San Joaquin Valley
Unified Air Pollution Control District

Best Performance Standard (BPS) x.x.xx

Date: 7/1/12

Class	**Steam Generator**
Category	**Combusting Sour Gas**
Best Performance Standard	**High Efficiency Steam Generator Design With:** 1. Split flow dual pass water feed configuration, a convection section having at least 128 square feet of heat transfer surface area per MMBtu/hr of maximum rated heat input (verified by the manufacturer) and at least six inches of castable refractory or a manufacturer's overall thermal efficiency rating of at least 85% And 2. Variable frequency drive high efficiency electrical motors driving the blower and water pump.
Percentage Achieved GHG Emission Reduction Relative to Baseline Emissions	10.5%

District Project Number	S1114465
Evaluating Engineer	David Torii
Lead Engineer	Allan Phillips
Public Notice: Start Date	5/31/12
Public Notice: End Date	7/1/12
Determination Effective Date	7/1/12

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I. Best Performance Standard (BPS) Determination Introduction

A. Purpose

To assist permit applicants, project proponents, and interested parties in assessing and reducing the impacts of project specific greenhouse gas emissions (GHG) on global climate change from stationary source projects, the San Joaquin Valley Air Pollution Control District (District) has adopted the polic*y: District Policy – Addressing GHG Emission Impacts for Stationary Source Projects Under CEQA When Serving as the Lead Agency.* This policy applies to projects for which the District has discretionary approval authority over the project and the District serves as the lead agency for CEQA purposes. Nonetheless, land use agencies can refer to it as guidance for projects that include stationary sources of emissions. The policy relies on the use of performance based standards, otherwise known as Best Performance Standards (BPS) to assess significance of project specific greenhouse gas emissions on global climate change during the environmental review process, as required by CEQA. Use of BPS is a method of streamlining the CEQA process of determining significance and is not a required emission reduction measure. Projects implementing BPS would be determined to have a less than cumulatively significant impact. Otherwise, demonstration of a 29 percent reduction in GHG emissions, from business-as-usual, is required to determine that a project would have a less than cumulatively significant impact.

B. Definitions

Best Performance Standard for Stationary Source Projects for a specific Class and Category is the most effective, District approved, Achieved-in-Practice means of reducing or limiting GHG emissions from a GHG emissions source, that is also economically feasible per the definition of Achieved-in-Practice. BPS includes equipment type, equipment design, and operational and maintenance practices for the identified service, operation, or emissions unit class and category.

Business-as-Usual is - the emissions for a type of equipment or operation within an identified class and category projected for the year 2020, assuming no change in GHG emissions per unit of activity as established for the baseline period, 2002-2004. To relate BAU to an emissions generating activity, the District proposes to establish emission factors per unit of activity, for each class and category, using the 2002-2004 baseline period as the reference.

Category is - a District approved subdivision within a “class” as identified by unique operational or technical aspects.

Class is - the broadest District approved division of stationary GHG sources based on fundamental type of equipment or industrial classification of the source operation.

C. Determining Project Significance Using BPS

Use of BPS is a method of determining significance of project specific GHG emission impacts using established specifications. BPS is not a required mitigation of project related impacts. Use of BPS would streamline the significance determination process by pre-quantifying the emission reductions that would be achieved by a specific GHG emission reduction measure and pre-approving the use of such a measure to reduce project-related GHG emissions.

GHG emissions can be directly emitted from stationary sources of air pollution requiring operating permits from the District, or they may be emitted indirectly, as a result of increased electrical power usage, for instance. For traditional stationary source projects, BPS includes equipment type, equipment design, and operational and maintenance practices for the identified service, operation, or emissions unit class and category.

II. Summary of BPS Determination Phases

The District has established oilfield steam generators combusting sour gas as a separate class and category which requires implementation of a Best Performance Standard (BPS) pursuant to the District's Climate Change Action Plan (CCAP). The District's determination of the BPS for this class and category has been made using the BPS development process established in the District's Final Staff Report, *Addressing Greenhouse Gas Emissions under the California Environmental Quality Act.* A summary of the specific implementation of the phased BPS development process for this specific determination is as follows:

Table 1 BPS Development Process Phases			
Phase	**Description**	**Date**	**Description**
1	Public Notice of Intent	2/1/12	The District's intent notice is attached as Appendix 1
2	BPS Development	2/22/12	See evaluation document.
3	Public Participation: Public Notice Start Date	5/31/12	A Draft BPS evaluation was provided for public comment. The District's notification is attached as Appendix 3
4	Public Participation: Public Notice End Date	7/1/12	No comments were received

III. Class and Category

In heavy oil production, steam generators are used to produce large quantities of steam. The steam is injected under great pressure into an oil production zone. The steam heats the crude oil, reducing its viscosity, making the oil easier to pump. The oil is pumped from the ground (as a produced fluid) and the oil contains a relatively large amount of water and dissolved gasses.

The water is separated from the oil in several stages, purified on-site, and used as feedwater for the steam generators.

Oilfield steam generators differ from typical boilers in several areas.

A. Steam generators produce large amounts of lower quality steam (in the area of 70%) under relatively high pressures (in the area of 1,000 psig).
B. The required temperature and pressure of the steam requirement varies depending upon the geological configuration of the wells that are being steamed.
C. Since the steam generator feedwater is generally water that has been produced from the oil wells, the temperature of the feedwater is relatively warm (above 115 degrees F), which limits overall thermal efficiency of the steam generator.
D. Steam generators typically operate constantly, year round, without stopping.
E. The useful output of the steam generated cannot be correlated to the useful product of *barrels of oil produced*, because the amount of steam and it's impact on each oil well is difficult to determine on an individual basis, and varies considerably due to the geological characteristics of each oil deposit and each well. Therefore, the useful output of a steam generator must be

described in terms of steam generator heat output (in MMBtu/hour) per unit of steam generator heat input (MMBtu/hour), (which is thermal efficiency).

Furthermore, oilfield steam generators combusting sour gas differ from typical steam generators as follows:

- In sour gas combusting steam generators, the exhaust SOx concentration is very high. Since sulfur trioxide will change from the gas phase to a corrosive liquid phase at around 340 deg F, the convection section must be designed for a flue gas flue gas exit temperature of at least 380 deg F to prevent corrosion of the convection box tubes. It is the higher convection section flue gas temperature requirement of sour gas fired steam generators that differentiates them from non-sour gas combusting steam generators with regards to BPS requirements.

- The APCD has developed a BPS for oilfield steam generators; however, in the development of that BPS the APCD did not account for steam generators combusting high-sulfur natural gas. Therefore, this project-specific BPS was developed to address units that combust high-sulfur natural gas

IV. Public Notice of Intent

Prior to developing the development of BPS for this class and category, the District published a Notice of Intent. Public notification of the District's intent to develop BPS for this class and category was sent on February 1, 2012 to individuals registered with the CCAP list server. The District's notification is attached in Appendix 1.

No comments were received during the initial public notice.

V. BPS Development

STEP 1. Establish Baseline Emissions Factor for Oilfield Steam Generators Combusting Sour Gas

The Baseline Emission Factor (BEF) is defined as the three-year average (2002-2004) of GHG emissions for a particular class and category of equipment in the San Joaquin Valley (SJV), expressed as annual GHG emissions per unit of activity. The Baseline Emission Factor is calculated by first defining an operation which is representative of the average population of units of this type in the SJV during the Baseline Period and then determining the specific emissions per unit throughput for the representative unit.

A. Representative Baseline Operation

Per SJVUAPCD project C-1100391, which developed BPS for new oilfield steam generators, the representative baseline operation has been determined to be a 77% thermally efficient steam generator with a vertical convection section, standard (non variable frequency drive) electric drive motors for the blower and water pump. This determination is based on a survey of permitted steam generators.

For the purpose of this document, thermal efficiency is defined as the ratio of the amount of heat transferred to the steam (useful heat output) compared to the amount of heat released during the combustion of the fuel (total heat input).

The following analysis of baseline GHG emissions is based on physical characteristics taken from a baseline-era steam generator as listed in the previous BPS project. This steam generator is considered to be a typical industry-wide example of baseline operation for steam generators.

B. Basis and Assumptions

- All direct GHG emissions are the result of the combustion of natural gas in the steam generator.
- Maximum heat input rating of the steam generator is 62.5 MMBtu/hr
- Actual fuel consumption of the steam generator 56.4 MMBtu/hr
- Thermal efficiency is 77.0% (heat output ÷ heat input)
- Heat output is (56.4 MMBtu/hr x 77%) = 43.4 MMBtu/hr
- The GHG emission factor for natural gas combustion is 117 lb-CO_2e/MMBtu (per CCAR document)
- **Thermal efficiency is based on determination of maximum efficiency permissible to prevent condensation of SO2 in exhaust**
- Fuel measurements are based on a “gross dry basis”, consistent with utility recording protocol.
- Indirect emissions are produced due to operation of the electric water pump and air blower.
- Blower motor hp at 60 hertz is130 hp
- Motor Electrical efficiency is 94.5%
- Water Pump motor input energy hp is 78.2 hp
- Indirect emissions from electric power consumption
    - the current PG&E electric power generation factor of 0.524 lb-CO_2e/kWh (http://www.pge.com/about/environment/calculator/assumptions.shtml)

C. Unit of Activity

To relate Business-as-Usual to an emissions generating activity, it is necessary to establish an emission factor per unit of activity, for the established class and category, using the 2002-2004 baseline period as the reference. The resulting emission factor is a combination of direct emissions from fuel consumption and indirect emissions from electricity consumption.

The useful output of the steam generated cannot be correlated to *barrels of oil produced*, because the amount of steam and its impact on each oil well is difficult to determine on an individual basis, and varies considerably due to the geological characteristics of each oil deposit and each well. Therefore, the useful output of a steam generator must be described in terms of steam generator heat output (in MMBtu/hour) per unit of steam generator heat input (MMBtu/hour), which is thermal efficiency.

D. Calculations

1. Indirect GHG Emissions from blower motor (IEb)

130 hp x 0.746 kW/hp x (1/94.5%) x 0.524 lb·CO_2e/kW·hr = 53.77 lb·CO_2e/hr

IEb = 53.77 lb·CO_2e/hr ÷ 43.4 MMBtu = **1.239** lb·CO_2e/MMBtu (of heat output)

2. Indirect GHG emissions from the water pump (IEp)

78.2 hp x 0.746 kW/hp x (1/94.5%) x 0.524 lb·CO_2e/kW·hr = 32.38 lb·CO_2e/hr

IEp = 32.38 lb·CO_2e/hr ÷ 43.4 MMBtu/hr = **0.746** lb·CO_2e/MMBtu (of heat output)

3. Direct GHG Emissions (DE)

56.4 MMBtu/hr (input) x 117 lb·CO_2e/MMBtu = 6,599 lb·CO_2e/hr

DE = 6,599 lb·CO_2e/hr ÷ 43.4 MMBtu/hr = **152** lb·CO_2e/MMBtu (of heat output)

4. Total Baseline Emission Factor (BEF) (Indirect + Direct emissions)

(1.239 + 0.746) lb·CO_2e/MMBtu
= 1.985 lb·CO_2e/MMBtu
= 1.985 lb·CO_2e/MMBtu ÷ 2,205 lb/metric ton
BEF Indirect = **0.00090 metric ton·CO_2e/MMBtu (heat output)**

152 lb·CO_2e/MMBtu ÷ 2,205 lb/metric ton
BEF Direct = **0.06893 metric ton·CO_2e/MMBtu (heat output)**

BEF Indirect + BEF Direct = 0.00090 + 0.06893
= **0.06983 metric ton·CO_2e/MMBtu (heat output)**

STEP 2. List Technologically Feasible GHG Emission Control Measures

For oilfield steam generators subject to this BPS analysis, all technologically feasible GHG emissions reduction measures are listed, including equipment selection, design elements and best management practices that do not result in an increase in criteria pollutant emissions compared to the proposed equipment or operation.

Based on a review of available technology and with consideration of input from industry, manufacturers, and other members of the public, the following is determined to be the *technologically feasible* GHG emission reduction measures for oilfield steam generators. Please note that while these measures are technologically feasible, further analysis will follow which will conclude whether the listed technologically feasible measures can be considered candidates for the BPS.

Table 2
Technologically Feasible GHG Control Measures for Oilfield Steam Generators Combusting Sour gas

Control Measure	Qualifications
1. High Efficiency Steam Generator Design	Split flow dual pass water feed configuration, a convection section having at least 128 square feet of heat transfer surface area per MMBtu/hr of maximum rated heat input (verified by the manufacturer) and at least six inches of castable refractory or a manufacturer's overall thermal efficiency rating of at least 85%
2. Additional economizer	Additional vertical heat exchange to further preheat water with exhaust gasses
3. Limiting the FGR controls	Reducing the recirculated flue gas air can reduce the amount of wasted heat which leads to thermal inefficiency
4. Ammonia Injection to control NO_x	This would allow for even less recirculated flue gas and further improve the thermal efficiency
5. Variable frequency drive high efficiency electrical motors driving the blower and water pump	Ability to run the water pump no faster than it needs to be run, and ability to vary airflow through the steam generator without the need to use restrictive louvers

Discussion of Each Technologically Feasible Item

1. Steam generator design using a high efficiency convection section.

Prior to the baseline period, many oilfield steam generators burned crude oil to produce steam. One design criteria was that the stack temperature needed to remain relatively high to prevent SOx from condensing in the stack.

The minimal convection section (heat transfer section) was of the vertical or pyramid style, and known to be only efficient enough to support the goal of maintaining a high exhaust temperature. Economically, these units were built on a small foot print, and a vertical heat transfer section seemed like a reasonable design for the efficiency required at the time. Based on a survey of permitted steam generators and submissions from the oilfield industry, these baseline-era steam generators, with a vertical convection section, and standard (non variable frequency drive) electric drive motors for the blower and water pump are considered to be representative of baseline operation. The thermally efficiency of these steam generators has been determined to be 77%.

Units that combust high-sulfur fuel have historically been, and remain to be, designed to allow for stack temperatures that are high enough to prevent the condensation of SO_2 in the flue gas. Therefore, the use of a vertical or pyramid style convection section is appropriate. As presented in assumptions for the baseline unit, the thermal efficiency of the units are designed to achieve the greatest efficiency while maintaining stack temperatures high enough prevent condensation of SO_2 in the flue gas.

In order to be considered BPS, the technology must be actually achieved-in-practice. Modern oilfield steam generators designed to combust sour gas, subject to this BPS analysis, are currently being equipped with split flow dual pass water feed configuration, a convection section having at least 128 square feet of heat transfer surface area per MMBtu/hr and at least six inches of castable refractory which allows for an overall thermal efficiency of at least 85%. Since this is greater than that of baseline units, and this technology is achieved-in-practice, it is a candidate for BPS.

2. Additional Economizer

Additional waste-heat can be transferred from the exhaust gasses to the steam by installing an extra economizer, further increasing the thermal efficiency of the steam generator.

Economizers are useful in steam generators that produce a higher quality and lower volume steam. With purified, de-ionized highly filtered water, high quality steam is possible and often necessary to serve a particular industrial need.

However, oilfield steam generators generally produce high volumes of lower quality steam from relatively dirty feedwater, and additional economizers are not currently employed.

Units that combust high-sulfur fuel have historically been, and remain to be, designed to allow for stack temperatures that are high enough to prevent the condensation of SO2 in the flue gas. As presented in assumptions for the baseline unit, the thermal efficiency of the units are designed to achieve the greatest efficiency while maintaining stack temperatures high enough prevent condensation of SO2 in the flue gas.

In order to be considered BPS, the technology must be actually achieved-in-practice. Since new oilfield steam generators subject to this BPS analysis do not have added vertical economizers, this technology is not achieved-in-practice in the oilfield, and therefore is precluded from being a candidate for BPS.

3. and 4. Limiting the FGR Controls and the Required Use of Ammonia Injection

Flue gas recirculation mixes a portion of the exhaust gas with the oxygen-rich incoming air in the burner's combustion zone. The added exhaust gas absorbs heat from the combustion process, lowering the peak combustion temperature below the threshold where excessive NOx is formed. Proven FGR technology has been used in steam generators for years to meet the District's standards for low NOx emissions. While FGR clearly lowers NOx levels, additional fuel is required to produce the same amount of steam, which reduces the overall thermal efficiency of the unit and creates more GHG emissions per unit of steam output. Therefore, limiting the FGR rate might be a means of reducing GHG emissions.

The achievement of criteria emission standards (NOx levels) is mandatory. The District realizes that while reducing the FGR rate on a steam generator will decrease GHG emissions, it will also increase NOx emissions. This increase in NOx emissions would have to be some how mitigated in order to maintain compliance with applicable NOx emissions limits.

A common method of reducing NOx emissions in many combustion devices, which could make a reduction in the FGR rate feasible, would be to supplement the FGR technology with a Selective Catalytic Reduction (SCR) system. With SCR, ammonia or urea is injected into the exhaust stack where the ammonia reacts in the presence of a catalyst with NOx to produce elemental Nitrogen and water. The SCR reduces NOx emissions without the need for such extensive FGR. However it should be noted that the SCR system itself results in higher exhaust stack resistance, the presence of which offsets some of the energy efficiency gains attributed to the reduced FGR requirement.

While promising, in order to be a BPS, this technology would have to be achieved-in-practice. To date, no oilfield steam generators are equipped with ammonia injection. Therefore, this technology can not be considered achieved-in-practice, and thus precluded from being a candidate for oilfield steam generator BPS.

5. Variable frequency drive high efficiency electrical motors driving the blower and water pump

According to the analysis that follows, the electric motors that drive the blowers and water pumps, contribute to indirect GHG emissions. High efficiency electric motors coupled with high efficiency variable frequency drives result in electricity savings. This reduces the indirect GHG emissions for the steam generator.

This electrical technology can save nearly 14,000 kW·hr/year on a typical oilfield steam generator. At an indirect emission factor of 0.524 lb·CO_2e/kW·hr, this amounts to a savings of 7300 lb·CO_2e per year.

While this technology may result in only a 0.1% decrease in overall CO2e as compared to the entire steam generator project, it does reduce GHG and it is achieved-in-practice. Therefore, this technology is a candidate for oilfield steam generator BPS for indirect GHG emissions.

STEP 3. Identify all Achieved-in-Practice GHG Emission Control Measures

Achieved-in-Practice is defined as any equipment, technology, practice or operation available in the United States that has been installed and operated or used at a commercial or stationary source site for a reasonable period of time sufficient to demonstrate that the equipment, the technology, the practice or the operation is reliable when operated in a manner that is typical for the process. In determining whether equipment, technology, practice or operation is Achieved-in-Practice, the District will consider the extent to which grants, incentives or other financial subsidies influence the economic feasibility of its use.

Pursuant to the discussion above for each technologically feasible item listed, those technologies that are achieved-in-practice have been identified as such and will be brought forward as achieved-in-practice GHG control measures, as indicated in the following table.

Table 3 **Achieved-in-Practice GHG Control Measures for Oilfield Steam Generators Combusting Sour Gas**	
Control Measure	**Achieved-Qualifications**
1. High thermal efficiency steam generator	Split flow dual pass water feed configuration, a convection section having at least 128 square feet of heat transfer surface area per MMBtu/hr of maximum rated heat input (verified by the manufacturer) and at least six inches of castable refractory or a manufacturer's overall thermal efficiency rating of at least 85%
2. Variable frequency drive high efficiency electrical blower and water pump motors	95% NEMA efficiency
3. High thermal efficiency steam generator and variable frequency drive high efficiency electrical motors driving the blower and water pump.	1. Split flow dual pass water feed configuration, a convection section having at least 128 square feet of heat transfer surface area per MMBtu/hr of maximum rated heat input (verified by the manufacturer) and at least six inches of castable refractory or a manufacturer's overall thermal efficiency rating of at least 85% **And** 2. Variable frequency drive high efficiency electrical motors driving the blower and water pump

STEP 4. Quantify the Potential GHG Emission and Percent Reduction for Each Identified Achieved-in-Practice GHG Emission Control Measure

For each achieved-in-practice GHG emission, the following are identified:

a. Quantify the potential GHG emissions per unit of activity (Ga)
b. Express the potential GHG emission reduction as a percent (Gp) of Baseline GHG emissions factor per unit of activity (BEF)

This section will analyze a steam generator that is equipped with variable frequency drive high efficiency electrical blower and water pump.

The following analysis of BPS steam generator GHG emissions is based on projected physical measurements taken from a currently designed project. This unit is considered to be a typical industry-wide example of BPS operation for steam generators combusting sour gas.

A. Basis and Assumptions

- All direct GHG emissions are the result of the combustion of natural gas in the steam generator.
- Maximum heat input rating of the steam generator is 62.5 MMBtu/hr
- Actual fuel consumption of the steam generator 56.4 MMBtu/hr
- Thermal efficiency is 85% (heat output ÷ heat input)
- Heat output is (56.4 MMBtu/hr x 85%) = 47.9 MMBtu/hr
- The GHG emission factor for natural gas combustion is 117 lb-CO_2e/MMBtu (per CCAR document)[1]
- **Thermal efficiency is based on determination of maximum efficiency permissible to prevent condensation of SO2 in exhaust**
- Fuel measurements are based on a “gross dry basis”, consistent with utility recording protocol.
- Indirect emissions are produced due to operation of the electric water pump and air blower.
- Blower motor hp at 60 hertz is110 hp
- High efficiency electric motor efficiency = 95.8% (NEMA)
- Water Pump motor input energy hp is 77.3 hp
- Indirect emissions from electric power consumption
  - the current PG&E electric power generation factor of 0.524 lb-CO2e/kw-hr (http://www.pge.com/about/environment/calculator/assumptions.shtml)

[1]EF CO2e = 52.92 kg/MMBtu x 2.2046 lb/kg = 116.67 → 117 lb CO2e/MMBtu

B. Calculation of Potential GHG Emissions per Unit of Activity (G_a)

1. Indirect GHG Emissions from blower motor (PIEb)

110 hp x 0.746 kW/hp x (1/95.8%) x 0.524 lb·CO_2e/kW·hr = 44.88 lb·CO_2e/hr

PIEb = 44.88 lb·CO_2e/hr ÷ 47.9 MMBtu/hr = 0.94 lb·CO_2e/MMBtu (of heat output)

2. Indirect GHG emissions from the water pump (PIEp)

77.3 hp x 0.746 kW/hp x (1/95.8%) x 0.524 lb·CO_2e/kW·hr = 31.54 lb·CO_2e/hr

PIEp = 31.84 lb·CO_2e/hr ÷ 47.9 MMBtu
/hr = 0.66 lb·CO_2e/MMBtu (of heat output)

3. Direct GHG Emissions (PDE)

56.4 MMBtu/hr (input) x 117 lb·CO_2e/MMBtu = 6,599 lb·CO_2e/hr

PDE = 6,599 lb·CO_2e/hr ÷ 47.9 MMBtu/hr = 137.8 lb·CO_2e/MMBtu (of heat output)

4. Total Potential BPS Emissions (Indirect + Direct emissions)

PIEb + PIEp = (0.94 + 0.66) lb·CO_2e/MMBtu

1.60 lb·CO_2e/MMBtu

1.60 lb·CO_2e/MMBtu ÷ 2,205 lb/metric ton

PIEt = **0.00073 metric ton·CO_2e/MMBtu (heat output)**

137.8 lb·CO_2e/MMBtu

137.8 lb·CO_2e/MMBtu ÷ 2,205 lb/metric ton

PDEt **= 0.0625 metric ton·CO_2e/MMBtu (heat output)**

PIEt + PDEt = 0.00073 + 0.0625 = 0.0632 metric ton·CO_2e/MMBtu (heat output)

C. Calculation of Potential GHG Emission Reduction as a Percentage of the Baseline Emission Factor (G_p)

G_p Indirect = (BEFi - G_a Indirect) ÷ BEF metric tons/MMBtu

G_p Indirect = (0.00090 - 0.00073) ÷ 0.00090 = 0.19 = 19%

G_p Direct = (BEF - G_a Direct) ÷ BEF metric tons/MMBtu

G_p Direct = (0.0689 - 0.0632) ÷ 0.0689 = 0.0827 = 8.27%

D. Calculation of Total GHG Emission Reduction as a Percentage of the Baseline Emission Factor (G_p)

Total BEF = 0.0698 metric ton·CO_2e/MMBtu (heat output)

Total PIEt = 0.0624 metric ton·CO_2e/MMBtu (heat output)

Gp = (0.0698 – 0.0625) ÷ 0.0698 = 0.105 = 10.5%

STEP 5. Rank all Achieved-in-Practice GHG emission reduction measures by order of % GHG emissions reduction

Based on the calculations presented in Section D above, the Achieved-in Practice GHG emission reduction measures are ranked in the Table below.

Table 4
Ranking of Achieved-in-Practice GHG Emission Control Measures

Rank	Control Measure	Potential GHG Emission per Unit of Activity (G_a) (Metric Ton-CO_2e/MMBtu)	Potential GHG Emission Reduction as a Percentage of the Baseline Emission Factor (G_p)
1	High efficiency steam generator design with: 1. Split flow dual pass water feed configuration, a convection section having at least 128 square feet of heat transfer surface area per MMBtu/hr of maximum rated heat input (verified by the manufacturer) and at least six inches of castable refractory or a manufacturer's overall thermal efficiency rating of at least 85% And 2. Variable frequency drive high efficiency electrical motors driving the blower and water pump.	0.0625	10.5%
2.	High efficiency steam generator design with: Split flow dual pass water feed configuration, a convection section having at least 128 square feet of heat transfer surface area per MMBtu/hr of maximum rated heat input (verified by the manufacturer) and at least six inches of castable refractory or a manufacturer's overall thermal efficiency rating of at least 85%	0.0632	8.27%
3.	Variable frequency drive high efficiency electrical motors driving the blower and water pump.	0.00072	0.1%

STEP 6. Establish the Best Performance Standard (BPS) for this Class and Category

For Stationary Source Projects for which the District must issue permits, Best Performance Standard is – "For a specific Class and Category, the most effective, District approved, Achieved-In-Practice means of reducing or limiting GHG emissions from a GHG emissions source, that is also economically feasible per the definition of achieved-in-practice. BPS includes equipment type, equipment design, and operational and maintenance practices for the identified service, operation, or emissions unit class and category".

Based on the definition above and the ranking of evaluated technologies, Best Performance Standard (BPS) for this class and category is determined as:

<u>Best Performance Standard for Oilfield Steam Generators Combusting Sour Gas</u>

Steam generator design with:

Split flow dual pass water feed configuration, a convection section having at least 128 square feet of heat transfer surface area per MMBtu/hr of maximum rated heat input (verified by the manufacturer) and at least six inches of castable refractory or a manufacturer's overall thermal efficiency rating of at least 85%

AND

Variable frequency drive high efficiency electrical motors driving the blower and water pump.

STEP 7. Eliminate All Other Achieved-in-Practice Options from Consideration as Best Performance Standard

The following Achieved-in-Practice GHG control measures identified and ranked in Table 4, above, are eliminated from consideration as Best Performance Standard since they have GHG control efficiencies which are less than that of the selected Best Performance Standard as stated in Step 6 of this evaluation.

Option 2. is eliminated because by itself it is not achieving the highest amount of GHG emission reductions. This option will be used in conjunction with variable frequency drive electrical motors driving the blower and water pump.

Option 3. is eliminated because by itself it is not achieving the highest amount of GHG emission reductions. This option will be used in conjunction with a high efficiency steam generator.

VI. Public Participation

A Draft BPS evaluation was provided for public comment. Public notification was sent on 5/31/12 to individuals registered with the CCAP list server. The District's notification is attached as Appendix 3.

No comments were received during the public notice period.

VII. Appendixes

Appendix 1: Public Notice of Intent: Notice
Appendix 2: Comments Received During the Public Notice of Intent and Responses to Comments
Appendix 3: Public Participation Request for Information: Notice
Appendix 4: Comments Received During the Public Participation Request for Information

Appendix 1

Public Notice of Intent: Notice

San Joaquin Valley AIR POLLUTION CONTROL DISTRICT

HEALTHY AIR LIVING

Notice of Development Of
Best Performance Standards

NOTICE IS HEREBY GIVEN that the San Joaquin Valley Air Pollution Control District solicits public comment on development of Best Performance Standards for the following Stationary Source class and category of greenhouse gas emissions:

OILFIELD STEAM GENERATOR/TEOR/TVR GAS INCINERATOR W/SOX SCRUBBER
Subject to District Permit Requirements

The District is soliciting public input on the following topics for the subject Class and Category of greenhouse gas emission source:

- Recommendations regarding the scope of the proposed Class and Category (Stationary GHG sources group based on fundamental type of equipment or industrial classification of the source operation),
- Recommendations regarding processes or operational activities the District should consider when establishing Baseline Emissions for the subject Class and Category. Baseline Emissions for this Best Performance Standard are the average GHG emissions emitted by a standard oilfield steam generator/TEOR/TVR gas incinerator w/SOx scrubber during 2002 – 2004.
- Recommendations regarding processes or operational activities the District should consider when converting Baseline Emissions into emissions per unit of activity, and
- Recommendations regarding technologies to be evaluated by the District when establishing Best Performance Standards for the subject Class and Category.

Information regarding development of Best Performance Standard for the subject Class and Category of greenhouse gas emission source can be obtained from the District's website at http://www.valleyair.org/Programs/CCAP/bps/BPS_idx.htm .

Written comments regarding the subject Best Performance Standard should be addressed to David Torii by email, david.torii@valleyair.org, or by mail at SJVUAPCD, 34946 Flyover Court, Bakersfield CA 93308 and must be received by **February 21, 2012**. For additional information, please contact David Torii by e-mail or by phone at (661) 392-5620.

Information regarding the District's Climate Action Plan and how to address GHG emissions impacts under CEQA, can be obtained from the District's website at http://www.valleyair.org/Programs/CCAP/CCAP_idx.htm .

Appendix 2

Comments Received During the Public Notice of Intent and Responses to Comments

No comments were received.

Appendix 3

Public Participation Request for Information: Notice

The San Joaquin Valley Air Pollution Control District is soliciting public comments on the development of Best Performance Standards (BPS). This email is to advise you the proposed Draft BPS documents for Steam Generators Combusting Sour Gas is available by clicking here.

Written comments regarding the subject Best Performance Standard should be addressed to David Torii by email, david.torii@valleyair.org , or by mail at SJVUAPCD, 34946 Flyover Court, Bakersfield, CA 93308 and must be received by **July 1, 2012**. For additional information, please contact David Torii by e-mail or by phone at (661) 392-5620.

Appendix 4

Comments Received During the Public Participation Request for Information

No comments were received.