110	130	0.50	0.50	14.71
40FB4010	FB4010	Tank 40FB4010	Material with TVP <= 10.9 psia	137	51	4,200,000	21,900,000	10,000	Welded	Light Rust	MS	RM	68	5.6	125	200	9.00	10.90	14.71
40FB4010	FB4010	Tank 40FB4010	Crude Oil (H2S Emission Basis)	137	51	4,200,000	21,900,000	10,000	Welded	Light Rust	MS	RM	50	7.1	125	200	4.00	5.70	14.71
40FB4011	FB4011	Tank 40FB4011	Material with TVP <= 10.9 psia	127	51	4,200,000	21,900,000	10,000	Welded	Light Rust	MS	RM	68	5.6	125	200	9.00	10.90	14.71
40FB4011	FB4011	Tank 40FB4011	Crude Oil (H2S Emission Basis)	127	51	4,200,000	21,900,000	10,000	Welded	Light Rust	MS	RM	50	7.1	125	200	4.00	5.70	14.71

EXTERNAL FLOATING ROOF TANKS
VOC

Tank calculations are based on AP-42, Section 7.1 (Nov. 2006).

FIN	EPN	Tank Name	Representative Material	Vapor Pressure Function P*	Vapor Pressure Function at maximum Temperature P*	Wind Speed V (mi/hr)	Rim Seal Losses: Zero Wind Speed Rim Seal Loss Factor Kra	Rim Seal Losses: Wind Speed Dependent Rim Seal Loss Factor Krb	Rim Seal Losses: Seal related Wind Speed Exponent n	Rim Seal Losses: Product Factor Kc	Rim Seal Losses: External Floating Roof Rim Seal Losses Lr (ton/yr)	Rim Seal Losses: Maximum External Floating Roof Rim Seal Losses Lr (lb/hr)	Withdrawal Losses: Shell Clingage Factor C (bbl/1000 ft^2)	Withdrawal Losses: External Floating Roof Withdrawal Losses Lw (ton/yr)	Withdrawal Losses: Maximum External Floating Roof Withdrawal Losses Lw (lb/hr)	Deck Fitting Losses: Deck Fitting Loss Factor Ff (lb-mol/yr)	Deck Fitting Losses: External Floating Deck Fitting Losses Lf (ton/yr)	Deck Fitting Losses: Maximum External Floating Deck Fitting Losses Lf (lb/hr)	TOTAL EXTERNAL FLOATING ROOF LOSSES Lr+Lw+Lf+Ld (ton/yr)	MAXIMUM EXTERNAL FLOATING ROOF LOSSES Lr+Lw+Lf+Ld (lb/hr)
08FB108R1	FB108R1	Tank 08FB108R1	Material with TVP <= 10.9 psia	0.3254	0.3254	12	0.6	0.4	1	1.0	7.1702	1.6370	0.0015	0.1980	0.7921	1,051.69	11.6370	2.6569	19.0053	5.0860
08FB108R1 (Incremental Increase)	FB108R1 (Incremental Increase)	Tank 08FB108R1 (Incremental Increase)	Material with TVP <= 10.9 psia	0.3254	0.3254	12	0.6	0.4	1	1.0	N/A	N/A	0.0015	0.0120	N/A	0.00	N/A	N/A	0.0120	N/A
08FB142	FB142	Tank 08FB142	Material with TVP <= 10.9 psia	0.3254	0.3254	12	0.6	0.4	1	1.0	19.4193	4.4336	0.0015	0.8896	1.0968	1,131.19	12.5168	2.8577	32.8257	8.3881
08FB142	FB142	Tank 08FB142	Crude OIl (H2S Emission Basis)	0.0792	0.1219	12	0.6	0.4	1	1.0	3.4736	1.2215	0.0015	1.1279	1.3906	1,131.19	2.2390	0.7873	6.8405	3.3993
08FB142 (Incremental Increase)	FB142 (Incremental Increase)	Tank 08FB142 (Incremental Increase)	Material with TVP <= 10.9 psia	0.3254	0.3254	12	0.6	0.4	1	1.0	N/A	N/A	0.0015	0.0934	N/A	0.00	N/A	N/A	0.0934	N/A
11FB408	FB408	Tank 11FB408	Material with TVP <= 0.5 psia	0.0086	0.0086	12	0.6	0.4	1	1.0	0.3641	0.0831	0.0015	0.6277	0.8369	286.15	0.1608	0.0367	1.1526	0.9568
11FB409	FB409	Tank 11FB409	Material with TVP <= 0.5 psia	0.0086	0.0086	12	0.6	0.4	1	1.0	0.4066	0.0928	0.0015	0.5621	0.7495	402.99	0.2265	0.0517	1.1952	0.8940
11FB410	FB410	Tank 11FB410	Material with TVP <= 0.5 psia	0.0086	0.0086	12	0.6	0.4	1	1.0	0.4066	0.0928	0.0015	0.5621	0.7495	287.19	0.1614	0.0368	1.1301	0.8792
15FB507	FB507	Tank 15FB507	Material with TVP <= 10.9 psia	0.3254	0.3254	12	0.6	0.4	1	1.0	11.3528	2.5920	0.0015	1.1413	0.2085	557.04	6.1637	1.4072	18.6578	4.2077
15FB507 (Incremental Increase)	FB507 (Incremental Increase)	Tank 15FB507 (Incremental Increase)	Material with TVP <= 10.9 psia	0.3254	0.3254	12	0.6	0.4	1	1.0	N/A	N/A	0.0015	0.0913	N/A	0.00	N/A	N/A	0.0913	N/A
15FB508	FB508	Tank 15FB508	Material with TVP <= 0.5 psia	0.0086	0.0086	12	0.6	0.4	1	1.0	0.5765	0.1316	0.0015	1.4470	1.0572	466.74	0.2623	0.0599	2.2858	1.2487
40FB4010	FB4010	Tank 40FB4010	Material with TVP <= 10.9 psia	0.2323	0.3254	12	0.6	0.4	1	1.0	5.8421	1.8689	0.0015	0.6331	0.5782	492.88	3.8922	1.2452	10.3674	3.6923
40FB4010	FB4010	Tank 40FB4010	Crude OIl (H2S Emission Basis)	0.0792	0.1219	12	0.6	0.4	1	1.0	1.4643	0.5149	0.0015	0.8027	0.7331	492.88	0.9756	0.3430	3.2425	1.5910
40FB4011	FB4011	Tank 40FB4011	Material with TVP <= 10.9 psia	0.2323	0.3254	12	0.6	0.4	1	1.0	5.4157	1.7325	0.0015	0.6830	0.6237	492.88	3.8922	1.2452	9.9908	3.6014
40FB4011	FB4011	Tank 40FB4011	Crude OIl (H2S Emission Basis)	0.0792	0.1219	12	0.6	0.4	1	1.0	1.3574	0.4773	0.0015	0.8659	0.7908	492.88	0.9756	0.3430	3.1989	1.6111

Sample Calculation for External Floating-roof tank

Lt = Lr + Lw + Lf + Ld
Lt = (7.1702) + (0.1980) + (11.6370) + (0.0000)
Lt = 19.0053 ton

Lr = (Kra + (Krb) (V^n)) (P*) (D) (Mv) (Kc) / (2000)
Lr = (0.6 + (0.4) (12)) (0.3254) (120) (68) (1) / (2000)
Lr = 7.1702 ton

Lw = (0.943) * (Q) (C) (Wl) (1 + ((Nc) (Fc)/ (D))) / (D)
Lw = (0.943) (6,000,000) (0.0015) (5.60) (1 + ((0) (1.0) / (120))) / (120) / (2000)
Lw = 0.1980 ton

Lf = (Ff) (P*) (Mv) (Kc)
Lf = (1,051.69) (0.3254) (68) (1.0) / (2000)
#REF!

Ld = 0 for EFR tanks

CALCULATED FITTING FACTORS

		IFR	IFR	IFR	IFR	IFR	IFR	IFR	IFR	IFR	IFR	IFR	IFR	IFR	IFR	IFR
		New	New	FB109R	FB137	FB147	FB402	FB403	FB509	FB510	40FB3043	40FB3044	FB4012	FB4013	40FB4014	40FB4015
	Diameter (ft)	135.0	115.0	120.0	120.0	225.0	100.0	100.0	220.0	220.0	110.0	110.0	112.0	112.0	138.2	135.8
Access hatch	Bolted cover, gasketed	1.6	1.6	0.0	0.0	1.6	0.0	0.0	3.2	3.2	6.4	6.4	0.0	0.0	6.4	6.4
	Unbolted cover, gasketed	0.0	0.0	31.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Unbolted cover, ungasketed	0.0	0.0	0.0	36.0	0.0	36.0	36.0	0.0	0.0	0.0	0.0	36.0	36.0	0.0	0.0
Fixed roof support column well	Round pipe, ungasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Round pipe, gasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	550.0	550.0	175.0	175.0	0.0	0.0	225.0	225.0
	Round pipe, flexible fabric sleeve seal	80.0	70.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Built-up column, ungasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Built-up column, gasketed sliding cover	0.0	0.0	231.0	726.0	462.0	858.0	858.0	0.0	0.0	0.0	0.0	231.0	231.0	0.0	0.0
Unslotted guide-pole and well	Ungasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Ungasketed sliding cover w/pole sleeve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover w/pole wiper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover w/pole sleeve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slotted guide-pole/sample well	Ungasketed or gasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Ungasketed or gasketed sliding cover, w/float	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover, w/pole wiper	0.0	0.0	0.0	41.0	41.0	0.0	0.0	0.0	0.0	0.0	0.0	41.0	0.0	0.0	0.0
	Gasketed sliding cover, w/pole sleeve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover, w/pole sleeve, wiper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover, w/float, pole wiper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0
	Gasketed sliding cover, w/float, pole sleeve, pole wiper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gauge-float well (auto. gauge)	Unbolted cover, ungasketed	0.0	0.0	14.0	14.0	0.0	14.0	14.0	0.0	0.0	0.0	0.0	14.0	14.0	0.0	0.0
	Unbolted cover, gasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Bolted cover, gasketed	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gauge-hatch/sample port	Weighted mechanical action, gasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Weighted mechanical actuation, ungasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Slit fabric seal, 10% open area	0.0	0.0	12.0	0.0	12.0	12.0	12.0	0.0	0.0	0.0	0.0	12.0	12.0	0.0	0.0
Vacuum breaker	Weighted mechanical actuation, ungasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	7.8	0.0	0.0
	Weighted mechanical actuation, gasketed	6.2	6.2	6.2	0.0	0.0	0.0	0.0	6.2	6.2	6.2	6.2	0.0	0.0	6.2	6.2
Deck drain	Open	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	90% closed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stub drain		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Deck leg	Adjustable, internal floating deck	0.0	0.0	323.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, pontoon area -ungasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, pontoon area -gasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, pontoon area -sock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, center area -ungasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, center area -gasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, center area -sock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, double-deck roofs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fixed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rim Vent	Weighted mechanical actuation, ungasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Weighted mechanical actuation, gasketed	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ladder well	Sliding cover, ungasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Sliding cover, gasketed	0.0	0.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	0.0	0.0	56.0	56.0	0.0	0.0
TOTAL DECK LOSS FITTING FACTOR, Ff (lb-mol/yr)		**87.80**	**77.80**	**674.81**	**873.00**	**575.40**	**976.00**	**976.00**	**559.40**	**559.40**	**187.60**	**187.60**	**397.80**	**377.80**	**237.60**	**237.60**

CALCULATED FITTING FACTORS

		IFR	EFR	EFR	EFR	EFR	EFR	EFR	EFR	EFR	EFR
		40FB4016	FB108R1	FB142	FB408	FB409	FB410	FB507	FB508	FB4010	FB4011
	Diameter (ft)	175.0	120.0	325.0	120.0	134.0	134.0	190.0	190.0	127.0	127.0
Access hatch	Bolted cover, gasketed	6.4	0.0	8.0	1.6	1.6	1.6	8.0	8.0	1.6	1.6
	Unbolted cover, gasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Unbolted cover, ungasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fixed roof support column well	Round pipe, ungasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Round pipe, gasketed sliding cover	475.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Round pipe, flexible fabric sleeve seal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Built-up column, ungasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Built-up column, gasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unslotted guide-pole and well	Ungasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Ungasketed sliding cover w/pole sleeve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover w/pole wiper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover w/pole sleeve	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Slotted guide-pole/sample well	Ungasketed or gasketed sliding cover	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Ungasketed or gasketed sliding cover, w/float	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover, w/pole wiper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover, w/pole sleeve	0.0	916.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover, w/pole sleeve, wiper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover, w/float, pole wiper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Gasketed sliding cover, w/float, pole sleeve, pole wiper	0.0	76.8	76.8	76.8	76.8	76.8	76.8	0.0	76.8	76.8
Gauge-float well (auto. gauge)	Unbolted cover, ungasketed	0.0	0.0	0.0	0.0	70.1	70.1	70.1	70.1	70.1	70.1
	Unbolted cover, gasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Bolted cover, gasketed	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gauge-hatch/sample port	Weighted mechanical action, gasketed	0.0	1.3	0.6	0.0	0.6	0.0	0.0	0.0	0.0	0.0
	Weighted mechanical actuation, ungasketed	0.0	0.0	0.0	2.3	0.0	0.0	0.0	2.3	0.0	0.0
	Slit fabric seal, 10% open area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vacuum breaker	Weighted mechanical actuation, ungasketed	0.0	0.0	0.0	115.2	115.2	0.0	115.2	115.2	172.8	172.8
	Weighted mechanical actuation, gasketed	6.2	0.0	30.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Deck drain	Open	0.0	0.0	65.3	9.3	9.3	9.3	18.7	18.7	9.3	9.3
	90% closed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stub drain		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Deck leg	Adjustable, internal floating deck	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, pontoon area -ungasketed	0.0	0.0	648.4	45.7	54.8	54.8	137.0	137.0	100.5	100.5
	Adjustable, pontoon area -gasketed	0.0	35.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, pontoon area -sock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, center area -ungasketed	0.0	0.0	297.6	35.3	43.0	43.0	99.7	99.7	46.0	46.0
	Adjustable, center area -gasketed	0.0	20.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, center area -sock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjustable, double-deck roofs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fixed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rim Vent	Weighted mechanical actuation, ungasketed	0.0	0.0	0.0	0.0	31.6	31.6	31.6	15.8	15.8	15.8
	Weighted mechanical actuation, gasketed	0.0	1.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ladder well	Sliding cover, ungasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Sliding cover, gasketed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL DECK LOSS FITTING FACTOR, Ff (lb-mol/yr)		**487.60**	**1051.69**	**1131.19**	**286.15**	**402.99**	**287.19**	**557.04**	**466.74**	**492.88**	**492.88**

FITTING FACTOR COUNTS

		IFR	IFR	IFR	IFR	IFR	IFR	IFR	IFR	IFR	IFR
		New	New	FB109R	FB137	FB147	FB402	FB403	FB509	FB510	40FB3043
	Diameter (ft)	135	115	120	120	225	100	100	220	220	110
Access hatch	Bolted cover, gasketed	1	1			1			2	2	4
	Unbolted cover, gasketed			1							
	Unbolted cover, ungasketed				1		1	1			
Fixed roof support column well	Round pipe, ungasketed sliding cover										
	Round pipe, gasketed sliding cover								22	22	7
	Round pipe, flexible fabric sleeve seal	8	7								
	Built-up column, ungasketed sliding cover										
	Built-up column, gasketed sliding cover			7	22	14	26	26			
Unslotted guide-pole and well	Ungasketed sliding cover										
	Ungasketed sliding cover w/pole sleeve										
	Gasketed sliding cover										
	Gasketed sliding cover w/pole wiper										
	Gasketed sliding cover w/pole sleeve										
Slotted guide-pole/sample well	Ungasketed or gasketed sliding cover										
	Ungasketed or gasketed sliding cover, w/float										
	Gasketed sliding cover, w/pole wiper				1	1					
	Gasketed sliding cover, w/pole sleeve										
	Gasketed sliding cover, w/pole sleeve, wiper										
	Gasketed sliding cover, w/float, pole wiper										
	Gasketed sliding cover, w/float, pole sleeve, pole wiper										
Gauge-float well (auto. gauge)	Unbolted cover, ungasketed			1	1		1	1			
	Unbolted cover, gasketed										
	Bolted cover, gasketed					1					
Gauge-hatch/sample port	Weighted mechanical action, gasketed										
	Weighted mechanical actuation, ungasketed										
	Slit fabric seal, 10% open area			1		1	1	1			
Vacuum breaker	Weighted mechanical actuation, ungasketed										
	Weighted mechanical actuation, gasketed	1	1	1					1	1	1
Deck drain	Open										
	90% closed										
Stub drain											
Deck leg	Adjustable, internal floating deck			41							
	Adjustable, pontoon area -ungasketed										
	Adjustable, pontoon area -gasketed										
	Adjustable, pontoon area -sock										
	Adjustable, center area -ungasketed										
	Adjustable, center area -gasketed										
	Adjustable, center area -sock										
	Adjustable, double-deck roofs										
	Fixed			34	41	112	32	32			
Rim Vent	Weighted mechanical actuation, ungasketed										
	Weighted mechanical actuation, gasketed			1							
Ladder well	Sliding cover, ungasketed										
	Sliding cover, gasketed			1	1	1	1	1			

FITTING FACTOR COUNTS

		IFR	IFR	IFR	IFR	IFR	IFR	EFR	EFR	EFR	EFR
		40FB3044	FB4012	FB4013	40FB4014	40FB4015	40FB4016	FB108R1	FB142	FB408	FB409
	Diameter (ft)	110	112	112	138.2	135.8	175	120	325	120	134
Access hatch	Bolted cover, gasketed	4			4	4	4		5	1	1
	Unbolted cover, gasketed										
	Unbolted cover, ungasketed		1	1							
Fixed roof support column well	Round pipe, ungasketed sliding cover										
	Round pipe, gasketed sliding cover	7			9	9	19				
	Round pipe, flexible fabric sleeve seal										
	Built-up column, ungasketed sliding cover										
	Built-up column, gasketed sliding cover		7	7							
Unslotted guide-pole and well	Ungasketed sliding cover										
	Ungasketed sliding cover w/pole sleeve										
	Gasketed sliding cover										
	Gasketed sliding cover w/pole wiper										
	Gasketed sliding cover w/pole sleeve										
Slotted guide-pole/sample well	Ungasketed or gasketed sliding cover										
	Ungasketed or gasketed sliding cover, w/float										
	Gasketed sliding cover, w/pole wiper		1								
	Gasketed sliding cover, w/pole sleeve							1			
	Gasketed sliding cover, w/pole sleeve, wiper										
	Gasketed sliding cover, w/float, pole wiper			1							
	Gasketed sliding cover, w/float, pole sleeve, pole wiper							1	1	1	1
Gauge-float well (auto. gauge)	Unbolted cover, ungasketed		1	1							1
	Unbolted cover, gasketed										
	Bolted cover, gasketed								1		
Gauge-hatch/sample port	Weighted mechanical action, gasketed							2	1		1
	Weighted mechanical actuation, ungasketed									1	
	Slit fabric seal, 10% open area		1	1							
Vacuum breaker	Weighted mechanical actuation, ungasketed		1	1						2	2
	Weighted mechanical actuation, gasketed	1			1	1	1		2		
Deck drain	Open								7	1	1
	90% closed										
Stub drain											
Deck leg	Adjustable, internal floating deck										
	Adjustable, pontoon area -ungasketed								142	10	12
	Adjustable, pontoon area -gasketed							22			
	Adjustable, pontoon area -sock										
	Adjustable, center area -ungasketed								194	23	28
	Adjustable, center area -gasketed							30			
	Adjustable, center area -sock										
	Adjustable, double-deck roofs										
	Fixed		37	37							
Rim Vent	Weighted mechanical actuation, ungasketed										2
	Weighted mechanical actuation, gasketed							1	1		
Ladder well	Sliding cover, ungasketed										
	Sliding cover, gasketed		1	1							

		EFR	EFR	EFR	EFR	EFR
		FB410	FB507	FB508	FB4010	FB4011
	Diameter (ft)	134	190	190	127	127
Access hatch	Bolted cover, gasketed	1	5	5	1	1
	Unbolted cover, gasketed					
	Unbolted cover, ungasketed					
Fixed roof support column well	Round pipe, ungasketed sliding cover					
	Round pipe, gasketed sliding cover					
	Round pipe, flexible fabric sleeve seal					
	Built-up column, ungasketed sliding cover					
	Built-up column, gasketed sliding cover					
Unslotted guide-pole and well	Ungasketed sliding cover					
	Ungasketed sliding cover w/pole sleeve					
	Gasketed sliding cover					
	Gasketed sliding cover w/pole wiper					
	Gasketed sliding cover w/pole sleeve					
Slotted guide-pole/sample well	Ungasketed or gasketed sliding cover					
	Ungasketed or gasketed sliding cover, w/float					
	Gasketed sliding cover, w/pole wiper					
	Gasketed sliding cover, w/pole sleeve					
	Gasketed sliding cover, w/pole sleeve, wiper					
	Gasketed sliding cover, w/float, pole wiper					
	Gasketed sliding cover, w/float, pole sleeve, pole wiper	1	1		1	1
Gauge-float well (auto. gauge)	Unbolted cover, ungasketed	1	1	1	1	1
	Unbolted cover, gasketed					
	Bolted cover, gasketed					
Gauge-hatch/sample port	Weighted mechanical action, gasketed					
	Weighted mechanical actuation, ungasketed			1		
	Slit fabric seal, 10% open area					
Vacuum breaker	Weighted mechanical actuation, ungasketed		2	2	3	3
	Weighted mechanical actuation, gasketed					
Deck drain	Open	1	2	2	1	1
	90% closed					
Stub drain						
Deck leg	Adjustable, internal floating deck					
	Adjustable, pontoon area -ungasketed	12	30	30	22	22
	Adjustable, pontoon area -gasketed					
	Adjustable, pontoon area -sock					
	Adjustable, center area -ungasketed	28	65	65	30	30
	Adjustable, center area -gasketed					
	Adjustable, center area -sock					
	Adjustable, double-deck roofs					
	Fixed					
Rim Vent	Weighted mechanical actuation, ungasketed	2	2	1	1	1
	Weighted mechanical actuation, gasketed					
Ladder well	Sliding cover, ungasketed					
	Sliding cover, gasketed					

AP-42 FITTING FACTORS

Fitting Type and Construction Details		Loss Factors KFa (lb-mol/yr)	KFb (lb-mol/(mph)^m-yr)	m (dimensionless)	EFR KF (lb-mol/yr)	IFR KF (lb-mol/yr)
Access hatch	Bolted cover, gasketed	1.6	0	0	1.6	1.6
	Unbolted cover, gasketed	31	5.2	1.2	97.86	31.
	Unbolted cover, ungasketed	36	5.9	1.3	129.85	36.
Fixed roof support column well	Round pipe, ungasketed sliding cover	31			31.	31.
	Round pipe, gasketed sliding cover	25			25.	25.
	Round pipe, flexible fabric sleeve seal	10			10.	10.
	Built-up column, ungasketed sliding cover	51			51.	51.
	Built-up column, gasketed sliding cover	33			33.	33.
Unslotted guide-pole and well	Ungasketed sliding cover	31	150	1.4	2982.77	31.
	Ungasketed sliding cover w/pole sleeve	25	2.2	2.1	217.05	25.
	Gasketed sliding cover	25	13	2.2	1428.97	25.
	Gasketed sliding cover w/pole wiper	14	3.7	0.78	33.46	14.
	Gasketed sliding cover w/pole sleeve	8.6	12	0.81	75.87	8.6
Slotted guide-pole/sample well	Ungasketed or gasketed sliding cover	43	270	1.4	5356.18	43.
	Ungasketed or gasketed sliding cover, w/float	31	36	2	2571.16	31.
	Gasketed sliding cover, w/pole wiper	41	48	1.4	985.57	41.
	Gasketed sliding cover, w/pole sleeve	11	46	1.4	916.21	11.
	Gasketed sliding cover, w/pole sleeve, wiper	8.3	4.4	1.6	140.83	8.3
	Gasketed sliding cover, w/float, pole wiper	21	7.9	1.8	385.19	21.
	Gasketed sliding cover, w/float, pole sleeve, pole wiper	11	9.9	0.89	76.8	11.
Gauge-float well (auto. gauge)	Unbolted cover, ungasketed	14	5.4	1.1	70.12	14.
	Unbolted cover, gasketed	4.3	17	0.38	42.47	4.3
	Bolted cover, gasketed	2.8	0	0	2.8	2.8
Gauge-hatch/sample port	Weighted mechanical action, gasketed	0.47	0.02	0.97	0.63	0.47
	Weighted mechanical actuation, ungasketed	2.3	0	0	2.3	2.3
	Slit fabric seal, 10% open area	12			12.	12.
Vacuum breaker	Weighted mechanical actuation, ungasketed	7.8	0.01	4	57.59	7.8
	Weighted mechanical actuation, gasketed	6.2	1.2	0.94	15.07	6.2
Deck drain	Open	1.5	0.21	1.7	9.33	1.5
	90% closed	1.8	0.14	1.1	3.25	1.8
Stub drain		1.2			1.2	1.2
Deck leg	Adjustable, internal floating deck	7.9			7.9	7.9
	Adjustable, pontoon area -ungasketed	2	0.37	0.91	4.57	2.
	Adjustable, pontoon area -gasketed	1.3	0.08	0.65	1.62	1.3
	Adjustable, pontoon area -sock	1.2	0.14	0.65	1.76	1.2
	Adjustable, center area -ungasketed	0.82	0.53	0.14	1.53	0.82
	Adjustable, center area -gasketed	0.53	0.11	0.13	0.68	0.53
	Adjustable, center area -sock	0.49	0.16	0.14	0.71	0.49
	Adjustable, double-deck roofs	0.82	0.53	0.14	1.53	0.82
	Fixed	0	0	0	0.	0.
Rim Vent	Weighted mechanical actuation, ungasketed	0.68	1.8	1	15.8	0.68
	Weighted mechanical actuation, gasketed	0.71	0.1	1	1.55	0.71
Ladder well	Sliding cover, ungasketed	98			98.	98.
	Sliding cover, gasketed	56			56.	56.

For EFR tanks, Kv= 0.7
For IFR tanks, Kv= 0
Average ambient wind speed = 12

Deck -Fitting Loss Factors from AP-42, Table 7.1-12 (Nov. 2006)
Average wind speed from AP-42, Table 7.1-9 (Nov. 2006)

Fugitive Emission Rate Estimates
Gasoline Blending System
New Components

FIN:	P-GB
EPN:	F-GB
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Current Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	0	0.059	97%	0
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	100	0.024	97%	0.072
Valves - Light Liquid (DM)	0	0.024	75%	0
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	0	0.251	85%	0
Pumps - Light Liquid (sealess)	4	0.251	100%	0
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	0	0.00055	75%	0
Flanges - Light Liquid	150	0.00055	75%	0.0206
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	0	1.399	85%	0
Pressure Relief Valves [3]	7	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.0926**
Total Annual Emissions				**0.406**

Sample Calculations: Valve Emissions = (0 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0 lb/hr

Annual Emissions = (0.0926 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 0.406 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	3.00%	0.003	0.012
Biphenyl	52475	0.05%	0.0000	0.000
Cumene	52440	0.15%	0.000	0.001
Ethylbenzene	52450	1.20%	0.001	0.005
Hexane	56600	1.30%	0.001	0.005
Naphthalene	52460	0.30%	0.000	0.001
Styrene	52480	0.78%	0.001	0.003
TMB 1,2,4	52416	2.40%	0.002	0.010
Toluene	52490	6.00%	0.006	0.024
Xylene	52510	7.00%	0.006	0.028
VOC-U	50001	77.82%	0.072	0.316
Total VOC	***59999***	***100%***	***0.09***	***0.41***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

Fugitive Emission Rate Estimates
Gasoline Blending System
Total Components

FIN:	P-GB
EPN:	F-GB
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	107	0.059	97%	0.189
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	759	0.024	97%	0.546
Valves - Light Liquid (DM)	0	0.024	75%	0
Valves - Heavy Liquid	20	0.00051	0%	0.0102
Pumps - Light Liquid	3	0.251	85%	0.113
Pumps - Light Liquid	4	0.251	100%	0
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	268	0.00055	75%	0.0369
Flanges - Light Liquid	1,798	0.00055	75%	0.247
Flanges - Heavy Liquid	50	0.00055	30%	0.0193
Compressors	0	1.399	85%	0
Pressure Relief Valves [3]	14	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**1.16**
Total Annual Emissions				**5.08**

Sample Calculations: Valve Emissions = (107 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0.189 lb/hr

Annual Emissions = (1.16 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 5.08 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	3.00%	0.035	0.152
Biphenyl	52475	0.05%	0.0006	0.003
Cumene	52440	0.15%	0.002	0.008
Ethylbenzene	52450	1.20%	0.014	0.061
Hexane	56600	1.30%	0.015	0.066
Naphthalene	52460	0.30%	0.003	0.015
Styrene	52480	0.78%	0.009	0.040
TMB 1,2,4	52416	2.40%	0.028	0.122
Toluene	52490	6.00%	0.070	0.305
Xylene	52510	7.00%	0.081	0.356
VOC-U	50001	52.82%	0.613	2.684
Total VOC	***59999***	***100%***	***1.16***	***5.08***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

Fugitive Emission Rate Estimates
Tank Farm - VOC Tank and Terminal 2
New Components

FIN:	P-VOC
EPN:	F-TK-VOC
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	0	0.059	97%	0
Valves - Gas (DM)	0	0.059	75%	0
Valves - Light Liquid	500	0.024	97%	0.36
Valves - Light Liquid (DM)	0	0.024	75%	0
Valves - Heavy Liquid	0	0.00051	0%	0
Pumps - Light Liquid	0	0.251	85%	0
Pumps - Light Liquid	4	0.251	100%	0
Pumps - Heavy Liquid	0	0.046	0%	0
Flanges - Gas	0	0.00055	30%	0
Flanges - Light Liquid	800	0.00055	30%	0.308
Flanges - Heavy Liquid	0	0.00055	30%	0
Compressors	0	1.399	85%	0
Pressure Relief Valves [3]	0	0.35	100%	0
Sampling Connections	0	0.033	97%	0
Total Hourly Emissions				**0.668**
Total Annual Emissions				**2.93**

Sample Calculations: Valve Emissions = (0 valves)(0.059 lb/hr-source)(1 - 0.97)
= 0 lb/hr

Annual Emissions = (0.668 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 2.93 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)[4]	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Benzene	52420	2.34%	0.016	0.068
Biphenyl	52475	0.09%	0.0006	0.003
Cumene	52440	0.13%	0.001	0.004
Ethylbenzene	52450	1.08%	0.007	0.032
Hexane	56600	0.99%	0.007	0.029
Naphthalene	52460	0.54%	0.004	0.016
Propylene	55600	0.11%	0.001	0.003
Styrene	52480	0.63%	0.004	0.018
TMB 1,2,4	52416	2.54%	0.017	0.074
Toluene	52490	4.74%	0.032	0.139
Xylene	52510	6.34%	0.042	0.185
n-Butane	56725	2.22%	0.015	0.065
Propane	56775	4.68%	0.031	0.137
VOC-U	50001	73.54%	0.491	2.152
Total VOC	***59999***	***100%***	***0.67***	***2.93***

NOTES:

(1) The emission factors used are refinery factors from the TCEQ Fugitive Guidance Document dated October 2000.
(2) The control factors are for a 28VHP program from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid flanges have a 30% control efficiency applied as a result of the weekly AVO monitoring. Difficult to monitor (DM) sources are monitored annually.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.
(4) Speciation is based on either sampling or PERF- Speciation of Petroleum Refinery Process Streams.

COOLING TOWERS

FHR is proposing to construct a new Mid Plant Cooling Tower No. 2 (44EF2) in the Mid Plant area. The new Mid Plant Cooling Tower No. 2 will be equipped with a high efficiency drift eliminator that will achieve a drift loss of at least 0.0005%. FHR is including proposed PM, PM_{10}, and $PM_{2.5}$ emission limits for the new Mid Plant Cooling Tower.

FHR will be installing a high efficiency drift eliminator in the existing Mid Plant Cooling Tower to reduce particulate matter emissions as part of a pollution control project separate from the project proposed as part of this application. The pollution control project will be completed prior to operating the changes proposed in this application. The drift eliminator will achieve a drift loss of at least 0.0005%.

General Process Description

The West Refinery is provided cooling water from a number of cooling towers throughout the refinery. The cooling towers are equipped with a TCEQ approved air-stripping system as described in Appendix P of TCEQ's Sampling and Procedure Manual. The cooling towers are monitored monthly for VOC emissions.

Emissions Data

Emission rate calculations for the following sources listed below are provided at the end of this section.

FIN	EPN	Source Name
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2

Cooling tower VOC emissions are estimated based on an emissions factor of 0.7 lb/MMgal from AP-42 Table 5.1-2 and the water circulating flow rate. Cooling tower PM emissions are derived from the equation in AP-42, Chapter 13.4, which is based on the water circulating flow rate, total dissolved solids (TDS) in the cooling water, and the drift loss (%). The drift loss is based on the type of drift eliminator installed on the cooling tower and the vendor guarantee for the drift eliminator. PM_{10} and $PM_{2.5}$ are estimated based on two publicly-available data sets on water droplet size distribution from cooling tower drift and the following methodology outlined in the Reisman Frisbie paper provided at the end of this section:

- Use a measured distribution of water droplet size
- Calculate the volume of liquid (water) in the droplet assuming a spherical shape
- Calculate the mass of solids in the droplet using the TDS (assuming the solids/water ratio is the same as in the circulating water)
- Assume each water droplet will evaporate shortly after being emitted into ambient air, into a single, solid, spherical particle
- Calculate the diameter of the resulting solid particle based on the mass of solids and assuming a spherical shape

The calculations assume a small amount of hydrogen sulfide emissions. These emission rates are based on a maximum hydrogen sulfide concentration of 1 ppm in the drift loss.

COOLING TOWER EMISSIONS

Cooling Tower	EPN	FIN	Flowrate (gpm)	VOC Emission Factor (1) (lb/MMgal)	Max Hourly TDS (ppm)	Annual Avg. TDS (ppm)	H2S (ppm)	Drift Loss (%)	PM10 Fraction (%)	PM2.5 Fraction (%)	Emissions VOC (lb/hr)	VOC (tons/yr)	PM (lb/hr)	PM (tons/yr)	PM10 (lb/hr)	PM10 (tons/yr)	PM2.5 (lb/hr)	PM2.5 (tons/yr)	H2S (lb/hr)	H2S (tons/yr)
Mid Plant Cooling Tower No. 2	F-S-202	44EF2	30000	0.7	5200	4600	1	0.0005	50	10	1.26	5.52	0.39	1.51	0.20	0.76	0.04	0.15	7.51E-05	3.29E-04

(1) Cooling tower VOC emissions are estimated with an emissions factor of 0.7 lb/MMgal from AP-42 Table 5.1-2, dated January 1995. The cooling water is monitored for VOC

Sample Calculations for Mid Plant Cooling Tower No. 2 Annual Emissions

VOC Emissions

$$\text{VOC} = \frac{30{,}000 \text{ gal water}}{\text{min}} \cdot \frac{0.7 \text{ lb VOC}}{1{,}000{,}000 \text{ gal water}} \cdot \frac{60 \text{ min}}{\text{hr}} \cdot \frac{1 \text{ ton}}{2{,}000 \text{ lb}} \cdot \frac{8760 \text{ hr}}{\text{year}} = 5.52 \text{ tons/yr}$$

PM Emission Rate Calculation Example: Flow Rate * TDS Concentration * Drift Loss%

$$\text{PM} = \frac{30{,}000 \text{ gal water}}{\text{min}} \cdot \frac{8.34 \text{ lb}}{\text{gal}} \cdot \frac{0.0005}{100} \cdot \frac{4600 \text{ lb PM}}{1{,}000{,}000 \text{ lb water}} \cdot \frac{60 \text{ min}}{\text{hr}} \cdot \frac{1 \text{ ton}}{2{,}000 \text{ lb}} \cdot \frac{8760 \text{ hr}}{\text{year}} = 1.51 \text{ tons/yr}$$

PM10 Emission Rate Calculation Example: PM Emission Rate * % PM10

$$\text{PM10} = \frac{1.51 \text{ lb PM}}{\text{yr}} \cdot \frac{50 \text{ lb PM10}}{100 \text{ lb PM}} = 0.76 \text{ tons/yr}$$

H_2S Emissions

For calculation purposes, it is assumed that the maximum concentration of 1 ppm is the concentration in the drift loss.

$$H_2S = \underbrace{\frac{30{,}000 \text{ gal water}}{\text{min}}}_{\text{Circulation Rate}} \cdot \frac{8.34 \text{ lb}}{\text{gal}} \cdot \frac{0.0005}{100} \cdot \underbrace{\frac{1 \text{ parts } H_2S}{1{,}000{,}000 \text{ parts } H_2O}}_{H_2S \text{ conc. (ppmw)}} \cdot \frac{60 \text{ min}}{\text{hr}} \cdot \frac{1 \text{ ton}}{2{,}000 \text{ lb}} \cdot \frac{8760 \text{ hr}}{\text{year}} = 0.00033 \text{ tons/yr}$$

Calculating Realistic PM_{10} Emissions from Cooling Towers

Abstract No. 216 Session No. AM-1b

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ABSTRACT

Particulate matter less than 10 micrometers in diameter (PM_{10}) emissions from wet cooling towers may be calculated using the methodology presented in EPA's AP-42[1] , which assumes that all total dissolved solids (TDS) emitted in "drift" particles (liquid water entrained in the air stream and carried out of the tower through the induced draft fan stack.) are PM_{10}. However, for wet cooling towers with medium to high TDS levels, this method is overly conservative, and predicts significantly higher PM_{10} emissions than would actually occur, even for towers equipped with very high efficiency drift eliminators (e.g., 0.0006% drift rate). Such over-prediction may result in unrealistically high PM_{10} modeled concentrations and/or the need to purchase expensive Emission Reduction Credits (ERCs) in PM_{10} non-attainment areas. Since these towers have fairly low emission points (10 to 15 m above ground), over-predicting PM_{10} emission rates can easily result in exceeding federal Prevention of Significant Deterioration (PSD) significance levels at a project's fenceline. This paper presents a method for computing realistic PM_{10} emissions from cooling towers with medium to high TDS levels.

INTRODUCTION

Cooling towers are heat exchangers that are used to dissipate large heat loads to the atmosphere. Wet, or evaporative, cooling towers rely on the latent heat of water evaporation to exchange heat between the process and the air passing through the cooling tower. The cooling water may be an integral part of the process or may provide cooling via heat exchangers, for example, steam condensers. Wet cooling towers provide direct contact between the cooling water and air passing through the tower, and as part of normal operation, a very small amount of the circulating water may be entrained in the air stream and be carried out of the tower as "drift" droplets. Because the drift droplets contain the same chemical impurities as the water circulating through the tower, the particulate matter constituent of the drift droplets may be classified as an emission. The magnitude of the drift loss is influenced by the number and size of droplets produced within the tower, which are determined by the tower fill design, tower design, the air and water patterns, and design of the drift eliminators.

AP-42 METHOD OF CALCULATING DRIFT PARTICULATE

EPA's AP-42[1] provides available particulate emission factors for wet cooling towers, however, these values only have an emission factor rating of "E" (the lowest level of confidence acceptable). They are also rather high, compared to typical present-day manufacturers' guaranteed drift rates, which are on the order of 0.0006%. (Drift emissions are typically expressed as a percentage of the cooling tower water circulation rate). AP-42 states that "a *conservatively high* PM_{10} emission factor can be obtained by (a) multiplying the total liquid drift factor by the TDS fraction in the circulating water, and (b) assuming that once the water evaporates, all remaining solid particles are within the PM_{10} range." (Italics per EPA).

If TDS data for the cooling tower are not available, a source-specific TDS content can be estimated by obtaining the TDS for the make-up water and multiplying it by the cooling tower cycles of concentration. [The cycles of concentration is the ratio of a measured parameter for the cooling tower water (such as conductivity, calcium, chlorides, or phosphate) to that parameter for the make-up water.]

Using AP-42 guidance, the total particulate emissions (PM) (after the pure water has evaporated) can be expressed as:

PM = Water Circulation Rate x Drift Rate x TDS [1]

For example, for a typical power plant wet cooling tower with a water circulation rate of 146,000 gallons per minute (gpm), drift rate of 0.0006%, and TDS of 7,700 parts per million by weight (ppmw):

PM = 146,000 gpm x 8.34 lb water/gal x 0.0006/100 x 7,700 lb solids/10^6 lb water x 60 min/hr = <u>3.38 lb/hr</u>

On an annual basis, this is equivalent to almost 15 tons per year (tpy). Even for a state-of-the-art drift eliminator system, this is not a small number, especially if assumed to all be equal to PM_{10}, a regulated criteria pollutant. However, as the following analysis demonstrates, only a very small fraction is actually PM_{10}.

COMPUTING THE PM_{10} FRACTION

Based on a representative drift droplet size distribution and TDS in the water, the amount of solid mass in each drop size can be calculated. That is, for a given initial droplet size, assuming that the mass of dissolved solids condenses to a spherical particle after all the water evaporates, and assuming the density of the TDS is equivalent to a representative salt (e.g., sodium chloride), the diameter of the final solid particle can be calculated. Thus, using the drift droplet size distribution, the percentage of drift mass containing particles small enough to produce PM_{10} can be calculated. This method is conservative as the final particle is assumed to be perfectly spherical; hence as small a particle as can exist.

The droplet size distribution of the drift emitted from the tower is critical to performing the analysis. Brentwood Industries, a drift eliminator manufacturer, was contacted and agreed to provide drift eliminator test data from a test conducted by Environmental Systems Corporation (ESC) at the Electric Power Research Institute (EPRI) test facility in Houston, Texas in 1988 (Aull[2], 1999). The data consist of water droplet size distributions for a drift eliminator that achieved a tested drift rate of 0.0003 percent. As we are using a 0.0006 percent drift rate, it is reasonable to expect that the 0.0003 percent drift rate would produce smaller droplets, therefore, this size distribution data can be assumed to be <u>conservative</u> for predicting the fraction of PM_{10} in the total cooling tower PM emissions.

In calculating PM_{10} emissions the following assumptions were made:

- Each water droplet was assumed to evaporate shortly after being emitted into ambient air, into a single, solid, spherical particle.
- Drift water droplets have a density (ρ_w) of water; $1.0\ g/cm^3$ or $1.0*10^{-6}\ \mu g/\mu m^3$.
- The solid particles were assumed to have the same density (ρ_{TDS}) as sodium chloride, (i.e., $2.2\ g/cm^3$).

Using the formula for the volume of a sphere, $V = 4\pi r^3/3$, and the density of pure water, $\rho_w = 1.0\ g/cm^3$, the following equations can be used to derive the solid particulate diameter, D_p, as a function of the TDS, the density of the solids, and the initial drift droplet diameter, D_d :

$$\text{Volume of drift droplet} = (4/3)\pi(D_d/2)^3 \qquad [2]$$

$$\text{Mass of solids in drift droplet} = (TDS)(\rho_w)(\text{Volume of drift droplet}) \qquad [3]$$

substituting,

$$\text{Mass of solids in drift} = (TDS)(\rho_w)(4/3)\pi(D_d/2)^3 \qquad [4]$$

Assuming the solids remain and coalesce after the water evaporates, the mass of solids can also be expressed as:

$$\text{Mass of solids} = (\rho_{TDS})\ (\text{solid particle volume}) = (\rho_{TDS})(4/3)\pi(D_p/2)^3 \qquad [5]$$

Equations [4] and [5] are equivalent:

$$(\rho_{TDS})(4/3)\pi(D_p/2)^3 = (TDS)(\rho_w)(4/3)\pi(D_d/2)^3 \qquad [6]$$

Solving for D_p:

$$D_p = D_d\ [(TDS)(\rho_w/\rho_{TDS})]^{1/3} \qquad [7]$$

Where,

TDS is in units of ppmw
D_p = diameter of solid particle, micrometers (μm)
D_d = diameter of drift droplet, μm

Using formulas [2] – [7] and the particle size distribution test data, Table 1 can be constructed for drift from a wet cooling tower having the same characteristics as our example; 7,700 ppmw TDS and a 0.0006% drift rate. The first and last columns of this table are the particle size distribution derived from test results provided by Brentwood Industries. Using straight-line interpolation for a solid particle size 10 μm in diameter, we conclude that approximately <u>14.9 percent</u> of the mass emissions are equal to or smaller than PM_{10}. The balance of the solid particulate are particulate greater than 10 μm. Hence, PM_{10} emissions from this tower would be equal to PM emissions x 0.149, or 3.38 lb/hr x 0.149 = 0.50 lb/hr. The process is repeated in Table 2, with all parameters equal except that the TDS is 11,000 ppmw. The result is that approximately 5.11 percent are smaller at 11,000 ppm. Thus, while total PM emissions are larger by virtue of a higher TDS, overall PM_{10} emissions are actually lower, because more of the solid particles are larger than 10 μm.

Table 1. Resultant Solid Particulate Size Distribution (TDS = 7700 ppmw)

EPRI Droplet Diameter (μm)	Droplet Volume (μm^3) [2][1]	Droplet Mass (μg) [3]	Particle Mass (Solids) (μg) [4]	Solid Particle Volume (μm^3)	Solid Particle Diameter (μm) [7]	EPRI % Mass Smaller
10	524	5.24E-04	4.03E-06	1.83	1.518	0.000
20	4189	4.19E-03	3.23E-05	14.66	3.037	0.196
30	14137	1.41E-02	1.09E-04	49.48	4.555	0.226
40	33510	3.35E-02	2.58E-04	117.29	6.073	0.514
50	65450	6.54E-02	5.04E-04	229.07	7.591	1.816
60	113097	1.13E-01	8.71E-04	395.84	9.110	5.702
70	179594	1.80E-01	1.38E-03	628.58	10.628	21.348
90	381704	3.82E-01	2.94E-03	1335.96	13.665	49.812
110	696910	6.97E-01	5.37E-03	2439.18	16.701	70.509
130	1150347	1.15E+00	8.86E-03	4026.21	19.738	82.023
150	1767146	1.77E+00	1.36E-02	6185.01	22.774	88.012
180	3053628	3.05E+00	2.35E-02	10687.70	27.329	91.032
210	4849048	4.85E+00	3.73E-02	16971.67	31.884	92.468
240	7238229	7.24E+00	5.57E-02	25333.80	36.439	94.091
270	10305995	1.03E+01	7.94E-02	36070.98	40.994	94.689
300	14137167	1.41E+01	1.09E-01	49480.08	45.549	96.288
350	22449298	2.24E+01	1.73E-01	78572.54	53.140	97.011
400	33510322	3.35E+01	2.58E-01	117286.13	60.732	98.340
450	47712938	4.77E+01	3.67E-01	166995.28	68.323	99.071
500	65449847	6.54E+01	5.04E-01	229074.46	75.915	99.071
600	113097336	1.13E+02	8.71E-01	395840.67	91.098	100.000

[1] Bracketed numbers refer to equation number in text.

The percentage of PM_{10}/PM was calculated for cooling tower TDS values from 1000 to 12000 ppmw and the results are plotted in Figure 1. Using these data, Figure 2 presents predicted PM_{10} emission rates for the 146,000 gpm example tower. As shown in this figure, the PM emission rate increases in a straight line as TDS increases, however, the PM_{10} emission rate increases to a maximum at around a TDS of 4000 ppmw, and then begins to decline. The reason is that at higher TDS, the drift droplets contain more solids and therefore, upon evaporation, result in larger solid particles for any given initial droplet size.

CONCLUSION

The emission factors and methodology given in EPA's AP-42[1] Chapter 13.4 *Wet Cooling Towers*, do not account for the droplet size distribution of the drift exiting the tower. This is a critical factor, as more than 85% of the mass of particulate in the drift from most cooling towers will result in solid particles larger than PM_{10} once the water has evaporated. Particles larger than PM_{10} are no longer a regulated air pollutant, because their impact on human health has been shown to be insignificant. Using reasonable, conservative assumptions and a realistic drift droplet size distribution, a method is now available for calculating realistic PM_{10} emission rates from wet mechanical draft cooling towers equipped with modern, high-efficiency drift eliminators and operating at medium to high levels of TDS in the circulating water.

Table 2. Resultant Solid Particulate Size Distribution (TDS = 11000 ppmw)

EPRI Droplet Diameter (μm)	Droplet Volume (μm^3) [2][1]	Droplet Mass (μg) [3]	Particle Mass (Solids) (μg) [4]	Solid Particle Volume (μm^3)	Solid Particle Diameter (μm) [7]	EPRI % Mass Smaller
10	524	5.24E-04	5.76E-06	2.62	1.710	0.000
20	4189	4.19E-03	4.61E-05	20.94	3.420	0.196
30	14137	1.41E-02	1.56E-04	70.69	5.130	0.226
40	33510	3.35E-02	3.69E-04	167.55	6.840	0.514
50	65450	6.54E-02	7.20E-04	327.25	8.550	1.816
60	113097	1.13E-01	1.24E-03	565.49	10.260	5.702
70	179594	1.80E-01	1.98E-03	897.97	11.970	21.348
90	381704	3.82E-01	4.20E-03	1908.52	15.390	49.812
110	696910	6.97E-01	7.67E-03	3484.55	18.810	70.509
130	1150347	1.15E+00	1.27E-02	5751.73	22.230	82.023
150	1767146	1.77E+00	1.94E-02	8835.73	25.650	88.012
180	3053628	3.05E+00	3.36E-02	15268.14	30.780	91.032
210	4849048	4.85E+00	5.33E-02	24245.24	35.909	92.468
240	7238229	7.24E+00	7.96E-02	36191.15	41.039	94.091
270	10305995	1.03E+01	1.13E-01	51529.97	46.169	94.689
300	14137167	1.41E+01	1.56E-01	70685.83	51.299	96.288
350	22449298	2.24E+01	2.47E-01	112246.49	59.849	97.011
400	33510322	3.35E+01	3.69E-01	167551.61	68.399	98.340
450	47712938	4.77E+01	5.25E-01	238564.69	76.949	99.071
500	65449847	6.54E+01	7.20E-01	327249.23	85.499	99.071
600	113097336	1.13E+02	1.24E+00	565486.68	102.599	100.000

Figure 1: Percentage of Drift PM that Evaporates to PM10

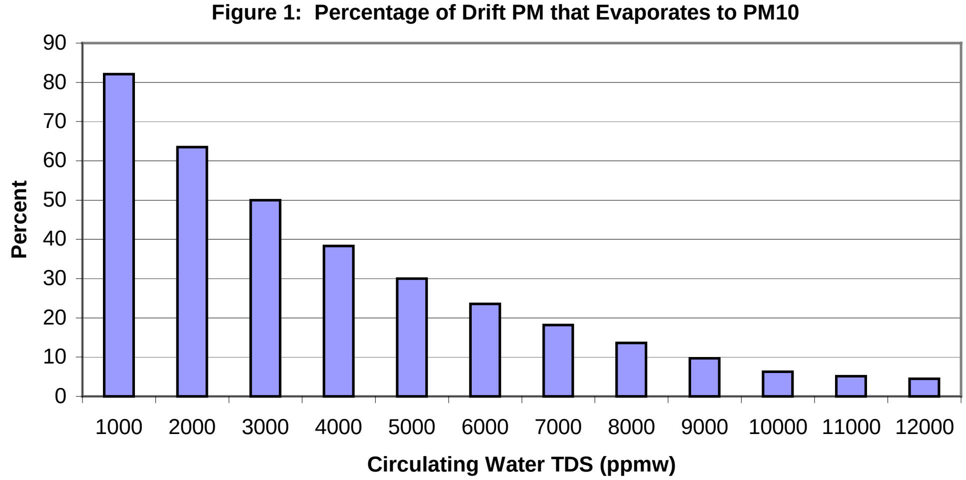
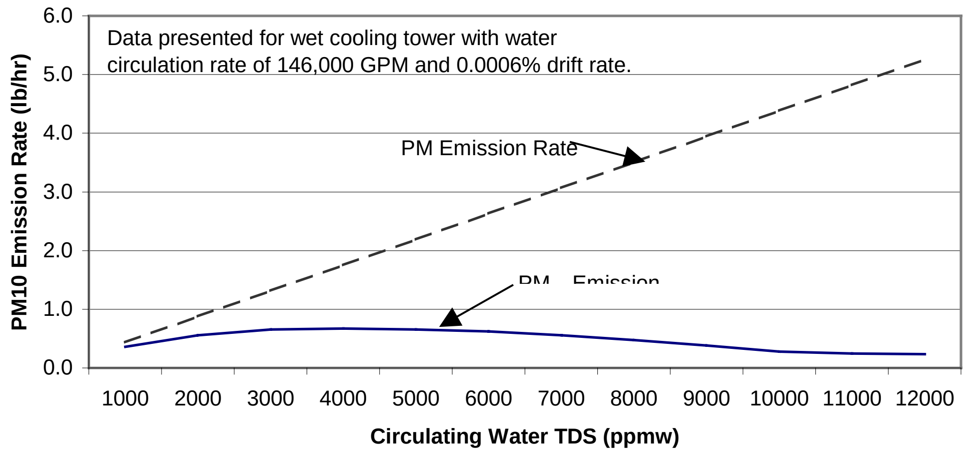


Figure 2: PM_{10} Emission Rate vs. TDS



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2. Aull, 1999. Memorandum from R. Aull, Brentwood Industries to J. Reisman, Greystone, December 7, 1999.

KEY WORDS

Drift
Drift eliminators
Cooling tower
PM_{10} emissions
TDS

MARINE LOADING

As a part of the project, FHR is proposing to increase the permitted annual loading rate of naphtha and gasoline into ships and barges at the marine terminal. Emissions resulting from these loading operations are controlled by the Marine Vapor Combustor, which is authorized under Permit No. 6819A. FHR is not proposing any changes to the annual loading rates of other products loaded at the marine terminal and controlled by the Marine Vapor Combustor. However, FHR is proposing to decrease the hourly loading rates of several of the materials loaded at the marine terminal and controlled by the Marine Vapor Combustor.

The Marine Vapor Combustor is considered a modified source for minor NSR purposes because of the proposed increase in the permitted annual naphtha and gasoline loading rates. FHR is also:

- Increasing the control efficiency and decreasing the NO_X and CO emission factors at the Marine Vapor Combustor based on recent stack test data.
- Adding Light Straight Run, or Mixed Pentanes, as an authorized material as a result of incorporating PBR Registration No. 103051.
- Incorporating PBR Registration No. 103706, which authorized an increase in the annual gasoline loading rate from 1,900,000 bbl/yr to 4,000,000 bbl/yr (Note: this amendment proposes to increase the gasoline loading rate to 6,935,000 bbl/yr).
- Decreasing the permitted annual benzene loading rate from 18,250,000 bbl/yr to 4,000,000 bbl/yr.
- Decreasing the permitted hourly loading rate of many of the materials controlled by the Marine Vapor Combustor.
- Revising the method for calculating the NO_x and CO allowable emission limits for the Marine Vapor Combustor to be based on the firing capacity of the Marine Vapor Combustor rather than the heat content of the vapors routed to the combustor
- Revising the method for calculating the hourly VOC emission rate from the Marine Vapor Combustor based on the maximum emission rate from any one material rather than the summation of multiple materials.
- Decreasing the fuel sulfur content of the natural gas combusted in the Marine Vapor Combustor to more accurately reflect supplier specifications and sampling. The hourly sulfur content is being decreased from 6 gr/100 scf to 5 gr/100 dscf based on supplier specifications, and the annual sulfur content is being decreased from 10 gr/100 dscf to 0.5 gr/100 dscf based on sampling.
- Revising the method for calculating crude oil emissions from the marine vapor combustor to be based on AP-42, Equation 5.2-1 rather than AP-42, Equations 5.2-2 and 5.2-3.
- Removing penexate as a material loaded at the marine terminal since the product is no longer produced at the refinery.

The result of all of the above changes is an overall decrease in the annual NO_X, CO, and VOC allowable emissions.

FHR is also proposing for the first time PM, PM_{10}, $PM_{2.5}$, and H_2S emission limits for the Marine Vapor Combustor. The particulate matter and H_2S emissions are not new emissions resulting from a physical change or change in the method of operation, but are being estimated now consistent with current TCEQ practices.

General Process Description

FHR's West Refinery uses three docks (No. 8, 9, and 10) for marine loading of both ships and barges. When loading toluene, benzene, xylene (all isomers), gasolines and blend stocks, naphthas, cumene, pseudocumene, light straight run (mixed pentanes), and crude oil, emissions are captured by a vacuum-assisted loading operation and routed to the Marine Vapor Combustor (VCS-1) for control. The Marine Vapor Combustor is an enclosed flare with a minimum VOC destruction efficiency of 99.5% based on stack testing. The Marine Vapor Combustor converts H_2S to SO_2 at a minimum efficiency of 98%. The Marine Vapor Combustor uses natural gas as the fuel to the burners of the combustor. With this amendment application, FHR is proposing to increase the annual loading rate for naphthas and gasolines/blendstocks and decrease the hourly loading rates of all materials except benzene and toluene. FHR is also proposing to include light straight run (mixed pentanes) as an authorized material as a result of incorporating PBR Registration No. 103051.

Emissions Data

Emission rate calculations for the following sources listed below are provided at the end of this section.

FIN	EPN	Source Name
LW-8	VCS-1	Marine Vapor Combustor

FHR is proposing to increase the permitted annual throughput rate of naphtha and gasoline and decrease the hourly loading rate of most of the materials. In addition, FHR is proposing additional changes as listed above. These changes will result in an overall decrease in the VOC, NOx, and CO allowable emission rates. FHR is also proposing PM, PM_{10}, $PM_{2.5}$, and H_2S emission rates for the Marine Vapor Combustor that have not been listed in the permit previously. As a result, emissions are calculated for all materials loaded at the marine terminal and controlled by the Marine Vapor Combustor.

VOC emission rates from marine loading operations are estimated using AP-42, (5th ed.), Section 5.2. Emission rates for all materials are estimated using the loading loss equation 5.2.1. FHR loads into three different types of vessels: ships, ocean barges, and shallow barges. With the exception of crude oil, FHR loads materials into all three types of vessels. Crude oil is loaded mostly into ships and ocean barges, but FHR loads a small amount of crude oil into shallow barges. Based on background documents for AP-42, Section 5.2, the saturation factor of 0.5 in Table 5.2-1 is for shallow barges and the saturation factor of 0.2 in Table 5.2-1 is for ships and ocean barges. VOC emission rates for materials other than crude oil are based on a saturation factor of 0.5 for shallow barges since it is higher than the saturation factor for ship/ocean barge loading. A VOC hourly emission rate is calculated for loading crude oil into shallow barges and into ships/ocean barges. Although there will be a small amount of crude oil loading into shallow barges, the annual VOC emission rate for crude oil loading is based on the saturation factor of 0.2 for ships/ocean barges. Controlled VOC emission rates from the marine vapor combustor are based on 100% capture efficiency and 99.5% destruction efficiency.

NO_X, CO, PM, PM_{10}, and $PM_{2.5}$ emission rates from the marine vapor combustor are based on a fired duty of 80 MMBtu/hr. NO_X and CO emission factors are from recent stack testing results.

PM, PM_{10}, and $PM_{2.5}$ emission factors are from AP-42 (5th Edition), Section 1.4, Table 1.4-2 for natural gas combustion.

Hourly SO_2 emission rate estimates from the combustion of natural gas are based on a sulfur content of 5 gr S/100 scf from fuel specifications. Annual SO_2 emission rate estimates from the combustion of natural gas are based on a sulfur content of 0.5 gr S/100 scf from fuel sampling. SO_2 emission rate estimates from the controlled loading of crude oil are based on 10 ppmw H_2S in the liquid. The K factor method from "Using K Factors to Estimate Quantities of Individual Vapor Species Emitted During the Storage and Transfer of Hydrocarbon Liquids" by Jeffrey Meling, Karen Horne, and Jay Hoover is used for the calculations. The estimated emission rate for SO_2 is based on a 100% conversion of H_2S to SO_2 in the marine vapor combustor. The estimated emission rate for H_2S is based on a 98% conversion of H_2S to SO_2 in the marine vapor combustor.

Annual Controlled Marine Loading Emission Rate Calculations (EPN VCS-1)

EMISSION FACTOR EQUATIONS

$$L = \frac{12.46\ S\ P\ M}{T}$$ (AP-42, Fifth Edition, Equation 5.2-1)

where: L = Loading loss (lb/1000 gal liquid loaded)
M = Vapor molecular weight of liquid loaded (lb/lb-mol)
P = True vapor pressure of liquid loaded (psia)
T = Temperature of bulk liquid loaded (°R)
S = Saturation factor (0.5 for submerged barge loading, from Table 5.2-1)

VOC EMISSIONS

Loading Vessel	Liquid Loaded	Type of Loading	Saturation Factor S *	(°F)	Average Temp. (°R)	Vapor Mol. Wt. (lb/lb-mol)	True Vapor Pressure (psia)	Loading Loss (lb/1000 gal)	Controlled Emissions – Marine Vapor Combustor (FIN LW-8, EPN VCS-1): Annual Controlled Loading Rate (bbl/yr)	Maximum Control Capture Efficiency (%)	Minimum Control Destruction Efficiency (%)	Annual MVRU VOC Loading Emissions (tons/yr)	Annual MVRU VOC Loading Emissions (g/s)
Ship, Ocean or Shallow Barge	Toluene	submerged	0.5	72	532	92	0.42	0.45	7,300,000	100%	99.5%	0.3468	0.0099852
Ship, Ocean or Shallow Barge	Benzene	submerged	0.5	74	534	78	1.70	1.55	4,000,000	100%	99.5%	0.6497	0.018706
Ship, Ocean or Shallow Barge	Xylene (m-, o-, p-)	submerged	0.5	74	534	106	0.14	0.17	18,250,000	100%	99.5%	0.3318	0.0095533
Ship, Ocean or Shallow Barge	Light Straight Run (Mixed Pentanes)	submerged	0.5	90	550	66	12.40	9.27	4,000,000	100%	99.5%	3.894	0.11212
Ship, Ocean or Shallow Barge	Gasolines/Blendstocks	submerged	0.5	72.1	532.1	66	7.10	5.49	6,935,000	100%	99.5%	3.995	0.11503
Ship, Ocean or Shallow Barge	Naphthas	submerged	0.5	72.1	532.1	85	5.00	4.98	8,030,000	100%	99.5%	4.196	0.12081
Ship, Ocean or Shallow Barge	Cumene/Pseudocumene	submerged	0.5	72.1	532.1	120	0.10	0.14	7,000,000	100%	99.5%	0.1033	0.0029743
Ship or Ocean Barge	Crude Oil & Heavier **	submerged	0.2	72	532	50	7.6	1.78	17,000,000	100%	99.5%	3.18	0.0916
									Total			**16.70**	**0.48**

* Based on the background documents for AP-42, Section 5.2, the 0.2 saturation factor in Table 5.2-1 is for ship and ocean barges and the 0.5 saturation factor in Table 5.2-1 is for shallow draft barges.
** Although FHR is proposing to load a small amount of crude oil into shallow barges, the annual emission limit is based on the loading into ship or ocean barges.

VOC Sample calculations:

Gasolines/Blendstocks

$$\text{Loading loss} = \frac{12.46\ S\ P\ M}{T}$$

$$= \frac{(12.46)\ (0.50)\ (7.100\ \text{psia})\ (66.00\ \text{lb/lb-mol})}{(532\ °R)} = 5.49\ \text{lb/1000 gal loaded}$$

Annual VCU emissions = (% loss emission factor) (Annual Controlled loading rate)(% captured)(% not destroyed)
= (5.49 lb/1000 gal) (ton/ 2000 lb) (6,935,000 bbl/yr) (42 gal/bbl) (100% captured) (0.5% not destroyed)
= 3.995 tons/yr

Annual Controlled Marine Loading Emission Rate Calculations (EPN VCS-1)

COMBUSTION EMISSIONS FROM BARGE AND SHIP LOADING

Annual Firing Capacity:	136,000	MMBtu/yr
NOx Emission Factor: *	0.0331	lb/MMBtu
CO Emission Factor: *	0.0805	lb/MMBtu
PM Emission Factor: **	0.0075	lb/MMBtu
VOC Emission Factor: **	0.0054	lb/MMBtu
NOx Annual Emissions:	2.25	tons/yr
CO Annual Emissions:	5.47	tons/yr
PM Annual Emissions:	0.51	tons/yr
VOC Annual Emissions:	0.37	tons/yr

* The NOx and CO emission factors are from stack testing data.
** The PM and VOC emission factor is from AP-42 (5th Ed.), Section 1.4 dated March 1998.

Sample calculation:

Annual NOx emissions = (136,000 MMBtu/yr) (0.0331 lb/MMBtu) (ton / 2000 lb)
= 2.25 tons/yr

SO_2 EMISSIONS FROM BARGE AND SHIP LOADING

	Annual Usage (scf/yr)	SO_2 Emission Factor (gr S/100 scf)	Annual SO_2 Emissions from Natural Gas (tons/yr)
Natural Gas	6,000,000	0.5	0.004

Sample calculation:

Annual SO_2 emissions from Natural Gas = (0.50 gr S/100 scf) (1 lb/7000 gr) (1lbmol S/32.1lb S) (lbmol SO2/lbmol S) (64.1lb SO2/1lbmol SO2) (6,000,000 scf/yr) (ton/ 2000 lb)
= 0.004 tons/yr

Annual Controlled Marine Loading Emission Rate Calculations (EPN VCS-1)

Controlled Loading Emissions from Barge and Ship Loading (FIN LW-8, EPN VCS-1)

	H_2S Content (ppmw)	Liquid Mole Fraction, x	K Value *	Vapor Mole Fraction, y	VOC Partial Pressure, P	Hourly Emissions: Mass Emission Ratio (MR) (lb H_2S/lb VOC)	Amount of H2S to Control Device (lb/yr)	% H_2S Converted to SO_2 for H_2S Emissions (%)	H_2S Emissions (tons/yr)	% H_2S Converted to SO_2 for SO_2 Emissions (%)	SO_2 Emissions (tons/yr)
Crude Oil & Heavier	10	0.0000588	22	0.00129	0.517	0.0017	2160	98%	0.0216	100%	2.03
						Total			**0.0216**		**2.03**

*K values are taken from H_2S K equilibrium factor graph published in Natural Gas Processors Suppliers Association, Engineering Data Book Ninth Edition, 1972

Sample Calculations:

Basis:

200 lb/lb-mole molecular weight (MW) of crude oil
34 lb/lb-mole MW of H_2S
64 lb/lb-mole MW of SO_2
50 lb/lb-mole MW of crude oil vapor
x = mole fraction of a component in the liquid phase
K = equilibrium factor, specifically for H_2S
y = mole fraction of a component in the vapor phase, where y = (x) (K)
P = VOC partial pressure (with respect to crude)
MR = mass rate (lb H_2S/lb VOC) to determine H_2S emission estimates
where: MR = (y)(MW H_2S)/(P)(MW crude vapor)

x = (10 lb H2S) (200 lb/lb-mol MW of crude) / (10^6 lb crude) (34 lb/lb-mol MW of H2S)
= 0.0000588

y = (x) (k) = (0.0000588) (22)
= 0.00129

P = (psia crude vapor pressure) / (14.7 psia total pressure)
= 0.517

MR = (0.00129) (34 lb/lb-mole H2S) / (0.517) (50 lb/lb-mol oil)
= 0.0017 lb H2S/lb VOC

Amount of H_2S to Control Device = (1.78 lb VOC/1000 gal) (42 gal/bbl crude) (17000000 bbl crude/yr) (0.0017 lb H2S/lb VOC)
= 2160 lb H2S/yr

H_2S Emissions = (2160 lb H2S/yr) (1 ton/2000 lb) (0.02)
= 0.0216 tons/yr
SO_2 Emissions = (2160 lb H2S/yr) (lb-mol H2S/34 lb H2S) (lb-mol SO2/lb mol H2S) (64 lb SO2/lb-mol SO2) (1 ton/2000 lb) (1)
= 2.03 tons/yr

Hourly Controlled Marine Loading Emission Rate Calculations (EPN VCS-1)

EMISSION FACTOR EQUATIONS

$$L = \frac{12.46\ S\ P\ M}{T}$$

(AP-42, Fifth Edition, Equation 5.2-1)

where:
- L = Loading loss (lb/1000 gal liquid loaded)
- M = Vapor molecular weight of liquid loaded (lb/lb-mol)
- P = True vapor pressure of liquid loaded (psia)
- T = Temperature of bulk liquid loaded (°R)
- S = Saturation factor (0.5 for submerged barge loading, from Table 5.2-1)

VOC EMISSIONS

									Controlled Emissions				
									Marine Vapor Combustor (FIN LW-8, EPN VCS-1)				
Loading Vessel	Liquid Loaded	Type of Loading	Saturation Factor S *	Average Temp. (°F)	Average Temp. (°R)	Vapor Mol. Wt. (lb/lb-mol)	True Vapor Pressure (psia)	Loading Loss (lb/1000 gal)	Hourly Controlled Loading Rate (bbl/hr)	Control Capture Efficiency (%)	Control Destruction Efficiency (%)	Hourly MVRU VOC Loading Emissions (lb/hr)	Hourly MVRU VOC Loading Emissions (g/s)
Ship, Ocean or Shallow Barge	Toluene	submerged	0.5	92	552	92	0.82	0.85	6000	100%	99.5%	1.073	0.13532
Ship, Ocean or Shallow Barge	Benzene	submerged	0.5	92	552	78	2.70	2.38	6000	100%	99.5%	2.995	0.3777
Ship, Ocean or Shallow Barge	Xylene (m-, o-, p-)	submerged	0.5	92	552	106	0.27	0.32	10000	100%	99.5%	0.6783	0.085541
Ship, Ocean or Shallow Barge	Light Straight Run (Mixed Pentanes)	submerged	0.5	90	550	66	12.40	9.27	5000	100%	99.5%	9.734	1.2276
Ship, Ocean or Shallow Barge	Gasolines/Blendstocks	submerged	0.5	76.1	536.1	66	9.70	7.44	10000	100%	99.5%	15.62	1.9699
Ship, Ocean or Shallow Barge	Naphthas	submerged	0.5	100	560	85	7.00	6.62	10000	100%	99.5%	13.9	1.7529
Ship, Ocean or Shallow Barge	Cumene/Pseudocumene	submerged	0.5	100	560	120	0.20	0.27	10000	100%	99.5%	0.5607	0.070711
Ship or Ocean Barge	Crude Oil & Heavier **	submerged	0.2	100	560	50	10	2.23	9000	100%	99.5%	4.21	0.531
Shallow Barge	Crude Oil & Heavier **	submerged	0.5	100	560	50	10	5.56	6000	100%	99.5%	7.01	0.884
									Total			**15.62**	**1.97**

* The 0.5 saturation factor is based on barge loading since that factor is higher than the factor for ship loading (0.2 from Table 5.2-1)

** Crude oil can only be loaded at a maximum rate of 9,000 bbl/hr at one dock and 6,000 bbl/hr at another. FHR is proposing to load a small amount of crude oil into shallow barges

VOC Sample calculations:

Gasolines/Blendstocks

$$\text{Loading loss} = \frac{12.46\ S\ P\ M}{T}$$

$$= \frac{(12.46)\ (0.50)\ (9.700\ \text{psia})\ (66.00\ \text{lb/lb-mol})}{(536\ °\text{R})} = 7.44\ \text{lb/1000 gal loaded}$$

Hourly VCU emissions = (% loss emission factor) (Hourly Controlled loading rate)(% captured)(% not destroyed)
= (7.44 lb/1000 gal) (10,000 bbl/hr) (42 gal/bbl)(100% captured)(0.5% not destroyed)
= 15.6 lbs/hr

Hourly Controlled Marine Loading Emission Rate Calculations (EPN VCS-1)

COMBUSTION EMISSIONS FROM BARGE AND SHIP LOADING

Maximum Firing Capacity:	80	MMBtu/hr
NOx Emission Factor: *	0.0331	lb/MMBtu
CO Emission Factor: *	0.0805	lb/MMBtu
PM Emission Factor: **	0.0075	lb/MMBtu
VOC Emission Factor: **	0.0054	lb/MMBtu

NOx Hourly Emissions:	2.65	lb/hr
CO Hourly Emissions:	6.44	lb/hr
PM Hourly Emissions:	0.60	lb/hr
VOC Hourly Emissions:	0.43	lb/hr

* The NOx and CO emission factors are from stack testing data.
** The PM and VOC emission factor is from AP-42 (5th Ed.), Section 1.4 dated March 1998.

Sample calculation:

Hourly NOx emissions = (80 MMBtu/hr) (0.033 lb/MMBtu)
= 2.648 lb/hr

SO_2 EMISSIONS FROM BARGE AND SHIP LOADING

	Hourly Usage (scf/hr)	SO_2 Emission Factor (gr S/100 scf)	Hourly SO_2 Emissions from Natural Gas (lb/hr)
Natural Gas	685	5	0.0098

Sample calculation:

Hourly SO_2 emissions from Natural Gas = (5.00 gr S/100 scf) (1 lb/7000 gr) (1lbmol S/32.1lb S) (lbmol SO2/lbmol S) (64.1lb SO2/1lbmol SO2) (685 scf/hr)
= 0.0098 lb/hr

Hourly Controlled Marine Loading Emission Rate Calculations (EPN VCS-1)

Controlled Loading Emissions from Barge and Ship Loading (FIN LW-8, EPN VCS-1)

	H_2S Content (ppmw)	Liquid Mole Fraction, x	K Value *	Vapor Mole Fraction, y	VOC Partial Pressure, P	Hourly Emissions: Mass Emission Ratio (MR) (lb H_2S/lb VOC)	Amount of H2S to Control Device (lb/hr)	% H_2S Converted to SO_2 for H_2S Emissions (%)	H_2S Emissions (lb/hr)	% H_2S Converted to SO_2 for SO_2 Emissions (%)	SO_2 Emissions (lb/hr)
Crude Oil & Heavier	10	0.0000588	30	0.00176	0.68	0.00176	1.48	98%	0.030	100%	2.79
						Total			**0.030**		**2.79**

*K values are taken from H_2S K equilibrium factor graph published in Natural Gas Processors Suppliers Association, Engineering Data Book Ninth Edition, 1972

Sample Calculations:

Basis:

200 lb/lb-mole molecular weight (MW) of crude oil
34 lb/lb-mole MW of H_2S
64 lb/lb-mole MW of SO_2
50 lb/lb-mole MW of crude oil vapor
x = mole fraction of a component in the liquid phase
K = equilibrium factor, specifically for H_2S
y = mole fraction of a component in the vapor phase, where y = (x) (K)
P = VOC partial pressure (with respect to crude)
MR = mass rate (lb H_2S/lb VOC) to determine H_2S emission estimates
where: MR = (y)(MW H_2S)/(P)(MW crude vapor)

x = (10 lb H2S) (200 lb/lb-mol MW of crude) / (10^6 lb crude) (34 lb/lb-mol MW of H2S)
= 0.0000588

y = (x) (k) = (0.0000588) (30)
= 0.00176

P = (psia crude vapor pressure) / (14.7 psia total pressure)
= 0.68

MR = (0.00176) (34 lb/lb-mole H2S) / (0.68) (50 lb/lb-mol oil)
= 0.00176 lb H2S/lb VOC

Amount of H_2S to Control Device = (5.5625 lb VOC/1000 gal) (42 gal/bbl crude) (6000 bbl crude/hr) (0.00176 lb H2S/lb VOC)
= 1.48 lb H2S/hr

H_2S Emissions = (1.48 lb H2S/yr) (0.02)
= 0.0296 lb/hr

SO_2 Emissions = (1.48 lb H2S/yr) (lb-mol/34 lb H2S) (lb-mol SO2/lb-mol H2S) (64 lb SO2/lb-mol SO2) (0.98)
= 2.79 lb/hr

OTHER SOURCES

FHR is not proposing any physical changes or changes in the method of operation for the FCCU CO Boiler/Scrubber, LSG Hot Oil Heater (47BA1), the Metaxylene Hot Oil Heater (54BA1), the DDS Charge Heater (56BA1), the DDS Fractionator Reboiler (56BA2), equipment piping components in the FCCU Unit, or equipment piping components in the Hydrocracker Unit that will increase emissions. There will, however, be emissions reductions at these units. FHR will operate the FCCU catalyst regenerator at full burn which will reduce the annual average CO concentration in the exhaust from the scrubber. FHR is reducing the annual CO concentration limit in the exhaust gas from 250 ppmv, dry to 50 ppmv, dry. FHR is proposing an emission reduction project that will reduce the sulfur content of the fuel gas prior to combustion in the heaters. Therefore, the SO_2 allowable emission limits are being reduced as a result of the emission reduction project. FHR is proposing an emission reduction project for the existing equipment piping components in the FCCU and Hydrocracker Units. Specifically, FHR will reduce VOC emissions by committing to annual flange monitoring in these unit. There are no new equipment piping components proposed for the FCCU and Hydrocracker Units.

As part of installing the SCR controls on some of the heaters, there will be new equipment piping components in ammonia service. FHR is proposing an Audio, Visual, and Olfactory (AVO) LDAR monitoring program to reduce fugitive emissions of ammonia from these new equipment piping components.

Detailed process descriptions and material balances are not provided in this section because FHR is not proposing any physical changes or changes in the method of operation for these emission units.

Emissions Data

Emission rate calculations for the sources listed below are provided at the end of this section.

FIN	EPN	Source Name
01BF102	AA-4	FCCU CO Boiler/Scrubber
47BA1	LSGHTR	LSG Hot Oil Heater
54BA1	MX-1	54BA1 MX Unit Hot Oil Heater
56BA1	DDS-HTRSTK	DDS Charge Heater (combined stack)
56BA2	DDS-HTRSTK	DDS Fractionator Reboiler (combined stack)
01	F-01	FCCU Fugitives
26	F-26	Hydrocracker Fugitives
SCRNH3FUG	SCRNH3FUG	SCR Ammonia Fugitives

There are no changes in the NO_X, SO_2, PM, PM_{10}, $PM_{2.5}$, and VOC emission rates for the FCCU CO Boiler/Scrubber. The annual CO emission rate is being revised based on the CO reduction project. The annual emission rate is estimated based on a maximum CO concentration limit of 50 ppmv, dry.

There are no changes in the NO_X, CO, PM, PM_{10}, $PM_{2.5}$, and VOC emission rates for either the LSG Hot Oil Heater, the Metaxylene Hot Oil Heater, the DDS Charge Heater, or the DDS Fractionator Reboiler. FHR is proposing to revise the SO_2 emission rates based on the SO_2 reduction project. The hourly SO_2 emission rate is based on an estimated maximum fuel gas sulfur content of 1 gr/100 scf, and the annual SO_2 emission rate is based on an estimated average fuel gas sulfur content of 0.6 gr/100 scf.

VOC emission rates from the existing equipment piping components in the FCCU and Hydrocracker Units are estimated based on the number of each type of component and the emission factors from the TCEQ's Fugitive Guidance Document dated October 2000. Control efficiencies are based on a 28 VHP LDAR monitoring program. FHR is committing to annual instrument monitoring for all existing gas/vapor and light liquid flanges/connectors. Therefore, a 75% control efficiency is applied to the existing gas/vapor and light liquid flanges/connectors.

Ammonia emission rates from the new equipment piping components are estimated based on the number of each type of component and the SOCMI without ethylene emission factors as specified in the TCEQ's Fugitive Guidance Document dated October 2000. Control efficiencies are based on an AVO LDAR monitoring program.

FCCU CO BOILER/SCRUBBER
EPN AA-4

The FCCU has estimated SO_2, CO, NOx, and VOC emissions as follows:

Annual Average SO_2	Hourly Maximum SO_2	Annual Average CO	Hourly Maximum CO	Annual Average NO_x	Hourly Maximum NO_x	Annual Average Ammonia	Hourly Maximum Ammonia	VOC Emission Rate
(ppmv dry, O_2 free)		(ppmv dry)		(ppmv dry, O_2 free)		(ppmv dry)		(lb/MM scf fuel)
25	250	50	500	93	550	15	25	5.5

The scrubber has an exhaust flow rate of approximately 212,000 scfm at standard conditions. The expected moisture content content of the stream is approximately 22 %. The expected oxygen content is approximately 2.0 %.

Dry exhaust rate = (212,000 scfm) (1-0.22) = 165360 dscfm
Dry, O2 free exhaust rate = (212,000 scfm)(1-0.22)[(20.9 -2.0) / 20.9] = 149536 dscfm

SO_2:
The maximum hourly SO_2 emission rate is:

(250 ppmv SO2) (149,536 dscfm) (lb-mol/387 scf) (1/1,000,000) = 0.097 lb-mol SO_2/min
(0.097 lb-mol SO2/min) (64 lb/lb-mol) (60 min/hr) = 370.94 lb/hr SO_2

Annual emissions are:

(25 ppmv SO2) (149,536 dscfm) (lb-mol/387 scf) (1/1,000,000) (60 min/hr) (8760 hr/yr) = 5,077.27 lb-mol SO_2/yr
(5,077.27 lb-mol SO2/min) (64 lb/lb-mol) (ton/2000 lb) = 162.5 tons/yr SO_2

CO and NOx emissions are estimated similarly with the appropriate flow rate and molecular weight.

NH_3:
The maximum hourly NH_3 emission rate is:

(25 ppmv NH3) (165,360 dscfm) (lb-mol/387 scf) (1/1,000,000) = 0.0107 lb-mol NH_3/min
(0.0107 lb-mol NH3/min) (17 lb/lb-mol) (60 min/hr) = 10.90 lb/hr NH_3

Annual emissions are:

(15 ppmv NH3) (165,360 dscfm) (lb-mol/387 scf) (1/1,000,000) (60 min/hr) (8760 hr/yr) = 3,368.73 lb-mol NH_3/yr
(3,368.73 lb-mol NH3/min) (17 lb/lb-mol) (ton/2000 lb) = 28.63 tons/yr NH_3

VOC
VOC emissions are generated primarily from the combustion of auxilliary fuel gas in the CO boiler. The CO boiler has a maximum fired duty of 280 MM btu/hr (LHV) from the combustion of regenerator gas and refinery fuel gas. The auxilliary fuel gas has an average heat content of 778 Btu/scf (LHV) and 865 Btu/scf (HHV), based on the 90 lb fuel gas system . From AP-42, Table 1.4-2, the VOC emissions factor for gas combustion is 5.5 lb/MM scf, which is based on a higher heating value of 1020 Btu/scf (HHV). This factor is converted to the heating value of the auxilliary fuel gas by multiplying the AP-42 factor by the ratio of the auxilliary fuel gas heating value to the AP-42 factor heating value.

(280 MM btu/hr) (scf/778 btu) = 0.36 MMscf/hr
(0.36 MMscf fuel/hr) (5.5 lb/MM scf) (865 Btu/scf fuel) (scf AP-42 fuel/1020 Btu) = 1.7 lb/hr VOC
(1.68 lb/hr) (1 ton/2000 lb) (8760 hr/yr) = 7.4 tons/yr

PM/PM_{10}
The FCCU scrubber controls particulate emissions to the NSPS level for emissions not to exceed 1 lb/1000 lb coke burn-off. The FCCU is expected to operate at a coke "make" rate of approximately 5% of the inlet feed on an annual basis with a short-term rate of 6.5%. It is assumed that 100% of the coke is then burned off.

(68,000 bbl/day) (317 lb/bbl) (0.065 lb-coke/lb-feed) x
(lb PM/1000 lb-coke) (day/24 hour) = 58.3 lb/hr PM/PM_{10}

(68,000 bbl/day) (317 lb/bbl) (0.06 lb-coke/lb-feed) x
(lb PM/1000 lb-coke) (365 day/yr) (ton/2000 lb) = 235.7 tons/yr PM/PM_{10}

SUMMARY:

Contaminant	Molecular Weight	Short-term Emissions (lb/hr)	Annual Emissions (tons/yr)
NOx	46	586.55	434.41
CO	28	358.92	157.21
SO2	64	370.94	162.47
PM/PM_{10}	n/a	58.30	235.70
VOC	16	1.68	7.35
Ammonia	17	10.90	28.63

Gas Combustion Emissions Calculator

LSG Hot Oil Heater (Potential to Emit), EPN LSGHTR

INPUT DATA

Combustion Unit Description:	LSG Hot Oil Heater (Potential to Emit)
Facility Identification Number (FIN):	47BA1
Emission Point Number (EPN):	LSGHTR
Control Identification Number (CIN)	
UTM Zone:	14
UTM Easting (m):	644447
UTM Northing (m):	3079590

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	222.4
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	10%
Stack Exit Temperature, °F:	100
Stack Diameter, ft:	11
Stack Height, ft:	175
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM
If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					1			
Nitrogen Oxides	NOx	0.045							
Particulate Matter	PM							7.6	
Carbon Monoxide	CO	0.05							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					0.6			
Nitrogen Oxides	NOx	0.045							
Particulate Matter	PM							7.6	
Carbon Monoxide	CO	0.05							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note th the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculatio

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Engineering estimate-fuel gas treating	Engineering estimate-fuel gas treating
Nitrogen Oxides	NOx	Permit Emission Limit	Permit Emission Limit
Particulate Matter	PM	AP-42, Table 1.4-2, July 1998	AP-42, Table 1.4-2, July 1998
Carbon Monoxide	CO	Vendor Estimate	Vendor Estimate
Total Organics	TOC	AP-42, Table 1.4-2, July 1998	AP-42, Table 1.4-2, July 1998
Volatile Organics	VOC	AP-42, Table 1.4-2, July 1998	AP-42, Table 1.4-2, July 1998

Volatile Organics Calculated-As Basis

Compound: C3H8 (CH4, C2H6, C3H8, etc.)
Molecular Weight 44.09 (lb / lb-mol)

INPUT DATA CONTINUED (LSG Hot Oil Heater (Potential to Emit), EPN LSGHTR

FUEL DATA

Fuel Gas Compositior				Pure Component Data			Fuel Gas Component Data		
Formula	Name	Mole %	(A) Mole Fraction	(B) Moleculai Weight (lb/lb-mol)	(C) HHV * (Btu/scf)	(D) LHV * (Btu/scf)	(A) X (B) lb/lb-mol Fuel Gas	(A) X (C) Btu (HHV) per scf Fuel Gas	(A) X (D) Btu (LHV) per scf Fuel Gas
CH4	Methane	55.10	0.5510	16.04	1012	911	8.84	557.61	501.96
C2H6	Ethane	9.07	0.0907	30.07	1773	1622	2.73	160.81	147.12
C3H8	Propane	4.38	0.0438	44.09	2524	2322	1.93	110.55	101.70
C4H10	n-Butane	0.59	0.0059	58.12	3271	3018	0.34	19.30	17.81
i-C4H10	Isobutane	0.53	0.0053	58.12	3261	3009	0.31	17.28	15.95
n-C5H12	n-Pentane	0.13	0.0013	72.15	4020	3717	0.09	5.23	4.83
i-C5H12	Isopentane	0.19	0.0019	72.15	4011	3708	0.14	7.62	7.05
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.33	0.0033	86.17	4768	4415	0.28	15.73	14.57
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.28	0.0028	28.05	1604	1503	0.08	4.49	4.21
C3H6	Propylene	0.40	0.0040	42.08	2340	2188	0.17	9.36	8.75
C4H8	n-Butene	0.05	0.0005	56.10	3084	2885	0.03	1.54	1.44
i-C4H8	Isobutene	0.02	0.0002	56.10	3069	2868	0.01	0.61	0.57
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide		0.0000	34.08	646	595	0.00	0.00	0.00
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	27.33	0.2733	2.02	325	275	0.55	88.82	75.16
O2	Oxygen	0.10	0.0010	32.00	0	0	0.03	0.00	0.00
N2	Nitrogen	1.08	0.0108	28.01	0	0	0.30	0.00	0.00
CO	Carbon Monoxide	0.05	0.0005	28.01	321	321	0.01	0.16	0.16
CO2	Carbon Dioxide	0.32	0.0032	44.01	0	0	0.14	0.00	0.00
TOTAL		99.95	0.9995				16.0	999.	901.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from
Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

Midplant fuel gas sytsem

GAS COMBUSTION CALCULATIONS (LSG Hot Oil Heater (Potential to Emit), EPN LSGHTR)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	222.4	200.6

(222.4 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/999 Btu) (lb-mol/379 scf) = 587 lb-mol/hr
(587 lb-mol/hr) (16 lb/lb-mol) = 9390 lb/hr
(587 lb-mol/hr) (379 scf/lb-mol) = 222000 scfh @ 60°F
(222000 scfh) (hr/60 min) = 3700 scfm @ 60°F
(222000 scfh) (100% - 0% dscf) / (100% scf) = 222000 dscfh @ 60°F
(587 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 227000 scfh @ 70°F
(227000 scfh) (hr/60 min) = 3780 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
Formula	Mole %	(A) Mole Fraction	(B)* Flow Rate lb-mol/hr	(C) lb-mol/ lb-mol fuel	(B) X (C) lb-mol/hr	(D) lb-mol/ lb-mol fuel	(B) X (D) lb-mol/hr	(E) lb-mol/ lb-mol fuel	(B) X (E) lb-mol/hr
CH4	55.10	0.5510	323.437	2.0	646.874	1.0	323.437	2.0	646.874
C2H6	9.07	0.0907	53.241	3.5	186.344	2.0	106.482	3.0	159.723
C3H8	4.38	0.0438	25.711	5.0	128.555	3.0	77.133	4.0	102.844
C4H10	0.59	0.0059	3.463	6.5	22.510	4.0	13.852	5.0	17.315
i-C4H10	0.53	0.0053	3.111	6.5	20.222	4.0	12.444	5.0	15.555
n-C5H12	0.13	0.0013	0.763	8.0	6.104	5.0	3.815	6.0	4.578
i-C5H12	0.19	0.0019	1.115	8.0	8.920	5.0	5.575	6.0	6.690
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.33	0.0033	1.937	9.5	18.402	6.0	11.622	7.0	13.559
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.28	0.0028	1.644	3.0	4.932	2.0	3.288	2.0	3.288
C3H6	0.40	0.0040	2.348	4.5	10.566	3.0	7.044	3.0	7.044
C4H8	0.05	0.0005	0.294	6.0	1.764	4.0	1.176	4.0	1.176
i-C4H8	0.02	0.0002	0.117	6.0	0.702	4.0	0.468	4.0	0.468
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.00	0.0000	0.000	1.5	0.000	1.0 (SO2)	0.000	1.0	0.000
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	27.33	0.2733	160.427	0.5	80.214	0.0	0.000	1.0	160.427
O2	0.10	0.0010	0.587	- 1.0	- 0.587	0.0	0.000	0.0	0.000
N2	1.08	0.0108	6.340	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.05	0.0005	0.294	0.5	0.147	1.0	0.294	0.0	0.000
CO2	0.32	0.0032	1.878	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.95	0.9995	587.		1140.		567.		1140.

* (B) = (A) X (587 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (LSG Hot Oil Heater (Potential to Emit), EPN LSGHTR)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (1140 lb-mol stoichiometric O2/hr) (1.001) = 1140 lb-mol total O2/hr
= (1140 lb-mol O2/hr) (32.00 lb/lb-mol) = 36500 lb O2/hr

Nitrogen in Supplied Air: (1140 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 4290 lb-mol total N2/hr
= (4290 lb-mol N2/hr) (28.01 lb/lb-mol) = 120000 lb N2/hr

Bone-dry (BD) Supplied Air: (1140 lb-mol O2/hr) + (4290 lb-mol N2/hr) = 5430 lb-mol BD air/hr
= (36500 lb O2/hr) + (120000 lb N2/hr) = 157000 lb BD air/hr

Moisture in Supplied Air: (157000 lb BD air/hr) (0.0132 lb water/lb BD air) = 2070 lb water/hr
= (2070 lb water/hr) (lb-mol water/18.02 lb water) = 115 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (1140 lb-mol O2/hr) + (4290 lb-mol N2/hr) + (115 lb-mol water/hr) = 5550 lb-mol/hr
= (36500 lb O2/hr) + (120000 lb N2/hr) + (2070 lb water/hr) = 159000 lb/hr
= (5550 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 35100 scfm @ 60°F
= (5550 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 35800 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	4290.00	6.340	0.000	4296.34	0.702	28.01	19.66	0.883
Oxygen	1140.00	0.587	-1140.000	0.59	0.000	32.00	0.	0.000
Carbon Dioxide	0.00	1.878	567.000	568.88	0.093	44.01	4.09	0.117
Water	115.00	0.000	1140.000	1255.00	0.205	18.02	3.69	0.000
TOTAL				6120.	1.000		27.44	1.000

Exhaust gas flow rate = 6120 lb-mol/hr
= (6120 lb-mol/hr) (27.44 lb/lb-mol) = 168000 lb/hr
= (6120 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 38700 scfm @ 60°F
= (6120 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 39500 scfm @ 70°F
= (38700 scfm) [(100 + 460)°R] acf / [(60 + 460)°R] scf = 41700 acfm @ 100°F
= (6120 total lb-mol/hr) - (1255 water lb-mol/hr) = 4870 lb-mol/hr dry
= (4870 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 30800 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (11 ft)^2 / 4 = 95 ft^2

Stack Exit Velocity = (41700 acfm) (min/60 sec) / (95 ft^2) = 7.32 ft/sec
= (7.32 ft/sec) (0.3048 m/ft) = 2.23 m/sec

GAS COMBUSTION CALCULATIONS (LSG Hot Oil Heater (Potential to Emit), EPN LSGHTR)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (1 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (222.4 MM Btu/hr) = 0.636064636064636 lb/hr

NOx: (222.4 MM Btu/hr) (0.045 lb/MM Btu) = 10.008 lb/hr (HHV Calculation Basis)

PM: (7.6 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (222000 scf fuel/hr) = 1.65246352941176 lb/hr

CO: (222.4 MM Btu/hr) (0.05 lb/MM Btu) = 11.12 lb/hr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (222000 scf fuel/hr) = 1.19586176470588 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (0.6 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (222.4 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 1.67157786357786 tons/yr

NOx: (222.4 MM Btu/hr) (0.045 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 43.83504 tons/yr (HHV Calculation Basis)

PM: (7.6 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (222000 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 7.23779025882353 tons/yr

CO: (222.4 MM Btu/hr) (0.05 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 48.7056 tons/yr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (222000 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 5.23787452941177 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	0.63606	64.06	0.00993	0.000162	0.000204	1.62	2.04
NOx	10.008	46.01	0.218	0.00356	0.00448	35.6	44.8
PM	1.65246	NA	NA	NA	NA	NA	NA
CO	11.12	28.01	0.397	0.00649	0.00815	64.9	81.5
VOC	1.19586	44.09	0.0271	0.000443	0.000556	4.43	5.56

Sample Calculations for NOx: (10.008 lb/hr) / (46.01 lb/lb-mol) = 0.218 lb-mol/hr
(0.218 lb-mol/hr) / (6120 lb-mol/hr exhaust gas) (100%) = 0.00356% mole composition
(0.218 lb-mol/hr) / (4870 lb-mol/hr dry exhaust gas) (100%) = 0.00448% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (LSG Hot Oil Heater (Potential to Emit), EPN LSGHTR)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

Pollutant	Short-term Emission Rate (lb/hr)	Short-term Emission Rate (g/sec)	Long-term Emission Rate (tons/yr)	Long-term Emission Rate (g/sec)
SO2	0.6360646	0.0802	1.6715779	0.0481
NOx	10.008	1.26	43.83504	1.26
PM	1.6524635	0.208	7.2377903	0.208
CO	11.12	1.4	48.7056	1.4
VOC	1.1958618	0.151	5.2378745	0.151

Sample Calculations for NOx: (10.008 lb/hr) (454 g/lb) (hr/3600 sec) = 1.26 g/sec
(43.83504 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 1.26 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 175 ft = (175 ft) (0.3048 m/ft) = 53.3 m

Stack Diameter = 11 ft = (11 ft) (0.3048 m/ft) = 3.35 m

Stack Exit Velocity = (7.32 ft/sec) (0.3048 m/ft) = 2.23 m/sec

Stack Exit Temperature = 100°F = (100 - 32) / 1.8 = 37.8°C = 37.8 + 273.16 = 311 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (222000 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 1940 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

LSG Hot Oil Heater (Potential to Emit), EPN LSGHTR

COMBUSTION UNIT DATA

Combustion Unit Description:	LSG Hot Oil Heater (Potential to Emit)	
Facility Identification Number (FIN):	47BA1	
Emission Point Number (EPN):	LSGHTR	
Control Identification Number (CIN):		
Fuel Gas Firing Capacity, MM Btu/hr:	222.4	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	999	
Excess Air, % (default to 10% if unknown):	0.1	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	644447	
UTM Northing (m):	3079590	
Stack Diameter:	11 ft	(3.35 m)
Stack Height:	175 ft	(53.3 m)
Stack Exit Temperature:	100° F	(311 K)
Stack Exit Velocity:	7.32 ft/sec	(2.23 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	1 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.636064636	0.0802
NOx	0.045 lb/MM Btu (HHV)	Permit Emission Limit	10.008	1.26
PM	7.6 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	1.652463529	0.208
CO	0.05 lb/MM Btu (HHV)	Vendor Estimate	11.12	1.4
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	1.195861765	0.151

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	0.6 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	1.671577864	0.0481
NOx	0.045 lb/MM Btu (HHV)	Permit Emission Limit	43.83504	1.26
PM	7.6 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	7.237790259	0.208
CO	0.05 lb/MM Btu (HHV)	Vendor Estimate	48.7056	1.4
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, Table 1.4-2, July 1998	5.237874529	0.151

Gas Combustion Emissions Calculator

54BA1 MX Unit Hot Oil Heater (Potential to Emit), EPN MX-1

INPUT DATA

Combustion Unit Description:	54BA1 MX Unit Hot Oil Heater (Potential to Emit)
Facility Identification Number (FIN):	MX-1
Emission Point Number (EPN):	MX-1
Control Identification Number (CIN)	N/A
UTM Zone:	14
UTM Easting (m):	644383
UTM Northing (m):	3079552

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	88.6
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	10
Stack Exit Temperature, °F:	300
Stack Diameter, ft:	4.17
Stack Height, ft:	123.44
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM

If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					1			
Nitrogen Oxides	NOx	0.0631							
Particulate Matter	PM							7.6	
Carbon Monoxide	CO	0.0451							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					0.6			
Nitrogen Oxides	NOx	0.0631							
Particulate Matter	PM							7.6	
Carbon Monoxide	CO	0.0451							
Total Organics	TOC							11	
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note th the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculatio

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Engineering estimate-fuel gas treating	Engineering estimate-fuel gas treating
Nitrogen Oxides	NOx	Permit Emission Limit	Permit Emission Limit
Particulate Matter	PM	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Carbon Monoxide	CO	Vendor Estimate	Vendor Estimate
Total Organics	TOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Volatile Organics	VOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98

Volatile Organics Calculated-As Basis

Compound:	C3H8	(CH4, C2H6, C3H8, etc.)
Molecular Weight	44.09	(lb / lb-mol)

INPUT DATA CONTINUED (54BA1 MX Unit Hot Oil Heater (Potential to Emit), EPN MX-1

FUEL DATA

Fuel Gas Composition				Pure Component Data			Fuel Gas Component Data		
			(A)	(B) Molecular	(C)	(D)	(A) X (B)	(A) X (C) Btu (HHV)	(A) X (D) Btu (LHV)
			Mole	Weight	HHV *	LHV *	lb/lb-mol	per scf	per scf
Formula	Name	Mole %	Fraction	(lb/lb-mol)	(Btu/scf)	(Btu/scf)	Fuel Gas	Fuel Gas	Fuel Gas
CH4	Methane	55.10	0.5510	16.04	1012	911	8.84	557.61	501.96
C2H6	Ethane	9.07	0.0907	30.07	1773	1622	2.73	160.81	147.12
C3H8	Propane	4.38	0.0438	44.09	2524	2322	1.93	110.55	101.70
C4H10	n-Butane	0.59	0.0059	58.12	3271	3018	0.34	19.30	17.81
i-C4H10	Isobutane	0.53	0.0053	58.12	3261	3009	0.31	17.28	15.95
n-C5H12	n-Pentane	0.13	0.0013	72.15	4020	3717	0.09	5.23	4.83
i-C5H12	Isopentane	0.19	0.0019	72.15	4011	3708	0.14	7.62	7.05
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.33	0.0033	86.17	4768	4415	0.28	15.73	14.57
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.28	0.0028	28.05	1604	1503	0.08	4.49	4.21
C3H6	Propylene	0.40	0.0040	42.08	2340	2188	0.17	9.36	8.75
C4H8	n-Butene	0.05	0.0005	56.10	3084	2885	0.03	1.54	1.44
i-C4H8	Isobutene	0.02	0.0002	56.10	3069	2868	0.01	0.61	0.57
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide		0.0000	34.08	646	595	0.00	0.00	0.00
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	27.33	0.2733	2.02	325	275	0.55	88.82	75.16
O2	Oxygen	0.10	0.0010	32.00	0	0	0.03	0.00	0.00
N2	Nitrogen	1.08	0.0108	28.01	0	0	0.30	0.00	0.00
CO	Carbon Monoxide	0.05	0.0005	28.01	321	321	0.01	0.16	0.16
CO2	Carbon Dioxide	0.32	0.0032	44.01	0	0	0.14	0.00	0.00
TOTAL		99.95	0.9995				16.0	999.	901.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

Midplant fuel gas sytsem

GAS COMBUSTION CALCULATIONS (54BA1 MX Unit Hot Oil Heater (Potential to Emit), EPN MX-1)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	88.6	79.9

(88.6 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/999 Btu) (lb-mol/379 scf) = 234 lb-mol/hr
(234 lb-mol/hr) (16 lb/lb-mol) = 3740 lb/hr
(234 lb-mol/hr) (379 scf/lb-mol) = 88700 scfh @ 60°F
(88700 scfh) (hr/60 min) = 1480 scfm @ 60°F
(88700 scfh) (100% - 0% dscf) / (100% scf) = 88700 dscfh @ 60°F
(234 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 90600 scfh @ 70°F
(90600 scfh) (hr/60 min) = 1510 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
Formula	Mole %	(A) Mole Fraction	(B)* Flow Rate lb-mol/hr	(C) lb-mol/ lb-mol fuel	(B) X (C) lb-mol/hr	(D) lb-mol/ lb-mol fuel	(B) X (D) lb-mol/hr	(E) lb-mol/ lb-mol fuel	(B) X (E) lb-mol/hr
CH4	55.10	0.5510	128.934	2.0	257.868	1.0	128.934	2.0	257.868
C2H6	9.07	0.0907	21.224	3.5	74.284	2.0	42.448	3.0	63.672
C3H8	4.38	0.0438	10.249	5.0	51.245	3.0	30.747	4.0	40.996
C4H10	0.59	0.0059	1.381	6.5	8.977	4.0	5.524	5.0	6.905
i-C4H10	0.53	0.0053	1.240	6.5	8.060	4.0	4.960	5.0	6.200
n-C5H12	0.13	0.0013	0.304	8.0	2.432	5.0	1.520	6.0	1.824
i-C5H12	0.19	0.0019	0.445	8.0	3.560	5.0	2.225	6.0	2.670
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.33	0.0033	0.772	9.5	7.334	6.0	4.632	7.0	5.404
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.28	0.0028	0.655	3.0	1.965	2.0	1.310	2.0	1.310
C3H6	0.40	0.0040	0.936	4.5	4.212	3.0	2.808	3.0	2.808
C4H8	0.05	0.0005	0.117	6.0	0.702	4.0	0.468	4.0	0.468
i-C4H8	0.02	0.0002	0.047	6.0	0.282	4.0	0.188	4.0	0.188
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.00	0.0000	0.000	1.5	0.000	1.0 (SO2)	0.000	1.0	0.000
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	27.33	0.2733	63.952	0.5	31.976	0.0	0.000	1.0	63.952
O2	0.10	0.0010	0.234	- 1.0	- 0.234	0.0	0.000	0.0	0.000
N2	1.08	0.0108	2.527	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.05	0.0005	0.117	0.5	0.059	1.0	0.117	0.0	0.000
CO2	0.32	0.0032	0.749	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.95	0.9995	234.		453.		226.		454.

* (B) = (A) X (234 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (54BA1 MX Unit Hot Oil Heater (Potential to Emit), EPN MX-1)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (453 lb-mol stoichiometric O2/hr) (1.1) = 498 lb-mol total O2/hr
= (498 lb-mol O2/hr) (32.00 lb/lb-mol) = 15900 lb O2/hr

Nitrogen in Supplied Air: (498 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 1870 lb-mol total N2/hr
= (1870 lb-mol N2/hr) (28.01 lb/lb-mol) = 52400 lb N2/hr

Bone-dry (BD) Supplied Air: (498 lb-mol O2/hr) + (1870 lb-mol N2/hr) = 2370 lb-mol BD air/hr
= (15900 lb O2/hr) + (52400 lb N2/hr) = 68300 lb BD air/hr

Moisture in Supplied Air: (68300 lb BD air/hr) (0.0132 lb water/lb BD air) = 902 lb water/hr
= (902 lb water/hr) (lb-mol water/18.02 lb water) = 50.1 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (498 lb-mol O2/hr) + (1870 lb-mol N2/hr) + (50.1 lb-mol water/hr) = 2420 lb-mol/hr
= (15900 lb O2/hr) + (52400 lb N2/hr) + (902 lb water/hr) = 69200 lb/hr
= (2420 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 15300 scfm @ 60°F
= (2420 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 15600 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	1870.00	2.527	0.000	1872.53	0.707	28.01	19.8	0.873
Oxygen	498.00	0.234	-453.000	45.23	0.017	32.00	0.54	0.021
Carbon Dioxide	0.00	0.749	226.000	226.75	0.086	44.01	3.78	0.106
Water	50.10	0.000	454.000	504.10	0.190	18.02	3.42	0.000
TOTAL				2650.	1.000		27.54	1.000

Exhaust gas flow rate = 2650 lb-mol/hr
= (2650 lb-mol/hr) (27.54 lb/lb-mol) = 73000 lb/hr
= (2650 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 16700 scfm @ 60°F
= (2650 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 17100 scfm @ 70°F
= (16700 scfm) [(300 + 460)°R] acf / [(60 + 460)°R] scf = 24400 acfm @ 300°F
= (2650 total lb-mol/hr) - (504.1 water lb-mol/hr) = 2150 lb-mol/hr dry
= (2150 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 13600 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (4.17 ft)^2 / 4 = 13.7 ft^2

Stack Exit Velocity = (24400 acfm) (min/60 sec) / (13.7 ft^2) = 29.7 ft/sec
= (29.7 ft/sec) (0.3048 m/ft) = 9.05 m/sec

GAS COMBUSTION CALCULATIONS (54BA1 MX Unit Hot Oil Heater (Potential to Emit), EPN MX-1)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (1 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (88.6 MM Btu/hr) = 0.253396253396253 lb/hr

NOx: (88.6 MM Btu/hr) (0.0631 lb/MM Btu) = 5.59066 lb/hr (HHV Calculation Basis)

PM: (7.6 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (88700 scf fuel/hr) = 0.660241058823529 lb/hr

CO: (88.6 MM Btu/hr) (0.0451 lb/MM Btu) = 3.99586 lb/hr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (88700 scf fuel/hr) = 0.477806029411765 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (0.6 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (88.6 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 0.665925353925354 tons/yr

NOx: (88.6 MM Btu/hr) (0.0631 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 24.4870908 tons/yr (HHV Calculation Basis)

PM: (7.6 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (88700 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 2.89185583764706 tons/yr

CO: (88.6 MM Btu/hr) (0.0451 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 17.5018668 tons/yr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (88700 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 2.09279040882353 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	0.2534	64.06	0.00396	0.000149	0.000184	1.49	1.84
NOx	5.59066	46.01	0.122	0.0046	0.00567	46.	56.7
PM	0.66024	NA	NA	NA	NA	NA	NA
CO	3.99586	28.01	0.143	0.0054	0.00665	54.	66.5
VOC	0.47781	44.09	0.0108	0.000408	0.000502	4.08	5.02

Sample Calculations for NOx: (5.59066 lb/hr) / (46.01 lb/lb-mol) = 0.122 lb-mol/hr
(0.122 lb-mol/hr) / (2650 lb-mol/hr exhaust gas) (100%) = 0.0046% mole composition
(0.122 lb-mol/hr) / (2150 lb-mol/hr dry exhaust gas) (100%) = 0.00567% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (54BA1 MX Unit Hot Oil Heater (Potential to Emit), EPN MX-1)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

Pollutant	Short-term Emission Rate (lb/hr)	Short-term Emission Rate (g/sec)	Long-term Emission Rate (tons/yr)	Long-term Emission Rate (g/sec)
SO2	0.2533963	0.032	0.6659254	0.0192
NOx	5.59066	0.705	24.4870908	0.705
PM	0.6602411	0.0833	2.8918558	0.0833
CO	3.99586	0.504	17.5018668	0.504
VOC	0.477806	0.0603	2.0927904	0.0603

Sample Calculations for NOx: (5.59066 lb/hr) (454 g/lb) (hr/3600 sec) = 0.705 g/sec
(24.4870908 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 0.705 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 123.44 ft = (123.44 ft) (0.3048 m/ft) = 37.6 m

Stack Diameter = 4.17 ft = (4.17 ft) (0.3048 m/ft) = 1.27 m

Stack Exit Velocity = (29.7 ft/sec) (0.3048 m/ft) = 9.05 m/sec

Stack Exit Temperature = 300°F = (300 - 32) / 1.8 = 149°C = 149 + 273.16 = 422 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (88700 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 777 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

54BA1 MX Unit Hot Oil Heater (Potential to Emit), EPN MX-1

COMBUSTION UNIT DATA

Combustion Unit Description:	54BA1 MX Unit Hot Oil Heater (Potential to Emit)	
Facility Identification Number (FIN):	MX-1	
Emission Point Number (EPN):	MX-1	
Control Identification Number (CIN):	N/A	
Fuel Gas Firing Capacity, MM Btu/hr:	88.6	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	999	
Excess Air, % (default to 10% if unknown):	10	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	644383	
UTM Northing (m):	3079552	
Stack Diameter:	4.17 ft	(1.27 m)
Stack Height:	123.44 ft	(37.6 m)
Stack Exit Temperature:	300° F	(422 K)
Stack Exit Velocity:	29.7 ft/sec	(9.05 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	1 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.253396253	0.032
NOx	0.0631 lb/MM Btu (HHV)	Permit Emission Limit	5.59066	0.705
PM	7.6 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.660241059	0.0833
CO	0.0451 lb/MM Btu (HHV)	Vendor Estimate	3.99586	0.504
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.477806029	0.0603

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	0.6 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.665925354	0.0192
NOx	0.0631 lb/MM Btu (HHV)	Permit Emission Limit	24.4870908	0.705
PM	7.6 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	2.891855838	0.0833
CO	0.0451 lb/MM Btu (HHV)	Vendor Estimate	17.5018668	0.504
TOC	11 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	2.092790409	0.0603

Gas Combustion Emissions Calculator

DDS Charge Heater (Potential to Emit), EPN DDS-HTRSTK

INPUT DATA

Combustion Unit Description:	DDS Charge Heater (Potential to Emit)
Facility Identification Number (FIN):	56BA1
Emission Point Number (EPN):	DDS-HTRSTK
Control Identification Number (CIN)	N/A
UTM Zone:	14
UTM Easting (m):	644210
UTM Northing (m):	3079837

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	40
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	10
Stack Exit Temperature, °F:	450
Stack Diameter, ft:	7
Stack Height, ft:	100
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM
If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					1			
Nitrogen Oxides	NOx	0.045							
Particulate Matter	PM							7.6	
Carbon Monoxide	CO	0.05							
Total Organics	TOC								
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					0.6			
Nitrogen Oxides	NOx	0.045							
Particulate Matter	PM							7.6	
Carbon Monoxide	CO	0.05							
Total Organics	TOC								
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note th the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculatio

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Engineering estimate-fuel gas treating	Engineering estimate-fuel gas treating
Nitrogen Oxides	NOx	Permit Emission Limit	Permit Emission Limit
Particulate Matter	PM	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Carbon Monoxide	CO	Vendor guarentee	Vendor guarentee
Total Organics	TOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Volatile Organics	VOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98

Volatile Organics Calculated-As Basis

Compound:	C3H8	(CH4, C2H6, C3H8, etc.)
Molecular Weight	44.09	(lb / lb-mol)

INPUT DATA CONTINUED (DDS Charge Heater (Potential to Emit), EPN DDS-HTRSTK

FUEL DATA

Fuel Gas Composition				Pure Component Data			Fuel Gas Component Data		
Formula	Name	Mole %	(A) Mole Fraction	(B) Molecular Weight (lb/lb-mol)	(C) HHV * (Btu/scf)	(D) LHV * (Btu/scf)	(A) X (B) lb/lb-mol Fuel Gas	(A) X (C) Btu (HHV) per scf Fuel Gas	(A) X (D) Btu (LHV) per scf Fuel Gas
CH4	Methane	55.10	0.5510	16.04	1012	911	8.84	557.61	501.96
C2H6	Ethane	9.07	0.0907	30.07	1773	1622	2.73	160.81	147.12
C3H8	Propane	4.38	0.0438	44.09	2524	2322	1.93	110.55	101.70
C4H10	n-Butane	0.59	0.0059	58.12	3271	3018	0.34	19.30	17.81
i-C4H10	Isobutane	0.53	0.0053	58.12	3261	3009	0.31	17.28	15.95
n-C5H12	n-Pentane	0.13	0.0013	72.15	4020	3717	0.09	5.23	4.83
i-C5H12	Isopentane	0.19	0.0019	72.15	4011	3708	0.14	7.62	7.05
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.33	0.0033	86.17	4768	4415	0.28	15.73	14.57
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.28	0.0028	28.05	1604	1503	0.08	4.49	4.21
C3H6	Propylene	0.40	0.0040	42.08	2340	2188	0.17	9.36	8.75
C4H8	n-Butene	0.05	0.0005	56.10	3084	2885	0.03	1.54	1.44
i-C4H8	Isobutene	0.02	0.0002	56.10	3069	2868	0.01	0.61	0.57
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide		0.0000	34.08	646	595	0.00	0.00	0.00
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	27.33	0.2733	2.02	325	275	0.55	88.82	75.16
O2	Oxygen	0.10	0.0010	32.00	0	0	0.03	0.00	0.00
N2	Nitrogen	1.08	0.0108	28.01	0	0	0.30	0.00	0.00
CO	Carbon Monoxide	0.05	0.0005	28.01	321	321	0.01	0.16	0.16
CO2	Carbon Dioxide	0.32	0.0032	44.01	0	0	0.14	0.00	0.00
TOTAL		99.95	0.9995				16.0	999.	901.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

Midplant fuel gas sytsem
Fuel gas composition is based on annual average data. Daily and future
annual composition may vary based on actual refinery operating conditions.

GAS COMBUSTION CALCULATIONS (DDS Charge Heater (Potential to Emit), EPN DDS-HTRSTK)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	40	36.1

(40 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/999 Btu) (lb-mol/379 scf) = 106 lb-mol/hr
(106 lb-mol/hr) (16 lb/lb-mol) = 1700 lb/hr
(106 lb-mol/hr) (379 scf/lb-mol) = 40200 scfh @ 60°F
(40200 scfh) (hr/60 min) = 670 scfm @ 60°F
(40200 scfh) (100% - 0% dscf) / (100% scf) = 40200 dscfh @ 60°F
(106 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 41000 scfh @ 70°F
(41000 scfh) (hr/60 min) = 683 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
Formula	Mole %	(A) Mole Fraction	(B)* Flow Rate lb-mol/hr	(C) lb-mol/ lb-mol fuel	(B) X (C) lb-mol/hr	(D) lb-mol/ lb-mol fuel	(B) X (D) lb-mol/hr	(E) lb-mol/ lb-mol fuel	(B) X (E) lb-mol/hr
CH4	55.10	0.5510	58.406	2.0	116.812	1.0	58.406	2.0	116.812
C2H6	9.07	0.0907	9.614	3.5	33.649	2.0	19.228	3.0	28.842
C3H8	4.38	0.0438	4.643	5.0	23.215	3.0	13.929	4.0	18.572
C4H10	0.59	0.0059	0.625	6.5	4.063	4.0	2.500	5.0	3.125
i-C4H10	0.53	0.0053	0.562	6.5	3.653	4.0	2.248	5.0	2.810
n-C5H12	0.13	0.0013	0.138	8.0	1.104	5.0	0.690	6.0	0.828
i-C5H12	0.19	0.0019	0.201	8.0	1.608	5.0	1.005	6.0	1.206
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.33	0.0033	0.350	9.5	3.325	6.0	2.100	7.0	2.450
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.28	0.0028	0.297	3.0	0.891	2.0	0.594	2.0	0.594
C3H6	0.40	0.0040	0.424	4.5	1.908	3.0	1.272	3.0	1.272
C4H8	0.05	0.0005	0.053	6.0	0.318	4.0	0.212	4.0	0.212
i-C4H8	0.02	0.0002	0.021	6.0	0.126	4.0	0.084	4.0	0.084
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.00	0.0000	0.000	1.5	0.000	1.0 (SO2)	0.000	1.0	0.000
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	27.33	0.2733	28.970	0.5	14.485	0.0	0.000	1.0	28.970
O2	0.10	0.0010	0.106	- 1.0	- 0.106	0.0	0.000	0.0	0.000
N2	1.08	0.0108	1.145	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.05	0.0005	0.053	0.5	0.027	1.0	0.053	0.0	0.000
CO2	0.32	0.0032	0.339	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.95	0.9995	106.		205.		102.		206.

* (B) = (A) X (106 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (DDS Charge Heater (Potential to Emit), EPN DDS-HTRSTK)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (205 lb-mol stoichiometric O2/hr) (1.1) = 226 lb-mol total O2/hr
= (226 lb-mol O2/hr) (32.00 lb/lb-mol) = 7230 lb O2/hr

Nitrogen in Supplied Air: (226 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 850 lb-mol total N2/hr
= (850 lb-mol N2/hr) (28.01 lb/lb-mol) = 23800 lb N2/hr

Bone-dry (BD) Supplied Air: (226 lb-mol O2/hr) + (850 lb-mol N2/hr) = 1080 lb-mol BD air/hr
= (7230 lb O2/hr) + (23800 lb N2/hr) = 31000 lb BD air/hr

Moisture in Supplied Air: (31000 lb BD air/hr) (0.0132 lb water/lb BD air) = 409 lb water/hr
= (409 lb water/hr) (lb-mol water/18.02 lb water) = 22.7 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (226 lb-mol O2/hr) + (850 lb-mol N2/hr) + (22.7 lb-mol water/hr) = 1100 lb-mol/hr
= (7230 lb O2/hr) + (23800 lb N2/hr) + (409 lb water/hr) = 31400 lb/hr
= (1100 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 6950 scfm @ 60°F
= (1100 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 7100 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	850.00	1.145	0.000	851.15	0.709	28.01	19.86	0.876
Oxygen	226.00	0.106	-205.000	21.11	0.018	32.00	0.58	0.022
Carbon Dioxide	0.00	0.339	102.000	102.34	0.085	44.01	3.74	0.105
Water	22.70	0.000	206.000	228.70	0.191	18.02	3.44	0.000
TOTAL				1200.	1.003		27.62	1.003

Exhaust gas flow rate = 1200 lb-mol/hr
= (1200 lb-mol/hr) (27.62 lb/lb-mol) = 33100 lb/hr
= (1200 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 7580 scfm @ 60°F
= (1200 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 7740 scfm @ 70°F
= (7580 scfm) [(450 + 460)°R] acf / [(60 + 460)°R] scf = 13300 acfm @ 450°F
= (1200 total lb-mol/hr) - (228.7 water lb-mol/hr) = 971 lb-mol/hr dry
= (971 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 6130 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (7 ft)^2 / 4 = 38.5 ft^2

Stack Exit Velocity = (13300 acfm) (min/60 sec) / (38.5 ft^2) = 5.76 ft/sec
= (5.76 ft/sec) (0.3048 m/ft) = 1.76 m/sec

GAS COMBUSTION CALCULATIONS (DDS Charge Heater (Potential to Emit), EPN DDS-HTRSTK)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (1 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (40 MM Btu/hr) = 0.114400114400114 lb/hr

NOx: (40 MM Btu/hr) (0.045 lb/MM Btu) = 1.8 lb/hr (HHV Calculation Basis)

PM: (7.6 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (40200 scf fuel/hr) = 0.299229882352941 lb/hr

CO: (40 MM Btu/hr) (0.05 lb/MM Btu) = 2 lb/hr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (40200 scf fuel/hr) = 0.216547941176471 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (0.6 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (40 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 0.300643500643501 tons/yr

NOx: (40 MM Btu/hr) (0.045 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 7.884 tons/yr (HHV Calculation Basis)

PM: (7.6 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (40200 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 1.31062688470588 tons/yr

CO: (40 MM Btu/hr) (0.05 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 8.76 tons/yr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (40200 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 0.948479982352941 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	0.1144	64.06	0.00179	0.000149	0.000184	1.49	1.84
NOx	1.8	46.01	0.0391	0.00326	0.00403	32.6	40.3
PM	0.29923	NA	NA	NA	NA	NA	NA
CO	2.	28.01	0.0714	0.00595	0.00735	59.5	73.5
VOC	0.21655	44.09	0.00491	0.000409	0.000506	4.09	5.06

Sample Calculations for NOx: (1.8 lb/hr) / (46.01 lb/lb-mol) = 0.0391 lb-mol/hr
(0.0391 lb-mol/hr) / (1200 lb-mol/hr exhaust gas) (100%) = 0.00326% mole composition
(0.0391 lb-mol/hr) / (971 lb-mol/hr dry exhaust gas) (100%) = 0.00403% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (DDS Charge Heater (Potential to Emit), EPN DDS-HTRSTK)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

Pollutant	Short-term Emission Rate (lb/hr)	Short-term Emission Rate (g/sec)	Long-term Emission Rate (tons/yr)	Long-term Emission Rate (g/sec)
SO2	0.1144001	0.0144	0.3006435	0.00866
NOx	1.8	0.227	7.884	0.227
PM	0.2992299	0.0377	1.3106269	0.0377
CO	2.	0.252	8.76	0.252
VOC	0.2165479	0.0273	0.94848	0.0273

Sample Calculations for NOx: (1.8 lb/hr) (454 g/lb) (hr/3600 sec) = 0.227 g/sec
(7.884 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 0.227 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 100 ft = (100 ft) (0.3048 m/ft) = 30.5 m

Stack Diameter = 7 ft = (7 ft) (0.3048 m/ft) = 2.13 m

Stack Exit Velocity = (5.76 ft/sec) (0.3048 m/ft) = 1.76 m/sec

Stack Exit Temperature = 450°F = (450 - 32) / 1.8 = 232°C = 232 + 273.16 = 505 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (40200 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 352 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

DDS Charge Heater (Potential to Emit), EPN DDS-HTRSTK

COMBUSTION UNIT DATA

Combustion Unit Description:	DDS Charge Heater (Potential to Emit)	
Facility Identification Number (FIN):	56BA1	
Emission Point Number (EPN):	DDS-HTRSTK	
Control Identification Number (CIN):	N/A	
Fuel Gas Firing Capacity, MM Btu/hr:	40	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	999	
Excess Air, % (default to 10% if unknown):	10	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	644210	
UTM Northing (m):	3079837	
Stack Diameter:	7 ft	(2.13 m)
Stack Height:	100 ft	(30.5 m)
Stack Exit Temperature:	450° F	(505 K)
Stack Exit Velocity:	5.76 ft/sec	(1.76 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	1 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.114400114	0.0144
NOx	0.045 lb/MM Btu (HHV)	Permit Emission Limit	1.8	0.227
PM	7.6 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.299229882	0.0377
CO	0.05 lb/MM Btu (HHV)	Vendor guarentee	2	0.252
TOC	None	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.216547941	0.0273

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	0.6 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.300643501	0.00866
NOx	0.045 lb/MM Btu (HHV)	Permit Emission Limit	7.884	0.227
PM	7.6 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	1.310626885	0.0377
CO	0.05 lb/MM Btu (HHV)	Vendor guarentee	8.76	0.252
TOC	None	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.948479982	0.0273

Gas Combustion Emissions Calculator

DDS Fractionator Reboiler (Potential to Emit), EPN DDS-HTRSTK

INPUT DATA

Combustion Unit Description:	DDS Fractionator Reboiler (Potential to Emit
Facility Identification Number (FIN):	56BA2
Emission Point Number (EPN):	DDS-HTRSTK
Control Identification Number (CIN)	N/A
UTM Zone:	14
UTM Easting (m):	644210
UTM Northing (m):	3079837

COMBUSTION UNIT DATA

Fuel Gas Firing Capacity, MM Btu/hr:	40
Basis of Heating Value Specified for Firing Capacity (LHV or HHV)	HHV
Excess Air, % (default to 10% if unknown)	10
Stack Exit Temperature, °F:	450
Stack Diameter, ft:	7
Stack Height, ft:	100
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown)	8760
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown	100
Ambient Temperature, °F (default to 80°F if unknown)	80
Barometric Pressure, psia (default to 14.7 psia if unknown)	14.7
Relative Humidity, % (default to 60% if unknown)	60

EMISSION FACTORS

ENTER ONLY ONE EMISSION FACTOR FOR EACH POLLUTANT FOR EACH TERM

If multiple factors are entered for a pollutant, the leftmost nonzero factor will be used in emission calculation

Short-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 3 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					1			
Nitrogen Oxides	NOx	0.045							
Particulate Matter	PM							7.6	
Carbon Monoxide	CO	0.05							
Total Organics	TOC								
Volatile Organics	VOC							5.5	

Long-Term Emission Factors Pollutant	Formula	lb/MM Btu (HHV)	lb/MM Btu (LHV)	ppmvd in Stack Gas @ 5 % O2	lb/hr	Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Grains per 100 dscf Stack Gas	lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	Weight % VOC in TOC
Sulfur Dioxide	SO2					0.6			
Nitrogen Oxides	NOx	0.045							
Particulate Matter	PM							7.6	
Carbon Monoxide	CO	0.05							
Total Organics	TOC								
Volatile Organics	VOC							5.5	

Note: When entering values in ppmvd for nitrogen oxides and volatile organics, the subsequent calculations presume molecular weights of 46.01 nitrogen oxides (NO2) and 44.09 for volatile organics (C3H8). The molecular weight for VOC can be changed on Rows 127 and 128. Also, note th the factors in terms of scf presume standard conditions of 1 atm and 60°F. These standard conditions are presumed throughout the calculatio

EMISSION FACTOR BASIS

Pollutant	Formula	Source of Short-Term Emission Factors	Source of Long-Term Emission Factors
Sulfur Dioxide	SO2	Engineering estimate-fuel gas treating	Engineering estimate-fuel gas treating
Nitrogen Oxides	NOx	Permit Emission Limit	Permit Emission Limit
Particulate Matter	PM	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Carbon Monoxide	CO	Vendor guarentee	Vendor guarentee
Total Organics	TOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98
Volatile Organics	VOC	AP-42, 5th Ed., Sec. 1.4, revised 3/98	AP-42, 5th Ed., Sec. 1.4, revised 3/98

Volatile Organics Calculated-As Basis

Compound:	C3H8	(CH4, C2H6, C3H8, etc.)
Molecular Weight	44.09	(lb / lb-mol)

INPUT DATA CONTINUED (DDS Fractionator Reboiler (Potential to Emit), EPN DDS-HTRSTK

FUEL DATA

Fuel Gas Compositior				Pure Component Data			Fuel Gas Component Data		
Formula	Name	Mole %	(A) Mole Fraction	(B) Moleculai Weight (lb/lb-mol)	(C) HHV * (Btu/scf)	(D) LHV * (Btu/scf)	(A) X (B) lb/lb-mol Fuel Gas	(A) X (C) Btu (HHV) per scf Fuel Gas	(A) X (D) Btu (LHV) per scf Fuel Gas
CH4	Methane	55.10	0.5510	16.04	1012	911	8.84	557.61	501.96
C2H6	Ethane	9.07	0.0907	30.07	1773	1622	2.73	160.81	147.12
C3H8	Propane	4.38	0.0438	44.09	2524	2322	1.93	110.55	101.70
C4H10	n-Butane	0.59	0.0059	58.12	3271	3018	0.34	19.30	17.81
i-C4H10	Isobutane	0.53	0.0053	58.12	3261	3009	0.31	17.28	15.95
n-C5H12	n-Pentane	0.13	0.0013	72.15	4020	3717	0.09	5.23	4.83
i-C5H12	Isopentane	0.19	0.0019	72.15	4011	3708	0.14	7.62	7.05
C5H12	Neopentane		0.0000	72.15	3994	3692	0.00	0.00	0.00
C6H14	n-Hexane	0.33	0.0033	86.17	4768	4415	0.28	15.73	14.57
C7H16	n-Heptane		0.0000	100.20	5503	5100	0.00	0.00	0.00
C2H4	Ethylene	0.28	0.0028	28.05	1604	1503	0.08	4.49	4.21
C3H6	Propylene	0.40	0.0040	42.08	2340	2188	0.17	9.36	8.75
C4H8	n-Butene	0.05	0.0005	56.10	3084	2885	0.03	1.54	1.44
i-C4H8	Isobutene	0.02	0.0002	56.10	3069	2868	0.01	0.61	0.57
C5H10	n-Pentene		0.0000	70.13	3837	3585	0.00	0.00	0.00
C6H6	Benzene		0.0000	78.11	3752	3601	0.00	0.00	0.00
C7H8	Toluene		0.0000	92.13	4486	4285	0.00	0.00	0.00
C8H10	Xylene		0.0000	106.16	5230	4980	0.00	0.00	0.00
C2H2	Acetylene		0.0000	26.04	1477	1426	0.00	0.00	0.00
C10H8	Naphthalene		0.0000	128.16	5854	5654	0.00	0.00	0.00
CH3OH	Methyl Alcohol		0.0000	32.04	868	767	0.00	0.00	0.00
C2H5OH	Ethyl Alcohol		0.0000	46.07	1600	1449	0.00	0.00	0.00
H2S	Hydrogen Sulfide		0.0000	34.08	646	595	0.00	0.00	0.00
H2O	Water Vapor		0.0000	18.02	0	0	0.00	0.00	0.00
H2	Hydrogen	27.33	0.2733	2.02	325	275	0.55	88.82	75.16
O2	Oxygen	0.10	0.0010	32.00	0	0	0.03	0.00	0.00
N2	Nitrogen	1.08	0.0108	28.01	0	0	0.30	0.00	0.00
CO	Carbon Monoxide	0.05	0.0005	28.01	321	321	0.01	0.16	0.16
CO2	Carbon Dioxide	0.32	0.0032	44.01	0	0	0.14	0.00	0.00
TOTAL		99.95	0.9995				16.0	999.	901.

* HHV/LHV data are from *Steam, Its Generation and Use* (Babcock & Wilcox, 1972); HHV/LHV data for C7H16 are from Engineering *Data Book* (Gas Processors Suppliers Association, Ninth Edition, as revised 1979)

NOTES

Midplant fuel gas sytsem
Fuel gas composition is based on annual average data. Daily and future
annual composition may vary based on actual refinery operating conditions.

GAS COMBUSTION CALCULATIONS (DDS Fractionator Reboiler (Potential to Emit), EPN DDS-HTRSTK)

FUEL FLOW RATE CALCULATIONS

	HHV	LHV
Fuel Gas Firing Capacity, MM Btu/hr:	40	36.1

(40 MM Btu/hr) (1,000,000 Btu/MM Btu) (1 scf/999 Btu) (lb-mol/379 scf) = 106 lb-mol/hr
(106 lb-mol/hr) (16 lb/lb-mol) = 1700 lb/hr
(106 lb-mol/hr) (379 scf/lb-mol) = 40200 scfh @ 60°F
(40200 scfh) (hr/60 min) = 670 scfm @ 60°F
(40200 scfh) (100% - 0% dscf) / (100% scf) = 40200 dscfh @ 60°F
(106 lb-mol/hr) (387 scf @ 70°F/lb-mol) = 41000 scfh @ 70°F
(41000 scfh) (hr/60 min) = 683 scfm @ 70°F

STOICHIOMETRIC CALCULATIONS

Assuming complete combustion, the combustion products are determined as follows:

Fuel Composition and Flow Rate				Stoichiometric Oxygen Requirement		Stoichiometric Carbon Dioxide Production		Stoichiometric Water Production	
Formula	Mole %	(A) Mole Fraction	(B)* Flow Rate lb-mol/hr	(C) lb-mol/ lb-mol fuel	(B) X (C) lb-mol/hr	(D) lb-mol/ lb-mol fuel	(B) X (D) lb-mol/hr	(E) lb-mol/ lb-mol fuel	(B) X (E) lb-mol/hr
CH4	55.10	0.5510	58.406	2.0	116.812	1.0	58.406	2.0	116.812
C2H6	9.07	0.0907	9.614	3.5	33.649	2.0	19.228	3.0	28.842
C3H8	4.38	0.0438	4.643	5.0	23.215	3.0	13.929	4.0	18.572
C4H10	0.59	0.0059	0.625	6.5	4.063	4.0	2.500	5.0	3.125
i-C4H10	0.53	0.0053	0.562	6.5	3.653	4.0	2.248	5.0	2.810
n-C5H12	0.13	0.0013	0.138	8.0	1.104	5.0	0.690	6.0	0.828
i-C5H12	0.19	0.0019	0.201	8.0	1.608	5.0	1.005	6.0	1.206
C5H12	0.00	0.0000	0.000	8.0	0.000	5.0	0.000	6.0	0.000
C6H14	0.33	0.0033	0.350	9.5	3.325	6.0	2.100	7.0	2.450
C7H16	0.00	0.0000	0.000	11.0	0.000	7.0	0.000	8.0	0.000
C2H4	0.28	0.0028	0.297	3.0	0.891	2.0	0.594	2.0	0.594
C3H6	0.40	0.0040	0.424	4.5	1.908	3.0	1.272	3.0	1.272
C4H8	0.05	0.0005	0.053	6.0	0.318	4.0	0.212	4.0	0.212
i-C4H8	0.02	0.0002	0.021	6.0	0.126	4.0	0.084	4.0	0.084
C5H10	0.00	0.0000	0.000	7.5	0.000	5.0	0.000	5.0	0.000
C6H6	0.00	0.0000	0.000	7.5	0.000	6.0	0.000	3.0	0.000
C7H8	0.00	0.0000	0.000	9.0	0.000	7.0	0.000	4.0	0.000
C8H10	0.00	0.0000	0.000	10.5	0.000	8.0	0.000	5.0	0.000
C2H2	0.00	0.0000	0.000	2.5	0.000	2.0	0.000	1.0	0.000
C10H8	0.00	0.0000	0.000	12.0	0.000	10.0	0.000	4.0	0.000
CH3OH	0.00	0.0000	0.000	1.5	0.000	1.0	0.000	2.0	0.000
C2H5OH	0.00	0.0000	0.000	3.0	0.000	2.0	0.000	3.0	0.000
H2S	0.00	0.0000	0.000	1.5	0.000	1.0 (SO2)	0.000	1.0	0.000
H2O	0.00	0.0000	0.000	0.0	0.000	0.0	0.000	0.0	0.000
H2	27.33	0.2733	28.970	0.5	14.485	0.0	0.000	1.0	28.970
O2	0.10	0.0010	0.106	- 1.0	- 0.106	0.0	0.000	0.0	0.000
N2	1.08	0.0108	1.145	0.0	0.000	0.0	0.000	0.0	0.000
CO	0.05	0.0005	0.053	0.5	0.027	1.0	0.053	0.0	0.000
CO2	0.32	0.0032	0.339	0.0	0.000	0.0	0.000	0.0	0.000
TOTAL	99.95	0.9995	106.		205.		102.		206.

* (B) = (A) X (106 lb-mol/hr)
Note that for the molar calculations, SO2 is grouped with CO2. This will have a negligible impact on MW and other calculations.

GAS COMBUSTION CALCULATIONS (DDS Fractionator Reboiler (Potential to Emit), EPN DDS-HTRSTK)

AIR SUPPLY CALCULATION

Oxygen in Supplied Air: (205 lb-mol stoichiometric O2/hr) (1.1) = 226 lb-mol total O2/hr
= (226 lb-mol O2/hr) (32.00 lb/lb-mol) = 7230 lb O2/hr

Nitrogen in Supplied Air: (226 lb-mol O2/hr) (3.76 lb-mol N2/lb-mol O2 in air) = 850 lb-mol total N2/hr
= (850 lb-mol N2/hr) (28.01 lb/lb-mol) = 23800 lb N2/hr

Bone-dry (BD) Supplied Air: (226 lb-mol O2/hr) + (850 lb-mol N2/hr) = 1080 lb-mol BD air/hr
= (7230 lb O2/hr) + (23800 lb N2/hr) = 31000 lb BD air/hr

Moisture in Supplied Air: (31000 lb BD air/hr) (0.0132 lb water/lb BD air) = 409 lb water/hr
= (409 lb water/hr) (lb-mol water/18.02 lb water) = 22.7 lb-mol water/hr

Note: The specific humidity of 0.0132 lb water/lb BD air was determined from the relative humidity (60%), the atmospheric pressure (14.7 psia), the ambient temperature (80°F), and a DIPPR correlation of water vapor pressure data.

Total Air: (226 lb-mol O2/hr) + (850 lb-mol N2/hr) + (22.7 lb-mol water/hr) = 1100 lb-mol/hr
= (7230 lb O2/hr) + (23800 lb N2/hr) + (409 lb water/hr) = 31400 lb/hr
= (1100 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 6950 scfm @ 60°F
= (1100 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 7100 scfm @ 70°F

EXHAUST FLOW CALCULATION

Exhaust Components	From Air (lb-mol/hr)	From Fuel (lb-mol/hr)	From Combustion (lb-mol/hr)	Total (lb-mol/hr)	(A) Mole Fraction Wet Basis	(B) Component MW (lb/lb-mol)	(A) X (B) Exhaust MW (lb/lb-mol)	Mole Fraction Dry Basis
Nitrogen	850.00	1.145	0.000	851.15	0.709	28.01	19.86	0.876
Oxygen	226.00	0.106	-205.000	21.11	0.018	32.00	0.58	0.022
Carbon Dioxide	0.00	0.339	102.000	102.34	0.085	44.01	3.74	0.105
Water	22.70	0.000	206.000	228.70	0.191	18.02	3.44	0.000
TOTAL				1200.	1.003		27.62	1.003

Exhaust gas flow rate = 1200 lb-mol/hr
= (1200 lb-mol/hr) (27.62 lb/lb-mol) = 33100 lb/hr
= (1200 lb-mol/hr) (379 scf/lb-mol) (hr/60 min) = 7580 scfm @ 60°F
= (1200 lb-mol/hr) (387 scf @ 70°F/lb-mol) (hr/60 min) = 7740 scfm @ 70°F
= (7580 scfm) [(450 + 460)°R] acf / [(60 + 460)°R] scf = 13300 acfm @ 450°F
= (1200 total lb-mol/hr) - (228.7 water lb-mol/hr) = 971 lb-mol/hr dry
= (971 lb-mol/hr dry) (379 scf/lb-mol) (hr/60 min) = 6130 scfm (dry) @ 60°F

STACK EXIT VELOCITY CALCULATION

Stack Cross-sectional Area = pi D^2 / 4 = (3.1416) (7 ft)^2 / 4 = 38.5 ft^2

Stack Exit Velocity = (13300 acfm) (min/60 sec) / (38.5 ft^2) = 5.76 ft/sec
= (5.76 ft/sec) (0.3048 m/ft) = 1.76 m/sec

GAS COMBUSTION CALCULATIONS (DDS Fractionator Reboiler (Potential to Emit), EPN DDS-HTRSTK)

SHORT-TERM EMISSION RATE CALCULATIONS

SO2: (1 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (40 MM Btu/hr) = 0.114400114400114 lb/hr

NOx: (40 MM Btu/hr) (0.045 lb/MM Btu) = 1.8 lb/hr (HHV Calculation Basis)

PM: (7.6 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (40200 scf fuel/hr) = 0.299229882352941 lb/hr

CO: (40 MM Btu/hr) (0.05 lb/MM Btu) = 2 lb/hr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (40200 scf fuel/hr) = 0.216547941176471 lb/hr

LONG-TERM EMISSION RATE CALCULATIONS

SO2: (0.6 grains sulfur/100 dscf fuel) (lb/7000 grains) (2 lb SO2/lb sulfur) (100 dscf fuel/100 scf fuel)
(scf fuel/999 Btu) (40 MM Btu/hr) (8760 hr/yr) (100% firing rate) (ton/2000 lb) = 0.300643500643501 tons/yr

NOx: (40 MM Btu/hr) (0.045 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 7.884 tons/yr (HHV Calculation Basis)

PM: (7.6 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (40200 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 1.31062688470588 tons/yr

CO: (40 MM Btu/hr) (0.05 lb/MM Btu)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 8.76 tons/yr (HHV Calculation Basis)

VOC: (5.5 lb/MMscf AP-42 fuel) (scf AP-42 fuel/1020 Btu) (999 Btu/scf fuel) (40200 scf fuel/hr)
(8760 hr/yr) (100% firing rate) (ton/2000 lb) = 0.948479982352941 tons/yr

POLLUTANT CONCENTRATIONS (BASED ON SHORT-TERM EMISSION FACTORS)

Pollutant	(A) lb/hr	(B) Molecular Weight lb/lb-mol	(A) / (B) lb-mol/hr	Pollutant Concentration Mole Comp., %	Dry Mole Comp., %	ppmv	ppmvd
SO2	0.1144	64.06	0.00179	0.000149	0.000184	1.49	1.84
NOx	1.8	46.01	0.0391	0.00326	0.00403	32.6	40.3
PM	0.29923	NA	NA	NA	NA	NA	NA
CO	2.	28.01	0.0714	0.00595	0.00735	59.5	73.5
VOC	0.21655	44.09	0.00491	0.000409	0.000506	4.09	5.06

Sample Calculations for NOx: (1.8 lb/hr) / (46.01 lb/lb-mol) = 0.0391 lb-mol/hr
(0.0391 lb-mol/hr) / (1200 lb-mol/hr exhaust gas) (100%) = 0.00326% mole composition
(0.0391 lb-mol/hr) / (971 lb-mol/hr dry exhaust gas) (100%) = 0.00403% mole composition (dry)

Note that the molecular weight for NOx is that of NO2, and the molecular weight for VOC is that of C3H8. The resultant compositions are thus in terms of NOx as NO2 and VOC as C3H8.

GAS COMBUSTION CALCULATIONS (DDS Fractionator Reboiler (Potential to Emit), EPN DDS-HTRSTK)

SUMMARY OF EMISSION RATES AND CONVERSION TO METRIC UNITS

Pollutant	Short-term Emission Rate (lb/hr)	(g/sec)	Long-term Emission Rate (tons/yr)	(g/sec)
SO_2	0.1144001	0.0144	0.3006435	0.00866
NO_x	1.8	0.227	7.884	0.227
PM	0.2992299	0.0377	1.3106269	0.0377
CO	2.	0.252	8.76	0.252
VOC	0.2165479	0.0273	0.94848	0.0273

Sample Calculations for NO_x: (1.8 lb/hr) (454 g/lb) (hr/3600 sec) = 0.227 g/sec
(7.884 tons/yr) (2000 lb/ton) (454 g/lb) (yr/8760 hr) (hr/3600 sec) = 0.227 g/sec

CONVERSION OF STACK PARAMETERS TO METRIC UNITS

Stack Height = 100 ft = (100 ft) (0.3048 m/ft) = 30.5 m

Stack Diameter = 7 ft = (7 ft) (0.3048 m/ft) = 2.13 m

Stack Exit Velocity = (5.76 ft/sec) (0.3048 m/ft) = 1.76 m/sec

Stack Exit Temperature = 450°F = (450 - 32) / 1.8 = 232°C = 232 + 273.16 = 505 K

PROPERTIES USED IN EMISSIONS INVENTORIES

Annual Process Rate: (40200 scf/hr) (MM scf/1,000,000 scf) (8760 hr/yr) (100% firing rate) = 352 MMscf/yr

Percentage of Maximum Emissions Potential: (8760 hr/yr) (yr/8760 hr) (100% firing rate) = 100.0%

Gas Combustion Emissions Calculator: Summary Report

DDS Fractionator Reboiler (Potential to Emit), EPN DDS-HTRSTK

COMBUSTION UNIT DATA

Combustion Unit Description:	DDS Fractionator Reboiler (Potential to Emit)	
Facility Identification Number (FIN):	56BA2	
Emission Point Number (EPN):	DDS-HTRSTK	
Control Identification Number (CIN):	N/A	
Fuel Gas Firing Capacity, MM Btu/hr:	40	
Basis of Heating Value Specified for Firing Capacity (LHV or HHV):	HHV	
Average Fuel Heating Value (HHV):	999	
Excess Air, % (default to 10% if unknown):	10	
Annual Operating Schedule, hr/yr (default to 8760 hr/yr if unknown):	8760	
Average Firing Rate, % (as percent of firing capacity; default to 100% if unknown):	100	
Ambient Temperature, °F (default to 80°F if unknown):	80	
Barometric Pressure, psia (default to 14.7 psia if unknown):	14.7	
Relative Humidity, % (default to 60% if unknown):	60	
UTM Zone:	14	
UTM Easting (m):	644210	
UTM Northing (m):	3079837	
Stack Diameter:	7 ft	(2.13 m)
Stack Height:	100 ft	(30.5 m)
Stack Exit Temperature:	450° F	(505 K)
Stack Exit Velocity:	5.76 ft/sec	(1.76 m/sec)

SHORT-TERM EMISSIONS DATA

Pollutant	Short-Term Emission Factor	Source of Short-Term Emission Factor	Short-term Emission Rate (lb/hr)	(g/sec)
SO2	1 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.114400114	0.0144
NOx	0.045 lb/MM Btu (HHV)	Permit Emission Limit	1.8	0.227
PM	7.6 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.299229882	0.0377
CO	0.05 lb/MM Btu (HHV)	Vendor guarentee	2	0.252
TOC	None	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.216547941	0.0273

LONG-TERM EMISSIONS DATA

Pollutant	Long-Term Emission Factor	Source of Long-Term Emission Factor	Long-Term Emission Rate (ton/yr)	(g/sec)
SO2	0.6 Grains Sulfur per 100 dscf Fuel Gas @ 999 Btu/scf (HHV)	Engineering estimate-fuel gas treating	0.300643501	0.00866
NOx	0.045 lb/MM Btu (HHV)	Permit Emission Limit	7.884	0.227
PM	7.6 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	1.310626885	0.0377
CO	0.05 lb/MM Btu (HHV)	Vendor guarentee	8.76	0.252
TOC	None	AP-42, 5th Ed., Sec. 1.4, revised 3/98	-	-
VOC	5.5 lb/MM scf AP-42 Fuel Gas @ 1020 Btu/scf (HHV)	AP-42, 5th Ed., Sec. 1.4, revised 3/98	0.948479982	0.0273

FUGITIVE EMISSIONS SUMMARY SHEET
FCCU

Facility Information

FIN	01
EPN	F-01
Hours of Operation	8760

Total VOC Emissions Estimates

Equipment Type	Component Count	Emission Factor [1]	Control Efficiency [2]	(lb/hr)	(tons/yr)
Valves - Gas/Vapor	1172	0.059	0.97	2.07	9.09
Valves - Gas/Vapor (DM)	125	0.059	0.30	5.16	22.61
Valves - Light Liquid	2342	0.024	0.97	1.69	7.39
Valves - Light Liquid (DM)	247	0.024	0.30	4.15	18.18
Valves - Heavy Liquid	0	0.00051	0.00	0.00	0.00
Pumps - Light Liquid	48	0.251	0.85	1.81	7.92
Pumps - Heavy Liquid	10	0.0463	0.00	0.46	2.03
Relief Valves	61	0.35	1.00	0.00	0.00
Compressors	1	1.399	1.00	0.00	0.00
Flanges - Gas/Vapor	2790	0.00055	0.75	0.38	1.68
Flanges - Light Liquid	6580	0.00055	0.75	0.90	3.96
Flanges - Heavy Liquid	1300	0.00055	0.00	0.72	3.13
Process Drains	170	0.0027	0.00	0.46	2.01
Total VOC Emissions				***17.81***	***77.99***

Emissions Speciation

Contaminant	Max Case Composition by Component (Wt %)			All
Benzene				1.88%
Diethanolamine				0.76%
Ethylbenzene				0.72%
Ethylene				4.13%
Propylene				76.40%
Toluene				3.82%
Xylene (Mixed Isomers)				7.64%
NMVOC-U				4.65%
Total VOC	***0%***	***0%***	***0%***	***100%***

NOTES:
(1) Refinery average emission factors from the EPA "Protocol for Equipment Leak Emission Estimates."
(2) Control efficiency based on 28VHP I&M program. PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.

Speciated Emissions Summary

Component	Contaminant Code	Proposed Emission Rates (lb/hr)	(tons/yr)
Benzene		0.33	1.47
Diethanolamine		0.14	0.59
Ethylbenzene		0.13	0.56
Ethylene		0.74	3.22
Propylene		13.60	59.58
Toluene		0.68	2.98
Xylene (Mixed Isomers)		1.36	5.96
NMVOC-U		0.83	3.63
Total VOC	***59999***	***17.81***	***77.99***

FUGITIVE EMISSIONS SUMMARY SHEET
HYDROCRACKER

Facility Information

FIN	26
EPN	F-26
Hours of Operation	8760

Total VOC Emissions Estimates

Equipment Type	Component Count	Emission Factor [1]	Control Efficiency [2]	(lb/hr)	(tons/yr)
Valves - Gas/Vapor	1017	0.059	0.97	1.80	7.88
Valves - Light Liquid	1062	0.024	0.97	0.76	3.35
Valves - Heavy Liquid	500	0.00051	0.00	0.26	1.12
Pumps - Light Liquid	21	0.251	0.85	0.79	3.46
Pumps - Heavy Liquid	15	0.0463	0.00	0.69	3.04
Relief Valves	60	0.36	1.00	0.00	0.00
Compressors	0	1.401	1.00	0.00	0.00
Flanges - Gas/Vapor	2745	0.000555	0.75	0.38	1.67
Flanges - Light Liquid	2677	0.000555	0.75	0.37	1.63
Flanges - Heavy Liquid	1250	0.000555	0.30	0.49	2.13
Process Drains	86	0.00134	0.00	0.12	0.50
Total VOC Emissions				***5.66***	***24.78***

Emissions Speciation

Contaminant	Max Case Composition by Component (Wt %)			All
Benzene				1.00%
Cyclohexane				2.00%
Hexane				4.00%
NMVOC-U				93.00%
Total VOC	***0%***	***0%***	***0%***	***100%***

NOTES:
(1) Refinery average emission factors from the EPA "Protocol for Equipment Leak Emission Estimates."
(2) Control efficiency based on MACT monitoring program. PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.

Speciated Emissions Summary

Component	Contaminant Code	Proposed Emission Rates (lb/hr)	Proposed Emission Rates (tons/yr)
Benzene	52420	0.06	0.25
Cyclohexane	56050	0.11	0.50
Hexane	56600	0.23	0.99
NMVOC-U	50001	5.26	23.05
Total VOC	***59999***	***5.66***	***24.78***

Fugitive Emission Rate Estimates
SCR Ammonia Fugitives
New Components

FIN:	SCRNH3FUG
EPN:	SCRNH3FUG
Operating schedule (hr/yr):	8760

Fugitive Emission Calculations:

Emission Source	Source Count	Uncontrolled Emission Factor [1] (lb/hr-source)	Control Factor [2]	Hourly Emissions (lb/hr)
Valves - Gas	52	0.0089	97%	0.0139
Valves - Gas (DM)	0	0.0089	75%	0
Valves - Light Liquid	110	0.0035	97%	0.0115
Valves - Light Liquid (DM)	0	0.0035	75%	0
Valves - Heavy Liquid	0	0.0007	97%	0
Pumps - Light Liquid	8	0.0386	93%	0.0229
Pumps - Light Liquid	0	0.0386	0%	0
Pumps - Heavy Liquid	0	0.0161	93%	0
Flanges - Gas	135	0.0029	97%	0.0118
Flanges - Light Liquid	285	0.0005	97%	0.00427
Flanges - Heavy Liquid	0	0.00007	97%	0
Compressors	0	0.5027	95%	0
Pressure Relief Valves [3]	6	0.23	100%	0
Sampling Connections	0	0.033	0%	0.00099
Total Hourly Emissions				**0.0654**
Total Annual Emissions				**0.286**

Sample Calculations:

Valve Emissions = (52 valves)(0.0089 lb/hr-source)(1 - 0.97)
= 0.0139 lb/hr

Annual Emissions = (0.0654 lb/hr)(8760 hr/yr)(1 ton/2000 lb)
= 0.286 tons/yr

Emissions Speciation

Contaminant	Contaminant Code	Maximum Speciated Composition by Component (Wt %)	Hourly Speciated Emission Rates (lb/hr)	Annual Speciated Emission Rates (tons/yr)
Ammonia	**70050**	**100.00%**	**0.065**	**0.286**

NOTES:

(1) The emission factors used are SOCMI w/out ethylene factors from the TCEQ Fugitive Guidance Document dated October 2000. Heavy liquid component emission factors are SOCMI non-leaker factors as specified in the guidance document.
(2) The control factors are for a AVO program from the TCEQ Fugitive Guidance Document dated October 2000.
(3) PRVs are routed to a flare or are equipped with a rupture disk upstream or downstream with a pressure gauge.

PLANNED MAINTENANCE, START UP, AND SHUTDOWN EMISSIONS

FHR is proposing an increase in annual VOC emissions from planned maintenance, start up, and shutdown (MSS) activities as described below as a result of constructing the new Sat Gas Plant No. 3 Unit and new storage tanks. The calculations provided are for the new MSS activities associated with the new Sat Gas Plant No. 3 Unit and new storage tanks. Total proposed MSS emission rates are estimated by adding the emission rates from the new MSS activities addressed in this application to the grouped MSS emission rate limit being transferred from Permit No. 8803A.

<u>General Process Description</u>

Various maintenance activities have fugitive emissions associated with them.

Vessel and Equipment Openings after Decommissioning

Once equipment has been cleaned, blinds for maintenance are installed. This requires opening the equipment to atmosphere releasing any residual VOC to the atmosphere.

Tank Landings and Degassing

MSS activities associated with tanks are landing the floating roofs, degassing and cleaning for the purposes of product service changes, off-spec product removal, and other tank maintenance. When a tank is cleaned, material in the tank is removed. Diesel is introduced into the tank several times to absorb any remaining VOCs in the tank. For tanks storing material with a TVP > 0.5 psia, the tank is degassed to a control device while the diesel is being flushed into the tank. The diesel and any residual liquid are then removed from the tank.

Degassing continues until the VOC concentration in the tank is below 10,000 ppmv. At that time, the tank is opened to vent any remaining VOCs.

Frac Tanks

Frac tanks are utilized as temporary storage containers for refinery process and chemical cleaning materials. Emissions are generated from filling and breathing loss. The frac tanks are controlled by carbon canisters.

PAN Emissions

Emissions are generated from residual hydrocarbons that remain in the process equipment after decommissioning. Emissions are also generated from leaks that occur during repair/replacement of components such as pumps, filters, valves, etc.

Vacuum Truck Loading

Vacuum trucks are used to transfer materials from one container to another and empty tanks and other vessels during maintenance activities. Vacuum trucks are also used for blinding activities, pump maintenance, and dewatering crude tanks etc. Vacuum truck emissions will be controlled by a carbon canister system, an engine, or a thermal oxidizer. Consistent with prior TCEQ permitting actions, a control device efficiency of 98% is used in the calculations.

Emissions Data

Emission rate calculations for the following sources listed below are provided at the end of this section.

FIN	EPN	Source Name
MSSFUGS	MSSFUGS	Miscellaneous MSS Fugitive Emissions

Emission rates are calculated for each MSS activity and summed to get a total emission rate for miscellaneous MSS activities.

Process Vessel and Equipment Openings to Atmosphere

Maximum hourly and annual VOC emission rates from process vessel and equipment openings are estimated based on the volume released to the atmosphere and the VOC content, which may vary. Although actual volume or VOC content values may vary and may be higher than those represented, actual emission rates will be below the proposed emission rates.

Tank Landings and Degassing

Emission rates from tanks landings due to product changes and refilling after degassing are estimated using AP-42, Chapter 7 Methodology. Although tanks storing a material with a true vapor pressure greater than 0.5 psia will be controlled by either an engine or thermal oxidizer, controlled degassing emissions are based on combustion emissions from engines since these emissions are highest. A control efficiency of 98% is used based on manufacturer’s design data. Variables represented in the calculations are used to estimate maximum hourly and annual emission rates. Although actual values of the variables used in the emission calculations may be higher than those represented, actual emission rates will be below the proposed emission rates.

Frac Tanks

Emission rates from filling frac tanks are estimated based on the loading loss equation from AP-42, Section 5.2. Standing storage losses are calculated based on equations for fixed-roof tanks from AP-42, Chapter 7. Frac tanks are controlled by carbon canisters with a minimum VOC control efficiency of 98%. Variables represented in the calculations are used to estimate maximum hourly and annual emission rates. Although actual values of the variables used in the emission calculations may be higher than those represented, actual emission rates will be below the proposed emission rates.

PAN Emissions

VOC emission rates from PAN emissions are estimated based on Section 6.2.3 of EPA 560/4-88-002 "Estimating Releases and Water Treatment Efficiencies for the Toxic Chemical Release Inventory Form." Although actual values of the variables used in the emission calculation may be higher than those represented, actual emission rates will be below the proposed emission rates.

Vacuum Truck Loading

Emission rates from filling liquid vacuum truck are estimated based on the loading loss equations from AP-42, Section 5.2. Based on TCEQ guidance, a saturation factor of 1.45 and a factor of 2 are used in the equation. For the materials with a true vapor pressure > 0.5 psia, a VOC control efficiency of 98% is used. Combustion emissions are based on engines as the control device since these emissions are highest. Variables represented in the calculations are used to estimate maximum hourly and annual emission rates. Although actual values of the variables used in the emission calculations may be higher than those represented, actual emission rates will be below the proposed emission rates.

Routine Start-up/Shutdown/Maintenance Fugitive Emissions
Emissions Summary
EPN MSSFUGS

Event	NOx Emission Rates (ton/yr)	CO Emission Rates (ton/yr)	SO2 Emission Rates (ton/yr)	PM Emission Rates (ton/yr)	PM_{10} Emission Rates (ton/yr)	VOC Emission Rates (ton/yr)	H_2S Emission Rates (ton/yr)
Equipment Openings		0.0004				0.10	0.001
PAN emissions						0.12	
Vacuum Truck Loading	0.21	0.14	0.06	0.003	0.00002	0.09	
Frac Tanks						0.02	
Tank Landings (Product Changes)	0.05	0.03	0.00	0.001	0.00000	0.38	
Tank Degassing to Control	0.56	0.37	0.01	0.01	0.0001	1.02	
Tank Refilling After Degassing	0.05	0.03	0.00	0.001	0.00000	1.91	
Total	**0.87**	**0.57**	**0.07**	**0.02**	**0.0001**	**3.64**	**0.001**

Routine Start-up/Shutdown/Maintenance Fugitive Emissions
Vessel and Associated Piping/Equipment Openings to Atmsophere
EPN MMSFUGS

Total Annual Flow Rate to the Atmosphere:	120,000	scf/yr
Maximum VOC Conent in the Vent Gas:	10000	ppmv
Assumed Molecular Weight of VOC to the Atmosphere:	62	lb/lb-mole
Maximum Hourly H_2S Content in the Vent Gas:	0.03	vol %
Annual Average H_2S Content in the Vent Gas:	0.01	vol %
Maximum Hourly CO Content in the Vent Gas:	0.01	vol %
Annual Average CO Content in the Vent Gas:	0.01	vol %

VOC Emissions

$$\text{Annual VOC} = \frac{120000 \text{ scf vent gas}}{\text{yr}} \left| \frac{0.01 \text{ scf VOC}}{\text{scf vent gas}} \right| \frac{\text{lb-mol VOC}}{379.5 \text{ scf VOC}} \left| \frac{62 \text{ lb VOC}}{\text{lb-mol VOC}} \right| \frac{\text{ton VOC}}{2000 \text{ lb VOC}} = 0.10 \text{ tons/yr}$$

H_2S Emissions

$$\text{Annual } H_2S = \frac{120000 \text{ scf vent gas}}{\text{yr}} \left| \frac{0.0001 \text{ scf H2S}}{\text{scf vent gas}} \right| \frac{\text{lb-mol } H_2S}{379.5 \text{ scf } H_2S} \left| \frac{34 \text{ lb } H_2S}{\text{lb-mol } H_2S} \right| \frac{\text{ton } H_2S}{2000 \text{ lb } H_2S} = 0.001 \text{ tons/yr}$$

CO Emissions

$$\text{Annual CO} = \frac{120000 \text{ scf vent gas}}{\text{yr}} \left| \frac{0.0001 \text{ scf CO}}{\text{scf vent gas}} \right| \frac{\text{lb-mol CO}}{379.5 \text{ scf CO}} \left| \frac{28 \text{ lb CO}}{\text{lb-mol CO}} \right| \frac{\text{ton CO}}{2000 \text{ lb CO}} = 0.0004 \text{ tons/yr}$$

Routine Start-up/Shutdown/Maintenance Fugitive Emissions
PAN Emissions
(repair/replacement of components such as pumps, filters, valves, etc.)
EPN MSSFUGS

$$W = \frac{(M)(K)(A)(P°)}{(R)(T_1)}$$

Basis: Section 6.2.3 of EPA 560/4-88-002 "Estimating Releases and Water Treatment Efficiencies for the Toxic Chemical Release Inventory Form." Also available in Volume II: Chapter 8, "Preferred and Alternative Methods for Estimating Air Emissions from Paint and Ink Manufacturing Facilities," August 2000, Updated March 2002.

W = vapor generation rate (lb/sec)
M = molecular weight (lb/lb-mol)
K = gas-phase mass transfer coefficient (ft/sec)
A = area of spill or sump (ft^2)
P° = vapor pressure at T_1 (psia)
R = gas constant (psia-ft^3/°R-lb mol) = 10.73
T_1 = liquid temperature (°R)
D = diffusion coefficient for chemical in air (ft^2/sec)
U = wind speed at liquid surface (miles/hr) = 12.1

The gas-phase mass transfer coefficient can be determined by using one of the following two equations:

(1) $K = 0.00438\,(U)^{0.78}\,(D/0.00031)^{2/3}$ or (2) $K = (0.00438)(U)^{0.78}\,[(18)/(M)]^{1/3}$

Method (1) should be used when the diffusion coefficient D of the material is known. Method (2) can be used if D is not known.

The diffusion coefficient is not known; therefore, method (2) is used to calculate the gas-phase mass transfer coefficient.

Pan Emissions

Annual Emissions

Material	Material VP (psia)	Material MW (lb/lb-mol)	Liquid Temperature (F)	Liquid Temperature (R)	Pool Diameter (ft)	Calculated Spill Area (sq. ft.)	Event Duration (minutes)	Number of Events (events/yr)	K (ft/sec)	Emissions (lb/sec)	Emissions (lb/event)	Emissions (tons/yr)	VOC Content (%)	VOC Emissions (tons/yr)
Gasoline (RVP = 10)	8	66	80	540	3	7.07	15	10	0.0199	0.0128	11.52	0.06	100.00%	0.06
Crude (RVP = 5)	4	50	80	540	3	7.07	15	20	0.0218	0.0053	4.77	0.05	100.00%	0.05
Distillate	0.012	130	80	540	6	28.27	60	50	0.0158	0.0001	0.36	0.01	100.00%	0.01
Wastewater	0.338	18.17	80	540	6	28.27	60	100	0.0305	0.0009	3.24	0.16	1.00%	0.00
													TOTAL	**0.12**

Routine Start-up/Shutdown/Maintenance Fugitive Emissions
Vacuum Trucks
EPN MSSFUGS

Materials with a true vapor pressure (TVP) < 0.5 psia will be loaded uncontrolled. For materials > 0.5 psia, FHR is proposing to use a control device (e.g., combustion, liquid scrubber, carbon absorption system, etc.) with a minimum control efficiency of 95%.

$$L_L = \frac{12.46 \times S \times M \times P \times Q}{T}$$ (AP-42, Section 5.2)

L_L = Loading Losses
S = Saturation factor from Table 5.2-1
M = Vapor molecular weight of liquid loaded, lb/lb-mol
P = True vapor pressure of liquid loaded, psia
T = Temperature of bulk liquid loaded, °R
Q = Filling rate

Annual Emissions

Material	Multiplier	Saturation Factor	Vapor MW (lb/lb-mol)	TVP (psia)	Temperature (R)	Filling Rate (gal/yr)	Events/yr	Control Efficiency	VOC in Vapor (wt%)	VOC Emissions (tons/yr)
Crude Oil (RVP 5)	2	1.45	50	4	540	2,940	100	98%	100%	0.039
Gasoline (RVP 13.5)	2	1.45	66	8	540	2,940	10	98%	100%	0.010
Distillates	2	1.45	130	0.012	540	2,940	100	0%	100%	0.015
Wastewater	2	1.45	18.17	0.814	540	2,940	200	0%	1%	0.003
									Total	**0.06**

Note: The variables represented in these calculations are used only to estimate emissions. Although actual values of
of the variables may vary and may be higher than represented, actual emissions will remain below the proposed emission rates.

Routine Start-up/Shutdown/Maintenance Fugitive Emissions
Combustion Emissions from Controlling Vacuum Trucks
EPN MSSFUGS

Hourly Basis H_2S Concentration (ppmv) = 5,000 = 0.50 vol. %

Standard gas volume (scf/lb-mol) = 379.5
MW of H_2S (lb/lb-mol) = 34
MW of SO_2 (lb/lb-mol) = 64
It is assumed that all of the H_2S sent to the engine is converted to SO_2 and emitted.

Volume Vented to Control	H_2S Vented to Control	SO_2 Emissions	Duration	Frequency	SO_2 Emissions
(ft^3/hr)	(lb/hr)	(lb/hr)	(hrs/event)	(events/yr)	(tons/yr)
1,348	0.60	1.1	1	110	0.06

Sample Calculations:

SO_2 Emissions (lb/hr) = (Volume x H_2S Concentration / Standard Gas Volume) x 1 mol SO_2 / 1 mol H_2S x MW of SO_2
SO_2 Emissions (lb/hr) = (1,348 ft^3/min) x (5,000 ppmv) / (1,000,0000) / (379.5 scf/lb-mol) x (64 lb/lb-mol)
SO_2 Emissions (lb/hr) = 1.1

Combustion Emissions

Individual engine horsepower (hp) = 460
Number of engines required = 1
Cumulative engine horsepower (hp) = 460

Emission factors are for natural-gas fired, 4-stroke lean-burn engines, from AP-42 Table 3.2-2:
NO_x (lb/MMBtu) = 8.47E-01
CO (lb/MMBtu) = 5.57E-01
SO_2 (lb/MMBtu) = 0.0147 based on 5 gr/100 dscf instead of 0.2 gr/100 dscf
VOC (lb/MMBtu) = 1.18E-01
PM (lb/MMBtu) = 9.91E-03
PM_{10} (lb/MMBtu) = 7.71E-05

Engine Horsepower	Fuel Usage	Emissions (lb/hr)					
(hp)	(MMBtu/hr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
460	4.60	3.90	2.56	0.07	0.54	0.05	0.0004

Sample Calculations:

NO_x Emissions (lb/hr) = Engine Horsepower x 2544 Btu/hp-hr x Fuel Usage x Emission Factor
NO_x Emissions (lb/hr) = (460 hp) x (2544 Btu/hp-hr) / (1,000,0000 Btu/MMBtu) * (0.847 lb/MMBtu)
NO_x Emissions (lb/hr) = 0.99

Total Combustion Emissions

Number of events	Hourly Emissions (lb/hr)					
(events/hr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
1	3.90	2.56	1.17	0.54	0.05	0.0004

Duration of Control	Number of events	Annual Emissions (tons/yr)					
(hr/event)	(events/yr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
1	110	0.21	0.14	0.06	0.03	0.003	0.00002

Routine Start-up/Shutdown/Maintenance Fugitive Emissions
Frac Tanks
EPN MSSFUGS

Frac Tanks Storing Wastewater and Material with True Vapor Pressure Less than 0.5 psia.

Short-term emission occur during filling of the frac tanks.
Annual emission are the total from filling the tanks and standing losses.
Emissions are calculated using the loading loss equation.

$$L_L = \frac{12.46 \times S \times M \times P \times Q}{T} \quad \text{(AP-42, Section 5.2)}$$

L_L = Loading Losses
S = Saturation factor from Table 5.2-1
M = Vapor molecular weight of liquid loaded, lb/lb-mol
P = True vapor pressure of liquid loaded, psia
T = Temperature of bulk liquid loaded, °R
Q = Filling rate

Frac Tanks Storing Material with True Vapor Pressure Greater than 0.5 psia.

Emissions are controlled by a carbon adsorption system.
Emissions are calculated based on a breakthrough concentration of 100 ppmv.

Annual VOC Emissions = Flow Rate (scf) x Concentration (ppmv) x Vapor MW (lb/lbmole) x (379 scf/lbmole) x (Number of Events/yr) x (ton/2000 lbs)

Annual Filling Emissions

Material	Saturation Factor	Vapor MW (lb/lb-mol)	TVP (psia)	Temperature (R)	Filling Rate (gal/hr)	Number of Events per Year	VOC in Vapor (wt%)	Flow Rate to Carbon Adsorption (scf/event)	VOC Breakthrough Concentration (ppmv)
Crude Oil (RVP 5)	N/A	50	N/A	N/A	18,900	10	N/A	2527	100
Gasoline (RVP 13.5)	N/A	66	N/A	N/A	18,900	3	N/A	2527	100
Distillates	0.6	130	0.012	540	18,900	20	100%	N/A	N/A
Wastewater	0.6	78.1	1.98	540	18,900	20	1%	N/A	N/A
									Total

Annual Standing Emissions

Material	Days Stored per Event	Vapor Space Volume	Vapor Density	Vapor Expansion Factor	Vapor Saturation Factor	Number of Events per Year	Control Efficiency	VOC in Vapor (wt%)	Standing Storage Losses (tons/yr)
Distillates	10	2051	0.0003	0.1673	0.997	20	0%	100%	0.01
Wastewater	10	2051	0.0262	0.1877	0.689	20	0%	1%	0.01

Total Emissions

Material	Annual Emissions (tons/yr)
Crude Oil (RVP 5)	0.0002
Gasoline (RVP 13.5)	0.0001
Distillates	0.01
Wastewater	0.01
Total	**0.02**

Routine Start-up/Shutdown/Maintenance Fugitive Emissions
Tank Landings from Product Changes
EPN MSSFUGS

Assumed that all landings are for tanks with a liquid heel
Annual emissions are the total from filling the tanks and standing losses.

Number of Uncontrolled Internal Floating Roof Tank Landings used to Estimate Annual Emissions	0	IFR tanks/yr
Number of Controlled Internal Floating Roof Tank Landings used to Estimate Annual Emissions	2	IFR tanks/yr
Control Efficiency for Refilling Emissions	98%	

Internal Floating Roof Standing Storage Losses

L_S = N x (P) x (Vv) x (Mv) x (Ke) x (Ks) / R / T

L_S = Standing Storage Losses, lb/event

N = Number of days tank is landed
= 1 days/event

P = True vapor pressure of material in tank, psia
= 10.9 psia

V_V = Vapor space volume, ft^3
= 57,227 ft^3

Mv = Molecular weight of stored material, lb/lbmol
= 68.0 lb/lbmol

T = Temperature, ^oR
= 545 ^oR

R = ideal gas constant
= 10.73 psia-ft^3/lbmol-^oR

Ke = Vapor expansion factor
= 0.15065

Ks = Vapor saturation factor
= 0.25717

L_S =										
1	days	10.9 psia	57227 ft^3	68 lb	0.1507	0.2572	lbmol-R		=	281.02 lb/event
	event			ft^3			10.73 psia-ft^3	545 R		

Internal Floating Roof Filling Losses

L_{FL} = S x (P) x (Vv) x (Mv) / R / T

L_{FL} = IFR Tank Refilling Losses, lb/event

S = Filling saturation factor
= 0.6

P = True vapor pressure of material in tank, psia
= 10.9 psia

V_V = Vapor space volume, ft^3
= 57,227 ft^3

Mv = Molecular weight of stored material, lb/lbmol
= 68.0 lb/lbmol

T = Temperature, ^oR
= 545 ^oR

R = ideal gas constant
= 10.73 psia-ft^3/lbmol-^oR

L_S =							
0.6	10.9 psia	57227 ft^3	68 lb	lbmol-R		=	4352.03 lb/event
			ft^3	10.73 psia-ft^3	545 R		

Event	Number of Events per Year	Emissions per Event (lbs)	Total Emissions (tons/yr)
Annual Uncontrolled IFR VOC from Refilling=	0	4352.03	0.00
Annual Controlled IFR VOC from Refilling=	2	4352.03	0.09
Annual Uncontrolled IFR VOC from Standing Loss=	2	281.02	0.28
Total			**0.37**

Note: The variables represented above are used only to estimate emissions. Although actual values of
of the variables may vary and may be higher than represented, actual emissions will remain below the proposed emission rates.

Routine Start-up/Shutdown/Maintenance Fugitive Emissions
Combustion Emissions from Controlling Tank Refills after Product Changes
EPN MSSFUGS

Hourly Basis H_2S Concentration (ppmv) = 0 = 0.00 vol. %

Standard gas volume (scf/lb-mol) = 379.5
MW of H_2S (lb/lb-mol) = 34
MW of SO_2 (lb/lb-mol) = 64
It is assumed that all of the H_2S sent to the engine is converted to SO_2 and emitted.

Volume Vented to Control	H_2S Vented to Control	SO_2 Emissions	Duration	Frequency	SO_2 Emissions
(ft^3/hr)	(lb/hr)	(lb/hr)	(hrs/event)	(events/yr)	(tons/yr)
16,845	0.00	0.0	6	2	0.00

Sample Calculations:

SO_2 Emissions (lb/hr) = (Volume x H_2S Concentration / Standard Gas Volume) x 1 mol SO_2 / 1 mol H_2S x MW of SO_2
SO_2 Emissions (lb/hr) = (16,845 ft^3/min) x (0 ppmv) / (1,000,0000) / (379.5 scf/lb-mol) x (64 lb/lb-mol)
SO_2 Emissions (lb/hr) = 0.0

Combustion Emissions

Individual engine horsepower (hp) = 460
Number of engines required = 2
Cumulative engine horsepower (hp) = 920

Emission factors are for natural-gas fired, 4-stroke lean-burn engines, from AP-42 Table 3.2-2:
NO_x (lb/MMBtu) = 8.47E-01
CO (lb/MMBtu) = 5.57E-01
SO_2 (lb/MMBtu) = 0.0147 based on 5 gr/100 dscf instead of 0.2 gr/100 dscf
VOC (lb/MMBtu) = 1.18E-01
PM (lb/MMBtu) = 9.91E-03
PM_{10} (lb/MMBtu) = 7.71E-05

Engine Horsepower	Fuel Usage	Emissions (lb/hr)					
(hp)	(MMBtu/hr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
920	9.20	7.79	5.12	0.14	1.09	0.09	0.0007

Sample Calculations:

NO_x Emissions (lb/hr) = Engine Horsepower x 2544 Btu/hp-hr x Fuel Usage x Emission Factor
NO_x Emissions (lb/hr) = (920 hp) x (2544 Btu/hp-hr) / (1,000,0000 Btu/MMBtu) * (0.847 lb/MMBtu)
NO_x Emissions (lb/hr) = 1.98

Total Combustion Emissions

Number of events	Hourly Emissions (lb/hr)					
(events/hr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
1	7.79	5.12	0.14	1.09	0.09	0.0007

Duration of Control	Number of events	Annual Emissions (tons/yr)					
(hr/event)	(events/yr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
6	2	0.05	0.03	0.00	0.01	0.001	0.00000

Routine Start-up/Shutdown/Maintenance Fugitive Emissions
Tank Degassing to Control
EPN MSSFUGS

VOC emissions will be controlled by a variety of control devices (i.e. engine, thermal oxidizer, carbon adsorption, scrubber). The control device will achieve a control efficiency of at least 95%. Combustion emission rates are based on control by an engine since this is most conservative.

Hourly Basis	VOC vapor pressure (psia) =	10.9		
	VOC Concentration (ppmv) =	741,497	=	74.15 vol. %
	H_2S Concentration (ppmv) =	0	=	0.00 vol. %
	MW of VOC (lb/lb-mol) =	62		
Annual Basis	VOC vapor pressure (psia) =	10.9		
	VOC Concentration (ppmv) =	741,497	=	74.15 vol. %
	H_2S Concentration (ppmv) =	0	=	0.00 vol. %
	MW of VOC (lb/lb-mol) =	80		

Standard gas volume (scf/lb-mol) = 379.5
MW of H_2S (lb/lb-mol) = 34
MW of SO_2 (lb/lb-mol) = 64
It is assumed that all of the H_2S sent to the engine is converted to SO_2 and emitted.

Basis	Tank Diameter	Tank/Leg Height	Volume Vented to Control	Duration of Degassing	Volume Vented to Control	VOC Vented to Control	H_2S Vented to Control	VOC Control Efficiency	VOC Emissions	SO_2 Emissions
	(ft)	(ft)	(ft^3/event)	(hr/event)	(ft^3/min)	(lb/hr)	(lb/hr)	(%)	(lb/hr)	(lb/hr)
Annual	135	7	100,197	24	70	656.50	0.00	98%	13.13	0.00

Sample Calculations:

VOC Emissions (lb/hr) = Volume x Concentration / Standard Gas Volume x MW
VOC Emissions (lb/hr) = (134 ft^3/min) x (60 min/hr) x (741,497 ppmv) / (1,000,0000) / (379.5 scf/lb-mol) x (62 lb/lb-mol) x (1 - 0.98)
VOC Emissions (lb/hr) = 19.48

SO_2 Emissions (lb/hr) = (Volume x H_2S Concentration / Standard Gas Volume) x 1 mol SO_2 / 1 mol H_2S x MW of SO_2
SO_2 Emissions (lb/hr) = (134 ft^3/min) x (60 min/hr) x (0 ppmv) / (1,000,0000) / (379.5 scf/lb-mol) x (64 lb/lb-mol)
SO_2 Emissions (lb/hr) = 0.00

Combustion Emissions

Individual engine horsepower (hp) = 460
Number of engines required = 2
Cumulative engine horsepower (hp) = 920

Emission factors are for natural-gas fired, 4-stroke lean-burn engines, from AP-42 Table 3.2-2:
NO_x (lb/MMBtu) = 8.47E-01
CO (lb/MMBtu) = 5.57E-01
SO_2 (lb/MMBtu) = 0.0147 based on 5 gr/100 dscf instead of 0.2 gr/100 dscf
VOC (lb/MMBtu) = 1.18E-01
PM (lb/MMBtu) = 9.91E-03
PM_{10} (lb/MMBtu) = 7.71E-05

Engine Horsepower	Fuel Usage	Emissions (lb/hr)					
(hp)	(MMBtu/hr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
920	9.20	7.79	5.12	0.14	1.09	0.09	0.0007

Sample Calculations:

NO_x Emissions (lb/hr) = Engine Horsepower x 2544 Btu/hp-hr x Fuel Usage x Emission Factor
NO_x Emissions (lb/hr) = (920 hp) x (2544 Btu/hp-hr) / (1,000,0000 Btu/MMBtu) * (0.847 lb/MMBtu)
NO_x Emissions (lb/hr) = 1.98

Total Degassing Emissions

Number of events	Hourly Emissions (lb/hr)					
(events/hr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
1	7.79	5.12	0.14	20.57	0.09	0.0007

Duration of Degassing	Number of events	Annual Emissions (tons/yr)					
(hr/event)	(events/yr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
72	2	0.56	0.37	0.01	1.02	0.01	0.00005

Routine Start-up/Shutdown/Maintenance Fugitive Emissions
Tank Refilling after Degassing
EPN MSSFUGS

Assumed that all landings are for tanks with a liquid heel.
Annual emissions are the total from filling the tanks and standing losses.

Annual Number of Internal Floating Roof Tanks Landed: 2 IFR tanks/yr

Internal Floating Roof Filling Losses

L_{FL} = S x (P) x (Vv) x (Mv) / R / T

L_{FL} = IFR Tank Refilling Losses, lb/event

S = Filling saturation factor
= 0.15

P = True vapor pressure of material in tank, psia
= 10.9 psia

V_V = Vapor space volume, ft^3
= 100,197 ft^3

Mv = Molecular weight of stored material, lb/lbmol
= 68.0 lb/lbmol

T = Temperature, ^oR
= 545 ^oR

R = ideal gas constant
= 10.73 psia-ft^3/lbmol-^oR

L_S =						=	
0.15	10.9 psia	100197 ft^3	68 lb	lbmol-R		=	1904.96 lb/event
			ft^3	10.73 psia-ft^3	545 R		

Total VOC Emissions from Refilling After Degassing

Annual IFR VOC =					
2	events	1904.96 lb	ton VOC	=	1.90 tons/yr
	yr		2000 lb VOC		

Note: The variables represented above are used only to estimate emissions. Although actual values of
of the variables may vary and may be higher than represented, actual emissions will remain below the proposed emission rates.

Routine Start-up/Shutdown/Maintenance Fugitive Emissions
Combustion Emissions from Controlling Tank Refills after Tank Degassing
EPN MSSFUGS

Hourly Basis H_2S Concentration (ppmv) = 0 = 0.00 vol. %

Standard gas volume (scf/lb-mol) = 379.5
MW of H_2S (lb/lb-mol) = 34
MW of SO_2 (lb/lb-mol) = 64
It is assumed that all of the H_2S sent to the engine is converted to SO_2 and emitted.

Volume Vented to Control	H_2S Vented to Control	SO_2 Emissions	Duration	Frequency	SO_2 Emissions
(ft^3/hr)	(lb/hr)	(lb/hr)	(hrs/event)	(events/yr)	(tons/yr)
16,845	0.00	0.0	6	2	0.00

Sample Calculations:

SO_2 Emissions (lb/hr) = (Volume x H_2S Concentration / Standard Gas Volume) x 1 mol SO_2 / 1 mol H_2S x MW of SO_2
SO_2 Emissions (lb/hr) = (16,845 ft^3/min) x (0 ppmv) / (1,000,0000) / (379.5 scf/lb-mol) x (64 lb/lb-mol)
SO_2 Emissions (lb/hr) = 0.0

Combustion Emissions

Individual engine horsepower (hp) = 460
Number of engines required = 2
Cumulative engine horsepower (hp) = 920

Emission factors are for natural-gas fired, 4-stroke lean-burn engines, from AP-42 Table 3.2-2:
NO_x (lb/MMBtu) = 8.47E-01
CO (lb/MMBtu) = 5.57E-01
SO_2 (lb/MMBtu) = 0.0147 based on 5 gr/100 dscf instead of 0.2 gr/100 dscf
VOC (lb/MMBtu) = 1.18E-01
PM (lb/MMBtu) = 9.91E-03
PM_{10} (lb/MMBtu) = 7.71E-05

Engine Horsepower	Fuel Usage	Emissions (lb/hr)					
(hp)	(MMBtu/hr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
920	9.20	7.79	5.12	0.14	1.09	0.09	0.0007

Sample Calculations:

NO_x Emissions (lb/hr) = Engine Horsepower x 2544 Btu/hp-hr x Fuel Usage x Emission Factor
NO_x Emissions (lb/hr) = (920 hp) x (2544 Btu/hp-hr) / (1,000,0000 Btu/MMBtu) * (0.847 lb/MMBtu)
NO_x Emissions (lb/hr) = 1.98

Total Combustion Emissions

Number of events	Hourly Emissions (lb/hr)					
(events/hr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
1	7.79	5.12	0.14	1.09	0.09	0.0007

Duration of Control	Number of events	Annual Emissions (tons/yr)					
(hr/event)	(events/yr)	NO_x	CO	SO_2	VOC	PM	PM_{10}
6	2	0.05	0.03	0.00	0.01	0.001	0.00000

ATTACHMENT VII.A.7

AIR PERMIT APPLICATION TABLES

A Table 1(a) is included in this section that summarizes the proposed emission limits for all sources to be included in Permit No. 6819A. A Table 7 is included in this section for the two new IFR tanks (EPNs IFRTK1, IFRTK2). A Table 6 is included in this section for the new Sat Gas #3 Heater (EPN SATGASHTR). TCEQ equipment tables are only provided for new emission units. Equipment tables for existing emission units that will be modified as part of the project have been submitted in the past. A separate confidential Table 2 (Material Balance) is provided for each process unit with the associated confidential process flow diagram in the confidential portion of this permit application.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012; Revised September 2013	**Permit No.:** 6819A	**Regulated Entity No.:** RN100235266	
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463	

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**	**3. Air Contaminant Emission Rate**	
EPN (A)	**FIN (B)**	**NAME (C)**		**Pounds per Hour (A)**	**TPY (B)**
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater	NOx	4.50	14.78
			CO	3.29	14.43
			SO2	6.06	2.65
			PM	4.60	15.23
			PM10	4.60	15.23
			PM2.5	4.60	15.23
			VOC	0.28	1.22
			NH3	1.89	8.28

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TCEQ-10153 (Revised 0408)
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012; Revised September 2013	Permit No.: 6819A	Regulated Entity No.: RN100235266	
Area Name: Corpus Christi West Refinery		Customer Reference No.: CN603741463	

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
JJ-4	39BA3901	CCR Hot Oil Heater	NOx	1.24	4.06
			CO	4.07	17.81
			SO2	3.79	4.61
			PM	1.40	3.66
			PM10	1.40	3.66
			PM2.5	1.40	3.66
			VOC	0.67	2.92
			NH3	0.52	2.27
JJ-4	39BA3900	NHT Charge Heater	NOx	0.38	1.25
			CO	1.25	5.48
			SO2	1.16	1.42
			PM	0.43	1.12
			PM10	0.43	1.12
			PM2.5	0.43	1.12
			VOC	0.20	0.90
			NH3	0.16	0.70

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	**December 2012**	**Permit No.:**	**6819A**	**Regulated Entity No.:**	**RN100235266**
Area Name:	**Corpus Christi West Refinery**			**Customer Reference No.:**	**CN603741463**

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**	**3. Air Contaminant Emission Rate**	
EPN (A)	**FIN (B)**	**NAME (C)**		**Pounds per Hour (A)**	**TPY (B)**
R-201	43BF1	43BF1 Boiler	NOx	15.99	70.05
			CO	22.15	24.25
			SO2	0.63	1.66
			PM	1.00	4.38
			PM10	1.00	4.38
			PM2.5	1.00	4.38
			VOC	1.20	5.24

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	**December 2012**	**Permit No.:**	**6819A**	**Regulated Entity No.:**	**RN100235266**
Area Name:	**Corpus Christi West Refinery**			**Customer Reference No.:**	**CN603741463**

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**	**3. Air Contaminant Emission Rate**	
EPN (A)	**FIN (B)**	**NAME (C)**		**Pounds per Hour (A)**	**TPY (B)**
KK-3	37BA1	37BA1 DHT Charge Heater	NOx	3.84	16.80
			CO	3.20	14.01
			SO2	0.20	0.53
			PM	0.64	2.80
			PM10	0.64	2.80
			PM2.5	0.64	2.80
			VOC	0.38	1.67

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TCEQ-10153 (Revised 0408)
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	December 2012	Permit No.:	6819A	Regulated Entity No.:	RN100235266
Area Name:	Corpus Christi West Refinery			Customer Reference No.:	CN603741463

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
KK-3	37BA2	37BA2 DHT Stripper Reboiler	NOx	3.84	16.80
			CO	3.20	14.01
			SO2	0.20	0.53
			PM	0.64	2.80
			PM10	0.64	2.80
			PM2.5	0.64	2.80
			VOC	0.38	1.67

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TCEQ-10153 (Revised 0408)
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012	**Permit No.:** 6819A	**Regulated Entity No.:** RN100235266
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
DDS-HTRSTK	56BA1	DDS Charge Heater (combined stack)	NOx	1.80	7.88
			CO	2.00	8.76
			SO2	0.11	0.30
			PM	0.30	1.31
			PM10	0.30	1.31
			PM2.5	0.30	1.31
			VOC	0.22	0.95

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012	**Permit No.:** 6819A	**Regulated Entity No.:** RN100235266	
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463	

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
DDS-HTRSTK	56BA2	DDS Fractionator Reboiler (combined stack)	NOx	1.80	7.88
			CO	2.00	8.76
			SO2	0.11	0.30
			PM	0.30	1.31
			PM10	0.30	1.31
			PM2.5	0.30	1.31
			VOC	0.22	0.95

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TCEQ-10153 (Revised 0408)
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012	**Permit No.:** 6819A	**Regulated Entity No.:** RN100235266	
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463	

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
A-203	42BA1	42BA1 Crude Heater	NOx	33.23	145.57
			CO	23.75	104.04
			SO2	1.51	3.96
			PM	2.38	10.40
			PM10	2.38	10.40
			PM2.5	2.38	10.40
			VOC	2.84	12.43

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012	**Permit No.:** 6819A	**Regulated Entity No.:** RN100235266	
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463	

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
A-204	42BA3	42BA3 Vacuum Heater	NOx	11.99	52.53
			CO	7.49	32.81
			SO2	0.48	1.25
			PM	0.75	3.28
			PM10	0.75	3.28
			PM2.5	0.75	3.28
			VOC	0.89	3.92

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TCEQ-10153 (Revised 0408)
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	December 2012	Permit No.: 6819A	Regulated Entity No.:	RN100235266
Area Name:	Corpus Christi West Refinery		Customer Reference No.:	CN603741463

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
LSGHTR	47BA1	LSG Hot Oil Heater	NOx	10.01	43.84
			CO	11.12	48.71
			SO2	0.64	1.67
			PM	1.65	7.24
			PM10	1.65	7.24
			PM2.5	1.65	7.24
			VOC	1.20	5.24

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FIN = Facility Identification Number

TCEQ-10153 (Revised 0408)
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	**December 2012**	**Permit No.:**	**6819A**	**Regulated Entity No.:**	**RN100235266**
Area Name:	**Corpus Christi West Refinery**			**Customer Reference No.:**	**CN603741463**

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**	**3. Air Contaminant Emission Rate**	
EPN (A)	**FIN (B)**	**NAME (C)**		**Pounds per Hour (A)**	**TPY (B)**
MX-1	54BA1	54BA1 MX Unit Hot Oil Heater	NOx	5.59	24.49
			CO	4.00	17.50
			SO2	0.25	0.67
			PM	0.66	2.89
			PM10	0.66	2.89
			PM2.5	0.66	2.89
			VOC	0.48	2.09

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TCEQ-10153 (Revised 0408)
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012; Revised March 2013	**Permit No.:** 6819A	**Regulated Entity No.:** RN100235266	
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463	

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
AA-4	01BF102	FCCU CO Boiler/Scrubber	NOx	586.55	467.11
			CO	358.92	157.21
			SO2	370.94	162.47
			PM	58.30	235.70
			PM10	58.30	235.70
			PM2.5	58.30	235.70
			VOC	1.68	7.35
			NH3	10.90	28.63

EPN = Emission Point Number
FIN = Facility Identification Number

TCEQ-10153 (Revised 0408)
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012; Revised August 2013	**Permit No.:** 6819A	**Regulated Entity No.:** RN100235266	
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463	

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
VCS-1	LW-8	Marine Vapor Combustor	NOx	2.65	2.25
			CO	6.44	5.47
			SO2	2.79	2.03
			PM	0.60	0.51
			PM10	0.60	0.51
			PM2.5	0.60	0.51
			VOC	16.05	19.38
			H2S	0.03	0.02

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TCEQ-10153 (Revised 0408)
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012; Revised August 2013	**Permit No.:** 6819A		**Regulated Entity No.:** RN100235266
Area Name: Corpus Christi West Refinery			**Customer Reference No.:** CN603741463

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
V-8	45BD3	API Separator Flare	NOx	0.26	1.13
			CO	2.20	9.64
			SO2	0.12	0.50
			VOC	1.07	4.68
			H2S	0.0012	0.0050
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives	VOC	2.66	11.66
F-14-UDEX	14-UDEX	UDEX Fugitives	VOC	0.02	0.07
F-37	37	DHT Fugitives	VOC	4.06	17.78

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012; Revised February 2014	**Permit No.:** 6819A	**Regulated Entity No.:** RN100235266	
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463	

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
F-39	39	NHT/CCR Fugitives	VOC	2.77	12.13
F-40	40	West Crude Fugitives	VOC	5.07	22.23
F-42	42	Mid Crude Fugitives	VOC	8.82	38.63
F-GB	P-GB	Gasoline Blender Fugitives	VOC	1.16	5.08
F-TK-VOC	P-VOC	VOC Tank/Loading Fugitives	VOC	0.67	2.93
F-01	01	FCCU Fugitives	VOC	17.81	77.99
F-26	26	Hydrocracker Fugitives	VOC	5.66	24.78
SCRNH3FUG	SCRNH3FUG	SCR Ammonia Fugitives	NH3	0.07	0.29

EPN = Emission Point Number
FIN = Facility Identification Number

TCEQ-10153 (Revised 0408)
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permit requirements and may be revised periodically. [APDG 5178v4]

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	**December 2012; Revised February 2014**	**Permit No.: 6819A**	**Regulated Entity No.: RN100235266**
Area Name:	**Corpus Christi West Refinery**		**Customer Reference No.: CN603741463**

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**	**3. Air Contaminant Emission Rate**	
EPN (A)	**FIN (B)**	**NAME (C)**		**Pounds per Hour (A)**	**TPY (B)**
F-S-202	44EF2	Mid-Plant Cooling Tower No. 2	VOC	1.26	5.52
			PM	0.39	1.51
			PM10	0.20	0.76
			PM2.5	0.04	0.15
			H2S	0.0001	0.0003
IFRTK1	IFRTK1	100,000 bbl IFR Tank	VOC	0.54	1.99
IFRTK2	IFRTK2	75,000 bbl IFR Tank	VOC	0.47	1.76
FB108R1	08FB108R1	Tank 08FB108R1	VOC	5.09	19.01
FB109R	08FB109R	Tank 08FB109R	VOC	4.16	15.30

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012; Revised February 2014	**Permit No.:** 6819A	**Regulated Entity No.:** RN100235266	
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463	

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
FB142	08FB142	Tank 08FB142	VOC	8.39	32.83
			H2S	0.32	0.21
FB147	08FB147	Tank 08FB147	VOC	10.01	38.10
			H2S	0.33	0.21
FB137	08FB137	Tank 08FB137	VOC	5.53	20.93
			H2S	0.21	0.13
FB402	11FB402	Tank 11FB402	VOC	3.03	11.88
FB403	11FB403	Tank 11FB403	VOC	3.55	14.14
FB408	11FB408	Tank 11FB408	VOC	0.96	N/A
FB409	11FB409	Tank 11FB409	VOC	0.89	N/A
FB410	11FB410	Tank 11FB410	VOC	0.88	N/A
Combined Limit for 11FB408, 11FB409, 11FB410			VOC	N/A	2.35
FB507	15FB507	Tank 15FB507	VOC	4.21	18.66

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012; Revised February 2014	**Permit No.:** 6819A	**Regulated Entity No.:** RN100235266	
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463	

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**	**3. Air Contaminant Emission Rate**	
EPN (A)	**FIN (B)**	**NAME (C)**		**Pounds per Hour (A)**	**TPY (B)**
FB508	15FB508	Tank 15FB508	VOC	1.25	N/A
FB510	15FB510	Tank 15FB510	VOC	1.14	N/A
Combined Limit for 15FB508, 15FB510			VOC	N/A	2.67
FB3041	40FB3041	Tank 40FB3041	VOC	54.60	2.76
FB3043	40FB3043	Tank 40FB3043	VOC	0.60	N/A
FB3044	40FB3044	Tank 40FB3044	VOC	0.60	N/A
Combined Limit for 40FB3043 and 40FB3044			VOC	N/A	1.03
FB4010	40FB4010	Tank 40FB4010	VOC	3.69	N/A
			H2S	0.14	N/A
FB4011	40FB4011	Tank 40FB4011	VOC	3.60	N/A
			H2S	0.13	N/A
Combined Limit for 40FB4010 and 40FB4011			VOC	N/A	19.73
			H2S	N/A	0.17
FB4012	40FB4012	Tank 40FB4012	VOC	1.62	5.63
FB4013	40FB4013	Tank 40FB4013	VOC	3.04	11.85

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FIN = Facility Identification Number

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012; Revised September 2013	**Permit No.:** 6819A	**Regulated Entity No.:** RN100235266	
Area Name: Corpus Christi West Refinery		**Customer Reference No.:** CN603741463	

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	3. Air Contaminant Emission Rate	
EPN (A)	FIN (B)	NAME (C)		Pounds per Hour (A)	TPY (B)
FB4014	40FB4014	Tank 40FB4014	VOC	0.66	0.88
FB4015	40FB4015	Tank 40FB4015	VOC	0.66	0.63
FB4016	40FB4016	Tank 40FB4016	VOC	0.58	N/A
FB509	15FB509	Tank 15FB509	VOC	0.80	N/A
Combined Limit for 40FB4016, 15FB509			VOC	N/A	1.67
Various	Various	MSS Grouped Emission Limit	NOX	228.04	16.58
			CO	262.28	28.95
			SO2	1726.99	56.97
			PM	27.44	1.30
			VOC	1069.14	30.77
			H2S	6.69	0.46

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	December 2012; Revised August 2013	Permit No.:	6819A	Regulated Entity No.:	RN100235266
Area Name:	Corpus Christi West Refinery			Customer Reference No.:	CN603741463

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 EPN			5. Building Height (Feet)	6. Height Avove Ground (Feet)	7. Stack Exit Data			8. Fugitives		
EPN (A)	FIN (B)	NAME (C)	Zone	East (Meters)	North (Meters)			Diameter (Feet) (A)	Velocity (fps) (B)	Temp (°F) (C)	Length (ft.) (A)	Width (ft.) (B)	Axis Degrees (C)
SATGASHTR	SATGASHTR	Sat Gas No. 3 Hot Oil Heater	14	644412	3079480		213	11.5	20.40	300			
JJ-4	39BA3900	NHT Charge Heater	14	645340	3079330		201	14.00	5.64	325			
JJ-4	39BA3901	CCR Hot Oil Heater											
R-201	43BF1	43BF1 Boiler	14	644319	3079608		88	11.00	3.35	100			
KK-3	37BA1	37BA1 DHT Charge Heater	14	644206	3079681		134.39	7.21	9.6	450			
KK-3	37BA2	37BA2 DHT Stripper Reboiler	14	644206	3079681		134.39	7.21	9.6	450			
DDS-HTRSTK	56BA1	DDS Charge Heater (combined stack)	14	644210	3079837		100	7	5.76	450			
DDS-HTRSTK	56BA2	DDS Fractionator Reboiler (combined stack)	14	644210	3079837		100	7.00	5.76	450			
AA-4	01BF102	FCCU CO Boiler/Scrubber	14	645346	3079472		158	9	57.8	140			
VCS-1	LW-8	Marine Vapor Combustor	14	645229	3080522		45	10	33.50	1400.0			
V-8	45BD3	API Separator Flare	14	644328	3080097		15	0.5	65.6	1833			
F-SATGAS3	F-SATGAS3	Sat Gas No. 3 Fugitives	14	644357	3079465						76	76	
F-14-UDEX	14-UDEX	UDEX Fugitives	14	645071	3079368						201.7	117.1	
F-37	37	DHT Fugitives	14	644190	3079643						445.1	347.4	

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012	**Permit No.:** 6819A	**Regulated Entity No.:**	RN100235266
Area Name: Corpus Christi West Refinery		**Customer Reference No.:**	CN603741463

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 EPN			5. Building Height (Feet)	6. Height Avove Ground (Feet)	7. Stack Exit Data			8. Fugitives		
EPN (A)	FIN (B)	NAME (C)	Zone	East (Meters)	North (Meters)			Diameter (Feet) (A)	Velocity (fps) (B)	Temp (°F) (C)	Length (ft.) (A)	Width (ft.) (B)	Axis Degrees (C)
F-39	39	NHT/CCR Fugitives	14	645276	3079227						253.2	301.8	
F-40	40	West Crude Fugitives	14	643515	3079855						302.1	126.0	
F-42	42	Mid Crude Fugitives	14	644335	3079649						568.4	340.8	
F-GB	P-GB	Gasoline Blender Fugitives	14	645384	3079931						286.0	255.5	
F-TK-VOC	P-VOC	VOC Tank/Loading Fugitives	14	644969	3080043						276.5	268.3	
F-01	01	FCCU Fugitives	14	645312	3079483						106.9	252.9	
F-26	26	Hydrocracker Fugitives	14	645066	3079177						442.1	133.2	
SCRNH3FUG	SCRNH3FUG	SCR Ammonia Fugitives	14										

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012; Revised August 2013	**Permit No.:** 6819A	**Regulated Entity No.:**	**RN100235266**
Area Name: Corpus Christi West Refinery		**Customer Reference No.:**	**CN603741463**

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 EPN			5. Building Height (Feet)	6. Height Avove Ground (Feet)	7. Stack Exit Data			8. Fugitives		
EPN (A)	FIN (B)	NAME (C)	Zone	East (Meters)	North (Meters)			Diameter (Feet) (A)	Velocity (fps) (B)	Temp (°F) (C)	Length (ft.) (A)	Width (ft.) (B)	Axis Degrees (C)
F-S-202	44EF2	Mid-Plant Cooling Tower No. 2	14	644085	3079980			3.28	0.0033	Ambient			
IFRTK1	IFRTK1	100,000 bbl IFR Tank	14	645436	3080272		48	0.0033	0.0033	Ambient			
IFRTK2	IFRTK2	75,000 bbl IFR Tank	14	645436	3080180		48	0.0033	0.0033	Ambient			
FB108R1	08FB108R1	Tank 08FB108R1	14	645437	3080091		56	0.0033	0.0033	Ambient			
FB109R	08FB109R	Tank 08FB109R	14	645337	3080457		50	0.0033	0.0033	Ambient			

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012	**Permit No.:** 6819A	**Regulated Entity No.:**	**RN100235266**
Area Name: Corpus Christi West Refinery		**Customer Reference No.:**	**CN603741463**

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AIR CONTAMINANT DATA			EMISSION POINT DISCHARGE PARAMETERS										
1. Emission Point			4. UTM Coordinates of EPN			5. Building Height (Feet)	6. Height Avove Ground (Feet)	7. Stack Exit Data			8. Fugitives		
EPN (A)	FIN (B)	NAME (C)	Zone	East (Meters)	North (Meters)			Diameter (Feet) (A)	Velocity (fps) (B)	Temp (°F) (C)	Length (ft.) (A)	Width (ft.) (B)	Axis Degrees (C)
FB142	08FB142	Tank 08FB142	14	644867	3080484		42	0.0033	0.0033	Ambient			
FB147	08FB147	Tank 08FB147	14	644867	3080325		42	0.0033	0.0033	Ambient			
FB137	08FB137	Tank 08FB137	14	645118	3080193		40	0.0033	0.0033	Ambient			
FB402	11FB402	Tank 11FB402	14	653432	3076810		40	0.0033	0.0033	Ambient			
FB403	11FB403	Tank 11FB403	14	653468	3076789		40	0.0033	0.0033	Ambient			
FB408	11FB408	Tank 11FB408	14	653337	3076786		40	0.0033	0.0033	Ambient			
FB409	11FB409	Tank 11FB409	14	653305	3076876		48	0.0033	0.0033	Ambient			
FB410	11FB410	Tank 11FB410	14	653334	3076951		48	0.0033	0.0033	Ambient			
FB507	15FB507	Tank 15FB507	14	644789	3079565		40	0.0033	0.0033	Ambient			

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	December 2012	Permit No.: 6819A	Regulated Entity No.:	RN100235266
Area Name:	Corpus Christi West Refinery		Customer Reference No.:	CN603741463

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 EPN			5. Building Height (Feet)	6. Height Avove Ground (Feet)	7. Stack Exit Data			8. Fugitives		
EPN (A)	FIN (B)	NAME (C)	Zone	East (Meters)	North (Meters)			Diameter (Feet) (A)	Velocity (fps) (B)	Temp (°F) (C)	Length (ft.) (A)	Width (ft.) (B)	Axis Degrees (C)
FB508	15FB508	Tank 15FB508	14	644661	3079565		40	0.0033	0.0033	Ambient			
FB510	15FB510	Tank 15FB510	14	644761	3079440		40	0.0033	0.0033	130			
FB3041	40FB3041	Tank 40FB3041	14	643321	3079969		48.2	0.0033	0.0033	130			
FB3043	40FB3043	Tank 40FB3043	14	643321	3080077		48.2	0.0033	0.0033	130			
FB3044	40FB3044	Tank 40FB3044	14	643321	3080129		48.2	0.0033	0.0033	130			
FB4010	40FB4010	Tank 40FB4010	14	643535	3079764		51	0.0033	0.0033	Ambient			
FB4011	40FB4011	Tank 40FB4011	14	643510	3079807		51	0.0033	0.0033	Ambient			
FB4012	40FB4012	Tank 40FB4012	14	643490	3079684		51	0.0033	0.0033	Ambient			
FB4013	40FB4013	Tank 40FB4013	14	643539	3079684		51	0.0033	0.0033	Ambient			

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date: December 2012	**Permit No.:** 6819A	**Regulated Entity No.:**	RN100235266
Area Name: Corpus Christi West Refinery		**Customer Reference No.:**	CN603741463

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 EPN			5. Building Height (Feet)	6. Height Avove Ground (Feet)	7. Stack Exit Data			8. Fugitives		
EPN (A)	FIN (B)	NAME (C)	Zone	East (Meters)	North (Meters)			Diameter (Feet) (A)	Velocity (fps) (B)	Temp (°F) (C)	Length (ft.) (A)	Width (ft.) (B)	Axis Degrees (C)
FB4014	40FB4014	Tank 40FB4014	14	643720	3079681		48	0.0033	0.0033	130.0			
FB4015	40FB4015	Tank 40FB4015	14	643659	3079681		48	0.0033	0.0033	130.0			
FB4016	40FB4016	Tank 40FB4016	14	643789	3079675		48	0.0033	0.0033	130.0			
FB509	15FB509	Tank 15FB509	14	644633	3079440		40	0.0033	0.0033	130.0			

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FIN = Facility Identification Number

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TABLE 6

BOILERS AND HEATERS

Type of Device: Sat Gas No. 3 Heater		Manufacturer:		
Number from flow diagram:		Model Number:		
CHARACTERISTICS OF INPUT				
Type Fuel	Chemical Composition (% by Weight)	Inlet Air Temp F (after preheat)	Fuel Flow Rate (scfm* or lb/hr)	
Natural Gas; Merox Treating Unit Off-gas	See Emission Calculations		Average	Design Maximum 19,600 lb/hr
		Gross Heating Value of Fuel	Total Air Supplied and Excess Air	
		(specify units) 1061 Btu/scf	Average _____ scfm* ___% excess (vol)	Design Maximum 81,300 scfm* 10 % excess (vol)

HEAT TRANSFER MEDIUM						
Type Transfer Medium	Temperature F		Pressure (psia)		Flow Rate (specify units)	
(Water, oil, etc.)	Input	Output	Input	Output	Average	Design Maxim
Oil						

OPERATING CHARACTERISTICS			
Ave. Fire Box Temp. at max. firing rate	Fire Box Volume(ft.^{3}), (from drawing)	Gas Velocity in Fire Box (ft/sec) at max firing rate	Residence Time in Fire Box at max firing rate (sec)

STACK PARAMETERS					
Stack Diameters	Stack Height	Stack Gas Velocity (ft/sec)		Stack Gas	Exhaust
10	215	(@Ave.Fuel Flow Rate)	(@Max. Fuel Flow Rate)	Temp F	scfm
				300	89,000

CHARACTERISTICS OF OUTPUT	
Material	Chemical Composition of Exit Gas Released (% by Volume)

Attach an explanation on how temperature, air flow rate, excess air or other operating variables are controlled.

Also supply an assembly drawing, dimensioned and to scale, in plan, elevation, and as many sections as are needed to show clearly the operation of the combustion unit. Show interior dimensions and features of the equipment necessary to calculate in performance.

*Standard Conditions: 70 F,14.7 psia

08/93

INTERNAL FLOATING ROOF STORAGE TANK SUMMARY

I. ***Tank Identification*** *(Use a separate form for each tank)*.

1. Applicant's Name: Flint Hills Resources Corpus Christi, LLC
2. Location (*indicate on plot plan and provide coordinates*): 645436, 3080272
3. Tank No. IFRTK1 4. Emission Point No. IFRTK1
5. FIN IFRTK1 CIN ______
6. Status: New tank [X] Altered tank [ ] Relocation [ ] Change of Service [ ]

Previous permit or exemption number(s) ______

II. ***Tank Physical Characteristics***

1. Dimensions
   a. Shell Height : 48 ft.
   b. Diameter: 135 ft.
   c. Nominal Capacity or Tank Volume: 4,200,000 gallons.
   d. Turnovers per year: 40
   e. Net Throughput : 168,000,000 gallons/year.
   f. Maximum Pumping Rate: 84,000 gallons/hour. (*Use the higher of the maximum fill rate or maximum withdrawal rate.*)
   g. Self-Supporting Roof ? Yes [X] No []
   h. Number of Columns: ______
   i. Column Diameter: ______ ft.
2. Shell/Roof and Paint Characteristics
   a. Shell Condition : Light Rust [X] Dense Rust [ ] Gunite Lining [ ]
   b. Shell Color/Shade : White/White [X] Aluminum/Specular [ ] Aluminum/Diffuse [ ] Gray/Light [ ] Gray/Medium [ ] Red/Primer [ ] Other [ ] (Describe ______)
   c. Shell Condition : Good [X] Poor [ ]
   d. Roof Color/Shade : White/White [X] Aluminum/Specular [ ] Aluminum/Diffuse [ ] Gray/Light [ ] Gray/Medium [ ] Red/Primer [ ] Other [ ] (Describe ______)
   e. Roof Condition : Good [ ] Poor [ ]
3. Rim-Seal System
   a. Primary Seal: Vapor-mounted [ ] Liquid-mounted [ ] Mechanical Shoe [X]
   b. Secondary Seal : Yes [X] No [ ]
4. Deck Characteristics
   a. Deck Type: Bolted [ ] Welded[X]
   b. Deck Construction (*Bolted Tanks Only*):
      - Continuous Sheet Construction 5 ft. wide [ ]
      - Continuous Sheet Construction 6 ft. wide [ ]
      - Continuous Sheet Construction 7 ft. wide [ ]
      - Rectangular Panel Construction 5 X 7.5 ft. wide [ ]
      - Rectangular Panel Construction 5 X 12 ft. wide [ ]
   c. Deck Seam Length (*Bolted Tanks Only*): ______ ft.
5. Roof Fitting Loss Factor: 87.8 * lb-mole/year
   Based upon Typical [ ] Controlled [ ] or Actual [X] fittings
   Complete Section IV, Fittings Information, to record fittings count used to calculate the roof fitting loss factor.

* See tank calculations for the fitting counts used to calculate the roof fitting loss factor.

Table 7(d): INTERNAL FLOATING ROOF TANK SUMMARY
Page 2

Permit No. N/A Tank No. IFRTK1

III. ***Liquid Properties of Stored Material***

1. Chemical Category: Organic Liquids [X] Petroleum Distillates [X] Crude Oils [X]
2. Single or Multi-Component Liquid

   Single [ ] *Complete Section III.3*

   Multiple [ ] *Complete Section III.4*

3. Single Component Information

   a. Chemical Name: Material with a TVP < 10.9 psia

   b. CAS Number: ______________________

   c. Average Liquid Surface Temperature: 85 °F.

   d. True Vapor Pressure at Average Liquid Surface Temperature: 10.9 psia.

   e. Liquid Molecular Weight: 68

4. Multiple Component Information

   a. Mixture Name: ______________________

   b. Average Liquid Surface Temperature: ____________ °F.

   c. Minimum Liquid Surface Temperature: ____________ °F.

   d. Maximum Liquid Surface Temperature: _________ °F.

   e. True Vapor Pressure at Average Liquid Surface Temperature: ______________ psia.

   f. True Vapor Pressure at Minimum Liquid Surface Temperature: ______________ psia.

   g. True Vapor Pressure at Maximum Liquid Surface Temperature: _________ psia.

   h. Liquid Molecular Weight: ____________

   i. Vapor Molecular Weight: ____________

j. Chemical Components Information

Chemical Name	CAS Number	Percent of Total Liquid Weight (typical)	Percent of Total Vapor Weight (typical)	Molecular Weight

INTERNAL FLOATING ROOF STORAGE TANK SUMMARY

I. ***Tank Identification*** *(Use a separate form for each tank)*.

1. Applicant's Name: Flint Hills Resources Corpus Christi, LLC
2. Location (*indicate on plot plan and provide coordinates*): 645436, 3080180
3. Tank No. IFRTK2 4. Emission Point No. IFRTK2
5. FIN IFRTK2 CIN ______
6. Status: New tank [X] Altered tank [ ] Relocation [ ] Change of Service [ ]

Previous permit or exemption number(s) ______

II. ***Tank Physical Characteristics***

1. Dimensions
   a. Shell Height : 48 ft.
   b. Diameter: 115 ft.
   c. Nominal Capacity or Tank Volume: 3,150,000 gallons.
   d. Turnovers per year: 53
   e. Net Throughput : 168,000,000 gallons/year.
   f. Maximum Pumping Rate: 63,000 gallons/hour. (*Use the higher of the maximum fill rate or maximum withdrawal rate.*)
   g. Self-Supporting Roof ? Yes [X] No []
   h. Number of Columns: ______
   i. Column Diameter: ______ ft.
2. Shell/Roof and Paint Characteristics
   a. Shell Condition : Light Rust [X] Dense Rust [ ] Gunite Lining [ ]
   b. Shell Color/Shade : White/White [X] Aluminum/Specular [ ] Aluminum/Diffuse [ ] Gray/Light [ ] Gray/Medium [ ] Red/Primer [ ] Other [ ] (Describe ______)
   c. Shell Condition : Good [X] Poor [ ]
   d. Roof Color/Shade : White/White [X] Aluminum/Specular [ ] Aluminum/Diffuse [ ] Gray/Light [ ] Gray/Medium [ ] Red/Primer [ ] Other [ ] (Describe ______)
   e. Roof Condition : Good [ ] Poor [ ]
3. Rim-Seal System
   a. Primary Seal: Vapor-mounted [ ] Liquid-mounted [ ] Mechanical Shoe [X]
   b. Secondary Seal : Yes [X] No [ ]
4. Deck Characteristics
   a. Deck Type: Bolted [ ] Welded[X]
   b. Deck Construction (*Bolted Tanks Only*):
      - Continuous Sheet Construction 5 ft. wide [ ]
      - Continuous Sheet Construction 6 ft. wide [ ]
      - Continuous Sheet Construction 7 ft. wide [ ]
      - Rectangular Panel Construction 5 X 7.5 ft. wide [ ]
      - Rectangular Panel Construction 5 X 12 ft. wide [ ]
   c. Deck Seam Length (*Bolted Tanks Only*): ______ ft.
5. Roof Fitting Loss Factor: 77.8 * lb-mole/year
   Based upon Typical [ ] Controlled [ ] or Actual [X] fittings
   Complete Section IV, Fittings Information, to record fittings count used to calculate the roof fitting loss factor.

* See tank calculations for the fitting counts used to calculate the roof fitting loss factor.

Table 7(d), INTERNAL FLOATING ROOF TANK SUMMARY
Page 2

Permit No. N/A Tank No. IFRTK2

III. ***Liquid Properties of Stored Material***

1. Chemical Category: Organic Liquids [X] Petroleum Distillates [X] Crude Oils [X]
2. Single or Multi-Component Liquid

   Single [ ] *Complete Section III.3*

   Multiple [ ] *Complete Section III.4*
3. Single Component Information
   - a. Chemical Name: Material with a TVP < 10.9 psia
   - b. CAS Number: ______
   - c. Average Liquid Surface Temperature: 85 °F.
   - d. True Vapor Pressure at Average Liquid Surface Temperature: 10.9 psia.
   - e. Liquid Molecular Weight: 68
4. Multiple Component Information
   - a. Mixture Name: ______
   - b. Average Liquid Surface Temperature: ______ °F.
   - c. Minimum Liquid Surface Temperature: ______ °F.
   - d. Maximum Liquid Surface Temperature: ______ °F.
   - e. True Vapor Pressure at Average Liquid Surface Temperature: ______ psia.
   - f. True Vapor Pressure at Minimum Liquid Surface Temperature: ______ psia.
   - g. True Vapor Pressure at Maximum Liquid Surface Temperature: ______ psia.
   - h. Liquid Molecular Weight: ______
   - i. Vapor Molecular Weight: ______

j. Chemical Components Information

Chemical Name	CAS Number	Percent of Total Liquid Weight (typical)	Percent of Total Vapor Weight (typical)	Molecular Weight

ATTACHMENT VII.E

DISASTER REVIEW

There are no chemicals associated with this application that would require a disaster review. The selective catalytic reduction (SCR) control will use aqueous ammonia rather than anhydrous ammonia.

ATTACHMENT VIII.A

PROTECTION OF PUBLIC HEALTH AND WELFARE [116.111(a)(2)(A)]

As demonstrated in this permit application, emissions from the project will comply with all rules and regulations of the TCEQ and with the intent of the Texas Clean Air Act (TCAA). In fact, the project-along with other proposed emission reduction projects-will result in an overall decrease in emissions of non-GHG pollutants, with the exception of ammonia. A modeling and effects review will be submitted upon TCEQ’s request to demonstrate that emissions from the project will be protective of public health and property and will not have any adverse short-term or long-term side effects on the individuals attending Tuloso Midway Middle School, which is located within 3,000 feet from the West Refinery.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
Chapter 101	**General Rules**		
§101.2	Multiple Air Contaminant Sources or Properties	☐ Yes ☒ No	FHR is not petitioning the commission to designate two or more properties as a single property.
§101.3.	Circumvention	☒ Yes ☐ No	FHR will not use a plan, activity, device or contrivance to conceal or appear to minimize emissions that would constitute a violation of the Act or a regulation.
§101.4	Nuisance	☒ Yes ☐ No	The facility will not discharge air contaminants in such concentration/ duration to be injurious or adversely affect human health or welfare, or interfere with the normal use/enjoyment of animal life, vegetation, or property.
§101.5	Traffic Hazard	☒ Yes ☐ No	The facility will not discharge air contaminants, uncombined water, or other materials from any source that cause or have a tendency to cause a traffic hazard or interfere with normal road use.
§101.8 and §101.9	Sampling and Sampling Ports	☒ Yes ☐ No	FHR will conduct sampling if requested by the TCEQ or Executive Director.
§101.10.	Emissions Inventory Requirements	☒ Yes ☐ No	FHR annually submits an emissions inventory by the required due date.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§101.14.	Sampling Procedures and Terminology	☒ Yes ☐ No	FHR will employ commonly accepted methods and procedures for sampling/measuring air contaminants when such methods/procedures are not otherwise specified in rules, regulations, determinations and/or orders of the commission.
§101.20.	Compliance with Environmental Protection Agency Standards	☒ Yes ☐ No	The sources in this application will be operated to comply with the applicable Environmental Protection Agency standards.
§101.23.	Alternate Emission Reduction ("Bubble") Policy	☐ Yes ☒ No	FHR does not seek approval of emission controls from another facility at this site in lieu of controlling regulated sources.
§101.24.	Inspection Fees	☒ Yes ☐ No	FHR submits the relevant inspection or emissions fees annually to the commission by the specified due date.
§101.26.	Surcharge on Fuel Oil in Specified Boilers	☐ Yes ☒ No	The site is not located in a metropolitan statistical area which is not meeting the National Ambient Air Quality Standard for ozone.
§101.27.	Emissions Fees	☒ Yes ☐ No	FHR submits the relevant inspection or emissions fees annually to the commission by the specified due date.
§101.28.	Stringency Determination for Federal Operating Permits	☐ Yes ☒ No	FHR will comply with the applicable requirements as defined by §122.10 rather than equivalent or more stringent requirements.
§101.150 through §101.155.	Voluntary Supplemental Leak Detection Program	☐ Yes ☒ No	Does not apply. FHR does not participate in the voluntary supplemental leak detection program.
§101.201.	Emissions Event Reporting and Recordkeeping Requirements	☒ Yes ☐ No	FHR will comply with the emissions events reporting and recordkeeping requirements.
§101.211.	Scheduled Maintenance, Startup, and Shutdown Reporting and Recordkeeping Requirements	☒ Yes ☐ No	Planned MSS emissions are authorized with individual emission limits in Permit No. 8803A. FHR will comply with the scheduled maintenance, startup, and shutdown reporting and recordkeeping requirements.
§101.221 through §101.224.	Operational Requirements, Demonstrations, and Actions to Reduce Excessive Emissions	☒ Yes ☐ No	FHR will comply with the applicable requirements of §101.221 through §101.224. Planned MSS emissions are authorized with individual emission limits in Permit No. 8803A.
§101.231 through §101.233.	Variances	☐ Yes ☒ No	FHR is not seeking a variance.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§101.300 through §101.311.	Emission Credit Banking and Trading	☐ Yes ☒ No	FHR does not participate in the emissions credit banking and trading system for this site.
§101.330 through §101.339.	Emission Banking and Trading of Allowances	☐ Yes ☒ No	FHR is not an electric generating facility or a broker.
§101.350 through §101.363.	Mass Emissions Cap and Trade Program	☐ Yes ☒ No	The site is not located in the Houston/Galveston ozone nonattainment area.
§101.370 through §101.379.	Discrete Emission Credit Banking and Trading	☐ Yes ☒ No	FHR does not participate in this voluntary reduction program.
§101.390 through §101.401.	Highly Reactive Volatile Organic Compound Emission Cap and Trade Program	☐ Yes ☒ No	This site is not located in the Houston/Galveston nonattainment area.
§101.501 through §101.508.	Clean Air Interstate Rule	☐ Yes ☒ No	There is not a fossil fuel-fired boiler or stationary, fossil fuel-fired combustion turbine associated with this application that meets the applicability requirements under 40 Code of Federal Regulations Part 96, Subpart AA or Subpart AAA.
Chapter 111.	**Visible Emissions**		
§111.111 through §111.113.	Visible Emissions	☒ Yes ☐ No	Visible emissions are not expected to be in excess of the opacity limits specified in 30 TAC 111.111.
§111.121 through §111.129.	Incineration	☐ Yes ☒ No	There is not an incinerator associated with this application that burns domestic, municipal, commercial, or industrial solid waste as defined in §101.1, medical waste, or hazardous waste as fuel for energy recovery.
§111.131 through §111.139.	Abrasive Blasting of Water Storage Tanks Performed by Portable Operations	☐ Yes ☒ No	Abrasive blasting of water storage tanks performed by portable operations will not be performed at the facility as part of this application.
§111.141 through §111.149.	Materials Handling, Construction, Roads, Streets, Alleys, and Parking Lots	☐ Yes ☒ No	The West Refinery is not located in the area of Nueces County outlined in the Group II State Implementation Plan for inhalable particulate matter adopted by the Texas Air Control Board (now TCEQ) on May 13, 1988.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§111.151.	Allowable Emissions Limits	☒ Yes ☐ No	The PM emission rates from new and modified facilities will not exceed the allowable emission rates presented in Table 1 in §111.151 as demonstrated at the end of this section.
§111.153.	Emissions Limits on Steam Generators	☐ Yes ☒ No	There are no steam generators with heat input greater than 2500 MM Btu/hr or any solid fossil fuel-fired steam generators associated with this application.
§111.171 through §111.175.	Emissions Limits on Agricultural Processes	☐ Yes ☒ No	There are no agricultural processes associated with this application.
§111.181 through §111.183.	Exemptions for Portable or Transient Operations	☐ Yes ☒ No	There are no portable or transient operations such as rock crushers associated with this application.
§111.201 through §111.221.	Outdoor Burning	☒ Yes ☐ No	FHR will conduct outdoor burning only as authorized by §111.201-111.221, and will comply with the General Requirements for Allowable Outdoor Burning in §111.219 for any outdoor burning conducted, such as for fire training or barbecues.
Chapter 112.	**Sulfur Compounds**		
§112.3 through §112.4.	Net Ground Level Concentrations	☒ Yes ☐ No	Sulfur dioxide emissions from sources associated with this application will not cause or contribute to an exceedance of the applicable net ground level concentration limit. FHR will comply with the compliance, recordkeeping, and reporting requirements under §112.2.
§112.5 and §112.6.	Allowable Emission Rates - Sulfuric Acid Plants	☐ Yes ☒ No	There is not an affected sulfuric acid plant associated with this application.
§112.7.	Allowable Emission Rates - Sulfur Recovery Plant	☒ Yes ☐ No	FHR will comply with the allowable emission rates.
§112.8.	Allowable Emission Rates from Solid Fossil Fuel-Fired Steam Generators	☐ Yes ☒ No	There is not a solid fossil fuel-fired steam generator associated with this application.
§112.9.	Allowable Emission Rates - Combustion of Liquid Fuel	☐ Yes ☒ No	There is not a liquid fuel combustion unit associated with this application.
§112.14.	Allowable Emission Rates from Nonferrous Smelter Processes	☐ Yes ☒ No	There is not an affected nonferrous smelter process associated with this application.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§112.15 through §112.18.	Temporary Fuel Shortage Plan	☒ Yes ☐ No	FHR will comply with all applicable filing, operating, notification, and reporting requirements in case of a temporary fuel shortage.
§112.19 through §112.21.	Area Control Plan	☐ Yes ☒ No	FHR does not intend to apply for an Area Control Plan at this time.
§112.31 through §112.34.	Control of Hydrogen Sulfide	☒ Yes ☐ No	Hydrogen sulfide emissions from sources associated with this application will not cause or contribute to an exceedance of the applicable net ground level concentration limits.
§112.41 through §112.47.	Control of Sulfuric Acid	☐ Yes ☒ No	Do not apply. The sources associated with this application will not emit sulfuric acid.
§112.51 through §112.59.	Control of Total Reduced Sulfur	☐ Yes ☒ No	FHR's West Refinery is not a kraft pulp mill.
Chapter 113.	**Toxic Materials**		
§113.55.	Radon Emissions from Phosphogypsum Stacks	☐ Yes ☒ No	The sources in this application will not emit radon emissions from the production, sale, distribution, or usage of phosphogypsum.
§113.100	General Provisions (40 C.F.R. Part 63, Subpart A)	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§113.110.	Synthetic Organic Chemical Manufacturing Industry (40 C.F.R. Part 63, Subpart F)	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§113.120.	Synthetic Organic Chemical Manufacturing Industry for Process Vents, Storage Vessels, Transfer Operations and Wastewater (40 C.F.R. Part 63, Subpart G)	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§113.130.	Organic Hazardous Air Pollutants for Equipment Leaks (40 C.F.R. Part 63, Subpart H)	☒ Yes ☐ No	FHR will comply with the applicable requirements.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§113.140.	Certain Processes Subject to the Negotiated Chapter for Equipment Leaks (40 C.F.R. Part 63, Subpart I)	☐ Yes ☒ No	The sources associated with this application are not subject to the requirements in 40 C.F.R. Part 63, Subpart I.
§113.150.	Polyvinyl Chloride and Copolymers Production (40 C.F.R. Part 63, Subpart J)	☐ Yes ☒ No	The facility is not a polyvinyl chloride (PVC) or PVC copolymers production facility.
§113.170.	Coke Oven Batteries (40 C.F.R. Part 63, Subpart L)	☐ Yes ☒ No	The sources associated with this application are not part of a coke plant with an existing coke oven battery.
§113.180.	Perchloroethylene Dry Cleaning Facilities (40 C.F.R. Part 63, Subpart M)	☐ Yes ☒ No	There is not a perchloroethylene dry cleaning process associated with this application.
§113.190.	Chromium Emissions from Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks (40 C.F.R. Part 63, Subpart N)	☐ Yes ☒ No	There is not an affected chromium electroplating process associated with this application.
§113.200.	Ethylene Oxide Sterilization Facilities (40 C.F.R. Part 63, Subpart O)	☐ Yes ☒ No	There is not an affected ethylene oxide sterilization process associated with this application.
§113.220.	Industrial Process Cooling Towers (40 C.F.R. Part 63, Subpart Q)	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§113.230.	Gasoline Distribution Facilities (40 C.F.R. Part 63, Subpart R)	☐ Yes ☒ No	There is not an affected bulk gasoline terminal or gasoline pipeline breakout station associated with this application.
§113.240.	Pulp and Paper Production (40 C.F.R. Part 63, Subpart S)	☐ Yes ☒ No	There is not an affected pulp and paper production process associated with this application.
§113.250.	Halogenated Solvent Cleaning (40 C.F.R. Part 63, Subpart T)	☐ Yes ☒ No	There is no halogenated solvent cleaning associated with this application.
§113.260.	Group I Polymers and Resins (40 C.F.R. Part 63, Subpart U)	☐ Yes ☒ No	There is not an affected Group I polymers or resins production unit associated with this application.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§113.280.	Epoxy Resins Production and Non-Nylon Polyamides Production (40 C.F.R. Part 63, Subpart W)	☐ Yes ☒ No	There is not an affected epoxy resins production or non-nylon polyamides production unit associated with this application.
§113.290.	Secondary Lead Smelting (40 C.F.R. Part 63, Subpart X)	☐ Yes ☒ No	There is no secondary lead smelting associated with this application.
§113.300.	Marine Vessel Loading (40 C.F.R. Part 63, Subpart Y)	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§113.320.	Phosphoric Acid Manufacturing Plants (40 C.F.R. Part 63, Subpart AA)	☐ Yes ☒ No	There is not an affected phosphoric acid manufacturing plant associated with this application.
§113.330.	Phosphate Fertilizers Production Plants (40 C.F.R. Part 63, Subpart BB)	☐ Yes ☒ No	There is not an affected phosphate fertilizer production plant associated with this application.
§113.340.	Petroleum Refineries (40 C.F.R. Part 63, Subpart CC)	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§113.350.	Off-site Waste Recovery Operations (40 C.F.R. Part 63, Subpart DD)	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§113.360.	Magnetic Tape Manufacturing Operations (40 C.F.R. Part 63, Subpart EE)	☐ Yes ☒ No	There are no affected magnetic tape manufacturing operations associated with this site application.
§113.380.	Aerospace Manufacturing and Rework Facilities (40 C.F.R. Part 63, Subpart GG)	☐ Yes ☒ No	There is not an affected aerospace manufacturing and/or rework process unit associated with this application.
§113.390.	Oil and Natural Gas Production Facilities (40 C.F.R. Part 63, Subpart HH)	☐ Yes ☒ No	There is not an affected oil and gas production unit associated with this application.
§113.400.	Shipbuilding and Ship Repair (Surface Coating) (40 C.F.R. Part 63, Subpart II)	☐ Yes ☒ No	There is not an affected shipbuilding and ship repair operation associated with this application.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§113.410.	Wood Furniture Manufacturing Operations (40 C.F.R. Part 63, Subpart JJ)	☐ Yes ☒ No	There is not an affected wood furniture manufacturing operation associated with this application.
§113.420.	Printing and Publishing (40 C.F.R. Part 63, Subpart KK)	☐ Yes ☒ No	There is not an affected printing and publishing operation associated with this application.
§113.430.	Primary Aluminum Reduction Plants (40 C.F.R. Part 63, Subpart LL)	☐ Yes ☒ No	There is not an affected primary aluminum reduction plant associated with this application.
§113.440.	Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand Alone Semichemical Pulp Mills (40 C.F.R. Part 63, Subpart MM)	☐ Yes ☒ No	Does not apply. This application does not include a chemical recovery combustion source at a kraft, soda, sulfite, or stand alone semichemical pulp mill.
§113.460.	Tanks - Level 1 (40 C.F.R. Part 63, Subpart OO)	☐ Yes ☒ No	This application does not include a tank for which another subpart in 40 C.F.R. Parts 60, 61, or 63 references Subpart OO.
§113.470.	Containers (40 C.F.R. Part 63, Subpart PP)	☐ Yes ☒ No	This application does not include a container for which another subpart in 40 C.F.R. Parts 60, 61, or 63 references Subpart PP.
§113.480.	Surface Impoundments (40 C.F.R. Part 63, Subpart QQ)	☐ Yes ☒ No	This application does not include a surface impoundment for which another subpart in 40 C.F.R. Parts 60, 61, or 63 references Subpart QQ.
§113.490.	Individual Drain Systems (40 C.F.R. Part 63, Subpart RR)	☐ Yes ☒ No	This application does not include an individual drain system for which another subpart in 40 C.F.R. Parts 60, 61, or 63 references Subpart RR.
§113.500.	Closed Vent Systems, Control Devices, Recovery Devices, and Routing to Fuel Gas System or Process (40 C.F.R. Part 63, Subpart SS)	☐ Yes ☒ No	This application does not include a closed vent system, control device, recovery device, or fuel gas system for which another subpart in 40 C.F.R. Parts 60, 61, or 63 references Subpart SS.
§113.510.	Equipment Leaks-Control Level 1 (40 C.F.R. Part 63, Subpart TT)	☐ Yes ☒ No	This application does not include process fugitive equipment for which another subpart in 40 C.F.R. Parts 60, 61, or 63 references Subpart TT.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§113.520.	Equipment Leaks-Control Level 2 (40 C.F.R. Part 63, Subpart UU)	☐ Yes ☒ No	This application does not include process fugitive equipment for which another subpart in 40 C.F.R. Parts 60, 61, or 63 references Subpart UU.
§113.530.	Oil-Water Separators and Organic-Water Separators (40 C.F.R. Part 63, Subpart VV)	☐ Yes ☒ No	This application does not contain an oil-water or organic-water separator for which another subpart in 40 C.F.R. Parts 60, 61, or 63 references Subpart VV.
§113.540.	Storage Vessels-(Tanks) Control Level 2 (40 C.F.R. Part 63, Subpart WW)	☐ Yes ☒ No	This application does not include a storage vessel for which another subpart in 40 C.F.R. Parts 60, 61, or 63 references Subpart WW.
§113.550.	Ethylene Manufacturing Process Units: Heat Exchange Systems and Waste Operations (40 C.F.R. Part 63, Subpart XX)	☐ Yes ☒ No	There is not an affected ethylene manufacturing process unit associated with this application.
§113.560.	Generic Maximum Achievable Control Technology Standards (40 C.F.R. Part 63, Subpart YY)	☐ Yes ☒ No	There is not an affected source category associated with this application.
§113.600.	Steel Pickling-HCl Process Facilities and Hydrochloric Acid Regeneration Plants (40 C.F.R. Part 63, Subpart CCC)	☐ Yes ☒ No	There is not an affected HCl process or HCl regeneration process associated with this application.
§113.610.	Mineral Wool Production (40 C.F.R. Part 63, Subpart DDD)	☐ Yes ☒ No	There is not an affected mineral wool production process associated with this application.
§113.620.	Hazardous Waste Combustors (40 C.F.R. Part 63, Subpart EEE)	☐ Yes ☒ No	There is not an affected hazardous waste combustor associated with this application.
§113.640.	Pharmaceuticals Production (40 C.F.R. Part 63, Subpart GGG)	☐ Yes ☒ No	There is not an affected pharmaceutical manufacturing operation associated with this application.
§113.650.	Natural Gas Transmission and Storage Facilities (40 C.F.R. Part 63, Subpart HHH)	☐ Yes ☒ No	There is not an affected natural gas transmission and storage process unit associated with this application.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§113.660.	Flexible Polyurethane Foam Production (40 C.F.R. Part 63, Subpart III)	☐ Yes ☒ No	There is not an affected flexible polyurethane foam or rebound foam process associated with this application.
§113.670.	Group IV Polymers and Resins (40 C.F.R. Part 63, Subpart JJJ)	☐ Yes ☒ No	There is not an affected Group IV polymers or resins production unit associated with this application.
§113.690.	Portland Cement Manufacturing (40 C.F.R. Part 63, Subpart LLL)	☐ Yes ☒ No	There is not an affected portland cement manufacturing process associated with this application.
§113.700.	Pesticide Active Ingredient Production (40 C.F.R. Part 63, Subpart MMM)	☐ Yes ☒ No	There is not an affected pesticide active ingredient production unit associated with this application.
§113.710.	Wool Fiberglass Manufacturing (40 C.F.R. Part 63, Subpart NNN)	☐ Yes ☒ No	There is not an affected wool fiberglass manufacturing process associated with this application.
§113.720.	Manufacture of Amino/Phenolic Resins (40 C.F.R. Part 63, Subpart OOO)	☐ Yes ☒ No	There is not an affected amino/phenolic resin manufacturing process associated with this application.
§113.730.	Polyether Polyols Production (40 C.F.R. Part 63, Subpart PPP)	☐ Yes ☒ No	There is not an affected polyether polyols production unit associated with this application.
§113.740.	Primary Copper Smelting (40 C.F.R. Part 63, Subpart QQQ)	☐ Yes ☒ No	The facility is not part of a copper smelting production facility.
§113.750.	Secondary Aluminum Production (40 C.F.R. Part 63, Subpart RRR)	☐ Yes ☒ No	The facility is not part of a secondary aluminum production facility.
§113.770.	Primary Lead Smelting (40 C.F.R. Part 63, Subpart TTT)	☐ Yes ☒ No	There is not an affected primary lead smelting process associated with this application.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§113.780.	Petroleum Refineries: Catalytic Cracking Units, Catalytic Reforming Units, and Sulfur Recovery Units (40 C.F.R. Part 63, Subpart UUU)	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§113.790.	Publicly Owned Treatment Works (40 C.F.R. Part 63, Subpart VVV)	☐ Yes ☒ No	There is not an affected publicly owned treatment works waste treatment facility associated with this application.
§113.810.	Ferroalloys Production: Ferromanganese and Silicomanganese (40 C.F.R. Part 63, Subpart XXX)	☐ Yes ☒ No	There is not an affected ferromanganese or silicomanganese production unit associated with this application.
§113.840.	Municipal Solid Waste Landfills (40 C.F.R. Part 63, Subpart AAAA)	☐ Yes ☒ No	There is not an affected municipal solid waste landfill associated with this application.
§113.860.	Manufacturing of Nutritional Yeast (40 C.F.R. Part 63, Subpart CCCC)	☐ Yes ☒ No	There is not an affected nutritional yeast manufacturing operation associated with this application.
§113.870.	Plywood and Composite Wood Products (40 C.F.R. Part 63, Subpart DDDD)	☐ Yes ☒ No	There is not an affected plywood or composite wood production operation associated with this site.
§113.880.	Organic Liquids Distribution (Non-Gasoline) (40 C.F.R. Part 63, Subpart EEEE)	☒ Yes ☐ No	FHR will comply with the applicable requirements.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§113.890.	Miscellaneous Organic Chemical Manufacturing (40 C.F.R. Part 63, Subpart FFFF)	☐ Yes ☒ No	The sources associated with this application are not part of an affected source category regulated by Subpart FFFF.
§113.900.	Solvent Extraction for Vegetable Oil Production (40 C.F.R. Part 63, Subpart GGGG)	☐ Yes ☒ No	There is not an affected solvent extraction operation for vegetable oil production associated with this application.
§113.910.	Wet-Formed Fiberglass Mat Production (40 C.F.R. Part 63, Subpart HHHH)	☐ Yes ☒ No	There is not an affected wet-formed fiberglass mat production unit associated with this application.
§113.920.	Surface Coating of Automobiles and Light-Duty Trucks (40 C.F.R. Part 63, Subpart IIII)	☐ Yes ☒ No	Surface coating of automobiles and light-duty trucks is not performed at the site.
§113.930.	Paper and Other Web Coating (40 C.F.R. Part 63, Subpart JJJJ)	☐ Yes ☒ No	There is not an affected paper or other web substrate coating operation associated with this application.
§113.940.	Surface Coating of Metal Cans (40 C.F.R. Part 63, Subpart KKKK)	☐ Yes ☒ No	Surface coating of metal cans is not performed at the site.
§113.960.	Surface Coating of Miscellaneous Metal Parts and Products (40 C.F.R. Part 63, Subpart MMMM)	☐ Yes ☒ No	There is not an affected miscellaneous metal parts and products surface coating facility associated with this application.
§113.970.	Surface Coating of Large Appliances (40 C.F.R. Part 63, Subpart NNNN)	☐ Yes ☒ No	There is not an affected large appliances surface coating operation associated with this application.
§113.980.	Printing, Coating, and Dyeing of Fabrics and Other Textiles (40 C.F.R. Part 63, Subpart OOOO)	☐ Yes ☒ No	There is not an affected fabric or other textile printing coating or dyeing process associated with this application.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§113.990.	Surface Coating of Plastic Parts and Products (40 C.F.R. Part 63, Subpart PPPP)	☐ Yes ☒ No	There is not an affected surface coating operation associated with this application.
§113.1000.	Surface Coating of Wood Building Products (40 C.F.R. Part 63, Subpart QQQQ)	☐ Yes ☒ No	There is not an affected coating operation associated with this application.
§113.1010.	Surface Coating of Metal Furniture (40 C.F.R. Part 63, Subpart RRRR)	☐ Yes ☒ No	There is not an affected coating operation associated with this application.
§113.1020.	Surface Coating of Metal Coil (40 C.F.R. Part 63, Subpart SSSS)	☐ Yes ☒ No	There is not an affected metal coil surface coating operation associated with this application.
§113.1030.	Leather Finishing Operations (40 C.F.R. Part 63, Subpart TTTT)	☐ Yes ☒ No	There is not an affected leather finishing operation associated with this application.
§113.1040.	Cellulose Products Manufacturing (40 C.F.R. Part 63, Subpart UUUU)	☐ Yes ☒ No	There is not affected cellulose products manufacturing operation associated with this application.
§113.1050.	Boat Manufacturing (40 C.F.R. Part 63, Subpart VVVV)	☐ Yes ☒ No	There is not an affected boat manufacturing operation associated with this application.
§113.1060.	Reinforced Plastic Composites Production (40 C.F.R. Part 63, Subpart WWWW)	☐ Yes ☒ No	Reinforced plastic composites production is not performed at this site.
§113.1070.	Rubber Tire Manufacturing (40 C.F.R. Part 63, Subpart XXXX)	☐ Yes ☒ No	There is not an affected rubber tire manufacturing operation associated with this application.
§113.1080.	Stationary Combustion Turbines (40 C.F.R. Part 63, Subpart YYYY)	☐ Yes ☒ No	There is not an affected stationary combustion turbine associated with this application.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§113.1090.	Stationary Reciprocating Internal Combustion Engines (40 C.F.R. Part 63, Subpart ZZZZ)	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§113.1100.	Lime Manufacturing Plants (40 C.F.R. Part 63, Subpart AAAAA	☐ Yes ☒ No	There is not an affected lime manufacturing plant associated with this application.
§113.1110.	Semiconductor Manufacturing (40 C.F.R. Part 63, Subpart BBBBB)	☐ Yes ☒ No	There is not an affected semiconductor manufacturing process operation associated with this application.
§113.1120.	Coke Ovens: Pushing, Quenching, and Battery Stacks (40 C.F.R. Part 63, Subpart CCCCC)	☐ Yes ☒ No	There is not an affected coke oven operation associated with this application.
§113.1140.	Iron and Steel Foundries (40 C.F.R. Part 63, Subpart EEEEE)	☐ Yes ☒ No	There is not an iron and steel foundry operated at this site.
§113.1150.	Integrated Iron and Steel Manufacturing Facilities (40 C.F.R. Part 63, Subpart FFFFF)	☐ Yes ☒ No	There is not an iron and steel manufacturing facility operating at this site.
§113.1160.	Site Remediation (40 C.F.R. Part 63, Subpart GGGGG)	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§113.1170.	Miscellaneous Coating Manufacturing (40 C.F.R. Part 63, Subpart HHHHH)	☐ Yes ☒ No	Miscellaneous coating manufacturing is not performed at this site.
§113.1180.	Mercury Emissions from Mercury Cell Chlor-Alkali Plants (40 C.F.R. Part 63, Subpart IIIII)	☐ Yes ☒ No	There is not an affected mercury cell chlor-alkali process operation associated with this application.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§113.1190.	Brick and Structural Clay Products Manufacturing (40 C.F.R. Part 63, Subpart JJJJJ)	☐ Yes ☒ No	Brick and structural clay products manufacturing are not performed at this site.
§113.1200.	Clay Ceramics Manufacturing (40 C.F.R. Part 63, Subpart KKKKK)	☐ Yes ☒ No	Clay ceramics manufacturing is not performed at this site.
§113.1210.	Asphalt Processing and Asphalt Roofing Manufacturing (40 C.F.R. Part 63, Subpart LLLLL)	☐ Yes ☒ No	Asphalt processing or asphalt roofing manufacturing is not performed at this site.
§113.1220.	Flexible Polyurethane Foam Fabrication Operations (40 C.F.R. Part 63, Subpart MMMMM)	☐ Yes ☒ No	Flexible polyurethane foam fabrication is not performed at this site.
§113.1230.	Hydrochloric Acid Production (40 C.F.R. Part 63, Subpart NNNNN)	☐ Yes ☒ No	Hydrochloric acid production is not performed at this site.
§113.1250.	Engine Test Cells/Stands (40 C.F.R. Part 63, Subpart PPPPP)	☐ Yes ☒ No	There is not an affected engine test cell associated with this application.
§113.1260.	Friction Materials Manufacturing Facilities (40 C.F.R. Part 63, Subpart QQQQQ)	☐ Yes ☒ No	There is not an affected friction materials manufacturing facility associated with this application.
§113.1270.	Taconite Iron Ore Processing (40 C.F.R. Part 63, Subpart RRRRR)	☐ Yes ☒ No	There is not an affected taconite iron ore processing facility associated with this application.
§113.1280.	Refractory Products Manufacturing (40 C.F.R. Part 63, Subpart SSSSS)	☐ Yes ☒ No	There is not an affected refractory product manufacturing facility associated with this application.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§113.1290.	Primary Magnesium Refining (40 C.F.R. Part 63, Subpart TTTTT)	☐ Yes ☒ No	There is not an affected primary magnesium refining facility associated with this application.
§113.1390.	Polyvinyl Chloride and Copolymers Production Area Sources (40 C.F.R. Part 63, Subpart DDDDDD)	☐ Yes ☒ No	There is not an affected polyvinyl chloride and copolymers production facility associated with this application.
§113.1400.	Primary Copper Smelting Area Sources (40 C.F.R. Part 63, Subpart EEEEEE)	☐ Yes ☒ No	There is not an affected primary copper smelting facility associated with this application.
§113.1410.	Secondary Copper Smelting Area Sources (40 C.F.R. Part 63, Subpart FFFFFF)	☐ Yes ☒ No	There is not an affected secondary copper smelting facility associated with this application.
§113.1420.	Primary Nonferrous Metals Area Sources - Zinc, Cadmium, and Beryllium (40 C.F.R. Part 63, Subpart GGGGGG)	☐ Yes ☒ No	There is not an affected primary nonferrous metals facility associated with this application.
§113.2060 through §113.2069.	Municipal Solid Waste Landfills	☐ Yes ☒ No	There is not an affected municipal solid waste landfill associated with this application.
§113.2070 through §113.2079.	Hospital/Medical/Infectious Waste Incinerators	☐ Yes ☒ No	There is not an affected hospital/medial/infectious waste incinerator associated with this application.
§113.2100 through §113.2174.	Small Municipal Waste Combustion Units	☐ Yes ☒ No	There is not an affected municipal waste combustion unit associated with this application.
§113.2200 through §113.2261.	Commercial and Industrial Solid Waste Incineration Units	☐ Yes ☒ No	There is not an affected solid waste incineration unit associated with this application.
§113.2300 through §113.2357.	Other Solid Waste Incineration Units	☐ Yes ☒ No	There is not an affected solid waste incineration unit associated with this application.
Chapter 115.	**Volatile Organic Compounds**		

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§115.112 through §115.119.	Storage of Volatile Organic Compounds	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§115.120 through §115.129.	Vent Gas Control	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§115.131 through §115.139.	Water Separation	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§115.140 through §115.149.	Industrial Wastewater	☐ Yes ☒ No	Do not apply. The site is not located in the Beaumont/Port Arthur, Dallas/Fort Worth, El Paso, or Houston/Galveston areas.
§115.152 through §115.159.	Municipal Solid Waste Landfills	☐ Yes ☒ No	There is not an affected municipal solid waste landfill source associated with this application.
§115.160 through §115.169.	Batch Processes	☐ Yes ☒ No	There is not an affected batch process associated with this application.
§115.211 through §115.219.	Loading and Unloading of Volatile Organic Compounds	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§115.221 through §115.229.	Filling of Gasoline Storage Vessels (Stage I) for Motor Vehicle Fuel Dispensing Facilities	☐ Yes ☒ No	There is not an affected vehicle fuel dispensing facility associated with this application.
§115.234 through §115.239.	Control of Volatile Organic Compound Leaks from Transport Vessels	☐ Yes ☒ No	The sources in this application are not associated with filling or emptying gasoline tank trucks.
§115.240 through §115.249.	Control of Vehicle Refueling Emissions (Stage II) at Motor Vehicle Fuel Dispensing Facilities	☐ Yes ☒ No	There is not an affected motor fuel dispensing facility associated with this application.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§115.252 through §115.259.	Control of Reid Vapor Pressure of Gasoline	☐ Yes ☒ No	Do not apply. The West Refinery is not located in El Paso County.
§115.311 through §115.319.	Petroleum Refining, Natural Gas/Gasoline Processing, and Petrochemical Processes	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§115.322 through §115.329.	Fugitive Emission Control in Petroleum Refineries in Gregg, Nueces, and Victoria Counties	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§115.352 through §115.359.	Fugitive Emission Control in Petroleum Refining, Natural Gas/Gasoline Processing, and Petrochemical Processes in Ozone Nonattainment Areas	☐ Yes ☒ No	FHR's West Refinery is not located in a designated ozone nonattainment area.
§115.412 through §115.419.	Degreasing Processes	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§115.420 through §115.429.	Surface Coating Processes	☒ Yes ☐ No	FHR will comply with the applicable requirements.
§115.430 through §115.439.	Flexographic and Rotogravure Printing	☐ Yes ☒ No	There is not an affected rotogravure or flexographic process associated with this application.
§115.440 through §115.449.	Offset Lithographic Printing	☐ Yes ☒ No	There is not an affected offset lithographic printing facility associated with this application.
§115.450 through §115.459.	Control Requirements for Surface Coating Processes	☐ Yes ☒ No	The West Refinery is not located in Dallas-Fort Worth and Houston-Galveston-Brazoria areas.
§115.460 through §115.469.	Industrial Cleaning Solvents	☐ Yes ☒ No	The West Refinery is not located in Dallas-Fort Worth and Houston-Galveston-Brazoria areas.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§115.470 through §115.479.	Miscellaneous Industrial Adhesives	☐ Yes ☒ No	The West Refinery is not located in Dallas-Fort Worth and Houston-Galveston-Brazoria areas.
§115.510 through §115.519.	Cutback Asphalt	☐ Yes ☒ No	There is not a source of cutback asphalt associated with this application.
§115.531 through §115.539.	Pharmaceutical Manufacturing Facilities	☐ Yes ☒ No	There is not an affected pharmaceutical manufacturing facility associated with this application.
§115.541 through §115.549.	Degassing or Cleaning of Stationary, Marine, and Transport Vessels	☐ Yes ☒ No	The facility is not located in an affected county.
§115.552 through §115.559.	Petroleum Dry Cleaning Systems	☐ Yes ☒ No	There is not an affected petroleum dry cleaning system associated with this application.
§115.600 through §115.619.	Automotive Windshield Washer Fluid	☐ Yes ☒ No	FHR's West Refinery does not sell, supply, offer for sale, distribute, or manufacture automotive windshield washer fluid as defined in §115.600.
§115.720 through §115.729.	Vent Gas Control	☐ Yes ☒ No	The facility is not located in the Houston/Galveston/Brazoria area.
§115.760 through §115.769.	Cooling Tower Heat Exchange Systems	☐ Yes ☒ No	The facility is not located in the Houston/Galveston/Brazoria area.
§115.780 through §115.789.	Fugitive Emissions	☐ Yes ☒ No	The facility is not located in the Houston/Galveston/Brazoria area.
§115.901 and §115.910 through §115.916.	Alternate Means of Control	☐ Yes ☒ No	FHR is not applying for an alternate means of control as part of this permit application.
§115.920 and §115.923.	Early Reductions	☐ Yes ☒ No	An extension of the compliance date is not being requested as part of this permit application.

CITATION	CITATION DESCRIPTION	APPLICABLE?	COMMENT
§115.930 through §115.940.	Compliance and Control Plan Requirements	☐ Yes ☒ No	There are no relevant compliance dates or control plan requirements.
§115.950. Emissions Trading	Emissions Trading	☐ Yes ☒ No	FHR is not participating in the emissions trading system to meet the emission control requirements.
Chapter 117.	**Nitrogen Oxides**	☐ Yes ☒ No	Chapter 117 is not applicable because the site is located in Nueces County which is not an affected county, and the facility is not a nitric acid production unit.
Chapter 122.	**Federal Operating Permits**	☒ Yes ☐ No	FHR's West Refinery operates under Permit No. O1272.

COMPLIANCE DEMONSTRATION FOR 30 TAC 111.151

DATA **SUMMARY**

Emission Point Number (EPN)	Emission Point Name	PM Emission Rate as per Table 1(a) (lb/hr)	Physical Stack Height (ft)	Stack Diameter (ft)	Stack Exit Velocity (ft/sec)	Stack Exit Temp (°F)	Stack Exit Temp (°R)	Effective Stack Height as per 111.151(c) (ft)	Estimated Volumetric Stack Flow Rate (acfm)	Standard Effective Stack Height as per 111.151(b) Table 2 Equation (ft)	Effective Stack Height less than Standard Effective Stack Height?	PM Allowable Emission Rate as per 111.151(a) Table 1 Equation (lb/hr)	Table 1(a) Emission Rate complies with Allowable Emission Rate as per 111.151(a)?
SATGAS3HTR	Sat Gas #3 Heater	3.352	213.0	11.5	27.0	300	760	318.81	168,268	70.8	NO	83.44	YES
JJ-4	CCR Hot Oil Heater	0.618	201.0	14.0	3.82	325	785	222.91	35,283	41.	NO	31.68	YES
VCS-1	Marine Vapor Combustor	0.26	45.0	10.0	33.5	1400	1860	247.29	157,865	69.3	NO	80.2	YES

SAMPLE CALCULATIONS (based on EPN SATGAS3HTR):

Effective Stack Height (h_e) = h + 0.083vD [1.5+ 0.82 D(T-550)/T)]

where: h_e = effective stack height in feet
h = physical stack height above ground level in feet
v = stack exit velocity in feet/sec
D = stack exit inside diameter in feet
T = stack exit temperature in °R

Effective Stack Height (h_e) = (213 ft stack height) + 0.083(27 ft/sec stack velocity)(11.5 ft stack diameter)
· [1.5 + 0.82(11.5 ft stack diameter)(760°R - 550°R)/(760°R)]
= 318.81 ft

Estimated Stack Volumetric Flow Rate (q) = (π D²/4) · v · 60
where: q = volumetric flowrate in acfm
D = stack exit inside diameter in feet
v = stack exit velocity in feet/sec

Effective Stack Volumetric Rate (q) = (π) (11.5 ft stack diameter)² (27 ft/sec stack velocity) (60 min/sec)/4 = 168,266 acfm

Standard Effective Stack Height (H_e)= 1.05 $q^{0.35}$

Standard Effective Stack Height (H_e) = (1.05) (168268 acfm)^0.35 = 70.8 ft

PM Allowable Emission Rate (E)
If effective stack height (h_e) < standard effective stack height (H_e),
then $E = 0.048q^{0.62}(h_e/H_e)^2$
otherwise $E = 0.048q^{0.62}$

PM Allowable Emission Rate (E) = (0.048) (168268 scfm)^0.62 = 83.44 lb/hr

ATTACHMENT VIII.B

MEASUREMENT OF EMISSIONS [§116.111(a)(2)(B)]

Measuring the emissions of significant air contaminants will be conducted as required by the Executive Director. The following table identifies the new and modified emission sources associated with this application and describes how emissions from each source will be monitored.

SUMMARY OF MONITORING ACTIVITY

Emission Unit	EPN	Description	Description of Emission Monitoring Method or Operating Measurements
CCR Hot Oil Heater	JJ-4	Measure NO_x, CO, and O_2 concentrations; Fuel gas usage and fuel gas H_2S content	NO_x, CO, and O_2 CEMS; Fuel flow rate measurements and fuel gas sampling
Sat Gas No. 3 Hot Oil Heater	SATGASHTR	Measure NO_x, CO, and O_2 concentrations; Fuel gas usage and fuel gas H_2S content	NO_x, CO, and O_2 CEMS; Fuel flow rate measurements and fuel gas sampling
Various Process Fugitives	N/A	Monitoring as specified in this application	Inspection and maintenance programs as specified in this application
Storage Tanks	N/A	Material stored, monthly average temperature, monthly throughput, etc.	Material inventories, temperature and throughput measurements
Mid-Plant Cooling Towers	F-S-201, F-S-202	Measure VOC concentration	Monthly monitoring of VOC in water per Appendix P
Marine Vapor Combustor	VCS-1	Measure pressure in the marine loading vapor collection system; Monitor the vapor combustor firebox temperature; Monitor the presence of a pilot flame in the vapor combustor before loading is initiated	A pressure monitoring device; Firebox temperature measurement device; Pilot ultraviolet scanner, thermocouple, temperature element or other TCEQ approved device to monitor the presence of the pilot flame
Miscellaneous MSS Fugitives	MSSFUGS	Monitor emissions according to existing MSS special conditions in NSR Permit No. 8803A.	Monitor emissions according to existing MSS special conditions in NSR Permit No. 8803A.

ATTACHMENT VIII.C

BEST AVAILABLE CONTROL TECHNOLOGY (BACT) [§116.111(a)(2)(C)]

As required by §116.111(a)(2)(C), best available control technology (BACT) must be evaluated and applied to all new and modified facilities. A facility is considered modified when there is a physical change or change in the method of operation which results in an increase in the amount of any air contaminant emitted by the facility or results in the emission of any air contaminant not previously emitted.

As part of the project, there will be many facilities at the West Refinery that will not be modified facilities (*i.e.* they will not undergo a physical change or change in the method of operation) but that will be affected facilities upstream or downstream of the project because they will see an increase in their actual emissions as a result of the installation of new or the modification of existing upstream or downstream facilities. Increased emissions from affected facilities upstream or downstream of the project will be below the allowable emission rate limits proposed in the deflex amendment application and future operations will be consistent with the deflex permit application representations. These upstream and downstream facilities are not modified sources and are not subject to a TCEQ BACT evaluation.

The TCEQ BACT analysis consists of three tiers, and in each tier BACT is evaluated on a case-by-case basis for technical practicability and economic reasonableness. Each tier of the three tier analysis is described below.

<u>Tier I</u>

In the Tier 1 analysis, a comparison is made between the proposed emission reduction performance levels and the emission reduction performance levels accepted as BACT in recent NSR permit reviews for the same process and/or industry. Because the emission reduction option has been previously accepted, the technical practicability and economic reasonableness has been demonstrated. This step should also consider any new technical developments, which may indicate that additional emission reductions are technically practical and economically reasonable.

<u>Tier II</u>

A Tier II analysis occurs when BACT requirements have not been established for a particular process/industry or if there are technical differences between the proposed process and others in the same industry. In the Tier II analysis, a comparison is made between the proposed emission reduction level to the emission reduction levels that have been accepted in recent TCEQ reviews for similar air emissions in a different process or industry type. Because the emission reduction option has been accepted for a similar process/industry, economic reasonableness has already been demonstrated, but a demonstration must be made that the emission reduction level for a similar process/industry is technically practical for the proposed process/industry.

<u>Tier III</u>

A Tier III analysis is performed only if the first two tiers have failed to identify an emission reduction level that is both technically practical and economically reasonable. In the Tier III analysis, a detailed technical and quantitative economic analysis is performed for all possible emission reduction options. The technical practicability of each emission reduction option is demonstrated by the success of that option based on past use in industry and/or the engineering evaluation of a new technology. The economic reasonableness is demonstrated by determining the cost effectiveness of controlling the emissions (expressed as dollars per ton of pollutant reduced).

FHR's BACT Review

FHR is basing its BACT review on a Tier I analysis. The TCEQ has established Tier I BACT requirements for a number of industry types and processes, including the types of facilities that will be newly constructed or modified as part of this project, based on the review of emission reduction performance levels accepted as BACT in recent permitting actions. For each of the relevant Tier 1 BACT requirements previously established by the TCEQ, FHR has undertaken an analysis to determine whether any new technical developments have occurred that would warrant additional emissions reductions. In several instances, the analysis resulted in FHR proposing an emission reduction level that goes beyond the most recently published Tier 1 BACT requirement. A table is provided at the end of this section that summarizes the proposed emission reduction level for each new or modified facility and the relevant Tier I BACT requirement. Copies of the BACT requirements from TCEQ's website are also provided at the end of this section. The current TCEQ BACT requirements were last revised by TCEQ on August 1, 2011. Further explanation of the proposed control technologies is provided below.

<u>Selective Catalytic Reduction (SCR)</u>

SCR is a process for controlling NO_x emissions from, among other things, stationary combustion sources. The basic principle of SCR is the reduction of NO_X to N_2 and H_2O by the reaction of NO_X and ammonia (NH_3) within a catalyst bed. Several different catalysts are used, but the most common are base metal catalysts, which typically contain titanium and vanadium oxides, and which also may contain molybdenum, tungsten, and other elements. A small amount of ammonia referred to as "ammonia slip" is present in the exhaust gas. Generally, SCR can achieve higher NO_x reductions than other available controls such as low-NO_x burners or selective non-catalytic reduction (SNCR).

<u>CO/VOC Control Using Catalyst</u>

A catalyst is used to remove CO and VOC from the exhaust gas prior to entering the atmosphere. The exhaust gas from the combustion source is passed through a catalyst bed to remove CO and VOC from the exhaust gas. The catalyst can achieve a reduction in CO and VOC of at least 90%.

<u>Leak Detection and Repair (LDAR)</u>

Fugitive emissions from piping equipment components such as valves, pumps, compressors, and flanges/connectors are controlled using leak detection and repair programs developed by the EPA. An LDAR program is defined by four different criteria: leak definition, monitoring frequency, properties of the materials inside the piping equipment, and repair requirements. The leak definition is a concentration (ppmv) that defines when an equipment component is leaking when monitored using a gas analyzer. Monitoring frequency defines how often each equipment component type has to be monitored using a gas analyzer. The properties of the materials inside the equipment piping such as true vapor pressure and weight percent VOC define which equipment components have to be monitored. Repair requirements are either directed or non-directed. A directed maintenance program requires the equipment components to be monitored using a gas analyzer after they are repaired to verify that they are no longer leaking. A non-directed maintenance program does not require the equipment components to be monitored using a gas analyzer after they have been repaired.

There are six different LDAR monitoring programs: 28 M, 28 RCT, 28 VHP, 28 MID, 28 LAER and Audio, Visual, and Olfactory (AVO). TCEQ's current BACT for fugitive emissions from piping equipment components in VOC service at facilities emitting more than 25 tons/yr of VOC uncontrolled is a 28 VHP LDAR monitoring program. The 28 VHP program specifies a leak definition of 2,000 ppmv for pumps and compressor seals and a leak definition of 500 ppmv for valves. These equipment component types are required to be monitored quarterly using an approved gas analyzer. Only piping equipment containing materials with a true vapor pressure greater than 0.044 psia at 68°F has to be monitored. The 28 VHP monitoring program is a non-directed maintenance program. For new fugitive components in VOC service, FHR will utilize the 28 VHP program. In addition to the 28VHP monitoring program, FHR will perform annual flange monitoring, and new pumps being installed as part of the project will be seal-less pumps if the service of the pump is compatible with this type of pump.

TCEQ's current BACT for fugitive emissions from piping equipment components in ammonia service is an AVO LDAR monitoring program. For the new piping equipment components associated with this project that will operate in ammonia service, FHR is proposing to use the AVO LDAR monitoring program. The AVO program requires an audio, visual, and olfactory check once every shift to verify there are no leaking components. Within one hour of detection of a leak, an attempt to stop, isolate, or repair the leak must be made.

<u>Drift Eliminators and VOC Monitoring for Cooling Towers</u>

Drift eliminators help reduce particulate matter emissions from cooling towers. Air passing through the cooling tower comes into contact with the cooling water and some of the water may get entrained in the air and released into the atmosphere as "drift" droplets. The cooling water can contain impurities such as dissolved solids. Particulate matter emissions are generated and released to the atmosphere when the drift droplets evaporate and the dissolved solids are remaining. Drift eliminators are used to remove as many water droplets as practical from the air stream before exiting the tower therefore reducing the particulate matter emissions.

The cooling water can also contain VOC as a result of leaks within the processes upstream delivering the cooling water to the tower. VOC emissions are controlled by monitoring the concentration of VOC in the cooling water. A sample of the water is air stripped and a flame ionization detector (FID) analyzer is used to analyze the resultant off-gases for VOC. If VOC is detected in the cooling water, the upstream process leak is repaired as soon as possible. If VOC is detected at a concentration above 0.08 ppmw, the cooling tower is shut down until it is repaired.

Internal and External Floating Roofs

Internal and external floating roofs in storage tanks are used to reduce VOC from tanks when storing materials with a relatively high true vapor pressure and H_2S emissions when storing crude oil. An internal floating roof tank has an external fixed-roof with an internal roof that floats on the surface of the stored liquid. An external floating roof tank is an open-top cylindrical steel shell with a roof that floats on the surface of the stored liquid. Both types of floating roofs minimize the evaporative loss of the material in the tank because the roofs are floating on the surface of the liquid.

Marine Loading

Emissions generated during the marine loading of naphtha and gasoline are controlled by a vacuum-assisted loading operation that captures 100% of the vapors and vents them to the Marine Vapor Combustor (VCS-1). The Marine Vapor Combustor is a vapor combustor with a minimum VOC destruction efficiency of 99.5%. The Marine Vapor Combustor converts H_2S to SO_2 at a minimum efficiency of 98%. Only marine vessels that have passed an annual vapor tightness test as specified in 40 CFR §63.565(c) (September 19, 1995) or 40 CFR §61.304(f) (October 17, 2000) are used during the loading operation. The vapor combustor firebox temperature is continuously monitored and recorded during loading of naphtha and gasoline and stack testing has been performed. This represents BACT for the loading of naphtha and gasoline, which have a maximum true vapor pressure greater than 0.5 psia.

BEST AVAILABLE CONTROL DEVICE (BACT) SUMMARY

FIN	EPN	Description	Pollutant	Control Technology Proposed	TCEQ BACT	Does the Proposed Control Technology Meet or Exceed TCEQ BACT?
SATGASHTR	SATGASHTR	Sat Gas #3 Heater	Nitrogen Oxides (NO_x)	Selective Catalytic Reduction (SCR) achieving a level less than or equal to 0.01 lb/MMBtu; Continuous Emissions Monitoring System (CEMS).	NO_X less than or equal to 0.01 lb/MMBtu; Continuous Emissions Monitoring System (CEMS).	YES
			Carbon Monoxide (CO)	Catalyst to control CO in the flue gas stream to a level less than or equal to 10 ppmv @ 3% Oxygen; Continuous Emissions Monitoring System (CEMS).	CO less than or equal to 50 ppmv @ 3% Oxygen.	YES
			Sulfur Dioxides (SO_2) *	Minimize the amount of sulfur in the natural gas and off-gas stream from the Merox Treating Unit.	Minimize the amount of sulfur in the fuel gas.	YES
			Particulate Matter (PM, PM10, PM2.5) *	Firing of gaseous fuels (natural gas and Merox off-gas) and good air/fuel mixing.	Firing of gaseous fuel and good air/fuel mixing.	YES
			Volatile Organic Compounds (VOC) *	Good combustion efficiency by promoting high combustion temperatures, long residence times at those temperatures, and turbulent mixing of fuel and combustion air. Catalyst to control VOC by 90%.	Good combustion efficiency by promoting high combustion temperatures, long residence times at those temperatures, and turbulent mixing of fuel and combustion air.	YES
			Ammonia (NH_3)	Maintain concentration of ammonia in vent gas stream to less than 10 ppmv.	Ammonia less than 10 ppmv.	YES
39BA3901	JJ-4	CCR Hot Oil Heater	Nitrogen Oxides (NO_x)	Selective Catalytic Reduction (SCR) achieving a level less than or equal to 0.01 lb/MMBtu; Continuous Emissions Monitoring System (CEMS).	NO_X less than or equal to 0.01 lb/MMBtu; Continuous Emissions Monitoring System (CEMS).	YES
			Carbon Monoxide (CO)	Control combustion efficiency to maintain the CO exhaust concentration to less than or equal to 50 ppmv @ 3% Oxygen; Continuous Emissions Monitoring System (CEMS).	CO less than or equal to 50 ppmv @ 3% Oxygen.	YES
			Sulfur Dioxides (SO_2) *	Minimize the amount of sulfur in the fuel gas.	Minimize the amount of sulfur in the fuel gas.	YES
			Particulate Matter (PM, PM10, PM2.5) *	Firing of gaseous fuel and good air/fuel mixing.	Firing of gaseous fuel and good air/fuel mixing.	YES
			Volatile Organic Compounds (VOC) *	Good combustion efficiency by promoting high combustion temperatures, long residence times at those temperatures, and turbulent mixing of fuel and combustion air.	Good combustion efficiency by promoting high combustion temperatures, long residence times at those temperatures, and turbulent mixing of fuel and combustion air.	YES
			Ammonia (NH_3)	Maintain concentration of ammonia in vent gas stream to less than 10 ppmv.	Ammonia less than 10 ppmv.	YES

BEST AVAILABLE CONTROL DEVICE (BACT) SUMMARY

FIN	EPN	Description	Pollutant	Control Technology Proposed	TCEQ BACT	Does the Proposed Control Technology Meet or Exceed TCEQ BACT?
LW-8	VCS-1	Marine Loading/ Marine Vapor Combustor	Nitrogen Oxides (NO_x) *	Good combustion efficiency by promoting high combustion flame and turbulent mixing of fuel and combustion air.	Good combustion efficiency by promoting high combustion flame and turbulent mixing of fuel and combustion air.	YES
			Carbon Monoxide (CO) *	Good combustion efficiency by promoting high combustion flame and turbulent mixing of fuel and combustion air.	Good combustion efficiency by promoting high combustion flame and turbulent mixing of fuel and combustion air.	YES
			Sulfur Dioxides (SO_2) *	Minimize the amount of sulfur in the fuel gas.	Minimize the amount of sulfur in the fuel gas.	YES
			Particulate Matter (PM, PM10, PM2.5) *	Firing of gaseous fuel and good air/fuel mixing.	Firing of gaseous fuel and good air/fuel mixing.	YES
			Volatile Organic Compounds (VOC)	VOC emissions from marine loading are collected using a vacuum-assisted operation (100% collection efficiency) and routed to a control device with a minimum destruction efficiency of 99.5%. Only marine vessels that have passed an annual vapor tightness test as specified in 40 CFR §63.565(c) (September 19, 1995) or 40 CFR §61.304(f) (October 17, 2000) are used during the loading operation.	Collect at least 95% of VOC marine loading emissions and route VOC to a control device with a minimum destruction efficiency of 99%. Vessel leak testing: the marine vessel must pass an annual vapor tightness test as specified in 40 CFR §63.565(c) or 40 CFR §61.304(f).	YES
			Hydrogen Sulfide (H_2S) *	Convert H_2S to SO_2 at a minimum efficiency of 98%.	Convert H_2S to SO_2 at a minimum efficiency of 98%.	YES
F-SATGAS3	F-SATGAS3	New Sat Gas 3 Unit Fugitives	Volatile Organic Compounds (VOC)	28 VHP Leak Detection and Repair Monitoring Program; Annual flange/connector monitoring; sealless (leak-free) pumps where material allows.	28 VHP Leak Detection and Repair Monitoring Program	YES

BEST AVAILABLE CONTROL DEVICE (BACT) SUMMARY

FIN	EPN	Description	Pollutant	Control Technology Proposed	TCEQ BACT	Does the Proposed Control Technology Meet or Exceed TCEQ BACT?
MSSFUGS	MSSFUGS	Miscellaneous MSS Fugitives	Volatile Organic Compounds (VOC)	Equipment Maintenance: process equipment containing liquid with a true vapor pressure greater than 0.5 psia will be purged to the flare gas recovery unit prior to opening to the atmosphere. Equipment will be drained into a closed system as much as possible prior to opening. Any remaining liquid will be caught in a pan and covered or placed in a covered container within one hour of being drained.	See TCEQ BACT guidance document at the end of this section.	YES
				Vacuum Trucks: exhaust vapors from loading liquid with a true vapor pressure greater than 0.5 psia will be routed to a control device with a minimum destruction efficiency of 98%.	For loading liquids with a true vapor pressure > 0.5 psia, route exhaust vapors to a control device or controlled recovery system.	YES
				Frac Tanks: frac tanks will be painted white, covered, and equipped with a fill pipe that discharges within 6 inches of the tanks bottom. Vapors generated while filling the tank with a material with a true vapor pressure greater than 0.5 psia will be routed to a carbon canister system with a breakthrough concentration of 100 ppmv.	Tanks must be painted white. Tanks shall be covered and equipped with a fill pipe that discharges within 6 inches of the tanks bottom. When filling the frac tank with materials with a true vapor pressure greater than 0.5 psia, the vapors shall be routed to a control device or controlled recovery system.	YES
				Floating Roof Tank Landings: tanks storing material with true vapor pressure greater than 0.5 psia will start degassing within 24 hours of landing and will continue degassing every 24 hours unless there is no standing liquid or the vapor pressure of the liquid remaining in the tank is less than 0.2 psia. Degassing vapors will be routed to a control device with a minimum destruction efficiency of 98%. Vapors generated while refloating the roof after a product change will be routed to a control device with a minimum destruction efficiency of 98%. New tanks will be designed to be drain dry with connections to control vapors under a landed roof.	See TCEQ BACT guidance document at the end of this section.	YES
14-UDEX	F-14-UDEX	UDEX Fugitives	Volatile Organic Compounds (VOC)	28 VHP Leak Detection and Repair Monitoring Program; Annual flange/connector monitoring; sealless (leak-free) pumps where material allows.	28 VHP Leak Detection and Repair Monitoring Program	YES

BEST AVAILABLE CONTROL DEVICE (BACT) SUMMARY

FIN	EPN	Description	Pollutant	Control Technology Proposed	TCEQ BACT	Does the Proposed Control Technology Meet or Exceed TCEQ BACT?
37	F-37	DHT Fugitives	Volatile Organic Compounds (VOC)	28 VHP Leak Detection and Repair Monitoring Program; Annual flange/connector monitoring; sealless (leak-free) pumps where material allows.	28 VHP Leak Detection and Repair Monitoring Program	YES
39	F-39	NHT/CCR Fugitives	Volatile Organic Compounds (VOC)	28 VHP Leak Detection and Repair Monitoring Program; Annual flange/connector monitoring; sealless (leak-free) pumps where material allows.	28 VHP Leak Detection and Repair Monitoring Program	YES
40	F-40	West Crude Fugitives	Volatile Organic Compounds (VOC)	28 VHP Leak Detection and Repair Monitoring Program; Annual flange/connector monitoring; sealless (leak-free) pumps where material allows.	28 VHP Leak Detection and Repair Monitoring Program	YES
42	F-42	Mid Crude Fugitives	Volatile Organic Compounds (VOC)	28 VHP Leak Detection and Repair Monitoring Program; Annual flange/connector monitoring; sealless (leak-free) pumps where material allows.	28 VHP Leak Detection and Repair Monitoring Program	YES
P-GB	F-GB	Gasoline Blender Fugitives	Volatile Organic Compounds (VOC)	28 VHP Leak Detection and Repair Monitoring Program; Annual flange/connector monitoring; sealless (leak-free) pumps where material allows.	28 VHP Leak Detection and Repair Monitoring Program	YES
P-VOC	F-TK-VOC	VOC Tank/Loading Fugitives	Volatile Organic Compounds (VOC)	28 VHP Leak Detection and Repair Monitoring Program; Annual flange/connector monitoring; sealless (leak-free) pumps where material allows.	28 VHP Leak Detection and Repair Monitoring Program	YES
SITENH3FUG	SITENH3FUG	Site-wide Ammonia Fugitive Emissions	Ammonia (NH_3)	Audio, Visual, Olfactory (AVO) Monitoring Program.	Audio, Visual, Olfactory (AVO) Monitoring Program.	YES
44EF2	F-S-202	Mid-Plant Cooling Tower No. 2	Particulate Matter (PM, PM_{10}, $PM_{2.5}$)	Drift eliminator to be installed achieving a drift loss of no more than 0.0005%.	Drift eliminators Drift < 0.001%	YES
			Volatile Organic Compounds (VOC)	Non-contact design cooling tower; Monthly monitoring of VOC in water per Appendix P; Leaks are repaired as soon as possible; Cooling tower shutdown if cooling water VOC concentration is greater than or equal to 0.08 ppmw.	Non-contact design; Monthly monitoring of VOC in water per Appendix P or approved equivalent; Repair identified leaks as soon as possible, but before next scheduled shutdown, or shutdown triggered by 0.08 ppmw cooling water VOC concentration.	YES

BEST AVAILABLE CONTROL DEVICE (BACT) SUMMARY

FIN	EPN	Description	Pollutant	Control Technology Proposed	TCEQ BACT	Does the Proposed Control Technology Meet or Exceed TCEQ BACT?
IFRTK1	IFRTK1	100,000 bbl IFR Tank	Volatile Organic Compounds (VOC)	True vapor pressure of materials greater than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; Internal floating roof tank with both a primary seal and secondary seal and a suspended roof to minimize the number of locations where VOC emissions can leak.	See TCEQ BACT guidance document at the end of this section.	YES
IFRTK2	IFRTK2	75,000 bbl IFR Tank	Volatile Organic Compounds (VOC)	True vapor pressure of materials greater than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; Internal floating roof tank with both a primary seal and secondary seal and a suspended roof to minimize the number of locations where VOC emissions can leak.	See TCEQ BACT guidance document at the end of this section.	YES
11FB408	FB408	Tank 11FB408	Volatile Organic Compounds (VOC)	True vapor pressure of materials less than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; external floating roof tank with both a primary and secondary seal. The slotted guide pole fitting has a gasketed cover, wiper, float, and sleeve.	See TCEQ BACT guidance document at the end of this section.	YES
11FB409	FB409	Tank 11FB409	Volatile Organic Compounds (VOC)	True vapor pressure of materials less than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; external floating roof tank with both a primary and secondary seal. The slotted guide pole fitting has a gasketed cover, wiper, float, and sleeve.	See TCEQ BACT guidance document at the end of this section.	YES
11FB410	FB410	Tank 11FB410	Volatile Organic Compounds (VOC)	True vapor pressure of materials less than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; external floating roof tank with both a primary and secondary seal. The slotted guide pole fitting has a gasketed cover, wiper, float, and sleeve.	See TCEQ BACT guidance document at the end of this section.	YES
15FB508	FB508	Tank 15FB508	Volatile Organic Compounds (VOC)	True vapor pressure of materials less than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; external floating roof tank with both a primary and secondary seal. The tank is not equipped with a slotted guide pole.	See TCEQ BACT guidance document at the end of this section.	YES

BEST AVAILABLE CONTROL DEVICE (BACT) SUMMARY

FIN	EPN	Description	Pollutant	Control Technology Proposed	TCEQ BACT	Does the Proposed Control Technology Meet or Exceed TCEQ BACT?
15FB510	FB510	Tank 15FB510	Volatile Organic Compounds (VOC)	White or aluminum uninsulated exterior surfaces exposed to the sun; an internal floating roof with both a primary and secondary seal will be installed as part of an emission reduction project outside of this application even though this type of control is not required when storing materials less than 0.5 psia. The tank will also have a suspended roof to minimize VOC emissions.	See TCEQ BACT guidance document at the end of this section.	YES
40FB3043	FB3043	Tank 40FB3043	Volatile Organic Compounds (VOC)	True vapor pressure of materials less than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; an internal floating roof with both a primary and secondary seal will be installed as part of an emission reduction project outside of this application even though this type of control is not required when storing materials less than 0.5 psia. The tank will also have a suspended roof to minimize VOC emissions.	See TCEQ BACT guidance document at the end of this section.	YES
40FB3044	FB3044	Tank 40FB3044	Volatile Organic Compounds (VOC)	True vapor pressure of materials less than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; an internal floating roof with both a primary and secondary seal will be installed as part of an emission reduction project outside of this application even though this type of control is not required when storing materials less than 0.5 psia. The tank will also have a suspended roof to minimize VOC emissions.	See TCEQ BACT guidance document at the end of this section.	YES
40FB4010	FB4010	Tank 40FB4010	Volatile Organic Compounds (VOC)	True vapor pressure of materials greater than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; external floating roof tank with both a primary and secondary seal. The slotted guide pole fitting has a gasketed cover, wiper, float, and sleeve.	See TCEQ BACT guidance document at the end of this section.	YES
			Hydrogen Sulfide (H_2S)	White or aluminum uninsulated exterior surfaces exposed to the sun; external floating roof tank with both a primary and secondary seal. The slotted guide pole fitting has a gasketed cover, wiper, float, and sleeve.	TCEQ's current BACT for storage tanks does not address H_2S emissions. Therefore, BACT was determined based on a review of recent permits issued by TCEQ for similar sources.	YES

BEST AVAILABLE CONTROL DEVICE (BACT) SUMMARY

FIN	EPN	Description	Pollutant	Control Technology Proposed	TCEQ BACT	Does the Proposed Control Technology Meet or Exceed TCEQ BACT?
40FB4011	FB4011	Tank 40FB4011	Volatile Organic Compounds (VOC)	True vapor pressure of materials greater than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; external floating roof tank with both a primary and secondary seal. The slotted guide pole fitting has a gasketed cover, wiper, float, and sleeve.	See TCEQ BACT guidance document at the end of this section.	YES
			Hydrogen Sulfide (H_2S)	White or aluminum uninsulated exterior surfaces exposed to the sun; external floating roof tank with both a primary and secondary seal. The slotted guide pole fitting has a gasketed cover, wiper, float, and sleeve.	TCEQ's current BACT for storage tanks does not address H_2S emissions. Therefore, BACT was determined based on a review of recent permits issued by TCEQ for similar sources.	YES

BEST AVAILABLE CONTROL DEVICE (BACT) SUMMARY

FIN	EPN	Description	Pollutant	Control Technology Proposed	TCEQ BACT	Does the Proposed Control Technology Meet or Exceed TCEQ BACT?
40FB4014	FB4014	Tank 40FB4014	Volatile Organic Compounds (VOC)	True vapor pressure of materials less than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; an internal floating roof with both a primary and secondary seal will be installed as part of an emission reduction project outside of this application even though this type of control is not required when storing materials less than 0.5 psia. The tank will also have a suspended roof to minimize VOC emissions.	See TCEQ BACT guidance document at the end of this section.	
40FB4015	FB4015	Tank 40FB4015	Volatile Organic Compounds (VOC)	True vapor pressure of materials less than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; an internal floating roof with both a primary and secondary seal will be installed as part of an emission reduction project outside of this application even though this type of control is not required when storing materials less than 0.5 psia. The tank will also have a suspended roof to minimize VOC emissions.	See TCEQ BACT guidance document at the end of this section.	YES
40FB4016	FB4016	Tank 40FB4016	Volatile Organic Compounds (VOC)	True vapor pressure of materials less than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; an internal floating roof with both a primary and secondary seal will be installed as part of an emission reduction project outside of this application even though this type of control is not required when storing materials less than 0.5 psia. The tank will also have a suspended roof to minimize VOC emissions.	See TCEQ BACT guidance document at the end of this section.	YES

BEST AVAILABLE CONTROL DEVICE (BACT) SUMMARY

FIN	EPN	Description	Pollutant	Control Technology Proposed	TCEQ BACT	Does the Proposed Control Technology Meet or Exceed TCEQ BACT?
15FB509	FB509	Tank 15FB509	Volatile Organic Compounds (VOC)	True vapor pressure of materials less than 0.5 psia. White or aluminum uninsulated exterior surfaces exposed to the sun; an internal floating roof with both a primary and secondary seal will be installed as part of an emission reduction project outside of this application even though this type of control is not required when storing materials less than 0.5 psia. The tank will also have a suspended roof to minimize VOC emissions.	See TCEQ BACT guidance document at the end of this section.	YES

* TCEQ's current BACT for Process Furnaces and Heaters does not address SO_2, PM, or VOC emissions. TCEQ's current BACT for Flares and Vapor Combustors does not address SO2, PM, or VOC emissions. Therefore, BACT was determined based on a review of recent permits issued by TCEQ for similar sources.

TCEQ Chemical Sources
Current Best Available Control Technology (BACT) Requirements

Flares and Vapor Combustors

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2011	Flares	VOC	Flare required to meet 40 CFR 60.18	Destruction Efficiency: 99% for certain compounds up to three carbons, 98% otherwise No flaring of halogenated compounds allowed Flow monitor will be required. Composition or BTU analyzer may be required.
		Non-VOC	Case-by-case	Case-by-case Flow monitor will be required. Composition or BTU analyzer may be required.
	Vapor Combustors	VOC	Monitor temperature, perform initial test	99% destruction efficiency

TCEQ Chemical Sources
Current Best Available Control Technology (BACT) Requirements

Storage Tanks
This information is maintained by the Chemical NSR Section and is subject to change. (Last Revision Date 08/01/2011

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2011	Storage Tanks	Tank capacity < 25 Mgal or Vp < 0.5 psia	Fixed roof with submerged fill. White or aluminum uninsulated exterior surfaces exposed to the sun.	
		Tank Capacity > 25 Mgal and Vp > 0.5 psia	Internal floating roof (IFR). White or aluminum uninsulated exterior surfaces exposed to the sun.	Alternative 1: Primary seal: mechanical or liquid mounted Alternative 2: Primary seal: vapor mounted and Secondary seal: rim mounted
			External floating roof (EFR). White or aluminum uninsulated exterior surfaces exposed to the sun. Slotted guide pole fittings must have gasketed cover, and at least 2 of the following – wiper, float, or sleeve.	Primary seal: mechanical or liquid mounted, and Secondary seal: rim mounted
			Vent to control	Appropriate control device efficiency

TCEQ CHEMICAL SOURCES
CURRENT BACT REQUIREMENTS FOR MSS ACTIVITIES

Storage Tanks

This information is maintained by the CHEMICAL NSR Section and is subject to change. Last update 4/2008.

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2006	Storage Tanks	All	Same as current BACT requirements, except as stated on this table.	Same as current BACT requirements, except as stated on this table.
	Fixed Roof Tank Draining	VOC	Send liquid to a covered vessel. If there is any standing liquid within the tank, and the tank is opened to the atmosphere or ventilated, the vapor stream must be controlled until there is no standing liquid or the VOC vapor pressure is less than 0.02 psia.	Control device must meet BACT.
		Acid	Drain to covered vessel. If there is any standing liquid within the tank, and the tank is opened to the atmosphere or ventilated, the vapor stream must be controlled until there is no standing liquid or the acid vapor pressure is less than 0.02 psia.	Control device must meet BACT.
	Floating Roof Landings	VOC	May land roof without control, subject to effects review, if meet a category detailed to the right. Control all other landings as detailed below.	Bulk gasoline terminals: two landings per tank per year when required for Reid Vapor Pressure changes.
				For change of service (incompatible liquids) if total site change of service tank landing emissions are less than 5 tpy.
		All	Route to appropriate control device when degassing. Control must be maintained until the VOC concentration is less than 10,000 ppmv VOC (or equivalent for non-VOCs). If there is any standing liquid within the tank, and the tank is opened to the atmosphere or ventilated, the vapor stream must be controlled until there is no standing liquid or the VOC vapor pressure is less than 0.02 psia. Route to control device during roof refloating if emissions from filling tanks without degassing and cleaning is > 5tpy. In this case, if controlling through fixed roof vent, route to control device during entire tank refill. New tanks must be desinged to be drain dry with connections to control vapors under a landed roof.	Commence under-roof degassing within 24 hours of landing. Degas every 24 hours unless no standing liquid in tank or vapor pressure of liquid in tank has a VOC partial pressure <0.02 psi.

TCEQ CHEMICAL SOURCES
CURRENT BACT REQUIREMENTS FOR MSS ACTIVITIES

Equipment Leak Fugitives

This information is maintained by the CHEMICAL NSR Section and is subject to change. Last update 11/17/2006

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2006	Equipment Leak Fugitives	Uncontrolled VOC emissions < 10 tpy	Same as current BACT requirements, except as stated on this table.	Same as current BACT requirements, except as stated on this table.
		Approved odorous compounds: NH_3, Cl_2, H_2S, etc.	Same as current BACT requirements, except as stated on this table.	Same as current BACT requirements, except as stated on this table.
	Pump Maintenance	VOC <0.5 psia	Send to a closed drain system. Drain any remaining liquid to a pan, then pump to a vacuum truck or put in a closed container.	Alternative: Drain to an absorbent pad and properly dispose of it.
		VOC >0.5 psia	Send material to the flare knockout drum to separate into vapors, light liquids, and heavy liquids. Vapors are routed to flare. Liquids go to slop drums or strippers. Drain any remaining liquid it to a pan then pump to a vacuum truck or put in a closed container.	Alternative 1: Send the material to the refinery slop drums to be recovered. If there is any remaining liquid in the system, drain it to a pan then pump to a vacuum truck or put in a closed container.
				Alternative 2: Drain to a recovery tank that is vented to the flare. Drain any remaining liquid to a pan then pump to a vacuum truck or put in a closed container.
				Alternative 3: Steam material to the enclosed sewer. Collect hydrocarbons in the unit sump, to be pumped to the slop tanks and recycled. If any liquids remain, steam or drain to a pan, then pump to vacuum truck or put in closed container
		Acid	Neutralize acid with caustic and drain to the sewer.	
		Sour water	Route sour water to the sour water unit.	Alternative: Pump sour water to sour water strippers
		Sulfur	Clear sulfur to pits or sump.	
	Pipe Maintenance	VOC <0.5 psia	Send to a closed drain system. Drain any remaining liquid to a pan, then pump the material to a vacuum truck or put in a closed container.	
		VOC > 0.5 psia	Send material to the flare knockout drum to separate into vapors, light liquids, and heavy liquids. Route the vapors back through the process to be recovered before going to the flare using the recovery compressors, where available. Route vapors to flare. Route liquids to slop drums or strippers. Drain any remaining liquid to a pan, then pump to a vacuum truck or put in a closed container.	Alternative 1: Drain material to a recovery tank that is vented to the flare. Drain any remaining liquid to a pan, then pump the material to a vacuum truck or put in a closed container.
				Alternative 2: Send the material to the refinery slop drums to be recovered. Drain any remaining liquid to a pan, then pump the material to a vacuum truck or put in a closed container.
		Sour Water	Route sour water to the sour water unit.	Alternative 1: Pump sour water to sour water strippers
				Alternative 2: Send sour water to a frac tank. Verify that there are no emissions from frac tanks.

TCEQ CHEMICAL SOURCES
CURRENT BACT REQUIREMENTS FOR MSS ACTIVITIES

Equipment Leak Fugitives

This information is maintained by the CHEMICAL NSR Section and is subject to change. Last update 11/17/2006

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
		Sulfur	Clear sulfur to pits or sump.	
		Fuel gas	Purge fuel gas, natural gas, and LNG to the furnace and/or waste heat boiler.	
		Acid	Neutralize acid with caustic and drain to the sewer	
	Valve Maintenance	VOC < 0.5 psia	Send to a closed drain system. Drain any remaining liquid to a pan, then pump to a vacuum truck or put in a closed container.	
		VOC > 0.5 psia	Send material to the flare knockout drum to separate into vapors, light liquids, and heavy liquids. Route the vapors back through the process to be recovered before going to the flare using the recovery compressors, where available. Route vapors to flare. Route liquids to slop drums or strippers. Drain any remaining liquid to a pan, then pump to a vacuum truck or put in a closed container.	Alternative 1: Send the material to the refinery slop drums to be recovered. Verify that there are no emissions from sending the material back to the process to be recovered. If there is any remaining liquid in the system, drain it to a pan, then pump to a vacuum truck or put in a closed container.
				Alternative 2: Steam material to the enclosed sewer. Collect hydrocarbons in the unit sump, to be pumped to the slop tanks and recycled. If any fluid remains, steam or drain it to a pan then pump the material to a vacuum truck or put in a closed container.
		Sour water	Route sour water to the sour water unit.	Alternative: Pump sour water to sour water strippers.
				Alternative: Send sour water to a frac tank. Verify that there are no emissions from frac tanks.
		Sulfur	Clear sulfur to pits or sump.	
	Compressor Maintenance	VOC	Send material to the flare knockout drum to separate into vapors, light liquids, and heavy liquids. Route the vapors back through the process to be recovered before going to the flare using the recovery compressors, where available. Route vapors to flare. Route liquids to slop drums or strippers. Drain any remaining liquid to a pan, then pump to a vacuum truck or put in a closed container.	Alternative: Steam material to the enclosed sewer. Collect hydrocarbons in the unit sump, to be pumped to the slop tanks and recycled. If any fluid remains, steam or drain it to a pan then pump the material to a vacuum truck or put in a closed container.
		Acid/Sulfur Recovery Unit Tail Gases	Clear acid gas, wastewater acid gas, and tail gas to reactor burners or incinerators. Send the remainder of the material to the acid gas flare.	

TCEQ Chemical Sources
Current Best Available Control Technology (BACT) Requirements

Loading Operations

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2011	Loading Operations	VOC vp < 0.5 psia	Submerged or bottom loading	No splash loading
		VOC vp > 0.5 psia	Route to VOC control device	See specific control device requirements
			Annual truck leak checking per NSPS XX Low back pressure	98.7% collection efficiency for annual NSPSXX leak check on non-gasoline loading
	Marine Loading Operations	VOC vp > 0.5 psia	Route to VOC control device Vessel leak testing: the marine vessel must pass an annual vapor tightness test as specified in 40 CFR §63.565(c) or 40 CFR §61.304(f)	95% collection efficiency from loading operation See specific control device requirement

TCEQ Chemical Sources
Current Best Available Control Technology (BACT) Requirements

Process Furnaces and Heaters

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2011	Process Furnaces and Heaters	NO_X	Burners with the best NO_X performance given the burner configuration and gaseous fuel used. Case-by-case review necessary if NO_X > 0.01 lb/MMBtu. Cost data must be submitted for SCR if firing rate is > 300 MMBtu/hr and burner NO_X is > 0.01 lb/MMBtu. CEMS required for 100 MMBtu/hr.	Performance is an annual average.
		CO	50 ppmv corrected to 3% O_2	

TCEQ Chemical Sources
Current Best Available Control Technology (BACT) Requirements

Equipment Leak Fugitives

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2011	Equipment Leak Fugitives	Uncontrolled VOC emissions < 10 tpy	None	
		10 tpy < uncontrolled VOC emissions < 25 tpy	28M leak detection and repair program	75% credit for 28M
		Uncontrolled VOC emissions > 25 tpy	28VHP leak detection and repair program	97% credit for valves, 85% for pumps and compressors
		VOC vp < 0.002 psia	No inspection required	No fugitive emissions expected
		Approved odorous compounds: NH3, C12, H2S, etc.	Audio/Visual/Olfactory (AVO) inspection twice per shift	Appropriate credit for AVO program

TCEQ Chemical Sources
Current Best Available Control Technology (BACT) Requirements

Cooling Towers

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2011	Cooling Towers	VOC	Non-contact design Monthly monitoring of VOC in water per Appendix P or approved equivalent – assume all VOC stripped out Repair identified leaks as soon as possible, but before next scheduled shutdown, or shutdown triggered by 0.08 ppmw cooling water VOC concentration	
		Particulate	Drift eliminators Drift < 0.001%	

ATTACHMENT VIII.D

PERFORMANCE DEMONSTRATION [§116.111(a)(2)(G)]

FHR will achieve the performance specified in this application and will submit additional performance data as may be required by the TCEQ Executive Director.

The emission calculation bases (including performance of control devices) are provided in Attachment VII.A.5&6. The monitoring to be performed is summarized in Measurement of Emissions section (Attachment VIII.B). FHR maintains operating and maintenance procedures and performs training to ensure that equipment is in good operating condition and is operated in compliance with applicable rules and permit requirements.

ATTACHMENT IX.A

NEW SOURCE PERFORMANCE STANDARDS (NSPS) [§116.111(a)(2)(D)]

A table is provided in this section that summarizes the applicability of NSPS to the new and modified emission units. FHR will comply with the control, monitoring, reporting, and recording requirements of NSPS Subpart A and the specific NSPS Subparts applicable to the new and modified emission units.

WEST REFINERY NSPS SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable NSPS	Explanation/Applicable Limit	Compliance Demonstration
Sat Gas #3 Hot Oil Heater	New source as part of building new Saturates Gas Plant No. 3 Unit.	Db, Ja	NSPS Db - New hot oil heater (meets definition of steam generating unit) - subject to emissions limitations (SO_2 - complying with NSPS Ja, PM - None for gas fired sources, NOx - 0.1-0.2 lb/MMBtu), inspection/monitoring, recordkeeping, and reporting requirements. NSPS Ja - Unit is new and is fired with natural gas and off-gas from Merox Treating Unit. Subject to emissions limitations (SO_2 - 20 ppmv (3-hr) and 8 ppmv (annual), NOx - 0.06 lb/MMBtu), inspection/monitoring, recordkeeping, and reporting requirements.	NOx emissions will meet a BACT limit of 0.01 lb/MMBtu, which is less than the emission limitations of NSPS Db and NSPS Ja. The SO_2 concentration in the exhaust is estimated at < 1 ppmv, and the sulfur concentration in the Merox Treating Unit off-gas is approximately 0.00004 ppmv. Therefore, SO_2 emissions will be less than the emission limitations of NSPS Ja. FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
New Sat Gas 3 Unit Fugitives	New fugitive piping components (i.e. valves, flanges, etc.) as part of building new Saturates Gas Plant #3.	GGGa	New process unit with affected equipment - subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
Mid-Plant Cooling Tower No. 2	New cooling tower	None	No NSPS applicable to cooling towers	N/A
100,000 bbl IFR Tank	New storage tank	Kb	New storage tank subject to design standards (fixed-roof tank with internal floating roof or external floating roof tank), inspection/monitoring, recordkeeping, and reporting requirements.	The tank will be a fixed-roof tank with an internal floating roof. FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
75,000 bbl IFR Tank	New storage tank	Kb	New storage tank subject to design standards (fixed-roof tank with internal floating roof or external floating roof tank), inspection/monitoring, recordkeeping, and reporting requirements.	The tank will be a fixed-roof tank with an internal floating roof. FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.

WEST REFINERY NSPS SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable NSPS	Explanation/Applicable Limit	Compliance Demonstration
CCR Hot Oil Heater	Increase in fired duty from 90 MMBtu/hr to 123.6 MMBtu/hr (HHV). Decrease in hourly SO2 allowable emission rate limit as a result of decreasing maximum hourly sulfur content based on current operations.	Db, Ja	NSPS Db - Modification of existing hot oil heater capacity will change applicability from NSPS Dc to NSPS Db based on size capacity (meets definition of steam generating unit) - subject to emissions limitation (SO2 - complying with NSPS Ja, PM - None for gas fired sources, NOx - 0.1-0.2 lb/MMBtu), inspection/monitoring, recordkeeping, and reporting requirements. NSPS Ja - Unit is modified and is fired with refinery fuel gas. Subject to emissions limitations (H2S - 162 ppmv (3-hr) and 60 ppmv (annual) but exempt from monitoring due to inherently low sulfur content, NOx - 0.06 lb/MMBtu), inspection/monitoring, recordkeeping, and reporting requirements.	NOx emissions will meet a BACT limit of 0.01 lb/MMBtu, which is less than the emission limitations of NSPS Db and NSPS Ja. The sulfur concentration in the Merox Treating Unit off-gas is approximately 0.00004 ppmv. Therefore, SO2 emissions will be less than the emission limitations of NSPS Ja. A CEMS will be used to measure NOx and SO2 emissions. FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.

WEST REFINERY NSPS SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable NSPS	Explanation/Applicable Limit	Compliance Demonstration
Marine Vapor Combustor	Increase in currently permitted naphtha and gasoline throughput. Therefore, considered modified for minor NSR purposes. Decrease in hourly loading rates of most materials. Decrease in NO_x and CO allowable emission rate limits as a result of updating the NOx and CO emission factors based on recent stack testing. Decrease in the VOC allowable emission rate limit as a result of updating the control device efficiency based on recent stack testing. Add particulate and H_2S emission rate allowables. Incorporate PBR Registration Nos. 103051 and 103706. Change in calculation method for NOx and CO based on firing capacity. Change in calculation method for hourly VOC based on highest emission rate of any one material. Change in calculation method for crude oil emissions. Decrease in fuel sulfur content. Removal of penexate as an authorized material.	J	NSPS J - Subject to emissions limitations (H2S - 162 ppmv (3-hr)), inspection/monitoring, recordkeeping, and reporting requirements.	H_2S concentration will be less than 162 ppmv. H_2S monitor to monitor and record H_2S concentration routed to the marine vapor combustor. FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
UDEX Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project.	GGGa	Modified process unit with affected equipment, compressors affected as new sources - subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.

WEST REFINERY NSPS SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable NSPS	Explanation/Applicable Limit	Compliance Demonstration
DHT Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	GGGa	Modified process unit with affected equipment, compressors affected as new sources - subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
NHT/CCR Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	GGGa	Modified process unit with affected equipment, compressors affected as new sources - subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
West Crude Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	GGGa	Modified process unit with affected equipment, compressors affected as new sources - subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
Mid Crude Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	GGGa	Modified process unit with affected equipment, compressors affected as new sources - subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
Gasoline Blender Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	GGGa	Modified process unit with affected equipment, compressors affected as new sources - subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.

WEST REFINERY NSPS SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable NSPS	Explanation/Applicable Limit	Compliance Demonstration
VOC Tank/Loading Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	GGGa	Modified process unit with affected equipment, compressors affected as new sources - subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
Site-wide Ammonia Fugitive Emissions	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of SCR system installations.	None	No NSPS applicable to ammonia piping components.	N/A
Tank 11FB408	Increase in annual throughput and decrease in true vapor pressure of material stored. A grouped ton/yr emission limit is being formed from 11FB408, 11FB409, and 11FB410 based on a total throughput going through any of these tanks. This results in an overall decrease in permitted allowable emissions. All tanks within the group have throughput increase above permitted throughput levels, so tank is considered modified for minor NSR purposes.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A
Tank 11FB409	Increase in annual throughput and decrease in true vapor pressure of material stored. A grouped ton/yr emission limit is being formed from 11FB408, 11FB409, and 11FB410 based on a total throughput going through any of these tanks. This results in an overall decrease in permitted allowable emissions. All tanks within the group have throughput increase above permitted throughput levels, so tank is considered modified for minor NSR purposes.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A

WEST REFINERY NSPS SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable NSPS	Explanation/Applicable Limit	Compliance Demonstration
Tank 11FB410	Increase in annual throughput and decrease in true vapor pressure of material stored. A grouped ton/yr emission limit is being formed from 11FB408, 11FB409, and 11FB410 based on a total throughput going through any of these tanks. This results in an overall decrease in permitted allowable emissions. All tanks within the group have throughput increase above permitted throughput levels, so tank is considered modified for minor NSR purposes.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A
Tank 15FB508	Decrease in true vapor pressure of the material stored in the tank. A grouped ton/yr emission limit is being formed from 15FB508 and 15FB510 based on a total throughput going through any of these tanks. This results in a decrease in permit allowable emissions. Although there are no physical changes or changes in the method of operation proposed for Tank 15FB508, the tank is considered modified for minor NSR purposes because it is being included in a group with Tank 15FB510, which is considered modified because of the increase in permitted throughput and vapor pressure.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A
Tank 15FB510	Increase in annual throughput and true vapor pressure of the material stored in the tank after improving controls. Tank has throughput increase above permitted throughput levels, so considered modified for minor NSR purposes. A grouped ton/yr emission limit is being formed from 15FB508 and 15FB510 based on a total throughput going through any of these tanks. This results in an overall decrease in permitted emissions.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A

WEST REFINERY NSPS SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable NSPS	Explanation/Applicable Limit	Compliance Demonstration
Tank 40FB3043	Increasing annual throughput and true vapor pressure of material stored in the tank above permitted levels. Forming a grouped ton/yr emission limit from 40FB3043 and 40FB3044 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A
Tank 40FB3044	Increasing annual throughput and true vapor pressure of material stored in the tank above permitted levels. Forming a grouped ton/yr emission limit from 40FB3043 and 40FB3044 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A
Tank 40FB4010	Increase in annual throughput and decrease in annual true vapor pressure of the material stored in the tank. One or both tanks within the group has throughput increase above permitted throughput levels, so considered modified for minor NSR purposes. Grouped ton/yr emission limits are being formed from 40FB4010 and 40FB4011 based on a total throughput going through any of these tanks. This results in a decrease in permitted VOC emissions.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A

WEST REFINERY NSPS SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable NSPS	Explanation/Applicable Limit	Compliance Demonstration
Tank 40FB4011	Increase in annual throughput and decrease in annual true vapor pressure of the material stored in the tank. One or both tanks within the group has throughput increase above permitted throughput levels, so considered modified for minor NSR purposes. Grouped ton/yr emission limits are being formed from 40FB4010 and 40FB4011 based on a total throughput going through any of these tanks. This results in a decrease in permitted VOC emissions.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A
Tank 40FB4014	Increasing the true vapor pressure of the material stored in the tank above permitted levels. This results in an increase in permit allowable emissions.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A
Tank 40FB4015	Increasing the true vapor pressure of the material stored in the tank above permitted levels. This results in an increase in permit allowable emissions.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A
Tank 40FB4016	Increasing the true vapor pressure of the material stored in the tank above permitted levels. Forming a grouped ton/yr emission limit from 40FB4016 and 15FB509 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A

WEST REFINERY NSPS SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable NSPS	Explanation/Applicable Limit	Compliance Demonstration
Tank 15FB509	Increasing the true vapor pressure of the material stored in the tank above permitted levels. Forming a grouped ton/yr emission limit from 40FB4016 and 15FB509 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	Kb	Changes in material stored or throughput do not qualify as a modification for NSPS purposes.	N/A

ATTACHMENT IX.B

NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP) [§116.111(a)(2)(E)]

There are no NESHAPS in 40 C.F.R. Part 61 applicable to the new and modified emission units.

ATTACHMENT IX.C

MAXIMUM ACHIEVABLE CONTROL TECHNOLOGIES (MACT) [§116.111(a)(2)(F)]

A table is provided in this section that summarizes the applicability of MACT to the new and modified emission units. FHR will comply with the control, monitoring, reporting, and recording requirements of MACT Subpart A and the specific MACT Subparts applicable to the new and modified emission units.

WEST REFINERY MACT SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable MACT	Explanation/Applicable Limit	Compliance Demonstration
Sat Gas #3 Hot Oil Heater	New source as part of building new Saturates Gas Plant No. 3 Unit.	DDDDD	New hot oil heater subject to emissions limitation (CO - 400 ppm by volume on a dry basis corrected to 3 percent oxygen), inspection/monitoring, recordkeeping, and reporting requirements.	The CO concentration in the exhaust is estimated at < 10 ppmv. FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
Sat Gas #3 Hot Oil Heater	New source as part of building new Saturates Gas Plant No. 3 Unit.	CC	Group 1 or Group 2 process vent subject to control requirements, inspection/monitoring, recordkeeping, and reporting requirements.	If Merox off-gas stream is determined to be a Group 1 process vent, FHR will reduce emissions of organic HAP's by 98 weight-percent using the Sat Gas Hot Oil Heater. No control requirements for Group 2 process vents. FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
New Sat Gas 3 Unit Fugitives	New fugitive piping components (i.e. valves, flanges, etc.) as part of building new Saturates Gas Plant #3.	CC	New process unit with affected equipment - subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
Mid-Plant Cooling Tower No. 2	New cooling tower	Q	No applicable emission limit for cooling towers	N/A
100,000 bbl IFR Tank	New storage tank	CC	Group 1 Storage Tank required to comply with NSPS Subpart Kb except as provided for in paragraphs (n)(8)(i) through (n)(8)(vi); inspection/monitoring, recordkeeping, and reporting requirements.	The tank will be a fixed-roof tank with an internal floating roof. FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
75,000 bbl IFR Tank	New storage tank	CC	Group 1 Storage Tank required to comply with NSPS Subpart Kb except as provided for in paragraphs (n)(8)(i) through (n)(8)(vi); inspection/monitoring, recordkeeping, and reporting requirements.	The tank will be a fixed-roof tank with an internal floating roof. FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.

WEST REFINERY MACT SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable MACT	Explanation/Applicable Limit	Compliance Demonstration
CCR Hot Oil Heater	Increase in fired duty from 90 MMBtu/hr to 123.6 MMBtu/hr (HHV). Decrease in hourly SO2 allowable emission rate limit as a result of decreasing maximum hourly sulfur content based on current operations.	DDDDD	Notification requirements.	FHR will comply with the notification requirements.
Marine Vapor Combustor	Increase in currently permitted naphtha and gasoline throughput. Therefore, considered modified for minor NSR purposes. Decrease in hourly loading rates of most materials. Decrease in NO_x and CO allowable emission rate limits as a result of updating the NOx and CO emission factors based on recent stack testing. Decrease in the VOC allowable emission rate limit as a result of updating the control device efficiency based on recent stack testing. Add particulate and H_2S emission rate allowables. Incorporate PBR Registration Nos. 103051 and 103706. Change in calculation method for NOx and CO based on firing capacity. Change in calculation method for hourly VOC based on highest emission rate of any one material. Change in calculation method for crude oil emissions. Decrease in fuel sulfur content. Removal of penexate as an authorized material.	Y, CC	Marine loading is exempt from the control requirements and FHR maintains documentation demonstrating the HAP emissions are less than 10 tons/yr of any individual HAP and less than 25 tons/yr of total HAPs.	FHR will comply with applicable recordkeeping and reporting requirements.
UDEX Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project.	F, G	New piping components subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.

WEST REFINERY MACT SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable MACT	Explanation/Applicable Limit	Compliance Demonstration
DHT Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	CC	New piping components subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
NHT/CCR Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	CC	New piping components subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
West Crude Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	CC	New piping components subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
Mid Crude Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	CC	New piping components subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
Gasoline Blender Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	CC	New piping components subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.

WEST REFINERY MACT SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable MACT	Explanation/Applicable Limit	Compliance Demonstration
VOC Tank/Loading Fugitives	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of project. Increase in monitoring frequency for existing connectors to reduce emissions.	CC	New piping components subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable design standards, inspection/monitoring, recordkeeping, and reporting requirements.
Site-wide Ammonia Fugitive Emissions	Addition of new fugitive piping components (i.e. valves, flanges, etc.) as part of SCR system installations.	None	No MACT applicable to ammonia piping components.	N/A
Tank 11FB408	Increase in annual throughput and decrease in true vapor pressure of material stored. A grouped ton/yr emission limit is being formed from 11FB408, 11FB409, and 11FB410 based on a total throughput going through any of these tanks. This results in an overall decrease in permitted allowable emissions. All tanks within the group have throughput increase above permitted throughput levels, so tank is considered modified for minor NSR purposes.	CC	Group 2 storage tank subject to inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
Tank 11FB409	Increase in annual throughput and decrease in true vapor pressure of material stored. A grouped ton/yr emission limit is being formed from 11FB408, 11FB409, and 11FB410 based on a total throughput going through any of these tanks. This results in an overall decrease in permitted allowable emissions. All tanks within the group have throughput increase above permitted throughput levels, so tank is considered modified for minor NSR purposes.	CC	Group 2 storage tank subject to inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
Tank 11FB410	Increase in annual throughput and decrease in true vapor pressure of material stored. A grouped ton/yr emission limit is being formed from 11FB408, 11FB409, and 11FB410 based on a total throughput going through any of these tanks. This results in an overall decrease in permitted allowable emissions. All tanks within the group have throughput increase above permitted throughput levels, so tank is considered modified for minor NSR purposes.	CC	Group 2 storage tank subject to inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.

WEST REFINERY MACT SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable MACT	Explanation/Applicable Limit	Compliance Demonstration
Tank 15FB508	Decrease in true vapor pressure of the material stored in the tank. A grouped ton/yr emission limit is being formed from 15FB508 and 15FB510 based on a total throughput going through any of these tanks. This results in a decrease in permit allowable emissions. Although there are no physical changes or changes in the method of operation proposed for Tank 15FB508, the tank is considered modified for minor NSR purposes because it is being included in a group with Tank 15FB510, which is considered modified because of the increase in permitted throughput and vapor pressure.	CC	Group 2 storage tank subject to inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
Tank 15FB510	Increase in annual throughput and true vapor pressure of the material stored in the tank after improving controls. Tank has throughput increase above permitted throughput levels, so considered modified for minor NSR purposes. A grouped ton/yr emission limit is being formed from 15FB508 and 15FB510 based on a total throughput going through any of these tanks. This results in an overall decrease in permitted emissions.	CC	Group 2 storage tank subject to inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
Tank 40FB3043	Increasing annual throughput and true vapor pressure of material stored in the tank above permitted levels. Forming a grouped ton/yr emission limit from 40FB3043 and 40FB3044 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	CC	Group 2 storage tank subject to inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.

WEST REFINERY MACT SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable MACT	Explanation/Applicable Limit	Compliance Demonstration
Tank 40FB3044	Increasing annual throughput and true vapor pressure of material stored in the tank above permitted levels. Forming a grouped ton/yr emission limit from 40FB3043 and 40FB3044 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	CC	Group 2 storage tank subject to inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
Tank 40FB4010	Increase in annual throughput and decrease in annual true vapor pressure of the material stored in the tank. One or both tanks within the group has throughput increase above permitted throughput levels, so considered modified for minor NSR purposes. Grouped ton/yr emission limits are being formed from 40FB4010 and 40FB4011 based on a total throughput going through any of these tanks. This results in a decrease in permitted VOC emissions.	CC	Group 1 or Group 2 storage tank subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	The tank is an external floating roof tank. FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
Tank 40FB4011	Increase in annual throughput and decrease in annual true vapor pressure of the material stored in the tank. One or both tanks within the group has throughput increase above permitted throughput levels, so considered modified for minor NSR purposes. Grouped ton/yr emission limits are being formed from 40FB4010 and 40FB4011 based on a total throughput going through any of these tanks. This results in a decrease in permitted VOC emissions.	CC	Group 1 or Group 2 storage tank subject to design standards, inspection/monitoring, recordkeeping, and reporting requirements.	The tank is an external floating roof tank. FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
Tank 40FB4014	Increasing the true vapor pressure of the material stored in the tank above permitted levels. This results in an increase in permit allowable emissions.	CC	Group 2 storage tank subject to inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
Tank 40FB4015	Increasing the true vapor pressure of the material stored in the tank above permitted levels. This results in an increase in permit allowable emissions.	CC	Group 2 storage tank subject to inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.

WEST REFINERY MACT SUMMARY TABLE

(All emission units with a physical change or change in method of operation causing an emissions increase are addressed)

Description	Proposal	Potentially Applicable MACT	Explanation/Applicable Limit	Compliance Demonstration
Tank 40FB4016	Increasing the true vapor pressure of the material sorted in the tank above permitted levels. Forming a grouped ton/yr emission limit from 40FB4016 and 15FB509 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	CC	Group 2 storage tank subject to inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.
Tank 15FB509	Increasing the true vapor pressure of the material stored in the tank above permitted levels. Forming a grouped ton/yr emission limit from 40FB4016 and 15FB509 based on a total throughput going through any of these tanks. This will result in an increase in permit allowable emissions.	CC	Group 2 storage tank subject to inspection/monitoring, recordkeeping, and reporting requirements.	FHR will comply with applicable inspection/monitoring, recordkeeping, and reporting requirements.

ATTACHMENT IX.D

NONATTAINMENT REVIEW [§116.111(a)(2)(H)]

The West Refinery is not located in a nonattainment county. Therefore, the requirement to conduct a nonattainment review is not applicable.

ATTACHMENT IX.E

PREVENTION OF SIGNIFICANT DETERIORATION (PSD) REVIEW [§116.111(a)(2)(I)]

FHR's West Refinery is considered a major source for purposes of PSD review because it emits more than 100 tons/yr of a criteria pollutant. An analysis was performed to determine if the net emission increase of any pollutant is a significant emissions increase. The EPA has established levels under 40 C.F.R. §52.21(b)(23)(i) at which a net emissions increase is considered significant as shown in the table below.

Pollutant	PSD Significance Level (tons/yr)
Nitrogen oxides (NO_x)	40
Carbon monoxide (CO)	100
Sulfur dioxide (SO_2)	40
Particulate matter (PM)	25
Particulate matter (PM_{10})	15
Particulate matter ($PM_{2.5}$)	10
Ozone	40
Lead	0.6
Fluorides	3
Sulfuric acid mist	7
Total reduced sulfur (including H_2S)	10
Hydrogen sulfide (H_2S)	10
Reduced sulfur compounds (including H_2S)	10

For those sources that are modified because they are undergoing a physical change or change in method of operation that will result in an emissions increase of a regulated pollutant, TCEQ's SIP-approved PSD regulations provide that emissions increases can be based on the difference between baseline actual emissions and either projected actual emissions or the potential-to-emit following the change. FHR has conservatively used the 2-year actual emissions from 2011 and 2012 and the future potential-to-emit after the project to determine each modified source's emissions increase. For those sources that are new, the future potential-to-emit after the project was used as the emissions increase. Although not mandated by TCEQ's PSD regulations, for those sources that are not new or modified but are affected upstream or downstream of the project due to debottlenecking, FHR has conservatively evaluated the 2-year actual emissions from 2011 and 2012 and the future potential-to-emit after the project to determine each source's emissions increase.

For the boilers in the utilities area of the West Refinery, which are not new or modified but are upstream support facilities that will be affected by the project due to the increase in steam demand, FHR has calculated the project emissions increase based on the maximum incremental increase in utilization of the boilers that could occur as a result of the project. Specifically, FHR subtracted the actual baseline steam demand from the projected actual steam demand that could occur as a result of the project to determine an incremental increase in steam demand. This incremental increase in steam demand was then used to determine an incremental increase in actual boiler firing or heat input (MMBtu/hr) that would be required to generate the increase in steam demand. The project emissions increase for the boilers is based on this incremental increase in boiler firing.

For all other sources that are not new or modified but are affected upstream or downstream of the project due to a project-related increase in the utilization of the source (i.e., certain storage tanks), the projected actual emissions (i.e., the maximum annual rate, in tons per year, at which the tanks are projected to emit in any rolling 12-month period during the five years following the date the tanks resume operations following the project) have been calculated based on relevant information in accordance with 30 TAC §116.12(29). Because the projected maximum annual emissions from the affected tanks are expected to reflect maximum emissions in recent years plus an incremental increase in emissions resulting from the project, the projected actual emissions have been based on historical operational data during the 2011/2012 baseline period and the expected incremental increase in utilization of the tanks resulting from the project. Specifically, for each affected tank, the highest monthly emission rate during the 2011/2012 baseline period determined based on actual data from the emissions inventory was used to project an annual emission rate. In addition, an incremental increase in emission rate was calculated based on the increase in tank throughput expected to result from the project. The annual emission rates based on the highest monthly actual emission rate and the incremental increase in emissions from the project were added together to determine the projected actual emission rate. Additionally, consistent with 30 TAC §116.12(30(A)), in calculating the project emissions increase for each affected tank, FHR excluded that portion of the tank's emissions following the project that the tank could have accommodated during the 2011/2012 baseline period and that are unrelated to the project.

Although not required by TCEQ's PSD rules, TCEQ requested that, for certain existing heaters and storage tanks that are neither modified nor affected by the project, FHR demonstrate that the source would not experience an emissions increase as a result of the project. Accordingly, as requested by TCEQ, for the selected heaters and storage tanks that are not new, modified, or affected upstream or downstream of the project, FHR calculated the project emissions increase (or lack thereof) based on the difference between baseline actual emissions and the projected actual emissions, excluding that portion of the tank's/heater's emissions following the project that the tank/heater could have accommodated during the 2011/2012 baseline period and that are unrelated to the project. For the unaffected tanks and heaters, the projected actual emissions have been calculated based on relevant information in accordance with 30 TAC §116.12(29). Because the projected maximum annual emissions from the unaffected tanks and heaters are expected to reflect maximum emissions in recent years, the projected actual emissions have been based on historical operational data during the 2011/2012 baseline period. Specifically, for each unaffected heater, the highest rolling 30-day average firing rate during the baseline period was determined and emission factors from CEMS data, stack testing data, or AP-42 were used to project an annual emission rate.

For each unaffected storage tank, the highest monthly emission rate during the baseline period was determined based on actual data from the emissions inventory, and this emission rate was used to project an annual emission rate. Additionally, consistent with 30 TAC §116.12(30(A)), in calculating the project emissions increase for each unaffected tank/heater, FHR excluded that portion of the tank's/heater's emissions following the project that the tank/heater could have accommodated during the 2011/2012 baseline period and that are unrelated to the project. Because these sources are unaffected by the project, each source's project emissions increase, calculated after excluding emissions the source was capable of accommodating during the baseline period and that are unrelated to the project, is zero.

Fugitive emission rate calculations are provided in Attachment VII.A.5&6 for each process unit that will have an increased number of equipment piping components and/or that will implement annual flange/connector monitoring to reduce VOC emissions. The equipment piping components in each of these process units can be divided into three categories: (1) new components, (2) existing unmonitored components, and (3) existing monitored components. Although the fugitive emission calculations provided in this application represent components from all three of these categories, only the new components and the existing unmonitored components are affected by this project. Because these two categories of components have not been monitored in the past, the methods described in TCEQ's Fugitive Guidance Document dated October 2000 were used for all parts of the net emissions increase calculation. In particular, the TCEQ Guidance method was used to: (1) establish the future potential to emit for new components as a part of the project; (2) establish the baseline actual emissions for existing unmonitored components; and (3) establish the future potential to emit for existing unmonitored
components. Because existing monitored components are not modified as part of this project, the netting calculations do not reflect an emissions increase from these components.

The sum of the emissions increases from all sources was calculated and compared to the values listed in the table above. As demonstrated in the following Tables 1F and 2F, only NO_X, PM_{10}, $PM_{2.5}$, and VOC (ozone) project emissions increases will be greater than the PSD significance levels defined at 40 C.F.R. § 52.21(b)(23)(i); 30 TAC §116.12(18)(A). Since the project emissions increases of CO, SO_2, PM, and H_2S are below the PSD significance levels, the PSD analysis for these pollutants is complete. Because NO_X, PM_{10}, $PM_{2.5}$, and VOC (ozone) project emissions increases exceed PSD significance levels, a further determination of the net NO_X, PM_{10}, $PM_{2.5}$, and VOC (ozone) emissions increases considering all site wide contemporaneous changes has been conducted. The contemporaneous period is defined as the period between the date the increase from the proposed change occurs and 5 years prior to the date that construction on the proposed change commences. We anticipate construction to commence on the project in 2015, with operation to begin in 2016; therefore, the contemporaneous period for this project is from 2010 to 2016. As set forth in Table 3F, the net NO_X, PM_{10}, $PM_{2.5}$, and VOC (ozone) emission increases and decreases are less than the PSD significance levels defined at 40 C.F.R. Part §52.21(b)(23)(i) and 30 TAC §116.12(18)(A). Therefore, PSD review is not triggered.

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TABLE 1F
AIR QUALITY APPLICATION SUPPLEMENT

Permit No.: N/A	Application Submittal Date: December 2012
Company: Flint Hills Resources Corpus Christi, LLC	
RN: RN100235266	Facility Location: West Refinery
City: Corpus Christi	County: Nueces
Permit Unit I.D.: N/A	Permit Name: N/A
Permit Activity: ☑ New Source ☐ Modification	
Project or Process Description: Domestic Crude Project	

Complete for all Pollutants with a Project Emission Increase.	POLLUTANTS					
	Ozone	CO	PM_{10}	NO_X	SO	Other[1]
	VOC	NO_X				PM,PM2.5,H2S
Nonattainment? ☐ YES ☑ NO	NO	NO	NO	NO	NO	NO
Existing site PTE (tpy)?	> 100	> 100	> 100	> 100	> 100	>100, >100,>10
Proposed project emission increases (tpy from 2F)[3]	67.48	65.37	23.01	61.83	15.34	23.79,22.41,0.73
Is the existing site a major source? [2] If not, is the project a major source by itself? ☐ YES ☐ NO	YES	YES	YES	YES	YES	YES
If site is major, is project increase significant?	YES	NO	YES	YES	NO	NO,YES,NO
If netting required, estimated start of construction? 09/2015						
5 years prior to start of construction 09/2010						contemporaneous
Estimated start of operation 09/2016						period
Net contemporaneous change, including proposed project, from Table 3F. (tpy)	-39.14	N/A	-2.13	-228.33	N/A	-4.28
FNSR APPLICABLE? ☐ YES ☑ NO	NO	NO	NO	NO	NO	NO

1 Other PSD pollutants.

2 Nonattainment major source is defined in Table 1 in 30 TAC 116.12(11) by pollutant and county. PSD thresholds are found in 40 CFR § 51.166(b)(1).

3 Sum of proposed emissions minus baseline emissions, increases only. Nonattainment thresholds are found in Table 1 in 30 TAC 116.12(11) and PSD thresholds in 40 CFR § 51.166(b)(23).

The representations made above and on the accompanying tables are true and correct to the best of my knowledge.

[signature]	Vice President and Mfg Manager	2/3/14
Signature	Title	Date

TCEQ - 10154 (Revised 10/08) Table 1F
These forms are for use by facilities subject to air quality permit requirements and may be revised periodically. (APDG 5912v1)

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TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [1]:	NO_X	**Permit:**	6819A
Baseline Period:	2011 to 2012		

	Affected or Modified Facilities [2] FIN	EPN	Permit NO.	Actual Emissions [3] (tons/yr)	B Baseline Emissions [4] (tons/yr)	A Proposed Emissions [5] (tons/yr)	Projected Actual Emissions (tons/yr)	Difference (A-B) [5] (tons/yr)	Correction [7] (ton/yr)	Project Increase [8] (tons/yr)
1	SATGASHTR	SATGASHTR	8803A	0.00	0.00	14.78	N/A	14.78	0	14.78
2	39BA3901	JJ-4	8803A	2.47	2.47	4.06	N/A	1.59	0	1.59
3	Various Boilers *	Various Boilers	8803A	N/A	N/A	30.36	N/A	30.36	0	30.36
4	37BA1 **	KK-3	8803A	7.35	7.35	16.80	9.86	2.52	(2.52)	0.00
5	37BA2	KK-3	8803A	4.07	4.07	16.80	N/A	12.73	0	12.73
6	39BA3900 **	JJ-4	8803A	6.22	6.22	1.25	1.18	-5.05	0	0.00
7	40BA101 **	A-103, 40BA101ST	8803A	19.39	19.39	41.50	22.73	3.34	(3.34)	0.00
8	42BA1 **	A-203	8803A	62.35	62.35	145.57	73.81	11.46	(11.46)	0.00
9	56BA1 **	DDS-HTRSTK	8803A	2.02	2.02	7.88	3.58	1.56	(1.56)	0.00
10	56BA2 **	DDS-HTRSTK	8803A	2.92	2.92	7.88	3.72	0.80	(0.80)	0.00
11	45BD3	V-8	8803A	0.92	0.92	1.13	0.95	0.03	0	0.03
12	LW-8 ***	VCS-1 ***	8803A	0.78	0.78	2.25	N/A	1.47	0	1.47
13	MSSFUGS	MSSFUGS	8803A	0.00	0.00	0.87	N/A	0.87	0	0.87
14										
							PAGE SUBTOTAL: [9]			61.83
								Total		61.83

* Project increase based on incremental increase in emissions since only a downstream affected source.

** This existing source is not modified or affected by the project but is nevertheless included in this table at the request of TCEQ. The "Correction" reflects that portion of the unaffected source's projected actual emissions that the source could have accommodated during the baseline period and that are unrelated to the project. Because the source is not affected by the project, its project emissions increase, after excluding emissions the source was capable of accommodating during the baseline period and that are unrelated to the project, is zero.

*** The baseline emissions were corrected based on calculation methods and emission factors used in this application.

TCEQ

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [1]:	CO	**Permit:**	6819A
Baseline Period:	2011 **to** 2012		

	Affected or Modified Facilities [2] FIN	EPN	Permit NO.	Actual Emissions [3] (tons/yr)	B Baseline Emissions [4] (tons/yr)	A Proposed Emissions [5] (tons/yr)	Projected Actual Emissions (tons/yr)	Difference (A-B) [5] (tons/yr)	Correction [7] (ton/yr)	Project Increase [8] (tons/yr)
1	SATGASHTR	SATGASHTR	8803A	0.00	0.00	14.43	N/A	14.43	0	14.43
2	39BA3901	JJ-4	8803A	0.01	0.01	17.81	N/A	17.80	0	17.80
3	Various Boilers *	Various Boilers *	8803A	N/A	N/A	14.72	N/A	14.72	0	14.72
4	37BA1 **	KK-3	8803A	0.02	0.02	14.01	0.03	0.01	(0.01)	0.00
5	37BA2	KK-3	8803A	0.01	0.01	14.01	N/A	14.00	0	14.00
6	39BA3900 **	JJ-4	8803A	0.01	0.01	13.67	0.02	0.01	(0.01)	0.00
7	40BA101 **	A-103, 40BA101ST	8803A	19.82	19.82	75.80	75.80	55.98	(55.98)	0.00
8	42BA1 **	A-203	8803A	0.82	0.82	104.04	1.66	0.84	(0.84)	0.00
9	56BA1 **	DDS-HTRSTK	8803A	0.005	0.005	8.76	0.009	0.004	(0.004)	0.00
10	56BA2 **	DDS-HTRSTK	8803A	0.009	0.009	8.76	0.011	0.002	(0.002)	0.00
11	45BD3	V-8	8803A	7.85	7.85	9.64	8.14	0.29	0	0.29
12	LW-8 ***	VCS-1 ***	8803A	1.90	1.90	5.47	N/A	3.57	0	3.57
13	MSSFUGS	MSSFUGS	8803A	0.00	0.00	0.57	N/A	0.57	0	0.57
14										
							PAGE SUBTOTAL: [9]			65.37
								Total		65.37

* Project increase based on incremental increase in emissions since only a downstream affected source.

** This existing source is not modified or affected by the project but is nevertheless included in this table at the request of TCEQ. The "Correction" reflects that portion of the unaffected source's projected actual emissions that the source could have accommodated during the baseline period and that are unrelated to the project. Because the source is not affected by the project, its project emissions increase, after excluding emissions the source was capable of accommodating during the baseline period and that are unrelated to the project, is zero.

*** The baseline emissions were corrected based on calculation methods and emission factors used in this application.

TCEQ

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [1]**:** SO_2		**Permit:**	6819A
Baseline Period:	2011 **to** 2012		

	Affected or Modified Facilities [2] FIN	EPN	Permit NO.	Actual Emissions [3] (tons/yr)	B Baseline Emissions [4] (tons/yr)	A Proposed Emissions [5] (tons/yr)	Projected Actual Emissions (tons/yr)	Difference (A-B) [5] (tons/yr)	Correction [7] (ton/yr)	Project Increase [8] (tons/yr)
1	SATGASHTR	SATGASHTR	8803A	0.00	0.00	2.65	N/A	2.65	0	2.65
2	39BA3901	JJ-4	8803A	0.05	0.05	4.61	N/A	4.56	0	4.56
3	Various Boilers *	Various Boilers *	8803A	N/A	N/A	6.01	N/A	6.01	0	6.01
4	37BA1 ***	KK-3	8803A	0.91	0.91	0.53	0.43	-0.48	0	0.00
5	37BA2	KK-3	8803A	0.51	0.51	0.53	N/A	0.03	0	0.03
6	39BA3900 **	JJ-4	8803A	0.03	0.03	1.42	0.07	0.03	(0.03)	0.00
7	40BA101 **	A-103, 40BA101ST	8803A	0.33	0.33	18.90	0.54	0.21	(0.21)	0.00
8	42BA1 ***	A-203	8803A	7.75	7.75	3.96	3.17	-4.58	0	0.00
9	56BA1 ***	DDS-HTRSTK	8803A	0.25	0.25	0.30	0.16	-0.09	0	0.00
10	56BA2 ***	DDS-HTRSTK	8803A	0.43	0.43	0.30	0.19	-0.24	0	0.00
11	45BD3	V-8	8803A	0.37	0.37	0.50	0.43	0.07	0	0.07
12	LW-8	VCS-1	8803A	0.09	0.09	2.03	N/A	1.95	0	1.95
13	MSSFUGS	MSSFUGS	8803A	0.00	0.00	0.07	N/A	0.07	0	0.07
14										
						PAGE SUBTOTAL: [9]				15.34
								Total		15.34

* Project increase based on incremental increase in emissions since only a downstream affected source.

** This existing source is not modified or affected by the project but is nevertheless included in this table at the request of TCEQ. The "Correction" reflects that portion of the unaffected source's projected actual emissions that the source could have accommodated during the baseline period and that are unrelated to the project. Because the source is not affected by the project, its project emissions increase, after excluding emissions the source was capable of accommodating during the baseline period and that are unrelated to the project, is zero.

*** This existing source is not modified or affected by the project but is nevertheless included in this table at the request of TCEQ. The projected actual actuals reflects the emission reduction project for treating sulfur in the fuel gas.

TCEQ

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [1]: PM		**Permit:**	6819A
Baseline Period:	2011	**to**	2012

	Affected or Modified Facilities [2] FIN	EPN	Permit NO.	Actual Emissions [3] (tons/yr)	B Baseline Emissions [4] (tons/yr)	A Proposed Emissions [5] (tons/yr)	Projected Actual Emissions (tons/yr)	Difference (A-B) [5] (tons/yr)	Correction [7] (ton/yr)	Project Increase [8] (tons/yr)
1	SATGASHTR	SATGASHTR	8803A	0.00	0.00	15.23	N/A	15.23	0	15.23
2	39BA3901	JJ-4	8803A	1.00	1.00	3.66	N/A	2.66	0	2.66
3	Various Boilers *	Various Boilers *	8803A	N/A	N/A	2.10	N/A	2.10	0	2.10
4	37BA1 **	KK-3	8803A	1.88	1.88	2.80	2.28	0.40	(0.40)	0.00
5	37BA2	KK-3	8803A	1.04	1.04	2.80	N/A	1.76	0	1.76
6	39BA3900 **	JJ-4	8803A	0.59	0.59	1.12	0.69	0.10	(0.10)	0.00
7	40BA101 **	A-103, 40BA101ST	8803A	4.95	4.95	6.86	6.27	1.32	(1.32)	0.00
8	42BA1 **	A-203	8803A	7.67	7.67	10.40	9.23	1.56	(1.56)	0.00
9	56BA1 **	DDS-HTRSTK	8803A	0.53	0.53	1.31	0.93	0.41	(0.41)	0.00
10	56BA2 **	DDS-HTRSTK	8803A	0.89	0.89	1.31	1.13	0.24	(0.24)	0.00
11	LW-8	VCS-1	8803A	0.00	0.00	0.51	N/A	0.51	0	0.51
12	MSSFUGS	MSSFUGS	8803A	0.00	0.00	0.02	N/A	0.02	0	0.02
13	44EF2	F-S-202	8803A	0.00	0.00	1.51	N/A	1.51	0	1.51
						PAGE SUBTOTAL: [9]				23.79
								Total		23.79

* Project increase based on incremental increase in emissions since only a downstream affected source.

** This existing source is not modified or affected by the project but is nevertheless included in this table at the request of TCEQ. The "Correction" reflects that portion of the unaffected source's projected actual emissions that the source could have accommodated during the baseline period and that are unrelated to the project. Because the source is not affected by the project, its project emissions increase, after excluding emissions the source was capable of accommodating during the baseline period and that are unrelated to the project, is zero.

TCEQ

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [(1)]:	PM_{10}	**Permit:**	6819A
Baseline Period:	2011	**to**	2012

	Affected or Modified Facilities [(2)] FIN	EPN	Permit NO.	Actual Emissions [(3)] (tons/yr)	B Baseline Emissions [(4)] (tons/yr)	A Proposed Emissions [(5)] (tons/yr)	Projected Actual Emissions (tons/yr)	Difference (A-B) [5] (tons/yr)	Correction [(7)] (ton/yr)	Project Increase [(8)] (tons/yr)
1	SATGASHTR	SATGASHTR	8803A	0.00	0.00	15.23	N/A	15.23	0	15.23
2	39BA3901	JJ-4	8803A	1.00	1.00	3.66	N/A	2.66	0	2.66
3	Various Boilers *	Various Boilers *	8803A	N/A	N/A	2.10	N/A	2.10	0	2.10
4	37BA1 **	KK-3	8803A	1.88	1.88	2.80	2.28	0.40	(0.40)	0.00
5	37BA2	KK-3	8803A	1.04	1.04	2.80	N/A	1.76	0	1.76
6	39BA3900 **	JJ-4	8803A	0.59	0.59	1.12	0.69	0.10	(0.10)	0.00
7	40BA101 **	A-103, 40BA101ST	8803A	4.95	4.95	6.86	6.27	1.32	(1.32)	0.00
8	42BA1 **	A-203	8803A	7.67	7.67	10.40	9.23	1.56	(1.56)	0.00
9	56BA1 **	DDS-HTRSTK	8803A	0.53	0.53	1.31	0.93	0.41	(0.41)	0.00
10	56BA2 **	DDS-HTRSTK	8803A	0.89	0.89	1.31	1.13	0.24	(0.24)	0.00
11	LW-8	VCS-1	8803A	0.00	0.00	0.51	N/A	0.51	0	0.51
12	MSSFUGS	MSSFUGS	8803A	0.00	0.00	0.00	N/A	0.00	0	0.0001
13	44EF2	F-S-202	8803A	0.00	0.00	0.76	N/A	0.76	0	0.76
						PAGE SUBTOTAL: [(9)]				23.01
								Total		23.01

* Project increase based on incremental increase in emissions since only a downstream affected source.

** This existing source is not modified or affected by the project but is nevertheless included in this table at the request of TCEQ. The "Correction" reflects that portion of the unaffected source's projected actual emissions that the source could have accommodated during the baseline period and that are unrelated to the project. Because the source is not affected by the project, its project emissions increase, after excluding emissions the source was capable of accommodating during the baseline period and that are unrelated to the project, is zero.

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [1]:	$PM_{2.5}$	**Permit:**	6819A
Baseline Period:	2011	**to**	2012

	Affected or Modified Facilities [2] FIN	EPN	Permit NO.	Actual Emissions [3] (tons/yr)	B Baseline Emissions [4] (tons/yr)	A Proposed Emissions [5] (tons/yr)	Projected Actual Emissions (tons/yr)	Difference (A-B) [5] (tons/yr)	Correction [7] (ton/yr)	Project Increase [8] (tons/yr)
1	SATGASHTR	SATGASHTR	8803A	0.00	0.00	15.23	N/A	15.23	0	15.23
2	39BA3901	JJ-4	8803A	1.00	1.00	3.66	N/A	2.66	0	2.66
3	Various Boilers *	Various Boilers *	8803A	N/A	N/A	2.10	N/A	2.10	0	2.10
4	37BA1 **	KK-3	8803A	1.88	1.88	2.80	2.28	0.40	(0.40)	0.00
5	37BA2	KK-3	8803A	1.04	1.04	2.80	N/A	1.76	0	1.76
6	39BA3900 **	JJ-4	8803A	0.59	0.59	1.12	0.69	0.10	(0.10)	0.00
7	40BA101 **	A-103, 40BA101ST	8803A	4.95	4.95	6.86	6.27	1.32	(1.32)	0.00
8	42BA1 **	A-203	8803A	7.67	7.67	10.40	9.23	1.56	(1.56)	0.00
9	56BA1 **	DDS-HTRSTK	8803A	0.53	0.53	1.31	0.93	0.41	(0.41)	0.00
10	56BA2 **	DDS-HTRSTK	8803A	0.89	0.89	1.31	1.13	0.24	(0.24)	0.00
11	LW-8	VCS-1	8803A	0.00	0.00	0.51	N/A	0.51	0	0.51
12	MSSFUGS	MSSFUGS	8803A	0.00	0.00	0.00	N/A	0.00	0	0.00
13	44EF2	F-S-202	8803A	0.00	0.00	0.15	N/A	0.15	0	0.15
							PAGE SUBTOTAL: [9]			22.41
								Total		22.41

* Project increase based on incremental increase in emissions since only a downstream affected source.

** This existing source is not modified or affected by the project but is nevertheless included in this table at the request of TCEQ. The "Correction" reflects that portion of the unaffected source's projected actual emissions that the source could have accommodated during the baseline period and that are unrelated to the project. Because the source is not affected by the project, its project emissions increase, after excluding emissions the source was capable of accommodating during the baseline period and that are unrelated to the project, is zero.

TCEQ

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [1]: VOC		**Permit:**	6819A
Baseline Period:	2011	**to**	2012

	Affected or Modified Facilities [2] FIN	EPN	Permit NO.	Actual Emissions [3] (tons/yr)	B Baseline Emissions [4] (tons/yr)	A Proposed Emissions [5] (tons/yr)	Projected Actual Emissions (tons/yr)	Difference (A-B) [5] (tons/yr)	Correction [7] (ton/yr)	Project Increase [8] (tons/yr)
1	SATGASHTR	SATGASHTR	8803A	0.00	0.00	1.22	N/A	1.22	0	1.22
2	39BA3901	JJ-4	8803A	1.07	1.07	2.92	N/A	1.84	0	1.84
3	Various Boilers *	Various Boilers	8803A	N/A	N/A	2.27	N/A	2.27	0	2.27
4	37BA1 **	KK-3	8803A	1.02	1.02	1.67	1.37	0.35	(0.35)	0.00
5	37BA2	KK-3	8803A	0.56	0.56	1.67	N/A	1.11	0	1.11
6	39BA3900 **	JJ-4	8803A	0.71	0.71	0.90	0.85	0.13	(0.13)	0.00
7	40BA101 **	A-103, 40BA101ST	8803A	3.80	3.80	4.96	4.54	0.74	(0.74)	0.00
8	42BA1 **	A-203	8803A	8.62	8.62	12.43	9.93	1.31	(1.31)	0.00
9	56BA1 **	DDS-HTRSTK	8803A	0.28	0.28	0.95	0.50	0.22	(0.22)	0.00
10	56BA2 **	DDS-HTRSTK	8803A	0.48	0.48	0.95	0.61	0.13	(0.13)	0.00
11	45BD3	V-8	8803A	3.80	3.80	4.68	4.43	0.63	0	0.63
12	LW-8 ***	VCS-1	8803A	3.80	3.80	17.06	N/A	13.26	0	13.26
13	MSSFUGS	MSSFUGS	8803A	0.00	0.00	3.64	N/A	3.64	0	3.64
14	F-SATGAS3	F-SATGAS3	8803A	0.00	0.00	11.66	N/A	11.66	0	11.66
15	14-UDEX	F-14-UDEX	8803A	0.00	0.00	0.07	N/A	0.07	0	0.07
16	37	F-37	8803A	21.29	21.29	17.78	N/A	-3.51	0	0.00
							PAGE SUBTOTAL: [9]			35.71
								Total		

* Project increase based on incremental increase in emissions since only a downstream affected source.

** This existing source is not modified or affected by the project but is nevertheless included in this table at the request of TCEQ. The "Correction" reflects that portion of the unaffected source's projected actual emissions that the source could have accommodated during the baseline period and that are unrelated to the project. Because the source is not affected by the project, its project emissions increase, after excluding emissions the source was capable of accommodating during the baseline period and that are unrelated to the project, is zero.

*** The baseline emissions were corrected based on calculation methods and emission factors used in this application.

TCEQ

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant (1):	VOC	**Permit:**	6819A
Baseline Period:	2011 **to** 2012		

	Affected or Modified Facilities (2) FIN	EPN	Permit NO.	Actual Emissions (3) (tons/yr)	B Baseline Emissions (4) (tons/yr)	A Proposed Emissions (5) (tons/yr)	Projected Actual Emissions (tons/yr)	Difference (A-B) 5 (tons/yr)	Correction (7) (ton/yr)	Project Increase (8) (tons/yr)
17	39	F-39	8803A	17.78	17.78	0.58	N/A	-17.20	0	0.00
18	40	F-40	8803A	25.01	25.01	22.23	N/A	-2.78	0	0.00
19	42	F-42	8803A	39.98	39.98	38.63	N/A	-1.35	0	0.00
20	P-GB	F-GB	8803A	6.83	6.83	5.08	N/A	-1.75	0	0.00
21	P-VOC	F-TK-VOC	8803A	0.00	0.00	2.93	N/A	2.93	0	2.93
22	44EF2	F-S-202	8803A	0.00	0.00	5.52	N/A	5.52	0	5.52
23	IFRTK1	IFRTK1	8803A	0.00	0.00	1.99	N/A	1.99	0	1.99
24	IFRTK2	IFRTK2	8803A	0.00	0.00	1.76	N/A	1.76	0	1.76
25	08FB108R1 ****	FB108R1	8803A	6.84	6.84	N/A	10.52	3.67	(3.66)	0.01
26	08FB109R ****	FB109R	8803A	3.49	3.49	N/A	5.23	1.74	(0.97)	0.78
27	08FB142 ****	FB142	8803A	7.28	7.28	N/A	9.11	1.83	(1.74)	0.09
28	08FB147 ****	FB147	8803A	15.89	15.89	N/A	19.90	4.01	(3.86)	0.15
29	08FB137 ****	FB137	8803A	4.15	4.15	N/A	5.53	1.37	(1.11)	0.26
30	11FB402 ****	11FB402	8803A	0.05	0.05	N/A	0.55	0.50	(0.12)	0.38
31	11FB403 ****	11FB403	8803A	0.04	0.04	N/A	0.55	0.52	(0.14)	0.38
							PAGE SUBTOTAL: (9)			14.24
								Total		

**** For this affected source, the "Correction" reflects that portion of the unaffected source's projected actual emissions that the source could have accommodated during the baseline period and that are unrelated to the project.

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TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [1]:	VOC		**Permit:**	6819A
Baseline Period:	2011	**to**	2012	

	Affected or Modified Facilities [2] FIN	EPN	Permit NO.	Actual Emissions [3] (tons/yr)	B Baseline Emissions [4] (tons/yr)	A Proposed Emissions [5] (tons/yr)	Projected Actual Emissions (tons/yr)	Difference (A-B) [5] (tons/yr)	Correction [7] (ton/yr)	Project Increase [8] (tons/yr)
32	Combined Limit for 11FB408, 11FB409, 11FB410		8803A	0.45	0.45	2.35	N/A	1.90	0	1.90
33	15FB507 ****	FB507	8803A	3.20	3.20	N/A	5.00	1.80	(1.71)	0.09
34	Combined Limit for 15FB508, 15FB510 *****		8803A	16.05	1.52	2.67	N/A	1.15	0	1.15
35	40FB3041 ****	FB3041	8803A	1.59	1.59	N/A	19.81	18.22	(17.08)	1.14
36	Combined Limit for 40FB3043 and 40FB3044 *****		8803A	5.55	0.59	1.03	N/A	0.44	0	0.44
37	Combined Limit for 40FB4010 and 40FB4011		8803A	7.70	7.70	19.73	N/A	12.03	0	12.03
38	40FB4012 ****	FB4012	8803A	2.13	2.13	N/A	4.20	2.07	(2.02)	0.04
39	40FB4013 ****	FB4013	8803A	2.05	2.05	N/A	3.69	1.64	(1.60)	0.04
40	40FB4014 ******	FB4014	8803A	0.71	0.71	0.88	N/A	0.17	0	0.17
41	40FB4015 ******	FB4015	8803A	0.46	0.46	0.63	N/A	0.17	0	0.17
42	Combined Limit for 40FB4016, 15FB509 ******		8803A	26.95	1.33	1.67	N/A	0.34	0	0.34
							PAGE SUBTOTAL: [9]			17.52
								Total		67.48

**** For this affected source, the "Correction" reflects that portion of the unaffected source's projected actual emissions that the source could have accommodated during the baseline period and that are unrelated to the project.

***** Baseline emissions are based on actual emission from 15FB508 and allowables from pollution control project for 15FB510.

****** Baseline emissions are based on allowables from pollution control project.

TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant [1]:	H2S	**Permit:**	6819A
Baseline Period:	2010	**to**	2011

	Affected or Modified Facilities [2] FIN	EPN	Permit NO.	Actual Emissions [3] (tons/yr)	B Baseline Emissions [4] (ton/yr)	A Proposed Emissions [5] (ton/yr)	Projected Actual Emissions (ton/yr)	Difference (A-B) [5] (ton/yr)	Correction [7] (ton/yr)	Project Increase [8] (ton/yr)
1	MSSFUGS	MSSFUGS	8803A	0.00	0.00	0.001	N/A	0.001	0	0.001
2	44EF2	F-S-202	8803A	0.00	0.00	0.0000	N/A	0.0000	0	0.0000
3	45BD3	V-8	8803A	0.0000	0.0000	0.0050	N/A	0.0050	0	0.0050
4	LW-8	VCS-1	6819A	0.00	0.00	0.02	N/A	0.02	0	0.02
5	08FB137	FB137	8803A	0.00	0.00	0.10	N/A	0.10	0	0.10
6	08FB142	FB142	8803A	0.00	0.00	0.21	N/A	0.21	0	0.21
7	08FB147	FB147	8803A	0.00	0.00	0.21	N/A	0.21	0	0.21
8	Combined Limit for 40FB4010 and 40FB4011		8803A	0.00	0.00	0.17	N/A	0.17	0	0.17
9										
10										
11										
12										
							PAGE SUBTOTAL: [9]			0.72
								Total		0.72

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TABLE 2F
PROJECT EMISSIONS INCREASE

1. Individual Table 2F=s should be used to summarize the project emission increase for each criteria pollutant
2. Emission Point Number as designated in NSR Permit or Emissions Inventory
3. All records and calculations for these values must be available upon request
4. Correct actual emissions for currently applicable rule or permit requirements, and periods of non-compliance.
   These corrections, as well as any MSS previously demonstrated under 30 TAC 101, should be explained in the Table 2F supplement.
5. If projected actual emission is used it must be noted in the next column and the basis for the projection identified in the Table 2F supplement
6. Proposed Emissions (column B) minus Baseline Emissions (column A)
7. Correction made to emission increase for what portion could have been accommodated during the baseline period. The justification and basis for this estimate must be provided in the Table 2F supplement
8. Obtained by subtracting the correction from the difference. Must be a positive number.
9. Sum all values for this page.

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TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant:	NO_X, CO, PM, PM_{10}, $PM_{2.5}$	Line	4, 6, 7, 8, 9, 10	Type [10]	Basis for Correction (Capable of Accommodating)
Explanation: Correction reflects that portion of the source's projected actual emissions that the source could have accomodated during the baseline period and that are unrelated to the project and are based on the highest average firing rate over any 30-day period during the baseline period projected out 12 months. See calculations in Attachment C.					

[10] Type of note. Generally would be baseline adjustment, basis for projected actual, or basis for correction (what could have been accomodated).

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TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant:	SO_2	Line	6, 7	Type [10]	Basis for Correction (Capable of Accommodating)

Explanation:

Correction reflects that portion of the source's projected actual emissions that the source could have accomodated during the baseline period and that are unrelated to the project and are based on the highest average firing rate over any 30-day period during the baseline period projected out 12 months.
See calculations in Attachment C.

[10] Type of note. Generally would be baseline adjustment, basis for projected actual, or basis for correction (what could have been accomodated).

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TABLE 2F
PROJECT EMISSIONS INCREASE

Pollutant:	VOC	Line	4, 6, 7, 8, 9, 10, 26, 27, 28, 29, 30, 31, 32, 34, 36, 39, 40	Type [10]	Basis for Correction (Capable of Accommodating)
Explanation: Lines 4, 6, 7, 8, 9, 10 - Correction reflects that portion of the source's projected actual emissions that the source could have accomodated during the baseline period and that are unrelated to the project and are based on the highest average firing rate over any 30-day period during the baseline period projected out 12 months. See calculations in Attachment C. Lines 26, 27, 28, 29, 30, 31, 32, 34, 36, 39, 40 - Correction reflects that portion of the source's projected actual emissions that the source could have accomodated during the baseline period and that are unrelated to the project and are based on the highest monthly actual emission rate during the baseline period calculated using AP-42, Chapter 7 methodology and projected out 12 months. See calculations in Attachment C.					

[10] Type of note. Generally would be baseline adjustment, basis for projected actual, or basis for correction (what could have been accomodated).

TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resources Corpus Christi, LLC	
Permit Application No:	N/A	Criteria Pollutant: NOx

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (tons/yr)
1	January-11	56BA1	DDS-HTRSTK	8803A	New DDS and SRU Units	2006, 2007	0.00	7.88	7.88	7.88
2	January-11	56BA2	DDS-HTRSTK	8803A	New DDS and SRU Units	2006, 2007	0.00	7.88	7.88	7.88
3	January-11	SRU NO. 3	H-15C	8803A	New DDS and SRU Units	2006, 2007	0.00	23.92	23.92	23.92
4	February-11	LW-8, VCS-1	VCS-1	6819A	Amendment for Crude Oil Loading	2009, 2010	1.43	2.86	1.43	1.43
5	January-12	N/A	N/A	8803A	Miscellaneous Changes to Flexible Permit	N/A	N/A	N/A	N/A	N/A
6	July-12	22BA2201	O-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	9.63	16.40	6.77	6.77
7	July-12	61BA1201	N-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	5.58	11.40	5.82	5.82
8	July-12	61BA1202	N-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	4.23	8.67	4.44	4.44
9	October-12	LW-8, VCS-1	VCS-1	103051	Authorize Natural Gasoline at Marine Loading Dock	2010, 2011	0.00	0.53	0.53	0.53
10	December-12	LW-8, VCS-1	VCS-1	103706	Increase in Gasoline Loading Rate at Marine Terminal	2010, 2011	1.47	0.89	(0.58)	(0.58)
11	Proposed	37BA2	KK-3	8803A	Proposed Expansion Project	2011, 2012	4.07	16.80	12.73	12.73
12	Proposed	39BA3901	JJ-4	8803A	Proposed Expansion Project	2011, 2012	2.47	4.06	1.59	1.59
13	Proposed	Various Boilers	Various Boilers	8803A	Proposed Expansion Project	2011, 2012	N/A	30.36	30.36	30.36
						PAGE SUBTOTAL: [8]				102.76
									Project Emissions	
	Summary of Contemporaneous Changes							Total		

Note: The project occurring in January 2012 did not have any physical changes or changes in method of operation associated with it.

TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resources Corpus Christi, LLC
Permit Application No: N/A	Regulated Pollutant: NOx

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (tons/yr)
14	Proposed	45BD3	V-8	8803A	Proposed Expansion Project	2011, 2012	0.92	0.95	0.03	0.03
15	Proposed	LW-8 **	VCS-1	6819A	Proposed Expansion Project	2011, 2012	0.78	2.25	1.47	1.47
16	Proposed	SATGASHTR	SATGASHTR	8803A	Proposed Expansion Project	2011, 2012	0.00	14.78	14.78	14.78
17	Proposed	MSSFUGS	MSSFUGS	8803A	Proposed Expansion Project	2011, 2012	0.00	0.87	0.87	0.87
18	Proposed	37BA1 *	KK-3	8803A	Proposed Expansion Project	2011, 2012	7.35	9.86	2.52	0.00
19	Proposed	39BA3900 *	JJ-4	8803A	Proposed Expansion Project	2011, 2012	6.22	1.18	(5.05)	(5.05)
20	Proposed	40BA101 *	A-103, 40BA101ST	8803A	Proposed Expansion Project	2011, 2012	19.39	22.73	3.34	0.00
21	Proposed	42BA1 *	A-203	8803A	Proposed Expansion Project	2011, 2012	62.35	73.81	11.46	0.00
22	Proposed	56BA1 *	DDS-HTRSTK	8803A	Proposed Expansion Project	2011, 2012	2.02	3.58	1.56	0.00
23	Proposed	56BA2 *	DDS-HTRSTK	8803A	Proposed Expansion Project	2011, 2012	2.92	3.72	0.80	0.00
18	Proposed	SRU NO. 1	H-15A	8803A	Proposed Expansion Project	2011, 2012	0.95	0.00	(0.95)	(0.95)
19	Future	56BA1	DDS-HTRSTK	8803A	Future Debottlenecking Project	2011, 2012	2.02	7.88	5.86	5.86
20	Future	56BA2	DDS-HTRSTK	8803A	Future Debottlenecking Project	2011, 2012	2.92	7.88	4.97	4.97
21	Future	29TA2903	Z-4	8803A	Cogeneration Pollution Control Project	2011, 2012	430.12	77.04	(353.08)	(353.08)
						PAGE SUBTOTAL: [8]				(331.09)
									Project Emissions	
	Summary of Contemporaneous Changes							Total		(228.33)

* "Proposed emissions" reflect projected actual emissions and include emissions that the source could have accomodated during the baseline period and that are unrelated to the project. See Table 2-F.

** The baseline emissions were corrected based on calculation methods and emission factors used in this application.

TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company: Flint Hills Resources Corpus Christi, LLC	
Permit Application No: N/A	Criteria Pollutant: PM10

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (tons/yr)
1	January-11	Sources Under PM/PM10 Emission Rate Cap	Sources Under PM/PM10 Emission Rate Cap	8803A	New DDS and SRU Units	2006, 2007	N/A	N/A	N/A	N/A
2	January-12	N/A	N/A	8803A	Miscellaneous Changes to Flexible Permit	N/A	N/A	N/A	N/A	N/A
3	July-12	22BA2201	O-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.07	1.39	1.32	1.32
4	July-12	61BA1201	N-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.21	4.45	4.24	4.24
5	July-12	61BA1202	N-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.16	3.40	3.24	3.24
6	Proposed	37BA2	KK-3	8803A	Proposed Expansion Project	2011, 2012	1.04	2.80	1.76	1.76
7	Proposed	39BA3901	JJ-4	8803A	Proposed Expansion Project	2011, 2012	1.00	3.66	2.66	2.66
8	Proposed	Various Boilers	Various Boilers	8803A	Proposed Expansion Project	2011, 2012	N/A	2.10	2.10	2.10
9	Proposed	SATGASHTR	SATGASHTR	8803A	Proposed Expansion Project	2011, 2012	0.00	15.23	15.23	15.23
10	Proposed	MSSFUGS	MSSFUGS	8803A	Proposed Expansion Project	2011, 2012	0.00	0.02	0.02	0.02
11	Proposed	SRU NO. 1	H-15A	8803A	Proposed Expansion Project	2011, 2012	0.20	0.00	(0.20)	(0.20)
							PAGE SUBTOTAL: [8]			30.37
									Project Emissions	
	Summary of Contemporaneous Changes							Total		

Notes: (1) The project occurring in January 2011 went through PSD review.

(2) The project occurring in January 2012 did not have any physical changes or changes in method of operation associated with it.

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TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company: Flint Hills Resources Corpus Christi, LLC
Permit Application No: N/A
Regulated Pollutant: PM10

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (ton/yr)
12	Proposed	44EF2	F-S-202	8803A	Proposed Expansion Project	2011, 2012	0.00	0.76	0.76	0.76
13	Proposed	LW-8	VCS-1	6819A	Proposed Expansion Project	2011, 2012	0.00	0.51	0.51	0.51
14	Proposed	37BA1 *	KK-3	8803A	Proposed Expansion Project	2011, 2012	1.88	2.28	0.40	0.00
15	Proposed	39BA3900 *	JJ-4	8803A	Proposed Expansion Project	2011, 2012	0.59	0.69	0.10	0.00
16	Proposed	40BA101 *	A-103, 40BA101ST	8803A	Proposed Expansion Project	2011, 2012	4.95	6.27	1.32	0.00
17	Proposed	42BA1 *	A-203	8803A	Proposed Expansion Project	2011, 2012	7.67	9.23	1.56	0.00
18	Proposed	56BA1 *	DDS-HTRSTK	8803A	Proposed Expansion Project	2011, 2012	0.53	0.93	0.41	0.00
19	Proposed	56BA2 *	DDS-HTRSTK	8803A	Proposed Expansion Project	2011, 2012	0.89	1.13	0.24	0.00
20	Future	44EF1	F-S-201	Future	Pollution Control Project to Install High Efficiency Drift Eliminator	2011, 2012	0.14	1.01	0.86	0.86
21	Future	40EF101	F-S-101	Future	Authorization to Increase Circulation Rate	2011, 2012	0.08	0.33	0.24	0.24
22	Future	07EF755	F-S-2	Future	Authorization to Increase Circulation Rate	2011, 2012	0.09	0.38	0.29	0.29
23	Future	07EF757	F-S-8	Future	Authorization to Increase Circulation Rate	2011, 2012	0.25	0.89	0.64	0.64
24	Future	56BA1	DDS-HTRSTK	8803A	Future Debottlenecking Project	2011, 2012	0.53	1.31	0.78	0.78
25	Future	56BA2	DDS-HTRSTK	8803A	Future Debottlenecking Project	2011, 2012	0.89	1.31	0.42	0.42
26	Future	29TA2903	Z-4	Future	Cogeneration Pollution Control Project	2007, 2008	51.87	14.86	(37.01)	(37.01)
							PAGE SUBTOTAL: [8]			(32.49)
									Project Emissions	
	Summary of Contemporaneous Changes							Total		(2.13)

* "Proposed emissions" reflect projected actual emissions and include emissions that the source could have accomodated during the baseline period and that are unrelated to the project. See Table 2-F.

TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resourcs Corpus Christi, LLC		
Permit Application No:	N/A	Criteria Pollutant:	PM2.5

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (tons/yr)
1	January-11	Sources Under PM/PM10 Emission Rate Cap	Sources Under PM/PM10 Emission Rate Cap	8803A	New DDS and SRU Units	2006, 2007	N/A	N/A	N/A	N/A
2	January-12	N/A	N/A	8803A	Miscellaneous Changes to Flexible Permit	N/A	N/A	N/A	N/A	N/A
3	July-12	22BA2201	O-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.07	1.39	1.32	1.32
4	July-12	61BA1201	N-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.21	4.45	4.24	4.24
5	July-12	61BA1202	N-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.16	3.40	3.24	3.24
6	Proposed	37BA2	KK-3	8803A	Proposed Expansion Project	2011, 2012	1.04	2.80	1.76	1.76
7	Proposed	39BA3901	JJ-4	8803A	Proposed Expansion Project	2011, 2012	1.00	3.66	2.66	2.66
8	Proposed	Various Boilers	Various Boilers	8803A	Proposed Expansion Project	2011, 2012	N/A	2.10	2.10	2.10
9	Proposed	SATGASHTR	SATGASHTR	8803A	Proposed Expansion Project	2011, 2012	0.00	15.23	15.23	15.23
10	Proposed	MSSFUGS	MSSFUGS	8803A	Proposed Expansion Project	2011, 2012	0.00	0.02	0.02	0.02
11	Proposed	SRU NO. 1	H-15A	8803A	Proposed Expansion Project	2011, 2012	0.20	0.00	(0.20)	(0.20)
						PAGE SUBTOTAL: [8]				30.37
									Project Emissions	
	Summary of Contemporaneous Changes							Total		

Notes: (1) The project occurring in January 2011 went through PSD review.

(2) The project occurring in January 2012 did not have any physical changes or changes in method of operation associated with it.

TCEQ

TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resources Corpus Christi, LLC		
Permit Application No:	N/A	Regulated Pollutant:	PM2.5

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (ton/yr)
12	Proposed	44EF2	F-S-202	8803A	Proposed Expansion Project	2011, 2012	0.00	0.15	0.15	0.15
13	Proposed	LW-8	VCS-1	6819A	Proposed Expansion Project	2011, 2012	0.00	0.51	0.51	0.51
14	Proposed	37BA1 *	KK-3	8803A	Proposed Expansion Project	2011, 2012	1.88	2.28	0.40	0.00
15	Proposed	39BA3900 *	JJ-4	8803A	Proposed Expansion Project	2011, 2012	0.59	0.69	0.10	0.00
16	Proposed	40BA101 *	A-103, 40BA101ST	8803A	Proposed Expansion Project	2011, 2012	4.95	6.27	1.32	0.00
17	Proposed	42BA1 *	A-203	8803A	Proposed Expansion Project	2011, 2012	7.67	9.23	1.56	0.00
18	Proposed	56BA1 *	DDS-HTRSTK	8803A	Proposed Expansion Project	2011, 2012	0.53	0.93	0.41	0.00
19	Proposed	56BA2 *	DDS-HTRSTK	8803A	Proposed Expansion Project	2011, 2012	0.89	1.13	0.24	0.00
20	Future	44EF1	F-S-201	Future	Pollution Control Project to Install High Efficiency Drift Eliminator	2011, 2012	0.007	0.201	0.194	0.194
21	Future	40EF101	F-S-101	Future	Authorization to Increase Circulation Rate	2011, 2012	0.004	0.066	0.061	0.061
22	Future	07EF755	F-S-2	Future	Authorization to Increase Circulation Rate	2011, 2012	0.004	0.076	0.071	0.071
23	Future	07EF757	F-S-8	Future	Authorization to Increase Circulation Rate	2011, 2012	0.013	0.177	0.164	0.164
24	Future	56BA1	DDS-HTRSTK	8803A	Future Debottlenecking Project	2011, 2012	0.53	1.31	0.78	0.78
25	Future	56BA2	DDS-HTRSTK	8803A	Future Debottlenecking Project	2011, 2012	0.89	1.31	0.42	0.42
26	Future	29TA2903	Z-4	Future	Cogeneration Pollution Control Project	2007, 2008	51.87	14.86	(37.01)	(37.01)
							PAGE SUBTOTAL: [8]			(34.65)
									Project Emissions	
	Summary of Contemporaneous Changes							Total		(4.28)

* "Proposed emissions" reflect projected actual emissions and include emissions that the source could have accomodated during the baseline period and that are unrelated to the project. See Table 2-F.

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TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resources Corpus Christi, LLC		
Permit Application No:	N/A	Criteria Pollutant:	VOC

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (tons/yr)
1	November-10	40FB4010	FB4010	106.478	Cyclohexane in Tank 40FB4010	2008, 2009	4.08	2.52	(1.56)	0.00
2	January-11	07EF758	F-S-10	8803A	New DDS and SRU Units	2006, 2007	0.00	1.84	1.84	1.84
3	January-11	11FB401, 11FB402, 11FB403, 11FB409, 11FB410	FB401, FB402, FB403, FB409, FB410	8803A	New DDS and SRU Units	2006, 2007	0.00	1.62	1.62	1.62
4	January-11	15FB-DSL	15FB-DSL	8803A	New DDS and SRU Units	2006, 2007	0.00	1.26	1.26	1.26
5	January-11	40FB3045, 40FB3046, 40FB3047	FB3045, FB3046, FB3047	8803A	New DDS and SRU Units	2006, 2007	0.00	3.82	3.82	3.82
6	January-11	56BA1	DDS-HTRSTK	8803A	New DDS and SRU Units	2006, 2007	0.00	0.94	0.94	0.94
7	January-11	56BA2	DDS-HTRSTK	8803A	New DDS and SRU Units	2006, 2007	0.00	0.94	0.94	0.94
8	January-11	C-DDS	F-S-9	8803A	New DDS and SRU Units	2006, 2007	0.00	0.92	0.92	0.92
9	January-11	DDSFUGS	F-DDS	8803A	New DDS and SRU Units	2006, 2007	0.00	24.66	24.66	24.66
10	January-11	P-VOC	F-TK-VOC	8803A	New DDS and SRU Units	2006, 2007	0.00	0.05	0.05	0.05
11	January-11	SRU NO. 3	H-15C	8803A	New DDS and SRU Units	2006, 2007	0.00	1.06	1.06	1.06
12	January-11	SRU1, SRU2, SRU3	F-RR	8803A	New DDS and SRU Units	2006, 2007	0.00	0.08	0.08	0.08
						PAGE SUBTOTAL: [8]				37.19
								Project Emissions		
		Summary of Contemporaneous Changes						Total		

TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resources Corpus Christi, LLC
Permit Application No: N/A	Regulated Pollutant: VOC

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (tons/yr)
13	February-11	40FB3046	FB3046	106.478	IFR Retrofit for Tank 40FB3046	2008, 2009	2.11	0.13	(1.98)	(1.98)
14	February-11	19FB1903	19FB1903	106.261, 106.262 (TCEQ Registration No. 94401)	SURE SOL-150 in Tank 19FB1903	2009, 2010	0.00	0.20	0.20	0.20
15	February-11	LW-8, VCS-1	VCS-1	6819A	Amendment for Crude Oil Loading	2009, 2010	0.02	4.95	4.93	4.93
16	December-11	P-VOC	F-TK-VOC	106.261, 106.262 (TCEQ Registration No. 97974)	West Tank Farm Additional Piping Fugitives	2009, 2010	0.00	0.17	0.17	0.17
17	January-12	44EF1	F-S-201	8803A	Miscellaneous Changes to Flexible Permit	2004, 2005	1.11	7.36	6.25	6.25
18	February-12	Various Tanks	Various Tanks	8803A	30 TAC 116.718 Tank Changes	N/A	N/A	N/A	N/A	N/A
19	June-12	25FA2570	PV25FA2570	102109	PBR for Gas Blanket Seal Drum Vent	2010, 2011	0.00	0.99	0.99	0.99
20	July-12	61	F-61	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.00	0.07	0.07	0.07
21	July-12	08FB149	08FB149	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.55	0.70	0.15	0.15
22	July-12	08FB150	08FB150	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.21	0.45	0.24	0.24
23	July-12	08FB154	08FB154	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.49	0.49	0.00	0.00
						PAGE SUBTOTAL: [8]				11.02
									Project Emissions	
		Summary of Contemporaneous Changes						Total		

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TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resources Corpus Christi, LLC		
Permit Application No:	N/A	Regulated Pollutant:	VOC

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (tons/yr)
24	July-12	22BA2201	O-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.53	0.90	0.37	0.37
25	July-12	25FB2501	25FB2501	102136	PBR for Parex No. 1 Modifications	2008, 2009	1.02	1.02	0.00	0.00
26	July-12	25FB2551	25FB2551	102136	PBR for Parex No. 1 Modifications	2008, 2009	0.05	0.90	0.85	0.85
27	July-12	61BA1201	N-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	1.36	1.36	0.00	0.00
28	July-12	61BA1202	N-3	102136	PBR for Parex No. 1 Modifications	2008, 2009	1.04	1.04	0.00	0.00
29	October-12	LW-8, VCS-1	VCS-1	103051	Authorize Natural Gasoline at Marine Loading Dock	2010, 2011	0.00	3.89	3.89	3.89
30	December-12	LW-8, VCS-1	VCS-1	103706	Increase in Gasoline Loading Rate at Marine Terminal	2010, 2011	7.68	3.40	(4.28)	0.00
31	December-12	Various	APICNTROL	107177	Pollution Control Project for Scrubber System on API & Edens Oil/Water Separators	N/A	N/A	N/A	N/A	N/A
32	December-12	Various	EDENCNTROL	107177	Pollution Control Project for Scrubber System on API & Edens Oil/Water Separators	N/A	N/A	N/A	N/A	N/A
33	December-12	F-WWSYS	F-WWSYS	107177	Pollution Control Project for Scrubber System on API & Edens Oil/Water Separators	N/A	0.00	0.98	0.98	0.98
34	December-12	SSMFUGS	SSMFUGS	107177	Pollution Control Project for Scrubber System on API & Edens Oil/Water Separators	N/A	0.00	0.01	0.01	0.01
							PAGE SUBTOTAL: [8]			5.73
								Project Emissions		
	Summary of Contemporaneous Changes							Total		

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TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resources Corpus Christi, LLC
Permit Application No: N/A	Regulated Pollutant: VOC

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (ton/yr)	A Proposed Emissions (ton/yr)	C Difference (A-B) [5] (ton/yr)	Creditable Decrease or Increase [6] (ton/yr)
35	February-13	TOTE	TOTE	106746	PBR for Nalco Chemical Storage Tote	N/A	0.00	0.01	0.01	0.01
36	April-13	40	F-40	107972	PBR for West Crude Unit Fugitive Components	N/A	0.00	0.42	0.42	0.42
37	May-14	14-UDEX	F-14-UDEX	109254	Annual PBR 106.261	N/A	0.00	0.91	0.91	0.91
38	May-14	P-V	F-38	109254	Annual PBR 106.261	N/A	0.00	0.12	0.12	0.12
39	May-14	25	F-25-3PX	109254	Annual PBR 106.261	N/A	0.00	0.05	0.05	0.05
40	May-14	01	F-01	109254	Annual PBR 106.261	N/A	0.00	0.23	0.23	0.23
41	May-14	P-VOC	F-TK-VOC	109254	Annual PBR 106.261	N/A	0.00	0.05	0.05	0.05
42	May-14	40	F-40	109254	Annual PBR 106.261	N/A	0.00	0.99	0.99	0.99
43	May-13	TOTE1	TOTE1	108255	PBR for Baker Petrolite TOLAD 3922 Totes/West Crude Fugitives	N/A	0.00	0.0002	0.0002	0.0002
44	May-13	TOTE2	TOTE2	108255	PBR for Baker Petrolite TOLAD 3922 Totes/West Crude Fugitives	N/A	0.00	0.0002	0.0002	0.0002
45	May-13	40	F-40	108255	PBR for Baker Petrolite TOLAD 3922 Totes/West Crude Fugitives	N/A	0.00	0.01	0.01	0.01
46	May-13	40	F-40	109682	PBR for Amine Storage Tank and Fugitives	N/A	0.00	0.39	0.39	0.39
47	May-13	H2S SCAV	H2S SCAV	109682	PBR for Amine Storage Tank and Fugitives	N/A	0.00	0.83	0.83	0.83
							PAGE SUBTOTAL: [8]			4.00
								Project Emissions		
		Summary of Contemporaneous Changes						Total		

TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resources Corpus Christi, LLC		
Permit Application No:	N/A	Regulated Pollutant:	VOC

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (ton/yr)	A Proposed Emissions (ton/yr)	C Difference (A-B) [5] (ton/yr)	Creditable Decrease or Increase [6] (ton/yr)
48	June-13	P-VOC	F-TK-VOC	07/13/2198	PBR for 40FB4007/40FB4015 Jumpers	N/A	0.00	0.02	0.02	0.02
49	August-13	38	F-FGHU	11/15/2202	PBR for Additional Fugitive Components in SRU No. 1	N/A	0.00	0.11	0.11	0.11
50	August-13	14	F-14	11/24/2202	PBR for Additional Fugitive Components in Process Units	N/A	0.00	0.48	0.48	0.48
51	August-13	16	F-16	11/24/2202	PBR for Additional Fugitive Components in Process Units	N/A	0.00	0.24	0.24	0.24
52	August-13	22	F-22	11/24/2202	PBR for Additional Fugitive Components in Process Units	N/A	0.00	0.01	0.01	0.01
53	August-13	40	F-40	11/24/2202	PBR for Additional Fugitive Components in Process Units	N/A	0.00	0.67	0.67	0.67
54	August-13	38	F-FGHU	11/24/2202	PBR for Additional Fugitive Components in Process Units	N/A	0.00	0.15	0.15	0.15
55	Pending	16	F-16	10/04/2202	PBR for Additional Fugitive Components	N/A	0.00	0.02	0.02	0.02
56	Pending	P-VOC	F-TK-VOC	10/04/2202	PBR for Additional Fugitive Components	N/A	0.00	0.01	0.01	0.01
57	Pending	SRU1, SRU2, SRU3	F-RR	10/04/2202	PBR for Additional Fugitive Components	N/A	0.00	0.001	0.001	0.001
							PAGE SUBTOTAL: [8]			1.71
								Project Emissions		
		Summary of Contemporaneous Changes						Total		

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TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company: Flint Hills Resources Corpus Christi, LLC
Permit Application No: N/A
Regulated Pollutant: VOC

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (tons/yr)
58	Proposed	37	F-37	8803A	Proposed Expansion Project	2011, 2012	21.29	17.78	(3.51)	(3.51)
59	Proposed	39	F-39	8803A	Proposed Expansion Project	2011, 2012	17.78	12.13	(5.65)	(5.65)
60	Proposed	40	F-40	8803A	Proposed Expansion Project	2011, 2012	25.01	22.23	(2.78)	(2.78)
61	Proposed	42	F-42	8803A	Proposed Expansion Project	2011, 2012	39.98	38.63	(1.35)	(1.35)
62	Proposed	08FB108R1 *	FB108R1	8803A	Proposed Expansion Project	2011, 2012	6.84	10.52	3.67	0.01
63	Proposed	08FB109R *	FB109R	8803A	Proposed Expansion Project	2011, 2012	3.49	5.23	1.74	0.78
64	Proposed	14-UDEX	F-14-UDEX	8803A	Proposed Expansion Project	2011, 2012	0.00	0.07	0.07	0.07
65	Proposed	15FB507 *	FB507	8803A	Proposed Expansion Project	2011, 2012	3.20	5.00	1.80	0.09
66	Proposed	37BA2	KK-3	8803A	Proposed Expansion Project	2011, 2012	0.56	1.67	1.11	1.11
							PAGE SUBTOTAL: [8]			(11.23)
									Project Emissions	
		Summary of Contemporaneous Changes						Total		

* "Proposed emissions" reflect projected actual emissions and include emissions that the source could have accomodated during the baseline period and that are unrelated to the project. See Table 2-F.

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TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resources Corpus Christi, LLC		
Permit Application No:	N/A	Regulated Pollutant:	VOC

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (tons/yr)
67	Proposed	39BA3901	JJ-4	8803A	Proposed Expansion Project	2011, 2012	1.07	2.92	1.84	1.84
68	Proposed	40FB3041 *	FB3041	8803A	Proposed Expansion Project	2011, 2012	1.59	19.81	18.22	1.14
69	Future	40FB4014	FB4014	Future	Pollution Control Project to Replace Floating Roof	2007, 2008	13.75	0.71	(13.04)	(13.04)
70	Proposed	40FB4014	FB4014	8803A	Proposed Expansion Project	2011, 2012	0.71	0.88	0.17	0.17
71	Future	40FB4015	FB4015	Future	Pollution Control Project to Install Internal Floating Roof	2007, 2008	12.16	0.46	(11.70)	(11.70)
72	Proposed	40FB4015	FB4015	8803A	Proposed Expansion Project	2011, 2012	0.46	0.63	0.17	0.17
73	Proposed	Various Boilers	Various Boilers	8803A	Proposed Expansion Project	2011, 2012	N/A	2.27	2.27	2.27
74	Proposed	44EF2	F-S-202	8803A	Proposed Expansion Project	2011, 2012	0.00	5.52	5.52	5.52
75	Proposed	45BD3	V-8	8803A	Proposed Expansion Project	2011, 2012	3.80	4.43	0.63	0.63
76	Proposed	08FB142 *	FB142	8803A	Proposed Expansion Project	2011, 2012	7.28	9.11	1.83	0.09
77	Proposed	08FB147 *	FB147	8803A	Proposed Expansion Project	2011, 2012	15.89	19.90	4.01	0.15
78	Proposed	08FB137 *	FB137	8803A	Proposed Expansion Project	2011, 2012	4.15	5.53	1.37	0.26
79	Proposed	11FB402 *	FB402	8803A	Proposed Expansion Project	2011, 2012	0.05	0.55	0.50	0.38
							PAGE SUBTOTAL: [8]			(12.11)
									Project Emissions	
		Summary of Contemporaneous Changes						Total		

* "Proposed emissions" reflect projected actual emissions and include emissions that the source could have accomodated during the baseline period and that are unrelated to the project. See Table 2-F.

TCEQ

TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resourcs Corpus Christi, LLC			
Permit Application No:		N/A	Regulated Pollutant: VOC	

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (tons/yr)
80	Proposed	11FB403 *	FB403	8803A	Proposed Expansion Project	2011, 2012	0.04	0.55	0.52	0.38
81	Proposed	Combined Limit for 11FB408, 11FB409, 11FB410		8803A	Proposed Expansion Project	2011, 2012	0.45	2.35	1.90	1.90
82	Future	15FB510	FB510	Future	Pollution Control Project to Install Internal Floating Roof	2007, 2008	19.71	1.05	(18.66)	(18.66)
83	Proposed	Combined Limit for 15FB508, 15FB510		8803A	Proposed Expansion Project	2011, 2012	1.52	2.67	1.15	1.15
84	Future	40FB3043	FB3043	Future	Pollution Control Project to Install Internal Floating Roof	2006, 2007	8.00	0.43	(7.57)	(7.57)
85	Future	40FB3044	FB3044	Future	Pollution Control Project to Install Internal Floating Roof	2007, 2008	9.11	0.16	(8.95)	(8.95)
86	Proposed	Combined Limit for 40FB3043 and 40FB3044		8803A	Proposed Expansion Project	2011, 2012	0.59	1.03	0.44	0.44
87	Proposed	Combined Limit for 40FB4010 and 40FB4011		8803A	Proposed Expansion Project	2011, 2012	7.70	19.73	12.03	12.03
88	Proposed	40FB4012 *	FB4012	8803A	Proposed Expansion Project	2011, 2012	2.13	4.20	2.07	0.04
89	Proposed	40FB4013 *	FB4013	8803A	Proposed Expansion Project	2011, 2012	2.05	3.69	1.64	0.04
88	Future	15FB509	FB509	Future	Pollution Control Project to Install Internal Floating Roof	2011, 2012	20.30	0.99	(19.31)	(19.31)
89	Future	40FB4016	FB4016	Future	Pollution Control Project to Install Internal Floating Roof	2006, 2007	16.63	0.34	(16.29)	(16.29)
90	Proposed	Combined Limit for 40FB4016, 15FB509		8803A	Proposed Expansion Project	2011, 2012	1.33	1.67	0.34	0.34
91	Proposed	F-SATGAS3	F-SATGAS3	8803A	Proposed Expansion Project	2011, 2012	0.00	11.66	11.66	11.66
92	Proposed	IFRTK1	IFRTK1	8803A	Proposed Expansion Project	2011, 2012	0.00	1.99	1.99	1.99
93	Proposed	IFRTK2	IFRTK2	8803A	Proposed Expansion Project	2011, 2012	0.00	1.76	1.76	1.76
						PAGE SUBTOTAL: [8]				(39.05)
								Project Emissions		
		Summary of Contemporaneous Changes						Total		

* "Proposed emissions" reflect projected actual emissions and include emissions that the source could have accomodated during the baseline period and that are unrelated to the project. See Table 2-F.

TCEQ

TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company:	Flint Hills Resources Corpus Christi, LLC		
Permit Application No:	N/A	Regulated Pollutant:	VOC

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (tons/yr)	Creditable Decrease or Increase [6] (tons/yr)
94	Proposed	LW-8 **	VCS-1	6819A	Proposed Expansion Project	2011, 2012	3.80	17.06	13.26	13.26
95	Proposed	P-GB	F-GB	8803A	Proposed Expansion Project	2011, 2012	6.83	5.08	(1.75)	(1.75)
96	Proposed	P-VOC	F-TK-VOC	8803A	Proposed Expansion Project	2011, 2012	0.00	2.93	2.93	2.93
97	Proposed	SATGASHTR	SATGASHTR	8803A	Proposed Expansion Project	2011, 2012	0.00	1.22	1.22	1.22
98	Proposed	MSSFUGS	MSSFUGS	8803A	Proposed Expansion Project	2011, 2012	0.00	3.64	3.64	3.64
99	Proposed	SRU NO. 1	H-15A	8803A	Proposed Expansion Project	2011, 2012	0.15	0.00	(0.15)	(0.15)
100	Proposed	01	F-01	8803A	Proposed Expansion Project	2011, 2012	87.16	77.99	(9.17)	(9.17)
101	Proposed	26	F-26	8803A	Proposed Expansion Project	2011, 2012	31.62	24.78	(6.84)	(6.84)
102	Proposed	37BA1 *	KK-3	8803A	Proposed Expansion Project	2011, 2012	1.02	1.37	0.35	0.00
103	Proposed	39BA3900 *	JJ-4	8803A	Proposed Expansion Project	2011, 2012	0.71	0.85	0.13	0.00
104	Proposed	40BA101 *	A-103, 40BA101ST	8803A	Proposed Expansion Project	2011, 2012	3.80	4.54	0.74	0.00
105	Proposed	42BA1 *	A-203	8803A	Proposed Expansion Project	2011, 2012	8.62	9.93	1.31	0.00
106	Proposed	56BA1 *	DDS-HTRSTK	8803A	Proposed Expansion Project	2011, 2012	0.28	0.50	0.22	0.00
107	Proposed	56BA2 *	DDS-HTRSTK	8803A	Proposed Expansion Project	2011, 2012	0.48	0.61	0.13	0.00
							PAGE SUBTOTAL: [8]			3.14
								Project Emissions		
		Summary of Contemporaneous Changes						Total		

* "Proposed emissions" reflect projected actual emissions and include emissions that the source could have accomodated during the baseline period and that are unrelated to the project. See Table 2-F.

** The baseline emissions were corrected based on calculation methods and emission factors used in this application.

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TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

Company: Flint Hills Resources Corpus Christi, LLC	
Permit Application No: N/A	Regulated Pollutant: VOC

	Project Date [2]	Facility at Which Emission Change Occurred [3] FIN	EPN	Permit NO.	Project Name or Activity	Baseline Period	B Baseline Emissions (tons/yr)	A Proposed Emissions (tons/yr)	C Difference (A-B) [5] (ton/yr)	Creditable Decrease or Increase [6] (ton/yr)
108	Future	40EF101	F-S-101	Future	Authorization to Increase Circulation Rate	2011, 2012	0.67	2.39	1.72	1.72
109	Future	07EF755	F-S-2	Future	Authorization to Increase Circulation Rate	2011, 2012	0.34	2.76	2.42	2.42
110	Future	07EF757	F-S-8	Future	Authorization to Increase Circulation Rate	2011, 2012	1.22	6.44	5.22	5.22
111	Future	56BA1	DDS-HTRSTK	8803A	Future Debottlenecking Project	2011, 2012	0.28	0.95	0.66	0.66
112	Future	56BA2	DDS-HTRSTK	8803A	Future Debottlenecking Project	2011, 2012	0.48	0.95	0.47	0.47
113	Future	29TA2903	Z-4	Future	Cogeneration Pollution Control Project	2007, 2008	30.74	10.34	(20.40)	(20.40)
114	Future	15FB501	FB501	Future	Pollution Control Project to Replace Floating Roof	2011, 2012	23.03	8.70	(14.33)	(14.33)
115	Future	08FB160	FB160	Future	Pollution Control Project to Replace Floating Roof	2010, 2011	17.51	8.70	(8.81)	(8.81)
116	Future	08FB161	FB161	Future	Pollution Control Project to Replace Floating Roof	2011, 2012	10.26	3.75	(6.51)	(6.51)
117										
118										
119										
120										
							PAGE SUBTOTAL: [8]			(39.54)
									Project Emissions	
	Summary of Contemporaneous Changes							Total		(39.14)

TABLE 3F
PROJECT CONTEMPORANEOUS CHANGES [1]

1. Individual Table 3F's should be used to summarize the project emission increase and net emission increase for each criteria pollutant.
2. The start of operation date for the modified or new facilities. Attach Table 4F for each project reduction claimed.
3. Emission Point No. as designated in NSR Permit or Emissions Inventory.
4. All records and calculations for these values must be available upon request.
5. All records and calculations for these values must be available upon request.
6. Allowable (column A) - Baseline (column B).
7. If portion of the decrease not creditable, enter creditable amount. If all of decrease is creditable or if this line is an increase, enter column C again.
8. Sum all values for this page.

All emissions must be listed in tons per year (tpy). The same baseline period must apply for all facilities for a given NSR pollutant.

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TABLE 4F
DESCRIPTION OF CREDITABLE REDUCTIONS

Company Name: Flint Hills Resources Corpus Christi, LLC	
Contaminant: VOC	
Date Action Occurred: January 2011	
SIC Code for this Source: 2911	
Permit No.: N/A	
For Creditable Reductions, verify each statement by checking all boxes:	
The reductions occurred within the contemporaneous period.	☑ YES ☐ NO
The reductions occurred at the same major stationary source.	☑ YES ☐ NO
The reductions have not been relied upon in issuing a previous federal permit.	☑ YES ☐ NO
The reductions have not been used as an offset in a previous nonattainment permit, and are not reserved in a permit condition for use as an offset.	☑ YES ☐ NO
As of the date of this application, the reductions are not required by any rule pursuant to the Texas SIP (30 TAC 111, 115, and 117).*	☐ YES ☐ NO
The reductions are federally enforceable.	☑ YES ☐ NO
The reductions are of the same qualitative significance.	☑ YES ☐ NO
Records for all facilities are available to demonstrate the baseline emissions.	☑ YES ☐ NO

* - required only for nonattainment applicability analysis.

Please give a complete description of project. Provide all EPNs affected by this project.

TABLE 4F
DESCRIPTION OF CREDITABLE REDUCTIONS

Company Name: Flint Hills Resources Corpus Christi, LLC	
Contaminant: NOx, SO2, PM, PM10, PM2.5, VOC	
Date Action Occurred: Proposed	
SIC Code for this Source: 2911	
Permit No.: N/A	
For Creditable Reductions, verify each statement by checking all boxes:	
The reductions occurred within the contemporaneous period.	☑ YES ☐ NO
The reductions occurred at the same major stationary source.	☑ YES ☐ NO
The reductions have not been relied upon in issuing a previous federal permit.	☑ YES ☐ NO
The reductions have not been used as an offset in a previous nonattainment permit, and are not reserved in a permit condition for use as an offset.	☑ YES ☐ NO
As of the date of this application, the reductions are not required by any rule pursuant to the Texas SIP (30 TAC 111, 115, and 117).*	☐ YES ☐ NO
The reductions are federally enforceable.	☑ YES ☐ NO (1)
The reductions are of the same qualitative significance.	☑ YES ☐ NO
Records for all facilities are available to demonstrate the baseline emissions.	☑ YES ☐ NO

* - required only for nonattainment applicability analysis.

Please give a complete description of project. Provide all EPNs affected by this project.

(1) The reductions will be federally enforceable at the completion of this project.

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TABLE 4F
DESCRIPTION OF CREDITABLE REDUCTIONS

Company Name: Flint Hills Resources Corpus Christi, LLC	
Contaminant: NOX, PM, PM10, PM2.5, VOC	
Date Action Occurred: Future	
SIC Code for this Source: 2911	
Permit No.: N/A	
For Creditable Reductions, verify each statement by checking all boxes:	
The reductions occurred within the contemporaneous period.	☑ YES ☐ NO
The reductions occurred at the same major stationary source.	☑ YES ☐ NO
The reductions have not been relied upon in issuing a previous federal permit.	☑ YES ☐ NO
The reductions have not been used as an offset in a previous nonattainment permit, and are not reserved in a permit condition for use as an offset.	☑ YES ☐ NO
As of the date of this application, the reductions are not required by any rule pursuant to the Texas SIP (30 TAC 111, 115, and 117).*	☐ YES ☐ NO
The reductions are federally enforceable.	☑ YES ☐ NO (1)
The reductions are of the same qualitative significance.	☑ YES ☐ NO
Records for all facilities are available to demonstrate the baseline emissions.	☑ YES ☐ NO

* - required only for nonattainment applicability analysis.

Please give a complete description of project. Provide all EPNs affected by this project.

(1) The reductions will be authorized via a separate permitting action prior to the completion of this project. The reductions will be made federally enforceable at the time of the separate permitting action.

TABLE 4-F SUPPLEMENTAL INFORMATION

Date Action Occurred	Pollutant	Project Desciption	Affected EPN	Affected EPN Description
January 2011	VOC	Installation of an internal floating roof in Tank 40FB3046 to reduce VOC emissions. The tank was previously a fixed-roof tank.	FB3046	Tank 40FB3046
Proposed	NOx	Installation of SCR.	JJ-4 (39BA3900)	NHT Charge Heater
Proposed	NOx, CO, SO_2, PM, PM_{10}, $PM_{2.5}$, VOC	Shutdown of the SRU No. 1 Unit including the incinerator as a result of decreasing the amount of sulfur produced at the refinery.	H-15A	SRU No. 1 Incinerator
Proposed	CO	Operating the FCCU catalyst regenerator in full burn.	AA-4	FCCU CO Boiler/Scrubber
Proposed	SO_2	Treat fuel gas to reduce sulfur concentration in the fuel gas which reduces SO2 emissions.	KK-3, A-203, A-204, LSGHTR, MX-1, DDS-HTRSTK	DHT Charge Heater, 42BA1 Crude Heater, 42BA3 Vacuum Heater, LSG Hot Oil Heater, 54BA1 MX Unit Hot Oil Heater, DDS Combined Heater Stack
Proposed	VOC	Implementation of annual flange/connector monitoring as part of the Leak Detection and Repair Program.	F-01, F-26, F-37, F-39, F-40, F-42, F-GB	FCCU, Hydrocracker, DHT, CCR/NHT, West Crude, and Mid Crude, and Gasoline Blender Fugitives
Future	NO_X, PM, PM_{10}, $PM_{2.5}$	Cogeneration pollution control project to install new burners	Z-4	Cogeneration Unit Frame 6 Turbine
Future	PM, PM_{10}, $PM_{2.5}$	Installation of more efficient drift eliminator to reduce particulate matter emissions.	F-S-201	Midplant Cooling Tower
Future	PM, PM_{10}, $PM_{2.5}$	Installation of more efficient drift eliminators to reduce particulate matter emissions.	F-S-2, F-S-8, F-S-101	Ultraformer, CCR, West Crude Cooling Towers
Future	VOC	Installation of an internal floating roof to reduce VOC emissions. The tanks were previously a fixed-roof tanks.	FB4014, FB4015, FB510, FB3043, FB3044, FB509, FB4016	Tanks 40FB4014, 40FB4015, 15FB510, 40FB3043, 40FB3044, 15FB509, and 40FB4016
Future	VOC	Pollution control project to replace current floating roof with suspended floating roof to minimize the number of fittings.	FB501	Tank 15FB501
Future	VOC	Pollution control project to replace current floating roof with suspended floating roof to minimize the number of fittings. Replace current bolted deck with a welded deck to remove deck seam losses. Install both primary and secondary seal to minimize rim seal losses.	FB160, FB161	Tanks 08FB160 and 08FB161

ATTACHMENT IX.F

HAZARDOUS AIR POLLUTANTS [§116.111(a)(2)(K)]

Does not apply. There are no emission units associated with this application for which the United States Environmental Protection Agency has not promulgated a maximum available control technology (MACT) standard under 40 C.F.R. PART Part 63.

ATTACHMENT XI

PERMIT FEE

Texas Commission on Environmental Quality
Table 30
Estimated Capital Cost and Fee Verification

Include estimated cost of the equipment and services that would normally be capitalized according to standard and generally accepted corporate financing and accounting procedures. Tables, checklists, and guidance documents pertaining to air quality permits are available from the Texas Commission on Environmental Quality, Air Permits Division Web site at **www.tceq.state.tx.us/nav/permits/air_permits.html**.

I. DIRECT COSTS [30 TAC § 116.141(c)(1)]	Estimated Capital Cost
A. A process and control equipment not previously owned by the applicant and not currently authorized under this chapter	$
B. Auxiliary equipment, including exhaust hoods, ducting, fans, pumps, piping, conveyors, stacks, storage tanks, waste disposal facilities, and air pollution control equipment specifically needed to meet permit and regulation requirements	$
C. Freight charges	$
D. Site preparation, including demolition, construction of fences, outdoor lighting, road and parking areas	$
E. Installation, including foundations, erection of supporting structures, enclosures or weather protection, insulation and painting, utilities and connections, process integration, and process control equipment	$
F. Auxiliary buildings, including materials storage, employee facilities, and changes to existing structures	$
G. Ambient air monitoring network	$
II. INDIRECT COSTS [30 TAC § 116.141(c)(2)]	**Estimated Capital Cost**
A. Final engineering design and supervision, and administrative overhead	$
B. Construction expense, including construction liaison, securing local building permits, insurance, temporary construction facilities, and construction clean-up	$
C. Contractor's fee and overhead	$
TOTAL ESTIMATED CAPITAL COST	$ > 250,000,000

I certify that the total estimated capital cost of the project as defined in 30 TAC § 116.141 is equal to or less than the above figure. I further state that I have read and understand Texas Water Code § 7.179, which defines CRIMINAL OFFENSES for certain violations, including intentionally or knowingly making, or causing to be made, false material statements or representations.

Company Name: Flint Hills Resources Corpus Christi, LLC

Company Representative Name (please print): Valerie Pompa Title: Vice President and Mfg Manager

Company Representative Signature: Valerie Pompa

Estimated Capital Cost		Permit Application Fee	PSD/Nonattainment Application Fee
Less than	$300,000	$900 (minimum fee)	$3,000 (minimum fee)
$300,000 to	$25,000,000	0.30% of capital cost	
$300,000 to	$7,500,000		1.0% of capital cost
Greater than	$25,000,000	$75,000 (maximum fee)	
Greater than	$7,500,000		$75,000 (maximum fee)

PERMIT APPLICATION FEE (from table above) = $ 75,000 Date: 12-13-12

TCEQ-10196 (Revised 05/07) Table 30
This form is for use by facilities subject to Air New Source Review permit requirements and may be revised. (APDG 5846 v1)

OTHER CHAPTER 116 REQUIREMENTS

Other requirements under §116.111(a)(2) not addressed on TCEQ's PI-1 are addressed in this section.

Air Dispersion Modeling [§116.111(a)(2)(J)]

FHR will submit air dispersion modeling upon request of the TCEQ.

Mass Cap and Trade Allowances [§116.111(a)(2)(L)]

FHR's West Refinery is not located in an ozone non-attainment area. Therefore, the mass cap and trade requirements do not apply.