San Joaquin Valley
Unified Air Pollution Control District

Best Performance Standard (BPS) x.x.xx

Class	Boilers
Category	**Direct Contact Water Heaters**
Best Performance Standard	The direct contact water heater shall be natural gas-fired and designed per the following criteria: 1. The unit shall be designed to operate at maximum firing rate with a temperature differential between the flue gas exhaust and the inlet water not exceeding 15°F. And 2. Electric motors driving combustion air fans or induced draft fans shall have an efficiency meeting the standards of the National Electrical Manufacturer's Association (NEMA) for "premium efficiency" motors and shall each be operated with a variable speed control or equivalent for control of flow through the fan.
Percentage Achieved GHG Emission Reduction Relative to Baseline Emissions	**0.02%**

District Project Number	C-1122805
Evaluating Engineer	Jesse A. Garcia
Lead Engineer	Joven Refuerzo
Public Notice: Start Date	September 12, 2012
Public Notice: End Date	October 8, 2012
Determination Effective Date	TBD

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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 Process

The District has established Direct Contact Water Heaters – All Industries 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 for Direct Contact Water Heaters

Phase	Description	Date	Description
1	Public Notice of Intent	9/12/2012	The District's intent notice is attached as Appendix 1
2	BPS Development	N/A	See evaluation document.
3	Public Participation: Public Notice Start Date	10/15/2012	A Draft BPS evaluation was provided for public comment.

III. Class and Category

Boilers are recognized as a distinct class based on the following:

- Boilers represent a distinct operation (external combustion equipment used to produce hot water or steam) when compared to all other permit units currently regulated by the District.
- The District already considers this a distinct class with respect to Best Available Control Technology (BACT) for criteria pollutant emissions.
- This is a distinct class with respect to the District's prohibitory rules for criteria pollutant emissions (Rules 4306 - 4308 and 4320).
- Boilers and steam generators differ from process heaters as boiler and steam generators are limited to boiling or raising the temperature of fluid.
- Boilers differ from dryers as boilers do not dry or cure material by direct contact with the products of combustion.
- Boilers differ from dehydrators as process heaters do not drive free fluid from products like fruits, vegetables, and nuts, at an accelerated rate without damage to the product.

Direct Contact Water Heaters are recognized as a distinct category based on the following:

- Direct contact water heaters heat water by having the flue gas in contact with the water.
- Boilers and steam generators typically raise the temperature of a fluid by indirect heat transfer.

Since direct contact water heaters are the only class and category that heat water by direct contact, it will be a separate class and category from other types of boilers.

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 September 12, 2012 to individuals registered with the CCAP list server. The District's notification is attached as Appendix 1.

The District did not receive any comments during the initial public outreach.

V. BPS Development

STEP 1. Establish Baseline Emissions Factor for Class and Category

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

Direct contact water heaters basically spray the inlet water down on to a packed bed, typically made up of poly rings which are made out of stainless steel, to break the water up into smaller droplets and increase surface area and to increase the residency time to allow the counterflow flue gas to transfer as much heat as possible to the water. The flue gas exits the top of the units with most heat removed and transferred to the water.

The heated water typically enters an integral storage tank at the bottom of the unit. The heated water can be either pumped from the integral storage tank to its final use, or it can be pumped to larger storage tanks for use at a later time. Based on a review of the units operated during the baseline period, a representative direct contact water heater has been determined to have the following attributes:

- Natural gas fired, forced draft burners
- Electrical motors powering the combustion air supply fan.
- Temperature differential between the inlet water temperature and the flue gas exhaust temperature of 15°F or less when operating at steady state.

B. Basis and Assumptions

- Heat loss through walls of uninsulated tank is negligible.
- All direct GHG emissions are the result of the combustion of natural gas in the direct contact water heater.
- Fuel consumption for this unit is 18 MMBtu/hr or 157,680 MMBtu/year.

- The GHG emission factor for natural gas combustion is 52.92 kg-CO2e/MMBtu (equivalent to 117 lb-CO_2e/MMBtu) per CCAR document[1].
- Indirect emissions are produced due to the operation of the combustion fan. There is one fan that requires 15 horsepower.
- The California Energy Commission document "Updated Macroeconomic Analysis of Climate Strategies Presented in the March 2006 Climate Action Team Report" dated October 15, 2007 (available at http://www.climatechange.ca.gov/climate_action_team/reports/2007-10-15_MACROECONOMIC_ANALYSIS.PDF) provides an estimate of GHG emissions due to electricity consumption in California as a result of implementing various strategies to reduce GHG emissions in the State by 2020. Indirect emissions from electric power consumption are calculated using this standardized emission factor for electricity use of 313 kg-CO2e/MWh = 0.690 lb-CO2e/kWh
- Electric motor efficiency will depend on the size and efficiency classification of the motor, as shown in the following table:

Table 2. Electric Motor Efficiency (%)

Rating HP	Standard	Premium
1 – 4	78.8	85.5
5 – 9	84.0	86.5
10 – 19	85.5	89.5
20 – 49	88.5	91.7
50 – 99	90.2	93.0

Notes:
- Standard Efficiency values reflect NEMA Design B motors, 1 hp and larger that operate more than 500 hours per year.
- Premium Efficiency values reflect the nominal efficiency standards for motors manufactured after December 19, 2010, under the *Energy Independence and Security Act of 2007*.

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.

[1] California Climate Change Action Registry (CCAR), Version 3.1, January, 2009 (Appendix C, Tables C.7 and C.8)

D. Calculations

1. Direct GHG Emissions

Direct GHG emissions from the burning of natural gas were calculated assuming the maximum burner firing rate and using the following formula:

Direct GHG = 18.0 MMBtu/hr x 117 lb-CO_2e/MMBtu
= 2,106.0 lb-CO_2e/hr

2. Indirect GHG Emissions

Indirect GHG emissions from the production of electricity of the electrical power for the motors were calculated using the following equations:

kW/hr = hp/hr x 0.7457 kW/hp x (1/efficiency)
lb-CO2e/hr = kW/hr x 0.524 lb-CO2e/kWh

Indirect GHG = 15 hp x 0.7457 kW/hp x (1 ÷ 85.5%) x 0.690 lb-CO2e/kWh
= 9.0 lb-CO2e/hr

3. Total Baseline Emissions

The Baseline Emission Factor is the sum of the direct and the indirect emissions:

BEF = 2,106.0 lb-CO_2e/hr + 9.0 lb-CO2e/hr
BEF = 2,115.0 lb-CO_2e/hr

STEP 2. List Technologically Feasible GHG Emission Control Measures

For the specific equipment or operation being proposed, 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.

Input and comments were solicited specifically from five different direct contact water heater manufacturers as well as information gathered from various internet searches. The District was able to obtain comments from representatives of two direct contact water heater manufacturers, Armstrong International and QuickWater. After consulting with the manufacturers and internet research, the following findings or considerations are applicable to this class and category:

- The GHG emissions strictly from the combustion of fuel is minimized when natural gas, with emissions of 117 lb-CO2e/MMBtu, is used as opposed to other higher carbon fuels such as diesel fuel oil, with emissions of 161 lb-CO2e/MMBtu.

- An electric motor efficiency standard is published by the National Electrical Manufacturers Association (NEMA) which is identified as the "NEMA Premium Efficiency Electric Motors Program". For large motors, the NEMA premium efficiency motor provides a gain of approximately 5-8 percentage points in motor efficiency when compared to a standard efficiency motor. The NEMA specification covers motors up to 500 horsepower and motors meeting this specification are in common use and are available from most major electric motor manufacturers.

- Control of the combustion air fan operation by use of a variable speed electric motor will provide substantial energy savings when compared to operation at a fixed speed and controlled by throttling the discharge flow. The most common and economical variable speed drive is the variable frequency drive (VFD) which has become commonly available in the last decade and is typical for new boiler fan applications. The VFD provides especially significant energy savings when a boiler is operated at substantial turndown rations which can result in throttling away more than half the rated energy output of the motor.

Considering the relatively low temperature of flue gas exhaust (typically less than 100°F as reported by a couple different manufacturers), and the maximum temperature differential between inlet water and flue gas exhaust, additional heat recovery is impracticable and negligible.

For the specific equipment or operation being proposed, with consideration of input from industry and manufacturers, 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.

Table 3 Technologically Feasible GHG Reduction Measures for Direct Contact Water Heaters	
Reduction Measure	**Qualifications**
1. The direct contact water heater shall be designed to operate at steady state with a maximum temperature differential between the inlet water temperature and the flue gas exhaust temperature of 15°F.	Limiting the temperature differential ensures no excess heat/energy loss through the stack and ensures high thermal efficiency.
2. Electric motors driving combustion air fans or induced draft fans shall have an efficiency meeting the standards of the National Electrical Manufacturer's Association (NEMA) for "premium efficiency" motors and shall each be operated with a variable speed control or equivalent for control of flow through the fan.	Ability to adjust airflow through the direct contact water heater without the need to use restrictive louvers and maximum efficiency for conversion of electrical energy to mechanical energy.

All of the control measures identified above are consistent with control equipment for criteria pollutants which meets current regulatory requirements. None of the identified control measures would result in an increase in emissions of criteria pollutants.

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

For all technologically feasible GHG emission reduction measures, all GHG reduction measures determined to be Achieved-in-Practice are identified. 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.

The following findings or considerations are applicable to this class and category:

- A survey of permitted units in the District revealed that there are several direct contact water heater that operate with a maximum temperature differential between the inlet water temperature and the flue gas exhaust temperature of 15°F. The counterflow flue gas design that is typically used in the direct contact water heaters has been in use since before 1980[2].

- An electric motor efficiency standard is published by the National Electrical Manufacturers Association (NEMA) which is identified as the "NEMA Premium Efficiency Electric Motors Program". For large motors, the NEMA premium efficiency motor provides a gain of approximately 5-8 percentage points in motor efficiency when compared to a standard efficiency motor. The NEMA specification covers motors up to 500 horsepower and motors meeting this specification are in common use and are available from most major electric motor manufacturers.

Based on a review of available technology and permitted units, the following is determined to be the Achieved-in-Practice GHG emission reduction measures for this class and category:

Table 4
Achieved-in-Practice GHG Control Measures for Direct Contact Water Heaters

GHG Control Measures	Achieved-Qualifications
1. The direct contact water heater shall be designed to operate at steady state with a maximum temperature differential between the inlet water temperature and the flue gas exhaust temperature of 15°F.	Limiting the temperature differential ensures no excess heat/energy loss through the stack and ensures high thermal efficiency.
2. Electric motors driving combustion air fans or induced draft fans shall have an efficiency meeting the standards of the National Electrical Manufacturer's Association (NEMA) for "premium efficiency" motors and shall each be operated with a variable speed control or equivalent for control of flow through the fan.	Ability to adjust airflow through the direct contact water heater without the need to use restrictive louvers and maximum efficiency for conversion of electrical energy to mechanical energy.

[2] One direct contact water heater manufacturer has claimed to have manufactured units with the same basic design since before 1980.

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 reduction measure 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)

- The direct contact water heater shall be designed to operate at steady state with a maximum temperature differential between the inlet water temperature and the flue gas exhaust temperature of 15°F.
- Electric motors driving combustion air fans or induced draft fans shall have an efficiency meeting the standards of the National Electrical Manufacturer's Association (NEMA) for "premium efficiency" motors and shall each be operated with a variable speed control or equivalent for control of flow through the fan.

Except for the premium-efficiency motors, all of the Achieved in Practice technology was in use during the Baseline Period and is commonly found in new installations. As a result, there is no GHG emission reduction associated with those control options.

A. Basis and Assumptions:

- All direct GHG emissions are the result of the combustion of natural gas in this unit.
- Indirect emissions are produced due to the operation of the combustion fan. There is one fan that requires 15 horsepower.
- Electric motor efficiency is 89.5% (NEMA Premium Motor Standard for 15 hp motors).
- Indirect emissions from electric power consumption are calculated based on the current PG&E electric power generation factor of 0.524 lb-CO2e/kWh

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

1. Direct GHG emissions

The combustion process of the baseline direct contact water heater is already highly efficient in controlling GHG emissions due to the use of natural gas, which has a lower carbon content than diesel fuel oil and direct heat transfer, which maximize the thermal efficiency. There are no known improvements which could further enhance the combustion process; therefore, there are no potential reductions in direct GHG emissions from this class and category.

The GHG emissions from the burning of natural gas were calculated assuming the maximum burner firing rate and using the following formula:

Direct GHG = 18.0 MMBtu/hr x 117 lb-CO_2e/MMBtu
= 2,106.0 lb-CO_2e/hr

2. Indirect GHG Emissions

The baseline units were constructed prior to the promulgation of high efficiency (Premium Efficiency) standards for electrical motors. Use of the newly developed Premium Efficiency motors to power the oven fans will reduce the indirect GHG emissions from electrical power generation by providing more horsepower output for every kilowatt input.

The GHG emissions from the production of electricity of the power for the motors were calculated using the following equations, assuming the use of Premium Efficiency motors:

kW/hr = hp/hr x 0.7457 kW/hp x (1/efficiency)
lb-CO2e/hr = kW/hr x 0.524 lb-CO2e/kWh

Indirect GHG = 15 hp x 0.7457 kW/hp x (1 ÷ 89.5%) x 0.690 lb-CO2e/kWh
Indirect GHG = 8.6 lb-CO2e/hr

3. Total GHG Emissions (Direct emissions + Indirect emissions)

G_a = (2,106.0 + 8.6) lb·CO_2e/hr
G_a = 2,114.6 lb·CO_2e/hr

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

$G_p = (BEF_{total} - G_{a\ Total}) \div BEF_{Total}$ lbs/MMBtu
Gp = (2,115.0 – 2,114.6) ÷ 2,115.0 = 0.00019

Gp = 0.02 %

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

Based on the calculations presented in Section II.4 above, the Achieved-in Practice GHG emission reduction measures are ranked in the table below:

Table 5
Ranking of Achieved-in-Practice GHG Emission Control Measures

Rank	GHG Control Measures	Potential GHG Emission per Unit of Activity (G_a) (Metric lb-CO_2e/MMBtu)	Potential GHG Emission Reduction as a Percentage of the Baseline Emission Factor (G_p)
1	The direct contact water heater shall be natural gas-fired and designed per the following criteria: 1. The unit shall be designed to operate at maximum firing rate with a temperature differential between the flue gas exhaust and the inlet water not exceeding 15°F. And 2. Electric motors driving combustion air fans or induced draft fans shall have an efficiency meeting the standards of the National Electrical Manufacturer's Association (NEMA) for "premium efficiency" motors and shall each be operated with a variable speed control or equivalent for control of flow through the fan.	**2,114.6**	**0.02%**

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:

Best Performance Standard for **Direct Contact Water Heaters**

The direct contact water heater shall be natural gas-fired and designed per the following criteria:

1. ***The unit shall be designed to operate at maximum firing rate with a temperature differential between the flue gas exhaust and the inlet water not exceeding 15°F.***

And

2. ***Electric motors driving combustion air fans or induced draft fans shall have an efficiency meeting the standards of the National Electrical Manufacturer's Association (NEMA) for "premium efficiency" motors and shall each be operated with a variable speed control or equivalent for control of flow through the fan.***

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

No other Achieved-in-Practice options were identified.

VII. Appendices

Appendix 1: District's Public Notice of Intent

Appendix 1

District's Public Notice of Intent

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:

Boilers – Direct Contact Water Heater

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,
- 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/CCAP_idx.htm.

Written comments regarding the subject Best Performance Standard should be addressed to Jesse A. Garcia by email, jesse.garcia@valleyair.org, or by mail at SJVUAPCD, 1990 East Gettysburg Avenue, Fresno, CA 93726 and must be received by **October 8, 2012.** For additional information, please contact Jesse A. Garcia by e-mail or by phone at (559) 230-5918.

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.

Joven Refuerzo

From: bps_and_ghg_emission_reduction_measures@lists.valleyair.org
Sent: Wednesday, September 12, 2012 4:35 PM
To: Joven Refuerzo
Subject: [BPS_and_GHG_Emission_Reduction_Measures] SJVAPCD - Development of Best Performance Standards
Attachments: ATT00001.txt

The San Joaquin Valley Air Pollution Control District is soliciting public participation for the development of Best Performance Standards (BPS). The Notice of Development for ***Boilers*** for the ***Direct Contact Water Heater*** category is available here.

Written comments for the Best Performance Standard, for Boilers for the Direct Contact Water Heater category, should be addressed to Jesse Garcia by email, jesse.garcia@valleyair.org, or by mail at SJVAPCD, 1990 East Gettysburg Avenue, Fresno, CA 93726 and must be received by **October 8, 2012**. For additional information, please contact Jesse Garcia by e-mail or by phone at (559) 230-5918.