



Rule 1109.1 - Refinery Equipment

Working Group Meeting #2

June 14, 2018

Agenda

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- Summary of Working Group Meeting #1
- Stakeholder meetings and comments
- Survey questionnaire
- Revised universe and equipment
- Best Available Retrofit Control Technology (BARCT) Assessment
- Emissions data
- Next Steps

Progress of Rule Development

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- Summary of Working Group #1 held 2/21/18
 - Presented initial concepts for Proposed Rule 1109.1
 - Discussed applicability/universe
 - Presented equipment types at major crude oil processing facilities
- Since working group meeting
 - Met with stakeholders
 - Populated and distributed survey questionnaire
 - Revised universe
 - Conducted site visits with Andeavor Carson and Phillips 66 Wilmington
 - Held stakeholder meetings with WSPA, Eco-Services, Phillips 66

Stakeholder Comments

- Proposed Rule 1109.1 needs to consider:
 - Space limitations
 - Ability to meet 2015 BARCT levels
 - Considerations for current planned projects to satisfy RECLAIM shave
 - Applicability of currently controlled equipment (i.e., incremental cost-effectiveness)
 - Low-volume and low-use equipment exemptions
 - Consideration for age of the control equipment
 - Refinery turnaround schedule
 - “Small heater” applicability(<40 MMBTU)
 - Startup and shutdown allowances
 - Monitoring, reporting, and recordkeeping

Progress of Rule Development - Survey Questionnaire

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- Staff developed a comprehensive survey questionnaire
- Survey included:
 - All permitted equipment, permit limits, specific information on the control equipment, fuel characteristics, age of equipment and controls, emissions, source test information, potential retrofit challenges, etc.
- Survey will provide essential equipment information for:
 - Reassessing the 2015 BARCT limits
 - Determining cost effectiveness and incremental cost effectiveness

Status of Survey Questionnaire

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- Distributed draft survey in March
- Met with stakeholders in April
- Revised survey to address comments and concerns
- Populated survey with equipment, permit limits, source test data, fuel type, and throughput
- Released finalized survey late May
- Completed survey due August 10, 2018
 - Seeking as much information as possible, recognize not all data is available
 - Default values can be used where appropriate



Revised Universe and Equipment

Facility Universe

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- Initially proposed including 31 refineries and refinery associated facilities
 - 9 crude oil refineries
 - 5 small refineries
 - 17 related operations
- Criteria for revised universe
 - Within the boundaries of crude oil refineries
 - Support facilities that primarily serve refineries
 - Similar operations
 - Facilities with equipment fueled by refinery gas

Revised Universe and Applicability

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9 Major Refineries

- Crude Oil Processing



4 Small Refineries

- Asphalt Plants
- Biodiesel Plant



4 Related Operations

- Hydrogen Plants
- Sulfuric Acid Plants

Revised Universe of Facilities

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Crude Oil Processing

ID	Name
151798	Andeavor - Sulfur Recovery Plant
171107	Phillips 66 Wilmington
171109	Phillips 66 Carson
174591	Andeavor - Calciner
174655	Andeavor Carson
181667	TORC
800026	Valero
800030	Chevron
800436	Andeavor Wilmington

Small Refineries

ID	Name	Facility Type
800264	Edgington Oil	Asphalt Refinery
800080	Lunday-Thagard DBA World Oil Refining	
800393	Valero Wilmington Asphalt Plant	
800183	Paramount	Biodiesel Refinery

Related Operations

ID	Name	Facility Type
148236	Air Liquide Large Industries	Hydrogen Plant
3417	Air Prod & Chem	
101656	Air Products and Chemicals	
178639	Eco Services Operations	Sulfuric Acid

Equipment Universe (Revised)

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Equipment Type	Total Number
Boiler/Heater	276
Coke Calciner ⁽²⁾	2
FCCU ⁽¹⁾	6
Gas Turbine/Duct Burner	23
ICE Prime	6
Sulfur Recovery Unit/Tail Gas Incinerator	28
Total	341

⁽¹⁾ FCCU related devices; ⁽²⁾ One coke calciner system (2 devices)

Equipment Categories

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Boiler/Heater	<ul style="list-style-type: none">• Boiler• Furnace• Heater
Coke Calciner	<ul style="list-style-type: none">• Coke Kiln• Coke Afterburner
FCCU	<ul style="list-style-type: none">• Reactor• Regenerator
Gas Turbine	<ul style="list-style-type: none">• Gas Turbine/Turbine• Duct Burner
ICE Prime	<ul style="list-style-type: none">• ICE Prime
SRU/TG Incinerator	<ul style="list-style-type: none">• Oxidizer• Thermal Oxidizer• Incinerator• SRU Incinerator• Thermal Incinerator

*ICE Emergency will not be included

BARCT Assessment

BARCT Requirements

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- California Health and Safety Code Section 40406 defines BARCT as
 - “...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.”
- Health and Safety Code Section 40920.6:
 - Requires evaluation of BARCT prior to adopting rules or regulations

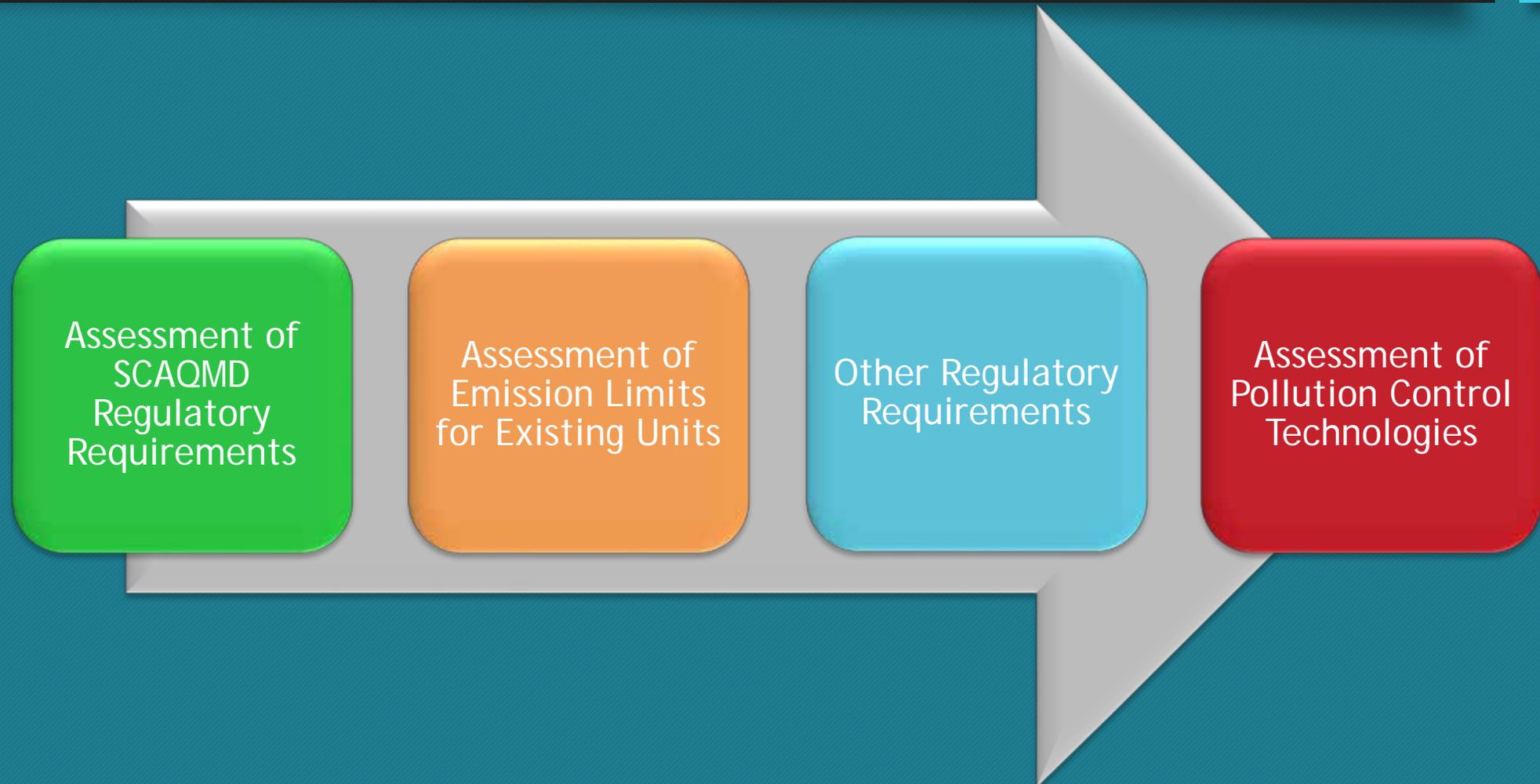
BARCT Assessment Guiding Principles

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- BARCT assessment includes a technology assessment
 - Equipment specific
 - Fuel specific
 - Equipment size specific - Range of equipment sizes depending on control strategies
 - Application and use of unit - capacity, types of uses, heat input, etc.
 - Possibly other considerations
- Overall cost-effectiveness will also consider:
 - Incremental cost-effectiveness
 - Stranded assets
 - Outliers
 - Recent installation to meet previous NOx reduction commitments

Overview of Technology Assessment

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Assessment of SCAQMD Regulatory Requirements

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Objective: Identify existing SCAQMD regulatory requirements for that particular source category

- Applicable SCAQMD rule
 - Current requirements
 - Other rules regulating the source category
 - Existing exemptions
- Potential issues identified during previous rulemakings

Assessment of Emission Limits for Existing Units

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Objective: Evaluate existing units to understand what emission levels can be achieved based on permitted and actual levels

- Permitted emission limits
- Actual emission rate
 - Source test
 - Continuous Emissions Monitoring Systems (CEMS)
 - Relative Accuracy Test Audit (RATA)
- Pollution control technology

Information Needed for Evaluating Existing Units

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Analysis of Permitted Emission Levels

- Emission limit
- Pollution control technology
- Equipment type
- Fuel type
- Equipment size
- Air pollution control technology
- When permitted
- Age of equipment
- Retrofit or replacement

Permit information

Analysis of Actual Emissions Data

- Emission limit
- Throughput data

Annual
Emission
Reports (AER)

Source
test or
CEMS data



Other Regulatory Requirements

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Objective: Evaluate other air districts and states with more stringent limits for same source categories

- Assess other rules and regulations outside of SCAQMD's jurisdiction that regulate same sources
- Consider
 - Implementation date
 - Applicability
 - Alternative compliance approach

Assessment of Pollution Control Technologies

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Objective: Identify pollution control technologies, approaches and potential emission reductions.

- Technology assessment should be all encompassing
- Identify known controls
- Consider emerging technology

2015 RECLAIM BARCT Analysis

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- 2015 NOx RECLAIM amendment
 - Included BARCT assessment
 - SCAQMD assessed BARCT for refinery equipment
 - Norton Engineering conducted a third party review
- RECLAIM amendment approved December 2015
 - NOx shave of 12 tons per day
 - 56% of the shave would affect 9 major refineries
 - Status:
 - 2016 - 2 tpd NOx reduction*
 - 2018 - 1 tpd NOx reduction*

* Overall RECLAIM cap

2015 RECLAIM BARCT Analysis (Reference Only)

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Equipment	RECLAIM BARCT	Technologies
Boiler/Heater	2 ppmv	LNB, ULNB, SCR (more common); LoTOx w/WGS, SNCR, Flameless Heaters, Clear Sign (less common)
Coke Calciner	10 ppmv @ 3% O2	LoTOx, UltraCat
FCCU	2 ppmv @ 3% O2	SCR, SCR w/ASC, LoTOx w/WGS, NOx Reduction Additives
Gas Turbine	2 ppmv @ 15% O2	Water/steam injection, SCR, SCR w/ASC, DLE/DLN, CLN
ICE Prime	11 ppmv @ 15% O2	SCR for lean burn, NSCR (3-way catalyst) for rich burn
SRU/TG Incinerator	2 ppmv @ 3% O2	SCR, LoTOx w/WGS



Emissions Data

Emissions Data Evaluation

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- Evaluate equipment by:
 - Fuel type (e.g., natural gas, refinery gas, process gas, diesel)
 - Equipment type (e.g., turbine, boiler, etc.)
 - NOx emissions from AER data
- Focus on low NOx units
- Evaluate permit conditions for each piece of equipment
 - Use permit limit first, if not available rely on CEMS (RATA) data
 - Future evaluation will compare permit limits to CEMS
- Preliminary evaluation based on available data
- Additional information from survey
 - Control technology, age, etc.

Emissions Data - Boiler/Heaters

Boiler/Heater				
Size (MMBTU/Hr)	Fuel Type	NOx Limit (ppm)	Data Source	2016 NOx Emissions (tons/year)
60	Refinery Gas	3	CEMS (RATA)	0.42
350	Refinery Gas	3	CEMS (RATA)	16.8
78	Refinery Gas	5	Permit Condition	0.54
199	Refinery Gas	5	Permit Condition	1.2
88	Refinery Gas	5	Permit Condition	0.31
123	Refinery Gas	5	Permit Condition	0.59
177	Refinery Gas	5	Permit Condition	0.62
315	Refinery Gas	5	CEMS (RATA)	6.6
653	Refinery Gas	5	Permit Condition	9.5
764	Refinery Gas	5	Permit Condition	1.7
780	Refinery Gas	5	Permit Condition	17.2
304	Refinery Gas	7	CEMS (RATA)	9.3
460	Refinery Gas	7	Permit Condition	5.9
245	Refinery Gas	7	Permit Condition	8.62
30	Refinery Gas	8	CEMS (RATA)	1.2
650	Refinery Gas	9	CEMS (RATA)	44.2
785	Refinery Gas	9	Permit Condition	31.6
300	Natural Gas	3	CEMS (RATA)	4.7
40	Natural Gas	9	Permit Condition	0.63

Summary of Initial Analysis of Boiler/Heaters

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- Total units: 276
- Permit Limits
 - Natural gas - as low as 5 ppm
 - Refinery gas - as low as 5 ppm
- Source test/CEMS (RATA) data
 - Natural gas - as low as 3 ppm
 - Refinery gas - as low as 3 ppm
- No permit limit for 48 units
- 2015 RECLAIM BARCT at 2 ppm

Emissions Data- Coke Calciner

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Coke Calciner

Size (MMBTU/Hr)	Fuel Type	NOx Limit (ppm)	Data Source	2016 NOx Emissions (tons/year)
120	Natural Gas	66	CEMS (RATA)	216

Summary of Initial Analysis of Coke Calciner

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- Total units: 1 unit with 2 devices
- CEMS (RATA) data: 66 ppm
- 2015 RECLAIM BARCT at 10 ppm

Emissions Data - FCCU

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FCCU		
NOx Limit (ppm)	Data Source	2016 NOx Emissions (tons/year)
5	CEMS (RATA)	68.2
21	CEMS (RATA)	14.5
41	Permit Condition	112.3
20	Permit Condition	60.6
20	Permit Condition	8.6
20	Permit Condition	76.3

Summary of Initial Analysis of FCCU

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- Total units: 6
- Permit limits:
 - As low as 5 ppm
- No missing permit limit
- 2015 RECLAIM BARCT at 2 ppm

Emissions Data - Gas Turbines

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Combined Cycle Gas Turbines				
Size (MMBTU/Hr)	Fuel Type	NOx Limit (ppm)	Data Source	2016 NOx Emissions (tons/year)
341.6	Natural Gas	2	Permit Condition	3.2
508.6	Natural Gas	2	Permit Condition	9.3
506	Natural Gas	9	Permit Condition	48.6
560	Natural Gas	9	Permit Condition	52.1
560	Natural Gas	9	Permit Condition	44.4
985.5	Refinery Gas	8	Permit Condition	78.1
985.5	Refinery Gas	8	Permit Condition	80.7
985.5	Refinery Gas	8	Permit Condition	86.6
985.5	Refinery Gas	8	Permit Condition	71.6
646.3	Refinery Gas	9	Permit Condition	50.3

Emissions Data - Gas Turbines (Continued)

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Simple Cycle Gas Turbines

Size (MMBTU/Hr)	Fuel Type	NOx Limit (ppm)	Data Source	2016 NOx Emissions (tons/year)
316	Natural Gas	n/a	Permit Condition	1.7
392	Refinery Gas	96	Permit Condition	50.6
392	Refinery Gas	96	Permit Condition	41.5

Summary of Initial Analysis of Gas Turbines

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- Total units: 23
 - 10 combined cycle turbines
 - 3 simple cycle turbines
- Permit limits:
 - Combined cycle
 - Natural gas - as low as 2 ppm
 - Refinery gas - as low as 8 ppm
 - Simple cycle
 - 2 refinery gas units at 96 ppm
 - No permit limit for 1 unit
- 2015 RECLAIM BARCT at 2 ppm

Emissions Data - ICE Prime

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Internal Combustion Engine (ICE) - Primary

Size	Fuel Type	NOx Limit (ppm)	Data Source	2016 NOx Emissions (tons/year)
18 HP	Diesel	n/a	Permit Condition	0
700 BHP	Diesel	880	Permit Condition	0.1
700 BHP	Diesel	880	Permit Condition	0.03
1095 HP	Diesel	882	Permit Condition	0.4
60 HP	Gasoline	191	Permit Condition	0
880 HP	Natural Gas	878	Permit Condition	0

Summary of Initial Analysis of ICE Prime

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- Total units: 6
- Permit limits:
 - Diesel - 880 to 882 ppm
 - Gasoline - 191 ppm
 - Natural gas - 878 ppm
- No permit limit for 1 unit
- High NOx concentration permit limits but low NOx emissions (e.g., low use)
- 2015 RECLAIM BARCT at 11 ppm*

* Command and control limit, i.e., Rule 1110.2

Emissions Data - SRU/TG Incinerators

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SRU/TG Incinerator

Size (MMBTU/Hr)	Fuel Type	NOx Limit (ppm)	Data Source	2016 NOx Emissions (tons/year)
4	Refinery Gas	38	Source Test (3% O2)	3.6
44.5	Refinery Gas	22	CEMS (RATA)	20.3
14	Natural Gas	45	Permit Condition	11.2
35.8	Natural Gas	35	CEMS (RATA)	3.7
50	Natural Gas	41	Permit Condition	8.3
52	Natural Gas	11	CEMS (RATA)	6.8

Summary of Initial Analysis of SRU/TG Incinerators

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- Total units: 28
- Permit Limits
 - Natural gas - as low as 41 ppm
 - Refinery gas - as low as 45 ppm
- Source test/CEMS (RATA) data
 - Source test (3% O₂) - as low as 38 ppm
 - Refinery gas - as low as 11 ppm
- No permit limit for 11 units
- 2015 RECLAIM BARCT at 2 ppm

Initial Consideration for Emission Limits

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- Achieved in practice limits will be one of several factors
- Limits to allow for retrofit or replacement of equipment
- Cost-effectiveness and incremental cost-effectiveness incorporated into BARCT assessment
- Include an ammonia emission limit
- Seeking third party for BARCT assessment
 - Request for proposal (RFP) to select consultant
- Effective date still under consideration
 - 2016 AQMP goal of 5 tons per day of NO_x reductions by 2025
 - AB 617 requirement of BARCT implementation by 2023

Next Steps

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Continue stakeholder site visits and meetings



RFP for BARCT validation



Evaluate current SCAQMD source specific rules



Evaluate other air districts and states



Analyze/refine data from survey spreadsheet



Develop rule concepts

Rule Development Staff Contacts

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