Rule 1109.1 - NOx Emission Reduction for Refinery Equipment

Working Group Meeting #6

January 31, 2019

Agenda

- Progress of Rule Development
- RFP Status and Update
- WSPA Comment Letter
- Control Technology Manufacturer Meetings
- Survey Data Update
- Next Steps

Progress of Rule Development

Summary of Working Group #5 (11/28/18)

- Presented survey data analysis
- Stakeholders requested more clarity on boiler heater data
    - How are low emissions being achieved? BACT or BARCT?
    - BACT installations or new installs are optimized for control technology performance
    - Manufacturer guarantees should
        - Achieve limits all the time not just some of the time
        - Consider what context (ideal conditions vs. real-world conditions)
        - Be representative of each equipment, since each case is different

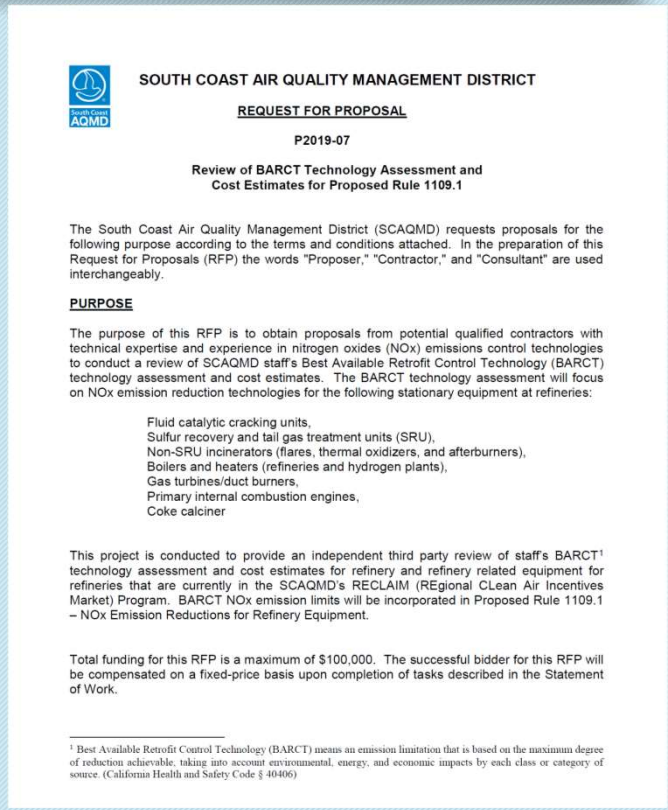
Since Last Working Group Meeting

- Revised and updated survey data
- Coke calciner stakeholder meeting #2 (December 14th)
- Met with control system suppliers (catalyst, burners, and SCR system)
- Continuing site visits and meetings with stakeholders
- RFP closed

Request For Proposal Updates

Request for Proposal Update

- Seeking Consultant with:
  - Engineering background
  - Refinery experience
  - Knowledge of NOx control technologies
- Bid Submissions
  - Three bids submitted
    - Fossil Energy Research Corporation
    - Norton Engineering
    - MD Environmental
- Tentative review panel selection
  - Planning
  - Engineering
  - BACT Team
  - Engineer from other air agency



SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

REQUEST FOR PROPOSAL

P2019-07

Review of BARCT Technology Assessment and Cost Estimates for Proposed Rule 1109.1

The South Coast Air Quality Management District (SCAQMD) requests proposals for the following purpose according to the terms and conditions attached. In the preparation of this Request for Proposals (RFP) the words "Proposer," "Contractor," and "Consultant" are used interchangeably.

PURPOSE

The purpose of this RFP is to obtain proposals from potential qualified contractors with technical expertise and experience in nitrogen oxides (NOx) emissions control technologies to conduct a review of SCAQMD staff's Best Available Retrofit Control Technology (BARCT) technology assessment and cost estimates. The BARCT technology assessment will focus on NOx emission reduction technologies for the following stationary equipment at refineries:

Fluid catalytic cracking units,
Sulfur recovery and tail gas treatment units (SRU),
Non-SRU incinerators (flares, thermal oxidizers, and afterburners),
Boilers and heaters (refineries and hydrogen plants),
Gas turbines/duct burners,
Primary internal combustion engines,
Coke calciner

This project is conducted to provide an independent third party review of staff's BARCT[1] technology assessment and cost estimates for refinery and refinery related equipment for refineries that are currently in the SCAQMD's RECLAIM (REgional CLean Air Incentives Market) Program. BARCT NOx emission limits will be incorporated in Proposed Rule 1109.1 – NOx Emission Reductions for Refinery Equipment.

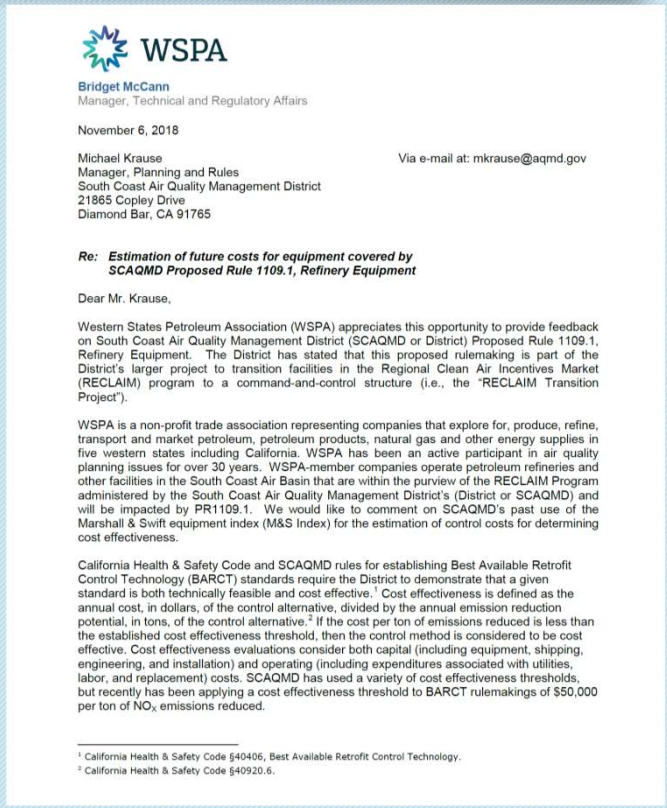
Total funding for this RFP is a maximum of $100,000. The successful bidder for this RFP will be compensated on a fixed-price basis upon completion of tasks described in the Statement of Work.

[1] Best Available Retrofit Control Technology (BARCT) means an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source. (California Health and Safety Code § 40406)

WSPA Comment Letter

WSPA Comment Letter on 11/6/18

- Comments regarding cost effectiveness calculations
  - SCAQMD uses the more general Marshall & Swift (M&S) Index covering all industry sectors
- Recommends alternative cost indices more representative
  - IHS Market Downstream Capital Costs Index (DCCI)
  - Nelson Farrar (N-F) Cost Index
- Staff preparing formal response



WSPA

Bridget McCann
Manager, Technical and Regulatory Affairs

November 6, 2018

Michael Krause
Manager, Planning and Rules
South Coast Air Quality Management District
21865 Copley Drive
Diamond Bar, CA 91765

Via e-mail at: mkrause@aqmd.gov

Re: Estimation of future costs for equipment covered by SCAQMD Proposed Rule 1109.1, Refinery Equipment

Dear Mr. Krause,

Western States Petroleum Association (WSPA) appreciates this opportunity to provide feedback on South Coast Air Quality Management District (SCAQMD or District) Proposed Rule 1109.1, Refinery Equipment. The District has stated that this proposed rulemaking is part of the District's larger project to transition facilities in the Regional Clean Air Incentives Market (RECLAIM) program to a command-and-control structure (i.e., the "RECLAIM Transition Project").

WSPA is a non-profit trade association representing companies that explore for, produce, refine, transport and market petroleum, petroleum products, natural gas and other energy supplies in five western states including California. WSPA has been an active participant in air quality planning issues for over 30 years. WSPA-member companies operate petroleum refineries and other facilities in the South Coast Air Basin that are within the purview of the RECLAIM Program administered by the South Coast Air Quality Management District's (District or SCAQMD) and will be impacted by PR1109.1. We would like to comment on SCAQMD's past use of the Marshall & Swift equipment index (M&S Index) for the estimation of control costs for determining cost effectiveness.

California Health & Safety Code and SCAQMD rules for establishing Best Available Retrofit Control Technology (BARCT) standards require the District to demonstrate that a given standard is both technically feasible and cost effective.[1] Cost effectiveness is defined as the annual cost, in dollars, of the control alternative, divided by the annual emission reduction potential, in tons, of the control alternative.[2] If the cost per ton of emissions reduced is less than the established cost effectiveness threshold, then the control method is considered to be cost effective. Cost effectiveness evaluations consider both capital (including equipment, shipping, engineering, and installation) and operating (including expenditures associated with utilities, labor, and replacement) costs. SCAQMD has used a variety of cost effectiveness thresholds, but recently has been applying a cost effectiveness threshold to BARCT rulemakings of $50,000 per ton of NO_x emissions reduced.

[1] California Health & Safety Code §40406, Best Available Retrofit Control Technology.
[2] California Health & Safety Code §40920.6.

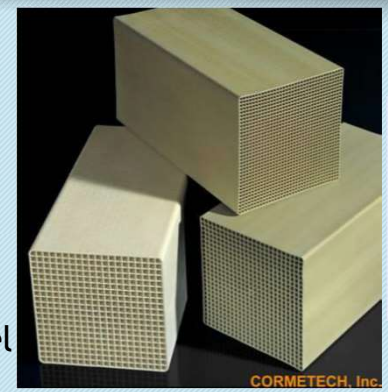
Control Technology Manufacturer Meetings

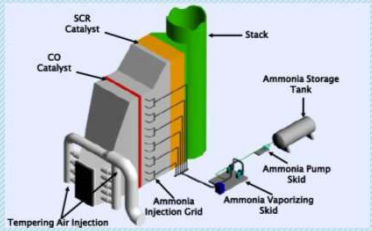
Control Manufacturer Meetings

- Met with four control technology manufacturers with experience in refinery applications
  (all with 30+ years experience)
  - Cormetech - Catalyst manufacturer (11/28/18)
  - Peerless - SCR system manufacturer (11/29/18)
  - Zeeco - Burner manufacturer (11/29/18)
  - Babcock Power/Struthers Wells – Process heater/boiler manufacturer, heat transfer equipment, burner manufacturer & SCR systems manufacturer (1/15/19)
- Key topics discussed
  - Refinery applications
  - Impacts of refinery fuel gas on NOx emissions
  - Capabilities in achieving NOx reduction with refinery equipment
  - Emission guarantees and performance (conditions)
  - Generalized cost estimates for equipment retrofits
  - Space limitations around equipment will affect costs

Cormetech - Catalyst Manufacturer

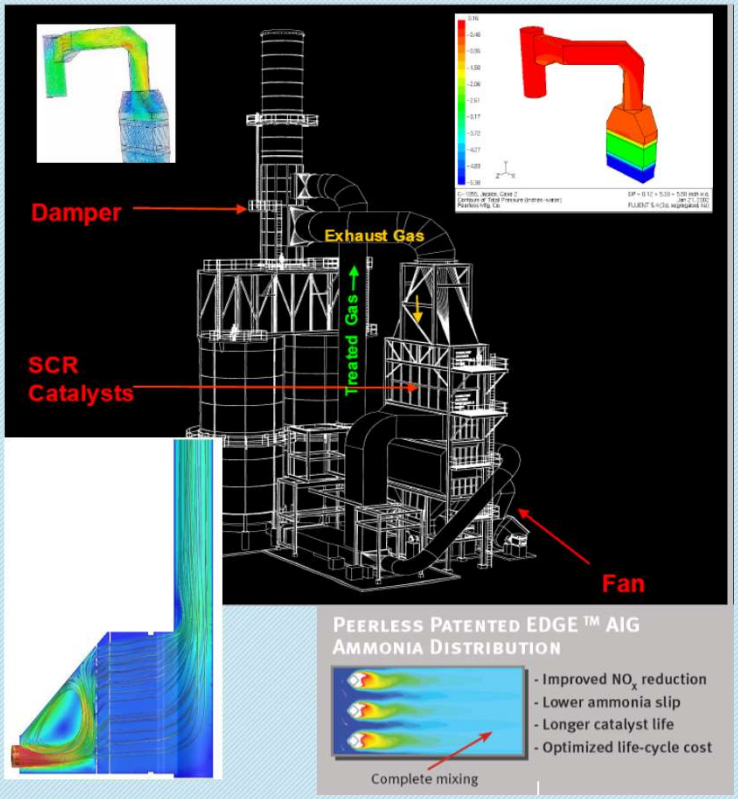
- Specializes in catalyst design and SCR Systems
- Experience with SCR reactor design, ammonia injection grid design, ammonia systems
- The size, cost, and capability of an SCR system are case specific
- Key variables are inter-related and have a cascading affect on performance and cost
  - **Key Design Inputs**: flue gas flow rate, NOx inlet, flue gas constituents, fuel type, particulate loading, reactor size, geometry, unit type
  - **Performance requirements**: NOx removal efficiency, ammonia slip, pressure drop, SO_2 oxidation limit
  - **Scale up factors**: Maldistribution (Ammonia, temperature, velocity)
  - **Catalyst deactivation and catalyst pitch selection**: Fuel type, unit type, ash characteristics, pressure drop
  - **Catalyst formulation**: Unit type, SO_2 oxidation limit, temperature range, NO/NO_2 ratio, required potential (function of DENOX %, inlet NOx, and slip)
  - **Output**: NOx emission target, end of life slip





Peerless – SCR System Manufacturer

- Specializes in retrofit applications - more than 1,000 SCR installations
- Full service: System design, performance analysis, engineering, fabrication, project and construction management
- SCR systems can achieve 90%+ NOx reduction & <7 ppm ammonia slip
- In-house Computational Fluid Dynamics and cold flow physical model used to optimize duct arrangement and flow devices for:
  - Pressure drop
  - Temperature gradient
  - Velocity distribution
  - Ammonia injection system
  - Mixing uniformity
- Experienced in engineering and building structural steel support
- Provide expert advice on workable design and duct arrangement for tight spaces



Babcock Power/Struthers Wells-TEI

Refinery Experience

- Riley Power manufactures boilers and low NOx gas & oil burners
- Vogt Power International heat recovery steam generators w/ and w/o SCRs
- Struther Wells heat transfer solutions including fired process heaters and once through steam generators
- Thermal Engineering International (TEI) feedwater heaters, condensers, and heat exchangers
- Boiler Tube Company of America (BTA) loose tubes and tube coil modules

Babcock Power

One Source. Many Solutions.

In-line SCRs

- Supplier of high performance SCRs through the use of patented mixing technology
- Experience to optimize the system design
  - Life-cycle cost
  - Operational & emissions performance
  - System reliability
  - Construction efficiency
  - Single OEM supplier provides the entire SCR system design under one contract wrapping all guarantees & providing a single point of responsibility reducing overall project risk and cost

Zeeco – Burner Manufacturer

- Specializes in low-NOx burners (LNB) and ultra low-NOx burners (ULNB)
  - Currently have new burners scheduled to be retrofit in two hydrotreater heaters (both 102 MMBtu/hr)
  - 15 ppm guarantee on refinery fuel gas (dependent on heater duty and operating conditions)
- Manufacturer has test facility for burners that uses natural gas and/or hydrogen
  - NOx emissions are typically 10% to 15% higher when using refinery fuel gas (refinery fuel gas contains hydrogen)
  - Burner arrangement and spacing in firebox matters due to flame characteristics of LNB/ULNB and can effect performance
  - Manufacturer issues guarantees and performs an analysis of each heater
    - Case by case basis, some retrofits may require more modifications than others
    - Many variables to consider for low-NOx burner or ultra low NOx burner performance
- Burner emission guarantees are over a specified operating heater parameter (excess air, volumetric heat release, burner adjustment)
  - Typically encompasses the design case for the heater
  - Designed in accordance with API 535 and API 560 standards

Burner Control Technology

Burner Technology *Revised*

- No clear definition of what constitutes a LNB and ULNB, so will classify as burner control technology
- Burner performance is dependent upon multiple variables, some include:
  - Burner orientation & arrangement
  - Firebox size & heater type (force or natural draft)
  - Fuel type
- Burner classification does not assure burners will be effective in achieving NOx levels guaranteed
- Burner NOx emissions will vary in real world applications
- Burner control technology can be applied to a majority equipment, but may not apply to some heater or boiler applications
- Newer burner control technology performs better than conventional burners

Burner projects currently in the permitting process

Manufacturer	Guaranteed NOx (ppm)*	Expected NOx (ppm)	(Number of burners) @ rating of each	Total Heater Rating
ZEECO GLSF	15	9	(72) @ 1.42 MMBTUH	102 MMBtu/hr
Callidus/Honeywell	15	9	(64) @ 1.44 MMBTUH	92 MMBtu/hr
Callidus/Honeywell	15	13	(16) @ 4.81 MMBTUH	77 MMBtu/hr
Callidus/Honeywell	15	13	(16) @ 4.38 MMBTUH	70 MMBtu/hr

*Over specific operating conditions

- Premix burner
- Raw gas burner

} Conventional Burner

- Staged fuel burner
- Staged air burner
- Flue gas recirculation burner

} LNB/ULNB

Survey Data Update

Survey Data Revised
Process Heaters & Boilers

Categories Summary and Update

Process Heaters & Boilers

(235 Units)

196 Primary Heaters

27 Boilers

7 Hydrogen reformers heaters (PSA off-gas)

5 Sulfuric acid heaters

Gas Turbines

(13 Units)

10 Cogeneration with duct burner

2 Cogeneration without duct burner

1 Gas Turbine combined with heater

FCCU

(13 Units)

5 Regenerator Units

1 with CO Boiler

7 Regenerator Start-up heaters

SRU/TG Incinerators

(19 units)

16 units

3 units with in-line stack heaters

Standby use

Thermal Oxidizers & Incinerators

(14 Units)

8 Thermal Oxidizers

6 Incinerators

Standby use

Auxiliary ICE

(3 Units)

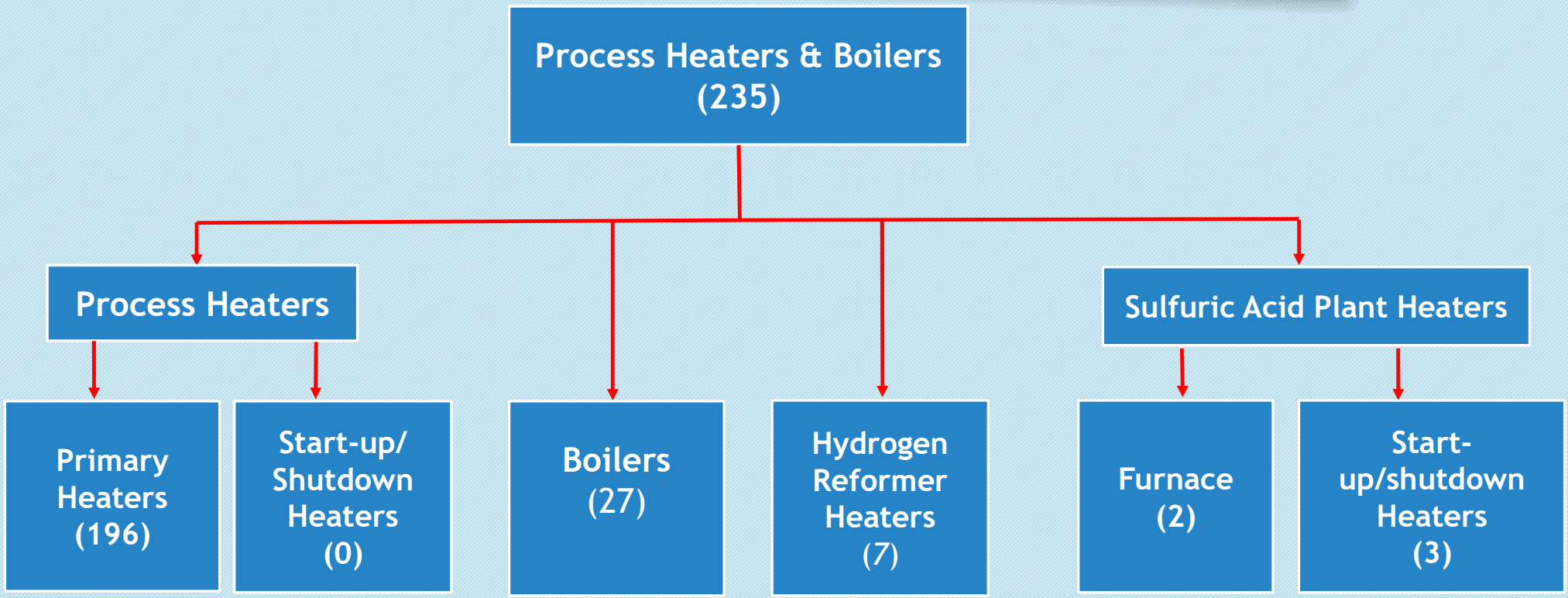
Start-up and shutdown only of cogeneration systems

Coke Calciner

(1 Unit)

- Adequate control information from survey already made available for most categories, but more clarity requested for heaters/boilers

Heaters & Boilers by Category Updated



Process Heaters & Boilers Categories

Process Heaters

- **Primary Heaters:** All direct-fired heaters used in a majority of refinery processing units fueled by RFG or NG
- **Start-up/Shutdown Heaters:** Heaters used for start-up and shutdown only (excludes FCCU start-up heaters)
- Hydrogen reformer heaters that use refinery gas a primary fuel (6 heaters)

Boilers (steam generation)

- Fuel-fired boilers that produce plant steam from boiling water
- Excludes heat recovery steam boilers and CO boilers (heat input is from heat recovery)

Hydrogen Reformer Heaters

- Primary fuel is PSA off gas
- Trim fuel can either be refinery gas or natural gas

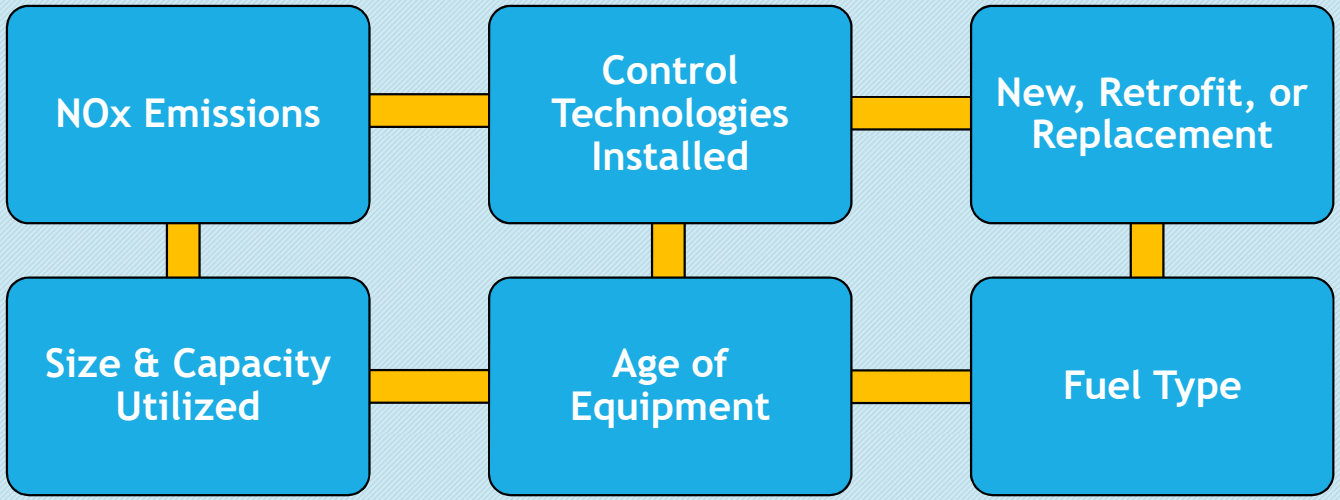
Sulfuric Acid Plant Heaters

- **Furnaces:** Spent acid and/or hydrogen sulfide is decomposed by combusting with air and fuel gas
- **Start-up/Shutdown Heaters:** Used as preheat during start-up, shutdown, maintenance activities and heater exhaust gases are aggregated with furnace

Heaters & Boilers Categories Revised

Size/Capacity (MMBtu/Hr)	Heaters		Boilers	Hydrogen Reformer Heaters (*PSA off-gas*)	Sulfuric Acid Plant Heaters		Total
	Primary Heaters	Start-up & Shutdown Heaters			Furnace	Start-up & Shutdown Heaters	
<20	23		2			1	26
20 to 40	55		3		0		58
>40 to 110	68		3		2	2	75
>110	50		19	7	0		76
Total	196		27	7	2	3	235

Process Heaters & Boilers Considerations



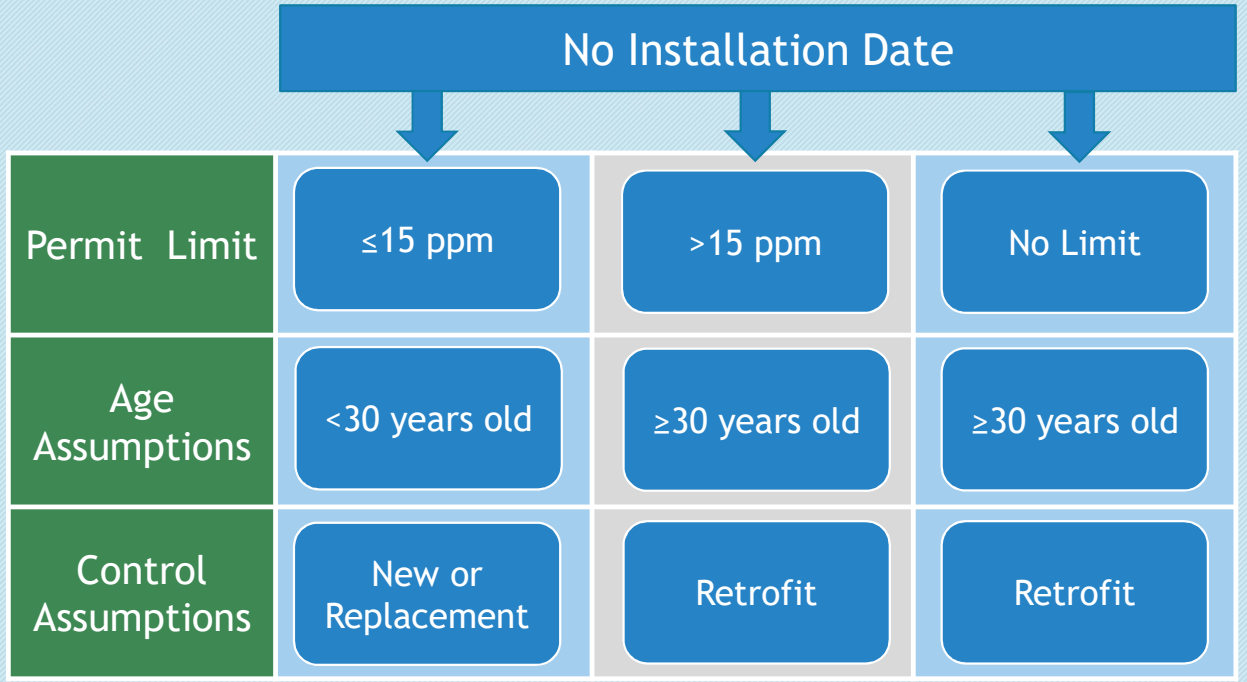
AB 617 requires the *"highest priority to those permitted units that have not modified emissions-related permit conditions for the greatest period of time."*

Low NOx emitting units and fuel type	Emissions achieved and number of units	Age of Equipment	Control Technology (new, retrofit or replacement)
• Primary heaters • Achieving ≤10 ppm • RFG, NG	• <5 ppm (9 units) • 5 to 10 ppm (6 units)	• <15 years old • <35 years old	New/retrofit burners & SCR
• Hydrogen reformer heaters • Achieving ≤10 ppm • PSA-off gas	• <5 ppm (4 units) • 5 to 10 ppm (2 units)	• <25 years old	New/retrofit burners & SCR
• Boilers • Achieving ≤10 ppm • RFG, NG	• <5 ppm (1 unit) • 5 to 10 ppm (7 units)	• <36 years old	New/retrofit burners & SCR
• Sulfuric acid heaters • Achieving ≤20 ppm • RFG, NG	• 14.4 ppm (1 unit) • 20 ppm (1 unit)	• 58 years old • 28 years old	Retrofit/replacement burners

High emissions in each category	NOx emissions and number of units	Age of equipment	Control technologies installed
Primary heaters	• >100 ppm (2 Units) • 50 to 100 ppm (8 Units)	>30 years old	Retrofit burners & no post combustion control
Hydrogen reformer heater	• 13 ppm (2 Unit)	30 years old	New burners & new SCR
Boilers	• >100 ppm (4 Units) • 50 to 100 ppm (2 Units)	>30 years old	No control
Sulfuric Acid Plant Heaters	• >25 ppm (2 Units)	28 years old	New burners & no post combustion control

Data Assumptions

- Determining new, replacement, or retrofit requires an installation date
- Not all installation dates provided in survey, either missing or not available
- Engineering and permitting division looking to verify installation dates
- If no dates available, assumptions were made based on other data provided
- Assumed data highlighted in dark red



Primary Heaters (<20 to 40 MMBtu/hr)

Primary Heaters		NOx Emissions @3% O2 (ppm)	% Capacity Utilized	Fuel Type	NOx Permit Limit (ppm)	Ammonia Limit (ppm)	Original Installation Date	Age (years)	New, Retrofit, or Replacement	Combustion Control			Post-Combustion Control		Representative Year NOx Emissions (tons/yr)
Size/Capacity Range (MMBtu/hr)										Control	Number of Burners	Installation Date	Control Type	Installation Date	
<20	Low NOx	4.4	41	RFG	5	5		<30	Retrofit	No			SCR	2007	0.1
		10	75	NG	30		1983	35		No			No Control		0.8
	High NOx	58	55	NG	41		1975	43		No			No Control		0.7
20 to 40	Low NOx	3.8	44	RFG	5	5	2007	11	New	Yes			SCR	2007	0.1
		7.8*	90	RFG	No Limit	20		≥30	New	No	48		SCR		1.8
		10.1	20	RFG	15		2005	13	New	Yes	1	2005	No Control		0.5
	High NOx	53	93	NG	60		1969	49		No			No Control		4.4
		97	96	RFG	No Limit		1979	39	New	Yes	12	1979	No Control		23.0

*Share a common SCR

Primary Heaters (40 to >110 MMBtu/hr)

Primary Heaters		NOx Emissions @3% O2 (ppm)	% Capacity Utilized	Fuel Type	NOx Permit Limit (ppm)	Ammonia Limit (ppm)	Original Installation Date	Age (years)	New,Retrofit, or Replacement	Combustion Control			Post-Combustion Control		Representative Year NOx Emissions (tons/yr)
Size/Capacity Range (MMBtu/hr)										Control	Number of Burners	Installation Date	Control Type	Installation Date	
>40 to 110	Low NOx	1.3	44	RFG	5	9		<30	New/Replace	Yes	8		SCR	2003	0.3
		1.7*	60	RFG	5	9		<30	New/Replace	Yes	18		SCR		0.4
		2.8	55	NG	5	5	2006	12	New	Yes		2006	SCR	2006	0.4
		2.8	24	RFG	5	5		<30	Retrofit	Yes	1		SCR	2008	0.4
		7.2	50	RFG	12	20		<30	Retrofit	Yes	1		SCR		1.6
	High NOx	83	69	RFG	No Limit			≥30		No	48		No Control		22
		84	34	RFG	No Limit			≥30		No	16		No Control		18
		85	49	RFG	No Limit			≥30		No	16		No Control		22
		105	78	RFG	No limit		1957	61		No			No Control		24
		154	77	RFG	No Limit			≥30		No	8		No Control		38
>110	Low NOx	1.5	78	RFG	5	20		<30	Replacement	Yes	384	2000	SCR		8.4
		1.7*	72	RFG	5	9		<30	New/Replace	Yes	24		SCR		0.7
		2.6	92	RFG	20	20	1994	25	New	Yes	15	1994	SCR	1994	9.7
		5.9	88	NG	No Limit	20		≥30	Retrofit	Yes	32		SCR		8.0
		7.9*	78	RFG	No Limit	20		≥30	Retrofit	Yes	64		SCR		6.7
	High NOx	66	64	RFG	No Limit		1981	37	Retrofit	Yes		2001	No Control		93.0
		70	34	RFG	40		1967	51	Retrofit	Yes	136	2006	No Control		159.0

*Share a common SCR

Primary Heaters Summary

- Observations/characteristics
  - Equipment can emit lower than what is permitted
  - Higher NOx emissions
    - Have no control
    - Older units
    - Highest NOx(154 ppm) is from oldest equipment with no control
  - New installation vs. retrofit
    - New install units (<25 years old) with burner control technology and SCR combination achieve the lowest NOx emissions (<5ppm and 5 ppm ammonia slip)
    - Retrofit units can also achieve low NOx emissions with burner control technology and SCR combination (<5 ppm and 5 ppm ammonia slip)
    - Units with SCR control only are also capable of achieving low NOx emissions (<5 ppm and 5 ppm ammonia slip)
    - Multiple heaters with burner control can share a common SCR system

Hydrogen Reformer Heaters

All hydrogen reformer heaters fueled by PSA off-gas in category

Hydrogen Reformer Heaters	NOx Emissions @3% O2 (ppm)	% Capacity Utilized	Fuel Type	NOx Permit Limit (ppm)	Ammonia Permit Limit (ppm)	Original Installation Date	Age (years)	New, Retrofit, or Replacement	Combustion Control			Post-Combustion Control		Representative Year NOx Emissions (tons/yr)
Size/Capacity Range (MMBtu/hr)									Control	Number of Burners	Installation Date	Control Type	Installation Date	
>110	3.5	68	PSA off-gas	5	20	1996	22	New	Yes	117	1996	SCR	1996	15.0
	3.7	71	PSA off-gas	5	5	2004	14	New	Yes	360	2004	SCR	2004	17.0
	3.8	30	PSA off-gas	7	20	1994	24	New	Yes		1994	SCR	1994	4.7
	4.9	48	PSA off-gas	9	20	1999	19	New	Yes	132	1999	SCR	1999	21.0
	5.1	33	PSA off-gas	12	20		<30	Retrofit	Yes	55		SCR		11.8
	7.2	25	PSA off-gas	12	20		<30	Retrofit	No	27		SCR		6.8
	13	61	PSA off-gas	40.0		1988	30	New	Yes	108	1988	SCR	1988	15.0

Hydrogen Reformer Heaters Summary

- Observations/characteristics
  - Large units (>110 MMBtu/hr)
  - All, except one,are equipped with burner control technology
  - All equipped with SCR
    - 5 new installation
    - 2 retrofit
  - Newest units achieve low emissions (<5ppm and <20 ppm ammonia slip)
  - Combination control can achieve 5 ppm or less
  - Retrofit units achieve 9 ppm or less
  - New burner control technology and SCR combination achieve the lowest NOx emissions

Boilers (Steam Generation)

Boilers		NOx Emissions @3% O2 (ppm)	% Capacity Utilized	Fuel Type	NOx Permit Limit (ppm)	Ammonia Permit Limit (ppm)	Original Installation Date	Age (years)	New, Retrofit, or Replacement	Combustion Control			Post-Combustion Control		Representative Year NOx Emissions (tons/yr)
Size/Capacity Range (MMBtu/hr)										Control	Number of Burners	Installation Date	Control Type	Installation Date	
<20		30	53	NG	40.0			≥30	Retrofit	Yes	1		No Control		1.7
20 to 40		6.4	17.4	NG	9.0		Prior 1989	>29		No			No Control		0.06
		6.5	50	NG	9.0		2007	11		No			No Control		0.3
>40 to 110		71	3.4	RFG	No Limit			≥30		No			No Control		0.5
		105	47	RFG	No Limit			≥30		No			No Control		13.5
>110	Low NOx	4.4	69	RFG	17	20	1982	36	Replacement	No			SCR	1992	3.1
		5.5	85	RFG	9	20	2006	12	New	Yes		2006	SCR	2006	8.5
		5.7	32	RFG	9		1993	25	New	Yes	2	1993			6.4
		6.2	60	RFG	12			<30	Retrofit	Yes		2003	No Control		10.3
		7.1	47	RFG	9		1994	24	New	Yes	2	1994	No Control		16
		10.1	48	RFG	12	5		<30	Retrofit	Yes		2001	SCR		12.1
	High NOx	96	38	RFG	No Limit			≥30		No			No Control		30
		103	80	RFG	No Limit			≥30		No			No Control		39
		114	98	RFG	No Limit			≥30		No			No Control		56.0
		126	51	RFG	No Limit		1965	53	Replacement	Yes	4	1986	No Control		133.0

Boilers Summary

- Observations/characteristics
  - <20 MMBtu/hr: High ppm due to no SCR and high permit limit
  - 20 – 40 MMBtu/hr: Low NOx ppm likely due to NG and permit limit (no controls)
  - 40 – 110 MMBtu/hr: High NOx due to no control and no limit
  - >110 MMBtu/hr:
    - Low NOx due to burner control (new/retrofit)
    - Higher NOx due no control and age
  - Highest NOx emissions
    - Older boilers
    - Larger boilers (>110 MMBtu/hr)
  - New boilers with burner control technology and/or SCR achieve the low NOx emissions
  - Can retrofit older boilers with control technology to achieve low NOx emissions

Sulfuric Acid Plant Heaters

All sulfuric acid heaters/furnaces in category

Sulfuric Acid Furnaces &Heaters / Size/Capacity Range (MMBtu/hr)	NOx Emissions @3% O2 (ppm)	% Capacity Utilized	Fuel Type	NOx Permit Limit (ppm)	Original Installation Date	Age (years)	New, Retrofit, or Replacement	Combustion Control			Post-Combustion Control		Representative Year NOx Emissions (tons/yr)
								Control	Number of Burners	Installation Date	Control Type	Installation Date	
<20		Start-up	NG	190	1993	25	New/Replace	Yes			No Control		0.05
>40 to 110	14.4	59	RFG	No Limit	1960	58	Retrofit	Yes			No Control		10.3
	20	49	NG	No Limit	1988	30	Replacement	Yes	2	2009/2013	No Control		25
	29.6	Start-up	NG	37	1990	28	New	Yes	1	1990	No Control		0.2
	94	Start Up	NG	102	1990	28	New	No	1	1990	No Control		0.3

Sulfuric Acid Plant Heaters Summary

- Observations/characteristics
  - Older units (>30 years old)
  - Equipped with burner control only
  - No post combustion control (e.g., SCR)
  - Start-up and shutdown heaters
    - High NOx
    - No control
    - Low use/low emitting
  - Low NOx achieved with burner control and no SCR

Next Steps

- Continuing Data Analysis
- Propose BARCT Limits
- Cost Effectiveness
- Develop Rule Concepts
- Review Bids and Select Consultant
- Consultant Recommendation to Board
- Contract Execution
- Commence BARCT Review Assessment

Rule 1109.1 Staff Contacts

Heather Farr
Program Supervisor
hfarr@aqmd.gov
909.396.3672

Jong Hoon Lee, Ph.D.
AQ Specialist
jhlee@aqmd.gov
909.396.3903

Sarady Ka
AQ Specialist
ska@aqmd.gov
909.396.2331

Michael Krause
Planning & Rules Manager
mkrause@aqmd.gov
909.396.2706

South Coast AQMD

RECLAIM Staff Contacts

Kevin Orellana
Program Supervisor
korellana@aqmd.gov
909.396.3792

Gary Quinn, P.E.
Program Supervisor
gquinn@aqmd.gov
909.396.3121

Michael Morris
Planning & Rules Manager
mmorris@aqmd.gov
909.396.3282

South Coast AQMD