APPENDIX A

EMISSION INVENTORY AND REDUCTION CALCULATIONS

As mentioned in the Rule 3.23 Staff Report, SCAQMD conducted surveys of water heaters and small boilers within the South Coast air basin, and documented those survey results in their staff reports for Rules 1121 and 1146.2. The following data was also used by SMAQMD when developing Rule 414 which required similar emission inventory and reduction calculations. It is assumed that the results of these surveys are expected to be applicable to Yuba and Sutter counties, as they were for Sacramento County, since the demand for hot water is not very sensitive to ambient temperatures. The following information was obtained from the SCAQMD staff reports regarding natural gas-fired water heaters, small boilers, and process heaters:

- 98.7 % of the units have capacities less than 75,000 Btu/hr (exempt from Rule 3.23 but required for the purpose of emission inventory calculations)
- 1.06 % of the units have capacities between 75,000 and 400,000 Btu/hr
- 0.215% of the units have capacities between 400,000 and 1,000,000 Btu/hr
- The capacity factors (the ratio of fuel actually burned to the maximum capacity) are 0.061 for units less than 75,000 Btu/hr and 0.215 for units greater than 75,000 Btu/hr
- The uncontrolled emission factors for NOx are 0.14 lb/MMBtu for units between 75,000 and 400,000 Btu/hr, and 0.17 lb/MMBtu for units between 400,000 and 1,000,000 Btu/hr

EMISSION INVENTORY CALCULATIONS

Calculation of % of emissions due to each size range (as per Appendix B of SMAQMD Rule 414 Staff Report)

Basis: 100,000 affected units

# of units < 75,000 Btu/hr = 0.987 x 100,000 = 98,700
# of units 75,000 – 400,000 Btu/hr = .0106 x 100,000 = 1,060
# of units 400,000 – 1,000,000 Btu/hr = 0.00215 x 100,000 = 215

Typical unit input ratings assumed for each size range

<75,000 Btu/hr: 40,000 Btu/hr typical
75,000 – 400,000 Btu/hr: 237,500 Btu/hr typical
400,000 – 1,000,000 Btu/hr: 700,000 Btu/hr typical

Fuel Consumed = (# of units) x (typical input rating) x (capacity factor) x (24 hrs/day)

<75,000 Btu/hr: 98,700 x 0.04 MMBtu/hr x 0.061 x 24 hrs/day = 5,780 MMBtu/day
75,000 – 400,000 Btu/hr: 1,060 x 0.2375 MMBtu/hr x 0.215 x 24 hrs/day = 1,299 MMBtu/day
400,000 – 1,000,000 Btu/hr: 215 x 0.7 MMBtu/hr x 0.215 x 24 hrs/day = 777 MMBtu/day

Emissions = (fuel consumed) x (emission factor)

<75,000 Btu/hr: 5,780 MMBtu/day x 0.07 lb/MMBtu = 405 lb/day
75,000 – 400,000 Btu/hr: 1,299 MMBtu/day x 0.14 lb/MMBtu = 182 lb/day
400,000 – 1,000,000 Btu/hr: 777 MMBtu/day x 0.17 lb/MMBtu = 132 lb/day
Total: 719 lb/day

Percentage of Emissions for Each Size Range
<75,000 Btu/hr: 100% x 405 lb/719 lb = 56.3%
75,000 – 400,000 Btu/hr: 100% x 182 lb/719 lb = 25.3%
400,000 – 1,000,000 Btu/hr: 100% x 132 lb/719 lb = 18.4%

Inventory allocation: sample calculation for 2021 emission inventory

Total inventory

Residential Natural Gas Water Heating: 0.0062 tpd
Service/Commercial Natural Gas Water Heating: 0.1008 tpd
Total: 0.1070 tpd

Emission inventory allocation to each size range = (fraction of emissions) x (total emissions)

75,000 – 400,000 Btu/hr: 0.253 x 0.1070 tpd = 0.0271 tpd
400,000 – 1,000,000 Btu/hr: 0.184 x 0.1070 tpd = 0.0197 tpd

EMISSION REDUCTIONS

Emission reduction percentages are calculated using the following assumptions:

- Current uncontrolled emission factor for units 75,000 – 400,000 Btu/hr is 115 ppm based on SCAQMD estimates
- Current uncontrolled emission factor for units 400,000 – 1,000,000 Btu/hr is 143 ppm based on SCAQMD estimates
- The average lifetimes of units are 15 years for units 75,000 Btu/hr and 20 years for units 400,000 – 1,000,000 Btu/hr
- Based on the average lifetimes, each year the following percentages of units get replaced: 6.67% for units 75,000 – 400,000 Btu/hr and 5% for units 400,000 – 1,000,000 Btu/hr.

Emission reduction percentages

Emission reduction percentages for each year were calculated using the percentage of units affected for that year, the uncontrolled emission factor, and the controlled emission factor (i.e., after the Rule limits take effect).

Emission reduction % = % of units affected x [1-(controlled emission factor) / (uncontrolled emission factor)]

Sample calculation for 2021

75,000 – 400,000 Btu/hr: 33.33% x (1 – 20/115) = 27.54%
400,000 – 1,000,000 Btu/hr: 25.0% x (1 – 20/143) = 21.5%

The emission reduction percentages for the implementation year as well as the following 5-year increments are presented in the table below.

	Emission Reduction Percentages				
Size	**2017**	**2021**	**2026**	**2031**	**2036**
75,000 – 400,000	5.51%	27.54%	55.07%	82.61%	82.61%
400,000 – 1,000,000	4.30%	21.50%	43.01%	64.51%	86.01%

Emission Reductions

Emission reductions for each year were calculated by multiplying the emission inventory for that year by its corresponding emission reduction fraction.

Sample calculation for 2021

75,000 – 400,000 Btu/hr: 0.2754 x 0.0271 tpd = 0.0075 tpd
400,000 – 1,000,000 Btu/hr: 0.2150 x 0.0197 tpd = 0.0042 tpd
Total: 0.0117 tpd

The emission reductions for the implementation year as well as the following 5-year increments are presented in the table below.

	Emission Reductions (tpd)				
Size	**2017**	**2021**	**2026**	**2031**	**2036**
75,000 – 400,000	0.0015	0.0075	0.0152	0.0234	0.0237
400,000 – 1,000,000	0.0008	0.0042	0.0086	0.0133	0.0180
Total	**0.0023**	**0.0117**	**0.0238**	**0.0367**	**0.0417**

APPENDIX B

COST INFORMATION AND CALCULATIONS

District staff estimated increased costs for water heaters and boilers that comply with the proposed limits of Rule 3.23. Such units are currently being sold in multiple Air Quality/Pollution Control Districts throughout California including Bay Area, Sacramento, San Joaquin, South Coast, and San Diego.

Units between 75,000 Btu/hr and less than 400,000 Btu/hr

District staff was able to compile a list of standard and ultra-low NOx units in the range of 75,000 Btu/hr to less than 400,000 Btu/hr from multiple online retailers including The Home Depot, Lowe's Home Improvement, and Sears. Based on the information compiled, the average cost increase varies greatly from unit to unit; however, staff was able to calculate an average increase as shown in the table below.

Cost of Ultra Low NOx Units Required By Rule 3.23 (75,000 Btu/hr to <400,000 Btu/hr)				
NOx Type	**Btu Rating**	**Description**	**Retail Cost**	**Increase**
Standard	75,100	Residential, (75 gal)	$791.99	
Ultra-Low NOx	75,000	Residential, (75 gal)	$1,111.00	$319.01
Standard	75,100	Commercial, (75 gal)	$2,762.25	
Ultra-Low NOx	75,100	Commercial, (75 gal)	$2,546.45	-$215.80
Standard	76,000	Residential, (75 gal)	$1,248.00	
Ultra-Low NOx	76,000	Residential, (60 gal)	$2,604.87	$1,356.87
Standard	76,000	Residential, (98 gal)	$1,469.00	
Ultra-Low NOx	76,000	Residential, (80 gal)	$3,058.07	$1,589.07
Standard	125,000	Commercial, 75 gal	$4,294.50	
Ultra-Low NOx	125,000	Commercial, 75 gal	$4,949.91	$655.41
Standard	156,000	Commercial, 82 gal	$4,756.50	
Ultra-Low NOx	156,000	Commercial, 82 gal	$6,101.00	$1,344.50
Standard	199,900	Commercial, 75 gal	$4,294.50	
Ultra-Low NOx	199,900	Commercial, 76 gal	$6,299.61	$2,005.11
Standard	199,900	Commercial, 100 gal	$5,699.99	
Ultra-Low NOx	199,900	Commercial, 100 gal	$6,415.50	$715.51
Standard	250,000	Commercial, 100 gal	$7,050.00	
Ultra-Low NOx	250,000	Commercial, 100 gal	$7,112.23	$62.23
Standard	270,000	Commercial, 100 gal	$6,999.99	
Ultra-Low NOx	270,000	Commercial, 100 gal	$9,385.01	$2,385.02
Standard	360,000	Commercial, 65 gal	$7,899.99	
Ultra-Low NOx	360,000	Commercial, 65 gal	$8,399.99	$500.00
Standard	399,000	Commercial, 100 gal	$9,567.75	
Ultra-Low NOx	399,900	Commercial, 100 gal	$10,660.96	$1,093.21
Average				$984.18

Units between 400,000 Btu/hr and less than 1,000,000 Btu/hr

District staff was not able to find readily available cost data for units in the range of 400,000 Btu/hr to less than 1,000,000 Btu/hr; therefore, staff used data compiled by SMAQMD staff in the Rule 414 Staff Report. Based on the information compiled, the average representative cost increase for units in this size range was $7,359.

Total Cost and Cost Effectiveness

Uncontrolled Emissions per Unit

Size Range	Midpoint Size (MMBtu/hr)	NOx Emission Factor (lb/MMBtu)	Capacity Factor	NOx Emissions (lb/day)	NOx Emissions (lb/yr)
75,000 - <400,000	0.24	0.140	0.215	0.173	63.282
400,000 - <1,000,000	0.70	0.174	0.215	0.628	229.398

Controlled Emissions per Unit

Size Range	Midpoint Size (MMBtu/hr)	NOx Emission Factor (lb/MMBtu)	Capacity Factor	NOx Emissions (lb/day)	NOx Emissions (lb/yr)
75,000 - <400,000	0.24	0.0243	0.215	0.0301	10.9840
400,000 - <1,000,000	0.70	0.0243	0.215	0.0878	32.0366

Capital Recovery Factor Calculations

	CRF 15 year	CRF 20 year
Interest	2.00%	2.00%
Years (lifetime)	15	20
CRF	0.078	0.061

Total Cost and Cost Effectiveness

Size Range	NOx Reduction per unit (lbs/yr)	Annualized Cost Per Unit ($/yr)	Number of Units Replaced per Year	Total Emission Reductions (lb/year)	Total Cost per Year	Cost Effectiveness ($ / lb NOx)
75,000 - <400,000	52.30	$76.59	15	784	$1,149	
400,000 - <1,000,000	197.36	$450.05	3	592	$1,350	
Total				1,377	$2,499	$1.82

APPENDIX C

PUBLIC COMMENTS

EPA Comments (July 27, 2016)

Comment #1: In section B.1, consider expanding the applicability of this rule to include units rated at more than 1 million Btu/hr (e.g., Placer County APCD Rule 247 regulates units up to 5 million Btu/hr, and San Joaquin Valley Unified APCD Rule 4308 regulates units up to 2 million Btu/hr).

Response: At this time, the District is going to stick to the current scope of 75,000 Btu/hr to less than 1,000,000 Btu/hr which was what the District committed to in the 2009 Sacramento Regional 8-Hour Ozone Attainment and Reasonable Further Progress Plan.

Comment #2: The proposed procedures for compliance reports in section F.2 only require resellers or manufacturers to submit to the APCO compliance reports "upon request." Other Districts require this report either upon certification of the unit by the manufacturer (e.g., San Joaquin Valley Unified APCD Rule 4308), or 30 days prior to sale (e.g., Placer County APCD Rule 247 and Sacramento Metro AQMD Rule 414). Placer County APCD and Sacramento Metro AQMD also allow manufacturers to submit an approved certification from South Coast AQMD or San Joaquin Unified APCD in lieu of a separate certification. We recommend aligning the compliance reporting language with the SIP-approved rules in other nearby Districts.

Response: After consideration of this information, District staff implemented the suggested changes into the rule in order to maintain consistency with similar SIP-approved rules in nearby Districts.

Public Workshop (August 18, 2016)

Participants: Michael Mitchener – Beale Air Force Base
Eric Maresh – Beale Air Force Base
Susan Stewart – Beale Air Force Base

Comment #1: Representatives from Beale AFB stated a concern with the Rule as currently written. The Base typically procures these devices from out of state in bulk. They use a supply chain, not a specific retailer.

Response: District staff suggested that they ask other Air Force bases located in nonattainment areas that have already adopted a similar rule, how they comply with the rule.

The commenter noted that there was a naval base near Fresno that they could check with.

Comment #2: Representatives from Beale AFB stated a concern with the procedure of having certification submitted 30 days prior to installation. Sometimes, units are ordered months prior to actual delivery. Also, the on-base installers have not been informed of the new procedure to provide the District with certification 30 days prior to installing the devices and they will need to be informed.

Response: District staff recommended sharing the certification requirement information with the on-base installers. Additionally, District staff stated that if the 30 day requirement would be a hardship to the base, the base could provide comments to the District prior to the end of the public comment period on October 3, 2016.

(As of September 9, 2016, the District has not received any additional comments regarding the proposed rule.)