CATEGORY: **DRYER (NON PROCESS HTR)**

BACT Size: Minor Source BACT **DRYER**

BACT Determination Number: 175	**BACT Determination Date:** 6/5/2018

Equipment Information

Permit Number: 25027
Equipment Description: DRYER
Unit Size/Rating/Capacity: <2.0 MMBtu/hr
Equipment Location: SACRAMENTO LAUNDRY COMPANY
3750 PELL CIR
SACRAMENTO, CA

BACT Determination Information

ROCs	**Standard:**	Natural gas fueled
	Technology Description:	
	Basis:	Achieved in Practice
NOx	**Standard:**	60 ppmvd @ 3% O2
	Technology Description:	Low-NOx burner
	Basis:	Achieved in Practice
SOx	**Standard:**	Natural gas fueled
	Technology Description:	
	Basis:	Achieved in Practice
PM10	**Standard:**	75% Control
	Technology Description:	Lint Collector and natural gas fuel, or equal
	Basis:	Achieved in Practice
PM2.5	**Standard:**	75% Control
	Technology Description:	Lint Collector and natural gas fuel, or equal
	Basis:	Achieved in Practice
CO	**Standard:**	No standard
	Technology Description:	
	Basis:	
LEAD	**Standard:**	N/A
	Technology Description:	
	Basis:	

Comments:

District Contact: Michelle Joe Phone No.: (916) 874 - 4853 email: mjoe@airquality.org

BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION

DETERMINATION NO.:	175
DATE:	May 3, 2018
ENGINEER:	Matt Baldwin

Category/General Equip Description:	Dryer
Equipment Specific Description:	Commercial Laundry Dryer, Natural Gas-fired, High Turndown Ratio ≤ 2,000,000 Btu/hr
Equipment Size/Rating:	Small Emitter BACT (PTE < 10 lb/day)
Previous BACT Det. No.:	69

This BACT determination will update Determination #69 for a natural gas-fired commercial laundry dryer with a high turndown ratio.

This BACT was determined under the project for A/Cs 25027, 25028, 25029, 25030, and 25031 (Sacramento Laundry Company; commercial laundry dryer with a high turndown ratio, 1.8 MMBtu/hr, equipped with lint trap).

These applications are for commercial laundry dryers that use burners with a high turndown ratio (≥ 30:1). Turndown ratio refers to the width of the operational range of a device, and is defined as the ratio of the maximum capacity to minimum capacity. Because of the need for high turndown, the burner manufacturer cannot guarantee NOx emissions that meet BACT #115 for commercial laundry dryers (30 ppmv @ 3% O_2). The dryers are part of an automated washroom process. The applicant claims that high turndown ratios are required so that sensitive linens are not scorched or damaged. The automated system varies the natural gas input from as high as 1,800,000 Btu/hr to as low as 40,000 Btu/hr (46:1 turndown ratio) to effectively dry sensitive linens without scorching. The system measures and monitors inlet and outlet exhaust temperatures as a surrogate for the effective linen temperature. Upon start-up, the dryer system fully opens the gas valve to maximum heat input to drive off the majority of the moisture in the linens. This results in a high inlet temperature and a low outlet temperature due to the high amount of evaporation. As the linen temperature increases, the outlet temperature increases. Once the outlet temperature rises to a certain set point, the system turns down the burner gradually such that any remaining moisture is driven off without heating the linens to the point of scorching. Towards the end of the cycle, the burner is firing close to its minimum firing capacity. The applicant states that this allows moisture caught in the folds of certain linens (i.e. duvet covers or linens with cuffs) to be driven off while maintaining the linen temperature of the already dried linen. The dryer then turns off the burner and switches to a cool-down cycle using any latent heat to finish the cycle.

BACT/T-BACT ANALYSIS

A. ACHIEVED IN PRACTICE (Rule 202, §205.1a):

The following control technologies are currently employed as BACT/T-BACT for commercial laundry dryers with a high turndown ratio and rated at less than 2 MMBtu/hr:

US EPA

BACT
Source: EPA RACT/BACT/LAER Clearinghouse

For natural gas-fired commercial laundry dryer ≤ 2 MMBtu/hr	
VOC	N/A – No BACT determinations found
NOx	N/A – No BACT determinations found
SOx	N/A – No BACT determinations found
PM10	N/A – No BACT determinations found
PM2.5	N/A – No BACT determinations found
CO	N/A – No BACT determinations found

The following process codes were reviewed:
(A) 19.600 – Misc. Boilers, Furnaces, Heaters
(B) 19.900 – Other Misc. Combustion

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
No applicable rule requirements were found.

Air Resources Board (ARB)

BACT
Source: ARB BACT Clearinghouse (A)

Dryer or Oven, Direct or Indirect Fired ≤ 2 MMBtu/hr	
VOC	N/A – No BACT determinations found
NOx	N/A – No BACT determinations found
SOx	N/A – No BACT determinations found
PM10	N/A – No BACT determinations found
PM2.5	N/A – No BACT determinations found
CO	N/A – No BACT determinations found

(A) See Attachment A

Air Resources Board (ARB)

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
No applicable rule requirements were found.

Sacramento Metropolitan AQMD

BACT
Source: SMAQMD BACT Clearinghouse, BACT Determination Number 69

For Natural Gas-Fired Batch-Type Linen Dryer ≤ 2 MMBtu/Hr; High Turndown Ratio (A)	
VOC	No Standard
NOx	70 ppmvd @ 3% O_2, Low-NOx burner
SOx	No Standard
PM10	No Standard
PM2.5	No Standard
CO	No Standard

(A) Lowest NOx concentration for high turndown ratio burner (>40:1) for a non-standard batch-type washer and dryer system for the hospitality industry.

Source: SMAQMD BACT Clearinghouse, BACT Determination Number 115

Commercial Laundry Dryer, Natural Gas-Fired (A)	
VOC	Natural gas fueled
NOx	N/A – Not applicable to this determination
SOx	Natural gas fueled
PM10	75% Control; Lint collector and natural gas fuel, or equal
PM2.5	75% Control; Lint collector and natural gas fuel, or equal
CO	Natural gas fueled

(A) This determination is for a dryer with a high turndown ratio. As discussed below, the NOx standard listed in BACT determination 115 is not considered technologically feasible. However, the PM10 and PM2.5 standards are not dependent on turndown ratio, and are thus considered achieved in practice for this category.

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

Sacramento Metropolitan AQMD

RULE REQUIREMENTS:
No applicable rule requirements were found.

South Coast AQMD

BACT
Source: SCAQMD BACT Guidelines for Non-Major Polluting Facilities, page 43

Dryer or Oven	
VOC	No standard.
NOx	1. Carpet Oven: 80 ppmvd @ 3% O_2 2. Rotary, Spray, and Flash Dryers[(A)]: Natural gas-fired, low NOx burner 3. Tray, Agitated Pan, and Rotary Vacuum Dryers: Natural gas-fired, low NOx burner 4. Tenter Frame Fabric Dryer: 60 ppmvd @ 3% O_2 5. Other Dryers and Ovens – Direct and Indirect Fired: 30 ppmvd @ 3% O_2
SOx	Natural gas-fired.
PM10	1. Carpet Oven: Natural gas-fired 2. Rotary, Spray, and Flash Dryers[(A)]: Natural gas-fired, baghouse 3. Tray, Agitated Pan, and Rotary Vacuum Dryers: Natural gas-fired 4. Tenter Frame Fabric Dryer: Natural gas-fired 5. Other Dryers and Ovens – Direct and Indirect Fired: Natural gas-fired
PM2.5	No standard.
CO	No standard.

(A) Dryers for foodstuff, pharmaceuticals, aggregate, & chemicals.

Note: SCAQMD Rule 219 exempts combustion equipment ≤ 2,000,000 Btu/hr unless it is integral to a process that would otherwise require a permit. (i.e. heated automotive spray booth). Pursuant to SCAQMD Rule 1303, BACT only applies to new or modified sources. Rule 1302 defines a source as any ***permitted*** individual unit, piece of equipment, article, machine, process, contrivance, or combination thereof, which may emit or control an air contaminant. Therefore, in the case of a dryer ≤ 2,000,000 Btu/hr, BACT would not apply because it is not otherwise required to obtain a permit to operate.

The following determination is listed for reference, but is not considered technologically feasible for burners with a high turndown ratio.

South Coast AQMD

Source: SCAQMD LAER/BACT Determinations

Dryer Or Oven: Dryer, Laundry A/N 391633 (12/6/02) 1.5 MMBtu/Hr Average Heat Input; 3.5 MMBtu/Hr Rated Heat Input.	
VOC	No standard.
NOx	30 ppmvd @ 3% O_2, Low-NOx burner [(A)]
SOx	No standard.
PM10	No standard.
PM2.5	No standard.
CO	No standard.

(A) SCAQMD determined on 12/06/2002 that BACT for NOx for a commercial laundry dryer was 30 ppmv @ 3% O_2. The MAXON Cyclomax burner used in this application has a maximum turndown ratio of 15:1. Source: SCAQMD Permit No. F45784 MAXON Packaged & EBMRV CYCLOMAX® Burners (09/03).

T-BACT

There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:

Reg XI, Rule 1147 – NOx Reductions from Miscellaneous Sources

This rule applies to ovens, dryers, dehydrators, heaters, kilns, calciners, furnaces, crematories, incinerators, heated pots, cookers, roasters, fryers, closed and open heated tanks and evaporators, distillation units, afterburners, degassing units, vapor incinerators, catalytic or thermal oxidizers, soil and water remediation units and other combustion equipment with nitrogen oxide emissions that require a District permit **and are not** specifically required to comply with a nitrogen oxide emission limit by other District Regulation XI rules.

Reg II, Rule 219 exempts combustion equipment firing natural gas, for which the maximum heat input is 2,000,000 Btu/hr or less. Therefore in practice, the below standards only apply to commercial laundry dryers with a heat input greater than 2,000,000 Btu/hr.

South Coast AQMD

SCAQMD Rule 1147 Emission Standards ppmvd @ 3% O_2 or lb/MMBtu heat input Rule 1147 §(c)(1), Table 1 for NOx			
Equipment Category	Process Temperature		
Gaseous fuel-fired equipment	≤ 800° F	> 800 ° F and < 1,200° F	≥ 1,200 ° F
Oven, Dehydrator, Dryer, Heater, Kiln, Calciner, Cooker, Roaster, Furnace, or Heated Storage Tank	30 ppm or 0.036 lb/MMBtu	30 ppm or 0.036 lb/MMBtu	60 ppm or 0.073 lb/MMBtu
Tenter Frame or Fabric or Carpet Dryer	30 ppm or 0.036 lb/MMBtu	NA	NA
Other Unit or Process Temperature	30 ppm or 0.036 lb/MMBtu	30 ppm or 0.036 lb/MMBtu	60 ppm or 0.073 lb/MMBtu

San Joaquin Valley Unified APCD

BACT

Source: SJVUAPCD BACT Guideline 1.19.11

Commercial Laundry Dryer < 5 MMBtu/hr, Natural Gas Fired	
VOC	No Standard
NOx	No Standard
SOx	No Standard
PM10	75% Control (Lint Collector and natural gas fuel, or equal)
PM2.5	No Standard
CO	No Standard

San Joaquin Valley Unified APCD

Source: SJVUAPCD BACT Guideline 1.19.14

Natural Gas Fired Dryer with High Turndown Ratio (A)	
VOC	No Standard
NOx	84 ppmvd @ 3% O_2, Low-NOx burner (B) (Achieved in Practice) 40 ppmvd @ 3% O_2, Low-NOx burner (B) (Technologically Feasible) (C)
SOx	No Standard
PM10	No Standard
PM2.5	No Standard
CO	No Standard

(A) For the purpose of this determination, a "high turndown ratio" is one that exceeds the turndown ratio of an ultra-low NOx burner system operating at 20 ppmv NOx @ 3% O2 (B) or 10 ppmv NOx @ 3% O2 (B).
(B) Emissions limits have been corrected from 19% Oxygen to 3% Oxygen for comparison purposes.
(C) The technologically feasible option was the standard applied to the project (Natural Gas Fired Dryer Used to Dry Prints on Polyethylene (or Other Similar Material) Coated Web. The dryer was rated at 2.5 MMBtu/hr.

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:

Rule 4309 – Dryers, Dehydrators, and Ovens

This rule does not apply to any dryer, dehydrator, or oven that has a total rated heat input of < 5.0 MMBtu/hr; however, the emissions standards are listed below for reference.

SJVUAPCD Rule 4309 Emission Standards ppmvd @ 3% O_2 (B) Rule 4309 §5.2, Table 1 for Gaseous Fuel Fired		
Process Description	NOx limit (B)	CO Limit (B)
Other processes (A)	40 ppm	395 ppm

(A) Excludes dryers, asphalt/concrete plants, and milk, cheese, and dairy processing.
(B) Rule 4309's limits are in ppmvd @ 19% Oxygen. The values listed in the table have been corrected to 3% Oxygen for comparison purposes.

San Diego County APCD

BACT
Source: NSR Requirements for BACT
Pursuant to Rule 11(d)(18)(iv), Laundry dryers, extractors, or tumblers used for fabrics cleaned only with solutions of bleach or detergents containing no volatile organic solvents are not required to obtain a permit and are therefore not subject to New Source Review (BACT).

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
Regulation 4, Rule 68 – Fuel-Burning Equipment – Oxides of Nitrogen
This rule does not apply to fuel burning equipment which has a maximum input rating of < 50 MMBtu/hr.

Bay Area AQMD

BACT
Source: BAAQMD BACT Guideline

For Natural Gas-Fired Commercial Laundry Dryer	
VOC	N/A – No BACT determinations found
NOx	N/A – No BACT determinations found
SOx	N/A – No BACT determinations found
PM10	N/A – No BACT determinations found
PM2.5	N/A – No BACT determinations found
CO	N/A – No BACT determinations found

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
Reg 8, Rule 2 – Organic Compounds from Miscellaneous Operations
Organic compound emissions from any operation consisting entirely of natural gas are exempt from this rule.

Reg 9, Rule 3 – Inorganic Gaseous Pollutants; NOx from Heat Transfer Operations §9-3-301
This rule does not apply to any new or modified heat transfer operation designed for a maximum heat input of less than 264 GJ (250 million BTU).

The following control technologies have been identified and are ranked based on stringency:

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES	
Pollutant	**ACHIEVED CONTROL TECHNOLOGIES**
VOC	1. Natural gas fueled [SMAQMD, BAAQMD] 2. No Standard [EPA, ARB, SCAQMD, SJUVAPCD, SDAPCD]
NOx	1. 70 ppmvd @ 3% O_2, Low-NOx burner [SMAQMD] 2. 84 ppmvd @ 3% O_2, Low-NOx burner [SJVUAPCD] 3. No Standard [EPA, ARB, BAAQMD, SCAQMD, SDAPCD]
SOx	1. Natural gas fueled [SMAQMD, SCAQMD] 2. No Standard [EPA, ARB, SJUVAPCD, SDAPCD, BAAQMD]
PM10	1. 75% Control (Lint Collector and natural gas fuel, or equal) [SMAQMD, SJVUAPCD] 2. No Standard [EPA, ARB, SMAQMD, SCAQMD, SDAPCD, BAAQMD]
PM2.5	1. 75% Control (Lint Collector and natural gas fuel, or equal) [SMAQMD] 2. No Standard [EPA, ARB, BAAQMD, SMAQMD, SCAQMD, SDAPCD, SJVUAPCD]
CO	1. Natural gas fueled [SMAQMD] 2. No Standard [EPA, ARB, SCAQMD, SJUVAPCD, SDAPCD, BAAQMD]
T-BACT	1. No Standard

The following control technologies have been identified as the most stringent, achieved in practice control technologies:

BEST CONTROL TECHNOLOGIES ACHIEVED		
Pollutant	**Standard**	**Source**
VOC	Natural gas fueled	SMAQMD, BAAQMD
NOx	70 ppmvd @ 3% O_2, Low-NOx burner	SMAQMD
SOx	Natural gas fueled	SMAQMD, SCAQMD
PM10	75% Control (Lint Collector and natural gas fuel, or equal)	SJUVAPCD
PM2.5	75% Control (Lint Collector and natural gas fuel, or equal)	SMAQMD, SJUVAPCD
CO	Natural gas fueled	EPA, ARB, SMAQMD, SCAQMD, SJUVAPCD, SDAPCD, BAAQMD
T-BACT	No standard	

B. TECHNOLOGICALLY FEASIBLE AND COST EFFECTIVE (Rule 202, §205.1.b.):

Discussion on High Turndown Ratio:
As noted in the previous SMAQMD BACT Determination #69 and SJVUAPCD BACT Guideline 1.9.14, high turndown ratios are a consideration with industries that need highly variable controls for their processes. For certain commercial laundry dryers, high turndown is required for dryers to ramp up to high-fire to initially drive off moisture, and then switch to mid- and low-fire to maintain a linen temperature high enough to drive off any remaining moisture, but low enough to not scorch and damage the fabric. The SCAQMD discussed burner turndown in their staff report for Rule 1147 (December 2008) – See Attachment B. The SCAQMD concluded that many low NOx burners can meet 20 to 40 ppm NOx @ 3% oxygen while maintaining turndown ratios of 15:1 to 10:1, with some burners achieving turndown ratios of 25:1. Also, equipment that traditionally use burners with a turndown ratio of 30:1 can use low NOx burners with turndown ratios of 15:1 or less, because the moderate temperatures in Southern California reduce some of the necessity of high turndown to quickly heat up equipment. The SCAQMD published their final Rule 1147 Technology Assessment on February 2017, which determined that burners rated below 325,000 BTU/hr that must regularly operate at less than 30% of this maximum firing rate (less than 97,500 BTU/hr) may have difficulties complying with the Rule 1147 NOx emission limits; as a result, burners rated below 325,000 BTU/hr were exempted from the NOx emission limits. Because these dryer burners are expected to frequently operate as high as 1,850,000 BTU/hr and as low as 40,000 BTU/hr (at least once per drying cycle), installing a burner with a lower turndown ratio or a Rule 1147-compliant burner that cannot meet the turndown requirements of this automated drying system is not considered technologically feasible.

Technologically Feasible Alternatives:
Any alternative basic equipment, fuel, process, emission control device or technique, singly or in combination, determined to be technologically feasible by the Air Pollution Control Officer.

The table below shows the technologically feasible alternatives identified as capable of reducing emissions beyond the levels determined to be "Achieved in Practice" as per Rule 202, §205.1.a.

Pollutant	Technology	Source
VOC	No other technologically feasible option identified	--
NOx	60 ppm @ 3% O_2 (A)(B)	SCAQMD
SOx	No other technologically feasible option identified	--
PM10	1. 99% Control (Baghouse and natural gas fuel, or equal.) 2. 90% Control (Venturi Scrubber and natural gas fuel, or equal.)	SJVUAPCD
PM2.5	1. Same as above for PM10 (assuming all PM10 falls within the PM2.5 range)	SJVUAPCD
CO	No other technologically feasible option identified	--
T-BACT	No other technologically feasible option identified	--

(A) The technologically feasible option of 60 ppm NOx @ 3% O_2 was for a pot furnace using an Eclipse Ratio Air burner in order to comply with the NOx emission limit, as identified on page K-1, SCAQMD Technology Assessment (October 26, 2016). Since it was stated that this burner was installed to comply with the NOx emission limit, it will be assumed that this technologically feasible option has been achieved in practice. Although large metal melting and heat treating furnaces typically use multiple small burners, the Eclipse Ratio Air burner was identified as also being used in many applications requiring only one burner (such as for commercial laundry dryers). Additionally, an Eclipse Ratio Air burner has already been proposed by the applicant as a high turndown ratio burner and meeting 60 ppm NOx @ 3% O_2.

(B) The technologically feasible option of 40 ppm NOx @ 3% O_2 was excluded, because it applied specifically to a Natural Gas Fired Dryer Used to Dry Prints on Polyethylene (or Other Similar Material) Coated Web. Because this process is inherently different in nature (drying inks on coated web vs removing moisture from linens), this was excluded as a technologically feasible option for dryers requiring a high turndown ratio. The SJVUAPCD also noted in its determination that turndown ratio should be reviewed on a case-by-case basis.

Cost Effective Determination:

After identifying the technologically feasible control options, a cost analysis is performed to take into consideration economic impacts for all technologically feasible controls identified.

Maximum Cost per Ton of Air Pollutants Controlled

A control technology is considered to be cost-effective if the cost of controlling one ton of that air pollutant is less than the limits specified below (except coating operations)

Pollutant	Maximum Cost ($/ton)
ROC	17,500
NOx	24,500
PM10	11,400
SOx	18,300
CO	TBD if BACT triggered

Baghouse

As shown in Attachment C, the cost effectiveness for the add-on baghouse to control PM10 was calculated to be $18,139 per ton (see Attachment D – Baghouse Cost Effectiveness Analysis). The following basic parameters were used in the analysis.

PM10 Control Level = 99%

PM10 Baseline Level= 1.82 ton PM10/year (9.9 lb/day x 92 days/quarter x 4 quarters)

Equipment Life = 10 years

Direct Cost = $54,076

Indirect Cost = $0

Direct Annual Cost = $14,814

Indirect Annual Cost = $18,054

Total Annual Cost = $32,868

PM10 Removed = 1.81 tons

Cost of PM10 Removal = $18,139 per ton reduced

Therefore, the add-on baghouse is considered not cost effective and is eliminated.

Venturi Scrubber
As shown in Attachment D, the cost effectiveness for the add-on Venturi scrubber to control PM10 was calculated to be $40,225 per ton (see Attachment E – Venturi Scrubber Cost Effectiveness Analysis). The following basic parameters were used in the analysis.

PM10 Control Level = 90%

PM10 Baseline Level= 1.82 ton PM10/year (9.9 lb/day x 92 days/quarter x 4 quarters)

Equipment Life = 10 years

Direct Cost = $105,351

Indirect Cost = $23,636

Direct Annual Cost = $29,627

Indirect Annual Cost = $39,640

Total Annual Cost = $69,267

PM10 Removed = 1.64 tons

Cost of PM10 Removal = $40,225 per ton reduced

Therefore, the add-on Venturi scrubber is considered not cost effective and is eliminated.

Using the PM10 BACT standard for PM2.5
Lint traps and natural gas fuel is already required as achieved in practice BACT for PM10 [SJVUAPCD]. Since both PM10 and PM2.5 trigger BACT at > 0 lb/day and PM2.5 is a subset of PM10 for both natural gas combustion and lint generation, BACT for PM2.5 will be triggered whenever BACT is triggered for PM10. Therefore there is no additional cost associated with requiring lint traps and natural gas as BACT for PM2.5 for new emission units.

C. SELECTION OF BACT:

Based on the above analysis, BACT for VOC, NOx, SOx, PM10, PM2.5, and CO is as follows:

BACT FOR COMMERCIAL LAUNDRY DRYER, NATURAL GAS-FIRED, HIGH TURNDOWN RATIO (≥ 30:1), RATED AT ≤ 2,000,000 BTU/HR		
Pollutant	**Standard**	**Source**
VOC	Natural gas fueled	BAAQMD
NOx	60 ppmvd @ 3% O_2, Low-NOx burner	SCAQMD
SOx	Natural gas fueled	SCAQMD
PM10	75% Control (Lint Collector and natural gas fuel, or equal)	SJUVAPCD
PM2.5	75% Control (Lint Collector and natural gas fuel, or equal)	SJUVAPCD
CO	No standard	EPA, ARB, SMAQMD, SCAQMD, SJUVAPCD, SDAPCD, BAAQMD
T-BACT	No standard	

REVIEWED BY: [signature] **DATE:** 6-5-18

APPROVED BY: [signature] **DATE:** 6/5/18

Attachment A

Review of BACT Determinations published by ARB

List of BACT determinations published in ARB's BACT Clearinghouse for Dryer or Oven, Direct or Indirect:

Capacity	Source	Date	NOx	VOC	CO	PM10
4.0 MMBtu/hr (A)	SCAQMD	12/01/1999	30 ppmvd @ 15% O_2	NA	2000 ppmvd @ 15% O_2	0.1 grains/scf
6 MMBtu/hr (B)	SCAQMD	05/01/2000	60 ppmvd @ 15% O_2	NA	NA	NA
3.5 MMBtu/hr, Average load equals 1.5 MMBtu/hr (C)	SCAQMD	10/27/2001	30 ppmvd @ 15% O_2	NA	NA	NA
5 MMBtu/hr, 400-600F operating temperature (D)	SCAQMD	02/06/2002	30 ppmvd @ 15% O_2	780 lb/month (facility wide)	NA	NA
5.4 MMBtu/hr (E)	SCAQMD	12/07/2001	18 ppmvd @ 15% O_2	NA	NA	NA
1.9 MMBtu/hr (F)	SCAQMD	05/27/2003	30 ppmvd @ 15% O_2	NA	NA	5 ppmvd
96 MMBtu/hr (G)	SCAQMD	01/02/1997	6 ppmvd @ 15% O_2	NA	NA	2000 ppmvd @ 15% O_2

(A) Dryer used to soften polystyrene sheet.
(B) Tenter frame fabric dryer used to dry cotton and cotton blended fabrics.
(C) Tumbler dryer used for drying clothes (commercial laundry); SCAQMD determined on 10/27/2001 that BACT for NOx for a commercial laundry dryer was 30 ppmv @ 3% O_2. The MAXON Cyclomax burner used in this application has a maximum turndown ratio of 15:1. Source: SCAQMD Permit No. F45784 and MAXON Packaged & EBMRV CYCLOMAX® Burners (09/03).
(D) Conveyorized powder coating curing oven.
(E) Polyethylene resin melting and curing.
(F) Direct-fired makeup air heater to control booth temperature.
(G) Conveyorized three-zone, 8-layer (no other notes given in description).

[shaded box] = Dryer/oven not used for commercial laundry or cannot provide a high turndown ratio and therefore not part of the scope of this determination.

Attachment B

Staff Report: Proposed Rule 1147 – NOx Reductions from Miscellaneous Sources (December 2008) Burner Turndown Discussion (pg. 12)

30 ppm for air heating, ovens and low temperature furnace applications. There are at least six models of burners from the same two manufacturers that can achieve 30 to 60 ppm in kiln, afterburner or higher temperature furnace applications. Other manufacturers (e.g., Astec, Hauck and North American) produce burners for asphalt and furnace applications. Burners from all of these manufacturers have been used as the basis for AQMD and other air district BACT determinations.

Fuel Efficiency

Most units requiring a burner replacement to meet the emission limit of PR1147 currently have burners with emissions of 110 to 170 ppm or more. Replacement of many of these older high emitting burner with new low NOx 30 ppm burner's will improve process efficiency because new burners are more fuel efficient. Improved combustion and process efficiency will also result in lower emissions of carbon dioxide. Replacement of 60 to 90 ppm burners with low NOx burners with 30 ppm burners may result in small efficiency gains.

Burner Turndown

Technical consultants working with businesses that use equipment subject to PR1147 have raised a concern about reduced turndown for low NO burners. Turndown is the ratio of the maximum firing rate to the minimum firing rate and is a way to represent a burner's heat output range. Some operations require process temperature to be maintained within a small range and a burner with a high turndown is typically used to maintain the temperature within that small range. Many standard burners can achieve a turndown ratio of greater than 30:1. However, the NOx emission rate for these burners is typically greater than 90 ppm (referenced to 3% oxygen) according to burner manufacturers.

The available turndown for any burner depends upon a variety of factors including process operations, emission limit to be achieved, and burner control system. Available low NOx burners for processes affected by PR1147 have significantly higher turndown than equivalent burners for boilers. A typical low NOx burner for a boiler has a turndown of 4:1. For PR1147 equipment, current low NOx burners with NOx emissions between 20 to 40 ppm (3% oxygen) have a turndown in the range of 15:1 to 10:1. However, there are low NOx burners with turndown of 25:1 or greater.

In many cases a large burner with a high turndown is used to start up a process quickly. After the equipment is brought up to the process operating temperature, the burner then fires up to 50 to 60% capacity. A large burner with high turndown is important in cold climates when the burner needs to be oversized in order to quickly heat up equipment. However, in Southern California an oversized burner is not essential because the climate is moderate. The equipment can be quickly brought up to operating temperature with a smaller burner.

When equipment with an oversized burner is in production mode and the burner operates at 60% capacity or less, the effective turndown for the process is about 15 percent. This is the reason why equipment that traditionally use burners with a turndown of 30:1 can meet today's BACT limits (20 to 40 ppm) using low NOx burners with turndowns of 15:1 or less. There may even be an efficiency benefit in switching to a smaller burner. Burners are typically more efficient when they operate closer to their maximum rated capacity.

Attachment C

Baghouse Cost Effectiveness Analysis

BAGHOUSE COST EFFECTIVENESS CALCULATION

EPA AIR POLLUTION CONTROL COST MANUAL, Sixth Edition, EPA/452/B-02-001, January 2002
Section 6 - Particulate Matter Controls, Chapter 1 - Baghouses and Filters

Capital Costs

Direct Costs	Factor		Cost
Purchased equipment costs			
Fabric filter (Bid from Air Dynamics, requested by G&K)		$	35,029
Bags and cages		$	-
Auxillary equipment		$	-
Total = A		$	35,029
Instrumentation	0.10 A	$	3,503
California Sales taxes	0.085 A	$	2,977
Freight	0.05 A	$	1,751
Purchased equipment costs, PEC	B= 1.24 A	$	43,261
Direct installation costs	0.25 B	$	10,815
Section 1.4.3 of the Cost Control Manual estimates that for prepackaged units, the installation costs would be 20-25% of the purchased equipment cost (B).			
Site Preparation	As required, SP	$	-
Buildings	As required, Bldg.	$	-
Total Direct Cost, DC	**1.74 B + SP + Bldg.**	**$**	**54,076**
Indirect Costs (installation) - included with direct installation costs			
Engineering	0.00 B	$	-
Construction and field expense	0.00 B	$	-
Contractor fees	0.00 B	$	-
Start-up	0.00 B	$	-
Performance test	0.00 B	$	-
Contingencies	0.00 B	$	-
Total Indirect Cost, IC	**0.00 B**	**$**	**-**
Total Capital Investment (rounded) = DC + IC	**2.19 B + SP + Bldg.**	**$**	**54,076**

BAGHOUSE COST EFFECTIVENESS CALCULATION (continued)

Annual Costs

Direct Annual Costs, DAC	Factor		Cost
Operating Labor			
Operator labor cost, O ($13.25/hr, 1 hr/8 hr shift, 2 shifts/day 260 days/yr)		$	6,890
*Hourly Rate provided by G&K Services			
Supervisor labor cost	15% of O	$	1,034
Operating Labor Total, OL		$	7,924
Maintenance Labor			
Labor, L ($13.25/hr, 0.5 hr/8 hr shift, 2 shifts/day 260 days/yr)		$	3,445
Material	100% of L	$	3,445
Utilities			
Electricity (system is passive due to high flow rate from dryer)		$	-
Replacement Parts		$	-
Total DAC		**$**	**14,814**
Indirect Annual Costs, IAC			
Overhead	60% OL+ML	$	8,888.10
Administrative charges	2% DC+IC	$	1,081.52
Property Tax	1% DC+IC	$	541
Insurance	1% DC+IC	$	540.76
Captial recovery (10-year equipment life, 5% interest)	0.129505 DC+IC	$	7,003.09
Total IAC		**$**	**18,054**
Total Annual Cost	**DAC + IAC**	**$**	**32,868**

Attachment D

Venturi Scrubber Cost Effectiveness Analysis

VENTURI SCRUBBER COST EFFECTIVENESS CALCULATION

EPA AIR POLLUTION CONTROL COST MANUAL, Sixth Edition, EPA/452/B-02-001, January 2002
Section 6 - Particulate Matter Controls, Chapter 2 - Wet Scrubbers for Particulate Matter

Capital Costs

Direct Costs		Factor		Cost
Purchased equipment costs				
Venturi Packaged Unit (Qsat = 9,000 acfm)		4.5 Qsat + 19,000	$	59,500
Auxiliary Costs (assumed to be include per Section 6, Chapter 2, Table 2.5)			$	-
Equipment Costs (assumed to be include per Section 6, Chapter 2, Table 2.5)			$	-
Total = A			$	59,500
Instrumentation (assumed to be include per Section 6, Chapter 2, Table 2.5)		0.00 A	$	-
California Sales taxes		0.085 A	$	5,058
Freight		0.05 A	$	2,975
Purchased equipment costs, PEC	B=	1.14 A	$	67,533
Direct installation costs				
Foundations & supports		0.06 B	$	4,052
Handling & erection		0.40 B	$	27,013
Electrical		0.01 B	$	675
Piping		0.05 B	$	3,377
Insulation for ductwork		0.03 B	$	2,026
Painting		0.01 B	$	675
Direct installation costs		0.56 B	$	37,818
Site Preparation		As required, SP	$	-
Buildings		As required, Bldg.	$	-
Total Direct Cost, DC		**1.56 B + SP + Bldg.**	**$**	**105,351**
Indirect Costs (installation)				
Engineering		0.10 B	$	6,753
Construction and field expense		0.10 B	$	6,753
Contractor fees		0.10 B	$	6,753
Start-up		0.01 B	$	675
Performance test		0.01 B	$	675
Contingencies		0.03 B	$	2,026
Total Indirect Cost, IC		**0.35 B**	**$**	**23,636**
Total Capital Investment (rounded) = DC + IC		**2.19 B + SP + Bldg.**	**$**	**129,000**

VENTURI SCRUBBER COST EFFECTIVENESS CALCULATION (continued)

Annual Costs

Direct Annual Costs, DAC	Factor		Cost
Operating Labor			
Operator labor cost, O ($13.25/hr, 2 hr/8 hr shift, 2 shifts/day 260 days/yr)		$	13,780
Supervisor labor cost	15% of O	$	2,067
Operating Labor Total, OL		$	15,847
Maintenance Labor			
Labor, L ($13.25/hr, 1 hr/8 hr shift, 2 shifts/day 260 days/yr)		$	6,890
Material	100% of L	$	6,890
Total DAC		**$**	**29,627**
Indirect Annual Costs, IAC			
Overhead	60% OL+ML	$	17,776.20
Administrative charges	2% DC+IC	$	2,580
Property Tax	1% DC+IC	$	1,290
Insurance	1% DC+IC	$	1,289.87
Captial recovery (10-year equipment life, 5% interest)	0.129505 DC+IC	$	16,704.42
Total IAC		**$**	**39,640**
Total Annual Cost	**DAC + IAC**	**$**	**69,267**