Montana Department of
ENVIRONMENTAL QUALITY
Brian Schweitzer, Governor
P. O. Box 200901 Helena, MT 59620-0901 (406) 444-2544 Website: www.deq.mt.gov

April 7, 2011

Thomas McIntyre
Renewable Energy Corporation – Advanced Silicon Materials, LLC
119140 Rick Jones Way
Silver Bow, MT 59750

Dear Mr. McIntyre:

Montana Air Quality Permit #2940-07 is deemed final as of April 7, 2011 by the Department of Environmental Quality (Department). This permit is for a high purity polycrystalline silicon manufacturing plant. All conditions of the Department's Decision remain the same. Enclosed is a copy of your permit with the final date indicated.

For the Department,

Vickie Walsh
Air Permitting Program Supervisor
Air Resources Management Bureau
(406) 444-9741

Julie A. Merkel
Air Quality Specialist
Air Resources Management Bureau
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VW: JM
Enclosure

Montana Department of Environmental Quality
Permitting and Compliance Division

Montana Air Quality Permit #2940-07

Renewable Energy Corporation
Advanced Silicon Materials, LLC
119140 Rick Jones Way
Silver Bow, MT 59750

April 7, 2011

MONTANA AIR QUALITY PERMIT

Issued to: Renewable Energy Corporation-
Advanced Silicon Materials LLC
Butte Operations
119140 Rick Jones Way
Silver Bow, MT 59750

MAQP #2940-07
Application Complete: 2/4/11
Preliminary Determination Issued: 3/4/11
Department Decision Issued: 3/22/11
Permit Final: 4/7/11
AFS #093-0015

A Montana Air Quality Permit (MAQP), with conditions, is hereby granted to Renewable Energy Corporation - Advanced Silicon Materials LLC (REC) pursuant to Sections 75-2-204 and 211, MCA, as amended, and Administrative Rules of Montana (ARM) 17.8.740, *et seq*., as amended, for the following:

Section I: Permitted Facilities

A. The REC facility consists of a high purity polycrystalline silicon manufacturing plant at 119410 Rick Jones Way near Butte, Montana. The legal description is Section 35, Township 3 North, Range 9 West, Silver Bow County. The plant consists of various boilers and process equipment used in the manufacturing process. A more complete listing of the equipment used at the facility is contained in the permit analysis.

B. Current Permit Action

On February 4, 2011, the Department of Environmental Quality (Department) received an application from Bison Engineering on behalf of REC for a modification of Permit #2940-06. Additional information was received by the Department on March 4, 2011. The modification request includes the replacement of the current burner system on the two 40 million British thermal units per hour (MMBtu/hr) hot oil heaters (H-1701 and H-2701). The proposed emission control system consists of ultra low oxides of nitrogen (NO_x) burners, which are capable of meeting current emissions limits without the use of a flue gas recirculation system.

In addition to the modification of control technology of the two 40 MMBtu/hr hot oil heaters, REC also requested a reduction of the current emission limits of the hot oil heaters. The NO_x emission limit will be reduced from 2.43 pounds per hour (lb/hr) to 2.134 lb/hr and the carbon monoxide (CO) limit will be reduced from 4.43 lb/hr to 4.058 lb/hr.

SECTION II: Limitations and Conditions

A. Emission Limitations

1. REC shall operate and maintain all emission control equipment as specified in their application for their Montana Air Quality permits and all supporting documentation (ARM 17.8.749).

2. REC shall not cause or authorize to be discharged into the outdoor atmosphere from any source installed after November 23, 1968, emissions that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes (ARM 17.8.304).

3. REC shall not cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter (ARM 17.8.308).

4. REC shall treat all unpaved portions of the haul roads, access roads, and the general plant area with water and/or chemical dust suppressant as necessary to maintain compliance with the reasonable precautions limitation in Section II.A.3 (ARM 17.8.749).

5. Incoming Metallurgical Grade Silicon processed at the facility shall be limited to 7,565 tons per rolling 12-month time period (ARM 17.8.749).

6. The natural gas consumed at the facility shall be limited to 1,247.77 million cubic feet ($MMft^3$) per rolling 12-month time period (ARM 17.8.749).

7. The two 40 MMBtu/hr Hot Oil Heaters, H-1701 (EP#107A) and H-2701 (#EP207A), shall be equipped with ultra low-NO_x burners (ARM 17.8.752).

8. When operating the two 40 MMBtu/hr Hot Oil Heaters, emissions shall not exceed the following limits (ARM 17.8.752):

NO_x[1]	2.134 lb/hr
Carbon Monoxide (CO)	4.058 lb/hr

9. The emissions from Boiler #1 (EP#113) shall not exceed the following limits (ARM 17.8.752):

NO_x[1]	6.48 lb/hr
CO	8.10 lb/hr

10. The two 23.5 MMBtu/hr Hot Oil Heaters, EP#107B and EP#207B, shall be equipped with ultra low NO_x burners (ULNB). The emissions from these heaters shall not exceed the following limits (ARM 17.8.752):

NO_x[1]	1.41 lb/hr
CO	2.59 lb/hr

11. Emissions of particulate matter 10 microns or less in diameter (PM-10) from the filter controlling the Metallurgical Grade Silicon Storage Bins (EP#101A&B) shall each be limited to 0.077 lb/hr (this includes back-half/impinger catch) (ARM 17.8.752).

12. Emissions of PM-10 from the filter controlling the Metallurgical Grade Silicon Feed Hopper (EP#102) shall be limited to 0.021 lb/hr (this includes back-half/impinger catch) (ARM 17.8.752).

13. Emissions of PM-10 from the filter controlling the Metallurgical Grade Silicon Feed Hopper (EP#202) shall be limited to 0.021 lb/hr (this includes back-half/impinger catch) (ARM 17.8.752).

14. Emissions of PM-10 from the filter controlling the Metallurgical Grade Silicon Lock Hopper (EP#104) shall be limited to 0.017 lb/hr (this includes back-half/impinger catch) (ARM 17.8.752).

[1] NO_X reported as NO_2

15. Emissions of PM-10 from the filter controlling the Metallurgical Grade Silicon Lock Hopper (EP#204) shall be limited to 0.017 lb/hr (this includes back-half/impinger catch) (ARM 17.8.752).

16. Emissions of PM-10 from the filter controlling the Lime Storage System (EP#116) shall be limited to 1.20 lb/hr (this includes back-half/impinger catch) (ARM 17.8.752).

17. REC shall operate and maintain the Chlorosilane Process Scrubber System (EP#105) to control emissions from the Hydrogenation Section and the Distillation Section of the Silane Area and the Chlorosilane Recovery Area (ARM 17.8.752).

18. Emissions that occur during the annual maintenance shutdown in the Hydrogenation Section and the Distillation Section of the Silane Area shall either be directed to the Maintenance Scrubber System (EP#127 via ST-1602) or to the Chlorosilane Maintenance Scrubber System (EP#105) (ARM 17.8.752).

19. Emissions of PM-10 from EP#105 shall be limited to 0.033 lb/hr (this includes back-half/impinger catch) (ARM 17.8.752).

20. REC shall operate and maintain the Silane Scrubber System (EP#106) to control emissions from the Silane Storage Section of the Silane Area (ARM 17.8.752).

21. Emissions of PM-10 from the Silane Scrubber System (EP#106) shall be limited to 2.34 lb/hr (this includes back-half/impinger catch) (ARM 17.8.752).

22. REC shall operate the emergency generators only when commercially supplied electric power is not available or during periods of planned maintenance. REC shall not operate these generators as part of routine operations (ARM 17.8.749).

23. All chlorosilane process equipment pressure safety valves in the Hydrogenation Section and Distillation Section of the Silane Area shall be vented to the Emergency Vent Scrubber (ARM 17.8.749).

24. The annual particulate silica (SiO_2) emissions from the Reactor Hydrogen Vent (EP#111) during Silane Area maintenance operations shall not exceed 25.5 tons during any rolling 12-month time period. The SiO_2 particulate emissions shall be calculated using the monthly polycrystalline silicon production, the silane concentration in the reactor hydrogen recycle stream, and the time that the vent stack was in operation (ARM 17.8.749).

25. REC shall comply with all applicable standards and limitations, and the reporting, recordkeeping, and notification requirements of 40 CFR 60, Subpart Dc for Boiler #1 (ARM 17.8.340 and 40 CFR 60, Subpart Dc).

B. Testing Requirements

1. REC shall test Hot Oil Heaters, H-1701 and H-2701, emissions for NO_x and CO within 180 days of start-up and operation to demonstrate compliance with the NO_x and CO emission limits contained in Section II.A.8 (ARM 17.8.105 and ARM 17.8.749).

2. All tests must be completed in compliance with the Montana Source Test Protocol and Procedures Manual (ARM 17.8.106).

3. The Department may require further testing (ARM 17.8.105).

C. Operational Reporting Requirement

1. REC shall supply the Department with annual production information for all emission points, as required by the Department in the annual emission inventory request. The request will include, but is not limited to, all sources of emissions identified in Section I.B of the permit analysis.

   Production information shall be gathered on a calendar-year basis and submitted to the Department by the date required in the emission inventory request. Information shall be in units as required by the Department.

   In addition, REC shall submit the following information annually to the Department by March 1 of each year. This information is required for the annual emission inventory, as well as to verify compliance with permit conditions (ARM 17.8.505).

   a. Amount of incoming Metallurgical Grade Silicon processed (TPY)

   b. Annual natural gas consumption from the facility ($MMft^3/yr$)

   c. Venting time of EP#111 (hours)

   d. Monthly polycrystalline silicon production (kilograms (kg))

   e. Silane concentration in the reactor hydrogen recycle stream (concentration used in each monthly calculation)

   f. Hours of operation for the 2000-kilowatt (kW) emergency diesel generator (hour/yr)

   g. Summary report listing the reasons the 2000-kW emergency generator(s) was operating

   h. Hours of operation for the 490-horsepower (hp) emergency diesel generator (hour/yr)

   i. Summary report listing the reasons the 490-hp emergency generator was operating

2. REC shall notify the Department of any construction or improvement project conducted pursuant to ARM 17.8.745 that would include a change in control equipment, stack height, stack diameter, stack flow, stack gas temperature, source location, or fuel specifications, or would result in an increase in source capacity above its permitted operation or the addition of a new emission unit. The notice must be submitted to the Department, in writing, 10 days prior to start up or use of the proposed de minimis change, or as soon as reasonably practicable in the event of an unanticipated circumstance causing the de minimis change, and must include the information requested in ARM 17.8.745(1)(d) (ARM 17.8.745).

3. REC shall document, by month, the incoming Metallurgical Grade Silicon processed at the facility. By the 25th day of each month, REC shall total the incoming Metallurgical Grade Silicon processed at the facility for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.5. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

4. REC shall document, by month, the natural gas consumed at the facility. By the 25th day of each month, REC shall total the natural gas consumed at the facility for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.6. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

5. REC shall document, by month, the particulate SiO_2 emissions from EP#111. By the 25th day of each month, REC shall total the particulate SiO_2 emissions from EP#111 for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.24. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

6. The records compiled in accordance with this permit shall be maintained by REC as a permanent business record for at least 5 years following the date of the measurement, shall be submitted to the Department upon request, and shall be available at the plant site for inspection by the Department (ARM 17.8.749).

Section III: General Conditions

A. Inspection - The recipient shall allow the Department's representatives access to the source at all reasonable times for the purpose of making inspections or surveys, collecting samples, obtaining data, auditing any monitoring equipment (Continuous Emission Monitoring System (CEMS), Continuous Emission Rate Monitoring System (CERMS)) or observing any monitoring or testing, and otherwise conducting all necessary functions related to this permit.

B. Waiver - The permit and all the terms, conditions, and matters stated herein shall be deemed accepted if REC fails to appeal as indicated below.

C. Compliance with Statutes and Regulations - Nothing in this permit shall be construed as relieving the permittee of the responsibility for complying with any applicable federal or Montana statute, rule or standard, except as specifically provided in ARM 17.8.740, *et seq.* (ARM 17.8.756).

D. Enforcement - Violations of limitations, conditions and requirements contained herein may constitute grounds for permit revocation, penalties or other enforcement as specified in Section 75-2-401 *et seq*., MCA.

E. Appeals – Any person or persons jointly or severally adversely affected by the Department’s decision may request, within 15 days after the Department renders its decision, upon affidavit setting forth the grounds therefore, a hearing before the Board of Environmental Review (Board). A hearing shall be held under the provisions of the Montana Administrative Procedures Act. The filing of a request for a hearing does not

F. Permit Inspection – As required by ARM 17.8.755, Inspection of Permit, a copy of the air quality permit shall be made available for inspection by the Department at the location of the source.

G. Permit Fee – Pursuant to Section 75-2-220, MCA, failure to pay the annual operation fee by REC may be grounds for revocation of this permit, as required by that section and rules adopted thereunder by the Board.

H. Duration of Permit – Construction or installation must begin or contractual obligations entered into that would constitute substantial loss within 3 years of permit issuance and proceed with due diligence until the project is complete or the permit shall expire (ARM 17.8.762).

Permit Analysis
Renewable Energy Corporation - Advanced Silicon Materials LLC
Montana Air Quality Permit (MAQP) #2940-07

I. Introduction

A. Permitted Equipment

A listing of the significant emission sources is contained in Table I below. The original application contains a complete listing and description of the emission sources located at the Renewable Energy Corporation - Advanced Silicon Materials LLC (REC) facility.

Table I

STACK IDENTIFIER	SOURCE(S)	SIZE	CONTROL EQUIPMENT
EP#100	MG Silicon Bag Unloader (BN-1106) and Unloading Hoppers (BN-1101 through F-1108)		Bin Vent Filter - 1000 dry standard cubic feet per minute (dscfm)
EP#101A	MG Silicon Storage Bin Filter Vent (BN-1105A)		Bin Vent Filter
EP#101B	MG Silicon Storage Bin Filter Vent (BN-1105B)		Bin Vent Filter
EP#113	Boiler #1	50.22 million British thermal units per hour (MMBtu/hr) (natural gas fired)	
EP#114	Boiler #2	6.70 MMBtu/hr (natural gas fired)	
EP#107A	Hot Oil Heater	40 MMBtu/hr (natural gas fired)	Ultra Low oxides of nitrogen (NO_x) burners (ULNB)
EP#207A	Hot Oil Heater	40 MMBTU/hr (natural gas fired)	ULNB
EP#107B	Hot Oil Heater	23.5 MMBtu/hr (natural gas-fired)	ULNB
EP#207B	Hot Oil Heater	23.5 MMBtu/hr (natural gas-fired)	ULNB
EP#102	MG Silicon Feed Hopper		Baghouse – 245 dscfm
EP#104	MG Silicon Lock Hopper		Bin Vent Filter - 100 dscfm
EP#116	Lime Storage System		Bin Vent Filter - 750 dscfm
EP#118	Cooling Tower	10,400 gpm/cell	
EP#122	Dryer Scrubber Vent	1 Stack	Wet Scrubber
EP#105	Chlorosilane Scrubber System		Wet Scrubber (alkaline)
EP#106	Silane Scrubber System		Wet Scrubber (alkaline)

STACK IDENTIFIER	SOURCE(S)	SIZE	CONTROL EQUIPMENT
EP#127	Maintenance and Emergency Scrubber Vent (ST-1602)		Wet Scrubber (alkaline)
EP#128	Emergency Scrubber Bypass Vent Stack		Wet Scrubber (alkaline)
EP#129	Process Scrubber System Emergency Bypass Vent Stack		Wet Scrubber (alkaline)
EP#130	Dryer Dump Scrubber Vent		Wet Scrubber (alkaline)
EP#108-01 to EP#108-50	Reactor Atmos. Vents (TDF-L)		
EP#108-51 to EP#108-58	Reactor Atmos. Vents (TDF-M)		
EP#109-01 to EP#109-50	Reactor Analyzer Vents (TDF-L)		
EP#109-51 to EP#109-58	Reactor Analyzer Vents (TDF-M)		
EP#202	MG Silicon Feed Hopper		Baghouse – 245 dscfm
EP#204	MG Silicon Lock Hopper		Bin Vent Filter - 100 dscfm
EP#111	Hydrogen Vent Stack		
EP#112	Silane Storage Tanks Emergency Vent Stack		Flare
EP#218	Cooling Tower	10,400 gpm/cell	
	Emergency Generators	2 @ 2000 kilowatts (kW) each	
	Emergency Generator	490 horsepower (Hp)	
	Emergency Fire Water Pump Diesel Storage	560-gallon tank	
	Emergency Generator Diesel Storage	2 – 3000-gallon tanks	
	Lab Hood		
	Dryer Reactor Atmospheric Safety Vents	2 Stacks	

B. Process Description

The REC facility produces high-purity polycrystalline silicon for the electronics industry by refining metallurgical grade (MG) silicon. The process areas of the plant are referred to as the Silane Area and the Polyreaction Area. The Silane Area contains three sections: the Hydrogenation Section, the Distillation Section, and the Silane Storage. In the Silane Area-Hydrogenation Section, metallurgical grade silicon is first fed to a pressurized, heated vessel where it reacts with a mixture of hydrogen and chlorosilanes to yield a

higher silicon content chlorosilane liquid. This liquid is distilled and catalytically rearranged to yield silane and unconverted chlorosilanes in the Silane Area-Distillation Section. Reclaimed chlorosilanes are recycled back to the initial reactor to react with more metallurgical grade silicon. Silane is an intermediate product from these operations and is transferred into intermediate storage tanks that feed the Polyreaction Area.

The Polyreaction Area consists of large thermal decomposition furnace reactors that are housed in a building that maintains clean room conditions. In the Polyreaction Area, the silane is decomposed in heated vessels to yield both a high-purity silicon product and hydrogen. The hydrogen is totally recycled back to the initial reactor in the Silane Area. After cooling, the product silicon is removed in rod form, broken, cleaned, and packaged for shipment.

C. Permit History

On June 6, 1996, Advanced Silicon Materials Incorporated (ASiMI) applied for **MAQP #2940-00,** proposing to construct and operate a high-purity polycrystalline silicon manufacturing plant at 119410 Rick Jones Way near Butte, Montana. This permit was issued final on August 3, 1996. The legal description is Section 35, Township 3 North, Range 9 West, Silver Bow County. ASiMI's facility would be constructed in two phases. Phase I construction would begin in August 1996, with operations of the first phase expected to begin in early 1998. Phase II construction was expected to begin during the second quarter of 1997, with operation of the second phase expected to begin during the second quarter of 1999.

On October 30, 1998, **MAQP #2940-01** was issued to ASiMI. MAQP #2940-01 was an alteration which identified that the scrubber system for the chlorosilane vents had been reconfigured and maintenance emissions could be routed and controlled by the Maintenance Scrubber (T-1604) and then vented to atmosphere through stack ST-1602. This change was contained in Section II.A.19 and resulted in a negligible emissions increase because maintenance emissions are small and infrequent. This alteration also identified that a neutralized solids bin (EP#126) was proposed to be added to the facility. This bin vented to a baghouse (F-1602) and would have an allowable PM-10 emission limitation of 2 pounds per hour (lb/hr).

In a January 12, 1998, letter to the Department of Environmental Quality (Department), several projects were identified that could be conducted pursuant to Administrative Rules of Montana (ARM) 17.8.705(1)(q). These changes were incorporated into ASiMI's permit at this time and were identified in the equipment list, as appropriate, and more completely in the January 12, 1998, letter from Foster Wheeler USA Corporation and subsequent correspondence. In addition, the address on the permit was changed to the address of the facility now that construction was progressing.

On June 24, 1999, ASiMI was issued **MAQP #2940-02** in response to a request from the facility. On December 9, 1998, the Department received a request from ASiMI to modify MAQP #2940-01. The permit identified projects that were excluded from the requirement to obtain a permit pursuant to ARM 17.8.705(1)(q). These projects affected the metals dryer process at the facility. The dryer neutralizes aluminum and iron chlorides by treating these acidic solids in the dryer with calcium carbonate and water. However, because of the potential to create an unsafe, exothermic reaction (which often results in plugged lines), ASiMI proposed to discharge the metal solids from the dryer into a water scrubber for neutralization. Any off gases (mainly hydrogen chloride (HCl)) would be routed to a high-energy venturi scrubber for emission control. The venturi

scrubber was a new emission point called the Dryer Dump Scrubber Vent (EP#130). EP#126, which was the Neutralized Solids Bin Vent, was removed from Table I. As part of this project, ASiMI proposed to test a new chemical, sodium sesquicarbonate, as a replacement for calcium carbonate for metals chloride neutralization in the dryer process.

This permit also identified the testing required of ASiMI, updated the equipment list in the permit analysis so it more accurately reflected the design of the facility, and increased the number of days the Reactor Hydrogen Vent (EP#111) could be used during maintenance operations in the Silane Area to 60 days. **MAQP #2940-02** replaced MAQP #2940-01.

On October 13, 2000, ASiMI was issued **MAQP #2940-03**. On September 11, 2000, ASiMI requested a permit change to allow for more operational flexibility by more accurately quantifying emissions from Reactor Hydrogen Vent Stack (EP#111). ASiMI requested that the condition limiting the days of use of the hydrogen vent stack be replaced with a condition that directly relates to the permitted emissions from EP#111 (25.5 tons per year (TPY)). ASiMI exceeded the 60-day use limit on EP#111, but because of the current reactor type, they only emitted approximately 13 tons per year. The permit condition limiting the use of EP#111 was intended to limit emissions to 25.5 TPY or less. ASiMI was capable of more accurately measuring the recycle gas composition. ASiMI proposed to use the monthly polycrystalline silicon production, the silane concentration in the reactor hydrogen recycle stream, and the time that the vent stack is in operation to calculate the annual silica (SiO_2) particulate emissions from EP#111. MAQP #2940-03 replaced MAQP #2940-02.

On July 22, 2005, ASiMI requested a permit change to more accurately reflect the emission limits for Hot Oil Heater H-1201 (EP#107A) and Hot Oil Heater H-2201 (EP#207A). Incorrect emission data was provided in the initial 1996 air permit application. In the permit application, ASiMI provided updated carbon monoxide (CO) and NO_x emissions and emission factors. ASiMI requested that the condition limiting the CO and NO_x emissions from EP#107A and EP#207A be modified. In addition, the permit format, language, and rule references were updated to reflect current Department permit format, language and rule references. **MAQP #2940-04** replaced MAQP #2940-03.

On April 14, 2006, the Department issued **MAQP #2940-05** to Renewable Energy Corporation (REC) reflecting the change in ownership from ASiMI to REC. This permit action changed the corporate name on MAQP #2940-04 from ASiMI to REC. MAQP #2940-05 replaced MAQP #2940-04.

On September 27, 2007, the Department received an application from Bison Engineering on behalf of REC for a modification of MAQP #2940-05. The modification request included two parts. First, the facility requested the addition of two 23.5 MMBtu/hr hot oil heaters to be located in the distillation section in the silane area. These two new hot oil heaters will supplement the silane production of the two existing 40-MMBtu/hr hot oil heaters, and increase the MG silicon usage from the current 5,952 TPY to 7,565 TPY.

The second request allows REC to suspend the operation of the FGR systems on the two existing 40-MMBtu/hr hot oil heaters during times when the ambient temperature falls below 25 degrees Fahrenheit (ºF). During these times, the moisture in the flue gas mixes with the cold inlet air and condenses, forming ice blocks in the inlet chamber. Over time, the ice that forms on the inlet surfaces restricts the air flow, breaks loose, and impacts the draft fan which damages the fan. REC has unsuccessfully attempted to address this icing

problem over the past several winters by using a variety of methods. Suspension of

operation of the FGR for up to 120 days/year slightly increased NO_x emissions. The Department required REC to submit a Best Available Control Technology (BACT) analysis to support the facility's request. **MAQP #2940-06** replaced MAQP #2940-05.

D. Current Permit Action

On January 25, 2011, the Department received an application from Bison Engineering on behalf of REC for a modification of MAQP #2940-06. The modification request includes the replacement of the current burner system on the two 40 MMBtu/hr hot oil heaters (H-1701 and H-2701). The proposed emission control system consists of ultra low NO_x burners, which are capable of meeting current emissions limits without the use of a flue gas recirculation system.

In addition to the modification of control technology of the two 40 MMBtu/hr hot oil heaters, REC also requested a reduction of the current emission limits of the hot oil heaters. The NO_x emission limit will be reduced from 2.43 lb/hr to 2.134 lb/hr and the carbon monoxide (CO) limit will be reduced from 4.43 lb/hr to 4.058 lb/hr. **MAQP #2940-07** replaces MAQP #2940-06

E. Additional Information

Additional information, such as applicable rules and regulations, BACT/Reasonably Available Control Technology (RACT) determinations, air quality impacts, and environmental assessments, is included in the analysis associated with each change to the permit.

II. Applicable Rules and Regulations

The following are partial explanations of some applicable rules and regulations that apply to the facility. The complete rules are stated in the Administrative Rules of Montana (ARM) and are available, upon request, from the Department. Upon request, the Department will provide references for locations of complete copies of all applicable rules and regulations or copies where appropriate.

A. ARM 17.8, Subchapter 1, General Provisions, including, but not limited to:

1. ARM 17.8.101 Definitions. This rule includes a list of applicable definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.105 Testing Requirements. Any person or persons responsible for the emission of any air contaminant into the outdoor atmosphere shall, upon written request of the Department, provide the facilities and necessary equipment (including instruments and sensing devices) and shall conduct tests, emission or ambient, for such periods of time as may be necessary using methods approved by the Department.

3. ARM 17.8.106 Source Testing Protocol. The requirements of this rule apply to any emission source testing conducted by the Department, any source or other entity as required by any rule in this chapter, or any permit or order issued pursuant to this chapter, or the provisions of the Clean Air Act of Montana, 75-2-101, *et seq*., Montana Code Annotated (MCA).

REC shall comply with the requirements contained in the Montana Source Test Protocol and Procedures Manual, including, but not limited to, using the proper test methods and supplying the required reports. A copy of the Montana Source Test Protocol and Procedures Manual is available from the Department upon request.

4. ARM 17.8.110 Malfunctions. (2) The Department must be notified promptly by telephone whenever a malfunction occurs that can be expected to create emissions in excess of any applicable emission limitation or to continue for a period greater than 4 hours.

5. ARM 17.8.111 Circumvention. (1) No person shall cause or permit the installation or use of any device or any means that, without resulting in reduction of the total amount of air contaminant emitted, conceals or dilutes an emission of air contaminant that would otherwise violate an air pollution control regulation. (2) No equipment that may produce emissions shall be operated or maintained in such a manner as to create a public nuisance.

B. ARM 17.8, Subchapter 2, Ambient Air Quality, including, but not limited to:

1. ARM 17.8.204 Ambient Air Monitoring,
2. ARM 17.8.210 Ambient Air Quality Standards for Sulfur Dioxide,
3. ARM 17.8.211 Ambient Air Quality Standards for Nitrogen Dioxide,
4. ARM 17.8.212 Ambient Air Quality Standards for Carbon Monoxide,
5. ARM 17.8.213 Ambient Air Quality Standard for Ozone
6. ARM 17.8.214 Ambient Air Quality Standard for Hydrogen Sulfide,
7. ARM 17.8.220 Ambient Air Quality Standard for Settled Particulate Matter,
8. ARM 17.8.221 Ambient Air Quality Standard for Visibility,
9. ARM 17.8.222 Ambient Air Quality Standard for Lead, and
10. ARM 17.8.223 Ambient Standard for PM-10.

REC must maintain compliance with the applicable ambient air quality standards.

C. ARM 17.8, Subchapter 3, Emission Standards, including, but not limited to:

1. ARM 17.8.304 Visible Air Contaminants. This rule requires that no person may cause or authorize emissions to be discharged into the outdoor atmosphere from any source installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes.

2. ARM 17.8.308 Particulate Matter, Airborne. (1) This rule requires an opacity limitation of 20% for all fugitive emission sources and that reasonable precautions be taken to control emissions of airborne particulate matter. (2) Under this rule, REC shall not cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter

3. ARM 17.8.309 Particulate Matter, Fuel Burning Equipment. This rule requires that no person shall cause, allow, or permit to be discharged into the atmosphere particulate matter caused by the combustion of fuel in excess of the amount determined by this rule.

4. ARM 17.8.310 Particulate Matter, Industrial Process. This rule requires that no

person shall cause, allow, or permit to be discharged into the atmosphere particulate matter in excess of the amount set forth in this rule.

5. ARM 17.8.322 Sulfur Oxide Emissions--Sulfur in Fuel. (4) Commencing July 1, 1972, no person shall burn liquid or solid fuels containing sulfur in excess of 1 pound of sulfur per million Btu fired. (5) Commencing July 1, 1971, no person shall burn any gaseous fuel containing sulfur compounds in excess of 50 grains per 100 cubic feet of gaseous fuel, calculated as hydrogen sulfide at standard conditions.

6. ARM 17.8.340 Standards of Performance for New Stationary Sources and Emission Guidelines for existing Sources. This rule incorporates, by reference, 40 CFR Part 60, Standards of Performance for New Stationary Sources (NSPS). REC is considered an NSPS affected facility under 40 CFR Part 60 and is subject to the requirements of the following subparts.

   40 CFR 60, Subpart Dc, *Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units* is applicable to steam generating units that commenced construction, reconstruction, or modification after June 9, 1989. The steam generation unit definition specifically excludes process heaters. Process heater means a device that is primarily used to heat a material to initiate or promote a chemical reaction in which the material participates as a reactant or catalyst. The hot oil heaters meet the definition of process heaters and therefore, Subpart Dc does not apply.

   40 CFR 60, Subpart Dc does apply to Boiler #1 and the two 23.5 MMBtu/hr hot oil heaters because they were manufactured after June 9, 1989, and has a heat input greater than 10 MMBtu/hr, but less than 100 MMBtu/hr.

   In addition, 40 CFR 60, Subpart Dc, does not apply to Boiler #2 because the boiler has a heat input less than 10 MMBtu/hr.

D. ARM 17.8, Subchapter 5, Air Quality Permit Application, Operation and Open Burning Fees, including, but not limited to:

1. ARM 17.8.504 Air Quality Permit Application Fees. This rule requires that an applicant submit an air quality permit application fee concurrent with the submittal of an air quality permit application. A permit application is incomplete until the proper application fee is paid to the Department. REC submitted the required permit application fee for the current permit action.

2. ARM 17.8.505 Air Quality Operation Fees. An annual air quality operation fee must, as a condition of continued operation, be submitted to the Department by each source of air contaminants holding an air quality permit, excluding an open burning permit, issued by the Department. The air quality operation fee is based on the actual or estimated actual amount of air pollutants emitted during the previous calendar year.

   An air quality operation fee is separate and distinct from an air quality permit application fee. The annual assessment and collection of the air quality operation fee, described above, shall take place on a calendar-year basis. The Department may insert into any final permit issued after the effective date of these rules, such conditions as may be necessary to require the payment of an air quality operation

fee on a calendar-year basis, including provisions that pro-rate the required fee amount.

E. ARM 17.8, Subchapter 7, Permit, Construction, and Operation of Air Contaminant Sources, including, but not limited to:

1. ARM 17.8.740 Definitions. This rule is a list of applicable definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.743 Montana Air Quality Permits--When Required. This rule requires a person to obtain an air quality permit or permit modification to construct, modify, or use any air contaminant sources that have the Potential to Emit (PTE) greater than 25 tons per year of any pollutant. REC has a PTE greater than 25 tons per year of PM, PM_{10}, NO_x, and CO; therefore, an air quality permit is required.

3. ARM 17.8.744 Montana Air Quality Permits--General Exclusions. This rule identifies the activities that are not subject to the Montana Air Quality Permit program.

4. ARM 17.8.745 Montana Air Quality Permits--Exclusion for De Minimis Changes. This rule identifies the de minimis changes at permitted facilities that do not require a permit under the Montana Air Quality Permit Program.

5. ARM 17.8.748 New or Modified Emitting Units--Permit Application Requirements. (1) This rule requires that a permit application be submitted prior to installation, modification, or use of a source. REC submitted the required permit application for the current permit action. (7) This rule requires that the applicant notify the public by means of legal publication in a newspaper of general circulation in the area affected by the application for a permit. REC submitted an affidavit of publication of public notice for the February 2, 2011, issue of the *Montana Standard*, a newspaper of general circulation in the city of Butte, Silver Bow County, Montana, as proof of compliance with the public notice requirements.

6. ARM 17.8.749 Conditions for Issuance or Denial of Permit. This rule requires that the permits issued by the Department must authorize the construction and operation of the facility or emitting unit subject to the conditions in the permit and the requirements of this subchapter. This rule also requires that the permit must contain any conditions necessary to assure compliance with the Federal Clean Air Act (FCAA), the Clean Air Act of Montana, and rules adopted under those acts.

7. ARM 17.8.752 Emission Control Requirements. This rule requires a source to install the maximum air pollution control capability that is technically practicable and economically feasible, except that BACT shall be utilized. The required BACT analysis is included in Section III of this permit analysis.

8. ARM 17.8.755 Inspection of Permit. This rule requires that air quality permits shall be made available for inspection by the Department at the location of the source.

9. ARM 17.8.756 Compliance with Other Requirements. This rule states that

nothing in the permit shall be construed as relieving REC of the responsibility for complying with any applicable federal or Montana statute, rule, or standard, except as specifically provided in ARM 17.8.740, *et seq*.

10. ARM 17.8.759 Review of Permit Applications. This rule describes the Department's responsibilities for processing permit applications and making permit decisions on those permit applications that do not require the preparation of an environmental impact statement.

11. ARM 17.8.762 Duration of Permit. An air quality permit shall be valid until revoked or modified, as provided in this subchapter, except that a permit issued prior to construction of a new or modified source may contain a condition providing that the permit will expire unless construction is commenced within the time specified in the permit, which in no event may be less than 1 year after the permit is issued.

12. ARM 17.8.763 Revocation of Permit. An air quality permit may be revoked upon written request of the permittee, or for violations of any requirement of the Clean Air Act of Montana, rules adopted under the Clean Air Act of Montana, the FCAA, rules adopted under the FCAA, or any applicable requirement contained in the Montana State Implementation Plan (SIP).

13. ARM 17.8.764 Administrative Amendment to Permit. An air quality permit may be amended for changes in any applicable rules and standards adopted by the Board of Environmental Review (Board) or changed conditions of operation at a source or stack that do not result in an increase of emissions as a result of those changed conditions. The owner or operator of a facility may not increase the facility's emissions beyond permit limits unless the increase meets the criteria in ARM 17.8.745 for a de minimis change not requiring a permit, or unless the owner or operator applies for and receives another permit in accordance with ARM 17.8.748, ARM 17.8.749, ARM 17.8.752, ARM 17.8.755, and ARM 17.8.756, and with all applicable requirements in ARM Title 17, Chapter 8, Subchapters 8, 9, and 10.

14. ARM 17.8.765 Transfer of Permit. This rule states that an air quality permit may be transferred from one person to another if written notice of intent to transfer, including the names of the transferor and the transferee, is sent to the Department.

F. ARM 17.8, Subchapter 8, Prevention of Significant Deterioration of Air Quality, including, but not limited to:

1. ARM 17.8.801 Definitions. This rule is a list of applicable definitions used in this subchapter.

2. ARM 17.8.818 Review of Major Stationary Sources and Major Modifications--Source Applicability and Exemptions. The requirements contained in ARM 17.8.819 through 17.8.827 shall apply to any major stationary source and any major modification, with respect to each pollutant subject to regulation under the Federal Clean Air Act (FCAA) that it would emit, except as this subchapter would otherwise allow.

This facility is not a major stationary source since this facility is not a listed source and the facility's PTE is below 250 tons per year of any pollutant (excluding fugitive emissions).

G. ARM 17.8, Subchapter 12, Operating Permit Program Applicability, including, but limited to:

1. ARM 17.8.1201 Definitions. (23) Major Source under Section 7412 of the FCAA is defined as any stationary source having:
   a. PTE > 10 tons/year of any one Hazardous Air Pollutant (HAP), PTE > 25 tons/year of a combination of all HAPs, or lesser quantity as the Department may establish by rule;

   b. PTE > 100 tons/year of any pollutant; or

   c. PTE > 70 tons/year of particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}) in a serious PM_{10} nonattainment area.

2. ARM 17.8.1204 Air Quality Operating Permit Program Applicability. Title V of the FCAA of 1990 requires that all sources, as defined in ARM 17.8.1204 (1), obtain a Title V Operating Permit. In reviewing and issuing air quality Permit #2940-07 for REC's facility, the following conclusions were made:

   a. The facility's PTE is less than 100 tons/year for any pollutant.

   b. The facility's PTE is less than 10 tons/year for any one HAP and less than 25 tons for all HAPs.

   c. The source is not located in a serious PM_{10} nonattainment area.

   d. The facility is not subject to any current NESHAP standards.

   e. The source is not a Title IV affected source or a solid waste combustion unit.

   f. The source is not an EPA designated Title V source.

   Therefore, REC's facility is not subject to Title V Operating Permit requirements.

III. Best Available Control Technology Analysis

A BACT determination is required for each new or altered source. REC shall install on the new or altered source the maximum air pollution control capability which is technically practicable and economically feasible, except that BACT shall be utilized.

A BACT analysis was submitted by REC in Permit Application #2940-07, addressing the available methods for controlling NO_x, CO, and VOC emissions from the modified burner system on the hot oil heaters. The Department reviewed these methods, as well as previous BACT determinations in order to make the following BACT determinations.

The control options selected have controls and control costs comparable to other recently permitted similar sources and are capable of achieving the appropriate emission standards.

A. NO_x BACT – New and Existing Boilers

NO_x formation occurs by three fundamentally different mechanisms. The principal mechanism is thermal NO_x. The second mechanism is termed "prompt NO_x" and a third and less predominant mechanism is fuel NO_x. Thermal NO_x results when the intense heat

of combustion causes atmospheric nitrogen to combine with atmospheric oxygen. Prompt NO_x occurs through early reactions of nitrogen molecules in the combustion air and hydrocarbon radicals present in the fuel. Fuel NO_x is formed by the oxidation of fuel-bound nitrogen. The contribution of this mechanism to total NO_x depends on nitrogen content of the fuel. For natural gas, the contribution of fuel NO_x is usually negligible.

NO_x Control Technologies

1. **Combustion controls**. Combustion controls are potential features of a heater that can reduce the formation of NO_x at the source. The combustion controls REC has identified are Ultra Low NO_x Burners (ULNB) and Flue Gas Recirculation (FGR).

   ULNB integrate staged combustion into the burner creating a fuel-rich primary combustion zone. Fuel NO_x formation is decreased by the reducing conditions in the primary combustion zone. Thermal NO_x is limited due to the lower flame temperature caused by the lower oxygen concentration. The secondary combustion zone is a fuel-lean zone where combustion is completed. ULNB may result in increased CO and hydrocarbon emissions, decreased heater efficiency, and increased fuel costs.

   FGR is a flame-quenching technique that involves recirculating a portion of the flue gas from the economizers or the air heater outlet and returning it to the heater through the burner or windbox. The primary effect of FGR is to reduce the peak flame temperature through absorption of the combustion heat by relatively cooler flue gas. FGR also serves to reduce the O_2 concentration in the combustion zone.

2. **Post-Combustion Controls**

   - SCR

   SCR is a post combustion gas treatment technique that uses a catalyst to reduce NO and NO_2 in an exhaust stream to molecular Nitrogen (N), water (H_2O), and oxygen (O_2). Ammonia (NH_3) is commonly used as the reducing agent. The basic chemical reactions are as follows:

   $$4NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O$$
   $$8NH_3 + 6NO_2 \rightarrow 7N_2 + 12H_2O$$
   $$2NO_2 + 4\,NH_3 + O_2 \rightarrow 3N_2 + 6H_2O$$

   Ammonia is vaporized and injected into the flue gas upstream of a catalyst bed, and NH_3 combines with NO_x at the catalyst surface to form an ammonium salt intermediate. The ammonium salt intermediate then decomposes to produce elemental nitrogen and water.

   The catalyst lowers the temperature required for the chemical reaction between NO_x and NH_3. Catalysts used for the NO_x reduction include base metals, precious metals, and zeolites. Commonly, the catalyst of choice for the reaction is a mixture of titanium and vanadium oxides.

   An attribute common to all catalysts is the narrow “window” of acceptable system temperatures. In the case of the hot oil heaters, the temperature window

is approximately 400°F to 800°F. At temperatures below 400°F, the NO_x reduction reaction will not proceed. Operation at temperatures exceeding 800°F will shorten catalyst life and can lead to the oxidation of ammonia to either nitrogen oxides (thereby increasing NO_x emissions) or possibly generating explosive levels of ammonium nitrate.

Technical factors impacting the effectiveness of SCR include catalyst reactor design, operating temperature, the type of fuel fired, sulfur content of the fuel, design of the NH_3 injection system, and the potential for catalyst poisoning. Given the prevalence of phosphorous-containing lubricating oils, catalyst poisoning remains a concern.

The control efficiency for an SCR applied to process heaters is approximately 80%, but actual effectiveness would depend on fuel quality and heater duty cycle (load fluctuations).

- **SNCR**

SNCR involves the noncatalytic decomposition of NO_x in the flue gas to nitrogen and water using a reducing agent (e.g. ammonia or urea). The reactions take place at much higher temperatures than in an SCR, typically between 1,600ºF and 2,200ºF.

3. Technically infeasible NO_x control options

In determining whether an alternative control technology is technically feasible, it must be "available" and "applicable". A technology is available if it has reached the licensing and commercial sales stage of development. An identified alternative control technique may be considered applicable if it has been or is soon to be deployed (e.g., is specified in a permit) on the same or similar source type.

As discussed previously, REC encounters operational problems with the FGR when temperatures are below 25 F. The moist air coming from the flue gas recirculation system combines with the freezing air from the air intake system. This creates an ice fog within the air intake system and ice collects on metal components, which eventually blocks the entire system. This requires a full system shutdown of 24-36 hours to thaw the system and return the process to normal operating temperatures. REC had previously sought to alleviate this problem by requesting to be allowed to not use the FGR system for up to 120 days per year, when temperatures fell below 25 F. Despite this allowance, problems persisted due to an inability to create complete blockages of the FGR system on a temporary basis. REC had installed two butterfly valves to block the recirculation of the flue gas. However, moist air from the FGR still bypasses the valves and creates icing and blockages in the air intake system. Due to the reasons explained above, the FGR system has been determined to not be technically feasible. REC requests to remove FGR as a technically feasible control.

4. Control Effectiveness

REC is proposing to replace the natural gas-fired burners on its 40 MMBtu/hr hot oil heaters in order to improve operations of the system, specifically when ambient temperatures are low. Because the ULNB combustion controls for NO_x are currently considered standard equipment on boilers and heaters, they are considered the baseline case. A NO_x reduction performance has not been calculated for this case.

Control Technology	NO_x Reduction Potential (%)	NO_x Emission Rate (lb/MMBtu)
SCR	70-90%	0.0053
SNCR	30-50%	0.027
ULNB	0%	0.053

5. Cost Effectiveness

The following table summarizes the total annual cost and cost-effectiveness for NO_x control for replacement burners on the 40 MMBtu/hr hot oil heaters.

Control Technology	NO_x Reduction Potential %	Annual Cost ($/yr)	Uncontrolled Emissions (ton/yr)	Control Efficiency (%)	Tons Removed (ton/yr)	Cost-Effectiveness ($/ton)
SCR	70-90	$164,000	9.35	90	8.41	$20,000
SNCR	30-50	$159,000	9.35	50	4.67	$34,000

6. Select BACT

The first option analyzed is the use of SCR, the best performing NO_x control. The use of an SCR on the hot oil heaters was demonstrated above to have acceptable environmental and energy impacts. However, the economic impacts are unacceptable at $20,000/ton. These costs are far above industry norms, and seem excessive for the small tonnage of NO_x removed. Therefore, the SCR control option as BACT is rejected.

The next best performing option analyzed is the use of SNCR. The use of an SNCR on the new hot oil heaters has also been demonstrated above to have acceptable environmental and energy impacts. However, the economic impacts are unacceptable at $34,000/ton. These costs are far above industry norms, and seem excessive for the small tonnage of NO_x removed. Furthermore, an SNCR installation is not common practice on natural gas-fired boilers, because of the low performance relative to SCR. Therefore, the SNCR control option as BACT is rejected.

Finally, the third best performing option, and the baseline case, is the use of combustion controls (ULNB) to reduce the formation of NO_x. The use of combustion controls on the hot oil heaters has been demonstrated above to have acceptable environmentaql and energy impacts. The economic impacts for ULNB are considered acceptable, as they are a part of the base purchase price of the boiler package and determined to be BACT.

REC proposes a BACT NO_x emission limit of 2.134 lb/hr on a 12-month rolling average for the hot oil heater. This limit is equivalent to the analyzed emission rate of 0.0534 lb/MMBtu, multiplied by the full firing rate of one boiler, 40 MMBtu/hr. Both the proposed UNLB emission controls and BACT emission limit conform to determinations made recently by the Department for other similar installations in Montana and determinations found in the RACT/BACT/LAER Clearinghouse (RBLC) as demonstrated in Appendix E of the permit application. This proposed emission limit to be met using only ULNB is more stringent than the previously determined BACT limit using low NO_x burners with flue gas recirculation. The Department determined that the emission limit of 2.134 lb/hr, using only ULNB constitutes BACT for NO_x for the current project.

B. CO and VOC BACT

CO and VOCs are formed from incomplete combustion of organic constituents within the natural gas in the facility's natural gas-fired hot oil heaters. Because CO and VOC are generated and controlled by the same mechanisms, they will be addressed in this section together. In an ideal process, complete combustion, or oxidation, of organics results in the emission of water and CO_2. When organic compounds do not oxidize completely, the result is CO and various modified organic compounds (VOCs). Two general and nonexclusive approaches are available for reducing emissions of these compounds:

- Improve combustion conditions to facilitate complete combustion in the heater burner, and

- Complete oxidation of the exhaust stream after it leaves the heater burner.

Post-combustion CO/VOC control is accomplished via add-on equipment that creates an environment of high temperature and oxygen concentration to promote complete oxidation of the CO and organic compounds remaining in the exhaust. This can be facilitated at relatively lower temperatures by the use of certain catalyst materials.

1. Control Technologies

This BACT analysis considers proper system design and operation; thermal oxidation; and catalytic oxidation.

- Proper system design and operation – Reduction of CO emissions can be accomplished by controlling the combination of system temperatures through operation at maximum loads, increasing oxygen concentrations, maximizing combustion residence time, and improving mixing of the fuel, exhaust gases, and combustion air (oxygen). Maximizing heating efficiency, and subsequently minimizing fuel usage, will also minimize CO formation. Paradoxically, all of these techniques also generally increase NO_x emissions.

- Thermal oxidation – Thermal oxidizers are essentially supplementary combustion chambers that complete the conversion of CO/VOC to CO_2 and water by creating a high temperature environment with optimal oxygen concentration, mixing, and residence time. They require temperatures of approximately 1400ºF to 1500ºF. This high-temperature environment is produced by the combustion of supplemental fuel, generally natural gas. Thermal oxidizers are typically locaed downstream of a particulate control device, especially when the exhaust stream contains high concentrations of particulate material. Reduced particulate loading improves thermal efficiency since the particulate matter would act as a heat sink, and it reduces equipment maintenance requirements.

  Several design variations address different inlet concentrations, air flow rates, fuel efficiency requirements, and other operational variables. All of them function using the basic principles described above. One commonly used design is called a regenerative thermal oxidizer (RTO), which is evaluated for this BACT analysis. This type of thermal oxidizer typically uses a bed of ceramic packing material to capture heat from the incineration process and preheat the incoming exhaust gas. This design improves thermal efficiency and reduces the amount of supplemental fuel that must be combusted. RTOs are capable of reducing CO/VOC emissions by 95 to 99 percent.

- Catalytic Oxidation – Catalytic oxidizers employ the same principles as thermal

oxidizers, but they use catalysts to lower the temperature required to effect complete oxidation. One commonly used design is called a regenerative catalytic oxidizer RCO, which is evaluated for this BACT analysis. The optimum temperature range for catalytic oxidizers is generally about 800ºF. Because catalysts are prone to plugging and poisoning, catalytic oxidizers must be located downstream of a particulate control device if the exhaust stream contains appreciable concentrations of particulate matter. Even so, contaminants that are not removed by the particulate control equipment, or those that are not removed in sufficient quantity, can potentially poison the catalyst and reduce or eliminate its effectiveness. For this application, the boilers will be combusting a clean fuel (natural gas), and particulate loading is not anticipated to be a problem.

Like thermal oxidizers, catalytic oxidizer designs include many varieties to address specific operational conditions and requirements. They are generally capable of 90 to 99 percent destruction or removal efficiency at steady-state conditions.

2. Technically infeasible control options

Technical issues do not allow either of the control devices to be eliminated based on technical feasibility.

3. Control effectiveness

Catalytic and thermal oxidizer units are expected to have VOC control efficiencies ranging from 90% to 99%. For this BACT analysis, each control device was assumed to have a control efficiency of 95% for VOC. For CO control, the catalytic oxidizers have high efficiencies around 90-99%. CO efficiencies are generally less for thermal oxidizers, in the range of 70-90%. Here, 95% was chosen for the catalytic oxidizer, and 90% for the thermal oxidizer, to be conservative.

Control Technology	CO Reduction Potential (%)	VOC Reduction Potential (%)
Catalytic Oxidizer	95	95
RTO	90	95
Good Combustion Practices	Baseline	Baseline

4. Cost effectiveness

Costs were estimated assuming 90% to 95% CO removal for RTO and RCO respectively, and 95% VOC removal for both control options.. The following table shows the approximate cost-effectiveness for catalytic oxidizer and RTO applications for the process heaters.

Unit (on hot oil heaters)	Annual Cost ($/yr)	Uncontrolled Emissions (ton/yr)	Control Efficiency (%)	Tons Removed (ton/yr)	Cost-Effectiveness ($/ton)
RCO for CO	$259,000	17.77	95	16.87	$15,000
RTO for CO	$411,000	17.77	90	15.98	$26,000
RCO for VOC	$259,000	0.35	95	0.33	$785,000
RTO for VOC	$411,000	0.35	95	0.33	$1,245,000

5. Select BACT

With a conservatively calculated cost-effectiveness ranging from $15,000 to $26,000 per ton of CO removed, and ranging from $785,000 to $1,245,000 for VOCs, additional CO and VOC controls are determined to be economically infeasible with costs significantly greater than industry norms.

The use of proper system design and operation on the hot oil heaters has been demonstrated to have acceptable environmental and energy impacts. The economic impacts are clearly acceptable, as they are a part of operating the heaters. After rejection of the other higher ranked control options, proper system design and operation for CO and VOC control on the hot oil heaters is considered BACT. REC proposed a corresponding BACT emission limit of 4.058 lb/hr for CO. The Department believes that proper design and combustion constitutes BACT for CO and VOC control, as well as an emission limit of 4.058 lb/hr limit for CO.

IV. Emission Inventory

	Tons/Year					
	PM	PM-10	SO_x	NO_x	VOC	CO
Boilers < 10 MMBtu/hr	0.09	0.09	0.02	2.94	0.16	0.59
All Boilers > 10 MMBtu/hr	2.20	2.20	0.22	26.39	3.52	32.99
2 Natural Gas Hot Oil Heaters (40 MMBtu/hr each)	2.66	2.66	0.21	18.57	0.70	35.88
2 Natural Gas Hot Oil Heaters (23 MMBtu/hr each)	1.54	1.54	0.12	6.18	1.13	11.32
MG Silicon Storage Bins	0.34	0.34				
MG Silicon Feed Hopper	0.09	0.09				
MG Silicon Lock Hopper	0.08	0.08				
Lime Storage System	5.27	5.27				
Cooling Tower	4.07	4.07				
Chlorosilane Scrubber System	0.07	0.07				
Silane Scrubber System	0.43	0.43				
Reactor Atmos. Vents	13.37	13.37				
Reactor Analyzer Vents	0.16	0.16				
MG Silicon Feed Hopper	0.09	0.09				
MG Silicon Lock Hopper	0.08	0.08				
Chlorosilane Scrubber System	0.07	0.07				
Silane Scrubber System	0.21	0.21				
Hydrogen Vent Stack	24.84	24.84				
Cooling Tower	4.07	4.07				
Emergency Generators	0.72	0.47	5.41	30.80	0.97	7.04
Emergency Generator	0.27	0.27	0.25	3.77	0.30	0.82
Total	**59.93**	**59.93**	**6.23**	**88.68**	**6.78**	**88.66**

Boilers < 10 MMBtu/hr Boiler #2 EP#114

N.G. Heat Value	1000	Btu/ft**3
Total Heat	6.7	MMBtu/hr
Fuel Consumed	58.7	MMft**3/yr

PM Emissions

Emission Factor:	3.00	lbs/MMft**3 {AFSSCC 1-02-006-03}
Control Efficiency:	0.0%	
Fuel Consumption:	58.7	MMft**3/yr (Maximum Consumption)
Calculations:	58.7	MMft**3/yr*3.00 lb/MMft**3*0.0005 ton/lb = 0.09 ton/yr

PM-10 Emissions:

Emission Factor:	3.00	lbs/MMft**3 {AFSSCC 1-02-006-03}
Control Efficiency:	0.0%	
Fuel Consumption:	58.7	MMft**3/yr (Maximum Consumption)
Calculations:	58.7	MMft**3/yr*3.00 lb/MMft**3*0.0005 ton/lb = 0.09 ton/yr

NO_x Emissions:

Emission Factor:	100.00	lbs/MMft**3	{AFSSCC 1-02-006-03}
Control Efficiency:	0.0%		
Fuel Consumption:	58.7	MMft**3/yr	(Maximum Consumption)
Calculations:	58.7	MMft**3/yr*100 lb/MMft**3*0.0005 ton/lb = 2.94 ton/yr	

VOC Emissions:

Emission Factor:	5.30	lbs/MMft**3	{AFSSCC 1-02-006-03}
Control Efficiency:	0.0%		
Fuel Consumption:	58.7	MMft**3/yr	(Maximum Consumption)
Calculations:	58.7	MMft**3/yr*5.30 ls/MMft**3*0.0005 ton/lb = 0.16 ton/yr	

CO Emissions:

Emission Factor:	20.00	lb/MMft**3	{AFSSCC 1-02-006-03}
Control Efficiency:	0.0%		
Fuel Consumption:	58.7	MMft**3/yr	(Maximum Consumption)
Calculations:	58.7	MMft**3/yr*20 lb/MMft**3*0.0005 ton/lb = 0.59 ton/yr	

SO_x Emissions:

Emission Factor:	0.60	ls/MMft**3	{AFSSCC 1-02-006-03}
Control Efficiency:	0.0%		
Fuel Consumption:	58.7	MMft**3/yr	(Maximum Consumption)
Calculations:	58.7	MMft**3/yr*0.6 lb/MMft**3*0.0005 tons/lb = 0.02 ton/yr	

All Boilers > 10 MMBtu/hr Boiler #1 EP#113

N.G. Heat Value	1000	Btu/ft**3
Total Heat	50.22	MMBtu/hr
Fuel Consumed	440	MMft**3/yr

PM Emissions

Emission Factor:	0.01	lb/MMBtu	{Manufacturer's Information}
Control Efficiency:	0.0%		
Firing Rate:	50.22	MMBtu/hr	(Maximum Firing Rate)
Calculations:	50.22	MMBtu/hr*0.01 lb/MMBtu *8760 hr/yr*0.0005 ton/lb = 2.20 ton/yr	

PM-10 Emissions:

Emission Factor:	0.01	lb/MMBtu	{Manufacturer's Information}
Control Efficiency:	0.0%		
Firing Rate:	50.22	MMBtu/hr	(Maximum Firing Rate)
Calculations:	50.22	MMBtu/hr*0.01 lb/MMBtu *8760 hr/yr*0.0005 ton/lb = 2.20 ton/yr	

NO_x Emissions:

Emission Factor:	0.120	lb/MMBtu	{Manufacturer's Information}
Control Efficiency:	0.0%		
Fuel Consumption:	50.22	MMBtu/hr	(Maximum Firing Rate)
Calculations:	50.22	MMBtu/hr*0.120 lb/MMBtu *8760*0.0005 ton/lb = 26.39 ton/yr	

VOC Emissions:

Emission Factor:	0.016	lb/MMBtu	{Manufacturer's Information}
Control Efficiency:	0.0%		
Fuel Consumption:	50.22	MMBtu/hr	(Maximum Firing Rate)
Calculations:	50.22	MMBtu/hr*0.016 lb/MMBtu *8760*0.0005 ton/lb = 3.52 ton/yr	

CO Emissions:

Emission Factor:	0.15	lb/MMBtu	{Manufacturer's Information}
Control Efficiency:	0.0%		
Fuel Consumption:	50.22	MMBtu/hr	(Maximum Firing Rate)
Calculations:	50.22	MBtu/hr*0.15 lb/MMBtu *8760*0.0005 ton/lb = 32.99 ton/yr	

SO_x Emissions:

Emission Factor:	0.001	lb/MMBtu	{Manufacturer's Information}
Control Efficiency:	0.0%		
Fuel Consumption:	50.22	MMBtu/hr	(Maximum Firing Rate)
Calculations:	50.22	MMBtu/hr*0.001 lb/MMBtu *8760*0.0005 ton/lb = 0.22 ton/yr	

Natural Gas Hot Oil Heaters (2 – 40 MMBtu/hr) H-1701 & H-2701

PM Emissions

Emission Factor:	7.6	lb/MMscf	{EPA AP-42 1.4-2}
Control Efficiency:	0.0%		(Ultra LOW NO_X BURNERS)
Firing Rate:	0.080	MMscf/hr	(Maximum Firing Rate)
Calculations:	0.080	MMscf/hr*7.6 lb/MMscf *8760 hr/yr*0.0005 ton/lb = 2.66 ton/yr	

PM-10 Emissions:

Emission Factor:	7.6	lb/MMscf	{EPA AP-42 1.4-2}
Control Efficiency:	0.0%		(Ultra LOW NO_X BURNERS)
Firing Rate:	0.080	MMscf/hr	(Maximum Firing Rate)
Calculations:	0.080	MMscf/hr*7.6 lb/MMscf *8760 hr/yr*0.0005 ton/lb = 2.66 ton/yr	

NO_x Emissions:

Emission Factor:	0.0534	lb/MMBtu	{Manufacturer's Information}
Control Efficiency:	0.0%		(Ultra LOW NO_X BURNERS)
Fuel Consumption:	80.00	MMBtu/hr	(Maximum Firing Rate)
Calculations:	80.00	MMBtu/hr*0.0534 lb/MMBtu *8760*0.0005 ton/lb = 18.71 ton/yr	

VOC Emissions:

Emission Factor:	0.002	lb/MMBtu	{Manufacturer's Information}
Control Efficiency:	0.0%		(Ultra LOW NO_X BURNERS)
Fuel Consumption:	80.00	MMBtu/hr	(Maximum Firing Rate)
Calculations:	80.00	MMBtu/hr*0.002 lb/MMBtu *8760*0.0005 ton/lb = 0.70 ton/yr	

CO Emissions:

Emission Factor:	0.1024	lb/MMBtu	{Manufacturer's Information}
Control Efficiency:	0.0%		(Ultra LOW NO_X BURNERS)
Fuel Consumption:	80.00	MMBtu/hr	(Maximum Firing Rate)
Calculations:	80.00	MMBtu/hr*0.1024 lb/MMBtu *8760*0.0005 ton/lb = 35.88 ton/yr	

SO_x Emissions:

Emission Factor:	0.60	lb/MMscf	{EPA AP-42 1.4-2}
Control Efficiency:	0.0%		
Fuel Consumption:	0.080	MMscf/hr	(Maximum Firing Rate)
Calculations:	0.080	MMscf/hr*0.60 lb/MMscf *8760*0.0005 ton/lb = 0.21 ton/yr	

Natural Gas Hot Oil Heaters (2 – 23.5 MMBtu/hr) EP#107B & EP#207B

PM Emissions

Emission Factor:	0.0075	lb/MMBtu	{AP-42, Table 1.4-2 (07/98}
Control Efficiency:	0.0%		(Ultra LOW NO_X BURNERS)
Firing Rate:	47.00	MMBtu/hr	(Maximum Firing Rate)
Calculations:	47.00	MMBtu/hr*0.0075 lb/MMBtu *8760 hr/yr*0.0005 ton/lb = 1.54 ton/yr	

PM-10 Emissions:

Emission Factor:	0.0075	lb/MMBtu	{AP-42, Table 1.4-2 (07/98}
Control Efficiency:	0.0%		(Ultra LOW NO_X BURNERS)
Firing Rate:	47.00	MMBtu/hr	(Maximum Firing Rate)
Calculations:	47.00	MMBtu/hr*0.0075 lb/MMBtu *8760 hr/yr*0.0005 ton/lb = 1.54 ton/yr	

NO_x Emissions:

Emission Factor:	0.03	lb/MMBtu	{Manufacturer's Information}
Control Efficiency:	0.0%		(Ultra LOW NO_X BURNERS)
Fuel Consumption:	47.00	MMBtu/hr	(Maximum Firing Rate)
Calculations:	47.00	MMBtu/hr*0.03 lb/MMBtu *8760*0.0005 ton/lb = 6.18 ton/yr	

VOC Emissions:

Emission Factor:	0.0054	lb/MMBtu	{AP-42, Table 1.4-2 (07/98}
Control Efficiency:	0.0%		(Ultra LOW NO_X BURNERS)
Fuel Consumption:	47.00	MMBtu/hr	(Maximum Firing Rate)
Calculations:	47.00	MMBtu/hr*0.0054 lb/MMBtu *8760*0.0005 ton/lb = 1.11 ton/yr	

CO Emissions:

Emission Factor:	0.055	lb/MMBtu	{Manufacturer's Information}
Control Efficiency:	0.0%		(Ultra LOW NO_X BURNERS)
Fuel Consumption:	47.00	MMBtu/hr	(Maximum Firing Rate)
Calculations:	47.00	MMBtu/hr*0.055 lb/MMBtu *8760*0.0005 ton/lb = 11.32 ton/yr	

SO_x Emissions:

Emission Factor:	0.0006	ls/MMBtu	{AP-42, Table 1.4-2 (07/98}
Control Efficiency:	0.0%		
Fuel Consumption:	47.00	MMBtu/hr	(Maximum Firing Rate)

Calculations: 47.00 MMBtu/hr*0.0006 ls/MMBtu *8760*0.0005 ton/lb = 0.12 ton/yr

PHASE I EMISSION SOURCES

MG Silicon Storage Bins EP#101A&B

PM Emissions

Emission Factor:	0.02	gr/dscf	(Bin Vent Filter Control)
Baghouse Flow:	450	dscfm	

Calculations: 0.02 gr/dscf * 450 dscfm * 60 *8760*1lb/7000gr= 676 lb/yr
676 lb/yr * 0.0005 ton/lb = 0.34 ton/yr

PM-10 Emissions

Emission Factor:	0.02	gr/dscf	(Bin Vent Filter Control & Assume 100% PM-10)
Baghouse Flow:	450	dscfm	

Calculations: 0.02 gr/dscf * 450 dscfm * 60 *8760*1lb/7000gr = 676 lb/yr
676 lb/yr * 0.0005 ton/lb = 0.34 ton/yr

MG Silicon Feed Hopper EP#102

PM Emissions

Emission Factor:	0.02	gr/dscf	(Baghouse Control)
Baghouse Flow:	122.5	dscfm	

Calculations: 0.02 gr/dscf * 122.5 dscfm * 60 *8760*1lb/7000gr = 184 lb/yr
184 lb/yr * 0.0005 ton/lb = 0.09 ton/yr

PM-10 Emissions

Emission Factor:	0.02	gr/dscf	(Baghouse Control & Assume 100% PM-10
Baghouse Flow:	122.5	dscfm	

Calculations: 0.02 gr/dscf *122.5 dscfm * 60 *8760*1lb/7000gr = 184 lb/yr
184 lb/yr * 0.0005 ton/lb = 0.09 ton/yr

MG Silicon Lock Hopper EP#104

PM Emissions

Emission Factor:	0.02	gr/dscf	(Bin Vent Filter Control)
Baghouse Flow:	100	dscfm	

Calculations: 0.02 gr/dscf * 100 dscfm * 60 *8760*1lb/7000gr = 150 lb/yr
150 lb/yr * 0.0005 ton/lb = 0.08 ton/yr

PM-10 Emissions

Emission Factor:	0.02	gr/dscf	(Bin Vent Filter Control & Assume 100% PM-10)
Baghouse Flow:	100	dscfm	

Calculations: 0.02 gr/dscf *100 dscfm * 60 *8760*1lb/7000gr = 150 lb/yr
100 lb/yr * 0.0005 ton/lb = 0.08 ton/yr

Lime Storage System EP#116

PM Emissions

Emission Factor:	0.187	gr/dscf	(Bin Vent Filter Control)
Baghouse Flow:	750	dscfm	

Calculations: 0.187 gr/dscf * 750 dscfm * 60 *8760*1lb/7000gr = 10,530 lb/yr
10,530 lb/yr * 0.0005 ton/lb = 5.27 ton/yr

PM-10 Emissions

Emission Factor:	0.187	gr/dscf	(Bin Vent Filter Control & Assume 100% PM-10)
Baghouse Flow:	750	dscfm	

Calculations: 0.187 gr/dscf *750 dscfm * 60 *8760*1lb/7000gr = 10,530 lbs/yr
10,530 lb/yr * 0.0005 ton/lb = 5.27 ton/yr

Cooling Tower EP#118

PM Emissions

Circulation Rate: 10400.00 gpm/cell
Max Drift: 0.005%
Total Dissolved Solids: 1200 ppm
Calculations: 10400 gpm*500 lb/hr/gpm*0.005%*1200*10-6= 0.31 lb/hr/cell
0.31*3 cells*8760*0.0005= 4.07 ton/yr

PM-10 Emissions
Circulation Rate: 10400.00 gpm/cell
Max Drift: 0.005%
Total Dissolved Solids: 1200 ppm
Calculations: 10400 gpm*500 lb/hr/gpm*0.005%*1200*10-6 = 0.31 lb/hr/cell
0.31*3 cells*8760*0.0005 = 4.07 ton/yr

Chlorosilane Scrubber System EP#105

PM Emissions
TPY SiO2 Formed: 72.70 ton/yr (From Permit Application, 6/6/96)
Control: 99.90% (WET SCRUBBER)
Calculations: 72.7* (1-0.999)= 0.07 ton/yr

PM-10 Emissions
TPY SiO2 Formed: 72.70 ton/yr (From Permit Application, 6/6/96)
Control: 99.90% (WET SCRUBBER)
Calculations: 72.7* 1-0.999)= 0.07 ton/yr

Silane Scrubber System EP#106

PM Emissions
TPY Silane: 23.00 ton/yr (From Permit Application, 6/6/96)
Control: 99.00% (WET SCRUBBER)
Calculations: 23* (1-0.99)*1.87 = 0.43 ton/yr

PM-10 Emissions
TPY Silane: 23.00 ton/yr (From Permit Application, 6/6/96)
Control: 99.00% (WET SCRUBBER)
Calculations: 23 * (1-0.99)*1.87 = 0.43 ton/yr

Reactor Atmos. Vents EP#108-01 through EP#108-50 for TDF-L
EP#108-51 through EP#108-58 for TDF-M

PM Emissions
TDF-L Reactors:
Calculations: 5.58 lb SiO_2*50 reactors*34 cycles/reactor/yr = 9486 lbs SiO_2/yr
9486*0.0005 = 4.74 ton/yr

TDF-M Reactors:
Calculations: 21.8 lb SiO_2*8 reactors*99 cycles/reactor/yr = 17265.6 lbs SiO_2/yr
17265.6*0.0005 = 8.63 ton/yr

TOTAL: 13.37 tons SiO_2/yr

PM-10 Emissions

TDF-L Reactors:
Calculations: 5.58 lb SiO_2*50 reactors*34 cycles/reactor/yr = 9486 lbs SiO_2/yr
9486*0.0005 = 4.74 ton/yr

TDF-M Reactors:
Calculations: 21.8 lb SiO_2*8 reactors*99 cycles/reactor/yr = 17265.6 lbs SiO_2/yr
17265.6*0.0005 = 8.63 ton/yr

TOTAL: 13.37 tons SiO_2/yr

Reactor Analyzer Vents EP#109-01 through EP#109-50 for TDF-L
EP#109-51 through EP#109-58 for TDF-M

PM Emissions

TDF-L Reactors:
Calculations: 50 reactors*4.67 lb/yr/reactor = 233.5 lbs SiO_2/yr
233.5*0.0005 = 0.12 ton/yr

TDF-M Reactors:
Calculations: 8 reactors*9.31 lb/yr/reactor = 74.48 lbs SiO_2/yr
74.48*0.0005 =0.04 ton/yr
TOTAL: 0.16 tons SiO_2/yr

PM-10 Emissions
TDF-L Reactors:
Calculations: 50 reactors*4.67 lb/yr/reactor = 233.5 lbs SiO_2/yr
233.5*0.0005 =0.12 ton/yr

TDF-M Reactors:
Calculations: 8 reactors*9.31 lb/yr/reactor = 74.48 lbs SiO_2/yr
74.48*0.0005 =0.04 ton/yr
TOTAL: 0.16 tons SiO_2/yr

PHASE II EMISSION SOURCES

MG Silicon Feed Hopper EP#202

PM Emissions
Emission Factor: 0.02 gr/dscf (Baghouse Control)
Baghouse Flow: 122.5 dscfm
Calculations: 0.02 gr/dscf * 122.5 dscfm * 60 *8760*1lb/7000gr= 184 lb/yr
184 lb/yr * 0.0005 ton/lb = 0.09 ton/yr

PM-10 Emissions
Emission Factor: 0.02 gr/dscf (Baghouse Control & Assume 100% PM-10)
Baghouse Flow: 245 dscfm
Calculations: 0.02 gr/dscf *245 dscfm * 60 *8760*1lb/7000gr = 184 lb/yr
184 lb/yr * 0.0005 ton/lb = 0.09 ton/yr

MG Silicon Lock Hopper EP#204

PM Emissions
Emission Factor: 0.02 gr/dscf (Bin Vent Filter Control)
Baghouse Flow: 100 dscfm
Calculations: 0.02 gr/dscf * 100 dscfm * 60 *8760*1lb/7000gr = 150 lb/yr
150 lb/yr * 0.0005 ton/lb = 0.08 ton/yr

PM-10 Emissions
Emission Factor: 0.02 gr/dscf (Bin Vent Filter Control & Assume 100% PM-10)
Baghouse Flow: 100 dscfm
Calculations: 0.02 gr/dscf *100 dscfm * 60 *8760*1lb/7000gr = 150 lb/yr
100 lb/yr * 0.0005 ton/lb = 0.08 ton/yr

Chlorosilane Scrubber System EP#105

PM Emissions
TPY SiO2 Formed: 72.70 ton/yr (From Permit Application, 6/6/96)
Control: 99.90% (WET SCRUBBER)
Calculations: 72.7*(1-0.999) = 0.07 tons/yr

PM-10 Emissions
TPY SiO2 Formed: 72.70 ton/yr (From Permit Application, 6/6/96)
Control: 99.90% (WET SCRUBBER)
Calculations: 72.7*(1-0.999) = 0.07 ton/yr

Silane Scrubber System EP#106

PM Emissions
TPY Silane: 11.30 ton/yr (From Permit Application, 6/6/96)
Control: 99.00% (WET SCRUBBER)
Calculations: 11.3*(1-0.99)*1.87 = 0.21 ton/yr

PM-10 Emissions

TPY Silane:	11.30	ton/yr	(From Permit Application, 6/6/96)
Control:	99.00%		(WET SCRUBBER)
Calculations:	11.3*(1-0.99)*1.87 = 0.21 ton/yr		

Hydrogen Vent Stack EP#111

PM Emissions
Calculations: 34.5 lb/hr*24hr/day*60day/yr*.0005 = 24.84 tons SiO_2/yr

PM-10 Emissions
Calculations: 34.5 lb/hr*24hr/day*60day/yr*.0005 = 24.84 tons SiO_2/yr

Cooling Tower EP#218

PM Emissions
Circulation Rate: 10400.00 gpm/cell
Max Drift: 0.005%
Total Dissolved Solids: 1200 ppm
Calculations: 10400 gpm*500 lb/hr/gpm*0.005%*1200*10-6 = 0.31 lb/hr/cell
0.31*3 cells*8760*0.0005 = 4.07 ton/yr

PM-10 Emissions
Circulation Rate: 10400.00 gpm/cell
Max Drift: 0.005%
Total Dissolved Solids: 1200 ppm
Calculations: 10400 gpm*500 lb/hr/gpm*0.005%*1200*10-6 = 0.31 lb/hr/cell
0.31*3 cells*8760*0.0005 = 4.07 ton/yr

Emergency Generators
(2) 2000-kW generators

PM Emissions
Emission Factor: 0.3253 gr/kW-hr {AP-42 Table 3.4-5}
Design Capacity 4000.00 kW
Hours of Operation: 500.00 hr/yr (EPA PTE Policy)
Calculations: 0.3253 gr/kW-hr*4000.00 kW*500hr/yr*.0022*0.0005 = 0.72 ton/yr

PM-10 Emissions
Emission Factor: 0.2116 gr/kW-hr {AP-42 Table 3.4-5}
Design Capacity 4000.00 kW
Hours of Operation: 500.00 hr/yr (EPA PTE Policy)
Calculations: 0.2116 gr/kW-hr*4000.00 kW*500hr/yr*.0022*0.0005 = 0.47 ton/yr

NO_x Emissions
Emission Factor: 14.00 gr/kW-hr {AP-42 Table 3.4-2}
Design Capacity 4000.00 kW
Hours of Operation: 500.00 hr/yr (EPA PTE Policy)
Calculations: 14.0000 gr/kW-hr*4000.00 kW*500hr/yr*.0022*0.0005 = 30.80 ton/yr

VOC Emissions
Emission Factor: 0.44 gr/kW-hr {AP-42 Table 3.4-2}
Design Capacity: 4000.00 kW
Hours of Operation: 500.00 hr/yr (EPA PTE Policy)
Calculations: 0.4400 gr/kW-hr*4000.00 kW*500hr/yr*.0022*0.0005 = 0.97 ton/yr

CO Emissions
Emission Factor: 3.20 gr/kW-hr {AP-42 Table 3.4-2}
Design Capacity 4000.00 kW
Hours of Operation: 500.00 hr/yr (EPA PTE Policy)
Calculations: 3.2000 gr/kW-hr*4000.00 kW*500hr/yr*.0022*0.0005 = 7.04 ton/yr

SO_x Emissions
Emission Factor: 2.46 gr/kW-hr {AP-42 Table 3.4-2 & Assume 0.5% S}
Design Capacity 4000.00 kW
Hours of Operation: 500.00 hr/yr (EPA PTE Policy)
Calculations: 2.4600 gr/kW-hr*4000.00 kW*500hr/yr*.0022*0.0005 = 5.41 ton/yr

Emergency Generator

(1) 490-Hp generator

PM Emissions

Emission Factor:	1.0	gr/hp-hr	{AP-42 Table 3.3-1, Assume PM & PM-10 are equal}
Design Capacity	490	Hp	
Hours of Operation:	500.00	hrs/yr	(EPA PTE Policy)
Calculations:	1.0 gr/hp-hr * 490 Hp* 500 hr/yr * 0.0022 * 0.0005 = 0.27 ton/yr		

PM-10 Emissions

Emission Factor:	1.0	gr/hp-hr	{AP-42 Table 3.3-1, Assume PM & PM-10 are equal}
Design Capacity	490	Hp	
Hours of Operation:	500.00	hr/yr	(EPA PTE Policy)
Calculations:	1.0 gr/hp-hr * 490 Hp* 500 hr/yr * 0.0022 * 0.0005 = 0.27 ton/yr		

NO_x Emissions

Emission Factor:	14.0	gr/hp-hr	{AP-42 Table 3.3-1}
Design Capacity	490	Hp	
Hours of Operation:	500.00	hr/yr	(EPA PTE Policy)
Calculations:	14.0 gr/hp-hr * 490 Hp* 500 hr/yr * 0.0022 * 0.0005 = 3.77 ton/yr		

VOC Emissions

Emission Factor:	1.12	gr/hp-hr	{AP-42 Table 3.3-1}
Design Capacity	490	Hp	
Hours of Operation:	500.00	hr/yr	(EPA PTE Policy)
Calculations:	1.12 gr/hp-hr * 490 Hp* 500 hr/yr * 0.0022 * 0.0005 = 0.30 ton/yr		

CO Emissions

Emission Factor:	3.03	gr/hp-hr	{AP-42 Table 3.3-1}
Design Capacity	490	Hp	
Hours of Operation:	500.00	hr/yr	(EPA PTE Policy)
Calculations:	3.03 gr/hp-hr * 490 Hp* 500 hr/yr * 0.0022 * 0.0005 = 0.82 ton/yr		

SO_x Emissions

Emission Factor:	0.931	gr/hp-hr	{AP-42 Table 3.3-1}
Design Capacity	490	Hp	
Hours of Operation:	500.00	hr/yr	(EPA PTE Policy)
Calculations:	0.931 gr/hp-hr * 490 Hp* 500 hr/yr * 0.0022 * 0.0005 = 0.25 ton/yr		

V. Existing Air Quality

REC is located at 119410 Rick Jones Way near Butte, Silver Bow County, Montana. The city of Butte and some of the immediate surrounding area is classified as nonattainment for the EPA-established National Ambient Air Quality Standards (NAAQS) for PM_{10}. A nonattainment classification means that an area does not meet one or more of the primary or secondary NAAQS for the criteria pollutants designated in the FCAA. REC's current project is a source of minimal PM_{10} emissions; however, the Department concludes that the PTE quantity of this pollutant is low enough that it does not negatively impact the ambient air quality in Butte. The screening analysis performed during the MAQP process demonstrated that the facility complies with all applicable ambient air quality standards and poses a negligible risk to human health as required for permit issuance. Additionally, MAQP #2940-07 contains operating and monitoring requirements to ensure that proper operation of the facility would not result in air emissions that violate any ambient air quality standards.

VI. Ambient Air Impact Analysis

The area in and around Butte is currently a nonattainment area for PM_{10}. The Department believes that since there will be a slight decrease in emissions, the current project will not cause or contribute to a violation of the NAAQS or a significant impact on the nonattainment area. Therefore, it is expected that REC's facility will continue to operate in compliance with the ambient standards

VII. Taking or Damaging Implication Analysis

As required by 2-10-105, MCA, the Department has conducted a private property taking and damaging assessment and has determined there are no taking or damaging implications.

YES	NO	
X		1. Does the action pertain to land or water management or environmental regulation affecting private real property or water rights?
	X	2. Does the action result in either a permanent or indefinite physical occupation of private property?
	X	3. Does the action deny a fundamental attribute of ownership? (ex.: right to exclude others, disposal of property)
	X	4. Does the action deprive the owner of all economically viable uses of the property?
	X	5. Does the action require a property owner to dedicate a portion of property or to grant an easement? [If no, go to (6)].
		5a. Is there a reasonable, specific connection between the government requirement and legitimate state interests?
		5b. Is the government requirement roughly proportional to the impact of the proposed use of the property?
	X	6. Does the action have a severe impact on the value of the property? (consider economic impact, investment-backed expectations, character of government action)
	X	7. Does the action damage the property by causing some physical disturbance with respect to the property in excess of that sustained by the public generally?
	X	7a. Is the impact of government action direct, peculiar, and significant?
	X	7b. Has government action resulted in the property becoming practically inaccessible, waterlogged or flooded?
	X	7c. Has government action lowered property values by more than 30% and necessitated the physical taking of adjacent property or property across a public way from the property in question?
	X	Takings or damaging implications? (Taking or damaging implications exist if YES is checked in response to question 1 and also to any one or more of the following questions: 2, 3, 4, 6, 7a, 7b, 7c; or if NO is checked in response to questions 5a or 5b; the shaded areas)

Based on this analysis, the Department determined there are no taking or damaging implications associated with this permit action.

VIII. Environmental Assessment

An environmental assessment, required by the Montana Environmental Policy Act, was completed for this project. A copy is attached.

DEPARTMENT OF ENVIRONMENTAL QUALITY
Permitting and Compliance Division
Air Resources Management Bureau
P.O. Box 200901, Helena, Montana 59620
(406) 444-3490

FINAL ENVIRONMENTAL ASSESSMENT (EA)

Issued To: Renewable Energy Corporation-Advanced Silicon Materials LLC
Butte Operations
119140 Rick Jones Way
P.O. Box 3466
Butte, MT 59702

Permit Number: **2940-07**

Preliminary Determination Issued: **March 4, 2011**
Department Decision Issued: **March 22, 2011**
Permit Final: **April 7, 2011**

1. *Legal Description of Site*: Section 35, Township 3 North, Range 9 West, Silver Bow County, Montana.

2. *Description of Project*: On January 25, 2011, the Department received an application for a permit modification from Bison Engineering, on behalf of REC. The project would be the replacement of the existing natural gas-fired low NO_x burners and flue gas recirculation system with ultra low NO_x burners for the two 40 MMBtu/hr hot oil heaters (H-1701 and H-2701).

3. *Objectives of Project*: The objective of this project would be to allow for more efficient operation of the two 40-MMBtu/hr hot oil heaters on a consistent basis.

4. *Alternatives Considered*: In addition to the proposed action, the Department also considered the "no-action" alternative. The "no-action" alternative would deny issuance of the air quality preconstruction permit to the proposed facility. However, the Department does not consider the "no-action" alternative to be appropriate because REC demonstrated compliance with all applicable rules and regulations as required for permit issuance. Therefore, the "no-action" alternative was eliminated from further consideration.

5. *A Listing of Mitigation, Stipulations, and Other Controls*: A list of enforceable conditions, including a BACT analysis, would be included in Permit #2940-07.

6. *Regulatory Effects on Private Property*: The Department considered alternatives to the conditions imposed in this permit as part of the permit development. The Department determined that the permit conditions are reasonably necessary to ensure compliance with applicable requirements and demonstrate compliance with those requirements and do not unduly restrict private property rights.

7. The following table summarizes the potential physical and biological effects of the proposed project on the human environment. The "no-action" alternative was discussed previously.

		Major	Moderate	Minor	None	Unknown	Comments Included
A	Terrestrial and Aquatic Life and Habitats			X			Yes
B	Water Quality, Quantity, and Distribution			X			Yes
C	Geology and Soil Quality, Stability and Moisture			X			Yes
D	Vegetation Cover, Quantity, and Quality			X			Yes
E	Aesthetics			X			Yes
F	Air Quality			X			Yes
G	Unique Endangered, Fragile, or Limited Environmental Resources			X			Yes
H	Demands on Environmental Resource of Water, Air and Energy			X			Yes
I	Historical and Archaeological Sites			X			Yes
J	Cumulative and Secondary Impacts			X			Yes

SUMMARY OF COMMENTS ON POTENTIAL PHYSICAL AND BIOLOGICAL EFFECTS: The following comments have been prepared by the Department.

A. Terrestrial and Aquatic Life and Habitats

Slight decreases in PM_{10}, NO_x, CO, and VOC emissions may be expected as a result of this project, resulting in minor, if any, impacts on existing terrestrial and aquatic life and habitats of the area because the proposed project would occur on industrial property that has already been disturbed. Where the facility would emit air pollutants and corresponding deposition of pollutants would occur, the Department determined that any impacts from deposition would be minor due to dispersion characteristics of pollutants and the atmosphere and conditions that would be placed in Permit #2940-07.

B. Water Quality, Quantity and Distribution

This permitting action would have little or no effect on the water quality, water quantity, and distribution, as there would be no discharges to groundwater or surface water associated with this project, the proposed project would not require any additional water usage by the facility, and because the proposed project would occur on industrial property that has already been disturbed. Where the facility would emit air pollutants and corresponding deposition of pollutants would occur, the Department determined that any impacts from deposition would be minor due to dispersion characteristics of pollutants and the atmosphere and conditions that would be placed in Permit #2940-07.

C. Geology and Soil Quality, Stability and Moisture

This permitting action would have a minor effect on geology and soil quality, stability, and moisture, as the proposed project would affect an existing industrial property that has already been disturbed. No additional land would be disturbed for the project. The decrease in PM_{10}, NO_x, CO, and VOC emissions for this project may have a little or no effect on the soil stability and moisture; however, the air quality permit associated with this project would contain limitations to minimize the effect of the emissions on the surrounding environment. Where the

facility would emit air pollutants and corresponding deposition of pollutants would occur, the Department determined that any impacts from deposition would be minor due to dispersion characteristics of pollutants and the atmosphere and conditions that would be placed in Permit #2940-07.

D. Vegetation Cover, Quantity, and Quality

This permitting action would have a minor effect on vegetation cover, quantity, and quality. The proposed project would affect an existing industrial property that has already been disturbed. No additional vegetation on the site would be disturbed for the project. The decrease in PM_{10}, NO_x, CO, and VOC emissions for this project would have little or no effect on the surrounding vegetation; however, the air quality permit associated with this project would contain limitations to minimize the effect of the emissions on the surrounding environment. Where the facility would emit air pollutants and corresponding deposition of pollutants would occur, the Department determined that any impacts from deposition would be minor due to dispersion characteristics of pollutants and the atmosphere and conditions that would be placed in Permit #2940-07.

E. Aesthetics

Replacing the burners with ultra low NO_x burners on the two natural gas-fired hot oil heaters would have minor impacts on the surrounding property from both the visual perspective, as well as noise pollution. However, most of the disturbance will be temporary, and once construction is complete, the natural landscaping and aesthetic value of the property will be restored. The Department determined little or no changes in the aesthetic value of the site will be experienced.

F. Air Quality

The air quality of the area would realize little or no impacts from the proposed project because the facility would decrease PM_{10}, NO_x, CO, and VOC emissions by very small amounts. Air emissions from the facility would be minimized by conditions that would be placed in Permit #2940-07. Permit conditions would be placed in Permit #2940-07 to establish limits to minimize emissions.

The Department believes controlled emissions from the source would not cause or contribute to a violation of any ambient air quality standard. Although deposition of pollutants would occur as a result of the proposed project, the Department determined that the impacts from deposition of pollutants would be minor due to dispersion characteristics of pollutants (stack height, stack temperature, etc.) and atmospheric conditions (wind speed, wind direction, ambient temperature, etc.). Therefore, any impacts to air quality from the proposed facility would be minor.

G. Unique Endangered, Fragile, or Limited Environmental Resources

There would be a slight decrease in emissions in the area where the facility is located, which would result in little or no impacts to existing unique endangered, fragile, or limited environmental resources in the area. However, the proposed project will take place at an existing facility that is normally used for such activities. Therefore, the Department determined that any impacts to unique endangered, fragile, or limited environmental resources would be minor.

H. Demands on Environmental Resource of Water, Air and Energy

While air emissions from the facility may decrease due to the proposed project, and a corresponding decrease in deposition of pollutants may occur, the Department determined that any impacts from deposition would be minor due to dispersion characteristics of pollutants and the atmosphere and conditions that would be included in Permit #2940-07. Overall, the demands on the environmental resource of water, air, and energy would be minor.

I. Historical and Archaeological Sites

The proposed project may decrease emissions in the area where the facility operates, which would result in little or no impacts to existing historical and archaeological sites in the area. However, the facility is an existing facility and is located within an area that is normally used for such activities. Therefore, there would be a low likelihood of disturbance to any known archaeological or historical site given the previous industrial disturbance in the area of operation and the chance of impacting any historical and archaeological sites would be minor.

J. Cumulative and Secondary Impacts

The proposed project would cause little or no effects on the physical and biological aspects of the human environment because the project would decrease emissions of PM, PM_{10}, CO, VOC and NO_x. Conditions that would be placed in Permit #2940-07 would ensure that no air quality impacts, other than minor air quality impacts, would occur. Limitations would be established in Permit #2940-07 to minimize air pollution. Overall, any impacts to the physical and biological environment would be minor.

8. The following table summarizes the potential economic and social effects of the proposed project on the human environment. The "no-action" alternative was discussed previously.

		Major	Moderate	Minor	None	Unknown	Comments Included
A	Social Structures and Mores				X		Yes
B	Cultural Uniqueness and Diversity				X		Yes
C	Local and State Tax Base and Tax Revenue				X		Yes
D	Agricultural or Industrial Production				X		Yes
E	Human Health			X			Yes
F	Access to and Quality of Recreational and Wilderness Activities				X		Yes
G	Quantity and Distribution of Employment				X		Yes
H	Distribution of Population				X		Yes
I	Demands for Government Services			X			Yes
J	Industrial and Commercial Activity				X		Yes
K	Locally Adopted Environmental Plans and Goals				X		Yes
L	Cumulative and Secondary Impacts			X			Yes

SUMMARY OF COMMENTS ON POTENTIAL ECENOMIC AND SOCIAL EFFECTS: The following comments have been prepared by the Department.

A. Social Structures and Mores

The proposed facility would not cause a disruption to any native or traditional lifestyles or communities (social structures or mores) in the area because the project would occur at a previously disturbed industrial site. The proposed project would not change the nature of the site.

B. Cultural Uniqueness and Diversity

The proposed project would not cause a change in the cultural uniqueness and diversity of the area because the land is currently used as a petroleum refinery; therefore, the land use would not be changing. The use of the surrounding area would not change as a result of this project.

C. Local and State Tax Base and Tax Revenue

This project would have no effect on the local and state tax base and tax revenue because the proposed project does not require any change in operation of the facility. No new employees would be added as a result of this project.

D. Agricultural or Industrial Production

The proposed project would take place at an existing facility located in a previously disturbed industrial area typically used for such operations. Therefore, the Department would not expect that the facility would affect or displace any agricultural land or industrial production.

E. Human Health

As described in Section 7.F of this EA, the impacts from this facility on human health would be minor because the emissions from the facility would increase, but not significantly from prior levels. The air quality permit for this facility would incorporate conditions to ensure that the facility would be operated in compliance with all applicable rules and standards. These rules and standards are designed to be protective of human health.

F. Access to and Quality of Recreational and Wilderness Activities

The proposed action would not alter any existing access to or quality of any recreational or wilderness area activities. This project would not have an impact on recreational or wilderness activities because the site is far removed from recreational and wilderness areas or access routes. Furthermore, the facility is contained on private property and would continue to be contained within private property boundaries.

G. Quantity and Distribution of Employment

The proposed project would not result in any impacts to the quantity or distribution of employment at the facility or surrounding community. No employees would be hired at the facility as a result of the project.

H. Distribution of Population

The proposed project does not involve any significant physical or operational change that would affect the location, distribution, density, or growth rate of the human population.

I. Demands for Government Services

The demands on government services would experience a minor impact. The primary demand on government services would be the acquisition of the appropriate permits by the facility (including local building permits, as necessary, and a state air quality permit) and compliance verification with those permits.

J. Industrial and Commercial Activity

The proposed project would not affect local industrial and commercial activity because no additional construction would be required.

K. Locally Adopted Environmental Plans and Goals

There are no locally adopted environmental plans and goals that are expected to be affected by the proposed change to emission limitations.

L. Cumulative and Secondary Impacts

The existing facility and the proposed emission decreases would cause little or no impacts to both the physical environment and the human environment because the operational limitations and other conditions within Permit #2940-07 will ensure that ambient air quality standards are protected.

Recommendation: No Environmental Impact Statement (EIS) is required.

If an EIS is not required, explain why the EA is an appropriate level of analysis: The proposed project would result in a slight decrease in emissions of PM, PM_{10}, CO, NO_x, and VOC. Permit #2940-07 includes conditions and limitations to ensure the facility will operate in compliance with all applicable rules and regulations. In addition, there are no significant impacts associated with this proposal.

Individuals or groups contributing to this EA: Department of Environmental Quality – Air Resources Management Bureau

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